WINTER 1979
HIVER 1979

Trees, shrubs and ornamentals from around the world are grown in the Dominion Arboretum on the Central Experimental Farm. See story on ornamental plant trials on page 18.

Arbres, arbustes et plantes ornementales d'un peu partout dans le monde font l'objet d'essais à l'Arboretum de la Ferme expérimentale d'Ottawa. Voir article à la page 18.

CANADA AGRICULTURE

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Agriculture Canada

RAPESEED TODAY

A. J. KLASSEN and
R. K. DOWNEY

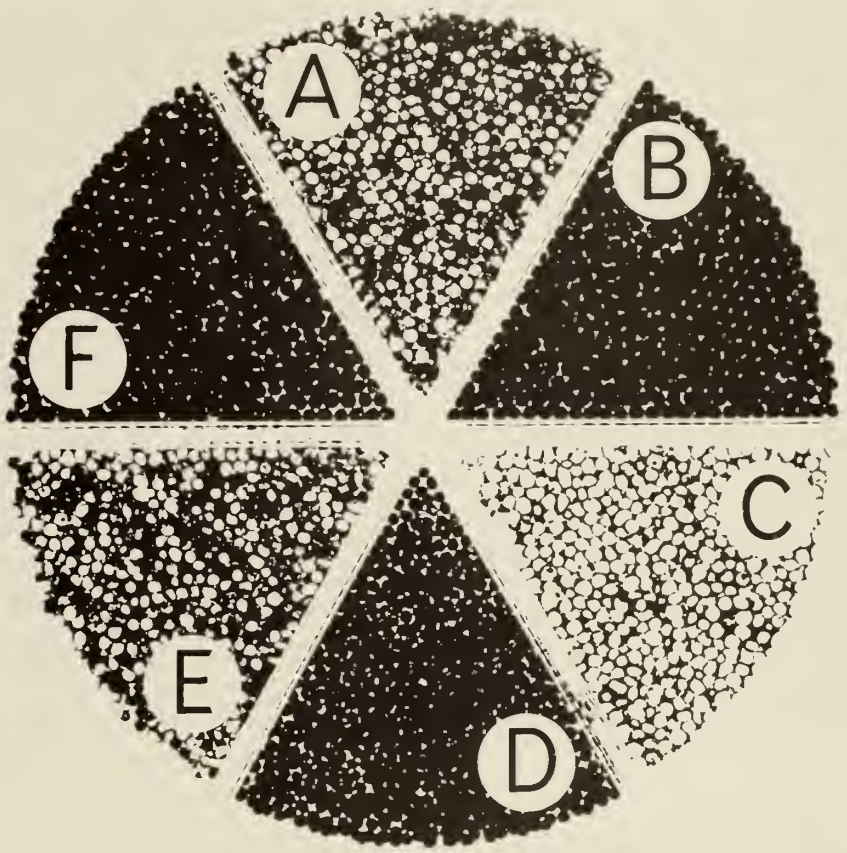
La production canadienne de colza a atteint cette année un nouveau record. On prévoyait en effet récolter 3,3 millions de tonnes dans les 2,77 millions d'hectares cultivés, pour une valeur totale à la production de $983 millions. Le colza pourrait pour la première fois supplanter l'orge au titre de deuxième culture en importance au Canada. L'évolution des caractéristiques chimiques des variétés de colza a permis d'améliorer la qualité et l'utilisation de cet oléagineux.

Rapeseed, Canada's number one edible oilseed crop, set new records in 1978 for area sown and the quantity and value of the crop produced. With an expected harvest of 3.3 million t, from 2.77 million ha, the farm value of this cash crop will approach $983 million. For the first time rapeseed will likely replace barley as Canada's second most valuable grain crop.

The small seeds of rape are harvested and collectively marketed from two distinct species, *Brassica napus* or summer rape, and *B. campestris* or summer turnip rape.

In past years approximately 72% of the crop has been exported, making a significant contribution to Canada's balance of payments.

However, few Canadians realize how important rapeseed grown and processed in Western Canada is to our domestic food supply. Of all the vegetable oils used by Canadian manufacturers of margarines, shortenings, salad and cooking oils, rapeseed oil is the leader. Indeed, of the vegetable oils consumed in Canada approximately 38% are of rapeseed origin.



Commercial rapeseed cultivars and future strains depicting the development of yellow seed color. A. Yellow *B. napus;* B. Tower; C. Yellow *B. campestris;* D. Torch; E. Candle; F. Midas.

Because rapeseed is of economic and nutritional importance to Canada, plant breeders have been working to improve the agronomic performance of the crop as well as the quality of the oil and the high protein residual meal that remains after oil extraction.

Early plant breeding resulted in better adapted varieties with increased seed and oil yields, and as new techniques became available the composition of rapeseed oil and meal was investigated.

In the late 1960s, strains producing a new kind of oil were developed. These strains were essentially free of erucic acid, a long-chain fatty acid component that was characteristic of oil from most *Brassica* seeds. Worldwide research indicated that this new oil was nutritionally more desirable, and in 1970-71, seed supplies of these new Canadian varieties were supplemented with a winter in-

Dr. Klassen is a research scientist, Oilseed Crops Section, and Dr. Downey is Assistant Director and Head, Oilseed Crops Section, at CDA's Saskatoon, Sask., Research Station.

crease in California and released to prairie producers.

Although the agronomic performance of these new cultivars — Oro, Zephyr and Span — was not equal to the agronomic performance of the existing high erucic cultivars, producers and processors realized the importance of their oil quality. By 1973 more than 85% of the Canadian rapeseed acreage was seeded with low-erucic cultivars. Combining the low erucic acid characteristic with high seed yield in the Midas variety of *B. napus* and the Torch variety of *B. campestris*, both released in 1973, ensured a complete changeover to the new oil type.

Animal nutritionists had demonstrated that rapeseed meal, with its 35 to 36% protein, could be used successfully as a livestock feed supplement. But feeding high levels caused metabolic disorders and reduced weight gains, particularly for non-ruminant animals such as swine and poultry. The problem was subsequently shown to be due to the presence of sulfur compounds known as glucosinolates in rapeseed meal. The fortuitous discovery in 1967 that the unadapted European *B. napus* cultivar, Bronowski, contained a much-reduced level of glucosinolates allowed plant breeders to incorporate this characteristic into their breeding programs. Scientists at the Prairie Regional Laboratory of the National Research Council played a vital role in this process by developing analytical techniques that facilitated the selection of low-glucosinolate genotypes.

Licensing of the *B. napus* cultivar Tower in 1974 established a new level of rapeseed quality, since it was the first cultivar to produce both low erucic acid oil and low-glucosinolate meal. Tower also has an excellent protein content. Improved double-low cultivars Regent and Altex were licensed in 1977 and 1978, respectively.

However, no source of low glucosinolate could be found in the *B. campestris* species and recurrent selection was only partially successful in reducing glucosinolate level. Interspecific hybridizations involving the rape species *B. napus*, *B. campestris*, and the mustard species *B. juncea*, produced *B. campestris* plants with an even lower glucosinolate level than Tower, and with the added feature of yellow seed color. This program culminated in the licensing of the *B. campestris* cultivar, Candle, in 1977.

The development of yellow seed color had been a breeding objective for a number of years because yellow seeds have a thinner seed coat than brown seeds, and consequently a substantially lower crude fiber level in the seed meal. In addition, yellow seeds contain 2 to 3% more oil than brown seeds, and frequently a higher protein content.

While yellow seeds occur naturally at a very low frequency in *B. campestris*, a great deal more difficulty has been experienced in developing yellow seed color in *B. napus*. Partially yellow seeded strains have been identified and are exhibiting the desirable features of lower crude fiber, higher oil content, and higher protein content found earlier in yellow *B. campestris*. However, further improvement in their agronomic characteristics is required before they can be released for commercial production. To date, no pure yellow *B. napus* genotypes have been identified and interspecific crosses are being explored for this purpose.

Programs are in progress to develop additional modifications in fatty acid composition of the oil. Linolenic acid, which makes up about 8 to 10% of the total fatty acids of rapeseed oil, is subject to oxidation during long-term storage at room temperature and this can produce off-flavors. Reducing the linolenic acid level to less than 3% would alleviate this problem.

Linoleic acid is a nutritionally desirable fatty acid and the breeding objective is to increase its level to 40% from the present 20 to 24%. Some variability in these fatty acids has been created with chemical mutagens, but breeding progress is slow due to the large influence of environmental factors.

Increased interest in high erucic acid rapeseed oil for industrial applications has developed recently as traditional European sources become less readily available and petroleum-based raw materials become more costly. A small acreage of the high-erucic, high-glucosinolate cultivar R-500 (yellow sarson) has been contracted for several years to supply part of this market. Breeding programs to develop strains combining high erucic acid oil with high-quality, low-glucosinolate meal are in progress.

The familiar expanses of yellow blossoms appear essentially the same today as in the past, but the oil and meal which will be the final products have vastly different chemical characteristics and will change even more in the future.

Success in achieving these changes through breeding can be attributed to (1) the necessary genetic variability within the crop, or its close relatives, (2) the development of fast, accurate analytical methods to measure the traits under selection, and (3) the availability of substantial research resources and cooperation among scientists and industry representatives. ■

BREEDING WHITE BEANS TO RESIST BACTERIAL BLIGHT

B. N. DHANVANTARI and
J. W. AYLESWORTH

La brûlure bactérienne entraîne une réduction du rendement des haricots blancs en Ontario allant jusqu'à 30%. Les chercheurs tentent de créer une variété résistante à la maladie et Agriculture Canada possède un programme qui vise à produire une semence généalogique exempte de la maladie.

In Canada, the white field bean (navy bean or pea bean) is mainly grown in southwestern Ontario where soil and climatic conditions are ideally suited. The white bean belongs to a group of leguminous plants scientifically known as *Phaseolus vulgaris L* together with other types of edible beans such as kidney, pinto, wax and green, red mexican, black turtle, yellow-eye, and great northern.

Bacterial blight is among the many problems affecting white bean culture in Ontario and other major bean-growing areas of the world. The main bean cultivars grown in Ontario — Sanilac, Seafarer and Kentwood — are all highly susceptible to the disease. Because of it, yield losses have ranged to 30% or more in all three varieties.

Primary infections are evident in late July and early August when individual affected plants show leaf spots accompanied by bright yellow chlorosis. Secondary spread then results in browning, wilting and defoliation of leaves, lesions on pods and reduction in plant canopy.

Two types of bacterial blight have been reported in Ontario, namely, common and fuscous blights. The two are mainly distinguishable when the causal bacteria are isolated on a culture medium containing carbohydrates. Both produce slimy yellow growth, but the fuscous blight bacteria are slower growing, form smaller colonies, and, most characteristically, produce a diffusible brown pigment, darkening the medium in a few days.

Figure 1. Bacterial blight on cv. Seafarer.

At Harrow, research has been launched to deal with many of the problems of bacterial blight of white beans. One of the objectives of the white bean breeding program is to incorporate blight tolerance into adapted varieties.

In general, bacterial diseases have no effective registered chemical control.

A few medical antibiotics are potentially effective, but it is unlikely that they will be registered in Canada. There is a growing awareness that agricultural use of medical antibiotics is hazardous as it may result in the development of drug resistance among bacteria harmful to human health.

Some copper compounds are available for disease control but their effectiveness is not clear-cut.

Because of the large size of white bean acreage, disease control by periodic chemical sprays is prohibitive. The blight bacteria do not overwinter in the soil, but may persist in the debris of the previous crop and occur as a contaminant in storage areas. It has been generally recognized that contaminated seed is responsible for primary incidence of blight in the field.

The Research and Food Produc-

Dr. Dhanvantari is a plant pathologist and Dr. Aylesworth is a white bean breeder at CDA's Harrow, Ont., Research Station.

tion and Marketing Branches of Agriculture Canada have developed a pedigreed seed program to produce white bean seeds free from diseases such as bacterial blight. This program includes inspection of seed-production plots and rejection of seeds for commercial planting from diseased plots. The system falls short of its objectives when seed supplies become scarce.

The bacteria can travel in subtle ways and show up in the commercial crop. It takes only a few infected plants to spread the disease under favorable weather conditions.

Bacterial strains are always evolving; blight bacteria are no exceptions. They may evolve for increased virulence, especially when new cultivars are introduced. The new cultivar may be susceptible if inadequately tested before release. In Ontario, increased bacterial blight occurred when the bean cultivar Sanilac was introduced and the old cultivar Michelite gradually disappeared.

