Canada Agriculture

Grain Production and Marketing Challenges – pages 4 and 8
Production de céréales et défis de la commercialisation – pages 4 et 8

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Cover photo

Photo de la page couverture

Wheat for world consumption

Consommation mondiale de blé

Agriculture Canada

Hon. Eugene Whelan,
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Deputy Minister/Sous-ministre

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COMMENTARY / COMMENTAIRE

Agriculture Canada food price survey

The importance of food costs in the family budget came into focus in the early 1970s when inflation became a major Canadian concern.

In 1973 the Government of Canada appointed the Food Prices Review Board (FPRB) to monitor food prices. The Board established its own food price monitoring system and published a Food-at-Home price index and The Nutritious Diet, a calculation of the cost of food to nutritiously feed a family of four. In 1975 the Anti-inflation Board replaced the FPRB and continued the price monitoring and the reporting procedure until 1979 when these services were transferred to Agriculture Canada.

In June 1980 the survey was revised. The food price index became the Agriculture Canada Food-at-Home Price Index and now includes 99 food items priced in 12 major Canadian centers. The nutritious diet became the Agriculture Canada Nutritious Food Basket.

Agriculture Canada food price data serve as the basis for monitoring and analyzing food price movements reported in a monthly news release and in the quarterly Food Market Commentary. Among other things, food price data are used to evaluate the effect of policy changes on retail food prices. Food price data are also used to calculate farm-to-retail and wholesale-to-retail price spreads. This information is of interest to producers faced with rising costs that seem to be constantly overtaking product prices, and to consumers seeking an explanation for steadily increasing food costs.

Enquête d'Agriculture Canada sur les prix des aliments

Au début des années 1970, [période où l'inflation a joint les rangs des grands problèmes nationaux,] les coûts de l'alimentation ont commencé à occuper une place de plus en plus grande dans le budget familial.

En 1973, le gouvernement fédéral créait la Commission de révision des prix des aliments (CRPA). La Commission a tôt fait d'établir son propre mécanisme de contrôle des prix et a publié l'Indice des prix des aliments consommés à la maison et le Panier à provisions. En 1975 la Commission de lutte contre l'inflation a remplacé la CRPA et ladite Commission a continué d'exercer un contrôle des prix et d'en informer le public jusqu'en 1979 alors que le ministère fédéral de l'Agriculture prenait charge de ce service.

En juin 1980, le Ministère remaniait la composition de l'étude. L'indice des prix devenait l'Indice des prix des aliments consommés à la maison d'Agriculture Canada et la gamme des produits alimentaires comprend maintenant 99 articles dont les prix sont relevés dans 12 grandes villes canadiennes. Le régime alimentaire fut rebaptisé le Panier à provisions bien équilibré d'Agriculture Canada.

Grâce aux données qu'il compile sur les prix des aliments, le ministère de l'Agriculture analyse et suit l'évolution des prix des denrées alimentaires, et publie les fruits de ses travaux dans un communiqué mensuel et la publication trimestrielle *Revue du marché alimentaire*.

Zuhair H. Hassan

Top photo. Photo du haut.

Z.A. Hassan

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Bottom photo. Photo du bas.

A price check at an Ottawa supermarket for Agriculture Canada's Retail Food Price Survey.

Vérification des prix dans un supermarché d'Ottawa pour Agriculture Canada (Inspection des prix de vente au détail des aliments.)

The grain marketing challenge of the 1980s

R.L. Kristjanson

The complicated marketing process for Canadian grain has five major elements—demand linked to markets, the setting of prices, transportation and handling to get the grain to buyers at home and abroad, selling arrangements handled by such agencies as the Canadian Wheat Board (CWB), and the production of the grain itself by the farm community. Each element must work well within itself and mesh externally with the needs of the others to create a cohesive process that will benefit all the actors in the marketing drama, particularly the Canadian farmer. To meet the big-market challenge of the 1980s, many of the rough spots of the marketing system must be smoothed out.

There's no doubt that the market is there. It is expected that international trade in grain will continue to grow significantly in the 1980s and beyond. By the end of the decade, Canada must annually export 36 million tonnes of grain and grain products to maintain its world market share. This compares with the 1979-80 export volume of approximately 23 million tonnes. We also anticipate a domestic requirement in 1990 of 18 million. This will require a total production of 54 million tonnes, compared with the record 1976 crop of 38 million.

L'auteur analyse le processus de commercialisation des céréales canadiennes qui comprend cinq éléments importants: la demande par rapport au marché, la fixation des prix, le transport et la manutention, les arrangements reliés à la vente et la production de céréales. Il conclut en disant qu'à moins de considérer ces éléments comme un tout significatif, l'industrie en souffrira. Si des efforts sont déployés en ce sens, les années 80 pourraient être très bonnes.

Our marketing targets are based simply on maintaining our share of growing world markets and we'll have to hustle on the production and the movement aspects to do that. Our competitors should have no fear that Canada seeks price-cutting or price wars to export an increasing volume. No one would benefit from such short-sighted pricing behavior. Canadian producers, as well as producers elsewhere, must receive price levels for their grain that will encourage increased production to avoid international food shortages.

A CWB Advisory Committee symposium last year involving agricultural scientists concluded that prairie farmers can produce enough grain to meet the 36-million-tonne export target in 1990 as long as there are market guarantees. Annual production on the Prairies can be increased about 16 million tonnes by 1990. The symposium suggested that an all-out effort would be needed involving less summer fallow, more fertilizer, better weed and pest control, new land, improved varieties, and, in general, more intensive farm management.

In the transportation field, Canada has made significant improvements, but more investment will be needed to meet its export goals. More hopper cars will be needed by 1985, not just to accommodate increased exports, but to offset the continuing loss of boxcars from the fleet. Even the rehabilitated boxcars now in use have an expected service life of only 7 years. Other parts of the domestic transportation system, including the Great Lakes vessel fleet, require improvement and expansion.

The construction of the grain-handling terminal at Prince Rupert, British Columbia, is also essential. About half the 1985 export goal of 30 million tonnes must move through the west coast ports. Vancouver's maximum single-year potential appears to be about 10 million tonnes. The balance—about 5 million tonnes—must move through Prince Rupert, as well as any further increases in west coast exports.

The first phase of the Prince Rupert development will have an annual capacity of only 3.5 million tonnes, even at high turnover rates, so another requirement is a large 'surge' facility adjacent to the new terminal. This would provide a buffer supply against interruptions in rail shipment or vessel arrivals and hence improve service to customers and reduce demurrage payments. Under some circumstances, 'surge' grain could be used for 'spot sales', an impossible luxury with the current system. The CWB recognizes that while surge storage would be an excellent investment for producers, it would at least initially be a poor one for an elevator company. This is why the board offered $100 million in producer money to build the surge facility and allow it to be operated by the consortium building the main terminal.

But good markets, large production, and an efficient transportation system are useless if the price farmers receive is too low to pay for production and an adequate living standard. One part of the problem of a fair return for the farmer's effort is the in-

Demand for high quality food challenges our marketing experts.

World marketing demands careful grain inspection.

creasing lack of stability for wheat prices. Without positive action, wheat prices in the 1980s are apt to be even more variable than in the past. In the past a 5¢/bu change in price was considered significant and months would go by when prices would vary only 2¢-3¢/bu. Now, changes of 50¢/bu over a few days have become quite common. The main reason for this is the smaller world carry-over (or surpluses) in relation to world requirements compared with those of a few years ago. Consequently, any change in crop conditions around the world can have dramatic price effects. So can sharp changes in government policy, as in the case of embargoes.

During the 1980s, farmers need a minimum wheat price of at least $5.00/bu on farm, an annual indexation of the minimum price to reflect increases in the production cost, and a guaranteed market plan so that if a temporary 'surplus' develops they do not have to wait to get paid for their production.

One way not to achieve our price objective is through negotiation of a new International Wheat Agreement (IWA). The IWA forum has three groups—five major exporters, a fairly substantial number of relatively wealthy importing nations, and developing countries. Importing countries tend to align themselves with the poorer developing countries to negotiate for the lowest prices possible. The exporting nations are left in the unenviable position of being amoral price gougers.

In the end, the developing countries leading the attack for lower prices tend to be the ones who get food aid or a lot of concessional price terms or both. The relatively wealthy importers, who joined the developing countries in their attack, achieve their own objective of buying cheap wheat. This is clearly a losing game for wheat-exporting countries and their farmers and an inhibition to feeding the world. Unless farmers receive production-incentive prices, shortages will inevitably follow and the developing countries will suffer most. The exporting nations will lack both the grain and funds for food aid.

A more promising way to achieve our price goals is through exporter cooperation—the synchronization of production and marketing policies by the five major wheat exporters: the United States, Canada, Australia, Argentina, and the European Economic Community. Some of the issues on which they would have to agree are:

— A floor price high enough to assure wheat production requirements in the 1980s.

— A mechanism to increase the floor to accommodate inflation.

The original CPR grain terminal at Port Arthur and its modern equivalent.

Rapid adoption of new technology is the proud claim of Canadian agriculture.

— A reserve mechanism to maintain the floor price during periods of temporary 'surplus'. The American system of farmer-held reserves and a guaranteed market plan here in Canada could be used for this purpose. The other three exporting countries have or could develop their own systems.

— Holding a reserve for famine relief.

— Increasing the level of food aid.

For the exporter cooperation route to be successful, certain principles must be agreed upon. Among them are the following:

— Exporters must agree to help feed the world in a manner that does not gouge the consumer. To achieve sufficient production, farmers need assurance of price levels that will encourage increased production.

— Exporting countries must accept the fact that each has its own set of internal marketing mechanisms. The goal is not to create one kind of marketing system that would apply to all but to make certain that we all agree on the production and marketing direction.

— Exporting countries must agree to revert to the principle that was once followed in international trade, that is, that food and medicine are not embargoed except during war.

— If, for domestic reasons, an exporting nation wants prices within its own boundaries lower than the export price this should be done with a two-price plan. Since the consumer lobby, particularly in the United States, is stronger than the farm lobby, it is imperative that the achievement of a rational export price not be subjected to the uncertainties of domestic policies.

Finally, Canada must maintain an aggressive, efficient, farmer-responsive marketing institution with real market power to protect producers' interests. It would be of little value to the producer, if production, markets, and prices all increase and someone else reaps the benefits. We have to pay for necessary marketing goals. Beyond that, the balance belongs to the farmer.

If we cannot fit the five pieces of the marketing puzzle together into a meaningful whole, the industry is going to suffer. If we can, the 1980s could be very good indeed.

Mr. Kristjanson is Assistant Chief Commissioner of the Canadian Wheat Board.

Challenges in western Canada's agricultural production

A.A. Guitard

Western Canada, because of its soil and a climate that offers a limited growing season and long cold winters, can be considered in the realm of northern agricultural development. Since prairie settlement first began in earnest more than 100 years ago, farmers and their allies in government have dealt with the northern flavor of agricultural problems with varying degrees of success and failure. The struggle will continue both in the settled areas of the west and in the more northerly areas where arable land remains as a new frontier. In the interest of western agriculture, both in the south and for the new frontier to the north, it is important to adapt and change now as some of the answers of the past become outmoded.

A look at early settlement and farming problems in the west may help us understand today's needs.

A classic example of agricultural disaster occurred in the southern parts of Manitoba, Saskatchewan, and Alberta known as the Palliser Triangle. Early settlers planted vast areas of the open prairie to wheat and left the land idle during alternate years to store moisture for the following year's crops. A series of dry, windy years in the early 1920s and again in the 1930s caused widespread crop failure and soil erosion. What little crop did survive the drought was damaged by grasshoppers and rust. Damage was so extensive that many abandoned their farms and moved north to more stable crop areas.

Many of these farmers moved into the Peace River area of Alberta and British Columbia where they experienced the many problems of frontier development.

À cause de la composition de son sol et du climat, on peut qualifier l'agriculture de l'Ouest du Canada de nordique.

L'auteur soutient qu'il est grand temps de réévaluer certaines méthodes culturales maintenant devenues courantes dans l'agriculture de cette région. Parmi les pratiques en question, mentionnons l'utilisation de l'énergie, l'entretien d'une banque de gènes et la mise en friche des terres pendant l'été. De plus, l'auteur souligne le potentiel des terres agricoles du nord et le besoin de les développer. Il insiste sur le besoin de mettre sur pied un organisme spécialisé dans ce genre de recherches en plus de structures permettant un tel développement, tout en se basant sur l'expérience passée.

Many of the Peace River grasslands were low and wet. Perennial forages grew well and provided a base for livestock production. Bordering woodlands provided summer pasture. However, ground water was lacking in some areas for livestock production, animals were attacked by biting flies during the summer and livestock was difficult to maintain during the winter. Unadapted cereal grain varieties grew rank, lodged, were late maturing, and were often damaged by frost in the spring and fall.

When the 1 million acres of black grassland soil were settled, new arrivals moved into the poplar forests. Here the clearing costs were high and, unless clearing and breaking were well done, poplar regrowth became a problem. The gray soils were low in organic matter, hence crusted and baked. About 10 percent of the soil was sufficiently acidic to restrict crop growth. Other soils were solonetzic. Phosphorous and nitrogen were generally inadequate. Often the land was too wet in the spring for timely seeding and the fall harvest was usually extended by small showers and sometimes completely stopped by excessive rain or snow. During the peak of the growing season, moisture was usually deficient.

From the outset, agricultural development throughout the west required a new technology. Much of this new technology was created by modifying concepts appropriate for southerly climates to fit the northern situation. A key to western expansion was the development of Marquis wheat by Charles Saunders in 1904, making cereal-based agriculture possible. Subsequently, the development of new wheat varieties with resistance to sawfly, rust, and other diseases, and the breeding of a multitude of regional adaptations kept wheat as the major crop in the west.

Even with these developments, cereal production would not have prospered throughout the west without the introduction of strip farming and stubble mulch systems for maintaining summer fallow. Also, the development of machine technology made the application of new production techniques possible.

Much later, the replacement of wheat and oats by barley along with the breeding of a wide range of adapted barley cultivars, gave to the northern part of the west a level of production and a production stability not previously achieved. Later still,

the development of rapeseed as a viable oilseed crop further strengthened agriculture.

For perennial forage varieties, improvements centered around techniques for combining greater winter hardiness, drought resistance, increased productivity, and better quality in adapted varieties. These provided the base for converting native rangelands in the south and native bushlands in the north to cultivated pasture and hay.

The viable agricultural industry developed is intensely energy consumptive, operates on a very narrow gene base, and continues to use summer fallow as insurance against drought. Viability cannot be maintained if high energy use, genetic poverty, and summer fallowing continue.

We are starting to think about energy conservation strategies. Zero and minimum tillage are receiving attention and research in the use of solar energy is increasing. There appears to be sufficient energy-saving research to move us in the right direction. Whether or not the movement is fast enough is a matter of opinion. What we must seriously debate is whether or not we are prepared to scale down, even moderately, our production expectations to gain the savings in energy that may be necessary. If we are, we should be starting now to do research to develop alternate production systems.

