

**ONTARIO HORTICULTURAL CROPS RESEARCH AND
SERVICES COMMITTEE**

2005 REPORT

TO

**Ontario Agricultural Services Co-ordinating
Committee**

December, 2005

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INTRODUCTION

The Ontario Horticultural Crops Research & Services Committee (OHCRC) is one of nine committees (Animal, Field Crops, Horticultural Crops, Food Processing, Rural Development, Agriculture and Food Engineering, Agricultural Economics and Business, Pest Management, Soil Water and Air) reporting to the Ontario Agricultural Services Co-ordinating Committee (OASCC). The OHCRC endeavours to compile the reports of 16 commodity sub-committees with 2 additional working groups. They are: Agroforestry, Apiculture & Pollination, Apple, Berry Crops, Crucifer Crops, Ginseng, Grape & Wine, Greenhouse Floriculture, Greenhouse and Protected Crops (including mushroom working group), Low Acreage & Special Crops (including Asparagus working group), Nursery/Landscape & Turfgrass, Potato, Root, Bulb and Leafy Vegetables, Sweet Corn and Pea and Beans, Tender Fruit, and Tomatoes. The membership is made up of industry, government and universities representatives. The main OHCRC is made up of 14 members with an additional 400 members making up the sub-committees. Horticultural Crops, through its sub-committees, identifies and prioritizes research needs for crop production, including pest management, and makes recommendations to address research gaps, re-allocation of support or re-direction of current research effort.

MANDATE

Main Committee:

- To review reports submitted by commodity committees.
- To assess the requirements for horticultural crops research and services.
- To establish priorities for horticultural crops research and services.
- To assess progress in horticultural crops research and services.
- To present reports and recommendations to OASCC describing the needs for horticultural crops research and services including information in relation to:
 - cost-benefit;
 - research and service facilities and personnel required in the investigation(s);
 - location best suited for the investigation(s);
 - how funds might be obtained or freed to conduct new research and services;
 - operation of subcommittees.
- To consider and approve chairs, vice-chairs and members of subcommittees.

Terms of Reference:

- To prepare research and service summaries and to recommend research and services priorities in Ontario for appropriate horticultural crops.
- To disclose problems that face the appropriate industry which require investigations.
- To coordinate research and services planning and cooperation.
- To assess and suggest priorities for new programs and recommend which programs presently underway should be expanded or terminated.
- To estimate, where possible, costs involved in the conduct of new research and services programs and to supply cost-benefit information.
- To suggest, where possible, how funds might be obtained or freed to conduct new research and development

ONTARIO HORTICULTURAL CROPS RESEARCH AND SERVICES COMMITTEE (OHCRC) EXECUTIVE SUMMARY

The Ontario horticulture industry represents approximately \$2 Billion farm gate value with approximately \$1 Billion in fruit and vegetable production and \$1 Billion in Greenhouse floriculture and nursery production. This represents over 40% of the Canadian production of horticultural crops. The sector contributes significant value beyond the farm gate through value-added processes, although this is much harder to quantify.

The OHCRC report is a compilation of the summary reports presented by the subcommittees at the OHCRC annual meeting December 6, 2005 in Guelph. The subcommittee reports provide a brief overview of the state of the industry, emerging issues, current research priorities and recommendations to further these research priorities. Due to length of the report, it is not possible to include all the information that is discussed at the subcommittee level. I would encourage anyone that has an interest in a specific commodity to contact the subcommittee chair for further information on industry issues, research and service updates that were reported, committee activities, subcommittee membership and responses to recommendations and action taken from 2004. This information is a great resource on the current activities and progress in research and technology in the Ontario horticulture sector.

The familiar saying that the only thing that is constant is change was perhaps an underlying theme of the meetings this year. The transfer of the research stations and colleges from Ontario Realty Corporation to the Agricultural Research Institute of Ontario, the amalgamation of the Animal and Plant program to the Sustainable Production System program, research funding and research station access fees, research and technical capacity, and the federal science strategy consultation highlights some of the challenges and opportunities that were discussed at this year's meeting.

A summary of the OHCRC priorities related to pest management was presented to the Ontario Pest Management Research and Services Committee (OPMRSC) on December 8, 2005. Minor use priorities for pesticide registration for horticultural crops were discussed at the subcommittee level and this information is forwarded to the OMAFRA Provincial Minor Use Coordinator to assist in identification of provincial minor use priorities that are taken to the National Minor Use Priority meeting each year in March. Further information on the minor use process and priorities is available at: <http://www.omafr.gov.on.ca/english/crops/minoruse/>

2006 will be a very important milestone in horticultural research in Ontario. The 100th anniversary of The Horticultural Research Institute of Ontario (now known as the University of Guelph Department of Plant Agriculture – Vineland Campus) is being celebrated throughout 2006 and includes activities such as a lecture series at the University of Guelph, on-site grower meetings, the planting of a centennial garden and orchard, and the publishing of a centennial book. Some photos of the station “now and then” are included in the report courtesy of the Department of Plant Agriculture.

A submission was made to Agriculture and Agri-Food Canada's online e-consultation process to communicate some of the research needs of the Ontario Horticultural industry to the federal Agri-Food Science Strategy. A copy of this report will also be forwarded to AAFC for their consideration of the needs of the horticultural sector.

OHCRC Research Priorities - Common Themes

Research priorities for each commodity can be found in the subcommittee sections of this report. However, there are a number of common themes that are apparent for the horticultural sector. These are not prioritized. However, the number in brackets indicates how many subcommittees have identified a similar research priority.

Innovation in Pest Management (16)

Pest management issues continue to be the “Achilles Heel” of the horticulture sector that can have implications on competitiveness, market access, environmental stewardship, food safety, plant health and human health. Sustainable IPM systems are an integral risk management strategy for the competitiveness of the horticultural sector. Research is needed on: Development and commercialization of Alternative and Reduce-Risk products, research on IPM strategies for resistance management and new and emerging pest complexes, strategies to deal with plant health

issues including invasive species and biodiversity, field validation of predictive models for Ontario conditions, development of rapid diagnostics, monitoring techniques and thresholds

Environmental Management

- Nutrient Management (13)

- Water Management (8)

- Energy/Bioenergy (2)

- Carbon sequestration modeling

Due to the diversity of crops and production systems in horticulture there is an ongoing need for research into nutrient use efficiency and practices and technologies that can assist horticultural producers to continue to enhance environmental management practices. For many crops it is important to integrate nutrient, water and pest management strategies and there can be significant influence of one on the other and ultimately on the overall quality and shelf life of horticultural produce and/or bioactive compounds. There was also concern raised by a number of the subcommittees uncertain impact of the recently proposed *Clean Water Act* and potential restrictions on nutrient use and pesticide application. The Great Lakes Charter is under negotiation and there is concern regarding potential impacts on availability of water for irrigation. Regardless of the charter there is significant research that could be undertaken on reducing irrigation requirements through more efficient irrigation scheduling or improving water treatment technologies that would increase adoption of recirculation.

Increases in energy have obvious significant impact on greenhouse production. It has renewed interest in research on energy efficiency and alternate renewable fuels. The increase in fuel costs also impacts the price of fertilizer, plastic pots and transportation to all crops. If interest continues in looking at ecological goods and services there will be further interest in development and validation of models to help quantify carbon sequestration.

Innovation in Production Systems

- Cultural Practices (6)

- Genomics /Variety/Cultivar Development (12) – Identification and evaluation of new germplasm to minimize production inputs, increase product quality and expand value-added opportunities.

 - Propagation (2)

 - Mechanization/Engineering (2)

 - Organic Production (2)

 - New crops

The need to continue to foster innovation of on-farm production practices and technologies that can have a significant impact on minimizing inputs, extending the season, developing new crops, adapting to climate change, enhancing crop quality, nutritional or health benefits can contribute significantly to a viable horticulture sector in the longer term.

Marketing

Increasing market share through the technologies/strategies for season extension, value-added products, niche markets, marketing strategies to improve profitability, utilization of by-products is definitely note in emerging issues for many horticultural crops. Promotion efforts to expand domestic markets to compete with imports and to buffer fluctuations in export markets was also identified.. Promotion of benefits of buying local produce and research to validate health benefits will be an important research need as the society looks to fruits and vegetables as our medicine cabinet. Market Intelligence research to assess global trends to capture market opportunities and develop market strategies to remain globally competitive are also important needs. Industry economic data to support economic development opportunities and to understand the potential economic impact of issues that effect the industry (. Eg. Economic of plant health issues.) were also identified.

Post Harvest Storage and Quality (6)

Development and Validation of Storage technologies and packaging to maximize shelf life, product quality and health benefits

Food Quality and Food Safety

Health Benefits (4) As Hippocrates said in 400 BC, “Let Food be your medicine and medicine be your Food”. Horticulture for Health is an emerging trend and opportunities to expand research efforts in this area could contribute to increased consumption of fruit and vegetables. . Nutraceutical and Functional Foods research to benchmark nutrition of fruits and vegetables, in particular domestic/locally grown produce and furthering the

linkages between fruit and vegetable impacts on human health were discussed. Production practices can also influence on some bioactive compounds in crops and research in this area would help to identify how to maximize these compounds in produce. Production/processing technology to minimize contamination (chemical/microbial) and the increasing necessity is also needed.

OHCRSC Recommendations

Recommendations for each subcommittee are included in their reports and subcommittee chairs will be following up with target agencies to obtain responses. The following are some recommendations that were felt need to be addressed at the main committee level.

1. **Research funding** – the chair was asked to communicate that concerns were raised at the subcommittee meetings about research station access fees and overhead at the University of Guelph and it that there may be merit in revisiting the fee structure to ensure that the costs that have been allocated in some situation are not creating barriers to research being undertaken.
(directed to University of Guelph)
2. **Innovation in Pest Management** – A renewed thrust in further development of innovative technologies and IPM strategies is needed to keep pace with the number of new and emerging pests facing the industry. In addition there is need to determine how to best manage reduced risk products and ensure that IPM programs are constantly evolving. Industry is looking for assistance in ensuring that trained resource personnel within the industry can be sustainable.
(Directed to OMAFRA Research and Innovation Branch and Crop Technology Branch)
3. **Diagnostic Testing** – there is increasing concern about the trend of growers/agribusiness sending pest samples out of the country for diagnosis due to concerns about turn around time. This could have serious consequences in the event of quarantenable pests. In addition, delays in crossing the border have been linked to deficiencies in adequate diagnostics. There are innovative technologies that can be pursued that can help address these issues, but they need to be validated for Ontario.
(Directed to OMAFRA Research Branch)
4. **Research Capacity and Expertise** – In order for the horticulture to continue to pursue innovation research and market opportunities and deal with plant health issues there needs to be a renewal of research capacity and technical expertise at the federal and provincial level. (Examples of expertise that had been identified includes nematology, entomology, insect toxicology, greenhouse and nursery pathology, sprayer technology) (Directed to OMAFRA, University of Guelph, Agriculture and Agri-Food Canada)
5. **Future Topics for Agri-Food Innovation Forums** – with increasing interest in Horticulture and linkages to Human Health the OHCRSC would propose that this would be an appropriate theme for a future Agri-Food Innovation Forum.
(Directed to Research and Innovation Branch)

Acknowledgements

The leadership provided by each of the OHCRSC subcommittee chairs and the participation of subcommittee members representing grower groups, industry, researchers and government personnel is a key element of success for this research priority setting process. Many of these subcommittees not only use the reports to communicate research and service priorities, but also look issues can be addressed through the collective expertise at the subcommittee level. Responses to recommendations provided by the various individuals and agencies back to the subcommittees is also sincerely appreciated.

Another key element of success for the subcommittee process is the support of Research and Innovation Branch staff. Stuart Budd, OMAFRA Research Analyst provides outstanding support to the OHCRSC chair and subcommittee chairs. The support of other staff in the branch in helping set up meetings and formatting reports for the web are sincerely appreciated. A huge thank you to Jeanne McCluskey, OMAFRA for her diligence at pulling this report together.

Respectfully submitted on behalf of the OHCRSC
Annette Anderson, Chair

Celebrating

A Century of Success



1906 ~ 2006

by the

Horticultural Experiment Station, Vineland
and the University of Guelph.

Photo courtesy of
Deborah Hilborn
University of Guelph
Department of Plant Agriculture - Vineland

AGROFORESTRY

Annual Report of the Agroforestry Sub-Committee

OVERALL SUMMARY FOR ALL SECTORS

Several significant environment programs associated with the Agricultural Policy Framework have been announced by Agriculture and Agri-Food Canada (AAFC) which are of particular interest to the Agroforestry Sub-Committee. They include: the Canada-Ontario Environmental Farm Plan (EFP) and Greencover Canada (GC). There are agroforestry-related aspects within each program. With these programs in place, the Ontario Soil and Crop Improvement Association in cooperation with OMAFRA and the Conservation Authorities are working closely with farming groups to help farmers across the province implement beneficial management practices such as riparian buffers and shelterbelt projects. It is anticipated that this will result in a modest increase in demand for trees in the near future.

Agroforestry technology can be used to produce biomass from short-rotation woody crops. This technology is being used widely in other parts of the world, especially in Europe and United States. Willows and poplars can be grown sustainably as a feedstock for bioenergy and can alleviate dependence on fossil fuel energy. The cultivation of woody crops could contribute towards a carbon neutral economy and provides many rural development benefits, as well as protecting soil and water resources. The University of Guelph will address research gaps associated with the potential establishment of a very short-rotation woody crop production system in southern Ontario, the location of 65% of the national greenhouse industry. Further exploration of the current economic viability of short rotation woody crop production systems in southern Ontario would be very beneficial.

It has been brought to the attention of this sub-committee by Mr. Ernie Grimo, Society of Ontario Nutgrowers representative, that there are at least three potential nut trees that offer growers a commercial option in Ontario. These three nut tree choices are heartnuts, sweet chestnuts and hazelnuts. It is also interesting to note that Ferraro of Italy is opening a processing facility in Brantford Ontario. They will require 6000 tons of hazelnuts annually. Therefore, there is a need to demonstrate to Ferraro that Ontario can quickly respond to their production requirements.

Significant progresses were made during 2005 in the maple syrup industry. A Phase 1 research investigation evaluating alternative filters for maple sap was completed in 2005 and a follow-up Phase 2 investigation is proposed for 2006. An investigation which evaluates alternative defoaming agents for use in the maple syrup industry is also proposed for 2006. Also, investigation of the impact of underground mainline systems on the health of sugar bushes is currently underway and will be completed in 2006 by an undergraduate student at Lakehead University. These projects are fully supported by the Ontario Maple Syrup Producers' Association.

There is a need to classify conifers grown in nurseries as a single commodity 'crop group'. Conifer nursery production is still categorized by end-use markets i.e. Christmas trees, forestry plantations and ornamental landscape uses. This division becomes inefficient for research endeavours. The Christmas Tree Farmers of Ontario along with Landscape Ontario will coordinate activities related to future minor use registrations in 2006. Christmas tree growers are also testing new fir cultivars that break bud later than Fraser fir to avoid frost injury and results from this study could be of use to many Ontario producers.

OMAFRA's Agroforestry Specialists are continuing to provide technical support for Conferences, Information Days and other events which have an Agroforestry component. In 2005 OMAFRA, working with Partners, has provided leadership in the development of a Best Management Practices Manual for Agroforestry which is targeted for publication in two volumes in 2006. OMAFRA's Agroforestry Specialists are also providing ongoing review and technical support for a variety of important research projects seen as high priority by client groups.

Last but not least, given the federal government's commitment to ratify the Kyoto protocol and the Ontario government's emphasis on green energy production, it is encouraging and important to note that agroforestry practices could positively contribute towards both government objectives. It is also expected that carbon trading will become a reality in Canada and when it happens this could be a significant source of revenue for agroforestry practitioners in Ontario.

Recommended web site for agroforestry :

- <http://www.aftaweb.org/>
- <http://www.ontariosoilcrop.org/>
- <http://www.grandriver.ca/>
- <http://www.omafra.gov.on.ca/english/crops/hort/agrofore.html>

PROGRAMS AND ISSUES SCAN

Environment

As a group, Conservation Authorities provide a number of agroforestry services to landowners including tree and shrub planting, tree and shrub sales, site planning as well as site assessment and monitoring. In 2004, Conservation Authorities forestry services staff planted over 1.7 million trees and shrubs on 2,500 acres of land. Reforestation and tree planting services are available at 30 Conservation Authorities across the province. Stewardship staff from these authorities meet on a regular basis to foster a common approach to stewardship issues.

With the announcement of the Canada-Ontario Environmental Farm Plan and Greencover Canada programs, funding is available to help farmers across the province implement beneficial management practices such as riparian buffers and shelterbelt projects. The federal funding may be combined with funds from other cost share programs such as the municipally funded programs being delivered by various Conservation Authorities. As a result, up to 80% funding will be available in some watersheds to implement various tree planting projects. It is anticipated that this will result in a modest increase in demand for trees in the near future.

The Canada-Ontario Environmental Farm Plan (EFP) and Greencover Canada (GC) are administered by the Ontario Soil and Crop Improvement Association. EFP and GC are clustered alongside two additional environmental cost-share programs that are similarly delivered by OSCIA- the Canada-Ontario Farm Stewardship Program (COFSP) and the Canada-Ontario Water Supply Expansion Program (COWSEP). All of these initiatives are scheduled to be available through to March 31, 2008.

- **Canada-Ontario Environmental Farm Plan (EFP)**

The Third Edition EFP workbook follows the same successful format and process as previous editions. Ontario farmers, both new and past workshop participants, are invited to attend at no cost in the two-day workshops (typically) organized locally by the Ontario Soil and Crop Improvement Association (OSCIA). The workshops are delivered in partnership with OMAFRA Specialists who continue to provide technical expertise.

The objectives of the Ontario Farm Environmental Coalition (OFEC) are to accommodate approximately 4,000 participants per year through EFP workshops. Workshops average 15 to 20 participants. Producers must pre-register.

Several of the 23 worksheets in the Third Edition deal with some aspects of agroforestry. They include #15- Soil Management; #21- Stream, Ditch and Floodplain Management; #22- Wetlands and Wildlife Ponds; and #23- Woodlands and Wildlife. In addition, a new section on Emerging Issues has been added to the workbook and offers discussion on a variety of items that may affect environmental decision-making on the farm. Agroforestry considerations are mentioned in two of the three sections; namely: Greenhouse Gas Emissions and Your Changing Climate; and Biodiversity on the Farm.

- **Greencover Canada (GC)**

The \$15 million GC program in Ontario is comprised of four components: Conversion, Critical Area Management (Riparian), Shelterbelt Establishment, and Technical Information.

These programs should complement the newly introduced Nutrient Management Act and the proposed Source Water Protection Act since both emphasize the need to protect Ontario water sources and thus preserve and enhance the water quality. Trees have been recommended as components of vegetative buffers close to aquatic sensitive areas adjacent to agricultural fields.

It has also been reported that shelterbelts are being widely used by livestock producers in Ontario for odour reduction. Shelterbelts work to reduce odours created directly by livestock, during manure storage and during land application of manure. The functional aspects of shelterbelts in this regard include but are not limited to, dilution, dispersion, collection and filtering of odorous gases and dusts. Apart from these, shelterbelts can also provide numerous production (timber, fuelwood, nuts, fruits etc.) and service roles (erosion control, microclimatic modifications, snow protection, wildlife corridors etc.) and hence have the potential to create numerous 'value chains'.

PRODUCTION SYSTEMS

Agroforestry land-use systems have tremendous potential to create sustainable production systems by positively influencing environmental (nutrient management, source water protection, water, soil and air quality), ecological (ecosystem health, biodiversity, energy capture), economic (product diversity – economic return from product diversity) and social (positive impacts on soil, water and air, aesthetic quality, sustained rural livelihoods) dimensions of any given ecosystem.

Conifer growers have expressed a desire to recognize the conifers grown in nurseries as a single commodity 'crop group'. Conifer nursery production is still categorized by end-use markets i.e. Christmas trees, forestry plantations and ornamental landscape uses. This division is inefficient for research. Herbicide registration tank-mix trials have been completed for Roundup Transorb, Simazine, Dual Magnum, Goal and a report summarizing field data has been submitted to PMRA. Growers want the herbicide Goal registered as soon as possible, as do forestry and producers of landscape conifers. PMRA has letters of support from OMAFRA and OMNR requesting minor use registration of Goal herbicide. Minor use registration of Quadris (azoxystrobin) on hazelnuts for suppression of eastern filbert blight disease has also been completed. It should also be noted

minor use registration of Surround (kaolin clay) on the tree nut crop group, for suppression of insect pests including leaf hoppers, husk maggot, codling moth and leaf rollers was completed in November 2005.

Ernie Grimo, Society of Ontario Nutgrowers representative mentioned that based on his experience three major nut trees are commercial viable for nut production in Ontario, heartnuts, sweet chestnuts and hazelnuts.

The Heartnut - In Ontario, we now have approximately 100 acres of improved cultivars planted. These planting range from two to three trees to plantings of 10 acres or more. Heartnut trees in their tenth year can produce on average about 50 pounds per tree and at an initial spacing of 50 tree per acre this would average over a ton per acre. The clones that are recommended in priority order for planting include: 'Imshu', 'Campbell CW1', 'Campbell CW3', 'Simcoe 8-2', 'Stealth', and 'Locket', all cultivars that have been identified in the last 15 years. The Ferraro Candy company has shown an interest in developing products with the heartnut, particularly the nuts like 'Imshu' that drop out of the shell whole without breaking.

Sweet Chestnuts - We import thousands of pounds of sweet chestnuts from Europe each year. This is a crop that we can grow in the sandy regions of Ontario. The Chinese chestnut is a high quality product that can be planted to replace some of this imported product. Grafted trees can be used to standardize the quality and nut size somewhat, but incompatibility has been a problem between the stock and scion even years later. Grafted trees are only recommended in the milder regions of Ontario. Large nuts (less than 35 nuts per pound) are the most valued by customers and demand the highest prices, while small nuts are almost unwanted. Cultivars with good blight resistance that produce large nuts and do well in Ontario include: 'Grimo 150Y', 'Lockwood', 'Grimo 114W'.

Hazelnut (Filbert)--The Ferraro Candy Company in Brantford, Ontario has indicated that it would use locally produced nuts if they became available in their products. The tobacco region of Ontario is ideal land for the production of this nut. Test plantings need to be established to determine if the European, Turkish, Oregon and local cultivars are suitable for our climate and will fit the requirements of the Ferraro Company. A planting is being planned for the spring of 2006 at the Simcoe Experimental Station. Hardiness and filbert blight resistance, preferably immunity, will be the primary concerns. The Society of Ontario Nut grower's representative believes that up to one ton of nuts per acre is possible in an average year.

Bio-Energy: The price of traditional energy (e.g. oil) remains volatile and will probably edge upward over time and have an adverse affect on profit margins if prices remain the same. This trend will prompt more interest in evaluating production efficiencies and in the development of alternative energy sources. Biomass from short-rotation woody crops can be grown sustainably as a feedstock for bioenergy and can alleviate our dependence on fossil fuel energy. The cultivation of woody crops enhances biodiversity, protects soil and water resources, could contribute towards a carbon neutral economy and provides many rural development benefits. Any sustainable production system, particularly in southern Ontario, should embrace, if not, amplify these well-accepted global sustainability traits. Short rotation woody crops (e.g. willow), grown close to the 'greenhouse' (within the 70 km economic zone), are a potential solution to this problem. We estimate that there are currently 1,000,000 ha of marginal agricultural land (including degraded riparian areas) that could be devoted to the growing of short-rotation woody crops at high densities (25,000 stems ha⁻¹) in southern Ontario, a great potential yet to be realized. However, further analysis of economic potential needs to be done.

PROGRAMS

BMP in Agroforestry - The Eastern Ontario Model Forest (EOMF) under contract to the Ontario Federation of Agriculture and with guidance provided by numerous stakeholders has completed developing the Agroforestry Best Management Practices Manual, the 17th in the series of Best Management Practices. This Manual will document methods of improving and expanding agroforestry practices by integrating environmental concerns with planned production methods and financial goals. It is expected that this Manual will be published in two volumes in 2006.

The OMNR's 2004 report outlined the importance of Ontario's Private Woodlands. Ontario has 5.6 million hectares of productive forests under private ownership, 14 percent of the province's inventoried productive forest land base. Approximately 95 percent (1.9 million hectares) of the productive forest south of the Planning Area is privately owned, while 11.1 percent (3.7 million hectares) of the productive forest in the Planning Area is privately owned. Private forests account for 13.5 percent of Ontario's growing stock, including almost one-half of the gross total volume of hard maple and "other hardwoods".

Agroforestry – University of Guelph

The need to actively promote the University of Guelph agroforestry research program through this sub-committee was strongly felt at the sub-committee table. This was emphasized mainly because the current contract comes to an end in April 2006 and the need to continue the domestic agroforestry research is vital. In this context, University of Guelph has submitted a Letter of Intent (LOI), entitled 'Feedstock to Furnace: Bioenergy Systems for the Ontario Greenhouse Industry', to the Sustainable Production Systems review committee. In this LOI a feasible 'bioenergy value chain' for the Canadian Greenhouse Industry has been envisioned.

PROGRESS IN ALL SECTORS DURING 2005:

1. A project implemented involving the design of a Vapour Compression System to process sap into maple syrup: once developed, the production efficiency of this system will be compared with other more conventional processing systems (OMAFRA, Member of the OMSPA RTTC Committee (Engineer), Grenville Land Stewardship Council). This project is ongoing - 2005/06.
2. A project implemented to determine the impact of the 1998 ice storm on the health and productivity of sugar bushes 5-6 years after the storm event (OMAFRA, OFRI, OMSPA – This project was completed in 2005 and transfer of the findings to maple producers continues.
3. The carbon dynamics in a 15 year old temperate agroforestry system and in an adjacent conventional agricultural system in southern Ontario was investigated for the last 4 years and the study has been concluded. In the poplar system, the net C sequestration was quantified to be approximately 2 t ha⁻¹ y⁻¹, and the net C sequestration in the spruce system was 1 t ha⁻¹ y⁻¹. In the sole cropping system, the net C sequestration was 0.4 t ha⁻¹ y⁻¹. It can therefore be concluded that the C sequestration in poplar and spruce systems was 5 and 2.5 times more than that of the sole cropping system, respectively. This aspect of enhanced C sequestration potentials in agroforestry systems should be further investigated along with an economic analysis so that the economics of C

sequestration in agro-ecosystems can be understood. The latter may become an important tool to measure C credits in the near future as being suggested by both federal and provincial governments.

4. In 2005, nitrate-N leaching losses from both, tree-based intercropping system and from an adjacent conventional agricultural system, was quantified with the use of ISCO tile drain monitors. Initial water samples analyzed for nitrate-N (before crop removal), indicates that there is no significant difference in leached nitrate-N between both systems. However, it will be interesting to see if there are any changes to nitrate-N leaching between the systems after crop removal. This feature is being investigated.
5. The analysis of tile-drain effluent from both systems suggest that there is significant reduction of *E.coli* count (40 to 50% less) in the effluent leaving the tree-based intercropping system when compared with effluent leaving from the conventional agricultural system. As suggested in the literatures it appears that the deep-rooted tree roots are effectively filtering bacterial colonies.
6. During the Spring of 2005, 8 ha of afforestation and 1 ha of bioenergy research plots were established respectively in collaboration with Canadian Forest Service. Further, 1.5 ha of riparian buffer bioenergy project was also initiated in 2005 with funding from Canadian Biomass Innovation Network (CBIN) administered through Agriculture and Agri-Food Canada.

IMPORTANT RESEARCH NEEDS

(NOTE: The research needs have NOT been prioritized, therefore they all should be considered as equally important research needs)

1. Bioenergy using biomass to heat greenhouses have been utilized with considerable success for many years. However, the lack of a continuous, economic supply of uniform biomass feedstock, in conjunction with some limitations in harvesting, drying and small-scale combustion technology, have seriously hampered the development of bioenergy systems on a large scale. Current high and increasing electricity costs, in conjunction with concerns about greenhouse gas emissions from burning fossil fuels in both the greenhouse industry and society in general, however, are strong precursors favouring the continued development of economically-efficient bioenergy systems. This area needs to be developed fully in southern Ontario, the home of 65% of the national greenhouse (University of Guelph).
2. Investigation of the value of trees to reduce nutrient loading in water courses – Nutrient Management and Source Water Protection (e.g. tree species, production system, density, buffer width) (University of Guelph, GRCA)
3. Investigation of the use of trees to filter harmful organisms such as coli form bacteria, including *E. coli*, especially from manure runoff or soil leachates - Source Water Protection (University of Guelph, GRCA)
4. Quantification of carbon sequestration and modelling of C dynamic in all agroforestry production systems, e.g. windbreaks / shelterbelts, riparian buffer plantings, green belt plantings, afforestation plantations - Forest 2020 program (University of Guelph, GRCA)
5. Investigation of Maple Sap Filters - A Phase 1 Research Investigation was completed in 2005 and a Phase 2 investigation is proposed for 2006. (Ontario Maple Syrup Producers' Association, University of Guelph, OMAFRA)
6. Evaluation of Defoaming Agents for Maple Syrup Production - A research investigation is planned for 2006. (Ontario Maple Syrup Producers' Association, Agriculture and Agri-Food Canada, OMAFRA)
7. Investigation of the Impact of Underground Mainline Systems on the Health of Sugar Bushes (Ontario Maple Syrup Producers' Association, Lakehead University-Graduate Student, OMAFRA)
8. Evaluation of a Steam Compression System to Process Maple Sap (Innovative Solutions-Brockville, OMAFRA, North American Maple Syrup Council)

9. Evaluation of the Sensory Properties of Consumer Grades of Maple Syrup (Centre Acer, International Maple Syrup Institute, OMAFRA)
10. Complete development of Prescription Writing course based on GLSL and Southern guides (OMNR)
11. Demonstrate Economic benefit of good forest management - specifically retaining larger trees (OMNR)
12. Continued support for minor use registrations to control unwanted vegetation, insects and other damaging agents is required by woodland owners, maple producers, Christmas tree growers and orchard managers and is essential (OMAFRA, OMNR, Agriculture and Agri-Food Canada)
13. Shelterbelts for odour control from livestock operations (GRCA).
 - Mechanisms of odour mitigation by shelterbelts include dilution of gas concentrations of odour into the lower atmosphere, dust and aerosol deposition, dust and aerosol interception, and absorption of chemical constituents of odours.
 - Do tree species vary in their effectiveness at mitigating odour from livestock barns?
 - What species/ combinations of species will provide the shelterbelt porosity required for optimum odour control function?
(Suggestions for research follow-up from Conservation Ontario)
14. Shelterbelt establishment using black plastic mulch (GRCA)
This establishment technique is being widely used in the Prairie Provinces and Quebec, and is now being attempted for the first time in Ontario.
 - What are the effects of this establishment technique on tree growth, mortality and water requirements?
 - Irrigation tape can be laid under the plastic mulch during installation. How effective is this technique at improving tree survival and growth?
(Suggestions from Conservation Ontario)
15. Achieving and maintaining optimum shelterbelt porosity
Wind tunnel research has thoroughly documented the effectiveness of porosity on shelterbelt function. However, the porosity of a shelterbelt changes with time due to growth and mortality. Many shelterbelts become too dense to provide optimum protection.
 - Need to study the effect of thinning and pruning practices on shelterbelt porosity.
(Suggestions for research from Conservation Ontario)
16. Hazelnut nut research – variety trials by Dr. Al McKeown and Dr. Adam Dale , Simcoe Research Station
17. There is interest among farmers of ‘Vegetation management under developing forest plantations’. Various options of understory management can be studied such as forage production, rotational grazing, shade tolerant crops. The concept is not new in North America and various universities are studying various options, however, much can be learned in Ontario. The site at Victoria Road can be converted to achieve some of these designs. With wood production as the primary focus, forage production and grazing appears to get the most attention from farmers for understory use. Diversity of tree species in any plantation is important for pest and disease management (University of Guelph).
18. Biomass production should continue. This has already moved beyond basic research. There is some emerging research that suggests that fast-growing trees could contribute extensively to production of volatile organic compounds (VOCs) that react with industrial pollutants to form ground level ozone pollution. The results of this research should be investigated to determine if there are any implications for agroforestry programs in Ontario. Ontario –based research may be necessary to evaluate this further (OMAFRA).

Technology Transfer

The University of Guelph published one journal paper and two more have been accepted for publication in 2006. Researchers also participated in IUFRO World Congress in Brisbane, Australia and presented their work.

The Ontario Ministry of Agriculture, Food and Rural Affairs continues to employ two full-time Agroforestry Specialists who are involved in the packaging and transfer of technical information to a variety of clients. OMAFRA's Innovation and Competitiveness Division maintains a website for Agroforestry. A number of publications have been finalized in 2005 and more expected to be finalized in 2006. OMAFRA's Agroforestry Specialists also continue to provide technical support for Conferences, Information Days and other events which have an Agroforestry component. In 2005 OMAFRA working with Partners has provided leadership in the development of a Best Management Practices Manual for Agroforestry which will be published in two volumes in 2006. OMAFRA's Agroforestry Specialists are also providing ongoing review and technical support for a variety of important research projects seen as high priority by client groups. OMAFRA's Agroforestry Specialist, along with a number of Partners have provided input to staff from PFRA regarding existing Agroforestry Programs in Southern and Eastern Ontario.

OMAFRA maintains a website for Agroforestry information which is extensively used by owners of woodlands and others.

In 2005, the production of a Best Management Practices Manual for Agroforestry was completed but yet to be published. The Eastern Ontario Model Forest (EOMF) was awarded the contract for the writing this document which will be published in Ontario's BMP series of agricultural publications. Publication of the Manual is expected in 2006.

Several important priced publications for the maple syrup industry are available through the Promotion Store of the Ontario Maple Syrup Producers' Association (OMSPA). These include a Report on the Economics of Maple Syrup Production, a Maple Info CD ROM and a Directory of Maple Orchards in Ontario.

New and/or revised OMAFRA Factsheets include a Factsheet entitled "What You Should Know about Maple Syrup" prepared for the general public and a Factsheet entitled "Use of High Pressure Steam in Maple Production". In 2005, Factsheets entitled "Measuring the Density of Maple Syrup" and "Filtration of Maple Sap" were also published.

OMAFRA is also working on two comprehensive Manuals for the Maple Syrup Industry, one focusing on proper maple tubing system installation and maintenance for sap collection to help improve sap productivity and quality and one on managing the sugar bush for improved health and productivity.

The North American Maple Syrup Council Manual is being revised and it is expected that the revised publication will be available in 2006. Dave Chapeskie, Agroforestry Specialist, OMAFRA is a contributing Author to this Manual.

Emphasis is currently being placed on transferring to maple producers what has been learned from operational investigations carried out in 2004. These include an investigation of lead in maple syrup and a study comparing the performance of small spouts, including the micro spout for sap collection. The results of ice storm recovery research (phase 2) and an investigation of sap filters (phase1) are being transferred in 2005 and 2006.

APICULTURE AND POLLINATION

Apiculture and Pollination Chair Report

Geoff Wilson

The reports from the apiculture and pollination subcommittee members have indicated a successful year. Although there were some set backs, most of the members were quite positive. The subcommittee would like to encourage more members of commodities requiring pollination such as orchard groups, vine crops, field crops and berry groups to help represent the other side of the pollination industry. It is felt that this would help to stimulate ideas for pollination research and services.

For the most part honey production was up over the 5 year average, and the demand for Ontario colonies to pollinate blueberries in Quebec and New Brunswick continues to grow. Unfortunately, the prices of bulk honey are very low and it is difficult to sell this year's crop in the barrel, so beekeepers are packing more of their own honey. There are some new issues that are developing such as best management practices for pollination, using new chemical treatments and the potential that bees are picking-up food contaminants from environmental sources. These are issues that should be passed on to the tech transfer and research sectors of this committee for further study.

The success of the Ontario Beekeepers Association technology transfer team has become very evident. Their vast amount of previous work has helped to make colonies healthier. The result is more colonies in Ontario. Through their successes such as publications promoting organic beekeeping and alternative treatment regimes, they have shown the importance of maintaining their positions. The apiculture industry continues to strongly support their work. Beekeepers realize that without the tech transfer team continuing to work on best management practices for honey bee production, the beekeepers will lose their ability to remain at the forefront of applying new technologies. This is very important because at the present there are new treatments and procedures being developed that must be proven useful in Ontario conditions.

The researchers at the University are currently settling into their new positions. Work is in progress and has started on many research topics. In addition to working with the tech transfer team, Dr. Guzman's results from developing new application methods for Thymol were very promising. This is a treatment that was previously found to be ineffective in Ontario. Dr. Guzman also worked on new methods of establishing colonies, determining genetic inheritance of grooming behaviour and defensive behaviour in honey bees. Dr. Otis is currently working on publishing articles with former student Dr. Heather Mattila. Dr. Scott-Dupree is continuing work with the effects of seed treatment of canola on honey bees. Dr. Kevan is continuing his work with pollen supplements, and distribution of biological control agents. New research initiatives of note include biocontrol of Varroa mites using fungus and genetic work in honey bees.

Despite the poor prices for honey, the apiculture industry is generally optimistic. There is a lot of support for the current researchers, tech transfer and government services. There is also general support of the committee for more participation by industries, researchers and services working with pollination.

Apiculture and Pollination State of the Industry

Doug McRory

Beekeepers have had an excellent year overall in Ontario in 2005. The estimated average production for 2005 is 103 pounds per colony. This compares to 106 pounds per colony in 2004. The colony count has increased from 72,000 in 2004 to 76,000 in 2005. Many areas would have had an even better crop if they had received rain in August. 2600 beekeepers were registered in 2005.

2004 winter loss was 18.5%. This has become about the normal loss now with the mites present in the bees. Previous to mites being present, the normal loss was considered to be 10%.

Beekeepers finally had a good spring to build up their numbers. They were able to recover the 18.5% loss and add an additional 5.5% increase. When conditions are good for bee development, it is amazing what they can do. It was a bad year for swarming. Those beekeepers with major swarming problems could have divided up their colonies much more in the spring to prevent this problem.

The bulk honey market continues to be returning less than the cost of production. The current price is about \$.80 per pound. The cost of production in Ontario is something over \$1.25 per pound.

The price of packaged honey continues strong. More beekeepers are again packing and selling their honey. 64% of the Ontario honey crop in 2004 was retailed as compared to 46% in 2003. These are the latest years that this data is available for. Beekeepers indicated renewed interest in selling retail with their 2005 crop.

Pollination has become a large source of income for Ontario beekeepers. 28 loads of bees went to New Brunswick and Quebec for blueberry and cranberry pollination. These loads came back quite variable in stores, brood and bee populations. Most of the beekeepers say they will ship again but some individuals have decided against it. Beekeepers continue to meet the demand for bees for pollination in Ontario. Summer pollination continues to grow.

OMAFRA did a major sampling and checking of honey labels in 2005. Many beekeepers received letters about items to correct on their labels. Phenol was found in several samples. Action was taken on two phenol situations. Sulfa drugs were found in several samples and recall action was taken in three situations. There is the possibility that the bees have picked up the Sulfa in the environment as none of the beekeepers involved say that they have used the product. Beekeepers should only use registered products in their colonies. To reduce the risk of losing your entire honey crop, beekeepers need to keep track of their lots of honey right down to the beeyards. Keep your lots as small as is workable in your system. The smaller the lot, the less risk there is.

Honey Bee Tracheal Mites continue to spread and have shown up at surprising levels where thorough surveys were conducted. Formic Acid must be used at least once per year to keep tracheal mites under control.

A new treatment, Mite-AwayII, has received full federal and provincial registration in 2005. This product was developed in Ontario and is the first Varroa and tracheal mite product to be fully registered in many years. An educational DVD has also been produced and is available to assist the industry to adopt Mite-AwayII's use as an alternative to hard chemicals. This is further proof that Ontario's research, tech-transfer and apiculture/pollination industry continues to lead the way in developing novel solutions and remains in the lead in North America.

Varroa mites continue to develop resistance to Apistan®. Those who use Apistan® should check by monitoring to see if it controls the mites. Once the Varroa are resistant to Apistan®, if the beekeeper does not use Apistan® for 4-5 seasons, it appears to work again.

The area of Check-Mite™ resistance does not appear to be increasing from the area between Iroquois and the Quebec border, and south of the 401. The beekeepers that have used Check-Mite™ for longer than two years should consider switching to Formic Acid in the spring, then as soon as the honey is taken off in the fall, followed by Oxalic Acid treatment when the bees are wrapped for winter.

With the PMRA exemption of Oxalic Acid for the fall of 2005, and not wanting to develop resistance to Check-Mite by over use, the recommendation for Varroa control this fall was to treat with the Mite-AwayII™ pads as soon as the honey is taken off and follow up with a treatment of Oxalic Acid using the trickle method just as the bees are wrapped for winter.

Beekeepers are using monitoring to decide if they need to treat a particular beeyard. Although monitoring can save you money and also reduce the exposure of the mites to products that will cause selection for resistance, monitoring can be labour intensive. Having sound data in your hand makes decision making much better. Many beekeepers are investing in screened bottom board systems so they can monitor easily. Beekeepers are again looking at drone removal as a method of reducing the Varroa population.

Overall, 2005 was a good year. The diseases and mites continue to be a challenge but beekeepers appear to be dealing successfully with these challenges.

University of Guelph Honey Bee Research Projects

Dr. Ernesto Guzman

The researchers at the University are currently settling into their new positions. Work is in progress and has started on many research topics. Regarding research activities conducted during 2005, Dr. Ernesto Guzman (the new professor of Apiculture) has been involved in several projects. A brief description of each one as described by Dr. Guzman follows:

Varroa and tracheal mite control using organic pesticides applied with different delivery methods.

Contamination of honey with chemical residues as a result of the application of hard chemicals to control parasitic mites in honey bee colonies is a major problem for the beekeeping industry worldwide. We tested two natural products that have shown promise as organic acaricides (Thymol and Oxalic Acid). These products are not harmful to human health and theoretically leave very small amounts of residues in honey. In order to increase the efficacy of these products, we applied them with three different delivery methods as single or combined treatments, to find which one provides the best mite control leaving the least residues in honey. Additionally, we estimated the bee population of the experimental colonies and took samples of brood and dead bees from treated and untreated colonies, to look for possible toxic side effects of these products to the bees. Food safety and efficacy are the main concerns of this project. We conducted the study with 70 colonies that were artificially infested with a similar load of mites in the beginning of the season, and spent several months waiting for the mite populations to develop. The products were applied, the samples were taken, and a final treatment with Coumaphos (Check-MiteTM) was used to compare the efficacy of the different treatments. We just finished the first part of the experiments and will have results analyzed by next year. The only major result that we can confirm at this point in time is that Thymol in dust mixed with confectionary sugar yielded the best control against Varroa mites. Berna Emsen, a visiting student from Turkey was the main person responsible of the development of this study, but six other students participated in this project too. The experiments so far conducted demanded a lot of effort and logistic organization, but the students' assistance, the work coordination and field experience of Paul Kelly, as well as the collaboration received from the Technology Transfer team of the OBA and that of beekeepers such as Geoff Wilson and Peter Bussell, allowed us to collect a good amount of data. We still have to process samples of bees and combs, and to analyze the data.

Methods of establishing honey bee colonies. We conducted a comparative study of establishing colony divisions. Factors involved in this study included the time of dividing colonies (early or late in the spring), as well as initiating colonies with mated queens versus queen cells. It is important to know how these alternative methods of establishing colonies affect the honey yields, population development, winter ability and mite control of honey bee colonies. This project is lead by Paul Kelly and several students have been involved in its development. Hopefully we will be able to report results on this project by next year.

Use of miniature mating nucs to rear queens. This is a small project also lead by Paul Kelly. Miniature baby nucs require less bees and food to rear queens, and thus could be more economical to use than larger units. Keeping a small population of bees inside them is very difficult to achieve (bees abscond) and this is the main inconvenience of using them. Trials with baby nucs were conducted using pheromone baits to keep the bees in the nuc. Data is still not analyzed but a gross view of them, allow us to conclude that results were encouraging.

Heritability and genetic effects of mechanisms of resistance against Varroa mites in honey bee colonies. This is a project that is being conducted in Mexico under my advisory and supervision by Laura Espinoza (graduate student). The objective is to determine which behavioural mechanisms of worker bees confer more resistance to honeybees against the Varroa mite and how heritable they are. So far results suggest that hygienic and grooming behaviour explain most of the resistance found in bee colonies. Laura also found that both of these mechanisms are highly heritable and therefore could be useful in breeding programs to develop Varroa resistant bees.

Dominance and parental effects in hybrid European-Africanized honey bee colonies. This project is also being conducted in Mexico under my advisory (by Felipe Becerra, another graduate student). We are studying how different characteristics of economic and evolutionary importance are inherited in hybrids colonies of European and African descent. The results of this project will help us to better understand the genetic architecture underlying important traits of honeybees.

Genetic basis of honey bee defensive behaviour. This is an international project that involves the collaboration of several institutions: the National University of Mexico, Purdue University (USA), the University of Illinois (USA) and the University of Guelph. The main objective of the project is to study the defensive behaviour of honeybees at the colony and individual levels, using stocks of bees that differ for this characteristic (European and Africanized bees). We study the guarding, pursuing and stinging tasks of honeybees and we perform different crosses to collect samples of bees performing the behaviour in order to study their genome with DNA techniques. We look for expression in candidate genes that may be associated to the above tasks.

Research conducted by other professors. Dr. Scott-Dupree is continuing work with the toxic effects of seed treatment of canola on honeybees. Dr. Kevan is continuing his work with pollen supplements and distribution of biological control agents.

