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

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

Fig. 1. Winter wheat seeding 1958. Background shows snow held on fenced area. Foreground bare of snow. March 15, 1959.

Cultural developments in winter wheat production

C. H. ANDERSON

L'expérience décrite dans cet article démontre l'étroite relation entre la couverture de neige et les dommages occasionnés au blé par l'hiver. Elle indique également le besoin d'une bonne couche de neige pour la survivance des récoltes pendant l'hiver.

It has been well demonstrated at Swift Current that the degree of winter injury to winter wheat is closely related to snow cover in the late winter and early spring. For example, snow fencing trapped and held snow during the winter of 1958-59 (Fig. 1) and prevented winter injury. This area produced a 30 bu/acre crop, while the wheat on adjoining bare land did not survive sufficiently to make a stand. Over the period 1959 to 1965, the lack of a protective snow cover resulted in total winterkill in three out of the seven seasons. Where snow cover was provided by artificial means winter injury was prevented and wheat yields averaged 29 bu/acre.

The question then became, "How could we provide the conditions to ensure an adequate snow cover?" Seeding of winter wheat into stubble land shortly after harvest was tried. Establishment usually was uncertain because of low moisture levels after crop removal or seeding was delayed beyond the safe establishment date because of a late harvest.

Studies initiated in late 1963 to compare chemical spray treatments with tillage as a means of preparing summerfallow indicated it might be possible to

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control weeds by the use of chemicals and thus leave the stubble standing to trap and hold snow the following winter. On the basis of this evidence we argued that winter wheat could be seeded directly into the stubble withut fear of winter injury. To test this hypothesis an experiment was undertaken in the autumn of 1965 in which Winalta winter wheat was seeded on (1) fallow prepared by total chemical control leaving erect stubble, (2) fallow prepared by chemical plus one preseeding tillage operation leaving semierect stubble, and (3) standard cultivated fallow which left only a very light trash cover horizontally positioned. Successive seedings

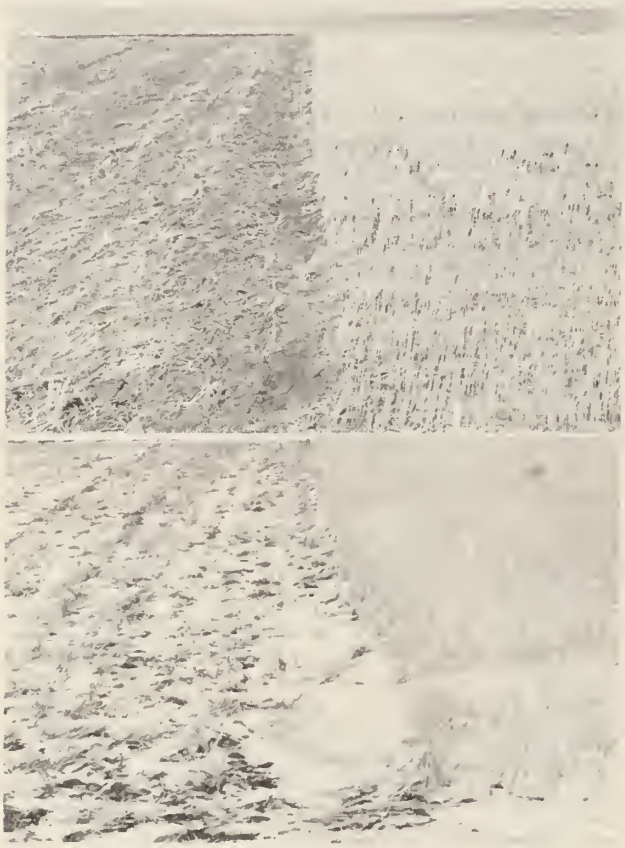

Fig. 2. Trash maintained in semi-erect position at left compared with chemical fallow (stubble erect) on the right.

were made in 1966 and 1967 using the same summerfallow treatments. The crop was seeded with a hoe press drill equipped with narrow (1-inch) shovels.

The wheat grown on total chemical fallow came through the winter of 1965-66 with little or no winter injury. The wheat grown on land that had been chemically treated but which received preseeding tillage suffered moderate damage while the wheat grown on cultivated land suffered considerable winter injury. The results were less marked during the winters of 1966-67 and 1967-68, presumably because of more uniform snow cover and higher late winter temperatures, respectively. Over the three-year period the yields were 30 bu/acre for the total chemical treatment, 26 bu/acre for the chemical plus preseeding tillage treatment and 21 bu/acre for the standard tillage treatment.

In seasons when volunteer grain and grassy weeds are troublesome it will be necessary to use tillage in

Fig. 3. Winter wheat grown on cultivated summerfallow on left and chemical summerfallow on the right. Note difference in length of the sub-crown internodes.

addition to chemicals, probably in late summer or prior to time of seeding in early September. If care is used during this tillage operation, maximum trash can be preserved and left in a semierect position to trap and hold snow (Fig. 2).

While snow cover is important to winter survival other factors also appear to influence establishment and yield performance. Summerfallow prepared by chemical only provides a firm seedbed. With the same depth setting of the drill it was found that the firmer seedbed of the chemically prepared fallow resulted in shorter subcrown internodes for wheat grown on these plots than was the case for wheat plants grown on a standard cultivated fallow (Fig. 3). When chemical fallow received a preseeding tillage the subcrown internodes of the wheat plants were equal in length to those of plants grown on cultivated fallow. The longer subcrown internodes developed by plants grown on cultivated fallow (loose seedbed) may have contributed to winter injury when frost action moved the soil, thereby severing the connection between the crown and the primary root system. The reduction of winter injury and superiority of plant vigor (Fig. 4) on chemically prepared fallow may be due in part to (1) a compaction-soil thermal conductivity interaction, and (2) a more favorable root zone moisture supply. These factors may combine to promote a higher degree of hardening, less freezing and less extreme fluctuations in soil temperature. ■

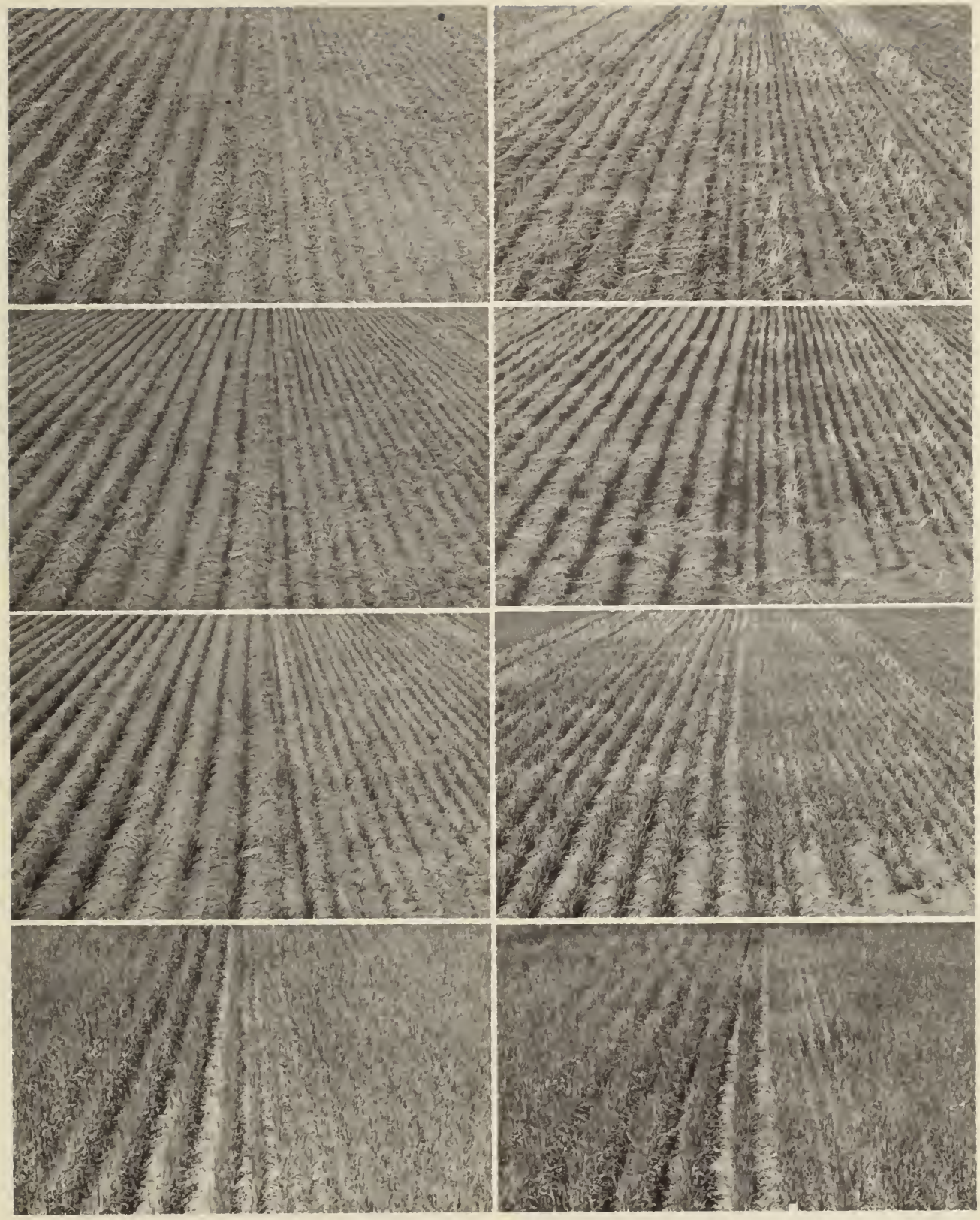

Fig. 4. Top to bottom condition of Winalta winter wheat on cultivated fallow (left) and chemical fallow (right) on April 19, May 8, May 27, and July 5. Note advanced growth on chemical fallow.

J. A. ROBERTSON

Le présent article démontre comment on a mis au point des méthodes permettant d'utiliser des fourrages moulus pour l'élevage du bœuf. Il explique également les effets de la qualité du fourrage et de la finesse de mouture sur la quantité consommée et le gain du poids des jeunes bouvillons.

GROUND ROUGHAGES

Forages constitute the main source of nutrients for the beef production industry. During particular phases of production, such as feedlot finishing, there is a trend toward use of high concentrate rations to get maximum rate of gain and finish to market standards. In many Western Canadian feedlots, where cereals are relatively inexpensive, rations containing 80-90 per cent concentrate are fed. If forages, especially those low in quality, are fed in appreciable quantities during the finishing period, rate of gain is slowed, finish is reduced and the operation may become uneconomic.

Because of climate, soil and other factors many areas are better suited for production of grasses and legumes than for cereals or corn silage. If forages could be employed to a much greater extent in beef finishing rations, cattle produced in these areas could also be finished there.

The major barrier to achieving nutrient intakes which are consistent with rapid growth and fattening on high forage rations is the rate at which the animal can process the forage and the low levels of available or digestible nutrients in low quality forages. Rate of processing is determined by a combination of factors including rate of chewing or mastication, rate of fermentation in the rumen, and rate of passage of the forages through the digestive tract. Forages, especially those of low quality, when fed in the long or coarsely chopped state, are processed very slowly.

Therefore, if roughages are to be utilized more efficiently, methods must be found to increase rate of breakdown and/or digestibility. Two main approaches to this problem have been made (1) mechanically grinding roughages before feeding and (2) irradiation or treatment with chemicals which, in effect partially predigest roughage, increasing rate of breakdown and digestibility. Our intention in this article is to discuss the first approach.

The animal husbandman has, for centuries, fed hay in the long form. What happens to intake, gain and feed efficiency if hay is ground? Our work at the CDA Research Station, Melfort, Sask., indicates that this will depend largely on the quality of material fed. For example, when we fed good quality brome hay to groups of calves, grinding increased intake by 15 per cent and average daily gain by approximately 40 per cent. When a poor quality native hay was ground, intake increased by 60 per cent. Steers fed this low quality hay in the long form lost weight whereas those fed the same hay in the ground form gained an average of 1 lb. per day. Grinding can therefore be expected to increase the efficiency with which roughage, and particularly roughage of poor quality, is utilized by the ruminant.

How critical is the degree of fineness to which roughage is ground? In our experience, chopping roughage has had little effect on intake, rate of gain or feed efficiency (Graph). Chopping does reduce the amount of sorting by the animal and chopped hay can be handled more readily in feed mixers, conveyors, and self-feeders than can long hay. However, from a nutritional standpoint, there is little advantage to chopping hay. In all probability,

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chopping does not reduce the particle size of the roughage sufficiently to have any effect on rate of passage or intake.

