FALL 1978
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Danny Whittaker, Florenceville, does his bit for the potato industry in New Brunswick. See story on potato quality on page 15.

Danny Whittaker, de Florenceville, fait sa part pour l'industrie de la pomme de terre au Nouveau Brunswick. Voir l'article sur la qualité de la pomme de terre à la page 15.

CANADA AGRICULTURE

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Agriculture Canada

SHORT-SEASON SOYBEANS

H. D. VOLDENG,
J. F. SEITZER, and
R. I. HAMILTON

La variété Maple Arrow, sélectionnée à Ottawa à partir du croisement des lignées Fiskeby et Harosoy, indique les progrès qu'on peut réaliser dans la sélection de soja à partir de matériel génétique suédois à maturation précoce et résistant au froid. Maple Arrow a un rendement supérieur à Altona et parvient à maturation légèrement plus tôt que cette dernière dans l'est de l'Ontario et dans les Maritimes, régions recevant de 2500 à 2600 unités thermiques. Les lignées avancées issues de croisements ultérieurs ont été évaluées dans le cadre d'un projet conjoint entre les stations de recherche d'Ottawa et de Brandon.

The soybean cultivar on the left is sensitive to low temperatures and produces small, short seedless pods. The plant on the right is relatively unaffected by the same temperatures.

The soybean is generally considered to be adapted to warm climates and long growing seasons, almost a semi-tropical crop. In fact, the soybean is believed to have originated in northeastern China and today production is centered around 40°N latitude in the American Corn Belt and central and northern China. Canadian production is centered in the southwestern Ontario counties of Elgin, Essex, Kent, Lambton and Middlesex, between 42° and 43°N where soybeans were grown on approximately 200 000 ha in 1977.

However, production from southwestern Ontario meets only 50% of Canada's requirement, and in 1976 we imported soybeans and soybean oil and meal worth $160 million. There is not the acreage available in the five southwestern Ontario counties to allow a large increase in production, and future expansion must come from regions with shorter growing seasons. In Ontario a significant soybean acreage is developing in the 2800-3000 Corn Heat Unit (CHU) area around London, adjacent to the established area of production. There are several potential production areas between 45° and 46°N with 2500 to 2600 CHU: eastern Ontario, the St. Lawrence Valley south of Montreal, the lower St. John's River Valley of New Brunswick and the Annapolis Valley of Nova Scotia. However, all these areas lack oilseed crushing facilities within a reasonable distance. No such limitation exists in southern Manitoba and Alberta between 49° and 50°N, but the CHU's available do not exceed 2000 to 2300.

To promote soybean production in Canada, the Department of Agriculture initiated a breeding program at Harrow in 1923 and at Ottawa in 1927. The program at Harrow, especially the release of the cultivar Harosoy in 1951, did much to expand production in southwestern Ontario. At Ottawa Dr. F. Dimmock developed eight cultivars, starting with Mandarin in 1934 and culminating in Merit in 1959. This program did not lead to extensive production in the shorter season areas, although after World War II there were more than 800 ha in the Ottawa Valley. However, Dimmock's cultivars were popular in northern regions of the United States, and even in 1974 Merit was grown on 82 800 ha in north central U.S.A.

Drs. Voldeng and Seitzer are in the Forage Crops Section of CDA's Ottawa Research Station. Dr. Hamilton is with CDA's Brandon, Man., Research Station.

The Research Station at Morden also had a breeding program that produced the cultivar Morsoy in 1970. The University of Guelph has had an active soybean program for many years, producing the cultivar OAC211 as early as 1925 and, more recently, Vansoy. At the University of Manitoba, Dr. Baldur Stefanson released the cultivars Altona and Portage in the mid 1960's, the latter being the earliest cultivar available. Dr. Stefanson also made the cross that resulted in the cultivar Beechwood, released in 1976 by Stewart Seeds.

In spite of efforts to develop improved short-season cultivars, soybeans are not a major crop outside southwestern Ontario. The lack of crushing facilities anywhere east of Toronto has certainly inhibited production, but this is not the case in southern Manitoba and Alberta where plants are already crushing large quantities of imported soybeans. Farmers and agronomists have complained that the cultivars available are too late, deficient in yield potential and stability and carry the lower pods too close to the ground.

In 1974 when the Research Branch expanded the breeding program at Ottawa, we selected as our primary objective the development of very early soybean cultivars that would mature with as few as 2000 CHU between emergence and the first killing frost in the fall, and have acceptable yield and agronomic qualities.

To develop varieties with such a degree of earliness we have turned to extremely early germplasm obtained from Dr. Sven Holmberg in Sweden. Selected at 58°N latitude, far north of any projected production area in Canada, Holmberg's Fiskeby strains complete flowering and seed production normally under mean temperatures of 16-17°C in late June and early July in Sweden. Derived from hybridization between short, early strains collected by Holmberg from the Kuril and Sakhalin Islands north of Japan and later, taller strains from German plant breeders, the Fiskeby lines contribute the important characteristics of earliness and cold tolerance to their progeny.

They have been widely recognized for their earliness (and are in the parentage of Altona and Beechwood) but their unique tolerance of low temperatures has not been fully appreciated. In controlled environment chambers at Ottawa with temperatures approximating those of late June at Brandon, Fiskeby lines or progeny from crosses with them maintain normal growth, whereas cold-sensitive strains have short, stunted pods with undeveloped ovules. The cold tolerance we have observed can be selected in segregating populations grown in controlled environment chambers. We have also noticed that some plants are shortened in height at low temperatures. This may partly explain the complaints from some areas of the Maritimes and the southern Prairies that soybean plants are too short and carry their lowest pods close to the coil. In addition to earliness and cold tolerance, we believe a short-season variety should be insensitive to daylength. Soybeans generally have a short daylength requirement, and when grown north of their region of natural adaptation, flowering and maturity are delayed. The short-season areas of Canada are not at the same latitude. Brandon, for instance is nearly 4° latitude north of Charlottetown and Nappan. Fortunately a significant proportion of early-maturing soybean introductions, including the Fiskeby lines, are daylength insensitive.

