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IN ONTARIO EN ONTARIO



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Food and Rural Affairs

Ministère de l'Agriculture,
de l'Alimentation et des Affaires rurales

Agri-food research La recherche agro-alimentaire

IN ONTARIO

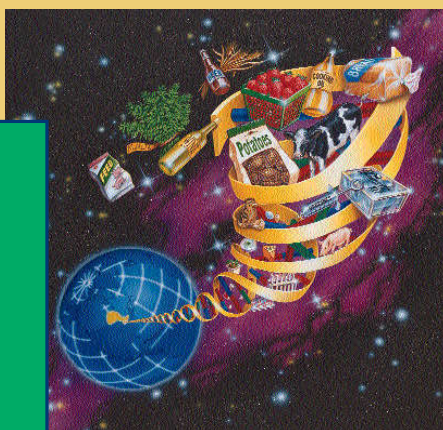
EN ONTARIO

READY-TO-USE PRODUCE
needs special care and handling
to ensure a safe landing on the
dinner plate



ONTARIO Agri-Food Technologies

From Discovery to Profit



There's strength in numbers, as the saying goes. Which describes the growing prominence of agri-food biotechnology in Ontario. The recently formed Ontario Agri-Food Technologies (OAFT) is a consortium of Ontario producer associations, industry, universities, and provincial and federal governments — all pooling their research and facilities to provide 'one-stop shopping' for biotech investors.

Agri-food biotechnology offers unprecedented opportunities to improve food safety, food processing, human and animal health, and crop and environmental protection. In other words: big benefits and big business opportunities.

That's where OAFT comes in. Their mission is to "provide leadership and coordination in utilizing biotechnology to generate wealth for the agriculture and food industries of Ontario." OAFT will help coordinate agri-food biotechnology research in Ontario, assist in the commercialization of new technologies, and raise the profile of Ontario's agri-food biotech industries at home and abroad.

Industry, Academic, Government Partnership Pools Resources

As of December 1996, the OAFT partnership included:

Universities and Government...

- five Ontario universities (Guelph, Queen's, Waterloo, Brock and Toronto)
- Ontario Ministry of Agriculture, Food and Rural Affairs, and Agriculture and Agri-Food Canada (observer)

Producer Associations...

- Ontario Federation of Agriculture
- Ontario Corn Producers' Association
- Ontario Soybean Growers' Marketing Board
- Ontario White Bean Producers' Marketing Board
- Ontario Fruit and Vegetable Growers' Association
- Dairy Farmers of Ontario
- Ontario Pork Producers' Association
- Ontario Cattlemen's Association
- Ontario Vegetable Growers' Marketing Board
- Ontario Flue-Cured Tobacco Growers' Marketing Board
- Ontario Wheat Producers' Marketing Board

Industry Members...

- Toronto Biotechnology Initiative
- Royal Bank of Canada
- Monsanto Canada Inc.
- Cyanamid — Crop Protection
- Dupont Canada Inc.
- Novartis Seeds Canada Inc.
- AgrEvo Canada Inc.
- Lingwood Farmers Ltd.
- Pioneer Hi-Bred Ltd.
- First Line Seeds Ltd.
- W.G. Thompson & Sons Ltd.

The group is supported by a well-established R&D infrastructure clustered at five major research centres in Ottawa, Kingston, Toronto, Guelph and London. Their strength lies in the wide range of research capabilities they offer — 'from discovery to profit.'

Researchers at these centres have already been successful in many areas of biotechnology, including gene discovery and transformation, embryo manipulation, plant stress tolerance and disease control, therapeutics and diagnostics, industrial yeasts, lipids and enzymes, nutraceuticals, as well as novel foods and feeds.

OAFT is located at the headquarters of the Ontario Ministry of Agriculture, Food and Rural Affairs. For more information, contact them at #1 Stone Road West, Guelph, Ontario, N1G 4Y2. Telephone: 1-888-ONT-AGRI or 1-519-826-4202.

Agri-food research La recherche agro-alimentaire

IN ONTARIO EN ONTARIO

DECEMBER 1996
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By the year 2000, the market share of ready-to-use (RTU) vegetables could climb as high as 20% of all produce purchased in Canada. Dr. Samuel Wang, with government and industry colleagues, is helping ensure that processors, shippers, buyers and users understand the special care that RTU produce requires.

Photo: Kerry Little,
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READYING INDUSTRY FOR ready-to-use

Vegetables

It takes teamwork

BY SAMUEL L. WANG¹ AND
JOSEPH ODUMERU²

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Ready-to-use (RTU) produce, freshly cut and packaged for immediate use, has recently become very popular in North America. Market research in the U.S. predicts a rise in RTU produce sales from \$5.2 billion in 1994 to \$19 billion in 1999 — an increase from 8.9% to 25.8% of the total produce market.

RESEARCH BENEFITS:

- Improved quality and longer shelf life through research in minimal processing, modified atmosphere packaging, and packaging film properties.
- Better understanding of the effect of temperature on microbial hazards under different storage conditions and length of storage.
- Recommendations for safe handling of RTU vegetables led to personnel training, including hospitals' HACCP training programs.

Figure 1. Projected annual increase of RTU produce market.

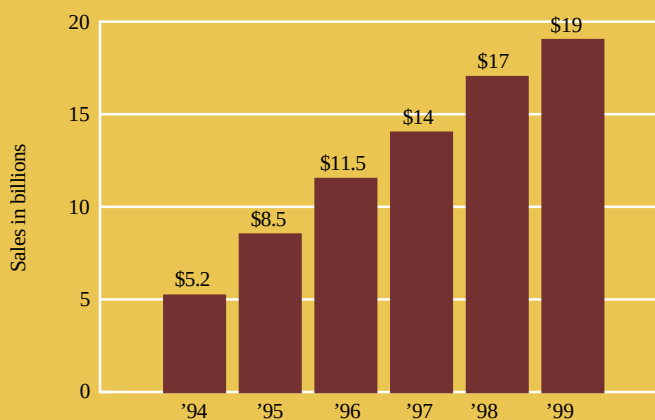


Figure 2. Percentage of RTU vegetable samples containing *Listeria monocytogenes* after 11 days storage at 4°C or 10°C.



Present market share of RTU produce in Canada, according to the Canadian Produce Market Association, is about 8% of the total produce market (\$0.48 billion). By the year 2000, market share could climb to as high as 20%. In Ontario supermarkets, more and more packaged RTU fruits and vegetables are showing up in produce sections (Fig. 1).

To sustain the growth of this new industry, which needed technical support in a number of areas, the Horticultural Products Laboratory (HPL) has been conducting processing research of RTU produce since 1990. Among the issues that have been studied are: plastic film evaluation and selection, shelf life study and extension, respiration of cut vegetables, and microbiological evaluation of cut and packaged vegetables during storage.

In recent years, processing technology of

RTU vegetables has evolved from the simple 'cut and bag' method to a much improved technique using modern processing equipment. Better quality and longer shelf life have been achieved through research in minimal processing, modified atmosphere packaging, and packaging film properties. Much progress has been made in the proper processing and packaging of RTU vegetables in the plant, but the importance of proper handling of packaged RTU vegetables has often been overlooked by food handlers and consumers.

Packaged RTU vegetables, like meat and dairy products, can pose a potential health hazard if the people involved in the delivery system do not follow correct handling practices. RTU vegetables are capable of supporting the growth of pathogens such as *C. botulinum* and *L. monocytogenes*. As consumption

Figure 3. Aerobic bacterial colony counts on RTU vegetables at days 0 and 7 of storage at 4°C or 10°C.

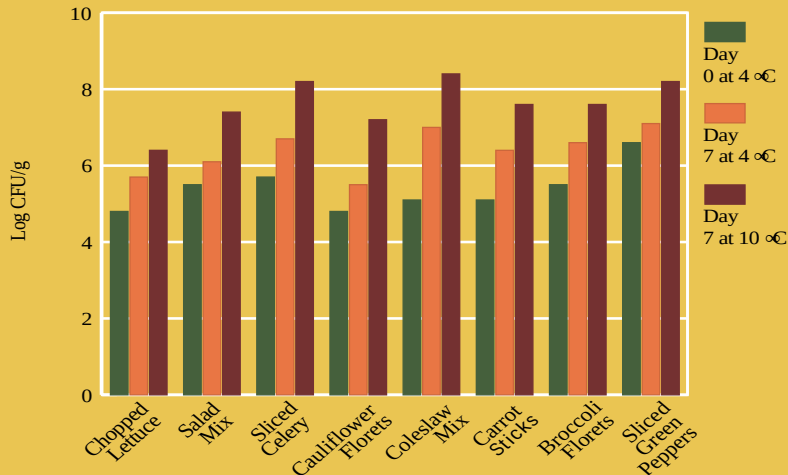


Figure 4. Frequencies of high temperatures in hospital coolers.

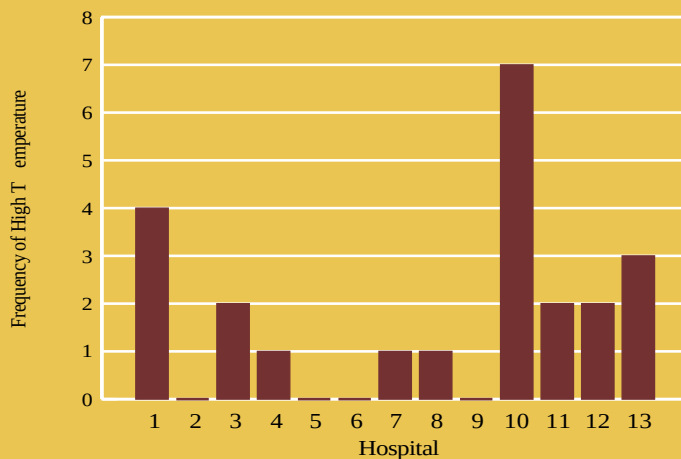
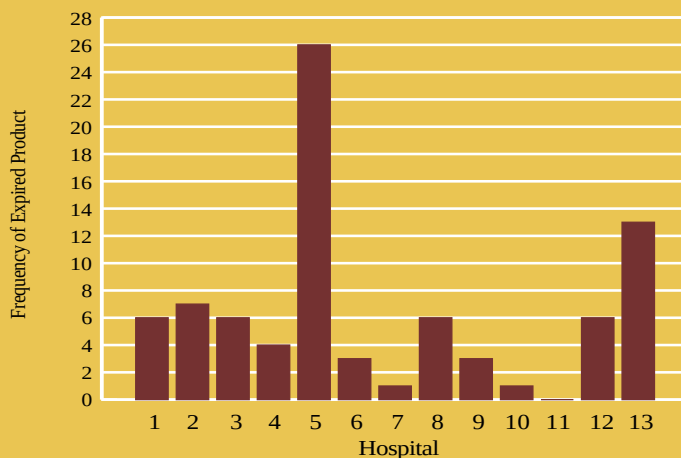


Figure 5. Frequencies of expired products found in hospital coolers.



of RTU vegetables continues to increase, the issue of microbial safety of RTU vegetables requires closer attention.

At the request of the Ontario Hospital Association (OHA), laboratories of the Ontario Ministry of Agriculture, Food and Rural Affairs conducted a shipping test for four weeks in early 1994. Processors and shippers participated. It became evident that temperature control was not always maintained by shippers and end-users, due to defective equipment and food service personnel's lack of training in handling of packaged RTU produce. A low level of pathogens was also detected from some samples by the Food Microbiology Laboratory (FML). These findings suggested that the quality and safety of RTU vegetables could not be fully assured after they were shipped from the processing plant.

More microbiological data were needed to advise food handlers in effective temperature and quality control. Under the Ontario Food Processing Research Fund, researchers began an assessment of microbial quality of RTU vegetables for healthcare food services.

In January 1995, a one-year project was initiated so that vegetables from different sources and different seasons could be sampled. The effects of temperature abuses on microbial hazards under different storage conditions and lengths of storage were also studied. Industry provided inputs in product sampling, equipment upgrading, personnel training, temperature verification, and problem reporting. Microbiological tests were carried out by FML. In summer 1995, HPL conducted a weekly monitoring program to examine the product quality and cooler temperature in the hospitals.

Throughout the testing period, a total of 65 unprocessed and 296 processed vegetable samples from the processor, and 135 samples from hospitals, were tested by FML and the Regional Public Health Laboratories of the Ontario Ministry of Health (MOH). Only low levels of *L. monocytogenes* and *E. coli* were detected from a small number of samples from the hospitals, and their counts remained stable if the vegetables were kept at 4°C.

No other pathogens were detected from these samples. Higher levels of total aerobic bacteria and *L. monocytogenes* were found in samples kept at 10°C (Figs. 2 and 3).

The eight-week auditing data again showed a number of temperature deviations (Fig. 4), and packages with expired code dates in users' facilities (Fig. 5), but repeated problems only occurred in one or two facilities.

Learning from the microbial profile of unprocessed and processed vegetables and the weekly auditing data gathered in this project, all participants became more conscious of temperature abuses in handling RTU produce, and adopted more effective means to protect its integrity. Recommendations for safe use of RTU vegetables were made by the researchers to industry, and MOH decided to include RTU vegetables in their Hazard Analysis Critical Control Point (HAACP) training program for hospitals.

The RTU vegetable research program continues as a collaborative effort among industry stakeholders and government researchers for a common goal — assuring the quality and safety of Ontario's food supply.