We have found that grinding hay through a hammermill screen with 2 in. diameter holes has significantly increased feed intake, rate of gain and feed efficiency compared with the same hay fed in the long or chopped form (Fig. 1). Further reducing the hole size of the hammermill screen to 1, ½, or 3/16 in. had varied effects on the factors studied. Using a screen size of less than ½ in. has seldom resulted in any further increase in feed efficiency, liveweight gain or level of intake and in some cases has brought about a decrease. Dustiness may limit the voluntary intake of some roughages fed in the finely ground state although we have little evidence to show this. In addition to any improvement in efficiency of utilization, increasing the degree of fineness of grind (a) increases the density of the roughage allowing more feed to be stored in a given volume and (b) further reduces problems of handling mechanically via auger systems and self-feeders. At the same time, costs increase because of the additional time and horsepower required to grind through smaller screens. The incidence of

FOR BEEF CATTLE

bloat is also likely to increase when legume hays are finely ground.

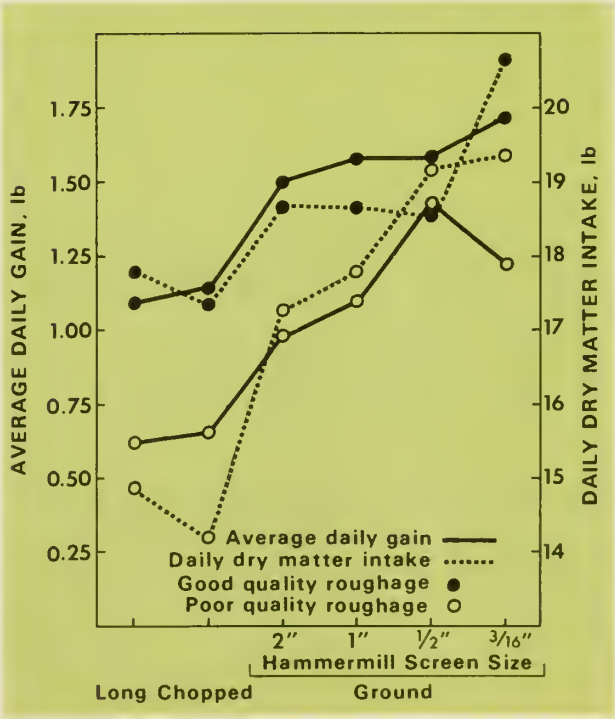
We have made no direct comparisons between long and ground roughage fed with grain in rations for finishing steers. However, based on the available knowledge of digestion in the rumen, the effects of fineness of grind would undoubtedly be similar and would decrease in importance as level of roughage decreased.

We have self-fed rations containing good, medium or poor quality ground roughage at levels of 20, 45, 70 or 95 per cent of the entire ration. Gain, feed efficiency, carcass quality, dressing percentage and "profit" per steer were highest for groups fed the 20 per cent level of roughage. At this level, roughage quality was of little importance but became increasingly important at the higher levels. In our opinion, ground roughage fed at the higher levels increased gain and produced good quality carcasses with higher dressing percentages than would have been the case had the same amount of long hay been fed. However, at current feed prices the economic situation favored the 20 per cent roughage level.

In summary, ground roughage is most likely to be economically practical for wintering calves or yearlings when poor quality hay or straw is all that is available. Feed that would otherwise produce little or no gain could, if ground, result in gains of 0.5 to 1.5 lb. per day. A level of 10-20 per cent ground roughage in complete mixed rations for finishing cattle also appears to be practical for many feedlot operators. Higher levels can be incorporated into the ration during the initial 2-3 weeks of the feeding period to prevent the occurrence of digestive disturbances associated with getting cattle on feed. Once the cattle are safely on full feed, the roughage level can be reduced gradually.

Additional research is required to determine if the utilization of poor quality roughage, in particular, can be further improved. Supplementation with protein may be of benefit. If dustiness does limit the intake of some ground roughages, pelleting or the addition of molasses could have beneficial results. Pre-treatment with chemicals or enzymes may also become a practical means of increasing the nutritive value of roughages in the future.

Our aim in this work has been to develop methods of utilizing roughage in rations for ruminants so that the beef cattle feeder will have available the alternative of formulating rations using a wide variety of hay to grain ratios according to the price situation prevailing in his area. We have found that finished carcasses of good quality can be produced by rations containing up to 95 per cent ground roughage. The challenge now is to make the utilization of roughage more efficient. ■



SYSTEMATIC TABULATION OF FEEDS...

CDA GRANTS CONTRIBUTED TO A NEW ENCYCLOPEDIA OF FEEDS

D. W. MacDONALD

Un programme américano-canadien a permis d'établir un nouveau système taxonomique permettant une classification plus précise des aliments du bétail. Maintenant huit mille sortes d'aliments différents seront classés par ordre alphabétique dans une "Encyclopedia of Feed Composition" de mille pages.

In calculating rations, the feeder has had access to tables of feed composition from various sources. Conventional tables have tended to categorize feedstuffs, or lacked the definition required to identify them accurately. Any errors in identification or selection of feeds are reflected in the final ration, and have a bearing on its efficiency and economy. The more precise the figures on nutritional ingredients, the better. And if the feeder can find all the data in one place, he avoids the frustration of searching numerous periodicals for complete information on a particular mix.

That brings up the new format developed to systematize feed composition data. The new system of tabulation appears in the Encyclopedia of Feed Composition, about to be published by the National Research Council (U.S.) for the National Academy of Sciences, and the latest edition of the U.S.-Canadian Tables of Feed Composition.

Mr. MacDonald is with the CDA Information Division, Ottawa, Ont.

Feed manufacturers, nutritionists, and students of nutrition are expected to find that the encyclopedia form is the most complete reference available on the subject. However, data can be selected from the complete volume to serve more specific, or practical purposes. For example, the revised edition of the joint U.S.-Canadian Tables of Feed Composition* contains data on 1500 common livestock feeds selected from the encyclopedia. Extension workers and specialized feeders will find the information in this publication useful in calculating livestock rations.

The thousand-page encyclopedia of data on 8000 distinctive feeds was six years in the making and largely evolved through the contributions of hundreds of nutritionists in laboratories across the United States and Canada.

Two members of the sub-committee on Feed Composition of the Committee on Animal Nutrition, Dr. E. W. Crampton, Professor Emeritus of Nutrition, Macdonald College, Que., and Dr. L. E. Harris, Professor of Nutrition, Utah State University planned and directed the gigantic joint U.S.-Canada project. Grants from the Canada Department of Agriculture enabled Dr. Crampton to carry on this

*The second revision (3rd edition) of the U.S.-Canada Tables of Feed Composition, tabulating data on all feeds to meet the requirements of ten types of livestock, has been published by the National Research Council (U.S., Publication No. 1684) and is available from the Printing and Publishing Office, National Academy of Science, 2101 Constitution Ave., Washington 20418. Price, $2.25 U.S. So far, it has not been published in Canada. The Encyclopedia of Feed Composition is expected to be published by summer 1969.

important work following his retirement as Head of Animal Nutrition at Macdonald College.

In 1963 the Committee on Animal Nutrition of the United States National Academy of Sciences — National Research Council, realized the need for a systematic feed nomenclature that would describe feeds accurately; be adaptable for coding to permit machine retrieval of data for specific tabulations; and be useful internationally.

The Crampton-Harris sub-committee established a final format for tables that would show in one place the NRC name of the feed, and *all* analytical data on "as fed" and a "dry-matter" basis, measured metrically.

An original feedstuff material may yield any number of by-products which find their way into rations, Dr. Crampton points out. For example, the wheat plant provides the following as edible products for animal feeds:

fresh grass	wheat germ oil
silage	wheat bran
hay	wheat shorts
straw	wheat middlings
grain	wheat germ
distillers grains	wheat grits
distillers solubles	feed flour
screenings	

Each by-product has unique feeding value and in order to talk about these products they must each have a unique name and the appropriate chemical and biological analytical data.

Alfalfa is a basic feedstuff material. There are several varieties from which hay is made and, if

Dr. E. W. Crampton, Professor Emeritus of Nutrition, Macdonald College, Quebec.

each of these varieties is sun-cured, dehydrated, fed fresh, or ensiled then the number of feeds increases by the number of forms or parts used as a power of the number of origin. For a given alfalfa hay of one specific variety, there may be as many as eight different recorded stages of maturity when the plant was cut and each of these stages shows a difference in feeding value.

In corn there are both white and yellow kinds, different varieties, and by-products of corn as the part eaten. These may all have certain specific guarantees as to fiber or sugar content, or some other characteristic. The treatments that may have been used in preparing the by-product such as heat, or distillation, or grinding all have different effects on the final feeding value of the end product.

Till the new system was developed, Dr. Earl W. Crampton observes, tables of feed composition tended to lump together, irrespective of variety, process, or other characteristics, available analytical data. Thus, in the case of corn, samples in the average may have contained all the way from 6 to 15 percent protein and/or 90 to 80 percent dry matter. Feeding values recorded in conventional tables therefore were variable because they included such a wide range of materials grouped together under common names such as corn meal.

"When we examined thousands of feeds that were named," Dr. Crampton recalls, "we found about 20 percent of them were duplicates, naming a product that was called by one name in one area and by another name in some other area. The new

system had to permit entering all names by which a product had ever been known and making cross-reference to the NRC name.

"There were gaps in our knowledge too," Dr. Crampton notes, "and the committee attempted to fill as many of them as possible by obtaining samples of the products in question and arranging for contract analysis to be done on them for nutrients which the committee specified. The Canada Department of Agriculture set aside money to cover the cost of such contract analysis in an attempt to augment the current information on the nutritional composition of many of the grains handled by the grain trade."

The NRC nomenclature came into existence, based on a scheme proposed by Dr. Harris in which the full name is built up from a possible eight components which together describe the particular form or physical nature of the product.

Three feeds are shown with the NRC names written in tabular form:

Components of Name	Feed No. 1	Feed No. 2	Feed No. 3
Origin or parent material	Alfalfa	Fish	Oats
Species, variety or kind	ranger	rockfish	unspec.
Part actually eaten	aerial part	whole	groats
Processes and treatments undergone	dehy.	raw	grnd. cooked
Stage of maturity	early bloom	n.a.	n.a.
Cutting or crop	cut 1	n.a.	n.a.
Grade or quality designation	mn 17% protein mn 27% fiber	unspec.	unspec.
Classification[1]	(1)	(5)	(4)

Under the new system, meat scrap and meat meal, become known as Animal, carcass res w blood dry — or wet — rend dehy grnd, mx 4.4 P (5).

Dried whole milk becomes Cattle, milk, dehy, feed gr mx 8 moisture mn 26 fat, (5).

Hominy feed becomes Corn, grits by-product, mn 5 fat (4).

Linseed meal becomes Flax, seed, mech-extd grnd, mx 0.5 acid insol ash, (5).

Oat middlings becomes Oats, cereal by-prod, mx 4 fbr (4).

The last component in the NRC name (a number from 1 to 8 in brackets) denotes the feed classification. The digit is also the first in a six digit reference number which identifies the feed and couples it with data recorded at the feed composition computer center at Utah State University: (1) classifies feed as dry forage; (2) forage fed green, such as pasture; (3) silages; (4) energy feeds; (5) protein supplements; (6) minerals; (7) vitamins; (8) additives.

According to the NRC nomenclature, products which when dry normally contain more than 18 percent crude fiber are classified as roughages. Products which contain 20 percent or more protein are classified as protein supplements. Products which contain less than 18 percent crude fiber are classified as energy feeds.

Approximately 8,000 feeds have been listed alphabetically (using the name of the parent material) in the encyclopedic format. All the analytical data pertaining to a specific feed is tabulated in the one place. Where a number of samples of a particular feed have been analyzed for a certain ingredient, the number of samples is noted, and the standard deviation calculated for all means based on more than five samples. In the alfalfa tabulation that follows, the crude fiber in 25 samples of alfalfa hay as specified could be expected to vary within a range of 11 percent of the average.

The table column for any one feed is as long as is necessary to include all of the analytical data that are available for it. Altogether the tables provide for eighty components, including forms of energy, minerals, amino acids and any special analysis that happens to be available. ■

EXAMPLE OF FEED COMPOSITION TABULATION

Feed name or analysis		As Fed	Dry	No.	Coef var.
Alfalfa, hay, cure unspec, milk stage (10)					
Dry matter	%	90.5	100.00	24	6
Ash	%	7.2	8.0	27	13
Crude fiber	%	32.1	35.5	25	11
Ether Extract	%	2.0	2.2	25	18
Protein (N x 6.25)	%	13.8	15.3	27	9
Protein, dig. rum	%	9.9	10.9		
Energy, dig. rum kcal/kg	%	1940	2160		
Energy, metab. rum kcal/kg	%	1590	1770		
TDN, rum	%	44	49		
Calcium	%	1.21	1.34	8	17
Phosphorus	%	.22	.24	8	22
Potassium	%	1.72	1.91	4	
Carotene mg/kg	%	24.3	26.9	3	
Vitamin A equiv IU/gm		40.5	44.8		

Note: "rum" in above table means "ruminants" but includes swine or poultry depending on the feed listed.

[1]See explanation in sixth paragraph following.

'MARKETING BILL'

Not a name, not a piece of legislation — just some simple facts concerning the marketing costs of food in this country.