Ontario Beekeepers Association Technology Transfer Report

Alison Skinner, Janet Tam and Rachel Bannister

A. Breeding and Maintaining Parasitic Mite Resistant Honey Bee Stocks:

1. Maintenance of Tracheal Mite Resistant Honey Bee Stocks

Ten bee breeders participated in the tracheal mite resistance testing. One assay was completed in early September, evaluating 76 colonies for the resistance trait. Bee breeders will be advised to use the top 25% of the resistant lines in their breeding programs.

2. Maintenance of the Hygienic Trait in Ontario Bee Stocks

In August and September, 12 bee breeders participated in hygienic testing of potential breeder colonies. 294 colonies were tested using the liquid nitrogen freeze kill method. Colonies which ranked in Group 1 (>75% of killed brood cells removed) and Group 2 (50-75% of killed brood cells removed) can be used as breeders for Varroa resistance. Hygienic colonies were included in the 2005 tracheal mite resistance testing.

3. The Importation of Russian Honey Bee Eggs into Ontario

The tech-transfer program is working with the Russian honey bee breeder to establish a sustainable Russian breeding program in Ontario. The imported Russian stock is maintained by the breeder and further selected for economic and mite resistance characteristics.

Two new strains of Russian honey bees were released by USDA-APHIS in 2005. Russian honey bee eggs representing this stock were imported from Lisbon, New York, to a quarantine facility in Moose Creek, Ontario, where they were reared into queens. The queens were mated with Russian drones in an isolated mating yard.

4. Health Status of Colonies Tested in the Breeding Program

Bee samples were taken from 120 potential breeder colonies from eight bee breeders and stored in alcohol. Varroa and tracheal mite infestation levels and the presence of nosema spores will be determined. The results of this survey will indicate the health of the colonies and will highlight problem areas that can be corrected. Monitoring the health of breeder colonies will ensure the quality of queens produced in Ontario.

B. Integrated Pest Management (IPM) Program to Control Honey Bee Parasitic Mites:

1. Determining the Colony Effects of a Spring Treatment of Mite-AwayII™, Oxalic Acid and Sucroside™

In the spring, 25 colonies were divided into five treatment groups (n=5): Mite-AwayII™ (formic acid), Sucroside™, a single oxalic acid application, a double oxalic acid application (two weeks apart) and no treatment (control). All colonies were evaluated to determine the numbers of frames of bees, brood and honey. The frame-by-frame examination of each colony was conducted before treatment, three weeks after treatment, six weeks after treatment and 13 weeks after treatment. Results will compare treatment effects on brood and honey production.

2. Summer Treatment Comparison

Oxalic acid and Sucroside™ were compared as summer “knock-down” treatments in Varroa mite infested colonies in July. Fifteen colonies were divided into three treatment groups (n=5): oxalic acid, a single dose of Sucroside™ and no treatment (control). Mite levels were monitored using alcohol wash samples before treatment and four weeks after treatment.

3. Fall Treatment Comparison

Mite-AwayII™, oxalic acid, Sucroside™ and no treatment (control) (n=10) were applied to 40 colonies in early October. Three weeks after treatment, Check-Mite+™ was applied as a finisher treatment for an additional three weeks. The efficacy of each treatment was monitored using the alcohol wash method before treatment, three weeks after treatment and three weeks after the finisher treatment.

4. Late Fall Treatment Comparison

Apistan® (fluvalinate), Bayvarol™ (flumethrin) and oxalic acid (n=11) were applied in the late fall. Three weeks after treatment, Check-Mite+™ was applied as a finisher treatment for an additional three weeks. The efficacy of each treatment was monitored using the alcohol wash method before treatment, three weeks after treatment and three weeks after the finisher treatment.

5. Organic Fall Treatments

A combination of organic fall treatments were compared to determine efficacy on Varroa mites. Thirty-six colonies were divided into three treatment groups (n=12): October Mite-AwayII™ (formic acid) and November oxalic acid; October Sucroside™ and November oxalic acid; October oxalic acid followed by oxalic acid again in November. Mite fall was monitored for three weeks following treatment in October using sticky boards. The late fall mite drop was monitored for an additional three weeks.

6. Fall Testing for Miticide Resistant Varroa Mites

The glass vial assay was used to evaluate Varroa mite populations for fluvalinate resistance. The LC90 of fluvalinate was determined for Varroa mites in bee colonies which had not been treated with Apistan® for two years. Trials to monitor for resistance were conducted in Niagara Region and Wellington County. Fluvalinate resistance was present in both areas.

Pettis testing was conducted in Wellington County, using Apistan® (fluvalinate), Bayvarol™ (flumethrin) and no treatment (control). Bayvarol™ was more effective than Apistan®.

7. Organic Beekeeping Practices

This project was completed in conjunction with Paul Kelly and Dr. Ernesto Guzman of the University of Guelph. Forty-five colonies were established on an organic farm and were managed organically. Combinations of organic treatments (Mite-AwayII™ and oxalic acid) and cultural techniques for Varroa mite control were evaluated. These included the removal of drone brood, interruption of brood rearing and the use of a screen bottom board. Honey production from each of the treatment groups was recorded.

Knowledge of colony mite levels is essential to manage a colony without the use of conventional chemicals. Colonies were monitored using a 24 hour sticky board, ether roll, sugar dust, alcohol wash and uncapping drone brood. The data collected will be used to determine the relationship between each of the monitoring techniques and to determine similarities between colony samples taken from the brood chamber and the honey super.

8. Honey Bee Mite Scouting

This is a pilot project to determine the effectiveness and practicality of a mite scouting service for beekeepers. In the spring, late summer, early fall and late fall, apiaries belonging to two hobby and five commercial beekeepers were scouted to determine the levels of Varroa mites, tracheal mites and the presence of bee diseases. Samples were analyzed from 581 colonies. Results were provided for each beekeeper. A survey was completed by participating beekeepers for evaluation of the scouting service.

9. Sulfa Residue Trial

Two single brood chamber colonies were each fed one gallon of sulfa treated sugar syrup in the fall. Honey produced by these two colonies in 2006 will be analyzed for residues.

C. Progressive Training and Information Program for Beekeepers:

1. Beekeeping Manuals

A new Ontario Beekeeping Manual and a new Honey Bee Queen Rearing Manual are currently under compilation with the cooperation of contributors. The manuals will be completed in February 2006.

2. Workshops

Two "Introductory Beekeeping with an Emphasis on IPM" workshops were held in Guelph (May) and in Sudbury (August). Another workshop, "Introductory Queen Rearing" was conducted in Guelph (May). The workshops consisted of classroom presentations accompanied by outdoor hands-on sessions. Workshop enrollment was at maximum capacity for all three dates.

Apiculture and Pollination Emerging Issues

- 1. The arrival of Coumaphos and Fluvalinate resistance, and the possibility of resistance to organic compounds in Varroa mites, is seen as the greatest risk to Ontario beekeeping in the future.**

Possible solutions:

1. Through extension, have beekeepers adopt Integrated Pest Management (IPM) mite control programs as developed by the OBA tech transfer program. This includes changing their stock over to the HBTM resistant hygienic stocks that are available from Ontario bee breeders, hard and soft chemical treatments and cultural management techniques.
 2. Register Oxalic Acid.
 3. Register Bayvarol™.
 4. Develop Thymol.
 5. Register Formic Acid.
 6. Develop and evaluate biocontrol methods for Varroa control (i.e. fungi)
 7. Develop resistance testing methodology for organic mite treatment compounds.
- 2. Potential chemical residues in hive products from environmental sources may be a risk to the beekeeping industry in Ontario.**

Possible solutions:

1. Environmental assessment in areas of hive product contamination.
 2. Research markets for non-human food use of honey (i.e. ethanol, animal feed etc.)
- 3. The risk of introducing Africanized genes to Ontario honey bees due to allowing imports of queen bees into Ontario under Federal permit.**

Possible Solutions:

1. To obtain and establish the laboratory infrastructure to identify African genes in the population of bees that are imported into Ontario.
2. Continue to test bees that come into Ontario from mainland United States.
4. **The quality of bee colonies returning from pollination is variable and affects production.**

Possible solutions:

1. Develop best management practices.
5. **Resistance of American Foulbrood (AFB) to the only registered chemical – Oxytetracycline. This has not happened yet in Ontario but the samples being tested for r-Oxytetracycline are showing “moderate” susceptibility to Oxytetracycline. Eventually, Ontario will have resistance to deal with.**

Possible solutions:

1. Register both Tylosin and Lincomycin in Canada.
2. Continue to monitor the susceptibility to Oxytetracycline of colonies that breakdown with AFB and destroy them by fire or irradiate the equipment.
3. Through the tech transfer program, continue to develop hygienic stocks of bees with the Ontario Bee Breeders.
4. Promote cultural controls and better management to minimize the effects of AFB on the health of honey bee colonies.
6. **Small Hive Beetles are across the border from Ontario.**

Possible solutions:

1. Continue to do surveys near high-risk areas.
2. Register Check-MiteTM.
3. Register Guard-Star.

Apiculture and Pollination Research Priorities**A. Apiculture Research Priorities**

Research Priority 1: Further development of an effective IPM and food safety program for controlling parasitic mites, small hive beetles and infectious diseases of honey bees. Example: Biocontrols or organic compounds.

Research Priority 2: Development of Varroa mite resistant bee stocks using different selection approaches and integrating resistance into Ontario hygienic tracheal mite resistant existing bee stocks.

Research Priority 3: Environmental assessment for possible contamination of hive products.

Research Priority 4: Develop viable requeening systems for Ontario utilizing Ontario stock.

Research Priority 5: Develop methods of overwintering large number of queens.

Research Priority 6: Develop resistance testing methodology for organic mite treatment compounds.

Research Priority 7: Projects to develop nutritional supplements for bees.

Research Priority 8: To identify and develop alternative control strategies for pests that have minimal impacts on beneficial insects. Example: Corn borer, wax moth control.

B. Pollination Research Priorities

Research Priority 1: Determine best management practices for colonies moved for pollination.

Research Priority 2: Pollination requirements and management of orchards and berry crops.

Research Priority 3: Management strategy for cucumbers and other vine crops.

Research Priority 4: Management strategy for pollination of field crops.

Research Priority 5: The importance of actively encouraging education and research on alternative pollinators.

Apiculture and Pollination Service Priorities

Service Priority 1: Surveying for resistance to Coumaphos, Fluvalinate, Oxytetracycline and organic compounds.

Service Priority 2: Maintenance and enhancement of the Ontario bee inspection program and the apicultural laboratory services.

Service Priority 3: Providing DNA and morphometric analysis of honey bees in Ontario.

Service Priority 4: Identify uses of honey that would allow its release from detention.

Service Priority 5: Provide mite scouting service.

Service Priority 6: Enhanced yard mapping using GPS.

Service Priority 7: Registration of Bayvarol™.

Service Priority 8: Registration of Check-Mite™.

Service Priority 9: Registration of Oxalic Acid.

Service Priority 10: Registration of Tylosin and Lincomycin.

Apiculture and Pollination Tech Transfer Priorities

Priority 1: Maintenance of Ontario government apicultural regulatory and technology transfer programs.

- Continue to monitor the susceptibility to Oxytetracycline of colonies that breakdown with AFB and destroy them by fire or irradiate them.

Priority 2: Maintenance and enhancement of the OBA Tech Transfer program.

Priority 3: Develop tech transfer materials on beekeeping.

Priority 4: Quality of hive products to meet consumer expectations.

Priority 5: Techniques for monitoring mite levels.

APPLE

State of the Industry (Nov 2005)

- Adrian Huisman, Harold Schooley, Ontario Apple Growers

2004 Crop

The 2004 apple-marketing season was one of the most difficult in recent memory. The original estimate for the 2004 crop was 8.4 million bushels but was revised to 9.8 million bushels. A world surplus of apples coupled with declining exchange rates resulted in extreme pressure on the pricing of Ontario apples. Of particular concern was a very large crop in the state of Washington and subsequent concerns over possible dumping of Washington apples onto the Canadian market. The OAG is currently conducting a review of this situation, which may lead to a dumping challenge by the Canadian apple industry.

West Coast apples took over a large portion of Ontario retail apple shelf space by offering volume discounts on a number of varieties. Once Washington State started this practice; British Columbia was forced to follow suit. It hurt sales of Ontario fruit severely in the latter part of the season as retailers strived to meet purchasing objectives in order to achieve the maximum discounts.

For the second consecutive year the industry experienced low packouts due to pressure bruising in McIntosh and marginal Brix levels in Empire. Cullage problems in these two major volume varieties severely impacted the bottom line of producers.

2005 Crop

The 2005 crop was originally estimated at 9.7 million bushels (as of September). Now that the crop has been harvested, it is more likely that the crop will exceed 12 million bushels. Indicators include:

- ✓ Juice apple volume will far exceed last year's numbers. Ontario processors alone will receive in excess of 5 million bushels of orchard juice with packing line juice apples yet to come.
- ✓ Processing into non-juice products will be at least the same as last year.
- ✓ Shipments of juice apples into Quebec and the U.S. will far exceed last year's volume.
- ✓ Fresh market sales have been higher than last year's volume for Sept. and Oct..
- ✓ November 1st storage holdings far exceed last year's holdings.

The U.S. apple crop is reported to be down about 10% from 2004 but still larger than the previous 5-year average. Other than Ontario, the Canadian crop is expected to be down from last year. Hopefully, this will result in increased returns to Ontario apple growers.

There were no major weather related incidents (hail or frost) during the 2005 growing season other than a severe lack of precipitation. As a result, fruit size is smaller than normal but for the most part fruit should be destined for fresh market.

From the production side of the picture comes the following:

- Codling moth control in Essex County has become an issue, as 85% control of this pest is not acceptable. Organophosphate resistance is suspected as it has been documented in nearby Michigan.
- Oblique banded leaf roller is present in several growing areas around Ontario but has been particularly difficult to manage in Georgian Bay orchards. Spray timing is critical for this pest and the insect development degree-day models need to be refined for the spray recommendations being utilized.
- Problems with Sooty Blotch and Fly Speck were widespread this harvest season and will have an impact on the marketability of some fruit. Consideration will have to be given as to the reasons for the increase in incidence of these summer diseases.
- Finally, fireblight was noticed to be more widespread this year than normal. There were no reports of destruction of orchards. But, late strikes were seen well after bloom was over and occurred on a large number of varieties including those not prone to this devastating disease. This means the bacterium lurks in or near many orchards and has the potential for severe infestations if weather is conducive another season.

Apples are a worldwide commodity and all producing countries aim to be the last competitor standing. Competing is a struggle for all producers made more difficult as:

- U.S. subsidies allow that country to buy shelf space in Ontario markets and elsewhere
- The cost of the every-day-low-prices policy of retailers is born by producers.
- Producers now pick up the cost of pest management delivery, as well as the environmental, food safety and quality assurance programs that some buyers now require, especially in international markets. These costs have been absorbed by growers as a cost of market access with no chance of recovery.
- Orchard replacement costs are very high as producers are faced with renovating orchards to newer strains or newer cultivars in order to continue to compete.
- There have been substantial tree losses due to harsh winters. This started 3 years ago weakening many trees culminating this spring in large tree losses. High value cultivars like Crispin and Gala were most severely affected.
- Our pest control arsenal languishes behind our competitors and we focus our attention on solving immediate problems.
- The cost of doing research is being downloaded to producers with station access and admin fees as well as the requirement for 50% grower funding. Research dollars are being spent on short-term problems rather than long-term competitiveness issues.

On the positive side the OAG have partnered with Foodland Ontario and the Apple Marketers Association of Ontario to implement an aggressive promotional program targeted at stimulating the sale of Ontario apples throughout the fall and into the new year. We have had good support from retailers with this program and to date results have been positive. A 'Buy Ontario First' policy strictly implemented in all government buildings and institutions with support strongly encouraged by the retail trade would be welcomed by this industry.

Report of Action Taken on 2004 Recommendations

Recommendation # 1

2004-1 Future of Postharvest Research

To: University of Guelph

Recommendation: It is recommended that the University of Guelph move forward and reveal plans for a dedicated postharvest research facility and show how they intend to ensure that leadership is available in postharvest to address industry needs.

Response from the University of Guelph

The University of Guelph has been exploring with the industry a number of options to ensure that postharvest research continues as a viable research (and educational) area. The current facilities will remain in place until May 2006 to allow the research planned for the 2005 crop to be completed. New facilities have been designed and pending a successful tender process will be constructed within the Bovey complex at U of G in early 2006 with an anticipated completion date of summer 2006. In addition, the University is currently advertising for a Senior Chair in Postharvest Physiology to ensure that we continue to provide leadership in this area for the industry and province.

Recommendation # 2

2004-2 Gaps in Delivery and Implementation of IPM Programs

To: OMAF, Bill Ingratta

Recommendation: It is recommended that OMAF investigate, review and evaluate these models and move to adapt a model to address the gaps in IPM delivery in Ontario.

Response from Crop Technology Branch, OMAFRA

OMAFRA continues to play a key role in supporting research and technology transfer for the development and validation of integrated pest management programs (IPM) in Ontario. There is also significant effort in education and training conducted through workshops, conferences and development of technical information.

Details were provided on - IPM Technical Update Meeting for Consultants, Scout Training, Ongoing Training of Consultants, and Grower Meetings.

OMAFRA also participates in the federal/provincial Expert Committee on IPM and continues to raise the issues and challenges faced by Ontario growers around the adoption of IPM. This November, OMAFRA IPM Systems Specialist, the Manager for Horticulture Technology, and Ontario IPM consultants will be participating in a national workshop on *Barriers to IPM Adoption* being held in Halifax by AAFC's Pest Management Centre. Here strategies will be developed to address the gaps and lack of delivery, as well as implementation of IPM on a national basis (and perhaps this can be adopted for Ontario).

To discuss IPM needs or for more information around IPM activities please contact Margaret Appleby, Acting Manager Horticulture Crops, Crop Technology Branch

Recommendation #3

2004-3 Promotion of Benefits to Eating Ontario Apples

To: OMAF, AAFC

Recommendation: Considering the substantial benefits that Ontario apples contribute to the Ontario and Canadian economy with little or no chance for cost recovery, it is recommended that the Federal and Provincial Ministers of Agriculture and Health and the Premier take an active role in promoting the benefits of consuming Ontario apples. Furthermore, it is recommended that both levels of government take steps to reduce onerous regulation and taxation that provides barriers to Ontario producers' ability to compete, maintain quality, or add value to their product.

Response from OMAFRA

The Ontario Government agrees that the potential health benefits of improved diets are significant, and is working on a number of fronts to place more emphasis on the role that proper nutrition can play in the prevention of health problems. Many of these activities relate to the horticulture industry including research and promotion that will further the understanding of the benefits of eating fruit and vegetables.

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) funds food and health research and innovation, generating new knowledge, products and technologies that support healthy eating. The input of OASCC research committees as to the research priorities related to health benefits of food will be used to inform future calls for proposals for research conducted under the OMAFRA/U of G contract and competitive research funding programs.

In 2005, the ministry organized the Agri-Food Innovation Forum which profiled the linkages and opportunities of food and health. One of the key issues identified during the Forum was the need to examine the regulatory system and the role that it can play to better encourage food solutions to some of our key health problems. It is hoped that this will lead to future and more focused discussions on how to improve policy in this area. In addition one event held at the Forum was an awards program to recognize achievements in agri-food research and innovation. The Innovation Award was presented to the Fresh Cut Apple Slices Team, consisting of Pride Pak Canada Ltd., Dr. Jennifer R. DeEll (OMAFRA), Dr. Peter M.A. Toivonen (AAFC – Summerland, BC.), Dr. H.P. Vasantha Rupasinghe, Nova Scotia Agricultural College, and the Ontario Apple Sales Group, which have helped McDonalds' Food Chain introduce a new product into their business and has resulted in a new market for Ontario apples.

In June, 2005 the Ministry of Health Promotion was created. The Ministry will help Ontarians lead healthier lives by delivering programs that promote healthy choices and health lifestyles. To do this the Ministry will work closely with partners, stakeholders and all levels of governments. OMAFRA has established linkages with the Ministry of Health Promotion and other ministries to promote the benefits of food and health to Ontarians. For example, the Ministry of Health Promotion, in concert with OMAFRA, is examining a number of strategies, including the possibility of promoting the consumption of Ontario fruits and vegetables in schools as part of a healthy meal or snacks program.

Mr. Don Taylor, Assistant Deputy Ministry of Agriculture, Food and Rural Affairs is the ministry contact leading discussions with OMAFRA and other ministries and partners in the agri-food and rural sector.

Emerging Issues (not ranked)

1. Competitiveness

Producers are expected to pick-up the costs for pest management delivery and all the environmental, food safety, and quality assurance/traceability programs that have arisen (e.g. Integrated Fruit Production (Biocrisp), Eurogap, Nature's Choice, etc). There is no cost recovery of these programs and imports from third world countries do not have to comply with them. Closer to home the U.S. Market Assistance Program buys shelf space in our domestic markets as well as our export markets. Foodland Ontario promotion funding is diminishing, whereas the U.S. is now spending \$54 million per year on value-added for specialty crops. To help us compete, Ontario consumers need to be made aware that buying local produce contributes over one billion dollars to the provincial economy, employs over two thousand people, supplies taxes to fund rural schools and hospitals, and provides safe high quality food that has been endorsed by the Canadian Cancer Society and the Health and Stroke Foundation as a major benefit to reducing health care costs. On the other hand, consumers need to be made aware that buying imported produce allows entry of foreign insects and diseases, and supports poverty, destruction of the environment, including rain forests and endangered species, with no regard for workplace safety and worker welfare! Furthermore, buying locally produced agricultural products has been proven to have a 7-fold multiplier effect on the Ontario economy.

2. Research Funding

Less research is being done and project costs are escalating. For-profit corporations must contribute 50:50 cash for cash to access funding and this has reduced investment in research projects from the private industry. There is no easy mechanism for non-governmental organizations to flow tax credits back to the producers and thus a huge opportunity for tax incentives to research is lost. Qualified, conscientious summer student assistance is difficult to acquire because government will only pay minimum wage, while at the same time these students are faced with increased tuition costs, higher fuel costs, and increased insurance premiums. There have been dramatic cuts to funding by the University of Guelph to cover overhead costs and research technicians. Limited industry funds are being demanded to pay for research station access and administration fees. The producer population is aging and less focused on developing their industry for the future, and innovative new producers are not entering the industry quickly enough to maintain the enthusiasm needed to generate required research funding. The net effect is that research institutes are relying more heavily on producer organizational funding up-front. Once CORD funding expires it will be very difficult for this commodity (and many others) to maintain that contribution.

3. Postharvest Research

There needs to be long-term commitment to postharvest research by the University of Guelph, as the current postharvest research facility and building is scheduled for demolition in May 2006. Currently there is a proposal for renovation within the Bovey building at the University of Guelph for some limited work in postharvest; however, this proposed lab will not accommodate the scale of research that could be conducted previously. In addition, the two full-time professors in the field of postharvest physiology have recently retired and there is no plan to fill these positions in the near future. Therefore, there is considerable angst about the future of postharvest research in Ontario.

4. Attaining and Maintaining Optimum Fruit Quality for Consumers

Produce buyers are becoming more demanding with excess supply to choose from and quality problems such as bruising, internal browning, low sugars, and poor fruit color are substantially reducing pack-outs and thus producer returns. These low pack-outs are a millstone around the necks of producers that severely affect profitability. Further costs are added to retailers if reduced shelf-life is associated with this fruit. Fruit prices are not expected to rise in the near future. The only avenue producers have to increase their returns is to send a higher percentage of fresh apples to market. This can be done in two ways. Work to attain higher quality parameters at the production end of the cycle and then work to maintain that quality in the storage, packaging and marketing end. Scientific data is needed to attain and maintain optimum consumer quality at both ends of the system.

5. Reduced Risk Pesticides

Apple growers strive to incorporate reduced risk pesticides into their pest management programs. Reduced risk pesticides are more environmentally friendly and are considered to be short lived, and target specific. Many of these products suppress pest populations, not control them. In some cases, reduced risk pesticides are not effective in managing secondary pests (leafhoppers, wooly apple aphid, rosy apple aphid, scale), and as a result these pests are becoming a problem. Thresholds and timing for application of these new products can also differ significantly from

traditional products. Resources are needed to evaluate the efficacy of reduced risk pesticides, their impact on secondary pests, and the thresholds and timing of application of these materials.

Research and Services Priorities

APPLE RESEARCH AND SERVICES PRIORITIES		
Allocation	Priority	Sustainable IPM Systems
R & D	1*	Strategies for management of fireblight on pome fruit including growth regulators, cultural methods, biocontrols and non-chemical alternatives (foliar nutrients, SAR, etc.).
R & D	1	Efficacy testing, pesticide timing and evaluation of biological controls for managing European apple sawfly and OBLR
R	1	Efficacy testing of reduced risk products and their fit into IPM programs
R	1***	Storage rots and postharvest disorders of pome fruit. Efficacy of current and potential new low risk materials and strategies.
D	2	Development of an integrated approach for control of black rot, apple Scab, fireblight and other disorders affecting fruit and/or foliage (including resistance management).
D	2	Field validation of predictive models and controls developed for insect and disease under Ontario conditions.
R & D	2	Development of sustainable IPM practices and resistance management for internal Lepidoptera pests (including OFM and CM) and the development of mating disruption strategies for apple insect pests such as codling moth and dogwood borer.
Post harvest Strategies for Quality and Safety Assurance		
R & D	1*	1-MCP, Storage Technology
R & D	1	Cultivar recommendations
R & D	1***	Disease control, fungicide resistance
D	1	Antioxidants and Bioflavonoid (Health Benefits)
R & D	2*	Field validation of predictive models.
Crop Cultural Management		
R	1***	Cultivar recommendations (i.e. thinning, crop growth regulators, rootstocks) on specific varieties (i.e. Honeycrisp, Ambrosia, Aurora Golden Gala)
R & D	2***	Orchard water conservation, use efficiency and fertigation
R & D	2	Rootstocks
* Currently being dealt with and funding in place. ** Ongoing on farm trials but research needed on variety specific attributes - storage life, etc. *** Ongoing but may require further funding. R - Needs Research D - Development and Delivery Note: - Each of the three section itemized above has been ranked in order of importance - Each of the three sections is equally important		

2005 Recommendations

Recommendation #1

2005-1 Continuation of Postharvest Research Program

To: University of Guelph, Attention: Dr. Alan Wildeman (VP Research) and Chair, Department of Plant Agriculture

Recommendation: The University of Guelph needs to develop a productive, relevant, state-of-the-art postharvest research program in the Dept of Plant Agriculture. A long-term strategy needs to be developed to ensure that the necessary staffing, space, and facilities are assembled in order to have a viable postharvest research program, which addresses needs of the fresh market produce industry in Ontario.

There needs to be long-term commitment to postharvest research by the University of Guelph, as the current postharvest research facility and building is scheduled for demolition in May 2006. A proposal has been developed for renovation within the Bovey building in Guelph, to allow for the continuation of some postharvest research. Although this is an admirable proposal, further space and staffing are required to meet the industry needs in postharvest research. The capacity of the proposed lab is simply insufficient, as it can not accommodate the scale of research that could be conducted in the building that will be demolished. In fact, the cold storage and controlled atmosphere capability will be reduced to less than half by this move.

In addition, the two full-time professors in postharvest physiology have recently retired and there is no plan to fill these positions with equivalent expertise in the near future. The University of Guelph is simply looking within its current faculty for a Chair in Postharvest, but there is no commitment to ongoing research per se in this discipline. There needs to be researchers with experience and knowledge in postharvest biology and technology in this program. Furthermore, industry should have input into such choices.

There should be a partnership established between the University of Guelph, provincial and federal governments, and industry to provide funding, establish priorities, and ensure that the postharvest program continues and is productive.

Postharvest research continues to be a high priority in the apple industry. This industry needs to have research facilities available to test new products and processes under small-scale commercial-like facilities, to help maximize returns for those who are adopting the use of new products (i.e. 1-MCP), processes (i.e. value-added), and/or cultivars (i.e. Honeycrisp, Ambrosia). Research needs to be conducted in a facility that models current and emerging state-of-the-art commercial facilities, so that industry can improve their ability to compete by reducing product losses during storage and by learning how to further reduce the costs of operation. Such research is too expensive to conduct on a full commercial scale, where an abundance of variables make results of trial and error difficult to interpret.

Recommendation #2

2005-2 Increasing Demand for Ontario Produce

To: OMAF, AAFC

Recommendation: The Provincial government should become actively involved in developing a brand that identifies Ontario produced fruits and vegetables with functional health benefits.

Foodland Ontario currently provides advertising for Ontario produce, creates brand awareness with consumers, makes consumers aware of what is available in fresh produce and where they can buy it, and provides incentives to retailers to provide Ontario produce. Therefore, Foodland could easily incorporate a branding campaign to identify Ontario produce with health attributes. For example, use the recognized Foodland Ontario symbol in a different color and promote the health benefits of fruits and vegetables (backed-up with scientific research studies), as well as other attributes that consumers value, such as locally grown and produced using environment-friendly practices, food safety protocols, with worker safety and welfare considerations.

The Federal and provincial governments should set an example and support this endeavor by buying provincially for institutions, such as hospitals, prisons, military, schools, etc...

Recommendation #3

2005-3 Maintain AAFC Entomology Position in Vineland

To: AAFC, Attention: Dr. Gary Whitfield

Recommendation: AAFC should maintain the position of entomology toxicologist. The position should remain at Vineland to ensure that the researcher continues to work to address the research priorities of the Ontario fruit industry.

Despite the fact that over half of the tree fruit in Canada is grown in Ontario there are only two AAFC entomologists working in fruit. Growers are aware of the AAFC theme system, but feel that local AAFC personnel are required to deal with issues that arise regionally, such as oriental fruit moth. Within the past few years, we have lost a nematologist and a population ecologist from the Vineland Station. The industry is again in jeopardy of losing a position, this time an insect toxicologist.

The entomology toxicologist at Vineland is expected to retire in the near future. This position has been invaluable to the Ontario fruit industry. Growers recognize the importance of this position, and also the significant contributions that Dr. Dave Pree has made to the Ontario fruit industry. He has received awards for his contribution to the Ontario apple industry. It is imperative that this position be maintained in light of the societal demands for new reduced risk pesticide programs to replace the use of older chemistries. The position should continue to be based in Vineland so that the scientist can focus on issues that impact apple growers which include insecticide resistance in codling moth, oriental fruit moth, and mites (see research priorities). Facilities, insect and mite colonies, and trained technical staff are already in position there.

Recommendation #4

2005-4 IPM Delivery Systems

To: OMAFRA

Recommendation: It is recommended that OMAFRA review and evaluate the existing IPM programs in other provinces. OMAFRA should then work toward adopting a program, that will provide financial support to growers, thereby encouraging them to continue to use IPM.

An IPM program for apples has been in use in Ontario for more than 20 years. Ontario apple growers continue to update implementation of these programs to minimize impact on the environment using new reduced risk pesticides, mating disruption technology, weather and insect development forecasting and other tools with economic viability in mind.

Growers know the benefits of using IPM to manage pest resistance, extend the life of pest control products, and provide consumers with a high quality, safe environmentally friendly product. They recognize the work of OMAFRA specialists to revise and enhance the apple IPM program. The costs of implementing an IPM program has increased dramatically, with growers spending more money to: receive agri-phones, hire crop scouts, purchase new reduced risk products, and pay for IPM certification. It should also be noted that these new target specific products are requiring more intensive and time consuming scouting because control levels are short of 100% or are lacking for some secondary pests. Currently Ontario apple producers are bearing the cost of IPM implementation and certification, while society reaps the environmental and food safety benefits of IPM. Other provinces (Quebec, Nova Scotia and British Columbia) have devised programs to help reduce the costs incurred by growers following an IPM program. These programs have helped encourage growers to continue to use IPM.

BERRY CROPS

Executive summary:

The cool spring and hot summer caused the harvest of the various berry crops to be short with low yields and poor quality. Overall, the industry is stable and increasing in some sectors. However, there continues to be pressure on wholesale markets.

Over the last three years, there has been a rapid and progressive loss of wholesale markets to the year-round flood of imported fresh berries. This is of serious concern to the industry and will need a major realignment within the industry. Also, there has been a reduction in sustainable agriculture research efforts, higher energy costs, dumping of California strawberries and the lack of good varieties for the early markets.

Research and service priorities are now aligned to a value-chain approach with the goal to maintain and increase domestic market share of Ontario Berry Crops in 5 years using sustainable production systems, which are profitable to the grower, to provide Ontario consumers with healthy fruit.

The OBCRSSC has two recommendations: 1) that the OHCRSC coordinate the development of a business case for Ontario to support a nematologist in AAFC in Ontario, and 2) that communication channels between food, marketing, production, environmental and medical groups be improved and facilitated, that greater priority be placed on ICAR, and that new technologies be developed to enable efficient tracking of current research project titles and progress.

Industry Scan:

1. Current state of Industry

The cool, spring followed by very hot weather during harvest led to a short season for various berry crops. Rainfall varied within the province with average levels in the east, but dry elsewhere.

The strawberry season was short with reduced berry quality and yields. However, where rainfall was adequate yields were up. The hot weather and the short season caused customers to stay away from the U-pick operations. Also, the heat meant that coolers were used for longer periods of time and with high electricity costs, cooling costs were 30-50% higher.

The dayneutral strawberry acreage increased slightly as a number of growers tried dayneutrals for the first time. However, the heat had a huge impact on fruit size and quality. Fruit was small and misshapen due to poor pollination. This juvenile sector of the industry is expected to expand, but there are several limiting factors that need to be overcome: tarnished plant bug, powdery mildew, heat tolerance and markets.

The wholesale market is facing increased and continuing pressure as there is a continued decline in direct store deliveries and increased competition from strawberries from California.

Raspberry yields were low due to winter injury for the second year in a row. This will impact on next year's crop. Several growers are now growing under high tunnels and are experiencing problems with mites and mildew with few pest control products.

Blueberries had low-average yields due to the lingering effects of winter injury and heat. Prices were stable as there was a poor wild blueberry crop in the East. However, there is increased volume coming from BC and other large production areas.

Currants and Saskatoons were again productive, but many fields went unharvested because fresh markets could not be secured.

Overall, the industry is stable and increasing in some sectors. However, there continues to be pressure on wholesale markets

Emerging Issues

1. Reduction of wholesale markets

In strawberries, raspberries and blueberries, wholesale growers now face a flood of imported berries, mainly from California into Ontario during our traditional market season at prices that could be considered to be below our costs of production. Over the last 20 years, the supermarket chains have consolidated into three major chains. These pressures are now apparent in the market place and over the last three years growers have seen margins and markets disappear. Also China is now exporting large quantities of frozen strawberries.

2. Reduction in sustainable agriculture research efforts.

With continued erosion in the value of the OMAFRA/Univ. of Guelph enhanced partnership, and the AAFC retreat from production horticulture research, the infrastructure for horticultural research is being noticeably reduced. The loss of scientists and technicians with the expertise to do this research is now such that in a few years we will be unable to find the expertise to do the needed research. For example, the University of Guelph has now lost its post-harvest research faculty.

3. Higher energy costs

The hot weather combined with the higher unit prices for all forms of energy increased the cost of energy to individual berry farmers by 30-100%. Added to this was the continued increase in the use of drip irrigation.

4. Dumping of California strawberries.

Large quantities of California strawberries were dumped into the Ontario market in spring and fall. For example, in October large quantities of California strawberries were retailing for \$1.99 /lb. This as \$5 per crate FOB California, which is considerably below the \$7-8 costs of production. This was particularly damaging as Ontario producers, are attempting to compete in this market.

4. Lack of good varieties for the early markets.

Growers are now noticing that there have been no new strawberry and raspberry varieties for the early market released in the last 10-15 years. The continued erosion of breeding support now leaves the industry vulnerable in this sector of their markets. No new early strawberry variety is due to be released from the reduced Univ. of Guelph strawberry program in 2007, and no new raspberries are on the horizon.

1 Report of Action Taken:

Actions taken on 2004 recommendations.

No responses have been received to 2004 recommendations

2 Issues:

1. Research Priorities.

The committee realigned their research priorities onto a value-chain model in 2004 . This was to bring our priorities in line with the AAFC and OMAF pillars for research and to give the research scientists involved in the University of Guelph/ OMAF contract guidance for the forthcoming program proposals.

This year the subcommittee revised the goal and all other priorities remained the same

The Ontario Berry Crops Research and Services Sub-committee's goal is:

“to maintain and increase domestic market share of Ontario Berry Crops in 5 years using sustainable production systems, which are profitable to the grower, to provide Ontario consumers with healthy fruit”.

The five areas are not in order of priority.

Time-frame considerations. We have set five years as the time-frame as this is what is considered long-term in a political framework. However, we consider that 10 years would be a more realistic time-frame for projects such as breeding.

Measurement of success. Success will be measured as a comparison of the Ontario farm-gate value as reported by OMAF against the Statistics Canada value of berry crop imports.

Crops considered berry crops.

The major crops are strawberries, raspberries and blueberries.

Other berry crops which are known to be commercially grown in Ontario are cranberries, currants and gooseberries, saskatoons, elderberries, lingonberries.

Other crops with potential include blackberries(or brambles) and sea buckthorn.

Unless otherwise stated, the research priorities apply to all these crops.

A. Marketing

Over the last ten years, imported berries are being consumed in larger quantities throughout the year. To counter, this marketing research is needed to enable Ontario growers to recapture market-share in the following areas:

- coordinated marketing
- develop new markets, e.g. school snack programs
- fruit quality
- quality control
- define varieties for specific markets
- develop new products
- expand the range of berry crops grown, e.g. wild strawberries
- develop improved packaging and shelf-life

B. Food Quality

- Food Safety
 - develop an industry-wide food safety plan
 - define quality assurance parameters
 - develop traceability systems
- Nutraceuticals
 - survey nutraceutical research programs which exist in Canada and U.S. to assist with marketing
 - survey nutrients in locally grown varieties to set the baseline standard, to assist in marketing

While the committee felt that nutraceutical research was of value, the preferred method to deal with the issue was a) to define the basic levels of nutrients in berry crops and market these benefits and then b) give thought to developing higher levels of the different constituents. We felt nutraceutical research would be very expensive and this should be considered to be a second level priority which does not divert resources away from the main goal.
- Shelf-life and packaging
 - develop systems to improve shelf-life of fresh berries destined for the wholesale market
 - develop improved modified-atmosphere packaging and films

C. Production

Increased imports and continued pressure on prices require innovative new production technologies. We now have techniques that can extend the season which need to be evaluated with Ontario varieties and tested for their economic viability. With these new production techniques the pest spectrum will change and present new challenges.

Strawberries

- Season extension
 - investigate high tunnels on dayneutral varieties
 - explore row covers and other systems as a service priority

- develop pest control methodologies for
 1. Tarnished plant bug
 2. Mildew
 3. Anthracnose
 4. Mites
 - investigate fertigation technologies
 - develop planting time recommendations for seed (F1 hybrid)- and vegetatively-propagated varieties
 - include economic justification in the results of season extension research
- The committee felt that much of the season extension research could be done on farms with cooperation between the growers and the researchers.
- Weed and pest control
 - develop innovative approaches
 - pursue minor use registrations for new products on an on-going basis

Raspberries

- Season extension
 - develop tunnel (high priority) and greenhouse production systems

Immediate short-term needs include fertility recommendations and investigation of water relations
- Weed and pest control
 - develop innovative approaches
 - To include monitoring systems for insects
 - pursue minor use registrations for new products on an on-going basis, especially for Botrytis, cane diseases and insects
 - develop education program on disease and pest control
- Nutrition
 - develop N and P recommendations for fall-bearing varieties
 - develop fertigation recommendations and compare these to broadcast recommendations

Other Berry crops

- Weed and pest control
 - pursue minor use registrations for new products
 - survey blueberry scorch and stunt infection in highbush blueberries
- Production systems

D. Breeding

Develop strawberries and raspberries that are adapted to Ontario

Strawberries

- June-bearing varieties – Trait priorities: 1) quality, 2) yield, 3) season extension, 4) pest and disease management
 - Dayneutral varieties – Trait priorities: 1) propagation ability, 2) tarnished plant bug resistance, 3) quality, 4) yield, 5) pest and disease management.
 - F1 Hybrids – Double haploid inbred lines through anther culture
- Seed-propagated F1 hybrid varieties of strawberries exist. Two inbred lines are cross-pollinated and the seed is genetically uniform. With conventional methodologies this breeding takes twice as long as the conventional breeding systems

Raspberries

- Summer-bearing varieties – good quality, winter hardy. One possible site with suitable winters would be New Liskeard.
 - Fall-bearing varieties – good quality, low chill, prolonged productivity for greenhouse production
- Identify varieties from other breeding programs that are of high quality and adapted to Ontario

Raspberries

- identify varieties from BC, NS, NY and MD breeding programs, that have virus-tested negative propagation material

Highbush blueberries

- identify varieties from MI and USDA programs

Other berry crops

- identify varieties as these crops develop

E. Propagation

- continue to develop and support the Ontario strawberry, raspberry and *Ribes* plant propagation program
- develop propagation methodologies for F1 hybrid dayneutral strawberry varieties
- develop a list of viruses and mycoplasmas known to infect other berry crops of interest, except highbush blueberries.

5. Recommendations

5.1 Recommendation number: 1.

5.1.1 Issue: nematology research in Ontario

5.1.2 OASCC linkages

5.1.3 Target Agency: Ontario Horticultural Crops Research and Services Committee

5.1.4 Title: that the Ontario Horticultural Crops Research and Services Committee coordinate the development of a business case for Ontario to support a nematologist in AAFC in Ontario.

5.1.5 Background: For the previous two years the OBCRSSC has brought a recommendation to the OHCRSC to support a nematologist at Vineland. In 2003, several other committees, i.e. Root, bulb and leafy vegetable, Crucifer crops, also indicated a similar need.

At the 2003 meeting, Dr Gary Whitfield indicated the need for a business case approach. The OBCRSSC feels that it is the role of the OHCRSC to coordinate the recommendations from the subcommittees into a single business case to be forwarded to AAFC.

5.2 Recommendation number: 2.

5.2.1 Issue: Agricultural research communication

5.2.2 OASCC linkages: OPMRRSC

5.2.3 Target Agency: OMAF, MNR, MOE, University of Guelph, AAFC

5.2.4 Title: that communication channels between food, marketing, production, environmental and medical groups be improved and facilitated, that greater priority be placed on ICAR, and that new technologies be developed to enable efficient tracking of current research project titles and progress.

5.2.5 Background:

Research and technology is progressing rapidly on a number of fronts, and is increasingly specialized within disciplines. A progressive berry industry, in a true value chain, must make use of information and resources from many research programs, including production, food science, marketing, environmental and medical. Effective communication, or at least awareness of, initiatives relating to the berry value chain will help to avoid duplication of effort, and in optimize the knowledge base that currently exists.

OMAF, the University of Guelph, and Agriculture and Agri-Food Canada are three examples of institutions where research relevant to the berry industry takes place. Traditionally, the Ontario Berry Research and Services Committee and the Inventory of Canadian Agri-Food Research were two vehicles for communicating research initiatives and informal results. However, many other groups are now involved in research indirectly related but still relative to the berry industry. In addition, many of these groups do not report projects through ICAR, and the inventory is incomplete. The *Compendium of OMAF Funded Food Safety* <http://www.gov.on.ca/OMAFRA/english/research/food/foodsafety/compendium.htm> is a good example of communication that we hope will be facilitated in other disciplines.

The Pest Management Research Reports published by the Expert Committee of Integrated Pest Management is also an important resource, that we hope continues.

Communication channels for reporting research initiatives must be developed or improved between branches and divisions within OMAF, between departments at the University of Guelph, and among the various AAFC research teams, Ontario universities, and Provincial ministries where research relative to the berry crop value chain exists.

6. **Committee Membership**

A. Dale is chair, J. Zandstra is vice-chair, all other members remain the same.

APPENDIX A

ICAR Projects involving berries in Ontario

1. Development of cultivars with high fruit quality and environmentally sustainable management systems in berry crops A. Dale, Dept of Plant Agriculture, University of Guelph, Simcoe
2. Selection and management studies to improve strawberry and seed production in Ontario and horticultural crop production in the North B. R. Hughes, NLARS, University of Guelph, New Liskeard
3. Management and variety evaluation of fruit crops in Southwestern Ontario J. Zandstra, Ridgetown College, University of Guelph, Ridgetown
4. Application of SSR markers for DNA fingerprinting of *Prunus* and *Fragaria* varieties S. Bowley, Dept of Plant Agriculture, University of Guelph, Guelph
5. Development of a real time RT-PCR method to detect Hepatitis A virus in Produce. M. W. Griffiths, Dept of Food Science, University of Guelph, Guelph

RESEARCH HIGHLIGHTS

Department of Plant Agriculture, Simcoe

Strawberry Breeding (Adam Dale and Becky Hughes).

From the main program, three selections have been identified, which will be released over the next few years. 25V151 is early, large and firm, 49Y102 is late-mid-season, very large, pale, bright, has long fruiting season, and has some tolerance to tarnished plant bug, and 2V55 early-mid season, large, and firm. We hope to release the 25V151 in 2007, 49Y102 and 2V55 will be virus-tested in 2006.

Two ornamental selections, derived from Dr. W. Evans' synthetic octoploids are now virus-tested negative and will be named

From the winter-hardiness program, we have identified 62NL4 as one with cultivar potential and are presently micropropagating it. 31NL1 appears to be extremely winter-hardy with high yields, and soft, attractive fruit. It is being propagated for trials in locations with severe winters.

Dayneutral F1 hybrids - this year 12 selections from five S2 inbred lines were selected. Test F1 hybrids are being made. Seed will be available for trials, if anyone is interested

Glyphosate resistance in strawberry (Adam Dale, Dragan Galic, John O'Sullivan and Robert Gros)

Five selections, derived from *Fragaria virginiana*, and 'Jewel' were crossed in a half-diallel. The seedlings were planted in Spring 2004 and sprayed with 2% glyphosate on 21 July. Regrowth was detected in some plants within two weeks of the spray application. Selections on plant growth were made in early October 2004 and 755 out of 5940 were retained. This year plants were selected for winter survival, horticultural traits and runner ability and 33 selections retained (figure 1).