The blight bacteria are internally seed-borne and may also occur as a surface contaminant. Their detection, as well as the establishment of levels of seed contamination critical for an outbreak of disease in select seed growers' or commercial fields, are important aspects of blight research at Harrow.

In a survey of the bean-growing counties of southwestern Ontario, common and fuscous blights were found in about equal proportions. Isolated bacterial strains varied in virulence on different types of white beans, but the majority were highly virulent on Seafarer and Kentwood. Such variation is an important consideration in the breeding program to identify resistance to virulent bacterial strains.

The Harrow bean-breeding program makes use of the Great Northern type of blight resistance developed in Nebraska.

Figure 2. Bacterial blight reaction of Great Northern selection Nebraska 1-27.

TABLE 1. FIELD RATINGS OF BLIGHT INFECTION ON SELECTIONS AND CULTIVARS OF WHITE BEANS AT HARROW.

Bean selection or cultivar	Field Blight infection rating* 1977	1978
408D-3	4.25	4.75
408D-7	4.25	4.00
408D-11	4.25	4.00
408D-25	3.75	5.00
412D-6	5.75	6.00
217D-3	5.00	4.00
Sanilac	5.25	5.50
Seafarer	5.75	5.75
Kentwood	5.50	5.75
Tara	3.00	3.00
Jules	2.25	2.50
GN 1-S27	3.00	4.00

* Blight rating: 1 = most resistant, 6 = most susceptible (Average of 4 replicates each year)

Parental material used in crosses, susceptible indicator varieties such as Seafarer, and preliminary and advanced selections have been tested for the past few years in the field. They were adequately replicated in a "blight nursery" at Harrow, and inoculated by delivering the bacterial suspension through a boom attached to a tractor-drawn tank.

Plants were inoculated twice; once after the second and third 3-foliate leaves developed, and again at early pod stage. Tolerant plants were selected and tested in the greenhouse during the winter.

Greenhouse screening methods were improved by infiltrating the bacterial suspension into the first or second 3-foliate leaf with an air brush. The plant reaction was assessed by grading lesions on leaves on a 1 to 6 scale, 1 being the most resistant and 6 being the most susceptible.

The vexing problem for the breeder is that blight tolerance is linked to the undesirable features of late crop maturity and indeterminate plant habit. In the 1978 preliminary blight test in the field, five out of 13 selections were highly tolerant. Reaction of selections in 1977 and 1978 advanced tests in the field are given in Table 1.

A special isolation medium, selective for bean blight bacteria, has been developed. It will enable researchers to quickly identify contaminated seed or other sources of contamination. Immunological methods are being developed for even quicker and more sensitive identification of bacterial strains.

Research is also directed towards developing innovative methods of disease control that include eradication of seed infection or contamination, and a search for closely related antagonistic bacterial strains for biological control. ■

HYBRID SUNFLOWERS ARE HERE TO STAY

W. DEDIO

Les chercheurs s'emploient à mettre au point du tournesol hybride de plus grande précocité et de bon rendement. Il se peut qu'un ou deux hybrides précoces créés à la Station de Morden soient homologués l'an prochain.

Hybrid sunflowers employing the cytoplasmic male sterility-fertility restorer system first became available to U.S. growers about five years ago. Since that time, hybrids have been grown more and more, and now they have almost replaced the open-pollinated varieties in the U.S. More than half of the sunflowers planted in Canada in 1978 were imported hybrids although no hybrid varieties have been licensed here. Hybrids are attractive to growers for several reasons. Besides yielding about 15 to 20% more than the open-pollinated varieties, most hybrids are resistant to several diseases. Verticillium wilt, downy mildew, and rust are conditioned by dominant genes and thus can be easily incorporated into the hybrids. Most hybrids are also fairly uniform in height and maturity which facilitates harvesting.

Production of hybrid seed is costly. To obtain a single-cross hybrid, three lines are required. Since the female line is cytoplasmic male sterile, it requires a fertile maintainer line before it can be multiplied. The line is increased by planting alternate strips of the cytoplasmic male sterile and maintainer lines and harvesting only the male sterile heads. The maintainer line is increased by selfing with bags placed over individual heads. The third line is a fertility restorer and is increased in isolation through sib-crossing.

The hybrid seed is produced by planting alternate strips of cytoplasmic male sterile and fertility restorer lines and harvesting only the cytoplasmic male sterile line. Removing off-type plants in both crossing blocks is essential for good-quality hybrid seed.

Development of a sunflower hybrid is not only a matter of putting two lines together which have good combining ability. The restorer line should be highly self-fertile. Most commercially available hybrids are fairly self-fertile and are less dependent on bees for fertilization than the open-pollinated varieties.

Dr. Dedio is a sunflower breeder at the CDA Research Station, Morden, Man.

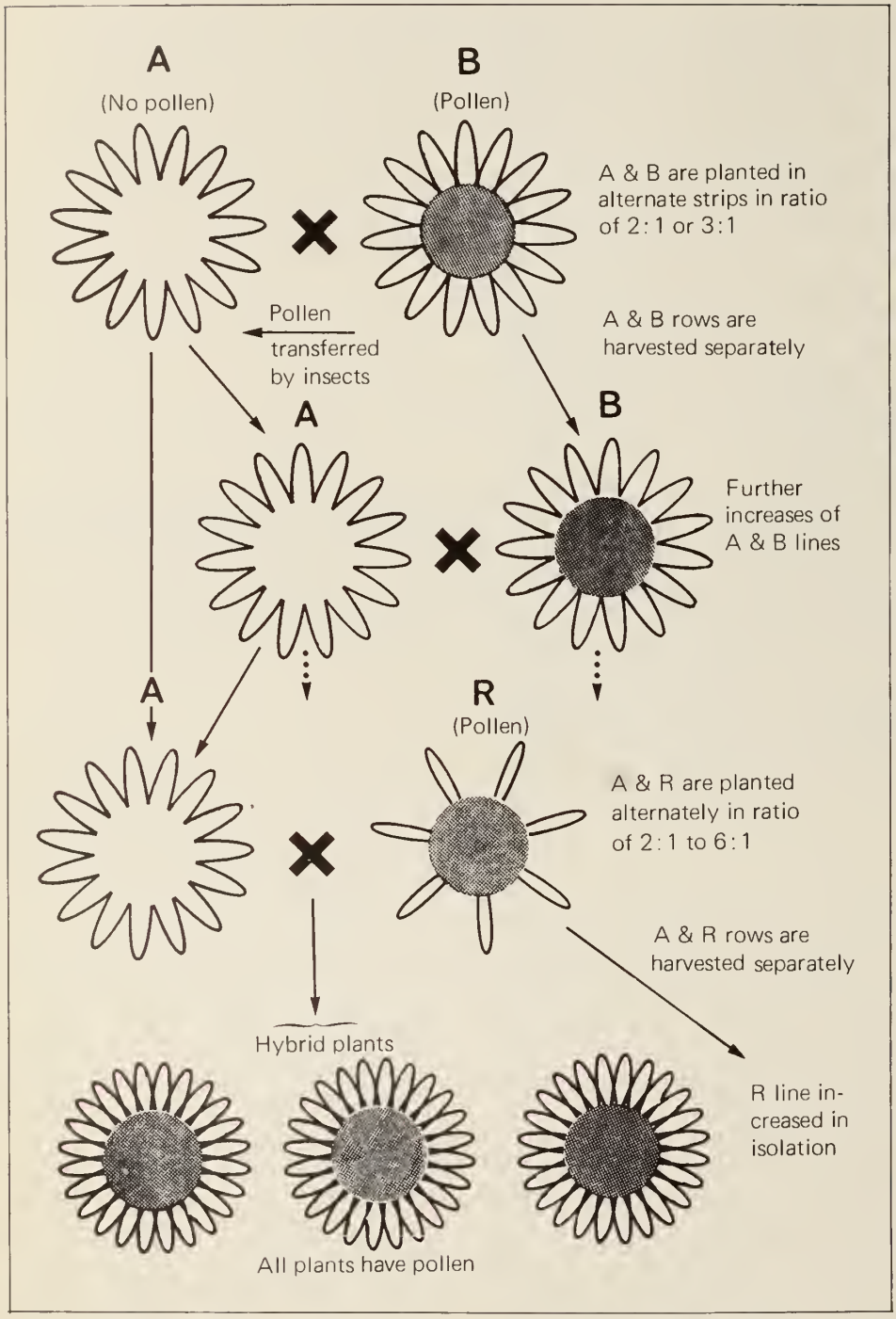


Figure 1. Schematic diagram showing the production of hybrid seed.

Figure 4. Author Walter Dedio examines hybrid sunflowers at the Morden Research Station.

It is also essential that the flowering of the two parental lines occurs at the same time in the crossing block. It might be necessary to stagger the planting of the two lines to achieve this. The restorer lines used in the U.S. are the branching-type. Since this characteristic is conditioned by recessive genes, it does not appear in the hybrid. However, the branching character may be desirable as pollen production is extended over a longer period.

The commercially available hybrids in the U.S. are considered too late for the Canadian prairies. They usually will outyield the open-pollinated varieties but their performance is not consistent from year to year because of the shorter growing season.

In Morden, we are aiming for earlier maturing hybrids and, at the same time, maintaining or improving the oil content. We have found that it is possible to obtain earlier hybrids with good yield and consideration is being given to license one or two hybrids in 1979. ■

SOIL CHANGES UNDER CRESTED WHEATGRASS

J. F. DORMAAR,
A. JOHNSTON, and
S. SMOLIAK

Les auteurs affirment que dans l'Ouest du Canada, près de 9 millions d'hectares de parcours et de terres à faible rendement peuvent être ensemencés de mélanges de graminées et de légumineuses pour en améliorer la capacité de paissance. Ils estiment que la production fourragère pourrait être triplée ou quintuplée en transformant les parcours en prairies artificielles et que l'agropyre à crête, graminée herbagère très utile, pourrait servir à remettre en végétation les terres abandonnées ou à faible rendement du sud-est de l'Alberta.

Coauthor Smoliak inspects a stand of crested wheatgrass at Lethbridge.

At the Lethbridge Research Station, we have found that rangelands and seeded pastures must be used systematically for efficient grazing management. We suggest that about 9 million ha of rangeland and marginal cropland in western Canada should be seeded to grass-legume mixtures. In addition to more efficient grazing use, we believe that forage production would be increased three- to five-fold by converting range to seeded pasture.

However, environmentalists are disturbed at the suggested destruction of much of the remaining native range of the region and the creation of what they consider to be an unstable monoculture in its place. Further, they do not believe that the increase in forage production will be long-lasting. Possible detrimental soil changes, the result of converting native range to seeded pasture, are also of concern to environmentalists.

Because of these concerns, we studied plant yields and soils under old stands of crested wheatgrass and compared them with plant yields and soils under adjacent native range. Our purpose was to see what differences existed between crested wheatgrass and native range sites and, more important, to determine if these changes were harmful.

Crested wheatgrass had been sown on abandoned croplands at the Manyberries Range Experiment Station in southeast Alberta during 1928-1937. These aging stands, and adjoining undisturbed native range of the mixed Prairie type, were used in our study.

Even though seeded about 50 years ago, crested wheatgrass has remained a monoculture with a basal ground cover of 10.35% and very little invasion by native species. Adjacent native range has remained a complex polyculture with a cover typical of the soil type and the region. Basal ground cover in 1977 was 10.59%, made up largely of blue grama, needle-and-thread, june grass, western wheatgrass, Sandberg's bluegrass, various forbs and fringed sage. Some club moss was on the native range site but not on the crested wheatgrass site.

Dr. Dormaar is a soils scientist and Dr. Johnston and Mr. Smoliak are range management specialists at the CDA Research Station, Lethbridge, Alta.

TABLE 1. YIELDS OF CRESTED WHEATGRASS (CWG) AND NATIVE RANGE (NR)

	Yield (kg/ha)		
Year	CWG	NR	Ratio CWG:NR
1940	1073	444	2.42
1948	395	213	1.85
1959	452	99	4.56
1960	382	70	4.69
1961	67	28	2.39
1962	472	38	12.42
1963	332	112	2.96
1965	1081	954	1.13
1966	1135	1048	1.08
1977	650	556	1.17
1978	1622	647	2.51
Avg.	696	382	1.82

Crested wheatgrass outyielded native range by from 1.08 to 12.42 times in the years for which data were available, and produced, on average, about twice as much forage (Table 1). In 1978, 50 years after the initial seeding, crested wheatgrass produced 2.5 times as much forage as native range.