K. E. CANN

La présent article explique comment le coût de mise en marché des aliments s'est élevé plus rapidement que la valeur marchande des denrées de la ferme.

When the consumer purchases Canadian produced foods, his dollar goes toward paying the farmer for his raw product and toward the cost of processing that product before it reaches the consumer. The difference between what the farmer receives and the retail value of food is the cost of marketing food products — or the 'marketing bill'.

We recently made a study of food marketing costs for the 1949-1967 period which reveals, for example, that the estimated retail value of food purchases made by Canadian consumers in 1967 totaled $7.7 billion, or $5.1 billion more than in 1949. We found, too, that the retail value of domestically produced foods was about 80 per cent of the total retail value of food purchases, with imported foods making up the other 20 per cent.

Our study also showed that the farm value for Canadian farm products consumed domestically was estimated about 65 per cent of total farm cash receipts, exports and non-food products made up the other 35 per cent.

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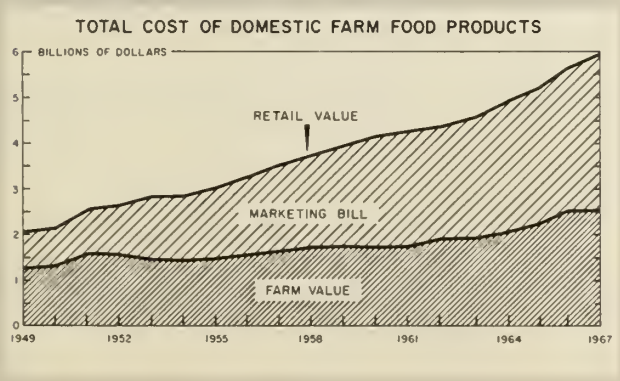
Fig. 1. The marketing bill has increased at a faster rate than the farm value of food.



ESTIMATES OF COST OF MARKETING DOMESTIC PRODUCED FOODS, CANADA, 1949 TO 1967

Year	Retail Value	Farm Value of Raw Food Materials	Farm-to-Retail Marketing Costs	Farm Value as a Per Cent of Retail Value
		million dollars		per cent
1949	2,064	1,243	821	60
1950	2,198	1,289	909	59
1951	2,585	1,548	1,037	60
1952	2,692	1,556	1,136	58
1953	2,866	1,492	1,374	52
1954	2,851	1,487	1,364	52
1955	3,029	1,499	1,530	49
1956	3,233	1,570	1,663	49
1957	3,527	1,621	1,906	46
1958	3,784	1,740	2,044	46
1959	3,979	1,791	2,188	45
1960	4,191	1,765	2,426	42
1961	4,221	1,789	2,432	42
1962	4,456	1,929	2,527	43
1963	4,572	1,990	2,582	43
1964	4,919	2,053	2,866	42
1965	5,224	2,289	2,935	44
1966	5,604	2,505	3,099	45
1967[1]	5,911	2,520	3,391	43

[1]Preliminary
Source: Based on Dominion Bureau of Statistics Data.

The accompanying table shows the farmer's share of the retail food value. The table gives the estimated costs of marketing domestically produced foods over the 1949-1967 period. Note that the farmer's share, as a proportion of retail value, decreased steadily from 1949 to 1960, and during the 1960's, his share remained relatively stable at 42 to 45 per cent.

A word concerning trends in cost of marketing. Total marketing costs have increased and the two main causes were (1) the greater physical volume of food passing through the marketing system and (2) the increased cost of marketing. It is estimated that the volume of food increased by 74 per cent during the 1949-1967 period and the costs of marketing an equivalent quantity of food increased by 137 per cent.

The costs of marketing food produced in Canada have increased at a faster rate than the farm value of the raw product (Fig. 1). There are numerous reasons for the more rapid growth in the costs of marketing. Food consumption patterns have changed with increases in purchase of convenience foods, and added services in merchandising; also, advertising has increased, as well as the cost of labor, supplies and equipment. ■

Mixing and weighing truck automatically loaded with silage
La goulotte d'un des silos déverse l'ensilage dans ce camion qui pèse et mélange automatiquement les aliments.

Rations are mixed en route, unloaded into a hopper and conveyed to barn (Above and to right).

REDUCED LABOR? INCREASED PRODUCTION?

CENTRALIZED FEED SYSTEM

Planners in the Animal Research Institute have produced Canada's most modern feeding system for large dairy operations. This system, on CDA's 2,800 acre farm in Ottawa's 'greenbelt' area is capable of feeding and maintaining some 1,200 head of dairy stock used in the Genetics Research Program.

Dr. Gowe, Director of the Animal Research Institute, believes that the trend to large scale production is essential for maximum efficiency and for minimum unit cost. If dairy farmers are not prepared to move in this direction then they cannot expect to make reasonable returns. The research facilities are therefore geared to study the problems of large scale production.

The feeding system is a unique concept of centralized feed storage and distribution developed as a result of study of the most modern dairy facilities. With conventional feeding systems hay and silage is fed to cattle from separate buildings each with their own storage, unloading and feed-mixing facilities. This method is more costly, and storage units are smaller creating problems of maintaining a year-round feed supply.

Centralized feed storage and multiple silos is a more efficient operation suited to year-round confinement housing. The feed center provides for long-term roughage storage, and concentrate storage in the bulk bins. Total roughage storage capacity of the six silos is 2,500 tons dry matter as silage (grass or corn based on harvesting approximately 1,500 tons of fresh silage per silo) and 850 tons of dry matter as chopped hay. Accordingly these facilities provide roughage for year-round requirements.

This centralized feed storage system, consisting of six 30 by 80 foot silos flanked by two hay barns is more efficient than separate units attached to each building. For example, only two silos are 'open' at any one time, and the other four silos remain sealed, each silo therefore, can be emptied completely before sealing leaving no problems of redistributing the feed between barns when storage supplies run out at the end of the season.

Components of the complete ration (hay, silage, concentrate) are mechanically loaded and weighed into a truck-mounted three-screw horizontal mixer which consists of a 280-cubic foot mixer box truck-mounted. Four load transducers are electronically linked to a scale indicator in the truck cab. This allows the truck driver to stop the mixer-truck under one of the feed received points to assemble and weigh each of the main feed components. The receiving points are silo chutes, chopped hay elevators, and bulk bin augers.

Rations are mixed as the truck moves from the storage area to the livestock barn. The mixed ration is re-weighed to each animal group when it reaches the barn. Feed is unloaded at an outside hopper, transferred by an endless belt to a double chain conveyor which distributes feed to each animal in the barn.

When cattle require individual rations feed is discharged into feed preparation rooms. This is well suited to dairy stock on genetic studies where cattle must be fed uniformly in respect to stage of development. ■

La ration équilibrée mélangée en route est déchargée dans la trémie de l'étable (Photos à gauche et au-dessus).

A self-propelled mechanical feeder distributes the ration evenly to each cow.

Un distributeur à traction mécanique distribue la même ration à chaque vache.

HAUSSER LA PRODUCTION BAISSER LA MAIN-D'ŒUVRE

ENTREPÔTS CENTRALISÉS

L'Institut de recherches zootechniques a mis au point un système d'alimentation pour grandes exploitations laitières. C'est le plus moderne du Canada. Ce système, installé à la ferme du ministère de l'Agriculture du Canada, peut nourrir le troupeau laitier de 1,200 têtes utilisé pour le Programme de recherches en génétique.

M. Gowe, directeur de l'Institut est d'avis que les exploitations doivent s'agrandir pour augmenter l'efficacité et réduire le coût de revient. Les producteurs de lait devront, pour s'assurer des revenus raisonnables, s'orienter dans cette direction. C'est donc sur ces problèmes que portent les recherches.

Le système dont il est question est une conception nouvelle, basée sur l'étude des installations laitières les plus modernes. L'entreposage et la distribution des aliments ont été centralisés. Avec les systèmes conventionnels, le foin et l'ensilage arrivent aux bovins, de divers bâtiments ayant chacun leur propres installations. Cette méthode est très coûteuse. Les entrepôts étant de faible contenance, posent des problèmes d'entreposage d'aliments pour une année complète.

La centralisation des entrepôts et de plusieurs silos permet une exploitation plus efficaces pour les bovins gardés à l'étable. Ceci permet de garder longtemps les fourrages et les aliments concentrés. La capacité des silos est de 2,500 tonnes de matières sèches (graminées ou maïs récoltés à raison d'environ 1,500 tonnes d'ensilage frais par silo) et de 850 tonnes de foin haché. Ces installations assurent donc des provisions pour toute l'année.

Ce système est composé de six silos de 30 pieds par 80 pieds de hauteur, et de deux granges à foin, c'est-à-dire une installation beaucoup plus efficace que des entrepôts séparés. Ainsi, on n'ouvre que deux silos à la fois et les quatre autres restent scellés; chaque silo peut donc être complètement vidé avant d'en ouvrir d'autres, ce qui évite les problèmes de redistribution des aliments d'une étable à l'autre en fin de saison.

Les composants des rations (foin, ensilage et aliments concentrés) sont chargés et pesés mécaniquement dans des mélangeurs autoportés de 280 pieds cubes équipés de trois brasseurs horizontaux. Quatre transducteurs reliés électroniquement à un indicateur dans la cabine du camion, permettent au camionneur de doser lui-même les composants, c'est-à-dire le foin haché, l'ensilage et les autres éléments concentrés.

Les ingrédients sont mélangés pendant le trajet entre les entrepôts et les étables à bestiaux. On ne décharge que la quantité nécessaire à chaque étable. Les aliments tombent dans une trémie extérieure, d'où ils sont transportés par une courroie sans fin qui les distribue à chaque animal.

Lorsque les bovins ont besoin de rations individuelles, les aliments sont déchargés dans des chambres pour la préparation des aliments. Ce système convient aux troupeaux laitiers servant aux études génétiques où les bovins doivent recevoir une alimentation uniforme par rapport au stade de leur développement. ■

COCCIDIOSIS OF CATTLE

L. NIILO

Beaucoup d'animaux domestiques sont atteints d'une grave maladie appelée coccidiose des bovins. L'objectif de l'étude décrite dans le présent article était de découvrir de quelle façon la maladie se propage, et de trouver des moyens efficaces pour la guérir et empêcher sa propagation.

Calf affected with coccidiosis loses appetite and weight, becomes gaunt and depressed. Tail and hindquarters become soiled.

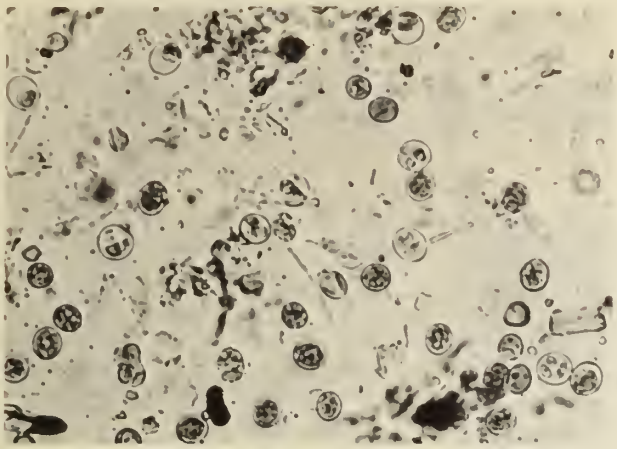
The disease known as coccidiosis occurs in many farm animals and poultry. It is of great economic importance in chickens, being one of the chief causes of loss to the operator. In cattle, the disease usually affects calves and young animals less than one year of age. It is an infectious enteric disease caused by host-specific microscopic protozoan organisms called coccidia which invade the bowel lining, thus producing tissue damage, diarrhea and possibly death.

About a dozen species of bovine coccidia are known to exist, but only two species are usually associated with the clinical disease. Coccidia from other animal species such as sheep, swine and poultry are harmless to cattle.

Cattle, who have suffered one clinical attack of coccidiosis, usually become resistant to subsequent infection with this disease. However, many continue to shed coccidial "eggs" (called oocysts) in the droppings which serve to provide source of infection for young and susceptible stock.

Coccidiosis occurs throughout the year, but most

Dr. Niilo is a veterinary parasitologist with the Animal Pathology Division, CDA Health of Animals Branch, Animal Diseases Research Institute, Lethbridge, Alta.



Coccidial oocysts (round bodies) in feces seen under the microscope.

commonly during the spring and winter. Spring coccidiosis is more common in young stabled calves, particularly in barns where less than adequate sanitary conditions prevail. Winter coccidiosis is prevalent in the prairie provinces of Canada and it affects older calves—range animals as well as those in the feedlots.

Economic losses to farmers and feedlot operators vary depending on the severity of the disease, the number of animals affected, type of husbandry and treatment. In feedlots, coccidiosis may cause reduced weight gains in mild cases to death in severely affected animals. The average death rate due to cattle coccidiosis in Canada is three to four per cent. The cost of treatment accounts for additional loss.