We have begun to broaden our gene base in animals and crops. Foreign cattle breeds have been introduced and evaluated and are being used in our breeding systems. We have developed adapted varieties of corn, sunflowers, peas, lentils, and other crops. Wheat cultivars with quality different from hard red spring are also being considered. But we must do much more in all our major soil-climatic regions if we are to have a mature industry based on a high-quality, stable yield of a wide range of crops to satisfy a diversified world market.

The most serious problem facing western Canadian agriculture is salinization of dryland farming soils due to summer fallowing. If not dealt with soon it will significantly reduce our production base. To adequately deal with this problem, close collaboration is required between the federal and the three prairie governments. It requires a large research effort coordinated by a strategically located salinity research group.

Harshness of the environment increases as agricultural expansion moves northward.

An additional 30 million acres remain to be developed in the north.

But these inherited problems of the west as a whole must not be our only concern. There remain some 20 to 30 million acres of potentially arable land in western Canada, north of our existing production base. Its development fringe is our present frontier. To do an efficient job of developing resources we must plan and guide the opening of this new arable land in a knowledgeable and responsible manner.

To achieve this goal it is important to have a northern agricultural research and development institute on the campus of one of our western universities, staffed with experts in soil, climate, crop and animal breeding, production, economics, marketing, human relations, and a wide range of related disciplines. The group would bring together all the present knowledge of the north and catalyze and coordinate future research. It could then use this knowledge to plan development strategies for agriculture in the north and continually update these in relation to changes in technology, markets, and the expectations of Canadians. Federal, provincial, and territorial governments could fund and guide this institute's activities.

What is needed is an orderly sequence of development extending north from areas that are now in production. The first phase would consist of converting large blocks of land for forage production and using these blocks for 10 to 20 years for summer grazing of beef cattle. The second phase would consist of dividing these large blocks into farms that become part of a developed agricultual community.

Our research programs should be adapted to provide for on-site research in the blocks that are in the first stage of development. When settlement occurs, it is important that the appropriate production technology be available for demonstrating to the new farmers. By doing this, we will avoid a lot of the problems associated with past development.

Many of the development and production methods that were right for our northern-style western agriculture when it was beginning now need modification. It is imperative that the required changes be recognized and implemented.

In the past, frontier settlement witnessed a consistent human drama. A majority of original settlers either gave up in discouragement and moved out or subjected themselves and their families to a generation or two of subsistence living until new lessons were learned about the agricultural needs of the area and until more appropriate techniques, crops, and technology became available. This constitutes a waste of human resources, to say nothing of individual hardship and deprivation in a modern, affluent, and technologically developed society. It is important that, in the process of bringing into production the remaining arable frontier farmland, present day settlers are spared some of the hardships of their predecessors.

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Enforcing the food protection and inspection laws

V. Meere

Every Holstein-Friesian dairy cow has distinctive body markings, as unique as human fingerprints — and as useful to Agriculture Canada in enforcing food production laws as fingerprints are to policemen in their fight against crime. Such 'bovine fingerprints' permitted the Investigations Unit of Agriculture Canada's Food Production and Inspection Branch to build a recent case against an Eastern Canadian cattle dealer who tried to export cows illegally to the United States by changing identification ear tags. The dealer pleaded guilty to four counts under the Animal Disease and Protection Act and was fined $1000.

Une unité d'enquête, composée de quatre hommes de la Direction générale de la production et de l'inspection des aliments, a été mise sur pied en janvier 1979 pour aider le personnel sur le terrain à fournir les preuves nécessaires pour poursuivre en justice les contrevenants à la Loi sur les maladies et la protection des animaux. Cette enquête connaît un succès grandissant alors que les condamnations et les amendes plus élevées vont en croissant.

The dealer was caught because the federal investigators were armed with ear tag numbers and corresponding 'fingerprints' — drawings and marking-descriptions provided by the Holstein-Friesian Association of Canada — as he attempted to ship a truckload of Holsteins into the United States. Nine of the 19 cattle were not the $1200 purebreds they were purported to be. They were $500-$700 substitutes bearing official Agriculture Canada tags belonging to purebreds. The tags falsely indicated that the animals had been found free of tuberculosis and brucellosis, two diseases which the Canadian government is committed to eradicating.

The case is one of many successful prosecutions of the four-man Investigations Unit, set up in January 1979, at Agriculture Canada's Ottawa headquarters. In its first 2 years, the unit — made up of former RCMP and military police detectives — developed 23 cases, either completed or before the courts. Twelve of the cases involved infractions of the Animal Disease and Protection Act. The majority of the other cases dealt with the Meat Inspection Act, which among other things provides penalties for conveying meat products which Agriculture Canada inspectors do not pass across a provincial border.

In all, the unit can lay charges under 13 federal acts and associated regulation.[1] But offences under the Animal Disease and Protection Act — because the act covers some 160 infractions — accounts for most of the investigative time and, because of large fines assessed recently, offers the most potential in deterring potential lawbreakers.

The agriculture industry has much to lose if the unscrupulous dealer damages its reputation for exporting disease-free cattle. The export market, mostly the United States, is huge. In 1979, more than 20000 purebred dairy cattle worth about $32 million were shipped abroad for breeding. Also exported were about 7400 purebred beef and some 250000 other cattle. The total export value of cattle shipped in that year was approximately $200 million.

Exports declined sharply earlier in the 1970s because of a brucellosis revival, an indication of the economic importance of maintaining acceptable disease-control standards. Foreign buyers' confidence in the product must be safeguarded. The brucellosis in Canadian cattle has been largely eradicated and exports have rebounded. But the Food Production and Inspection Branch is wary of slackening effort on any front, including the legal, against this disease.

Agriculture Canada has always been a strong regulator but it wanted a better success rate in prosecutions. Many cases were thrown out of court on technicalities since departmental officials lacked training in police methods such as preserving evidence. Also, the criminal element was organized and heavily into cattle movement. The arrival of the Investigations Unit changed this picture.

The unit's investigators — Frank Hammersley, Bob Bazinet, Jack Weir, and André Pepin — work closely with the RCMP and provincial police; how-

[1]Animal Disease and Protection Act
Canada Agricultural Products Standards Act
Feeds Act
Fertilizers Act
Fertilizers Act
Fruit, Vegetables and Honey Act
Humane Slaughter of Food Animals Act
Livestock and Livestock Products Act
Livestock Pedigree Act
Maple Products Industry Act
Meat Inspection Act
Pest Control Products Act
Pesticide Residue Compensation Act
Plant Quarantine Act
Seeds Act

ever, most of the leads that end up in prosecutions come from the department's veterinarians and inspectors in the field. They, and concerned members of the livestock and meat industry, are the eyes and ears of enforcement. The investigators are the backup crew, the management service in guiding field staff and coordinating their efforts in gathering evidence and preparing cases for government prosecutors. Investigators also often assist in seminars for inspectors.

The unit tries to get the men on the spot to do as much of the leg work as possible in finding, preserving, and presenting evidence in court. The investigators, however, still spend 75 percent of their time in the field — especially dealing with high-profile cases that might involve the crossing of provincial and international borders and tracing lawbreakers involved in cattle dealing or meat sales. There are many ongoing cases. It's often a matter of watching and waiting for the culprit to make a mistake, which may take as long as 2 years. But most cases take a few months to bring to court.

Meat inspection regulations

Four Ottawa catering companies were recently fined in Hull, Quebec, for transporting across the Ontario-Quebec border meat sandwiches which were not federally inspected. Agriculture Canada officials had repeatedly warned the companies and explained how they might become registered establishments under the federal Meat Inspection Act. Such registration allows firms to transport meat legally across provincial borders.

Why is inspection necessary?

The Meat Inspection Act is the basic regulation controlling Canada's international and interprovincial movement of meat and meat products. This legislation has been in place since 1955; however, in the last 2 years there have been more prosecutions under the act because Agriculture Canada has seen the need to increase enforcement.

A section of the act states that all meat and meat products transported across provincial borders must originate in federally-inspected plants. If that meat is reprocessed, sliced, or cooked before shipment, it must be reinspected.

Agriculture Canada inspects meat to ensure that only safe, wholesome products reach the consumer. Even sandwiches that contain meat or meat products are subject to inspection before they may be legally transported between provinces.

The provinces want assurance that meat entering their jurisdiction is safe and wholesome. Because provincial meat inspection regulations vary across Canada and concern only intraprovincial meat transport, federal inspection is the only means of standardizing the wholesomeness of meat moving between provinces.

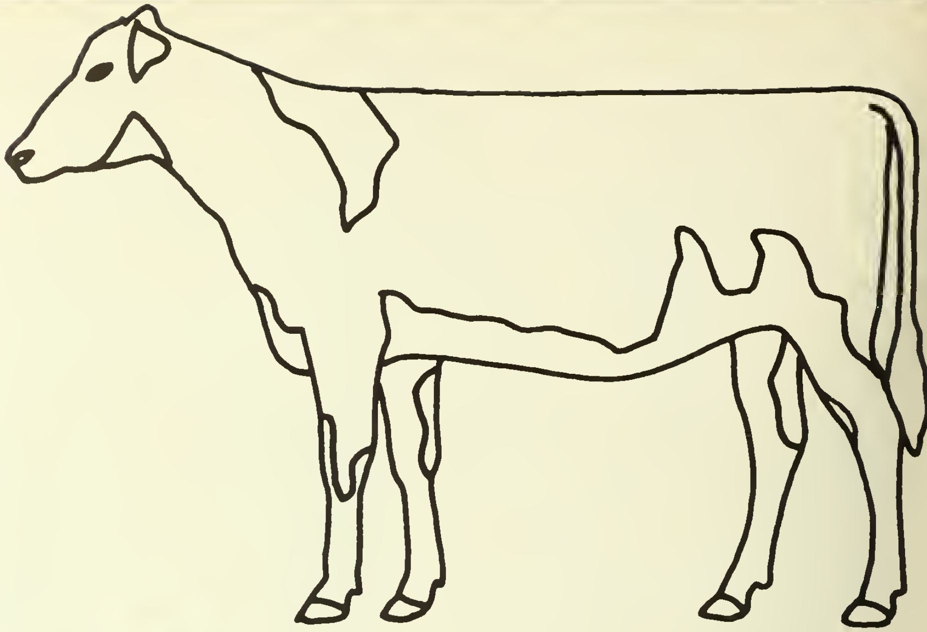
Quebec is particularly concerned that only inspected meat enters its jurisdiction.

Inspection is important in processing facilities and in plants or kitchens using processed meat that will later be sold in another province. The buildup of harmful bacteria can be readily controlled under federal inspection by ensuring that processed meat is refrigerated below 10°C and handled in a sanitary environment.

If raw meat is improperly stored, it deteriorates rapidly. Bacteria multiply quickly and spoilage may occur within 12 hours.

Once meat is processed by heat, most spoilage bacteria are destroyed. During later handling, such meat can be recontaminated and toxins can develop rapidly.

More dramatic than the watching



Agriculture Canada inspectors found that the Holstein-Frisian cow (in photo), held as evidence from a shipment bound for the United States, was a cheap substitute—not the prize animal whose markings (see drawing) were kept on file by the breed association. Government prosecutors used the drawing in court to prove that the ear tags had been switched. Since this is a violation of animal health regulations the lawbreaker was penalized.

Checking an ear-tagged steer is an Agriculture Canada inspector, the first line of defence against animal health regulation violators.

and waiting is when a hunch pays off. An inspector's suspicions were recently aroused when he was checking the forms filled out by a cattle exporter. The dealer was shipping cattle a few hundred miles to the United States. The loads were small and there didn't appear to be any money in it. The inspector called the Investigations Unit and a check with the Ontario provincial police and the RCMP established that the driver and dealer had criminal links. Further investigation led to evidence of illegal animals shipped under dummy forms as part of a bigger fraudulent network.

The investigators travel thousands of miles by air and another 10000 miles by automobile throughout Canada each year. They've had to learn inside out the acts they help to enforce and they've been asked for input about possible redrafting of legislation and regulations. The investigators prefer stiffer laws and penalties as deterrents, but the fact that more cases have gone to court has helped. Judges today are less likely to impose a $10 fine for a prosecution that took 6 months to prepare. They are more apt to understand the importance of controlling diseases particularly related to livestock and meat products, and to impose the maximum $500 penalty per offence.

A recent judgment is a good example. A man was caught conspiring to export 70 cattle to the United States with forged health certificates. Falsified Agriculture Canada certificates showed that the cattle had been cleared for tuberculosis and burcellosis. The defendant argued for the charge's dismissal because the animals were later found to be disease-free in the United States. But the judge agreed with the prosecutor that dismissal would invite others to commit similar offences. The prosecution argued strongly that Canada's substantial cattle export market could disappear if purchasers could not rely on getting disease-free cattle. The man was convicted and fined $5000.

In another case, a dealer was charged with stealing pre-stamped Agriculture Canada health certificates. He forged a veterinarian's name and sold a truckload of crippled cattle to a U.S. packer. He was subsequently convicted and fined $3000.

A livestock dealership and its owner were convicted under the act and fined $2750 for moving cattle that might have been infected with brucellosis. The defendants pleaded guilty to five out of ten charges of breaking brucellosis regulations, including moving cattle both into and out of a herd which had been quarantined for burcellosis. They were also charged with adding cattle to their registered livestock dealer premises without the prescribed brucellosis-negative certificate. Animal health officials quarantine herds in which animals reacting positively to a brucellosis test are detected. They are kept in quarantine until at least two tests verify no further evidence of the disease. The dealer was fined $200 on each of the five charges. The company was fined $1750.

Two Ontario cattle dealers were recently convicted and fined for infractions of the Animal Disease and Protection Act. Under the act, dealers are required to keep records of any cattle moving on to or off their premises. During a routine brucellosis inspection, Agriculture Canada inspectors found that one dealer had no sales or transfer certificates for some of his cattle. A second dealer was found guilty of moving cattle without a change-of-ownership test as stipulated in the act. Both were fined $500.

The investigators and other Agriculture Canada officials know that they are only scratching the tip of an iceberg with the cases they have brought to court. They know they can't catch all those who break laws administered by Food Production and Inspection Branch — let alone try to cover every corner of Canada. But they are pleased with the results and are learning more about their adversaries. With the help of other law enforcement agencies, the main problem area has been isolated and a wider plan of action is being prepared.

Mr. Meere is feature writer for *Canada Agriculture*.

Organic farming... A new appraisal

[In Canada, as elsewhere, there is a growing concern about the long-term environmental effects of the increasing dependence of agriculture on chemical applications—fertilizers, insect controls, feed additives, and weed killers—to maintain and increase the volume of food production. There are no easy answers to this problem, given the ever-expanding world demand for food and the constant struggle for economic survival in agriculture. Concerns are related to long-term health effects and other environmental implications.

In 1980 the U.S. Department of Agriculture (USDA) published a report on organic farming that considers the question of reducing or eliminating the use of chemicals in farming. This type of farming is applied in Canada and elsewhere although the report deals mainly with the U.S. situation. The study, report, and recommendations on Organic Farming, were prepared by a team of scientists at the USDA's request. The full 94-page report is issued through the Science and Education Administration, USDA, Room 6005, South Building, Washington, D.C. 20250. Key excerpts from the report are carried below. — **The Editors]**

It has been most apparent in conducting this study that there is increasing concern about the adverse effects of our U.S. agricultural production system, particularly in regard to the intensive and continuous production of cash grains and the extensive and sometimes excessive use of agricultural chemicals. Among the concerns most often expressed are the following:

— Sharply increasing costs and uncertain availability of energy and chemical fertilizer, and our heavy reliance on these inputs.