Soil texture did not differ between crested wheatgrass and native range sites. This was an unexpected result because the crested wheatgrass sites had been cultivated for varying periods of time, might have been eroded by wind, and had then been abandoned; whereas the native range sites had not been disturbed.

Soil organic matter and its components were studied in the soils from the crested wheatgrass and native range sites (Table 2). Bulk density, a measure of soil compaction, was higher on crested wheatgrass sites whereas water-stable aggregates, a measure of the susceptibility to erosion, were higher on native range sites.

Amount of polysaccharides, which are long, chain-like molecules in the soil, did not correlate positively with water-stable aggregates although polysaccharides have been considered a major contributor to aggregate stability in the soil.

TABLE 2. CHARACTERISTICS OF THE AH HORIZONS OF CRESTED WHEATGRASS (CWG) AND NATIVE RANGE (NR)

	CWG	NR
pH	6.7	6.7
Bulk density (g/cm^3)	1.34	1.28
Water-soluble aggregates (%)	41.56	48.01
Nitrogen (%)	0.16	0.18
Available NH_4-N (mg/100 g)	8.40	11.02
Organic matter (%)	1.48	1.94
Total organic C (%)	1.05	1.14
Extractable C (% of total C)		
With $EtOH/C_6H$	3.01	3.73
With chelating resin	15.2	13.1
Total acidity of humic substances (meq/g)	5.67	6.27
Polysaccharides (mg/100 g)	268	224
Moisture retention (%)		
At 15 bar	6.19	6.29
At 0.3 bar	15.88	13.82
Root weight to 13 cm (g/m^2)	399	828
Calorific value of root mass (cal/g)	4,639	4,525

Total organic carbon, which plays a direct role in providing nutrients for good plant growth, was higher on native range than on corresponding crested wheatgrass sites.

Although the amount of energy generated by burning the root mass was similar for crested wheatgrass and native range, the root mass was greater under native range than under crested wheatgrass (Table 2). Total energy input into the soil system through breakdown of these roots was 3317 kcal/m^2 for native range and 1873 kcal/m^2 for crested wheatgrass. As a result of increased energy flow into native range sites, more energy was available to produce stable organic matter, and the biological processes of transformation of organic matter in the soil were probably more intense.

TABLE 3. VEGETATIVE PRODUCTION (KG DM/HA) AT 2 SITES, 1977.

	Vegetation type	
Vegetative component	Crested wheatgrass	Native range
Roots	3,990	8,280
Litter	936	421
Grass	552	445
Forbs and shrubs	29	114
Total	5,507	9,260

While we were not able to determine how harmful they may be, the reduced energy flow into the crested wheatgrass soil system, the increased bulk density, and the loss of stable aggregates under crested wheatgrass may adversely affect the environment of the crested wheatgrass study sites sometime in the future.

An interesting comparison can be seen by looking at the above- and below-ground vegetative production (Table 3). Since about 25% of the roots of crested wheatgrass and native range die and are replaced each year, the data refer to more than the 1977 production of roots. Nevertheless, in terms of total biomass, native range outyielded crested wheatgrass in 1977 and probably in other years as well.

Although a good root system is essential to the utilization of soil moisture and the uptake of soil nutrients, the range manager is most interested in the above-ground vegetative production since it provides forage for his animals and plant litter for ground cover.

Therefore, primarily on the basis of increased forage yield, we concluded that crested wheatgrass is a useful pasture grass for the revegetation of abandoned or marginal cropland in southeastern Alberta. ■

LA VALEUR FERTILISANTE DU FUMIER SUR LA FERME

Y. MARTEL et J. ZIZKA

Cattle and swine manures on several farms in Quebec were analysed to determine their fertilizing values at the time of application. Results showed that cattle manure maintained good fertilizing value with storage in a solid form outside, whereas swine manure stored in a liquid form lost enough nitrogen to affect the recommendations based on the composition of fresh manure.

Il est nécessaire de connaître la valeur fertilisante du fumier au temps de l'épandage.

L'application du fumier sur les sols agricoles constitue la meilleure façon de disposer des déchets animaux sur les fermes. Mais les recommandations de taux d'application des fumiers ne sont pas toujours faciles à faire car elles sont le plus souvent basées sur des valeurs théoriques qui sont habituellement obtenues à partir de la valeur fertilisante des fumiers frais.

Pourtant il est nécessaire de connaître plus précisément la valeur fertilisante du fumier au temps de l'épandage car le système d'entreposage et la manutention peuvent provoquer des pertes d'éléments utiles aux sols et aux plantes. Dans cet ordre d'idées, on a effectué un travail dans vingt fermes laitières et seize porcheries du Québec, dans le but de déterminer la valeur fertilisante du fumier au moment de l'épandage. Le fumier de bovins était entreposé sous forme solide, en tas, à l'extérieur tandis que le fumier de porcs était conservé sous forme liquide dans des fosses à purin et protégé par une couverture. Ce sont deux systèmes typiques d'entreposage du fumier au Québec.

Les résultats des analyses sont présentés aux tableaux 1 et 2. La variation dans la composition des fumiers entre les fermes est exprimée par les coefficients de variation (Io x 100/M) qui varient de 8 à 33% entre les fermes laitières et de 4 à 45% entre les porcheries. Ces variations que l'on peut considérer comme modérées proviennent des différences dans l'alimentation et la régie des fumiers d'une ferme à l'autre. Elles indiquent que les moyennes obtenues peuvent donner une bonne idée des doses de fumier à appliquer sur les sols pour les deux systèmes d'entreposage de fumier étudiés dans ce travail.

Les résultats moyens indiquent que la valeur fertilisante du fumier de bovins est sensiblement supérieure à celle du fumier de porcs au temps de l'épandage (2,4 fois plus riche en N, 1,5 fois en P et 3,8 fois en K). Ils indiquent, de plus, qu'en se basant sur les valeurs théoriques, on sous-estimera les quantités appliquées de N mais surestimera

TABLEAU 1. VALEUR MOYENNE DE LA COMPOSITION DU FUMIER DE VACHES LAITIERES.

H_2O	N	P	K
%		kg/t	
Au temps de l'épandage dans 20 fermes			
73±6	4,7±1,1	2,1±0,7	4,9±1,2
Valeurs théoriques*			
85	5,5	0,85	2,9

* Les valeurs théoriques représentent des moyennes provenant de plusieurs sources.

TABLEAU 2. VALEUR MOYENNE DE LA COMPOSITION DU FUMIER DE PORCS

H_2O	N	P	K
%		kg/t**	
Au temps de l'épandage dans 16 fermes			
M±1σ 93±4	2,0±0,9	1,4±0,6	1',3±0,4
Valeurs théoriques*			
85	6,5	1,5	4,6

* Voir note du tableau 1.
** Une tonne = 300 gallons impériaux

Yvon Martel et Jean Zizka sont spécialistes des sols à la Station de Ste-Foy.

les doses de P et K pour le fumier de bovins alors qu'on sous-estimera les recommandations de N et K pour le fumier de porcs. Ceci prend une importance pratique lorsque l'on veut nourrir adéquatement les plantes en cultures et prévenir la pollution des eaux par des doses excessives de fumier.

La quantité de fumier à manipuler au Québec est estimée à près de 15 millions de tonnes pour les bovins et à 2,8 millions de tonnes pour les porcs. Tout ce fumier contient donc à l'épandage 76,000 de tonnes de N, 35,000 tonnes de P et 77,000 tonnes de K. Si on considère que l'on emploie annuellemet environ 40,000 tonnes de N, 25,000 tonnes de P et 65,000 tonnes de K sous forme d'engrais chimiques, on peut voir que les fumiers de bovins et de porcs contiennent à eux seuls plus d'éléments fertilisants sous forme de N, P et K que tous les engrais chimiques.

Le fumier existe dans les fermes ou habituellement près des sols agricoles. Puisqu'il provient des récoltes de la ferme, il devient donc prioritaire de le régir adéquatement puisque ce serait un moyen de conserver les ressources d'éléments fertilisants au niveau même de la ferme et de les recycler dans les plantes.

Des efforts sont faits pour disposer des fumiers de la façon la plus agronomique possible. Il ne coûte pas plus cher d'appliquer le fumier à des taux profitables pour les plantes que de l'appliquer à des doses injustifiables. De plus, l'utilisation rationnelle des fumiers peut permettre de diminuer les applications d'engrais chimiques tout en améliorant les propriétés physiques du sol par des apports organiques. Dans ce sens, le fumier peut indirectement aider à diminuer le grand besoin d'énergie sur les fermes. ■

TABLEAU 3. QUANTITES DE N, P ET K CONTENUES DANS TOUS LES FUMIERS DE BOVINS ET DE PORCS AU TEMPS DE L'EPANDAGE.

	Fumier épandu t (millions)	Contenu en N	P	K
			t	
Bovins	15	70,500	31,500	73,500
Porcs	2,8	5,600	3,920	3,640
Total	17,8	76,100	35,420	77,140

FISH WASTE TO FISH SILAGE — A LIVESTOCK FEED

K. A. WINTER and
A. H. JAVED

Les recherches révèlent que l'ensilage à base de déchets de poisson pourrait servir en alimentation du bétail dans les régions situées près des ports de pêches. L'utilisation de ce type de déchets permettrait ainsi aux petites usines de poissons d'accroître leurs revenus en commercialisant ces produits dont l'élimination coûte cher ou crée des problèmes de pollution.

In processing fish into edible portions, a considerable amount of waste material is generated. In large processing plants with continuous operation this waste is usually converted to fish meal. However, on the Canadian east coast many small fish-processing plants do not produce enough waste to make fishmeal production economical. However, much of this waste could be processed into fish silage and used by local livestock producers as a protein supplement.

The production and use of fish silage is not a new idea. Fish silage has been used as a livestock feed in European countries such as Denmark, Poland, and the United Kingdom for several decades. In these countries, fish silage is used mainly as a source of high-quality animal protein for swine and poultry.

The production of fish silage begins with the fish waste or offal being ground or minced through a suitable type of grinder. This ground material is placed in an acid-resistant vat, formic acid is added, and the materials are mixed thoroughly. Mixing may be repeated for several days after the acid is added.

The mixture is allowed to stand for a period of time while autolysis or breakdown of the tissue proteins

Dr. Winter is a ruminant nutritionist at CDA's Charlottetown, P.E.I., Research Station, and Dr. Javed is extension nutritionist with the P.E.I. Dept. of Agriculture and Forestry, Charlottetown.

takes place in the acid medium due to the action of cellular enzymes released by the grinding.

After a period of time, which varies depending on temperature, the mixture liquefies. The resulting product is relatively stable and can be stored for at least a year without spoilage. This process is the basis of most current fish silage production.

Earlier attempts in Canada to preserve fish waste generally utilized mineral acids such as sulfuric rather than the organic formic acid. These mixtures were very corrosive and required neutralization with limestone before being fed. Current techniques utilize organic acids, mainly formic, that is added at 3 to 3.5% (w/w) of the fish waste.

Formic acid controls bacterial growth, yields a product with a higher pH than mineral acids, is less corrosive, and does not require neutralization before feeding. Norwegian workers have recently produced a silage using 0.75% formic acid and 0.75% propionic acid which stored successfully up to one year.

Several cooperative studies were conducted in Prince Edward Island on the production and use of fish silage involving the Provincial Departments of Agriculture and Forestry, and Fisheries, as well as the Agriculture Canada Research Station. The fish silage for these studies was produced from whitefish offal which was ground and had 3.5% formic acid added as a preservative.

The initial study was an on-farm experiment to assess the acceptability of the product to young ruminants, the growth rate of the animals, and to observe any disease or other problem that could be related to the fish silage feeding. A group of 17 Holstein and Holstein X Hereford steers and heifers 3 to 5 months old were used. During the 208-day test period, feed consumption averaged 4 kg/head/day of poor-quality hay and 6 kg of a grain mix, mainly oats plus minerals and vitamins. Fish silage was top-dressed on the grain at the rate of 1 kg for each 4 kg of grain. The animals consumed the fish silage readily and very few health problems were encountered. Daily gains for the animals ranged from 0.6 to 0.9 kg while the fish silage was fed — acceptable gains in view of the diet being fed.

Calves adapt quickly to eating a grain-fish silage mixture at the Charlottetown Research Station.

Ground fish waste is mixed with formic acid. The mixture eventually liquefies and can be stored for at least a year without spoilage.