Ontario Small Fruit Propagation Program (Becky Hughes and Adam Dale).

The Ontario berry crop plant propagation program has been consolidated at NLARS in northern Ontario. All strawberry and raspberry cultivars in the program have now been re-tested for viruses. Stock plants are being DNA tested before propagation. New guidelines for the strawberry propagation program are in the final stages of approval

Development of a Sea Buckthorn industry.

We started a project on developing a sea buckthorn industry Ontario. One goal was to increase vegetative propagation. We were able to show that cuttings would root only if they were not dormant. However, one interesting observation, was that the buds broke dormancy before the cambium did. This led to buds growing but the cuttings not rooting.

Figure 1. Mid-parent values for Percentage of seedlings selected in Glyphosate resistance diallel and parental tolerance

Parent	% seedlings retained	% parental survival 2003	No. of Seedlings retained
40ZZ21	18.6	34	8
40ZZ12	16.5	56	9
40ZZ13	15.1	57	13
225AA1	14.4	19	13
182AA1	11.4	5	13
Jewel	7.5	2	9

New Liskeard Agricultural Research Station (NLARS)- Becky Hughes

***Colletotrichum acutatum* resistant strawberries through in vitro selection**

Work on a somatic embryogenesis system is continuing. Dr. Jayasankar Subramanian, Department of Plant Agriculture has been consulted on this project.

Breed and select winter-hardy strawberry cultivars

Four winter-hardy selections were planted in 2003 in a replicated trial to evaluate their winter hardiness with and without a straw mulch. Considerable differences in winter hardiness between these and the controls have been noted. The results of the two picking years are currently being summarized for statistical analysis. One selection is currently being propagated for grower trials in other “climatically challenged” parts of Canada.

Ten selections were made in New Liskeard in 2005 from approximately 950 seedlings with New Liskeard and Simcoe parents. Several selections were made from these same crosses planted in Simcoe. An advanced selection from 2001 appears promising for yields, size and appearance. It has been established in culture and was virus tested in 2005.

Day Neutral Strawberry Trials

Two day-neutral strawberry trials were planted in a plasticulture system in 2005 in conjunction with trials planted in Ridgetown and Simcoe as part of a project to develop a value chain for the wholesale market. Strawberries were picked from July through to mid October in New Liskeard.

Berry Crop Observation Trials

Two observation trials were terminated in 2005 and a new strawberry trial was established.

Strawberry Micropropagation

The SPUD Unit currently maintains over 50 strawberry selections in vitro for the Department of Plant Agriculture in Simcoe. Thermotherapy was conducted on several strawberry selections in 2004/05. Virus testing of promising advanced selections from Simcoe continued in 2005. Selections which tested virus negative are being propagated for potential release.

Cedar Springs Research Station, Ridgetown College, University of Guelph ; John Zandstra

Day Neutral Strawberry Trials

A day neutral variety trial and a day neutral planting date trial were established in high tunnels and in the open in 2005, in conjunction with trials at Simcoe and New Liskeard. Plots were harvested from July to November. Quality was poor due to heat; insect and disease pressure was minimal.

Berry Crop Observation Trials

An observation trial containing 20 new selections, which was established in 2004 was harvested in 2005.

SERVICE HIGHLIGHTS

Ontario Plant Propagation Program -Becky Hughes

Consolidation of the stock plant maintenance, virus testing and micropropagation at the SPUD Unit in New Liskeard has resulted in a more efficient and effective plant propagation program for Ontario. The centre ensures that virus-tested stock plants are available for the berry industry in Ontario. This new program has already expanded with the addition of five new strawberry cultivars from California for the southern plant market.

2005 Berry Team Report

**Ontario Ministry of Agriculture, Food and Rural Affairs
Crop Technology Branch**

By Pam Fisher, Berry Crop Specialist, OMAFRA

Box 587 Simcoe, Ontario N3Y 4N5
519-426-2238 pam.fisher@omaf.gov.on.ca

On-Farm Variety Trials

Pam Fisher, OMAFRA, Adam Dale, University of Guelph,

Achene Committee of the Ontario Berry Growers Association

2003 strawberry trial

12 varieties at 12 sites: *St. Pierre, L'Authentique Orleans, St. Laurent d'Orleans, St. Jean D'Orelans, Harmonie, Serenity, Darselect, Ovation, Eros, Clancy, L'Amour.*

Harvested in 2004 at 5 sites: presented in potser

Harvested in 2005 at 4 sites: pending compilation

2001 raspberry trial (3 sites)

Harvested at 1 location in 2005.

2005 strawberry trial

8 new selections at 10 grower sites. These will be harvested in 2006.

25V151	A. Dale, Simcoe
4V58	A. Dale Simcoe
49Y102	A Dale Simcoe
LL93224-24 (Cle de Champs)	S. Khanizedeh, St. Jean, PQ
APF9311-1	S. Khanizedeh, St. Jean, PQ
KRS-2	A. Jamieson, Kentville NS
KRS-10	A. Jamieson, Kentville NS
MNUS138	J. Luby, Minnesota
Kent	Kentville, NS
Annapolis	Kentville NS

2005 GHG project: Nitrogen rate and in-season monitoring of nitrogen using quick tests in June-bearing fertigated strawberries

Christoph Kessel, Nutrition (Horticulture)-Program Lead; Pam Fisher, Berry Crop Specialist; OMAFRA Grower: Rudy Heeman

- To compare reduced fertilizer nitrogen rates with the grower's standard fertilizer program in fertigated June bearing strawberries.
- To develop independent petiole sap, soil or percent leaf N thresholds related to specific development stages of crop development.
- To collect crowns in spring before growth, at renovation and fall dormancy and evaluate N status.

2005 results pending compilation. Posters from 2003-04 projects available on request:

pam.fisher@omaf.gov.on.ca

Strawberry Root Weevil Control

Kenna McKenzie, Agriculture and Agri-Food Canada, Nova Scotia, Jeff Tolman, Agriculture and Agri-Food Canada, London, Pam Fisher, Berry Crop Specialist, Hannah Fraser, Small Fruit Entomology Program Lead, OMAFRA

Initiated 2004, by Agriculture and Agri-food Canada, to study root weevil species complex, assess monitoring techniques and thresholds, assess alternate control strategies and reduced risk products. Team includes researchers and extension agents from 5 provinces and 1 US state. Ontario results reported here.

In 2004 monitoring techniques were evaluated. Pitfall traps and barrier pitfall traps were effective at monitoring black vine weevils. Grooved board traps were not effective. Visual assessments were tedious and inefficient. Thirteen different species of root weevil were identified, black vine weevil predominant. Most adult weevils were active from late July-Sept. Sporadic spring activity may indicate an overwintering population. Beneficial nematodes were successfully applied at one grower site (almost 100% larvae infected with nematodes). The carry-over effect of this was obvious in 2005. A poster was presented at the OFVC Feb 2005.

In 2005: Pitfall, barrier pitfall and visual assessments used to monitor populations again in 2005. Adult activity similar to last year. Beneficial nematodes applied at two sites, 3 rates, replicated plots. At site 1, predominant species was not black vine weevil, and no control observed. At the second site, infected larvae recovered, rate response observed, control was much less than the previous year at the same site. Vernon barriers (extruded plastic trough developed for CPB control) were evaluated at two sites for protecting new plantings from migrating weevil adults. Sheet plastic barriers appear to be more effective.

An Interactive Key to the Root Weevil Pests of Strawberry Crops in Canada is being developed by Pat Bouchard, AAFC, Ottawa. (bouchardpb@agr.gc.ca)

Surround (kaolin clay) on strawberries

Pam Fisher, OMAFRA

Determine efficacy of Surround WP Crop Protectant for control of various insect pests (leafhoppers, other insect pests) of strawberry, and to assess crop tolerance and secondary plant growth effects.

Treatments: Surround vs untreated, 6 reps

Varieties: Jewel, Brunswick, bare root plants established 2005 on black plastic mulched beds.

Timing Applications approx 2 week intervals June 20-Sept 19

Rate: 2 applications 50 kg/ha followed by 8 applications 25 kg/ha

Evaluations:

Mites (2x): low numbers in all plots, but fewer in Surround treated plots

Leafhoppers (1x) : very low populations, but fewer in Surround treated plots
Angular leaf spot (1x): high levels, no difference due to Surround
Powdery mildew (1x) : block and variety effect, no obvious difference due to Surround
Runner number and weight (4 times): greater number of runners and weight of runners in Surround plots, especially for first 3 evaluations
crowns /plant in October: no apparent difference

Next year: evaluate yield

Surround plots, runners removed, Surround plots, runners remain
Untreated plots, runners removed, Untreated plots, runners remain

CAS04 for red stele control:

Mike Celetti, Plant Pathology Program Lead; Christoph Kessel, Hort Crop Nutrition Program Lead; Pam Fisher,

Berry Crop Specialist; Jennifer DeEll, Fresh Market Quality Program Lead

Results of this project resented in poster format.

Microbial Assessment of Compost Tea as a Tool to Improve Food Safety

(August – October 2005)

Lindsay Arthur, Applied Research Coordinator – On-Farm Food Safety (Crops); Sandra Jones, On-Farm Food Safety Programs (Lead); Hugh Martin, Organic Crops Specialist; Grant Campbell, Microbiologist; Canadian Research Institute for Food Safety (CRIFS)

Recently, research has suggested that the use of competitive exclusion microorganisms have the potential to out-compete harmful microflora, improving the safety of food produced. Compost tea has the potential to contain competitive exclusion microflora, including bacteria, fungi, yeasts and protozoa.

This study was conducted to evaluate the ability of compost tea to competitively exclude human pathogens – and potentially be used as tool to improve food safety.

Demonstration of Drip Irrigation Water Movement in Raised Beds

Rebecca Shortt, Irrigation Engineer ,Anne Verhallen, Soil Management Program Lead, Pam Fisher, Berry Crop Specialist

Project Objective:

1. To study the movement of water applied by drip irrigation, in various soil types.
2. To learn the optimum irrigation times for different flow rates on different soil types.

We hope to demonstrate to growers how water moves down and across raised beds and how management practices affects scheduling, by using different run times and the effect of pulsing (shorter more frequent irrigations). The “dye test” will be used to study the movement of water in soil, and will be evaluated for its potential as an on-farm management tool. It will be tested at the Simcoe Experimental Farm (University of Guelph) in order to become familiar with the technology. Several demonstrations are planned at grower sites. Blue dye will be run through the beds at different intervals and different flow rates, and beds will be cut away to show the distribution of dye after 1, 2, 3, 4, and 6, hours. This technique has been successfully used by Dr. John Duvall at the Dover Experimental Farm in Dover, Florida

APPENDIX B

Terms of Reference

1. To prepare research and service summaries and to recommend research and service priorities for berry crops in Ontario.
2. To disclose problems that face the berry crop industry which require investigations.
3. To assess and suggest priorities for new programs and supply cost-benefit information, where possible.
4. To present written reports and recommendations to the Horticultural Crops Research and Services Committee.
5. To invite additional research and development personnel to information meetings where progress can be presented and discussed.
6. To contact federal, provincial, university and industry managers for representatives to serve on the committee.

CRUCIFER CROPS

Executive Summary

Jennifer Bush has agreed to Vice Chair the OCCRSC next year.

Emerging Issues:

1. There is a concern about the move away from Integrated Pest Management specific research under the new OMAFRA – U of G program. Funding constraints along with the loss of technicians make field scale research difficult.
2. Emerging pests and diagnostic services – growers and consultants need access to accurate and economical pest identification services.

Research Priorities:

Research priorities were discussed and ranked as given below. The overwhelming need in this sector is for pest management research, and as such all pest management research (insects, diseases and weeds) has been grouped together as the top priority.

1. Pest Management Systems
 - a) Management of insect, disease and weed pests, including development of thresholds and monitoring practices
 - b) Reduced risk products
 - c) New and emerging pests
 - d) Established pests
2. Minor Use Registrations – crop groupings
3. Nutrient Management Practices and Nutrient Uptake of Crucifer Crops
4. Variety Evaluation
5. Post Harvest Handling

Service Priorities:

Service priorities were discussed and ranked as given below. The overwhelming need in this sector is for continued technology transfer and as such has been given the top priority.

1. Efficient Technology Transfer – OMAFRA (scout training, Hort. Matters), CFIA (greenhouse certification)
2. Swede midge Pheromone Trapping, Degree Day Model and Alerts – required by industry and growers to better time insecticide applications until thresholds can be developed
3. Value Added Products and Marketing – product marketing should be explored to maintain competitive edge in global marketplace
4. Identify Diseases and Pests of Specialty Crucifer Crops

RECOMMENDATIONS TO OHCRSC AND OPMRSC

There are six recommendations, ranked in decreasing priority, in 2005.

1. *IPM research in the new OMAFRA-U of G Research Program Structure*
2. *Crop loss of rutabaga industry due to cabbage maggot*
3. *Lack of delivery and implementation of IPM programs in Ontario*
4. *Lack of diagnostic facility*
5. *Requirements for Nutrient Management Strategies and Plans*
6. *Nematode Research capabilities*

Details of each recommendation are provided below.

Recommendation 1:

Issue: Integrated Pest Management Research in the new OMAF–U of G Research Program Structure.

Background: With the new restructuring in the OMAFRA–U of G Research Program there has been a shift away from Pest Management specific research to an integrated and interdisciplinary approach to significant industry issues. Under the new program, project funding must now support individual projects that include multiple researchers and multiple disciplines, thus increasing overall operating costs. This, in conjunction with increased overhead costs, technician layoffs and static research dollars will have a significant impact on research for the vegetable industry in Ontario.

Recommendation: The OCCRSC recommends that the OMAFRA–U of G Research Program Administration re-evaluate the operating costs (land rental fees, overhead fees) and limitations (loss of technicians, static funding, and availability of matching money) associated with doing research at the U of G under the new Sustainable Production Systems Program.

Target Agencies:

- Rob McLaughlin, Associate Vice President (Research) Agri-Food & Partnerships
- John O’Sullivan, Research Program Director, Plant Program
- Ken Hough, OMAF Research Support
- Sandi Christopher, OMAF Research Programs Administrator
- Michael Dixon, Chair, Environmental Biology, U of G
- Dr. Gary Ablett, Chair, Plant Agriculture, U of G

OASCC Linkages: OHCRSC and OPMRSC

Recommendation 2:

Issue: The rutabaga industry continues to face the prospect of major crop losses due to lack of registered pest control products for cabbage maggot. Currently there is reliance upon only one control option and there are few if any available alternatives.

Background: Rutabaga growers in Canada have lost access to cabbage maggot control options in the past several years leading to reliance upon only one group of insecticides, the organophosphates: Lorsban and Counter. Both of these materials are under review by the Pest Management Regulatory Agency and may be lost or restricted for this use. In addition, the use of one group of organophosphates repeatedly will lead to insecticide resistance and loss of control.

The OCCRSC wishes to emphasize the urgency of the situation to PMRA of Health Canada, AAFC Research Branch and the University of Guelph. Until suitable alternatives can be developed and registered in Canada, it is vital that the PMRA maintain registration of currently labeled pest control options which are presently the minimum required.

A comprehensive research program which identifies and evaluates effective alternatives to currently labeled insecticides and breeding resistance is urgently needed.

Recommendation: In light of the urgent need for the rutabaga industry to address an increasing problem with cabbage maggot control options, the OCCRSC recommends to Agriculture and Agri-Food Canada Research Branch, London and to University of Guelph's Ridgetown College and Plant Agriculture Department, Guelph that a comprehensive research program be implemented for cabbage maggot management and resistance breeding on rutabagas. Recognizing the response to this recommendation and the initial work conducted in 2003 and 2004, the OCCRSC wishes to see continued funding for this work.

In addition the OCCRSC wishes to strongly remind the Pest Management Regulatory Agency of Health Canada that they must consider carefully any reviews of pest control products for rutabagas as there are presently no alternatives to currently labeled materials.

Target Agencies:

- Ken Campbell, Pest Management Center
- Dr. Gary Ablett, Chair Department of Plant Agriculture, University of Guelph
- Richard Aucoin, Health Canada, Pest Management Regulatory Agency

OASCC Linkages: OPMRSC and OHCRSC

Recommendation 3:**Issue: Lack of delivery and implementation of IPM programs in Ontario**

Background: OMAF withdrew from providing IPM services to growers a number of years ago. Since then attempts to establish province-wide crop monitoring and scouting services that are independent of seed, fertilizer and pesticide suppliers have failed (e.g. AIMS). Crop consulting services will likely be more successful on a regional basis, but will need to service a wide range of crops within their area.

Integrated Pest Management (IPM) programs, which include resistance management strategies, help to prolong the effective life of pest control products and have been developed for many high value crops but have not been fully adopted or available to growers and processors due to:

- 1) lack of availability of training opportunities and trained IPM consultants and scouts in some regions;
- 2) lack of economic viability for privately delivered IPM consulting/scouting services;
- 3) lack of affordability of such services for growers.

Increased need for IPM services is expected as new reduced risk pesticide products often need more intensive monitoring and understanding of the pest complex and the activity of the product in order to be used successfully. In addition, IPM is an integral part of agricultural risk management.

Recommendation: OMAF should make a commitment to effectively address the barriers to IPM implementation and delivery in Ontario, including those identified above. At a minimum, OMAF should ensure that scout training and support is offered in all vegetable-growing regions of Ontario.

Target Agency: OMAF

OASCC Linkages: OHCRSC and OPMRSC

Recommendation 4:**Issue: Growers require access to accurate diagnostic testing with quick turn around times. Quick field tests and bioassays would help to identify pests and determine management strategies quickly.**

Background: More resources are required at the University of Guelph Pest Diagnostic Centre to make real time diagnostics usable for growers. The major problem stems from the requirement of the lab to ensure full cost recovery. The U. S. Homeland Security Bill has restructured the network of their diagnostic labs, allowing suspicious samples to be detected quickly through one main database system. As the threats of bioterrorism through agriculture continue to threaten biosecurity there will be decreased opportunities for growers to send samples for diagnostics to the United States.

Current Activities: None

Gaps/Barriers/Deficiencies:

Unless a guaranteed number of samples can be given to the lab and coordinated through Provincial specialists, consultants, scouts and industry the budgetary constraints will be too high.

Recommendation: It is imperative that improved diagnostic services be available to Canadian growers. With the growing number of independent field scouts, growers and consultants require access to accurate diagnostic testing with quick turn around times.

Target Agencies:

- CFIA (Charles Brisco / Rob Favrin) and U of G (Marc Saborin)

OASCC Linkages: OPMRSC and OHCRSC**Recommendation 5:**

Issue: Requirements for Nutrient Management Strategies and Plans

Background: OMAF is currently supporting work that is characterizing the nutrient quality of on-farm fruit and vegetable wash waters, and surveying leachate, soils and ponds from greenhouse and container nurseries. OMAF is also exploring options to increase the amount of resources available for research to support nutrient management standards.

Research is currently being undertaken by OMAF on 17 horticultural crops in preparation for the inclusion of vegetable crops under Nutrient Management legislation in 2008. Current research is focusing on 3-year trials to verify current management guidelines and includes soil sampling (particularly available nitrogen, organic matter, texture) and surveys on management practices.

Growers are concerned about the impact of nutrient management plans and legislation on production of crucifer crops. Of particular concern is the applicability and accuracy of current nutrient parameters in assessing nutrient input/output of cole crop production practices.

OCCRSC is pleased to see these issues being addressed by OMAF as noted above. However if it is necessary to change current recommendations, detailed rate response studies conducted over an additional 3-year period will be required, making it difficult to meet the 2008 timeline for inclusion of horticultural crops in NMR legislation.

Recommendation: The Ontario Crucifer Crops Research & Services Committee requests that OMAF ensure that Nutrient Management research pertaining to horticultural crops (including detailed response rate studies) is initiated and completed as quickly as possible in order that suitable recommendations can be developed prior to the inclusion of horticultural crops under NMR legislation in 2008. Additionally, when studies are completed, information must be readily available to growers and industry.

Target Agency: OMAF

OASCC Linkages: OHCRSC and OPMRSC

Recommendation 6:

Issue: Loss of Nematode Research Capabilities in Ontario

Background: Previously, at AAFC-Vineland there were 4 nematologists active in research. In 2002, the last nematologist in Ontario retired. In the past, this committee was given assurances by previous directors of AAFC Southern Crop and Food Protection Research Centre that the capacity for conducting nematode research and addressing nematode concerns in this province would be maintained. AAFC now requires a business case to justify the creation of any position, including nematology. The presence, introduction, and outbreaks of nematodes in Ontario vegetable crops have the potential to result in serious quarantine and trade issues, and as such it is essential that a significant nematode research program is available to support the Ontario root, bulb and leafy vegetable sector.

There are currently nine nematodes regulated by the CFIA that have the potential to become established and threaten the production of horticultural crops in Ontario. The lack of an 'in house' nematode taxonomist at AAFC will force Ontario producers to use US resources for identification which may lead to quarantine and trade issues on exported crops.

Although there is one nematologist at AAFC - Horticulture Crops Research & Development Centre (St-Jean-sur-Richelieu), that research program focuses on nematodes of potato, corn and turf and does not address vegetable crops.

Very few nematologists are left at any AAFC locations throughout the country. Correct identification of all taxa of crop pest pests and the maintenance of a research effort is crucial for the adequate protection of root, bulb and leafy vegetables and the stability and competitiveness of the industry.

Recommendation: Given the range of crops under the purview of OHCRSC that are concerned by the lack of nematology expertise of relevance to the vegetable and horticultural crop sectors in Ontario, the OCCRSC recommends that OHCRSC & OPMRSC coordinate and develop a business case to support the hiring of a nematologist by AAFC.

Target Agencies:

- Annette Anderson, OHCRSC
- Hugh Berges, OPMRSC

OASCC Linkages: OHCRSC and OPMRSC

GINSENG

Executive Summary:

In the fall of 2005 there was a substantial increase in the acreage of ginseng seeded. The partial failure of the seed crop in 2005, as a result of high temperatures coupled with a general inability to store seed beyond 1 year, led to the decision on the part of many growers to expand their acreage using up all of the stratified seed available. It is expected to be a temporary increase and will not be reflected in crop returns until harvest in 2008 or 2009. A reduced supply of stratified seed for planting in 2006 is expected to result in a lower than average seeded acreage a year from now.

In 2005 the industry initiated a co-operative market analysis in the Peoples Republic of China and will participate jointly with the PRC in product differentiation. The industry also initiated a consumer awareness program for the use of ginseng as a medicinal plant in western culture. One focus has been the establishment of a new web site where members can connect with buyers and where non-members can obtain information about ginseng. Informational leaflets were also prepared for distribution. Discussions are underway with CITES to simplify the sale of small lots of ginseng directly from the farm for transport overseas as gift packages.

Production of *Panax quinquefolius* in China will be about 800,000 lbs greater than in 2004. *P. quinquefolius* in China sells for approximately \$9/lb CAN. This is a definite competitive advantage.

STATE OF THE INDUSTRY:

Crop size: It is too early at this time to state an accurate number for lbs harvested. Initial figures range around 4 million lbs. for Ontario.

Ontario: Most of the stored root from the 2004 harvest has been sold but there is still some remaining from the 2003 crop. Demand in China is being driven by the Asian Bird Flu and perceived use of ginseng as a preventive. There have not been a significant number of sales yet for the 2005 crop. It is hoped that sales will increase as the Chinese New Year approaches on Jan 28, 2006. There continues to be a portion of the crop delivered to Hong Kong on consignment. There are fewer buyers in 2005.

Wisconsin: Production continuing to decline.

B.C. CNT has moved production completely to Ontario. The last of the BC crop will be harvested in 2006/7. There are only 2 growers left in BC with about 40 acres in the ground.

Crop prices: Current farm gate prices are at \$10-\$15/lb. CAN. Price is dependant on quality and rust on the root, even superficial rust, downgrades the value considerably.

Crop Production Issues: There has been a failure of the green seed crop in 2005. The immediate impact was aborted seed due to high temperatures during flowering. Seed that did form appears to have poor viability. This will impact on 2006 plantings.

This seed crop failure has led to concerns about importation of seed from China. These concerns were addressed through discussions with the CFIA and the phytosanitary restrictions on ginseng are under review. During this time seed will not be imported into Canada from China.

Rust continues to increase in gardens with resultant impact on root value. Causal agent(s) need to be more clearly identified and measures taken to reduce or prevent this symptom. This is a multi-focal issue involving pathogens and cultural practices.

Crop uptake of nitrogen, the type of nitrogen applied, the impact of mulching, soil organic matter and the relationship of nitrogen to seeding rate are not clearly defined. There is concern about the impact of the Nutrient Management Act on crop yield and quality.

Emerging Issues:

1. As the Asian market declines, alternative markets such as pet foods and the North American/European consumer (e.g. nutraceuticals and pharmaceuticals) may provide additional outlets for the crop. Current efforts on the part of the industry have identified and addressed consumer awareness as a key to increasing sales of *Panax quinquefolius*. Alternative markets must go beyond alternative medicinal uses. A corollary to this issue is the need to develop cultivars that exploit extractable components and that increase productivity to provide a competitive advantage.
2. The Source Water Protection Act will impact the ability of ginseng producers in Norfolk and surrounding counties to utilize the land base for this crop under current land preparation practices. Approximately 15,000 acres are directly affected by this Act. Research programs are needed that will examine organic matter requirements for ginseng, and develop pre and post crop rotations for optimum crop production and pest control.
3. Recent reviews of fumigant products may affect their availability to the ginseng industry. Fumigant use is the basis of land preparation for this crop and reduces a number of pathogens that impact on root yield and quality. The industry encourages real-world discussion on this issue between PMRA and OMAF.
4. Federal APF programs and related Safety Net issues as they relate to short-term perennials such as ginseng fail to address industry needs. Dollars for the support of the horticulture industry are insufficient to address industry needs and do not reflect crop values. Safety net programs are slow to respond to urgent grower needs.
5. Loss of and changes to the research infrastructure in both AAFC and the University of Guelph will have a serious impact on the ability of the horticulture industry to remain competitive. Loss of support positions, for example a nematologist at AAFC and ginseng-focused research at the U of G, have left growers in the position of using limited research dollars to respond to immediate pest and production issues rather than supporting proactive research that improves long term competitiveness. **Note:** This subcommittee recommended in 2004 that AAFC staff a germplasm research position. This request has not been addressed or responded to by AAFC.
6. Labour issues continue to place an untenable financial burden on ginseng producers, and on horticulture producers and their farm organizations. Growers cannot shoulder the costs of legislative changes when farm gate prices are less than the cost of production.
7. The rising cost of research is impairing the ability of the ginseng industry to address research needs. Current funding programs require a higher degree of input than growers can afford. Administration fees charged for University research and additional station access fees have reduced the ability of producers to leverage research dollars. Beyond these costs, demands associated with funding approval such as 50% grower contributions and outside partnerships impact the ability to fund ginseng research in Ontario.

Industry Research Priorities:

1. Cultivar development: selecting and propagating new strains of ginseng. Unique Canadian cultivars possessing traits such as increased root size, disease resistance, drought stress resistance, to mention only a few, will provide growers with a competitive edge in the global marketplace. **Note:** the 2004 recommendation by this subcommittee that AAFC staff a germplasm research position has not been addressed or responded to by AAFC.
2. Mechanization/Engineering: developing a mechanical seed harvester and mechanical aids for weeding and harvest. This will increase competitiveness of Ontario ginseng. Addressing garden design to reduce ambient temperatures and improve air movement will reduce pest control costs, improve seed production and mitigate losses due to heat stress.
3. Organic production: developing workable organic production protocols for ginseng. This will distinguish Ontario root in the marketplace and increase access to western markets. Specific emphasis should be placed on pesticide reduction through reduced risk products and the use of biological and cultural control methods. Preplant rotational crops, soil amendment and fertility should be emphasized.
4. Seed storage: improving the ability of growers to “bank” seed. This will reduce dependence on imported seed and address associated biosecurity issues. Ginseng seed must be stratified, naturally or artificially, for 12 months, planted and naturally stratified until germination the following spring. After the 12 month period the seed is “committed” to germination. This does not allow growers to retain seed from years of excessive supply and use the seed in years of reduced supply. Research is needed to extend to life of partially stratified (after 12 months) seed to several years.

5. Cultural practices and active ingredients: utilizing practices that enhance specific properties of ginseng roots. Where extractable components can be used to develop products for new markets, production practices that improve the % of these components needs to be examined for maximum competitiveness. Special emphasis should be placed on specific and total ginsenosides and polysaccharides.
6. Health benefits of ginseng: providing sufficient information to state health claims on Ontario ginseng products. Information must be provided in order to meet NHPD (Natural Health Product Directorate) regulations for allowable claims. Required information extends from clinical trial data to literature reviews.
7. Seed production: utilizing production practices that maximize seed production: Research is needed on the production practices that impact on seed quantity and quality. Plant density, fertility, irrigation, mulch and garden age should be considered.

Recommendations:

The OHCRSC ginseng subcommittee recommends:

1) That OMAFRA work closely with farm organizations and the Ontario Ministry of Labour to address producer concerns about a secure work force. The ginseng subcommittee urges the Ministry of Agriculture, Food and Rural Affairs to work closely with farm organizations and the Ministry of Labour to reach a consensus that does not impair the security of Ontario horticultural crops. This subcommittee also urges OMAFRA to develop and deliver worker and manager training programs that address workplace safety.

Background: Ginseng, and indeed much of the horticulture industry, depends on seasonal labour to care for and harvest crops. Issues have arisen that question the legitimacy of the off-shore worker program and the integrity of producers as managers of this workforce. The potential unionization of farm workers is a serious threat to the security of horticultural crops and Ontario's food supply. This subcommittee recognizes the need for safety of the agricultural workforce. Acceptable changes to workplace safety programs should take place through consensus and training.

Target Agencies: *OMAFRA, ADM - Don Taylor, Innovation and Competitiveness Division*

2) That food safety or other research funding be made available to specifically address reduced pesticide use. The ginseng subcommittee urges OMAFRA to establish research funding specifically targeted at reducing pesticide risk.

Background: This subcommittee recognizes that proper pesticide use does not pose a significant threat to the health of Ontarians. However, media coverage of pesticide issues and consumer awareness of the use of pesticides has placed an unfair burden on producers in explaining their use of these products. Active and publicized research programs that highlight reduced risk alternatives will improve the competitiveness of Ontario product in the marketplace. The termination of the FS2002 program has placed an unfair burden on producers and their organizations by forcing them to address immediate critical pest issues with limited research dollars, often at the expense of improving competitiveness.

Target Agencies: *OMAFRA; Gwen McBride, Food Safety Programs and Phil Malcolmson, Research and Innovation*

3) That CFIA assess the biodiversity threat of ginseng (*P. quinquefolius* and *P. ginseng*) seed imported from China to Canadian growers. The ginseng subcommittee recommends that CFIA review restrictions on the import of ginseng seed from countries where both *Panax ginseng* and *Panax quinquefolius* are produced from the viewpoint of biodiversity and that where there is the potential for mixed seedlots those shipments be denied entry.

Background: *Panax ginseng* is the primary species of ginseng produced in China. Production of *P. quinquefolius* in China is increasing annually. This positions China as a source of seed for the Ontario industry. It is not currently possible to differentiate the seeds of *P. quinquefolius* from *P. ginseng*. It is known that these two species can cross-pollinate. Accidental importation of *P. ginseng* seed would threaten the biodiversity of *P. quinquefolius* both in the wild in Ontario and in commercial gardens. The **CFIA** is asked to assess the biodiversity threat of imported ginseng (*P. quinquefolius* and *P. ginseng*) seed.

Target Agencies: *CFIA, Ken Bruce, Chief of Special Projects, OMAFRA, Bill Ingratta, Director, Crop Technology*

New Business:

It is the recommendation of this committee that Jan Schooley, OMAFRA be the chair beginning in 2006.

Service Needs:

1. Maintain seasonal grower workshops
2. Maintain Ginseng Crop Report (formerly the ginseng agriphone)
3. To maintain OMAF support services via the specialist position in Simcoe.
4. To address post harvest quality issues arising from drying and storage protocols.

Reports Submitted:

Research reports were submitted by R. Reeleder

The OMAF services report was submitted by J. Schooley.

Simcoe Research Garden report was submitted by A. Stechyshyn and J. Proctor, and J. Sutton

GRAPE AND WINE

Excerpts from State of the Industry Reports

We are expecting our lowest crop ever in the 58 year history of the Grape Growers of Ontario (GGO) - approximately 25,000 tonnes for the total grape crop. However, the quality of grapes is excellent and will lead to the production of high quality VQA wines. The GGO, along with the Wine Council of Ontario (WCO) entered into a short crop Memorandum of Understanding with the Province and the LCBO. Pricing negotiations for wine grapes resulted in a 3 year wine grape price agreement. Juice grape prices were set in November following arbitration which ruled in favour of GGO's prices. The GGO, along with the Canadian Horticultural Council, has been pursuing a National Replant program which would assist growers who have sustained severe winter damage, and growers of juice grapes who find themselves growing for a market in decline. GGO successfully launched the 1st phase of "VITIS", a multi-phased vine management system, based on the latest advancements in GIS/GPS technology. *(Debbie Zimmerman, GGO)*

The Coronation harvest began one week earlier than 2004 with little or no interruption resulting from weather. As presented in the table below, the Coronation crop was down 17% to 1340 tons. Winter damage and smaller than normal berry size both contributed to this reduction. The overall crop was down about 7% to 2090 tons. Concords were up sharply to 250 tons which made up for most of the difference. The projection for the 2006 Coronation crop is 2050 tons as plantings recorded in 2003 come into production. *(Adrian Huisman, OFGGMB)*

Ontario members of National Grape Co-op delivered 1,542 tons of Niagaras as well as 1,862 tons of excellent quality Concords at an average Brix level approaching payment maximum of 18.0 %, significantly above National's eastern region average of 17 %. None of the Concords or Niagaras delivered from Ontario were rejected. Although Ontario Concord and Niagara yields were near historical averages in 2005 and quality was significantly above average, yields still fell well below the averages of other Eastern production areas. The record Concord and Niagara crops produced in all three of the major U.S. juice grape regions exceeded demand, and will continue to put downward pressure on prices. The need is greater than ever for Ontario juice growers to find ways to increase yields to remain competitive. *(Jay Hardenburg, National Grape Co-op/Welch's)*

Most of the grape areas of the Niagara Region, home to over 95% of the grapes grown in Ontario, were affected by extreme winter temperatures. The extent of damage was related to the quality of site, low areas within the site, and location of the fruiting zone within the plant. Buds were weakened in late December and damaged further by 2 or 3 cold events in January. Many vineyards protected with wind machines had very good vine survival with fair to good crops. Full bloom for most cultivars was around the 3rd week in June and around the 15th for the table grape Sovereign Coronation (4-5 days ahead of 2004). Growers in most areas irrigated several times throughout the summer. Berries were generally small as a result of the hot, dry summer. There is still concern for the overall health of vines that were located in cold spots and might have been damaged by winter. 2005 was "an extremely cold winter and a hot dry summer" and one of the most challenging growing seasons in many years. *(Ken Slingerland, OMAFRA)*

Research Priorities 2005

Research priorities are essentially unchanged from last year and not ranked.

1. Development of advanced integrated pest management tools.

- Evaluate alternative pest control products (incl. conventional, biopesticides, bio-controls and pheromones) to replace products that will be lost from re-evaluations
- Conduct Good Laboratory Practices (GLP) residue trials to support minor use registration applications for pesticides including herbicides.
- Conduct efficacy trials on miticides, insecticides and fungicides to support full registrations and minor use registration applications.
- Develop and validate predictive and management models for pests of grapes including but not limited to, Asian lady beetle, grape berry moth, and diseases

- Develop efficient, rapid monitoring methods and economic action thresholds for insects, mites, weeds, and grape diseases.
 - Develop systems-based resistance management strategies for pests with the potential for rapid development of resistance including botrytis, powdery mildew, and mites
 - Evaluate area-wide mating disruption for grape berry moth in different areas of Ontario
 - Efficacy testing of growth regulators for table grapes.
 - Evaluate appropriate product use to minimize pesticide residues on fresh market grapes.
 - Evaluation of bird control techniques.
 - Development of integrated pest management strategies for pests including, but not limited to, mites, leafhoppers, crown gall, etc.
 - Development of guidelines for efficient spray application based on canopy size and density using various application technologies.
2. **Economic and environmental sustainability for both production and processing components of the industry through improved strategies for nutrient management, irrigation, and waste management.**
- Determine nutrient requirements and nutrient budgeting for grapes (juice, table and wine grapes) recognizing the particular characteristics of our climate and wide range of soil types
 - Determine availability, losses and tracking of nutrients in Ontario grape and wine production systems across different varieties and vine ages.
 - Develop soil testing standards, leaf testing protocols, and nutrient recommendation standards for all types of grapes reflective of Ontario conditions and resources.
 - Evaluate soil amendments and crop nutrition recommendations.
 - Develop appropriate computer software to accommodate perennial crops and their cultural practices such as pre-plant land preparation and addition of large amounts of organic matter soil amendments such as paper waste, composted mushroom production waste, and livestock manure. Nutrient budgets for vineyards must also consider non-bearing years during establishment of new vineyards or recovery surrounding winter injury events, internal system recycling from crop matter (prunings, mowing and/or incorporation of cover crops, etc.)
 - Determine parameters and need for irrigation while ensuring food quality; e.g. *E. coli* contamination in water.
 - Develop commercially viable, accurate systems for measurement of soil water and water relations in wine, juice and table grapes.
 - Develop accurate scheduling for irrigation and fertigation of grapes.
 - Develop and encourage the adoption of systems of efficient water use.
 - Development of waste management strategies for processing and production practices.
 - Development of environmental charter.
3. **Vineyard management to maximize productivity, quality, and sustainability.**
- Training and other cultural practices to regulate vigour while maximizing productivity, ensuring good fruit composition and high wine quality (including site suitability and crop load considerations; canopy management strategies for Ontario conditions).
 - Application of precision agriculture; e.g. GPS and GIS to support various activities (nutrient applications, irrigation, IPM and other disciplines) and help growers make better management decisions that are economically viable.
 - Evaluate mechanization of vineyard operations and reduction of labour and costs.
 - Evaluations of varieties, clones and rootstocks for wine, juice and fresh market grapes throughout the province (incl. southwest Ont and eastern Ont) and on different soil types.
 - Long-term research utilizing new and innovative scientific approaches to enhance winter hardiness, management, and resistance to crown gall.
4. **Post-harvest handling and processing factors affecting wine, juice, and grape by-products quality and acceptance.**
- Aroma, colour, phenolic constituents, and flavour profiles as influenced by terroir, and winemaking and viticultural techniques.
 - Improved methods for icewine vinifications and icewine downstream processing issues, including filtration and preservation.

- Yeast and bacterial interactions and metabolism in fermentation and wine making processes.
- Determine human health benefits of wine consumption.
- Source and quality validation (icewines).
- Development and validation of analytical techniques.
- Microbial spoilage, preservation and plant sanitation.
- Fining, ageing and chemical stability of wines.
- Factors controlling stuck and sluggish fermentations.
- Wine by-products including vinegar and grape-seed oil

Most Important Pests Lists

Top Insect and Mite Pests for Grapes - 2005	Top Diseases for Grapes- 2005
1. Grape berry moth	1. Powdery mildew
2. Multicoloured Asian lady beetle	2. Downy mildew
3. Leafhopper complex	3. Sour rot complex
4. Yellow jackets	4. Botrytis
5. Phylloxera	5. Crown gall
6. Mites (including European red mite and Two-spotted spider mite)	6. Phomopsis
7. Erineum mite	7. Black rot
8. Japanese beetle	

Grape and Wine Research and Services Sub-Committee Responses in 2005 to Recommendations from 2004

Recommendation #1 (2004)

Issue: *Harmonia axyridis*. (See 2004 OGWRSSC report for details of recommendations.)

Action: This recommendation was not formally pursued.

Response: Target agencies continued to participate in the MALB Task Force in 2005. Task Force meetings were less frequent than in 2004, but cooperation on communications, research, pest updates, funding, pesticide registrations, and other matters continued through the year.

Recommendation #2 (2004)

Issue: Harmonization of pesticide registrations.

Action: Recommendation sent to Richard Aucoin, PMRA and Gary Whitfield, AAFC.

Response: A detailed response was received from Richard Aucoin, PMRA. See full 2005 OGWRSSC report.

Recommendation #3 (2004)

Issue: Staffing shortfalls in grape research, esp. AAFC Vineland.

Action: This recommendation was again sent to Gary Whitfield, AAFC. As well, a note was sent to GGO and OFGGMB asking for any additional comments on this issue. This recommendation was also to be pursued by the parent committee (OHCRSC), since the recommendation is similar to ones from several sub-committees (particularly for a nematology research position).

Response: Virtually the same recommendation was made in 2003 and responses received were in the 2004 OGWRSSC report. No responses were received to the most recent recommendation.

Recommendation #4 (2004)

Issue: Not enough information on water management.

Action: Recommendation #4 was sent to Gary Ablett, U of G, Charles Lalonde, OMAFRA, Dan Brown, AAFC and John Warner, AAFC.

Responses: John Warner, Research Manager, Harrow AAFC replied that he was forwarding the recommendation to "Dr. Rick Butts, Science Director, Soil, Water and Air Quality, Environmental Health National Program and to Dr. Peter Hicklenton, Science Director, Crop Production Systems, Sustainable Production Systems National Program for response."

Peter Hicklenton replied “I am passing the recommendations on to Gary Whitfield who is heading the regional consultation on research priorities process for AAFC in Ontario.”

Recommendation #5 (2004)

Issue: Not enough information on nutrient management in grapes.

Action: This recommendation was to be pursued by the parent committee (OHCRSC), since the recommendation is similar to ones from several sub-committees.

Response: None received. The NM Act has been modified to impact only new and expanding livestock operations, and large livestock operations located near municipal wells. There is currently no further phasing in scheduled for this act. The 2008 deadline for all farms to be incorporated no longer applies.

Recommendation #6 (2004)

Issue: Herbicide drift on grapes.

Action: Recommendation 6 was sent to Lorraine Goulty and Susan Kelner, Ridgeway College, Hugh Berges, OMAFRA, and Violet VanWessener, MOE.

Responses: Susan Kelner, Ontario Pesticide Education Program, replied detailing the content on spray drift management in the OPEP courses. (See full report for details)

Violet van Wassenae, Senior Pesticide Regulatory Scientist (A), Pesticides Section

Standards Development Branch at MOE indicated by phone that a written response was forthcoming once responses were received from various “regions”. The written response was not received by the deadline for this report.

In addition, a follow-up message was sent to Mike Cowbrough, Weed Management Field Crops Program Lead, OMAFRA who replied with the details of the extension efforts made in the previous year to inform field crop growers about the issue. (See full report for details)

Recommendation #7 (2004)

Issue: Need for more integrated grape & wine industry information

Action: Recommendation was pursued by the CRC.

Response: This recommendation was partly addressed by the grape and wine industry survey carried out by the GGO in conjunction with the WCO and presented to the CRC. It is expected that the future development of a sustainable funding basis for grape and wine research in Ontario will involve further surveys providing detailed industry information.

Issues and Recommendations 2005

Recommendation #1 - 2005 (Edited for this summary report)

1. Issue:

The OGWRSSC has submitted recommendations to the PMRA and others for many years concerning the issue of pest control product availability (see previous OGWRSSC reports). Despite the reply on this issue from PMRA, the sub-committee feels there is still a substantial gap between the availability of products in Canada and the U.S. This is particularly evident in regards to “reduced risk” products. This lack of “harmonization” remains a critical issue.

2. Background:

- The basic history of problems with registration of pest control products, especially reduced risk products, remains unchanged (see OGWRSSC 2004 report for complete background)
- The OGWRSSC appreciates the response from PMRA to last year’s recommendation (included in full report) but feels it is lacking in substance. If the various programs and protocols as outlined are designed to facilitate Canadian growers access to reduced risk products to replace older products, why are we still so far behind in registrations of new products in Canada?

3. Gaps/Barriers/Deficiencies:

- Problems not addressed: long response times for product review; lack of sufficient staff to handle the volume of registration requests within reasonable time-frames; need to truly harmonize the regulatory process between US and Canada; etc.
- Fees should be reduced and charged after 3 years of sales, not up front.

- Continuing demand by PMRA for data that no other OECD country has requested -on conventional, reduced risk and biopesticide submissions. This includes occupational exposure data, environmental data, extra residue data, etc.
- Major data requirements for formulation changes that are not required in the US. This puts Canadian producers in a disadvantaged position with regard to access to newer products.

4. Recommendations:

- The OGWSSC recommends that PMRA address the problems outlined by this committee's yearly recommendations with substantial action as outlined below.
- That PMRA allocate additional personnel and resources to ensure that product registration for reduced risk pesticides and biopesticides be achieved at the same time as their US counterparts to maintain competitive balance and ensure sustainability of economically viable and environmentally responsible grape production.
- That PMRA adopt a fast-track system for reduced risk pesticides and truly waive residue data for food grade products, biopesticides, and products for which tolerance has already been established but for a different purpose than pest control.
- PMRA reduce fees, especially for URMUR and charge after 3 years of sales, not up front.
- That PMRA rescind and cease requests for data that no other OECD country requires.
- That PMRA cease requests for major data requirements for formulation changes that are not required in the US

Target Agency: PMRA, Dr. Richard Aucoin, Acting Chief Registrar.