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Pour préparer l'industrie aux légumes prêts-à-l'emploi

La consommation des légumes frais prêts-à-l'emploi (PAE), en croissance rapide en Amérique du Nord, a pris au dépourvu les autorités sanitaires et les intervenants de la filière de distribution alimentaire. La salubrité des légumes PAE conditionnés passe par une manipulation consciencieuse et un contrôle strict de la température, et personne ne savait vraiment si les distributeurs étaient en mesure de remplir ces conditions. Depuis que de nombreux établissements hospitaliers sont devenus des acheteurs réguliers de légumes PAE, le secteur de la restauration collective dans les établissements de santé a exprimé ses préoccupations rel-

ativement aux risques que ces produits peuvent présenter à l'égard de la santé.

Au terme de travaux concertés qu'ils ont menés en Ontario, des chercheurs publics et des intervenants des secteurs de l'agroalimentaire et de la restauration dans les établissements de santé se sont rendu compte que des problèmes se posaient à plusieurs étapes de la filière de distribution des produits PAE : le réchauffement en cours de transport et d'entreposage chez les utilisateurs, les mauvaises conditions d'entreposage, et l'absence de méthode de rotation des stocks dans les chambres froides.

Il apparaît donc que le maintien des températures recommandées

d'entreposage, le contrôle régulier des températures, le respect des délais de consommation des produits et le bon entretien des installations sont des précautions indispensables pour réduire au minimum les risques à l'égard de la santé. Le moyen le plus sûr de préserver la qualité alimentaire des légumes PAE est de les maintenir constamment au froid, étant donné que l'on ne décèle aucune croissance d'organismes pathogènes à la température de 4 °C. La formation du personnel est également cruciale à l'application d'un programme efficace d'HACCP (points de contrôle critiques pour l'analyse des dangers).

GETTING THE OMEGA INTO THE EGG



Feeding Flax Seed to Hens Boosts Human Health

Not all eggs are alike. The old saying ‘we are what we eat’ applies to the chicken just as much as it does to the consumer. By altering the chicken’s diet, we can change the composition of the egg — and improve the nutrition and health of the consumer.

RESEARCH BENEFITS:

- Opportunity for increased egg sales.
- Healthier food product for consumers.

By feeding the hen flax seeds, we can dramatically influence the type of fat found in the egg. Omega-3 fatty acids, found in fish and in seeds such as flax, are useful in the prevention and control of certain cardiovascular diseases. The breakdown products of omega-3 fatty acids, known as DHA and EPA, seem to lower blood triglyceride levels, reduce the risk of blood clots, and reduce inflammation that occurs with rheumatoid arthritis.

Flax seed is very rich in omega-3 fatty acids, and when we incorporate this natural ingredient into the diet of the laying hen, a different fat profile is created in the yolk. If we feed a layer 20% flax seed in her diet, the fat in the yolk will contain 12% omega-3 fat. This compares to less than 0.7% found in most other eggs (Table 1). The other characteristics of the egg are unchanged. While the hen’s diet is a little more expensive, the number of eggs produced and their size grading remain the same.

BY STEVE LEESON AND LINDA CASTON,
Dept. of Animal and Poultry Science, University of Guelph

Table 1. Fat composition of egg yolks (%).

	% Flax in the diet		
	0	10%	20%
Linolenic acid ¹	0.7	6.8	12.8
Total saturated fat	45.7	45.7	44.8
Total polyunsaturated fat	16.3	25.0	30.4

¹Major omega-3 fatty acid

Table 2. Serum lipids and cholesterol in volunteers eating four eggs daily.

	Day 0	Day 7	Day 14
Total tryglyceride (mmol/litre)			
Control eggs	1.7	1.5	1.5
Modified eggs	2.0	1.3*	1.3*
Total cholesterol (mmol/litre)			
Control eggs	6.0	6.1	6.3
Modified eggs	6.2	6.6	6.4

*Significant change

Omega-enriched eggs offer triple wins to the egg market: important nutrients and reduced risk of heart disease for consumers, new markets for egg farmers, and wholesome, natural feeds for hens.

Other research has shown that the important fatty acids in the egg can also be modified by feeding fish oils to the hen. The drawback to this feeding strategy is the naturally 'fishy' odour of these oils, which can be transmitted to the egg. In future, it may be possible to develop less pungent fish oils for use in the hen's diet.

At the same time as modifying the fat profile of the egg, we can also enrich the content of vitamin E, an important nutrient in human nutrition and also an antioxidant, protecting fats from natural breakdown. Simply adding more vitamin E to the hen's diet results in her adding more vitamin E to the egg. Vitamin E helps to maintain the health of the laying hen, at the same time as adding protection for fats in the egg, and providing consumers with an enriched source of this important nutrient.

We have fed birds diets containing up to 100 mg vitamin E/kg of their diet, which is

about 10 times the normal level. When the eggs are analyzed, we find a level of about 10 mg vitamin E in each of the enriched eggs, compared to 2 mg in the normal egg. The daily requirement of vitamin E for an adult is around 7.5 mg/day, and so eating just one of the vitamin-enriched eggs daily provides the entire need for this important nutrient.

So what are the consequences for consumers eating these designer eggs? In co-operation with Bruce Holub, Dept. of Nutritional Sciences, University of Guelph (see *Agri-Food Research in Ontario* Vol. 18 No. 1), we have conducted blind studies on people eating eggs. Volunteers were asked to eat four eggs daily, and unknown to them, the eggs were either regular eggs or omega-3 enriched eggs. Sometimes we changed the source of eggs from regular to enriched and vice versa. Some volunteers ate no eggs in the test period, and served as a control.

Additional reading:

1. *Poultry Science* 69: 1522-1528.
2. *Food Research International* 25: 263-268.
3. *American Journal of Clinical Nutrition* 62: 81-86.

We found that egg type had no effect on blood cholesterol of the volunteers, but most interestingly neither did eating four eggs daily versus no eggs daily (Table 2). The positive aspect of eating the enriched eggs was a slight decline in serum triglycerides (fat levels in the blood) and a dramatic increase in the DHA content of fat in blood platelets (35%). This DHA (docosahexaenoic acid) is beneficial in preventing blood platelets from clumping together in the arteries, which can lead to thrombosis, arteriosclerosis and other circulatory problems.

The fatty acids in flax are similar to those found in fish, and this causes some concern with potential off-flavour of enriched eggs. While there is interest in maximizing the omega-3 levels in the eggs, this must obviously not be at the expense of reduced taste and flavour characteristics. In taste-panel studies, we find that consumers are unable to differentiate among eggs from birds fed up to 10% flax,

which is about the level now being used in commercial production of designer eggs.

However, at 20% flax in the hens' diet, some taste-panelists are able to detect a slight taste problem. For this reason, we are now interested in defining more closely the maximum level of enrichment that can be achieved, without causing any taste or flavour problems.

Although Health Canada recognizes the importance of omega-3 fatty acids in our diet, until very recently the food industry has not been able to make any claims about omega-3 enrichment in their packaging or advertising material. This situation is now resolved, and egg retailers are able to market omega-3 enriched eggs. Burnbrae Farms was one of the commercial sponsors of this early work on producing designer eggs, and is now marketing these eggs.

With careful selection of natural products, we may be able to develop other designer poultry products that meet the needs of health-conscious consumers.

For more information, contact:

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Des oeufs enrichis en acides gras oméga : Pour la santé du consommateur, les pondeuses mangent des graines de lin

Il est facile de modifier la composition des matières grasses de l'oeuf en ajoutant différents corps gras à la ration des pondeuses. On sait par exemple que les graines de lin contiennent naturellement des acides gras oméga-3, dont les chercheurs ont établi l'importance pour la santé des humains, en particulier pour ceux qui sont prédisposés aux maladies

cardiaques et cardiovasculaires.

Les pondeuses qui reçoivent des graines de lin produisent des oeufs dont le jaune renferme des acides gras oméga-3. La personne qui consomme chaque jour deux de ces oeufs ainsi enrichis ingère 60 % de la quantité totale d'acides gras oméga-3 qui est recommandée par Santé Canada. Chez les personnes qui ont

accepté de tester ces oeufs, le taux de triglycérides sériques (graisses) baisse légèrement, tandis que les plaquettes sanguines présentent une très haute teneur en DHA (acide docosahexanoïque), un acide qui s'oppose à la coagulation plaquettaire. Les oeufs enrichis en acides gras oméga-3 seront bientôt en vente en Ontario.

Fly Control in Swine Barns

Swine producers are moving towards large-scale operations to increase production efficiency. With that trend come the increased challenges of manure management and fly control. Large populations of flies within a swine facility are a nuisance to both workers and animals. Depending on the species of fly, a variety of problems may occur — ranging from the spread of disease to weight loss of animals.

Producers have traditionally used insecticides to keep fly populations under control. But with increased fly resistance, and concern about chemical exposure of workers and animals, there is growing interest in the development of integrated fly control that utilizes non-chemical (i.e., non-insecticidal) control methods.

Producers have a number of methods available to them. Some of the more common are baited-jug traps and sticky fly tapes. The use of biological control agents to control flies has received considerable attention in the United States. These agents have become commercially available in Canada only recently.

Pupal Parasitoids

One biological control agent is a tiny wasp (~2-3 mm) from the family Pteromalidae (Hymenoptera). They are raised within commercial insectaries in the U.S. and are shipped to supply companies in Canada. Unlike pesticides, there is no legislative requirement to determine the efficacy of the wasps before making them available for sale to producers in Canada. To assist producers, we conducted studies of the pupal parasitoids and compared their effectiveness in controlling flies in swine barns, relative to other non-chemical methods.

Several wasp species are available, but the one most recommended is *Muscidifurax raptor* Girault and Sanders. All pteromalid wasps that are reared for fly control attack the pupal stage (an inactive immature stage) of the fly, but do not sting animals or humans. An adult female wasp lays an egg within a fly pupa, the egg hatches, and the wasp larvae feed on the

developing fly, thereby killing it before it reaches adulthood. One adult female wasp is capable of parasitizing 14 pupae a day, and lives for about a week.

Wasp development (egg to adult) takes about three weeks at 27°C, whereas, at the same temperature, a fly can develop in about two weeks. Because of this, wasps would have to be released at least once every two weeks to keep up with the faster developing flies.

Comparing Non-Chemical Control Strategies

In our studies, weekly releases of 5,000 *M. raptor* within a weaning room (98.4 m³) and two grower-finisher rooms (244.7 m³) provided unsatisfactory fly control. Parasitism rates averaged 38.6% within a weaning room and 27.2% within two grower-finisher rooms. At a cost of \$244.50 per room for the 17-week trial, this level of control is considered to be too low. The high cost of the parasitoids (averaging \$44.15 per 15,000), compounded with low parasitism rates and low emergence rates of adult wasps, indicated this was not an economical choice for fly control. Also, there was no evidence that wasps would create a self-perpetuating population. Therefore, wasps must continually be released throughout the fly season.

Another biological product that is available to producers is the lesser black garbage fly, *Hydrotaea aenescens* (Harris). It also is not recommended because it could potentially become a pest itself, as we saw at our research site, where it ultimately displaced the house fly.

The effectiveness of fly tapes in swine housing was limited due to the airborne dust commonly found, which quickly coated the tapes. Baited-jugs, which use an attractant to lure the flies into the trap, provided good control. Within the smaller weaning room used in the

PHOTO: DR. STEVE MARSHALL



This pupal parasitoid, *Muscidifurax raptor*, is parasitizing a house fly pupa. Note the size of the wasp, compared to the fly pupa.

RESEARCH BENEFITS:

- Studies showed that pupal parasitoids such as wasps are not a cost-effective means of non-chemical fly control.
- Development of fly resistance to insecticides is delayed when non-chemical control methods are used.

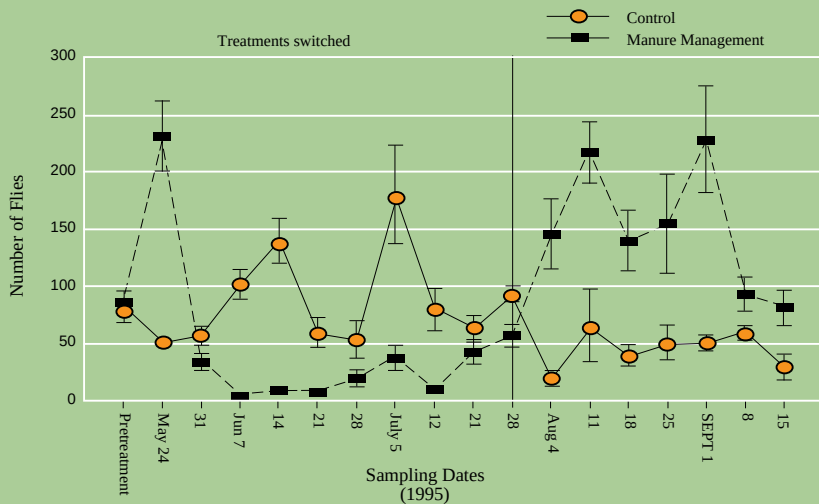


Figure 1. The number of flies observed resting on ten pen partitions within a manure-managed and an untreated room.

study, a single trap reduced the fly population by 57% compared to a control, but was not effective in the grower-finisher room, where there was a 10% reduction in flies.

However, after the trial had concluded, three traps were placed within a grower-finisher room that experienced an outbreak of flies, and the population was lowered to an acceptable level within three weeks. The baited-jug traps represent a one-time cost to the producer. (NB: They are not effective against stable flies.)