The Fiskeby strains are shorter than 40 cm and shatter as soon as they mature at Ottawa and Brandon. In our continental climate, their earliness, cold tolerance and daylength insensitivity must be incorporated into higher yielding adapted varieties. The first major attempt to do this was started by Dr. Lorne Donovan at Ottawa in 1971. Crosses were made between Fiskeby strains and Altona and Portage and/or varieties from southernwestern Ontario and the U.S. Corn Belt. The

TABLE 1. PERFORMANCE OF MAPLE ARROW IN THE MARITIMES (1976-77) AND EASTERN AND CENTRAL ONTARIO (1974-76*)

	Yield (kg/ha)		Days to maturity	
	Maritimes	Ontario	Maritimes	Ontario
Maple Arrow	2535	2628	135	110
Altona	2244	2291	136	113
Portage	2148	—	131	—

* Altona has not been included in Ontario tests after 1976.

TABLE 2. AVERAGE PERFORMANCE OF EARLY SOYBEANS AT 12 LOCATIONS IN 1977

	Yield (% of Portage)	Maturity ± days of Portage
Portage	100	Sept. 12
Altona	102	+5
BD 21117 (Maple Presto)	82	−15
BD 1413	112	−10

Portage yields average 2450 kg/ha.

variety Maple Arrow, selected from a cross between a Fiskeby line and Harosoy, is an indication of the progress that is possible. Maple Arrow yields more than Altona and matures slightly earlier in areas of eastern Ontario and the Maritimes that have 2500-2600 CHU (Table 1).

Advanced lines from later crosses have been evaluated in a co-operative project between the Ottawa and Brandon Research Stations. The earliest of these, BD 21117, is 3 weeks earlier than Maple Arrow and 10-14 days earlier than Portage, yet it yields equal to Portage (Table 2). It is nearly as early as the Fiskeby lines, and like them is cold tolerant and daylength insensitive but it is much taller and does not shatter. It is expected that this line will be licensed in 1979 with the name Maple Presto. Another promising line is BC 1413. Although not quite as early as BD 21117, it has excellent yield potential (Table 2).

The lines available now are a large step towards our goal of very early soybeans for the short-season areas. We are searching for additional genes for cold tolerance and earliness that might provide cultivars for areas with less than 2000 CHU's. We are also incorporating into selected early lines such characteristics as high height of pods above the ground, small seed size, high seed protein and greater plant height. ■

HOUSING SPACE FOR LAYERS

A. T. HILL

Des expériences menées à Agassiz (Colombie-Britannique) révèlent que les pondeuses Leghorn sont les plus productives à une densité de peuplement de trois sujets par cage à raison de 464 cm² d'espace par sujet.

Until recent years, layers were allowed 0.37 to 0.42 sq. m (4 to 4½ sq. ft.) per bird in large floor pens. Under particularly ideal management conditions and with smaller Leghorn-type birds, this was reduced to 0.28 sq. m (3 sq. ft.) per bird without seriously lowering egg production. In both cases the population of birds in each pen was large. This allowed approximately 0.71 cu. m (25 cu. ft.) of housing space per bird and cost approximately $5/bird.

Under current economic conditions, floor housing of layers with this amount of space is too expensive and labor costs are too high. Also, it is recognized that with insulation and more birds in a given volume, desirable room temperatures in winter and summer can be maintained more easily. This results in more consistent egg production and lower feed consumption for body maintenance in winter.

Increasing bird housing density implies using laying cages stacked in tiers and subdividing birds into small populations. Tiering cages has already proven satisfactory. Thus the choice becomes one of selecting the most profitable cage size and shape. Studies at the Research Station at Agassiz have demonstrated that it is not enough to test for the optimum space/bird (stocking density) independent of the number of birds/cage (population). Both must be examined simultaneously.

Four experiments with 14,080 layers were conducted between 1969 and 1976. Agassiz, Shaver 288 and Babcock 300 birds were tested and all three stocks tended to respond similarly to the treatments. Layers were tested for 60 weeks in populations of 1, 2, 3, 4, 6, 8, 12, 16, 18, 24 and 30 birds/cage and at 310, 387, 464, 542 and 619 cm²/bird. Cages with populations of 18, 24 and 30 birds were designated "colony," and those with

Dr. Hill researches poultry management at CDA's Agassiz, B.C., Research Station.

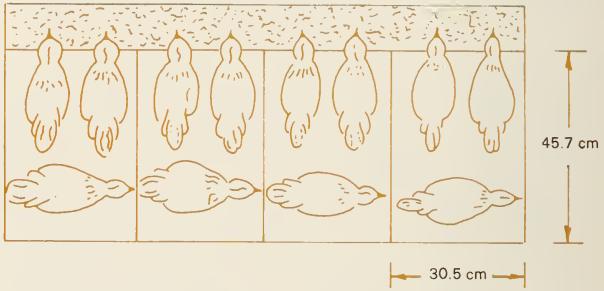
3, 6 and 12 "conventional." With conventional cages, deep, shallow and, in certain cases, reverse cages were tested. Reverse cages are a special form in which the conventional cage front and depth are switched, thus creating a shallow cage. As in the shallow cages, this increases feed trough space to 15.2 cm/bird from 10.2 cm. Control populations were used to relate performance in each of the four experiments. To establish egg returns over feed and bird costs, Grade A large eggs were valued at 75¢/dozen, bird costs at $2.50 and feed costs at 16.5¢/kg. The results in Tables 1 and 2 typify the relative performance of the Leghorn-type layers in the various cages.