Recommendation #2 – 2005 (Edited for this summary report)

1. Issue:

The OGWSSC and other sub-committees within the OASCC system have made repeated recommendations for many years to AAFC (and others) outlining the need for replacement or enhancement of the staffing in research capacity especially at Vineland AAFC (SCPFRC). No real action has been taken to fill vacant positions and more gaps are occurring over time.

2. Background:

- The industry has made extensive efforts for many years to illuminate the problem and has justified the need for additional staffing in this area at Vineland. The committee suggests that it is the responsibility of AAFC and OMAFRA to rectify the lack of personnel available rather than simply "putting the ball back in the court" of industry to once again justify the need for research and extension support. Further, the committee felt that the suggestions from OMAF in 2004 that existing technical staff could address the needs of the sprayer application specialist and the IPM system modeling specialist were unrealistic.
- There is some research capacity outside of the publicly funded agencies, but there is a need for the government to bring this expertise into research and services through contract funding for specific projects.

3. Gaps/Barriers/Deficiencies:

- Vacancies, current or soon to be, plus understaffed areas - AAFC Vineland: nematology; insect population ecology; plant pathology, insect toxicology.
- Vacancies, OMAFRA: spray application technology, advanced IPM modeling.

4. Details:

- Positions at facilities listed above need to be filled promptly so that important grape and wine research and services can be conducted and delivered in a timely fashion.
- It should be acknowledged that experienced and qualified privately-funded professional research entities exist and are active in the Ontario industry. If government agencies are willing to enter into contract arrangements to deal with the continuing needs for research in grapes and wine, they should indicate that willingness promptly and clearly.

5. Recommendations:

- AAFC-SCPFRC, should address the gaps in publicly funded crop protection research at AAFC-Vineland by creating and filling an ecologist/epidemiologist entomologist position. In addition, a re-allocation of the AAFC tree fruit pathologist resources to address mycology needs of grapes is needed at the Vineland research facility. AAFC

should also state clearly how they plan to deal with the future for continued work in insect toxicology research at AAFC Vineland.

- OMAFRA – Innovation and Competitiveness Division should fill the vacant sprayer application technology specialist and IPM system modeling positions, which are seen as important gaps in services by the GGO and other fruit producer groups.

6. Target Agencies:

- AAFC, SCPFRC – Vineland. Dr. Gary Whitfield, National Science Director for Theme 160- Environment: IPM and Protection.
- Bill Ingratta, OMAFRA – Crop Technology Branch

Recommendation #3 – 2005 (Edited for this summary report)

1. Issue:

Water management is becoming important for grape growers but there is not enough information specific to Ontario's conditions to guide their irrigation and soil water management decisions.

2. Background:

- In recent years, grape growers in Ontario have had to increasingly rely on irrigation
- Efficient strategies will be necessary in the future to make the best use of available water.
- Excess irrigation could compromise fruit quality and vine hardiness but withholding water altogether will seriously impact both fruit and vine health.

3. Gaps/Barriers/Deficiencies:

- We need much more data on the relationship between irrigation and winter hardiness.
- There remains a significant gap in information with respect to irrigation and wine grapes.
- Current overhead irrigation practices can have a negative impact on IPM systems

4. Details:

- Several substantial research studies are completed or underway in the Niagara Region. Additional research trials are needed in other grape growing areas.
- Good, practical, economical soil monitoring systems need to be developed for diverse soil types. Information is needed to develop BMP's and water application rates tied to soil percolation, infiltration and absorption rates, to prevent runoff and/or leaching of nutrients.
- The effects of appropriate irrigation on fruit and wine quality need to be well defined to allay the fears of some winemakers that irrigation will detract from wine quality.

5. Recommendations:

Resources and personnel should continue to be assigned to develop standards, protocols and schedules for irrigation management for specific soil types in the grape growing areas of Ontario.

6. Target Agencies:

- University of Guelph and Brock University (CCOVI)
- OMAFRA
- AAFC-GPCRC, Harrow; AAFC-SCPFRC, Vineland

Recommendation #4 – 2005 (Edited for this summary report)

1. Issue:

New import restrictions on all *Vitis* material from France and Germany in reference to phytoplasma infection. None of the Interim Conditions for Entry described in the draft document from the CFIA are considered acceptable by the industry.

2. Background:

- With improved detection techniques, disease spread has been documented in France, and the CFIA has changed the import structure by imposing import restrictions on *Vitis*.

- Extensive winter injury over the last three years has killed a large number of vines in Ontario and growers are dependent on vines from Europe for replanting to re-establish and sustain the industry. Restrictions come too late in the year for growers to act for the 2006 season.

3. Gap/Barriers:

- Hot water treatment of *Vitis* has been shown to cause bud mortality and is unsuitable for many varieties. Hot water treatment must be acceptable for field material with minimal losses.
- No commercial equipment for hot water treatment of *Vitis* is currently available in Canada.
- A comprehensive pest risk assessment for Phytoplasma diseases has not been done.
- A survey for the disease(s) and vector(s) has not been done.
- A national *Vitis* certification program needs to be established, decreasing the industries dependence on imported vines to meet our needs.

4. Recommendations:

- A complete pest risk assessment including pathogens and vectors is required.
- More research is needed on hot water treatment.
- Research is needed to define the risk of potential disease spread by leafhoppers
- A survey should establish the presence of both phytoplasma pathogen(s) and vectors.
- The committee recommends that the nursery industry revisits domestic *Vitis* certification.
- A practical protocol is needed for 2007, allowing suppliers time to adjust practices and re-defining acceptable nurseries in pest free areas.

5. Target Agencies:

- AAFC, SCPFRC – Vineland. Dr. Gary Whitfield
- Brock University, CCOVI.
- Ontario Vine Improvement Committee (WCO, GGO, nurserymen, and vine importers)
- CFIA
- OMAFRA – Crop Technology Branch Director, Bill Ingratta.

Recommendation #5 – 2005 (Edited for this summary report)

1. Issue: Winter Injury is causing extensive crop loss in grapes

The last three winters have all caused major economic damage, with 2004-2005 being one of the coldest on record. Overall, 2005 grape yields are down 50% from normal.

2. Background:

Already, Ontario grape growers have installed at least 200 wind machines. Many grape growers believe that wind machines are one technology that can allow them to make a consistent living.

3. Gaps:

- winter grape bud hardiness stages by doing systematic field sampling
- determine if wind machines prevent/reduce cold injury damage
- where and how best to operate wind machines and how noise might be reduced
- develop Best Environmental Management Practices (BEMP) information

4. Details:

As of October 2005, funding was approved for a 3 year CanAdvance/Crestech funded project with 10 industry partners. The four project leaders are Hugh Fraser – OMAFRA; Ken Slingerland – OMAFRA, Kevin Ker – Brock University, and Dr. Helen Fisher – University of Guelph.

5. Recommendation:

OMAFRA, University of Guelph, and Brock University conduct research into ways to mitigate grapevine damage from winter injury, specifically wind machine research.

6. Target agencies: OMAFRA, AAFC, Brock University, University of Guelph

Recommendation #6 – 2005 (Edited for this summary report)

1. Issue:

Consumers and governments are requiring action and reporting on environmental initiatives from those wishing to sell products in their markets. Consumer concerns regarding food traceability are leading governments to institute food safety/traceability programs in many sectors. The grape and wine sector has begun work on an environmental charter for the industry, but better tools will be needed to implement environmentally sustainable practices.

2. Background:

A new Environmental Farm Plan is providing a guide to sustainable agricultural practices for farmers, but this guide is not sector specific. The Wine Council has just finished a guide for wineries on current legal requirements, and the WCO and the GGO have agreed to collaborate on a “best practice” self evaluation program and guide. This work has identified several gaps in information and resources for the grape and wine sector .

3. Gaps/Barriers/Deficiencies:

- There is a need for a consistent spray diary format that could be used across the industry
- A reference is needed on the relative environmental impacts of different pesticides
- There is insufficient Ontario data to create accurate profiles of nutrient use and/or sequestering in vineyards by labrusca, French Hybrids and vinifera.
- There is insufficient data on the use of alternative organic matter sources and their N release in the nutrient cycle of a producing vineyard.
- There needs to be more information on cover crop management
- There is insufficient data from fertigation trials to document uptake and/or loss of nitrogen
- There is a need for new tools for growers to access environmental impacts

4. Details:

- Research programs need to be encouraged to assist the grape and wine industry in improving sustainable practices...
- Work is underway with the U of G/Vineland and Brock University to address irrigation strategies, fertigation strategies and organic matter amendments for producing vineyards
- Crop removal studies are underway by OMAFRA/Speranzini and University of Guelph/Fisher that are following these and other sites to determine the amount of N removed after the application of specific nitrogen and/or soil amendments to these plots.

5. Recommendation:

Identified agencies work with the grape and wine industry to identify needs and support research in the area of environmental sustainability and to provide education and training in this area.

6. Target agencies:

University of Guelph , Department of Land Resource Science, Plant Agriculture

Ontario Ministry of Agriculture, Food and Rural Affairs, Crop Nutrition Specialists/Horticulture

Brock University, Department of Biology/CCOVI

Ontario Ministry of the Environment

2005 Issues (Edited for this summary report)

The following issues were identified by the Sub-committee as being important for the future of grape and wine production in Ontario. No recommendations are attached to these issues.

Multicoloured Asian Lady Beetle (*Harmonia axyridis*)

For two years, the OGWRSSC stressed the need for industry cooperation and research into the problems associated with MALB. The beetle is still an extremely important issue in the grape and wine industries but no recommendation is required on this insect this year.

Premature Grape Breakdown

The cause of increased premature grape breakdown was undetermined but likely multi-fold: physiological breakdown due to intense heat and heavy rains during the pre-harvest interval, bunch rot due to infections by *Botrytis cinerea*, sour rot due to the activity of *Acetobacter*, and fruit fly and yellow jacket activity.

Land Use – Greenbelt

A summary of greenbelt issues was included in the 2004 OGWRSSC report. The Greenbelt places a freeze on lands for agricultural purposes and limits the rights of farmers. There are concerns over plans to classify drainage ditches as fish habitat and woodlots as wildlife habitats.

Salt Damage

The province and local municipalities continue to use salt on roads adjacent to farm land. This has resulted in damage to fruit trees caused by salt spray. Alternatives to salt need to be tested in order to mitigate the damage and the resulting financial losses being sustained by producers.

Deer Damage

Grower complaints from deer browsing and loss of crop are common. There are local restrictions which prohibit the discharge of firearms, so the only control is by bow. There are also limits on the hunting season and number of deer which can be killed.

Juice Grape Production and Profitability

Juice grape producers continue to suffer from poor demand, oversupply, and low prices.

Herbicide drift causing damage on grapes

This issue was submitted last year as an issue with recommendations. Several of the targeted agencies responded and are contributing to finding solutions but it is an ongoing problem.

Great Lakes Charter

The charter is under review and there will likely be restrictions on how much water can be taken from the Great Lakes system for irrigation.

Wind Machine Noise

There are now over 200 wind machines in the Niagara Peninsula. The noise they produce may be disturbing especially at night. The industry needs to show the positive effect of wind machines as non-farming residents may challenge the use of wind machines as a normal farm practice.

GREENHOUSE FLORICULTURE

Executive Summary

The committee meeting was attended by 18 people, of who 8 were industry representatives, including 7 growers all from the Vineland area. This was a bit disappointing but not unusual. The plan is to try to have the next meeting in a more central location such as London to encourage more attendance from South Eastern Ontario.

Growers continue as in 2004 to be concerned about pressure on the industry resulting from:

- The increasing number of imports threatening domestic production and reducing export sales to the US that were further threatened by the strength of the \$CD and border delays as a result of increased security and quarantine issues
- A growing trend among some of the major large retail outlets to hold the growers financially responsible for the quality of the product right to the point of purchase by the consumer even though the growers had no control on the environment or handling in the retail outlets where post harvest care was generally being managed poorly.
- The need for the industry to continue to develop plans to invest in the promotion of the floriculture industry with the public and different levels of government
- The need for greater sustained support for research and development to keep the industry competitive to be combined through combined government and industry partnerships.
- The continued escalating cost of energy
- The pressures on water usage in the industry
- The need for more data and research on management of greenhouse environments including strategies for long term recycling of nutrient solutions
- The lack of clarity of Ontario Green Belt Task Force with several growers expressing concern that the viability of the grower had to be considered as well as that of the farm operation with the further growth of the urban population
- The need for pathology expertise dedicated to ornamentals
- The shortage of skilled labour that remains acute and the need for more harmony in the way existing educational programs are able to train graduates for the greenhouse industry
- The implementation of more stringent rules regarding work place safety in controlled environments and the lack of adequate agrichemical to implement effective IPM programs

This was a strategic transition year for funding for numerous floriculture projects through the efforts of the industry, primarily Flowers Canada Ontario. For the period of 2005 to 2007 FCO helped fund marketing and research projects valued at \$3.1 million in total. Although several researchers were successful in obtaining sizable operating grants from government agencies such as NSERC and OCE the concern remains that 2004-5 marks the end of a four year cycle of floriculture projects funded by the OMAFRA/Guelph contract. Only one project remains funded by AFFC. There is a need for sustainable funding for all aspects of research for the floricultural industry. FCO was taking on priority one voiced in 2004, namely, promotion, marketing and advancing the floriculture industry in Ontario and integrating with all levels of government. Marketing research remains a high priority for the competitiveness and survival of the floriculture industry. Because FCO is taking a lead on marketing and promoting, the sub committee identified seven other pressing issues and priorities for immediate attention in 2005 – 2006. These include:

1. Hiring a new pathologist or identifying an expert at the University of Guelph who could devote time to floriculture crops
2. Development and implementation of IPM programs
3. Optimisation of the greenhouse environment and efficient energy use
4. Integration of nutrient, water and disease management strategies from an environmental perspective
5. Post-harvest handling and production issues
6. Development of improved and new floricultural crops
7. Training of a skilled labour force for the industry
8. Promoting, marketing of Canadian products domestically and for export

Five recommendations emerged from the meeting. Issues on which Recommendations were made included:

1. The need for pathology expertise in greenhouse ornamentals
2. The need for harmonization of new pesticides for the industry through the minor use registration program

3. The need to become more energy efficient and environmentally friendly management of greenhouse environment
4. The need for educational programs both at the college level, and as a component of continuing education
5. The need for the industry to continue to promote itself within the domestic market and continue to improve better lines of communication within the industry and various levels of government and emphasizing the value to Ontario economy

State of the Industry and Major Emerging Issues

Markets

According to Statistics Canada that Ontario represents over 50% of the total greenhouse floriculture production. In the past year, a series of pressures has had pushed the greenhouse floriculture sector into one of the worst economic slumps in the past 25 years. These pressures including 1) the rapid rising gas price, 2) the rapid and significant rise in the value of Canadian dollars, 3) increased competition in the cut flower sector from cheap imports, primarily from South America, 4) cold and wet weekends during May in the previous couple of years delayed and lowered consumer demand for bedding plants.

Briefly, the total farm-gate sale was down by 2% to \$734,000,000, however, the sales by retail florists, direct retail grower sales, and domestic wholesalers were down by 7% to 8%. For the whole greenhouse industry, the gross yearly payroll dropped by 5%, while total investment increased by 25%. The total fuel cost declined by 8% partially due to the fact that some vegetable growers have switched to bunker oil and flower growers are now utilizing waste wood products.

Cut Flowers: This sector is in the midst of major changes. Over the next couple of years, there will likely be some consolidation within the cut flower sector as some of the smaller growers leave the sector or industry. Some will switch to growing alternate crop for niche market to survive. For the last few years the margins have been down and there have been various border issues that have caused periodic bottlenecks in the shipment of exports. The industry still suffers from decisions by US border inspectors at various times during the year. Flowers Canada worked closely with CFIA and USDA to resolve the issue. The cumulative impact of reduced margins, boarder problems and competition from abroad has seen cut roses, alstroemeria, and spray chrysanthemums all dramatically decreasing in 2004-5 from 14.5% to 36.5% comparing 2004 to 2003. The foreign competition has been stiff and effective. Cut gerbera production increased 46% due to the fact that local growers could compete based on quality but it is hard to predict that this can be maintained. Encouraging also is that fact that snapdragon production has remained stable due in part to the difficulties for long-distance shipping. There was a 95% increase in tulip production due to the high demand in winter months and the adaptation of new technologies.

Potted Flowering Plants: Growers of potted crops have been under pressure from low margins for a number of years and this sector has experienced considerable turmoil during the past year. Growers have noted shifts in the purchasing pattern of North American buyers. Now buyers are basing commitments on sell-through from the previous season, or committing to a percentage of their needs and buying as needed. The industry feels that poor handling of the product by retail outlets is a key reason sell-through is declining. Poinsettia production, the single largest holiday crop grown in Ontario, was down by almost 30% in 2004 comparing with 2003. Also, there was 17% decrease in azalea, 16% decrease in geranium. However, there was 12% increase in chrysanthemum, 25% increase in Easter lilies.

Spring crops: The spring crop was a good one that stretched in to the summer, in terms of the weather and the movement of product through the market, however profits were down. Bedding plants and spring flowering hanging baskets continued to drive the industry in both Ontario and the U.S. in terms of growth and return on investment. For bedding plants, floriculture plants increased 12% while vegetable plants decreased 20%.

Pests/diseases: The significance of pests and diseases to the industry is often closely tied to the availability of effective pest control products. This is emphasised by the most important priorities as identified over the last few years to the AAFC Minor Use Priority Meeting in Ottawa.

This year Graeme Murphy and Jim Chaput (OMAFRA) reviewed the current strategies and chemicals that were available or might become available for dealing with what the subcommittee agreed were the FIVE major pests (i.e., issues) 1) Thrips, 2) Whiteflies, 3) Leaf Miner, 4) Mites and 5) Mealy bugs.

The Five major diseases (i.e., issues) threatening different sectors of the industry remain 1) Powdery Mildew, 2) *Fusarium*, 3) *Pythium/ Phytophthora*, 4) Downy mildew and 5) Leaf spots due to a number of viral and bacterial agents. It was pointed out by several growers and the experts that all diseases require treatment and the issue is becoming registration and testing. As downy mildew has no registered fungicides for its control discussion revolved around setting specific priorities for the registration of specific compounds such as Acrobat (dimethomorph). Other important diseases such as *Fusarium* have only one recently registered microbial. While powdery mildew has several, but resistance has become a major concern.

The subcommittee decided to be guided by the expert committee and let them determine the best course of action for registration based on recommendations from other sub-committees and the cold reality that in Ottawa at the annual meetings of PMRA when final recommendations are considered it is rare to receive approval for more than a single new chemical. Co-ordination with other sectors such as greenhouse vegetables was also suggested as both horticultural industry groups share a common problem of meeting requirements of work place safety.

It is being recommended this year that:

- PMRA reconsider its position on occupational exposure data requirements for greenhouse pesticide registrations to bring it into line with requirements in the USA and other OECD countries
- PMC continues to generate dislodgeable foliar residue data for the greenhouse industry for priority products where this data is required by PMRA

The subcommittee felt that this was necessary because we need to be in line with US usage for exports. Quarantine pests and diseases are just one of the many border issues growers must deal with.

Sudden Oak Death (SOD) was of concern last year but there were no reports of problems in Ontario in the floriculture industry. From an Ontario perspective, the industry has been affected by the regulation of all host plants and soil coming from abroad and vigilance and a wide array of solutions were considered the best solution as from year to year all five pests and all five diseases listed above tend to offer difficulty to one or other sector of the industry.

FLOWERS CANADA ONTARIO

Summary of Newly Funded Research Projects

A number of projects were funded in 2004-5. Most of these have two years of funding and will terminate at the end of 2007. The total value of these projects is over \$3.1 million with almost 50% of the funding coming from Flowers Canada (Ontario). These projects include:

Economic Impact Study of the Ontario Greenhouse Industry (TOGA)

Oxygenation of Nutrient Solutions (Mike Dixon and Youbin Zheng – UofG)

- To determine the efficacy of root zone super saturation for improving greenhouse ornamental crop productivity
- To evaluate the efficacy of using root zone super saturation to control root pathogens
- Develop protocols for implementing these oxygenation technologies into production systems with a focus on energy efficiency and production improvements

Height Control of Potted Plants (Theo Blom – UofG)

- To find effective and environmentally friendly techniques to control plant height
- To quantify any effects B-9 and Sumagic have on compounding heat delay effects on chrysanthemums
- To study the effect of red and far-red supplementation during the dark period on plant height of chrysanthemums and Easter Lilies

High Intensity Pulse Lighting (Theo Blom– UofG)

- To investigate the response of potted gerbera, campanula and kalanchoe (Ps, plant growth rate and development) to high intensity pulse lighting under Ontario greenhouse conditions
- High Intensity Pulse lighting is a system where lamp fixtures move along a track system over the crop
- Fewer light fixtures are needed and some preliminary work indicates plants grown under this system have shorter internodes and earlier flowering dates

Breeding to Develop New Floriculture Crops (Al Sullivan – UofG)

- To develop new cultivars and germplasm to provide a unique competitive advantage for Ontario floriculture
- To adapt and breed native species that would be commercially viable for our industry (e.g. Trillium, Echinacea)

Ornamental R&D Management (Jamie Aalbers – FCO and LO)

- Manage government and industry funds allocated to non-edible horticulture (FCO and LO) R&D
- Develop a research company managed through FCO and LO that will be able to maintain long term, sustainable research funding and commercialize research results
- Develop stronger ties with OMAF, AAFC and IRAP to improve the ornamental sector's representation in publicly funded institutions
- Manage issues for FCO and LO that have an R&D focus

Pest Management Risk Reduction (Garry Watson – FCO)

- To further the adoption of reduced risk IPM programs
- To encourage pesticide companies to invest in Canadian registrations of their products
- To reduce the need for off-label pesticide use in the floriculture sector
- To be the contact person for FCO at the new AAFC Pest Management Centre

University of Guelph Trial Gardens (Rodger Tschanz – UofG)

- Compare growth and bloom performance of a wide variety of different species of annual and perennial bedding plants grown in both soil and containers
- Conduct an All American Selections bedding plant trial
- Evaluate different plant species and cultivars for summer production and fall container garden centre sales

New Control Strategies for Leaf Miner (Cynthia Scott-Dupree – UofG)

- To identify alternative biocides and insecticides which could replace currently recommended insecticides that are no longer effective
- Determine the impact of the alternative insecticides and biocides on non-target biocontrol agents

Dev't of a Quick Immunoassay for Quantification of Erwinia (T. Blom and Chris Hall – UofG)

- To develop a grower-friendly, on-site test to determine the number of Erwinia bacteria in a recirculating nutrient solution
- Growers will be able to do a cheaply and quickly do multiple tests on-site

Development of Novel Techniques for Improving Shelf-Life of Floriculture Crops (Gopi Paliyath – UofG)

- Evaluate MCP applications to potted plants and flowers to block ethylene action
- Investigate the effectiveness of an Enhanced Freshness Formula (EFF) to inhibit phospholipid degradation and enhance membrane preservation in floral crops

Poinsettia Variety Trials (Wayne Brown – OMAFRA)

- Grow, evaluate and show poinsettia varieties for the Ontario greenhouse grower

Retail Florist Survey (Olya Grod – FCO)

- The groundwork needed to support a proposal to the Ministry of Colleges and Training for an apprenticeship program for floral designers

Reducing Energy Costs During Year-Round Production of Ornamentals**(B. Grodzinski – UofG)**

- To determine reduced temperature responses of photosynthesis and C and N partitioning
- To employ non-invasive crop monitoring techniques and use the plant as a sensor for greenhouse environmental control

Investigation of ozone and chlorine to control *Pythium* and *Phytophthora* in greenhouse and nursery applications (M. Dixon, Y. Zheng and C. Chong – UofG)

- Determine ozone and chlorine thresholds required to control these diseases
- Determine ozone and chlorine phytotoxicity effects on floriculture and nursery plants
- Develop disease prevention protocols in recirculating irrigation systems using ozone and/or chlorine

Diagnosis, measurement and remediation of root diseases in floral crops**(John Sutton and Grodzinski– UofG)**

- To evaluate the ability of biological agents to suppress a *Pythium* infection before the infection affects plant growth and productivity
- To determine the value of CO₂ enrichment for reducing losses in growth and productivity due to *Pythium*

Ion specific Nutrient Management (Mike Dixon – UofG)

- To evaluate the performance of an in-line HPLC system in a greenhouse recirculating irrigation system in controlling nutrient balance over time

Cut flower Marketing Program (Irwin Smith – FCO)

- Develop a “Foodland Ontario” type marketing campaign for Ontario grown cut flowers

Development of an IPM program for thrips on greenhouse ornamentals**(Les Shipp – AAFC Harrow)**

- Evaluation of *Beauvaria bassiana*, *Steinernema feltia* and trap plants for control of western flower thrips on floriculture crops

Summary of Floriculture Research in Controlled Environment Systems Research Facilities (CESRF), UoG

Prepared for the Greenhouse Floriculture Sub- Committee (November 2005)

By Youbin Zheng, Mike Dixon, John Sutton, Chris Hall and Bernie Grodzinski

1. Low nutrient strategy in subirrigation production systems for potted crops—Mike Dixon and Youbin Zheng

The accumulation of salts in the upper section of growth media is a perennial problem in subirrigation system. Our previous research on potted gerbera showed that the nutrient solution concentration currently used in commercial greenhouses (~EC 1.7) can be reduced by > 50% without causing any negative effect on crop production. Potted gerbera is a relatively short-term crop (4-5 weeks in sub-irrigation system). To test whether the nutrient solution concentration can be reduced for the production of longer-term crops in subirrigation system, miniature roses were grown in a subirrigation system for 12 weeks and fertigated with 100, 75, 50, 25 or 10% of a full strength (EC 1.76) nutrient solution. Results showed that currently used

nutrient solution concentrations can be reduced up to 50% without negatively affecting crop production, however, the 75% treatment was the best among all the treatments.

2. **Oxygenation of nutrient solution in greenhouse production—Mike Dixon, Youbin Zheng, Linping Wang & Sally Taylor**

To investigate the potential positive and negative effects of nutrient solution or plant root zone oxygen supersaturation on crop production, two varieties of cut rose were grown in pots and watered with nutrient solution with different dissolved oxygen (DO) concentrations (8, 20, 30 and 40 ppm) for about 3 months. This experiment will be carried on for another several months. In the coming year, we will also conduct experiments to investigate the effects of DO on the production of several other floriculture crops (e.g. miniature roses, African violet) in a subirrigation system; and to investigate the potential of using oxygenation technology in diseases control in greenhouse hydroponic production systems. The project will provide protocols for oxygenation in greenhouse hydroponic productions.

3. **Using aqueous ozone in diseases control – Mike Dixon, Youbin Zheng, Tom Graham and Ping Zhang**

We are investigating the efficacy and developing the protocols in applying aqueous ozone in controlling leaf diseases (e.g. powdery mildew) and root diseases (*Pythium*) for greenhouse production of ornamental crops (e.g. miniature roses, African violets), and in sterilizing plant tissues in commercial tissue culture processes. Initial tests of this residue free disinfection technique show promise and the research will focus on establishing efficient application protocols for a range of greenhouse crops.

4. **Using aqueous ozone to extend shelf-life of cut roses—Mike Dixon, Youbin Zheng, Stacey Robinson and Tom Graham**

Our results showed that ozonated water can extend the shelf-life of cut roses by nearly 3-fold. Bacterial blockage in the xylem was identified as the main cause of reduced shelf-life of cut roses. Although long suspected as a significant factor in cut flower demise, the actual role of the bacteria and the specific site of xylem blockage has eluded researchers until now. Bacteria were localized near the cut surface of a stem and invaded the open xylem vessels. However they were unable to infiltrate the xylem beyond the open vessels at the cut end and eventually clog the tiny pores which interconnect xylem vessels. This resulted in the observed symptoms of water stress and reduced shelf life. A protocol for aqueous ozone treatment of cutflower vase solutions was tested and found to significantly extend the shelf life. Stacey Robinson successfully defended her MSc thesis based on this study and now is working for Flowers Canada (ON).

5. **Ion specific fertigation feedback control system—Mike Dixon, Tom Graham, Stefan Richard, Jamie Lawson, Glenn Roberts & Youbin Zheng**

Algorithm, software and hardware are almost ready. Currently we are assembling the system and preparing for bench test trials. Earlier work focussed on ion specific sensors developed by Sentron Ltd (subsidiary of Priva Computers in The Netherlands). However, the application of this technology has proven to be unreliable and alternative solutions are under investigation. Priva Computers has now invested in HPLC technology to achieve individual ion control in a feedback system. We will continue to work with Priva in establishing operation protocols and fine-tuning the applications for the commercial greenhouse industry.

6. **Endophyte technology for enhanced vigor, fitness and productivity of greenhouse flowers—John Sutton, Weizhong Liu, Jianhua Ma and William Brown**

The endophytic fungus *Clonostachys rosea* is the active ingredient in EndoFine® a commercial product recently developed by Adjuvants Plus Inc. and the University of Guelph. This beneficial endophyte can grow inside the roots, foliage and flowers of a very wide range of crop species including numerous kinds of greenhouse flowers. The endophyte was originally recognized for its ability to suppress disease organisms in plants, but it is now known to enhance the vigor, fitness, and productivity of plants independent of its effects on diseases. Plants treated with EndoFine® commonly are more robust, exceptionally well-formed, have better-looking foliage, more prolific fine roots and produce flowers or fruits earlier and more abundantly than do untreated plants. Treated plants have also been found to have better fitness and to tolerate environmental stress conditions such as periods of high temperature and deviant root-zone pH. Factors contributing to the beneficial effects of EndoFine® may include improved acquisition of otherwise unavailable or limiting micronutrients and assisting the plant to maintain a good balance of hormonal

activity, natural disease resistance, and other critical metabolic functions, even under stress conditions. Unlike many microbial products, EndoFine® sustains itself *within* plants and is not known to produce toxic substances such as antibiotics. Beneficial effects of EndoFine® have been found in roses, mini roses, lilies, gerberas, cyclamen, cucumbers, peas, cereals and several other crops. Work is continuing to develop the best practical protocols for using EndoFine®, and to augment the availability of the product to growers.

7. **Phenolic compounds that build up in root infected by *Pythium* can be bad news in hydroponic systems – Nathan Owen-Going, John Sutton and J.Chris Hall.**

We have identified and quantified phenolic compounds that build up in roots after they are infected by *Pythium aphanidermatum*. These phenolics do not inhibit *Pythium*, but rather promote zoospore production by the pathogen and so increase the rate of infection of roots. The phenolics also leak into the nutrient solution of plants grown hydroponically, exert allelopathic (injurious) effects on other plants, and predispose them to even more severe *Pythium* attack. The cycle then starts all over again. The phenolics are thus the centre of a root rot "meltdown" in the hydroponic crop, and help to explain the explosiveness of *Pythium* root rot epidemics. A PhD thesis on this topic by Nathan Owen-Going will be defended in December 2005.

8. **Efficacy of fish hydrolyzate in *Fusarium* control – John Sutton, Weizhong Liu and Calvin Chong**

Our results showed that fish hydrolyzate greatly increased the vigour and whiteness of the cucumber roots; and the data for cyclamen were promising but less convincing. From our limited investigations we conclude that fish hydrolyzate products such as Drammatic, and also the microbial products Companion and Endofine, can have substantial beneficial effect in promoting and maintaining health in crops.

9. **Early Diagnosis and Management of Micro-organisms and Allelochemicals in Recycling Systems – Bernie Grodzinski, John Sutton, Chris Hall, Demos Leonardos, Javaid Iqbal, George Lin, Jason Deveau, Renee Cloutier, Noe Ortiz, Weizhong Liu**

Our results show that it is possible to detect pathogenicity of root diseases such as *Pythium* prior to visible symptoms appearing in several snapdragon and chrysanthemum cultivars. We have employed several new techniques that lend themselves to future remote monitoring and greenhouse control. We have been studying the use of a combination of leaf chlorophyll fluorescence and gas exchange analyses. Most recently we have successfully tested a new 3-D imaging laser scanning technology for determining changes in leaf canopy development. The imaging data coupled with gas exchange analyses seem to confirm that changes in plant productivity attributable to decreased photosynthesis are indirect and related to arrested canopy development. With new funding established from several sources for 2006-8 our plan is to refine these procedures and determine the most practical integration of early detection protocols. We also will be testing these protocols for early diagnosis and remote monitoring so that novel biocontrol and physical/chemical remediation protocols can be applied and their efficacy tested.

10. **An integrated genetic and phenotypic approach to selecting and producing ornamentals of high quality year round in Canada–Bernie Grodzinski, Demos Leonardos, Javaid Iqbal, M Micallef, Cliff Beninger, Mr, George Lin, Renee Cloutier, Noe Ortiz, Jamie Doran.**

Although there were serious interruptions in financial support during 2005 from our traditional sources, OMAFRA, the University of Guelph and FCO due to restructuring in these groups we have been successful in caring an active program and attracting funding from NSERC, OCE and companies interested in the greenhouse industry. As indicated below we have also active in improving infrastructure for future research activities. We extended earlier preliminary studies showing improved carbon partitioning traits that lead to better winter production of selected greenhouse ornamentals namely snapdragons. We identified and studied several new commercial lines released by colleagues in the USA with improved low light and temperature tolerant traits. Photosynthesis and export response curves for key lines have been determined and the biochemical bases of productivity under low light, and low temperature and various CO₂ atmospheric conditions have been studied and are being published now that we have release to do so by our funding partners. We are about to start on a new phase of these studies.

11. **Inter-University Activity To Broaden The Base Of Research And Critical Infrastructure Available For Advanced Research In Closed Environment Systems – Bernie Grodzinski, Mike Dixon, J Chris Hall and Norman Huner (UWO)**

As indicated above we have been endeavouring to improve infrastructure and research capabilities. We have recently started development of a new facility at Guelph that will allow us entirely new analytical procedures to examine the anatomical, physiological and genetic basis of canopy development that manifest these traits that previously were noted only in some of our native, over wintering perennials, forest floor species such as garlic and trillium. With the assistance of a CFI/OIT program major new infrastructure support of about \$28.6 million to Huner (UWO) and Grodzinski (Guelph) is being used to build specialized "Biotron" facilities at Western and a low temperature facility at Guelph. The new Controlled- Environment analytical facilities at Guelph (\$1.53M) is currently in design and construction should be completed by 2007-8 adding to an already existing facility opened in 2001 and recently completed. In addition with new operating funding in place from the floriculture industry and hopefully through OMAFRA in 2006-10 through the new Sustainable Programs program our investigations of improved year round production of ornamentals and other greenhouse crops will be expanded to include a more comprehensive study of energy efficient management strategies for maximizing shoot and root environments year round. In December 2005 a proposal to the Canadian Foundation of Innovation lead by the CESRF team at the University of Guelph in collaboration with the Universities of Western Ontario, Windsor and Waterloo will be submitted. The application seeks new funding (approximately \$ 20M , 2006-2011) for a major initiative to improve computer and robotic technologies in greenhouse and closed environment operations. Two of the commodities directly benefiting from this team activity in the CESRF are the vegetable greenhouse production and ornamentals.

Al Sullivan, University of Guelph - Dept. of Plant Agriculture

Principle Investigator: J. Alan Sullivan, Plant Agriculture, University of Guelph

Title: Breeding and Management of Native Canadian Species for the Ornamentals Industry

OBJECTIVES

1. Create new ornamental species for the greenhouse and ornamentals industries.
2. Develop strategies for the sustainable use of carbon and nitrogen for the production and management of new species (varieties) in the greenhouse and landscape.

MILESTONES

Year 1 Collect and evaluate native Canadian species for their potential in the ornamentals industry.

Year 2 Develop a model system for the creation of unique variants in ornamental species.

Create populations of species for breeding and selection.

Year 3 Refine strategies to optimize carbon and nitrogen management in species with greatest economic potential.

Year 4 Evaluate first generation of progeny from crossing program for characteristics that contribute to a commercially successful variety.

Projects List of Theo Blom, Department of Plant Agriculture, UoGuelph. 2005/2006

NAME PROF ¹	TECH/YR	PROJECT/YR	TITLE
Blom, T.	.10	.20	NUTRITION
			- Effect of Ethrel on leaf tip burn on Lily hybrids
			- Phosphorous on cucumbers and tomatoes in a recirculating system (nutrient balance study).
			HEIGHT CONTROL
Blom, T.	.25	.25	- The effect of night and day temperature, photo period and the use of PGR's on flowering of chrysanthemums.
			- Effect of End-of-Night light quality on height of potted chrysanthemums (J. Bjerregaard, PhD, Denmark)
			- The use of Sumagic bulb dip on Easter lily

Blom, T.	.15	.30	PHYSIOLOGY - The effect of watering regime on root morphology of bedding plant plugs (Dr. Nabil Albatal, Syria) -The effect of light pulsing on plant growth (Y.Zheng,UoG)
Blom, T.	.20	.25	CONTRACT PROJECTS - Effect of IBA and light quality on rooting of chrysanthemum cuttings (Hussain Ahmad, MSc, UoG) - Effect of substrate and N-nutrition on St. John's Wort (Eric Wierenga, MSc, UoG) - BTM biocontrol (A. Wiegiersma) - Quantification of <i>Erwinia carotovora</i> in nutrient solution (M.Bassoriello, Msc, UoG)
Total:	0.70	1.0	

¹Note: Technical person is David Kerec.

Researcher Names: Les Shipp, Rosemarije Buitenhuis (NSERC Postdoctoral Fellow), Graeme Murphy and Bruce Broadbent

Project Title: Development of an integrated pest management program for thrips on greenhouse ornamentals

Project Objectives:

- Evaluation of the effectiveness of trap crop system for IPM of WFT on greenhouse ornamentals.
- Evaluation of the parasitic nematode *Steinernema feltiae* for control of WFT on greenhouse ornamentals.
- Evaluation of the efficacy of the entomopathogen *Beauveria bassiana* for control of WFT on greenhouse ornamentals.
- Determination of the dispersal movement of thrips and other insects into greenhouses in order to develop adoption strategies for screening greenhouse vents and to determine the dispersal of thrips within the greenhouse to determine the optimal trap plant density for attracting thrips.

Major Accomplishments:

1. Trap crop system

- Trap plants attract mostly migrating thrips. Thrips that are already on a plant are less likely to move to a trap plant. Trap plant efficacy is greatest when they are placed between the point of entry of the thrips and the crop.

2. Nematodes

- Prepupae and pupae are the most susceptible thrips stages to infection by the parasitic nematode *S. feltiae*. Preliminary results show that 15% of western flower thrips stay on potted chrysanthemum plants to pupate. When flowers are present, this number increases to 40%, because the florets offer suitable pupation sites. Thrips control with *S. feltiae* should therefore target the substrate and the flowers.
- *Steinernema feltiae* caused 20-30% mortality of thrips pupae in Petri dishes filled with potting substrate.
- Currently, we are testing the efficacy of different application methods of *S. feltiae* to potted chrysanthemum in greenhouse trials (foliar application, a single high dose of *S. feltiae* to the substrate when planting the cuttings or weekly applications to the substrate). Initial results indicate that thrips numbers at flowering were lower than the control in all treatments. Weekly application of *S. feltiae* to the substrate results in very low thrips damage at the marketable stage. Foliar application seems less effective due to more damage to the foliage and some damage to the flowers. The experiment will be repeated this winter.
- Following a single application of *S. feltiae* to the substrate of potted chrysanthemum, nematode numbers declined for 5 weeks, after which numbers stabilized. In one experiment, nematodes were still present in the substrate after 14 weeks.

3. *Beauveria*

- *Beauveria bassiana* causes mortality to the pupal stage of western flower thrips when applied to the substrate. Greenhouse trials were initiated to test the application of *Beauveria* to the substrate of potted chrysanthemum plants (one single high dose of *Beauveria* when planting the cuttings or weekly *Beauveria* applications). Preliminary results show that compared to the control, there were less thrips at flowering and less thrips feeding damage on the plants in both *Beauveria* treatments. These trials will be repeated in 2006.

4. Dispersal of thrips

- Objective met.

Research and Services Issues/Priorities

As indicated the industry had one of its worst years in over a decade. However, it remains strong and the research priorities identified over the last few years continue to reflect the industry's primary needs and best opportunities to remain sustainable and even expand. Although key words such as marketing or energy remain similar the priorities have been refined considerably and have evolved as market strategies and research have evolved.

List of Issues

1. Hiring a new pathologist or identifying an expert at the University of Guelph who could devote time to floriculture crops
2. Development and implementation of IPM programs
3. Optimisation of the greenhouse environment and efficient energy use
4. Integration of nutrient, water and disease management strategies from an environmental perspective
5. Post-harvest handling and production issues
6. Development of improved and new floricultural crops
7. Attention to the training of skilled labour force for the industry
8. Promoting, marketing of Canadian products domestically and for export

Issue #1: There is an immediate need for pathology expertise in greenhouse ornamentals

The Issue

The greenhouse ornamental industry is the largest horticultural sector by farm gate sales in Ontario and Canada with 2004 sales of \$734 million and almost \$1.5 billion respectively. As an industry of great economic importance provincially and nationally, it is important that governments and universities support it with appropriate research. From a pathology point of view in particular, there is an immediate concern. A major priority for the industry in recent years has been the responsible use of irrigation water through the use of recycling technologies. Recycling of nutrient solution increases problems of root diseases spread. The only pathologist retired in 2005.

Gaps/Barriers/Deficiencies

The University of Guelph has supported the industry with pathology research in recirculating systems; however, the recent retirement of a key researcher in that field has left the industry with limited pathology resources. Since 2003, AAFC has not support greenhouse ornamental research in this area. At that time the pathologist working in ornamentals research at Vineland was moved and the program on ornamentals terminated.

Disease management issues can become a barrier to even wider adoption of recirculating technology. The environmental benefits of these systems have in many instances been offset by production losses as a result of serious infections by pathogens such as *Pythium*, *Fusarium*, *Erwinia* and *Rhizoctonia*. If the industry is to fulfil its environmental obligations under new nutrient management legislation, it is important that associated disease issues be resolved.

Issue #2: Development and Implementation of IPM programs in Floriculture

The Issue

Pest and disease control is an ongoing concern and an immediate production issue. The year-round nature of the industry in an environment highly conducive to the development of pests and diseases, means that pest management is always a priority. Pests of ongoing concern to the industry include: 1) Thrips, 2) Whiteflies, 3) Leaf Miner, 4) Mites and 5) Mealy bugs.

Background:

Western flower thrips is the most important insect pest in greenhouse production areas around the world, not only for its direct feeding damage, but also for its role as a vector of several important viruses that have devastated ornamental crops around the world including Ontario. Other pests such as whitefly, leafminer, twospotted spider mite, fungus gnats, aphids, lygus and mealybug are chronic pests in many Ontario flower greenhouses. Apart from direct feeding damage, their presence alone is sufficient to devalue a crop and cause problems in shipping particularly at border crossings.

Diseases are similarly important. New irrigation technologies have been rapidly adopted by the industry over the last ten years. As a result, there have been increasing concerns over a number of pathogens including *Pythium*, *Phytophthora*, *Rhizoctonia*, *Fusarium* and *Erwinia*. Foliar diseases such Botrytis and powdery mildew are both aerial pathogens that can cause serious damage and losses in a number of different ornamental crops. Powdery mildew in particular is widespread and found on many different crops. In the last 5-10 years, there have been a number of crops in which powdery mildew has been diagnosed for the first time. A lack of effective fungicides has made growers' battles with this disease difficult. Downy mildew is another foliar disease becoming more prevalent. To compound the difficulties with this disease, there are no registered fungicides for its control. From a more crop-specific perspective, bacterial diseases of geranium are causing widespread losses to the industry, not only through direct damage, but also through quarantine action. There are no effective pesticides for control of many of the bacterial diseases are occurring.

The industry is currently increasing the use of biocontrol systems to control insects and diseases. Many growers are using biological control successfully and many others have tried it without success. A major reason for failure is the lack of biocontrol friendly pesticides, many of which are already registered in the US. Additionally, biological control agents for diseases are treated as pesticides by PMRA, and suffer from the same bottleneck in registration.

Current Research/Extension Activities

A research project on thrips management commenced at AAFC, Harrow in 2002 with industry start-up funding. This project is ongoing and making valuable progress into IPM strategies of thrips.

Extension activities in insect and disease management of ornamentals are primarily carried out through OMAF, Vineland staff. Activities include workshops, surveys, grower advice, newsletters and publications.

Research activity in plant pathology at Vineland has decreased, but there are now more projects at University of Guelph. Nevertheless, the retirement of our resident pathologist Dr. John Sutton jeopardises continuity of research on ornamentals after 2004.

Gaps/Barriers/Deficiencies

Continued support of research and extension activities that focus on the management of pests and diseases is required to maintain the competitiveness of the industry in the global marketplace. Specifically, work is needed on the control of thrips and fungus gnats to continue the work carried out at AAFC Vineland in recent years. Disease management research into the epidemiology and control of major pathogens is needed as a result of the increased use of new irrigation technologies. The work at Vineland and Guelph should be continued into these aspects of disease management (see **Recommendation #1 & #3**). New pesticides compatible with biocontrol are desperately needed if the use of natural enemies in floriculture is to reach its potential. The registration of microbial fungicides for biocontrol of diseases is also an important issue for the industry (see **Recommendation #2**).

Issue #3: Optimization of the Greenhouse Environment and Efficient Energy Use**The Issue**

This year more than in any other recently this issue was very high on the agenda of growers because fuel costs are rising. The issue is actually much more complex in that it relates to selecting the correct plants to grow and managing an optimal greenhouse environment for timely production schedules. While growers have computer monitored and controlled environmental management systems, the costs of energy in the form of heating for example are high and many factors specific to individual greenhouses exist. Every greenhouse and crop is unique in its environmental management. Disease and pest control depend on the crop being grown, the computer control system, the heating system configuration, the boiler type, and greenhouse design including, covering, ventilation and

irrigation systems. The efficient use of energy is critical and is likely to remain so in the foreseeable future as cost of fuel escalates.