A second experiment was conducted at the Agriculture Canada Research Station with early-weaned calves. Holstein bull calves were weaned from milk at 3 weeks of age and then fed either a conventional calf starter or a dry-grain mix plus fish silage. Two parts of the grain mix were mixed with one part fish silage before feeding. The calves adapted quickly to the grain-fish silage mixture and dry matter intake increased rapidly after weaning. For the entire 10-week experimental period the calves consumed an average of 1.73 kg/day (dry

matter) of the grain-fish silage mixture compared with 2.0 kg/day of the conventional starter. Weight gains for the same period averaged 0.72 kg/day for the fish silage-fed group and 0.78 kg/day for the other group. In view of the similar intake and growth results for the two treatments and the lack of any health problems or other adverse effects, fish silage appeared to be a satisfactory source of supplemental protein for young calves.

Some calves from this experiment were fed the experimental ration until they were slaughtered at about 140 kg live weight. Fish-silage feeding was withdrawn from the calves at 0, 14, and 28 days before slaughter.

The meat was evaluated by a taste panel and no "fishy" flavor or aroma was detected in the meat of calves fed fish silage, even when the feeding was continued up to the day of slaughter.

A third experiment was conducted as an on-farm experiment using a dried fish silage-bran mixture in the ration for broiler chicks. The test ration, using the bran-fish silage as a protein source, was combined with a commercial broiler ration in the following ratios: 0:3, 1:2, 2:1, and 3:0. The birds on all four treatments were switched to a commercial broiler-finisher ration after 4 weeks, except one-half of the birds that were on the 100% bran-fish silage test ration.

Final weights declined slightly as the proportion of test ration increased. This was attributed to the increasing amounts of bran in the ration and the decreasing digestible energy (D.E.) contents of the rations. Also, feed:gain ratios were poorer with the chicks fed an increasing proportion of test ration.

It was concluded that the use of another material with a higher D.E. content than bran to mix with the fish silage should improve the performance of fish silage-fed birds. Meat from these broilers was evaluated by a taste panel and, as with the calves, no fishy flavor or aroma was detected even in the broilers fed the test ration up to the time of slaughter.

An on-farm trial is underway on the use of fish silage in pig rations. However, based on European work and the acceptance of fish silage in Europe for pig feeding, its use for this class of farm livestock here should present no problems.

Based on our studies, the results of other research, and the developed uses of fish silage in other countries, it appears to have a definite place in livestock feeding in Prince Edward Island and other east coast provinces where livestock-production areas are located adjacent to fishing ports.

This technique of fish-waste processing, which is particularly adapted to smaller processors, should enable many of our smaller plants to realize an income from a waste product that, in some cases, is costing them money for disposal or is creating environmental problems. ■

RESEARCH RESCUES THE SPARTAN

M. MEHERIUK

Grâce aux recherches effectuées à Summerland, les pommes Spartan sont trempées dans une solution de calcium et d'épaississant pour réduire la fréquence de brunissement et de ramollissement de la chair en entrepôt.

The Spartan apple, introduced in 1936 by the Research Station at Summerland, B.C., constitutes a significant portion of the total apple production in British Columbia today. But susceptibility to internal flesh browning during storage nearly eliminated Spartan as a commercial variety.

The first indication of the disorder appeared in 1951. There was no serious recurrence until 1964. Breakdown was extensive and losses substantial enough to have the cultivar removed from the planting list. Growers were advised to graft young Spartan trees to other cultivars. Incidence of breakdown was much less over the subsequent years but disaster struck in 1969 and 1970. A major portion of the crop was lost in both years and market

Dr. Meheriuk researches fruit storage at CDA's Summerland, B.C., Research Station.

Flesh breakdown in Spartan apples.

resistance was high. Growers received a small fraction of the cost of production. Elimination of Spartans from commercial production seemed imminent. However, costs to replace the cultivar would be very high considering tree removal, replacement, and loss of production before another cultivar reached the same production level of 0.75 million bushels. Losses approaching $100 million were suggested.

A breakthrough occurred in 1965 when Dr. J. Mason found calcium deficiency to be a major factor in the cause of the disorder. Subsequent work by Dr. S. Porritt and P. Lidster revealed that storage humidities in excess of 80% promoted the disorder whereas humidities of 75-80% nearly eliminated the problem. Controlled atmosphere (CA) storage reduced the incidence of the disorder markedly. Treatment of the fruit immediately after harvest with 18% CO_2 or the use of low pressure storage (100 mm Hg) for 2 weeks before regular storage was effective in reducing the disorder.

More experimental work showed preharvest calcium sprays to be beneficial, but dipping the fruit in a calcium solution after harvest was more effective and convenient and could be done at packing houses. The use of the thickener has resulted in a greater uptake of calcium by the fruit. As a consequence of the research at Summerland, industry has adopted the practice of dipping all Spartan apples destined for air storage (−1°C) in a solution of calcium and thickener (Keltrol). This program is responsible for a return of confidence in Spartan apples judged by the significant recovery of the market and profitable returns to the growers. Demand for the cultivar continues to increase and the future of Spartan is assured. ■

BLACKFLY SPECIES ADAPT TO CHANGE

F. J. H. FREDEEN

La région de Stoney Rapids sur les affluents nord et sud de la rivière Saskatchewan ont été la source de graves foyers d'infestation bovine par la mouche noire, *Simulium arcticum*. Le débit saisonnier de ces affluents est actuellement régularisé, ce qui entraîne de profonds bouleversements dans la fréquence des six principales espèces de mouches noires qui habitent cette région.

For years, stony rapids in the north and south branches of the Saskatchewan River were the sources of periodically severe outbreaks of the cattle-infesting blackfly, *Simulium arcticum*. Livestock lost due to massive outbreaks of this species were reported as early as 1886 by ranchers south of Saskatoon, and in 1895 near Prince Albert.

Following four unusually severe outbreaks in Saskatchewan in the mid 1940's in which more than 1,100 domestic livestock were killed, Agriculture Canada entomologists at Saskatoon developed a chemical larviciding program. After 1947, one or both branches of the Saskatchewan River were treated almost every year because of annual reinfestations by larvae drifting downstream from some 800 to 1 000 km of untreated tributaries to the west.

In 1968, the normal seasonal flow pattern of the South Saskatchewan

Mr. Fredeen is an entomologist at CDA's Saskatoon, Sask., Research Station.

River in Saskatchewan was permanently reversed with closure of a new hydroelectric dam at Outlook. For the first time in the history of this river the large summertime river volumes were stored to provide power for wintertime periods of peak demands. During the summer months since 1968 the South Saskatchewan River has been shallow and clear rather than deep and turbid (Figure 1).

The volume of the North Saskatchewan River also is regulated, but in this river the dams are in the Alberta foothills. Big Bend reservoir on the Brazeau River was closed in 1960 and Bighorn on the North Saskatchewan in 1972. Since July 1972, summertime volumes of the North Saskatchewan River have been less than one-half those of the 65-year average and this river also has become relatively shallow and clear (Figure 2). The general drought on the Prairies in 1976 and 1977 accentuated these reductions.

Aquatic plants have invaded both rivers, providing new attachment bases for blackfly larvae. Turbid water prevented plant growth in earlier years. Water temperatures also have increased. On the North Saskatchewan River mean daily water temperatures attained 20°C or higher on only 21 days in 1972, but 71 days in 1976.

In view of these changes it is not surprising that there have been large reversals in the abundance of six major species of blackflies inhabiting these rivers.

Larvae of *S. arcticum*, formerly abundant, have been relatively scarce in the South Saskatchewan River since 1968, and in the North Saskatchewan since 1972. Until 1968, concentrations of larvae and pupae as dense as 100 or more per cm^2 of boulder surface were regular-

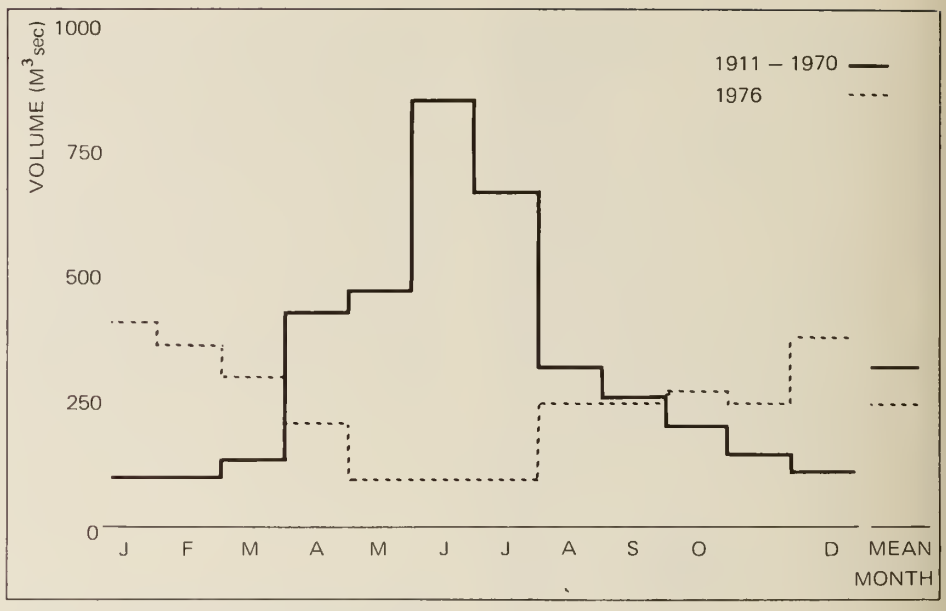


Figure 1. Average monthly volume flows in the South Saskatchewan River at Saskatoon, Sask., 1911 to 1970 inclusive, and in 1976.

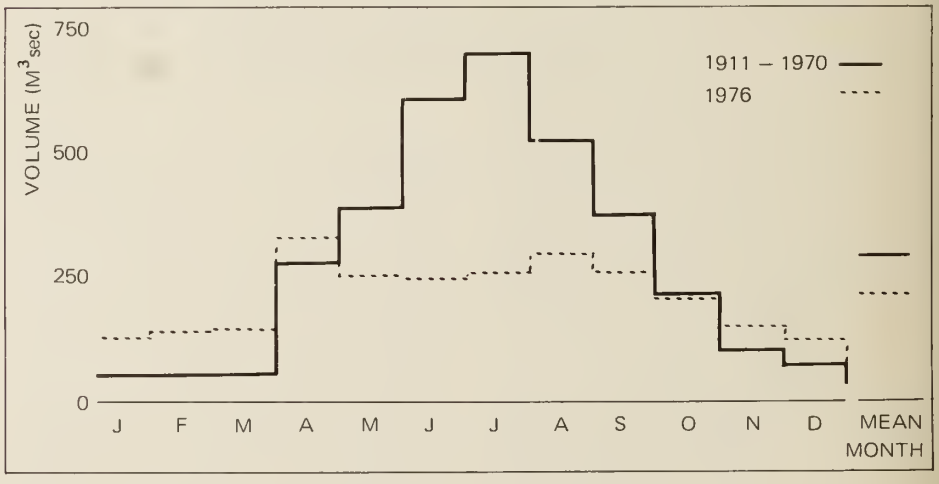


Figure 2. Average monthly volume flows in the North Saskatchewan River at Prince Albert, Sask., 1911 to 1970 inclusive and in 1976.

ly observed in both branches of the river (see Table). However, in 1977 the densest population seen in the south branch was only 3 per cm^2 and in the north branch, 17.

While the numbers of larvae of *S. arcticum* have declined, those of *S. luggeri* have increased. Larvae of *S. luggeri* normally are found only in small shallow rivers and were not detected in the South Saskatchewan River until 1968. By 1971, it was breeding so abundantly that emerging blackflies were harassing livestock in adjacent pastures.

In the North Saskatchewan River, larvae of *S. luggeri* sometimes occurred in very small numbers, having drifted in from small tributary rivers such as the Battle and Shell. In 1971, there was evidence for the first time that *S. luggeri* was multiplying in the North Saskatchewan River (see Table), and by 1976 its larvae had become more abundant than those of *S. arcticum.* That year widespread outbreaks of *S. luggeri* blackflies originated repeatedly from this river, affecting livestock and people in some 10,000 km^2 of farmlands in the Prince Albert-Nipawin regions.

