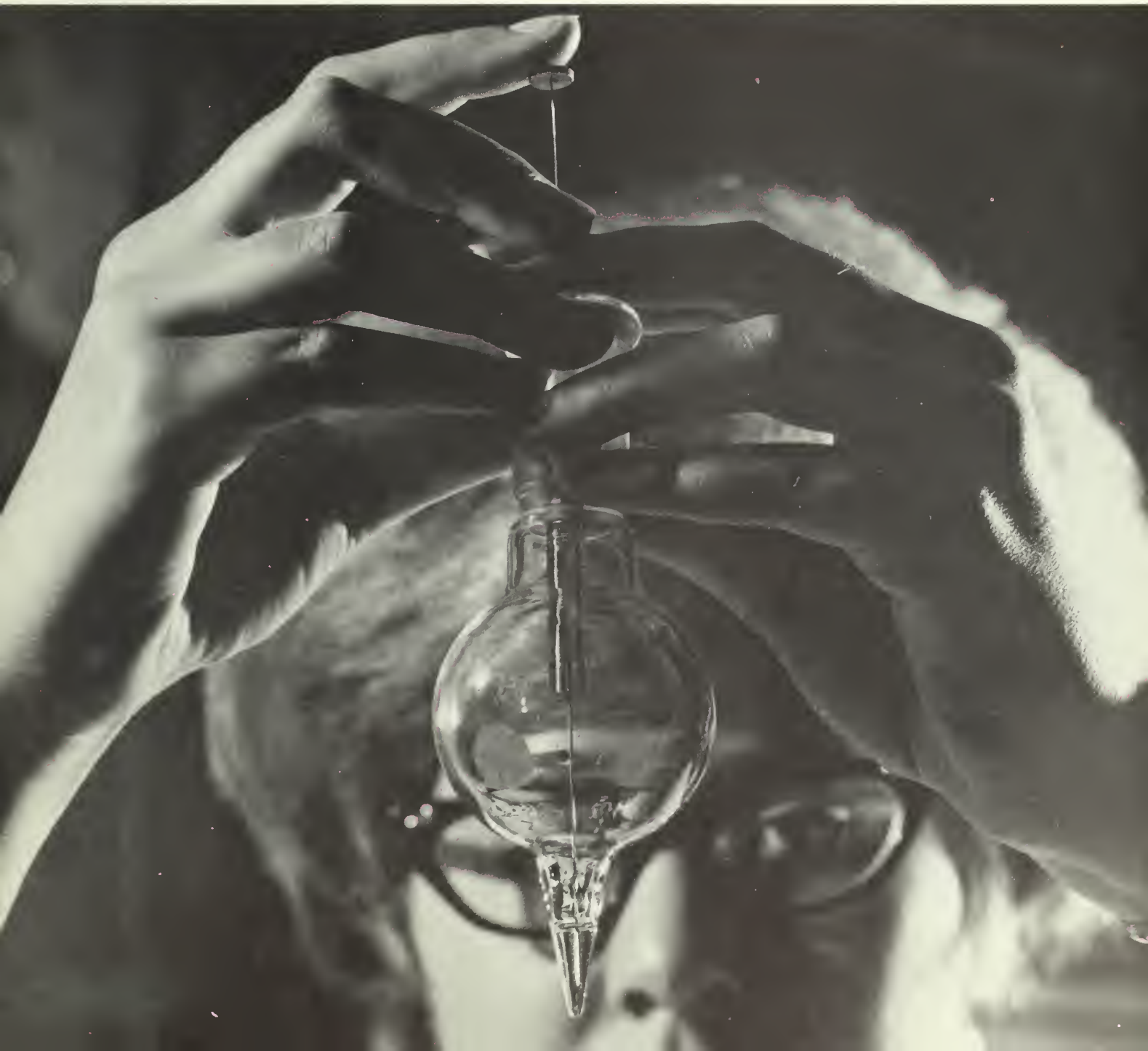
FALL 71
AUTOMNE 71

Preparation of rapeseed oil for chemical erucic acid analysis (article on page 3).

Préparation de l'huile de colza pour l'analyse chimique de l'acide érucique (voir article page 3).

CANADA AGRICULTURE



CANADA AGRICULTURE

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Contributors may submit articles in either English or French to the Secretary, Editorial Board, Information Division, Canada Department of Agriculture, Ottawa.

La revue trimestrielle *CANADA AGRICULTURE* renseigne les vulgarisateurs et représentants du négoce agricole sur les développements de la recherche et des autres services agricoles du gouvernement fédéral.

Les articles en anglais ou en français doivent être adressés au secrétaire du Comité de rédaction, Division de l'information, ministère de l'Agriculture du Canada, Ottawa.

THE RISE OF RAPESEED IN CANADA

SCOTT HATFIELD

L'augmentation de la production et des exportations de colza a été spectaculaire au cours des dernières années. Le colza est une solution de rechange pour l'économie des Prairies qui cherche la stabilité par la diversification.

Canada is the world's largest exporter of rapeseed and in 1970 was, for the first time, the largest producer of this oilseed crop.

Export sales have shot upward in the last three years. In the crop year 1968-69 some 14 million bushels found markets outside Canada, in 1969-70 some 22 million bushels were sold overseas and in 1971 export sales are estimated at over 45 million bushels for the crop year 1970-71, ending July 31, 1971.

In the past, India and Mainland China have produced the most rapeseed Combined, these two countries have produced about one-half of the world's production. They do not export any significant amounts as most of their rapeseed is consumed domestically. Other important producers of rapeseed are Poland, France, Pakistan, Sweden and East Germany. When all production figures are put to paper, in 1971 Canada may top the list again as the world's largest producer of rapeseed with an estimated production of over 80 million bushels, valued at an estimated $225 million.

Aside from export growth, the consumption of rapeseed oil in Canada has been described as being a little short of fantastic. In the past decade the increase has been 20-fold. The seed crushed in the crop year 1957-58 amounted to 11,614, short tons, oil extracted 4,159 tons and meal produced 7,034 tons. Five years later this had risen to 40,396 tons crushed, 15,440 tons oil extracted and 24,094 tons meal produced—the 1962-63 crop year. By the 1968-69 crop year, 173,346 tons of seed were crushed and 70,272 tons of oil were extracted with 98,207 tons of meal produced.

The author is an information officer with the CDA Information Division, Ottawa, Ont.

The rise in domestic consumption of rapeseed oil and meal has added $25 million to the foreign exchange balance. This is the amount it would cost Canadians annually to substitute imported products for the rapeseed oil and meal now being consumed domestically. Canada is in fact its own second best customer, up until recently consuming about one-third of what it produces.

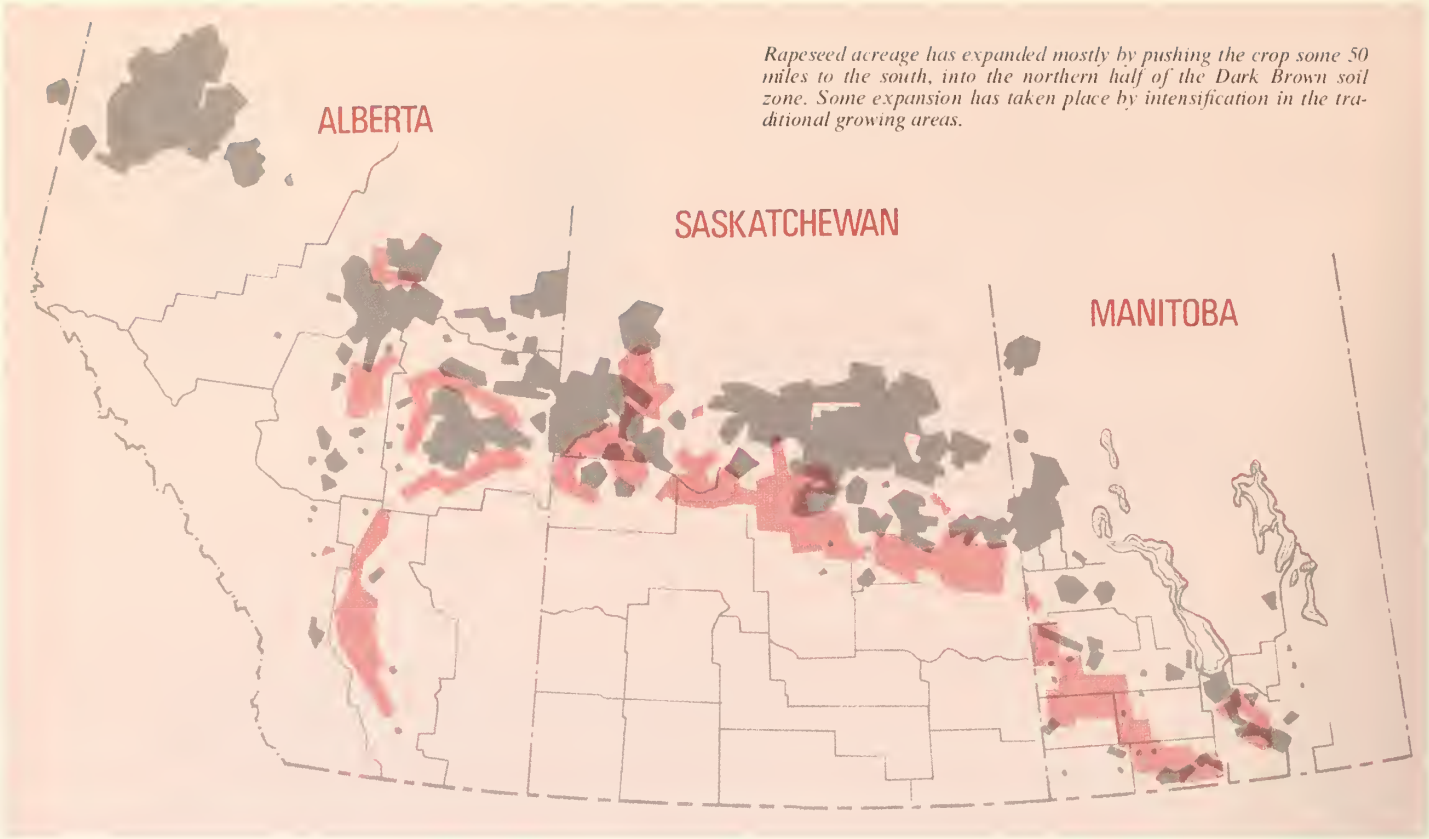
The rapid rise in export markets, production and consumption in Canada is reflected in expanded acreage in the three Prairie Provinces. Acreage is concentrated in the north-central part of Saskatchewan with 2,400,000 acres in 1971, in mid and northern Alberta with 2,200,000 and Manitoba with 500,000 acres this year. The total of over 5 million acres in 1971 compares with 4 million in 1970 and 2 million in 1969.

AN ALTERNATE CROP

Many of the 42,902 Western growers, registered with the Rapeseed Association of Canada, who sowed rape for the first time in 1970 as an alternate crop to wheat found their returns greater than expected. As a result, explains Dr. Keith Downey, in charge of oilseed breeding at the CDA Research Station in Saskatoon, both they and their neighbors expanded acreage further in 1971.

Dr. Downey, who has been closely associated with the development of rapeseed, says, "The established rapeseed producer in the northern prairies has known for some years that returns from rape are equal to or better than those from wheat, but that the crop requires more attention and has a higher risk."

Rape is unique to the Prairies in North America as



Rapeseed acreage has expanded mostly by pushing the crop some 50 miles to the south, into the northern half of the Dark Brown soil zone. Some expansion has taken place by intensification in the traditional growing areas.

it is a cool season crop requiring the cool night temperatures to recover from the extreme heat or dry weather. Recently the rapeseed growing areas have been pushed southward some 50 miles (see map).

"Now the traditional wheat grower of the Dark Brown and Brown soil zones on the southern edge of the rapeseed Park Belt is finding that with proper management he can also expect good returns, giving him an alternate crop to wheat, barley and oats," explains Dr. Downey.

Rapeseed fits into the rotation with the cereal crops with wheat generally following rape. For the Western producer it is also a crop that can be handled with the standard cereal implements and does not require special outlays for machinery and equipment.

While the growth of rapeseed acreage has been dramatic in recent years, it has also been pointed out that the requirements for crop rotation will impose some agronomic restrictions on total acreage that can be developed. Rape is never seeded on rape or mustard stubble because of the increase in crop losses that would occur from disease and insect pests. The rule of thumb recommended is that it is best not to seed rape or mustard on land that has grown these crops in the previous two years.

Mustard and rapeseed crops are not compatible. As rapeseed acreage has expanded southward into the drier mustard growing areas, practices which will prevent the mixing of two crops are being stressed. This is essential if purity of varieties is to be maintained.

The yield of rape after summerfallow is about 19 bushels an acre and lower when rape is sown on stubble. Rape responds well to fertilizers and yields of 25 to 30 bushels are common in the well adapted areas.

Other limitations to the crop have been in spring and fall frosts in the northernmost areas and drought in the southernmost areas. Of the two species of rape, *B. campestris*, commonly known as summer turnip (Polish type) is grown most extensively. It is earlier maturing than the other species *B. napus* (Argentine type), and so reduces the risk of frost damage.

Returns to rapeseed growers in 1971 should be higher than average. Stuart Carmichael of the CDA Economics Branch says, "The average farm price of rapeseed fluctuates considerably from year to year but only once since 1962-63 has the annual average price been less than $2 a bushel." The CDA economist says that Canadian rapeseed prices are influenced by the quantity produced domestically and by the price of competing vegetable oils on world markets. Cash prices quoted at Thunder Bay in mid-July, 1971, were running close to $3 a bushel while rapeseed December futures were nearly $2.90.

With 1971 estimates of 5.35 million acres and an average 18 bushel yield and a price of, say, $2.50 a bushel, the total cash returns to the thousands of farmers growing rapeseed in 1971 could amount to a record $225 million, on an 80 million bushel crop. According to DBS figures, this 1971 record would compare with total farm cash receipts for rapeseed of $97 million in 1970 and $51 million in 1969.

PLANT BREEDING ADVANCES

Even though rapeseed is popularly known as Canada's 'Cinderella' crop, it took more than the luck of Cinderella to make the rapeseed success story come true.

One of the more recent successes that helped make Cinderella's shoe fit was the response to demands for rapeseed oil that was essentially free of erucic acid and nutritionally more desirable. The Canada Department of Agriculture initiated a program whereby varieties producing such an oil would constitute a substantial proportion of the crop in future years.