Colony cages clearly result in higher mortality, poorer hen-day egg production, heavier feed consumption and much lower net egg returns over feed and bird costs compared with conventional cages (Table 1). Layers in populations of 18, 24 and 30 birds, at acceptable cage densities, do not generate acceptable profits.

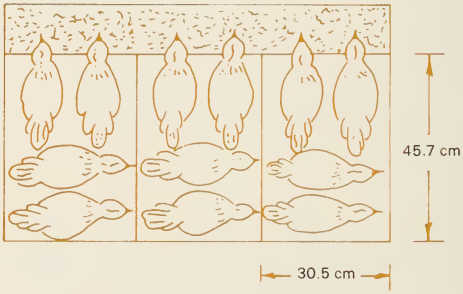
Birds in deep cages invariably consumed less feed and had a better feed conversion than birds in shallow cages. Consequently net egg returns over feed and bird cost were usually greater in traditional 40.6-45.7 cm deep cages. Judging by feed consumption and larger body size, it appeared that birds in shallow cages, with 15.2 cm of feeding space/bird, ate too much.

Of the three birds in 30.5 x 45.7 cm cages (Table 1), those in reverse cages layed fewer eggs, consumed more feed and had a slightly higher egg breakage level than those in traditional cages. Consequently the net egg returns over feed and bird costs were lower in reverse cages. Admittedly these particular results

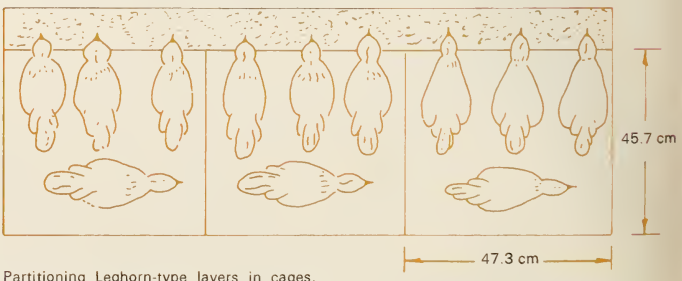
RECOMMENDED — 3 birds/cage at 464 cm²/bird



NOT RECOMMENDED — 4 birds in above 3-bird cage (348 cm²/bird)



RECOMMENDED for 4 birds. (542 cm²/bird)



Partitioning Leghorn-type layers in cages. (Example with 12 birds)

TABLE 1. LAYING TEST RESULTS FOR LEGHORNS IN VARIOUS CAGING SYSTEMS.

Caging System	Mortality	Hen day eggs per bird	Feed consumption per bird	Feed conversion	Eggs grade A	Total eggs cracked and lost	Net egg returns over feed and bird costs
	%	No.	kg		%	%	$/bird
Colony[1]	29.2	259	47.5	3.03	83.4	–	2.69
Conventional[2]	9.6	296	46.4	2.60	85.2	6.8	6.48
Deep[3]	8.6	297	45.6	2.55	85.8	6.4	6.63
Shallow[4]	10.6	295	47.3	2.66	84.5	7.1	6.34
Traditional[5]	3.6	312	44.8	2.38	84.6	5.8	7.24
Reverse[6]	4.7	298	45.5	2.54	83.5	7.3	6.44

1. 18,24 and 30 birds at 310, 387 and 464 cm²/bird.
2. 3, 6 and 12 birds at 310, 387 and 464 cm²/bird.
3. 30.5 – 45.7 cm deep.
4. 20.3 – 30.5 cm deep.
5. Cage for 3 birds with 30.5 cm front and 45.7 cm width.
6. Cage for 3 birds with 45.7 cm front and 30.5 cm width.

TABLE 2. NET EGG RETURNS OVER FEED AND BIRD COSTS FOR BIRDS IN 3 POPULATION SIZES AND AT 3 DENSITIES ($/BIRD)

Density/bird cm²	Number of birds in cage		
	3	6	12
310	5.87	5.69	5.33
387	6.54	6.28	5.96
464	7.24	6.44	6.27

are controversial. Stations in California, Scotland, Maine and North Carolina tend to show equally good or better results in reverse cages. However, findings in New York, Michigan and New Zealand are more in keeping with the Agassiz results. Reverse cages may yet prove more profitable, but until specific management practices have been identified for their superior operation, claims for reverse cages should be examined critically. Furthermore, there is a 50% increase in the cost of feed troughs and water lines which must be offset by birds in reverse cages.

In Table 2, it is clear that the population of three birds/cage each at 464 cm²/bird was the most profitable. With every increase in population and reduction in space/bird there was a noticeable decline in net egg returns over feed and bird costs. Without exception these trends were evident in terms of increasing mortality, feed consumption, feed conversion and egg cracking, and declining egg production.

One final thought must be introduced before deciding on an optimal laying cage size. Under Canadian climatic conditions it is generally conceded that, to a point, it is advantageous to crowd more birds into a house. However, with the present egg-marketing quota system, the emphasis is on obtaining as many eggs as possible from each layer housed. Thus the important question each poultryman should be asking is, "With the cage space available, what space/bird and in what population size should the birds be housed?" Results at Agassiz show that, for Leghorn-type layers, best results are obtained by housing three birds/cage at 464 cm²/bird. If for some reason four birds are to be placed together in a cage and a somewhat lower performance is acceptable, the space should be increased to 542 cm²/bird. The addition of a fourth bird to a 30.5 x 45.7 cm cage automatically reduces the space/bird to 348 cm² and seriously lowers the profitability/bird. There seems to be no advantage in reversing the cages. ■

APPLE VIRUSES — AN ENDANGERED SPECIES?