The bites of *S. luggeri* are not as toxic to animals as those of *S. arcticum.* Nevertheless this species presents some serious problems:

1) It attacks man and livestock. *S. arcticum* rarely attacks man. During the 1976 outbreaks there were many days when people could not work out-of-doors unless protected with repellents.
2) *S. luggeri* swarms about the heads of animals, biting them around the eyes and causing them to panic and stampede. Cattle spent a lot of time running during the 1976 outbreaks when they should have been grazing or resting. One livestock owner reported that his stampeding cattle had broken down one half-mile of fencing. Some animals, especially calves, were lost because of trampling. Some were burnt when pushed into smudges. Weight gains were less than expected and in fact some animals became thinner rather than heavier that summer.
3) A more serious loss showed up in delayed calving in 1977 due to interrupted breeding activities in 1976. Some bulls became impotent due to infections.

Larvae of two other species of blackflies, *S. meridionale* and *S. vittatum,* also have increased in abundance in recent years in the two branches of the Saskatchewan River. *S. meridionale* is a small blackfly that bites birds as well as mammals. There is some concern that *S. meridionale* could transmit a form of malaria to birds (but not to mammals) and thus its population changes will be watched with care.

S. vittatum is a large silvery-grey species that attacks animals, mainly in their ears. The stable water conditions of the South Saskatchewan River have encouraged increases because the eggs of *S. vittatum* are laid in bands around boulders at the water line and must remain wet for a few days until hatched.

The dam at Outlook has fortunately eliminated one species, *S. griseum,* swarms of which used to attain nuisance proportions every summer at Saskatoon. This is a small yellowish species that breeds abundantly in warm water in the South Saskatchewan River in south-

TABLE MAXIMUM POPULATION DENSITIES OF FIVE SPECIES OF BLACKFLY LARVAE AND PUPAE OBSERVED IN THE NORTH AND SOUTH SASKATCHEWAN RIVERS IN SASKATCHEWAN (NUMBERS/CM^2).

	North Saskatchewan River near Prince Albert, Sask.				South Saskatchewan River near Birch Hills, Sask.				
	S. arcticum	*S. luggeri*	*S. meridionale*	*S. vittatum*	*S. arcticum*	*S. griseum*	*S. luggeri*	*S. meridionale*	*S. vittatum*
1947 to about 1968	100+	<1	<1	<1	100+	10±	<1*	<1	<1
1969	8	0	<1	<1	8	0	<1	<1	3
1970	91	<1	<1	<1	–	–	–	–	–
1971	49	3	<1	<1	–	–	–	–	–
1972	36	6	<1	<1	–	–	–	–	–
1973	34	1	<1	18	–	–	–	–	–
1974	3	<1	<1	<1	–	–	–	–	–
1975	35	33	<1	<1	–	–	–	–	–
1976	12	32	<1	1	–	–	–	–	–
1977	17	170	3	38	3	0	37	<1	16

*In the South Saskatchewan River larvae of *S. luggeri* were first detected in 1968.

ern Alberta. Larvae used to migrate downriver abundantly before the dam was closed in 1968, but now are prevented from doing so.

In review, changes in the Saskatchewan River system in Saskatchewan, brought about by hydroelectric dams are believed mainly responsible for declines in the numbers of *S. arcticum* and *S. griseum*, and increases in *S. luggeri, S. meridionale* and *S. vittatum.* Although *S. luggeri* is much less toxic to livestock than *S. arcticum*, abatement procedures were initiated in 1977 following widespread outbreaks in 1976. The ultimate solution to the blackfly problems will come with the eventual creation of a series of hydroelectric reservoirs that will flood major breeding sites in the rapids. ■

ORNAMENTAL PLANT TRIALS

T. J. COLE

Des essais destinés à trouver des espèces résistantes à l'hiver convenant à la région de la Capitale nationale sont menés à l'Arboretum de la Ferme expérimentale d'Ottawa. Ils portent sur des arbres, arbustes et plantes ornementales provenant d'un peu partout dans le monde. Les résultats obtenus sont régulièrement publiés dans les journaux d'horticulture, les revues professionnelles et les brochures du ministère de l'Agriculture du Canada.

The Dominion Arboretum on the Central Experimental Farm in Ottawa is a pleasant parkland with trees and shrubs from all over the world. During the summer, it provides a colorful background for wedding parties and photographers, picnickers and strollers.

Mr. Cole is Assistant Curator, Ornamental Research Section, at CDA's Ottawa Research Station.

When it was started in the late 1880's, the Arboretum's primary function was to grow trees and shrubs from around the world to find winterhardy species for the Ottawa area. Today that function remains basically the same, although it has been expanded to include ornamentals. New cultivars are grown and compared with those already established in the area.

Hardiness is still the most important criterion for new plants. It was discovered that some plants, not normally hardy here, may be root-hardy. The tulip tree (*Liriodendron*), which grows naturally as far north as the Niagara peninsula, was planted in 1897. For more than 20 years it was killed back each winter. Eventually a hardy shoot grew that, in time, formed a tree more than 15 m tall. However, the tree was struck by lightning in 1971 and had to be removed.

Other plants, while they may grow well, do not make good ornamentals in this climate. An example is Forsythia or Golden Bells. While these make good specimen shrubs up to 3 m tall, they cannot be recommended for this climate as the flower buds are not sufficiently hardy and survive only below the snow-line. However, among a group of seedlings grown here in 1936 was one plant that flowered to the top, and kept doing so year after year. This is now available from nurseries as *Forsythia ovata* 'Ottawa'.

With many cultivated hybrids sold by nurseries in North America and Europe, the evaluation of trees and shrubs takes on new significance. The question inevitably asked is, "Is it an improved form?" By comparing it with cultivars in our collection and other assessed forms, an evaluation of the new cultivar can be made.

There are limited alpine and perennial cultivars on the market, so new introductions can be readily assessed. However, in some species there are several hundred named

forms. Representative collections of the main groups of perennials are on display in the Ornamental Gardens and new varieties are evaluated in the nursery area.

Periodically the collections are reviewed and new varieties put on display while varieties no longer available commercially are eliminated. Thus the collections of peonies, lilies, phlox, daylilies, etc., are a good sample of the cultivars available commercially. More than 100 iris cultivars are on display in the Ornamental Gardens and another 150 are being tested in a nursery area. This is only a small percentage of the available named clones.

In addition to evaluating cultivars, we continually screen wild plant species for new or improved plants that can be successfully cultivated. Seeds are obtained from many sources, then germinated and grown in nursery beds or rows for evaluation as potential garden subjects. *Juniperus virginiana* 'Silver Column' presently growing in the rock garden is an example of one plant that has been selected, named and introduced to the trade in this way.

Annual plants are also tested to determine those best suited for the Ottawa area. Each year one or more types of annuals are chosen for a complete test that involves obtaining seed of every strain and named variety available from seed houses around the world. (For example, there are nearly 400 types of petunias.) These seeds are then germinated, grown, and planted in the area east of Heritage Barn 76. During the growing season they are observed at regular intervals. The period of bloom, size of flower, texture of blossom, ease of cultivation, resistance to pests and diseases and uniformity and purity of each particular strain or cultivar are considered. These factors are scored on a point system.

Author T. J. Cole examines a bed of tulips in the Ornamental Gardens on the Central Experimental Farm in Ottawa.

Seeds of many annuals are received from merchants throughout the world. These are grown, planted out, and evaluated the same way. At the end of the season a report on their seed strains is sent to contributing firms.

The results of these trials are published in trade and general horticultural journals. The information is also used in revising and rewriting CDA publications and in answering inquiries from both commercial firms and private individuals.

Ornamentals publications from CDA include: Annual Flowers for Canada, Hedges for Canadian Gardens, Culture of Ornamental Trees for Canadian Gardens, The Rock Garden and The Pruning Manual. Copies can be ordered from Agriculture Canada, Information Services, Ottawa K1A 0C7. ■

THE MOUSE IN AGRICULTURAL RESEARCH

J. NAGAI

L'Institut de recherches zootechniques d'Agriculture Canada vient de terminer à Ottawa un projet de sélection portant sur les souris. Trois lignées ont été respectivement sélectionnées pour les facteurs suivants: aptitude d'allaitement accrue, poids du corps adulte plus lourd et une combinaison de ces deux caractères. Les lignées visent à évaluer leur performance à long terme et celle de leurs croisements. L'étude présente certaines analogies avec d'autres projets de l'Institut sur la sélection des bovins laitiers ou sur l'amélioration du mouton. Le projet visant les souris peut fournir des renseignements utiles bien avant la réalisation des projets sur ceux visant les bovins laitiers et les moutons.

One of the goals of livestock breeding is to genetically improve quality and yield of lean meat in beef cattle. Livestock breeding research is done on the specific species of interest if the research is not limited by facilities, labor or equipment. Many times it is not feasible to adequately research directly all the relevant principles, especially for meat animals and dairy cattle.

In this circumstance, one approach is to use laboratory species such as mice. The rationale is that genetic principles are the same in livestock and laboratory species. Mice are relatively inexpensive and have a shorter life cycle (50-80 days); a planned genetic experiment can be completed in a relatively short time, and genetic information per unit cost is relatively large. Although two avenues of research using dairy cattle and mice, for example, are complementary, the results extracted from mouse experiments must be extrapolated to dairy cattle with caution. Both dairy cattle and mice produce milk, but they differ in the way milk yield is measured and the physiological mechanism underlying milk production. Livestock research can be aided by research using the mouse, but it cannot be replaced by mouse research alone.

Another approach is to use a computer for simulation studies. Future performance of a hypothetical population can be predicted quickly. However, all factors involved with performance must be known and all parameters (e.g. gene frequency) must be defined at the initial generation. If they are far from reality, computer outputs are of little value.

The three approaches (using livestock of interest, laboratory species, and computer) have advantages and disadvantages. For maximum efficiency, they must be used with a sense of balance. In breeding research, particularly of large livestock, a logical strategy is to research with a laboratory species and computer, then to research on a livestock species. In this sense, mouse research is considered a pilot study. With relative ease of operation (feed, space, etc.) it provides overall views on genetic improvement resulting from breeding.

Use of the fruit fly *(Drosophila)* or the flour beetle *(Tribolium)* for livestock breeding research can be of value because these species have a much shorter life cycle. However, they do not exhibit lactation, litter size, etc. Mice are more akin to domestic mammals (e.g. cattle and swine) in this regard. Mice and swine are similar in that they are both litter-bearing species.

Many theories that are currently used for livestock breeding have been developed and verified by mouse experiments. Some of the common research topics are: selection for single or multiple traits, effects of the selection on other traits, selection limits, mating systems and in-breeding, performance of various crosses, and performance of different strains (breeds) under different environments. Traits commonly examined include: body size, weight gain, body composition, feed efficiency, fertility, ovulation rate and sex ratio. Mice are useful for livestock breeding when they are used for studying the methods of genetic improvement of a population. With the exception of poultry, it is difficult to compare experimentally various methods of genetic improvements in livestock. Those methods can be compared with less difficulty in mice. By exploring methods that are common to livestock and mice, mouse research offers relevance to livestock breeding research, providing guidance to solutions of specific livestock breeding problems.

J. Nagai is a geneticist at CDA's Animal Research Institute, Ottawa.

A mouse selection project was recently completed at Agriculture Canada's Animal Research Institute, Ottawa. Three lines (M, W and B) were selected — for increased nursing ability in the M line, for heavier body weight at the adult stage (42-days old) in the W line, and for both traits using an index in the B line. The C line was maintained unselected as a control population for monitoring genetic improvement. These lines are used for experiments testing long-term performance of the selected lines and their crosses.

This project has analogies to the current National Cooperative Dairy Cattle Breeding Project (NCDCBP) and the Sheep Breeding Project at the Animal Research Institute. The objective of the NCDCBP is to examine the long-term performance of the Holstein and Ayrshire lines and their crosses. The objectives of the Sheep Breeding Project are to develop specialized sire and dam lines in confinement and to examine the performance of crosses between sire lines superior in growth and dam lines superior in reproduction.

The mouse project can provide results before such dairy cattle and sheep-breeding projects are completed. A separate mouse experiment revealed that in the degree of hybrid vigor in growth, crosses between lines selected for adult weight or post-weaning gain were superior to crosses between unselected lines. The result suggests that selection within lines, as in the NCDCBP or sheep projects, is effective in producing crosses with superior performance.

The selected mouse lines (M, W and B) differed from the unselected control line (C) in milk yield, and in DNA, RNA and protein content of the mammary glands. Milk yield was more closely associated with DNA than with protein/DNA ratio, indicating that milk yield is more dependent on cell number than on cell size in mammary glands. This information might be useful in considering breeding plans for improvement of milk producing livestock such as cattle and swine.