— Steady decline in soil productivity and tilth from excessive soil erosion and loss of soil organic matter.

— Degradation of the environment from erosion and sedimentation and from pollution of natural waters by agricultural chemicals.

— Hazards to human and animal health and to food safety from heavy pesticide use.

— Demise of the family farm and localized marketing systems.

Consequently, many feel that a shift to some degree from conventional (that is, chemical-intensive) toward organic farming would alleviate some of these adverse effects, and in the long term would ensure a more stable, sustainable, and profitable agricultural system.

While other definitions exist, for the purpose of this report organic farming is defined as follows:

> Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic farming systems rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivation, mineral-bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients, and to control insects, weeds, and other pests.

The concept of the soil as a living system which must be 'fed' in a way that does not restrict the activities of beneficial organisms necessary for recycling nutrients and producing humus is central to this definition.

Principal findings

The study team found that the organic movement represents a spectrum of practices, attitudes, and philosophies. On the one hand are those organic practitioners who would not use chemical fertilizers or pesticides under any circumstances. These producers hold rigidly to their purist philosophy. At the other end of the spectrum, organic farmers espouse a more flexible approach. While striving to avoid the use of chemical fertilizers and pesticides, these practitioners do not rule them out entirely. Instead, when absolutely necessary, some fertilizers and also herbicides are very selectively and sparingly used as a second line of defence. Nevertheless, these farmers too consider themselves to be organic farmers. Failure to recognize that the organic farming movement is distributed over a spectrum can often lead to serious misconceptions. We should not attempt to place all these organic practitioners in the same category. For example, we should not lump 'organic farmers' and 'organic gardeners' together.

Organic farming operations are not limited by scale. This study found that while there are many small-scale (10 to 50 ac) organic farmers in the northeastern region, there is a significant number of large-scale (more than 100 ac and even up to 1500 ac) organic farms in the West and Midwest. In most cases the team members found that these farms, both large and small, were productive, efficient, and well managed. Usually the farmer had acquired a number of years of chemical farming experience before shifting to organic methods.

Motivations for shifting from chemical farming to organic farming include concern for protecting soil, human, and animal health from the potential hazards of pesticides; the desire for lower production inputs; concern for the environment; and protection of soil resources.

Contrary to popular belief, most organic farmers have not regressed to agriculture as it was practiced in the 1930s. While they attempt to avoid or restrict the use of chemical fertilizers and pesticides, organic farmers still use modern farm machinery, recommended crop varieties, certified seed, sound methods of organic waste management, and recommended soil and water conservation practices.

Most organic farmers use crop rotations that include legumes and cover crops to provide an adequate supply of nitrogen for moderate to high yields.

Animals comprise an essential part of the operation of many organic farms. In a mixed crop and livestock operation, grains and forages are fed on the farm and the manure is returned to the land. Sometimes the manure is composted to conserve nitrogen, and in some cases farmers import both feed and manure from off-farm sources.

The study team was impressed by the ability of organic farmers to control weeds in crops such as corn, soybeans, and cereals without the use (or with only minimal use) of herbicides. Their success here is attributed to timely tillage and cultivation, delayed planting, and crop rotations. They

Le ministère de l'Agriculture des États-Unis publiait récemment une étude sur l'agriculture biologique, qui traitait tout particulièrement de la réduction ou du retrait des produits chimiques de l'agriculture. Quelques extraits importants de ce rapport sont repris dans cet article.

have also been relatively successful in controlling insect pests.

Some organic farmers expressed the feeling that they have been neglected by the U.S. Department of Agriculture and the land-grant universities. They believe that both extension agents and researchers, for the most part, have little interest in organic methods and that they have no one to turn to for help on technical problems.

In some cases where organic farming is being practiced, it is apparent from a study of the nutrient budget that phosphorus (P) and potassium (K) are being 'mined' from either soil minerals or residual fertilizers applied when the land was farmed chemically. While these sources of P and K may sustain high crop yields for some time (depending on soil, climatic, and cropping conditions), it is likely that eventually some organic farmers will have to apply supplemental amounts of these two nutrients.

The study revealed that organic farms on the average are somewhat more labor intensive but use less energy than conventional farms. Nevertheless, data are limited and a thorough study of the labor and energy aspects of organic and conventional agriculture is needed.

This study showed that the economic return above variable costs was greater for conventional farms (corn and soybeans) than for several crop rotations grown on organic farms. This was largely due to the crop mix required in the organic system and the large portion of the land that was in legume crops at any one time.

There are detrimental aspects of conventional production, such as soil erosion and sedimentation, depleted nutrient reserves, water pollution from fertilizer and pesticide runoff, and possible decline of soil productivity. If costs of these factors are considered, then cost comparisons between conventional (that is, chemical-intensive) crop production and organic systems may be somewhat different in areas where these problems occur.

Conclusion

The study team found that many of the current soil and crop management methods that organic farmers practice are also those which have been cited as best management practices (USDA/EPA joint publication on "Control of Water Pollution from Cropland," Volume I, 1975, U.S. Government Printing Office) for controlling soil erosion, minimizing water pollution, and conserving energy. These include sod-based rotations, cover crops, green manure crops, conservation tillage, strip cropping, contouring, and grassed waterways. Moreover, many organic farmers have developed unique and innovative methods of organic recycling and pest control in their crop production sequences.

Because of these and other reasons outlined in this report, the team feels strongly that research and education programs should be developed to address the needs and problems of organic farmers. Certainly, much can be learned from a holistic research effort to investigate the organic system of farming, its mechanisms, interactions, principles, and potential benefits to agriculture at home and abroad.

The future

The future expansion of organic farming in the United States will depend upon such things as the cost and availability of energy and concentrated nutrient sources, demand for food and fiber, including organically produced food, and research and education programs. There may be strong incentives for some organic practices in a number of areas including energy conservation, organic waste utilization, food safety, environmental protection, and soil productivity maintenance. These incentives will undoubtedly continue to give impetus to increased interest in organic farming.

The scope of organic farming is currently limited. The best opportunities for commercial-scale production are limited to situations in which P and K fertilizer requirements are low, because of either lower yield levels or a very highly buffered P and K status of the soil, or where there is large-scale importation of nutrients onto the farms in the form of feed, manure, sewage sludge, composts, or other organic wastes. Most organic farmers do not use organic practices solely for economic reasons. They are more concerned with potecting human and animal health and the environment, conserving energy, and perserving soil resources, and will, if necessary, accept some economic loss to achieve these objectives.

The increasing cost of chemical fertilizers, pesticides, and energy inputs and their uncertain availability, or both, may lead to increased organic farming. As input price relationships change, some farmers, especially the mixed crop-livestock farmers or those operating small farms, may find organic farming just as economical or even more so than chemical-intensive farming. Further impetus to increased interest in organic farming may be brought about by the increasing public concern for the adverse effects of conventional agriculture on the environment.

A large number of chemical pesticides have already been banned for agricultural use. Pesticide use and its effects on human life are highly controversial issues. If more agricultural chemicals used in conventional agriculture are banned and not replaced with effective and less toxic compounds, many farmers may have to shift to an alternative production system, including the use of organic methods.

Organic agriculture greatly depends on the recycling of plant nutrients in the production system. Major increases in the recycling of nutrients in the U.S. agricultural production system may be difficult to achieve because of the large amount of grain exported or concentrated in large-scale livestock feeding operations that are far removed from the crop production area. Increases in recycling of nutrients through conversion of cash grain farming to increased regional livestock production, with an associated increase in legume production, would require major changes in U.S. agriculture. Organic farmers would need to be close to an economical source of acceptable organic waste. A change in input mix would also result in a major change in the output mix. Consequently, the future prospects for large-scale shifts to organic farming are limited unless significant changes are brought about in pubic policy and in the overall structure of U.S. agriculture.

Regulatory reform at Agriculture Canada

V. Meere

Among the first regulations passed in colonial Canada were those that affected agriculture. As early as 1707 a public health act decreed that an officer of the King had to be present when a food animal was being slaughtered. By 1805 there were regulations in effect covering the curing, packing, and inspection of beef and pork. Other laws to protect the food supply followed. A report issued in 1877 showed that 51.5 percent of food samples examined (mainly spices and milk) were adulterated to some extent.

Today, the degree of regulation of the agricultural and food industry—especially in food-processing plants—is considerably more extensive than for most types of manufacturing (see Appendix 1). In fact, the regulatory explosion of the 1970s, which affected all areas of business and society, caused a backlash which has brought charges of wasteful and uneconomic types of regulation. This has sparked a drive for deregulation, or at least for regulatory reform.

Regulatory reform is now a federal (Treasury Board) priority. In a report last December the Special Committee of Parliament on Regulatory Reform issued 29 recommendations, many of which are concerned with agriculture. Two earlier studies, for the Economic Council of Canada, had urged steps to ease the food inspection burden (see Appendix 2).

Agriculture Canada, which had been steadily moving ahead in improving the regulatory process, is carefully examining the committee's findings and will be acting on most of its recommendations. The coordinator is Dr. John McGowan, Assistant Deputy Minister, Food Production and Inspection Branch, who also is working on regulatory review initiated by a special departmental task force appointed in late 1979. The task force's work won the approval of the department's Senior Management Committee (SMC) in early 1980 and was praised in the December report of the Special Committee of Parliament.

The policy that the SMC adopted consisted of two phases. Under Phase I, the 40 or so acts that the department administers were grouped as follows: those containing sunset (or expiry) clauses, those to which sunset clauses should be added, those that should be revoked, those that required detailed review, and those that required future consideration. Under Phase II, an action plan was developed that established the responsibility and timing for steps required for each statute. Nine statutes and subordinate regulations were identified as outdated, redundant, counterproductive, or wasteful and Treasury Board has been asked to include them in a Repeal Omnibus Bill that will revoke a long list of obsolete federal statutes.

Agriculture Canada has been looking at other possible improvements in the regulatory process:

—One element would be a regulatory calendar—a published roster of planned changes in statutes and regulations to which the public and industry could respond with suggestions.

—Initial approval has been given to setting up a regulatory affairs office, attached to the Food Production and Inspection Branch but serving the whole department. Key elements would be experts in a regulatory reform unit and the Investigations Unit of Food Production and Inspection. The office would provide advice on how statutes and regulations could be made more readily enforceable.

—The possibility of increased industry self-regulation is being investigated with industry cooperation. One of the most important moves made recently was the formation of the Agriculture Canada—Canadian Food Processors Liaison Committee. This committee provides a forum to discuss everything from labeling requirements to grading standards. Further meetings are planned to explore some of these areas in detail. This will help to streamline regulations.

—The department continues to consolidate statutes and regulations. Its aim is to reduce the number of statutes and regulations as much as possible and to ensure that they are consistent and easily understood.

The federal drive for regulatory reform is also tied to the need for each department to hold down spending. All departments and agencies, including Agriculture Canada, face constraints on available person-years. Spending on regulatory activity is heavy. For example, in the last decade the budget to run a key service, the federal meat inspection system, has tripled to about $45 million a year. There are about 1500 inspectors in some 500 slaughtering and processing plants who annually approve about $7.3 billion in red meat and poultry sold interprovincially plus all meat imports and exports.

Thus the department is looking at alternatives to full inspection, to ensure more efficient use of its person-years and other resources, and to answer its critics. But the department can only go so far. Deregulation, to satisfy concerns that the extensive array of food production and inspection regulations seriously affect industry efficiency and productivity, must be weighed against the need to adequately protect consumers by ensuring a safe and wholesome food supply. The department cannot afford to step back in this area. The public wouldn't stand for it.

What are some of the specific moves being studied to meet departmental objectives?

To remove duplication in regulations, the department could roll into one statute the Meat Inspection Act and the Canada Agricultural Products Standards Act. Such a document, already drafted but not introduced in Parliament, sets out all the standards and procedures of the federal inspection system for red meat, dairy products, honey and maple products, fruits and vegetables, poultry, and livestock. This consolidation could answer the call for uniformity in regulations and terminology and facilitate both enforcement and compliance.

Liaison with the following departments responsible for regulations that apply to the food industry is being increased: Health and Welfare (health hazards), Consumer and Corporate Affairs (fraud, packaging, and labeling), and Fisheries (effluent regulations). This is expected to improve enforcement coordination and use of manpower.

Industry self-regulation is being explored for processing plants making low-meat-content products (such as pizza) and for producers of fresh vegetable products. Such regulation would be patterned after the procedure followed in the dairy and poultry industry, where the processor grades the products in accordance with established standards. For example, government inspectors do not check every pound of butter. It was found in the early 1970s that 99 percent of the products met requirements. So a monitoring system was started to spot check the processor's quality control procedures.

The department, for example, has been working with potato producers in New Brunswick and Prince Edward Island to abolish compulsory inspection. The plan is for the grower to grade and ship on his own and federal inspectors to visit the producer at random and check samples. If the producer consistently passed the spot checks he would be visited less frequently. If his record was bad the inspectors would visit more often, applying all sanctions necessary to improve compliance. The ultimate weapon would be to disallow the producer to sell his goods across provincial borders. It is hoped that a small trial can be launched soon, followed by a larger test run. If the system doesn't work, the matter will be dropped and because of its involvement on the ground floor in developing the system the industry would know the reasons why.

This system of early consultation with industry—at the problem-identification level—is very important to the department and processing plants have shown a tremendous response. For example, early in the year the department proposed to a major association that inspections be stopped at plants that make products containing less than 2 percent meat. The reaction was negative but the association produced a positive counter-proposal, asking that the inspectors stay but provide only a low level of inspection. Deregulation was turned down because the processors who use the federal meat inspection 'legend' or mark have a competitive edge over those whose products are not federally inspected.

The proposal discussed would apply only to quality control because standards could be maintained with fewer resources. However, the department doesn't see the spot-check system working in packing houses. Detailed examination of animals to ensure that they are disease-free before and after slaughter is a necessary tool to protect consumers from tainted products, and the department is convinced the taxpayer is more than willing to pay for this high level of inspection.

Agriculture Canada has not found support for widespread deregulation but it does agree that alternative and sometimes less costly techniques exist for achieving regulatory objectives. The department intends to stress further improvements in consultation procedures with industry; subject all major new regulations to extensive cost-benefit analysis; conduct a regular, systematic, and thorough evaluation of existing regulations; and to expand self-regulation where feasible.

The major thrust will remain—food wholesomeness and safety.

Appendix I

The British North America Act divides legislative jurisdiction over the production, processing, and distribution of food products between federal and provincial governments.

In the red meat industry, for example, there are two distinct and separate inspection systems—the federal, which oversees about 90 percent of commercial livestock slaughter and meat output, and the provincial systems, operating under similar standards. Meat from the two cannot be mixed. Only federally inspected meat can be moved and sold across provincial borders or exported.