Current Research/Extension Activities

There are now several research projects examining modification of production for more efficient use of energy. A number of years ago the CESRF (Guelph) began work on *novel* forms of inner canopy illumination. Although the lighting systems (microwave and fiber optics) used have not been practical technologies at commercial scale the principles of that research namely inner canopy irradiation have been tested in Europe for some vegetable crops. Currently research on mobile lighting systems is progressing at Guelph as are studies of diurnal regulation of supplementary lighting and heating. In addition there has been identification of low-temperature and low-light tolerance in some ornamental lines and breeding programs have recently received additional funding to continue improving energy efficiency by selecting crops with improved genetic and physiological traits to handle Canadian winter greenhouse conditions. Learning how to control greenhouse settings etc requires a clear choice of the cultivar and crop. Unfortunately in the ornamentals industry many crops are grown. As energy efficiency is a major issue with the greenhouse vegetable industry as well more joint research and extension activities should be planned. Currently, in the area of floriculture research, only one project has been submitted to OMAFRA under its new Sustainable Plants Program. This is a cross commodity approach to examining energy while conservatively managing nutrient and water recycling. These issues are all major priorities of this committee and the vegetable greenhouse growers.

Gaps/Barriers/Deficiencies

There are many deficiencies in the research on energy conservation. The development in greenhouse structures and infrastructures (computerized controls, heating, ventilation, lighting, etc.) is largely in the hands of the private sector. Currently, sensor technology in the greenhouse environment to optimize energy savings without affecting crop growth is ongoing but slow. Very little comprehensive testing of different greenhouse systems occurs and specific types of information such as how to achieve greater efficiencies through boiler and heating design are difficult to test except at the growers site. Development and validation of predictive models for disease and pest control based on greenhouse environmental parameters is lacking and staff to do this do not exist. Most of the research now occurs at Guelph which is only partially equipped in personnel and equipment to handle the many permutations that need to be tested for the variety of crops grown by the ornamental industry.

Issue #4: Integration of Nutrient, Water and Disease Management Strategies from an Environmental Perspective

The Issue

With increasing environmental concerns surrounding the off-site movement of nutrients in irrigation water, it is important that the industry continue to address this issue. There are options for individual growers to address these concerns and many growers in the industry have already taken proactive steps towards reducing or eliminating nutrient run-off.

One of the reasons the issue is still high on the industry's priorities is because of the already significant adoption of recirculating technology to reduce off-site movement of irrigation water. As a result, associated production issues have become apparent, and in some cases may be a barrier to even wider adoption. For example, new challenges in disease management have developed as a result of the use of closed systems. The environmental benefits of these systems have in many instances been offset by production losses as a result of serious infections by pathogens such as *Pythium*, *Fusarium*, *Erwinia* and *Rhizoctonia*. This is a problem from two directions: the alteration of the root zone environment (oversaturation of the medium, high temperatures in summer); and the spread of pathogens in the recirculating system).

Current Research/Extension Activities

To assist in developing possible future requirements for plans and strategies, OMAF in conjunction with the University of Guelph carried out a study to characterize run-off and leachate water from greenhouse operations. The aim of this study is to develop practical and effective nutrient management strategies. The project, started in the fall of 2002, was to be completed in the mid of 2005 and reports presented to the industry and researchers late in 2005. The study consists of monitoring and sampling water from tiles, collection ponds and soil solution, as well as soil sampling under greenhouses, however, the report is not yet available and its recommendations have not be addressed. These data and recommendations are needed to identify research project objectives.

Another issue that was raised during the 2002 NMA Regulations and Protocols consultations and discussions was the handling, storage and disposal of horticultural wash-waters. Wash-water is water that is used to cool, wash or store product or equipment after harvest or during production. Through OMAF Resource Management and Nutrient Management Branches, a project was funded to collect and characterize horticultural wash-water samples, which included samples from greenhouse operations. This study will help in developing practical and effective nutrient management strategies for the handling, storage and disposal of wash-water, but it too is not available for assessment.

Research into nutrient management in recirculating systems is currently being addressed at the University of Guelph. The Guelph work is focused on how to maintain nutrient solution quality (balanced nutrient elements and free of disease) for long term recirculation and methods of irrigation and fertilization.

Gaps/Barriers/Deficiencies

There are gaps in our knowledge of nutrient usage by greenhouse floriculture crops, a problem exacerbated by the number of different crops grown. Some of these knowledge gaps are currently being addressed by the current OMAF/University of Guelph research. There is also a major need for better information on the impact of nutrient recycling on disease management in greenhouse ornamental crops. Recirculating technology is being encouraged by different levels of government promoting reduced off-site movement of irrigation water, but it must be supported by complementary research into related issues. For example, the engineering design of some of these systems should be evaluated to understand their impact on disease severity. Rapid and accurate PCR diagnostic tools that can be used in-house and other specific biochemical markers are also useful for early detection of the presence and levels of pathogens.

Issue #5: Post Harvest Handling and Shelf-Life Issues with Potted and Cut Flower Crops

The Issue

Maintaining the shelf life of various flowering potted plants and bedding plants is important for both growers and for buyers from the large retail chains. Growers are concerned that they lose control of their product once it leaves the greenhouse. In the world of mass marketing, the delivery process from greenhouse to the individual store requires a minimum of three to four days. Plant quality becomes a major concern as more and more of the products are sold through chain stores and supermarkets where the flowers are in contact with ethylene producing fruits and vegetables. Ethylene, internally generated and/or from an external source, is causing serious post-harvest plant quality problems. Assessment of the levels of ethylene present throughout the marketing chain has determined that problems can arise anywhere throughout the distribution system and that some of these incidents can be quite severe. The Canada-US border is a major obstacle. There are an increasing number of reasons why plant product is being delayed at the border, and while the reasons are unimportant with regard to this issue, even short delays reduce the shelf-life of the shipped product. Shelf life can also be affected by production parameters. Studies into the impact of factors such as nutrition and pre-harvest quality are important in any post-harvest studies.

Current Research/Extension Activities

Research was carried at University of Guelph, Vineland on the use of ethylene inhibiting products for floricultural products.

Gaps/Barriers/Deficiencies

Two professors at the University of Guelph, Dr. D. Murr and Dr. G. Chu, retired in 2005. The University is currently looking for a senior researcher to take on post-harvest science. In addition, as the export market grows. However, there is clearly a gap before work on floriculture crops will continue in earnest. Reducing premature flower senescence, leaf yellowing and leaf epinasty is critical to the continued growth of flower sales through the mass-market outlets. A vast array of new crops is being introduced to the market place every year. These new plants need evaluation for ethylene sensitivity and best shipping temperatures before introduction to the market. Technology transfer activities are a key component. Research needs to continue on the relationship between pre-harvest and post harvest conditions. For example, the role of ethylene metabolism needs to be addressed in the context of its impact on greenhouse production and post-harvest responses.

Issue #6: Development of Improved and New Floricultural Crops and Production Techniques

The Issue

Ongoing improvements in the introduction, evaluation and development of new and existing crops remain critical to the competitiveness of the floriculture industry. Evaluation of new crops and new cultivars of existing crops for characteristics such as growth habit, flowering, pest and disease resistance, and post-harvest shelf-life under Ontario growing conditions is considered important to all growers within the industry. The potential for native North American plants already adapted to northern growing conditions needs to be studied. Production based research on plant nutrition, growing media and growth regulation on new and existing crops is also essential if the industry is to grow and maintain its position as one of the most important floricultural production areas in North America.

Current Research/Extension Activities

Ongoing research and extension projects are being carried out at the University of Guelph and in Vineland. Work at U of G includes investigations into low light tolerance, cultivar trials, effect of light quality on plant height and flowering, and growth regulation trials. New research at the University of Guelph is investigating the potential of native species for use as potted plants or cut flowers.

Gaps/Barriers/Deficiencies

Although research is currently being conducted to address this priority, ongoing studies are needed to improve the efficiency and quality of existing and new crops in the following areas:

1. Development of new cultivars with enhanced light harvesting and/or lower temperature tolerance that can reduce production costs during low light and cooler winter production periods.
2. Development of new cultivars that are adapted to northern climates and provide a unique competitive advantage for Ontario growers.
3. Development of a better understanding of the role of red and far red light in manipulating natural plant hormones including gibberellins and ethylene and determining how these findings can be applied in commercial greenhouses.
4. The ongoing need for applied, production-oriented research to establish best crop management practices including studies on media and nutrition, irrigation practices, growth regulation and cultivar evaluation under Ontario conditions.

Issue #7: Training of a skilled labour force for the industry

The Issue

The greenhouse floriculture industry is the third largest agricultural industry sector in the province. Even though there was a small decrease in 2004, it remains strong. There are many excellent career opportunities for skilled work force. Individuals with training in basic computer science who also have horticultural training, specifically in greenhouse crop production are rare. Employees currently working in the industry need the opportunity to upgrade their knowledge and skills.

Current Activities

The Ontario Greenhouse Alliance (TOGA) HR committee has been working with Flowers Canada (Ontario) Inc. and the Ontario Ministry of Training, Colleges and Universities (MTCU) to address this need for the industry. TOGA undertook a HR survey to identify needs. MTCU has committed to instituting an apprenticeship program for the greenhouse industry, but as yet efforts have not been finalised.

Gaps/Barriers/Deficiencies

There is a shortage of skilled labour trained in Canada in this industry. Educational programs designed for greenhouse production are needed to provide new graduates with the necessary skills for a career in greenhouse floriculture. Additionally, a campaign at schools is needed in order to inform young people of the opportunities that exist in the industry. For growers and employees already in this industry, more continuing education opportunities are required.

Issue #8: Promotion, Marketing and Advancing the Floriculture Industry in Ontario

The Issue

Although the greenhouse ornamentals industry experienced dramatic expansion in last 15 years largely due to export to the USA, this trend has stopped. Current pressures on export to the US include higher \$CD, quarantine issues, and

border delays due to increased security. There is an urgent need to expand domestic markets, so that the industry has a buffer to protect itself against fluctuations in the foreign market and pressures from imports.

Current Market Research/Extension Activities

Flower growers and handlers remain fiercely independent entrepreneurs and are beginning through the efforts of FCO and other groups such as TOGA to work collaboratively to promote the greenhouse industries. The industry is examining voluntary check off systems to enhance funding opportunities for researchers and consulting groups. There remains a need for trained economists to work with all sectors of the government, university and industry to develop business strategies. The trend in this industry and the need for self promotion and closer ties with all levels of government are currently priorities with FCO. New staff has been hired.

Gaps/Barriers/Deficiencies

One of the greatest strengths of the floriculture industry is that there are a wide range of growers and retailers of a wide variety of crops. Many growers remain independent and in spite of efforts to pull in the same direction the process has been slow. Something fairly simple that works among the vegetable greenhouse growers is a check off system to generate working capital to invest in market research and research in horticultural and greenhouse sciences. To date the floriculture industry has not adopted such a system of generating adequate working revenue. It seems unlikely that royalties from new inventions (cultivars lines) will come on stream fast enough to make the industry self-sufficient and confident. The industry needs to continue to work with both the province and Ottawa to develop marketing strategies for its diverse membership. The local industry within Ontario and Flowers Canada approached Foodland Ontario but a plan has not been implemented yet to promote the industry. The industry (FCO) has recently hired new staff and consultants, and is developing better economic information on its various sectors (i.e. bedding plants, potted plants and cut flowers). A thorough economic analysis of the industry by sector should provide the foundation upon which future domestic and export marketing and promotional strategies can be based by all.

Detailed Recommendations

Ontario Greenhouse Floriculture Research and Services Subcommittee

Recommendation #1.

Issue: There is an immediate need for pathology expertise at University of Guelph in greenhouse ornamentals

Background: The greenhouse ornamental industry is the largest horticultural sector by farm gate sales in Ontario and Canada with 2004 sales of \$734 million and around \$1.5 billion respectively. As an industry of great economic importance provincially and nationally, it is important that governments and universities support it with appropriate research. From a pathology point of view in particular, there is an immediate concern. A major priority for the industry in recent years has been the responsible use of irrigation water through the use of recycling technologies. Recycling nutrient solutions greatly increases the spread of root diseases.

Details: AAFC has supported greenhouse ornamental research for many years, in particular through its research in diseases in sub-irrigation systems between 1998 and 2003. However, in 2003 with the departure of the pathologist working in ornamentals research ended this program. The University of Guelph has always supported the industry with pathology research in recirculating systems; however, the recent retirement of Dr. John Sutton, an expert in this field has left the industry with no resident pathologist.

Disease management issues can become a barrier to even wider adoption of recirculating technology. The environmental benefits of these systems have in many instances been offset by production losses as a result of serious infections by pathogens such as *Pythium*, *Fusarium*, *Erwinia* and *Rhizoctonia*. If the industry is to fulfil its environmental obligations under new nutrient management legislation, it is important that associated disease issues be resolved.

Recommendation: It is recommended that the U. of Guelph identifies and commit to continuing with its research support in greenhouse pathology, and the industry consider partially funding a replacement for Dr. Sutton.

Target Agency: Flowers Canada, U. of Guelph.

Recommendation #2.

Issue: Registration of new pesticides for the industry through the minor use registration program

Background: In recent years, the greenhouse industry has increasingly relied on the Minor Use Registration process for access to new active ingredients. The initiative of the industry itself in hiring a Pesticide Registration Coordinator in the late 1990s, and the establishment of the Pest Management Centre at the federal level were major milestones in moving new products forward.

However, a major concern in recent years has been the reluctance of PMRA to accept registration of new products for greenhouse use, because of perceived deficiencies in occupational exposure data, specifically their request for dislodgeable foliar residue data. Since about 2000, submissions for 6-7 products have been rejected based on the need for this type of data. Most recently, a product selected as an A priority at the annual PMC meeting in Ottawa in 2005, was rejected for this reason.

Registrants have indicated that they are not interested in generating the data, because the projected sales would not make the cost worthwhile.

Details: With the federal government's increased investment into the Minor Use Registration Program, and the success of the priority setting exercises in Ottawa, there are promising signs of progress. The decision by PMC at the 2004 meeting to accept the argument of the floriculture industry, and agree to carry out occupational exposure data generation for two priority products, was much appreciated. At the 2005 priority setting meeting, the industry was advised that priorities would no longer be accepted for products requiring occupational exposure data, until the data generation costs for the previous year's priorities were determined.

Recent information suggests that PMC will no longer support this type of work because of the high costs.

Recommendation: It is recommended that:

- PMRA reconsider its position on occupational exposure data requirements for greenhouse pesticide registrations to bring it into line with requirements in the USA and other OECD countries
- PMC continues to generate dislodgeable foliar residue data for the greenhouse industry for priority products where this data is required by PMRA

Target Agency: PMRA; AAFC

OASCC Linkages: Ontario Pest Management Research and Services Committee

Recommendation #3

Issue: Optimization of the Greenhouse Environment for Conserving Energy and the Environment

Background: This year more than in any other recently this issue was very high on the agenda of growers because fuel costs are rising sharply. The issue is actually much more complex in that it relates to selecting the correct plants to grow and developing management strategies to optimise greenhouse environment for timely production schedules. While growers have computer monitored and controlled environmental management systems, the costs of energy in the form of heating for example are high and many factors specific to individual greenhouses exist. Every greenhouse and crop is unique in its environmental management. Disease and pest control depend on the crop being grown, the computer control system, the heating system configuration, the boiler type, and greenhouse design including, covering, ventilation and irrigation systems. The efficient use of energy is critical and is likely to remain so in the foreseeable future as cost of fuel escalates.

Details: There are many deficiencies in the research on energy conservation. The development in greenhouse structures and infrastructures (computerized controls, heating, ventilation, lighting, etc.) is largely in the hands of the private sector. Currently, research development of sensor technology in the greenhouse environment to optimize energy savings without affecting crop growth is ongoing but slow. Very little comprehensive testing of different greenhouse systems occurs and specific types of information such as how to achieve greater efficiencies through boiler and heating design are difficult to test except at the growers site. Development and validation of predictive

models for disease and pest control based on greenhouse environmental parameters is lacking and research funding and staff to do this do not exist. Most of the research now occurs at Guelph which is only partially equipped in personnel and equipment to handle the many permutations that need to be tested for the variety of crops grown by the ornamental industry.

Recommendation: As energy efficiency remains a major issue with the greenhouse vegetable industry as well more joint research and extension activities should be planned. **Currently, only one project has been submitted from all researchers on ornamentals to OMAFRA under its new Sustainable Plants Program for operating funds.** This is a complex cross commodity approach to examining energy efficiency while conservatively managing nutrient and water recycling. These issues are all major priorities of this sub-committee.

Target Agencies: OMAFRA, University of Guelph, ARIO and AFFC.

Recommendation #4

Issue: The need for educational programs both at the college level, and as a component of continuing education.

Background: The greenhouse floriculture industry has been expanding since the 90's at a rate averaging about 10% per year. In the last year, expansion over all stopped, because marketing to the US particularly has been curtailed by many cross border issues and the strength of the \$CD. Nevertheless, the size of the industry and the need of the expansion to the domestic markets mean that there are many excellent career opportunities for people with a range of skills. There is a particular need for employees with horticultural training, specifically in greenhouse crop production. Additionally, there is a need to provide employees currently working in the industry, with educational opportunities to upgrade their knowledge and skills.

Details: The industry has a shortage of skilled labour to meet its needs. It is not uncommon to find growers and consultants being hired from Europe to meet the needs of greenhouse operations in Ontario. Educational programs designed for greenhouse production are needed to provide new graduates with the necessary skills for a career in greenhouse floriculture. Additionally, a promotional campaign aimed at schools to increase awareness of the industry, is needed in order inform more young people of the opportunities that exist in the industry and to foster their interest. For growers and employees already in then industry, there is a need to provide further education opportunities in various aspects of crop production.

Workshops and night courses put on by OMAFRA and the University of Guelph are very well received. The Ontario Greenhouse Alliance (TOGA) HR committee need to work more vigorously with Flowers Canada (Ontario) Inc. and the Ontario Ministry of Training, Colleges and Universities (MTCU) to address the need for this industry and the greenhouse vegetable industry.

Recommendation: The committee supports the initiative of TOGA and Flowers Canada (Ontario) in establishing its education program and recommends it continue to work with educational institutions in achieving its objectives. It is also important that these industries address the need for continuing education as part of their mandate.

Target Agencies: Flowers Canada (Ontario), TOGA and University of Guelph

Recommendation #5

Issue: The need for the industry to continue to promote itself within the domestic market and continue to improve better lines of communication within the industry and various levels of government emphasizing its value to the Ontario economy

Background: There is a need for better communication that will allow information to be disseminated, exchanged and debated at short notice. Within the industry, selected governmental agencies and University researchers. With the increased expansion and sophistication of computers, it is felt that there is an excellent opportunity to address this need. Flowers Canada has already taken significant steps to address communication issue through upgrading of its web site, and improving it links with key provincial and federal agencies. The system still needs more refinement. The industry needs a communication package that would allow it to access effectively and in a timely fashion with:

- Other industry associations (e.g. in the US)

- Its members
- Government

There have been a number of issues that the industry must take a lead on. Where more rapid communication technologies would allow the industry to better serve the needs of its members. Examples of how this technology would be useful include:

- Updates by industry to growers on quarantine issues at the border or other current concerns
- Production and pest management issues where timely alerts or dissemination of information by extension specialists to growers would be valuable
- Communication between growers in discussing production concerns

Details: The industry should determine exactly what its communications needs are and how they can best be met. At that point, there needs to be an evaluation of current communication technologies that are already in use, to determine how they can be best used to continue to serve the industry's needs, now and into the future.

Recommendation: It is recommended that:

Flowers Canada (Ontario) conduct a comprehensive review of its communication needs to determine if they can be met by existing systems and experts, or whether they need to develop a new communication package and network tailored to the specific needs of the ornamental industry of Ontario.

Target Agencies: Flowers Canada (Ontario), Flowers Canada Growers.

GREENHOUSE AND PROTECTED CROPS

EXECUTIVE SUMMARY

The value of Ontario greenhouse vegetable and mushroom crops for 2004 is estimated at 610 million dollars.

The total greenhouse vegetable acreage in 2005 was about 592 ha, approximately the same area as in the previous year. A slight decrease in tomato acreage was balanced by a corresponding increase in pepper acreage. The cucumber acreage remained approximately the same. Generally, production and fruit quality was acceptable despite problems induced by growing conditions. High energy costs and lower than average commodity prices were a concern this year as well. Other concerns for the industry included the strength of the Canadian dollar, labour, diseases, and lack of sufficient registrations of IPM-compatible products.

Total Ontario mushroom production in 2005 of approximately 53.2 million kg was estimated at \$161 million. Brown mushrooms (portabella and cremini) occupied up to 15% of the Canadian market share. Fresh mushroom exports to USA may be 15%. There appears to be an increase in the incidence of dry bubble disease. The aggressive green mould occasionally shows up on some farms but it is rapidly brought under control. Insects remain minor pests. Environment, energy costs, over production, threats of organized labor and food safety issues are major concerns. Research and service issues principally focus on food safety, environment, mushroom quality, energy and pest management.

INTRODUCTION

This is the Annual Report of the Greenhouse and Protected Crops Sub-Committee within the Ontario Horticultural Crops Research and Services Committee.

COMMITTEE ACTIVITIES

The Greenhouse and Protected Crops Sub-Committee of the OHCRSC (without the Working Group on Mushrooms) met on October 19, 2005, (9:30 a.m. - 2:50 p.m.) at Wilson Hall, Ridgetown College, Ridgetown for their Annual Meeting.

Present: G. Ferguson (OMAFRA) (Chairperson), Shalin Khosla (OMAF) (Vice-Chairperson), Sharon Jochim (OMAFRA) (acting Secretary)

Government & Research: Hugh, Berges, Ray Cerkaskas, Xiuming Hao, Barry Micallef, Tom Papadopoulos, Les Shipp.

Grower Representatives: Kristen Callow, James Cornies, Ernie Delcancio, Steve Enns, Tom Ferencevic, Peter Haakman, Craig Hunter, Margaret Ingratta, Tom Magri, Gerry Mastronardi, Tony Mastronardi, Dean Tiessen, Ron Voorberg.

Industry Representatives: Ann Marie Cooper, Richard Groen, Chris Stickles, Bill Straver, Bernie Watts.

The Working Group for Mushrooms do not meet with the Greenhouse and Protected Crops Sub-committee. Although some interests may be common, the commodities and research interests are substantially different, necessitating a working group(s) for mushrooms. This year the working groups for mushrooms did not meet formally but responded to a questionnaire. The sections of this report on the mushroom industry were prepared by Dr. Dan Rinker (Chair of the Working Group).

Questionnaire responders:

Grower representatives: Tim Adlington, Glenn Martin, Lorenzo Piccioni, Clay Taylor, Lyle Whitham, Bill Wylie

University Representative: Ron Pitblado

SIGNIFICANT RESEARCH/SERVICE ACCOMPLISHMENTS

A. GREENHOUSE VEGETABLES

- Demonstrated a novel application methodology for microbial biocontrol agents using bumble bees to vector the entomopathogenic fungus, *Beauveria bassiana*, for pest control in greenhouse tomatoes and sweet pepper.
- Determined that the physiological basis for extended photoperiod damage in tomato is nitrite toxicity.
- Demonstrated that micropore filtration studies excludes bacteria and fungi in tomato and cucumber crops. Commercial trials (large scale) were also successful and these units are now commercially available to Ontario growers.
- Obtained emergency registration of Floramite for spider mites on greenhouse cucumber
- Obtained emergency registration of Pristine for powdery mildew on greenhouse cucumber
- Obtained registration of Endeavor for management of aphids on greenhouse tomato and peppers
- Obtained registration of Milstop for management of powdery mildew on greenhouse cucumber
- Completed revision and printing of Pub. 371 – OMAFRA's "Growing Greenhouse Vegetables" production guide

B. MUSHROOMS

- Obtained emergency (re-issued) label for Senator 70WP Fungicide for control of *Trichoderma* green mould until February 28, 2006. This was again a national effort with British Columbia taking the lead role.
- Demonstrated activity of Gnatrol DG is limited to young sciarid larvae, requiring application when young larvae are anticipated.
- Demonstrated that protein/carbohydrate supplements used to increase mushroom production are sufficient alone to support a *Trichoderma* green mould infection
- Confirmed that casing *Trichoderma* appears 'manageable' with Senator 70 WP, Mertect or Benlate 50 WP and not with Bravo the only registered product for the casing in Canada.
- Cultivated mushrooms to provide subject matter for filming mushroom growth which was used in the recent release of the Foodland Ontario mushroom commercial
- Identified disease samples, providing a significant asset to the industry in the management of mushroom diseases

REPORT OF ACTIONS TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS

RECOMMENDATION #1

It is recommended that the status quo for the regulation of invertebrate biological control agents be maintained.

ACTION TAKEN: Recommendation was forwarded by Hugh Berges, Chair, Ontario Pest Management Research & Services Committee (OPMRSC) to PMRA.

RESPONSE: Although the PMRA legally has the authority to regulate IBCAs such as beneficial arthropods and nematodes, the Agency does not require their registration at this time. We are working co-operatively with CFIA and AAFC to monitor the importation and use of these products. We are also monitoring international developments in regulation (e.g. via OECD) to ensure any proposals are in Canada's best interests. The PMRA recognizes that any change proposed in the future regarding the way to which IBCAs are regulated will require extensive multi-stakeholder consultation.

RECOMMENDATION #2: It is recommended that there be increased collaboration among researchers nationally in particular, and internationally if possible, to improve communication and coordination of research efforts

ACTION TAKEN: Recommendations forwarded to Gary Whitfield, Science Director, Environmental Health, National Program, AAFC, and Gary Ablett, Chair, Plant Agriculture, University of Guelph

RECOMMENDATION #3: It is recommended that appropriate CFIA personnel be invited to the next annual Protected Crops Sub-committee meeting to address the issue of invasive species in greenhouse vegetables.

ACTION TAKEN: Invitation extended to Charles Briscoe, Horticulture Specialist, CFIA, to attend Protected Crops Subcommittee meeting in 2005

RESPONSE: Although the invitation was accepted, Mr. Briscoe was unable to attend the meeting.

RECOMMENDATION #4: It is recommended that research be carried out on development of new arthropod biological control agents and on potentially useful new microbial biological control agents.

ACTION TAKEN: Recommendations forwarded to Gary Whitfield, Science Director, Environmental Health, National Program, AAFC, and Gary Ablett, Chair, Plant Agriculture, University of Guelph

STATE OF THE INDUSTRY

A. GREENHOUSE VEGETABLES

Crop Update

General Comments

The lower than average sunlight in January 2005 was followed by 4 weeks of above average light in February. Between weeks 8 and 26 there were periods of lower light followed by periods of high light (20% higher in one week followed by 20% lower the following week). Subsequently light levels remained at or above average for most of the remainder of the year. The growing conditions early in the year caused some problems in plant development and poor fruit setting. Later in the season, the high light and temperatures resulted in blossom-end-rot (BER) problems in both tomatoes and peppers. Although there was no oversupply of produce, early season prices were low especially in cucumbers. Energy continues to be a big issue as a large number of growers' contracts are up for renewal and current prices for natural gas is 50% higher than last year. More growers are considering alternative fuels.

Cucumber

In 2005, the slow start to the season resulted in a slightly lower early production. This followed by the fluctuating light conditions and the hotter summer resulted in average to lower than average production year. Mini cucumbers continue to be popular with the area in production having increased to 34 acres (14 ha). The normal 3-crop system has worked well but some growers are using a 4-crop system in order to maintain market share with high quality cucumbers. Overall, average production was 110-130 cucumbers/m² with some of the better growers achieving 150 cucumbers/m². The cultivars Bodega, Camaro, Kasja, Pyralis, Frida, Gardon, Logica, and Dominica were commonly grown. Cultivar selection continues to be of concern as there still is not a clear-cut winner and growers continue to try new numbered cultivars provided by the seed companies.

Pepper

The early pepper growers (planted late Nov/early Dec) established plants under low light conditions and set fruit when the light levels were better. Unfortunately, some cultivars did not perform well as the transplants were of poor quality (blind heads, flat stem, odd shaped leaves). After the initial problem, these plants performed well. The light and temperatures conditions in 2005 resulted in an increase in BER in many greenhouse pepper operations. This also resulted in smaller-sized thin-walled fruit, which was marketed at a lower price. The commonly grown red cultivars in 2005 were 4-ever and Zambonie. A new numbered red line showed promise and will be grown on a larger scale in 2006. The cultivar 4-ever will lose some production area. The yellow cultivar, Striker, continues to remain popular and maintains its production (some Gretzky was planted in 2005). The orange coloured cultivar, Sympathie, continues to remain popular. The pepper production will be at or slightly above average. The shift to coir (coco-peat) growing media continued in 2005 as most of the larger ranges opted for this growing media.

Tomato

The start of the 2005 season did not hold any surprises resulting in balanced plants and good early production. The high light and temperature conditions did result in fruit quality issues (BER, soft fruit, poor setting, poor colour and shelf life). This was prevalent for both the beefsteak and cluster types of tomatoes. The common cultivars grown in 2005 were Macarena, Dundee and Bigdena with some Rapsodie still planted. The cultivar, Heritage, was planted in some large operations and performed well as it was firm, uniform in shape and size although a bit smaller and slightly later in production. Macarena and Big Dina will be the key cultivars in 2006 with several numbered lines on trial.

The cluster (tomato on the vine) production was good despite the weather conditions. The main cultivar planted was Clarence with some operations planting Frisby. The Frisby cultivar is a bit smaller than Clarence but has a nicer fishbone appearance and is slightly easier to set uniformly. The practice of grafting and increasing stem density in cluster tomatoes continues to show positive results with some growers looking at earlier stem density increase as well as increasing the stem density. The cultivars Tricia and Tresco were interplanted in the fall. However, Tresco produced soft first three sets which were unmarketable. A new cultivar, Grandella, performed well and will be planted on a larger scale in 2006. The niche market for specialty tomatoes (small, high sugar content, unique shape) continues to develop, but, there was evidence that certain markets reached saturation as the price returned to the grower was lower than in the past..

B. MUSHROOMS

Commercial mushrooms

Canadian mushroom production in 2004 was approximated 93.3 million kg at an estimated farm gate value of \$283.2 million. (According to the Canadian Mushroom Growers' Association, the statistics remain suspect.) Ontario continues to lead the nation in mushroom production with 53.2 million kg produced with a farm gate value of \$161.6 million. Browns (portabella and cremini) production continues to occupy up to 15% of the market share. Overall mushroom sales to the USA are estimated to be up to 15%.

The expansion of the industry in 2003 through the construction of stand-alone compost to fully-mycelia-colonized compost operations continued to realize problems in 2004 in the quality of the compost and the resultant production by the substrate recipients. The shift by several corporations to two breaks per crop and the adoption of other technologies now can realize up to 13 cycles of compost per growing room per year, a change from 4 crops 20 years ago. These changes in the industry have the potential to dramatically increase the annual production with one of the concerns noted by the committee as 'over production'.

The incidence and severity of insects and diseases, as always, varied with the farm. However, there appears to be an increase in the incidence of dry bubble disease, likely related to material choices. The aggressive green mould occasionally shows up on some farms but it is rapidly brought under control. Insects remain minor pests

Specialty mushrooms

The specialty mushroom industry is comprised of generally small growers, producing oyster and shiitake mushrooms. No formal production statistics are published in Canada. An educated guess would place the combined annual production of oyster and shiitake mushrooms in Ontario between 1 and 2 million pounds at a sales value of between \$4 and 8 million. Farmgate price has remained stable for several years. The production of portabella mushrooms has had negative impact on the growth of the specialty mushrooms.

Competitor moulds (e.g. green moulds, bacterial blotch, *Penicillium* spp) continue to be problematic in both oyster and shiitake operations. Flies for some farms are problematic.

Greenhouse Vegetable and Protected Crop value (Millions of \$), and production volume (Millions of Kg, or dozen), since 1992

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Greenhouse Vegetables													
Tomatoes (\$ M)	24	33	39	42	55	79	126	145	177	217	232	226	244
kg (000,000)		18	23	31	38	49	80	106	131	148	153	149	161
Cucumbers (\$ M)	23	32	334	41	46	62	77.8	91.9	97.5	113	118	114	120
doz. (000,000)		4.4	4.7	5.3	6	8.3	9.8	11.9	12.8	14.4	14.6	14.2	14.8
Lettuce (\$ M)	1	1	1	1	1	1	1	1	1	1	1	1	1
Sweet Peppers (\$ M)	4	4	4	5	11	12	27	27.6	32.7	52.3	80.5	72.3	83.3
kg (000,000)		1.5	1.3	1.4	3	4.4	6.7	7.4	9.7	14.9	21.7	18.1	21
SUB-TOTAL (\$ M)	52	70	78	89	113	154	232	266	308	383	432		448.3
[Greenhouse Vegetables]												413	
Mushrooms (\$ M)	77	85	98	109	104	111	117	110	141	143	154	165	162
kg (000,000)	29	32	33	35	34	36	38	33	44	43	46	49	53.2
TOTAL (\$ M)	129	155	176	198	217	265	349	376	449	526	586	578	610.3

EMERGING ISSUES

A. GREENHOUSE VEGETABLES

1. Energy: High energy costs are having an increasingly negative impact on the profitability of the industry.
2. Competition from countries in tropical/semi-tropical climates
3. Urbanization of agriculture and associated issues
4. Enhancement and implementation of food safety assurance programs
5. New invasive species of pests and diseases
6. Non-tariff trade barriers
7. Decreasing profitability of older, smaller facilities
8. The higher dollar exchange rate
9. Focus by news media on food safety
10. Environmental impact of alternative fuels

B. MUSHROOMS

Commercial mushrooms

1. Environmental issues: Compost odours, waste water
2. Food safety
3. Over production
4. Energy costs
5. Impact of farm workers to organize
6. Rising strength of Canadian dollar

Other issues in the 'background' that remain as concerns include the nutrient management legislation, US border crossing requirement, and mushroom worker shortages.

Specialty Mushrooms

1. Lack of quality at retail level
2. Energy costs

FERTILIZER RECOMMENDATIONS

A new edition of Publication 371 was printed in 2005 and no new recommendations were required for this meeting.

RESEARCH PRIORITIES OF SUB-COMMITTEES

A. GREENHOUSE VEGETABLES

1. Develop production technologies for more efficient energy use. Such technologies could include environmental controls, gutters, greenhouse design, new products such as polyfilm, new varieties for our conditions, alternate crops, automation, closed greenhouses, alternative fuels, sources (wind, biomass, etc.), conservation (thermal screen in poly), boiler efficiency (bunker efficiency, etc.), software improvements, greenhouse waste (affordable biodegradable twine/clips, alternative techniques/products)
2. Maintain research on pest management issues including integrated control techniques for managing current, new, and emerging pests and diseases of economic concern, biocompatible products for registration, and production systems for pest and disease control, interaction of field production practices and greenhouse pest & disease incidence.
3. Develop production technologies to enhance productivity and contribute to economic viability. Research areas include the following:
 - Alternative products (crops, fruit types)
 - Breeding (new cultivars/varieties that grow under our conditions)
 - Physiology (i.e. what temps can optimize production)
 - Fruit Quality (taste, keeping quality/shelf life, packaging/modified containers)
 - Health benefits
 - Tiered cropping (growing above/below in greenhouse, maximizing light, different crops at one time)
 - Growing media (relationships among microbes)
 - Recirculation solutions (nutrients, emitters clogging)
4. Address environmental impact issues such as re-circulation, waste, Nutrient Management Act, organic production, alternate and renewable fuels.
5. Develop innovative technologies for more efficient use of labour and automation.
6. Investigate areas within the Food Safety Program that require research.

B. MUSHROOMS

Committee members were provided with the 2004 list and additional research areas for 2005. They were then asked to prioritize them as very important, moderately important, slightly important or unimportant to their own operation.

Commercial mushrooms - The farm perspective varied among respondents. No single research item was unanimously determined to be the most important. Only those items noted as moderate to very important are listed below.

1. Improve mushroom quality or enhance its value through on-farm treatment
2. Address food safety issues
3. Maintain research on pest management issues by developing (especially biological materials), evaluating control products and providing necessary data to PMRA for registration of products for management of mushroom diseases, especially green mould and dry bubble

4. Address compost odour management and its treatment
5. Determine criteria for 'best' casing soil
6. Determine the effect of water quality on mushrooms
7. Determine the influence of straw cultivars, poultry litter bedding, feed additives, ammonia suppressants, and pesticide residues on composting, mushroom production and human health
8. Prepare literature review on the nutritional benefits of mushrooms
9. Determine energy efficient and effective post-crop kill temperatures and procedures
10. Investigate alternative uses for spent mushroom substrate

Specialty mushrooms

1. Develop "best practices" procedures for packaging and storage of specialty mushrooms to improve shelf life and quality at the retail level.
2. Train retail produce managers in display and shelf-life
3. Develop marketing strategies and retail presentation to improve profitability to mushroom growers
4. Develop controls for blotch and trichoderma diseases, including biological control

SERVICE PRIORITIES

Commercial mushrooms

1. Identification of insects, diseases and weed moulds
2. The use of internet as means for providing technology transfer from own research and published work of others
3. Workshops

Specialty mushrooms

1. Identification of insects, diseases and weed moulds
2. Telephone consultations
3. Be an information centre on advances in specialty mushroom production
4. Deliver Trichoderma control information on Shiitake mushrooms
5. The use of internet as means for providing technology transfer from own research and published work of others

RECOMMENDATIONS FOR 2005

RECOMMENDATION #1:

BACKGROUND:

Within recent years, there have been several incidences of new invasive pests (tomato pinworm (*Keiferia lycopersicella*), potato psyllids (*Paratrioza cockerelli*), tomato bug (*Engytatus modestus*) and diseases (Tomato powdery mildew (*Oidium neolyopersici*), Fusarium crown and stem rot in cucumber (*Fusarium oxysporum* f.sp. *radicus-cucumerinum*), Pepper powdery mildew (*Leveillula taurica*), and Pepino Mosaic Virus in the greenhouse vegetable industry. It is believed that increased movement of personnel and produce across borders without adequate monitoring has contributed to this recent surge in new pest species. As such, consultation with the federal authorities is considered as a necessary first step towards addressing this problem.

RECOMMENDATION:

It is recommended that appropriate CFIA personnel be invited to the next annual Protected Crops Sub-committee meeting to address the issue of new invasive species in greenhouse vegetables.

RECOMMENDATION #2

BACKGROUND:

Greenhouse vegetable producers face almost constant pressure from pests and diseases because of year-round production. Such intensive production is necessary to facilitate maximum productivity and economic viability. Integrated pest management techniques that incorporate use of biological controls are favoured by greenhouse vegetable growers because it facilitates pollination by bees in tomato crops, generally improves crop vigour and quality of product, and provides a better work environment. Despite the availability of biological control agents (biocontrols) for many of the major pests encountered in greenhouse crops, not all pests have corresponding biocontrols, nor is biological control always sufficiently suppressive. Invasion of greenhouses by outdoor pest

populations often result in surges in pest populations, particularly during the warmer months when vents have to be wide open for cooling purposes. Other causes of excessive pest populations may be attributed to poor establishment of biocontrols due to climatic conditions, sub-optimal quality of product, poor timing of releases etc. For various reasons therefore, pest populations sometimes need to be quickly reduced to prevent excessive pest levels. To facilitate rapid reduction in pest populations and management of diseases, and at the same time, conserve natural enemy populations, chemistries that are compatible with beneficial arthropods are required. Currently, very few chemistries of low toxicity to beneficial arthropods are registered in greenhouse vegetable crops. By contrast, greenhouse vegetable producers in other competing jurisdictions, such as in The Netherlands, have available many more such products. Greenhouse producers in Ontario are facing ever-increasing costs, particularly energy and labour costs, and need to have access to at least the same pest management tools that are available in other competing areas of the world. Access to less chemistries, particularly the newer, IPM-compatible chemistries by Canadian greenhouse vegetable producers, places them at an economic disadvantage. For our producers to remain viable and globally competitive, there is need for more timely registration of pest control products.

RECOMMENDATION:

We appreciate the steps that the Pest Management Regulatory Agency has taken to improve their responses to Minor Use registration requests. We ask that they continue this improvement, and in particular, provide incentives that would bring more new active ingredients into Canada for registration.

RECOMMENDATIONS #3

BACKGROUND:

The farm gate value of the greenhouse vegetable industry in Ontario is about 550,000 million dollars, and Ontario has approximately 60% of Canada's total area of greenhouse vegetables. In recent years, reduced market prices combined with increased costs, particularly energy costs, have made maximum productivity extremely critical to the survival of our growers. Maximum productivity, in turn, is consistent with preventing or minimizing losses including those caused by root rotting diseases and bacterial diseases such as Bacterial Canker in tomatoes. An example of the losses that can be inflicted by a root rot disease is that of *Pythium* root rot which can reduce production in all crops by at least 20%. Further research is required, not only of this particular disease, but also of other unexplained wilt-causing diseases that plague greenhouse vegetable growers annually. Added to this is the constant threat of new invasive diseases. Indeed, within recent times, new diseases have occurred in Ontario greenhouse vegetables and these include Pepino mosaic virus, Fusarium stem and root rot in cucumber, and powdery mildew in peppers and tomato. Yield losses attributed to these diseases have been as high as 40% in some instances. Other diseases that currently exist in other greenhouse vegetable-growing regions also pose a threat to our industry due to the global nature of travel and trade.

Until recently, research resources for greenhouse vegetable diseases at the Greenhouse and Processing Crops Research Centre consisted of two pathologists who together devoted a total of approximately 1.5 person years annually to this area of work. As of April, 2006, resources will be down to only 0.87. Given the value of Ontario's greenhouse vegetable industry, the potential significant economic impact of diseases, the fine margin that currently exists between viability and collapse, it is important that the resources devoted to management of greenhouse vegetable diseases be not diminished.

RECOMMENDATION: Given that 60% of Canada's greenhouse vegetable industry is in Ontario, and given that 90% of Ontario's greenhouse vegetable industry is situated in Essex County where the Greenhouse and Processing Crops Research Centre is also situated, it is highly recommended that resources in greenhouse vegetable pathology at this Centre be at least increased to its former level of 1.5 person years to assist the industry in addressing disease issues.

RECOMMENDATIONS #4

BACKGROUND:

Greenhouse vegetable production in Ontario, with a farm gate value of about \$0.5 billion, and over half of the produce exported, is a major sector in the agricultural industry in Canada. The climate in Ontario is continental in nature, characterized by cold winters and hot summers, which is quite different from the climate in other major greenhouse production areas in the world, such as Western Europe (maritime climatic type characterized by mild winters and summers). Therefore, greenhouse vegetable production in Ontario requires quite different techniques from Western Europe, such as different greenhouse structures, different climate control strategies, and different crop

production systems and pest management programs. The dominant greenhouse structure in Ontario is of double-inflated, gutter-vented polyethylene instead of glass, for facilitating heat energy savings in winter, and effective cooling in summer. The consumer requirements for produce in North America are also quite different from those of Europe. Techniques suitable for our climatic conditions and developed by Agriculture and Agri-Food Canada research programs in the past have made significant contributions to the growth of our greenhouse industry. With increasing competition in the marketplace and higher production costs such as energy prices, our growers are facing increasing challenges to maintain economic viability. The demand for research to develop techniques suitable for our climatic conditions continues to increase significantly. Clearly, it is critical that research required to improve our growers' productivity needs to be strengthened to assist our growers in remaining competitive in the global marketplace.

RECOMMENDATION:

It is recommended that the greenhouse research program at Agriculture and Agri-Food Canada be strengthened to assist growers in addressing climate and production issues.

APPENDIX I

Ontario Horticultural Crops Research and Services Committee
Greenhouse & Protected Crops
Research and Services Sub-committee

TERMS OF REFERENCE -

To prepare research and service summaries and to recommend research and service priorities in Ontario for greenhouse and protected crops.

To disclose problems that face greenhouse and protected crops which require investigation.

To co-ordinate research and services planning and cooperation.

To assess and suggest priorities for new programs and recommend which programs presently underway should be expanded or terminated.

To estimate, where possible, costs involved in the conduct of new research and services programs and to supply cost-benefit information.

To suggest, where possible, how funds might be obtained or freed to conduct new research and development.

To present written reports and recommendations to the Horticultural Crops Research and Services and Pest Management Committees.

To invite additional research and development personnel to information meetings where progress within crops can be presented.

To assist in the preparation of recommendations for grower use.

To contact federal, provincial, university, and industry managers for representatives to serve on the committee.

LOW ACREAGE

Executive Summary

The Low Acreage and Special Crops Research Sub-Committee identifies issues, prioritizes research and service requirements, and makes recommendations with respect to 14 or more crops. Twenty eight individuals (growers 8, input suppliers 3, processors 3, researchers 5, and extension 9) actively participated in the Nov. 16, 2005 meeting.

The 2005 growing season was unusually hot and dry, which was a mixed blessing. For many crops, the heat reduced the time to harvest and increased yields, but sometimes at the expense of quality (e.g. asparagus). Water management was a big challenge, since growers had to deal with both shortages and excesses of moisture throughout the season. The number of buyers and retailers of fresh and processed produce continues to diminish causing rationalization and consolidation in the industry.

The viability and expansion of those crops identified as Low Acreage and Special is somewhat limited by a number of issues including: 1) a general reduction in research funding for production agriculture; 2) marketing challenges; 3) escalating energy costs; 4) an influx of new growers into limited markets; 5) a need for enhanced GMO research; and 6) IPM restrictions that make it difficult to compete on the global market.