A. J. HANSEN and
L. DENBY

Figure 1 Ring russett symptoms on Golden Delicious. These apples cannot be sold on the fresh market and have to be diverted to processing. Tree growth and yield are not affected by this virus.

Fig. 1: Symptômes de roussissure annulaire sur des Golden Delicious. De toute évidence, ces pommes ne pourront être vendues sur le marché des fruits frais et devront prendre le chemin de la transformation. La croissance et le rendement de l'arbre ne sont pas affectés par ce virus.

Fruit, especially apples, is to the Okanagan Valley what wheat is to the Prairies: the mainstay of the agricultural economy. From a humble beginning at the turn of the century, fruit production has become a 30-million-dollar industry. Produce is shipped to all major population centers in North America and to some overseas countries.

Since the local market is limited, fruit has to be of better-than-average quality to compete successfully in markets outside the valley. Much of that final fruit quality is predetermined when the young tree is planted in the orchard, 2 or 3 years before it begins to produce. Planting the wrong color strain of Red Delicious, or a virus-infected source of Golden Delicious, or Lambert cherry, (Figs. 1 and 2) can mean disaster at harvest time. To avoid these pitfalls, the Summerland Research Station has assisted orchardists and nurserymen for many decades by providing budwood of named cultivars tested for freedom from viruses.

In the beginning, selected stock was distributed directly to individual growers and nurserymen, partly with the aim of testing new varieties under a wide range of field conditions. But soon nurseries realized that budwood of virus-free material resulted in an improved bud take and growers became increasingly aware of the improved quality of the fruit from these trees. Demand for budwood began to grow rapidly, and a special budwood program was initiated by virologist Dr. M. F. Welsh and pomologist Dr. D. V. Fisher, in co-operation with the provincial certification program. Trees of the major cultivars were thoroughly tested and, if found to be free of viruses, were planted in an isolated budwood orchard on land provided by the Research Station.

This testing program revealed that most orchard trees were infected by one or more viruses. While these viruses are harmless to the consumer, they reduce the productivity of the trees by 10-30%. In fact with some virus infections, fruit symptoms were so severe that whole crops had to be diverted from the fresh fruit market to processing at a much-reduced return to the grower. The tests also showed that apple viruses rarely, if ever, spread naturally; in other words, field infections could always be traced to the planting of infected trees, and not to a spread from tree to tree. Most of the increase in virus occurrence apparently came about by the use of clonal understocks that were thoroughly infected. Seedling understocks, on the other hand, tend to be free from virus, and our tests confirmed that some older trees, which had been propagated on seedlings, had indeed remained healthy. These trees in turn became the source of budwood for our virus-free collection (Fig. 3).

In other cases no virus-free material of major cultivars could be found, and heat-treatment had to be

Dr. Hansen and Mr. Denby are research scientists at CDA's Summerland, B.C. Research Station.

VIRUS DU POMMIER ENFIN VAINCU?

A. J. HANSEN et
L. DENBY

Les vergers, particulièrement les pommiers, sont à la vallée de l'Okanagan ce que le blé est aux Prairies, c'est-à-dire le point d'appui de l'économie agricole. De débuts modestes au tournant du siècle, l'arboriculture fruitière s'est développée en une industrie de quelque $30 millions dont les produits sont exportés à tous les principaux centres urbains d'Amérique du Nord et à des pays d'outre-mer. La consommation locale étant relativement faible, la qualité des fruits doit être supérieure à la moyenne pour pouvoir concurrencer les marchés extérieurs. Cette qualité des fruits dépend substantiellement de l'état du jeune arbre transplanté dans le verger, deux ou trois ans avant de porter une certaine quantité de fruits. Une mauvaise pigmentation des Red Delicious, des Golden Delicious ou des cerises Lambert infectées par un virus (figures 1 et 2) suffisent pour détruire toute une récolte et entraîner l'annulation des ventes. Pour éviter ces problèmes, la Station de recherches de Summerland aide depuis des dizaines d'années arboriculteurs et pépiniéristes à se procurer de bons greffons de cultivars exempts d'infections virales depuis quelques années.

Au début, on a distribué des lots sélectionnés de greffons aux producteurs et pépiniéristes pour encourager partiellement l'essai de nouvelles variétés dans des conditions de sol variées. Les pépiniéristes se sont rapidement rendu compte du meilleur bourgeonnement des arbres sains et de la bonne qualité de leurs fruits. Devant la croissance des demandes pour des greffons, Dr. M. F. Welsh et Dr. D. V. Fisher, respectivement virologiste et pomologiste, ont mis sur pied un programme spécial parallèle à celui de certification provinciale. Les arbres des principaux cultivars qui, après des tests rigoureux, ont montré qu'ils étaient exempts de virus, ont été transplantés dans un terrain de la station de recherches. Ce programme a révélé, en fait que la plupart des vergers étaient infectés par un ou plusieurs virus. Bien que les germes de fruits ne représentent aucun danger aux consommateurs, ils réduisent cependant la productivité fruitière de 10 à 30%. Certaines infections virales déforment tellement les fruits, que la récolte entière prend le chemin, à faible prix, des usines de transformation plutôt que celui du marché des fruits frais.