The first variety producing low erucic acid oil was Oro, developed from the Argentine species. The rapeseed industry had several years' experience in growing small lots of this initial breeding stock to make sure that it was essentially free of erucic acid. By crossbreeding, Dr. Downey improved the original variety. As a result, the CDA has recently licensed the variety Zephyr which is 5% higher yielding and slightly earlier maturing than Oro, and has oil that is also free of erucic acid.

Another new strain, Span, has been licensed for sale in Canada. It was developed from the Polish species at the Research Station in Saskatoon as well. This zero erucic acid variety is as early maturing as the earliest standard Polish variety. Span was tested against standard varieties Echo, Polar and Arlo at 17 stations in Western Canada and was found to yield 92% of Echo and 93% of Polar. It was similar to Arlo in yield. The oil and protein is only 1% lower than Echo.

Span is being used for contact growing in 1971, as a result of a seed multiplication program in the Imperial Valley of California last winter which produced over one million pounds of seed. Production would have been higher had an unseasonal March frost not destroyed much of the crop. By 1972, a substantial changeover to new varieties of rapeseed low in erucic acid content is planned.

The changeover will not be a simple matter. Scientists believe that cross-pollination will make it difficult to maintain purity in the new varieties. But Canada will be the only major supplier to have low erucic acid rapeseed in the world.

With a breakthrough in development of erucic-acid-free rapeseed, other areas in rapeseed breeding are being concentrated upon now. Presently, a major objective in rapeseed improvement is the development of glucosinolate-free varieties which will produce a protein meal that can be fed in greater quantities to all classes of livestock. As S. H. Pawlowski of the CDA Research Station, Saskatoon, has reported in a companion article on page 8, the removal of glucosinolates through plant breeding would result in more extensive use of rapeseed meal in feeding of livestock, especially non-ruminants such as swine and poultry. Glucosinolates are sulphur compounds

(Top) Conducting chemical analysis of oil and meal from rapeseed.

(Middle) Seeding experimental plots of new varieties of rapeseed such as Span and Zephyr.

(Bottom) The same machinery is used for combining swathed rape as cereals but the combine settings must be adjusted especially for rape. Combine settings used for wheat, oats, and barley can result in high dockage and seed losses at both ends of the combine.

held responsible for metabolic upsets when improperly processed meal is fed to non-ruminant animals.

Future prospects in plant breeding are promising. Dr. Downey predicts: "Future developments in rapeseed breeding will bring further but more gradual changes to Canadian rapeseed. Seed with more desirable agronomic characteristics will be available within a very few years."

EXPANSION OF WORLD MARKETS

Even though export markets are picking up in Europe and other countries, Japan is still Canada's best customer. In 1969-70, Japan imported 13.6 million bushels out of the total exports of 22 million.

Canada also exports increasing, but smaller, amounts to Italy, Holland, West Germany and the United Kingdom.

For many years, Japan has used rapeseed meal as a fertilizer for tobacco and citrus fruits. A two-man scientific delegation to Japan in September, 1970, confirmed that this use pattern was continuing. CDA's Dr. Downey and Professor J. M. Bell of the University of Saskatchewan were the two scientists. They also observed the rapid increase in annual per capita protein food consumption—and a 31% increase in edible oils. Most of this increase in demand for vegetable oils has been met by oil extracted from soybeans and local rice bran. At the same time, rapeseed oil consumption has increased steadily but not as fast.

The decline in Japanese production of rapeseed, due mainly to shortage and high cost of labor, has therefore been offset by a corresponding increase in Canadian rapeseed imports.

A potential exists for further expansion of rapeseed exports to Japan; however, when contacted recently, Dr. Downey and Professor Bell said that their main objective in visiting Japan was to encourage Japanese research on the practical use of rapeseed meal as an additive in swine, poultry and cattle rations.

What did the scientists find out about Japanese research? Dr. Downey said that they found a marked change in the interest and attitude towards the use of rapeseed meal in animal feeds from their previous visit of 1968. He explained that this interest has been stimulated by these and other Canadian missions to Japan and return visits of Japanese delegations to Canada.

"The increased amount of good research on rapeseed meal now being conducted in Japan by government laboratories, universities and industry is encouraging. This development can, in part, be termed responsible for an estimated 10,000 metric tons of rapeseed meal being utilized in feeds in 1969 compared with only 4,000 metric tons used in 1968, and practically no feed meal usage in previous years," says Dr. Downey.

The CDA scientist says that there is general agreement between Canadian and Japanese research findings which augers well for further development.

"Recent information from Japan suggests that their requirements for oilseed meals has reached a

A field of rapē in full bloom.

The rapeseed plant in its fully podded stage.

plateau, but that the demand for oil continues to grow at a rapid rate. If this trend were to continue, crops high in oil content such as rape, sunflowers and peanuts would be in a more advantageous market position than crops such as soybeans, which have a low oil, high meal ratio," he says.

The interest in Japan in low erucic acid content varieties was high, as well as in the potential for rapeseed meal produced from varieties that are glucosinolate-free.

SCANNING THE HORIZON

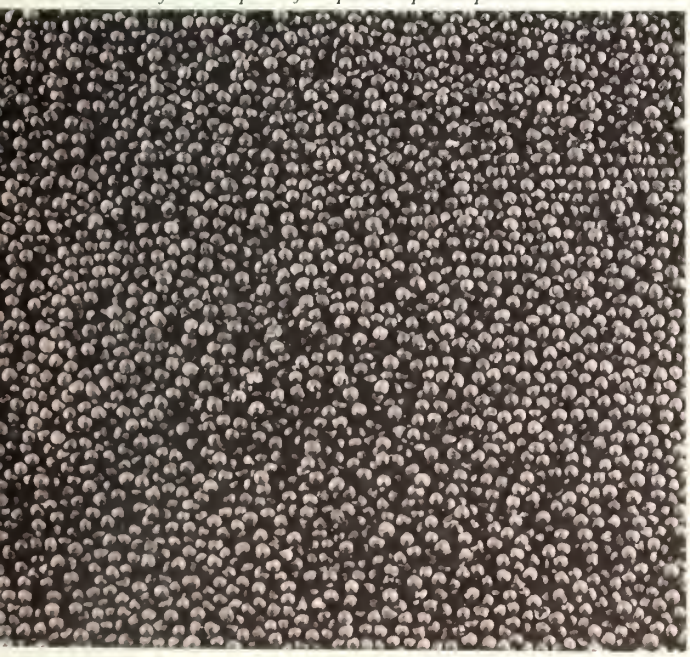
The Federal Task Force on Agriculture in its report to the Minister of Agriculture in December, 1969, reported that "... the future prospects for vegetable oil crops, particularly rapeseed, appear to be very bright in Canada." The need for Canada to be price competitive and to continue expansion of world markets for rapeseed is cited in the report, "Agriculture in the Seventies."

Limited storage facilities may hamper the movement and transportation of this crop to export markets—especially with record crops being produced.

Potential exists in domestic markets as well as export markets for rapeseed oil. "It is conceivable that a doubling of consumption could take place by replacing the vegetable oils presently being imported from other countries," says the Task Force report.

The use of rapeseed meal in livestock rations is expected to increase as improvements in the meal are made through plant breeding and better crushing and processing techniques. ■

The small pinhead size, round, dark colored seeds have been threshed from the pods of a ripened rapeseed plant.



RAPESEED ORIGIN AND USES

The word rape is still an interesting conversation opener and headline writers delight. Agronomically, the word means turnip and is derived from the Latin word 'rapum.'

Rape is unique to Canada on the North American continent as the crop is suited only to the northern climate found in Canada's three Prairie Provinces.

Canadian rapeseed, marketed at home and abroad, is really two different crop plants. The main crop, commonly known as turnip or Polish rape, belongs to the species Brassica campestris *and makes up about 80% of the total crop. The remaining 20% comes from Argentine type rape of the* Brassica napus *species.*

Polish rape varieties are earlier maturing (86 days), making them better suited to the northern growing areas, while the Argentine varieties are later maturing (104 days) making them more suited to the southern growing areas of the Prairies. The early maturing turnip rape also allows the crop to escape late summer drought in the south as well as allowing growers to spread out their sowing and harvesting schedules and to fight wild oats.

The seed from the rapeseed crop contains about 42 to 44% high quality vegetable oil and a well balanced protein meal. The meal contains 37% protein and 60 to 70% TDN. Oil extraction plants in Canada and throughout the world buy Canadian rapeseed for its edible oil and sell the meal that is left, after extraction, as a high quality protein feed supplement for livestock and poultry.

The prime use of rapeseed oil is in the manufacture of margarines and shortenings. It has gained a large share of the salad oil and cooking oil market, particularly in Western Canada. About 90% of the crude rapeseed oil produced in Canada is extracted in the West.

Rapeseed has a wide range of uses dating back to its early uses as a source of illumination and as a lubricant for steam engines. During World War II it was widely used as a marine oil lubricant. Its industrial uses include use in the cold rolling of steel where it lubricates between the steel and press surfaces and is used in the bearings. Among other things, rapeseed oil is fractionated to remove particular fatty acids, such as erutic acid, and is then used as a coating for plastic sheeting and even in the manufacture of nylon.

RAPESEED IMPROVEMENT OBJECTIVE

S. H. PAWLOWSKI

L'objectif fondamental de l'amélioration du colza est la création de variétés exemptes de glucosinolates, qui donneraient un tourteau riche en protéine pouvant servir à l'alimentation de l'ensemble du bétail, ainsi qu'une huile à faible teneur en acide érucique.

Rapeseed has recently become Canada's most important edible oilseed crop. It is evident that the expanding production of this crop must be accompanied by an equal increase in our markets in order to avoid a surplus situation. This requires the combined effort of various groups to improve our competitive position and to develop and promote more extensive uses of rapeseed and rapeseed products in both our domestic and export markets.

The oilseed market is very competitive. Competition is not confined to other rapeseed-producing countries but also involves other sources of edible oil such as soybeans, sunflowers, groundnuts, cottonseed, and so on. Improvement in our competitive position can best be achieved by improving the quality of our rapeseed and efficiency of production. Major improvements in both quality and efficiency of production depend quite heavily upon our research effort, especially in the field of plant breeding.

One of the plant breeding objectives at the Research Station, Saskatoon, is to develop rapeseed varieties that are free of glucosinolates. The hydrolysis products of these glucosinolates can upset certain metabolic processes when fed to nonruminant animals. Removal of these compounds through plant breeding would result in more extensive use of rapeseed meal in feeding livestock, especially swine and poultry. It would also be more suitable for replacing soybean meal for other uses as well.

Glucosinolate-free rapeseed varieties would have a major effect on some of our export markets, such as Japan, where rapeseed meal is presently used for fertilizer rather than as feed for livestock. Once glucosinolate-free seed is made available, the use of rapeseed meal as a livestock feed is expected to expand dramatically. Such new varieties are likely to be available within the next few years in the later-maturing *Brassica napus* species. More time will be required to develop glucosinolate-free varieties in the earlier-maturing *B. campestris* species.

Reduction in the fiber content of rapeseed meal would make it more suitable for higher energy rations generally required in the production of broilers. Recent research at Saskatoon in cooperation with the Prairie Regional Laboratory, National Research Council, has shown that a breeding program which would incorporate a yellow seed coat into our present varieties would give us a very significant improvement, not only in lowering the fibre content, but would also increase the protein and oil content rapeseed. It is anticipated that future rapeseed varieties will therefore eventually be yellow-seeded instead of the present dark brown.

The author is a crop specialist at the CDA Research Station, Saskatoon, Sask.

Advances through plant breeding have already illustrated that varieties can be developed that produce oils differing in chemical composition. Development of the erucic acid-free varieties Oro, Zephyr and Span is only one example of the types of oil that can be developed to meet the requirements of our present and future markets. Although varieties with oils having various fatty acid ratios are possible, one of the present objectives is to reduce or eliminate the linolenic acid content of rapeseed oil. Removal or reduction in the level of linolenic acid would reduce processing costs, increase the shelf life of the oil and place it in a premium class. The end result of such a change would increase the demand for rapeseed oil which in turn would benefit both growers and processors.

Green seed, which in turn results in green oil, is at times a problem in rapeseed, especially when frost damage occurs. A genetic source of rapeseed has been found that does not contain any chlorophyll during its development. Incorporation of this feature into a suitable variety would eliminate the quality problems associated with green seed.

In rapeseed improvement we have always considered the requirements of the producer and we will continue to do so. Although all the previously mentioned objectives on quality help to market the crop, agronomic improvements which will help lower the cost of production and reduce the risks involved from climatic hazards are also considered in the development of new varieties. In addition to the usual features of higher seed yield and oil content, such characteristics as drought tolerance, shattering and disease resistance can be incorporated by crossing present rapeseed varieties with other species.

We have subjected new varieties to extensive tests for both agronomic and chemical properties and have evaluated varieties with new characteristics through extensive feeding trials where comparisons were made with soybean meal. These trials have been done in cooperation with other Research Stations, the Prairie Regional Laboratory of N.R.C., and Animal Science Department, University of Saskatchewan, at Saskatoon, which helped to determine the nutritional value of our end product and assisted both plant breeders and crushers in producing better protein meals. Changes in fatty acid composition also involve extensive evaluation tests at both the crushing and manufacturing levels. These are just some of the tests that must be carried out if an improvement program is to be successful.

The breeding objectives mentioned previously are only a few of the possible changes that can be made to improve our competitive position. However, these are the areas in which we feel research will give us the most significant advances. Most of the techniques for reaching the above objectives have been developed. It is now essentially a matter of manpower and resources that will determine how soon the objectives will be accomplished. Research in competitive crops such as soybeans and sunflowers is being carried out on a large scale throughout the world; hence we must work hard to even maintain our present position. It is evident that rapeseed research must continue to increase if we hope to successfully expand and market our rapeseed products. ■

A. D. L. GORRILL

La croissance des génisses Holstein n'a pas varié, quelque soit le régime, lait entier ou aliment d'allaitement donné *une* ou *deux* fois par jour. Les veaux peuvent être sevrés d'un coup dès l'âge de 15 jours sans affecter le taux de croissance, si on leur donne un quart de livre de ration de début-croissance. Dans de bonnes conditions de gestion un seul service par jour d'aliment d'allaitement et un sevrage hâtif réglé sur la consommation de ration de début devrait être suffisant si l'on se sert de préparations commerciales.