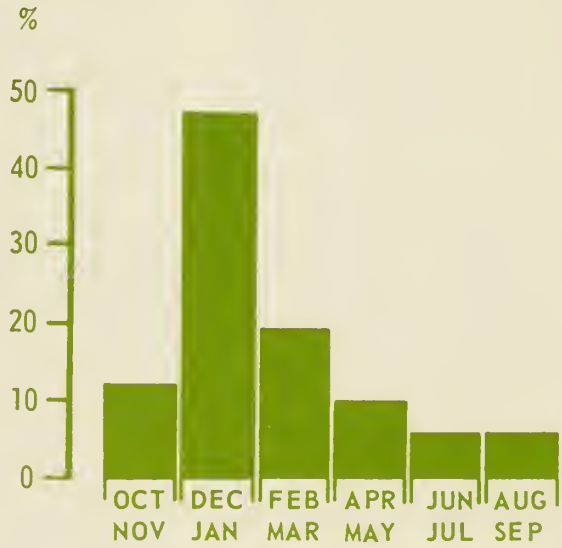
Winter coccidiosis is becoming an increasingly important disease in the rapidly expanding feedlot industry in the West. Because of the economic losses from this disease, research on cattle coccidiosis has been undertaken at the CDA Animal Diseases Research Institute of the Health of Animals Branch, Lethbridge, Alberta. The objectives of the studies are to find out how the disease spreads from animal to animal and to devise effective and practical measures to treat or prevent the disease.

The first and most characteristic sign is scours which in some animals may become bloody on the second or third day. There is profuse diarrhea, the affected animal loses appetite, becomes gaunt and moves sluggishly. There is loss of weight and the tail and rear quarters become soiled with manure. Straining is common. The attack may last five to seven days, or even longer if complications set in and the animal is not treated. Death may occur during the first five days or later from secondary complications such as pneumonia. If the animal survives the first week, recovery usually follows. In a typical outbreak about ten per cent of the animals are affected at a time, but in crowded feedlots more than half of the animals may become ill.

So far there is no effective and practical method to control coccidiosis in cattle. Sulfa drugs are used for treatment and appear of value in the prevention of secondary complications. A logical approach to control of coccidiosis would be its prevention.

Statistics compiled in Canada over the last five years by the Health of Animals Branch show that a majority of the cattle coccidiosis outbreaks occur during the winter months. The peak occurs in December and January. At Lethbridge we have observed that initial cases of winter coccidiosis occur about three or four weeks after the calves are brought in from the summer pastures and weaned. More cases are noticed in subsequent weeks and the most severe outbreaks often coincide with periods of very cold weather.

The association of severe outbreaks with cold weather may suggest that cold favors the development of the disease by imposing a form of stress on the animals. However, we have found in our studies that cold alone is not to blame. We kept



Graph showing seasonal distribution of cattle coccidiosis in Canada. Percentage annual cases, based on a five-year average.

groups of weaned calves in a barn while other groups were left outside in cold weather without much shelter. When experimentally inoculated with coccidia the housed calves developed just as severe coccidiosis as the unsheltered ones. This observation suggests that factors other than direct exposure to cold trigger the outbreaks of winter coccidiosis. Cold itself inhibits the normal hatching process of the coccidial oocysts in the manure which is necessary before the coccidia can infect other animals.

There is still much to be learned about coccidiosis in cattle. What is the life cycle of the parasite, how do cattle become infected, how are they treated and how can coccidiosis be prevented, are questions that must be answered. ■

ECHOES

FROM THE FIELD AND LAB

CDA officials have recently developed a bilingual lectern prompter for use at conferences. The new device lets speakers know when their time is up, and can give them six other messages. It uses colored lights on a 1.4 x 1.4 screen, eliminating warning bells or gongs. (see story below.)

BILINGUAL SPEAKER PROMPTER A bilingual lectern prompter recently developed by two officials of the Canada Department of Agriculture at Ottawa proved to be a great success at the Canadian Agricultural Congress held last March. Developed by Peter W. Voisey of the CDA Engineering Research Service and Ted Root of the CDA Information Division, the prompter is the result of attempts to find a way to let speakers know, clearly and unobstrusively, when their time is up. It does so by flashing colored lights on a 1.4 by 1.4 inch screen, eliminating noisy warning bells or gongs.

Only seven messages are used: speak faster; speak slower; move toward the microphone; move away from the microphone; two minutes to go; one minute to go: stop.

The prompter, when mounted on a lectern by a standard clamp, looks like an extra microphone and it connected to a lap-size control box which can be placed anywhere in the conference room. Seven push-buttons on the control-box cover — all identified in both languages — operate the prompter, while flashlight batteries provide six-volt direct current power.

Experience has shown that a flashing light attracts the eye more effectively than a continuous light, so the button is pressed about two times per second to obtain this effect. A toggle switch changes the system from French to English or English to French, as required.

Le M.A.C. a récemment mis au point pour les conférenciers, un appareil avertisseur qui leur indique, dans les deux langues, le temps écoulé ainsi que six autres messages. Finis les sonneries ou les gongs remplacés par des signaux lumineux en couleur sur un écran de 1.4 x 1.4 (lire l'article ci-dessous).

VOYANT AVERTISSEUR POUR CONFÉRENCIER L'avertisseur bilingue, mis au point dernièrement au ministère de l'Agriculture du Canada à Ottawa, a remporté un grand succès lors du Congrès de l'agriculture canadienne en mars dernier. C'est le fruit du travail d'équipe de MM. Peter W. Voisey du Service des recherches techniques et Ted Root de la Division de l'information. Quand le temps alloué au conférencier est épuisé, l'avertisseur l'indique clairement et discrètement au conférencier, par des signaux lumineux colorés projetés sur un écran de 1.4 x 1.4 po. Finis les coups de sonnette ou de gong bruyants!

L'appareil transmet sept messages: plus vite; plus lentement; plus près du micro; plus loins du micro; encore deux minutes; encore une minute; fin.

Fixé au lutrin, l'avertisseur ressemble à un micro supplémentaire. Il est relié à un coffret de commande portatif installé dans la salle. Sept boutons-poussoirs actionnent l'avertisseur dans les deux langues. Le coffret de commande utilise du courant direct de six volts, de piles à lampes de poche.

L'expérience a enseigné qu'une lumière clignotante attire l'oeil plus sûrement qu'une lumière continue. Pour obtenir cet effet clignotant, on presse le bouton à raison de deux coups à la seconde. Un commutateur fait passer le système du français à l'anglais, ou vice versa.

NEEPAWA LICENCED A new hard red spring wheat named Neepawa was licensed recently by the Canada Department of Agriculture. It was developed by the Rust Area Project Group at the CDA Research Station, Winnipeg, through a complex crossing program involving Thatcher, Frontana and Kenya Farmer. Two rust resistant strains developed by backcrossing were combined to produce the new variety. Some of the segregating generations were grown in Mexico in the winter.

Neepawa is the first hard red spring wheat to combine resistance to many races of stem and leaf rust, common root rot, head discoloration, loose smut and bunt. It is, however, susceptible to sawfly damage.

The new wheat is quite similar to Manitou, also developed by the same Rust Area Project Group and released several years ago. Yields averaged 4.6 per cent higher than Manitou in tests across the Prairie Provinces. At some locations, it yielded up to 14 per cent more than Manitou, at others yield was slightly less.

Neepawa has stronger straw than Manitou, is a few days earlier and has slightly larger seeds. It is shatter resistant and has quality superior to Marquis.

The small quantity of seed available will be further increased in 1969 by Select Growers of hard red spring wheats in the Prairie Provinces. Pedigreed stocks will be more generally available in 1970.

HOMOLOGATION DU NEEPAWA Le ministère de l'Agriculture du Canada a récemment homologué une nouvelle variété de blé vitreux rouge de printemps, le Neepawa. Ce blé créé par le Comité d'études conjointes sur la rouille, à la Station de recherches du ministère de l'Agriculture à Winnipeg, est le fruit d'un programme de croisements complexes des variétés Thatcher, Frontana et Kenya Farmer. Deux lignées résistantes à la rouille, obtenues par rétrocroisement ont été combinées pour créer la nouvelle variété. Certaines des générations de ségrégation ont été cultivées au Mexique pendant l'hiver.

Le Neepawa est le premier blé vitreux rouge de printemps dans lequel est combinée la résistance à plusieurs races de rouilles de la tige et de la feuille, au piétin fusarien commun, à la mélanose, au charbon nu et à la carie. Il est cependant vulnérable au cèphe (mouche à scie).

Le nouveau blé ressemble beaucoup au Manitou, également crée par le même

ECHOS
DES LABOS ET D'AILLEURS

Comité d'études conjointes sur la rouille et homologué il y a plusieurs années. Le rendement moyen a dépassé de 4.6 p. 100 celui du Manitou au cours d'essais dans toutes les provinces des Prairies. Dans certains endroits, sa production a été jusqu'à 14 p. 100 supérieure à celle du Manitou et un peu moins dans d'autres.

Le Neepawa a une tige plus solide que celle du Manitou, il est de quelques jours plus hâtif et ses graines sont un peu plus grosses. Il résiste à l'éclatement et sa qualité est supérieure à celle du Marquis.

La petite quantité de graines disponibles sera multipliée en 1969 par les producteurs de semence Sélecte de blés vitreux rouges de printemps dans les Prairies. Les stocks généalogiques seront d'une façon générale plus faciles à obtenir en 1970.

INDIAN FARM LOANS Cabinet approval was recently given to an agreement which opens the way for long-term loans to Indians farming on reserves.

Recent amendments to the Farm Credit Act permit an agreement between the Minister of Indian Affairs and Northern Development and the Farm Credit Corporation to provide a basis of security for such loans. With the approval of this agreement, the Corporation may now accept applications from Indian farmers for loans under this act.

This program was initiated at the request of the Indian people and procedures for implementation of lending operations are being developed through consultations between representatives of Indian farmers, the Farm Credit Corporation and Indian Affairs.

The program is being established on the premise that Indians farming on reserves should have the same services available to them as other farmers—services that will assist them in developing sound farm businesses.

Farm Corporation Credit Advisors, in whose field areas reserve farmers are located, are now prepared to deal with enquiries and loan applications under this new program.

ANOTHER QUARANTINE STATION Canada and France recently signed an agreement to establish a new livestock quarantine station on St. Pierre, a French island in the Gulf of St. Lawrence.

Construction began this spring, and occupancy is scheduled for late this year or early in 1970.

France is building and will maintain the station, but the Canada Department of Agriculture will have charge of its health aspects, including quarantine regulations and tests.

Quarantine regulations will be the same as those now in effect at the CDA's Grosse Ile station, about 40 miles east of Quebec City in the St. Lawrence river.

The Grosse Ile station, which is used to capacity, handles 240 cattle; the St. Pierre station will handle 200 cattle destined for Canadian farms.

Cattle from any country from which imports into Canada are permitted under the Animal Contagious Diseases Act may be allowed into the St. Pierre station, but for the immediate future, it is likely that most cattle importations will be from France and Switzerland.

Canadian farmers will require CDA import permits and will pay the cost involved in importing cattle under terms similar to those now in effect at Grosse Ile.

MANY FCC LOANS TO FUR FARMERS Some 45 Canadian fur farmers, mostly mink producers, have borrowed mortgage money from the Farm Credit Corporation since they became eligible last June for long-term loans under the Federal Farm Credit Act. Their borrowings have averaged $11,775 each, and total $800,000.

Loans by provinces: British Columbia 17; Alberta 6; Saskatchewan 1; Manitoba 3; Ontario 15; Quebec 2; New Brunswick 1.

Loans are being made to experienced fur farmers where the additional capital will help develop a profitable operation and strengthen the producers' position in a very competitive business.

The money is being used for many purposes, mostly lands and buildings, including the re-financing of land debts — GEORGE OWEN, CHAIRMAN, FARM CREDIT CORPORATION.

SHEEP FARMING A team of 4 research scientists in the Animal Research Institute of the Canada Department of Agriculture at Ottawa is currently experimenting with ideas that could move sheep farming from the hillsides into total confinement under an automated system.

The goal of the team is to develop management and strains of sheep that will produce at least two lambs per litter, ideally twice a year.

The team is working with breeds that are capable of increasing litter size. One of these — the Finnish Landrace — usually yields twins, and some ewes have produced as many as six lambs in a litter.

There is evidence from research at other centres that this multiple birth characteristic can be cross bred into the next generation. The breeding program will also emphasize the growth rate of lambs.

The scientists working on the project are nutritionists Dr. David Heaney and Dr. E. E. Lister, geneticist Dr. Hobart Peters and physiologist Dr. Hamish Robertson.

NEW POTATO VARIETY York, a new potato variety, has been licensed by the Canada Department of Agriculture. It was developed by the Department's Research Branch in its Potato Breeding Program.

York is a high-quality potato, especially adapted for growing on organic (muck or peat) soils. It may replace the two main varieties now grown on muck soil, Sebago and Ontario.

York is much earlier maturing than either Sebago or Ontario, is a good yielder considering its earlier maturity, and is tolerant to scab and silver scurf.