Not surprisingly, regular manure management showed itself to be one of the most reliable means of keeping fly populations under control. Manure was removed from the corners of the pens and around the feed bunkers with a high

Treatments within each room were switched on July 28, 1995. Manure was managed in the control room after this date, and unmanaged in the other room. After the switch, the number of flies within the two rooms reversed, demonstrating that manure management is effective.

pressure sprayer, and collected in the manure pits below. Liquefied manure within the pit was too wet to support any fly development. By removing manure at least once every 10 days (fly development from egg to adult can occur in seven days at 35°C), the amount of food available to the developing flies is limited, and any developing maggots and pupae are washed into the manure pit where they do not survive. In our study, fly populations were reduced by 64% compared to a control room (Fig. 1).

The cost of manure management is largely dependent on the cost of labour. On average, it took 30 minutes to clean each room. Based on a \$10/hr wage, this cost the producer \$5 per room per week.

Our comparison of non-chemical control methods showed that manure management and baited-jug traps can most effectively lower a fly population to an acceptable level, as well as slow the development of insecticidal resistance because no chemicals are used.

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Désinsectisation des porcheries sans produits chimiques : Évaluation des diverses méthodes

Nous avons vérifié l'efficacité de divers moyens non chimiques de lutte contre les mouches à l'intérieur des porcheries. Les moyens de lutte biologique sont de plus en plus recherchés en raison de la résistance croissante des mouches aux insecticides chimiques et des préoccupations relatives à l'exposition des travailleurs et des animaux aux substances nocives.

D'après les résultats observés avec les parasitoïdes des pupes et les petites mouches des ordures, nous ne

recommandons pas l'emploi de ces agents biologiques dans les porcheries. Les parasitoïdes des pupes sont d'un emploi peu économique car, outre leur coût élevé, ils ne parasitent que faiblement les pupes. Nous ne recommandons pas non plus la petite mouche des ordures (*Hydrotaea acnescens*) car elle est susceptible de devenir nuisible à son tour.

La gestion du fumier s'est avérée la méthode la plus efficace pour limiter les populations d'insectes. Mais

elle ne donne ses pleins effets que lorsque le fumier est évacué au moins tous les 10 jours puisque l'intervalle entre la ponte et le premier vol des adultes n'est que de 7 jours. D'autres méthodes, comme les pièges contenant un appât liquide et les rubans tue-mouches, ne sont vraiment efficaces qu'en cas d'infestation importante. Les pièges appâtés peuvent également être efficaces s'ils sont mis en place avant l'infestation. L'utilité des rubans tue-mouches est de courte durée à cause de la poussière, abondante dans les porcheries, qui diminue rapidement le pouvoir de la colle.

BY JIM JOHNSTON,
NEW LISKEARD RESEARCH STATION

Growing

Alfalfa

IN GOOD COMPANY

Managed properly,
companion crops help
forages get established
and provide respectable
yields in their own right

RESEARCH BENEFITS:

- Cereal companion crops yield up to 5.1 t/ha of forage within 60 days of seeding, while still providing weed and erosion control in new alfalfa seedlings.
- The addition of field peas to cereal companion crops consistently increases forage crude protein by two to four percentage units, and decreases NDF by two to six percentage units without harming alfalfa establishment.
- Companion crop management options are available to ensure optimum alfalfa establishment.

Perennial forages like alfalfa are usually established with a cereal companion crop. The companion crop helps suppress weeds and protects soil from erosion while the alfalfa seedlings get established. In most cases, dry grain and straw are harvested from the cereal companion crop.

However, companion crops left to mature for dry grain harvest can suppress the underseeded alfalfa by competing for light, water, and soil nutrients. In an effort to improve the establishment of perennial forages, many producers remove the cereal companion crop for silage during early summer. This allows the weed and erosion control benefits of the cereal companion crop to be realized, while greatly reducing the risk of excessive competition with the underseeded forages.

Oats have traditionally been the companion crop of choice in Ontario. Barley is used widely in western Canada, and spring triticale has become popular in parts of the U.S. midwest. Some producers mix field peas with the cereal companion crop in an effort to increase the feeding value of the resulting silage.

The impact of the various combinations of cereal companion crops on alfalfa establishment is not well-documented. This project was designed to examine the yield and quality of cereal or cereal-pea companion crops, and to evaluate the effect of each companion crop combination on subsequent alfalfa-timothy yield.

Figure 1. Companion crop yield at New Liskeard – average of 1994 and 1995.

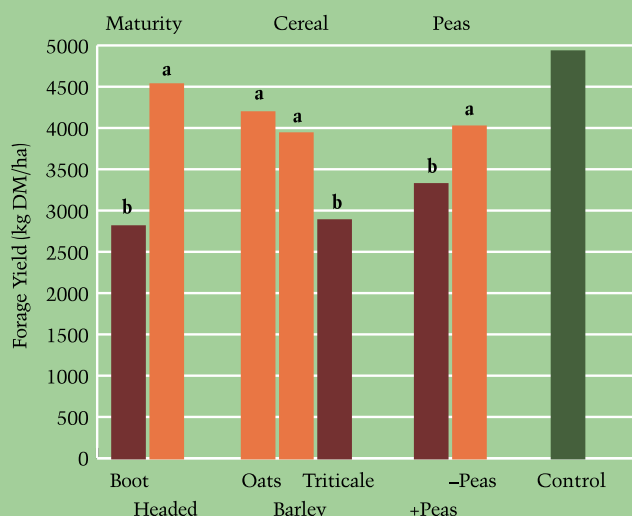


Figure 2. Companion crop protein at New Liskeard – average of 1994 and 1995.

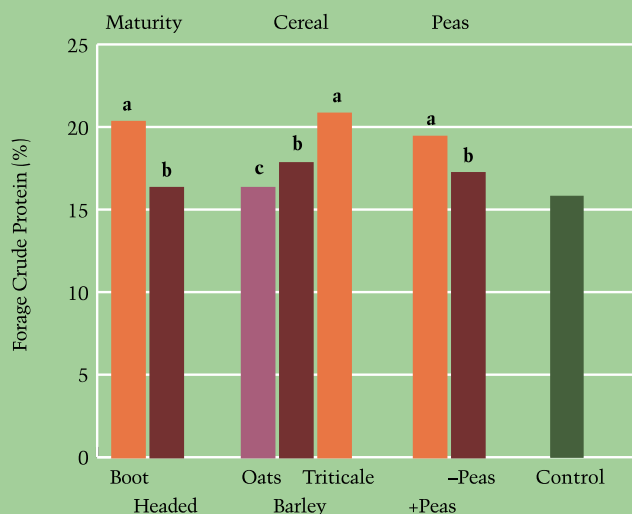
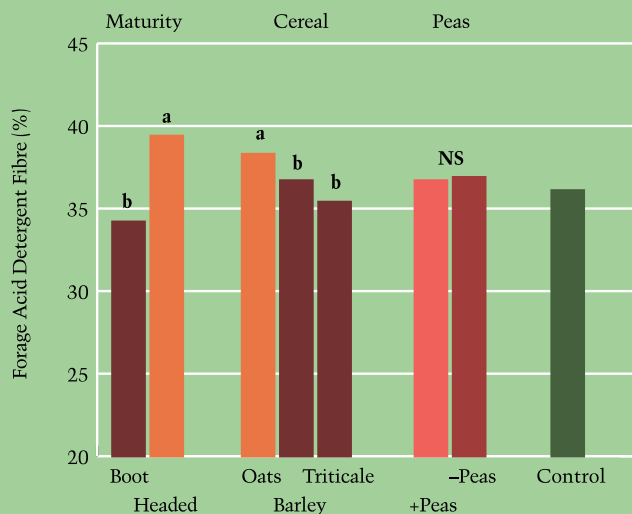


Figure 3. Companion crop ADF at New Liskeard – average of 1994 and 1995.



Oats, Barley and Triticale Evaluated

Field plot experiments were carried out at New Liskeard, Verner, and Thunder Bay in 1994 and 1995. The data reported here concern only New Liskeard, but results were similar at Verner and Thunder Bay. Companion crop maturity was examined by harvesting at the late boot and heads-emerged stage of cereal development.

Three cereal species were evaluated as companion crops — oats, barley, and triticale. Each cereal species was tested in pure stand or mixed with field peas. All plots were underseeded to an alfalfa-timothy mixture. In addition to the companion crops, check plots of direct-seeded alfalfa-timothy were included twice in each of four replicates. Details of the companion crop treatments are shown in Table 1.

Companion Crop Performance

i) Forage Yield

Companion crop forage yield was significantly increased by harvesting at the heads-emerged as compared to the late boot stage (Fig. 1). The magnitude of the yield difference varied between the two years, with a 100% yield increase in 1994 and a 34% increase in 1995. Oats and barley consistently outyielded triticale in forage yield. Mixing field peas with the cereal generally decreased the forage yield of the companion crop; however, this effect was less pronounced at the late boot harvest stage as compared to the heads-emerged harvest stage. It appears that in areas well-suited to cereal production, peas interfere with maximum dry matter accumulation of the cereals during the heading period, reducing total forage yields. Similar results would be expected in the cooler areas of southern Ontario (less than 2600 CHU's). Averaged over the two years of the study, forage yields were as high as 5.1 t/ha for pure oats harvested at the heads-emerged stage.

ii) Forage Quality

Companion crop crude protein content averaged four percentage units higher at the late boot harvest stage (Fig. 2), although this varied from two to six units between the two harvest years. Triticale consistently had higher crude protein, although this appears to be related to the composition of the harvested forage and not the species *per se*. Due to its relatively uncompetitive growth, triticale companion crops tended to have a higher pea content in mixture than other cereals, as well as having more seedling alfalfa in the harvested forage. The increased presence of these legumes in the triticale forage is likely the primary reason for increased protein in this companion crop, as compared to oats and barley. Cereal-pea mixtures consistently had crude protein levels two percentage units higher than pure cereals. Mixtures had average crude protein contents over four percentage units higher at Verner. It should be noted that the seeding rate of peas used here is perceived by producers to be quite high. Using seed mixtures of less than 50% peas by weight is unlikely to be worthwhile, as the pea content in the harvested forage will be too low to have a practical impact on feed quality.

Acid detergent fibre (ADF) levels were much lower in companion crops harvested at the boot as compared to heads-emerged stage of development (Fig. 3). Lower ADF values in the forage indicate higher Total Digestible Nutrient (TDN) content. Triticale and barley had lower ADF levels than oats. Adding peas to cereal companion crops had no effect on ADF content, suggesting that TDN levels were not different between pure cereals and cereal-pea mixtures.

Neutral detergent fibre (NDF) levels were much lower in companion crops harvested at the boot stage of development (Fig. 4). Lower NDF levels indicate an increased intake potential of forage by ruminants. Triticale had lower NDF levels than either oats or barley. The addition of peas to cereal companion crops reduced NDF by three percentage units at New Liskeard (Fig. 4) and by seven units at Verner. Thus, silage made from cereal-pea

Table 1. Details of companion crop treatments and underseeding.

Treatment Main Effect		
Harvest Maturity	Harvest 1994*	Harvest 1995*
Late Boot	July 13	July 27
Heads-Emerged	July 25	Aug. 2
Cereal Species	Variety	Seeding Rate (200 seeds/m²)
Oats	Rigodon	82 kg/ha
Barley	Kippen	85 kg/ha
Triticale	Frank	67 kg/ha
Peas Added	Variety	Seeding Rate
Yes	Trapper	100 kg/ha
No	-	0 kg/ha
Underseeded Forage and Direct Seeded Checks	Variety	Seeding Rate
Alfalfa	Centurion	13 kg/ha
Timothy	Climax	4 kg/ha

* 1994 seeding date: May 25; 1995 seeding date: June 2



Pure barley (left) and barley-pea companion crops (right) at the heads-emerged stage of maturity.

mixtures should have higher intake by cattle than pure cereal silage harvested at the same stage of maturity.

The relative trends in forage quality described here would be applicable to all parts of Ontario, assuming similar harvest maturities and seed mixtures were used. Averaged over the two years of the study, the maximum quality occurred in the triticale-pea mixture harvested at the boot stage. This treatment averaged 23.7% crude protein, 33.0% ADF, and 43.8% NDF.

Figure 4. Companion crop NDF at New Liskeard – average of 1994 and 1995.

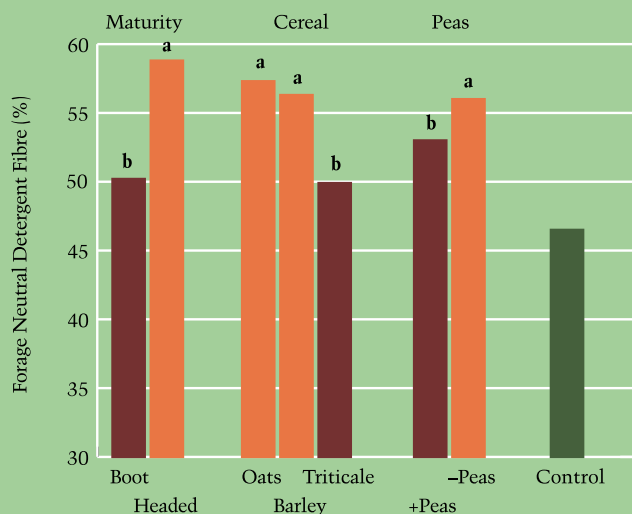


Figure 5. First-cut yield of alfalfa in 1995 after companion crop treatments in 1994.

