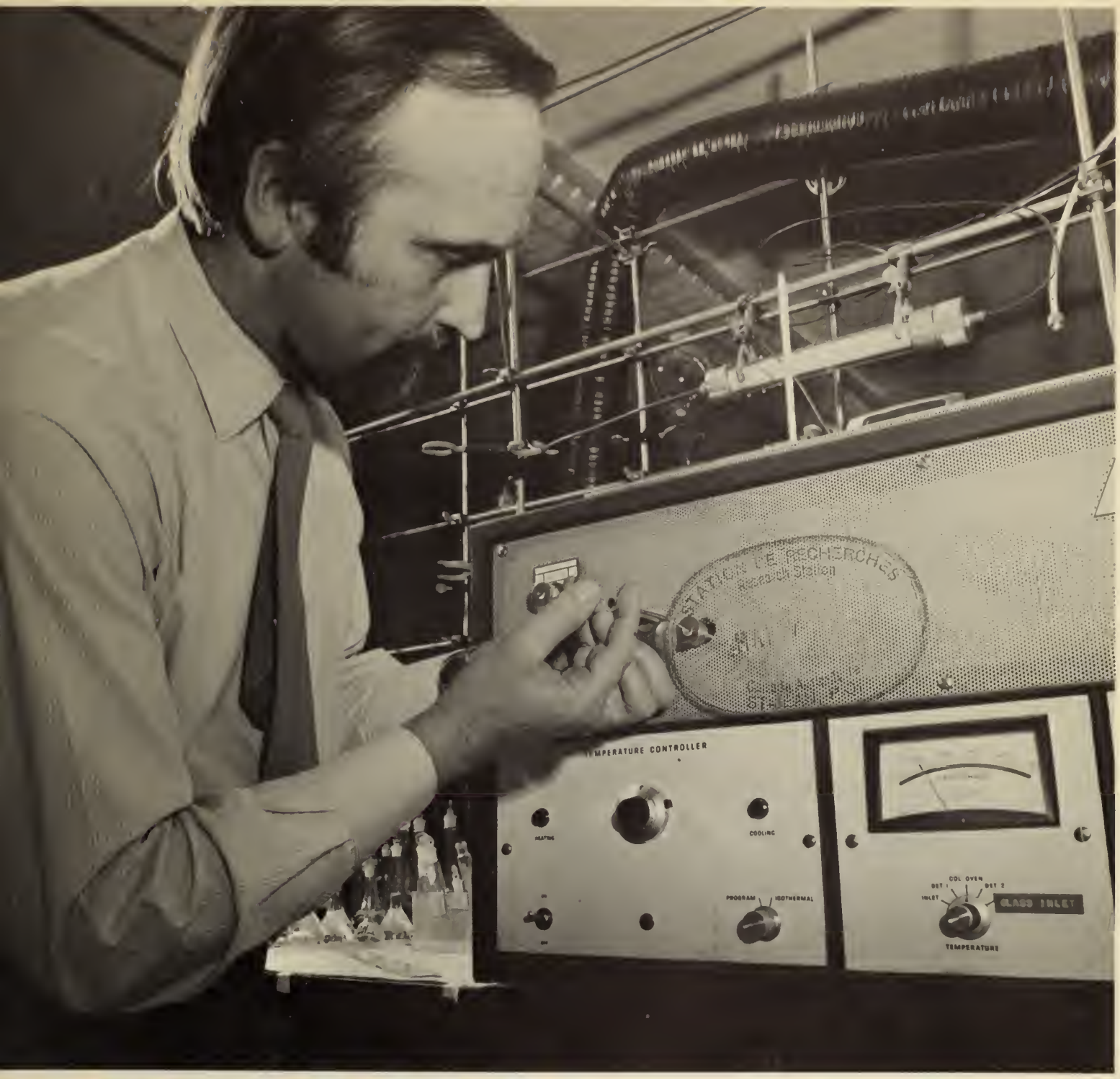

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climatic factors and plant winter survival

C. E. OUELLETT

L'auteur examine les différents effets du climat sur la survivance des arbres et des plantes fourragères. Pour les arbres, la durée de la période sans gelée et les basses températures de l'hiver sont des facteurs importants, auxquels s'ajoutent l'épaisseur de neige, la teneur en eau et le gel et dégel du sol pour les fourrages.

Let's compare the most important climatic factors influencing the winter survival of trees and forage crops. These comparisons—which are meaningful in selecting plants best adapted to a region or locality—are mostly based on the study of a large number of hardiness ratings collected across Canada and the analysis of the relationships between these data and climatic normals.

The author is with the Agrometeorology Section, CDA Plant Research Institute, Ottawa, Ontario.

A few morphological and physiological differences between trees and forage crops can be pointed out before dealing with climate. Trees over-winter with a root system deep in the ground, except during their first few years, and they have aerial parts including stem, branches and buds. But the root system of forage crops is located mostly in the uppermost layers of soil, their crown and leaf buds are either mainly below the soil surface (sweetclover, bromegrass, or reed canary grass) or close to the soil surface (red clover and timothy). Above ground the leaves and stems dry out during most winters. An important physiological difference between trees and forage crops is an inherent or genetic periodic rhythm. This promotes the cessation of tree growth in late summer or early fall even when the temperature is warm. The growth of forage crops is mainly slowed down or arrested by the shortening of days and the lowering of temperature.

For an understanding of the effects of climatic factors on the winter survival of perennial plants we consider the plant life cycle and the climate over the whole year. We may think of the growth in summer, the hardening in fall, the rest period in winter, and the dehardening and the resumption of growth in spring, even though there is some overlapping of these interdependent processes from one season to another.

First, the growing period: The arrest of growth in trees is mainly controlled by inherent factors. If the growing period is too short for a particular species, that species will not complete its growth and nature in time to develop the cold hardiness required to withstand the first severe frosts in fall and bitter cold in winter. This may partly explain why only very hardy species can survive on the Prairies and other locations where the frost-free period is short and the winter is very cold. Also, any climatic condition or cultural practice which extends the growth of trees beyond the normal time will make their hardening more difficult or inadequate and their overwintering more risky.

Forage crops are less exacting than trees with respect to the frost-free period, because their growth is arrested mainly by shortening days and cooler temperatures. Study of the local hardiness rating reports suggests that the winter survival of several forage crops is as good at Fort Vermilion (Alberta), where the normal frost-free period is only 65 days, compared to Ottawa (Ontario) where it is 133 days. Forages seem to need a sufficient number of growing degree-days and hours of sunshine and an adequate soil moisture level for satisfactory growth. However, if a short frost-free period is coupled with low summer temperatures, the growth of many forage species may not be enough for hardening and a successful winter survival, as at Fort Chimo (Quebec) and Haines Junction (Yukon Territory) where the mean daily maximum temperatures of July are 63° and 68° F respectively and the mean frost-free period is only 50 days.

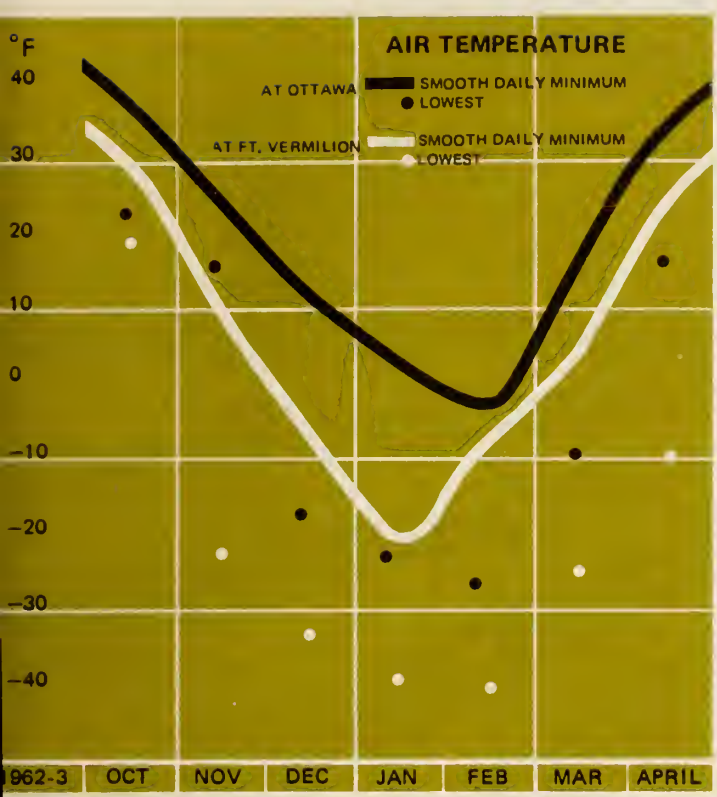
Plants harden in the fall. The major part of hardening in many trees depends on the endogenous rhythmic mechanism, more or less independent of temperature and triggered by a photoperiodic response in the leaves. The process results in an increase of ribonucleic acid, soluble proteins and protoplasm. Subsequent temperatures near or below the freezing point complete the hardening process, the hardening may be inadequate if the frost-free period is too short with respect to the time of cessation of growth.

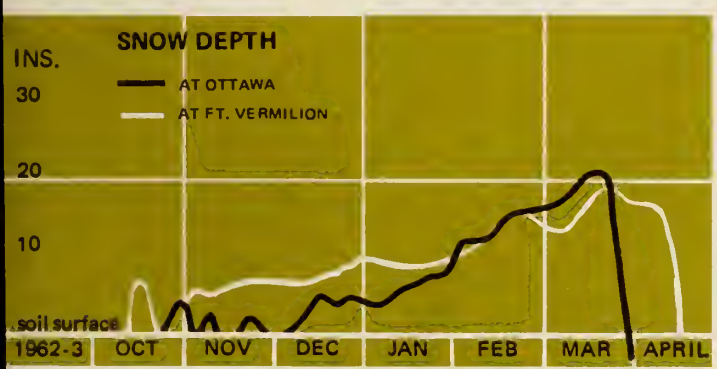
The hardening of forage crops is prompted by shortening days and lower temperatures, early enough so that crops can store photosynthetic materials in their roots and harden properly before severe frosts. Sunny days and cool nights favor this process, but warm and rainy days may promote growth and slow down storage of reserves and a proper hardening. Rainfall from September to December is 14.3 and 2.3 inches at Truro (Nova Scotia) and Beaverlodge (Alberta) respectively, so a proper hardening of forage crops may be assumed to be more probable at Beaverlodge than at Truro.

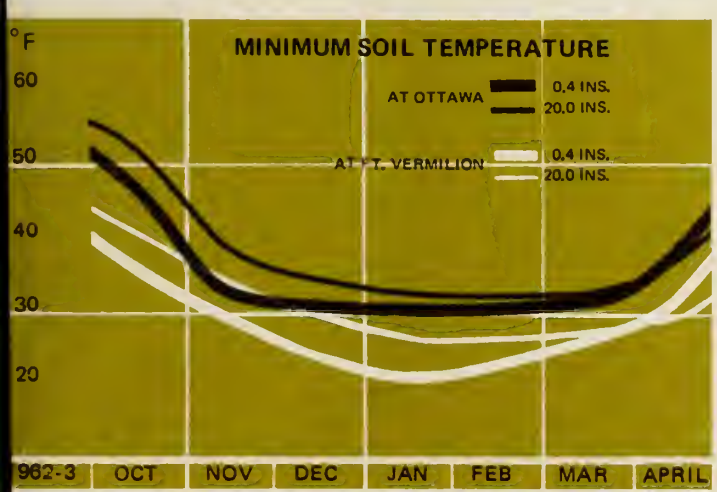
Next, we consider the winter itself: The resistance of the plants to severe winters will depend on their inherent hardiness and that developed during the preceding fall. Adequately hardened trees are likely to be injured only if the air temperature drops below the limit of their inherent resistance to cold. Periods of warm temperatures or the warmth of sun on southwest sides of trees may promote growth of tissues, particularly if trees are out of the rest period, and may cause them to be injured by cold temperatures that may follow.

The roots, which are less hardy than stem and branches, may be damaged by low temperatures in the absence snow cover. Especially those roots of newly transplanted trees where the root system has not yet developed in depth.

Forage crops will overwinter well if their roots and crown buds do. Minimum temperatures at the soil surface or in the superficial layers as well as the degree of protection provided by plant debris and snow, are important for root survival. The continuity of snow cover is more important than the amount of snowfall or the depth of snow cover. Breaking and drying out of roots may result from the heaving of soil caused by alternating freezing and thawing when there is accumulation of water near or at the soil surface and the snow cover is very limited or absent. These conditions may also induce the formation of ice sheets over the soil surface and cause the smothering of forage crops, particularly the species with the crown parts close to the surface. More continuous snow cover and the absence of alternating freezings







Climate and Winter Survival of Trees and Forages at Ottawa and Fort Vermilion—Only the hardiest trees can survive at Fort Vermilion because of the very low winter temperatures (and short frost-free periods); moderately hardy species may overwinter in Ottawa. Several forage species surviving in Ottawa can do so at Fort Vermilion due to a long period of ground snow cover and because soil temperatures (even close to the surface) are much higher than air temperatures.

and thawings at Melfort (Saskatchewan) and Fort Vermilion (Alberta) might explain why the survival of several forage species is reported to be better at these stations than at locations further south where winter temperatures are higher.

The spring is not without problems for the survival of plants. Trees lose their hardiness and are ready to grow as soon as the weather permits. A dangerous situation exists if a severe frost comes after trees have started growing.

Forage crops lose their hardiness rapidly after the snow disappears and they may be injured by severe frosts, particularly to the crown buds. Soil heaving may be frequent at this time and it may damage crops greatly, especially in poorly drained soils.

To sum up, weather may affect the survival of rees and forage crops in different ways. The most important climatic factors for the winter survival of trees are the length of the frost-free period and the low temperatures of winter. Those for forage crops are low winter temperatures, ground snow cover, water content of soil, and the alternating freezing and thawing conducive to soil heaving.

The knowledge of pertinent climatic factors affecting the winter survival of plants leads to very useful applications. It permits the preparation of mathematical models relating plant winter survival to climate, the numerical estimation of the suitability for plant survival at a great number of stations, and the preparation of plant hardiness maps such as the map for woody ornamentals. The latter may be obtained from the Information Division, Canada Department of Agriculture, Ottawa. ■

CANADIAN CROP INSURANCE BENEFITS

LES AVANTAGES DE L'ASSURANCE-RÉCOLTE AU CANADA

W. R. BIRD

The value of crop insurance as a measure of protection against financial losses due to crop failure and as a significant factor in stabilizing farm income was never more evident to Canadian farmers than in 1969.