On moderately acid soils, such as at the Ste. Clothilde Marsh in Quebec, it is susceptible to the fungus Rhizoctonia. The resulting "black surf" that occurs on the skin of the potatoes and which will not wash or brush off, somewhat mars the appearance and renders the product less attractive when displayed on supermarket shelves. However, this condition in no way affects the cooking quality.

NEW DISEASE OF RED FESCUE What appears to be an important disease of creeping red fescue grass seed crops has been discovered at the CDA Research Station, Saskatoon, Sask.

The disease was first noticed at the CDA Research Station, Beaverlodge, Alberta.

Efforts are being made at both Stations to control the new stem spot fungus. Only a few cases of the disease were found at the Saskatoon Station in 1967 but in 1968 it was present in all crops examined in the Beaverlodge area.

Attempts are being made at Beaverlodge to select resistant strains of red fescue. At Saskatoon and at the grass disease test area at Big River, 120 miles to the north, the biology of the fungus is being studied.— R. ELLIOTT, BEAVERLODGE, ALTA., AND J. D. SMITH, SASKATOON, SASK.

JARDINAGE À INUVIK

R. E. HARRIS

Special techniques such as terraces and plastic mulches make vegetable growing on permafrost an exciting possibility in far northern areas like Inuvik, N.W.T. (127 miles north of the Arctic Circle, near the mouth of the Mackenzie River).

Le jardinage dans les régions arctiques et subarctiques n'est pas chose nouvelle. Dès 1789, Alexander Mackenzie, en route pour explorer la rivière qui porte maintenant son nom, mentionnait dans ses écrits, l'excellent jardin que cultivait à l'embouchure de la rivière Athabasca le trafiquant de fourrures Peter Pond. Feu M. Albright, alors qu'il était surintendant de la sous-station expérimentale de Beaverlodge, visitait une quinzaine de jardins le long de la rivière Mackenzie, en 1930, dont trois au nord du cercle arctique. Selon ses rapports, tous étaient excellents. Ces jardins étaient établis sur des sols de texture légère qui dégelaient et se réchauffaient rapidement au printemps.

Comme plus de 75 p. 100 des sols du Canada se trouvent sous des climats polaires ou subpolaires, on compte de vastes étendues où une saison courte et un sol froid limitent considérablement le nombre des légumes qui peuvent y être cultivés sans traitement spécial. Cette situation atteint son point critique dans l'extrême nord où le sol est naturellement gelé de façon permanente.

La ville d'Inuvik (68°N), près de l'embouchure de la rivière Mackenzie, à 127 milles au nord du cercle arctique, est construite sur du pergélisol. Pourtant, grâce à des façons culturales appropriées, on peut y cultiver de nombreux types de légumes durant les longs jours du court été. En aménageant l'emplacement de la ville, le ministère du Nord canadien et des Affaires indiennes a réservé certaines étendues pour des jardins. On l'a fait pour encourager les habitants du nord à améliorer leur niveau de vie, et réduire leurs frais de subsistance, en produisant une partie de leur nourriture.

En 1956, pour résoudre quelques-uns des problèmes associés au jardinage sur pergélisol, la Direction de la recherche du ministère de l'Agriculture du Canada établissait un lopin d'essai d'une acre dans la région des jardins d'Inuvik. La recherche se trouvait placée sous la surveillance de la ferme expérimentale de Fort Simpson jusqu'en 1964. Depuis cette date, elle est dirigée par la Station de recherches de Beaverlodge.

Cet endroit, situé dans le delta de la rivière Mackenzie n'est pas des plus favorables au jardinage. Certains des sols du delta, le long de la rivière, sont sans doute meilleurs, mais ces terrains sont trop éloignés de la ville. La nature défavorable de la région des jardins d'Inuvik nous prouve que si la culture des légumes y est possible, elle le sera également dans beaucoup d'autres endroits du Grand-Nord. De nombreuses techniques créées par la recherche à cet endroit pourront généralement être utiles dans les régions où un sol froid limite la croissance des plantes.

Les jardins d'Inuvik se trouvent sur la pente sud-ouest d'une petite crête. Les arbres qui s'y trouvent sont des peupliers faux-tremble d'une vingtaine de pieds, avec ici et là des épinettes, des bouleaux et des arbustes nains. Ils poussent sur 8 à 14″ de mousse et de matière organique partiellement décomposées, isolées de l'argile par une couche de 4 à 6″ de terre franche graveleuse. Dans le cours ordinaire des choses, seulement 15″ de la couche supérieure du sol dégèlent en été. Après avoir défriché et défoncé le sol dégelé, il devient de plus en plus profond chaque année pour atteindre une profondeur maximale de 7′ au bout de huit ans.

En 1956, à Inuvik, le lopin d'une acre a été défriché et nettoyé de sa végétation ainsi que de 6 à 8″ de sa matière organique insuffisamment décomposée. Le sol qui restait avait un pH de 6.4 et une conductivité de 0.8 mmhos; il était dépourvu de nitrates et de sulfates, et contenait 3.2 livres de phosphore à l'acre, ainsi que des traces de potasse et 130 parties par million de calcium. A la fin de mai, la température du sol défriché à 4″ est d'environ 35°F, et elle monte à 45° à la mi-juin, 57° à la mi-juillet et 60° à la mi-

M. Harris est chef de la Section des céréales, des graines oléagineuses, des fruits et des légumes à la station de recherches du ministère de l'Agriculture du Canada, à Beaverlodge, Alberta.

gumes cultivés sur le pergélisol.

ng du haut: de gauche à droite, poirée Lucullus, choux arché hâtif de Copenhague, laitue Simpson à graine noire.

rangée: betteraves Ruby Queen, choux, écossais, frisé, radis ench Breakfast.

rangée: carottes nantaises écarlates sans coeur, choux-fleurs per Snowball, brocoli Italian sprouting.

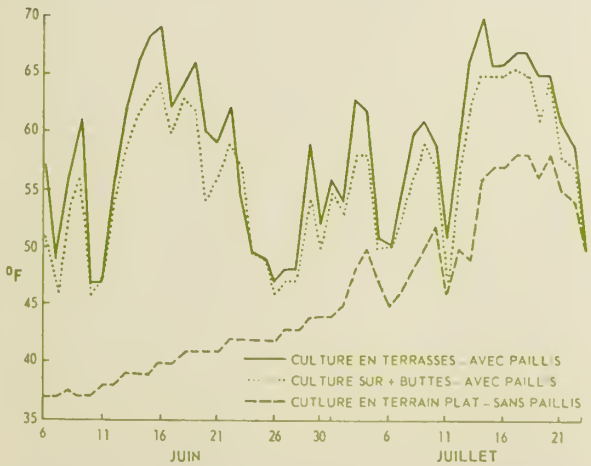
ng du bas: rutabagas Victory Neckless, pommes de terre arba, rutabagas Milan à couronne pourpre.

TABLEAU 1. QUELQUES RENDEMENTS DE LÉGUMES OBTENUS SUR LE PERGÉLISOL À INUVIK, DANS LES TERRITOIRES DU NORD-OUEST.

Légume	Variété	Espacement entre les rangs	Espacement entre les plants	Rendement en quintaux à l'acre	Remarques
		pieds	pouces		
Radis	Comet	2	2	27.95	Plat sans paillis
Laitue	Simpson à graine noire	2	8	70.18	Plat sans paillis
Rutabagas	Milan à couronne pourpre	2	4	185.13	Plat sans pallis
Betteraves	Ruby Queen	2	3	126.11	Buttes avec paillis 9 jours plus tôt
		2	3	74.81	Plat avec paillis
		2	3	57.50	Plat sans paillis
Choux	Marché de Copenhague hâtif	3	18	27.31	Plat sans paillis
Brocolis	Italian sprouting	3	18	1.47	Plat sans paillis
Choux-fleurs	Stokes Super Snowball	3	18	8.09	Plat sans paillis
Choux fourrager	Vert écossais, frisé	3	18	4.43	Plat sans paillis
Poirée	Lucullus	3	12	7.58	Plat sans paillis
Pois	Alaska	3	—	13.64	Plat sans paillis
Rutabagas	Victory Neckless	4	4	97.87	Terrasse avec paillis
Carottes	Écarlate de Nantes sans coeur	4	2	10.89	Terrasse avec paillis
Pommes de terre	Warba	4	12	130.68	Terrasse de 14" avec paillis
		4	12	81.78	Buttes de 12" avec paillis
		4	12	68.41	Buttes de 8" avec paillis

août. La saison de croissance dure environ 90 jours dont 900 degrés-jours à des températures dépassant 42°F. La période sans gelées dure environ 52 jours, et celles sans gelées destructrices 80 jours, tandis que la température moyenne de juillet est d'environ 55°F.

Durant les quelques premières années, la production des légumes a été décevante. Toutefois, les connaissances acquises chaque année ont servi à améliorer la gestion pour l'année suivante. Les essais faits en pleine terre pour déterminer les exigences nutritives du sol n'ont pas été concluantes, mais les expériences faites en serres ont démontré une pénurie d'azote, de phosphore, de potasse et de soufre dans



Températures du sol à 4" — prise à 8h. du matin, du 6 juin au 24 juillet 67. Le réchauffement du sol a été en dessous de la moyenne en juin.

le sol vierge. Utilisant le radis Comet comme plante indicatrice, on a trouvé que l'addition de ces quatre éléments dans les premiers six pouces de la couche supérieure du sol, augmentait le rendement de 150 p. 100 tandis qu'à la profondeur de 6 à 12", le rendement était augmenté de 700 p. 100. L'addition de chaux, de magnésium et d'autres oligoéléments n'a pas augmenté le rendement. Après neuf années de culture, les applications de soufre n'ont pas donné de résultats dans les essais en serre, mais la réaction a été bonne pour les applications d'azote, de phosphore et de potasse. En conséquence, on a fait des applications de 300 à 400 livres d'engrais 13-13-13 à l'acre en 1966 et 67, ce qui avec des méthodes améliorées de culture a permis d'obtenir les rendements indiqués au tableau 1.

En raison de la courte saison, il est essentiel de semer tôt pour la plupart des légumes. Pour favoriser des semis hâtifs, le sol est préparé à l'automne précédent en enlevant les résidus de la récolte de l'été, en appliquant l'engrais, en labourant ou en bêchant, puis en laissant la surface aussi raboteuse que possible. De plus, quand on fait des billons ou du terrassement, il faut compléter ce travail avant que le sol soit complètement gelé.

On a obtenu une meilleure production de choux, de choux-fleurs, de choux frisés, de brocolis et de laitue pommée lorsque la semence était germée à l'avance et piquée dans des pots de tourbe ou des bandes à planter. Les plantes sont ensuite endurcies puis transplantées dans le champ entre le 6 et le 15 juin. Les radis, la laitue en feuille, les betteraves, la

poirée et le rutabaga d'été ont été germés à l'avance puis plantés directement dans le champ aussitôt que possible, en juin. Ce travail est souvent exécuté en se tenant sur des planches pour ne pas enfoncer dans la boue. Dans le cas des radis, de la laitue en feuilles et des rutabagas, on pouvait compter sur un approvisionnement continu en semant tous les dix jours jusqu'à la fin juin début juillet.

D'autres légumes n'ont pu atteindre convenablement leur maturité qu'à la suite de l'augmentation de la température du sol. Des paillis formés de bandes de polyéthylène clair, de 3 ou 4′ de largeur ont été très efficaces à cette fin. Ils ont augmenté dans une proportion allant jusqu'à 12°F les températures maximales du sol, et jusqu'à 5°F ses températures moyennes. On a réussi à remonter à 16°F, au maximum, la température du sol en plantant sur des buttes ou des terrasses et en utilisant des paillis de polyéthylène clair. Les augmentations de température les plus considérables ont été obtenues durant la première partie de la saison de végétation.

Des paillis de polyéthylène clair, placé à plat sur le sol, ont augmenté les rendements des betteraves, des poirées, des laitues et des pois. Les carottes, les rutabagas et les pommes de terre n'ont donné des récoltes satisfaisantes qu'en les cultivant sur des billons de 12″ ou des terrasses de 14″ de hauteur recouvertes d'un paillis de polyéthylène clair.

En plus des légumes, on peut cultiver avec succès de nombreuses fleurs et quelques plantes vivaces. Les meilleures fleurs annuelles pour semer directement dans le sol sont l'alysse Carpet of Snow et le Rosie O'Day, puis l'eschscholzie double Mission Bells et la gypsophile Copenhagen Market. Les meilleures fleurs annuelles à transplanter sont le souci Pacific Beauty, l'oeillet Double Gaiety, la dimorphothèque, les tagètes Petite et Choice Double, la matthiole à deux cornes et le pétunia simple.

Les meilleures plantes vivaces sont le pied-d'alouette, le lupin indigène, les variétés d'arabète alpine, Nana compacta et Snowcap, le pentstémon et la variété Pearl de l'achillée sternutatoire; puis suivent la gypsophile rosée, la némésie Blue Gem, l'anémone multifide et le lin à grandes fleurs.