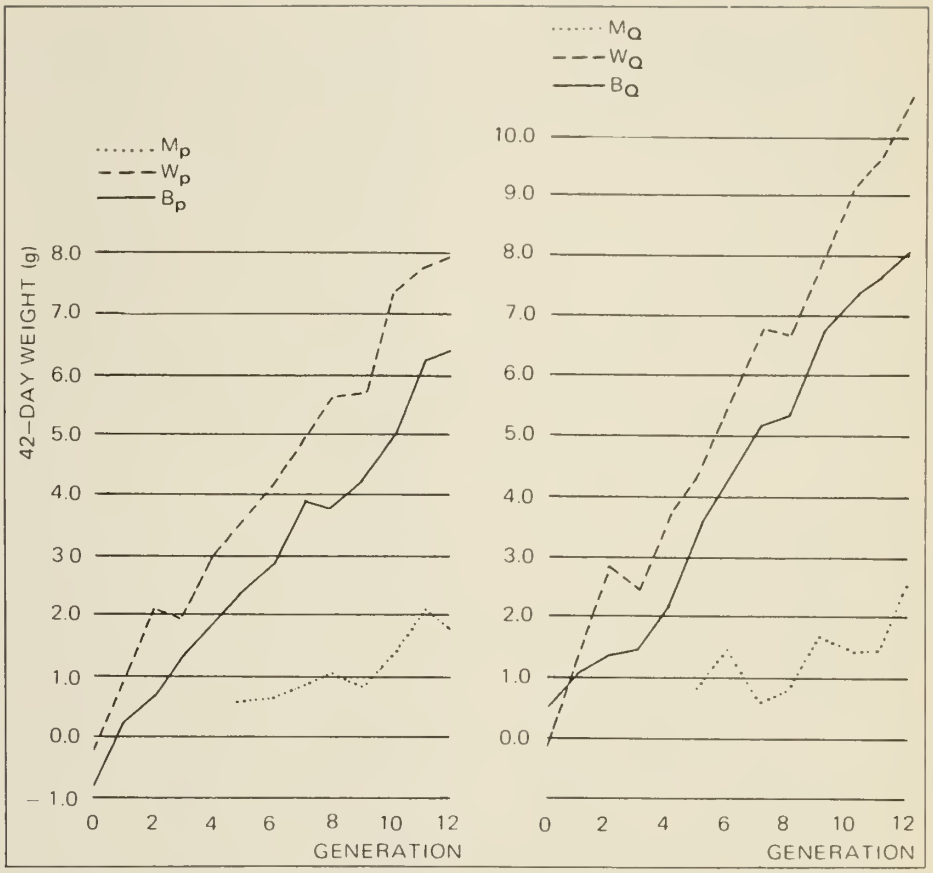


Figure 1. Changes in adult weight (at 42 days) of selected lines (M, W and B) in two populations (P and Q), expressed as the deviation from the control line (C). The mean 42-day weights during generations 0 - 12 were 22.89 ± .14 g and 27.29 ± .20 g for CP and CQ, respectively.

In the course of developing the mouse lines (M, W and B), a cross-fostering technique was applied whereby the offspring were exchanged among dams at birth so that each dam within a cross-fostering set suckled a nursed litter consisting of her own young and young from each of the other dams. This scheme permits us to measure genetic variation without interference of differential maternal performance among dams. By cross-fostering and selection, body weight at 42 days (at adult stage) increased significantly during 12 generations (Figure 1). The cross-fostering technique can

be used to evaluate maternal performance separately from growth potential of the offspring. It is used in swine herds at the Brandon, Man., Research Station, and in beef herds in Wisconsin.

In Agriculture Canada, mouse-breeding research is conducted at Ottawa and Lacombe. At the Greenbelt Farm, Ottawa, a facility to accommodate small laboratory animals was completed in 1977. This facility is designed to control environmental factors such as temperature, humidity and pathogens. In controlled environments, the quality of genetic experiments is expected to be upgraded, providing more accurate and useful information for livestock breeding. ■

BLACKLEG OF RAPE

G. A. PETRIE

La nouvelle souche de jambe noire pourrait être la maladie la plus dévastatrice qui ait touché le colza au Canada depuis de nombreuses années. Les producteurs doivent éviter de semer ce crucifère dans les champs contaminés de la campagne précédente ni dans les parcelles qui leur sont adjacentes. Parmi les autres méthodes de lutte, mentionnons la surveillance de la moutarde sauvage et du colza spontané, les pulvérisations aériennes (moyen faisant l'objet d'études) et le traitement des semences, que l'on recommande tout particulièrement.

Blackleg virtually wiped out the rapeseed industry in western Australia in 1972, two years after Canadian cultivars were introduced to the area as an alternative cash crop.

In 1973 blackleg caused severe damage in the important cabbage seed-producing area of Washington state, prompting one researcher to describe the situation there as a disaster. The fungus responsible,

Dr. Petrie is a plant pathologist at CDA's Saskatoon, Sask., Research Station.

Figure 1. Leaf spots on rape caused by the virulent rape strain of the blackleg fungus, *Leptosphaeria maculans*.

Leptosphaeria maculans or *Phoma lingam*, has caused economically significant yield losses in various cruciferous crops in many parts of the world for more than 100 years. In rutabagas, the disease affects the fleshy taproot both in the field and in storage and is known as "dry rot".

A weakly virulent form of blackleg has been present on rape in Western Canada for at least 20 years but has caused minimal damage. However, in 1975 the severe form of the disease was detected in a few rape fields in east-central and northeast Saskatchewan, important centers for the production of pedigreed rapeseed.

In 1978 virulent blackleg was still largely confined to these two regions, with minor outbreaks having occurred since 1975 at scattered locations elsewhere in central Saskatchewan. In 1977 a mini epiphytotic occurred east of Melfort, with more than 50% of the plants in some fields infected.

In 1977, virulent blackleg was detected in more than 17% of the Saskatchewan fields surveyed, compared with 12% of the 1976 fields, and 3% of the 1975 fields. The severity of the disease appears to have abated somewhat in 1978. To date there have been no verified instances of this strain of *L. maculans* in Alberta and Manitoba.

Appearance of the disease, life cycle, and epidemiology Windborne ascospores are discharged from the residue of the previous year's rape crop following rain showers. Primary infections on leaves in the developing crop show as dark-bordered spots having whitish centers dotted with small black fruiting bodies (pycnidia) (Figure 1). Pycnidiospores are spread by splashing rain to other leaves and to stems.

Figure 2. Stem infections on rape caused by the virulent rape strain of blackleg.

Stem infections also result from growth of the fungus directly into the stem from diseased leaves. Stem lesions generally resemble those on the leaves (Figure 2), but when they occur at the base of the plant, black cankers result. If basal infection begins sufficiently early, the taproot may be completely rotted and the plant severed at the base (Figure 3). The ascospore stage begins to develop in the fall on blackened stem or root tissue and in virulent strains, is completed the following spring.

Pod infection and subsequent seed infection appear to be relatively infrequent. Nevertheless, diseased seed may be an important means of dissemination of blackleg; hence the concern when the disease occurs where certified seed is produced. Blighted seedlings may serve as infection foci through the production thereon of pycnidia and pycnidiospores.

Spread of the pathogen via seed is of little significance in areas where there is an abundance of rape residue from which ascospores are being actively discharged. However, seed infection can introduce this disease to blackleg-free areas. It has been shown in Australia that even low levels of infected seed (less than 0.1%) can establish blackleg in rape crops. It is also known that the minimum level of seed infection required to initiate the disease in the field varies considerably from year to year in response to changing environmental conditions.

Approximately 2% of 800 Western Canadian rapeseed samples from the crop years 1976 and 1977 contained virulent rape strain. Usually less than 0.5% of the seeds in a lot were infected. However, as many as 2.5% of the seeds were infected in samples taken from severely diseased fields in 1977. Almost all of the affected seed lots originated in the pedigreed-seed producing area of northeast Saskatchewan, which gives the results added significance.

Weakly virulent strains of blackleg occur on several common cruciferous weeds. Wild mustard (*Brassica kaber*) is the only important weed host of the virulent rape strain. Stinkweed (*Thlaspi arvense*) harbors a strain that is highly virulent on this host but will not attack rape beyond the seedling stage. The major physiological races of this

pathogen in Western Canada are described in Table 1.

It appears that ascospore production by the different strains or races on plant residue does not begin at the same time (Table 1). The weakly virulent rape strain generally starts discharging ascospores in early August. A high level of spore production is maintained throughout September and October, making this strain widespread on stubble in the fall but rare on senescent plant material earlier.

The stinkweed strain often begins to discharge spores in April, and infections on *Thlaspi* occur early and increase throughout the spring and summer.

Ascospore discharge by the virulent rape strain has been detected as early as May, but it usually begins in June, with peak discharge in July.

Spore discharge in the stinkweed strain coincides with the period of greatest susceptibility of its adult host. The correspondence is less exact in the virulent rape strain, as its ascospore discharge occurs near the end of the six-leaf stage of growth, near the end of the period of greatest susceptibility. In some other parts of the world the virulent strain continues to discharge ascospores throughout the growing season.

Already the virulent rape strain has shown a tendency under Saskatchewan conditions to fluctuate considerably in incidence and severity at given locations from year to year. Preliminary data suggest that this may be due to a high degree of sensitivity of the ascospore-producing apparatus to temperature and moisture conditions.

Management practices will be of utmost importance in the short-term control of this disease.

Heavy blackleg infections have occurred only where rape has been seeded beside or in a field that had the disease the previous year. By the second year following a rape crop, the original sources of infection will have largely disappeared.

Burial of infected rape stubble also appears to be an effective means of control. Evidence to date indicates that the production of both ascospores and pycnidiospores on naturally infected rape stem pieces ceases in two to three months or

Figure 3. Severe basal stem cankers (two center stems) on rape caused by the virulent rape strain of blackleg (lightly infected stems on the far left and right).

TABLE 1. MAJOR RACES OF THE BLACKLEG FUNGUS IN WESTERN CANADA

Source	Description in text	Host reaction upon inoculation*		Ascospore production begins
		Rape	Stinkweed	
Rape	weakly virulent rape strain	R	R	late (August)
Rape	virulent rape strain	S	R	early (June)
Stinkweed	virulent stinkweed strain	R	S	very early (April)

*Adult plant reaction: S = susceptible, R = resistant.

less following burial in moist soil and does not resume after the material is uncovered.

Wild mustard should be kept in check as it is an important reservoir of infection for blackleg and a number of other rape diseases. Volunteer rape must also be eliminated.

Genetic resistance to blackleg has been identified in several rape and mustard introductions from other countries. Some cultivars of *Brassica juncea* (brown and oriental mustard) have excellent resistance at both seedling and adult stages of growth. Work is progressing in various parts of the world on the development of new blackleg-resistant cultivars. At Saskatoon we are working with several accessions that have appeared promising in preliminary tests.

Seed treatment with a combination of benomyl and thiram or benomyl and captan is strongly recommended to reduce spread of the disease to new areas. Control of blackleg through aerial sprays is being investigated.

The "new" strain of blackleg is potentially the most devastating disease to appear on rape in Canada for many years. An effective means of control must be found quickly. The importance of the appropriate management practices by growers cannot be overly stressed. The more spectacular examples of infection, in which 50 to 100% of the plants in a field are infected, could be avoided by not sowing rape in, or adjacent to, a field infected the previous year. ■

PRODUCING BEEF WITH LITTLE OR NO GRAIN

S. E. BEACOM

Des études révèle qu'il est possible d'obtenir d'assez bons rendements et des carcasses de qualité chez des bovins de boucherie alimentés de rations de fourrage broyé ne contenant pratiquement pas de céréales.

For centuries after man first began to hunt and later domesticate wild animals to supply part of his food, forage crops or other plant materials have directly or indirectly supplied the nutrients from which meat or milk was produced.

Dr. Beacom is Director of CDA's Melfort, Sask., Research Station.

Ruminants, through their unique ability to produce nutritious food from feeds that humans and other single-stomached animals cannot digest, are performing an important function that is likely to ensure their survival long after the pig and chicken, which compete directly with man for grains and other feeds, have disappeared.

Some years ago, when grain became relatively cheap, cattlemen discovered that ruminants grew more rapidly when the energy content of the ration was increased. Consequently, there has been a trend towards finishing beef cattle on grain. In some feedlots no forage or conventional roughage is fed at all.