From coast to coast a variety of adverse weather conditions resulted in crop losses for many farmers. Those who are participating in the various provincially operated, federally supported crop insurance programs received or will receive indemnities which are expected to exceed $13,500,000.

A deep freeze late in December of 1968 almost totally destroyed the British Columbia strawberry crop with 1600 out of 1900 acres being ploughed down prior to mid-season. It is estimated that $600,000 will be paid to insured growers for strawberry losses alone and that further damage to other small fruits and tree fruits, as well as to fruit trees and grape vines, will result in further claims amounting to about $1,400,000. In the Peace River district of British Columbia grain crops were damaged both by frost and unfavorable harvest weather. While

The author is Director, Crop Insurance Div., CDA Production and Marketing Branch, Ottawa. Ont.

W. R. BIRD

La valeur de l'assurance-récolte comme mesure de protection contre les pertes financières dues à de mauvaises récoltes et comme facteur actif de stabilisation du revenu agricole, n'a jamais été plus évidente pour les fermiers canadiens qu'en 1969.

De mauvaises conditions atmosphériques d'un océan à l'autre ont causé de mauvaises récoltes. Les fermiers, qui avaient souscrit à un des programmes d'assurance-récolte organisés par les gouvernements provinciaux et subventionnés par le gouvernement fédéral ont reçu ou recevront des indemnités qui, suivant les prévisions, dépasseront $13,000,000.

Une forte gelée à la fin de décembre 1968 a presque totalement détruit la récolte de fraises de la Colombie-Britannique. Des 1900 acres de culture, 1600 ont été labourées avant la mi-saison. Rien que pour les pertes de fraises, on s'attend à payer aux cultivateurs assurés un montant de $600,000. D'autre part, les dommages causés aux petits et gros fruits tout comme aux arbres fruitiers eux-mêmes et aux vignes, s'additionneront pour former un montant de

Directeur de la Division de l'assurance-récolte, Direction de la production et des marchés, Ministère de l'agriculture du Canada, Ottawa.

much of the grain still lays out over winter and claims cannot be settled pending spring harvest, the total amount paid out for grain losses is expected to be at least $1,000,000.

Early summer drought in parts of central and northern Alberta followed by a heavy June frost and widely scattered hailstorms caused extensive damage to grain crops during the growing season. On top of all these problems Alberta experienced one of the worst harvest seasons on record and many fields of grain in the northern half of the province will not be harvested until next spring. The Alberta Hail and Crop Insurance Board has already paid out $2,000,-000 in indemnities and many more claims are being held pending the result of the spring harvest. Total losses could run as high as $4,000,000.

In Saskatchewan an early summer frost and numerous hailstorms resulted in a number of crop loss claims and very unfavorable harvest weather has presented a significant number of potential losses which could occur if large acreages, still unthreshed, cannot be harvested in the spring. Losses paid to date amount to $350,000.

In Manitoba excessive June rains flooded many fields in the Red River Valley and other low-lying areas of the province and excessive rain at harvest time resulted in further losses. To date the Manitoba Crop Insurance Corporation has paid over 4,000 claims totalling $2,800,000. Some 600 claims are

Examining hail-damaged sugar beet field.

$1,400,000 d'indemnités. Dans la région de Rivière-de-la-Paix en Colombie-Britannique les récoltes ont été endommagées, à la fois par la gelée et une mauvaise température, au moment de la récolte. Comme une grande partie de ces céréales sont encore sur le sol après l'hiver et que les demandes de remboursement ne peuvent pas être réglées avant la récolte du printemps, on s'attend à ce que le montant total pour couvrir les pertes de céréales s'élève à au moins $1,000,000.

Dans le centre et le nord de l'Alberta des sécheresses du début d'été suivies d'une gelée en juin et de chutes de grêle un peu partout ont causé de grands dommages aux récoltes de céréales au cours de la saison. En plus de ces difficultés, l'Alberta a eu une des plus dures saisons de récolte connues jusqu'ici et de nombreux champs de céréales de la moitié nord de la province ne seront pas récoltés avant le printemps prochain. L'"Alberta Hail and Crop Insurance Board" a déjà payé $2,000,000 en indemnités et de nombreuses autres demandes attendent les résultats de la récolte du printemps pour être réglées. Les pertes totales pourront s'élever à environ $4,000,000.

En Saskatchewan, une gelée en début d'automne et de nombreuses chutes de grêle ont occasionné de nombreuses demandes d'indemnité. En plus, de mauvaises conditions atmosphériques au moment de la récolte, laissent présager un grand nombre de pertes potentielles si de grandes superficies, qui n'ont toujours pas été battues, ne peuvent être récoltées au printemps. Les pertes jusqu'ici s'élèvent à $350,000.

Au Manitoba des pluies abondantes en juin ont inondé de nombreux champs de la Vallée de la Rivière Rouge ainsi que d'autres terres basses de la province. D'autres grandes chutes de pluie au moment de la récolte ont causé encore d'autres pertes. Jusqu'ici la "Manitoba Crop Insurance Corporation" a payé plus de 4,000 demandes d'indemnité s'élevant à $2,800,000. Quelques 600 autres demandes attendent la récolte du printemps pour être réglées.

Les récoltes d'Ontario ont également souffert d'un excès d'humidité en 1969. Le soya, les tomates, les céréales de printemps et le blé d'hiver ont été forte-

Champ de betteraves sucrières endommagé par la grêle.

being held in abeyance pending spring harvest of unthreshed crops.

Ontario crops also suffered from excessive moisture in 1969. Soybeans, tomatoes, spring grains and winter wheat were hard hit by the adverse weather with the result that the Ontario Crop Insurance Commission estimates total indemnities will be about $1,000,000.

Quebec crop insurance officials estimate that they will pay from 6,000 to 8,000 claims totalling about $2,500,000 in respect of 1969 crop losses.

1969 was the first year of operation for the Nova Scotia crop insurance plan and coverage was provided for spring grain crops. Despite the fact that conditions were generally good in the province there were a number of losses due to poor germination, early summer drought and yellow dwarf virus in barley with total claims paid being about $8,000.

Prince Edward Island Crop Insurance authorities report that due to high winds and wet weather at harvest time they will pay claims totalling more than $29,000.

The federal government assists the provinces in making crop insurance available to farmers by contributing 25 per cent of the necessary premiums and 50 per cent of the administrative costs incurred by the provinces in operating the various schemes. I is estimated that total federal contributions for the cturrent crop year will be about $5,000,000. ■

ment touchés par les mauvaises conditions atmosphériques. La "Ontario Crop Insurance Commission" estime que le total des indemnités s'élèvera à $1,000,000.

Des porte-paroles de l'assurance-récolte du Québec estiment qu'ils devront payer de 6,000 à 8,000 demandes d'indemnité s'élevant à $2,500,000. pour les pertes de récoltes de 1969.

1969 a été la première année du programme d'assurance-récolte de la Nouvelle-Écosse. Ce programme couvrait des récoltes de céréales du printemps. En dépit du fait que les conditions atmosphériques ont généralement été bonnes dans la province, il y a quand même eu un certain nombre de pertes causées par une mauvaise germination, une sécheresse au début de l'été et le nanisme jaune de l'orge. La totalité des demandes d'indemnité s'élèveront à $8,000.

Les porte-paroles de l'assurance-récolte de l'Île du Prince-Édouard ont déclaré qu'ils auront à payer des demandes s'élevant à plus de $29,000, en raison des grands vents et du climat humide au moment de la récolte.

Le gouvernement fédéral aide les provinces à l'établissement de leur assurance-récolte en contribuant de 25 pour cent aux primes d'assurance et de 50 pour cent des dépenses administratives encourues par les provinces à l'opération de leurs divers programmes. On s'attend à ce que la totalité des contributions fédérales pour la récolte de cette année soit d'environ $5,000,000. ■

A hail-damaged Manitoba wheat field.
Champ de blé du Manitoba endommagé par la grêle.

A flooded grain field.
Champ de céréales inondé.

DRAINAGE AND SALINITY

J. C. van SCHAIK,
T. G. SOMMERFELDT, and E. RAPP

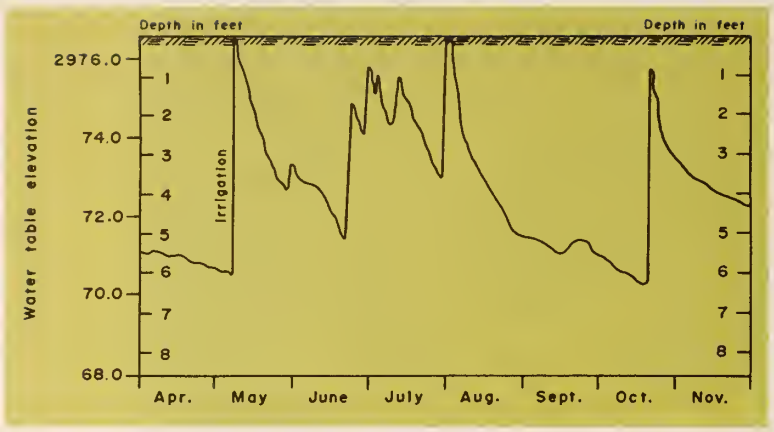
De nombreux problèmes relatifs à l'irrigation sont difficiles à résoudre. On cherche à prévenir plutôt que récupérer les sols salins.

The benefits of irrigation for agriculture in the semiarid regions of the Canadian prairies are well recognized. Not only can production be increased but also a great variety of field crops can be grown that otherwise would not be possible. About half a million acres of land are now 'under the ditch' in Alberta, and many small irrigation projects are scattered throughout the rest of the Prairie Provinces.

An important part of the plant-soil-water studies, conducted by the CDA Research Station at Lethbridge, Alta., involves the water requirement or consumptive use by crops. Answers to the questions of when and how much water should be applied are now available and are used in preparing guidelines for farmers to achieve the most efficient irrigation. Yet, drainage and salinity still pose irrigation problems basic to the preservation of land for sustained crop production in irrigated areas.

Is all the water diverted to an irrigation project available to the crops? No. For instance, recent studies on one irrigation project indicated that about 35 per cent of this water was lost from the canals and laterals before it reached the farm. In addition, another 'loss', calculated to be at least 30 per cent, results from excessive and inefficient application. Some of this 'wasted' water finds its

The authors, respectively, are a soil physicist, a soil chemist, and a drainage engineer. All were on the staff of the CDA Research Station, Lethbridge, Alta., but Mr. Rapp is now Assistant Professor of Agricultural Engineering, University of Alberta, Edmonton.



Water table fluctuation as influenced by irrigation and precipitation. Fluctuation during June and early part of July are due to the precipitation.

way to the rivers downstream; some contributes to a buildup of the water table or collects in depressions, particularly where permeable surface soil is underlain by slowly permeable sub-soil.

DRAINAGE PROBLEM

The soils of southern Alberta that are irrigated are primarily alluvial and lacustrine in origin. They overlay a glacial till that has a low permeability and a high salt content, which constitute a potential danger for sustained crop production. When the water is close to the surface, plant growth is restricted not only because of waterlogging but also because of salts that may accumulate in the root zone by capillary action and evaporation of water. In most irrigation districts in Western Canada, this salinization of the surface soil due to shallow water tables and seepage from canals affects about 10 per cent of the irrigated land. Water tables are often within 7 to 8 feet of the surface. The graph illustrates the effect of irrigation and rainfall on the water table in the Lethbridge area. After an irrigation, the water table rises to within a short distance from the surface then gradually recedes. The rise of the water table in June and July was entirely due to heavy rainfall during this period.

In some small irrigation projects that have been established on reclaimed lake bottoms, we have found that poor drainage is a serious problem resulting from unsatisfactory natural topography and the fine texture of the soils. In other projects, waterlogging and salinization of the soil are mainly due to seepage from canals or to water moving in sandy layers to lower areas where such strata terminate.

SALINITY PROBLEM

Reclamation of saline soils requires proper subsurface drainage to enable the salts to be leached out of the soil. This has led to many drainage studies being focused on the drainability of the subsoil,

Seepage and drain waters collect in depressional areas. Saline conditions often develop around the perimeter. Generally only aquatic and salt tolerant plants grow here.

Seepage from canal causing considerable waterlogging and salinization to adjacent land. Drain, beginning in the distant background, is effective in relieving the problem.

Top and center: Installation of plastic liners and of concrete liners for canal seepage control.
Bottom: An observation well, being used for monitoring water table.

particularly of the glacial till. In most areas when tile drains are installed 200 feet apart and 6 feet deep—a normal depth for arid regions—water must move through at least 3 feet of glacial till to reach the drain. However, in our investigations at Lethbridge, we found that under these circumstances water-table recession was not appreciably greater than where tile drains were not used. But we did discover, by installing closely spaced (30 feet) tile drains, 2.5 to 3 feet deep, that saline soil could be successfully reclaimed. With this method, salts were leached out of the upper 2 feet of the profile. However, we also found that when the water table was kept at 30 inches and grass was growing on the site, the soil became saline in one season.

An important aspect of our investigation concerns the water and salt balance in the profile during the summer and winter. These studies are all basic to the preservation of land for sustained production in irrigated areas. For example, orchardgrass was grown in the presence of water tables at 3-, 4-, and 5-foot depths but without irrigation. We found that a good stand could be maintained and that evapotranspiration of these crops amounted to about 60 per cent of the potential evapotranspiration. Most of the water uptake in the last half of the growing season was from the capillary fringe of the water table.

Some of our studies also involve the water movement to freezing zones from shallow water tables. Our research has revealed that, apart from the winter precipitation, the moisture content of the upper 2 feet could increase from 1 to 8 per cent when the water table was not lower than 5 feet below the surface.

Both federal and provincial irrigation agencies are monitoring water tables in irrigation projects. Their findings, from such studies as the possible use of plastic tile drains and various canal linings, have helped to relieve the problem of keeping land productive. It is clear that many of the problems resulting from irrigation cannot be solved easily, and our main efforts must be directed to the prevention rather than the reclamation of saline soils. In other words, we have to live with the existing situation and to take proper precautions before crop production problems occur. ■

FIRMER McINTOSH APPLES

F. R. FORSYTH and C. A. EAVES

Des expériences conduites par les scientifiques du ministère de l'Agriculture indiquent que les pommes McIntosh restent plus fermes si elles sont conservées en atmosphère contrôlée dont on a enlevé l'éthylène.