Les fraises, les rhubarbes, les ciboulettes et les oignons vivaces sont les plantes alimentaires vivaces sur lesquelles on peut le mieux compter. Il faut les stimuler avec des applications annuelles d'engrais 13-13-13 que l'on mélange au sol, tôt au printemps en faisant suivre d'autant de binages que possible pour ameublir le sol et contribuer à le réchauffer. Les variétés qui se sont révélées les plus prometteuses aux essais sont la Bonanza, la Northerner et la Protem dans le cas des fraises, puis la MacDonald dans le cas des rhubarbes.

Les fonctionnaires de la Direction des recherches ne sont pas seuls à se préoccuper de la production de légumes à Inuvik. A peu près au temps où nos lopins ont été établis, le Père Adam, jardinier expérimenté du Grand-Nord, a commencé à cultiver un jardin sur les bords du terrain de l'école. Il utilise des méthodes différentes et son jardin produit également bien. Il a commencé par défricher l'endroit en abattant les arbres et les arbustes, puis en défonçant parfaitement la couche de matière organique non décomposée. Il a ensuite étendu en surface une couche de sol arable de 14″ d'épaisseur. Une clôture basse en planches a été installée du côté des vents, mais on a conservé une bonne circulation de l'air en laissant le côté opposé ouvert au-dessus d'une vallée peu profonde. Le Père a construit des couches froides de 6′ de large sur 30′ de long et 10″ de haut, avec des châssis amovibles recouverts en polyéthylène. Ces couches sont placées sur le sol et on les laisse se remplir de neige. Au début du printemps, on place les châssis sur les couches par dessus la neige. La neige fond, imbibe le sol et il n'est plus besoin d'arrosage pour le reste de la saison. Aussitôt que la neige est fondue, on sème les radis, la laitue et les carottes, puis on repique les choux et les choux-fleurs pour les transplanter plus tard en plein champ. Lorsque le temps se réchauffe, on enlève graduellement les châssis pour les mettre à l'abri. Le Père Adam utilise des tasses usagées en plastique ou en papier pour cultiver ses plants au bord des fenêtres tandis que le ministère de l'Agriculture du Canada utilise des pots de tourbe ou des bandes à planter pour produire ses plants dans des serres couvertes de verre ou de plastique.

Il en coûte plus cher pour établir un jardin selon la méthode du Père Adam en raison du prix du transport de sol arable et de la construction des couches froides. Toutefois, ces améliorations sont plus ou moins permanentes et les frais subséquents faibles, tandis que les couches froides peuvent servir à proproduire des récoltes hâtives. Nos frais à l'origine ne comprennent que le défrichement du sol et la préparation de la couche de semis; c'est tout ce qu'exigent certaines cultures. Toutefois, si les paillis et le terrassement sont nécessaires, ils augmentent les frais, car les paillis doivent être remplacés tous les ans.

On ne peut comparer la croissance et les rendements de ces méthodes en raison des grandes différences entre les procédés de culture et les endroits où on les utilise. Il n'est pas davantage nécessaire de les comparer puisque les deux fournissent des quantités suffisantes de légumes frais pour la table.

Il reste à résoudre de nombreux problèmes associés au jardinage sur le pergélisol, mais on a fait suffisamment d'essais pour démontrer que plusieurs légumes ordinaires peuvent être produits dans le Grand-Nord. Nous croyons que la découverte de nouvelles techniques permettra d'obtenir de meilleurs rendements et de produire une plus grande variété de cultures. De tels résultats continueront à être l'aboutissement des efforts de personnes qui, comme le Père Adam, résident en permanence dans cette région. Nous espérons sincèrement que nos recherches sur le pergélisol à Inuvik serviront de base à cette production permanente et croissante. ■

fertilizing hay meadows of the cariboo

A. L. PRINGLE and
A. L. VAN RYSWYK

La valeur de la fumure a été démontrée pour la production de fourrage dans la vallée de la haute Fraser en Colombie-Britannique. Sept ans après l'application initiale, on récolte encore les profits des taux élevés de fumure.

About 100 years ago, in the days of the gold rush to the upper Fraser River, when the towns of Quesnel and Barkerville were booming, the freighting companies set up a system of mile houses for changing stagecoach and freight-wagon horses. The early staging points later became the center for ranching. Horses gradually gave way to cattle and the native sedge hay meadows of the Cariboo provided hay for overwintering cattle.

The hay was cut from the open sedge meadows which dot the interior plateau and string out from the lakes along the stream courses. The native hay grows on organic deposits, built up from ancient glacial lakes. Other organic deposits have resulted from beaver activity along the water courses. In some areas up to 15 per cent of the land surface is in sedge bog varying in depth from one foot to 25 feet. Between the 70 Mile House and Quesnel, including the Horsefly and Chilcotin districts, there are over 50,000 acres of native hay cut for livestock feed.

Cattle ranchers have been faced with the problem of low yield and poor quality hay, therefore, in 1960 the Range Research Station in Kamloops started research work on the problem. The question we considered was: Could chemical fertilizers bring about an economic increase in hay production? Earlier trials had indicated that light rates of fertilizer (50 to 100 lbs per acre) were of little value, especially N application at this low rate.

In our experiments we established a trial at Miocene, B.C., on a typical hay meadow which had been harvested for 50 years. We used the three major fertilizer elements in various combinations at the rate of 0, 200 and 400 lbs of N, P_2O_5 and K_2O per acre. We applied fertilizer to the surface in October 1961. After this single application no further application was made. The hay in the plots has now been cut each year since 1961.

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In Table 1, selected treatments show the costs per acre and the profit on a yearly basis. All figures are based on actual yields at $25.00 per ton of dry matter. No account has been taken for the cost of application and neither have we considered that, with the same equipment and same travel time, twice as much forage could be harvested. This consideration could offset any application charges.

The cost for fertilizer (used to make up the mixtures) are derived from the cost of a ton of 33.0.0, 0.45.0 and 0.0.60 at Quesnel in 1966. Had a cheaper form of P_2O_5, such as 11.48.0, been used, the costs would have been reduced by about $1.50 per acre for the P_2 treatments.

Analysis of the forage from the plots does not show appreciable differences in chemical composition or total digestible dry matter level. Aftermath grazing from the plots definitely indicates a palatability preference by cattle for fertilized hay.

The benefits of one application of fertilizer in 1961 are still being realized 7 years later. Thus, the profit picture for this trial is not complete. The treatments containing P and K were still giving increases in 1967 almost equal to the six year average (Table 1). These could continue for another year or more.

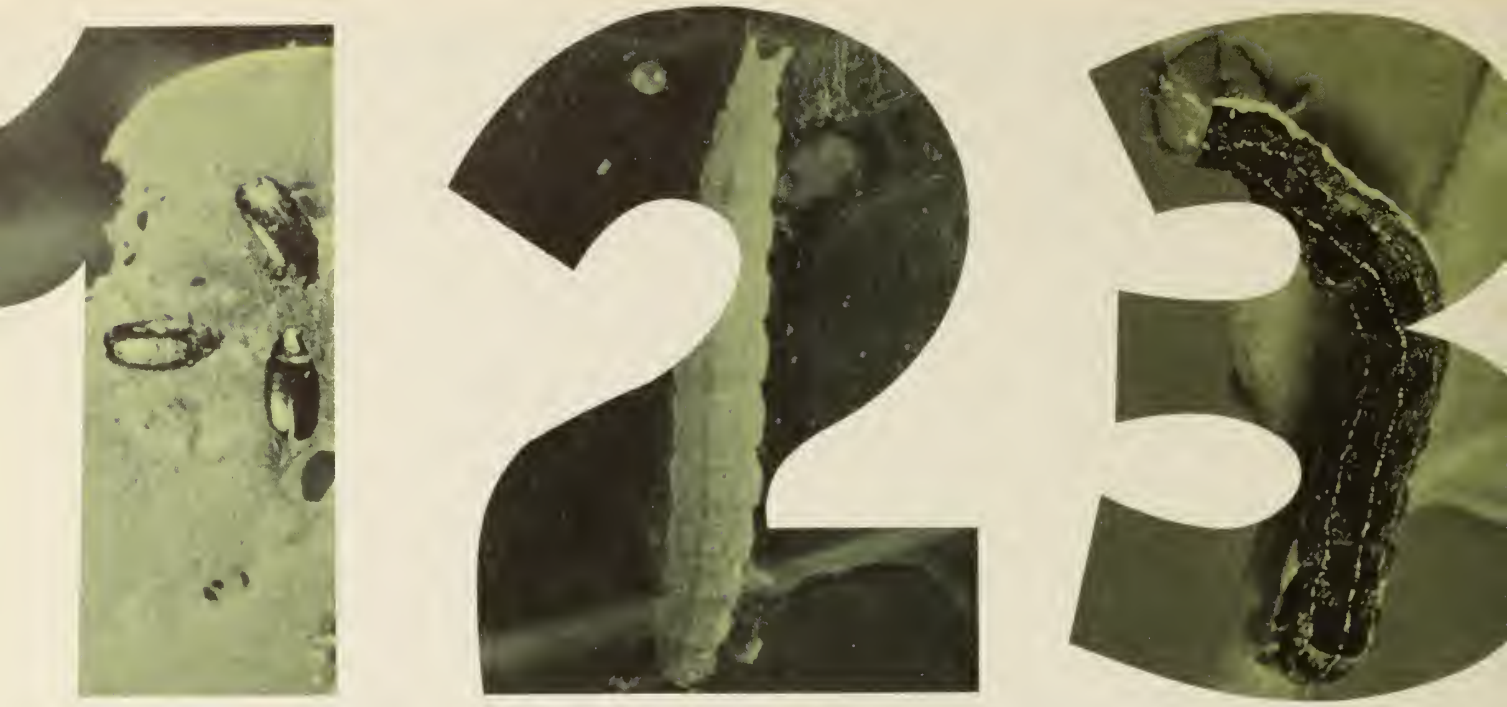
Even though we used heavy rates of fertilizer primarily for research purposes, which seemed unreasonable at the time, certain rates have proven to be economically sound.

We are continuing with the next step in our work; that of determining the optimum rate of the most satisfactory formulations. It is already evident that yearly applications of up to 50 lb N will be necessary since excess applied N is largely dissipated within a season. In addition adequate P and K must be present for maximum yields. ■

TABLE 1. COMPARISON OF SELECTED FERTILIZERS

Fertilizer treatment	Yield lbs 1967[1]	Six year average: 1962-67 Dry matter per acre	Returns $/acre (Hay $25/ton)	Increase $/acre	Cost of fert. $/acre	Profit $/acre
$N_0P_0K_0$	1066	1216	15.21	—	—	—
$N_0P_0K_2$	1324	1391	17.11	1.90	2.50	—0.60
$N_0P_0K_4$	1512	1575	19.69	4.48	5.00	—0.52
$N_0P_2K_0$	1723	2100	26.25	11.04	4.43	6.61
$N_0P_2K_2$	1831	1841	23.02	7.81	6.93	0.88
$N_0P_2K_4$	2191	2291	28.47	13.26	9.43	3.83
$N_0P_4K_0$	1929	1925	23.90	8.69	8.87	—0.18
$N_2P_0K_4$	1726	2033	25.41	10.20	9.60	0.60
$N_2P_4K_0$	2104	2316	28.71	13.50	13.46	0.04
$N_2P_2K_2$	2037	2525	31.56	16.35	11.53	4.82
$N_2P_2K_4$	2314	2975	37.19	21.98	14.03	7.95
$N_4P_2K_0$	2083	2391	29.90	14.69	13.63	1.06

[1]1967 yields indicate a postive carryover effect into the sevénth year.



L. G. PUTNAM

Les récoltes de colza du Canada sont menacées par trois insectes: la teigne des crucifères au stade de la chenille, l'altise et la légionnaire bertha. Le présent article fait l'exposé des moyens de lutte.

1–Flea beetles on a young rapeseed plant.

2–Diamondback caterpillars infest a rapeseed plant.

3–Maturing Bertha armyworm.

Canada's position as the foremost exporter of rapeseed is threatened by three insect pests: the diamondback moth (caterpillar stage), the flea beetle and the Bertha armyworm. Without some means of control many rapeseed growers would have stopped producing this crop, in some districts, as it would be too risky.

In a study of rapeseed insects at the CDA Research Station of Saskatoon, Sask., we have devoted most of our attention to the control of caterpillars of diamondback moths. As an annual migrant, this insect differs from our resident pests. Some researchers with the Department have proved that the diamondback can't survive our winters and, to re-establish the local infestation the insects must come up from the south or southeast every year.

Weather can create trouble for prairie growers of mustard and rapeseed. Strong southerly winds, that are common on the prairies during the summer, bring hordes of diamondback moths. Their descendants, the caterpillars, can devastate rapeseed or mustard crops unless controlled by insecticides.