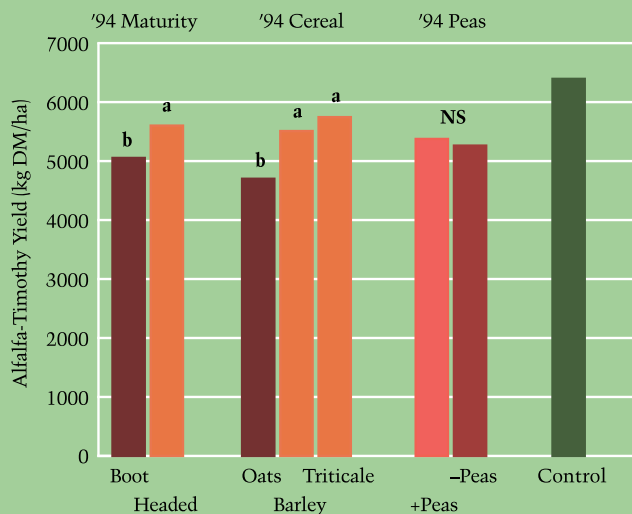
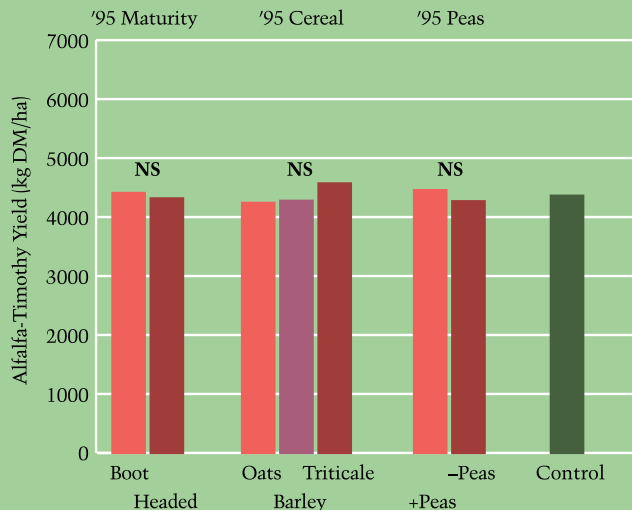


Figure 6. First-cut yield of alfalfa in 1996 after companion crop treatments in 1995.



Subsequent Alfalfa-Timothy Yields

The effect of companion crop management on subsequent alfalfa-timothy yields varied in the two years of the study. In 1995, first-cut alfalfa-timothy yields were lower when the previous year's companion crop was harvested at the boot rather than the heads-emerged stage of development (Fig. 5). Yields were also lower in oats as compared to barley or triticale, but were unaffected by the presence of peas in the previous year's companion crop. In 1996, there were no differences in first-cut alfalfa-timothy yield, regardless of the previous year's companion crop management (Fig. 6).

The 1995 results are due to the cereal regrowth that occurred following the companion crop harvest in the seeding year. In 1994, the companion crops cut at the boot stage regrew quite vigorously, while those cut at the heads-emerged stage regrew much less. The degree of regrowth was greatest with oats, intermediate with barley, and least with triticale. There did not appear to be any difference in cereal regrowth between mixed and pure plots of a given cereal species. Conditions following companion crop harvest in 1995 were much hotter and drier than in 1994, and no cereal regrowth occurred in any treatment.

The excessive oat regrowth in the fall of 1994 suppressed the underseeded forage mixture greatly. In longer season areas (greater than 2600 CHU's), a standard practice would be to take a second cut of cereal regrowth and underseeded forage just before the start of the critical harvest period. This practice would be questionable in northern Ontario and the short-season areas of southern Ontario, since the critical period starts between August 15 to 25. Further research is now underway to examine the effect of taking a second cut (consisting of cereal regrowth and alfalfa) in the seeding year on subsequent alfalfa performance.

Cereal regrowth following silage harvest varies greatly from year to year. In addition to stage of maturity and cereal species, it appears that soil moisture, air temperature, and possibly day length affect cereal regrowth following forage harvest. If conditions seem

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suitable for regrowth, letting the cereal begin to head out at least 50% before cutting should help to reduce the amount of regrowth. Using a barley companion crop should result in less regrowth as compared to oats. If cereal regrowth is excessive, taking a second harvest prior to the start of the critical harvest period for alfalfa may be necessary.

Conclusions About Yield and Quality

Companion crop forage yield is increased by later harvesting, but quality is reduced. In general, triticale has performed poorly relative to oats and barley. But it has good quality, since the harvested forage has more peas and underseeded alfalfa in it.

Adding peas tends to reduce forage yields relative to pure cereals, and this effect is increased by later harvesting. Adding peas at 100 kg/ha will consistently increase crude protein by two to four percentage units and decrease NDF by two to six percentage units. Vigorous cereal regrowth can represent a threat to alfalfa establishment. Strategies such as cereal species used and harvest maturity can reduce this problem, although it may only occur occasionally due to weather conditions.



Early oats (top left); late oats (top right); early barley (bottom left) and late barley (bottom right).

Under certain conditions, regrowth of cereal companion crops can reduce alfalfa establishment. Oats (top photos) regrew more than barley (bottom photos), while companion crops harvested at the late boot stage grew more (left photos) than those harvested at the heads-emerged stage (right photos).

Établissement d'un semis de luzerne : Influence de différentes cultures-abris et techniques culturales

Comme il existe peu de données sur cette question, nous avons cherché à déterminer le rendement et la qualité fourragère de différentes cultures-abris — céréales seules ou céréales associées à des pois de grande culture — et en avons mesuré l'effet sur l'établissement d'un peuplement de luzerne et de fléole des prés.

Nous avons constaté que le fait de retarder la fauche de la culture-abri permettait d'augmenter le rendement quantitatif de celle-ci, au prix toutefois d'une baisse de la qualité.

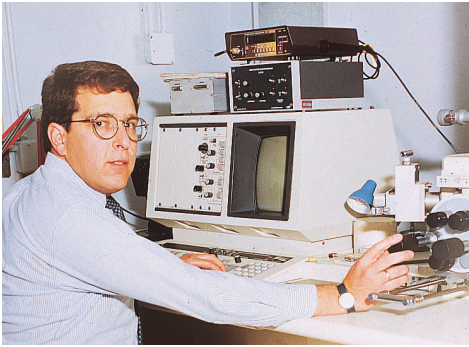
Dans tous nos essais, l'association triticale-pois a affiché un moins bon rendement quantitatif que l'avoine ou l'orge associée aux pois, mais sa qualité était bonne parce qu'elle renfermait plus de pois et de plantules de luzerne.

Comparativement aux cultures-abris constituées seulement d'une céréale, les associations pois et céréale donnent en général un rendement inférieur, effet qui s'accroît lorsqu'on fauche à un stade de maturité tardif. Dans les parcelles où des pois avaient

été ajoutés à la céréale à raison de 100 kg à l'hectare, la teneur en protéine brute du fourrage était de 2 à 4 points plus élevée et la teneur en cellulose au détergent neutre (NDF) de 2 à 6 points moins élevée. Une repousse drue de la céréale peut cependant gêner le bon établissement de la luzerne. Cet inconvénient ne se produit qu'à l'occasion, à cause de certaines conditions météorologiques, et il est possible de le réduire en adoptant certaines stratégies fondées sur le choix de la céréale et de l'époque de fauche.

Modifying Protein Gels for New Food Products

A Clear Choice for Consumers



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Being able to modify the appearance and textural properties of protein gels is important to food companies developing new products. Depending on the product, gels need

a certain texture — from tough to brittle — high water-holding capacity to reduce purge, and an attractive appearance. Research into various protein systems is helping determine the ways that gels can be formed according to product need.

The textural attributes of processed foods, such as cheese, custard and meat products, are directly related to the type of protein used in their manufacturing and the way it is prepared. Gels made from proteins (dairy, egg, meat, soy) or carbohydrates (pectin, carageenin) can exhibit diverse mechanical and microstructural properties.

In general, gels are defined as materials containing a continuous solid network that is assembled from particles or polymers embedded in an aqueous phase. Some of those networks can hold over 99% water in their structure.

Opaque and Clear Gels

Gels can be divided into two major categories.

The first is an opaque structure, typically formed by egg white proteins at their natural pH (Fig. 1a). This structure is composed of relatively large protein aggregates bound to one another to form the network.

The second category is a fine-strand gel structure produced by the association of small diameter molecules to form an order network.

These gels are usually clear (Fig. 1b) and are more elastic than the opaque gels. Variation between these two groups exists, and mixed gels can also be formed.

In Fig. 1a, you can see a typical egg white gel prepared with 5% protein at pH 8 (normal egg pH). The same figure also shows a clear egg white gel prepared at pH 3.2. This pH modification resulted in the formation of fine protein strands (see example in Fig. 2a), which allow light to pass through. Hence, the gel appears clearer.

By comparison, the opaque gel is composed of large aggregates (see Fig. 2b) that reflect most of the light and, therefore, the structure appears white/opaque. The microscopy pictures (Figs. 2a,b) were taken at high magnification of about 20,000 times, which was required to view the fine protein strands in the clear gel.

Water-Holding Capacity: Important to Consumers

Another major difference between the two gels is their water-holding capacity — an extremely important attribute to consumers. In products such as yogurt, cheese, and sliced meat, gels that possess high water-holding capacity show no purge in the package.

In terms of structure, opaque gels generally have poor water-holding capacity compared to clear gels. The reason is that the small capillary spaces within the structure of the clear gel can better retain the water than can the large open spaces within the opaque gel structure. These spaces are generally very small, measured in nanometres (10^9 of a meter). As they become larger, such as in opaque gels, water can no longer be tightly held within the structure. Obviously, consumers prefer to buy products that show no exudate in the package.

Whey proteins, which are used to make certain cheeses or additives in various foods,

RESEARCH BENEFITS:

- Food materials research leads to improved textural properties of protein-based food products, e.g., meat, dairy, soy.
- New cold gelation process develops protein system that will form a gel at room temperature, therefore reducing damage to heat-sensitive nutrients, such as vitamins.

can also be induced to form clear and opaque gels. Fig. 1c shows a typical opaque whey protein gel prepared with calcium salt. A clear gel produced with low levels of sodium salt is also shown in Fig. 1d. Both gels were prepared by conventional heating of the protein solutions. This is similar to heating a scrambled egg mix, where you heat up the protein solution (i.e., egg content) and get an elastic gel structure. In the case of whey proteins, the type of salt can dictate the structure formed during heating.

Cold Gelation

A third type of semi-transparent gel can be produced at room temperature with calcium salt. Using a new process called 'cold gelation', a protein solution is first pre-heated without any salt, and hence no gel is formed. The solution is then cooled down and held in a refrigerator overnight prior to a slow calcium salt addition. This results in a medium-size protein strand formation, which gives the gel a semi-transparent appearance (Fig. 2a). This process will resemble preparing a gelatin-type dessert without the need of hot water. Such a process can be important in protecting heat-sensitive nutrients (e.g., vitamins) in fortified foods.

Our current work examines the modifications required to the secondary and tertiary protein structure in order to achieve the right conditions for cold gelation. This includes examining the preheating conditions used to achieve partial/total protein conformational changes, which later can be used to control

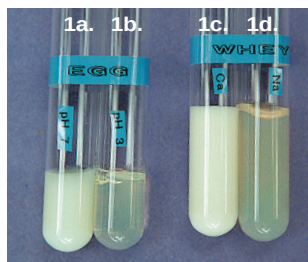


Figure 1. Protein gels: a) an opaque egg white protein prepared at pH 8.0 by heating; b) a transparent egg 'white' protein prepared at pH 5.0; c) an opaque whey protein gel prepared with 25 mM calcium; d) a clear whey protein gel prepared with 25 mM sodium.

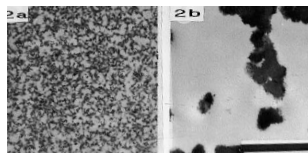


Figure 2. Transmission electron micrographs of: a) clear whey protein isolate gel prepared with 25 mM sodium; b) opaque whey protein isolate gel prepared with 25 mM calcium.

the hardness and elasticity of the gel. As well, we study factors affecting gelation rate (i.e., temperature, salt concentration), which can also be used to alter the gel characteristics.

Increasing gelation temperature and/or salt concentration results in an initial increase in gel hardness and the formation of larger aggregates. This by itself is desirable to the food technologist, up to the point when water-holding starts to decrease.

Determining the optimal conditions for this type of cold gelation is important to the food industry, which is interested in using the process to provide texture to products such as mayonnaise, and binding restructured meat products or onion rings prior to heating. We are approaching the point of being able to design the properties of a gel according to the industry's specific requirements.

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Additional Reading:

1. Barbut, S. Effects of calcium level on the structure of pre-heated whey protein isolate gels. *Food. Sci. Technol.*, 28:598.
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Gel à base de blanc d'oeuf

Les produits alimentaires tels que les charcuteries, les fromages et le tofu doivent leur texture à une structure protéique gélifiée. Cette structure doit être suffisamment forte pour empêcher l'aliment de se scinder, mais sans être dure ni caoutchouteuse. L'article ci-joint traite des facteurs qui influent

sur les propriétés texturales, la rétention de l'eau et l'aspect des gels à base de blanc d'oeuf. En gros, ces gels se présentent sous plusieurs aspects, allant d'opaque et friable à transparent et élastique retenant beaucoup d'eau. L'exemple utilisé pour illustrer ce point est la

modification d'une gelée à base de blanc d'oeuf qui prend un aspect translucide et laiteux. En outre, l'article présente la possibilité d'obtenir des structures protéiques gélifiées à température ambiante comme moyen de protéger les éléments nutritifs sensibles à la chaleur.

BY HUGH M. PEARSON,
Kemptville College of Agricultural Technology

Teeing up wildflowers to cut costs
and improve environmental quality
on the golf course



Wildflowers

Good for low-traffic areas

Residential lawns and turf areas in golf courses demand a high degree of maintenance. This includes expensive inputs such as weekly cutting, proper fertilizing and watering, and the application of chemicals to control weeds and other pests. In an effort to cut costs and improve land stewardship, we evaluated wildflowers as a natural, lower maintenance alternative to intensively cultivated turf areas.