Major food legislation at the federal level falls under the Food and Drug Act, the Canada Agricultural Products Standards Act, the Meat Inspection Act, and the Consumer Packaging and Labelling Act. Other federal statutes, such as the effluent regulations of the Fisheries Act, touch on food as well as numerous provincial statutes. Many complement federal rules.

Appendix II

Economic Council of Canada studies of the $5 billion red meat industry and the $1 billion fruit and vegetable processing industry found that a proliferation of regulation, at both federal and provincial levels, is a burden and that compliance costs millions of dollars annually and reduces productivity.

While there has only been a moderate increase in new statutes, the studies discovered a much greater growth in subordinate regulations, especially in the number of official circulars, directives, and bulletins about interpretation of enforcement decisions related to regulations. But it also found that the processing industry now accepts that a relatively high degree of regulation is desirable or necessary. Therefore, when a new regulation is proposed, the processing industry does not 'dig in its heels' and demand no regulation. There is a process of give-and-take between regulators and industry to produce rules that both can best live with, that will be less costly than alternatives, and that meet desired objectives. Overlap among federal statutes affecting food inspection is avoided through interdepartmental agreement and cooperation. This is also true of provincial-federal overlap.

The council's studies recommended that Agriculture Canada and provincial departments implement a systematic evaluation of existing regulations, explore possibilities of increasing industry self-regulation, and establish effective consultation with industry, including the giving of adequate notice of proposed changes in regulation. Agriculture Canada had already adopted this line of thinking before the studies were made public last fall.

Mr. Meere is feature writer for *Canada Agriculture.*

Oxygen limits crop growth in organic soils

J.A. Campbell, J.A. Millette, F. Rayment, and L. Frascarelli

Considerable research has been done relating water table management, drainage techniques, and cultural methods to crop yield. Most of this research has been empirical and has not shown how these practices affect soil properties that limit crop yield. The role of oxygen in the soil has been the least studied of these soil properties.

Crop yield is sensitive to water table level. Hence, if the water level is too low, plant moisture deficits develop. Conversely, if the water table is too high, not enough oxygen enters the soil and the plants suffocate. Ideal water tables have been determined for many organic soils and locations (Valk 1973 and Synder *et al.* 1978). Water table level also influences subsidence. In Florida, Shih *et al.* (1979) have recently shown that proper water table management can substantially reduce subsidence, extending the life of these organic soils as much as 20 years.

The influence of different cultural practices on crop yield is highly variable in organic soil. Sometimes ridging or various types of raised soil beds would increase yields, in other instances it would not. Similar variable results have been reported for ploughing, disking, rotovation, and subsurface drain designs. Much of this variability remains unexplained. Frequently, mole drainage and a higher frequency of subsurface drains would increase yields. This is usually attributed to better soil aeration or a reduction in spring flood damage.

Agriculture Canada scientists have recently begun to study how soil properties, particularly soil oxygen levels, limit crop yield and subsidence and are controlled in turn by water table level, cultural methods, and drainage techniques.

These management techniques are being evaluated in the greenhouse and in the field in southwestern Quebec and eastern Newfoundland. The production of potatoes and rutabagas is being evaluated in Newfoundland and carrot production in Quebec. Some of the different drainage techniques evaluated include ditch drains, subsurface drains, mole drains, different subsurface drain designs, and subirrigation. The cultural methods evaluated include ploughing, disking, rotovation, and ridging. The effects of wrapping plastic tile drains with fiber, pipe diameter, and embedding drains in sawdust were evaluated with the Norwegian or tileless type of subsurface drain (Rayment and Campbell 1980).

Photo 1 shows how the oxygen level in the soil affects carrot growth in the greenhouse. Too little oxygen, <20 units, stunts root development, causing short, hairy, and often forked carrots. Carrots grown in soil with the oxygen level between 40 and 80 units were well shaped and reached maximum yield. If the oxygen level exceeded 80 units, moisture deficits developed; the carrot roots became long and slender; and the yield decreased. Oxygen levels were controlled by raising and lowering the water table in large organic soil columns.

Some of the effects of the different cultural methods and crops on the soil oxygen level are shown in Figures 1 and 2. The movement or flux of oxygen in the soil towards a sensor probe was measured with an electronic meter (Campbell 1980). In one study at Farnham, Quebec, when the water table was maintained 30 cm from the soil surface, rotovation markedly in-

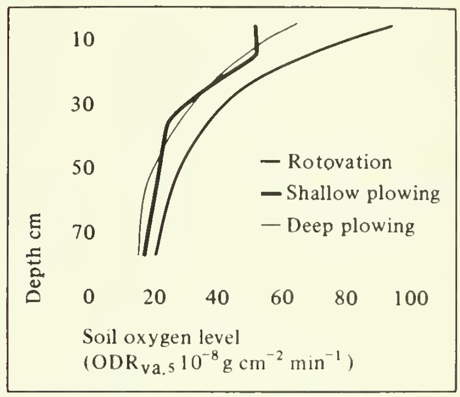


Figure 1. Effect of cultural method on soil oxygen flux ($ODR_{va.5}$) at Farnham, Quebec.

Photo 1. Carrots grown in organic soil columns in the greenhouse; left *with <20 units of oxygen and a water table of 19cm,* right *with 40-80 units of oxygen and a water table of 35 cm.*

creased the soil oxygen level, especially near the soil surface (Figure 1). On another site at Colinet, Newfoundland, the cultural methods had a large influence on soil oxygen flux. The combination of ridges and mole drains provided the most aerated or oxygen-rich environment (Figure 2). Raising and lowering the water table in field and greenhouse experiments also markedly raised and lowered the soil oxygen level. Surprisingly, the different subsurface drain designs did not have much effect on soil oxygen levels.

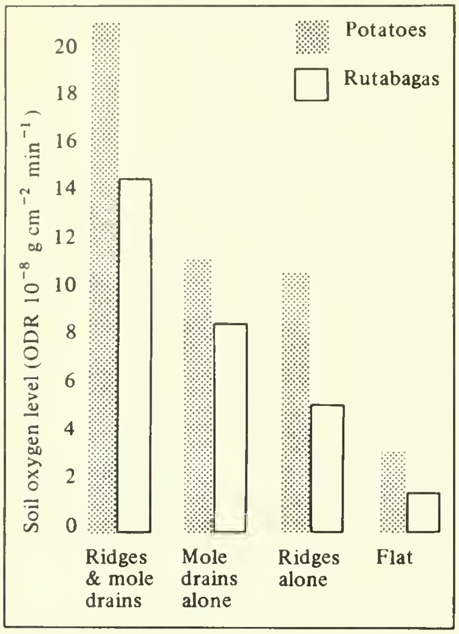


Figure 2. Effect of cultural methods and crop type on soil oxygen flux at 20 cm depth at Colinet, Newfoundland.

Variations in soil oxygen level resulted in large changes in crop yield. Figure 3 summarizes measurements from Quebec and Newfoundland and shows that despite differences in soils, climates, crops, and management techniques, yield is mostly controlled by the supply or movement of oxygen in the soil. These data also suggest that in Quebec the soil is more productive because of its higher oxygen content.

These experiments indicate that the oxygen requirements for vegetable production in the rhizosphere, or surface 30-cm soil layer, is about 40 to 80 units (x 10^{-8} g cm^{-2} min^{-1}) of oxygen.

Measurements of soil oxygen flux provided a rapid, simple way of assessing the productivity of a soil and the efficiency of the various drainage and cultural methods used. This procedure could be easily applied to other sites and would provide better empirical calibration than using yield measurements alone.

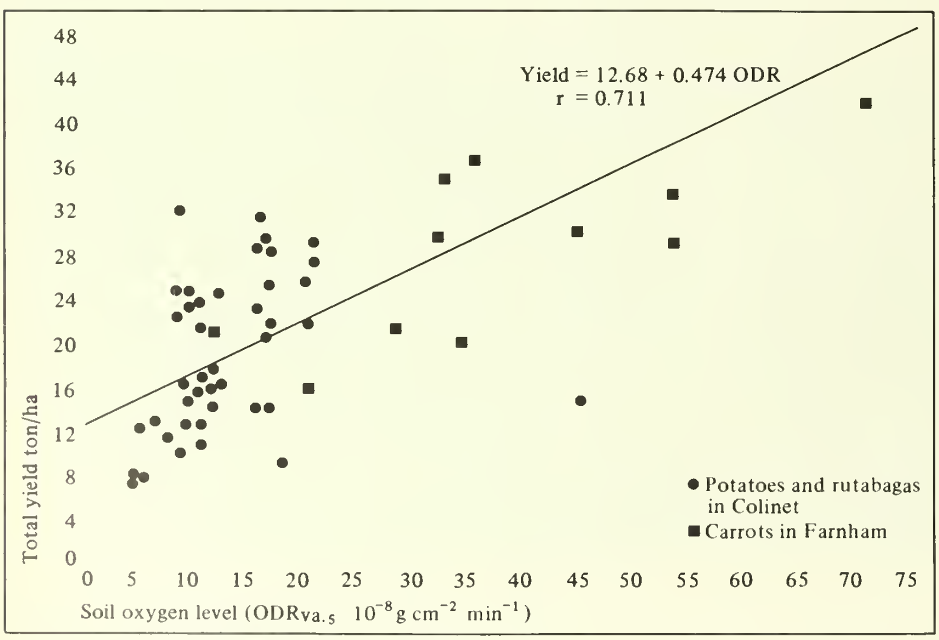


Figure 3. Comparison of carrot, potato, and rutabaga yield to oxygen levels at 20 cm soil depth.

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Le rôle limitatif de l'oxygène dans la croissance des plantes en sol organique

J.A. Campbell, J.A. Millette, F. Rayment et L. Frascarelli

On a cherché dans beaucoup de travaux à établir un rapport entre l'aménagement de la nappe phréatique, les techniques de drainage et les méthodes culturales, d'une part, et le rendement des cultures, d'autre part. Cependant, la plupart de ces recherches étaient empiriques et n'ont pas montré comment les pratiques mises à l'essai modifiaient les propriétés pédologiques qui limitent le rendement des cultures, comme la teneur en oxygène du sol, qui est sans doute la propriété la moins étudiée.

Le niveau de la nappe phréatique exerce un effet déterminant sur le rendement des cultures: s'il est trop bas, une pénurie d'eau se manifeste chez la plante; s'il est trop haut, une quantité insuffisante d'oxygène pénètre dans le sol et la plante suffoque. Le niveau idéal a été déterminé pour beaucoup de sols organiques et d'emplacements (Valk 1973 et Synder et coll. 1978). Le niveau phréatique influe également sur la subsidence, comme l'ont confirmé les travaux récents de Shih et coll. (1979) en Floride. Ils ont montré qu'un bon aménagement de la nappe phréatique pouvait réduire de beaucoup la subsidence, et ainsi prolonger la vie des sols organiques de vingt ans dans certains cas.

L'influence des différentes techniques culturales sur le rendement végétal varie énormément dans les sols organiques. Parfois, le billonnage et d'autres types de relèvement de la couche de semis augmenteront les rendements, dans d'autres cas, non. Le labourage, le discarge, le rotobinage et différents types de drainage souterrain ont donné des résultats tout aussi variables, encore impossibles à expliquer pour la plupart. Souvent, le drainage taupe et le rapprochement des drains souterrains accroîtront les rendements, ce que l'on attribue habituellement à une meilleure aération du sol ou à une réduction des dégâts occasionnés par les crues printanières.

Les chercheurs du ministère de l'Agriculture du Canada ont commencé récemment à étudier comment les propriétés pédologiques, notamment la teneur en oxygène du sol, limitent le rendement des cultures et la subsidence, mais dépendent, par contre, du niveau de la nappe phréatique, des méthodes culturales et des techniques de drainage.

Ces techniques d'aménagement font actuellement l'objet d'une étude en serre et sur le terrain dans le sud-ouest du Québec et dans l'est de Terre-Neuve où l'on évalue respectivement la production de carottes et celle de pommes de terre et de rutabagas. Parmi les différentes techniques de drainage à l'étude, mentionnons le drainage à fossé ouvert, le drainage souterrain, le drainage taupe ainsi que différents modes d'égouttement et d'irrigation souterrains. Sur le plan des méthodes culturales, on s'est intéressé plus particulièrement au labourage, au drainage, au rotobinage et au billonnage. On a aussi évalué par la même occasion l'effet que pouvaient avoir l'enveloppement des tuyaux de drainage en plastique avec de la fibre, l'enfouissement des drains dans du bran de scie, le diamètre du tuyau et enfin le drainage souterrain de type norvégien ou sans tuyau (Rayment et Campbell 1980).

La photo 1 montre comment la teneur en oxygène du sol modifie la croissance des carottes en serre. Une quantité insuffisante d'oxygène soit moins de 20 unités freine le développement racinaire, produisant une carotte courte et poilue, souvent bifurquée. Les carottes cultivées dans un sol dont la teneur en oxygène va de 40 à 80 unités sont bien formées et donnent un rendement maximal. Si la teneur dépasse 80 unités, on constate une carence en eau: le tubercule s'allonge et s'amincit, et le rendement diminue. Dans l'expérience, la teneur en oxygène était contrôlée par l'élévation ou l'abaissement du niveau phréatique dans de grosses colonnes de sols organiques.

Dans les figures 1 et 2, on voit certains effets des différentes façons culturales et cultures sur la teneur en oxygène du sol. Le déplacement de ce dernier dans le sol en direction d'une sonde a été mesuré à l'aide d'un appareil électronique (Campbell 1980). Dans une étude menée à Farnham (Québec), on a constaté que le rotobinage augmentait sensiblement la concentration en oxygène du sol notamment près de la surface, lorsque le niveau phréatique était maintenu à une profondeur de 30 cm (Fig. 1). À Colinet (Terre-Neuve), les méthodes culturales influaient énormément sur l'apport d'oxygène. La combinaison de billons et de drains de taupe produisait le milieu le plus aéré ou le plus riche en oxygène (Fig. 2). Par ailleurs, l'élévation et l'abaissement du niveau

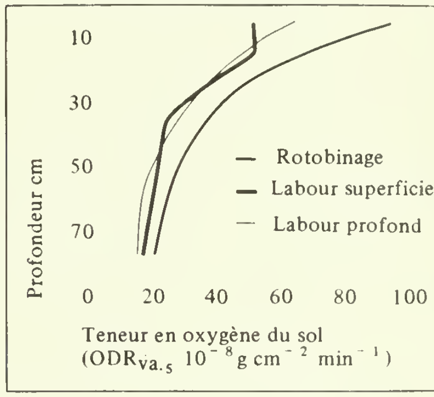

Figure 1. Effet des méthodes culturales sur le déplacement de l'oxygène du sol à Farnham (Québec).

Photo 1. Carottes cultivées en serre dans des colonnes de sol organique; avec 20 unités d'oxygène et un niveau phréatique de 19 cm (à gauche); avec 40-80 unités d'oxygène et un niveau phréatique de 35 cm (à droite).

phréatique dans les expériences sur le terrain et en serre augmentait et réduisait respectivement de beaucoup la concentration d'oxygène. Chose surprenante, cependant, cette dernière ne changeait guère selon les différents modèles de drainage souterrain.