REARING DAIRY CALVES IMPROVED . . .

EARLY WEANING AND ONCE-A-DAY FEEDING REDUCES LABOR AND COSTS

Feeding Holstein heifer calves once instead of the customary twice-a-day and early weaning can mean savings in labor and feed costs for dairy farmers.

At the CDA Research Station, Fredericton, we found that when calves had a single feeding of milk or milk replacer there was no difference in growth rate when compared to feeding twice-a-day. On either the single or twice-a-day feeding, heifers could be weaned as early as 15 days of age, if over one pound of starter-grower was eaten per day.

Our research with calves involved three main objectives. First, we wished to reduce the labor involved in rearing replacement heifer calves. This could be achieved in part by feeding milk or milk replacer *once* instead of *twice* a day. Second, we wished to reduce feed costs for rearing calves. Whole milk or milk replacer are relatively high priced feeds for calves, compared with grain and supplements. Therefore, feed costs could be reduced by *early* weaning. Third, we wished to test the practicality of weaning calves according to starter-grower intake.

Thirty-four Holstein heifer calves were started on test when three to five days old. Eighteen calves were fed either whole milk or milk replacer twice a day in two equal feedings. Sixteen were fed the same amount of milk or replacer at one feeding per day. The once-a-day feeding schedule is shown in Table 1. All calves were given the same amount of milk or replacer, regardless of birth weight. The total daily amount of water added to the milk replacer was greater when the calves were fed twice a day.

Dr. Gorrill is a specialist in calf and lamb nutrition at the C.D.A. Research Station, Fredericton, N.B.

The milk replacer powder contained 21% protein and 10% homogenized lard.

Each calf was given 1.1 lb (0.5 kg) of a commercial calf starter-grower (21% protein) when started on test. When this was eaten, the same amount was added again. We weaned the calves when 1.1 lb of starter-grower was eaten on three consecutive days. However, all calves were weaned at five weeks of age, even if 1.1 lb of starter-grower was not being eaten in a day. After weaning a maximum of 4.4 lb/day of starter-grower was offered to each calf. From 15 to 26 weeks of age the same amount of a grower mixture (17% protein) was fed.

Water and medium quality timothy hay were given free choice to the calves at all times.

We observed no differences in the growth rates of calves fed milk or milk replacer once, compared with those fed twice a day. Average daily gains of all calves to weaning, 105 and 180 days of age were 0.8, 1.4 and 1.5 lb, respectively. Calves fed the liquid diets only once a day had somewhat more diarrhea, but this did not adversely affect body weight gains.

The average weaning age for all 34 calves was 25 days. However, we weaned some calves as early as 15 days old, since 1.1 lb of starter-grower had been eaten for three consecutive days. This very early weaning did not reduce growth rates to six months of age.

Calves which we weaned at 15 days of age were fed a total of only six lb of milk replacer powder, or 65 lb of whole milk. A total of 37 lb milk replacer powder, or 220 lb of whole milk were fed to calves weaned when 5 weeks old.

Feed costs for calves weaned at about 25 days of age and fed 20 lb of milk replacer powder were about 17¢ for each pound of body weight gain to six months of age.

From the results of our calf research to date we conclude the following:

1. Milk or milk replacer can be fed *once* instead of *twice* a day without influencing body weight gains. However, the calves should be observed at least twice a day for signs of diarrhea or other disease. The calves must have a supply of fresh, clean water at all times.
2. Calves can be abruptly weaned as early as 15 days of age, if over one pound of starter-grower is being eaten per day. Under most circumstances this should not adversely affect the growth of heifers, if 4 to 6 lb of starter-grower are fed daily to about 15 weeks of age.
3. Weaning calves according to starter intake could be used in commercial herds if the calves are kept in individual stalls or pens until about five weeks old. Such a system also prevents calves from sucking each other.
4. Under good management conditions, replacement heifer calves should be weaned by five weeks of age. Feed costs will then be reduced without sacrificing calf performance. ■

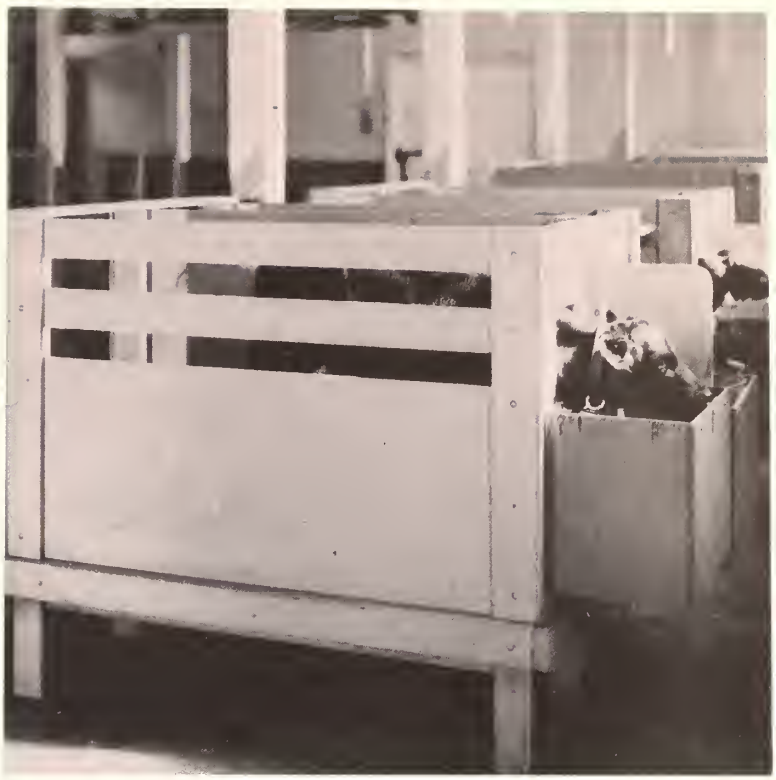


Fig. 1. Elevated stall for heifer calves to 5 weeks of age.

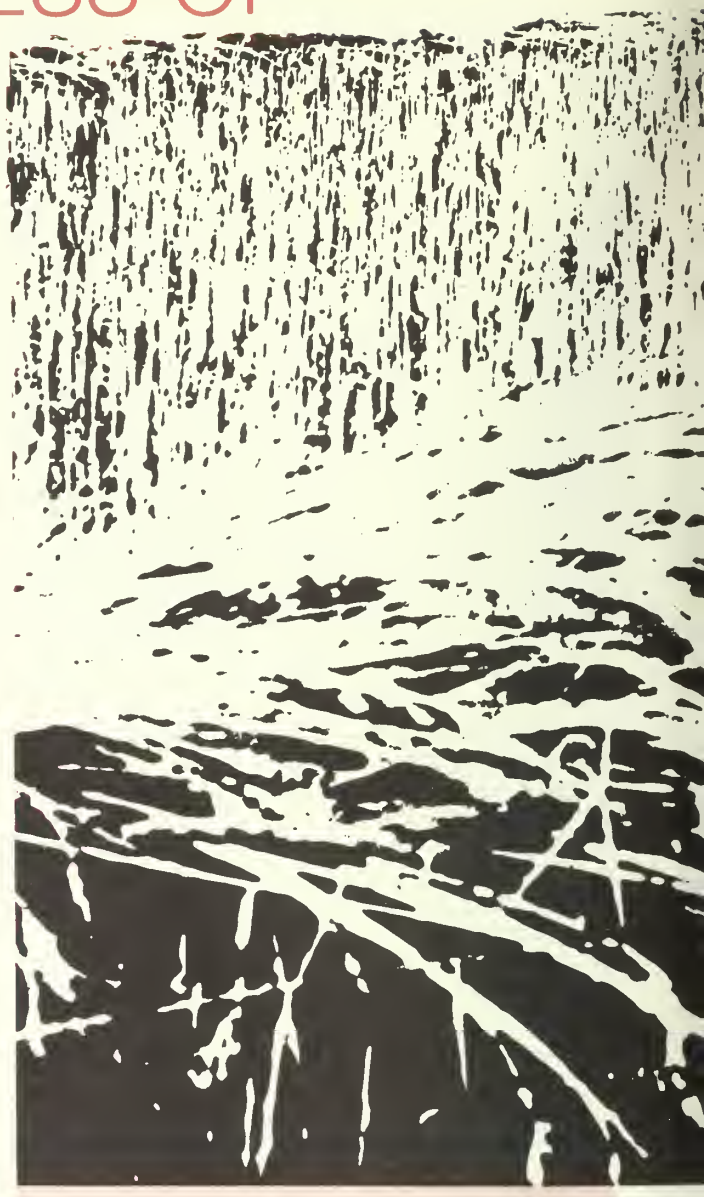
TABLE 1. ONCE-A-DAY FEEDING SCHEDULE

Days on test	Ration			
		Milk replacer		
	Milk (lb)	Milk (lb)	Replacer (lb)	Water (lb)
1—3	2.6 (twice a day)	2.6 (twice a day)	—	—
4—6	5.3	2.6	0.44	0.9
7—13	5.3	—	0.88	3.1
14—weaning	7.7	—	1.32	4.0

FROST HARDINESS OF FORAGE CROPS AND CEREALS

C. WILLEMOT, R. PAQUIN, H. J. HOPE and G. GRENIER

Les scientifiques de la Station de recherches de Ste-Foy étudient les réactions des plantes à basse température et les mécanismes qui leurs permettent de survivre. Le but est de réduire les problèmes des gelées sur les cultures.



Who among us has not noticed on a meadow or lawn, in an area where there was little or no snow the previous winter, dead brown foliage which contrasts with lush green surroundings and is undoubtedly an indication of frost damage?

Statistics tell us that the average annual losses in the United States due to frost, from 1963 to 1968 were about 2.9 million acres of forage and cereal crops with a crop value of 68 million dollars.

In Quebec, where the winter is more severe, the losses are proportionately higher. In several regions of Quebec, the losses due to frost can be as high as 40%, or higher in certain years. If by appropriate cultural methods and the creation of varieties with greater frost resistance we could reduce losses to 10% it would assure, as Fig. 1 shows, the survival of our pastures, increase the yield of several plant species and also increase the farmer's income.

To better understand the phenomenon of frost resistance it is necessary to study plant behavior at low temperatures and the mechanisms which permit a plant to survive. It is to this difficult job that we, a group of researchers at the St-Foy Research Station, have addressed ourselves in the hope of finding solutions to the numerous problems associated with the reduction of frost damage to agricultural crops.

Field grown alfalfa tested in midsummer shows relatively weak frost resistance. However, during autumn the same plants acquire increased frost resistance, they harden, and can survive more and more severe frosts. This phenomenon is reversible and in the spring plants rapidly lose their frost resistance.

The authors specialize in plant physiology and biochemistry at the CDA Research Station, St. Foy, Que.

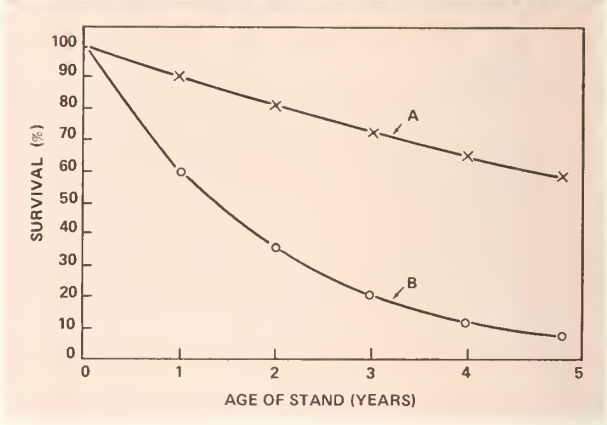


Fig. 1. Theoretical figure showing the effects of frost on two pastures where the annual losses are 10 (A) and 40 (B) percent.

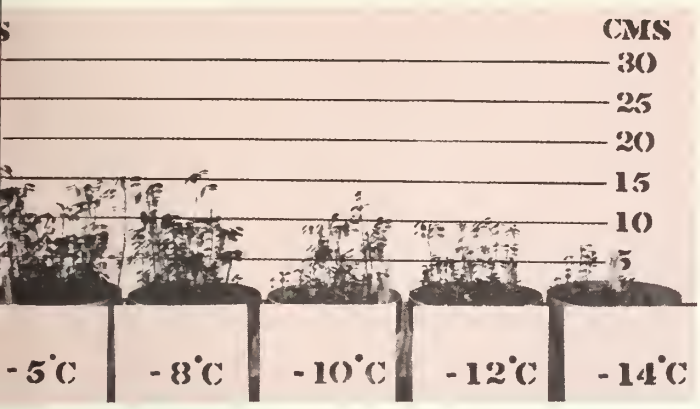


Fig. 2. Survival test of Rambler alfalfa. Plants were hardened 3 weeks, subjected to low temperatures then allowed to recuperate 14 days.

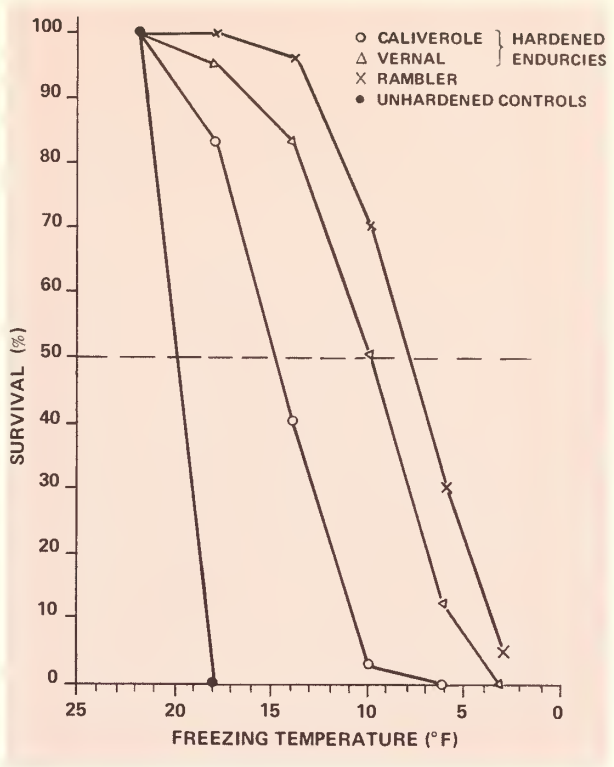


Fig. 3. Survival curves for Caliverde (o), Vernal (Δ) and Rambler (x) alfalfa hardened three weeks and for all three varieties not hardened (•). The dashed line indicates the resistance threshold.