The Low Acreage and Special Crops Research Sub-Committee identified several research and service priorities indicating attention be directed to 1) pest management; 2) nutrient management; 3) water management; 4) development and evaluation of horticultural crop production systems; 5) food safety, and 6) the promotion of frozen/processed Ontario produce.

Recommendations being forwarded for this sub-committee 1) re-focus research and service efforts into the area of production oriented agriculture 2) increase funding, and relax the requirements for obtaining funding for production oriented agricultural research, 3) introduce programs to educate the public on the nutritional qualities of frozen and/or processed Ontario produce.

It is important that these research and service priorities and recommendations to the OHCR&S Committee to be acted upon to ensure future agri-business viability within Ontario's rural communities during a time of increased production pressure and global competition.

Industry/Sector Scan

2005 Crop Updates and Research and Service Accomplishments

Sweet Potatoes: An estimated 600 acres of sweet potatoes were grown by 18 producers, which represents a 50% increase over 2004. The unusually warm growing season resulted in above average yields, with some growers claiming 16000 lbs per acre. Some growers harvested an increased abundance of jumbos; likely due to the combination of a hot summer and timely rainfalls. Several growers reported weed pressure was high, but that grub and wireworm damage to the crop was minor. Post-harvest storage problems, ranging from mould to chilling injury, have occurred on several farms. A privately sponsored tissue cultured plant propagation experiment, which began in 2004, is continuing. M. Columbus, OMAFRA organized a well attended sweet potato field day. There is a lot of interest in the Canadian Sweet Potato Alliance, which is proposing to utilize some of the 100,000 acres of suitable land made available by the reduction in the tobacco crop, for the production of sweet potatoes for both the fresh market and for the production of ethanol. Some growers who are already supplying the fresh market are concerned that the CSPA will negatively impact their current business. AAFC will do some testing for starches and sugar; do address the question of how sweet potatoes will compare to corn as a feedstock for ethanol production.

Asparagus: Approximately acres of mineral soils are planted into asparagus. Growers reported an average yield for the 2005 crop, but the extreme heat of the summer reduced quality by 10 to 20%. This quality reduction, together with a general decline in price of between 10-20%, had a negative impact on the profitability of this crop. Furthermore, the entrance of new growers caused some problems as they were unfamiliar with growing and marketing of asparagus. Another common concern was the apparent lack of loyalty of the major food chains towards buying Ontario grown asparagus. In response to industry demands for registration of

a product for control of purple spot, OMAFRA sponsored the emergency registration of Bravo (chlorothalonil) to control purple spot. Another fungicide, Quadris (azoxystrobin), has been registered to control purple spot, but would need to be rotated with Bravo to avoid the development of resistance. Rust also continues to be a concern. Several higher yielding hybrids with better grade out and lower incidence of rust have been identified, and are currently in test trials. Results of research on the use of mini-tunnels to permit earlier cutting, frost protection, improved yield and spear quality will not be continued because of the difficulties the use of these tunnels imparts to mowing, spraying and harvesting operations. (D. Wolyn & P. Banks, University of Guelph, Guelph/Simcoe)

NB: Asparagus Research and Services Sub-Committee meeting minutes appended.

Pickling Cucumbers: Of the 10,000 acres contracted by four packer/ processors, less than half of the crop was machine harvested. The 2005 crop yield was excellent, although angular leaf spot was observed in some of the later planted cucumber fields. A replacement for Guthion is needed for control of cucumber beetles, and cucumber mosaic virus (CMV), is becoming more of a problem. Some occurrences of downy mildew were also seen. D. Robinson, U. of Guelph, Ridgetown, continues to conduct weed management studies. J. O'Sullivan, R. Grohs and R. Riddle, U. of Guelph, Simcoe continue to conduct trials with respect to multi-pick, once over machine harvest, herbicide and efficacy evaluations. The high heat experienced over the growing season had an overall negative impact on these trials.

Melons: Several hundred acres of muskmelon and watermelon were grown primarily trickle irrigated on black plastic mulch with and without plastic hoop tunnels or sometimes row covers. Watermelon acreage increased significantly (100 acres) mainly in the Norfolk area. In general, the watermelon harvest was excellent, with the occurrence of hollow heart being 10-20% less than in 2004. Most of the watermelon crop was grown with drip irrigation. In order to develop fertigation recommendations, E. Roddy, OMAFRA is conducting a fertigation trial with AAFC to compare the efficacy of a fertigation based on a normal irrigation schedule vs. a schedule based on plant tissue analysis. It was noted for several crops that heat stress was a problem which was sometimes misdiagnosed as a disease problem.

Pumpkins: It is estimated that the 2005 acreage was equal to that planted in 2004. A bumper crop of pumpkins was reported for the 2005 season. Powdery mildew was kept under control, but there were some occurrences of Sclerotinia and soft rot with growers who failed to spray when required. Spider mites were also reported to be a problem, and the dry summer made irrigation a big issue. Both D. Robinson, U. of Guelph, Ridgetown and J. O'Sullivan, U. of Guelph, Simcoe conducted weed management and herbicide evaluation trials for pumpkins.

Squash: The acreage of squash planted remained stable. Processors reported a bumper crop and a 5 fold increase in demand for squash. Disease pressure was not great, with both weed and insect control programs working well. There is interest in increasing the acreage of machine harvested squash, something not typically done for the fresh market. CMV was reported as becoming more of a problem, and some growers were running into post-harvest storage problems. Some of the later planted squash fields were not harvested. D. Robinson, U. of Guelph, Ridgetown, conducted a trial to examine the tolerance of squash to pre-emergence applications of various herbicides. J. O'Sullivan, U. of Guelph, Simcoe conducted a trial to evaluate herbicides for weed control in squash.

Peppers: The yield of this year's pepper crop was above average. The crop matured approximately 1 week early and growers found irrigation made a huge difference in yield. The heat did cause an increase in flower abortion. Problems were seen with Fusarium stem rot, bacterial spec and spot, aphids, weeds (nightshade, lamb's-quarters), and viruses (possibly CMV), but tarnished plant bug wasn't an issue. There were challenges with fertigation brought on by the sporadic, heavy rainfalls that occurred over the course of the season. Powdery mildew was a problem in Essex and Kent counties, with the infection likely being picked up in the greenhouse. D. Robinson, U. of Guelph, Ridgetown, conducted a trial examining weed control and tolerance of transplanted pepper to pre-emergence applications of various herbicides. J. O'Sullivan, R. Grohs, and R. Riddle, U. of Guelph, Simcoe conducted three cultivar trials evaluating hot banana, sweet banana, hot cherry and Jalapeno peppers. Pre-emergence herbicide evaluations were also conducted at U. of Guelph, Simcoe.

Sugarbeets: Growers and processors report average yields (~25 tons/ac) and quality (~16 % sugar) harvested from approximately 10,000 acres. The harvest season was excellent with respect to the weather. There were some problems with viruses and aphids, but weed management was the biggest challenge.

Globe Artichokes: Globe artichokes were grown in the Holland Marsh, and at Sparta and Turkey Point. The yield was poor this year due to the high temperatures experienced during the growing season. Globe artichokes prefer a cooler weather.

Eggplant: The eggplant crop was of excellent quality this year, but Verticillium wilt remains a problem.

Culinary Herbs: It remains difficult to estimate the acreage for each of the many culinary herbs. Generally growers report that the heavy rainfalls experience during the season resulted in significant problems, particularly with respect to disease pressure. One grower found that disease pressure significantly impacted the quality of his product (bunch radish, parsley), but the diagnostic lab in Guelph was unable to identify any specific disease organisms. In one instance, Downey mildew was misdiagnosed as leafhopper damage on some sage samples. Another grower had a very high quality rosemary crop. Leaf hoppers represented the main source of insect pressure. Pest pressures remain difficult to manage since the culinary market prefers to source pesticide free product. Jan Schooley, OMAFRA and A. McKeown and C. Bakker, U. of Guelph, Simcoe, continued with the lavender trial started in 2003, evaluating cultivars for winter hardiness, plant morphology and flower aroma. With respect to on-farm food safety, Jan Schooley, OMAFRA provided a draft GAP manual for growers to look at and indicated that a final GAP manual will be available in the spring of 2006 to growers who attend a training session. Four pilot projects were conducted in 2005 to address GAP for on farm food safety for herbs, spices and natural health products.

Emerging Issues

- 1) **Funding:** There is a strong concern about the lack of emphasis on basic production oriented research by the provincial government. The difficulty of obtaining grants without having matching funds was identified as a significant challenge. The high overhead charged on grants, and the field costs charged by the University of Guelph leave little money for conducting research. Growers recognize that Ontario has many good researchers, and they want to support Ontario research, but in many cases they feel they can get more “bang for their buck” if they take their funding out of the province to places like Michigan State University.
- 2) **Marketing:** The lack of loyalty exhibited towards the growers by the main domestic retailers is becoming more of a problem as marketers tend to be more concerned with consistent supply rather than where any particular commodity is grown. The possibility of doing an economic study to show the benefits of buying Canadian produce and how buying foreign produce negatively affects our economy was raised. Local growers want the government to address the subsidy issue (both foreign and provincial), because they are being forced to compete on a playing field that is not level. They would like to see the Ontario government support farming to the levels given their competitors (e.g. Quebec and the U.S.). The high Canadian dollar has also hurt the export market for Low Acreage and Specialty Crops. There remain barriers to exporting Low Acreage and Special Crops including zero tolerance pesticide residues, quarantinable pests, USA homeland security policy and bio-terrorism issues. The shortage of options for registered pesticides puts Ontario producers at a trade disadvantage
- 3) **Energy Costs:** Rising energy costs are a major problem for the majority of producers. The increasing cost of fuel (natural gas, oil, propane, diesel) and electricity is significantly impacting cost of production, since most production practices, including field operations, irrigation, fertilizer inputs and post harvest conditioning, are dependant on energy unit inputs. Producers need assistance in reducing energy costs. Growers did recognize that in some cases there was an “up-side” to rising energy costs, in that the high cost of shipping was forcing retailers to look locally for produce.
- 4) **Influx of New Growers:** There is a general concern that growers exiting the tobacco industry will turn to other crops currently grown by existing operations. This will have a negative impact on the price of these commodities, something already seen in the asparagus pumpkin and sweet potato markets. It was voiced that it is the government’s responsibility to identify new opportunities and solutions for these transitioning growers. The development of an Agri-Food Innovation Centre in Simcoe was viewed as a positive and necessary step in helping growers meet new transition challenges. It was felt that the policy makers need to ensure that those policies they put forward are sustainable and actually bring some tangible benefit to the Low Acreage and Specialty Crops sector.

- 5) **Genetically Modified Organisms:** There exists a need to move research forward in establishment of GMO varieties. Consumers must be educated with respect to acceptance of such food products. If Ontario fails to move forward, growers may be unable to compete effectively in the market place thus loss of market and economic development opportunities.
- 6) **Pesticide/Herbicide Issues:** In the course of discussion, the several concerns were raised by the attendees. The lack of registered chemicals is hindering the ability of growers to compete against foreign producers who have access to cheaper control methods. It was brought up that next year, most seed from the U.S. will be treated with a chemical not registered for use in Canada. Since most Low Acreage and Special Crops growers buy their seed from the States, this could develop into a major supply issue in the near future.

Research & Services Priorities

1) **Pest Management Systems:**

Issue:

There exists a shortage of registered pesticides (for aphids in particular), a lack of qualified IPM consultants, scouts and a declining interest in cultivar research. Viruses (e.g. CMV), are becoming an increasingly significant problem. Variety research and demonstration trials are vital for Ontario producers to stay competitive in the marketplace and for continued economic viability of the agri-business community.

Current Research/Extension Activities: John O'Sullivan and Darren Robinson, University of Guelph are conducting herbicide screening trials for Low Acreage and Special Crops. University of Guelph researchers (John O'Sullivan, Al McKeown,) are performing cultivar trials for some of the Low Acreage and Special Crops.

Gaps/Barriers: Replacements for traditional pesticides are either slow in getting approval from the PMRA, unavailable to the Canadian market, too expensive or no research is being completed to find replacements. Unlike the EPA, efficacy data must be submitted to the PMRA in Canada. Furthermore, agricultural chemical companies do not have a keen interest in small markets.

2) **Nutrient Management Information:**

Issue:

Growers are concerned about the shortage of reliable and current information on which to base fertility recommendations for specific crops. In many instances, the fertilizer rates being used are above current OMAFRA recommended rates, but growers are hesitant to reduce fertilize amounts for fear it could affect yield and quality. The Nutrient Management Act (NMA), which does not currently require horticultural commodities to have nutrient management plan was also touched on. Similar to last year, the points of concern are:

- A shortage of human resources dedicated to implementation of nutrient management planning for Low Acreage and Special Crops
- A shortage of personnel dedicated to nutrient management research, especially in the area of Low Acreage and Special Crops
- Extra expense for the grower. Will the Ontario grower be able to compete against imported products from abroad where nutrient management is not an issue.

Current Research/Extension Activities: Little if any current research is being conducted in Ontario with respect to nutrient management recommendations for specific Low Acreage and Special Crops. The lack of research is likely due to the difficulties in obtaining funding for projects addressing the needs of Low Acreage and Special Crops.

Gaps/Barriers: Agronomic research with respect to all aspects of nutrient management planning criteria for all Low Acreage and Special Crops requires completion. The criteria for soil nutrient deficiencies, pH, different soils, nutrient removal rates, nutrient values for waste, cull piles and wash water, for respective yields of those crops considered Low Acreage and Special must be developed as soon as possible at a reasonable cost to the agri-business community.

3) **Water Management:**

Issue:

The 2005 growing season was hot and dry, and served to heighten awareness of the importance of efficient water usage. There is concern that watering restrictions could become enforced if dry conditions persist. Such enforcement would impact growers of Low Acreage and Special Crops since most require irrigation during a normal growing season. There is a need to educate growers transitioning to new crops on the use of unfamiliar irrigation systems and proper water/fertigation management.

Current Research/Extension Activities: Rebecca Shortt, OMAFRA's Irrigation Specialist is available for consultation. Elaine Roddy and AAFC staff (Ridgetown College), are looking at whether fertigation should follow the normal irrigation schedule, or whether it is better to base the fertigation schedule on the results of plant tissue analysis.

Gaps/Barriers: Gaps still remain for identifying critical irrigation times for crops. It is important that research continues on the scheduling of trickle irrigation and fertigation practices. Many of the Low Acreage and Special Crops are grown on fragile sandy soils, The AAFC Research Biologist position at Delhi not being reinstated significantly impacts progress in water management on drought prone soils.

4) **Development and Evaluation of Horticultural Crop Production Systems:**

Issue:

In recent times both Agriculture and Agri-Food Canada and the University of Guelph crop research programs have shifted to a more diversified approach encompassing food and health, environment, bio-products, etc. The competition for limited research dollars amongst researchers is of concern to farmers, food processors and the general agri-business community. Of particular concern is the need for research on energy efficient production methods (e.g. reduced/conservation tillage), on post-harvest storage issues, and on cultivation practices for herbs used in the essential oil, nutraceutical and bio-actives industries.

Current Research and Extension Activities: Traditionally both AAFC and University of Guelph researchers conducted applied agronomic research i.e. variety trials, plant spacing, date of planting, fertilization, northern vigour, cold tolerance, etc.

Gaps/Barriers: Crop researchers indicate that in order to acquire research dollars they must partner with outside interest, however work within the mandate of their program directive. It is often the interest of a researcher to publish scientific papers therefore agronomic research may not get the attention it has had in the past. It remains important to identify resources, develop and evaluate production systems for Low Acreage and Special Crops.

5) **Food Safety:**

Issue:

Public liability with respect to food safety continues to be an issue for those involved in the production, distribution and retail distribution of Low Acreage and Special Crops. The market continues to express concern over chemical residues, wash water quality, irrigation water quality, processing equipment cleanliness and worker hygiene. The trade continues to indicate the need for HACCP certification or equivalent from field to fork. Growers are concerned over the added cost of record keeping, liability insurance and the ability to compete in the market place with imported product from countries that are not subject to quality food safety standards.

Current Research/Extension Activities: Federal and Provincial governments continue to address the food safety issues. Federally such a mandate is addressed through the CFIA, PMRA, Health Canada and Agri-Food Canada. Provincially an On-Farm Food Safety Program Lead position (Sandra Jones, OMAFRA, Guelph) and a Fresh Market Quality Program Lead position within Crop Technology, OMAFRA (Jennifer DeEll, OMAFRA, Simcoe), have been set in place. The Good Agricultural Practices manual for the Canadian Herb, Spice and Natural Products Industry is being drafted (Jan Schooley, OMAFRA, Simcoe), and will be available to growers in the spring of 2006.

Gaps/Barriers: The Low Acreage and Special Crops fresh market and processing sectors could benefit from increased human resources and financial assistance towards implementation of food safety programs. Although some industry players have taken a pro-active approach to the implementation of HACCP, others have not.

6) Promotion of Processed/Frozen Produce:

Issue:

There is a need to promote the value of processed/frozen produce to the general public. Consumer education is necessary to increase the acceptability of processed or frozen vegetables in the marketplace. Although the Foodland program is widely recognized as being beneficial to the industry, it only addresses the fresh market aspect of fruits and vegetables.

Current Research/Extension Activities: The Provincial government is working on a branding Ontario food program, which will include produce grown in Ontario, whether it is sold fresh or frozen/processed.

Gaps/Barriers: The Low Acreage and Special Crops processing sectors could benefit from increased education of the consumer on the healthy aspects of frozen and/or processed fruits and vegetables that were grown in Ontario.

Recommendations

Recommendation 1

The Low Acreage and Special Crops Sub-Committee requests that Federal and Provincial Government sponsored research (U. of Guelph) re-focus efforts into the area of production oriented agriculture which best services the needs of growers, processors and the general agri-business community. In particular, there is a need for field production and cultivation research on growing herbs for the developing essential oil and nutraceutical industries. The development and evaluation of Horticultural Crop Production Systems is vital to the economic well being of Ontario's Agri-Food Sector. (Directed to AAFC, OMAF, U. of Guelph)

Recommendations 2

The Low Acreage and Special Crops Sub-Committee recommends that OMAFRA provide more money for basic field production research. Furthermore, the requirements for matching funds/in-kind contributions should be relaxed to help foster research on smaller projects designed to help the Low Acreage and Special Crops growers.

Recommendations 3

The Low Acreage and Special Crops Committee recommends that the Federal and Provincial Governments provide market development resources to promote minor crops, and educational resources to communicate the benefits of purchasing locally grown crops that fall under the Low Acreage and Special Crops umbrella. These benefits range from the nutritional quality to the positive economic spin-offs of buying Ontario produce. Market development opportunities such as using the Royal Winter Fair as a venue to showcase some of these minor crops should be addressed by both levels of government.

Asparagus Research and Services Working Group Minutes -18 October 2005

D. Wolyn convened the meeting at 10:10 a.m. in room 1118, the Tiessen room, of the Bovey building at the University of Guelph.

Present: R. Baker, A. Boecker, P. Banks, D. Hoffman, J. Jaques, B. Lammens, E. Roddy, J. Wilson, D. Wolyn

1. Minutes of the previous meeting: The minutes of the previous meeting were approved with no changes.

2. Business arising/correspondence: There was no business arising from the minutes.

3. Research Reports

3a. Plastic Mini-Tunnels – P. Banks

Plastic mini-tunnels were set up at four locations, but the results have only been analyzed for one location. The harvest with tunnels was two weeks earlier and 33% greater than that from bare soil,. The percent marketable yield was low because guard rows were used from the Third International Asparagus Cultivar Trial. Many of the entries have lower percent marketable yield because they were bred for white asparagus.

The Benefits of Plastic Mini-Tunnels for Asparagus Production
Simcoe Research Station 2005

Treatment	Myld (kg/ha)	Eyld (kg/ha)	Pmyld (%)	Sprwt (g)
Tunnel	3642	2728	66	20
Bare soil	2748	2014	67	22

J. Wilson commented that the tunnels did what growers wanted them to do: produce an earlier crop and protect against frost. Harvest was, however, much more complicated and he was more interested in high tunnels. B. Lammens thought that asparagus prices would have to be very good to justify the higher production costs. J. Jaques did not think that the tunnels would be practical. Mowing and spraying would have to be finished very early if the tunnels were to be up by 1 April. The spears he harvested were pale and curved. Spears also ferned out rapidly with the arrival of hot weather at the end of May. Plastic tunnels also made it impossible to spray for beetles. The preliminary results would not justify further research effort.

3b. D. Wolyn, P. Banks - University of Guelph

The Cambridge research station closed in 2002, the year the first trials were planted at Simcoe. The first 6-week harvest at Simcoe was in 2005. Hybrids were identified in the A02 and A03 trials with higher yield, better grade-out and lower rust than the check variety Guelph Millennium. Several of the new hybrids were produced with females identified from old Viking fields. Seed of the best hybrids identified last year was produced in cages. This seed will be distributed in 2006 for strip trials in growers' fields and in 2007 for multi-location trials. The first 6-week harvest of these new hybrids will be in 2010.

The Third International Asparagus Cultivar Trial was planted at the Simcoe Research station. Both Millennium and Giant were surpassed by new hybrids. Two were from California, but these varieties usually do not persist well in colder climates. The Rutgers breeding program has some new hybrids that show promise.

D. Hoffman commented that the Board expected a considerable increase in seed sales now that the British company Hargreaves would be selling Guelph hybrids outside of North America. Seed production was low last year, and the Board could not meet demand. J. Wilson wondered how long it would take to double seed production. D. Wolyn thought it would take four years to establish a new seed bed, and estimated the cost of new plants at \$4/crown. P. Banks said that it would be best if this was decided in November in order to find and train part-time help to multiply crowns in time for spring planting. J. Jaques wondered if the University would be spending part of its royalty earnings to defray the cost of a new seedbed. D. Wolyn answered that royalties were earmarked for research, not for expanding seed sales.

R. Baker asked how much seed would need to be produced for new plantings in Ontario. D. Hoffman thought that increasing spear production was likely to dampen seed sales in Ontario. New plantings were coming into production, and Ontario asparagus production was already 25% above consumption

4. Elaine Roddy, OMAFRA

The Ministry had sponsored the emergency registration of Bravo (chlorothalonil) to control purple spot. Another fungicide, Quadris (azoxystrobin), has been registered to control purple spot, but would need to be rotated with Bravo to avoid the development of resistance. Emergency registration for Bravo will need to be requested again next year.

An IPM training session was organized in May for growers and distributors, a date that was too late for many because harvest had already started. B. Lammens suggested that the training sessions should be advertised more widely, not just in OMAFRA newsletters. A date in March would be more convenient, and the meeting could be

expanded to an asparagus information day that might interest new growers. There were two calls a week to the OMAFRA office on planting asparagus, and at least as many enquiries on spray rates of pesticides.

Publication 363, the OMAFRA Vegetable Production Guide, would be updated this year. Suggestions should be submitted by the middle of November because the Guide would be printed in December for 2006

OMAF has been analyzing wash water from asparagus packers because of concerns about water quality. Preliminary results would suggest that the wash water could be spread on fields and would not need to be collected and treated as industrial waste.

5. J. Wilson - Ontario Asparagus Growers' Marketing Board

Asparagus production was increasing in Ontario, but the Board was not sure by how much. Quality delivered to the brokers was high. There were, however, concerns that the retailers were not handling asparagus properly to maintain quality in stores. Growers were generally happy with the yield of Millennium and Giant, but were concerned about increasing fuel and labour costs. Ontario Health and Safety Legislation now applies to farm workers, and this was expected to increase costs by 10%.

Marketing was becoming more complicated, and the Board saw the need to collaborate with producers who would have been considered competitors in the past. The best marketing opportunity was thought to be at the end of the season. Prices rose rapidly as growers stopped cutting, and there was interest in having a long harvest one year, a short harvest the next, in order to take advantage of the high prices. The Board saw this as an opportunity for production research in collaboration with a plant physiologist like Dan Drost.

Growers have long debated if selling #2 asparagus depresses the price of #1 spears. It would help if #2 spears, as well as overproduction of #1 spears, could be removed from the market. The spears could be sold for the extraction of nutraceuticals. There are two compounds of interest, and the Board intends pursue this. B. Lammens added that the provincial government would be launching an initiative to tie fruit and vegetable consumption to human health and welfare. The Ontario Fruit and Vegetable Growers' Association intended to participate in this program because it would not be a narrow, commodity-based approach.

Growers have seen their net returns drop by \$2-3/case over the past two years. When this is combined with decreasing prices, the financial prospects are discouraging. The Board has approached the Department of Agricultural Economics at the University of Guelph to see if there were opportunities that they hadn't identified for asparagus. A. Boecker thought to start with a study of market channels because offshore asparagus is marketed very differently from local product. There should also be a study of consumers' perceptions to determine what they value in asparagus and what they would be willing to pay more for. A study of the current costs of production would also be useful given the recent changes in costs.

J. Jaques commented that there was no reliable information for prices during the cutting season. Although Agriculture Canada posted daily high and low prices from the Ontario Food terminal, growers did not consider these prices to be reliable. Several years ago, growers had considered selling vegetables at auction, the same way flowers are marketed, but this was never done.

D. Wolyn added that there was a lot of interest in packaging at the International Asparagus Symposium. Improved packing would permit fresh asparagus, not just processed asparagus, to be shipped by sea rather than air freight from areas of low-cost production. This would have a profound impact on the market.

B. Lammens pointed out that marketing was complicated by the carryover of US imports into the Ontario harvest season. Retailers stocked US asparagus because they could never be certain when local production would start. Imported asparagus would need to be cleared before local produce would be stocked.

D. Hoffman wondered what the role of the Board was in marketing. It had never acted as a broker in the past. Retailers were, however, interested in dealing with suppliers who could offer asparagus year round, not just during our short season. Acting as a broker might be necessary to assure market access for Ontario asparagus.

6. Minor-Use Registrations – P. Banks

Insecticides

Agriculture and Agri-Food Canada (AAFC) sponsored trials in 2004 to support the registration of cyhalothrin-lambda (Warrior, Matador) to control asparagus beetles and asparagus aphids. The results have been submitted to PMRA. Although spinosad (Success) was accepted for testing in 2003, nothing appears to have been done. Pirimicarb (Pirimor), the aphicide currently registered, is a carbamate and is no longer registered in the United States. Pymetrozine (Fulfill) has been proposed as a replacement, a proposal that is supported by Washington state where aphids are considered to be the most serious insect pest of asparagus. Tolerances have been established by the EPA.

Fungicides

AAFC is sponsoring tebuconazole (Folicur) to control rust, and residue trials were conducted in 2005. Syngenta has submitted Chlorothalonil (Bravo) to PMRA for a label expansion to control both rust and purple spot. Azoxystrobin (Quadris) has been registered to control purple spot.

Boscalid (Lance) was included last year to control purple spot. Fungicides with different modes of action are needed to rotate with Quadris because strobilurins have only one site of action. Diseases have developed resistance very rapidly to this class of fungicides. Boscalid was removed because of doubts that the product was effective.

Herbicides

New herbicides that have been registered in the United States for weed control in asparagus like sulfentrazone (Spartan) and norflurazon (Solicam) have no registrations on any vegetable crop in Canada. Thus, full registration must be requested (URMUR) rather than a label expansion (URMULE). There has been no progress which is why the list of herbicides is so long. Many of the herbicides listed have been ranked as an A priority for asparagus. J. Wilson thought that Spartan was proving to be very useful in Michigan.

7. Research Priorities

The Ontario asparagus industry is facing increased threats from foreign competition. Peru has the capacity to ship product into North America 12 months of the year, and is likely to increase fresh asparagus exports due to emerging competition in the processing industry from China. Washington and Michigan, which harvest during the Ontario season, are increasing fresh product shipments due to closings of canning plants. Despite these threats, opportunities also exist for the Ontario industry, because of proximity, to significantly grow and expand its exports to the 80 million consumers of the Eastern Seaboard in the US, whom currently buy asparagus from distant suppliers during our harvest season.

For the industry to be competitive internationally and expand, it must: 1) be productive by reducing costs per unit product; 2) provide value-added to consumers; and 3) develop marketing strategies to penetrate the Eastern US. To do this the following research should be considered.

Long-term Research

Develop new asparagus hybrids with improved rust resistance and yields compared to Guelph Millennium. High-yielding, high quality, disease resistant cultivars are the cornerstone to a successful asparagus industry. Improved cultivars improve profitability and result in a sustainable industry.

Short-term Research

- Conduct research to understand the physiological relationship between senescence and winter-hardiness. Die-out is a significant problem in some cultivars and may be related to slow senescence in the fall; plants may not be dormant before a killing frost. Understanding the physiological basis of this relationship may lead to breeding strategies to improve the trait.
- Establish proof of principle for application of plant growth-promoting rhizo-bacteria (PGRB) to enhance establishment, growth and vigor of seedling nurseries and transplanted crowns. PGRB can increase vigor and plant biomass especially under stress. Use of these organisms with asparagus could improve the establishment of seedlings and transplanted crowns, and result in increased yields over the lifetime of the plantation.
- Test new methods to control Fusarium in asparagus. The perennial nature of asparagus creates challenges for the control of soil-borne diseases because fungicides or compounds to control the disease can not be incorporated after plantation establishment. Consequently, disease control can be difficult where soil is not

disturbed around a plant living for a decade or more. New delivery methods, i.e. trickle, should be tested for effectiveness.

- Assess the value of alternative harvesting practices (e.g. long/short long, or short/long/short) for growers to optimize profits when prices are highest. Because prices can double after the traditional close of the harvest season, an extended harvest season, which stresses the plant, followed by a shortened season to regenerate the root system, could lead to increased returns. Thus, experiments are necessary to determine the extent to which plants can be stressed by long harvests and recover in subsequent shortened harvest seasons.
- Explore the exploitation of human health benefits for asparagus based on natural antioxidants (e.g. rutin). Several opportunities exist to increase the value of asparagus by branding the fresh product for health benefits or using #2 product as a source to extract nutraceuticals. To brand the fresh product, seasonal and cultivar variation for antioxidants (rutin) should first be assessed in Ontario; currently data are only available from Japan where the Guelph Millennium cultivar had the highest levels of rutin in an international trial. The potential for extraction of nutraceutical compounds and product development should also be explored with the appropriate partners.
- Conduct market analysis for North American asparagus to determine means to promote sales in major centers of the northeastern US. More than 80 million Americans on the eastern seaboard of the US consume asparagus produced from sources more distant than Ontario during our harvest season. Proximity can allow us to deliver reasonably priced, and higher quality product than that from distant sources. An analysis is necessary to determine how to penetrate this market.
- Conduct competitive analysis for Ontario growers in the US market to assess profitability. As part of a strategy to penetrate the US market, one must determine factors necessary to be competitive relative to foreign growers supplying product during our harvest season.
- Develop economic feasibility model of alternative harvest regimes described above to determine viability of the system. Based on historical pricing data of product during and after the Ontario season, and in conjunction with yield studies determining the biological impact of extended/shortened harvest seasons, models should be developed to determine feasibility and optimization of harvest regimes.

The meeting adjourned at 12.45 p.m.

Secretary: P. Banks

NURSERY, LANDSCAPE AND TURF

Subcommittee Executive Summary

Nursery/Landscape & Turfgrass

The 2005 growing season was characterized by less than average precipitation in spring and early summer (in many areas) with warmer than average temperatures (many areas had at least 40 days where the temperature exceeded 30°C). There was a significant amount of winter damage this year, much of which was not noticeable until plants suddenly died in the heat of the summer. The cool, wet growing season of 2004 followed by a warm, dry autumn resulted in plants that were not well acclimated before winter suddenly arrived in late autumn. Uncharacteristically large growth rings were often evident on killed deciduous trees, whose trunks virtually popped open over the winter months. The spring was cool and dry, which resulted in an extended leaf emergence period but a low level of disease (in most areas) and delayed insect development. The cool, dry spring allowed for an extended period of spring digging and sales of nursery stock.

The winter of 2005 had a significant impact on turf, starting with torrential rains and a thaw around New Year's Eve followed by a quick deep freeze. We lost snow cover again in mid-February and that too was followed by torrential rain. The second freeze thaw left a very thick sheet of ice over everything. This persisted well into the beginning of March or later. There were many courses in the Toronto area that had the worst winter injury in many years. Snow mould was moderate. Snow mould is usually worse under deep snow where the temperature on the greens hovers around freezing. The lack of a good insulating cover of snow could have resulted in sub-optimum temperatures for the development of snow mould.

Warm, dry conditions continued into summer resulting in an excellent year for growth of nursery crops and landscape plants (with a reduction in most plant diseases, even tar spot). Leaf blights were reduced to powdery mildew and the odd foliar blight. The hot, dry conditions took their toll on landscape specimens, especially where soil was covered by concrete or sites were exposed to the elements. It is expected that dieback and mortality of large, established trees will be evident in the next couple of years. The dry spring had many repercussions for turf. The spring flush of growth that helps the turf recover from winter injury and snow mould injury, etc. did not materialize. Weeds took over in many of the thinned turf areas. The dry spring had a big impact on sod growers who were faced with irrigating turf much earlier than usual. Once July hit, there were some torrential scattered rains throughout the province accompanied by a long period of hot, humid weather. As a result, the summer turf diseases such as anthracnose, brown patch, summer patch and *Pythium* blight were the worst that we have seen in many years. The weather conditions, coupled with intensive management lead to a lot of turf loss on greens, tees and fairways. Many areas lost their roots in the middle of the summer. That combined with the summer patch lead to a lot of turf loss. The weather also caused an explosion of crabgrass in the middle of the summer. During the summer of 2005 a new disease was found in Ontario, bentgrass dead spot (*Ophiosphaerella agrostis*).

In spite of the cold winter weather, overwintering insects survived well. Moderate to high levels of aphids and mites were reported in some areas, with an explosion of two-spotted spider mites in late summer. Thanks to the minor use program, a few new uses were registered for miticides in 2005, but other uses are still needed (e.g. spruce spider mite on ornamental evergreens). Populations of Japanese beetle adults were reported to be higher than average in Niagara and Hamilton, with more than average foliar feeding damage. Thankfully, Intercept received full registration for this pest in nursery stock this year. Borers and scale insects present some of the greatest challenges to pest management in the nursery and landscape. Of special note was the unusual incidence of Gypsy moth populations in Toronto and its surrounding areas. Professional arborists are reporting 400-800 egg masses per tree this autumn, and have noted a significant level of dieback and mortality on oak species that were infested (not to discount the role of hot, dry conditions). Public distress regarding the implications of such spring larval pressure is building.

As far as insects go for turf in 2005, it was a fairly normal year. There were routine calls about annual bluegrass weevil, black turfgrass atenius and cutworms. There were more calls than normal about turfgrass ants. European chafers levels were normal and European crane fly and leatherjackets were down significantly from last year. It was fortunate that leatherjackets were not much of a problem because currently there is no insecticide registered for use for home lawns in Ontario to control leatherjackets. This leaves homeowners and lawn care companies without any

pesticide control product to use on this pest. Efficacy trials for reduced risk products and alternatives to pesticides for turfgrass management continue to be assessed at the University of Guelph, Guelph Turfgrass Institute.

Industry statistics point to continued growth in the nursery, landscape and turf sectors. The continued decline of the US dollar relative to the Canadian dollar and border issues were reflected in a continued strain on the export market for ornamental nursery stock. Land use for nursery stock production increased slightly in the year 2004, farm gate sales were also up by 7%. Increased fuel prices have snowballed into increased costs for most nursery supplies (e.g. plastic pots, greenhouse plastics). Growers would like to raise prices for nursery stock but they fear it would not be accepted. The amount of land devoted to the production of sod dropped only slightly in 2004 and prices stayed static. There is continued growth in the golf course construction sector. These are mainly high end golf courses in Muskoka, Georgian Bay and Niagara Falls areas. The new Health Promotion Ministry could increase interest in outdoor sports which could lead to a demand for more sports fields.

The hot, dry summer created problems with water quality and quantity available for irrigation for most growers this year. More and more growers have had to deal with water shortages and poor water quality during high summer, sometimes resorting to the high cost option of trucking in water for irrigation of containers (e.g. Strathroy). As water quality and availability is becoming the limiting factor for horticulture, nursery growers are incorporating more low volume irrigation technology into their production systems (e.g. underground drip tape in high-value field budding blocks). The industry has concerns over the implications of the Source Water Protection Act and hopes to work with government on solutions for taking water in horticulture.

Water and nutrient management continues to be on the radar screen for most growers. Although they are relieved that the provincial government is focusing on large livestock operations right now, growers are still very concerned about implications of the regulations in the future. OMAFRA specialists and nursery growers have been working closely to characterize leachate and runoff from container production nurseries and help develop BMP's that will improve irrigation/nutrient use efficiency and minimize off-site movement of runoff. Growers would like to see more research regarding nutrient and irrigation efficiency that minimize leaching from container production. There is also room for improvement of irrigation delivery systems for container crops (e.g. ebb and flow systems that are applicable for outdoor production). The nursery research team at the University of Guelph is addressing some of these research needs (e.g. water and nutrient requirements of selected nursery container crops, recycling systems and utilization of waste products for propagation media). Some of this research is slated for CORD funding.

Pesticide use on turf continued to be an issue in Ontario in 2005, with more pesticide by-laws adopted. To date in Ontario there are eight municipalities with some restrictions of pesticide use on home lawns. These are Cobalt, Perth, North Bay, Parry Sound, Thorold, Caledon, Waterloo Region and Toronto. As of Sept. 2005, lawn care operators in the city were issued fines for applying pesticides (\$255.00). Enforcement for homeowner applied pesticides will not begin until September 1, 2007. The City of Toronto adopted the OMAFRA thresholds for insect infestations on home lawns. The Ontario Allied Golf Associations have been working closely with the City of Toronto to come up with a system that works for golf courses. The Region of Waterloo is the most recent municipality to vote to ban pesticides. They have banned applications during the months of July and August unless there is an infestation. Insect infestations can be treated only if verified by a lawn care professional. In addition, in November of this year, CropLife was refused their request for leave to appeal the City of Toronto's Pesticide by-law.

The IPM/PHC Council of Canada voluntary turf IPM accreditation program has been in place for four years for lawn care and three years for golf courses. Approximately 200 lawn care companies and 160 golf courses are enrolled in the program. IPM accreditation for landscape and nurseries will be much more challenging due to the huge range of crop species grown and their related array of pests. Because of this diversity, much needed action thresholds do not exist for outdoor ornamentals

Quarantined pests have had an enormous impact on nursery production in the last few years. Emerald ash borer (EAB) continues to plague ash trees in Essex, Chatham-Kent, Lambton and now Elgin counties. It is estimated that over 15 million trees have been killed by EAB so far in Michigan and Ontario (ash trees make up 25-80% of woodlots). Because of EAB, many Ontario nurseries are unable to sell inventories of ash since they have been removed from planting lists in many municipalities. Before EAB was found in 2002, ash trees comprised 10-30% of the total sales of Ontario shade trees. Since 2003, growers have been destroying young ash nursery stock while

holding the higher value ash caliper trees in hopes that the market will turn around. If the market for ash continues to decline, Ontario growers may have to destroy several thousand ash caliper trees in 2005-2006. Since Asian Long Horned Beetle (ALHB) was found infesting trees within the City of Toronto and Vaughn, new detections have been small and close to the original zone, which seems to indicate that the eradication program has been effective. ALHB presents a huge threat to the urban forest and nursery industry since a) so many of the host tree genera (e.g. maple) are found in the landscape and sold in the nursery industry and b) the centre of infestation is not very far away from large caliper tree nurseries. The action of quarantine at a nursery (e.g. moratorium on shipping for ALHB host trees) could easily put a caliper tree nursery out of business within a period of a few months. The host species for EAB and ALHB make up the top 10 to 15 species of trees grown in Ontario nurseries. OMAFRA specialists actively participate on science committees and taskforces related to Invasive Alien Species, often communicating impacts of draft regulations to government and technology transfer (e.g. biology, detection) to industry stakeholders. Positive detections of *Phytophthora ramorum* (Sudden Oak Death, SOD) in B.C. nurseries have contributed to the probability of Ontario growers importing this disease via nursery trade. The unpredictable behaviour of this pathogen and the every-increasing host list make it a real threat to Eastern forests and horticulture. OMAFRA specialists have given numerous presentations to industry stakeholders on SOD biology and BMP's for nursery production. U of G Pest Diagnostic Clinic is on standby should *P. ramorum* testing become a needed service for Ontario. Industry awarded CORD funding will be used to support research regarding the disinfection of recycled water for water born pathogens (e.g. *Phytophthora* and *Pythium*) at the University of Guelph. To help prevent further spread of this disease, systems-based, voluntary certification programs are being developed by the BC nursery industry and CFIA. Disputes over the new Japanese Beetle infestation zones continue, as growers in previously uninfested zones are required to be certified and Ontario-Quebec growers could face restricted access to maritime markets.

The sub committee decided to amalgamate "Christmas Trees" into the "Outdoor Ornamentals" crop grouping for future Minor Use Label Expansions. Aside from harvesting technique, there is virtually no differences between the production of field grown conifers sold as Christmas trees compared to those grown for planting and therefore should not necessitate separate efficacy and crop tolerance trials.

The OMAFRA Turfgrass Specialist and Crop Nutrition Lead made a motion to change the fall nitrogen application rate for OMAFRA Publication 384 Turfgrass Production Recommendations at the 2005 OSRMSC subcommittee meeting. The OSRMSC asked that the Nursery-Landscape Turf OHCRSC subcommittee to review the recommendation first. The recommendation was to: reduce the rate of the second application of nitrogen from 1.0-1.5 kg N/100m² to 0.25-1.0 kg N/100m² in late October to early November, with a high nitrogen, low potassium fertilizer. The Nursery-Landscape Sub Committee accepted the motion and voted unanimously in favour after some discussion. The recommendation will be tabled at the next meeting of the OSRMSC subcommittee.

Skilled labour shortages are still a large issue in turf and ornamentals. Off-shore labour continues to be the backbone labour force for the nursery industry but the recent discussions around unions and tightening of labour protocols are of concern. The Nursery Sod Growers were approved to utilize off shore labour through the HDRC Caribbean/Mexico Seasonal Agricultural Workers Program in early 2004 and several sod growers took advantage of this program again this year. Landscape Ontario has been sending recruiters to high schools to attract young people into the field of ornamental horticulture. In addition, the industry is working on models for scholarships and horticultural internships (more structured than co-op terms) that will add educational value to diploma and degree courses. Many nursery growers are looking toward increased mechanization as a solution to the skilled labour shortage in nurseries.

The sub-committee is pleased to welcome their newest member, Dr. Katerina Jordan as the newest turf faculty researcher at the University of Guelph. Katerina plans to make large contributions to turf IPM (e.g. alternatives to creeping bentgrass on greens).

Emerging Issues

Budget Cuts at the University of Guelph

University of Guelph researchers are very concerned about the future of their programs. Two full time technicians (Nursery, Pathology) were deemed "redundant" this year and were subsequently cut. The University of Guelph announced overhead costs of 25-35% on all research funds (which puts them at a competitive disadvantage to other

organizations). The subcommittee was very concerned over the pending retirement of two nursery professors, with no indication that their positions will be filled upon retirement. (It should be noted that aside from these two positions, there are no other university-level research programs for nursery crops in Canada). It appears that the University is actively reducing faculty in OAC.

Exotic Pests/Invasive Alien Species

EAB, SOD and ALHB have huge implications for the nursery and landscape sectors. The agencies devoted to the management of quarantinable pests do not seem to have adequate resources to deal with the high volume of issues. In addition, there are still major research gaps regarding the pest biology in its new environment (e.g. emerald ash borer, Asian long horned beetle), mechanisms for dispersal, host range, detection and management strategies. Although these two pests are urban forestry issues to date, they have already had a huge impact on the nursery industry (e.g. significant decrease in ash sales). Quarantines (e.g. moratorium on shipping) against shipment of ALHB host species could put caliper tree nurseries out of business within one growing season. CNLA has been working with CFIA and APHIS to develop national nursery certification programs that will deal with exotic pests (invasive aliens) preventatively with a better system of record keeping that will streamline trace back and trace forward activities. Certification should reduce the amount of time growers are prohibited from shipping, and also increase the efficiency of eradication. The Ontario nursery industry is very concerned about the movement of SOD (Sudden Oak Death, *Phytophthora ramorum*) into Eastern Canada. Growers are very keen to support research projects that will help eradicate or slow the spread of this waterborne pathogen. Industry-awarded CORD funding will be used to support research into disinfection of recycled irrigation water (nursery, greenhouse) at the University of Guelph. The impact of exotic/introduced pests on outdoor ornamentals is often difficult to quantify due to lack of industry statistics. There is a need to develop more data regarding plant groups (e.g. deciduous trees, value, acreage and pests).

Pesticide Issues: Loss of Old Formulation Pesticides

Many of the older formulation pesticides are the backbone of chemical pest management for nursery and turf producers/maintenance professionals. PMRA's re-evaluation and manufacturers voluntary discontinuations are leaving the industry with gaps in pest management (e.g. there are no products currently registered for pine shoot beetle). Old formulations are being replaced by new ones and often, ornamental uses have been lost due to lack of "bridging data". Companies who produce biopesticides often complain that they are too small to meet the requirements to register their product in Canada. The turf industry is concerned about the over-reliance on Sevin T&O as the only curative insecticide in the near future. Increasing requirements for occupational health and exposure data by PMRA are also bogging down label expansion requests. Chemical registrants have reported lack of industry data on ornamentals with which to make business decisions regarding new product uses. The industry needs to develop more data regarding plant groups (e.g. deciduous trees, value, acreage and pests).