McIntosh apples remain firmer in controlled atmosphere if ethylene is removed, according to experiments conducted at the CDA Research Station, Kentville, N.S.

Controlled atmosphere (C.A.) storage of fruit at present means control of carbon dioxide and oxygen levels. A minimum of oxygen, capable of keeping the product's metabolism functioning slowly but healthily, is necessary. Carbon dioxide levels above the 0.03 per cent normally found in air are generally believed to be of benefit. By now the optimum levels of oxygen and carbon dioxide for most varieties of apples has been agreed upon by workers in this field.

But what about the other gaseous components of an apple storage atmosphere? Can the levels of any of them be manipulated to give a better apple? This would seem to be true for nitrogen, the third gas found in major proportions in controlled atmosphere storage, since Eaves and co-workers found that fruit to be stored in C.A. benefited from an initial conditioning in a pure nitrogen atmosphere for one to two weeks.

We have been concerned that, although high levels of ethylene accumulate in C.A. storage rooms, little attention has been paid to its possible effect on apple quality. Ethylene is called a fruit ripening hormone but investigators have considered that at the temperatures normally used for apple cold storage the ethylene has little or no stimulating action on respiration or ripening. But is this true?

Because we are attempting to study the total environment of apples and other fruit in storage, we compared apples stored in ethylene with apples stored in an atmosphere from which the greater part of the ethylene was removed by absorption on a moistened mixture of potassium permanganate and diatomaceous earth (Celite), a method recently developed by us. Since good commercial storage practices dictate that McIntosh apples be stored in a mixture of 5 per cent carbon dioxide and 3 per cent oxygen at 37°F, our experimental McIntosh apples were held in these conditions with and without ethylene.

That the ethylene levels can be kept at a low level in a storage chamber equipped with an absorbent is shown in the graph. Details of the experimental container are to be seen in Fig. 2. Apples in 'low' ethylene were exposed to less than 10 ppm while those in 'high' ethylene levels were exposed to approximately 2600 ppm.

The McIntosh apples stored in less than 10 ppm ethylene were consistently firmer by about 2 lb pressure, as measured on a Magness-Taylor pres-

The authors are with the CDA Research Station, Kentville, N.S.

sure tester, than those in high ethylene levels. This was true both immediately upon removal from controlled atmosphere after 189 days at 37°F and after 7 days at 72°F (Table 1).

In addition to keeping the apples firmer, the low ethylene also kept the storage disorder known as core browning at a minimum. Although there was only slight core browning in apples examined directly from storage at 37°F those stored in high ethylene levels had the most. Whenever the apples were held at room temperature for a week, those previously stored in reduced ethylene levels had the least core browning.

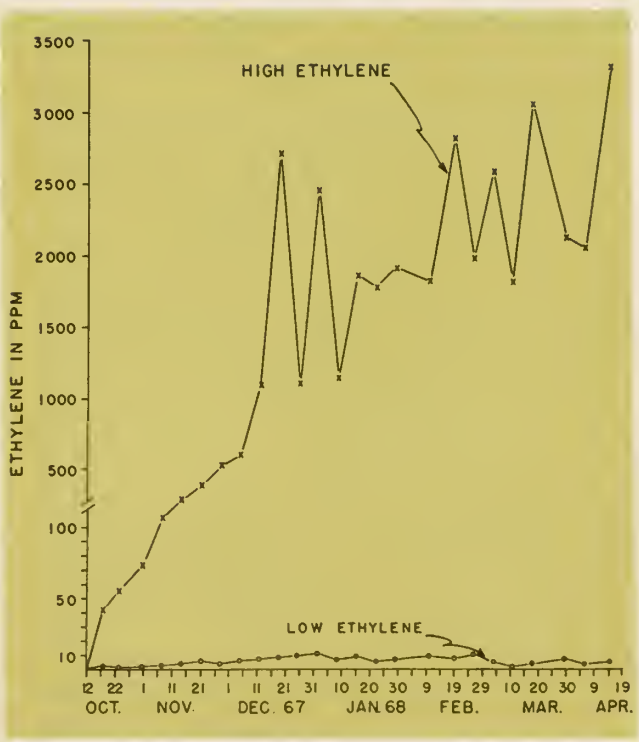
These findings may well be commercially important in the future but the effect of this treatment on the fruit will require further study and confirmation before it can be recommended for use in commercial fruit storages in other than small scale trials. ■

TABLE 1. STORAGE QUALITY OF MCINTOSH APPLES AFTER CONTROLLED ATMOSPHERE AT 37° FOR 189 DAYS IN LOW OR HIGH LEVELS OF ETHYLENE, 1968.

	Low ethylene	High ethylene	Difference
Direct from 37°F			
Firmness (lb. pressure)	11.43	9.42	2.01
Core browning index	0.00	6.40	6.40
After 7 days at 72°F			
Firmness (lb. pressure)	9.70	7.40	2.30
Core browning index	6.70	28.40	21.70

Bottom right: Average levels of ethylene in 3-bushel containers of McIntosh apples stored for 189 days in 5 per cent CO_2 and 3 per cent 0_2 at 3.3°C. Low ethylene containers had potassium permanganate-Celite absorbent. High ethylene containers did not have absorbent.

Bottom left: Aluminium foil-coated experimental container for three bushels of apples. Pyrex dish at top centre contains the permanganate-Celite mixtures for absorbing ethylene. Metal projection to the left of container holds the lime to remove and control carbon dioxide levels in the attached container.



root and stalk rot of corn

Fig. 1—The contrast between stalk rot resistant and susceptible lines of corn shows clearly.

L. F. GATES and C. G. MORTIMORE

Rouille de la racine et de la tige du maïs. Les pratiques présentes de production visant un meilleur rendement imposent un grand stress (eau et éclairement) sur chaque plante ce qui tend à accroître la rouille de la tige, une des principales causes de pertes de récoltes. Les chercheurs mettent au point les variétés inogames de maïs résistantes à la rouille de la tige et de la racine.

Stalk rot research and corn breeding at the CDA Research Station, Harrow Ont. are aimed at developing inbred lines resistant to root and stalk rot and to the European corn borer, *Ostrinia nubilalis*. Lines with these qualities and with good combining ability are released to commercial hybrid corn companies, and in this way contribute to the production of hybrids for the Canadian corn industry.

Stalk rot is one of the main causes of yield loss, mainly because ears on fallen plants are frequently missed by the picker. Those that are harvested are often infected with fungi and are centers of infection for ear rot in storage.

Present trends in corn growing carry a risk of increased trouble from stalk rot. Increasing the number of plants per acre is likely to increase stalk rot, and the use of narrow rows may make lodged plants more difficult to pick up at harvest.

Stalk rot is a problem wherever corn is grown, but following the introduction of hybrid corn in the 1940's stalk lodging and stalk breakage decreased for a time. Mature ears were obtained on plants which still had green foliage and stalks. In recent years, however, changes in farming practice have been introduced which greatly increase yield. These practices impose greater stresses on the plants, and as a consequence their resistance to stalk rot is decreased. Since about 1948 stalk rot has become increasingly important again, and unfortunately the most productive fields are frequently the hardest hit.

Stalk rot fungi, frequently species of *Fusarium*, invade the roots during the season and enter the bases of the stalks when the plants are nearing maturity. At this time the development of the ear imposes a drain on the food reserves and productivity of the stalk and leaves. In high populations leaves shade each other, and root systems overlap more. This causes competition between plants for light and moisture, and results in the plant being unable to develop a full ear and at the same time maintain its stalk in good condition. Under these stress conditions, fungi are more readily able to attack the roots and stalks.

Substances have been isolated from corn stalks which inhibit the growth of stalk rot fungi. However, work at Harrow and other research centres indicates that living cells of susceptible and resistant inbreds studied so far contain similar amounts of these materials. Susceptible inbreds differ from resistant ones, however, in that the cells of their stalks, in particular the pith, become senescent and die during the maturation of the ear, whereas resistant inbreds maintain their stalks in good condition during and after ear maturation.

Inbreds and hybrids with higher levels of substances inhibitory to stalk rot fungi than are present in today's hybrids would be advantageous provided that they also had the characteristic of maintaining their stalks in good condition while developing the

L. F. Gates is a plant pathologist and C. G. Mortimore a plant breeder, at the CDA Research Station, Harrow, Ont.

ear. Both these aspects of resistance need further research.

At Harrow we have studied the factors which affect the ability of resistant and susceptible plants to maintain their stalks in good condition, in order to have criteria to use in the selection of inbreds and hybrids. Studies of the period during which stem deterioration occurred showed that until four weeks before physiological maturity, the effects of stress on individual kernel weight were small or were reversible after reduction of plant competition. It was after this time, which is approximately half way between mid-silk and physiological maturity, that stress factors increasingly and irreversibly reduced the weight of individual kernels and predisposed the plant to stalk rot.

In evaluations of the contributions to yield and stalk rot resistance made by leaves in different positions on the plant, removal of the leaves from the top quarter of a susceptible hybrid doubled stalk rot, while removal of leaves from the top half of the plant trebled stalk rot. In contrast, a resistant hybrid was considerably less affected by removal of the corresponding upper leaves. The resistant hybrid also showed a marked reduction in stalk rot when competition for light and moisture was reduced at three weeks after midsilk, while the susceptible hybrid was able to respond only very slightly. Pith taken from the lower internodes of resistant plants shortly before physiological maturity showed more enzyme activity than pith from susceptible inbreds, though the two types of inbreds could not be differentiated before midsilk by this test.

Single and double crosses using resistant inbreds as the original parents are frequently much less resistant than expected from the performance of the parent inbreds. Presumably sets of genes required to maintain stem condition are not being complemented by genes from the other parents, or else the physiological development of hybrids is such that the ear competes more strongly with the stem for available photosynthetic materials.

Despite the complexity of the interactions between fungi, environment and plant genotypes, present hybrids are much improved in their ability to keep their stalks in good condition while the ears mature. However, under present production practices for maximum yields the resistance of the best hybrids often breaks down if growing conditions become unfavorable during the season.

The ability to separate resistance factors into various types, particularly those of direct chemical resistance from those centering around stress resistance, should aid progress in studies of stalk rot. ■

Fig. 2—In studies of stress, alternate plants are cut and staked in place to compete for light but not for moisture or nutrients.

Fig. 3—Removing or leaving groups of leaves indicates the contribution of each group to maintaining stem condition and preventing stalk rot.

ECHOES
FROM THE FIELD AND LAB

A technician gingerly pushes a bottle containing a vaccine to combat Marek's disease under a microscope at the Animal Diseases Research Institute at Hull, Que. (see story below).

A l'Institut de recherches de pathologie vétérinaire à Hull, P.Q., un technicien place avec précaution une bouteille de vaccin sous le microscope.

MAREK'S DISEASE Scientists at the Animal Diseases Research Institute, Hull, Que., are testing a vaccine which shows promise as an effective control against Marek's disease, the number one killer of Canadian poultry. The institute, operated by the Health of Animals Branch of the Canada Department of Agriculture, developed the vaccine.

It was developed by attenuating the virus that caused the disease. The approach —attenuating the virus in tissue culture— was the same as that followed by researchers in Houghton, England, who have also developed a vaccine against Marek's disease.

The Canadian vaccine is being tested in a number of different groups of chickens that vary in their susceptibility to the disease. Dr Allan Grunder of the Animal Research Institute in Ottawa is co-operating in the project.

While early results are most encouraging, the false impression should not be gained that a surefire solution to the problem has been developed. Exactly how effective this vaccine is won't be known until much more testing has been done.—LLOYD SPENCER, HULL, P.Q.

LA MALADIE DE MAREK Les scientifiques de l'Institut de recherches de pathologie vétérinaire à Hull, P.Q. font l'essai d'un vaccin qui semble devoir être efficace contre la maladie de Marek, le fléau le plus grave de la volaille au Canada. Le vaccin a été mis au point par cet institut, sous la tutelle de la Direction de l'hygiène vétérinaire du Ministère de l'Agriculture du Canada.

Il a été réalisé par atténuation des effets du virus causant la maladie. La même méthode a été utilisée par les chercheurs de Houghton en Angleterre qui possèdent également un vaccin contre la maladie de Marek.

Le vaccin canadien est essayé sur plusieurs groupes de poulets ayant une résistance variée à la maladie. Le Dr Allan Grunder de l'Institut de Hull coordonne le projet de recherches.

Bien que les premiers résultats semblent prometteurs, il ne faut pas en conclure que c'est là une solution radicale. Cela ne sera possible qu'après de longs essais.—LLOYD SPENCER, HULL, P.Q.

ROOTING LOWBUSH BLUEBERRY CUTTINGS UNDER NUTRIENT MIST In the Canada Department of Agriculture program of research on the lowbush blueberry, our main goal has been the selection of superior clones and the development of methods of propagating these vegetatively for field planting. The most satisfactory method has been rooting softwood cuttings under intermittent mist in a glasshouse.

During 1968, the importance of adding nutrients to the misting water to improve growth was shown in tests at the CDA Research Station, Kentville, N.S. Nutrients in the form of a 20-20-20 cheleated fertilizer at 2.5 oz. per 100 gallons were added by using a commercial fertilizer.

We found no significant difference in the per cent of cuttings rooted, but those in nutrient mist had significantly larger root balls when potted six weeks after setting than did checks. Three weeks later, we rated the plants again without knowledge of treatment and those subjected to nutrient mist were consistently larger than those rooted in water.

Larger plants have been found to grow much better when set to the field than do smaller plants, and the extra growth obtained though adding nutrients to the mist water offers promise for a higher degree of success in field planting lowbush blueberry cuttings than is presently the case—I. V. HALL AND L. E. AALDERS, KENTVILLE, N.S.

LYSINE AND FAT ADDITIONS TO BROILER CHICKEN DIETS Chickens need 12 of the amino acids contained in proteins in their diets to assure normal growth. However, different proteins contain different ratios of the amino acids. Plant proteins, for example, contain very little of the amino acid lysine, and a diet of wheat and soybean meal as sources of energy and protein contains barely enough amino acid for normal growth of the chicken.

A deficiency of amino acids can be corrected in three ways. The first is by adding the acid to the diet in pure form. This is usually too expensive to be practical. The second is by increasing the protein level of the diet. Since protein is expensive, this is wasteful. The third is by choosing a combination of proteins so that the amino acid ratios compensate for each other.

At the CDA Research Station, Lethbridge, Alta., we added lysine to a wheat-soybean meal broiler diet to see whether this would induce growth, since lysine is now produced commercially. We also used two different dietary energy levels.