Grain has become the mainstay of the feedlot industry. Current feeding standards for beef cattle recommend that finishing cattle weighing more than 320 kg and gaining over 1.1 kg/day receive no more than 15 - 20% "roughage" in their diet. If one uses 50% roughage, gains of only 0.9 kg/day can be expected, according to the feeding standards!

What the standards fail to take into account is that animals can eat more lower energy feedstuffs such as hay, if it is "densified" by grinding or pelleting. Animals can thus consume sufficient energy to support higher rates of gain.

Because forage production, harvesting and utilization technology has lagged behind cereal and oilseed crop production, farmers who have a choice have tended to grow cash crops, with or without summerfallowing, to the exclusion of forage crops. This has led to an alarming increase in soil erosion and the development of salinity problems affecting much of the most productive soils in Western Canada.

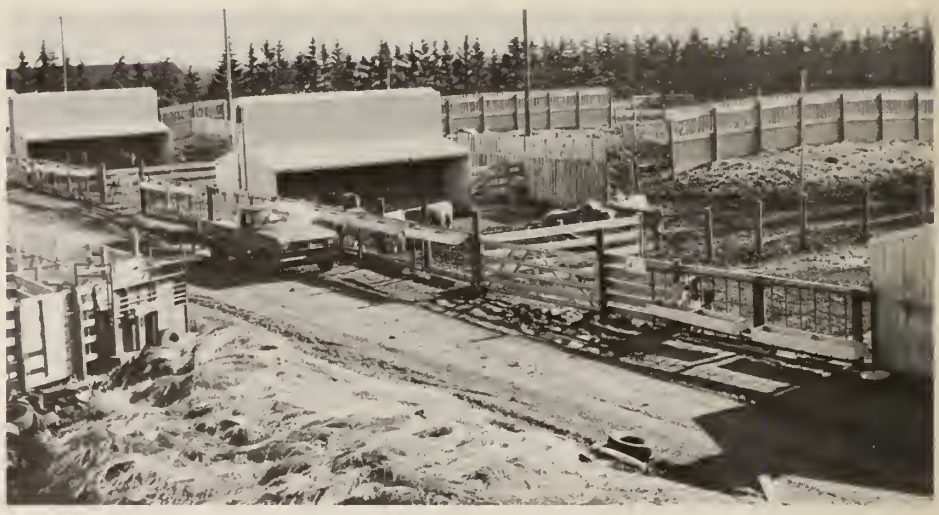
Recognizing that increased forage production could solve some of these soil problems, work was initiated in the mid-1950s at the Melfort Research Station to improve forage production, harvesting and utilization technology to the point where forage crops could offer an economically attractive alternative to cereal crops in the rotation.

In 1962, we started an investigation to improve the use of forage crops in rations for wintering and finishing beef steers, and to determine how much grain could be replaced with forage without affecting animal performance and carcass grades. This information gave feedlot operators more flexibility when formulating finishing rations, making them less dependent on grain when grain is in short supply or high in price.

Results of several feeding experiments with wintering steer calves to determine the effect of chopping and grinding various kinds and qualities of hay are in Table 1.

This work showed that the intake of hays could be increased by increasing the density of the forage through chopping and grinding, and that rate of liveweight gain would be increased more than proportionately.

If we value liveweight gain at $1.32/kg and assume that 60% of the value of the liveweight gain pro-



At Melfort, animals eat more lower energy feedstuffs such as hay if it is "densified" by grinding and pelleting. They can thus consume sufficient energy to support higher rates of gain.

TABLE 1. EFFECT OF CHOPPING AND GRINDING HAYS OF DIFFERENT KINDS AND QUALITY ON PERFORMANCE OF WINTERING STEER CALVES

	Daily DM consumed % live wt	Av daily gain (kg)	Live wt gain /tonne hay consumed	Estimated value of hay $/tonne
Timothy-Alfalfa (13.6% Crude Protein) 290 kg steers				
Long	3.29	.85	73	58
Chopped (≅9 cm)	3.34	1.07	83	71
Ground (5 cm)	3.50	1.03	76	62
Ground (1.3 cm)	3.50	1.12	74	59
Alfalfa (12.7% C.P.) 254 kg steers				
Long	2.67	.29	31	25
Chopped (≅9 cm)	2.54	.30	35	29
Ground (5 cm)	3.09	.45	43	40
Ground (2.5 cm)	3.18	.50	47	45
Ground (1.3 cm)	3.45	.62	53	53
Ground (.5 cm)	3.47	.56	48	46
Sweetclover (11.3% C.P.) 241 kg steers				
Long	2.13	.41	38	30
Chopped (≅9 cm)	2.54	.59	57	55
Ground (5 cm)	2.91	.69	64	65
Ground (1.3 cm)	3.19	.81	71	73
Slough Hay (9.5% C.P.) 273 kg steers				
Long	1.83	.32	48	38
Chopped (≅9 cm)	2 24	.44	53	45
Ground (5 cm)	2.34	.47	55	47
Ground (1.3 cm)	2.50	.55	60	54

duced from a tonne of hay will be a fair value for that hay, we can estimate the value of processed hay. Table 1 indicates that fine grinding of the good-quality timothy-alfalfa hay was not economical, but that processing the lower quality forages increased their feeding value in most cases, more than enough to cover the cost of grinding. Note also the good rate of gain made by steer calves fed the good-quality forage and the fact that grinding poorer quality forages made them, in some cases, almost equal to the unprocessed good-quality hay in terms of animal performance.

Fourteen steer-finishing experiments have been carried out since 1962. A summary of one of these experiments, in which the hay-to-grain ratio was held constant over the finishing period, is presented in Table 2. It shows it was possible to attain reasonable animal performance and acceptable carcass grades, even under the old grading system (which required more fat cover for top grading beef than does the current system), when steers were fed 95% good-quality ground hay (0.8 cm screen). It also indicated that where lower levels of ground hay were fed (45% or less), medium-to poor-quality forage gave better results (with the exception of dressing percentage) than did the high-quality forage. Dressing percentage was more adversely affected as the level of lower quality forage increased.

In both 1971 and 1972, when grain was relatively cheap, each of four rations were fed to 12 Charolais X Angus steers. The control lot received a 50% ground hay ration that was gradually changed to a 90% grain ration over 9 days. Steers in lot 2 received 909 kg batches of 70, 60, 50, 40, 30 and 20% ground, good-quality, brome-alfalfa hay rations and were placed on the finishing ration (90% grain) on the 39th day. Lot 3 received 1818 kg batches of the above-mentioned series of rations and were on the high-grain ration on the 74th day. Lot 4 received 2727 kg batches of the series of rations and were on the high-grain ration on the 95th day. The average content of ground roughage (straw and/or hay) was 11, 19, 28 and 35% for the four lots, respectively, of which 0, 11, 22 and 31% was forage. The condensed summary of results is shown in Table 3. Rate of liveweight gain and carcass grades (old system) were not adversely affected as the amount of ground roughage in the ration increased to 35%. Gains exceeded those predicted in feeding standards for steers receiving this level of roughage.

By 1973, grain prices had increased. Another experiment was carried out to determine how much higher hay levels could be increased. Table 4 shows that even at 65% ground hay, rate of gain was still slightly over 1.36 kg/hd/dy; dressing percentage was not reduced compared to the control (high grain) treatment and grades were as good as those of grain-fed steers.

In 1975, Charolais X Hereford and Angus X Hereford steers fed a medium-quality ground wheatgrass hay ration, containing only 8-10% grain, gained at the rate of 1.27 kg/day with a feed-to-gain ratio of

TABLE 2. EFFECT OF HAY QUALITY AND LEVEL IN RATIONS FOR FINISHING STEERS (2 LOTS OF 8 STEERS EACH TREATMENT)

		Hay level %			
		20	45	70	95
Good Hay Quality					
Crude protein		14.8	15.1	15.7	16 4
A.D. Gain (kg)		1.77	1.31	1 40	1 35
F/G Ratio		7.65	10.78	11.34	11 30
Dressing %		53.9	54.4	53 6	52 8
Carcass grade*	Ch	6	5	2	4
	Gd	10	10	13	12
	Std	14.8	15.1	15.7	16.4
Medium Hay Quality					
Crude protein		13.6	13.2	12.4	11 8
A.D. Gain		1.89	1.58	1.35	1 09
F/G Ratio		7.00	8.68	10 29	13 40
Dressing %		53.6	53.0	52 2	50.8
Carcass grade	Ch	9	7	5	4
	Gd	7	9	11	12
	Std	0	0	0	0
Poor Quality Hay					
Crude protein		13.1	12.1	11.5	10 0
A.D. Gain		1.76	1.64	1.33	75
F/G Ratio		8.38	9.62	12.12	17 25
Dressing %		53.2	52.6	51.3	47.5
Carcass grade	Ch	11	5	3	1
	Gd	5	11	11	11
	Std	0	0	2**	4**

(All forages ground through 5/16" screen).
*Grading system 1966-67.
**Utility.

9.0. Dressing percentage averaged 54.8 and 16 of the 18 steers graded A_1 or A_2.

Roasts from the Charolais crossbred steers fed high-hay rations scored less for tenderness than did those from the grain-fed Charolais steers (2.8 vs 3.4 on a scale from 0-6). However, the tenderness scores for the Angus crossbreds and the scores for flavor and juiciness of meat from both kinds of crossbreds fed high-forage rations were not significantly different from those obtained from the steers fed the high-grain ration.

In 1977, steers (half of which were implanted) finished on 98.8% ground (1.27 cm screen) medium to good brome-alfalfa hay (no grain) gained 1.1 kg/dy with a feed-to-gain ratio of 12.4, a dressing percentage of 53.5 and graded 9 A_1, 6 A_2, 1 A_3. When 20% rolled barley was fed with ground hay, rate of gain averaged 1.2 kg/dy, feed-to-gain ratio was 11.0, dressing percentage averaged 54.5, and grades were 9 A_1 and 7 A_2. Steers fed a 90% barley control ration averaged 1.4 kg/dy, had a feed-to-gain ratio of 8.7, dressed 56.3%, and graded 12 A_1 and 4 A_2.

Experiments to date lead us to believe that for best animal performance a high-grain ration should be fed for at least a few weeks just prior to marketing. However, if grain is very expensive relative to ground hay, it could be economically sound to finish cattle on good-quality ground forage only.

Having shown that reasonably good performance and carcass quality can be achieved on ground forage rations, the challenge is to further improve performance of forage-fed steers.

Perhaps with further improvements in forage varieties and harvesting and storage techniques, the unit cost of forage crops can be reduced and still provide the producer with a reasonable profit. For example, in long-term rotation studies on various soil types in northeastern Saskatchewan, it has been possible to justify using forage two years in a six-year rotation on the basis of increased yields of subsequent cereal crops alone. In situations like this, use of that forage in wintering or finishing beef steers should give farmers an economic advantage in the cattle-feeding business. ■

TABLE 3. EFFECT OF RATE OF INCREASING THE LEVEL OF GRAIN IN STEER FINISHING RATIONS CONTAINING HIGH LEVELS OF GROUND HAY INITIALLY

	On 90% grain in 9 days	Start on 70% ground hay to 90% grain at 39 days	Start at 70% ground hay to 90% grain at 74 days	Start at 70% ground hay to 90% grain at 95 days
% Total roughage	11	10	28	35
Av daily gain (kg)	1.46	1.45	1.47	1.52
Feed: Gain ratio	7.54	8.05	8.19	8.22
Dressing %	56.5	56.4	56.2	56.1
Carcass grades* Ch	15	14	17	16
Gd	7	8	5	6
Std	2	2	2	2

*Old system of grading.

TABLE 4. EFFECT OF INITIAL LEVEL OF GROUND FORAGE AND LENGTH OF TIME TO CHANGE TO A HIGH-GRAIN RATION ON PERFORMANCE OF FINISHING STEERS (147-DAY TEST).