Plants can be hardened artificially in growth cabinets under controlled conditions of light, temperature and humidity. Experiments conducted at the St. Foy Research Station on Rambler alfalfa have shown that plants grown under long day conditions (16 hours) at 70°F and 55°F at night are killed at 18°F (−8°C). The same variety grown for 3 weeks under short day conditions (8 hours) and a constant temperature of 35°F was not killed (Fig. 2) by a temperature of 10°F (−12°C). After a further three weeks growth under short day conditions the plants were not killed by a temperature of 7°F.

All alfalfa varieties do not have the same hardening capacity. Following three weeks growth at 35°F with an 8 hour day a frost sensitive variety, Caliverde, has a 50 percent survival at 15°F. The temperature at which 50% of the plants survive is called the resistance threshold. Under the same hardening and freezing conditions, the resistance threshold of Vernal is 10°F and that of Rambler is 8°F (Fig. 3).

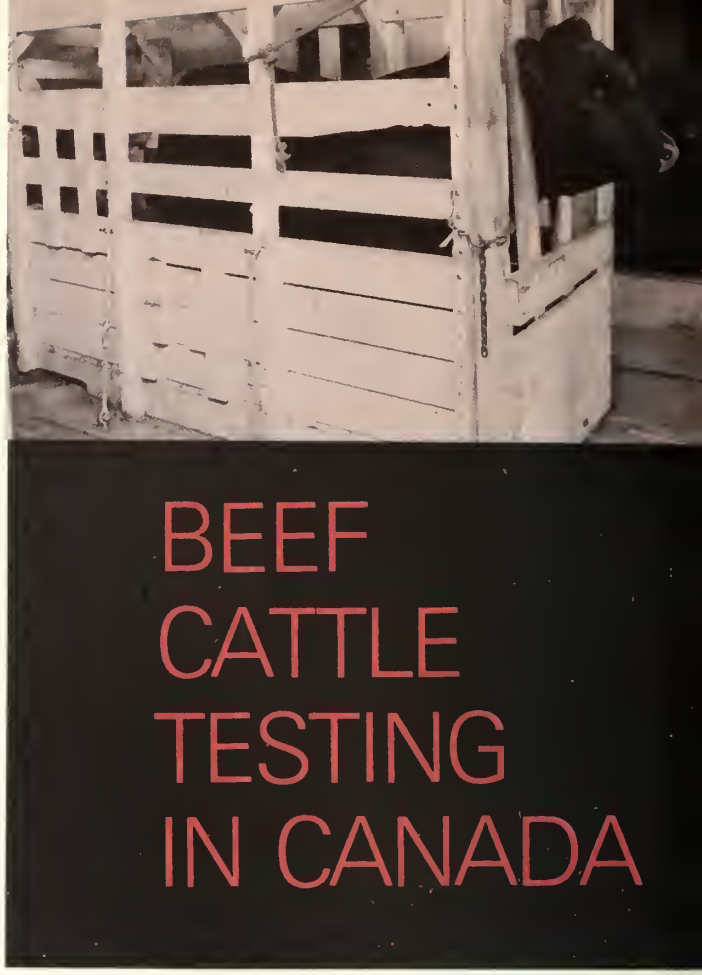
We have observed changes in fatty acids which occur during the hardening process to show how plants become frost hardy. Since membranes, which consist mainly of fatty acids and proteins, play an important role in cell permeability, it is quite likely that these changes in fatty acids reflect changes in membrane properties and form part of the answer to the riddle of frost hardiness. We also studied cell protein, in particular that of the membranes. Recent work indicates that changes in protein accompany increases in frost hardiness. Finally, one of us is interested in the fate of amino acids and sugars during hardening. It is well known that there is an accumulation of certain sugars and amino acids in plants submitted to low temperatures. What is the role of these compounds during hardening? There are so many questions which we must answer if we want to achieve rapid progress in these studies.

The conditions which favor hardening are also those which arrest plant growth. In several laboratories, changes favorable to hardening have been achieved with growth retardants such as Cycocel, Alar, and B9. Would it be possible to increase hardening and to improve the frost resistance of our forage crops and cereals by using some of these compounds? Promising results have been obtained, at our station, on the hardening of young alfalfa plants treated with Cycocel (Chlorocholine chloride or CCC). Some field work is in progress along these lines with the collaboration of a group from the La Pocatière Research Station.

For many biological phenomena, the answer to a question often gives rise to ten other questions. Nevertheless it is the answers to these questions which will permit us to better understand the resistance of plants to frost, to assist the geneticists in their breeding program to increase this resistance and to extend northward the range of our cultivated crops. Through a breeding program, the geneticists have succeeded in creating varieties which mature more rapidly in cold climates. By combining our efforts with theirs, it might be possible to increase the chances of survival of our forage plants and cereals, and thus to make a substantial contribution to agriculture. It is a challenge to be met. ■

D. B. YOUNG

Le ministère de l'Agriculture du Canada se préoccupe de l'amélioration génétique du cheptel canadien de reproduction. Des programmes d'accouplement, de vérification et de sélection sont activement développés.



BEEF CATTLE TESTING IN CANADA

Beef testing starts with the home herd test. It is basic to any national R.O.P. (record of performance) program, as it provides the breeder with information from which he can make selections to improve his herd.

For the breeder who has completed a number of annual tests on the herd test and has applied selection on the basis of the test results comes the opportunity to step out and compare the performance of his individual bulls, sire progeny groups of bulls, or sire progeny groups of steers with contempories from other herds. This is done through the Canadian Beef Cattle Test Station Policy, which is a federal-provincial program.

There has been a distinct increase in the number of herds testing at home and at stations under the federal-provincial R.O.P. Program, in the last few years.

In 1960, there were 140 herds testing 2,400 calves on the R.O.P. for Beef Cattle Program. In 1970, there were 1,066 herds testing 36,450 calves. We are projecting an estimated 1,300 herds with 45,000 calves for 1971.

There was an equivalent increase in the numbers tested in 1970, under the Ontario Program, and in this connection, I would like to quote the following from their "Summary of Results": "The sharp increase in the number of bulls tested is undoubtedly due to new show ring requirements, as well as an increased interest in performance testing per se". Whatever the reason, the increase in the number of beef bulls available which have objective measures of performance is welcome. On the other hand, the number of bulls tested still represents only a fraction of those present in Ontario and the industry requires greater use of performance testing if it is to improve the growth rate of cattle.

STATION TESTING PROGRAM

The Station Testing Program is also expanding rapidly. In 1965, 437 bulls being tested individually and in sire progeny groups were station tested in 7 stations, in 1968-69, 666 bulls were tested in 11 stations, and this year, there will be approximately 1,300 bulls completing tests in 14 stations across Canada. These include 1 station in British Columbia, 3 in Alberta, 2 in Saskatchewan, 1 in Manitoba, 4 in Ontario, 2 in Quebec and 1 in the Maritimes.

In addition to the station testing of bulls there has been activity in testing sire progeny groups of steers from birth to slaughter, as a means of evaluating the productive worth of bulls in A.I. Units and bulls owned privately. Last year there were 26 sire progeny groups of steers tested at Tranquille, Bassano and Saskatoon.

The testing of progeny groups of steers by A.I. Unit sires is an indication of the growing contribution being made to the beef industry by the A.I. industry. Perhaps one might say that the Angus, Hereford and Shorthorn breeds have made a contribution to A.I. by adopting a set of regulations for their breeds that permits the registration of A.I. sired calves.

One quarter of the cows bred artificially in 1969 were bred to beef and dual purpose bulls. Some 90,000 beef calves were registered in the year—only 4,500 or 2% of these were A.I. calves. With the advent of the 'exotic' breeds, which can only have much

The author is Chief, Production Section, Livestock Div., CDA Production and Marketing Branch, Ottawa, Ont. This article is based on a paper given recently at the Beef Cattle Test Station Field Day, Tranquille, B.C.

(Above left) A bull on test.

(Above) Good calves result when good cows are bred by sires of tested quality.

influence through A.I. at this stage, and with the new A.I. regulations for the 'traditional' breeds, one would expect a marked increase in A.I. in beef herds in the years ahead.

An increase in the use of beef bulls in the A.I. units, means an increase in the use of performance and progeny tested bulls, for our A.I. units across Canada have made a real effort to get a complete test on the sires in use. Perhaps the Canadian Charolais Association's 'Conception to Consumer' program is the most complete progeny test in existence anywhere. There can be no doubt that this program represents a real challenge to the other cattle breed associations. This kind of breed rivalry will be of immense benefit to the cattle industry. The aim of this program is to attempt to establish how the run-of-the-mill calf by a particular sire will perform relative to his contemporaries. There are five essentials in meeting this aim:

(1) Complete supervision from semen delivery to carcass cutout.
(2) Use of commercial cow herds reflecting diversified management, and a broad genetic base.
(3) Random mating of the test sires in the various cow herds.
(4) Testing of all progeny (involving no pre-selection).
(5) Detailed analysis of each phase of the test.

There are new beef breeds, new beef breed associations. Crossbreeding of beef breeds and beef and dairy breeds is becoming commonplace. The introduction of the Simmentals, Limousins, Maine-Anjous, and Chianinas this year has created considerable excitement. There was no back-log of graded up animals for these new breeds to improve, so every beef and dairy cow available suddenly has become a forebearer of these breeds through grading up programs. The trend in these breeds will most likely be to more stringent performance requirements as their base of graded up animals develops. This will be reflected in A.I. regulations, and progeny testing for A.I. sires will doubtlessly become a requirement.

With expanded use of beef sires in A.I. we will eventually reach a position where we will be able to evaluate sires through a progeny contemporary comparison system such as we presently employ for dairy sire evaluation. Now that we have the exotic breeds and the tremendous promotional and speculative activity behind them, it becomes very important that our performance testing programs evaluate them under our conditions as straight breeds and as crossing breeds. We are presently designing a system of breed coding so that we can identify by machine tabulation the multiplicity of breed combinations being recorded in our herds. The combinations involving 29 breeds is staggering and must be controlled as quickly as possible using performance data as a basis for sound selection.

The Beef Improvement Federation in the United States has been showing some concern in respect to the selection of sire progeny groups. In other words, too much selection is being practised in picking the calves going into the test progeny group. The Federation supports the following:

(1) *Ideal*—selection of all bull calves born;

(2) *Next Best*—random selection of all bull calves "on paper".

There has been a very important development in getting on with the progeny testing of A.I. Sires. Recently established is an organization known as Canadian Beef Sires which will be contracting producers to make their cow herds and calf crops available to a sire progeny test designed along the same lines as the Conception to Consumer program. Some 45 herds have been contracted to this program.

On the front of new developments is sex selection or sex separation. It may be closer than we had anticipated. Developments are to the point where by 1972 A.I. lab technicians will be trained in the use of an intricate machine now perfected to do the sex separation job before the semen is frozen. Scientists are speaking in terms of guaranteeing semen with a 70-30 or even 80-20 sex ratio. What an influence this can have on beef production—whether the need is for replacement heifers or feeder steer calves by proven progeny tested sire.

Our objective for beef cattle R.O.P. might be stated in a nutshell: "To improve the genetic merit of Canadian beef breeding stock through the development and implementation of breeding-testing-selection programs which have the capacity of achieving genetic progress over time, adequate to meet the needs for improvement of commercial beef herds for competitive production." We, in the CDA Livestock Division, will continue to work towards this objective. ■

ECHOES
FROM THE FIELD AND LAB

Fig. 1. Leaves of *Nicotiana debneyi* Domin. removed from stems just above the inoculated leaves. L. to R., respectively: Healthy control, PVS (21 days after inoculation), PVX (8 days), and PVY (8 days).

DETECTIVES UNCOVER NEW CLUES At CDA Research Station, Fredericton, N.B., scientists have found a plant, whose scientific names is *Nicotiana debneyi,* that is an effective indicator for potato viruses S, X and Y. It allows a single reliable test to be made for three of the most common viruses.

These viruses can be transmitted mechanically, and rubbing freshly-cut slices of tuber tissue on *N.debneyi* leaves serves as an excellent means of innoculation. This eliminates the need to grow eye-index plants for testing—ideal for a virus-free seed program where greenhouse space is at a premium—provided that the leaf roll virus (PLRV) is not a problem. More extensive tests can be applied to smaller back-up stocks of virus-free seed

Diagnosis of potato virus S (PVS) using this plant was found on several occasions to be more reliable than by more complicated serological tests.—J. P. MACKINNON AND R. H. BAGNALL, FREDERICTON, N.B.

BETTER SOIL IMAGE Soil surveyors rely more and more on aerial photographs for information on the less accessible regions in the mapping of soil resources. The relative accuracy of photographs is important, of course, and at the CDA Research Station, Vancouver, the usefulness of four types of aerial photographic film was investigated The area chosen was near Port Renfrew on the southwest coast of Vancouver Island. Here the topography is rugged, ranging from a few feet to over 3,000 feet above sea level. Photographs were taken at 18,000 feet and the scale was approximately 1:36,000. The four types of Kodak film exposed were black and white Plus X Aero Type 5401, Infrared Aero Type 5424, Ektachrome Aero Type 8442 and Ektachrome Infrared Type 8443.

The most significant results were the high accuracies obtained with the infrared, color, and color infrared compared to the black and white film. This is found in the total accuracy and in the separate mountain and valley groups. Although the best film overall was the Ektachrome color (80% accuracy compared with 72% for black and white), it was inferior to the two infrared films for the valley units. The reason for this is probably that the valley units often had contrasting surface moisture levels in the outwash and deltaic sands, marine clays and alluvial silts. These contrasts showed up more clearly on the infrared film.—. K. W. G. VALENTINE, T. M. LORD, W. WATT, A. L. BEDAWAY, CDA RESEARCH STATION, VANCOUVER, B.C.

PESTICIDE CONCENTRATION IN STREAMS The erosion of agricultural soils into creeks and, from there, into lake systems is a possible source of insecticide contamination. Work has been carried out on this subject at the CDA Research Institute, London, Ont., since 1964. Studies have been made of the accumulation of residues of the organochlorine insecticides in farm soils in southwestern Ontario, the movement of insecticides into crops from the most contaminated soils, and profiles to check on possible leaching into ground water. Last year, these studies were extended and the insecticide content of two water systems draining areas containing contaminated farms was examined.