The added lysine did not increase the growth or feed efficiency when compared with that of the control group, which contained no fat or lysine. The added fat improved growth. However, adding both fat and lysine significantly improved growth rate over the other treatments. Thus, lysine apparently had no effect on growth or feed efficiency unless fat was present in the diet. When fat was present, it would appear that the reduced feed intake resulted in lysine becoming the factor limiting growth.

Further work is required before we can make firm recommendations on the use of lysine in the diets of broiler chickens. However, the results of our experiments indicate that it becomes a limiting factor in wheat-soybean meal diets containing 10 per cent added fat.—E. E. GARDINER, LETHBRIDGE, ALTA.

NEW BARLEY LICENSED The Canada Department of Agriculture recently licensed a new variety of six-rowed barley.

The variety, named Bonanza, was developed at the Canada Department of Agriculture's Research Station, Brandon, Man., and is the third malting variety to have originated there in the past five years.

Developed from a rather complicated crossing program with both Conquest and Parkland as parents, Bonanza is smooth-awned, and in the field can be distinguish-

(continued on p. 17)

'OPERATION LIFT'
lower inventory for tomorrow...

WHEAT STOCK REDUCTION PROGRAM

DETAILS OF PROGRAM

- Summerfallow includes any land held out of production in 1970 if in 1969 the land was cultivated but not in perennial forage.
- Cover crops may be sown on summerfallow after July 15, 1970.
- No producer may receive payments for more than 1,000 acres of reduction in wheat acreage.
- This program does not apply to Soft White Spring Wheat.

Wheat Reduction Payments: A payment will be made to every 1970 permit book holder who this year reduces total acres seeded to wheat from that stated in his 1969 permit book. Total acres eligible for payment for any producer may not exceed the total by which he increases summerfallow plus the net increase in acres of perennial forage. Putting it another way: the producer will receive the full acreage payment only if he has increased the sum of his summerfallow and perennial forage acreage by an amount equal to that removed from wheat. For example, if he had 400 acres in wheat, 200 acres in summerfallow and 200 acres in perennial forage last

PROJET DÉBLOCAGE DES INVENTAIRES

PROGRAMME DE RÉDUCTION DES STOCKS DE BLÉ

LES DÉTAILS DU PROGRAMME DE RÉDUCTION DES STOCKS DE BLÉ

- La jachère comprend tout terrain qui, en 1970, sera soustrait à la production pourvu que ce terrain ait été cultivé en 1969 mais, non en fourrage permanent.
- Des plantes couvertures pourront être semées sur la jachère après le 15 juillet 1970.
- Aucun producteur ne sera indemnisé pour une réduction de superficies en blé supérieures à 1,000 acres.
- Ce programme ne s'applique pas au blé tendre de printemps.

Paiements pour la réduction des emblavures: Chaque détenteur d'un carnet de livraison qui, en 1970, réduira la superficie inscrite pour 1969, sera indemnisé. Pour chaque producteur, la superficie totale qui peut faire l'objet d'un paiement ne peut dépasser le total de l'augmentation des superficies en jachère augmentée ou diminuée de la différence de superficie semée en fourrage permanent. Autrement dit, le producteur ne recevra plein paiement que s'il a augmenté le total des superficies en jachère et celles semées en fourrage permanent d'une quantité égale à celle qui est soustraite aux emblavures en blé. Par exemple: s'il avait l'an dernier 400 acres de blé, 200 acres en jachère et 200 en fourrage permanent, il doit, pour bénéficier d'un paiement pour les 400 acres qu'il ne sèmera pas en blé, avoir au total 800 acres de jachère et/ou de fourrage permanent dont au moins 200 acres doivent être en fourrage permanent.

Le paiement pour une pareille réduction sera de $6 l'acre. Un premier paiement sera versé avant la fin de la présente année-récolte (31 juillet 1970) et le solde, en automne.

Un producteur peut décider de semer cette année en fourrage permanent la superficie qu'il a soustraite de ses emblavures en blé. S'il en est ainsi, il recevra une indemnité supplémentaire de $4 l'acre pourvu que cette superficie soit laissée en fourrage jusqu'à ce que le terrain soit examiné vers la mi-1971.

year, he must have 800 acres in summerfallow and/or perennial forage (of which 200 acres must be perennial forage) to get payment on his full 400 acres taken out of wheat.

Payment will be $6.00 for each acre of such reduction. A partial payment will be made before the end of July, with the balance in the fall.

A producer may choose to seed the acreage he has taken out of wheat to a perennial forage this year. If he does he will receive an additional $4.00 for each acre by which his 1970 forage acreage exceeds his 1969 acreage, providing the acreage remains in forage until the land is inspected in the mid-summer of 1971.

Special Provisions: In cases where producers planted less than 100 acres of wheat in 1969 (according to their 1969 permit books) and plant no wheat in 1970, such producers may choose to use their 1968 quota book acreage as the basis of comparison with 1970 for payments under the wheat reduction program. In such cases, the 1968 wheat acreage used in calculating payment due to the producer shall not exceed 100 acres.

If acreage in excess of half of the acres included in any producer's 1970 permit book was stated to be summerfallow on the 1969 permit book, the producer may treat that excess as though it had been seeded to wheat in 1969, for reduction payment purposes.

Grain Delivery Quotas: There will be no unit quotas in the 1970 quota system.

Acres qualified for wheat delivery quotas in 1970 will be the total of 1970 summerfallow and the net increase in perennial forage acreage in 1970 over 1969. Acres seeded to wheat in 1970 will not qualify for quota.

In addition, 25 per cent of the summerfallow stated in the 1969 permit book may be claimed for quota purposes this year. For example, if a farmer has 1,000 acres in summerfallow this year and had

Dispositions spéciales: Si le producteur a, suivant les indications de son carnet de livraisons, semé moins de 100 acres de blé en 1969, et s'il s'abstient de semer du blé en 1970, il pourra à volonté employer son carnet de 1968 en guise de comparaison avec 1970 aux fins de bénéficier du paiement. En pareil cas, la superficie de blé en 1968 ne pourra, pour le calcul de l'indemnité, dépasser 100 acres.

Les cultivateurs qui ont mis en jachère une superficie supérieure à la moitié de celle spécifiée dans leur carnet pour 1969 peuvent, pour le calcul des indemnités de réduction, faire intervenir le nombre d'acres qui excèdent la moitié de la superficie spécifiée, comme si ces acres avaient été semées en blé, en 1969.

Contingents de livraison du blé: Il n'y aura pas de contingent par unité dans le système de 1970.

La superficie qui sera admise à livrer du blé en 1970 sera le total de la jachère de l'année courante à laquelle s'ajoutera la différence nette entre la superficie en jachère d'été et en fourrages permanents en 1969 et cette même superficie en 1970. Les superficies semées en blé cette année ne seront pas prises en considération pour l'établissement du contingent de 1970.

En outre, 25% de la superficie en jachère déclarée en 1969 peut intervenir dans le calcul du contingent de l'année 1970. Par exemple, si le cultivateur a cette année 1,000 acres en jachère et s'il en avait 800 l'année dernière, il a droit au contingent correspondant à 1,000 plus 200 acres, soit un total de 1,200 acres.

Donc plus le cultivateur aura de jachère, plus élevé sera son contingent de blé.

Les détenteurs d'un carnet de permis pour cette année recevront un contingent de livraison de 8 boisseaux l'acre pour la superficie admise comme base du contingentement.

Le contingent de 8 boisseaux l'acre pour la superficie de base sera en vigueur aussi longtemps que le total des superficies ne dépassera pas 53 millions d'acres. Ce chiffre représente la superficie totale semée en blé et laissée en jachère en 1969. Il est donc peu probable qu'elle soit dépassée sous le régime du nouveau programme.

Si la superficie de base est inférieure à 47 millions d'acres, le contingent pourra éventuellement être porté à 9 boisseaux.

Si la demande en blé dur ou en d'autres catégories de blé exige des livraisons supplémentaires, un contingent spécial sera alloué d'après le contingent initial.

Les contingents pour l'avoine, l'orge et les autres grains seront basés sur le nombre d'acres ensemencées pour chaque produit et inscrits dans le carnet

800 acres in summerfallow last year, he has 1,000 acres plus 200 acres eligible for quota for a total of 1,200 acres.

This means that the more summerfallow a farmer has the more wheat quota he will have.

Permit book holders in 1970 will receive wheat delivery quotas of eight bushels for each acre qualified for wheat quota.

The eight bushel quota on qualified acreage will apply so long as qualified acreage does not exceed 53 million acres—at this level wheat deliveries in the 1970-71 crop year would be approximately 425 million bushels. This was the total acreage in wheat and summerfallow in 1969 and therefore is unlikely to be exceeded under the new program.

If the qualified acreage is less than 47 million acres then the quota may be raised to nine bushels per qualified acre.

In the event that demand for durum or specific grades of wheat requires additional deliveries, special quotas would be opened on the basis of acreage qualified for wheat quota.

Quotas for oats, barley, soft white spring wheat, and other crops to which delivery quotas apply will be based on acres seeded to each crop as stated in the producers' 1970 permit book. A producer may if he wishes allocate any or all of his acres qualified for wheat to any other crop—in which case the acres available for wheat quota would be reduced accordingly.

Detailed information on the regulations governing the 1970 quota system and the stock reduction payments will be mailed to producers.

A program to remove up to 22 million acres of prairie cropland from production this year was announced by the federal government on February 27, 1970.

While the actual acreage involved will depend on the decisions made by individual farmers, up to 22 million acres could come under the program. The estimated actual cost of the program, which will be administered by the Canada Department of Agriculture, is about $100 million.

The program will apply to the Wheat Board Designated Region, which includes all of Alberta, Manitoba, and Saskatchewan, and portions of British Columbia.

Farmers who turn wheat acreage into summerfallow or perennial forage will receive federal compensation payments of $6.00 per acre for summerfallow or $10.00 per acre for additions to perennial forage acreage. Partial payments will be made before the end of July.

As a further incentive to reduce wheat acreage and increase summerfallow, wheat delivery quotas in the 1970-71 crop year will be based on total acreage

de permis de l'année 1970. Un producteur peut, à son gré, employer la totalité ou une partie de la superficie admise à l'ensemencement en blé à d'autres fins, et alors le contingent de la surface à semer en blé serait réduit d'autant.

Des informations détaillées sur le système de contingentement employé en 1970 seront envoyées aux producteurs.

Un programme qui retirera de la production jusqu'à 22 millions d'acres de terrains cultivables cette année dans l'ouest du Canada a été annoncé le 27 février par le gouvernement fédéral.

Bien que l'étendue moyenne réelle des terres soustraites à la production soit sujette aux décisions prises par tous et chacun des agriculteurs, le programme peut en englober un maximum de 22 millions d'acres. On estime à environ $100 millions le coût véritable du programme, qui sera administré par le ministère de l'Agriculture du Canada.

Le nouveau programme s'appliquera à la région désignée de la Commission canadienne du blé qui comprend l'Alberta, le Manitoba et la Saskatchewan en entier ainsi que des parties de la Colombie-Britannique.

Les cultivateurs qui remplaceront des surfaces en blé par de la jachère d'été ou des fourrages vivaces recevront du gouvernement fédéral des indemnités en espèces de $6 l'acre de jachère d'été et de $10 l'acre pour les étendues ajoutées aux cultures fourragères vivaces. Les premiers paiements seront effectués avant la fin de juillet.

Pour inciter davantage les cultivateurs à remplacer la culture du blé par des jachères d'été, les contingents (quotas) de livraison pour la campagne agricole de 1970-1971 seront fondés sur la superficie globale en jachère d'été et l'addition de nouvelles cultures fourragères, mais non sur les superficies en blé.

Les cultivateurs pourront faire valoir 25% des sols en jachère l'an dernier pour leurs contingents de blé de cette année.

Le nouveau programme de réduction des emblavures s'appuiera sur un programme rigoureux d'inspection de ferme en ferme afin de prévenir une division artificielle des exploitations agricoles et les autres abus qui pourraient se produire.

D'après les prévisions actuelles, les stocks de blé au 31 juillet 1970 (au début de la nouvelle campagne céréalière) totaliseront environ 950 millions de boisseaux ou l'équivalent des ventes normales de deux ans.

Ce programme est destiné à encourager un ajustement maximal cette année. Il aura pour effet de réduire considérablement les stocks de blé au bénéfice permanent de cette industrie agricole.

of summerfallow and net addition to forage land — not on acreage seeded to wheat.

Farmers will be able to count 25 per cent of land they fallowed last year towards wheat quotas this year.

The new acreage reduction program will be backed up by a full on-the-farm inspection system to prevent artificial division of farm units and other abuses that might occur.

Present indications are that stocks of wheat at July 31, 1970, (the beginning of the new crop year) will be about 950 million bushels — about two year's normal disappearance.

This program is designed to encourage maximum adjustment this year. The effect will be a substantial drop in wheat stocks to the permanent benefit of the industry.

The stock position of the major crops, with the exception of wheat, is of manageable proportions. The stock position of oats and barley is high but not at a critical level. However, any substantial diversion of acreage from wheat or summerfallow to production of other crops would result in burdensome surpluses and lower prices for these products.

The new federal program will provide needed income to hard-pressed grain growers and encourage them to dispose of wheat stocks already piled up on their farms. It will allow farmers to cut back drastically on wheat acreage while at the same time discouraging a wholesale switch to other crops.

A sharp reduction in wheat stocks would greatly enhance the continuing effort to strengthen international wheat prices.

The Canadian Wheat Board on February 27, 1970, announced that notwithstanding the very heavy grain movement off the farms for exports during the balance of the crop year, it will be the intention of the Board to equalize grain deliveries at a 4 bushel per specified acreage quota by July 31. Equalization at this level, together with special quotas, will provide delivery opportunities to western grain producers for all grains equal to or slightly in excess of last year's deliveries.

Wheat utilization including farm requirements and domestic and export sales should total about 500 million bushels between July 31, 1970 and July 31, 1971.

If farmers take full advantage of the wheat stock reduction program, reducing acreage seeded to wheat by 22 million acres, carryover at July 31, 1971, would be more than sufficient to meet any commercial requirements at the beginning of a new crop year.

With the successful completion of this major reduction program, market forecasts could indicate that Canada will be able to return to a level of production in the area of 20 million acres. Additional measures will be required in 1971 to assure that production does not exceed acceptable levels.