La variation de la teneur en oxygène du sol a fortement influé sur le rendement des cultures. Dans la Figure 3, on constate, d'après les mesures effectuées au Québec et à Terre-Neuve, que malgré les différences dans les sols, le climat, les cultures et les techniques d'aménagement, le rendement dépend surtout de l'apport d'oxygène ou de son déplacement dans le sol. Ces données suggèrent qu'au Québec le sol est plus productif à cause d'une plus forte teneur en oxygène.

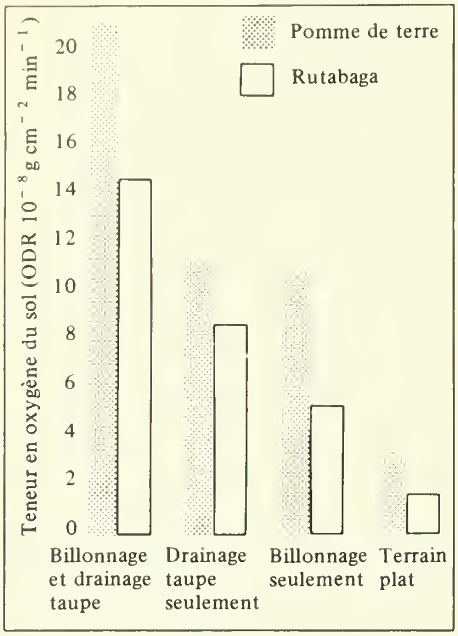

Figure 2. Effet des méthodes culturales et du type de culture sur le déplacement de l'oxygène du sol à une profondeur de 20 cm à Colinet (Terre-Neuve).

D'après ces expériences, il semble que les besoins en oxygène pour la production végétale dans la rhizosphère ou la couche supérieure de 30 cm se situent aux alentours de 40 à 30 unités (x 10^{-8} gm cm^{-2} min^{-1}) d'oxygène.

En conclusion, la mesure du déplacement de l'oxygène fournit un moyen rapide et simple d'évaluer la productivité d'un sol de même que l'efficacité des différentes méthodes de drainage et de culture utilisées. Ce procédé pourrait s'appliquer facilement en d'autres lieux et permettrait une meilleure calibration empirique que la mesure du rendement seule.

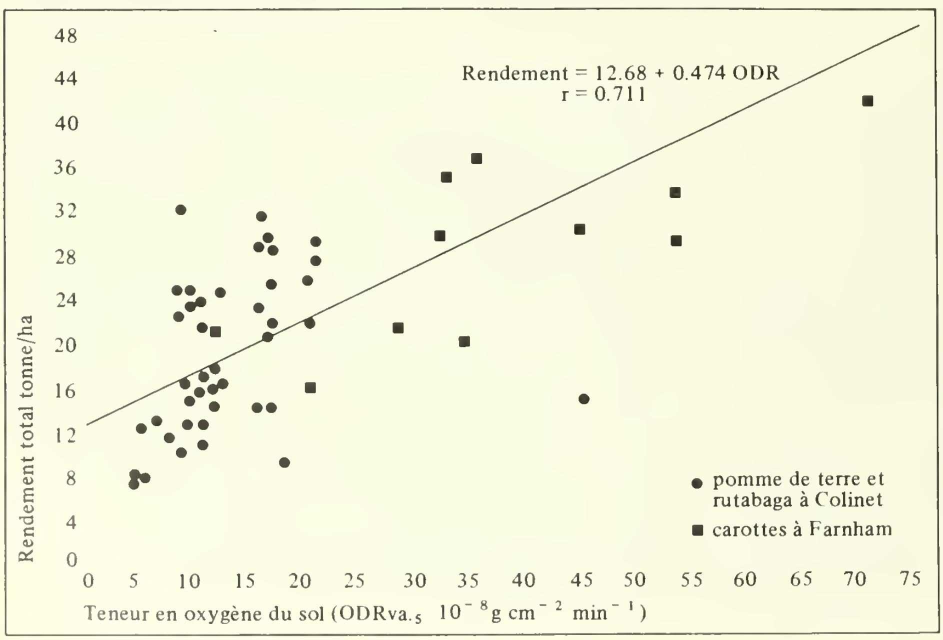

Figure 3. Comparaison entre le rendement de la carotte, de la pomme de terre et du rutabaga et les concentrations d'oxygène à une profondeur de sol de 20 cm.

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Scientific irrigation scheduling

E. H. Hobbs

Improving the efficiency of on-farm irrigation has several potential benefits. Besides increasing crop yields, these benefits include optimum utilization of a limited but renewable water resource; conservation of the energy required in water application and of the fertilizer needed for plant growth; preservation of a productive, non-polluted soil resource; and more efficient irrigation district management.

A procedure being developed to assist scheduling of farm irrigation in Alberta is an adaptation of methods now used in many American states. A computer assists in determining, for specific fields, the timing and quantity of water required for each irrigation. Inputs to the computer program involve the disciplines of crop and soil science, engineering, and agrometeorology. Computer use permits instantaneous integration of the individual effects of these influences on crop water requirements. The output is used to assist farm managers, extension personnel, or agricultural consultants by creating realistic pro-

Le présent article décrit les procédures reliées au programme d'irrigation des fermes de l'Alberta. Une gamme d'informations concernant les niveaux d'humidité et les particularités des différentes cultures sont introduites dans un ordinateur qui donnera ensuite tous les éléments nécessaires pour que l'irrigation puisse s'effectuer dans les conditions et au moment requis.

jections of the irrigation requirements of each crop.

The crop information required for the computer program includes planting and expected harvest dates and mean daily water requirements. Scientists have determined the latter at the Lethbridge Research Station for the traditionally irrigated crops (alfalfa, forage grasses, wheat, oats, barley, flax, peas, sugar beets, potatoes, and corn) and for several promising new ones (rapeseed, faba beans, soybeans, and sorghum). As the plants grow, their increasing root development and their differing varietal abilities to extract water from the soil without restricting their growth rate are considered in conjunction with the soil physics data. These include soil characterization in terms of water-holding capacity, soil moisture release rate, and evaporation from a wet soil surface.

The principal engineering input concerns the ability of the farm irrigation system to supply a specific amount of water and the efficiency with which this can be applied to the soil.

Since the computer program uses average crop-use data, and local growing conditions are seldom average, actual plant requirements are estimated by relating current and historical meteorological data. The departure of daily temperature and radiation from normal indicates whether the plant system is liable to be operating at a level above or below the potential rate of the input curves.

The program, including the fixed and variable inputs, is usually run weekly. The output is a statement of daily crop-water use, total water deficit, and a projection of both the date of the next irrigation and the gross amount of water required (Figure 1).

The scheduling program may be made more complex by including rainfall probabilities and additional meteorological variables. However, the inclusion of rainfall probabilities for southern Alberta altered the predicted date for irrigation by at most 1 day in a 7-day period. Use of a more complex meteorological equation that includes the less readily available parameters of air movement and humidity had even less effect. It is often impossible for the irrigator to react on a specific day and an irrigation often takes several days to complete. Consequently, it seems impractical to complicate the program unless the additional inputs contribute appreciably to its usefulness.

The program, currently called LETHIRR, is being calibrated against a series of crops whose soil moisture is being carefully monitored. Good agreement between the moisture loss predicted by LETHIRR and that actually used indicates that the program is soundly based and practical.

Agreement between measured and predicted soil moisture for a 1979 barley crop was excellent throughout most of the season (Figure 2). The program underestimated moisture loss early in the season before the crop was established and when soil moisture was actually in excess of calculated field capacity. Precipitation was negligible throughout the season.

In Figure 3 (also for a barley crop but grown in 1978) initial soil moisture was high as well, but there was appreciable summer precipitation. The program adequately allowed for this and once again realistically portrayed the existing soil moisture. The barley curve apparently needs some fine tuning for the period just before harvest. Although it is impractical to irrigate as harvest approaches, it is useful to have a reliable estimate of residual soil moisture to determine the need for applying a fall irrigation to assure adequate moisture the following spring.

REGION: LETHBRIDGE

FARM. LETHBRIDGE RESEARCH DATE OF COMPUTATION JULY 07 1980

		SOIL MOISTURE DEPLETION			IRRIGATIONS MM		
CROP-FLD	COEF	TO DATE	OPTIMUM	RATE	LAST	NEXT	AMOUNT
RAPE TEST	1.20	46	95	10	JUL 2	JUL 12	95
BEET U	0.86	37	95	7	JUL 4	JUL 15	95
ALFALFA U	1.20	73	150	10	JUL 3	JUL 15	150
WHEAT U	1.19	101	125	10	JUN 17	JUL 9	125
BARLEY U	1.18	82	125	10	JUN 17	JUL 11	125
OATS U	1.20	73	125	10	JUN 19	JUL 12	125
CORN	0.75	65	125	6		JUL 17	125

Figure 1. A sample of a LETHIRR printout for various crops and fields at the Lethbridge Research Station.

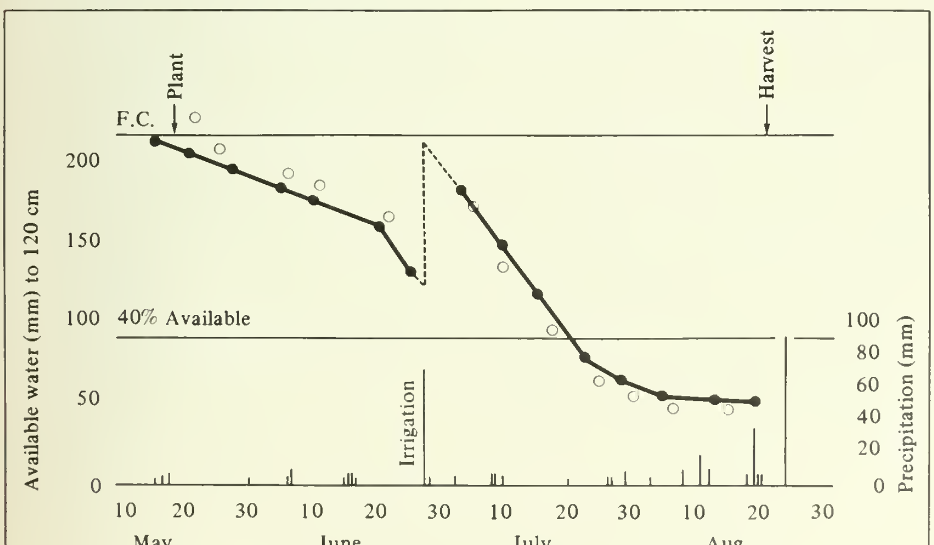

Figure 2. A comparison of actual soil moisture use (○) with the computer prediction (●) for barley, 1979.

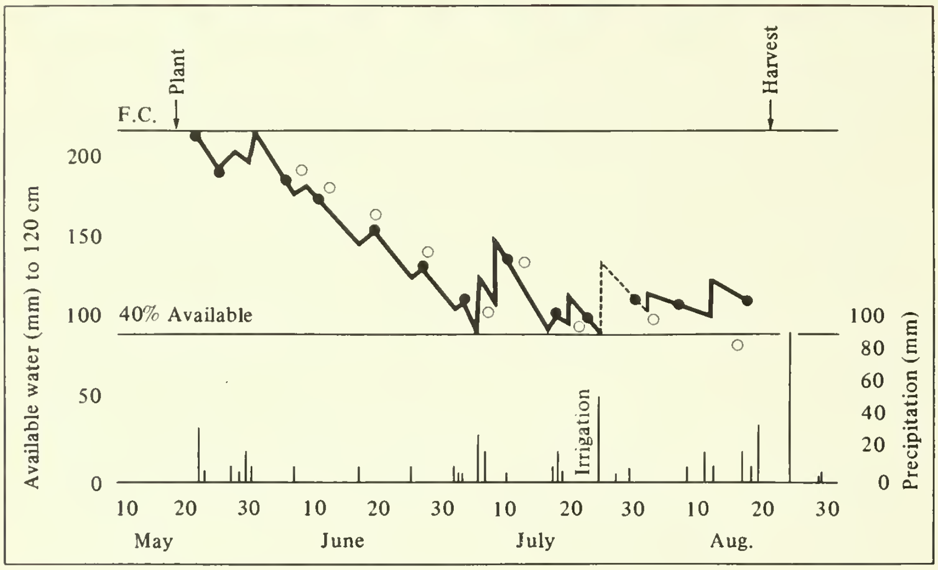

Figure 3. A comparison of actual soil moisture use (○) with the computer prediction (●) for barley, 1978.

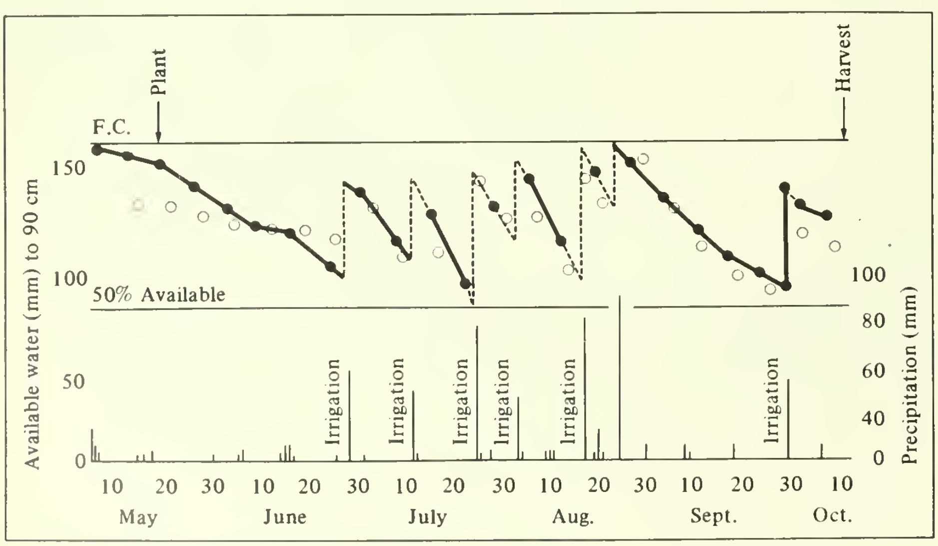

Figure 4. A comparison of actual soil moisture use (○) with the computer prediction (●) for sugar beets, 1979.

The sugar beet field depicted in Figure 4 showed the need to decrease the estimate of the early rate of use indicated by the program. But from the time that the crop was well established and using appreciable amounts of water, there was good agreement between the measured and predicted rates.

Although the program does estimate moisture loss from bare soil, it is not really practical to put it into operation before the crop is well established. Before that, water requirements are visibly obvious because only surface moisture is important.

It is not suggested that the scheduling program will replace a competent operator's field observatons. Disease, insects, fertility, even unusual soil and weather conditions, may unusually influence crop growth. What the program should do is direct the manager to the field at about the right time to check the program recommendation, relieving him of the tedium and expense of routine field checks and soil moisture measurements.

In trial use of the program on farm fields, some problems have arisen which are being studied further. It is difficult to accurately estimate the moisture contribution from a high water table. This can markedly influence apparent crop water use. There has also been difficulty in getting accurate feedback concerning the irrigations which cooperating farmers apply. This is primarily a communication problem that should improve as the benefits of the service become more apparent.