Big Creek, Norfolk County, Ont., drains 280 square miles of, chiefly, tobacco farms. The use of DDT in Canada has been restricted but this insecticide is still used to control cutworms on tobacco and some vegetable crops. DDT and dieldrin were found in the water, bottom mud and fish of the creek.

The concentrations of insecticide residues found in the water were extremely small and were below maximum reasonable stream allowances. Residues in the mud were from 1570 to about 13,000 times and residues in the fish 50,000 to 80,000 times the concentration in the water. This shows the importance of magnification as the insecticides move up through the biological chain.

Movement of total DDT compounds plus dieldrin into Lake Erie from this creek was calculated to average about 0.11 lb/week in April through October 1970.

The drainage system, near Erieau, Ont., drained about 1500 acres of muck land used for growing vegetables. Concentrations of insecticides were greater than those in Big Creek but still below maximum reasonable stream allowances. As water is pumped into the lake only when the ditch water level rises above a certain point, the insecticide transfer into Lake Erie from the drainage ditch was much smaller than from Big Creek.—. J. R. W. MILES AND C. R. HARRIS, LONDON, ONT.

ECHOS
DES LABOS ET D'AILLEURS

ENGINEERS AT WORK An experiment started at CDA Research Institute, London, Ont., is studying the effects of insecticides on the biomass of earthworms in the soil.

Earthworms play an important part in establishing and maintaining the structure and fertility of soil. Any chemical that disturbs them influences soil structure. Even if they survive the dosage applied, they may accumulate residues in their tissues and, as carriers, they then contaminate food chains.

Earthworms can be separated into two types, those which are small and active and live in the surface layers of soil, and those which rarely emerge from the burrows which help to aerate and drain the soil and live mainly in the deeper layers. They feed on the remains of plants, which they pull into their burrows from the surface.

Poor aeration and drainage of soil and slower decomposition of leaf litter may result when numbers of larger earthworms are decreased. Minerals and energy normally available to plants and other animals may be cycled less when the biomass of earthworms is lowered.

The experiment is studying the effects of nine insecticides on earthworms immediately after treatment of the soil and also the later recolonization of treated plots. Three weeks after treatment, it was found that three of the insecticides had very little effect, but three others drastically reduced numbers and biomass of earthworms.—. A. R. THOMPSON, LONDON, ONT.

AN INTRODUCTION TO BIRTH CONTROL As long as male codling moths function normally, in their natural environment, formal introductions to females are neither necessary nor desirable. Sterile males, on the other hand, need some assistance in meeting females if they are to accomplish their purpose. The method usually involves the release of large numbers of laboratory-reared insects that have been sterilized by gamma radiation. Matings between the sterile males and wild females result in sterile eggs. The wild population is consequently reduced, the rate of reduction being directly proportional to the ratio of sterile to fertile males.

At the CDA Research Station, Summerland, B.C., where sterile male codling moths are raised on an appreciable scale, ground methods of releasing them have been found effective but rather slow and expensive for treating large areas. Free release of moths from helicopter has proved satisfactory however.

Moths must be completely immobilized for accurate metering. They are therefore kept at 1 to 2°C in a refrigerator. The refrigerator containing boxes of sterile moths is strapped to the helicopter seat between the pilot and the technician who releases the moths. A vibratory feeder unit is used to meter the moths into a drop tube that extends below the helicopter cabin. The moth flow rate is controlled by a rheostat.

Flight paths are flagged 30 meters apart across the area to be treated. The helicopter flies about 65 kilometers per hour, about 10 meters above the tree tops. Moths are metered out continuously except when the helicopter turns at the ends of the panels. To determine the flow rate required to get uniform distribution of moths over the area, the technician divides the total weight of moths by the expected release time. He then checks a graph to determine what basic rheostat setting to use. The moths are then emptied into the hopper, one box at a time as required.

In assessing the efficiency of release methods, moths are marked with fluorescent pigments so they can be subsequently identified in the field. Female baited traps located in the drop area attract the males and allow for identification and counting.

It has been concluded that the equipment and procedures developed for free insect release from helicopter or tractor-mounted blower do not cause appreciable codling moth mortality or adversely affect the response of males to sexually-attractive female moths. The helicopter appears ideal for moth release operations in the Okanagan and Similkameen Valleys where orchards are small and power lines and buildings are frequently right amongst the trees. However, because fixed-wing aircraft are cheaper to operate than helicopters, their use should not be ruled out.—. A, D, McMECHAN, AGRICULTURAL ENGINEER, M. D. PROVERBS, ENTOMOLOGIST, CDA RESEARCH STATION, SUMMERLAND, B.C.

TELLING THE STORY OF AGRICULTURE At one time, most of those attending fairs and exhibitions were farmers seeking information on farming methods. But times have changed. More and more exhibition visitors have little, if any, involvement in farming.

"So we have an increasing requirement to tailor presentations to the growing non-agricultural audiences rather than the dwindling agricultural audience," F. E. Payne, Director, CDA Livestock Division, stated recently as he officially opened the Silver Anniversary of the Medicine Hat Exhibition and Stampede.

"The success of exhibitions in the future depends on the promotion of exhibits and activities which will lend themselves to participation by our visitors, or at least relate to their personal interests and experiences.

"Every one has an interest in agriculture because agriculture is food. Most people have an interest in how food is produced, processed, packaged and distributed. Our exhibitions must communicate—must tell a story of interest to our patrons.

"Our fairs are where the city and the country meet. Here at Medicine Hat, you are the showcase for the most diversified agricultural area in the West. With the tremendous strides resulting from research, development and innovation, there is always a new story to tell. From what I have heard of the work of your association and what I have seen I know you will continue to devise new and better ways of telling the agricultural story with emphasis on the future," Mr. Payne observed.

PIPELINE FOR NEMATODES Tobacco farmers often make use of steam or fumigants to control insects, diseases and weeds in the seedbed Annual treatment of greenhouse soils normally keeps these pests, including the nematode, in check.

But one tobacco greenhouse operator at Langton, Ont., has a history of ineffective treatment. In spite of annual steaming, tobacco plants in small localized areas of the seedbed were stunted in growth. It couldn't be nematodes, the operator reasoned, because they couldn't survive the treatment. Nitrogen leaching was considered as a possible cause, particularly since the stunted areas were near the drip-spots below sprinklers of an automatic watering device. However, only one portion of the seedbed was affected, although the automatic system watered the whole greenhouse.

Finally, tobacco seedlings were submitted to the Ontario Nematode Diagnostic and Advisory Service at Vineland Station, Ont. Sure enough, examination of soil samples and galled roots confirmed the presence of northern root-knot nematodes.

But how had the nematodes persisted in a seedbed that was fallow about 10 months of the year and steamed before each tobacco seeding?

Someone then spotted a 20-year-old rhubarb plant growing outside, by the greenhouse wall. It was found the rhubarb roots extended under the footings of the greenhouse to the seedbed inside. They were too deep to be affected by the steam sterilization process. Root-knot nematodes had survived in galls located in the areas where tobacco seedlings were most severely stunted.

The lesson is that weed hosts of nematodes should be considered as potential sources for re-infestation. Common biennial farm weeds with deep roots or tap roots, which are very good hosts of root-knot nematodes are: bull thistle, burdock, Canada thistle, chicory, common dandelion, curled dock, lamb's quarters, perennial sow thistle, prickly lettuce, St. John's wort, shepherd's purse, stinking mayweed, tumbling mustard and yellow rocket —. J. W. POTTER, CDA RESEARCH STATION, VINELAND STATION, ONT.

REGULATION AND MANAGEMENT OF PESTICIDES

STEVE HART

Man's technological conquest of the world has provided us with countless conveniences, many of which were unheard of even a few short year ago. Unfortunately, this technological conquest has brought about a number of undesirable by-products, one of which is pollution. So we are faced with the task of finding ways to reap the benefits of technology while, at the same time, preserving and enhancing the quality of our enrironment.

Pollution may be defined as follows: "environmental pollution is the unfavorable alteration of our surroundings which is largely the by-product of man's activities and which may affect his atmosphere, food, water, physical possessions and his opportunities for recreation and appreciation of nature."

Pests, by definition, are pollutants, since they destroy man's food, health and possessions as well as detracting from his opportunities for recreation and enjoyment of nature. Pest control products (pesticides) provide a means by which man can control his environment. However, they are powerful chemicals which, if misused, could cause undesirable side effects. This is why management and regulation of pesticides is necessary.

The principal federal method for regulation and

The author is an information officer with the CDA Information Division, Ottawa, Ont.

STEVE HART

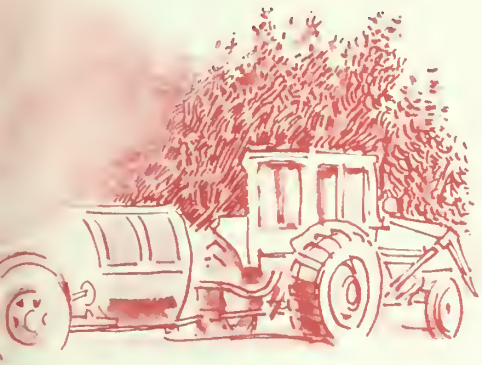
L'avance technologique a permis à l'homme d'agir sur son environnement et d'en tirer des avantages innombrables dont la plupart nous étaient inconnus il y a peine quelques années. Malheureusement, les avantages techniques ont aussi des conséquences néfastes, dont l'une est la pollution. Notre tâche est d'apprendre à profiter des bienfaits de la technologie tout en améliorant l'environnement.

La pollution peut se définir ainsi: «La pollution de l'environnement est une altération du milieu due en grande partie à l'homme dont les activités ont des effets sur l'atmosphère, l'eau, les aliments, ses biens matériels et ses possibilités de récréation et d'appréciation de la nature.»

Les parasites par définition, sont des polluants puisqu'ils détruisent les aliments et les biens de l'homme et qu'ils l'empêchent de profiter de la nature. Les pesticides permettent à l'homme d'influer sur son environnement. Cependant, étant des pro-

De la Division de l'information du ministère de l'Agriculture, à Ottawa.

RÈGLEMENTS ET EMPLOI DES PESTICIDES



management of pesticides is the Pest Control Products (PCP) Act which is administered by the Control Products Section of the Plant Products Division of the Canada Department of Agriculture (CDA). In addition, there are a number of other mechanisms which have been set up in collaboration with other federal departments and provincial agencies to assure the proper use of pesticides in Canada.

In a recent interview with Ralph Houghton, Chief of the Control Products Section, the problem of pesticide regulation and management in Canada was discussed.

"There have been a number of refinements and improvements in the registration process for pesticides over the last few years which have led to a much more efficient control of pesticide use in Canada. This has been brought about largely by an increase in staff within the Control Products Section and also by the development of various committees on a national and international level," Mr. Houghton said.

There are approximately 450 active ingredients formulated into about 3,300 pest control products of

duits chimiques très actifs, employés à mauvais escient ils peuvent avoir des effets secondaires indésirables. Ceci explique pourquoi les réglements pour l'emploi des pesticides sont indispensables.

Le principal moyen d'action du gouvernement fédéral est la Loi sur les produits antiparasitaires appliquée par la Sous-section des produits antiparasitaires de la Division des produits végétaux du ministère fédéral de l'Agriculture. De plus, un certain nombre d'autres mécanismes ont été établis en collaboration avec d'autres ministères fédéraux et des organismes provinciaux, dans le but de s'assurer du bon emploi des pesticides au Canada.

Au cours d'un entretien récent avec M. Ralph Houghton, chef de la Sous-section des produits antiparasitaires, nous avons discuté du problème de la réglementation de l'usage de ces produits.

«La marche à suivre pour l'homologation des produits antiparasitaires a connu au cours des dernières années bon nombre d'améliorations et de modifications subtiles qui ont eu pour effet d'améliorer l'efficacité du contrôle de l'usage des antiparasitaires au Canada, a précisé M. Houghton. Cette plus grande efficacité a été rendue possible en grande partie grâce à une augmentation du personnel de la Sous-section des antiparasitaires et aussi par la création de divers comités nationaux et internationaux.».

On compte environ 450 substances actives qui entrent dans la composition d'environ 3,300 pesticides de tous genres au Canada. Plusieurs de ces composés chimiques sont très anciens et remontent à bien avant 1945. Cependant, avec l'avènement du DDT et du 2,4,-D, la période qui suit immédiatement la Deuxième guerre mondiale est considérée comme le début de l'ère moderne des pesticides.

La Loi sur les produits antiparasitaires est en vigueur depuis 1927. Avec son personnel, M. Houghton est en train de rédiger de nouveaux règlements, qui accompagneront une nouvelle loi. On espère que ces nouveaux règlements permettront aux autorités du ministère de l'Agriculture chargées de l'application de la loi de répondre aux besoins actuels et futurs.

La Loi sur les produits antiparasitaires exige que tous les pesticides soient soumis à une méthode d'évaluation rigoureuse et la plus complète possible avant d'être homologués. L'homologation (ou enregistrement) est en effet un permis de vente. Le ministre fédéral de l'Agriculture peut, en vertu de l'autorité que lui confère cette Loi, refuser d'homologuer un pesticide si, à son avis et de façon générale, ce produit porte atteinte ou nuit gravement à la santé publique lorsqu'il est employé conformément au mode d'emploi de l'étiquette. L'enregistrement expire à la fin de chaque année et est renouvelable le 1er janvier de l'année suivante. Cette disposition de la Loi donne au Ministère la

various kinds in Canada. Many of these compounds are very old, dating back to well before 1945. However, the period starting from immediately after World War II is considered to be the beginning of the modern era of pesticides with the advent of DDT and 2,4-D.

Pesticide legislation has been in effect since 1927. Mr. Houghton and his staff are in the process of drafting new regulations to go with a new act. It is anticipated that these new regulations will enable the regulatory authorities of the Department of Agriculture to keep pace with current and future needs.

The PCP Act requires that all pest control products go through a rigorous and extensive evaluation process before registration is granted. Registration is, in effect, a license to sell. The federal Minister of Agriculture, under the authority of this Act, may refuse to register a pest control product, if in his opinion it is generally detrimental or seriously harmful to public health when used in accordance with label directions. All registrations expire annually and are renewable on the first of January of the succeeding year. This provides the Department with a chance to reevaluate and revise the status of all pesticides at least once a year. In addition, the Minister may at any time cancel the registration of a product which has been found to be of doubtful value or which has undesirable side effects.