Les stocks des principales récoltes, à l'exception du blé, sont de proportions maniables. Ceux de l'avoine et de l'orge sont considérables, mais n'atteignent pas un niveau critique. Toutefois, toute déviation considérable des superficies en blé ou en jachère d'été pour favoriser d'autres cultures pourrait être cause d'excédents onéreux et de prix réduits pour ces récoltes.

Le nouveau programme fédéral fournira le revenu nécessaire aux producteurs de céréales aux abois et les encouragera à disposer des stocks de blé accumulés sur leurs fermes. Il permettra aux cultivateurs de réduire considérablement leurs superficies en blé tout en les encourageant à ne pas tous se lancer dans la production d'autres récoltes.

Une réduction considérable des stocks de blé nous mettrait en meilleure posture pour raffermir les prix du blé sur le marché international.

Selon M. Lang, "les acheteurs étrangers ne sont pas disposés à payer des prix élevés lorsqu'ils savent que nous sommes assis sur une montagne de céréales; si les cultivateurs acceptent ce programme et l'appuient à fond, comme je suis assuré qu'ils le feront, les disponibilités en espèces des producteurs de céréales, comme l'économie globale des Prairies, seront considérablement améliorées à l'automne".

La Commission canadienne du blé annoncera le 27 février 1970 qu'en dépit du mouvement considérable des céréales entre nos fermes et l'étranger durant le reste de la campagne agricole, elle a l'intention de s'en tenir, pour les livraisons de céréales, à la péréquation de 4 boisseaux par contingent de superficie spécifiée d'ici le 31 juillet. La péréquation à ce niveau, en y ajoutant les contingents spéciaux, permettra à tous les producteurs de céréales de l'Ouest de livrer des quantités globales de toutes les céréales au moins égales, sinon un peu supérieures, à celles de l'an dernier.

L'utilisation du blé, y compris les besoins de la ferme en plus des ventes au pays et à l'exportation, devrait atteindre 500 millions de boisseaux entre le 31 juillet 1970 et le 31 juillet 1971.

Si les cultivateurs profitent pleinement du programme de réduction des superficies, en abaissant de 22 millions d'acres la superficie globale des emblavures, le report au 31 juillet 1971 serait plus que suffisant pour répondre à tous les besoins du commerce au début de la nouvelle campagne agricole.

Advenant la réussite de cet important programme de réduction, les perspectives du marché indiqueraient que le Canada peut revenir à un niveau de production comportant la culture d'environ 20 millions d'acres. Il faudra cependant prendre de nouvelles mesures en 1971 pour s'assurer que la production ne dépassera pas des niveaux acceptables.

ECHOS
DES LABOS ET D'AILLEURS

ed from other malting varieties by the more erect attitude of the heads.

It is intermediate between Conquest and Paragon in maturity and length and strength of straw.

Bonanza is adapted to the Park belt of Western Canada where in tests it has outyielded other malting varieties. In Manitoba it has equalled or surpassed in yield the recommended feed types.

The new variety is resistant to stem rust, loose smut and covered smut and has shown moderate resistance in the field to some of the diseases causing leaf blotching.

In preliminary trials Bonanza has been noted to have good malting and brewing qualities.

Only limited quantities of seed of Bonanza are available. Seed will be distributed this year for a multiplication increase to seed growers in Manitoba, Saskatchewan and Alberta through Provincial Seed Stock Committees.

By spring, 1971, registered seed should be generally available to the public.

NOUVELLE VARIÉTÉ D'ORGE Le ministère de l'Agriculture du Canada a homologué récemment une nouvelle variété d'orge à 6 rangs. Mise au point à la station de recherches de Brandon, c'est la troisième variété brassicole lancée par cette station au cours des cinq dernières années. Elle est baptisée Bonanza.

Elle résulte d'un programme compliqué de croisements entre les variétés Conquest et Parkland. L'épi, à barbes lisses, se distingue des autres variétés brassicoles par son port dressé. Elle se situe à mi-chemin entre la Conquest et la Paragon pour la précocité, la taille et la résistance de la paille.

La Bonanza est destinée à la zone prairie-parc de l'Ouest Canadien, où les essais ont démontré sa supériorité sur les autres variétés de brassiere. Au Manitoba, elle dépasse même en rendement les variétés fourragères recommandées. Résistante à la rouille de la tige, aux charbons nu et couvert, elle affiche en plein champ une résistance moyenne aux maladies responsables des taches foliaires.

Les essais provisoires indiquent de bonnes qualités brassicoles.

On dispose actuellement de peu de semences de la nouvelle variété. Cette année, les producteurs—multiplicateurs du Manitoba, de la Saskatchewan et de l'Alberta en obtiendront par l'entremise des comités provinciaux de production de semences. La semence enregistrée devrait être disponible au producteurs au printemps de 1971.

NEW REFERENCE BULLETIN ON FEDERAL AGRICULTURE LEGISLATION A new reference bulletin on Federal Agricultural Legislation has recently been issued by the Economics Branch, Canada Department of Agriculture. The text is based on the *Revised Statutes of Canada, 1952*, and on legislation and amendments enacted as of August 1, 1969. Agricultural legislation and sections relating to agriculture in other Acts are outlined. In many cases, the pertinent sections are given. Some of the Acts mentioned are administered by Departments other than the Department of Agriculture.

The bulletin replaces *Federal Agricultural Legislation in Canada, 1954*, and the supplements issued by the Economics Branch between 1955 and 1960. The earlier publications are out of print and not available for distribution.

Contents of the new bulletin include: Administration; Land Policy; Finance; Production; Marketing; Trade and Commerce and Transportation.

Copies of this bulletin are available from the Economics Branch, Canada Department of Agriculture, Sir John Carling Building, Ottawa.

UN NOUVEAU FASCICULE DE RÉFÉRENCES SUR LES LOIS DE L'AGRICULTURE FÉDÉRALE La Direction de l'économie du ministère de l'Agriculture du Canada a publié un nouveau fascicule de références sur les lois agricoles. Le texte s'appui sur les *Statuts révisés du Canada de 1952*. Il traite également des articles et de leurs amendements (1er août 1969) et des articles relatifs à l'Agriculture dans d'autres lois. Dans de nombreux cas on donne des références des articles mentionnés. Quelques-unes de ces lois ne sont pas mises en vigueur par le ministère de l'Agriculture.

Le fascicule remplace *La législation agricole fédérale au Canada de 1954* ainsi que les suppléments publiés par la Direction de l'économie entre 1955 et 1960. Les plus anciennes publications ne sont plus disponibles pour la distribution.

Ce fascicule traite de: l'administration, le régime foncier, les finances, la production, la commercialisation et les méthodes de vente ainsi que le transport.

Ce fascicule est disponible sur demande à la Direction de l'économie, ministère de l'Agriculture du Canada, édifice Sir John Carling, Ottawa.

CDA INSPECTORS VISIT HOLLAND Three inspectors from the Canada Department of Agriculture Plant Protection Division recently visited Holland to inspect some 35,000,000 bulbs destined for Canadian gardens.

All bulbs entering Canada must be inspected for disease by inspectors from this division. It is thus easier, more efficient, and more economical, to have this check made in the 40-mile area between Amsterdam and The Hague, where the bulbs are grown and prepared for shipment, than at more widely spaced Canadian customs points.

From the Dutch point of view, the preinspection of bulbs in Holland means faster clearance at Canadian customs points and speedier delivery to Canadian buyers.

Bulbs coming into Canada are very closely inspected by both Dutch and Canadian inspectors. Dutch authorities examine them thoroughly to make sure they are certified to meet Canadian standards. After the shipments are crated or bagged—just before sealing—CDA representatives take over.

They do sample checks which involve cutting and opening bulbs. For equipment they prefer a good hand lens, although when something is suspicious they take the sample to a laboratory for closer inspection.

Since it is the job of the Plant Protection Division to keep destructive pests and insects out of Canada, the three inspectors are particularly interested in finding new diseases that are not known in Canada. On rare occasions, such as the discovery during pre-inspection of a rust on crocus, they find diseases unknown even to the Dutch.

NEWFOUNDLAND ROSES Rose growers in Newfoundland should choose either Queen Elizabeth or Vogue varieties. Both proved far superior in hardiness to 15 others in tests carried out over a three-year period at the Canada Department of Agriculture Research Station, St. John's West, Nfld., to determine their suitability for that province.

Flowers of the Queen Elizabeth variety are pale pink; those of Vogue are a pale red. Both varieties bloom from late July until mid-October.

Queen Elizabeth was the hardiest variety and had an average survival rate of 85 per cent. Vogue had an average rate of 70 per cent but the others trailed far behind with only 22 per cent.

Other rose varieties tested were Miss Canada, Crimson Glory, Eclipse, Kordes Perfecta, Peace, Sutter's Gold, New Dawn and Paul Scarlet.—B. G. PENNY, ST. JOHN'S WEST, NFLD.

WHAT'S THE FUTURE FOR CROP PROTECTION?

Despite emphasis on alternatives to chemical pest control, the latter still remains the only really reliable method we have today. A strong research effort must be maintained to assure chemical control being used wisely, and, where possible, be replaced by safer, more effective methods.

J. H. ROMAHN

Quel est l'avenir de la protection des récoltes? Bien que l'on mette en lumière des moyens de lutte contre les ravageurs autre que les produits chimiques, ceux-ci restent quand même la seule méthode de confiance de nos jours. On doit poursuivre les efforts de recherche visant à assurer que les produits chimiques sont utilisés comme il se doit, et qu'ils soient remplacés, lorsque cela est possible, par d'autres méthodes plus efficaces.

The myth has been exploded—the myth that pesticides are a cure-all in the fight against pests and disease.

In its place another myth is arising—the myth that pesticides are evil polluters responsible for a wide range of murderous deeds.

Whereas the old myth painted pesticides whiter than white, the new myth tars and feathers them.

"If there is such a thing as an ultimate truth about pesticides, it would fall somewhere between these extremes," says Dr. W. B. Mountain, Director of the CDA Entomology Research Institute at Ottawa.

"Agricultural scientists realize that we cannot continue to use pesticides with complete abandon. We already know that pesticides can cut like a two-edged sword, controlling pests and disease, but at the same time affecting natural predators and parasites, fish and fowl.

"However, some recent attacks on pesticides have been calculated to frighten—rather than enlighten—the public.

"Facts have been taken in isolation and interwoven with speculation and emotion to create a highly-charged atmosphere of suspicion and doubt about pesticides," says Dr. Mountain. "Pesticides are not the cure-all some people once thought they were. But, neither are they all bad."

Mr. Romahn is a science writer with CDA Information Division, Ottawa, Ont.

THE PAST

The first modern pesticide, put into widespread use in the early 1940s, was DDT. Like all modern chemical pesticides, it differed completely from any other type of pest control.

We know DDT works, but don't know how, apart from the fact that it affects the nervous system.

However, all modern pesticides affect more insects than the ones they are designed to control and kill. When pesticides were first used, man did not know exactly how broad the killing spectrum of DDT would be. We are still investigating the scope of DDT, the pesticide we now know the most about.

At the same time, we are employing new pesticides which appear to have a much narrower spectrum—ones that work like a rifle rather than a shotgun.

However, we do not know as much about these pesticides as we do about DDT, simply because they have not been around as long and we have not had the same opportunity to study them in action in the environment.

When DDT was first used on orchards, for example, it killed the pests that were causing the problem. These included pests that were attacking the fruit directly and other pests which were attacking the trees. Entomologists refer to these two types of pests as direct and indirect.

A farmer can't tolerate many direct pests but he can allow higher populations of indirect pests in his orchard. For example, one codling moth per apple tree is about the economic limit, but the European red mite population can safely go as high as 5,000 per tree. The codling moth will attack the fruit directly, putting a worm into the core; European red mites attack the leaves.

DDT knocked out both types of pests; however, at the same time, it knocked out a broad spectrum

of other insects. In some cases, these other insects were natural enemies of the problem pests.

If we were to stop using all modern pesticides, the population of pests would explode, and a global disaster could follow. No one person can accurately assess the dimensions of that disaster, just as no one person could foresee all of the effects and side effects arising from the discovery and widespread use of pesticides.

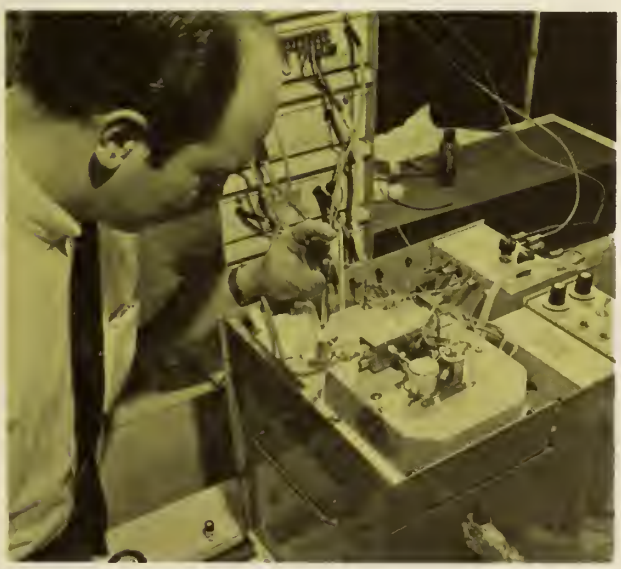
Realizing that a sudden ban on all pesticides would create a disaster, and realizing that pesticides are not a permanent and completely acceptable solution to our pest problems, scientists are currently engaged in a many-pronged search for new and better controls.

THE PRESENT

As scientists began to chart the outlines of the side effects of some of our better-known pesticides, governments changed old regulations and created new ones to control pesticides. In some cases, pesticides have been banned. The ban given the widest publicity affected the widespread use of DDT against a number of pests.

"In one way, the ban against DDT may hurt more than it helps", says Dr. Mountain. "Scientists have discovered more about DDT than any other pesticide, simply because it has been around longer. Because we have a big foundation of knowledge to build on, it stands to reason that we have a better chance of learning more about pesticides in general from continued DDT research than we do from new studies of other individual pesticides.

"However, that is merely the research aspect of the question. There were other factors when they were considered; the decision was to institute a widespread Canadian ban against the continued use of DDT."



Injecting sample into the gas chromatograph—mass spectrometer to positively identify the pesticides present.

In actual fact, many of the industries and people who used DDT switched to other forms of pest control long before the ban was announced. The general public, however, continued to use DDT instead of alternatives.

The heaviest industrial user of DDT for the past few years in Ontario has been the tobacco industry. DDT is used by tobacco farmers to control cutworms. The natural drainage basin for this industry is Lake Erie, yet studies show that the residue level of DDT is much lower in Lake Erie than in Lake Simcoe.