Eight commercial wildflower seed mixes were sown in a replicated trial at Kemptville College of Agricultural Technology (KCAT) and were observed for several growing seasons under eastern Ontario conditions. Initial establishment of the wildflower plots was successful, but some weed competition was noted.

During the first growing season, the plots were very colourful, with annual wildflower species predominating. In the second growing season, perennial wildflower species began their colourful show, as the annual species provided less than half of the floral display in most plots.

The third growing season was characterized by the failure of the annual wildflower species to reseed themselves. Only one annual species was still present. Several perennial species appeared to dominate in each mixture, and throughout the replications more similarities among the composition of the mixtures of wildflowers became apparent.

Weed competition throughout the three growing seasons was a concern. Generally, none of the wildflower mixtures that was tested was successful at eliminating or controlling weed competition. To that end, the wildflower mixtures were unacceptable for use as total replacements to turf in highly maintained areas.

Annual wildflower species: California poppy, scarlet flax, coreopsis, and catchfly.





Beyond the green: how wildflowers can be put to use along fairway edges.



In a cottage or rural setting, wildflowers are a low-maintenance alternative to lawns.

If the most successful of the annual and perennial wildflower species were grouped together, the resulting mixture would have potential use in lower traffic turf areas and areas with lesser visibility. The edges of golf course fairways and service areas could be planted with wildflowers to reduce the maintenance required and to provide colourful summer floral displays. Lower visibility areas along roads, railways, and hydro lines could be planted with wildflowers to reduce the maintenance and input costs.

The recommended mixture or improved blend of wildflower species useful in the cooler, shorter season regions of Ontario is:

annual	California poppy, scarlet flax, dame's rocket, baby's breath, and bishop's lace
perennial	yarrow, bachelor's buttons, coreopsis, purple coneflower, blanket flower, blue flax, iceland poppy, mexican hat coneflower, and black-eyed susan

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Les fleurs sauvages : Une solution de rechange au gazon?

Les pelouses de nos jardins et les étendues gazonnées de nos terrains de golf nécessitent beaucoup d'entretien. Soucieux de diminuer les coûts d'entretien et d'améliorer la gestion de notre patrimoine foncier, nous avons cherché à savoir si des semis de fleurs sauvages pouvaient être une solution de rechange naturelle et moins contraignante aux gazons qui exigent des soins intensifs.

Nous avons réalisé des essais

répétés avec huit mélanges commerciaux de semences de fleurs sauvages au Collège de technologie agricole de Kemptville (CTAK) et nous avons observé les semis obtenus pendant plusieurs saisons de végétation dans les conditions de l'Est de l'Ontario.

Au long des trois saisons de végétation, la concurrence des mauvaises herbes a été problématique. Nous en avons conclu que les

mélanges de fleurs sauvages ne sauraient remplacer totalement le gazon dans les zones dont on s'attend qu'elles soient bien entretenues.

Si l'on associe les espèces annuelles et vivaces qui réussissent le mieux, le peuplement de fleurs sauvages obtenu pourrait remplacer le gazon dans les endroits peu fréquentés et dans les zones moins exposées au regard.

Findings for Industry from the Ontario Food Processing Research Fund

The Ontario Food Processing Research Fund was a five-year program established by OMAFRA to:

- help Ontario processors make use of new and efficient production R&D, and
 - encourage commercial development of new opportunities where the Ontario food industry was not yet established.
- In its partnership with Ontario food processors, it has produced many innovative technologies and new market opportunities.

Spanish Onions – extending storage to increase Ontario market share

Spanish onions are used widely for processing into onion rings. Those parts of the inner bulb that can't be used for rings are processed into pieces for use on pizzas, subs, hamburgers, and other fast-food products.

Ontario grows about 15% of the Spanish onions used in the province. Research trials at Vineland have shown that some cultivars grown in Ontario can be held in cold storage until February or March. This would help Ontario growers increase market share.

Cultivars with good storage, fresh market and processing potential included Bullring, Vaquero, Winner and Cuzco. As well as having few double hearts — which reduce ring yield when onions are processed — rings from these cultivars have good flavour, colour, firmness and integrity. In addition to the cultivars preferred for processing, Vega, Yula, Quest, Corona, Sundance, Sunrise and Candy have good storage and fresh market potential.

In Ontario, climatic conditions are very variable and thus Spanish onions should be forced-air dried (accomplished by blowing warm air through the onions). Air temperatures of 20°C to 40°C have been evaluated at Vineland. Rate of drying at 40°C was twice that at 20°C. Following four months of storage, onions dried at 40°C had more rot than onions dried at 20°C. This could have been caused by heat injury. Onions dried at 25°C, 30°C and 35°C did not have appreciably higher levels of rot than those dried at 20°C.

At a 35°C temperature and an air flow of 3 cfm to 4 cfm per cubic foot of onions, bulbs

with partially dried tops would dry in one or two days. Onions with green tops would require three to four days to dry under these same conditions. Much of this moisture comes from the two- to three-inch stub left on the onion after it has been detopped.

Increasing the volume of air flowing through the onions from 3 cfm to 7 cfm per cubic foot of onions did not accelerate the drying process. The tops of these onions had already partially field-dried before the trial was conducted. It is possible that onions with green tops may dry faster as volume of air through the onions increases.

Data from our research indicate Ontario-grown Spanish onions are softer than onions grown in drier climates. When Ontario onions were piled to depths exceeding four to five feet, the onions became severely deformed on the bottom of the pile. Ontario onions should therefore be held in bulk bins rather than in bulk storage rooms.

Research into methods of curing and storing onions will continue at Vineland as will cultivar selection trials. Research to date indicates that this crop has potential for commercial expansion for both fresh market consumption and processing.

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Coleslaw – keeping it light

Several million pounds of coleslaw are processed in Ontario each year. This coleslaw is shipped to fast-food outlets throughout much of Canada and parts of the U.S. Some is packaged for retail chains.

There have been instances of premature browning and/or greying in the finished product. It was suspected that some cultivars (varieties) of cabbage could be resistant to the darkening process or that some processing variable could be contributing to the darkening process.

When some late maturing (winter storage cabbage) cultivars were processed into coleslaw and the coleslaw exposed to air, the

Onions for processing or fresh market can be held in bulk bins in cold storage for several months at temperatures of 1°C and a relative humidity of 70%.





product changed colour very slowly. When this coleslaw was placed in low oxygen permeability bags, there was very little change in colour. Those cultivars included 1973YR, Lennox, Marathon, Masada and Galaxy. Coleslaw that darkened more extensively when exposed to air, but retained good quality in low oxygen permeability bags, was made from Multiton, National, Hybrid No. 4, Avalon, Bingo, and Bartolo. Other cultivars darkened rapidly when exposed to air and showed some colour change when packed in low oxygen permeability bags.

A search for coleslaw processing cultivars maturing from early to late summer was initiated in 1995. More than 20 cultivars were evaluated; six of these have been included in our 1996 trials for further evaluation (Masada, Hinova, Colegard, Bravo, Discovery and Transam).

In other trials it was found that the size of the shredded pieces would affect the darkening process. The larger chunks of leaf in the coleslaw tended to darken faster than the medium- or small-sized pieces. However, if ground too fine, the slaw would be mushy.

Coleslaw made from Hinova from each of 10 consecutive weekly harvests did not exhibit faster rates of darkening as the cabbage matured. Removing the outer green leaves and using solely the inner white leaves for making coleslaw did not slow the rate of darkening in the finished product. In some instances, making coleslaw from the inner leaves only resulted in a more rapid darkening of the coleslaw. Compared to coleslaw from non-frozen cabbage, repeated shallow and deep freezing of the heads in the field did not result in any change in the rate of darkening of coleslaw.

Research is continuing on evaluating summer maturing cultivars suitable for processing into coleslaw.

Richard B. Smith, Lisa Skog and Randy Baker, OMAFRA Horticultural Research Institute of Ontario, Vineland Station, Ontario, L0R 2E0. Phone: (905) 562-4141.

Coleslaw made from the Bently cabbage cultivar darkens rapidly, compared to coleslaw from the Lennox cultivar.

Pears – managing storage to maximize quality

Ontario's pear industry has approximately 3,600 acres of land producing \$6,000,000 worth of pears for fresh and processing markets. Research in controlled atmosphere (CA) storage of fresh pears is required to extend the storage life and maintain the marketable quality of Ontario-grown pears.

Four commercial pear orchards provided Bartlett pears for this research project. Fruit were held in three storage conditions: cold storage at -1°C ; regular CA storage ($2.5\% \text{ O}_2 + 1.0\% \text{ CO}_2$ at -10°C); and low oxygen CA ($1.0\% \text{ O}_2 + 0.2\% \text{ CO}_2$ at -1°C). Fruit handling practice between harvest and storage was also evaluated to study the effect of temperature cooling and oxygen reducing on fruit quality.

Post-storage and shelf-life fruit quality evaluations were performed after two and four months in storage. Results indicated that pears stored in both CA conditions maintained better firmness than pears stored in cold storage without CA. Low oxygen CA-stored pears were slightly firmer than regular CA-stored pears. However, it may not be economically feasible to lower the oxygen level from 2.5% to 1.0% in CA storage rooms just to obtain a marginal benefit in maintaining fruit firmness.

Fast temperature cooldown is a very important practice for pear storage. Pear quality can be maintained if fruit temperature can be lowered soon after harvest. Fast oxygen reduction upon the establishment of CA conditions is essential to maintain the best possible quality for pears.

Dr. C.L. (George) Chu, OMAFRA Horticultural Research Institute of Ontario, Vineland Station, Ontario, L0R 2E0. Phone: (905) 562-4141.



Above are Bartlett pears subjected to various post-harvest pre-storage holding conditions. They were photographed after two months of low oxygen controlled atmosphere (LOCA) storage and three days of shelf life.



Turkey – helping industry avoid PSE in young turkey breast meat

The occurrence of pale soft exudative (PSE) type conditions in poultry meat has significant economic implications when the meat is either sold fresh or further processed. The fact that this meat is incapable of containing its own original and/or added moisture can substantially affect consumer satisfaction, as well as processing yields. The soft texture can also cause problems during processing and slicing.

Research was conducted into the magnitude of the PSE problem in commercial young turkey flocks. In addition, the potential use of two-colour measuring systems to separate PSE from normal turkey meat was examined.

Findings showed that a colour measurement could be used on a commercial scale to assess PSE conditions in turkey breast meat. Overall, mean L value (lightness) was highest during summer, lowest during winter, and intermediate during spring and autumn. Colour measuring time (3 vs 24h) post mortem affected the measured L value, especially at the low range (L value < 45).

The approach for selecting an appropriate cutoff L value, for industrial purposes, by targeting a certain water-holding capacity level has also been examined.

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Recommendations for Agri-Food Research in Ontario

The Ontario Agricultural Services Coordinating Committee (OASCC) held its annual meeting in Guelph, Ontario, on March 21, 1996.

The eight research and services committees presented reports that included research and service recommendations directed to the Ontario Ministry of Agriculture, Food and Rural Affairs through the Agricultural Research Institute of Ontario, to Agriculture and Agri-Food Canada, and/or to the Vice President, Research, University of Guelph.

The following were the priority research recommendations for the eight major committees.

Compiled by Janet Fraser, Education, Research and Laboratories Division,
Ontario Ministry of Agriculture, Food and Rural Affairs

Recommandations sur la recherche agro-alimentaire en Ontario

Le Comité de coordination des services agricoles de l'Ontario (CCSAO) a tenu son assemblée annuelle à Guelph (Ontario), le 21 mars 1996.

Les huit comités de la recherche et des services ont soumis leurs rapports et notamment des recommandations sur la recherche et les services au ministère de l'Agriculture, de l'Alimentation et des Affaires rurales de l'Ontario, par l'intermédiaire de l'Institut de recherche agricole de l'Ontario, à Agriculture et Agroalimentaire Canada et (ou) au vice-président, Recherches, Université de Guelph.

Voici les recommandations concernant les domaines de recherche prioritaires formulées par les huit principaux comités

Information recueillie par Janet Fraser, Division de l'éducation, de la recherche et des laboratoires, ministère de l'Agriculture, de l'Alimentation et des Affaires rurales de l'Ontario

Ontario Agricultural Economics Research and Services Committee

Recommendations:

- Analyze the implications of reduced public services for the agri-food sector and the ability of alternative business and marketing arrangements to contribute effectively in a market-driven agri-food sector.
- Monitor, analyze and evaluate trade agreements to determine their economic impact and implications for the agri-food industry.
- Continue research to characterize the benefits and costs, both on and off the farm, of using conventional and alternative farm production practices that might be advantageous from an environmental perspective. This research would also contribute to the development of "economic instruments" in environmental regulation to control conventional practices, and foster the adoption of alternative farm practices.

Ontario Agriculture and Food Engineering Research and Services Committee

Recommendations:

- Develop better application equipment that can apply solid and liquid manure plus bio-solids evenly at target rates specified by a nutrient management plan; acquire information that can be used to fine-tune the application rates; and identify future research needs in the design of solid and liq-

uid manure plus bio-solid spreaders.