Ces tests ont aussi démontré par ailleurs que les virus des pommiers sont rarement infectieux, c'est-à-dire que le sol infecte l'arbre et que le virus ne se communique pas d'un arbre à un autre. La fréquence des maladies virales était due, en bonne partie, à l'utilisation de porte-greffes gravement atteints et qui sont obtenus par multiplication végétative. Par contre, les porte-greffes francs sont très peu infectés. Ceci a été confirmé par nos tests sur de vieux pommiers sains qui avaient été greffés sur des porte-greffes francs. Ces arbres, à leur tour, sont devenus des sources de greffons pour notre collection de spécimens exempts de virus (fig. 3).

Dans d'autres cas, on n'a pu trouver de cultivars importants sains, et il a fallu avoir recours au traitement thermique pour éliminer les foyers d'infection. Ce traitement consiste essentiellement à exposer les jeunes plants, pendant environ trois semaines, à une température de quelque 37°C. Les arbres, pendant cette période, croissent beaucoup plus rapidement que le foyer d'infection.

Fig. 2: Cerises Lambert gravement attaquées par le virus RBT (rabougrissement buissonneux de la tomate) qui provoque également une dégénérescence de l'arbre.

Figure 2 Lambert cherries severely affected by TBS virus that also causes a decline of the tree.

MM. Hansen et Denby sont des chercheurs de la Station de recherches d'Agriculture Canada à Summerland, C.-B.

used to eliminate the virus infection. This treatment essentially consists of exposing young trees to about 3 weeks of heat at approximately 37°C. During this time, the tree makes rapid growth, while the virus multiplies slowly. At the end of the treatment, individual buds are removed from the heated tree, placed on healthy understock, and grown into young trees. These are then tested for up to 5 years to make sure that no trace of virus survived the treatment. At the end of this period they are ready for planting in the budwood orchard, where the trees will be checked again for trueness-to-type once they start to bear fruit. A similar program for grapes has been initiated, and distribution of a limited number of cuttings begun. What sounds like a simple, though time-consuming, procedure on paper is in fact a complicated advance guessing game involving personnel from the Research Station, the B.C. Ministry of Agriculture, the nurserymen and the growers. New cultivars are constantly being introduced and have to be evaluated not only for freedom from viruses, but also for horticultural characteristics and, above all, for market acceptance. The Research Station realized early in the development of the program that grower and industry participation would be of paramount importance in this process. At first, a group of representatives from the BCMA, the nurserymen and the B.C. Fruit Growers' Association advised on cultivars and distribution policies. Recently, growers and nurserymen have taken even more initiative. Under the leadership of a former nurseryman, and with support from the two governments, they have formed an association that directs the operation, cultivar selection and policies.

Budwood distribution figures for the past 2 decades tell an exciting story: the beginning was modest, with a production of about 40,000 buds per year during the 1950's. The total collection at that time consisted of 14 cultivars. Since then, steady growth has taken place and in 1977 the distribution reached a record 400,000 buds from 71 different cultivars. As a result of the more active role of the nurserymen and the industry, new apples, pears, cherries, peaches, plums and nectarines were added to the program in 1975, 1976 and 1977. At the same time, some specialized understock nurseries have taken steps to multiply sufficient virus-free understocks to make sure that the demand can be satisfied and that budwood does not become re-infected by being budded onto infected stock.

The development of this program has been so rapid that today more than 80% of all the nursery trees produced in the interior of British Columbia are created with virus-free budwood originating in the program. In addition, budwood is sold to growers who wish to produce their own trees and to outside nurseries. Growers are more eager to switch to new cultivars, and since many old orchards have recently been replaced by high-density plantings, a sizeable percentage of Okanagan apple orchards are already fully virus-free. The program has become increasingly self-supporting, and the day may not be far when it will be financially independent.

Future plans of the association include not only a deeper involvement in industry-wide testing of new strains, but also a controlled expansion of the collection so that some day all desirable cultivars can be distributed in virus-free form. Hence the day may not be far when apples viruses will indeed be an endangered species in the Okanagan. ■

Fig. 3: Prélèvement de greffons indemnes de virus dans un verger certifié en vue de leur expédition aux pépiniéristes et arboriculteurs.

Figure 3 Virus-free budwood is collected in the certified budwood orchard for shipment to nurseries and growers.

A la fin du traitement, on prélève des greffons que l'on fixe sur des porte-greffes sains. Les jeunes arbres sont ensuite testés pendant 5 ans pour s'assurer qu'aucun germe n'a survécu au traitement. Ils sont alors prêts pour être transplantés dans le verger où, lorsqu'ils commencent à porter des fruits, on vérifie si ces derniers sont conformes au type original. Un programme similaire a récemment été mis sur pied en viticulture et un certain nombre de boutures ont été distribuées. Ce qui semble être un travail simple mais long sur papier, est en réalité un jeu compliqué de devinettes pour le personnel de la Station de recherches, le ministère de l'Agriculture de la Colombie-Britannique, les pépiniéristes et les producteurs. De nouveaux cultivars sont constamment introduits et doivent être étudiés non seulement pour se rendre compte qu'ils sont exempts de virus, mais qu'ils répondent aussi adéquatement aux caractéristiques horticoles et de la mise en marché. La Station de recherches a vite réalisé l'importance de la participation des producteurs et des industriels à l'élaboration du programme. Au début, un groupe de représentants du ministère provincial, des pépiniéristes et de l'Association des producteurs et pépiniéristes ont montré plus d'initiative. Sous la direction d'un ancien pépiniériste et forts de l'appui des deux gouvernements, ils ont formé une association qui supervise l'ensemble des opérations, y compris la sélection des cultivars et l'élaboration des politiques.