"It would appear that even our heaviest agricultural user of DDT is not polluting the environment to the same extent as our householders and summer cottage owners," says Dr. Mountain.

"We may not be willing to give up the use of some pesticides if the choice is between eating well and starving. However, if the choice is between pesticides pollution and nuisance insects (such as mosquitoes biting at twilight) the answer may be quite different."

There is a renewed research emphasis today on pest controls that do not involve chemicals such as DDT.

When DDT and the other pesticides arrived on the scene, instead of treating their advent as a welcome breather in the continuing search for new pest control measures, many entomologists tended to relax, thinking the problem was solved once and for all. We now know, of course, that this was a mistake.

In search of replacement control measures, scientists are using both old and new approaches.

Orchards provide one example of several approaches being combined for pest control.

CDA researchers in the Okanagan Valley of British Columbia are attempting to control codling moths by the sterile male technique. In brief, this involves dropping so many sterilized males over the area that the females never get a chance to mate with a virile male. As a result, they lay sterile eggs that won't hatch.

The technique has worked well in tests to date. However, a complete control program based on this technique would be expensive because of the cost to raise sterile males and drop them over an area. The technique should work well in a sealed-off area such as the Okanagan Valley, which is ringed by mountains, but, if the area were open, virile male moths could float in from the surrounding countryside. In other words, the sterile male approach may work in the Okanagan Valley, but may not in Ontario and Quebec orchards.

That takes care of the codling moths in Okanagan Valley apple orchards, and of this insect on pears. But there are also three other serious pests of pear trees. A fungicide will handle one fungus disease and one of the other insects bothering the pear trees.

Scientist takes reading from the gas chromotograph.

This particular chemical pesticide is not toxic to mammals, with little danger to fish, fowl and animals, including man.

Because sterile male codling moths are taking care of the moth problem, the orchard owner never sprays with strong chemical pesticide.

That, in turn, means there will be more predator and parasite action in the orchard which will take care of the fourth pest—a mite—an indirect pest that attacks the leaves of pear trees.

This approach to pest control is called integrated control because it integrates natural control with chemical control and biological control (the sterile male moths).

"It will take at least six years to work out that one integrated control for pears," says Dr. Mountain. "The task of devising integrated control programs is time-consuming, tedious, exacting and frustrating. Integrated control programs for all Canadian crops will obviously not appear overnight. And there is some indication that, even if we do develop integrated control programs for all of our agricultural crops, it may take an exceptionally well-trained and clever grower to apply the technique properly.

"For example, using integrated control to handle a direct pest with one spray instead of six sprays during the season, we may have to hit the third generation of that pest within a three-day period of its life cycle. The person applying that type of control must not only be able to spot the third generation of that pest, but also be able to apply the precise amount of pesticide during the three-day period when the insect is vulnerable."

The problem in Ontario and Quebec apple orchards is even more difficult than the pear pest problem in British Columbia because eight serious pests occur there. Obviously, it will be much more difficult to develop effective integrated control for eight rather than four pests.

The CDA Research Branch has the work under way, however, and includes everything from the development of new varieties resistant to apple scab to experiments with the sterile male approach for codling moth control.

Chemical companies have already found new types of pesticides, including ones that need not be sprayed on the foliage. Instead, they will travel through the 'blood' of the plant. These pesticides are called systemics. Only pests that attack the plant or its fruit are affected. The industry is searching for more, still safer and more effective systemics.

One of the safest and best answers has been the development of new varieties of plants which have resistance to a pest bred into them.

Examples include rust-resistant wheat, wilt-resistant tomatoes, smut-resistant barley, sawfly-resistant wheat and scab-resistant apples.

THE FUTURE

CDA researchers will continue to place emphasis on the development of pest controls which do not have the harmful side effects of modern chemical pesticides, says Dr. Mountain.

More specifically, some of the control methods currently being researched by agricultural scientists here and in other countries include:

- Chemical attractants and repellents. These include sex attractants (called pheremones). The idea is to find the chemical which attracts a male to a female insect or vice versa, then to manufacture this chemical in large quantities to attract, repel or confuse the insect. In the case of a female sex attractant, perhaps it would be placed in a box with a poison and the insect would be attracted inside where it would be killed. Presumably there is some phenomenon which attracts insects to particular plants. For example, a codling moth is attracted to an apple tree rather than a maple. If the factor influencing the insect's choice of the apple tree could be discovered, perhaps we could keep insects away from our food and food-producing plants.
- Hormone sprays. Scientists are currently studying insect hormones, attempting to isolate and identify the role of each hormone. One study currently under way in the Canada Department of Agriculture involves the juvenile and moulting hormones. As the balance between these two hormones changes, the insect goes through the stages of development which make up its life cycle. To make the transition from the larval through to the adult stage, the juvenile hormone must be absent. Perhaps man will be able to make synthetic juvenile hormone and use it to prevent the insect from completing its life cycle.

• Radio waves. Insects 'smell' by trapping molecules of the attractant odors in spaces in their antennae. The molecules fit into these spaces just as a key fits into a lock. Once they fit into these spaces, they vibrate at a high frequency. Scientists think they could confuse insects by discovering this frequency, then setting up a transmitter in the field to transmit at this same frequency. This would completely confuse insects so they might never mate.

• A flash of light. Some insects prepare for winter as the days in autumn become shorter. Their biological clock is apparently set by the shortening length of daylight. If this pattern of light and darkness is upset, the clock fails to function and the insect will not prepare for winter. Then cold weather kills the insect. Some scientists think pests could be controlled by a flash of light in the middle of the night at precisely the time of year when the pest is setting its biological clock.

• Insect diseases. Scientists are studying the various fungi, bacteria and viruses that attack each of our Canadian pests. They are particularly interested in the bacteria and viruses which plague these pests, but which have no effect on other forms of life. Several viruses and at least one bacteria are already emerging as promising alternatives to chemical pesticides.

There are at least 80,000 different kinds of insects in Canada. They are hardy customers, well-adapted to the Canadian environment. Of course, the great majority of them are beneficial and very important in helping to check the pest species.

Dr. Mountain says we will never be able to control all of these insect pests to our complete satisfaction, but that does not mean we are giving up our efforts at control. On the contrary, we are increasing our efforts to control pests.

In the Canada Department of Agriculture, the research includes:

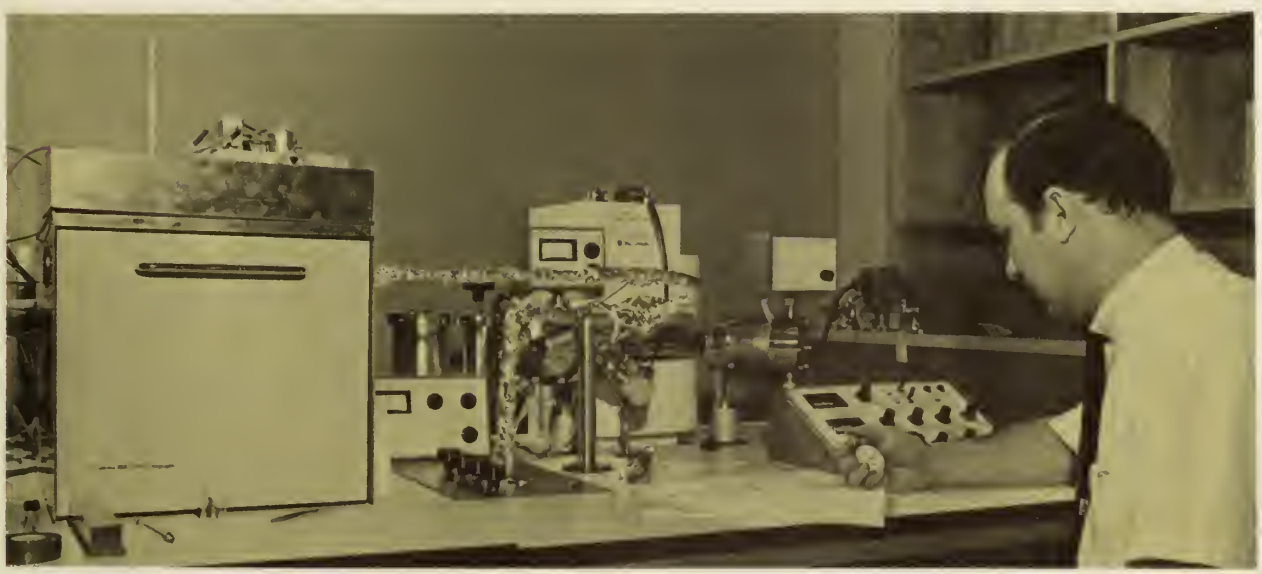
• Ecological studies at the Belleville, Ontario, Research Institute. The research concentrates on biological and integrated control—for example, the careful importation of insects that will prey on Canadian pests.

• Chemical studies at the London, Ontario, Research Institute. The research ranges from pesticide residue studies to investigations of the chemistry of insects, and the mechanism by which chemicals actually kill insects.

• Taxonomy and physiology studies at the Entomology Research Institute at Ottawa where scientists identify insects and study their physiology. Once correctly identified it can mean setting up an integrated control program—such as currently being done for the cereal leaf beetle—and eradicating an insect before it becomes a major pest.

• A wide range of studies at CDA Research Stations from coast to coast. They include everything from studies of chemical pesticides to integrated control, to biological control, to studies as basic as insect hormone investigations. Every Station is involved in either the breeding or evaluation of new crop varieties. The research and development program involves every crop grown commercially in Canada, and a major objective of the breeding programs is to develop and improve insect and disease resistance.

"Chemical pesticides are not the total answer," says Dr. Mountain, "and we know it. We are working as hard as we can to replace them, where possible, with safer, effective alternatives." ■



The mass spectrometer-gas chromotograph combination is the only one of its kind in Canada being used for pesticide research.

Harvesting date affects corn silage yields

L. LACHANCE and T. CAMERON

Cet article traite de l'influence de la date de récolte sur la productivité du maïs hybride fourrager. L'hybride mi-hâtif Pride 5 et le tardif Warwick 600 ont servi à ces essais à Lennoxville depuis 1966. Cette étude ne s'applique qu'aux régions agricoles dont le degré de chaleur varie entre 1,700 et 2,500 unités thermiques. Cet article a déjà paru en français dans le numéro du printemps de 1969.

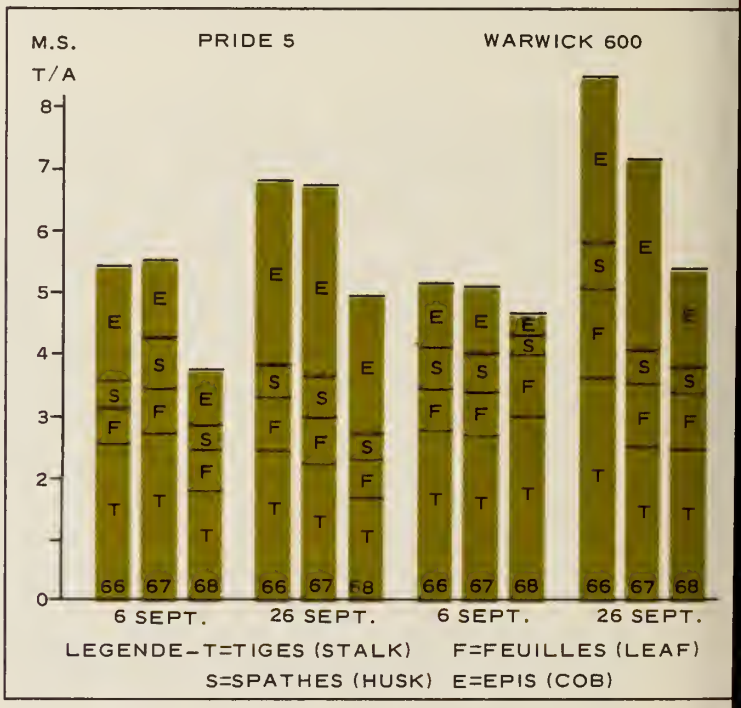
The use of corn silage as a ruminant feed is increasing in the Eastern Townships of Quebec. This region averages about 2,400 heat units (h.u.) ranging from 1,700 in the vicinity of Quebec city to 2,700 h.u. in the Montreal area. It is not possible to produce grain corn in much of this region since most corn hybrids require at least 2,500 h.u. to reach maturity. However, silage corn will reach the dough stage required for good silage at about the end of September.

Experiments on the effect of date of harvest on the yields of two silage corn varieties, Pride 5, a semi-early hybrid (2,600 h.u.), and a late-maturing hybrid, Warwick 600 (3,000 h.u.) have been conducted at the Lennoxville Research Station since 1966.

Two well-drained fields of 10 acres each were used. Half of each field was seeded to each variety. Each field received an application of 15 tons per acre of barnyard manure. Fertilizer in a 1:1:1 ratio was applied at the time of seeding. Ammonium nitrate at 250 lb per acre was applied as a side dressing when the plants grew to approximately 8 inches. The corn was seeded about the middle of May in rows 36 inches apart at 12 lb per acre. Weeds were controlled by an application of 1.5 lb per acre to Atracine 65W. Half of each variety was harvested on September 6. The remainder of the corn was harvested on September 26.

Corn forage harvested on September 6—The climatic conditions modified the physiological development of the corn. In 1966, both varieties had reached the dough stage of maturity while at the same date in 1968 they reached the milk stage. The average green yields (Table 1) were 23.9 and 26.5 tons per acre for Pride 5 and Warwick 600, respectively. The physiological differences between the two varieties resulted in differences in the green forage yield. Pride 5, an early-maturing variety had a moisture content of 79.2 per cent. Warwick 600,

Fig. 1. Yield components of silage corn varieties at two dates of harvest—1966, 67, 68.



Mr. Lachance specializes in plant science and Mr. Cameron in animal science at the CDA Research Station, Lennoxville, Que.