- Assess and establish standards and protocols for the use of differential global positioning systems data, input controllers, yield monitors and crop sensors for site-specific crop management.
- Assess the potential impact of large livestock operations on the rural environment.
- Develop guidelines for the bioremediation and/or disposal of soil and water contaminated by diesel and heating fuel on farms.
- Determine the extent of corrosion and deterioration problems of agricultural building components and develop a recommended course of action.
- Research the availability of suitable economical warning devices, evaluate them, and develop procedures for preventing/dealing with gas

hazards in typical animal environments and feed storage areas; and examine and evaluate the chronic effects of sub-lethal gas levels on both humans and livestock.

- Develop innovative, improved and better processing technologies for improving food processing systems (long term). New and improved ways of food processing are required to improve process economics and food quality. The new or improved technologies should provide raw material flexibility, higher yields, less energy, reduction in labour costs, environmental protection, quality and shelf-life improvement, and safety.
- Develop in-line sensors to improve food safety and quality (long term). Develop rapid, reliable, non-destructive and non-invasive sensor systems.



RECOMMENDATIONS •

Comité de la recherche et des services en matière d'économie agricole

Recommandations

- Analyser les répercussions sur le secteur agro-alimentaire des coupures dans les services publics, et l'efficacité des dispositions de rechange en matière de commerce et de commercialisation dans le contexte d'un secteur agro-alimentaire axé sur le marché.
- Surveiller, analyser et évaluer les accords commerciaux afin de déterminer leur influence sur l'économie et leurs conséquences sur le secteur agro-alimentaire.
- Poursuivre la recherche sur les avantages et les coûts, au niveau de la ferme et hors-ferme, des pratiques de production traditionnelles et de rechange qui semblent souhaitables sur le plan environnemental. Cette recherche faciliterait également la mise au point d'« instruments économiques » utiles à la réglementation de la protection de l'environnement destinée à limiter le recours aux pratiques agricoles traditionnelles et à favoriser l'adoption de pratiques agricoles de rechange.

Comité de la recherche et des services en matière de génies agricole et alimentaire

Recommandations

- Perfectionner le matériel d'épandage afin qu'il puisse appliquer les fumiers sec et liquide et les biosolides en une couche uniforme, selon les doses cibles précisées dans un plan de gestion

des éléments nutritifs; recueillir de l'information pouvant servir à rendre les doses d'application plus précises; et identifier les points sur lesquels doit porter la recherche relative à la conception des épandeurs de fumiers sec et liquide et de biosolides.

- Évaluer et adopter des normes et des protocoles pour l'utilisation des données différentielles des systèmes de positionnement par satellite, des dispositifs de contrôle des entrées, des moniteurs de rendement et des tâteurs des récolteuses utilisés en agriculture de précision.
- Évaluer les répercussions possibles des grandes exploitations d'élevage sur le milieu rural.
- Élaborer des directives visant la biodégradation accélérée, l'élimination, ou les deux, des sols et des eaux contaminés par le diesel et le mazout sur les fermes.
- Déterminer la gravité des problèmes de corrosion et de détérioration affectant les bâtiments agricoles et recommander un plan d'action.
- Voir s'il existe des dispositifs d'avertissement convenables et économiques, les évaluer et élaborer des méthodes pour parer ou réagir aux dangers que présentent les gaz dans les bâtiments d'élevage et structures de stockage des aliments; étudier et évaluer les problèmes chroniques engendrés par les gaz sublétaux chez les humains et les animaux.

- Élaborer des technologies de transformation meilleures, innovatrices et plus efficaces pour améliorer les systèmes de transformation des aliments (long terme). Des méthodes de transformation nouvelles et améliorées sont nécessaires pour rendre les procédés plus économiques et accroître la qualité des aliments. Les technologies nouvelles ou améliorées doivent se prêter à différentes matières premières, offrir de meilleurs rendements, consommer moins d'énergie, réduire les coûts de main-d'oeuvre, protéger l'environnement et améliorer la qualité, la durée de conservation et la salubrité des aliments.
- Mettre au point des capteurs en ligne pour améliorer la salubrité et la qualité des aliments (long terme). Élaborer des systèmes de détection rapides, fiables, non destructifs et non invasifs.

Comité de la recherche et des services en matière de zootechnie

Recommandations

Aquaculture

- Étudier le plein potentiel génétique de nos stocks intérieurs de poissons, particulièrement des salmonidés de culture commerciale, dans le but de les améliorer.
- Déterminer les causes et l'évolution des maladies ayant une incidence économique, afin d'offrir des mesures de lutte et de détection plus efficaces.

Ontario Animal Research and Services Committee

Recommendations:

Aquaculture

- Research the full genetic potential of our domestic stocks of fish, especially commercially-cultured salmonids, with the aim of improving those stocks.
- Determine the causes and development of economically significant diseases, in an attempt to offer more effective measures of control and detection.
- Maintain or reduce the present cost of feeding salmonids through diet reformulation and improved processing techniques, and improve efficiency and reduce waste discharge by optimizing diets and feeding strategies.

- Develop production systems and technologies that maximize the efficiency of rainbow trout culture and permit efficient fish production at sites with limited water availability.
- Focus research on identifying new market opportunities and trends, determining key factors essential for industry success, and enhancing the impact of specific management skills and training programs designed to improve the profitability of aquaculture operations.
- Develop innovative, value-added products using rainbow trout and other domestically farmed fish species in order to improve our competitive position against other red and white meat commodities, and to better challenge imports from other countries like the United States.

Beef

- Identify the important factors that contribute to quality beef in order that the industry provide a consistent, high-quality product. Cow-calf, feedlot and meat science resources at the University of Guelph, New Liskeard Agricultural Research Station, and Ridgetown and Kemptville Colleges of Agricultural Technology should be focused on a "conception to consumption" integrated approach to investigate the important determinants of meat quality. Research should identify genetic, management, slaughter and processing factors that contribute to a consistently high quality and safe product. This initiative is a high priority and is vital to the future competitiveness of the beef industry.

- Provide new technological innovations and refinements that will improve the cost effectiveness and efficiency of Ontario beef farmers and processors.

Dairy

- Encourage research that identifies the herd level epidemiology, efficacious preventive practices and useful diagnostic tests for infectious diseases which limit the productivity of Ontario dairy cattle.
- Investigate nutritional strategies that complement the current and future pricing systems for milk components, meet consumer demand and improve the profitability of Ontario dairy herds, while preserving the excellent quality of Ontario dairy products.

Deer

- Determine the nutritional requirements of the various deer species using basic research.
- Conduct research that will lead to the improved reproductive efficiency of deer farmed under Ontario conditions.

Equine

- Investigate methods for the prevention of lameness in equines, including: the development of the musculo-skeletal system as affected by factors such as nutrition, growth rate, subsequent conditioning, locomotion, shoeing, and how these factors affect the predisposition to trauma-induced lameness; the treatment of trauma-induced leg and foot injuries as it relates to anaesthesiology and surgical methodology.

RECOMMANDATIONS • RECOMMANDATIONS • RECOMMANDATIONS

Bovins de boucherie

- Identifier les grands facteurs qui contribuent à la qualité du boeuf de sorte que l'industrie puisse offrir un produit de qualité élevée et uniforme. Les ressources consacrées aux exploitations de naissance, aux parcs d'engraissement et aux viandes de l'Université de Guelph, de la Station de recherche agricole de New Liskeard et des Collèges de technologie agricole de Ridgetown et de Kemptville devraient adopter une approche intégrée « de la conception à la consommation » dans leur étude des grands facteurs déterminants de la qualité des viandes. La recherche doit identifier les facteurs génétiques, de gestion, d'abattage et de transformation qui concourent à donner de façon constante un produit sûr et de haute qualité. Cette initiative est hautement prioritaire, car elle est vitale pour la compétitivité future de l'industrie du boeuf.
- Mettre au point des innovations et des perfectionnements technologiques de nature à améliorer l'efficacité et l'efficacité de la production et de la transformation du boeuf de l'Ontario.

Bovins laitiers

- Encourager la recherche sur l'épidémiologie au niveau des troupeaux, et l'identification de stratégies de prophylaxie efficaces et de tests diagnostiques utiles pour lutter contre les maladies infectieuses qui limitent la productivité des bovins laitiers de l'Ontario.
- Trouver des stratégies nutritionnelles qui font écho aux systèmes d'établissement des prix actuels et futurs relatifs aux composants du lait, répondre à la

demande des consommateurs et améliorer la rentabilité des troupeaux laitiers de l'Ontario tout en préservant l'excellente qualité des produits laitiers qu'on en tire.

Cervidés

- Déterminer, par la recherche fondamentale, les besoins nutritionnels des différentes espèces de cervidés.
- Mener des recherches en vue d'améliorer l'efficacité de reproduction des cervidés élevés dans les conditions propres à l'Ontario.

Équidés

- Étudier des méthodes de prévention de la boiterie chez les équidés, notamment : l'évolution du système musculo-squelettique tel qu'il est affecté par des facteurs comme la nutrition, le taux de croissance, le conditionnement qui en résulte, la locomotion, le ferrage et la façon dont ces facteurs influencent la prédisposition à la boiterie causée par un traumatisme; le traitement des blessures aux pattes et aux pieds causées par des traumatismes en axant la recherche sur l'anesthésie et la méthodologie chirurgicale.
- Étudier les maladies respiratoires en s'attardant particulièrement aux organismes infectieux et aux allergènes par l'isolation et l'identification de l'agent infectieux, et déterminer comment la gestion et le logement influencent le déclenchement de maladies respiratoires. Poursuivre la mise au point et l'évaluation de vaccins contre les maladies respiratoires, et de traitements ainsi que de modes de gestion des hémorragies pulmonaires causées par l'exercice.



- Maintenir à leur niveau actuel ou réduire les coûts d'alimentation des salmonidés par une reformulation des régimes alimentaires et de meilleures techniques de transformation, améliorer l'efficacité alimentaire et réduire les déchets rejetés en tirant le maximum des régimes et des stratégies alimentaires.
- Élaborer des technologies et des systèmes de production qui maximisent l'efficacité de l'élevage de la truite arc-en-ciel et permettent une production piscicole efficiente aux endroits où les ressources hydriques sont limitées.
- Faire porter les efforts de recherche sur l'identification de nouvelles tendances et de nouveaux débouchés, la détermination des facteurs de réussite clés pour l'industrie, et la mise en valeur des programmes de formation et des aptitudes de gestion conçus pour améliorer la rentabilité des exploitations aquacoles.
- Mettre au point des produits innovateurs, à valeur ajoutée, en utilisant la truite arc-en-ciel et d'autres espèces de poissons élevées chez nous afin de mieux faire face à la concurrence exercée par les produits de viandes rouge et blanche, et afin de mieux rivaliser avec les importations en provenance de pays comme les États-Unis.

- Investigate respiratory diseases as they relate to infectious organisms and allergenic agents by the isolation and identification of the infectious agent, and determine how management and housing affect the onset of respiratory diseases. Continue the development and evaluation of respiratory disease-related vaccines, and the treatment and management of exercise-induced pulmonary haemorrhage.

Fur-Bearing Animals

- Evaluate the availability, accessibility and cost of 'opportunity feeds' for fur farmers.
- Determine methods of improving the welfare of farmed mink, fox and chinchilla, thereby increasing productive efficiency and customer confidence and acceptance.

Goat

- Identify the components necessary for product development considering consumer emphasis on quality.
- Develop nutritional standards for goats raised under Ontario conditions.

Pork

- Develop mathematical modelling of swine growth and development, evaluate alternative feedstuffs for swine and continue investigation of treatments to reduce the incidence of mycotoxins.
- Focus research on the impact of swine production on the environment and develop systems that reduce this impact as well as improve the health, safety and comfort of pigs and operators.

Poultry — Broilers

- Identify areas of increased efficiency/cost-saving in building design, construction materials, house climate control, and automated equipment specific to Ontario situations and climatic extremes. Adapt and improve house design and bird handling, loading and transportation techniques and equipment in order to improve bird welfare and reduce economic losses due to condemnations and dead-on-arrivals at processing plants.
- Increase research into improvement of nutrient availability in order to maintain environmental integrity and lower input costs by reduction of nitrogen and phosphorus excretion.

Poultry — Egg Layers

- Continue research into the understanding and enhancement of functional properties of eggs and their components.
- Continue research on making the cage system more acceptable from an animal welfare perspective.

Poultry — Turkeys

- Investigate factors influencing poult mortality, focusing on management (husbandry), nutrition, hatchery environment and behaviour. Develop husbandry techniques that optimize production without compromising the bird's welfare. Also, assess welfare and research to confirm the bird's optimal welfare under 'Alternate Production Systems'.
- Investigate leg weakness in heavier birds grown commercially for meat and for breeding purposes.

Sheep

- Develop and evaluate techniques for improving reproduction in sheep.
- Evaluate the health and productivity status of selected sheep flocks in Ontario.

Ontario Field Crops Research and Services Committee

This committee grouped its recommendations into six core areas as follows:

Recommendations:

Field Crop Breeding

- Continue the strong emphasis on breeding for yield potential and stability in soybeans.
- Develop soybean varieties with new or modified oil and protein traits for specific food, feed, and industrial uses.
- Control diseases of oilseeds and other field crops by breeding for disease resistance and developing effective management practices.
- Investigate the influence of varieties and processing on the nutritional properties of Ontario soy food products.
- Breed non-pastry winter wheats with high quality and high nitrogen efficiency.
- Maintain current levels of publicly funded corn breeding and corn physiology research resources (personnel, support funding, etc.)
- Investigate the genetic improvement and biotechnology of alfalfa and perennial forage grasses other than timothy.

Animaux à fourrure

- Évaluer la disponibilité, l'accessibilité et le coût des aliments d'éventualité pour animaux à fourrure.
- Trouver des méthodes permettant d'améliorer le bien-être des visons, renards et chinchillas d'élevage, et d'augmenter du coup l'efficacité de la production de même que la confiance et l'acceptation du consommateur.