En comparant les chiffres des deux dernières décennies, on constate que la distribution des greffons a connu un grand essor. Après un départ modeste avec environ 40 000 drageons par année, au cours des années 1950, pour un total de 14 cultivars, ce chiffre s'est progressivement décuplé jusqu'en 1977 pour 71 cultivars différents. En raison du rôle plus actif des pépiniéristes et des producteurs, de nouvelles variétés de pommes, de poires, de cerises, de pêches, de prunes et de nectarines sont venus s'ajouter aux programmes de 1975, 1976 et 1977. Simultanément, des pépiniéristes spécialisés dans les arbres fruitiers ont augmenté la production de porte-greffes indemnes de virus pour répondre à la demande et empêcher que les greffons ne soient réinfectés après implantation. L'expansion du programme a été tellement rapide qu'aujourd'hui plus de 80% des arbres de pépinière produits dans la région intérieure de la Colombie-Britannique proviennent de greffons indemnes de virus. En outre, les producteurs qui désirent cultiver leur propre matériel de multiplication et les pépiniéristes de l'extérieur de la province peuvent aussi acheter des greffons. Les producteurs sont impatients d'obtenir de nouveaux cultivars, et puisque plusieurs vieux vergers ont été rajeunis, un pourcentage appréciable de vergers de pommes de la vallée de l'Okanagan sont déjà entièrement indemnes de virus. Cette étroite collaboration permet de croire que le programme fédéral-provincial deviendra financièrement autonome à plus ou moins brève échéance.

A l'avenir, l'Association prévoit non seulement pousser l'essai de nouvelles lignées, mais aussi la création réglementée de nouveaux cultivars, de sorte qu'un jour, tous les spécimens exploitables pourront être garantis indemnes de virus. Le jour où les virus des pommiers seront effectivement vaincus dans la vallée de l'Okanagan n'est donc plus très loin. ■

DRAINING ARID LAND

T. G. SOMMERFELDT

Il faut trouver la source d'eau disponible et étudier longuement les caractéristiques de la nappe phréatique avant de pouvoir mettre au point un réseau de drainage efficace.

Draining agricultural land in the arid and semi-arid regions of the Canadian Prairies serves two functions. First, it improves soil-water-air conditions and thereby enhances productivity. In the spring, well drained soil warms earlier than poorly drained soil, lengthening the growing season. It has better tilth, is easier to work, and has better biological and nutritional conditions than poorly drained soil. Because of their oxygen requirement, plant roots generally grow only to within 30 cm of free water in the soil. Consequently, plants growing on waterlogged, poorly drained lands often suffer from inadequate soil depth in the root zone.

The second function is to control and remove soluble salts in the soil. Waterlogged and poorly drained soils in arid and semi-arid climates often become saline, sodic, or both. If severe enough, these conditions make the soil non-productive. The salts not only affect the plants directly, but also can create a soil moisture stress whereby the plants have difficulty obtaining water. They may also adversely affect the soil physical properties, and this will restrict plant growth.

When the water table is sufficiently close to the soil surface (within 150 cm as a rule of thumb), groundwater bearing dissolved salts migrates through capillarity to the surface and evaporates. The salts remain to accumulate and salinize the soil (Figure 1). Also, plants can intercept and use the capillary water before it reaches the soil surface. Then the salts accumulate and salinize the soil in the root zone. (Salts visible as a crust on the soil surface are usually only a small portion of the total in salinized soil.) The objective is to lower the water table, generally to at least 150 cm of the surface, through drainage or other means, and cut off the upward movement of salts. With natural precipitation and irrigation water, the accumulated salts can be leached downward beyond the root zone and out through the drains, if installed.

Sources of water that cause high water tables include runoff that accumulates in depressions, drifted snow, over irrigation, seepage from canals and higher land, and artesian water.

Before drains are installed, the source of water must be determined and the water table characteristics should be studied for an extended period, preferably for at least 1 year. Observation wells and piezometers

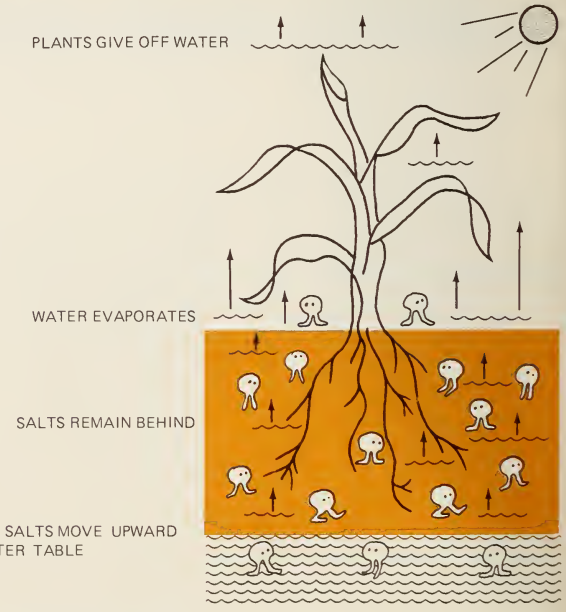


Figure 1. Water migrates from the water table to the soil surface and evaporates, resulting in salinization of the soil at the surface and in the root zone.

Dr. Sommerfeldt is a research scientist at CDA's Lethbridge, Alta., Research Station.