Mr. Hobbs is an irrigation specialist at the Agriculture Canada Research Station, Lethbridge, Alberta.

Residual effects of nitrogen fertilizer

D.W.L. Read

The soil under grass stands is usually deficient in nitrogen. Under prairie conditions this soil is also often deficient in moisture for part of the growing season. Grass will usually respond to nitrogen fertilizer if it is applied so that the nitrogen is available to the plants when moisture is also available.

At the Swift Current Research Station, in the fall of 1969, nitrogen was broadcast to old stand plots of crested wheatgrass. The stand was in excellent condition. Nitrogen was applied at rates of 0, 50, 100, 400, and 800 lb of nitrogen per acre. The soil was clay loam. The hay had been harvested each year and analyzed for dry matter yield and protein content. The soil had been sampled each fall to a depth of 4 ft and the samples analyzed for nitrogen content.

The yield from the 800-lb rate has been double, or more than double the yield from the 50-lb rate in every year except 1970. The 400-lb rate has yielded on the average about as much as the 800-lb rate (Table 1). The values of 10¢/lb for nitrogen and 1¢/lb for dry matter were used to determine the profitability of fertilizer use. These values are low compared with present costs as the value of fertilizer and hay have both risen, but they do give a reasonable evaluation of the profit. The 100-lb rate has provided the greatest profit, followed closely by the 400- and 50-lb rates. The 800-lb rate has not yet increased the yield sufficiently to pay for the extra cost.

Other factors that must be considered in evaluating the benefit from fertilizer are the increased protein content of the forage and the amount of nitrogen remaining in the soil. There has been a 30- to 50-percent increase in the protein content of the forage from the 400- and 800-lb rates each year. The amount of nitrogen remaining in the soil from the higher application rates would lead one to expect the response pattern to continue for several years, increasing the profitability of the higher rates of fertilizer application.

Soil tests indicated that there was no buildup of nitrogen from the 50- or 100-lb application rates, compared with that obtained from the 400- and 800-lb rates, even in the first year of the test. Other researchers, including Power in Mandon, North Dakota, working with native grass, and Ukrainetz in Saskatoon working with bromegrass, have found similar results. In all cases rates in excess of 100 lb of nitrogen were needed before a pool of residual nitrates was built up in the soil. There was no indication of surface movement of the fertilizer and very little nitrogen had moved below 36 in. in the soil.

This study indicates that a residual pool of nitrogen can be built up in the soil and this nitrogen remains available for crested wheatgrass plants for several years. Rates of over 100 lb of nitrogen must be applied before a reserve is built up in the soil. Rates of 200 to 400 lb appear to be high enough and probably rates down to 200 lb would be satisfactory. But there must be a good stand of grass to make use of the fertilizer, and the rainfall must be low enough so that there is no leaching through the soil profile.

Une réserve résiduelle d'azote peut être développée dans le sol et cet azote demeure assimilable par l'agropyre à crête durant plusieurs années. Il est nécessaire d'utiliser au moins 100 livres de cet azote avant que la réserve puisse être constituée. Une quantité se situant entre 200 et 400 livres semble être idéale mais 200 livres devraient normalement suffire. Le terrain doit comporter un bon peuplement de graminées lors de l'utilisation du fertilisant et le niveau de pluie doit être suffisamment bas pour éviter le lessivage du sol.

TABLE 1. Summary of dry matter yield, 1974 and 5-year total, percent protein, profit from fertilizer, and nitrogen remaining in soil

Nitrogen applied in 1969	Yield of dry matter lb/ac 1974	5-yr total	Protein in forage (5-yr av)	Value of increased yield of hay (hay at 1¢ lb)	Cost of fertilizer (N at 10¢ lb)	Profit from fertilizer	Nitrogen in top 4 ft of fall of 1974
lb/ac	-	lb/ac	%	-	$/ac	-	lb/ac
0	1379	5 078	9.2	—	—	—	10
50	1463	7 533	10.0	24.55	5.00	19.55	12
100	1674	8 274	10.2	31.96	10.00	21.96	15
400	2493	11 070	13.8	59.92	40.00	19.92	42
800	2823	11 747	15.0	66.69	80.00	− 13.31	180

Mr. Read is a cereal harvesting specialist at the Agriculture Canada Research Station, Swift Current, Saskatchewan.

Controlling soil insect pests of row crops

D.C. Read

Many people who apply insecticides to destroy crop insect pests do not appreciate the harmful effects that these materials can have on predators and parasites. Or, they do not appreciate the tremendous value these beneficial organisms can have in maintaining low pest populations under natural field conditions.

An example of one situation can show how valuable these predators and parasites can be. There are at least five different kinds of insect that kill root maggots in such vegetable crops as carrots, rutabagas, cabbage, and cauliflowers. In experimental test plots, a single species of parasite destroyed 97 percent of the root maggots in the crop. However, this parasite destroys the root maggot pupae after instead of before the crop has been damaged. Nevertheless, one can readily understand the value of the various species of predators and parasites in keeping the crop pest populations under control from one generation to the next.

Insecticides destroy the weakest individuals in an insect population. Hence, the strongest are left to multiply and produce strains which are more tolerant to the insecticide. If in-

On ne se rend pas toujours compte des effets négatifs qui suivent l'application des insecticides. Souvent, en plus de détruire les insects nuisibles, le produit attaquera d'autres parasites ou prédateurs. Ces derniers font de ces parasites leur proie ce qui voit à garder l'équilibre écologique. Pour une utilisation efficace, l'application d'un insecticide devrait se faire de façon à ce qu'il soit très toxique pour l'insecte nuisible et moins dangereux pour les prédateurs; de plus, un niveau de toxicité suffisant devrait se maintenir tout au long de la période "active" de l'insecte ravageur.

secticides destroy most of the predators, the strongest of the pest species can rapidly build up a large population that is resistant to the insecticide.

A recent situation in Prince Edward Island clearly demonstrated this phenomenon. A rutabaga field was spray drenched in mid-season with Furadan® to control root maggot attacking rutabagas. Examining the field the next day showed a vast array of dead insects on and between the rows. These included several species of parasites, predator beetles, and flies that would normally have destroyed large numbers of root maggot eggs, larvae, pupae, and adults. Dead grasshoppers, leafhoppers, moths, butterflies, wasps, and other insects also littered the field. An examination of the rutabagas' roots also showed large numbers of root maggot larvae inside the roots. They, however, were not dead. The spray-drench treatment was obviously more concentrated against, and more harmful to, the beneficial predators and parasites than it was against the pest larvae.

With the ever increasing problem of resistance to different types of insecticide, it is becoming more and more important to learn exactly how different insecticides move in the soil, and how they affect insects. Compounds should be applied selectively and in a manner which will insure that they are more concentrated against the pest species than against beneficial predators and parasites. In addition, residual pesticides should not be used against pests that attack a crop during a short, specific period.

Tests have demonstrated that soil applications of some types of insecticide were highly toxic and fast acting against flies and other specific insects standing on the soil surface. When banded 1 to 3 cm below the surface, these compounds were carried upward with moisture moving to and evaporating from the surface and became as highly toxic to insects standing on the soil surface as when they were applied at the surface. When toxicants were applied at lower depths (10 or 12 cm), toxic levels reached at the surface were not as high.

Carbamate insecticides showed the highest adulticidal potency against flies. Temik® and Baygon® moved to the surface more quickly than Furadan but were less persistent. Under greenhouse conditions and where the soil was kept continuously moist, Furadan toxicants at a depth of 3 cm persisted for at least 2 years. If the soil was allowed to become air dry for periods of 2 to 4 weeks, toxicants persisted longer — obviously related to the total 'dry' period when microorganism degradation would be at a minimum. Generally, the deeper the placement of the band, the more persistent are the toxic residues. However, their potency at the soil surface is reduced accordingly.

Figure 1. Parasitized pupa of the cabbage maggot, with puparium cover partially removed to show parasite larva destroying pupa.

The carbamate materials were also potent larvicides in the soil. Several organophosphorus insecticides, which were potent larvicides, showed low to moderate adulticidal potency while other organophosphorus compounds had little or no effect on flies. One organophosphorus compound was a more potent adulticide than the other test materials against carabid ground beetles but it showed little effect on flies. The three carbamates were much slower acting against beetles than against flies.

Toxic residues of all the compounds tested were absorbed into vegetable crops such as rutabagas and carrots grown in treated soil. But most of them were quickly degraded to nontoxic metabolites by rutabagas in storage. However, certain newer materials, which have not been registered for use on vegetables, were degraded slowly in plant tissue in storage.

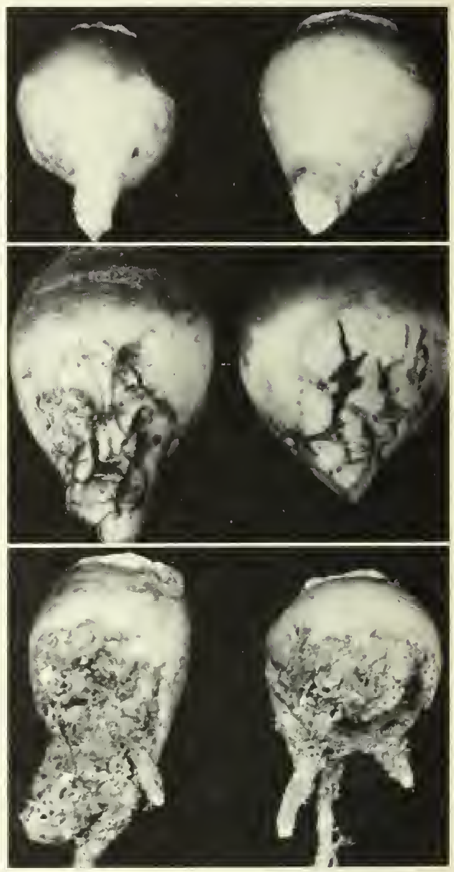

Figure 2. Top: rutabagas grown where insecticide was effective; middle: severe root maggot injury in rutabagas not treated with insecticide; bottom: injury in rutabagas after root maggots, but not predators and parasites, had developed resistance to insecticide.

Since the insecticides which move upward in the soil from a subsurface band application become distributed through the soil around the roots of the plants, they are most concentrated against the pest insects in or near the roots. And since some of them have high adulticidal potency, the adult female insects can be killed as they move on the soil around plant stems to lay eggs. Furthermore, if the rows are slightly ridged and compacted, heavy rains tend to run off and soak into the soil between the rows rather than leaching downward through the insecticide band in the rows.

To make the most efficient use of an insecticide, it should be applied so that it is most toxic against the pest species, least harmful to beneficial predators, and has sufficient residual toxicity to last throughout the pest species' period of attack. Temik, which is only prepared in granular form because of its high mammalian toxicity and used as a soil insecticide, can be highly effective against nematodes, cutworms, white grubs, and other insects attacking crops early in the season. It is also systemic and toxicants in plant tissue have controlled foliage pests. However, its residual potency is usually not adequate for all-season control of such pests as root maggots attacking carrots or rutabagas because these can attack the crops almost continuously from early June to October.

The bioactivity pattern of Baygon is quite similar to that of Temik but it does not have as high a level of systemic activity. Nevertheless, it can have adequate residual toxicity to give all-season control of root maggots if seasonal moisture is not excessive. Abnormally high seasonal rainfall can presumably reduce its residual effectiveness by leaching toxicants down below the insects' point of attack. Baygon is a fast acting and potent adulticide, a strong larvicide, and has a relatively low mammalian toxicity rating. Its major drawback is that it can be highly poisonous to plants when soil moisture is relatively low during seed germination and early plant growth.

Furadan moves more slowly in the soil and is much more persistent than Temik or Baygon. However, it can become relatively inactive in dry soil and it may be leached downward during growing seasons of abnormally high rainfall.

Dilution of insecticide concentration in the soil by excessive rainfall must inevitably allow the strongest pest insects to survive. This seems to have happened with Furadan since there is now in some areas evidence of highly increased tolerance in root maggots. Furadan has been used commercially for some years for controlling foliage and soil insect pests of several crops, and there has been abnormally high rainfall during 4 of the past 10 years in Prince Edward Island. Mid-season drenches or sprays of a residual compound such as Furadan can be extremely harmful to the beneficial predators and parasites that move on the soil, plant stems, and foliage. It is possible that the surface treatments, as well as the excess rainfall, have contributed to the development of resistance of the pest species. Test results with Furadan and other insecticides indicate that the most toxic and residual compounds initially gave the best results. However, the shotgun approach to application is surely going to result in problems for the near future if more attention is not given to efficient use of the newer insecticides in pest programs.

Dr. Read is a research scientist at the Agriculture Canada Research Station, Charlottetown, Prince Edward Island.

Effect of sanitation and temperature on retail beef spoilage

G.G. Greer and L.E. Jeremiah

One of the prime sensory attributes influencing consumer selection of retail beef is color. Consequently, beef cuts are overwrapped in a transparent film and displayed in refrigerated, illuminated cabinets to accentuate the bright, red color and facilitate consumer selection. Unfortunately, under the present conditions of retail display, the color shelf life of beef rarely exceeds 2 to 3 days. This relatively limited retail case life is due to the development of undesirable surface discoloration resulting from the growth of a group of bacteria called psychrotrophs, meaning 'cold-thriving' or 'cold dwelling'. In Photo 1, steaks had been on display from 0 (A) to 5 days (F). The progressive increase in the extent of steak surface discoloration is a result of an increase in psychrotrophic bacterial numbers from about 100/cm^2 on freshly cut steaks (A) to 100 million/cm^2 on 5-day-old steaks (F). Consequently, the case life of beef on retail display can be extended by reducing the initial number of bacteria contaminating the meat (sanitation) and by retarding the growth rate of organisms which are present.

Chez le détaillant, la couleur de la viande est le principal facteur sur lequel se base le client pour choisir ses coupes de boeuf. A cause de l'augmentation rapide de bactéries dans la viande, le boeuf sur les tablettes ne gardera sa couleur originale que deux à trois jours. Il est possible de retarder cette décoloration en améliorant les conditions hygiéniques au niveau du matériel de transformation et des grossistes.

Sanitation

Since the unexposed muscle tissue of healthy animals is considered to be sterile, two important sources for the bacterial contamination of retail cuts include poorly sanitized processing equipment and the contaminated surfaces of wholesale cuts and carcasses. The concentration of spoilage bacteria on meat processing surfaces has been found to increase by as much as a million-fold if soiled cutting surfaces are not sanitized within 24 hours following a cutting operation. The ultimate consequence of poor retail sanitation management is an increase in the number of bacteria initially contaminating the meat and a reduction in retail shelf life. Table 1 shows that the retail shelf life for rib steaks was more than 3 days when the initial bacterial load was 100/cm^2 of surface area. Shelf life, however, was appreciably reduced if the initial level of contaminating bacteria increased to 100 million/cm^2.