Chèvres

- Identifier les éléments nécessaires à la création de produits en tenant compte de l'importance que le consommateur accorde à la qualité.
- Mettre au point des normes de nutrition pour les chèvres élevées dans les conditions propres à l'Ontario.

Porc

- Élaborer un modèle mathématique de la croissance et de l'engraissement des porcs, évaluer des aliments de remplacement pour les porcs et poursuivre l'étude de traitements visant à réduire l'incidence des mycotoxines.
- Centrer la recherche sur les répercussions environnementales de la production porcine et mettre au point des systèmes pour les atténuer et améliorer la santé et la sécurité des porcs et des exploitants et la qualité de leur environnement.

Volaille — poulets à griller

- Identifier les secteurs de plus grande efficacité ou d'économie de coûts au niveau de la conception des bâtiments, des matériaux de construction, des dispositifs de régulation d'ambiance et des dispositifs automatiques propres aux situations et aux conditions climatiques extrêmes de l'Ontario.

Adapter et perfectionner la conception du logement et les techniques et le matériel de manutention, de chargement et de transport afin d'améliorer le bien-être des oiseaux et de réduire les pertes économiques engendrées par les condamnations et les morts à l'arrivée à l'abattoir.

- Intensifier la recherche visant à améliorer la biodisponibilité des éléments nutritifs afin de maintenir l'intégrité environnementale et d'abaisser le coût des intrants par la réduction de l'excrétion d'azote et de phosphore.

Volaille — pondeuses

- Poursuivre la recherche visant à mieux comprendre et à améliorer les propriétés fonctionnelles des oeufs et leurs constituants.
- Continuer de rechercher des moyens de rendre le système d'élevage en cages plus acceptable du point de vue du bien-être des animaux.

Volaille — dindes

- Étudier les facteurs de mortalité chez les dindonneaux en centrant la recherche sur la gestion (méthodes d'élevage), la nutrition, l'environnement des couvoirs et le comportement. Mettre au point des techniques d'élevage qui optimisent la production sans compromettre le bien-être des animaux. Également, évaluer le bien-être des oiseaux et chercher à confirmer le bien-être optimal des oiseaux soumis à des « systèmes de production de rechange ».
- Étudier la faiblesse des pattes chez les volailles plus lourdes élevées commercialement pour leur chair et la reproduction.

Moutons

- Mettre au point et évaluer des techniques permettant d'améliorer la capacité de reproduction des troupeaux de moutons.
- Évaluer la santé et la productivité de troupeaux de moutons sélectionnés de l'Ontario.

Comité de la recherche et des services en matière de grandes cultures

Ce comité répartit ses recommandations dans les six grandes catégories suivantes :

Recommandations

Sélection des grandes cultures

- Continuer de centrer la recherche sur la sélection de cultivars de soya offrant stabilité et bon potentiel de rendement.
- Mettre au point des cultivars de soya présentant des caractéristiques nouvelles ou modifiées quant à l'huile et aux protéines en vue d'utilisations précises, qu'il s'agisse de transformation ou d'alimentation humaine ou animale.
- Lutter contre les maladies des oléagineux et d'autres grandes cultures par une sélection axée sur la résistance à la maladie et par la mise au point de pratiques de gestion efficaces.
- Étudier l'influence des cultivars et de la transformation sur les qualités nutritives des produits alimentaires à base de soya faits en Ontario.
- Créer, pour des usages autres que la pâtisserie, des cultivars de blé d'automne de grande qualité qui assimilent très efficacement l'azote.

- Continue cultivar development and genetic improvement of white and coloured beans.
- Terminate OMAFRA support for oat breeding and testing at the University of Guelph in May of 1996, but continue support for barley breeding. (Barley and oat breeding are recommended to continue at Agriculture and Agri-Food Canada, Ottawa.) Terminate OMAFRA support for canola breeding at the University of Guelph in the 1997-98 fiscal year.

Field Crop Biotechnology

- Include biotechnology research in alfalfa breeding.
- Seize opportunities for biotechnology in Ontario soybean improvement in the areas of plant transformation and technologies to enhance conventional breeding.
- Improve technologies for cereal breeding to incorporate agronomically important traits.

Variety Testing

- Emphasize performance testing of corn hybrids if the requirement for variety testing for registration is dropped.
- Continue testing the huge numbers of soybean cultivars and the newer types emerging, e.g., high protein, conventional, and transgenic herbicide-resistant lines.
- Continue testing of cereals, e.g., wheats, barleys, and oats, to provide information on yield, disease resistance, protein levels, lodging resistance and other traits.
- Continue variety and strain testing of perennial forage crops.

- Continue variety and performance testing of dry bean varieties and canola cultivars.

Agronomic Practices

- Increase the efficiency of nitrogen fertilizer use and decrease nutrient inputs for field crops.
- Improve performance of corn with no-till planting.
- Improve corn (grain) drying and storage technology.
- Enhance corn quality for industrial and food product users.
- Improve the production efficiency of spring canola.
- Improve the utilization of nutrients (nitrogen fixation) in soybeans.
- Develop agronomic practices that utilize innovative technologies, enhance sustainable production and exploit the yield potential of new cultivars.
- Direct forage research toward the evaluation of species and management systems to enhance quality, productivity and profitability. Place emphasis on forage quality in stored feed and grazing management systems.
- Investigate the effects of various tillage systems on the survival of winter wheat.
- Investigate the pathology of Fusarium head blight on wheat and other crops.
- Investigate the effects of the nutrients sulphur, copper, chlorine, and nitrogen, and protein content on quality and disease incidence of cereals.
- Increase yield and net returns to the grower and/or decrease the cost of production of white and coloured beans through reduced tillage systems.

Plant and Crop Physiology

- Maintain a minimum level of basic research on plant and crop physiology to enable future advancement in the 'applied' research areas, e.g., abiotic environmental stresses, biotic pest control.

Recognized Need for Industry-Supported Research on Tobacco

- Develop transgenic tobacco cultivars with value-added traits.
- Determine how curing conditions can be changed or adjusted to optimize the curing process for specific types of harvested tobacco and to generally maximize the quality of the cured leaf.
- Develop transgenic tobacco cultivars resistant to plant diseases and insects.
- Conduct regional evaluation of elite tobacco strains.

Ontario Food Processing Research and Services Committee

Recommendations:

- Continue the operation of the OMAFRA competitive Ontario Food Processing Research Fund with priorities that parallel those established for OMAFRA's core programs in food research and development.

- Maintenir à leur niveau actuel les ressources (humaines, financières et autres) provenant des fonds publics et affectées à la recherche sur la sélection et la physiologie du maïs.
- Étudier l'amélioration génétique et la biotechnologie de la luzerne et des graminées fourragères vivaces autres que la fêve des prés.
- Continuer de mettre au point des cultivars et d'améliorer les caractéristiques génétiques des haricots blancs et colorés.
- Mettre un terme en mai 1996 à l'appui par le MAAARO du programme de sélection et d'essais de l'avoine à l'Université de Guelph, mais continuer de soutenir les activités de sélection de l'orge. (On recommande que la sélection de l'orge et de l'avoine se poursuive à Agriculture et Agroalimentaire Canada, Ottawa). Mettre un terme, au cours de l'exercice 1997-1998, à l'appui par le MAAARO du programme de sélection du canola à l'Université de Guelph.

Biotechnologie applicable aux grandes cultures

- Inclure la recherche en biotechnologie dans les activités de sélection de la luzerne.
- Mettre la biotechnologie au service de l'amélioration du soja de l'Ontario eu égard à la transformation des plantes et aux technologies visant à améliorer les méthodes de sélection traditionnelles.
- Améliorer les technologies de sélection des céréales afin d'incorporer des traits importants sur le plan agronomique.

Essais de cultivars

- Mettre l'accent sur le contrôle des performances des hybrides de maïs, si l'exigence visant les essais de cultivars en vue de l'enregistrement vient à tomber.
- Continuer de soumettre à des essais le nombre impressionnant de cultivars de soja et les types plus nouveaux qui font leur apparition, dont les souches à forte teneur en protéines traditionnelles et transgéniques résistantes aux herbicides.
- Continuer de soumettre à des essais des céréales, notamment les blés, orges et avoines afin de fournir de l'information sur le rendement, la résistance à la maladie, la teneur en protéines, la résistance à la verse et d'autres caractéristiques.
- Continuer de soumettre à des essais des cultivars et des souches de cultures fourragères vivaces.
- Continuer de soumettre à des essais des cultivars de haricot sec et de canola et d'en mesurer le rendement.

Pratiques agronomiques

- Accroître l'efficacité des utilisations d'engrais azotés et réduire les apports de fertilisants dans les grandes cultures.
- Améliorer le rendement du maïs cultivé sans travail du sol.
- Améliorer l'efficacité des technologies de séchage et d'entreposage du maïs-grain.
- Accroître la qualité du maïs destiné à l'alimentation et à la transformation.
- Améliorer l'efficacité de production du canola de printemps.

- Améliorer l'assimilation des éléments nutritifs (fixation de l'azote) par le soja.
- Élaborer des pratiques agronomiques qui utilisent des technologies innovatrices, améliorent la production durable et exploitent le potentiel de rendement des nouveaux cultivars.
- Orienter la recherche sur les fourrages sur l'évaluation des espèces et des systèmes de gestion afin d'améliorer la qualité, la productivité et la rentabilité. Mettre l'accent sur la qualité du fourrage dans les aliments entreposés et sur les systèmes de gestion des pâturages.
- Étudier les effets de différentes méthodes de travail du sol sur la survie du blé d'automne.
- Étudier la pathologie de la brûlure de l'épi sur le blé et d'autres cultures.
- Étudier sur les céréales les effets des éléments nutritifs que sont le soufre, le cuivre, le chlore et l'azote, et de la teneur en protéines sur la qualité et l'incidence de la maladie.
- Augmenter le rendement et le bénéfice net pour le producteur, diminuer le coût de production des haricots blancs et colorés, ou atteindre ces deux objectifs, au moyen de systèmes de travail réduit du sol.

Physiologie des plantes et des cultures

- Maintenir un niveau minimal de recherche fondamentale sur la physiologie des plantes et des cultures afin de favoriser le progrès dans les domaines de recherche « appliquée » comme les facteurs de stress environnementaux non biologiques, la lutte contre les ravageurs et les maladies d'origine biologique.

- Operate OMAFRA'S core food programs on the basis of four priority areas as follows: Innovative Technologies Process & Systems, Food Quality & Safety, Value-added Products & Processes, and Waste Management Processes & Systems.

Innovative Technologies Processes and Systems

- Investigate techniques for the dry milling and heat processing of pulses and legumes to develop flours and coarse meals for use in food currently being imported into Ontario.

- Develop and evaluate emerging/alternative processing technologies that limit the impact on the environment of the cereal food and feed industry in Ontario without unduly affecting the cost competitiveness of the product.
- Develop innovative techniques to process Ontario oilseeds to improve the value of the products produced and to improve their nutritive properties.
- Develop and encourage applied research to adopt appropriate engineering technology to the fruit and vegetable processing industry.

- Study preservation methods that are compatible with all fruit and vegetable varieties and will maximize sensory and nutritional qualities of these varieties.
- Develop objective quality measurements for the Ontario meat industry.
- Develop a systems approach for evaluating beef tenderness.
- Develop a systems approach to reducing PSE in Ontario pork.
- Develop technology for determining fat in blocks of meat trimmings.
- Direct dairy research and development at product technologies, processes or strategies to improve plant efficiency.

Food Quality and Safety

- Investigate/develop alternatives to the use of chemical improvers in milling and bakery products.
- Develop on-line methods for monitoring product quality throughout the milling and baking process.
- Determine chemical, physical, nutritional and organoleptic quality parameters of Ontario-grown fruit and vegetable varieties for processing.
- Study techniques for shelf-life extension of fresh and minimally processed fruits and vegetables.



Appui nécessaire de l'industrie dans la recherche sur le tabac

- Mettre au point des cultivars de tabac transgéniques présentant des caractéristiques à valeur ajoutée.
- Déterminer en quoi les conditions de séchage peuvent être changées ou ajustées pour optimiser le procédé de séchage de différents types de tabac récolté et pour maximiser en général la qualité des feuilles séchées.
- Mettre au point des cultivars de tabac transgéniques résistant aux insectes et aux maladies.
- Effectuer une évaluation régionale des souches de tabac élite.

Comité de la recherche et des services en matière de transformation des aliments

Recommandations

- Poursuivre les activités du Fonds de recherche en transformation des aliments du MAAARO dans le contexte d'une recherche de compétitivité en établissant les priorités en parallèle avec celles qui sont établies pour les grands programmes de recherche et de développement du MAAARO dans le secteur alimentaire.
- Gérer les grands programmes du secteur alimentaire du MAAARO en fonction des quatre

domaines prioritaires suivants : procédés et systèmes faisant appel à des innovations technologiques, qualité et salubrité des aliments, produits et procédés à valeur ajoutée, et procédés et systèmes de gestion des déchets.

Procédés et systèmes faisant appel à des innovations technologiques

- Étudier des techniques de mouture à sec et de traitement thermique des légumineuses à grain et des autres légumineuses afin de mettre au point des farines qui entrent dans la composition des aliments actuellement importés en Ontario.
- Élaborer et évaluer les technologies de transformation naissantes ou de rechange qui limitent les répercussions sur l'environnement de l'industrie ontarienne des aliments à base de céréales destinés à la consommation humaine ou animale sans nuire indûment au coût du produit ni à son caractère concurrentiel.
- Élaborer des techniques innovatrices pour transformer les oléagineux cultivés en Ontario afin d'améliorer la valeur des produits issus de la transformation et d'améliorer leurs qualités nutritives.
- Pousser et encourager la recherche appliquée afin d'adopter la technologie industrielle appropriée au secteur de la transformation des fruits et des légumes.