The registration process calls for the inspection and checking of all pest control products offered for sale. Previous to registration all products must be tested to assure compliance with the standards in relation to which registration is to be granted. A pesticide label must contain information concerning the chemical content, the rate of application, the registered uses and other information respecting effective and safe use.

Mr. Houghton said:

"The evaluation of an application for registration of a new pesticide is a complex and time-consuming process. Such an application must be accompanied by volumes of scientific and technical information to enable an in-depth evaluation to be made. The generation of this information is the responsibility of the sponsoring company. It represents an investment of millions of dollars over many years."

All this information is submitted to CDA in several copies so as to allow a review and evaluation by the Control Products Section with assistance from the following agencies within the federal government.

—The Pesticide Technical Information Office of the Research Branch of CDA, which provides reviews on the effectiveness of agricultural pesticides, together with assessments of the possible effects their use may have on the environment.

—The Animal Diseases Research Institute of CDA, which provides reviews on the effectiveness and safety of products applied to domestic animals.

—The Analytical Services Section of the Plant Prod-

possibilité de réévaluer et de revoir le statut de chaque produit au moins une fois l'an. De plus, le Ministre a le pouvoir d'annuler l'homologation d'un pesticide dont la valeur est contestable ou qui possède des effets secondaires nuisibles.

Les exigences de l'enregistrement impliquent qu'il y ait examen et vérification de tous les pesticides homologués mis en vente. Tous les produits doivent subir des essais avant l'enregistrement afin de s'assurer qu'ils sont conformes aux normes de leur homologation. L'étiquette d'un pesticide doit fournir des renseignements sur la nature des produits chimiques entrant dans sa composition, la dose d'emploi, les usages homologués, le mode d'emploi et les précautions à prendre lors de son usage.

«L'évaluation de l'usage homologué d'un nouveau pesticide est un travail complexe qui exige beaucoup de temps, affirme M. Houghton. L'homologation d'un usage doit être fondée sur une masse de renseignements scientifiques et techniques qui permettent une analyse sérieuse. Ces renseignements doivent être fournis par la société qui en fait la demande. Ils représentent un investissement de plusieurs millions de dollars répartis sur plusieurs années.

Tous ces renseignements sont soumis au ministère de l'Agriculture en plusieurs exemplaires de façon à permettre un examen et une évaluation du produit par la Sous-section des produits antiparasitaires et les organismes suivants du gouvernement fédéral:

—La Sous-section de l'information technique sur les antiparasitaires de la Direction de la recherche du ministère de l'Agriculture, qui effectue des examens de l'efficacité des antiparasitaires agricoles, de même que des appréciations de leurs effets possibles sur le milieu:

—L'Institut de recherche vétérinaire du ministère de l'Agriculture, qui effectue des examens sur l'efficacité et la sécurité d'emploi des pesticides sur les animaux domestiques;

—La Section des services d'analyse de la Division des produits végétaux, qui examine les analyses chimiques, qui vérifie l'exactitude des méthodes d'analyse et qui fait des analyses de détection des résidus dans les produits végétaux;

—La Direction générale des aliments et drogues du ministère de la Santé nationale et du Bien-être social, qui effectue des examens en ce qui concerne:

a) les résidus possibles dans les aliments, en relation avec les normes établies en vertu de la Loi sur les aliments et drogues, et

b) les dangers possibles pour l'homme, qui sont inhérents aux antiparasitaires, en relation avec l'usager et les personnes susceptibles d'être atteintes par leur usage;

—Le ministère de l'Environnement, qui regroupe plusieurs organismes directement concernés par l'efficacité et la sécurité d'emploi des antiparasitaires;

ucts Division of CDA, which provides reviews of the chemical aspects, including the adequacy of methods of analysis for pesticides and the detection of residues resulting from their use.

–The Food and Drug Directorate of the Department of National Health and Welfare, which provides reviews regarding:

(a) potential pesticide residues in food related to standards under the Food and Drug Act, and

(b) a review of the potential hazard to humans inherent in pesticides, with respect to the user and the persons likely to be affected by their use.

–The Department of the Environment, which includes a number of disciplines having a direct interest in the effectiveness and safety of pest control products:

(a) The Canadian Wildlife Service provides evaluation of the potential effects of pesticides on wildlife;

(b) the Chemical Control Research Institute of Forestry provides advice on the effectiveness of pesticides used for forest management purposes and comments on the impact of use on forests;

(c) the fisheries component provides comments on the probable effects of pesticides on fish.

Based on the evaluations carried out by the aforementioned agencies, a decision is reached by the Control Products Section on the conditions under which registration may be granted. Registrations are not issued until all substantive questions on usefulness and safety have been resolved.

The foregoing procedures provide an opportunity to assess the pollution potential of a control chemical in light of modern criteria.

The PCP Act also provides for continuing evaluation of those pesticides already registered. The reevaluation process is carried out by the same agencies under which the original registration was granted. New information from all sources is taken into account.

For example, in 1969, ten widely used insecticides were reevaluated in depth to update their total use pattern in light of current evaluation criteria. This was part of a continuing review program that has been accelerated in recent years with the growth in number and volume of pesticides used in Canada. The 1971 schedule calls for the reevaluation of 25 compounds.

The evaluation of a pesticide entails not only an identification of possible adverse effects, but also an assessment of their significance in relation to the benefits arising from their use.

One of the most important current preoccupations of scientists is the development of evaluation criteria and environmental quality standards. This has particular significance in the management of pesticides in respect to their regulation under the PCP Act. Sev-

a) Le Service canadien de la faune, qui évalue les effets possibles des pesticides sur la faune;

b) L'Institut de recherches en répression chimique, qui renseigne sur l'efficacité des pesticides forestiers et sur les effets de leur usage sur les forêts;

c) L'élément des Pêches fournit des appréciations quant aux effets probables sur le poisson.

S'appuyant sur les évaluations des organismes cidessus, une décision est prise par la Sous-section des antiparasitaires quant aux conditions permettant d'accorder l'homologation. Cette dernière est accordée seulement après que tous les points importants concernant l'utilité et la sécurité d'emploi aient été résolus.

Les formalités qui précèdent, fournissent donc la possibilité d'établir le potentiel de pollution d'un pesticide chimique à la lumière des critères modernes.

La Loi sur les produits antiparasitaires permet également en tous temps de reconsidérer la situation des pesticides déjà enregistrés. La réévaluation est effectuée par les mêmes organismes qui ont accordé l'homologation, en tenant compte des nouveaux renseignements de toutes origines.

Ainsi, en 1969, dix insecticides d'un emploi répandu ont été réévalués en profondeur, afin de s'assurer que l'ensemble de leurs usages correspond aux critères d'évaluation actuels. Cette opération faisait partie d'un programme d'examen permanent qui a été accéléré ces dernières années à la suite de l'augmentation du nombre et du volume de pesticides utilisés au Canada. Pour 1971, le programme prévoit la réévaluation de 25 composés.

L'examen d'un pesticide n'entraîne pas seulement une détermination de ses effets nuisibles possibles, mais établit également, en parallèle, quels sont les avantages que procure son emploi.

L'une des préoccupations actuelles les plus importantes des chercheurs est la mise au point de critère d'évaluation et de normes de qualité concernant l'environnement. Cet aspect revêt une signification particulière en ce qui concerne l'utilisation des pesticides dans le cadre de la réglementation d'application de la Loi sur les produits antiparasitaires. Plusieurs membres du personnel du Ministère de l'Agriculture du Canada sont impliqués au premier chef dans la mise au point de ces critères. Le Sous-comité des pesticides et des substances organohalogénées du Comité associé du C.N.R.C. (Conseil national de recherche) sur les critères scientifiques concernant l'état de l'environnement, est chargé de l'étude des renseignements existants sur les relations de cause à effet des antiparasitaires et des substances organo-halogénées et de la mise au point des critères relatifs à leur évaluation et à leur présence dans l'environnement. Son Président actuel est M. Henry Hurtig, coordonnateur de la recherche sur les pesticides au Ministère de l'Agriculture du Canada, qui

eral of the staff members of CDA are deeply involved in this process of developing criteria.

The Sub-Committee on Pesticides and Organo-Halogens of the National Research Council Associate Committee on Scientific Criteria for Environmental Quality is charged with studying available information in the cause-effect relationships of pesticides and organo-halogens and to develop criteria relative to their evaluation and presence in the environment. The present chairman is Dr. Henry Hurtig, Coordinator, Environmental Quality, in CDA, who also serves on several international committees that deal specifically with pesticide problems on a worldwide basis.

The federal government has formed a working group on contingency planning which is oriented to the corrective action to be taken in the event of spills of toxic materials that could affect the environment. The purpose of this committee is to establish a readiness plan, together with an inventory of equipment and expertise, which can be mobilized momentarily in the event of dangerous spills. This group was initially preoccupied with oil spills, but it is now turning its attention to industrial chemicals, including pesticides.

No discussion on management of pesticides can exclude the Canada Committee on Pesticide Use in Agriculture (CCPUA) and the Canada Committee on Weeds (CCW). These committees, which report to Canadian Agricultural Services Co-ordinating Committee (CASCC), are both chaired by members of the CDA staff who, in turn, draw their members from federal, provincial, university and industry sources. The first-named committee is concerned with pesticides other than herbicides.

Another body, the Federal Interdepartmental Committee on Pesticides (FICP), was established by an Order of Cabinet and has the responsibility of looking at the pesticide picture from an overall federal government standpoint. The Assistant Deputy Minister of Agriculture (Research) is chairman of this committee.

Mr. Houghton said, "there is a new association in prospect. The proposed name of this association is the Canadian Association of Pesticide Control Officers (CAPCO). It is expected that the founding meeting will take place in the fall of 1971. This association will provide a forum for the exchange of information between federal and provincial pesticide regulatory officials on subjects peculiar to regulatory work."

From the foregoing it can be seen that CDA regulatory officials are continually on the lookout to improve and refine the process of registration and management of pesticides in Canada. This can only result in a diminution of harmful environmental effects attributed to pesticides and an increase in the positive role these chemicals have to play in modern agricultural and urban life. ■

fait également partie de plusieurs comités internationaux dont la mission spécifique est l'étude, sur une base mondiale, des problèmes causés par les pesticides.

Le gouvernement fédéral a formé un groupe d'étude sur la planification touchant les cas imprévus, dont l'activité est orientée vers les actions correctives à entreprendre dans les cas d'épandages accidentels de produits toxiques pouvant polluer l'environnement. Le but de ce Comité est la mise au point d'un plan d'urgence en même temps que l'établissement de l'inventaire du matériel et des personnes qualifiées pouvant être mobilisées momentanément dans le cas où se produirait un de ces incidents dangereux. Au départ, ce groupe s'était préoccupé des épandages de pétrole, mais son attention s'oriente maintenant vers les produits chimiques à usage industriel, y compris les pesticides.

Tout échange de vue sur ce problème des pesticides ne peut se faire sans la présence de la Commission nationale de l'emploi des antiparasitaires en Agriculture et de la Commission nationale des mauvaises herbes. Ces commissions, qui rendent compte à la Commission de coordination des services agricoles canadiens sont toutes deux présidées par les membres du personnel du ministère de l'Agriculture. Elles choisissent leurs membres parmi le personnel des administrations fédérales et provinciales, des universités ou de l'industrie. La première de ces commissions s'occupe des pesticides autres que les herbicides.

Un autre organisme, la Commission interministérielle fédérale des antiparasitaires, a été instituée par décret du cabinet. Elle est chargée de l'étude du problème des pesticides, d'un point de vue général, à l'échelon du gouvernement fédéral. Le président de cette Commission est le sous-ministre adjoint de l'Agriculture chargé de la recherche.

M. Houghton précise: «Parmi les projets, figure la création d'une nouvelle association. Son nom serait: l'Association canadienne des responsables du contrôle des pesticides (ACRCP). La réunion constitutive en est prévue pour l'automne de 1971. Cette association fournira une tribune pour l'échange de renseignements entre les fonctionnaires fédéraux et provinciaux chargés de la réglementation des antiparasitaires, et cela précisément sur le plan de l'application de la réglementation.»

Ce bref exposé démontre que les fonctionnaires du ministère de l'Agriculture chargés de la réglementation sont continuellement en éveil afin d'améliorer les modalités de l'enregistrement et l'utilisation des antiparasitaires au Canada. Leur action ne peut se traduire que par une diminution des risques que peuvent causer les pesticides à l'environnement, et par l'amplification du rôle positif que ces produits chimiques ont à jouer vis-à-vis de l'agriculture et de la vie urbaine moderne. ■

F. TITTIGER

Des milliers de tests sont faits chaque année pour vérifier la présence de bactéries de la viande cuite afin d'assurer aux consommateurs canadiens une nourriture saine et nourrissante.

Convenience foods are enjoying increased popularity with the Canadian public. The number and variety of prepared meat products such as sausages, meat loaves, canned meats and T.V. dinners are steadily increasing.

As meat is a most perishable food article and provides a rich medium for food poisoning and spoilage bacteria, strict sanitary conditions must be observed during the handling and processing of these products. If one lot of sausages or meat loaves is contaminated with food poisoning organisms and is processed and handled in a careless manner, it can be a widespread and potential hazard to the health of thousands of consumers.

TESTS ON READY-TO-EAT MEATS

Last year, 2,432 ready-to-eat meat samples and 1,735 cans of processed meats were bacteriologically tested at the Animal Pathology Laboratories across Canada. These figures include samples of imported canned meat products, which must be found satisfactory on laboratory examination before a shipment is released for distribution in Canada.

New types of food, packaging and market methods frequently require the development of new test methods or the modification of existing ones. Currently, research is being conducted at the Animal Diseases Research Institute, Hull, Quebec, on methods to detect the adulteration of a meat product made from one species with meat from another species of animal. For example, the detection of horse meat in a beef product.

There are three major types of bacterial food poisoning—botulism, staphylococcal food poisoning and salmonellosis. Botulism can be prevented by the proper processing of canned food. Most often, it is home-canned foods that are incriminated in this type of poisoning. Staphylococcal and salmonella food poisoning usually result from the human handling of food after it has been processed. Foodborne illness can be caused also by other types of bacteria such as *Clostridium perfringens* and *Bacillus cereus*.

Dr. Tittiger is officer in charge of the Guelph laboratory, Animal Pathology Division, CDA Health of Animals Branch.

The Hull, Que., laboratory is one of several across Canada that tests prepared meats.