TABLE 1—EFFECT OF HARVEST DATE ON THE PRODUCTIVITY OF TWO VARIETIES OF SILAGE CORN

Harvest date	September 6		September 26	
Variety	Pride 5	Warwick 600	Pride 5	Warwick 600
Maturity	milk-dough	milk-soft-dough	hard-dough	milk-dough
		Green yield (t/acre)		
Whole plant	23.9	26.5	26.3	31.4
		Dry matter yield (t/acre)		
Stalk	2.38	2.79	2.10	2.84
Leaves	0.65	0.79	0.76	1.12
Husk	0.56	0.52	0.51	0.56
Ears	1.36	0.85	2.85	2.39
Whole plant	4.95	4.95	6.22	6.91
		Dry matter content (%)		
Stalk	18.0	16.7	19.4	17.3
Leaves	22.5	21.4	26.4	23.6
Husk	20.4	17.2	24.4	19.6
Ears	26.6	19.2	42.3	31.4
Whole plant	20.8	18.1	25.6	21.8
		Dry matter yield component (%)		
Stalk	48.1	56.4	33.8	41.1
Leaves	13.1	15.9	12.2	16.2
Husk	11.3	10.5	8.2	8.1
Ears	27.5	17.2	45.8	34.6
Whole plant	100.0	100.0	100.0	100.0

a late-maturing variety had a moisture content of 81.9 per cent. The total dry matter yields were the same for the two varieties. However, the contribution of the yield components varied considerably between varieties (Fig. 1). The dry matter content of all plant parts was less for Warwick 600 than for Pride 5.

Corn forage harvested on September 26—Pride 5 reached the late dough stage and Warwick 600 was between the milk and dough stages of maturity on September 26. This difference in maturity was apparent in the dry matter content (25.6 per cent for Pride 5 and 21.8 per cent for Warwick 600). The green and dry matter yields were, respectively, 26.3 and 6.22 for Pride 5 and 31.4 and 6.91 tons per acre for Warwick 600. The percentage of ear was less and the percentage of stalk and leaves were greater for Warwick 600 than for Pride 5. The dry matter yields for early- and late-harvested Pride 5 and Warwick 600 were 4.95 and 6.22; and 4.95 and 6.91 t/acre, respectively. These increases in yield with maturity were associated with the physiological development of the ear. The ear yield for Pride 5 increased from 1.36 for the early-cut to 2.85 tons per acre for the late-cut. The corresponding yields for Warwick 600 were 0.85 and 2.39 tons per acre.

Late-maturing hybrids have a high yield potential. They utilize the resources of their environment to a maximum. These varieties will produce large quantities of forage in the areas surrounding Quebec city, the lower St-Lawrence, and the North Shore. Mid varieties are recommended for regions where grain corn can be grown as the grain content will increase the feeding value of the silage. Varieties of different maturities are sometimes grown at the same time. In this way the high forage yields from the late varieties will compensate for the low yields from the ear-rich varieties. ■

Corn harvested on September 6, 1966. Warwick 600 (left) at the milky stage, Pride 5 (right) at the thick stage.

MICHAEL CORLETT

Des recherches visant à accroître nos connaissances de l'organisme pathogène de la tavelure du pommier se poursuivent en utilisant des microscopes modernes à la lumière ou aux électrons. Des connaissances plus approfondies de la structure interne de ce champignon pourront permettre une lutte plus simple et moins coûteuse contre ce fléau. Les exploitants de verger auront ainsi un autre fongicide à leur disposition.

Probing the secrets of THE APPLE SCAB FUNGUS

Apple scab is a fungus disease that affects both the fruit and foliage of commercial apples and flowering crab apples. Orchardists can suffer substantial losses from scab, although disease incidence is greatly reduced through the application of fungicide sprays at various times during the growing season. But an effective spray program is expensive for the grower.

In our investigations at the Plant Research Institute, we are relying on the modern light and electron microscopes to increase our scientific knowledge about the apple scab fungus and its annual life cycle. A greater understanding of the structure and development of the fungus possibly may shed some light on how the disease can be better controlled in the future.

The apple scab fungus lives through the winter in fallen leaves where it produces flask-shaped reproductive structures, the perithecia. In the spring, small seed-like ascospores are formed within the perithecia and then are shot up toward the emerging apple leaves and blossoms. There they germinate and infect the immature foliage, causing the primary lesions or scab spots. The summer spores or conidia are produced in the primary lesions and washed by rain to other leaves where they cause new (secondary) infections. Conidia continue to be produced and increase the number of infections throughout the summer. Since the disease can only be initiated each year by the ascospores, the overwintering stage is probably the most significant part of the annual cycle of the fungus.

Could more be learned about the overwintering stage of the apple scab fungus? In one study, using a light microscope (Leitz phase contrast) and paraffin embedded material, we examined 7 micron thick sections of the perithecia and ascospores (1 micron = 0.00004 inch). At magnifications of ×500 to ×1000, it was possible to observe the origin and development of fungus tissues, various stages in the formation of the ascospores and the nuclear condition of the cells. These light microscope observations are essential steps in helping to interpret observations made with the electron microscopes.

In a similar study, we used a transmission electron microscope (Philips 100) and epoxy-embedded material sectioned at a thickness of 0.04 micron. At magnifications of ×5000 to ×20,000 we could make out fine detail not seen with the light microscope. For example, layers in the ascospore wall were visible while mitochondria and other cytoplasmic particles were apparent. The fine structure of the perithecia and ascospores at these high magnifications may reveal some clues about the ability of the fungus to overwinter or to cause the initial infections in the spring.

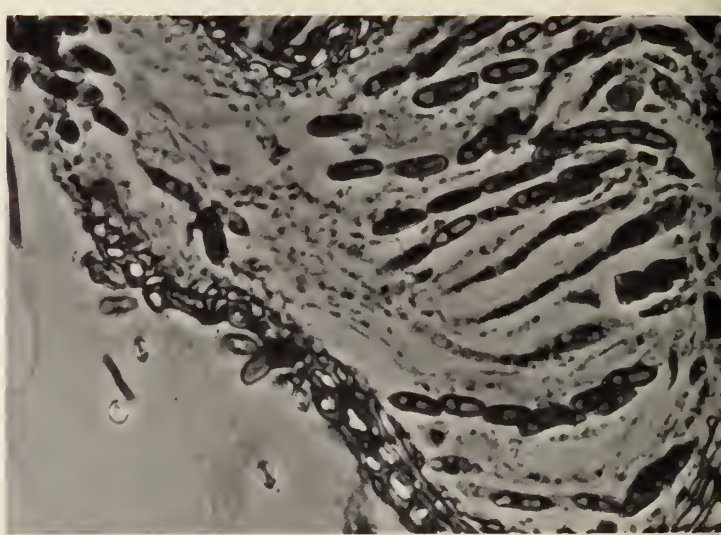


Fig. 1. Section of a perithecium, the overwintering stage of the fungus which produces the two-celled ascorpores that cause the primary infection in the Spring. Photographed with the Leitz phase contrast light microscope. Magnification ×600.

However, now that we have a new Cambridge Stereoscan scanning electron microscope (S.E.M.) in the Electron Microscopy Unit at the Central Experimental Farm, we can examine specimens without having to section them. For example, we can now cement a piece of scab-infected leaf to a specimen holder and scan the surface of the leaf with an electron beam to produce a three-dimensional image on a viewing screen.

Dr. Corlett is with the Mycology Section, CDA Plant Research Institute, Central Experimental Farm, Ottawa.

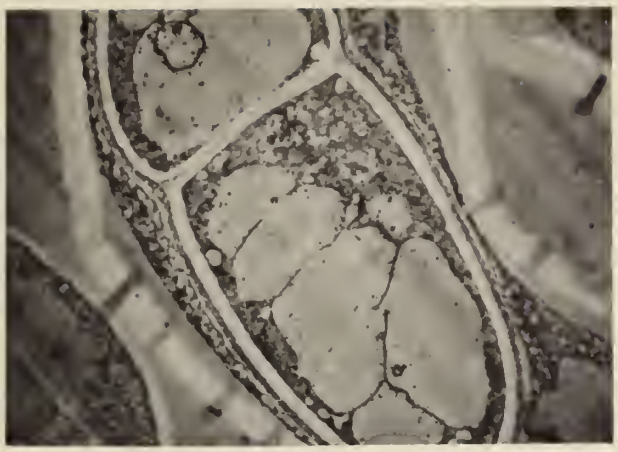


Fig. 2. Section of an ascospore. Photographed with the Philips 100 transmission electron microscope. Magnification ×6200.

Our research has revealed that many details of the surface structure of the conidial stage of the apple scab fungus could be distinguished only with the scanning electron microscope. We can now see wall markings and surface texture as they have never been seen before.

Fig. 3. Portion of a scab-infected leaf of "Almey Crab Apple". Scab spots are producing conidia, the Summer spore stage of the fungus. Photographed with a low power dissecting light microscope. Magnification ×3.

Let's take a look. Each conidium is found at the apex of a stalk-like conidiophore. The conidium matures and then drops off. A circular scar remains around the top of the stalk, representing the point at which the conidium was previously attached. The scanning electron microscope reveals that the ring-like scar is an external structure consisting of the outer wall layer of the stalk cell. The apex of the stalk then elongates upward, beyond the scar of the previous conidium. This new elongated portion becomes the next spore and is derived from the inner wall layer of the stalk. Many conidia are produced from a single stalk during the summer and autumn. The stalk gets longer after each conidium detaches. The base of each new conidium is slightly higher than the previous one. Eventually the upper part of the stalk is ringed by numerous scars, one scar for every conidium produced.

Fig. 4. Cluster of conidia on spore-producing stalks (conidiophores) from one of the scab spots seen in Fig. 3. Photographed with the Cambridge Stereoscan scanning electron microscope. Magnification ×2000.

What can electron microscopy in relation to the apple scab fungus mean to the apple grower, the nurseryman, the farmer? Our answer to this question is that in probing the secrets of the fungus with the new scanning electron microscope and the transmission electron microscope, we are learning more about its annual cycle. We are probing the fine internal structure to try and discover exactly how the parasite develops and are hopeful that this type of research may eventually lead to simpler and less costly control measures. ■

DIRECT SEEDING OF PROCESSING TOMATOES

J. W. AYLESWORTH

Des recherches on indiqué qu'il est possible de cultiver des tomates à partir de la graine sur l'argile Brookston dans le sud-ouest de l'Ontario. Cependant il faut dire que les résultats ont principalement été possibles par l'emploi de la variété hâtive Fireball et d'un humus de plastique pour accélérer la maturité.

At the Soil Substation, Woodslee, Ontario, during the past three years we have conducted research on the seeding of processing tomatoes directly in the field. The purpose of this work was to determine whether direct-seeding of tomatoes was feasible on clay soil and to study the cultural and soil management problems involved.

The direct-seeding method for tomatoes has a number of advantages such as: (1) reducing cost of labor and plants and increasing mechanization of production (2) saving of time at planting (3) allowing planting when the soil and weather conditions are favorable, in contrast to the present method of transplanting, which depends on the availability of plants rather than favorable field condiions.

A disadvantage appears to be the added cost of a mulch; however, the mulching has promoted higher yields and early ripening, has given almost complete weed control in the row, and in the past two years it gave protection against flood damage.

The varieties Fireball, Heinz 1350 and Roma were tested in rows 5 ft. apart for direct-seeding in 1966. Only Fireball was early enough to produce satisfactory yields. This variety was used in subsequent tests in 1967-68. The later tests were seeded with a John Deere Precision Unit planter using sugar beet plates and ¾ in. depth bands. The black plastic (3 ft. wide, 1.5 mil thick) mulch was applied mechanically on the mulched treatments at the time of planting. Holes were cut by hand in the black plastic shortly after emergence to allow the plants to come through it. Phosphorus and potassium fertilizer (100 lbs per acre each) was applied in the fall and plowed under and the nitrogen fertilizer (50 lbs per acre) was applied at planting time. A 10-52-17 fertilizer was used in

Dr. Aylesworth is Officer-in-Charge of the Soil Substation, CDA Research Branch, Woodslee, Ont.

Fireball variety seeded directly in field on May 18. Left—with black plastic mulch, right—without mulch.

Fireball variety seeded directly in field on April 20 with black plastic mulch gave early vigorous growth, heavy fruit set and retention of foliage.

solution at 25 lbs per acre on the transplant treatments. Transplant treatments were planted through the mulch by hand and by mechanical planter where no mulch was used.

Maturity was advanced significantly with the use of black plastic mulch as indicated by the large increase in yield to September 1st where the mulch was used on both the direct seeding and transplant treatments (Table 1). This advantage was reflected in total yields where an increase of over 10 tons per acre was obtained for the mulch on both the transplants and early, direct seeding. Where black plastic mulch was used the total yield of the early, direct seeding was almost as good as the transplant treatment.

A band application of 150 lbs per acre of 11-48-0 fertilizer beside the seed at planting resulted in a small improvement of both early yield and total yield of the direct seeding treatments, particularly where seeding was done early. Part of this increase may have been due to an increase in fruit size (Table 2).

Excessive rainfall during the early summer of both 1967 and 1968 caused severe flood damage to the tomato crop. This damage was much less severe where the plastic mulch was used in these tests.

In summary, on the basis of the work at Woodslee since 1966, the direct-seeding method for processing tomatoes appears feasible on Brookston clay soil. The success of the method depends on use of an early variety such as Fireball and a mulch cover to advance maturity. The present estimated cost of direct seeding with mulch is $100 per acre compared with $80 for plants and transplanting. A coated paper mulch is presently being developed commercially which would presumably cost less than plastic and also deteriorate in the soil when worked under in the fall.

Germination may be a problem in dry years. More research is required with respect to seed-bed tillage and seeding depths to provide good stands. Chemically treated seed to promote germination and plastic coated seed to allow fall or early spring planting are other possibilities which require investigation. Engineering problems include developing a technique to allow the tomato seedlings to emerge through the mulch cover at the proper time and spacing. ■

TABLE 1. TONS PER ACRE OF RIPE FRUIT FROM DIRECT SEEDED OR TRANSPLANTED PROCESSING TOMATOES (AV. 1967-68).

Planting treatment	Without mulch	Black plastic mulch	Increase due to mulch
		Yield to Sept. 1	
Transplant	3.84	10.96	7.12
Direct — early	2.96	13.15	10.19
Direct — late	1.10	3.40	2.30
		Yield to Sept. 30	
Transplant	15.66	25.73	10.07
Direct — early	11.78	23.07	11.29
Direct — late	6.65	12.17	5.52

Dates of planting:	1967	1968
Direct — early	Apr. 20	Apr. 30
Direct — late	May 17	May 21
Transplants	May 17	May 23

TABLE 2. WEIGHT PER 100 FRUIT (LBS) IN DIRECT SEEDING TEST FOR PROCESSING TOMATOES (AV. 1967-68).