In view of sanitation's importance, experiments were designed and conducted to determine the effects of lab-

TABLE 1. The effect of the initial level of bacterial contamination on the color shelf life of rib eye steaks

Bacteria/cm^2 of steak surface	Retail shelf life
no.	days
100	3.3
10 000	2.5
1 000 000	1.6
100 000 000	0.7

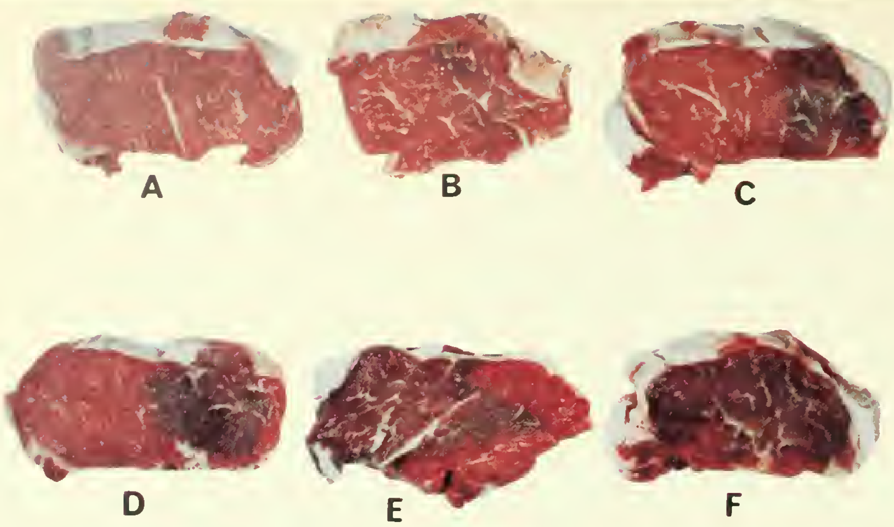

Photo 1. The progressive increase in the level of surface discoloration on retail displayed rib eye steaks. Freshly cut steaks (A) were displayed for 1 (B), 2 (C), 3 (D), 4 (E), and 5 (F) days.

oratory-simulated extremes of retail sanitation on the bacterial quality and shelf life of steaks. Unexpectedly, the initial bacterial load and the shelf life of steaks fabricated under sterile or septic conditions were identical. Further studies revealed that steak shelf life was more closely related to the extent of bacterial contamination of the wholesale rib than the degree of retail sanitation. Thus in this particular experiment, the ribs were so highly contaminated at the wholesale level that retail contamination had little influence upon the ultimate microbial quality of the steaks. These findings stress that good retail sanitation may be of limited value if it is not preceeded by a rigid sanitation program at the abattoir and wholesale processing stages. It is conceivable that a retailer could be condemned for selling an unwholesome product although his meat cutting operation was strictly hygienic.

Temperature

In addition to reducing the initial bacterial load through sanitary meat processing techniques, it is also necessary to control the growth of organisms which are present. Temperature is the most critical factor in controlling the growth of beef spoilage psychrotrophs. The psychrotrophic bacterial growth rate can more than triple as incubation temperature is increased from 1° to 10°C. Consequently, the color shelf life of beef is reduced from 9 days at 1°C to 2.5 days at 10°C.

Because of the importance of temperature in maintaining meat quality, the Canadian Meat Council recommends that fresh meats be stored at less than 4°C. However, extensive surveys of retail outlets in Canada and the United States have shown that the temperature of meats on retail display can exceed 10°C. These results have recently been confirmed under laboratory simulated conditions of retail display where steak surface temperatures ranged from 7.5° to 14.2°C.

The retailer should be aware that retail case thermometers are located directly in front of the incoming blower air and are thereby indicative of the blower temperature, not the temperature of retail displayed meats. The temperature of a product on retail display can exceed the temperature recorded at the blower by as much as 9°C. The large discrepancy between retail case and displayed meat surface temperature results from the cumulative effects of the following factors: 1) intensity of display illumination, 2) occurrence of retail case defrost cycles, 3) fluctuations in ambient temperature, and 4) the position of meats within the case relative to the blower and the load line.

Since meats on retail display appear to be subjected to considerable temperature abuse, experiments were designed to determine the effects of a variety of retail case temperatures on steak temperature and shelf life. From the results shown in Table 2 it is apparent that steak surface temperatures are considerably higher than the blower's temperature (about 9°C on the average). Also, as blower temperature was increased from −8.6° to +2.0°C there was a concomitant increase in steak surface temperature and bacterial growth, and as a result, a reduced retail case life. Steak shelf life can be extended from about 2 to 8 days by decreasing blower temperature from +2 to −8.6°C. These findings suggest that retail cases may not be operating at maximum efficiency and may explain the normal shelf life for beef of only 2 to 3 days. In addition, it appears that recommended storage temperatures can be achieved and a simple adjustment by the retailer could substantially extend the keeping quality of displayed beef.

TABLE 2. The influence of retail display case blower temperature on bacterial growth and steak shelf life

Retail blower temperature	Steak surface temperature	Rate of bacterial growth (generations/h)	Steak shelf life
°C	°C	generations/h	days
−8.6	1.9	0.09	8.2
−5.7	4.2	0.11	6.0
−3.6	5.3	0.14	5.6
−0.5	7.3	0.17	3.8
+2.0	11.8	0.28	1.9

Conclusion

A good program of sanitation management (from abattoir to retail display) should be complemented with proper retail temperature control to retard bacterial growth and thereby maintain the acceptable appearance of fresh beef. Not only will these procedures be of direct economic benefit to the retailer but the consumer will be more satisfied with the increased keeping quality during storage in the home refrigerator.

Dr. Jeremiah and Mr. Greer are research scientists at the Agriculture Canada Research Station, Lacombe, Alberta.

A bait-trap for wireworms

J.F. Doane

Wireworms continue to be the major soil insect pests of grain and field crops in the Prairie Provinces. Although approximately 137 species are known to occur in the prairie region, only a few damage crops. Of these, the prairie grain wireworm, *Ctenicera destructor* is by far the most destructive (Photos 1 and 2).

The advent of several effective and persistent soil insecticides in the late 1940s and early 1950s brought a welcome respite from the heavy damage that was often encountered in the 1930s and early 1940s. Chemical seed treatment of grain and other seeded crops has been the major method of applying insecticides for wireworm control. Soil broadcast treatments, recommended for controlling wireworms in potato and vegetable crops have been used to a limited extent. Seed treatments usually do not reduce the wireworm population in a field by more than approximately 60 percent. Consequently, even though seed treatment has been used for about the last 25 to 30 years, wireworm populations still persist. Fields may also be reinfested following egg-laying by adult wireworms (click beetles) that move into fields from adjacent grassy areas.

Wireworms are difficult to detect because of their soil habitat. Often the first indication of their presence is seen in areas of plant thinning, or in more severe cases, patchy stands. At this point it is too late for any control measures since the damage has already been done. Farmers must determine if a wireworm infestation is present before seeding.

Research workers locate wireworm infestations and measure their densities by taking soil samples and counting the number of wireworms per unit area. But this is usually too time-consuming and impractical for individual growers. Because of these difficulties the practice of using an 'insurance treatment' before planting grain in potentially infested fields, or a broadcast treatment for such crops as potatoes or vegetables, has been common. However, it is important from an economic and an environmental standpoint to use pesticides only where actual wireworm infestations exist. Therefore, methods of wireworm detection, such as baiting or trapping, need to be improved so that farmers can use them to determine if wireworm infestations are present in individual fields.

Wireworms have been known for many years to be attracted to various types of bait. Before the organochlorine insecticides were available, various inorganic chemicals mixed with baits were sometimes used for wireworm control, particulary in small gardens. These, however, were ineffective. We now know that wireworms are strongly attracted by carbon dioxide (CO_2). This explains their ability to rapidly locate germinating seeds and plant roots in the soil. Attraction to baits such as oatmeal or bran can also be attributed to CO_2 produced during decomposition of the bait by soil fungi. Although baits are useful for detecting wireworms, their effectiveness is sometimes reduced by low soil moisture. Also, wireworms may feed on baits and then move away before they are captured. Therefore, researchers at Saskatoon developed a trap designed to hold wireworms after they have contacted an attractant. This trap should be useful for wireworm survey and detection and for research into their feeding and seasonal activity.

Le ver fils-de-terre est un insecte des céréales très nuisible dans les récoltes des provinces des Prairies. Des chercheurs de la Station de recherches de Saskatoon ont mis au point un piège permettant de le capturer et cet article en fait une description. Pour mieux en contrôler les infestations, il faudrait être en mesure de déterminer plus précisément la relation entre le nombre de sujets capturé et le nombre présent dans le champ. Ce genre de détection permettrait d'appliquer les insecticides appropriés et ainsi améliorer nos moyens de contrôle de cet insecte.

The trap is designed so that CO_2 from germinating seeds builds up in a bait-chamber and diffuses up through a central tube to form a concentration gradient between two circular plexiglass plates. The plates, 15 cm in diameter, are separated by spacers 2 mm thick, which also divide the surface of the lower plate into quadrants. A central hole connects the bottom plate with an attached bait-chamber. The assembly of the trap is complete when the upper plate is clamped onto the lower plate (Photo 3A). A trap is prepared by placing wheat kernels or sunflower seeds and

Photo 1. Prairie grain wireworm larvae and adults (click beetles); length of largest larvae is about 20 mm.

Photo 2. Wireworm damage to sprouting wheat.

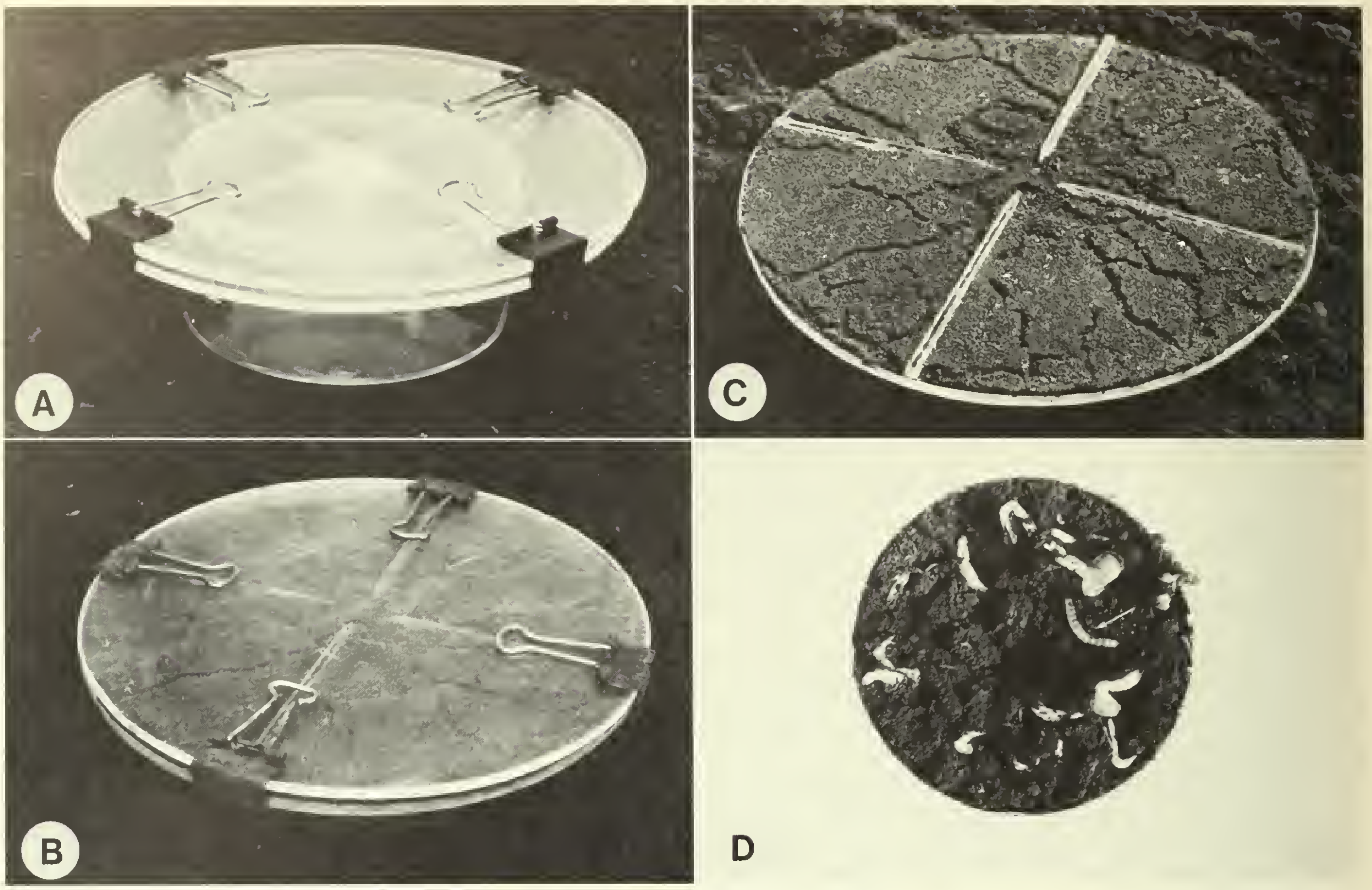

Photo 3. Wireworm bait-trap: A — an assembled bait-trap to show construction details; B — a trap just removed from the soil showing wireworm trails between the plates; C — a trap with the upper plate removed to show wireworm trails converging on the center where a tube leads to the bait-chamber; and D — the bait-chamber containing soil and germinating sunflower seed (the arrow is pointing to a wireworm on the soil surface).

soil in the bait-chamber. Soil is then distributed on the surface of the lower plate to loosely fill the central tube and quadrants marked off by the spacers. The upper plate is then attached. Traps are buried about 6 to 7 cm deep in the soil with the plates parallel with the soil surface. Wireworms attracted by the CO_2 produced by the germinating seeds in the bait-chamber enter the space between the plates, move to the central tube, enter the bait chamber, and are captured (Photos 3 B, C, and D). The traps are checked for wireworms after about 2 weeks.

During a 2-year period the traps were compared with various types of bait in a summer fallow field in a series of successive 2-week tests from May to September. Traps in soil covered by a sheet of black plastic captured the most prairie grain wireworm larvae, followed by traps under bare soil and then by oatmeal baits (Table 1). Unbaited traps captured very few larvae, showing that wireworms entered traps mainly in response to the germinating seed and not because of a physical contact stimulus.

The smaller *H. bicolor* larvae entered traps to a limited extent, but were more attracted by oatmeal baits. Additional *C. destructor* and *H. bicolor* larvae to those shown in Table 1 were found in soil cores taken around the oatmeal baits, but few were found near traps. Some of the larvae around baits may have fed and begun to move away or possibly were feeding on fungal mycelium growing out from the bait.

Two main periods of wireworm activity determined by the number of captures were observed — one about mid-June, the other about mid-August. If traps as bait are ever to be used for survey and detection it will be important to place them in the field during such periods of wireworm activity.

Competition from food in the soil

TABLE 1. Wireworms (*Ctenicera destructor* and *Hypolithus bicolor*) captured in wireworm bait-traps or collected from baits near Clavet, Saskatchewan, from May to September 1978 and 1979.