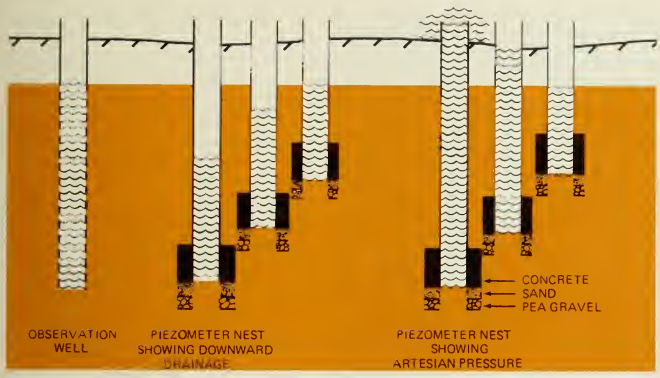


Figure 2. Perforated casings in observation wells allow water to enter at any depth. Depth to water is the same as the water table. Piezometer casings are not perforated and water enters only at the bottom. Piezometers measure groundwater pressures at the bottom of the casing, and depth to water may not be the same as that of the water table.

Figure 3. Installing a piezometer. (Drill rig in background.) When tube is in place, the hole at the tip is backfilled with a few centimeters of pea gravel, followed by a few centimeters of sand and a meter or more of concrete to seal off the tip of the piezometer from incoming water from above.

(Figures 2, 3 and 4) are used to determine water table depths and gradients. The soil should be thoroughly investigated to establish its hydraulic conductivity, layers of greater and lesser hydraulic conductivity, water-bearing layers, depth to impermeable barrier, salt content, and kinds of salt. A drain outlet should be available and a topographic survey should be done. The information obtained can be used to design a suitable drainage system. Often the investigation shows that corrective action at the source of the water may eliminate the need for drainage.

A suitable drainage system will depend upon the conditions specific to that parcel of land. Any drainage system will consist of surface or subsurface drains, or both. Surface drains are used to convey water off the land, whereas subsurface drains convey groundwater out of the land, and then only when submerged in the groundwater (Figure 5). Subsurface drains may be deep open trenches or buried tubes, generally of tile or plastic. Interceptor drains are used to cut off incoming water. If more than one soil layer bears water, an open drain may be most satisfactory. However, if the water is being transmitted along a permeable layer, a buried drain can be effective. Relief drains lower the general water table, usually on a flat piece of land or for a depressional area.

After the drainage system has been installed, continued cleaning and maintenance are necessary to ensure its effective operation over a long period.

The cost of drainage generally is high and varies with each problem. For instance, to drain a field with subsurface plastic drains (common in southern Alberta) at a depth of

Figure 4. Sampling groundwater from a piezometer using a pneumatic pressure pump developed at the Lethbridge Research Station.

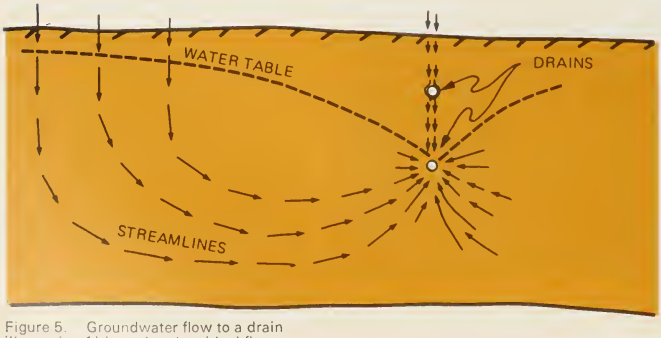


Figure 5. Groundwater flow to a drain illustrating 1) lateral and residual flow to the drain (streamlines), 2) the free water surface, and 3) groundwater bypassing a non-submerged drain (because of surface tension).

1.6 m and 20 m apart would require 500 m of drain/hectare. Based on 1977 installation costs of $2/m, the total would be $1,000/ha. Other costs, such as investigations, designing the system, and engineering would be additional: in Alberta, the provincial government provides these services. To justify such a large investment, the cash returns from the land or the land value must be high. After such a drainage system had been installed, we were able to bring nonproductive land back to near full production in 1 to 3 years. Sometimes return to full production can take longer, depending on local conditions.

Besides the benefit of bringing land into production, there are other benefits in reclaiming a parcel of land. These include eliminating breeding sites for insects, weeds, and diseases; reducing costs of construction and maintenance of highways and similar structures, if they are near waterlogged and saline land; enhancing the aesthetic value; and facilitating tillage and management of the land. ■

MEETING THE DEMAND FOR QUALITY POTATOES

D. W. MACDONALD

Les producteurs canadiens de pommes de terre disposent des variétés et des capacités nécessaires à la production de stocks de semence de haute qualité destinés à des marchés spécialisés dans le monde entier. L'expansion éventuelle de leurs marchés dépendra de leur capacité à appliquer des nouvelles techniques et programmes nécessaires à l'élimination de certaines maladies des tubercules.

Certified varieties provide uniform quality for potato processing.

At one time producers stored a few potatoes in the cellar, and bagged the rest for market. Consumers chose to boil, bake, or fry this main staple in their diet.

Today the fast food industry has made a delicacy of the potato. They are dehydrated, frozen and processed into a variety of exotic foods. Export seed potato markets have opened up for yellow-fleshed varieties not previously grown in Canada, and these may some day be sold in the local market for table use.

This growing list of special markets for potatoes requires specific varieties, depending on particular use. Agriculture Canada's Seed Potato Certification Program sets the standard for seed production and marketing so that commercial growers can secure the variety required to meet the more exacting quality standards of the consumer and food industry.

Growers in this country would like to expand their export market for seed, notably to the Mediterranean area and European Economic Community countries. They have the varieties and potential to produce seed for such special markets. But buyers at home and abroad demand seed that is of top-quality, and disease free.

"The welfare of the potato industry depends to a large degree on our sales performance in export markets," says John Mulders, Chief of Crop Certification, Plant Quarantine Division. "To meet demands for quality seed potatoes, our certification program is being updated continuously.