Before an effective control measure can be applied against an insect pest, its life cycle must be well known. Unfortunately, there are many knowledge gaps about the life cycle of diamondback moths. For example, where do they breed in the United States and what food plant supports them there? Do they have a two-year cycle of abundance and scarcity? Why do they become airborne? Why do they fly between the time they reach adulthood and begin laying eggs?

In our investigations at Saskatoon we have found that the diamondback moths seem to arrive in large numbers during even-numbered years and are scarce in the odd-numbered years. Because of the knowledge gaps, we do not know why this population fluctuation should exist.

When the adult diamondbacks arrive in Canada, the rapeseed crop will not likely have emerged and the insects begin to lay eggs on related plants such as stinkweed and flixweed. In four to six weeks, a new generation of moths emerges and deposits its eggs on crops of rapeseed and mustard which are growing. The newly hatched caterpillars are almost microscopic in size and attack the plant by burrowing in among plant cells where they feed. Older larvae can feed from the surface of leaves and also on rapeseed pods and flowers as they appear.

Because they attack pods and flowers, the small larvae, if numerous enough, can drastically reduce yields without having much effect on the whole plant. The hatching larvae seem to be unable to develop on more mature rapeseed plants. This means that the locally bred generation of adults must appear about the last week in June if their larvae are to cause a problem at the crucial time a month later.

Last year (1968), for example, moths emerged on

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RAPESEED'S 'BIG 3' INSECT PESTS

time and in sufficient numbers to generate a destructive infestation of larvae. Farmers and retail outlets were alerted. Insecticides were stockpiled. But the weather patterns changed abruptly on July 12 when a lengthy period of cool, wet weather ended any threat of an outbreak.

Diamondbacks have enemies and the most common are the parasitic wasps which lay eggs in the larvae. No apparent damage is done to the larvae until they approach the pupal stage, when the host larvae is killed. Parasites often affect a high proportion of first generation diamondback larvae. They are therefore important in reducing numbers of moths present at the critical time late in June. However, at the present time, no means are visualized to make deliberate use of parasites for their control. So far, only insecticides have been economically effective. By continuing our studies, we hope to find weak spots in the diamondback life cycle which could lead to better controls.

One of the studies we have been conducting for nearly a decade is a method to determine the diamondback population. By measuring the abundance of moths, it might become possible to predict the amount of damage their larval descendants would likely do in any given year, and farmers could then prepare to spray for their control.

The only population index developed so far attempts to relate the number of moths captured in light traps to the likely population in fields, and hence to subsequent larval infestations.

Our attempts to correlate light-trap catches to the damage done in outbreaks will remain unsatisfactory without associated measurements of the reproductive success of the moth populations, e.g. how many eggs were laid and how many larvae hatched? We are experimenting with another sampling device, a kind of vacuum cleaner that sucks up diamondbacks while going through the field. We hope to discover how big an area and how many areas in any one field should be sampled to give us an accurate picture of the diamondback population.

FLEA BEETLE

We are also working on another serious local problem — the flea beetle. It attacks rapeseed in the seedling stage and can wipe out many acres. Flea beetles overwinter in the soil or in plant debris and, during warm weather they move into a rapeseed crop from an adjoining field.

Our studies have revealed that insecticidal seed treatment is an effective control. The insecticide is applied to seeds and is either carried up on the surface of the seedlings or travels through the plant as it grows. As long as sufficient poison remains in or on the young plants, flea beetles are killed in their attempts to feed on the crop. In some districts, growers use seed treatments in a routine manner, almost as insurance.

BERTHA ARMYWORM

Another important insect that attacks rapeseed is the Bertha armyworm which can be locally disastrous in some years. It is particularly destructive when feeding on pods and on maturing plants. It has been observed to devour a pod as we would eat a banana. Our research has revealed that these armyworms can be controlled by persistent insecticides which, unfortulately, leave a residue. In our investigations, we are seeking an effective non-persistent insecticide to control this caterpillar.

An insecticide to handle all of these insect pests would be welcomed and we have tested some in the laboratory which show promise. But such an insecticide must have other commercial use before it becomes economically priced for use by rapeseed growers. Companies are not likely to spend millions of dollars developing an insecticide for the relatively small rapeseed-grower's market. This limits the number of insecticides we can study, but we do have reasonable hopes of success. ■

Areas (white) adapted to growing rapeseed.

DIETARY FACTORS affecting fat content of milk

L. J. FISHER

Grâce à la biochimie nous comprenons mieux les causes des fluctuations de la teneur en matière grasse du lait. Des essais font ressortir l'importance d'une proportion suffisante de fourrages grossiers dans la ration des animaux laitiers, si l'on veut que les animaux tirent plein profit des céréales qu'ils consomment.

The Canadian milk pricing system is currently based on milk fat content. Many aspects of feeding and environment will influence milk fat levels, including level of forage consumption, particle size of the forage, type, amount and specie of grain fed. For example, placing the cows on early spring pasture almost invariably results in a marked drop in milk fat percentage.

Although we know that many feeding and environmental factors affect milk fat level, the basic mechanism whereby these factors exert their effect is only partially understood. The process of digestion in ruminant animals is characterized by the production and utilization of volatile fatty acids (primarily acetate, propionate and butyrate). The ratio of acetate to propionate production in the rumen reflects the type of ration fed, which in turn affects the quantity and composition of production whether it be body weight gain or milk. In general, as the ratio of roughage to concentrate is lowered there is a decrease in the proportion of acetate to propionate produced in the rumen. In terms of molar percentage of rumen volatile acids, it is known that there is a positive correlation between the proportion of acetic to propionic acid produced by fermentation in the rumen, and milk fat content. It has further been shown that efficiency of milk secretion defined as the amount of milk produced per unit of digestible energy consumed increases as the molar proportion of propionic acid increases. However, efficiency of milk production begins to decrease when the fat content of the milk becomes adversely affected by larger amounts of propionic acid produced in the rumen. Although the molar percentage of acetic acid in the rumen is decreased under these conditions it has been shown by other workers that there is sufficient acetic acid present to fulfill its role as a precursor of milk fat. Further proof of this is given by British workers who added acetic acid to the rumen of lactating cows receiving a fat depressing diet without appreciably increasing milk fat content.

In an effort to clarify the reason for the reduction in milk fat content which occurs when a high proportion of concentrate is fed in a dairy ration, the staff of the CDA Animal Research Institute, Ottawa, has carried out a series of experiments. Since there is no actual shortage of acetic acid, we suggested the hypothesis that the high level of propionic acid interferes with the absorption or metabolism of acetic acid. To test this theory we fed acetic acid intravenously to cows consuming a ration which caused a decrease in milk fat production.

We increased the concentrate in the ration of six Holstein cows in mid-lactation from one pound of concentrate per four pounds milk to free choice (30 lb./cow/day). At the same time a high quality mixed hay was reduced from free choice to four pounds per cow per day. The change in hay and

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concentrate intake resulted in the expected change in rumen volatile fatty acids (VFA) (Table 1). The ratio of acetate to propionate was reduced from 2.9:1.0 to 1.0:1.0. The change in proportion of rumen VFA's was accompanied by a 30 per cent decrease in the fat content of the milk. Although the six cows had been receiving sufficient feed to satisfy their nutrient requirements before the ration change, the increased intake of concentrate resulted in a 16 per cent increase in milk production for the group of six cows.

Once the animals were established on the new rations they were intravenously infused with a solution of acetic acid neutralised to a pH of 7.0 with NaOH. The concentration and infusion rate was controlled to provide each animal with approximately 500 g. of acetic acid daily for six days. Although there was no appreciable change in milk production during the intravenous infusion of acetic acid, we found that the milk fat recovered to 90 per cent of its original value while fat production returned to the level that prevailed when hay was fed free choice (Table 2). The rate of recovery was not consistent as shown in Table 3. There was an initial sharp increase in milk fat content with the acetic acid treatment followed by a plateau effect for 3 days then a further response on the last day of the treatment period. If the acetic acid infusion had been continued milk fat percent may have been increased further.

We have concluded that excess propionic acid was interferring with the absorption of acetic acid from the rumen. The intravenous infusion of acetic acid by-passed this block and provided the mammary gland with sufficient acetic acid for normal milk fat synthesis. The results of this experiment point out the importance of maintaining sufficient roughage in the ration for the most efficient use of high intakes of grain by lactating cows. ■

TABLE 1. MOLAR PERCENT RUMEN VOLATILE FATTY ACIDS AS RELATED TO PROPORTIONS OF HAY AND CONCENTRATED IN A DAIRY RATION

	Acetic	Propionic	Butyric	Isobutyric	Valeric	Isovaleric
Hay ..... free choice	62.3	21.2	8.8	2.9	2.4	2.4
Concentrate free choice	40.7	41.6	10.0	2.9	2.4	2.4

TABLE 2. THE EFFECT OF TYPE OF RATION AND INTRAVENOUS INFUSION OF ACETIC ACID ON MILK AND MILK FAT PRODUCTION

	Milk (lbs)	Fat (lbs)	Fat (%)
Hay (free choice)	37.2	1.21	3.25
Concentrate (free choice)	44.2	1.00	2.27
Acetic acid (500 g/day) ..	42.2	1.22	2.89

TABLE 3. THE EFFECT OF CONTINUOUS INTRAVENOUS ACETIC ACID INFUSION ON YIELD OF MILK FAT

Day	1	2	3	4	5	6
Milk yield (lb) ..	42.5	41.9	42.3	43.0	42.4	42.2
Fat yield (lb)	1.02	1.13	1.15	1.14	1.14	1.22
Fat %	2.40	2.70	2.71	2.64	2.70	2.89

ENEMIES

OF THE CODLING MOTH

C. R. MACLELLAN

En Nouvelle-Écosse, les chercheurs ont découvert que la pyrale de la pomme, insecte ravageur de pommiers, peut être mise en échec par ses ennemis naturels après que la population a été réduite par une vaporisation avec des produits chimiques sélectifs.

In Nova Scotia's Annapolis Valley the codling moth is such a serious pest that it must be kept under control if apple growers are to avoid serious losses. But the pest has many natural enemies which attack it. These enemies include birds (woodpeckers), fungal parasites (*Beauveria bassiana*), insect parasites (*Ascogaster quadridentata*), predacious insects (ostomids, thrips, mirids, chrysopids, clerids, and others), predacious mites (amystids, atomids) and low winter temperatures (−15°F).

When codling moth occur in high numbers they should be controlled by spraying with a pesticide. Once the high population has been reduced, natural enemies are capable of containing the pest at low levels for several years, with an occasional assist by a selective chemical such as ryania.

Natural enemies are most effective in reducing numbers of codling moth at three specific times during its life cycle: the egg stage, newly hatched larvae, and the wintering larvae. In our investigations at the CDA Research Station, Kentville, N.S., we have found that woodpeckers are most important enemies since they effectively attack the codling moth when they are at their lowest numbers. Woodpeckers attack the codling moth as soon as the larvae leave the fruit to spin cocoons on the tree trunk. These birds start their activity in August, increasing in early fall and reaching a peak in November after which the numbers of larvae available decline as winter advances (Table 1).

TABLE 1 — WOODPECKER PREDATION ON CODLING MOTH LARVAE

CM cocoons per vertical foot of tree trunk	Number of orchards sampled	Percentage CM larvae taken by woodpeckers
0-2	247	42
2-3	60	50
3-5	32	54
5-8	36	56
8	45	58

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Where the codling moth population is below an average of 2 larvae per vertical foot of tree trunk surface, and other enemies are operating unhindered, experience in Nova Scotia has shown that insecticides need not be used. In many orchards woodpeckers depress the numbers of codling moth from potentially damaging pests to below this level for a number of years.

Mortality due to low winter temperatures is usually less than two per cent. The temperature must drop below −15°F and remain below for several hours before significant mortality occurs. A maximum kill of 22 per cent has been recorded in one orchard but this is an exception.

The parasitic fungus *B. bassiana* is also unimportant when codling moth numbers are low and this decrease was not found during extensive sampling in the years 1965-67. The maximum fungal infestation ever recorded in one orchard was 7 per cent.

The insect parasite, *A. quadridentata*, on the other hand, is frequently a major mortality factor of codling moth. When numbers of host are low, parasitism averages nearly 5 per cent but when host numbers increase, the percentage also increases. In 1949, the year following our worst codling moth infestation, 82.5 per cent of the wintering population in one orchard was parasitized by *A. quadridentata*.

Ostomid beetles attack both the overwintered larvae and the pupae in spring. Unfortunately these beetles seldom reach numbers sufficiently large to act as an important enemy of codling moth.

We studied the mortality of codling moth eggs and young larvae intensively for five years in a commercial orchard operating on an integrated control program. In the first four years, egg mortality due to parasitism by a small chalcid, *Trichogramms* sp., and to predation by thrips, mirids and atomids averaged 20 per cent each year. In the fifth year egg mortality dropped to 2 per cent. Mortality of young larvae ranged from 61 to 76 per cent in the first four years and dropped to 46 per cent in the fifth year. This mortality was due to predation by mirid, chrysopid, and elerid insects and by anystid and atomid mites, and to other natural causes of death such as failure to find fruit, unsuccessful fruit penetration, and dispersal of larvae. The decrease in mortality in the fifth year (1964) is attributed to interference of natural enemies by non-specific chemicals (Table 2).