	Lot 1	Lot 2	Lot 3	Lot 4
On 90% grain in -days	9	105	119	126
Av % ground roughage at start	50	70	80	90
Av % ground roughage (total)	11	37	51	65
Av daily gain (kg)	1.54	1.56	1.45	1.39
Feed: gain ratio	7.0	7.9	8.5	8.8
Dressing percentage	56.3	55.8	56.1	56.5
Carcass grades A_1, A_2	10	10	10	10
A_3	1	1	1	1

SUGAR BEET CYST NEMATODE AND RAPESEED

E. J. HAWN

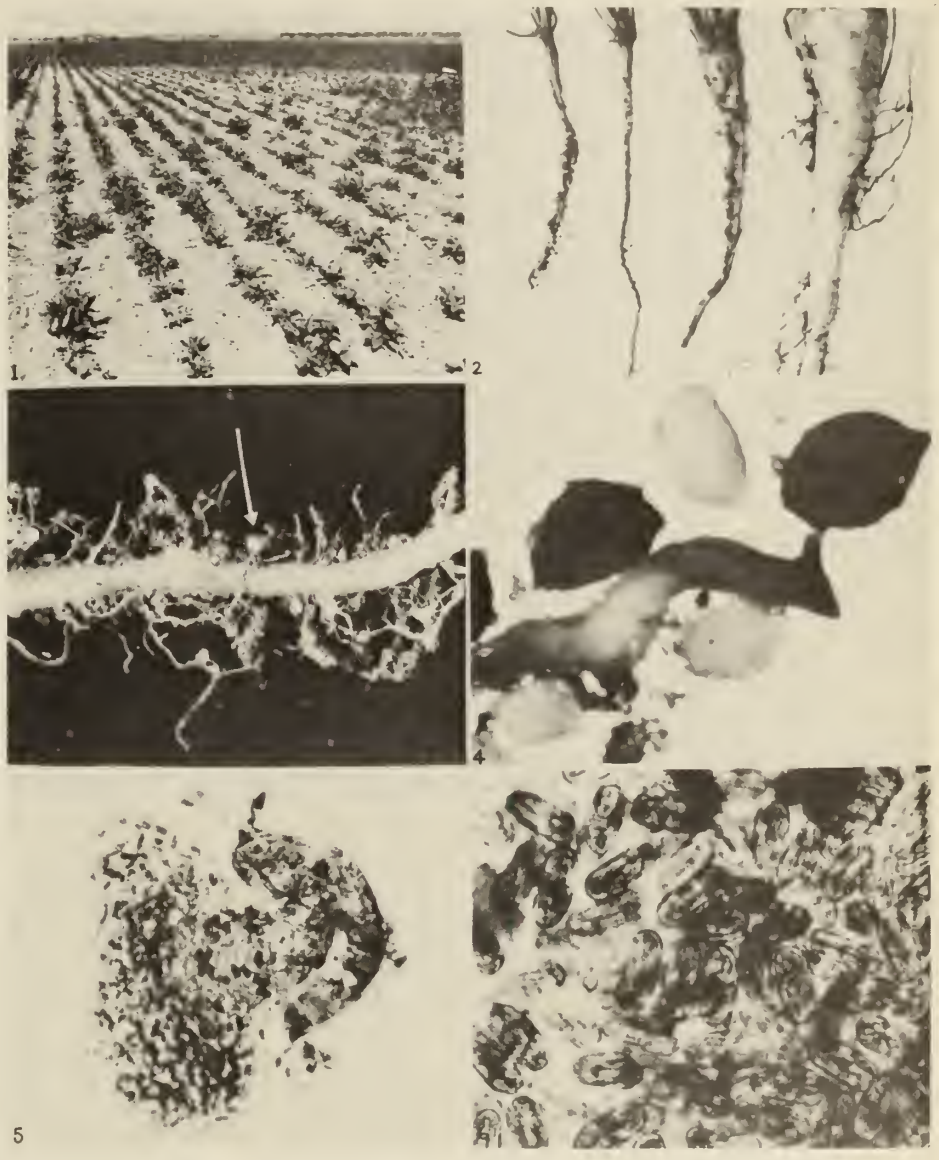
Selon les études effectuées par la Station fédérale de recherches de Lethbridge, les variétés recommandées de colza ne doivent pas entrer dans un assolement avec la betterave sucrière parce qu'elles sont aussi sensibles à l'anguillule qui s'attaque à cette dernière.

Recommended varieties of rapeseed are susceptible to the sugar beet cyst nematode according to recent studies at the Lethbridge Research Station. Therefore, rapeseed should not be planted in rotations of sugar beet.

The sugar beet cyst nematode, *Heterodera schachtii,* has been recognized as a hazard to sugar beet production in southern Alberta since it was first found near Taber in 1961. The nematodes were initially detected because of the appearance of obviously 'sick' beets in a field that had produced beets in 10 of the previous 17 years. Subsequent examinations of tare dirt samples collected at beet-receiving stations in 1961, 1962 and 1963 established that low populations of nematode cysts were in some fields of all principal sugar beet-producing districts.

Further spread and economic damage from this nematode have been avoided over the past 15 years because the sugar-beet industry adopted our recommendations that sugar beets or other crops susceptible to this nematode be grown only once every 4 years.

The recent proposal by a local oilseed processor that production of rapeseed be increased in southern Alberta has caused concern because



(1) Patch of sugar beets stunted by sugar beet cyst nematode; (2) Taproots with varying degrees of nematode infection (extreme, left, to healthy, right); (3) White cysts (arrow) on lateral roots of sugar beet; (4) White and mature cysts on lateral roots of sugar beet; (5) Egg content of a mature cyst; (6) Cyst nematode larvae in the eggs.

E. J. Hawn is a plant pathologist (nematode diseases of forages) at the CDA Research Station, Lethbridge, Alberta.

...rapeseed a host

rapeseed is known to be a host of the sugar beet cyst nematode. It was recognized that an increased area of a second nematode-susceptible crop in the irrigated areas of southern Alberta would increase the hazard to sugar beet growers.

Tests at the Research Station have determined the effect of locally recommended varieties of rapeseed on the buildup of cyst nematode populations. Three low-erucic acid varieties — Midas (Argentine), Tower (Argentine), and Torch (Polish) — were compared with the recommended commercial sugar beet. Consecutive crops were seeded in pots of nematode-infested beetfield soil mixed with cyst-free greenhouse soil to give initial egg-bearing populations of 0, 30, 60, and 120 viable cysts/kg of soil. Using controlled environment chambers, the test soils were recropped every 5 months, the growing time for sugar beets in southern Alberta.

Each of the rapeseed varieties tested was a good host of the nematode, in many instances comparable to the sugar beets (Table 1). The data show that, despite care in handling, even the zero-level controls had become contaminated after three consecutive croppings. The level of 22 viable cysts/kg in the check seeded to sugar beet would be sufficient to cause unthriftiness in sugar beets under field conditions. Second-crop levels, which exceeded 100 cysts/kg in the three initially infested soils, would cause 'sick' patches in beets in the field. Third-crop cyst levels surpassed 'sick' levels and in Tower, Torch, and sugar beets, exceeded 1,100 cysts/kg — sufficient to cause complete failure of the sugar beet crop. In contrast, even at these high levels, none of the rapeseed varieties showed any obvious top symptoms. This characteristic of rapeseed makes it a particularly insidious host of the cyst nematode.

Our results show clearly that rapeseed should not be grown in rotation with sugar beets because of a concomitant increase in levels of sugar beet cyst nematodes. ■

TABLE 1. LEVELS OF *HETERODERA SCHACHTII* CYSTS IN TEST SOILS CROPPED CONSECUTIVELY WITH RAPESEED OR SUGAR BEET

Initial level of viable cysts (no./kg)	Consecutive crops	Viable cysts (no./kg)			
		Midas rapeseed	Tower rapeseed	Torch rapeseed	Commercial sugar beet
0	1	0	0	0	0
	2	0	0	0	0
	3	4	3	1	22
30	1	10	12	9	18
	2	173	126	200	480
	3	517	537	601	517
60	1	18	16	22	35
	2	165	112	133	726
	3	460	558	546	1,133
120	1	43	45	24	29
	2	340	361	479	567
	3	837	1,330	1,141	1,309

(1) Patch of sugar beets stunted by sugar beet cyst nematode; (2) Taproots with varying degrees of nematode infection (extreme, left, to healthy, right); (3) White cysts (arrow) on lateral roots of sugar beet; (4) White and mature cysts on lateral roots of sugar beet; (5) Egg content of a mature cyst; (6) Cyst nematode larvae in the eggs.

ECHOES
FROM THE FIELD AND LAB

ECHOS
DES LABOS ET D'AILLEURS

THE STING A new aggressive wasp has found its way into Ontario. A type of yellow jacket, a catch-all phrase for several species of wasp, that originated in Europe, then spread to the U.S., stings readily and frequents places where people gather for summer fun. The wasp also invades beehives in search of honey.

The new wasp was first brought to the attention of Rolf Boch, an entomologist with the Canada Department of Agriculture in Ottawa, during last summer's Central Canada Exhibition. More than 100 fairgoers were treated for stings during the first 6 days of the exhibition – more than double the usual number. Dr. Boch began surveying wasp populations and collecting specimens, and identified the species Vespula germanica, a wasp not known to have spread north from the United States.

He says there is little that can be done to control the wasps. Their nests are hard to locate to destroy. He suggests keeping refuse containers closed to reduce the smell of food that lures the wasps.

A wasp new to Canada, Vespula germanica, may become a future pest.

AMMONIA-TREATED STRAW The energy yield of straw treated with anhydrous ammonia is normally increased by 25 to 30%, says J. E. Knipfel of CDA's Swift Current, Sask., Research Station. Also, the straw is more readily eaten by cattle than is untreated straw, he says.

The treated straw must still be supplemented for a complete ration, although the amount of supplement is less than that required with untreated straw.

There are some problems in treating straw with ammonia: anhydrous ammonia can be handled safely only by trained personnel who may not be available; and the economics of treating straw with ammonia varies as price of grain and/or other feedstuffs fluctuates.

Before treating straw with ammonia, Dr. Knipfel suggests cattle producers contact their agricultural representative, regional livestock specialist, the Swift Current Research Station or the University of Saskatchewan.

PRESERVING FLOWERS Your home can be decorated with real roses and daffodils all winter by following the steps given in a new Canada Department of Agriculture publication, "Preserving Flowers with Silica Gel".

Silica gel is a chemical used extensively as a drying agent in industry. It is not poisonous, does not cake or attract insects, acts quickly and is lightweight. Author Peggy Bolster of Ottawa describes which flowers are easier to dry and takes the reader step by step through the process. Black-and-white photographs make the process all the easier to follow. A useful manual, "Preserving Flowers with Silica Gel" is available free of charge from Information Services, Canada Department of Agriculture, Ottawa K1A 0C7.

INSECTICIDE FOR LIVESTOCK Permethrin, a new insecticide, is being evaluated for control of insects affecting man, livestock and crops. Permethrin is a chemical modification of pyrethrins, found in chrysanthemums, that have been used as insecticides for more than a century.

Dr. M. A. Khan and J. Weintraub of CDA's Lethbridge, Alta., Research Station, found that permethrin kills warble larvae and a few other livestock insects by direct contact.

Pour-on applications of permethrin were effective against larvae in warbles at the time of treatment, against warbles formed after treatment, and against sucking lice on cows habitually heavily infested with lice. Permethrin sprays and permethrin dust bags were effective in controlling horn flies.

Detailed information about permethrin's subclinical, latent, or delayed toxicity, if any, and about its effects on mammalian reproduction is not yet complete. Research on these aspects continues at Lethbridge and at other research centres.

Azuki beans grown in Canada may be exported to Japan where they are used as a filling for pastry.

NEW CROP Azuki beans (pronounced a-zoo-kee), a delicacy in Japan, could one day be a rotation crop for some parts of the Canadian Prairies. Grown mostly in Asia, the beans are processed with sugar and used as a pastry filling in Japan. But only 5% of the demand can be grown in the tiny country, and beans imported from other parts of Asia do not meet Japanese standards.

Some testing on azuki beans is being done at CDA's Morden, Man., Research Station, and in some parts of the U.S.

There's a problem in Manitoba with frost affecting the crop, says Dr. M. D. Stauffer of Morden. Their earliest variety is Morden 44, developed by Dr. Charles Walkof, now retired.

A bigger problem than the frost is transportation costs. However, if these problems can be overcome, the crop may one day be economically feasible for southern Manitoba.

COMPUTERS AND CATTLEMEN A computer model to evaluate crossbreeding programs in cattle has been set up at CDA's Lethbridge, Alta., Research Station. Proposals for crossbreeding schemes will be fed into the computer, and the results will tell cattlemen whether or not the proposed scheme is economically feasible.

The model has been set up as an interdisciplinary project headed by animal geneticist D. G. Keller and economist K. K. Klein.

Once completed, the computer simulation will be evaluated under practical farm conditions.

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