Trap and bait	*C. destructor* 1978	*C. destructor* 1979	*H. bicolor* 1978	*H. bicolor* 1979
	no.			
Trap [a]	200	193	15	29
Trap [b]	146	149	4	12
Trap [c]	—	7	—	6
Sunflower seed bait	29	—	3	—
Potato bait	—	26	—	2
Oatmeal bait	76	138	37	73
Total	451	513	59	122

[a]Trap baited with 15 sunflower seeds; soil surface over the trap covered by a 1 m^2 sheet of black polyethylene.
[b]Trap baited with 15 sunflower seeds, but with no cover on soil surface.
[c]Trap with no bait and with no cover on soil surface.

near the traps markedly reduced the number of captures of *C. destructor.* In a series of tests throughout the summer, an average of only 4.5 *C. destructor* larvae were caught in traps placed in wheat plots, compared with an average of 40.5 in summer fallow plots.

TABLE 2. Sugar-beet wireworm (*Limonius californicus*) larvae captured in wireworm bait-traps in a cultivated windbreak near Blaine Lake, Saskatchewan, 1978

Date	Trap A[a]	Trap B
	no.	
April 27 to May 9	2	6
May 9 to 23	4	4
May 23 to June 6	10	5
June 6 to 20	8	32
June 20 to July 4	7	6
July 4 to 18	16	11
July 18 to August 1	9	5
August 1 to 15	2	2
August 15 to 29	0	3
Total	58	74

[a] All traps were baited with 15 sunflower seeds; bait was renewed every 2 weeks.

The wireworm bait-trap has been particularly effective for capturing the prairie grain wireworm and the sugar-beet wireworm. We now need to determine the relationship between numbers of wireworms captured in traps and the actual wireworm density. This information could lead to better means of wireworm detection so that decisions on the damage potential and need for control can be made.

Dr. Doane is a wireworm specialist at the Agriculture Canada Research Station, Saskatoon.

ECHOES / ÉCHOS
from the field and lab / des labos et d'ailleurs

CEMENT KILN DUST IN LIVESTOCK RATIONS Supplementing ruminant feed rations with cement kiln dust could be an effective and inexpensive way to improve livestock performance.

Dr. Roy Bush, an animal nutritionist at Agriculture Canada's research station at Fredericton has been feeding this by-product of cement manufacture to test groups of sheep and cattle for 2 years. Rates of gain were increased up to 22 percent in sheep and 9 percent for some cattle.

"The concept isn't new," Dr. Bush says. 'It was first noticed in livestock raised near a cement-making operation in Georgia and subsequently tested by the U.S. Department of Agriculture."

"Our best results have been with finishing lambs and young Holstein heifers. Yearling beef heifers and dairy cows showed no response to the kiln dust additive."

The scientist feeds the kiln dust in a basic grain ration, and gives the livestock free access to timothy hay. The dust makes up 3.5 percent by weight of the total grain ration. A salt-trace-mineral supplement is also fed.

Last summer, Dr. Bush's test lambs grew from 9 to 22 percent faster than lambs in a control group.

The Holstein heifers tested were from 3 to 7 months of age, and grew about 9 percent faster than the control group.

There are a number of factors that could explain why kiln dust increases weight gain.

High lime content in the dust does neutralize rumen acids. This may create healthier conditions for rumen bacteria, making feed digestion more efficient.

The dust also neutralizes acids in the intestine, possibly improving starch digestion.

Cement dust also contains small amounts of many trace minerals, and these may interact with feed and the animal's rumen chemistry to produce an improved growth response.

"Other research conducted in Canada and the United States has shown both positive and negative results from mixing cement kiln dust in ruminant rations," Dr. Bush says.

"It is possible some kiln dusts have unique properties that make them effective as a feed additive," he says.

The scientist says a lot of research remains to be done.

"But, this waste product could become an inexpensive, plentiful feed supplement," Dr. Bush says.

NEW FEED BARLEY LICENSED
Agriculture Canada has licensed a new high-yielding, six-rowed variety of feed barley.

The new variety, Johnston, was developed at Agriculture Canada's Brandon, Man., Research Station. It is the eleventh barley variety developed at the station in the past 45 years.

Testing shows Johnston to be superior in yield to all barley varieties now grown in the Prairie Provinces. It is particularly well adapted to central Alberta where it outyields Bonanza and Klondike by 14 and 15 percent.

Johnston is resistant to stem rust as well as scald. It has superior field tolerance for leaf diseases compared to major varieties now grown in western Canada. It is similar to Klondike in resistance to root rot.

Johnston is 3 to 4 days later than Klondike in maturity and is weaker in straw strength. It is intermediate between Klondike and Bonanza in height and similar to them in test weight and seed size.

The new variety was named after Dr. W.H. Johnston who was a barley breeder at Brandon from 1936 to 1971.

NUTRIENTS FROM THE AIR Farmers could enjoy lower fertilizer bills in the future as a result of today's research efforts.

"Already legume producers are saving money usually spent on fertilizers by using the ability of their crops to draw nitrogen from the air through a process called nitrogen fixation," says R.J. Rennie, a soil microbiologist at the Agriculture Canada Research Station in Lethbridge, Alberta.

"The air we breathe is 80 percent nitrogen, making it a vast, untapped source of this essential plant nutrient," Dr. Rennie says.

All legumes, including alfalfa, clover, fababeans, field beans and peas, lentils, and soybeans can use atmospheric nitrogen because of rhizobia bacteria in nodules on their roots. The bacteria draw nitrogen from the air and make it directly available to the plants. This ability can be ensured by inoculating the crops with additional rhizobia bacteria.

By working with nature in this way, there are several benefits for farmers, the most important being savings in fertilizer costs.

Western Canadian farmers will spend about $250 million this year on nitrogen fertilizer for all crops. With prices on the rise and the amounts needed also growing, fertilizer bills can only go up, unless alternatives are considered.

Researchers are optimistic that nitrogen fixation is one such alternative which will soften the financial burden.

Research has shown that legumes can fix up to 300 kg of nitrogen per hectare yearly from the air.

"Why should anyone pay $20/ha to apply 40 kg of nitrogen fertilizer to field beans when for less than $2.00 he can inoculate his seed with rhizobium bacteria and get equal results?" Dr. Rennie asks.

Research is continuing to select legume cultivars and bacteria strains that together provide the best results in fixing nitrogen.

"This is just the beginning we hope," Dr. Rennie says. "Perhaps in another decade we will have improved nitrogen fixation in other crops such as wheat and corn."

NEW POTENTIAL FOR ALFALFA PRODUCTION New findings at Agriculture Canada's Beaverlodge, Alberta, Research Station could dramatically expand alfalfa production in western Canada.

There are about 2.4 million hectares of land in western Canada where alfalfa production is limited or nonexistent because of the soil's high acidity.

"When the soil is too acidic—where it has a pH level below 6.0—the bacteria on the roots of the alfalfa plant that fix nitrogen have trouble surviving," says Wendell Rice, who heads up the environment and soils section at the Beaverlodge station.

Up to now, the only way to overcome this problem was to add lime to the soil.

"But that is expensive because of the size of the areas involved and the transportation costs," Dr. Rice says.

He decided to approach the problem from another angle—by developing new bacteria strains that perform well at pH levels between 5.6 and 6.0.

Dr. Rice began his program by collecting healthy rhizobium bacteria from nodules on alfalfa growing in acid-soil areas.

Alfalfa seedlings were then inoculated with the bacteria and planted in acidic soil. The most efficient bacteria strains were selected out and put through a rigorous series of tests in soils of different pH levels.

Final selections now have been made and two new strains of rhizobium bacteria will be available for next year's seeding in western Canada.

"One strain is most effective for soil pH levels ranging from 5.6 to 6.0. The second works best in more neutral soils of 6.0 to 7.0," Dr. Rice says. "But both will work well in a variety of soils."

"If inoculant manufacturers widely use these new strains they could help farmers in areas with low pH levels increase alfalfa production up to 50 percent."

BIOLOGICAL CONTROL FOR MOSQUITOS A fungus native to the irrigated areas of Canada's West could prove a valuable new tool for mosquito control.

Scientists at Agriculture Canada's Lethbridge, Alberta, Research Station working with the University of Washington in Seattle have achieved about 60 percent control of one mosquito species' population with this 'water mold'.

The fungus destroys mosquito larvae by attaching to the insects' outer skin and feeding on the internal fat and muscle tissues. The larvae first swell to an abnormal size, become sluggish, and finally die.

This mold lives in the stagnant waters that are the natural environment of mosquito larvae. It was first identified in 1956, but its complex life cycle and its potential as a mosquito pathogen were not discovered until 1971.

Although it attacks only one of the 18 mosquito varieties found in southern Alberta, that one is the species that can infect humans and horses with sleeping sickness. Several tropical species, including the one that carries yellow fever, are also vulnerable to attack by the fungus.

Joe Shemanchuk, head of the mosquito research team at Lethbridge, says that, "we are trying to find out why this fungus attacks only one local species. We are also examing pathogens from other parts of the world to see if they might be effective against other mosquitos that cause us problems."

Scientists are now planning an attempt to establish this fungus outside its natural range, that is, outside the irrigated areas of southern Alberta. They hope that it will provide a continual biological control of mosquito populations, keeping them below the levels at which pesticide application becomes necessary.

WHEY FOR ANIMAL FEED Running a swine or cattle feeding operation near a cheese factory could offer farmers a chance to save money and improve their livestock quality.

This is the finding of an Agriculture Canada research team that has been investigating the economic and technical prospects of feeding whey to livestock. Whey is a by-product of cheesemaking.

"Every year about 500 million kg, or about 36 percent of Canada's total whey production is wasted," says H.W. Modler, head of the Agriculture Canada team.

Large quantities of whey are discarded because its high water content means that it must undego expensive processing to be marketed.

Small- to medium-sized cheese factories cannot afford to process whey further. They are also too widely scattered to establish a central cooperative processing facility. This leaves the factories with a serious disposal problem.

"Our findings show that there is another alternative use for the surplus whey—livestock feed," Dr. Modler says.

Whey is a proven source of nutrients for livestock feeding. It contains about 6 to 7 percent solids composed of lactose and small amounts of protein and ash. The digestibility of whey protein is about 91 percent for swine and 65 percent for ruminants.

Whey feeding can result in improved carcass quality, reduced feed costs, and better manure for fertilizer.

But a farmer considering using whey for feed should keep the following in mind.

Equipping, hauling, storing, and feeding whey could mean extra work.

Whey cannot be stored in cement silos or reservoirs, and acid resistant materials are required for transport, storage, and feeding systems. Cement floors of barns may also be subject to corrosion.

Whey must be picked up fresh every day. If it is not available on weekends, water can be added to extend the supply. However, the effect of such dilution must be accounted for in the feed ration formula.

Special attention must be paid to management techniques when introducing animals to a whey diet. Higher barn humidity and wetter floors can be expected in poorly ventilated barns.

The Agriculture Canada scientists carried out most of their research in Ontario and Quebec which produce 80 percent of Canada's whey. They estimate that if 30 percent of livestock rations were replaced by whey on a hog operation of average size and efficiency, average savings would be $10.45 per hog in Ontario and $11.22 per hog in Quebec.

These figures were based on whey supplied free, but with the farmers paying the hauling costs.

Where cheese factories exist in areas of dense livestock population, feeding whey is of direct benefit to agriculture, the dairy industry, and the environment.

NEW WINTER WHEAT FOR ONTARIO Agriculture Canada has licensed a new winter wheat adapted for the southern part of Ontario.

The new variety, Gordon, fills a demand from the milling and baking industry for a winter wheat which produces flour of excellent pastry quality.

Gordon is suited to pastry production because of its low protein content. It has less protein than Fredrick, the winter wheat variety widely grown in Ontario now.

The late Frederick Gfeller and Dr. D.R. Sampson developed Gordon at Agriculture Canada's Ottawa Research Station. It is named after Gordon Whiteside, former head of the cereal division at Agriculture Canada's Ottawa Research Station.

In 4 years of testing at several Ontario locations, Gordon outyielded Fredrick by almost 7 percent and the variety Yorkstar by almost 5 percent.

The new variety is similar to Yorkstar in many ways; it has shorter straw and a lower test weight. At maturity, Gordon has erect, brown heads in contrast to the white, nodding Fredrick heads.

Gordon is particularly suited to areas of the province where winter survival of fall-sown wheat has been a problem.

The Animal Diseases Research Institute, Lethbridge, Alberta

In 1905 the federal government bought 3½ sections (2500 ac) of land 8 miles west of the present city of Lethbridge to establish a quarantine station. Its purpose was to control an outbreak of Dourine disease in horses, animals on which the North West Mounted Police relied at the time.

The first building went up the following year on a site by the Old Man River. The first director, Dr. E.A. Watson, discovered the cause of the disease and developed a test for detecting carrier animals.

The facility, once known as the Veterinary Research Station, grew from a single log house to the 30-building complex that exists today as the Animal Diseases Research Institute. The institute is an important component of Agriculture Canada's largest branch—Food Production and Inspection—and is one of nine laboratories in the Animal Pathology Division.

Under Dr. D. Mitchell, the institute's director, the staff of 55 provides diagnostic services to support branch programs aimed at controlling or eradicating infectious diseases such as brucellosis, rabies, bluetongue, anthrax, equine infectious anemia, and enzootic bovine leukosis. The main thrust of the extensive research program is in beef cattle, particularly respiratory diseases and the effects of management systems on disease.

Dr. Douglas Mitchell, Director.
M. Douglas Mitchell, directeur.

L'Institut de recherches vétérinaires de Lethbridge, Alb.

En 1905, le gouvernement fédéral achetait 3 ½ sections de terres (2500 acres), situées à huit milles à l'ouest de l'actuelle ville de Lethbridge, afin d'y installer une station de quarantaine. Cette dernière devait servir à contrôler et à éviter que la dourine ne se répande chez la population chevaline, car les chevaux représentaient alors un élément important pour la Gendarmerie du Nord-Ouest.

La construction du premier bâtiment se mettait en branle l'année suivante sur un site près de la Old Man River. Le D^r E.A. Watson, le premier directeur de la station, réussit à découvrir l'origine de la maladie et à mettre au point un test afin de détecter les animaux porteurs de virus.

Ces installations, autrefois appelées Station de recherches vétérinaires, ne comprenaient alors qu'un seul bâtiment en bois équarri. Aujourd'hui, le complexe compte un trentaine de bâtiments connus sous le nom de l'Institut de recherches vétérinaires, une partie intégrante de la Direction générale de la production et de l'inspection des aliments, la plus grande direction générale du ministère fédéral de l'Agriculture. L'Institut fait partie d'une série de neuf laboratoires relevant de la Division de la pathologie vétérinaire.

Le directeur de l'Institut, le D^r Douglas Mitchell, dirige un personnel de 55 employés chargé d'assurer un service de diagnostic rattaché aux programmes de la Direction, ces derniers conçus pour le contrôle et l'éradication de maladies infectieuses telles que la brucellose, la rage, la fièvre catarrhale, la fièvre charbonneuse, l'anémie infectieuse des équidés et la leucose enzootique des bovins. Les programmes de recherches extensives touchent principalement les bovins de boucherie, tout particulièrement les maladies respiratoires et les répercussions du système de gestion sur la maladie.

First laboratory building in 1906.
Premier bâtiment à abriter le laboratoire en 1906.

Some of the present buildings.
Quelques-uns des bâtiments actuels.

Canada