In Canada, over 80% of all meat is slaughtered and prepared in federally inspected packing plants. The Meat Inspection Division of the CDA Health of Animals Branch is responsible for the sanitary operation of these plants assuring that the products they produce are wholesome.

Laboratory examination of products processed in these plants is an integral part of the inspection service. These laboratory examinations are conducted by the Branch's Animal Pathology Division in their laboratories located at Sackville, N.B.; Macdonald College, Que.; Hull, Que.; Guelph, Ont.; Winnipeg, Man.; Saskatoon, Sask.; Lethbridge, Alta. and Vancouver, B.C. Specially trained personnel are employed to conduct these examinations. Bacteriological tests are conducted to determine if the products have been properly processed and to check for the presence of potentially pathogenic bacteria. Another test is conducted for the presence of indicator bacteria that suggest faulty handling procedures that may occur in the plant or between the plant and the consumer's table. Other tests reveal the presence of bacterial inhibiting substances such as antibiotics. In addition to these bacteriological tests, examinations are also carried out for the presence of extraneous material and undersirable animal portions such as hair and skin and for the detection of chemical contamination such as pesticide residues.

If laboratory examination suggests that products from a particular processing plant are contaminated, the Meat Inspection Division conducts a thorough investigation into the sanitation and production methods of the plant. Laboratory examinations monitor further production.

These services, which complement those provided by the Meat Inspection Division, help to assure a wholesome and safe meat supply for the Canadian consumer. ■

S. SMOLIAK

L'élyme de Russie se compare très avantageusement aux autres graminées en raison de sa grande digestibilité et de sa longue période d'utilisation. Il donne un gain de poids vif de trois à six fois supérieur aux pâturages naturels.

Forage supplies must be increased to balance the forecast expansion of the beef cattle population. But increased supplies can be realized only by intensifying production on additional or existing pasture lands. In the southern region of the Canadian prairies, Russian wild ryegrass has made this possible.

Russian wild ryegrass, a native of Siberia, is unique among grasses because of its high digestibility and long season of use. It begins growth in spring as early as crested wheatgrass and the leaves remain green throughout most of the summer. Although Russian wild ryegrass was introduced into Canada in 1926 and tested at the Dominion Range Experiment Station at Manyberries, Alberta in 1931, its use at first was restricted because production of seed was very erratic. In the 1950's, techniques for stabilizing the production of seed were worked out by Agricultural Research Stations in Western Canada and in the United States.

In spring 1957, fields of Russian wild ryegrass, crested wheatgrass, and native range pastures were included in a grazing experiment at the Manyberries Station. Five grazing treatments were used. Separate fields of Russian wild ryegrass (Fig. 1), crested wheatgrass, and native range pastures were each grazed continuously during a 7-month season beginning the third week in April. The fourth grazing treatment tested was a rotation system involving crested wheatgrass for spring pasture, native range for summer, and Russian wild ryegrass for fall pasture. The fifth grazing treatment included the three pasture types in one field and allowed the animals to graze free-choice. Native range pastures were stocked at the rate of 4.7 acres per animal unit month (AUM). The seeded pastures were stocked at the rate of 1.6 acres per AUM, or three times as heavily as the native range.

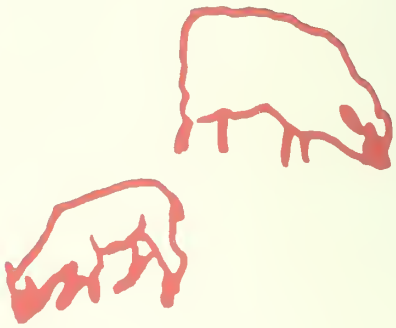
YEARLING EWE GAINS GREATEST

Yearling ewe gains per acre were greatest on Russian wild ryegrass pastures, averaging 26.3 pounds or 3.2 times the gain on native range (8.3 pounds per acre). Continuously grazed crested wheatgrass pastures produced the next highest ewe gain per acre (21.7 pounds) or 2.6 times the gain on native range. Yearling ewe gains on the rotation and free-choice systems were 16.5 pounds and 18.5 pounds per acre or 2.0 and 2.2 times the gain produced on native range, during the 10-year experiment.

The author is a range management specialist with the CDA Research Station, Lethbridge, Alta.

Yearling ewes provided with shelter on Russian wild ryegrass study pasture.

GRAZING



Gains per head, which varied during different periods of the grazing season, were greatest during spring, intermediate during summer, and lowest during fall. In spring ewes gained the most weight while continuously grazing crested wheatgrass; in summer they gained most while on native range or Russian wild ryegrass continuously, or on free-choice range. The greatest gains during fall were made on pastures containing Russian wild ryegrass, regardless of whether it was grazed continuously, in rotation, or free-choice.

On all pasture daily gains declined with the advance of the season and maturity of the forage. At comparable stages of growth Russian wild ryegrass contained more protein than crested wheatgrass or the native grasses, and equalled or excelled them in phosphorus content. The phosphorus content of Russian wild ryegrass is especially high during the leafing and flowering stages. Protein content of Russian wild ryegrass during late fall and winter is sufficient to maintain livestock. Russian wild ryegrass cures on the stem and can be used for winter grazing.

Production of forage in pounds per acre during the study period ranged from 500 to 1290 on crested wheatgrass, 405 to 920 on Russian wild ryegrass, and 245 to 630 on native range. The average yields were 830, 645, and 390 pounds per acre, respectively.

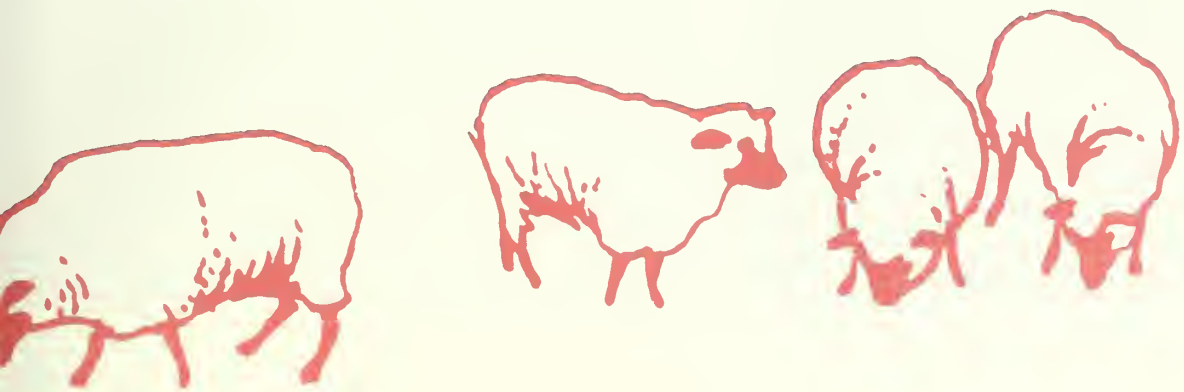
GRAZING TESTS BY YEARLING STEERS

In 1967, the rotation and free-choice test fields were grazed by yearling steers. Additional fields of native range and Russian wild ryegrass were each grazed continuously for 6 months. The Russian wild ryegrass field was sown in 24-inch rows in 1961, and because production of forage had been greater than on the other fields, this field had been stocked at the rate of 0.8 acres per AUM. In terms of beef produced per acre, preliminary results show that continuously grazed native range pasture yielded 17 pounds whereas Russian wild ryegrass pasture yielded 110 pounds, 6½ times as much. The rotation system of grazing produced 29 pounds of beef per acre, and the free-choice system produced 30 pounds, or about twice as much as native range. These trials are being continued by the CDA Research Station at Lethbridge to evaluate fully the productivity, durability, and longevity of the seeded pastures.

SWIFT CURRENT RESEARCH STATION GRAZING TESTS

Grazing tests on grass-alfalfa pastures have been conducted by J. B. Campbell at the Research Station, Swift Current, Saskatchewan. In a five-year study, liveweight gain by yearling ewes grazing Russian wild ryegrass was over 50 pounds per acre, compared with 36 pounds per acre on intermediate wheatgrass, and 35 pounds on crested wheatgrass when pastures were stocked from early May through mid-October. Continuous grazing of either Russian wild ryegrass or crested wheatgrass was recommended over a repeated seasonal pasture system employing crested wheatgrass in the spring, intermediate wheatgrass in mid-summer, and Russian wild ryegrass in the fall. After July, liveweight gains of sheep were greater on

USSIAN WILD RYEGRASS



Russian wild ryegrass-alfalfa than on crested wheatgrass-alfalfa, but after September 1 the animals continued to gain weight only on the Russian wild ryegrass-alfalfa pastures. The benefits of adding alfalfa to a grass for pasture were shown in greater dry matter yields and higher percentage contents of crude protein. These increased yields were reflected in higher carrying capacity, increased liveweight gains per ewe and per acre, and greatly reduced consumption per pound of liveweight gain.

TESTS AT MELFORT RESEARCH STATION

At Melfort, Saskatchewan, researchers J. A. Robertson and D. A. Cooke compared Russian wild ryegrass and crested wheatgrass over a three-year period. Yearling steer gains per acre averaged 255 pounds on Russian wild ryegrass pastures grazed from late May through to late August. The carrying capacity of Russian wild ryegrass was higher than that of crested wheatgrass pasture. However, steers grazing crested wheatgrass had a higher rate of daily gain and were more efficient in converting grass to gain than steers grazing Russian wild ryegrass.

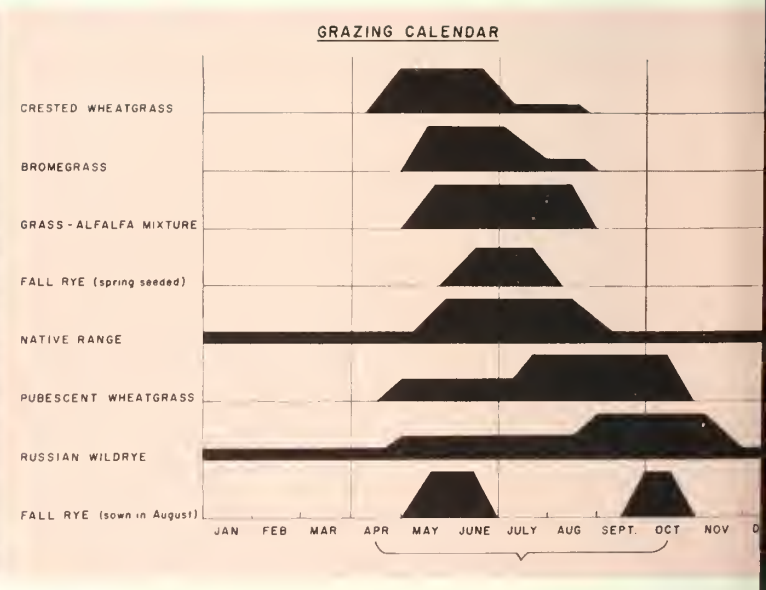
COMPARATIVE PRODUCTIVITY AND SEASON OF PRIME USE

The superiority of Russian wild ryegrass and other introduced grasses makes it possible to provide excellent grass pastures for six, or more, months of the year (Fig. 3). A legume should be added to the grass to increase the production and nutritive value of the pasture. Research at the Lethbridge Station has determined the comparative productivity and season of prime use for various pastures commonly used in the area. If well planned, a grazing program can make full use of these pastures when they are in prime condition and at peak production. In dry areas, a grazing program that must utilize native range (Fig. 2) should include pastures seeded to crested wheatgrass for spring use and Russian wild ryegrass for fall pasture. Pubescent or intermediate wheatgrass may be substituted for crested wheatgrass during May and June, or for native range during July and August. Bromegrass should be grazed during June and July; other forage species could be grazed in May and during August and September. Fall rye and other cereal crops can be used to advantage to provide pasture during the summer or fall grazing season. Russian wild ryegrass seeded in 3- to 4-foot rows can be used as winter pasture. Thus, the grazing season can be extended to 9 or even 11 months.

Grazing studies on other introduced grasses and legumes are carried out at the Lethbridge Station and at other Research Stations in Western Canada. Through these evaluations specific recommendations can be made on proper grazing management that will enable livestock producers to increase their forage supply and their beef cattle numbers. Forage production programs, sponsored by various government agencies, offer incentives to increase forage acreages and supplies. Livestock producers taking advantage of these programs will be able to maximize production per acre and meet the increasing demand for beef. ■

Fig. 2. Native range pasture stocked at 4.7 acres per AUM.

Fig. 3. Grazing calendar showing optimum periods of use for various pasture crops.



CATTLE + WORMS = REDUCED PROFITS

H. J. SMITH

Le diagnostic et le traitement rapide des parasites du bétail peuvent éviter des pertes financières. Au cours d'une étude, des veaux Holstein d'un an sans parasite, pesaient 128 lb de plus que des sujets témoins qui avaient souffert d'une grave infection de parasites gastro-intestinaux.

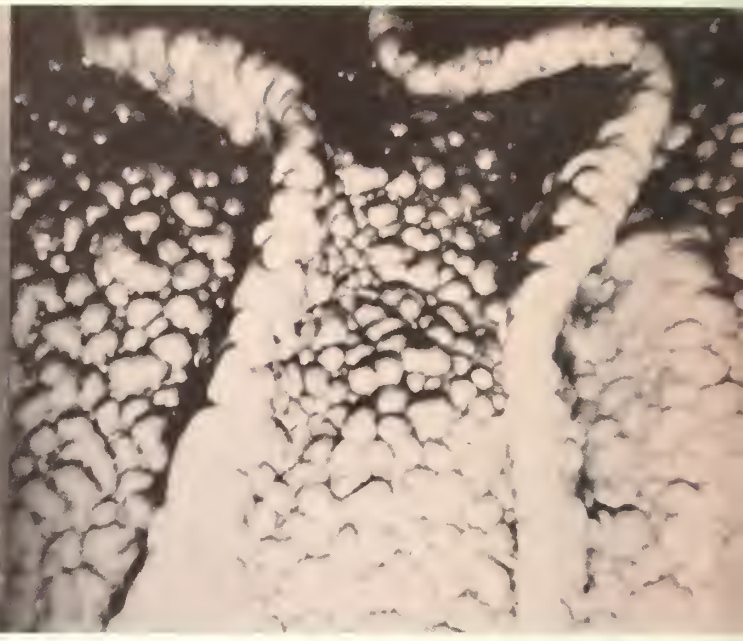
Studies carried out in the Maritimes during the last decade have shown that worm infestations in cattle are more common than was formerly believed. Since parasitism is often an insidious and chronic disease, appreciable losses may occur without the stock owner being fully aware of it. With the development of improved types of grasses with increased yields, it is expected that the incidence of parasitism will increase as more cattle are able to graze in a given unit of pasture. Technology has permitted the development of pastures that will support more animals nutritionally than it is now possible to graze safely from a parasitological point of view. This overstocking leads to heavy fecal contamination and subsequent worm infections.