Irrigation and Water Management

Although Nutrient Management legislation will be focusing on large livestock operations, the ornamental horticulture industry is very committed to working towards decreasing the impacts of production and maintenance on the environment. The industry wishes to see more research regarding irrigation and nutrient efficiency and have more specific information on the timing of application(s) to minimize leaching of nutrients. The industry is also concerned about implications of the Source Water Protection Act and wishes to work with government to come up with solutions that are applicable for horticulture. There is considerable scrutiny of nitrogen and phosphorus levels in urban runoff in the United States, with many areas banning phosphorus fertilizers for use on turf. These nutrients are the first line of defense against weeds and some diseases. There is a need to educate the industry on the best management practices for utilizing these nutrients in the turf setting. The industry is also very concerned about water quality and availability and would like to see more research dedicated to the efficient use of irrigation water (or someone to interpret the latest research that exists and transfer the knowledge into the nursery, landscape and turf industries). There is also room for improvement on irrigation delivery systems for container crops (e.g. low volume systems that are applicable for outdoor production).

Pesticide Issues: Integrated Pest Management

With the industry focusing on IPM as the solution to pesticide bans, it is becoming apparent that there are information gaps on pest biology, monitoring and detection techniques and thresholds. The registration of low risk, IPM friendly pesticides is also crucial to the adoption of IPM in maintenance and plant production. The increasing number of municipal pesticide bans is proof that the activists are not accepting IPM accreditation. In many cases

for landscape plants, a lack of pest population/pest damage action thresholds is preventing the acceptance of IPM as an alternative to pesticide bans. Research is needed to verify the action thresholds in the literature for pests on turf in Ontario. Action thresholds need to be established for outdoor ornamentals.

Pesticide Issues: Pesticide Bans

There is considerable need for industry to work with municipalities to develop practical and legal IPM programs. The turf industry's response to the possibility of pesticide bans has been to become politically active. The IPM Council has put together a program of voluntary turf IPM accreditation to demonstrate a willingness to reduce pesticide use in lawn care, parks and on golf courses. There is plenty of IPM research already done/being done but it does not always get adopted and there is a need for much more IPM work in the turf and landscape area. IPM programs are based on action threshold for pests, these thresholds are not established on most outdoor ornamental pests. There is a need for industry to support a position that delivers education of citizens/municipalities (in addition to industry groups) to balance risk with benefit of using pesticides responsibly.

Pesticide Issues: Use of Alternative Products

The University of Guelph and the Guelph Turfgrass Institute are addressing the need for research into alternative products to pesticides (e.g. non-chemical and low risk replacement pesticides). The research trials for these alternative products are more difficult to design and carry out, given they are part of a systems approach to the integrated management of a particular pest. The industry is concerned about the illegal use of alternatives products (i.e. those without PCP numbers) and off label recommendations from municipalities for homeowners (e.g. acetic acid, hot water, horticultural soaps, etc.). This problem has also been discussed at the Healthy Lawns Working Group and PMRA is putting together factsheet on this topic.

Energy

The huge increases in crude oil and trickled down to all facets of the industry. Costs of fuel and the price of materials (e.g. plastic pots, greenhouse plastics etc.) have risen significantly. Current energy cost trends indicate that growers need to be more efficient with their energy and materials. The industry suggested the need to investigate alternative sources of heating (greenhouse propagation systems) and the use of longer-lasting or recyclable plastics. The industry also felt they should investigate the applicability of an energy audit, where producers could streamline their production systems to become more efficient and reduce their "energy footprint".

Recommendations Arising From Gaps/Barriers/Deficiencies

Title: Biology and Management of New and Emerging Pests - Research

Recommendation:

The subcommittee on Nursery, Landscape and Turf recommends support of research efforts into the detection, biology and management of emerging pests which have the potential to become economically damaging. This research request includes necessary efficacy trials for quarantined pests as these trials can only be carried out at registered government quarantine pest facilities. Pests of concern include Asian Long Horned beetle, emerald ash borer, sudden oak death, bentgrass dead spot and European crane fly

Details:

Many of the emerging pests are new to Ontario and their biology, detection and management are not well understood in our region. There is real concern as to the eradication and management practices that will keep the pest population from expanding. To ensure the economic sustainability of the industry, these pests need to be managed. The Canadian Food Inspection Agency needs more resources to act in a more effective and timely manner (e.g. support certification and auditing or verification of audit process of such programs). The industry needs access to more university-level research into pest management solutions for these high priority pests.

Background:

New and emerging pests are responsible for significant losses in sales (e.g. EAB causing decreased ash sales) as well as crop losses each year. Quarantinable pests have a great effect on access to markets (e.g. moratorium on shipping). Registered pesticides are not available for most of the quarantined nursery and emerging turf pests. The economic future of these industries is at risk unless more rapid pest management solutions to these new and emerging pests are found.

Target Agencies: Canadian Food Inspection Agency. University of Guelph

Title: Water and Nutrient Management - Research/Service

Recommendation:

The subcommittee of Nursery, Landscape and Turf recommends a concerted effort to support more research on nutrient uptake, N and P content in leachate and have more specific information on the timing of application(s) to minimize leaching of nutrients (e.g. container nursery production). The industry is very concerned about water quality and availability and would like to see more research dedicated to the efficient use of irrigation water and reduction in off-site movement of runoff. The industry feels that there should be a reward for being proactive about collecting water for irrigation (reservoirs from roof runoff etc.). Also needed is the transfer of new technology to the industry.

Details:

OMAFRA has been working with the industry to characterize leachate/runoff and develop BMP's that will minimize the off-site movement of leachate/runoff. U of G nursery research team has evaluated fertilizer placement and timing as well as specific research into the uptake of N and P throughout the season. Further research is needed to address quantification of nutrient uptake and N and P losses in leachate, to establish more practical protocols for handling spent leachate and minimizing its off-site movement. Given the impact of regulations such as the Source Water Protection Act, the industry is in full support of research that can improve irrigation efficiency.

Background:

Research data regarding N and P uptake by ornamental nursery crops and sod is lacking. The industry appreciates the nutrient uptake research being conducted at the University of Guelph and would like to see the support for this kind of research to continue. Water quality and quantity have been identified as limiting factors in the production of nursery crops (especially containers) in Ontario. Unless this issue is addressed, there will be increased crop losses and reduced quality and limitation on the expansion of this industry. The long-term changes in climate and weather (e.g. hot, dry growing seasons over the last decade) have resulted in low water availability, which is limiting production and harvest and sales of turf and ornamentals. Areas that could be addressed include irrigation delivery systems (e.g. fertigation and recycling), irrigation scheduling, use of grey water and the development of low water use systems.

Target Agencies: OMAFRA, University of Guelph

Title: Registration of Reduced Risk Pesticides and IPM - Research/Service

Recommendation:

The subcommittee of Nursery, Landscape and Turf recommends continued support for research on the development and adoption of integrated pest management and registration of new, lower risk, IPM-friendly pesticides (e.g. curative insecticides) for the turf and nursery production and landscape.

Details:

The aim of this recommendation is to improve the ability to manage insect, disease and other pests in the in the face of reduced availability of registered pesticides and increasing concern about their effect on the environment. Current initiatives by the nursery industry include the hiring of an IPM technician who will also deal with minor use coordination. The committee is looking for increased collaboration with government and universities to fill research gaps and product registration gaps.

Background:

Despite the loss of older formulation pesticides (e.g. organophosphates) and possibility of municipal pesticide bans, landscape/turf maintenance and nursery growers are still expected to produce high quality plants with reduced pest management tools. Research should address the registration of pesticides as a component of an IPM program, as well as the development and adoption of low risk alternatives to current practices.

Target Agencies: Pest Management Regulatory Agency, Agri-chemical industry, University of Guelph

Title: Development of Stronger IPM Programs - Research/Service

Recommendation:

The subcommittee on Nursery, Landscape and Turf recommends that more information on pest biology in Ontario (with emphasis on action thresholds for pest populations and pest damage) be developed for outdoor ornamentals and turf.

Details: The industry has spent a great deal of time developing an IPM accreditation program to give more confidence in the responsible use of pesticides by licensed applicators. The increasing number of pesticide bans is proof that IPM accreditation is not being accepted by the activists. In many cases, the lack of pest population and/or damage action thresholds for landscape plants are preventing the acceptance of IPM as an alternative to pesticide bans.

Background: It is becoming apparent that there are information gaps on pest biology, monitoring and detection techniques and thresholds. The registration of low risk, IPM friendly pesticides is also crucial to the adoption of IPM in maintenance and plant production. Research is needed to establish action thresholds for pests on turf and outdoor ornamentals.

Target Agencies: University of Guelph (and other institutions for horticultural research)

Title: Acquisition of Current Industry Economic/ - Research/Service - Production Data

Recommendation:

The subcommittee on Nursery, Landscape and Turf recommends that current economic industry data specific to nursery production (e.g. value and acreage of crop groups, energy use), assessment of CO₂ credits and the overall value of the turf industry be acquired.

Details:

Although the industry supports the research into opportunities for skills-based training (Ridgetown College), there is a need for specific data regarding the land base dedicated to production of various crop groupings (e.g. number of acres in Ontario used for production of field grown conifer trees). Similarly, the total value of the turf industry in Ontario is not known. Quantification of the sizes of these two industries could justify more resources being diverted to deal with research and service needs (e.g. economic implications of EAB).

Background:

The nursery and turf industries in Ontario are large and are increasing in value every year. Turf industry statistics would help to designate the position relative to other commodities and its applicability for research funding. Statistics for individual nursery crop groups are required in data submission packages for minor use registrations and industry impact data (such as the impact of EAB on the shade tree market). This type of data is difficult to procure and often must be estimated.

Target Agencies: University of Guelph, OMAFRA

APPENDIX

2005 Research and Service Priorities for OHCRSC Subcommittees

- 1) Biology and Management of New and Emerging Pests - Research
- 2) Water and Nutrient Management - Research/Service
- 3) Registration of Reduced Risk Pesticides and IPM - Research/Service
- 4) Development of Stronger IPM Programs - Research/Service
- 5) Acquisition of Current Industry Economic Data - Research/Service

POTATOES

State of the Industry

There were approximately 200 commercial potato growers in Ontario growing 36,000 acres, (9% of Canadian plantings of potatoes) in 2005. About 57% of the Ontario acreage is for the fresh or table-stock market. The remaining 43% is for the processing market, mainly for potato chips. There were approximately 900 acres of certified seed potatoes grown in Ontario in 2005.

The main potato-production areas in the province are Alliston, Shelburne, Leamington, Ancaster, Simcoe-Scotland-Burford, Grand Bend and Mount Albert. Potato production is also located around population centers in the north, such as Thunder Bay and Sudbury.

The main fresh-market varieties grown in Ontario are Superior, Goldrush, Yukon Gold, Shepody, Kennebec, Cal White Cherokee Chieftain, Envol, Onaway and Fabula. Some of these also go for soup and pre-peel processing. Snowden, FL1867, Atlantic, FL1879, Andover, FL1833, FL1533, Pike, Reba and Dakota Pearl are the main chipping varieties grown in Ontario.

Potato acreage in Ontario has declined 17% (7000 Acres) since 2003. The very hot weather so early, reduced yields of early planted potatoes in areas like Leamington, the Lake Erie Sands, Alliston and Mount Albert 10% to 25%. The later and heavier soils of Dufferin County fared better. Due to weather disasters in other areas, the removal of 10,000 acres out of production in P.E.I. and reduced acreage in other areas, the prices for open table-stock have changed from \$5/cwt in Nov 2004 to \$15/cwt by Nov 2005.

Ontario chip stock is also in tight supply as volumes contracted for in 2005 were down 17%. This is a grower processor price negotiation year for the 2006 processing crop. Ontario seed potato acreage is fairly stable with very low field rejections in 2005, and reasonable yields.

The most grown seed potatoes in 2005 were Shepody, Kennebec, Yukon Gold, Superior and Chieftain. The potato is one of the few crops shining in a dark sky of vegetable economic hardship.

The Ontario Potato Board partly funded one research project in 2004 but resumed research funding again in 2005 after receiving a 1.5 million dollar allotment for commodity directed research over three years.

Emerging Issues

1. Emerging Issue

Our emerging issue is a concern about the future viability of the potato industry and Ontario agriculture as we know it to-day

This is a list of some conditions pressuring the potato industry and Ontario agriculture:

- Greater government and research emphasis on consumer food concerns and demands
- Narrow wholesale customer bases to sell to (mom and pop stores mostly controlled by the big chains)
- Continued increases in the costs of production
- The extreme financial penalty for excellence in production
- The apparent demise of the once influential O.A.C. degree at University of Guelph
- The aging farmer and the number of farmers forced to get a part-time job to support their hobby
- The erosion of hope growers once had that next year will be better

Research Priorities

1. Production and Productivity

- identification and evaluation of new germplasm for characteristics that increase productivity and profitability
- further research into seed and soil-borne diseases, (including, but not limited to late blight, scab, verticillium, fusarium) and the impact of infected seed on Ontario production

- future research into the use of integrated pest management practices and the control of pests, diseases and weeds which may have an impact on production
- examination of factors regulating post harvest storage and strategies to extend storage life while maintaining quality.
- further research regarding the use of mini-tuber technology to produce high quality seed.

2. Food for Health

- investigate nutritional qualities and variability of potato germplasm and possible application of this data in production and marketing . Examine the healthy aspects of potatoes (e.g., a good source of energy, vitamin C, fibre etc
- identification of factors (pre and post harvest) regulating storage quality and strategies to extend storage life while maintaining all quality characteristics.

3. Marketing

- promote the health aspects of potatoes (e.g., a good source of vitamin C, fibre etc)
- better promote the high quality of disease free Ontario seed potatoes through mini-tuber research
- improved branding of regions and varieties (e.g., Ontario potatoes, Yukon Gold)
- identification of value-added end uses of potatoes
- identification and exploration of new markets and lucrative niche markets
- assessment of cost-competitiveness of Ontario production practices in the North American marketplaces
- monitoring and evaluating present production practices to determine efficiencies and enhance competitiveness

Service Priorities

1. Extension Services—provided by the OMAF potato specialist are essential to the potato industry. The strong liaison with USA counterparts and local agri-business and the Ontario Potato Board as well as strong grower education programs have kept the grower industry up to date and competitive. This potato specialist's chores include a timely weekly fax on real-field conditions and pests, training field scouts, conducting technology transfer trials and organizing field days, a potato school, and most recently as author of a pictorial guide to potato pests and problems acclaimed by growers on both sides of the border.

2. Registration of Pesticides for Potato Pests

Pesticide registration is an issue for Canadian potato producers. Producers in other countries, namely the US, have access to pesticides not currently registered for potatoes in Canada. New pesticides often pose a reduced risk or are effective resistance management tools. Many times the pesticide company will make a submission for registration of one of these pesticides in Canada. However if they don't, IR-4 data is usually not available as potatoes are not a minor crop in the US. It is very costly to obtain the data required for residue levels, occupational exposure, crop tolerance, efficacy, etc to support registration.

3. Nuclear Seed Potato Production

The Seed Potato Upgrading and Distribution (SPUD) Unit is the foundation of the Ontario seed potato program supplying Ontario seed potato producers with high quality Nuclear minitubers. This service is essential to the seed potato industry in Ontario.

Ontario Research and Services Subcommittee

Recommendation # 1

Issue: Funding for the Potato Research Program in Plant Agriculture at University of Guelph.

Background: The Potato Research Program has made a successful transition to the Elora Research Station from the Cambridge Research Station, but this move has substantially increased the operating costs required to conduct the program. The major increase relates to the absence of suitable storage space at the Elora Research Station for potatoes, and the resulting need to rent a climate-controlled trailer for approximately 10 weeks at harvest time. There are also increased costs for land use, farm labour, and basic input. These are the result of the adjustments to the OMAF contract and the closure of the Cambridge Research Station.

Details: The potato research program harvests approximately 20 tons of potatoes which must be stored immediately after harvest under specific temperature and humidity conditions, until they can be sorted, graded and evaluated. A reefer trailer was rented to accommodate this need and will be required in future seasons . The cost to rent, operate and insure the trailer is about \$4,000 annually. The operating budget of the potato program is \$16,500 annually. Increased costs of \$4,000 represent a significant obstruction that is solely due to the compulsory move from Cambridge.

Recommendation: It is recommended that the University of Guelph/OMAF increase the operating budget of the Potato Research Program to cover the additional costs of conducting this research at the Elora Research Station.

Target Agency: Alan Wildeman, Vice President Research and Rob McLaughlin, Associate Vice-President (Research) Agri-Food and Partnership, University of Guelph

Recommendation # 2

Issue: Loss of potato processing lab facilities at University of Guelph

Background: The cold storage facility/ post harvest evaluation building is scheduled to be closed in 2006, due to a ruptured return condensate line. The potato processing lab is situated in this building. Loss of the potato lab threatens the completion of research projects as these facilities are required for all quality evaluations.

Details: The potato lab, which is approximately 360 sq ft, is equipped with an industrial range hood, fire suppression system, deep fryers, stove, and other related equipment. These specialized facilities are not duplicated anywhere else on campus. There is a wet lab room in Bovey which would be suitable for the relocation of these facilities. It is expected that the existing equipment can be moved successfully. The costs and supervision of the renovation will be handled by U of G Physical Resources. Funding sources will be sought for this by the U of G.

Recommendations: The lab equipment and processing facilities be moved to the Bovey Building and operational for the 2006 crop.

Target Agencies: Alan Wildeman, Vice President Research
Rob McLaughlin, Associate Vice-President (Research) Agri-Food and Partnership, University of Guelph,
Chair Department of Plant Agriculture

Recommendation # 3

Issue: Research in Insect Toxicology at the Southern Crop Protection & Food Research Centre (SCPFRC)-London

Background: Protection of Ontario potatoes against the attack by a number of serious insect pests has been a continuing battle. While the Colorado potato beetle (CPB) has historically been the most notorious problem, other significant pests have included potato leafhopper, tarnished plant bug, potato flea beetle, wireworm and white grubs. Although cultural and biological management of some of these pests has had some impact, historically the most important management programs have been based on judicious use of pesticides. Researchers based at research centres operated by Agriculture and Agri-Food Canada (AAFC) in Ottawa, Harrow, Chatham and London have all contributed to Ontario potato insect management programs in the past. Over the years, with changes in programs and retirement of staff, the AAFC contribution has dwindled to the extent that during the last 10 years only London has maintained a Toxicology program that has supported our industry. In May 2003 the insect toxicologist at SCPFRC-London retired.

Details: Ontario potato production is a significant component of an industry that in 2003 harvested potatoes valued at \$882 Million from just over 185,000 ha. Over the years, failure or inability to control insect pests has resulted in very significant losses. CPB, undoubtedly the most important insect pest of Ontario potatoes, has a notorious ability to develop resistance to insecticides applied for its control. Since the 1960's, CPB has successively developed resistance to the cyclodiene, organophosphorus, carbamate and pyrethroid insecticides. Now there is some indication that tolerance may be developing to imidacloprid, registered for CPB control in 1995. Research by AAFC toxicologists over the years has not only provided invaluable information on efficacy of a series of insecticides for control of CPB and other insect pests, but has also provided warning and then confirmation of

developing resistance, supplied information on toxicity of candidate insecticides to non-target and beneficial arthropods and furnished data on the persistence of control agents in the crop and in the environment. Insect toxicology research within AAFC has now dwindled to the point that scientists remain active only at SCPFRC-Vineland and at the Summerland site of the Pacific Agri-Food Research Centre; both toxicologists have full programs supporting the tree fruit industry. No insect toxicologists within AAFC currently support the potato industry. The threat posed to the industry has not been eliminated; indeed the threat is increasing with threatening resistance in CPB and reappearance of historic pests such as wireworm.

Recommendation: That Agriculture and Agri-Food Canada maintain its toxicological capability in Ontario to service the Ontario potato industry.

Target Agency: Dr. Gary Whitfield, AAFC, Science Director, Plant Protection.

ROOT, BULB AND LEAFY VEGETABLES

EXECUTIVE SUMMARY

Emerging Issues

1. Emerging pests – including cutworm in carrots; bulb & stem nematode in garlic; leek moth in Alliums. In addition, Iris yellow spot virus of *Allium* spp. is of concern. Iris yellow spot virus is a tospovirus, transmitted by onion thrips. It is a persistent virus known to affect all *Allium* spp. and a number of weeds common to Ontario landscapes. The main concern is introduction to Ontario by way of transplants from the United States.
2. Movement of processors to other countries and the prevalence of practices such as payment delays of 90 to 120 days are contributing to a very difficult situation for the Ontario vegetable growers. Growers are not certain that they will also be able to shoulder the burden of increased financial contributions to research.
3. Many of the crops represented by this committee have reported health benefits (i.e. bioactive compounds). With increased consumer awareness about the health benefits of fruits and vegetables, the ORBLFRSC identified the need for a comprehensive literature review of published research to identify gaps where research is still required. This additional information could be incorporated into marketing strategies to increase consumer awareness of the health benefits of these commodities.

Research Priorities:

Research priorities were discussed and ranked as given below.

1. **Funding Crisis.** A reduction in available research dollars coupled with rising overhead costs at the University of Guelph is directly impacting pestmanagement research on root, bulb and leafy vegetables, as well as other horticultural commodities.
2. **Pest Management Systems.**
 - Integrated management of insect, disease and weed pests, including development of thresholds and monitoring practices, relevant biological and ecological research and research on disease–nutrient interactions.
 - Reduced risk pesticides
 - New and emerging pests - included in IPM programs
 - Established pests - improving/updating programs within IPM
3. **Food Safety Concerns.**
4. **Crop Fertility and Diagnostic Screening.** Nutrient Management research is still required to update and complete provincial recommendations for all vegetable production systems. This research needs to be completed on various soil types throughout Ontario. In addition, the Pest Diagnostic Clinic has validated a soil PCR analysis for the greenhouse industry that provides both qualitative and quantitative information of soil-borne pests (e.g. fungi, bacteria, etc). This technology could be of value to commodities represented by this committee and need to be validated under Ontario growing conditions.
5. **Cultivar Evaluations.** Particularly the simultaneous evaluation of cultivars from different seed suppliers for agronomic characteristics under uniform conditions.

Service Priorities:

Service priorities were discussed and ranked as given below.

1. Lack of scouting companies in some regions of the province is a serious concern. Unavailability of scouting and crop management advice from companies independent of product suppliers is also an issue. There is continuing concern about the lack of continuity and consistency of crop scout expertise; OMAFRA should help to address this issue by providing training and support to crop scouts and consultants in all regions.
2. There is ongoing concern about the lack of timely and accurate plant diagnostic testing. The University of Guelph Pest Diagnostic Clinic needs more resources in order to meet growers' needs for shorter turn-around times, quicker processing of disease samples so that positive identifications can be made more frequently, and to provide PCR diagnostic services.

3. There is a need for OMAFRA to ensure that IPM programs are updated with respect to newly available products and information related to new thresholds, application timings, etc.

Recommendations

There are four recommendations, ranked in decreasing priority, in 2005.

1. Integrated Pest Management Research in the new OMAF-UofG Research Program Structure
2. Lack of delivery and implementation of IPM programs in Ontario
3. Nematode Research capabilities
4. Requirements for Nutrient Management Strategies and Plans

Details of each recommendation are provided below.

RECOMMENDATION NUMBER: 1

Issue: Integrated Pest Management Research in the new OMAF–UofG Research Program Structure.

Background: With the new restructuring of the OMAFRA–UofG Research Program there has been a shift away from Pest Management specific research to an integrated and interdisciplinary approach to industry issues. Under the new program, project funding must now support individual projects that include multiple researchers and multiple disciplines, thus increasing overall operating costs. This, in conjunction with increased overhead costs, technician layoffs and static research dollars will have a significant impact on research for the vegetable industry in Ontario.

Recommendation: The OCCRSC recommends that the OMAFRA–UofG Research Program Administration re-evaluate the operating costs (land rental fees, overhead fees) and limitations (loss of technicians, static funding, and matching funding requirements) associated with doing research at the UofG under the new Sustainable Production Systems Program.

Target Agencies:

- Rob McLaughlin, Associate Vice President (Research) Agri-Food & Partnerships
- John O’Sullivan, Research Program Director, Plant Program \
- Ken Hough, OMAF Research Support
- Sandi Christopher, OMAF Research Programs Administrator
- Michael Dixon, Chair, Environmental Biology, UofG
- Gary Ablett, Chair, Plant Agriculture, UofG

OASCC Linkages: OHCRSC; OPMRSC

RECOMMENDATION NUMBER: 2

Issue: Lack of delivery and implementation of IPM programs in Ontario

Background: OMAFRA withdrew from providing IPM services to growers a number of years ago. Since then attempts to establish province-wide crop monitoring and scouting services that are independent of seed, fertilizer and pesticide suppliers have failed (e.g. AIMS). Crop consulting services will likely be more successful on a regional basis, but will need to service a wide range of crops within their area.

Details: Integrated Pest Management (IPM) programs, which include resistance management strategies, help to prolong the effective life of pest control products and have been developed for many high value crops but have not been fully adopted or available to growers and processors due to:

- 1) lack of availability of training opportunities for IPM consultants and scouts in some regions;
- 2) lack of economic viability for privately delivered IPM consulting/scouting services;
- 3) lack of affordability of such services for growers.

Increased need for IPM services is expected as new reduced risk pesticide products often need more intensive monitoring and understanding of the pest complex and the activity of the product in order to be used successfully. In addition, IPM is an integral part of agricultural risk management.

Recommendation:

ORBLVRSC is pleased to see the number and diversity of training sessions offered by OMAFRA in 2005; however, this list does not include many activities focused on the commodities represented by this committee. Therefore, this committee recommends that OMAFRA continue their commitment to address the barriers to IPM implementation and delivery in Ontario, as well as: 1) deliver additional training sessions for root, bulb and leafy vegetables; and, 2) ensure training and resources are available to all vegetable-growing regions of Ontario.

Target Agency: OMAFRA

OASCC Linkages: OHCRSC; OPMRSC

RECOMMENDATION NUMBER: 3

Issue: Loss of Nematode Research Capabilities in Ontario

Background: As reported in previous year's reports, as of 2002, the last of four nematologists in Ontario retired. To-date, AAFC has not filled any of these nematology positions. In 2004, AAFC required a business case to justify the creation of any position. As of 2005, AAFC announced that they were holding consultations for a federal agri-food science strategy, and that all business cases might be better to pursue after the strategy is developed. Unfortunately, the presence, introduction, and outbreaks of nematodes in Ontario vegetable crops continue to have the potential to result in serious quarantine and trade issues. Therefore, it is essential that a significant nematode research program is available to support the Ontario root, bulb and leafy vegetable sector as soon as possible.

There are currently nine nematodes regulated by the CFIA that have the potential to become established and threaten the production of horticultural crops in Ontario. Three of which are known pests of: alliums (stem and bulb nematode, *Ditylenchus dipsaci*), and carrots and parsnips (potato rot nematode, *Ditylenchus destructor* and Columbia root-knot nematode, *Meloidogyne chitwoodi*). One of these pests, stem and bulb nematode was positively identified in Ontario garlic samples in 2005.

In addition to regulated genera, there are a number of established nematodes including northern root-knot (*Meloidogyne hapla*), root-lesion (*Pratylenchus penetrans*), root-knot (*Meloidogyne spp.*) and sugar beet cyst nematode (*Heterodera schachtii*) that cause economic damage to carrots, parsnips, celery, spinach, lettuce and onions grown in Ontario.

On several occasions in the past, correct identification of nematode species was crucial to the root, bulb and leafy vegetable sector. The lack of an 'in house' nematode taxonomist at AAFC will force Ontario producers to use US resources for identification which may lead to quarantine and trade issues on exported crops.

Although there is one nematologist at AAFC - Horticulture Crops Research & Development Centre (St-Jean-sur-Richelieu), that research program focuses on nematodes of potato, corn and turf and does not address vegetable crops.

Details:

Very few nematologists are left at any AAFC location throughout the country. Correct identification of all taxa of crop pest pests and the maintenance of a research effort is crucial for the adequate protection of root, bulb and leafy vegetables and the stability and competitiveness of the industry.

Recommendation:

Given the range of crops under the purview of OHCRSC that are concerned by the lack of nematology expertise of relevance to the vegetable and horticultural crop sectors in Ontario, the ORBLVRSC recommends that OHCRSC & OPMRSC continue to coordinate and develop a business case to support the hiring of a nematologist by AAFC.

Target Agency: Annette Anderson, OHCRSC; Hugh Berges, OPMRSC

OASCC Linkages: OHCRSC; OPMRSC

RECOMMENDATION NUMBER: 4

Issue: Requirements for Nutrient Management Strategies and Plans

Background: OMAFRA is currently supporting work that is characterizing the nutrient quality of on-farm fruit and vegetable wash waters, and surveying leachate, soils and ponds from greenhouse and container nurseries. OMAFRA is also exploring options to increase the amount of resources available for research to support nutrient management standards.

Research is currently being undertaken by OMAFRA on 17 horticultural crops in preparation for the inclusion of vegetable crops under Nutrient Management legislation in 2008. Current research is focusing on 3 year trials to verify current management guidelines and includes soil sampling (particularly available nitrogen, organic matter, texture) and surveys on management practices.

Details: Growers are concerned about the impact of nutrient management plans and legislation on production of root, bulb & leafy vegetable crops. Of particular concern is the applicability and accuracy of current nutrient parameters in assessing nutrient input/output of root, bulb & leafy vegetable production practices. ORBLVRSC is pleased to see these issues being addressed by OMAFRA. However if it is necessary to change current recommendations, detailed rate response studies conducted over an additional 3-year period will be required, making it difficult to meet the 2008 timeline for inclusion of horticultural crops in NMR legislation.

Recommendation:

The Ontario Root, Bulb & Leafy Vegetable Research & Services Committee requests that OMAFRA ensure that Nutrient Management research pertaining to horticultural crops (including detailed response rate studies) is initiated and completed and results made available as quickly as possible in order that suitable recommendations can be developed prior to the inclusion of horticultural crops under NMR legislation in 2008.

Target Agency: OMAFRA

OASCC Linkages: OHCRSC; OPMRSC

SWEET CORN, PEA AND BEAN

Sweet Corn, Bean and Peas Research and Services Committee Meeting November 25, 2005 - Woodstock, Ontario

Attendance: Dave Simpson and Alan S (Family Tradition Foods), John Zink (Seminis), Charles Welsh and Bob Allison (fresh market growers), Jeff Ferguson (processing grower), Wade Bickle (Kraft), Barry Cavanagh (Carriere Foods), Janisse Routledge (Ontario Food Processors Association), Jim Chaput (OMAFRA), Tiequan Zhang (AAFC), Elaine Roddy (OMAFRA), Darren Robinson (RCUG).

Minor Use Update

New registrations include Headline on all corn types, Headline on all legume crops, Matador/Warrior on all legume crops. Pursuit reduced harvest interval for peas.

Active URMULE projects include
Snap Beans: Quadris, Allegro, Kocide seed treatment and Gaucho
Sweet Corn: Quadris, Assail, Lontrel, Accent
Succulent Legumes: Cruiser

Lontrel will be held up by a lack of residue data for NS and AB.

State of the Industry

Chilling injury and seed insect damage was significant on early peas and sweet corn. The very early crops in Essex county suffered from poor planting conditions and a lack of moisture throughout the season. Processing yields in all three crops improved as the harvest moved eastwards. Processing sweet corn yields for most of Southwestern Ontario were excellent. Harvest scheduling to maintain quality was a challenge for all crops. Snap green and yellow beans suffered under the extreme heat during much of July, August and September. High temperatures caused blossom abortions and an increased amount of split sets, reducing yields and making harvest scheduling difficult.

For most processors they ended the season slightly under budget for peas, slightly under budget for beans and over budget for sweet corn.

Fresh market yields and quality were good despite low rainfall in most areas. The yields were steady throughout the season, although hot conditions resulted in harvest bunching and an early end to the season. Prices were fairly steady with a nice increase at the end of the season as availability became limited due to the heat. The market for high quality fresh market sweet corn is high. The large grocery stores have a difficult time maintaining good quality. They are moving towards pre-husked and cello-pack corn in an effort to maintain quality and decrease wastage. The consumer perception is that this corn is not as fresh, or that it is American. Discerning consumers are actively seeking out farmer's markets and farm gate markets for high quality sweet corn.

Wholesale prices are still a concern in the fresh industry. Large grocery chains are determined to sell corn at \$1.99/doz. This price is just not sustainable for the grower.

Residual weed control was a major challenge for both the fresh and processing industries.

Emerging Issues

Northern Corn Leaf Blight.

- This disease appears to be sporadic in Ontario. Yield loss due to foliar symptoms in sweet corn has not been observed to date. However, it is known to cause yield loss in the mid-western states.

PMRA PMRA seed treatment attitudes. Research into reduced exposure. Canadian data requirement. Literature reviews, rationales.

PMRA

- Growers and researchers continue to feel frustration at the slow pace of product registrations in Canada. They are often handicapped by the lack of pest control solutions readily available in the US and Europe.
- Increased demands regarding worker exposure data for seed treatment registration has significantly delayed the adoption of many new insecticides and fungicides. These products are efficacious, use reduced rates of active ingredients and often have significantly lower environmental toxicity compared to the currently registered foliar alternatives.

Viruses

- Virus pressure in vegetable crops is often directly linked to soybean aphid populations. With no effective viral control methods, breeding remains the most viable solution.

Transgenic Varieties

- In the fresh market, GMO's no longer appear to be a significant concern for the consumer. Growers would benefit from a wider range of transgenic (bt.) varieties in the fresh market.
- Consumer acceptance in Europe and Asia is still an issue for processed industry.

US Dollar

- This is a major issue for both the processed and fresh industries. In the past 10 years a significant amount of export development has been a direct result of a weak Canadian dollar.

Tobacco Diversification

The sweet corn industry has not felt a lot of pressure from the decrease in tobacco acreage. Many tobacco growers have prior experience with the fluctuating markets associated with sweet corn and are not eager to enter the wholesale market. The major activity lies with tobacco growers wanting to align themselves with current veg growers to act as broker/sellers.

Research Funding

- As the University of Guelph has now downloaded the direct operating costs on to research programs, it is expected that the cost of research will increase.

Rising Fuel and Input Costs

Nutrient Management Act

Processing plant waste will be phased into the Act in 2007.

Research Reports

Presented by: Darren Robinson and John Zandstra (Ridgetown College) John Warner and Tiequan Zhang (AAFC – Harrow) and Elaine Roddy (OMAFRA)

Research and Service Priorities

1. Pest Management

- Product Registration
 - Loss of existing products
 - Delays in registering replacement products
 - Resistance to pesticides
- Biology, Management and Control of new pests

2. Nutrient Management and Water Quality

- Utilization and environmental fate of nitrogen, phosphorous and potassium
 - Economic applications rates
 - Efficient timing
 - Crop uptake and removal values

Evaluation of the phosphorous index for vegetable crops
Environmental soil test for vegetables (phosphorus)
Livestock manure management for hort crops

- Effects of fertility on crop quality
- Disposal of vegetable by-products and wash waters

3. Crop Culture for Quality and Yield

- Breeding for heat stress tolerance in legumes
- Varietal response to environmental stresses
- Breeding for virus tolerance in legumes
- Soil Management
- Variety Evaluations

4. Marketing and Economic Sustainability of Fresh Market Commodities

Recommendations

1. This committee would like to see the PMRA work towards harmonization with the US for all crop protection products.
2. This committee would like to request that the several branched of government (PMRA, CFIA and the MOE) develop more stringent standards for pesticide residues coming into Canada from both NAFTA and non-NAFTA countries. These standards should reflect the availability of pest control products registered for use by Canadian growers. Imported produce (fresh and processed) should be held to the same standards that Ontario growers are held to through our domestic pesticide registration process. Ontario growers are being regulated out of business, while the same regulations do not apply to imported product.
3. This committee would like to see a stronger commitment for domestic marketing of both fresh and processed Ontario vegetables. This commitment should be aimed at the market promotion of safe, healthy food. Efforts are need to strengthen the commitment of Ontario consumers to Ontario grown products.

TENDER FRUIT

Introduction

This report was prepared by the “Tender Fruit Research and Services Sub-Committee of the Ontario Horticultural Crops Research and Services Committee”. It summarizes the work of the subcommittee over the past year, especially the discussions at the Sub-Committee Meeting organized by Michael Celetti, chairperson (OMAFRA) and Richard Matthie, Vice-chair (Kraft Canada Inc.) held on November 8, 2005 at Rittenhouse Hall, Vineland, Ontario. Contained in this report is a summary of the accomplishments of the tender fruit industry, issues, research and service priorities, pest management issues, minor use priorities and recommendations affecting the industry. Officers elected for 2006-2007: Chair Mr. Ken Slingerland (OMAFRA); Vice-Chair Dr. Antonette Svircev (AAFC-Vineland).

State of the Industry

Crop Summary

Most of the tender fruit areas of the Niagara Region, home to over 90% of the tender fruit crops in Ontario, were affected by the extreme winter temperatures. Fruit buds were weakened in late December and damaged further in January. Some areas between the lake and the escarpment were hardest hit with around 90% bud damage.

Peaches came into blossom a few days behind normal, May 5-8th at Virgil, and around the 15th at Vineland Station during a long cool bloom period. The light bloom, especially in the lower portion of the trees, indicated the severity of the damage to blossoms of peach and Japanese plum. Throughout the growing season, 1 and 2 year old trees as well as older trees collapsed and died during the additional stress of the hot and dry conditions.

Fruit trees needed irrigation early in June as the moisture in the soil was depleted. Growers in most areas irrigated several times throughout the summer to replenish moisture levels. Most peach cultivars had a light set which resulted in some early season split pits. Several cultivars needed only a touch up thinning. Growers in the traditional growing areas along the lake escaped a lot of the winter injury and had fair to good crops. Overall, the peach crop was down about 30%. The pear crop also did not fair well and fruit size was generally small. Plums and cherries rebounded from a poor year in 2004. The quality of the fruit crop was excellent as dry weather and lots of sunshine enhanced fruit flavours.

There is still some concern for older orchards and the overall health of trees that were located in cold spots and might have been damaged by winter injury. 2005 can be summed up as “an extremely cold winter and a hot dry summer” year.

Market

With the exception of the tail end of the Bosc pear crop, the 2005 tender fruit crop has been successfully marketed. Returns for the processing crops were either lower or relatively unchanged from 2004 with the exception of the over 2½ inch Bartlett category which received a \$100 per ton premium. Returns for all fresh market fruit crops were up partially due to this year’s aggressive media and advertising programs coupled with an overall decreased North American and Canadian crop. Sweet cherry volume for brine was down sharply but the fresh market was strong and the entire crop was eventually marketed successfully.

Plum Pox Virus Surveys

Agricorp and CFIA collected and tested 1,041,422 *Prunus* samples for PPV from 7,293 orchard blocks in 2005 (Figure 1). Only 282 trees tested positive for PPV in 168 blocks. This is a significant reduction in the number of trees and blocks that tested positive compared to 2004 (942 positive samples in 302 blocks) and the number of positives found in 2000 (1,879 positive samples in 246 blocks) when the disease was first discovered in Ontario. Of the 168 blocks that tested positive in 2005, 103 were blocks that never had an infected tree, while the remaining 65 an infected tree previously but only the positive trees were removed. The data clearly indicates the eradication program is driving the incidence of disease down in Ontario. Unfortunately, the new infected blocks strongly suggest that aphids are the primary means of PPV spread in Ontario at this point.

In addition to the Orchard Block survey, 29,637 home owner properties in St. Catharines and Niagara-on-the-Lake were visited with 15,096 *Prunus* samples being taken. A total of 24 trees on 19 homeowner properties were found infected with PPV strain D (6 peach, 4 flowering plum, 4 apricot, 3 European plum, 1 Japanese plum, 1 flowering almond, 5 plum rootstock from flowering almond). Tracebacks indicated mostly propagative links (plants from friends). However, some trees were grown from seeds and so the source of the infection is not known in these cases. PPV strain D is not considered to be seed transmitted.

A stone fruit industry viability study was commissioned by AAFC and conducted by the George Morris Centre in 2005 to determine how other countries are dealing with PPV, what the Ontario grower opinion of the PPV Eradication Program in Canada is, and how many block removals a farm can sustain while still remaining viable.

The International PPV Expert Panel (IEP) met in Niagara Falls on October 24-25, 2005 to review the progress of the Canadian PPV Eradication program and make recommendations to improve the chances of successful eradication. The EIP recommended that the CFIA change the PPV Eradication Strategy to contain aphid spread by removing a buffer zone of trees around infected trees rather than the entire block. The International Expert Panel still believes that PPV can be eradicated.

2005 Emerging Issues (not ranked)

1. Plum Pox

Plum Pox still remains the primary concern of the Ontario tender fruit industry. Results from research into aphid transmission of the Ontario isolate is required immediately to help growers and government regulators understand the rate of transmission of PPV in Niagara. In addition, virus-tested disease-free budwood is required immediately by the nurseries who supply the industry with trees. Currently, two “Elite” *Prunus* blocks of required peach varieties have been established in southern Ontario away from the quarantine zones. The virus-tested, disease-free budwood for the elite block was obtained from nuclear stock at CFIA Sydney, B.C. More research into managing aphid vectors, resistant cultivars and PPV is required.

2. Shortage of nursery trees

The PPV survey in 2005 found 168 blocks infected with the virus with 103 of these blocks being new detections while the remaining blocks had PPV detected previously but at low levels. Most of the newly detected blocks only had one positive tree and a few were only recently planted with new young trees propagated from “Best Available” budwood indicating probable aphid transmission. The nursery industry is faced with the challenges of supplying the peach industry with large numbers of virus-free trees to replace the large numbers of PPV-infected trees and blocks that are being removed. Currently the supply of peach trees available for 2006 and 2007 cannot meet the demand and all nursery trees being planted for 2006 and 2007 have been sold or committed. Furthermore, the industry’s requirements for replacement trees are anticipated to increase significantly in 2006 and 2007. It will be 2010-2012 before the Elite mother blocks set up in southwestern Ontario as part of the *Prunus* Certification Program can meet the needs of the industry. The interim “Best Available” program (propagation from tested PPV-free mother block trees) will continue until the Elite block can supply the industry.

3. Bacterial Canker on Sweet Cherries

Bacterial canker has been diagnosed in a number of Niagara sweet cherry orchards. A number of the recommended products in the United States are outdated and only offer suppression rather than control (e.g., copper sulphate applications). A literature review is recommended as a good starting point to formulate a plan of action to address this disease as it relates to sweet cherry production in Ontario. This review should cover, but not be limited to, cultivar resistance, cultural methods of control, and new chemical products.

4. Sweet Cherries Competition

The sweet cherry crop in 2005 was smaller than in 2004. Competition from the United States in 2003, 2004 and again in 2005 resulted in a flat market for Ontario producers. The quality of imported fruit in both years was impressive - large, firm, and fresh quality. It is imperative that Ontario producers compete with the US, by optimizing fruit size and firmness through the use of best management practices such as irrigation, fruit thinning, gibberellic acid, and size-controlling rootstocks.

5. Shortage of pest management products for minor pest in minor crops

In the United States, tender fruit acreage is much larger and pesticide companies often register products on these fruit crops. Furthermore, products are often registered based on crop groupings. Tender Fruit is considered a minor crop in Canada. Most pesticide companies register products on major crops and leave the publicly funded minor use system to register the products on minor crops such as tender fruit. This has led to a shortage of pest management products available to Ontario tender fruit producers. Although it would be efficient to register products by crop group, AAFC and PMRA have realized that this is more challenging and expensive than anticipated. These federal agencies announced in March, 2004 that they would only concentrate on minor use registration for crops on which the data was obtained and not the crop group. The TFRSSC is concerned with the competitive advantages with the new reduced risk products registrations available to US producers that are not available to Ontario producers. With the announcement at the Minor Use Prioritization meeting in March 2004 that minor uses will only be granted to the crop on which data was generated and not on the crop group has led to products being registered in apples but not on pears even though both are pome fruits. The TFRSSC is concerned that pest control registrations as currently practiced are neglecting many tender fruit crops.

6. Industry expansion on nontraditional peach growing areas resulting in production problems

As the peach industry expands into nontraditional peach growing areas in Ontario, new growers are attempting to plant in zones that are marginal for peach production, particularly in areas away from large bodies of water in southwestern Ontario. This may result in severe winter injury in some years. New growers must learn about the agronomics of growing *Prunus* spp. such as zone hardiness of peach cultivars and proper soil conditions. In some situations, growers are not aware of the effect previously planted crops on certain sites may have on establishing *Prunus* spp. or their sensitivity to older herbicide products used on the sites previously.

Deer damage in tender fruit

Deer damage to tender fruit trees has increased over the past few years resulting in significant losses to the industry.

Land Use Issues and the Greenbelt

The Ontario government has established a Greenbelt which includes the unique tender fruit lands in the Niagara Peninsula. The Greenbelt places a freeze on these lands for agricultural purposes only and limits the rights of farmers. The industry is monitoring the effects this legislation has on the value of farm land.

Lack of technical support for breeding program at University of Guelph

The technical support position for the tree fruit breeding program at the Vineland Campus of the University of Guelph is currently vacant, due to the recent retirement of Bill Lay. There is no commitment from the University to fill the position due to funding reductions made by the department of Plant Agriculture at the University of Guelph in order to manage the shortfall of the University/OMAFRA contracts. Tree fruit breeding is very vital to the tender fruit industry of the Niagara peninsula and is one of the largest field programs in the Department of Plant Agriculture. It is imperative that this position is filled soon in order to continue with new lab research. The TFRSSC very strongly recommends that full time technical support is provided to this position immediately.

Winter Injury is causing extensive crop loss in tender fruits

Although late spring and early autumn frosts can cause considerable damage to tender fruits, winter cold injury has been a more serious problem in recent years. Normally, one would expect one winter in ten to cause damage, however the last three winters have all caused major economic damage, with 2004-2005 being one of the coldest on record. Overall, tender fruit yields are down 25% from normal mostly due to winter injury caused by cold temperatures. Many growers believe that the use of \$30,000 wind machines is one technology that can assist them to make a consistent living in the Greenbelt Area, since economic survival is the only way to keep farmers on the land.