Larva of the codling moth.

TABLE 2—CODLING MOTH INJURY, NUMBERS OF PREDATORS AND TREATMENT USED IN AN INVESTIGATIONAL COMMERCIAL ORCHARD

Year	CM injury per 100 fruits	CM pre-dators	Total pre-dators	Treatment and Date	
1960	2.1	423	854	LA	May 20
1961	2.4	629	868	None	
1962	4.8	506	840	LA	May 31
1963	0.8	275	838	Malathion	June 26
				LA	July 8
1964	13.5	71	433	Azinphos-methyl	May 29
				Malathion	June 8
				LA	July 10
1965	1.1	—	—	Malathion	June 25
				Ryania	July 5
				LA	July 15

LA — Lead Arsenate

Natural enemies of codling moth were seriously reduced by non specific chemicals in 1964. As a result, there was a great increase in codling moth damage that year.

The insecticides used during the study were chiefly of low dosage applied against the winter moth, *Operophtera brumata*, and the brown bug, *Atractotomus mali*, and regular dosages of lead arsenate for the apple maggot, *Rhagoletis pomonella*. The malathion used for brown bug control in 1963 and azinphosmethyl and malathion for winter moth and brown bug control respectively in 1964 reduced the numbers of codling moth predators below effective levels.

This experiment illustrates the value of natural enemies in reducing damage by a major pest; in this instance, the codling moth. More than 90 per cent of the pest was killed when all natural mortality factors were operating unhindered. The grower then need concern himself only with reducing damage to the desired level. It is important therefore to treat natural enemies as allies and to allow them to function as unmolested as possible. In practice this is done by avoiding the use of sprays toxic on beneficial species. ■

Pasture and Drylot Finishing of Dairy Steers

A. D. L. GORRILL and R. C. PARENT

Il est possible, avec une assez bonne marge de bénéfices, d'élever pour la boucherie, des bouvillons de races laitières. On a aussi constaté, que les éleveurs qui s'adonnent à cette spéculation peuvent retirer plus de profit en vendant leurs animaux d'après le classement à l'abattage plutôt que de les vendre au poids vif aux abattoirs, aux acheteurs ou aux commerçants de bestiaux.

Experiments at the Research Station in Charlottetown have shown that Ayrshire steers raised for beef can provide a reasonable return over feed costs. In our research we have compared several systems of management over a five-year period to determine the most economical method for finishing dairy cattle steers. This class of livestock represents a large proportion of the cattle killed for beef in Eastern Canada.

In our research we obtained a slightly greater net return over feed costs by roughing steers through the winter and feeding on pasture, compared with marketing from the feedlot at a younger age (Table 2).

In our first experiment, Ayrshire yearling steers averaging 550 lb. were fed 4 lb. crimped barley per day while rotationally grazing pasture from May to September. The barley supplement increased body weight gains by 21 per cent compared with no supplement (2.3 vs. 1.9 lb/day) in 1962. When the experiment was repeated in 1964, barley had no effect on weight gains. This variability of response to the barley supplement was probably associated with the quality and quantity of pasture available to the steers. Grain feeding in both years had no effect on dressing percentage, eye of lean area or official carcass grades. However, all carcasses lacked sufficient finish and conformation to grade higher than Commercial 1.

In a second experiment, we fed either poor quality, field-cured timothy hay (7 per cent crude protein) or second-cut, barn-dried red clover-alfalfa hay (12 per cent crude protein) to six month old Ayrshire steers averaging 210 lb. during a 27 week winter feeding period. In addition, all steers received about 3 lb. per day of a grain mixture. Average daily body weight gains were 22 per cent greater for steers fed the red clover-alfalfa hay (1.6 vs. 1.3 lb.), and less hay was consumed per pound of gain compared with those fed the timothy hay. The effect of hay quality was still evident when the steers were re-

Fig. 1—Ayrshire steers fattened in the feedlot from Sept., 1964.

TABLE 1—TOTAL FEED CONSUMPTION PER STEER FATTENED IN FEEDLOT OR ON PASTURE

	Feed consumption (lb.)	
Feedstuff	Feedlot fattening (Oct. 21 to Feb. 23)	Pasture fattening (Oct. 21 to Sept. 30)
Oats or mixed grain	45	360
Barley	1080	320
24% protein concentrate	460	120
Potatoes	730	—
Corn silage	1420	4620
Hay	1090	3840

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moved from pasture the following September. This illustrates the value of good quality roughage for wintering calves.

We compared pasture and drylot feeding of steers in a third experiment. One group of 18 month old Ayrshire steers averaging 750 lb. was fed from September to February on up to 17 lb. per day of a 3:1 mixture of crimped barley and 24 per cent protein supplement plus timothy hay free choice, and either 12 lb. of potatoes or 30 lb. per day of corn silage (Fig. 1). The steers were then marketed from the feedlot.

The second group of 14 steers of the same age and weight were fed timothy hay, corn silage, and 1 to 2 lb. per day of the grain mixture from September until May and then were put on fertilized pasture and received in addition up to 12 lb. per day of a 1:4:1 mixture of crushed oats, crimped barley and 24 per cent protein supplement until October 1 (Fig. 2).

The total feed consumption per steer on each fattening system are shown in Table 1. Winter feedlot gains of the first and second groups of steers averaged 2.0 and 0.3 lb. per day, respectively, and weight gains of the second group on pasture averaged 1.6 lb. per day. The final body weights of the steers fed in drylot and on pasture averaged 1010 and 1080 lb., respectively. Carcass grades of the steers were nearly all in the Commercial 1 class.

Factors which should be considered in roughing steers through the winter and feeding grain on pasture include the relative value of the pasture, and labor and investment costs of feeding the steers for a longer period of time.

Fig. 2 — Ayrshire steers after pasture fattening (Sept., 1965), which followed the maintenance ration.

We also found, by comparing liveweight with carcass returns, that net income over feed costs were 58 and 36 per cent higher when steers from the feedlot and from pasture, respectively, were sold on a railgrade rather than on a liveweight basis (Table 2). These results strongly suggest, at least for dairy-type steers at present, that farmers could reap greater economic returns by marketing these animals on a railgrade basis rather than direct to packers, buyers or drovers on a liveweight basis. ■

TABLE 2 — FEED COSTS AND NET RETURNS FROM AYRSHIRE STEERS FATTENED IN FEEDLOT OR ON PASTURE

	Feedlot fattening	Pasture fattening
Av. liveweight value, Oct. 21, 1964 (11¢/lb.)	$ 84.01	$ 82.10
Av. liveweight value, Feb. 23, 1965 (18¢/lb.)[1]	164.13	—
Av. carcass value, Feb. 23, 1965 (30-31¢/lb.)	166.78	—
Av. liveweight value, Sept. 30, 1965[2]	—	191.66
Av. carcass value, Sept. 30, 1965 (33-34¢/lb.)	—	197.20
Increase in steer value — liveweight	80.12	109.56
— carcass	82.77	115.10
Total feed cost[3]/steer	75.59	94.20
Net income over feed costs — liveweight	4.53	15.36
— carcass	7.18	20.90
Net income/steer/day[4] — liveweight	.036	.045
— carcass	.057	.061

[1]Price/lb. on shrunk liveweight varied from 16.5 to 19¢ (Av. of 18¢).

[2]Price/lb. on shrunk liveweight varied from 18 to 19¢.

[3]Cost of feeds: (per 100 lb.) oats and barley, $3.00; 24% protein concentrate, $4.90; potatoes, $0.40; corn silage, $0.35; hay, $1.00; bonemeal, $6.00; salt, $2.25; and pasture, $15.00/steer.

[4]Steers finished in feedlot and on pasture were fed for 126 and 344 days, respectively.

Marsh crane flies T. paludosa, *in copula.*

LEATHERJACKETS

a new pest in british columbia

A. T. S. WILKINSON

La tipule des marais d'Europe, *Tipula paludosa* Meig., infeste les pelouses et les prés des côtes de la Colombie-Britannique. Des moyens chimiques ont été mis au point et d'autres biologiques sont à l'étude pour la combattre.

One of the most common and damaging turf pests of north-western Europe, the marsh crane fly, *Tipula paludosa* Meig., has become a serious pest of lawns and pastures in the coastal area of British Columbia. These pests, leatherjackets, were discovered in 1965. They were causing severe damage to lawns in the eastern outskirts of Vancouver.

The first North American record of this pest was in 1955 on Cape Breton Island. In 1959 damage was reported to cabbage transplants and turnip seedlings in Newfoundland. In British Columbia damage has been primarily to grass, but strawberries, flowers and vegetable crops have also been attacked.

In the past four years they have become well established in lawns in and around Vancouver and in pastures on large dairy farms, up to 65 miles east of Vancouver. The pest has spread south, as determined by U.S.D.A. staff, who have captured adults in light traps along the B.C.-Washington border.

In 1966, the problem became so severe that the grass was nearly eliminated on 10 acres of pasture on a small farm near New Westminster. In studies carried out by the Research Station in Vancouver we showed an average leatherjacket count of 110 per square foot during April and May, or 4½ million per acre. The number of adults that emerged in August and September averaged 98 per square foot. Populations in 1967 and 1968 averaged about 46 per square foot. In the four years of studying this pest we have encountered no parasites or diseases. The only predators observed were spiders, European starlings, and seagulls that feed primarily on the adults.

The marsh crane fly has one generation per year. The adults emerge from the soil in August and September and mate immediately. The female lays about 280 shiny black eggs in the grass within 24 hours after emerging. The larvae feed on crowns and blades of grass, grow during the autumn and overwinter in the larval stage. In spring when the soil warms the leatherjackets continue feeding. During March and April the damage is greatest as they feed voraciously. Larvae can be seen feeding on the

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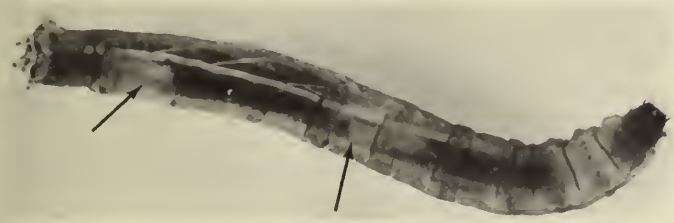
Mature 3rd-instar larvae of T. paludosa.

Pupa of T. paludosa.

Leatherjacket parasite S. geniculata.

Leatherjacket showing 2 parasites.



surface on warm evenings and dark warm days. Pastures and hay meadows heavily infested show little, if any, growth before May 15, at which time the larvae stop feeding. The first cutting of hay, normally taken before the end of May, is lost in infested fields. At $70 per ton, the loss is serious. Grains and grasses planted on heavily infested land are usually killed in the early seedling stage. The larvae pupate in July and August. The mature pupa works its way to the surface to protrude about ½ inch when the adult emerges.

There are good reasons why the marsh crane fly is doing so well. European workers have concluded that this pest is favored by mild winters, cool summers and rainfall averaging at least 24 inches. Based on the 30-year averages it appears that the maritime climate of the wet coastal belt of British Columbia is practically ideal. In 1967 we had one of our hottest, driest years, especially during the egg and early larval stages, which are highly susceptible to desiccation. Although the population was down from the previous year it still averaged 46 per square foot in the test plots. In the winter of 1968-69 we had one of the longest cold periods experienced in several years, but it appears to have had little effect on the population.

For control on lawns, boulevards and golf greens, a single application of DDT during fall or early spring gives excellent results. Similarily a single application of parathion will give control on pasture and forage crops without danger of harmful residues.

Once we established an adequate chemical control to satisfy the immediate needs of the farmer, we studied the possibility of biological control. In 1968 the tachinid parasite *Siphona geniculata* (de Geer) was obtained from Germany through the Research Institute at Belleville, Ontario. Several generations were bred successfully at the Vancouver Station and adults and parasitized leatherjackets were released in the summer in a heavily infested area. To date we have not been able to determine if this parasite is established.

Attempts to establish the fatal Tipula iridescent virus in laboratory colonies have failed. Leatherjackets at various stages have been immersed in the virus and have been fed food soaked in the virus but none has become infested. A polyhedral virus obtained from England has not been tested.

Until this European pest became established, pastures and forage crops were grown successfully without the use of insecticides. It is hoped that we can return to this ideal situation by establishing the tachinid parasite and possibly the less effective viruses. We cannot expect to eradicate this pest but we do hope to bring it below the economic threshold so that insecticides will not be necessary. ■

Centralized feed storage — multiple silos and hay barns — featured at CDA's Animal Research Institute 'greenbelt' farm on the outskirts of Ottawa (see article page 12).

Silos et grandes à foin de l'Institut de recherches zootechniques du MAC, en banlieue d'Ottawa, sont groupés pour améliorer le rendement (voir page 13).

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