Dr. Smith is a parasitologist, Animal Pathology Div., Health of Animals Branch, Atlantic Area Lab., Sackville, N.B.

In acutely and severely infected animals clinical signs of parasitism in cattle are a marked unthriftiness, watery diarrhea, dehydration, dull coat, gaunt 'tucked-up' appearance and death. Coughing and respiratory distress will be present in heavy lungworm infestations. In the more common, insidious, slow, chronic form of parasitism, the only signs that may be detected are some unthriftiness and lower weight gains than expected. A recent study, in collaboration with Mr. Frank Calder of the Experimental Farm, Nappan, N.S., has shown that the economic yield in terms of weight gain in parasitized steers may be reduced by as much as $50 or more per acre over a grazing season under Maritime conditions from those in which parasitism is kept to a minimum by anthelmintic treatment. Furthermore, young animals which survive heavy infections remain unthrifty for prolonged periods and tend to be 'stunted' even though they recover and eventually do make reasonable gains. In one study using Holstein calves, parasite-free animals weighed, on the average, 128 lbs. more as yearlings than did those animals which had been acutely infected with gastrointestinal parasites as calves.

Greater worm burdens and more marked clinical signs are usually observed in calves and yearlings than in older cattle. This is attributed, in part at least, to the development of resistance in older animals and probably explains why older animals may be grazed under conditions which are unsafe for susceptible animals.

A Holstein calf showing the typical dull, unthrifty, dejected appearance associated with clinical gastrointestinal parasitism.



The thickened, oedematous and pebbled appearance of the abomasal folds and mucosa observed in acute ostertagiasis.

What are the species of worms most commonly encountered in Canadian cattle? Studies to date would indicate that the brown stomach worm, *Ostertagia ostertagi;* the intestinal worm, *Cooperia oncophora;* the thread-necked intestinal worm, *Nematodirus helvetianus* and the bovine lungworm *Dictyocaulus viviparus* are the predominant species in Canada. Other species such as *Haemonchus placei, Trichostrongylus axei, Bunostomum phlebotomum, Oesophagostomum radiatum* and *Trichuris discolor* occur in cattle and under certain climatic or other conditions may be found in large numbers.

The nematodes mentioned above have direct life cycles, i.e. the adults live within the gastrointestinal tract or other organ and shed either eggs or larvae in the feces. The parasite undergoes several free-living stages outside the host before finally developing into an infective stage. Cattle become infected by ingesting the infective larvae (or infective eggs in the case of *Trichuris*), most commonly, while grazing on infected pastures. The infective larva of the hookworm, *Bunostomum phlebotomum*, can gain entrance to its host by burrowing through the skin.

How do pastures become infected? Pastures may become infected by two methods: residual infection and auto-infection. Residual infections are those established on pastures as a result of overwinter survival of parasite eggs or infective larvae. Investigations carried out in the Maritimes have demonstrated that very large numbers of *Ostertagia, Cooperia* and *Nematodirus spp.* survive over winter to give rise to heavy infections in susceptible cattle the following grazing season. The numbers of infective *Ostertagia* and *Cooperia* larvae tend to decrease quite rapidly as the grazing season progresses until by late summer or early autumn the numbers on pastures are low. On the other hand, infective *Nematodirus* persist in large numbers throughout the grazing season. Recently it has been shown that large numbers of *Nematodirus* may survive over a second winter on pastures.

Auto-infections are those established or carried on to pastures during a grazing season by carrier animals. The evidence indicates that this is the primary method by which pastures become infected with the lungworm, *Dictyocaulus.* Under suitable climatic conditions, heavy pasture infections may build up quite rapidly resulting in lungworm outbreaks in susceptible cattle.

What are the factors affecting rate of build-up of infections on pastures? Climatic conditions are important, as sunlight and dessication are inimical to the free-living stages of parasites. The type of vegetation is important as lush pastures provide a suitable micro-environment to permit parasites to survive even under otherwise adverse conditions. Also, lush pastures support more animals. Overcrowding and overgrazing lead to greater pasture contamination as animals are forced to graze close to the ground and so close to fecal pads. These are the areas where greatest concentration of infective larvae are found.

The presence of young, susceptible animals on infected pastures also may increase pasture in-

festations, since non-resistant animals develop larger infections and in turn shed greater numbers of worm eggs.

The number of generations of worms per season may also have a bearing on the development of parasitism. Owing to the prolific nature of lungworms and the short generation interval, there may be several generations of *Dictyocaulus* during one grazing season resulting in a rapid buildup of infection, while other species of worms may not have more than one or two generations per season. With the latter species, it may take two or three grazing seasons for heavy pasture infections to build up depending upon climatic and other factors.

The greater resistance of eggs and larvae of certain species to adverse conditions also is a factor in pasture infections.

How is parasitism diagnosed? Owing to the insiduous nature of parasitism and the number of worm species that may contribute to its development, diagnoses are based on history, clinical signs, postmortem findings, worm counts and fecal examinations. It should be emphasized that fecal egg counts are of limited value and should be used only as an aid to disgnosis. As was mentioned earlier, high egg counts are more commonly associated with infections in calves. High counts occur for several weeks beginning about three weeks after exposure but soon drop to low levels as the hosts' resistance developes. On the other hand, high egg counts are infrequently observed in older animals even though large worm burdens may be present. A comparative study recently carried out, on yearlings and calves infected with large burdens of *Ostertagia, Cooperia* and *Nematodirus*, showed that average egg counts seldom rose above 200 eggs per gram of feces in the yearlings while the typically high initial rise in worm egg output occurred in the calves. It also should be noted in regards to egg counts that certain worms, *Nematodirus* for example, are notoriously low egg producers so that egg counts for these species are not indicative of the worm burden present.

How can parasitism be controlled? In consideration of the many factors mentioned above that contribute to the development of parasitism, control must involve good husbandry and pasture management, augmented by antihelmintic treatment if signs of disease develop.

Young susceptible stock should not be grazed with older animals, since older cattle may be carriers. This would appear to be the primary method by which lungworm disease is maintained from season to season.

Young susceptible stock should not be grazed on permanent pastures. Such pastures often have large residual infections from year to year. If permanent pastures must be used, they should be grazed by the more resistant animals. As over-wintering residual infections of *Ostertagia* and *Cooperia spp.* are greatest during the early part of the grazing season, pastures should be left ungrazed as long as possible so that fewer infective parasites will be available for the grazing animals. However, since large numbers of infective *Nematodirus* may remain throughout the grazing season, such pastures should be grazed only by the more resistant animals. If infected pastures must be used by susceptible animals, maintain as low a stocking rate as possible.

Overgrazing and overstocking should be avoided. Cattle are not only likely to pick larger numbers of worms up from infected pastures but recontamination is also greater when pastures are heavily stocked.

Rotation of pastures several times within a grazing season with the same species is not necessarily an advantage. The rate of development of the free-living stages of parasites depends on climatic and other conditions. Unless pastures are left vacant for very prolonged periods, infective larvae could be present in greatest numbers when cattle are returned even after several weeks.

On the other hand, annual rotation of pastures with different species of livestock has given effective control on problem pastures, where it has been practical to implement. There may be some cross transmission of certain parasite species but the numbers normally established in the alternate host do not appear to affect the animals appreciably.

Excessively wet or low-lying pastures should be avoided or drained, since conditions in these areas often are suitable for maximum survival of the free-living stages of parasites, particularly lungworm larvae. A source of good clean water should be provided in all pastures so as to discourage animals from drinking in ditches, muddy water holes or other contaminated areas.

The strategic treatment of cattle with an appropriate antihelmintic may be useful when combined with sound pasture management practices and based on clinical, climatic, and other factors. As an example, the treatment of cattle, particularly calves, prior to being moved from an infected area to a clean pasture may contribute greatly towards the prevention of a buildup of pasture infections, especially on problem farms.

Zero-grazing may be a practical method of controlling parasites under certain limited conditions of highly intensified farming.

Finally, a discussion on the control of parasites would not be complete without mention of vaccination. A vaccine prepared by irradiating infective larvae has proven to be effective in the control of lungworm disease in Great Britain and Europe. This vaccine is not available in Canada. Practical vaccines against other bovine worms have not been developed to date. ■

PLANT POPULATIONS AND ROW SPACING

AFFECT YIELD OF SUNFLOWERS CORN AND SOYBEANS

HENRY ENNS and
JOHN E. GIESBRECHT

La densité de semis et l'écartement entre les lignes de tournesol, de maïs et de soja, sont deux facteurs qui influent sur le rendement. Jadis, on déterminait l'écartement en se basant sur l'espace que prenait un cheval pour traîner des machines agricoles. De nos jours, on se sert de produits chimiques pour lutter contre les mauvaises herbes et l'on dispose de machines modernes pour les cultures en lignes. Il devient alors possible de varier l'écartement entre les lignes et les densités des peuplements en vue d'augmenter la production.

Are you getting the maximum yield from your sunflower, corn and soybean crops? If not it might be worth your while to reconsider your row spacings, populations and other management practices. These could raise your yields by 25 to 100%.

When row crops were first introduced to Manitoba the distance between rows and hills depended more on the space needed for a horse to walk than for plants to grow. With corn especially this resulted in populations that were far below optimum levels. All of the three crops mentioned respond to either row spacing or plant populations or both. With modern row crop equipment and chemical weed control it is possible to choose the optimum population and row spacing and combine this with good management. Corn yields of 126 bushels per acre and sunflower yields of over 3500 pounds per acre have been obtained in test plots at the Research Station, Morden.

SUNFLOWERS

Spacing trials with sunflowers, conducted in 1965 to 1967, showed that spacings and populations have

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TABLE 1. SUMMARY OF RECOMMENDED POPULATIONS PER ACRE FOR PEREDOVIK AND ARMAVIREC SUNFLOWER CULTIVARS BASED ON THREE YEARS OF TESTING AT MORDEN.

Variety	Row width in feet	Population per acre	Plant spacing in inches
Peredovik	1	23,000	22-24
	3	20,000	8-9
	12	11,000	4
Armavirec[1]	1	26,000	20
	3	22,000	6-7
	12	14,000	3

[1]The newly licensed cultivar, Krasnodarets, should be planted at the same rates as Armavirec.

important effects on yield and oil content. Row spacings of 1 foot, 3 feet and 12 feet were used with several seeding rates in each.

The highest yields in each of the three years were obtained with rows 1 foot apart. The average increases for Peredovik and Armavirec amounted to 20% and 16% more than those obtained from rows spaced 3 feet apart. Optimum populations for the test were 23,000 plants per acre for Peredovik and 26,000 for Armavirec. Table 1 provides the recommendations in summary form. Actual plant counts in the 1 foot spacings averaged one plant per 20-24 inches of row. Therefore, spacing rows at 20-24 inches and plants at 12 inches would be more practical.

With rows 12 feet apart and plants closely spaced within the row, yields were about one half that obtained with 3 foot spacing.

Although sunflowers will compensate for low plant populations by producing large heads, the oil content will be considerably higher in heavier stands where the heads remain small. Other advantages of high population are earlier maturity and quicker drying of small heads as well as better competition against weeds.

CORN

Corn, at Morden, was grown at 12,000 to 30,000 plants per acre in 1966 and 1967. Four hybrids and four spacings were used (Table 2). As an average of all plots the high population yielded 51% more than the low population. In 1966 the difference in yield between the high and low populations was greater than in the drier season of 1967. But in spite of the dry season in 1967, yield increases of 68% were obtained with some hybrids. Each of the four hybrids yielded more at high plant populations but some responded better than others.

With corn the greatest yield increase results from high populations. Using narrow rows also tends to raise the yield but not to the same extent. Yield was increased by about four bushels in 20-26 inch rows compared to 32-38 inch rows. This small but consistent increase would probably not warrant the purchase of narrow row equipment. However, if the equipment is available or new machinery purchases are being contemplated, then this increase should be borne in mind.

Good management, such as good weed control and the use of adequate amounts of fertilizer, must also be practised along with narrow spacing and high populations, if full advantage is to be gained from the high planting rates.

SOYBEANS

Soybeans responded to row spacing but not to population. In studies at Morden and Portage la Prairie three cultivars were grown at three row spacings and two populations in 1967 and 1968 (Table 3). The 12-inch spacing yielded 4.6 bushels per acre more than the 36-inch spacing. At present prices this represents more than $13.00 per acre with no increase in production costs. With narrow row spacing there was also less lodging but height was reduced slightly. Both spacings matured at the same time.

Using a high population (2 bushels per acre) with soybeans resulted in virtually no difference in yield from low population (1 bushel per acre). This was consistent for locations, years and cultivars.

With the use of recent herbicides such as Trifluralin it appears practical to grow soybeans in rows 12 inches apart or even solid seeded.

By following the above recommendations for these three crops it appears probable that some farmers could very well double their present yields or at least increase their profits to some extent. ■

TABLE 2. ROW SPACING AND POPULATIONS TRIAL WITH FOUR CORN HYBRIDS AT MORDEN IN 1966 AND 1967.

Plants per acre	Ear height	Percent moisture in ear	Bushels per acre
30,000	35	27.6	98.4
24,000	34	27.8	97.0
18,000	32	28.1	83.7
12,000	31	29.1	65.0
Row spacing			
38 inches	33	28.2	84.7
32 inches	33	26.7	82.2
26 inches	32	29.0	88.5
20 inches	33	28.7	88.8

TABLE 3. ROW SPACING AND POPULATION TRIAL WITH THREE SOYBEAN CULTIVARS, PORTAGE, ALTONA AND MORSOY AT MORDEN AND PORTAGE LA PRAIRIE IN 1967 AND 1968.

Plants per acre	Days to mature	Plant height (in.)	Lodging (1-5)[1]	Bushels per acre
350,000	119	30	2.6	31.8
175,000	119	30	2.3	32.1
Row spacing				
36	119	31	2.9	29.4
24	119	30	2.5	32.4
12	119	30	2.1	34.0

[1] 1 = no lodging. 5 = very severe lodging.

CANADA AGRICULTURE

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