Roadside salt damage to tender fruit orchards

The province and local municipalities continue to use salt on roads adjacent to farm land. This has resulted in serious damage to fruit trees caused by salt spray. Alternatives to salt needs to be researched and tested in order to mitigate the damage and the resulting financial losses being sustained by producers.

Loss of Lorsban

The insecticide Lorsban will be lost in 2006, and none of the economical replacement insecticides appear to be as efficacious for control of oriental fruit moth.

2005 Research Priorities

It is recognized by TFRSSC that there are inter-relationships between the following research priorities and integrated approaches will provide the best opportunities for progress. With the expansion of the peach industry into new areas, and the recent cold temperatures experienced over the past few years resulting in significant cold injury, winter hardiness will be a consideration in breeding, orchard management and plant nutrition research objectives. The following Research Priorities will provide significant value to the industry in the value chain continuum over the next 5 years.

1. Plum Pox Research

Plum Pox remains the primary concern of the tender fruit industry. Agriculture and Agri-Food Canada and the Canadian Food Inspection Agency are encouraged to continue research that supports the eradication of this virus from *Prunus* in Ontario. Additional research into pathways of virus transmission and the role of aphid transmission in nearby planted orchards blocks is required immediately. An understanding of pathways is critical to protect the *Prunus* certification efforts.

2. IPM including Minor Use for Tender Fruit Crops

The continual research on broad-based IPM programs in all tender fruit crops are necessary to keep the industry competitive. Research on alternative pest controls and new reduced risk products to replace the loss of older products such as organophosphates (e.g. Lorsban) is necessary. In addition, resistance management strategies must be developed to retain new products recently registered that have single site mode of action. The evaluation of unregistered and registered products for the control of new pests, as well as difficult to control pests such as plum curculio on tender fruit is also required. IPM research objectives should include:

- Develop and implement IPM resistance management strategies for fungicides and insecticides used on tender fruit crops
- establish base line data on efficacy for pesticide resistance management strategies
- IPM for commodity pest complexes (includes insects, mites, diseases and weeds) considerations include - products which will be phased out after PMRA re-evaluations, alternative pest control products, reduced risk products, pest dynamics and resistance management.
- products to replace the loss of effectiveness of traditional organophosphates (OP's) and pyrethroids due to pesticide resistance and re-evaluation of older chemistries
- replacement products that are economical, efficacious and IPM friendly

3. Breeding and germplasm improvement for winter hardiness, resistance to pests, diseases and abiotic stresses

An integrated approach to breeding and germplasm improvement will help sustain the tender fruit industry and maintain the industry's competitiveness in Ontario. Specific breeding objectives include:

- breeding and germplasm improvement for winter-hardy fresh peach cultivars for new plantings e.g. Stellar series and Paul Friday cultivars
- long term research and assessment of germplasm for PPV resistance and screen new potential imports
- maintain input especially cling stone and pear breeding programs
- fire blight resistance in pear breeding program
- continuing need for suitable late season processing peach and pear cultivars
- winter hardy processing peach cultivars for new plantings in areas outside traditional tender fruit growing regions and along the south shore of Lake Erie
- evaluation and development of fresh market varieties
- peach canker, brown rot, and bacterial spot resistance
- plums - colour, size, taste, fresh market alternatives, and black knot resistance

4. Tree Fruit Physiology and Management

Winter injury to tender fruit crops has been a more serious problem in recent years. To meet the demand for processing peaches, it is anticipated that new orchards will be planted outside the traditional production areas and

more plantings are expected in regions where the most favourable climates occurs for tender fruit crops north of Lake Erie. Unfortunately, these regions are also more prone to colder temperatures more frequently than the traditional production areas. Evaluation of cold hardiness, productivity, adaptability, and longevity of processing cultivars outside the traditional growing regions of the Niagara Peninsula and southwestern Ontario is required to sustain the expansion of the peach growing industry. An integrated approach to conducting orchard physiology and management research will help sustain the tender fruit industry and maintain its prominent place in Ontario.

Additional research objectives include:

- winter tender fruit bud hardiness stages by doing systematic field sampling
- investigate wind machines to move warm air temperature during inversions and prevent/reduce cold injury damage
- develop Best Environmental Management Practices (BEMP) information
- orchard training systems for higher density, improved fruit quality, production and harvest efficiency.
- pear pollen compatibility of new cultivar combinations
- irrigation systems including trickle and sub-surface drip irrigation for water conservation and prevention of pesticide contamination of groundwater.
- scion-rootstock interactions in cherry, plum, peach and pear, for tree size control (dwarfing for high density orchards), disease resistance, improved tree habit, hardiness, and production efficiency

5. Post-harvest and fruit quality

Several post harvest diseases, uneven ripening and other post harvest disorders cause significant losses to the tender fruit industry each year. Post harvest research objectives include:

- control of brown rot and other post harvest pathogens of all tender fruit
- regulation of fruit ripening for improved quality at harvest and extended storage and shelf life
- prevention of mealiness or chilling injury of peaches and nectarines
- modified atmosphere packaging
- value added products

6. Plant nutrition and nutrient management

Research into the best rates of nutrients particularly N, P, and K applied to tender fruit crops to ensure healthy trees as well as the quantity and quality of yields is critical to both sustainable production and the environment. Research and support in determining the impact of NMA legislation on the tender fruit industry is required. Micronutrient deficiencies often show up in a few orchards every year which mask or mimic other disorders. Some companies have capitalized on this issue and often prescribe foliar sprays of particular micronutrients that may or may not be necessary. A better understanding of the symptoms of micronutrient deficiencies, the rate of micronutrient deficiencies as well as the effectiveness and timing of applying micronutrients is required by the industry.

7. Water use, quality and conservation

Provision of services to ensure efficient use of water, methods of reducing environmental impact from irrigation practices, and strategies to ensure a reliable and high-quality water source is available to the horticulture industry are important to the tender fruit industry.

2005 Service Priorities (not ranked)

1. Training of IPM personnel and delivery of pest monitoring services
2. Tender Fruit and Grapevine and Hort Matters Newsletters
3. Plum Pox Virus (PPV) Strategies
4. Safe and Healthy Food
5. Water Quality/irrigation
6. Nutrient Management Plans and the Nutrient Management Act
7. Sound, Objective Financial Information for Growers
8. Improve training and delivery of Food Inspection services e.g. Point of Origin

ONTARIO TENDER FRUIT RESEARCH AND SERVICES SUB-COMMITTEE

2005 Recommendations

TFRSSC 2005-1 Shrinking Resource and Personnel Base in Tender Fruit Personnel

The research and extension capacities to support the Ontario tender fruit industry should be maintained by AAFC, OMAFRA and the University of Guelph in the Niagara region where 90% of the tender fruit is produced.

To: AAFC, OMAFRA, UofG, OHCRSC

Background: The OTFPMP challenges the research and extension services to ensure that the research and technical support required to service the tender fruit industry is available. The TFRSSC is concerned about the erosion of research and service support in various aspects of tender fruit production. Growers rely on research and recommendations for control of pests, diseases and nematodes in order to maintain a high level of fruit production. Several pests and diseases have been identified by TFRSSC, and IPM of pests and diseases is included in the research priorities of this committee. Alternative control measures are required as the industry faces review of currently registered materials.

The TFRSSC is concerned that positions in OMAFRA, AAFC and the University of Guelph that provided critical services and research to the industry have become vacant in recent years. For example, the OMAFRA sprayer application specialist position (formerly in Simcoe) is vacant. This position is very important in providing education and training pertinent to sprayer application technologies to prevent pesticide contamination and minimize pesticide residues. The IPM modeling position is also vacant and is a required fit with the Ontario Weather Network (OWN) program. With the loss of the plant nutrition program at the University of Guelph, Vineland Campus in 2002, the TFRSSC stated its concern for lack of research and support in tree fruit nutrition and activities surrounding nutrient management for perennial horticulture crops. At a time when increased research inputs into nutrient management are needed, the University/OMAFRA has eliminated research in this area on tender fruit. Several research positions including the nematologist position has been vacant for several years. The vacancies at AAFC, Vineland, OMAFRA and University of Guelph are an outstanding concern to the TFRSSC.

Recommendations: The TFRSSC recommends AAFC, University of Guelph and OMAFRA to commit to refilling these positions to ensure continuity in these programs. The TFRSSC also recommends that the Ontario Horticulture Crop Research and Services Committee coordinate a “Business Case” for these positions and submit them to AAFC, University of Guelph and OMAFRA.

TFRSSC 2005-2 Registrations of products through the Minor Use process by Crop Groups and eliminate climatic sub-zones 5A and 5B for pesticide residue data requirements

TO: AAFC, PMRA

Background: During the Minor Use Priority Setting Meeting in March 2004 and 2005, AAFC announced that they did not have the resources to register minor use requests based on crop groupings for individual pests. If a registration for a crop grouping is requested, additional funds or other A priorities must be forfeited to fund the research on the representative crops required to obtain the crop grouping registration. Registration of products based on crop grouping is an efficient use of funds. A pesticide that controls a pest on apples would be expected to control the same pest in pears. The TFRSSC is concerned that without adequate funding to obtain crop group registrations, many reduced risk pesticides will not be registered on minor crops such as pears, a pome fruit, while the same pesticide is registered on apples, also a pome fruit. The TFRSSC recommends that AAFC pursue minor use registrations on crop groupings.

The Pest Management Regulatory Agency (PMRA) continues to demand pesticide residue data from climatic zones 5A and 5B. These are arbitrary subzones of zone 5 and there is no scientific evidence that Zone 5 should be subdivided. In the US, Zone 5 includes parts of New York and Michigan. Residue data is often not accepted by the PMRA from Zone 5 in the US and expensive trials are required from sub-zones 5A and 5B to register the same product on both sides of the border.

Recommendations: The TFRSCC recommends that AAFC conduct the required research to register products through the Minor Use Program based on crop groupings and that the PMRA eliminate climatic sub-zones 5A and 5B for pesticide residue data requirements.

TFRSSC 2005-3 Improve training and delivery of food inspection services such as Point of Origin

TO: OMAFRA Food Inspection Branch and Foodland Ontario

Background: During 2005, several growers indicated that tender fruit grown outside Ontario was being marketed and retailed as Ontario grown particularly at farmers markets under the Foodland Ontario logo. Growers acknowledge the marketing benefits of the Foodland Ontario Program and are concerned about inspectors' inability to determine the point of origin of produce marketed in Ontario.

Recommendations: The TFRSCC recommends that inspectors be better trained in determining country and/or province of origin and to monitor the marketing of imported tender fruit as Ontario grown.

TFRSSC 2005 -4 Conduct research into methods to reduce winter injury in tender fruit

To: OMAFRA, AAFC, Brock University, University of Guelph

Background: Winter cold injury has been a more serious problem in recent years particularly in 2005. The last three winters have all caused major economic damage. Overall, tender fruit yields are down 25% from normal. Thirty-five Ontario grape growers have installed over 200 wind machines at a cost of \$30,000 each in an effort to reduce cold injury in grapes. Many grape growers believe that the use of wind machines is one method that can assist them to make a consistent living in the Greenbelt Area, since economic survival is the only way to keep farmers on the land. Very little information on the effectiveness of these wind machines to reduce winter and cold injury to tender fruit is available.

Recommendations: The TFRSCC recommends that OMAFRA, University of Guelph and Brock University conduct research to mitigate the damage of winter injury, specifically wind machine research.

*As of October 2005, funding was approved for a 3 year CanAdvance/Crestech funded project with 10 industry partners. The four project leaders are Hugh Fraser – OMAFRA; Ken Slingerland – OMAFRA, Kevin Ker – Brock University and Dr. Helen Fisher – University of Guelph.

TFRSSC 2005 -5 Research and verify the effect of PPV on the quality of canned fruit

TO: AAFC

Background: European scientists studying PPV have often claimed that the virus causes yield reduction and only superficial blemishes on peaches. They have indicated that the ring and blotchy symptoms of PPV on the peel of infected fruit does not extend into the flesh of peaches and therefore would not affect the quality of peaches once they are peeled for processing. In 2003, a research trial was conducted by AAFC Vineland to determine the effect of PPV on canned fruit. The assumption had always been that PPV positive fruit did not show any symptoms after it was canned and therefore only the tree was directly affected by PPV. The trial consisted of baskets of Babygold 5 peaches, from verified PPV positive trees, being delivered to the Kraft St. Davids processing plant by AAFC personnel. The limbs that fruit were picked from were verified by CFIA to be PPV positive. All fruit delivered was canned under strict control and during a period when no other peaches were being processed. Samples were put into 14 oz cans by hand and were inspected for PPV symptoms, of which none were found. All product was canned under normal canning procedures and held for 3 - 4 months.

When the product was opened at AAFC Vineland, very pronounced symptoms were observed. The typical mottled rings of PPV infection was observed in over half of the canned peach samples. The symptoms were pronounced enough that Kraft personnel present at the time were of the opinion that a consumer complaint would be possible if this product was sold at retail. Pictures of the samples were taken by AAFC staff. Copies of the pictures were distributed to PPV taskforce and the Minister of Agriculture's office.

Follow-up research to verify the findings was promised by AAFC in 2004 and 2005 but was never conducted mainly due to arguments over funding arrangements within AAFC. Kraft Canada and the industry have expressed concern over the 2003 findings and suggested that the trials need to be repeated in order to make decisions on PPV positive fruit. Kraft Canada is not able to conduct the research without assistance. CFIA must indicate which clingstone peach trees are positive and indicate which limb was showing positive for PPV. Only after verification can Kraft receive the fruit and do a canning trial. There is also the issue of confidentiality concerning the grower and positive PPV results. AAFC personnel can assist CFIA with the harvest of the fruit and assist Kraft in assessing the results after processing. Kraft Canada would again assume the costs of actually canning the fruit.

This is an important research trial for the industry as a whole. While Kraft understands PPV positive fruit may have been received in past years, it is not able to segregate this fruit by physical symptoms if they are not visible at the time of canning. If the trial is replicated and symptoms in the processed fruit are found again, peaches from PPV trees cannot be processed. All trees in all blocks will have to be thoroughly sampled and only fruit from PPV negative trees could be harvested for processing. Without replication of this research, the industry and Kraft will not know if the 2003 results were only a one year anomaly. Having zero consumer complaints is Kraft's number one concern and this potential threat has to be assessed properly.

Recommendation: The TFRSSC recommends that further research into the effect of the canning process on PPV visual symptoms in commercially canned fruit be authorized immediately.

TOMATOES

QUICK REFERENCE – OTRSS Issues & Priorities

	Emerging Issues		Research & Services Priorities	
	Processing	Fresh market	Processing	Fresh market
1	Bacterial disease	Fruit quality	Access to Crop Protection Materials/Minor Use Registrations	Access to Crop Protection Materials/Minor Use Registrations
2	Waste management of culled and extracted fruit	New and emerging pests (eg. spider mites – 2005)	Breeding and Cultivar Development	Fresh Market Tomato Quality
3	Drip irrigation/ fertigation scheduling and tomato quality (solids, colour disorders)	Bacterial disease	Integrated Pest Management in Field Tomatoes	Breeding and Cultivar Development
4	Identification and registration of bacterial disease control and transplant growth regulators	Waste management of culled and extracted fruit	Crop Water Management Through Irrigation and Fertigation	Integrated Pest Management in Field Tomatoes
5	Water volumes and application pressures in field and greenhouse pesticide application	Drip irrigation/ fertigation scheduling and tomato quality (cracking, colour disorders)	Soil Fertility and Crop Nutrition	Crop Water Management Through Irrigation and Fertigation
6	Phytophthora	Identification and registration of bacterial disease control and transplant growth regulators	Transplant Quality	Soil Fertility and Crop Nutrition
7	Water rights	Water volumes and application pressures in field and greenhouse pesticide application	Availability of Suitable Land and Land Selection	Transplant Quality
8	New and emerging pests (eg. spider mites – 2005)	Phytophthora		Availability of Suitable Land and Land Selection
9		Water rights		

State of the Industry:

The 2005 season began dry and a bit cool, but soon became dry and hot.

The combined farm value for processing and fresh market acres in Ontario for 2004 was

Accumulated Rainfall for Southern Ontario May 1 – Oct 31, 2005 Accumulated CHU for Southern Ontario May 1 – Oct 31, 2005

	2005	Normal	% of Normal
Barrie	368.9	504.3	73.2%
Delhi	490.4	520.7	94.2%
Hamilton	498.2	481.2	103.5%
London	349.0	512.5	68.1%
North Bay	422.7	594.1	71.1%
Ottawa	548.7	508.4	108.4%
Ridgetown	262.4	505.0	52.0%
Sarnia	315.9	466.7	67.7%
Thunder Bay	483.5	479.3	100.9%
Toronto	329.3	442.3	74.5%
Trenton	410.6	447.9	91.7%
Vineland	408.2	460.7	88.6%
Waterloo	479.0	489.1	97.9%
Warton	412.3	501.4	82.2%
Windsor	293.6	493.2	59.5%

	2005	Normal	Difference
Barrie	3230	3092	138
Delhi	3679	3409	271
Hamilton	3698	3339	358
London	3776	3299	478
North Bay	3281	2634	648
Ottawa	3551	3302	248
Ridgetown	3839	3665	174
Sarnia	3822	3420	402
Thunder Bay	2610	2396	214
Toronto	3964	3301	663
Trenton	3638	3222	417
Vineland	3974	3664	310
Waterloo	3341	3094	247
Warton	3323	2834	489
Windsor	4328	3878	450

\$72,118,000. This was up 12.6% from \$64,049,000 in 2003 and up 11.0% from the 1999-2003 average of \$64,964,000. Most of the increase is due to the processing tomato industry, as the fresh market value has remained fairly steady, according to OMAFRA figures.

a) Processing Tomatoes

Acreage, contracted tons, and tons delivered were up in 2004 for processing tomatoes. The final yield set a new record for Ontario. About 800 ac were left unharvested as processors met their packing goals on fewer acres due to the record yields.

Table 1: Recent trends in the processing tomato industry in Ontario. (Sources: OPVG, OMAFRA)

Year	Contracts	Measured Acres	Processed Tonnage	Avg. Yield (tons/ac)	Gross Farm Value
1996	222	15,940	502,000	31.2	\$52,475,000
1997	192	14,800	497,000	33.3	\$50,310,000
1998	183	15,060	562,000	37.0	\$58,942,000
1999	187	16,866	544,940	32.0	\$57,286,000
2000	173	15,818	450,490	28.4	\$44,233,000
2001	173	16,821	533,440	31.6	\$50,866,000
2002	176	17,126	618,830	36.2	\$62,015,000
2003	173	14,863	540,968	36.4	\$53,149,000
2004	169	16,464	651,890	39.6	\$61,218,000
2005	166	16,375	651,697	39.8	N/A

p = preliminary. N/A = not available.

The growers of the Ontario Tomato Seedling Growers' Marketing Board (OTSGMB) produced approximately 216 million seedlings in 2005, up from 211 million in 2004.

In 2005, transplant growers continued to follow a bacterial disease management protocol set out by the OTSGMB. This included five applications of copper for bacterial disease control. Most field growers also focussed on applying copper early and often. It is generally felt that these measures have been beneficial in managing bacterial disease.

Some bacterial disease was present in 2005 (worse in the limited area that received some heavy rains), but generally at low levels which did not cause significant losses. The potential for serious losses due to bacterial disease is still a major concern to the industry, as currently available control options are not sufficient when disease pressure is high and conditions conducive to spread.

The hot, dry summer kept disease pressure low and advanced maturity. There was some problem with overmaturity at certain points in the harvest season due to spring planting schedules and higher than average heat unit accumulation through the summer and fall. Colour, solids, and recovery were excellent, although solids remain a concern in fields affected by bacterial disease and in irrigated fields. Again in 2005, the research and infrastructure in place (breeding, transplant production systems, irrigation, production and harvesting practices, and processing capabilities) allowed the industry to overcome adverse conditions and produce and process a high yielding crop.

The first day of processing was August 10 and processing finished by mid-October.

b) Fresh Market Tomatoes

Table 2: Recent trends in the fresh market tomato industry in Ontario. (Source: OMAFRA)

Year	Harvested Acres	Farm Value
1994	6,308	\$36,705,000
1995	5,217	\$26,454,000
1996	5,714	\$22,603,000
1997	5,500	\$19,800,000
1998	2,325	\$10,865,000
1999	2,200	\$11,400,000
2000	2,230	\$12,490,000
2001	2,560	\$14,480,000
2002	2,600	\$10,000,000
2003	2,500	\$10,900,000
2004	1,800	\$10,900,000
2005	N/A	N/A

N/A = not available.

The hot, dry summer kept disease pressure low and advanced maturity. Insect pests, including hornworm, cabbage looper, and spider mites were troublesome. Size and quality were excellent, until some rains were received, when weather checking became a major problem. This is a recurring problem year after year. Up to 60% of the crop can be unmarketable at times due to weather checking.

Prices were poor, at some points lower than 2004 prices. Early production is very important to receive the better prices. By Canadian Thanksgiving, most of the grocery chains stop buying Ontario field tomatoes.

Emerging issues/concerns (Processing Industry):

1. **Bacterial disease.** Although this is certainly not a new problem, current strategies and available products do not reach the level of efficacy needed by the industry. An action plan involving research, production, and industry activities implemented in 2003 has been beneficial. More effective control products, more reliable commercially available diagnosis, and more research are needed.
2. **Waste management of culled and extracted fruit.** This has become a more challenging and costly issue for tomato growers and processors in recent years.
3. **Drip irrigation/fertigation scheduling and tomato quality (solids, colour disorders).** Questions remain about irrigation levels, cut off dates, and other factors influencing solids. How can we optimize solids, quality, and yield with drip irrigation and fertigation? Research is underway to try to provide answers. Maximizing water use efficiency is also a priority.
4. **Identification and registration of bacterial disease control and transplant growth regulators.** Systemic Acquired Resistance (SAR) products exist which have the potential to reduce bacterial disease problems. Growth regulator products have been identified which could revolutionize transplant production and advance

harvest by up to a week. This would dramatically increase the competitiveness of the Ontario processing tomato industry. To date, no progress has been made in registering these products for use in the Ontario processing tomato industry.

5. **Water volumes and application pressures in field and greenhouse pesticide application.** Do high pressure field sprayers cause damage and disease infection? What is the optimum water volume for greenhouse and field copper applications? Are growers achieving effective coverage with fungicides and insecticides under current practices?
6. **Phytophthora.** Phytophthora blight (*P. capsicii*), affecting peppers, tomatoes, and vine crops has become a major pest issue in neighbouring states. The disease has been found in peppers in Ontario and is expected to become a major disease in vine crops as well. Tomatoes are susceptible to this disease, and rotations with vine crops, such as cucumbers, would be a problem if the disease became established. Screening for fungicides with efficacy against this pest, in co-operation with U.S. efforts, is essential. This work needs to be done before there is an Ontario outbreak. Pathologists feel that an Ontario outbreak is inevitable.
7. **Water Rights.** New legislation, regulations under development, international agreements will need to be monitored as to how they may impact the Ontario agriculture industry's access to water. This includes "Watershed Based Source Protection Planning" (see Ministry of Environment - <http://www.ene.gov.on.ca/envision/water/spp.htm>) and "Protecting Great Lakes Basin Waters" (see Ministry of Natural Resources - <http://www.mnr.gov.on.ca/mnr/water/greatlakes/index.html>).
8. **New and Emerging Pests (eg. spider mites – 2005).** The lack of access to new pesticides in Canada gives Ontario growers a very limited range of choices for pest control. In many cases, no pesticide options are available for new and emerging or existing pests. With reductions in research funding and retiring researchers not being replaced, there is concern that sufficient infrastructure is not in place to deal with new and emerging pest problems.

Emerging issues/concerns (Fresh Market Industry):

1. **Fruit Quality.** Weather checking is a major problem for fresh market growers every year, causing losses in marketable yield of up to 60%. Other disorders causing quality problems include gray wall, blotchy ripening, catfacing, and fruit cracking. Post harvest technology is another area where research is needed.
2. **New and Emerging Pests (eg. spider mites – 2005).** See *Processing Industry*, above.
3. **Bacterial disease.** Although this is certainly not a new problem, current strategies and available products do not reach the level of efficacy needed by the industry. Many of the strategies implemented by the processing industry are also beneficial for the fresh market industry. More effective control products, more reliable commercially available diagnosis, and more research are needed.
4. **Waste management of cull fruit and vegetable waste.** This has become a more challenging and costly issue for tomato growers in recent years.
5. **Drip irrigation/fertigation scheduling and tomato quality.** Questions remain about irrigation levels, cut off dates, and other factors influencing yield and quality. Maximizing water use efficiency is also a priority.
6. **Identification and registration of bacterial disease control and transplant growth regulators.** Systemic Acquired Resistance (SAR) products exist which have the potential to reduce bacterial disease problems. Growth regulator products have been identified which could revolutionize transplant production and advance harvest by up to a week. This would increase returns to Ontario fresh market tomato growers. To date, no progress has been made in registering these products for use in the Ontario tomato industry.
7. **Water volumes and application pressures in field and greenhouse pesticide application.** See *Processing Industry*, above.
8. **Phytophthora.** See *Processing Industry*, above.
9. **Water Rights.** See *Processing Industry*, above.

Research & Services Accomplishments & Subcommittee Activities:

SubCommittee activities. The Ontario Tomato Research and Services Subcommittee met on Nov. 8, 2005 in Ridgeway, Ontario. The committee discussed the state of the industry, research and service activities, research and service issues/priorities, technology transfer priorities and concerns, and prepared a list of minor use priorities.

Research activities. - Highlights of research reports

- Released 60 varieties of breeding lines to OTRI members for 2005 (Loewen)
- One line identified that can hold ripe fruit quality for 5 weeks (Loewen)
- 1,303 breeding lines (F2-F6) planted in 2005 (Loewen)
- Selecting for acceptable vine size, acceptable maturity, large fruit size, then earliness, firmness, colour, yield, holding ability (Loewen)
- Horizontal resistance breeding for anthracnose, bacterial spot, early blight (Loewen)
- Working on controlling seedling height through crossing – dwarf trait one strategy (Loewen)
- Noticing more blotchiness with increasing firmness in some lines; in other lines, firmness is not linked with colour (Loewen)
- 36 entries in yield trial (Loewen)
- Tanos gave poor control of fungal disease and did not control bacterial disease in trials (Pitblado)
- Tanos & Kocide 2000 showed results on bacterial disease but only slightly better than Kocide alone (Pitblado)
- At high rates of Kocide 2000, mancozeb did not improve bacterial disease control; at low Kocide rates, mancozeb improved bacterial disease control (Pitblado)
- There was no increase in bacterial disease control when the spray solution was adjusted to lower pH (Pitblado)
- Agri Fos 400F applied one week before transplanting (in greenhouse) boosted early season vigour, but was not effective in the control of bacterial and fungal diseases– Agri Fos did not impact yield or maturity (Pitblado)
- Agri Fos applied after transplanting was not effective in controlling disease and when used on its own made the fruit soft and mushy (Pitblado)
- Conducted bridging work for formulation change in Matador (Pitblado)
- Work was done on the over wintering of bacterial diseases in Ontario (Cuppels)
- Refining the method of extracting bacterial disease from transplants (Cuppels)
- Effectiveness of seed treatments in combating bacterial disease (Cuppels)
- Wheat roots seem to be harbouring the speck and spot viruses (Cuppels)
- Wild carrot, green foxtail, catnip are hosts for bacterial disease (Cuppels)
- Completing work on growth regulators to establish advanced maturity plants (Zandstra)
- Used propiconazole last season but unlikely to be registered (Zandstra)
- Now looking at other PGR's – triazoles and Apogee (Zandstra)
- Effect of propiconazole and mycobutanil wears off, requires multiple applications but gives better plants than paclobutrazol and uniconazole; Apogee no effect as applied (Zandstra)
- Adding Cabrio to Pinnacle resulted in commercially significant injury (Robinson)
- Evaluated tolerance of 16 processing tomato varieties to Pinnacle (Robinson)
- Acceptable margins of safety using low rates of Dual applied at 21 or 28 days after transplanting (Robinson)
- Time of day of application affected tolerance to Pinnacle, even in varieties believed to be tolerant to Pinnacle; time of day of application also influenced velvetleaf control (Robinson)
- Valor and Callisto cause significant injury to tomato crop (Robinson)
- Looked at deficit irrigation, irrigation cutoff time – 2003-2005 (Warner)
- In 2005 (dry), yield and total solids/ha increased with increased water applied (Warner)
- Total solids (%) decreased with increasing water applied (Warner)
- In all 3 years (wet and dry) drip irrigation increased tomato yield (Warner)

Research activities - Research projects

Breeding

Breeding and cultivar evaluation of processing tomatoes. 2005. Loewen, S.

Soil, Fertilizer and Irrigation Management

Agronomic and environmental consequences of applying fertilizer nitrogen and phosphorus to processing tomatoes under drip fertigation. 2005. Zhang, T.Q., C.S. Tan, J. Warner, C.F. Drury, W.D. Reynolds, A. Hamill.

Drip irrigation water management strategies to enhance processing tomato fruit solids, quality and yield. 2005. Warner, J., C.S. Tan, T.Q. Zhang.

Effect of Stoller “Root Feed” products on the development, maturity and yield of processing tomato. 2005.

Zandstra, J.W.

Evaluation of phytoremediation organisms on seedling tomatoes and the response in the field. 2005. Pitblado, R.E.

Transplant Production

Development of strategies to manage transplant vigour and advance maturity in processing tomatoes. 2005. Zandstra, J.W.

Disease management

Ecological/epidemiological studies of the highly virulent Group C and D forms of the bacterial spot pathogen. 2005. Cuppels, D.A.

Registered fungicide programs for the control of fungal disease in processing tomatoes. 2005. Pitblado, R.E.

Effectiveness of the fungicide Tanos 50DF in suppressing bacterial spot in field tomatoes. 2005. Pitblado, R.E.

Copper products for the control of bacterial spot in field tomatoes. 2005. Pitblado, R.E.

The effect of Agri-Fos for the reduction of transplant stress and control of bacterial spot in tomatoes. 2005. Pitblado, R.E.

Cuprofix Ultra and Agri-Fos for the control of bacterial and fungal diseases in tomatoes. 2005. Pitblado, R.E.

Evaluation of timing of treatments of Heads Up for the control of bacterial spot in field tomatoes. 2005. Pitblado, R.E.

Organic plant wash for the control of bacterial spot in tomatoes. 2005. Pitblado, R.E.

Epidemiology, preliminary control measures, and characterization of isolates of *Phytophthora capsici* from pepper, tomato, and cucurbit fields in Ontario. 2005. Cerkaskas, R.

Insect Management

Insect control in processing tomatoes using DPX-E2Y. 2005. Pitblado, R.E.

Evaluation of co-formulations of imidacloprid and deltamethrin for the control of insects in tomatoes. 2005. Pitblado, R.E.

Bridging NPE variants of Matador for the control of insects in tomatoes. 2005. Pitblado, R.E.

Weed Management

The effect of weed management programs on tomato establishment and yield. 2005. Robinson, D., Hamill, A.

Weed control and tolerance of tomatoes to tank mixes of Pinnacle, Prism, or Sencor with Quadris or Cabrio. 2005. Robinson, D., Hamill, A.

Weed management in tomatoes with new tank mixes. 2005. Robinson, D., Hamill, A.

Effect of postemergence applications of Dual II on weed control and tolerance in tomato. 2005. Robinson, D., Hamill, A.

Tolerance of processing tomato varieties to Pinnacle. 2005. Robinson, D.

Effect of timing on postemergence applications of Dual II. 2005. Robinson, D.

Effect of time of day on tolerance of tomato to Pinnacle. 2005. Robinson, D.

Extension Activities.

OMAFRA Extension activities included:

- Production of factsheet “Bacterial Diseases of Tomato: Bacterial Spot, Bacterial Speck, Bacterial Canker” with LeBoeuf, Cuppels, Dick, Pitblado, Loewen, Celetti.
- “Tomato and Pepper”, “Weed Management”, “Manure Management & Cover Crops”, “Innovations & Fresh Market Quality”, and “Hort Issues” sessions organized at Ontario Fruit and Vegetable Convention, February, 2005 (LeBoeuf, Huffman, Verhallen, DeEll, Jones)
- Projects on greenhouse gas mitigation, soil nitrogen, irrigation scheduling, cover crops (LeBoeuf, Verhallen)
- Food safety studies in tomatoes, other vegetable crops (Arthur).
- Great Lakes Vegetable Working Group activities, in co-operation with Ohio, Michigan, Indiana colleagues. This is a forum for communication and collaboration between vegetable specialists across the Great Lakes vegetable growing areas. (LeBoeuf)
- Eleven “Processing Crop Updates” and nine “Fresh Market Grower Update” issued. (LeBoeuf)
- Updating OMAFRA vegetable web pages, organizing meetings and events, responding to inquiries. (LeBoeuf, Verhallen, others)
- Attended 20th Annual Tomato Disease Workshop, October 20-21, Wooster, Ohio. (LeBoeuf)
- Organized tour of southwest Ontario vegetable industry for Ohio Vegetable & Potato Growers’ Association (LeBoeuf).

Research & Service Issues/Priorities:

There is a need for ongoing funding to support research and service (technology transfer) activities in support of the Ontario tomato industry. The following highlights the research and service issues.

Research & Service Issues/Priorities (Processing Industry):

1. Access to Crop Protection Materials/Minor Use Registrations.

Improved access to newer, safer, more environmentally friendly and biocontrol materials through the URMULE and URMUR programs is required. The following concerns need to be addressed.

1. Canadian growers require equal access to new pest control products and plant growth regulators available in the US and this can be accomplished with shared registration, residue levels, preharvest intervals, and re-entry intervals set at the same time and at the same levels as the US. Canada still has a number of registration requirements unique to Canada which increases the cost of Canadian registrations, slows the process and often results in denial of access to products in Canada.
2. The registration process needs to be speeded up so that Canadian farmers have access to the newer products at the same time as their US counterparts.
3. Adequate funding for the URMULE and URMUR programs is required.
4. GLP compliant facilities need to be available to ensure that residue and other data development work to support minor use registrations in Ontario that are not funded by AAFC may be carried out.

2. Breeding and Cultivar Development.

The availability of suitable cultivars is essential for the tomato industry to continue in Ontario. The Ontario breeding program has been a key factor in maintaining the competitiveness of the processing industry and has played a major role in yield and quality advances made over the last 15 years. Current research efforts are addressing the opportunities that will continue to provide a basis for sustained development of the Ontario processing tomato industry. Emphasis should be placed on earliness, disease and pest resistance, reduction in mould counts, fruit firmness, peeled colour, field storage capability and field and factory yield. Bacterial diseases have been a persistent industry problem and breeding to select for field resistance (horizontal resistance) should be emphasized

3. Integrated Pest Management in Field Tomatoes.

The sustainability of the tomato industry depends on safe, blemish free produce. Continued research efforts are needed to address the current and new insects, diseases and weeds that compete with the production of tomatoes. The focus should be to identify safe and effective pest control materials such as herbicides, fungicides and insecticides, their proper rates, timing and application. Ongoing support into IPM development and delivery of IPM programs in Ontario are required.

The following are the issues that need to be addressed:

1. Bacterial diseases are persistent problems for both processing and fresh market growers. The development of diagnostic tools and management/control strategies, including biological control, greenhouse sanitation, disease screening of seed and improved methods for detection of bacterial diseases in seed and transplants is a high priority.
2. New pest (insect, disease, weed) control product development should remain a focus for tomato research in Ontario.
3. Adequate diagnostic services for the identification of insects, diseases and weeds. An improved diagnostic service for bacterial diseases is required (PCR based).
4. Erosion of IPM support by the public sector.
5. Lack of control of variegated cutworm is a concern. Resistance testing is required. A degree day model for variegated cutworm is also required.
6. Improved use of the Ontario Weather Network for delivery of pest modelled information, IPM programs, irrigation scheduling.
7. Pesticide and greenhouse sanitation registrations for the greenhouse tomato seedling industry.

8. The organic market for both fresh and processing tomatoes is generating interest. There is essentially no research to assist any of these growers to adopt this technology.
9. Food safety.
10. Effect of new cultural practices on pest management.
11. Effect of production practices on productivity of soils.

4. Crop Water Management Through Irrigation and Fertigation.

Research in the area of crop water management through efficient and environmentally benign irrigation and fertigation techniques is required.

The following areas require more research:

1. Efficient use of irrigation water to maximize yield and quality. More research is needed on scheduling of drip irrigation for tomatoes on a variety of soil types. What is the effect on tomato fruit quality such as soluble solids? What is the cost effectiveness of fertigation?
2. Water use restriction. Under drought conditions, water use restrictions are likely. More research is required to determine the critical stages for irrigation and to determine the impact on yield, quality and crop returns with restrictions on water use at various times.
3. Water quality. More research is required in the area of impact of irrigation water quality on yield and crop quality and food safety concerns.
4. Irrigation use expansion - availability of water sources.

In addition to these research activities, legislation which may have an impact on agricultural water use will need to be monitored and actions may be needed through the extension service.

5. Soil Fertility and Crop Nutrition

Soil fertility and crop nutrition research including evaluating current recommendations through crop response research (crop uptake/removal of nutrients and effects on nutritional aspects of tomato), assessments of nutrient application technology, best management practices, nutrient application timing and the environmental fate of essential crop nutrients, with particular attention to nitrogen and phosphorous, is required.

The following areas require more research:

1. Basis for the phosphorous recommendations. The nitrogen and potassium recommendations have had some work in the past 10 years, but few if any people appear to know the basis for the phosphorous recommendation. The phosphorous recommendation needs to be updated.
2. Losses/leaching. Information on the loss of nitrogen through leaching and other means during and after the crop and the use of cover crops to trap nitrogen is required.
3. Split application. Information on the efficient use of fertilizer and how to use split applications of fertilizer to best advantage with the least impact on the environment is required. The question of fertigation with many scheduled feedings is part of this.
4. Reduced tillage. The impact of reduced tillage on nutrient management is required.
5. Cover crops. Information on the uptake and predicting the release of nutrients is required.
6. Manure use and organic amendments. How does this impact on nutrient planning?
7. Fruit quality and fertilizer recommendations.

6. Transplant Quality

High quality healthy transplants are essential for a successful tomato crop. Continued research into crop management and pest management systems for the plug transplant crop is required.

Plant growth regulators have the potential to improve transplant health, transplant quality, and field establishment. Research on plant growth regulators has also indicated the potential for harvest to be advanced by several days. Plant growth regulators may also play a role in enhancing disease control when used in combination with disease control products. Further research is needed to identify compounds which can be registered in Canada and to determine how to use these products for maximum benefit.

7. Availability of Suitable Land and Land Selection.

Some of the yield enhancement that has occurred in the last several years has resulted from growers renting or purchasing land that has never been used for tomato production. This land produces heavy crops of tomatoes for the first few times it is used, but production seems to decline rapidly after the 2nd or 3rd crops. Cost effective methods to combat the 'replant syndrome' should be investigated, including proper field selection, tillage systems, irrigation and fertility practices, the use of soil amendments including cover crops, fumigation, different crop rotations and choice of herbicides.

Research & Service Issues/Priorities (Fresh Market Industry):

1. Access to Crop Protection Materials/Minor Use Registrations.

See *Processing Industry*, above.

2. Fresh Market Tomato Quality.

Weather checking is a major problem for fresh market growers every year, causing losses in marketable yield of up to 60%. Other disorders causing quality problems include gray wall, blotchy ripening, catfacing, and fruit cracking. Post harvest technology is another area where research is needed.

3. Breeding and Cultivar Development.

The availability of suitable cultivars is essential for the tomato industry to continue in Ontario. Most fresh market tomato cultivars used commercially in Ontario were developed outside our growing area, such as in the southern U.S. Emphasis should be placed on earliness, disease and pest resistance, fruit quality, good shipping and shelf life characteristics, and yield. Bacterial diseases have been a persistent industry problem and breeding to select for field resistance (horizontal resistance) should be emphasized.

Cultivar evaluation for fresh market tomatoes should also continue. Growers need trial information to help them select cultivars well adapted to our growing conditions and market requirements.

4. Integrated Pest Management in Field Tomatoes.

See *Processing Industry*, above.

5. Crop Water Management Through Irrigation and Fertigation.

Research in the area of crop water management through efficient and environmentally benign irrigation and fertigation techniques is required.

The following areas require more research:

1. Efficient use of irrigation water to maximize yield and quality. More research is needed on scheduling of drip irrigation and fertigation for tomatoes on a variety of soil types. What is the effect on tomato fruit quality and yield? What is the cost effectiveness of fertigation?
2. Water use restriction. Under drought conditions, water use restrictions are likely. More research is required to determine the critical stages for irrigation and to determine the impact on yield, quality and crop returns with restrictions on water use at various times. How can water use efficiency be maximized?
3. Water quality. More research is required in the area of impact of irrigation water quality on yield and crop quality and food safety concerns.
4. Irrigation use expansion - availability of water sources.

In addition to these research activities, legislation which may have an impact on agricultural water use will need to be monitored and actions may be needed through the extension service.

6. Soil Fertility and Crop Nutrition

See *Processing Industry*, above.

7. Transplant Quality

See *Processing Industry*, above.

8. Availability of Suitable Land and Land Selection.

See *Processing Industry*, above.

Technology Transfer Priorities:

Technology transfer activities occur through a number of channels. In the processing tomato industry, OMAFRA, Ridgetown College – University of Guelph, AAFC – Harrow and London, processing companies, the Ontario Tomato Seedling Growers' Marketing Board (OTSGMB), and the Ontario Processing Vegetable Growers (OPVG) all play a part in disseminating information. Examples of technology transfer include the OPVG District 1 Tomato Day, a one-day learning program in March, and the summer Vegetable Tour, where farms and research plots are visited to observe and discuss innovative technologies and techniques. The OTSGMB has been active in developing bacterial disease management protocols for their growers. AAFC researchers' technology transfer activities include presenting research results and information at industry events as well as hosting the weed tour and vegetable twilight tour. Ridgetown College researchers and staff also participate in educational events including many of those mentioned above. They work closely with growers and processors to make new information available. Processing companies are also very active in technology transfer to their growers. A number of OMAFRA staff work closely with the processing tomato industry to deliver information through various methods, such as educational events, in-season crop updates via e-mail, conference calls, discussion groups, newsletters, and training.

In the fresh market tomato industry technology transfer occurs through OMAFRA and some growers' associations. Less technology transfer occurs through researchers, as there is very little research funding available to allow them to work on fresh market tomatoes.

Consultants and agribusiness are involved in technology transfer in both the fresh market and processing industries.

A key aspect of technology transfer over the next few years will be transferring information on new crop protection products - where they fit in, and how to use them effectively. Many new reduced risk products will require higher levels of management skill and more intensive scouting to be used effectively and to avoid the development of resistance. They may need to be used in combination with other pest management techniques in order to provide adequate control.

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ACRONYMS

- **AAFC:** Agriculture and Agri-Food Canada
- **AAFC-GPCRC:** Greenhouse and Processing Crops Research Centre - Agriculture and Agri-Food Canada
- **AFB:** American Foul Brood
- **AFHRC:** Atlantic Food and Horticulture Research Centre
- **AIMS:** Agricultural Integrated Management Services
- **APF:** Agriculture Policy Framework
- **CARC:** Canadian Agri-Food Research Council
- **CFIA:** Canadian Food Inspection Agency
- **EPA:** Environmental Protection Agency
- **EVb:** Environmental Biology, University of Guelph
- **FQPA:** Food Quality Protection Act
- **GLP:** Good Laboratory Practices
- **IPM:** Integrated Pest Management
- **LCBO:** Liquor Control Board of Ontario
- **MFTIP:** Managed Forest Tax Incentive Program
- **MNR:** Ministry of Natural Resources
- **NISA:** Net Income Stabilization Account
- **NMP:** Nutrient Management Planning
- **NRC-IRAP:** National Research Council - Industrial Research Assistance Program
- **NSERC:** National Science Engineering and Research Council
- **OAC:** Ontario Agricultural College
- **OAMC:** Ontario Apple Marketing Commission
- **OASCC:** Ontario Agricultural Services Coordinating Committee
- **OBA:** Ontario Beekeepers' Association
- **OBGA:** Ontario Berry Growers' Association
- **OF&VGA:** Ontario Fruit and Vegetable Growers' Association
- **OFM:** Oriental Fruit Moth
- **OGGA:** Ontario Ginseng Growers' Association
- **OGVG:** Ontario Greenhouse Vegetable Growers
- **OHCRSC:** Ontario Horticultural Crops Research and Services Committee
- **OMAF:** Ontario Ministry of Agriculture and Food
- **OMSPA:** Ontario Maple Syrup Producers' Association
- **OPMRSC:** Ontario Pest Management Research and Services Committee
- **ORBLVRSC:** Ontario Root, Bulb and Leafy Vegetable Research and Services Committees
- **OSCIA:** Ontario Soil and Crop Improvement Association
- **OTFPMB:** Ontario Tender Fruit Producers Marketing Board
- **OTSPGMB:** Ontario Tomato Seedling Plant Growers' Marketing Board
- **PCR:** Polymerase Chain Reaction
- **PMRA:** Pest Management Regulatory Agency
- **PPV:** Plum Pox Virus
- **SCPFRC:** Southern Crop Protection and Food Research Centre, Agriculture and Agri-Food Canada
- **SHB:** Small Hive Beetle
- **SONG:** Society of Ontario Nutgrowers
- **TFRSSC:** Tender Fruit Research and Services Subcommittee
- **URMULE:** User Request Minor Use Label Expansion
- **URMUR:** User Requested Minor Use
- **WTO:** World Trade Organization