Treatment	Without mulch	Black plastic mulch	Increase due to mulch
Transplant	21.8	22.9	1.1
Transplant + band fert	19.9	22.5	2.6
Direct — early	25.6	25.7	0.1
Direct — early + band fert	24.4	25.8	1.4
Direct — late	24.9	25.6	0.7
Direct — late + band fert	26.4	27.5	1.1
Av.	23.8	25.0	1.2

Band fertilizer—150 lbs/acre 11-48-0 applied 2 inches deep and 2 inches away from row.

MEET "BUFFALO GNAT"

ENEMY OF LIVESTOCK AND PRODUCER

F. J. H. FREDEEN

Une vigilance constante est nécessaire pour éviter une explosion des populations de mouches noires. L'auteur décrit quelques méthodes de lutte efficaces.

History has it that when 'Buffalo Gnat'—one of various names for *Simulium arcticum*, the black-fly—broke out in central Saskatchewan in the years 1944 to 1947, more than 1,100 farm animals were killed and numerous others were injured. Those were devastating attacks, causing losses that robbed the farmers of their livelihood.

In the early days of settlement on the Western Canadian prairies, outbreaks of the black fly *Simulium arcticum* were as unpredictable and uncontrollable as changes in the weather. Damaging outbreaks probably occurred almost every spring but losses were particularly heavy in 1913, 1919 and 1930. Mr. Mawson, a pioneer rancher near Dundurn,

The author is an entomologist with the CDA Research Station, Saskatoon, Sask.

An animal showing some initial signs of "black-fly sickness". It had ceased grazing and had some fluid-filled swellings along the underline and laboured breathing.

reported that an outbreak in that district, about the time of the Riel Rebellion, killed cattle, oxen and horses.

One of the local names for this black fly, 'buffalo gnat', suggests that it was originally a pest of buffalo. Another name, 'sandfly', sprang from the belief that the dense swarms originated in the sand-dune areas bordering the rivers. It was difficult to imagine that these hordes of actively biting insects could emerge from a river. However, in 1922 Dr. A. E. Cameron, the first officer-in-charge of the Canada Agriculture Entomology Laboratory at Saskatoon, reported discovery of breeding places of *S. arcticum* in the South Saskatchewan River.

In 1947, his successor Dr. A. P. Arnason with Dr. J. G. Rempel of the University of Saskatchewan, accurately pin-pointed some of the sources of the destructive outbreaks of that time in the large rapids downriver from Saskatoon and Prince Albert but were unable to suggest a means of control. Thus in 1947, the Canada Department of Agriculture initiated a project for this purpose. Fortunately, in

THE BLACK-FLY BANDIT!

Rapids in the South Saskatchewan River near Weldon, Sask., a typical breeding site for the larvae of S. arcticum.

that year Dr. C. R. Twinn, CDA, Ottawa, in small-scale tests near Churchill, Manitoba, showed that DDT was an effective black-fly larvicide, even in very small dosages. Beginning in 1948 DDT proved so successful in full-scale tests on the Saskatchewan River that widespread, damaging outbreaks became a thing of the past. In these tests it was shown that the downstream movement of a single mass of water containing only 0.1 to 0.3 parts of DDT per million parts of water and requiring only 15 minutes to pass a given point was sufficient to kill black-fly larvae for distances of up to 115 miles. Although pockets of infestation occasionally survived to produce small outbreaks, this method of control was used with considerable success for several years. We discovered that the DDT molecules became attached to silt particles carried in the turbid water and the larvae filtered these particles from the water while feeding. This explained why the larvae of *S. arcticum* were particularly susceptible to minute amounts of DDT while other insect larvae were less affected.

The total amount of DDT used each year was small, adding only about 1 per cent to the estimated "background" load in the river derived from other sources. However, tests were recently resumed to determine if one of the new 'low-residue' chemicals could do the same job.

Although many facts about the life cycle of *S. arcticum* are now known, the precise events essential for the development of outbreaks still require investigation. The eggs overwinter in the sand of the river bed and commence hatching a week or so after the ice breaks up in the spring. At this time enormous numbers of young larvae attach themselves to willow branches and gravel on the flooded beaches. Later in the spring, the older larvae densely colonize boulders in rapids, in water flowing at least as fast as seven feet per second. There the pupae are formed, sometimes as early as mid-May. About a week later the adults commence to emerge from the river. For the first while, they feed on flower nectars and in some instances are capable of developing a first batch of eggs without additional food. However, as soon as these eggs are laid, the hungry black flies commence searching for their first blood meal. Along the Athabaska River, outbreaks do not begin until late June or in July. In Saskatchewan, swarms of black flies dense enough to kill cattle were

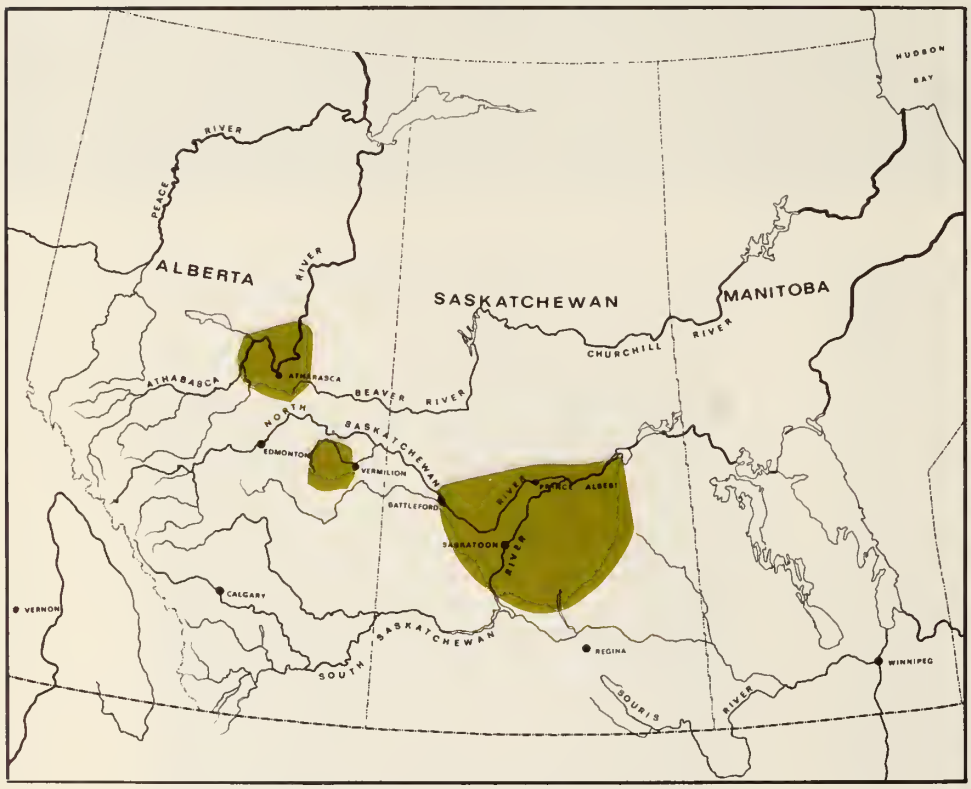
frequently carried by the wind 30 to 50 miles from the river. In 1947 some cattle were killed as far as 140 miles from rapids where the black-flies had emerged.

No animal is immune but fortunately man is seldom bitten. Bulls, especially those recently imported, are particularly sensitive to attack and are generally the first to show ill effects. Deaths can occur within a few hours after an attack begins. Post mortems show that deaths are caused by direct toxemia or anaphylactic shock, rather than by disease organisms or by the inhalation of flies. There are indirect losses as well, such as reductions in weight gains and milk production, and a delayed calf crop caused by interruption of the breeding season. Secondary infections cause the sterilization of some bulls.

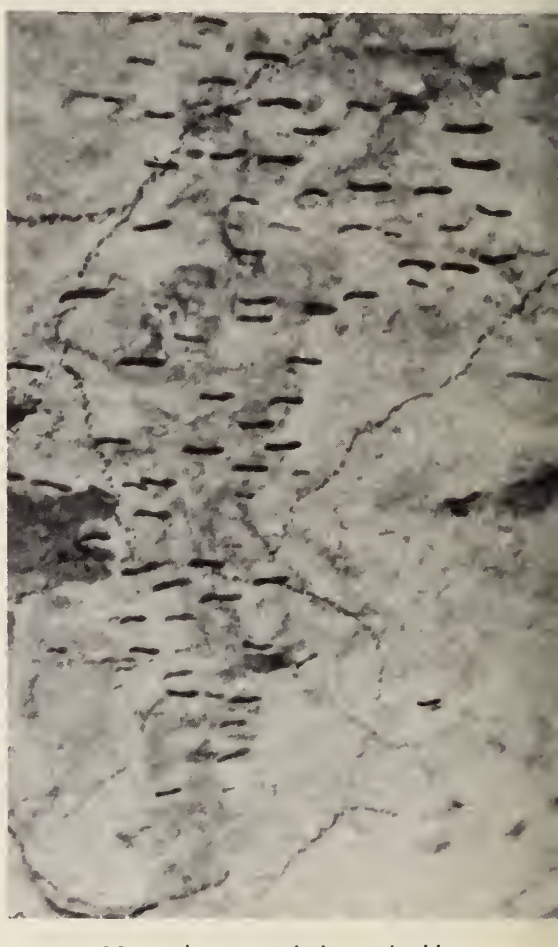
Black-fly attacks are generally sudden and violent and reach their peaks in the early morning and late evening. Often the first warning of an outbreak is the sight of animals stampeding into the barnyard. Less fortunate animals attempt to hide in the brush and in sloughs.

A darkened shelter will provide adequate protection against attack. Thus at the first sign of a severe outbreak, bulls and milk cows at least should be stabled. Smudges offer some protection but insecticides and repellents have not proved fully satisfactory and require further study as to economics. A change in the wind direction, or to cool or wet weather, is usually required to bring an outbreak to an end. Occasionally brief outbreaks have occurred in August or September. Along the downstream sections of the Athabaska and Saskatchewan Rivers fresh outbreaks may occur repeatedly throughout the early summer.

The larvae of *S. arcticum* are uniquely adapted to living in the largest rivers originating in the mountains in Western Canada and do not occur abundantly anywhere else. However, the larvae of at least 40 other species occur in smaller steams and lake-fed rivers in Western Canada. Of these, only *S. venustum* has proved to be a pest of animals and man. Although this pest does not kill animals, it is sometimes an annoying pest along the Souris, Beaver, and other large rivers, especially in years when these attain high flood levels. ■



Areas occasionally subjected to damaging outbreaks of S. arcticum.



Larvae of S. arcticum *attached to a boulder in fast-flowing water.*

TICKS and technology

P. R. WILKINSON

Les tiques, et la technologie. Des études sur l'écologie et les populations des tiques ont démontré que l'homme, par ses activités technologiques, a favorisé la dispersion de cet insecte.

Tick paralysis, is the only conspicuous tick-induced disease in Canada. At present it is controlled in livestock by spraying the animals, and is of low, though persistent, incidence in man; other tick-borne diseases of man and livestock are potentially important but their status has not yet been fully worked out. The possibility of ticks developing resistance to insecticides, or of some insecticides being banned for use on livestock still exists.

The main species concerned are the Rocky Mountain wood tick (*Dermacentor andersoni*), the American dog tick (*D. variabilis*), and the Pacific tick, (*Ixodes pacificus*). Much information on the distribution of these pests has been recorded and summarized at the Entomology Section of the Kamloops Research Station.

D. andersoni, especially, is associated with "ecotones", and man's engineering activities are altering its distribution. An ecotone is the transition zone between bioclimatic zones, e.g. between Douglas fir forest and open "bunchgrass" pastures. Conditions in this particular ecotone are often favorable to shrubs which provide food and shelter for rodents (and in turn their predators), and spring browse and grazing for deer and cattle; thus many hosts are available for the Rocky Mountain wood tick, and soil temperature and humidity relations are more favorable than in the cool forest or arid grassland. Similar conditions are frequently obtained around natural rocky outcrops and gullies in grassland, and along man-made roads, power lines, pipe lines, ski slopes, parts of the U.S.—Canada border clearing, logging and other clearings, and camp grounds.

Dr. Wilkinson specializes in ticks at the CDA Research Station, Kamloops, B.C.

Man-made clearings provide suitable bioclimatic conditions for Rocky Mountain ticks.

Linear clearings are often used as deer trails and thus spread of the ticks is facilitated, so that new clearings are colonised if conditions are suitable.

The Pacific tick is sometimes abundant in clearings in the moister coastal areas of British Columbia, but little is known about its ecological requirements. An unusual feature of this tick is that a favorite host of the immature stages is a lizard. The bite of this tick often leaves a painful sore.

In addition to the production of new areas suitable for tick colonisation, man is increasing the mobility of tick hosts and ticks by the construction of bridges and use of rapid ground and air transport. An important host of Rocky Mountain wood ticks, the yellow bellied marmot, can be assumed to have moved north into the B.C. dry belt since the retreat of the last Ice Age glaciers, but has apparently been unable to cross to the west of the turbulent Fraser River. Favorable sites await colonization on the west banks of the Fraser and Chilcotin Rivers and along Seton and Anderson Lakes, and it must be a matter of time before these "groundhogs" cross man-made bridges and tick numbers increase.

With modern motor and air transport, the American dog tick of eastern North America is frequently carried into British Columbia and even the Yukon. This is an eastern species adapted to the humid summers of eastern North America and not normally found west of 105° longitude in Canada, though it is reported in restricted localities in California. There is a good chance that this tick may be able to establish itself in the more humid regions of British Columbia, for example on river flats. Since it is active much later in the season than the Rocky Mountain wood tick, it would be a considerable nuisance to campers and hikers.

Technology then is invading the countryside, and its effects on tick populations are of fascinating complexity, and may be of increasing practical importance. ■

Cover: Many studies on pesticides are being carried out by CDA, ranging from determining the fate of pesticides in soils, plants and animals to biological control. Here, in the Analytical Chemistry Research Service, Pesticide Residue Section, a scientist injects an egg sample extract, obtained by adding low levels of pesticides to chicken rations, into a gas chromatograph to identify pesticide residues (see article page 18).

Couverture: De nombreuses études sur les pesticides sont effectuées par le Ministère de l'Agriculture du Canada. Celles-ci couvrent les conséquences futures de ces pesticides dans le sol, sur les plantes, sur les animaux, jusqu'aux répercussions biologiques. Ici, un scientifique de la section de résidus des pesticides, du Service de recherches de chimie analytique, afin d'identifier les résidus de pesticides, injecte dans un chromatographe à gaz un extrait d'un œuf qui a été obtenu en ajoutant de faibles quantités de pesticides aux rations de la poule. (Voir l'article page 18).

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