RECOMMENDATIONS •

- Étudier les méthodes de conservation qui sont compatibles avec tous les cultivars de fruits et de légumes et qui maximisent les qualités organoleptiques et nutritives de ces cultivars.
- Élaborer des critères d'évaluation de la qualité objectifs pour l'industrie de la viande de l'Ontario.
- Élaborer une approche systématique à l'évaluation de la tendreté du boeuf.
- Élaborer une approche systématique visant la réduction de la viande exsudative au niveau de la viande de porc produite en Ontario.
- Mettre au point une technologie pour déterminer la teneur en gras dans des blocs de parures de viande.
- Orienter la recherche et le développement dans l'industrie laitière sur les technologies visant les produits, les procédés ou les stratégies afin d'améliorer l'efficacité des usines.

Qualité et salubrité des aliments

- Rechercher et mettre au point des solutions de rechange à l'utilisation d'améliorants chimiques dans les produits de meunerie et de boulangerie.
- Mettre au point des méthodes en ligne pour la surveillance de la qualité des produits pendant les opérations de meunerie et de boulangerie.
- Établir des paramètres permettant d'évaluer les qualités organoleptiques, nutritives, chimiques et physiques des cultivars de fruits et de légumes destinés à la transformation qui sont produits en Ontario.
- Étudier les techniques de prolongation de la durée de conservation des fruits et légumes frais ou ayant subi un minimum de transformation.

- Investigate alternative techniques or substances to lessen the dependency on sulfiting agents for fruit and vegetable processing.
- Study the risks associated with distribution of deli-type meat entrées.
- Develop rapid methods for detection of key food-borne pathogens in meat.
- Study factors affecting colour variability in cooked hamburger meat.
- Conduct studies to define critical control points in poultry slaughter operations.

Value-added Products and Processing

- Develop innovative process technologies for the isolation of valuable constituents during oilseed processing. (Such constituents could have nutritional, nutraceutical, cosmetic, pharmaceutical, agricultural or industrial value.)
- Develop new technologies/innovative processes for the isolation of value-added natural constituents from Ontario-grown oats, wheat, barley and corn.

- Develop valuable alternative uses of fruits and vegetables so that the most valuable constituents, such as nutraceuticals or proteins, are processed.
- Utilize milk components in value-added products including both dairy and non-dairy uses and both food and non-food uses.
- Develop dietetic and therapeutic dairy foods.
- Address imbalance between dairy fat and protein.

Waste Management Processes and Systems

- Develop methods for utilization of surplus wastes and by-products from the fruit and vegetable processing industry.
- Investigate new, economical uses and processing alternatives for dairy permeate.
- Investigate new uses for other dairy wastes, e.g., tank residues.
- Investigate improved shelf-life and processing alternatives for returned dairy products.

Ontario Horticultural Crops Research and Services Committee

This committee did not submit any specific research recommendations, but did compile a list that included the following research-related priorities:

- Emphasize the integration of all aspects of crop production technologies, e.g., new cultivar development, testing, high density plantings, training and rootstock evaluation, combined with crop nutrition and Integrated Pest Management (IPM) in a systems approach.



RECOMMENDATIONS

- Étudier des techniques ou des substances de rechange pour réduire la dépendance aux agents de sulfitage dans la transformation des fruits et légumes.
- Étudier les risques associés à la distribution de plats principaux de type charcuterie.
- Élaborer des méthodes rapides de détection des pathogènes d'origine alimentaire dans les viandes.
- Étudier les facteurs affectant la variabilité de la couleur dans la viande à hamburger cuite.
- Faire des études pour définir les points de contrôle critiques dans les abattoirs de volaille.

Produits et procédés à valeur ajoutée

- Élaborer des technologies de transformation innovatrices pour l'isolation de constituants valables au cours de la transformation des oléagineux. (Ces constituants peuvent avoir une valeur nutritive, nutraceutique, cosmétique, pharmaceutique, agricole ou industrielle.)
- Élaborer de nouvelles technologies ou des procédés innovateurs pour l'isolation de constituants naturels à valeur ajoutée à partir de l'avoine, du blé, de l'orge et du maïs produits en Ontario.
- Trouver de nouvelles utilisations des fruits et des légumes afin que les constituants les plus valables, nutraceutiques ou protéiques, soient transformés.

- Utiliser des composants du lait dans des produits à valeur ajoutée, qu'il s'agisse d'utilisations laitières ou non laitières ou d'utilisations alimentaires ou non alimentaires.
- Élaborer des produits laitiers diététiques et thérapeutiques.
- Remédier au déséquilibre entre la teneur en protéines et en matières grasses du lait.

Procédés et systèmes de gestion des déchets

- Élaborer des méthodes d'utilisation des sous-produits et des déchets provenant des surplus de l'industrie de la transformation des fruits et légumes.
- Trouver des utilisations nouvelles et économiques et des solutions de rechange aux ultrafiltrats laitiers.
- Trouver de nouvelles utilisations pour d'autres déchets laitiers, comme les résidus des cuves réfrigérantes.
- Étudier des solutions de rechange pour augmenter les durées de conservation et trouver de nouveaux procédés de transformation permettant d'utiliser les produits laitiers retournés.

Comité de la recherche et des services en matière d'horticulture

Ce comité n'a pas soumis de recommandations précises en ce qui concerne la recherche, mais a produit une liste qui fait état des priorités suivantes en

matière de recherche :

- Mettre l'accent sur l'intégration en un système de tous les aspects des technologies de production végétale, tels que mise au point de nouveaux cultivars, essais, plantations à forte densité, tuteurage/formation, évaluation des porte-greffes, nutrition et lutte intégrée.
- Stimuler la mise au point et l'application de mécanismes de lutte antiparasitaire biorationnels et de lutte intégrée de rechange pour répondre aux besoins des producteurs tout en réduisant l'utilisation des pesticides.
- Mettre l'accent sur l'élaboration de stratégies ou de technologies post-récolte qui aident les produits de l'Ontario à mieux faire face à la concurrence mondiale.
- Veiller à ce que l'on réponde adéquatement aux besoins de la gestion des éléments nutritifs des cultures horticoles, dont les crucifères. À l'heure actuelle, certaines données sont fournies sur cet important sujet.
- Mettre l'accent sur la technologie de pulvérisation, un programme hautement prioritaire servant à la mise au point et au transfert de technologies de pulvérisation utiles aux applications de pesticides et conçues pour réduire au minimum la pollution de l'environnement et l'exposition de l'humain à ces produits chimiques.
- Élaborer et mettre en oeuvre des règlements visant l'utilisation commerciale des déchets et sous-produits générés par les fermes et l'élimination d'autres déchets agricoles.

- Increase development and application of alternative biorational pest control mechanisms and IPM systems to meet growers' needs while reducing chemical pesticide use.
- Emphasize development of post-harvest strategies/technologies that position Ontario commodities to most effectively compete in the global marketplace.
- Ensure that proper needs of the nutritional management of horticultural crops, i.e., crucifer, are met adequately. At present, some input is provided in this important area.
- Emphasize sprayer application technology, a high priority program used to develop and transfer spray technologies as they relate to pesticide application, and designed to minimize pollution of the environment and human exposure to these chemicals.
- Develop and implement regulations for the commercial utilization of farm-generated wastes and by-products, and disposal of other farm wastes.
- Continue input into the development and application of reusable/recyclable containers. Use of these types of containers will reduce environmental pollution and production costs.
- Develop a tracking system for fresh horticultural produce that could be beneficial in identifying specific lots of product. This system would secure the availability of safe food to consumers and, at the same time, would protect innocent producers from adverse publicity.

Ontario Soil, Water and Air Research and Services Committee

Recommendations:

- Develop methodology to evaluate the effect of scale (mapping and spatial) on the description, modelling and management of non-point source pollution.
- Evaluate the practical and economic feasibility of biological/chemical remedial techniques for management of agricultural/rural water quality.
- Develop feasible methods and techniques to evaluate the effects of pollution control and remediation measures in agricultural/rural watersheds.
- Develop an integrated approach for the management of water quality and nutrients for environmentally sustainable use of farm manure, green manure and agro-chemicals.
- Conduct research that would quantify a wetland's water quality functions within the ecosystem as they relate to sustainable agriculture.
- Develop improved technical means and methods to properly interface the use of fertilizers in conjunction with livestock manures within the farm system. The intent is to minimize probable impacts to the surface and ground water systems.
- Determine optimum rates, application methods and nitrogen availability of organic nitrogen amendments and their effects on soil properties.
- Identify crop characteristics and soil conditions that may limit grain corn yield under minimum tillage.
- Establish rate, placement, timing and source of fertilizer for horticultural crops in Ontario.
- Use measuring and modelling of trace gases

and investigate the composition of the organic components of aerosol particulates found in agricultural areas across Ontario.

- Develop more accurate diffusion models both within vegetation canopies and across irregular or discontinuous surfaces.
- Investigate management systems to minimize contamination of air, surface and ground water by nitrogen originating from fertilizers, legumes, manures and other organic sources, and by bacteria from manures and organic wastes applied to soils.

Ontario Pest Management Research and Services Committee

Recommendations:

- Increase emphasis on research in weed control directed to lower rates of product, use of adjuvants, reduced volumes and improved targeting.
- Continue research into controls for northern fowl mite in brooder flocks, blackfly control on horses and non-chemical control for house flies.
- Initiate a lygus bug conference, to develop a research program aimed at this pest on a number of fruit and vegetable crops.
- Encourage and foster biotechnology research applicable to Ontario crop needs.
- Continue to support crop-specific pest research with emphasis on bio-control, alternatives to pesticides and development of strategies for control programs.

- Continuer de travailler à l'élaboration et à l'application de contenants réutilisables ou recyclables. L'utilisation de ces types de contenants réduira la pollution de l'environnement et les coûts de production.
- Élaborer un système de suivi pour les produits horticoles frais, qui pourrait être utile à l'identification de lots précis de produits. Ce système garantirait la disponibilité de produits sains pour le consommateur et, en même temps, éviterait de faire mauvaise presse aux producteurs innocents.

Comité de la recherche et des services en matière de sol, d'air et d'eau

Recommandations

- Mettre au point une méthodologie pour évaluer l'effet des échelles (cartographie et détection spatiale) sur la description, la modélisation et la gestion de la pollution de sources non ponctuelles.
- Évaluer la faisabilité pratique et économique des solutions biologiques ou chimiques employées pour gérer la qualité de l'eau en milieu agricole ou rural.
- Élaborer des méthodes et des techniques réalisables pour évaluer les effets des mesures d'assainissement et de lutte contre la pollution dans les bassins versants agricoles ou ruraux.
- Élaborer une approche intégrée à la gestion de la qualité de l'eau et des éléments nutritifs en vue d'une utilisation durable, sur le plan environnemental, du fumier, de l'engrais vert et des produits agrochimiques.

- Mener une recherche qui permettrait de quantifier les fonctions de qualité de l'eau des marécages à l'intérieur de l'écosystème dans une perspective d'agriculture durable.
- Mettre au point des moyens et des méthodes techniques améliorés pour assurer une meilleure complémentarité des utilisations d'engrais et de fumiers d'élevage au niveau de la ferme. Le but est de réduire au minimum les répercussions probables sur les réseaux des eaux de surface et des eaux souterraines.
- Déterminer les doses, les méthodes d'application et la biodisponibilité optimales des apports d'azote organique et leurs effets sur les caractéristiques des sols.
- Identifier les caractéristiques des cultures et les conditions de sol qui peuvent limiter le rendement du maïs-grain soumis au travail minimal du sol.
- Établir le taux, la localisation, le moment de l'épandage et la source de fertilisant pour les cultures horticoles de l'Ontario.
- Utiliser les dispositifs de mesure et de modélisation des gaz à l'état de trace et étudier la composition des composants organiques des particules d'aérosol trouvées dans les zones agricoles partout en Ontario.
- Élaborer des modèles de diffusion plus précis à la fois à l'intérieur du feuillage et sur des surfaces irrégulières ou discontinues.
- Rechercher des systèmes de gestion aptes à réduire au minimum la contamination de l'air, des eaux de surface et des eaux souterraines

par l'azote provenant des engrais, des légumineuses, des fumiers et d'autres sources organiques, et par les bactéries présentes dans les fumiers et déchets organiques épandus sur les sols.

Comité de la recherche et des services en matière de lutte antiparasitaire

Recommandations

- Centrer la recherche au niveau de la lutte contre les mauvaises herbes sur l'utilisation de doses plus faibles, d'adjuvants et de volumes réduits, et sur un accroissement de la précision des jets de pulvérisation.
- Poursuivre la recherche en matière de lutte contre le liponyse des volailles dans les troupeaux d'élevage, la lutte contre la mouche noire chez les chevaux et la lutte non chimique contre la mouche domestique.
- Mettre sur pied une conférence sur la punaise en vue d'élaborer un programme de recherche qui lui soit consacré relativement à un certain nombre de cultures fruitières et légumières.
- Encourager et favoriser la recherche en biotechnologie axée sur les besoins des cultures en Ontario.
- Continuer d'appuyer la recherche sur les ennemis de cultures précises en mettant l'accent sur la lutte biologique, les solutions de rechange à l'utilisation de pesticides et l'élaboration de stratégies pour les programmes de lutte.