"Visual inspection is no longer sufficient to assure quality seed. Sophisticated testing methods have to be implemented. Potatoes must be handled more carefully during harvest, grading and transportation to market. All this calls for careful planning and investment in research, production, marketing and regulation of the seed potato industry."

The mainland of Canada is known to be free of several serious pests of potatoes, including potato wart, golden nematode, gangrene and potato tubermoth.

Bacterial ring rot still occurs in some areas of North America, but can be controlled through rigid sanitation and proper handling. Some tablestock growers are now planting whole small tubers, using cup-type planters to control the disease.

Canada's Elite Seed Program started about 12 years ago to obtain more effective control of bacterial ring rot. More recently, the program has been based exclusively on the selection of single plants of superior clones tested for the ring rot pathogen by the gram positive test. Plants from individual eyes are indexed for freedom from all visible symptoms

Mr. MacDonald is with Information Services, Agriculture Canada, Ottawa.

of viruses, and further tested serologically, or by the plant indicator host method, to indicate their freedom from latent viruses. Those found to be completely free are multiplied to produce Elite I Grade seed. From this, Elite II and Elite III Grades respectively are produced in successive years. Further annual multiplication results in commercial grades known as Foundation and Certified.

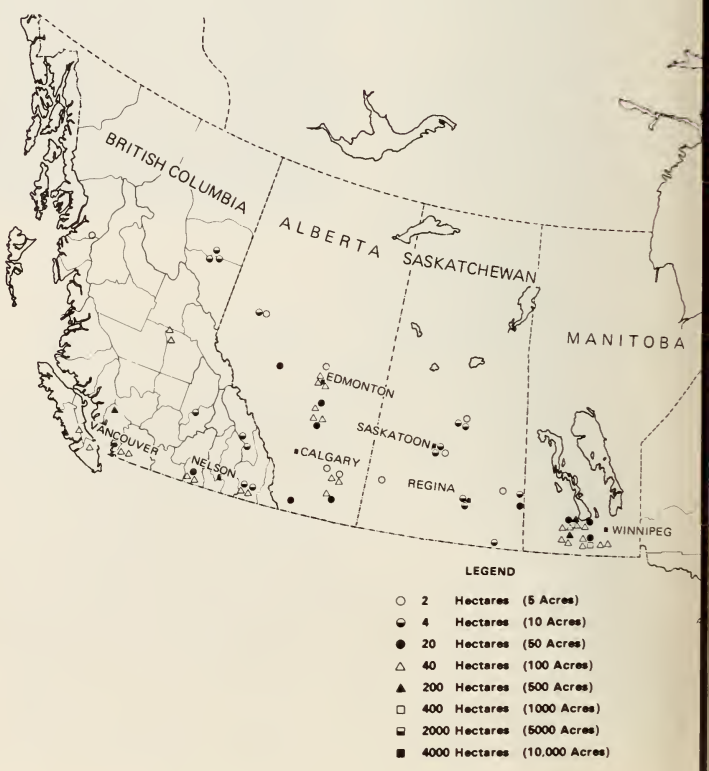
"In more recent years, certain widely distributed latent viruses have been eliminated through a process of heat treatment combined with meristem culture that originated at the Vancouver Research Station in 1967. This work has been supplemented by the establishment of similar facilities at La Pocatière, Que. Virus-free selected clones of all varieties are now available for increase," says Mr. Mulders. "The program is gradually changing over to the production of stem cuttings obtained from virus-free mother plants that produce Elite I Grade seed. The mother plants and cuttings are tested again to ensure freedom from disease."

The production system varies by province. Elite seed farms, operated by provincial agencies, have been established at a number of locations, i.e. Fox Island, P.E.I.; Bon Accord, N.B.; Manicouagan, Que.; Portage la Prairie, Man.; and Glenwood, Nfld. Elite seed stocks may also be increased by individual growers selected by the Plant Quarantine Division based on the grower's experience and ability to maintain disease-free conditions.

Seed farms are generally selected for consistently low aphid populations and shelter from winds, particularly those that prevail from neighboring potato fields. Strict sanitation practices have enabled certain seed growers to maintain their stocks relatively free from viruses, and with a zero tolerance for bacterial ring rot in seed, some growers have not had the disease for more than 25 years.

In B.C., selected growers in five areas of the province increase the Elite virus-tested seed. Pemberton and Cariboo have been designated Seed Control Areas by the B.C. Certified Seed Potato Act. High quality seed production is assured by planting only the higher classes of seed, limiting varieties on farms, and permitting only approved seed stock into the area.

A disease-indexed stem-cutting (DISC) procedure demonstrated at the Fredericton Research Station has been adapted as a method of initial increase. Virologists start with



plants known to be free of bacterial ring rot, the latent viruses PVX and PVS and the visible viruses, spindle tuber, leafroll, PVA and PVY, and multiply the clone by cuttings. By this method, tuber-borne diseases are not carried over to the next plant generation. The Fredericton Station currently maintains DISC stocks of eight varieties — Avon, Katahdin, Kennebec, Keswick, Netted Gem, Red Pontiac, Sebago and Tobique — as pre-Elite material.

Elite multiplication plots of this material now occupy about ¼ acre, depending on variety and certification level. To date no reinfection or recontamination of bacterial ring rot, blackleg, silver scurf, Verticillium wilt or skin spot has been observed in any of these plots. The program has maintained seed stocks free from spindle tuber, PVA, PVY, and PVX. Trace leafroll infections were observed in Netted Gem and Red Pontiacs in 1976 but were eliminated.

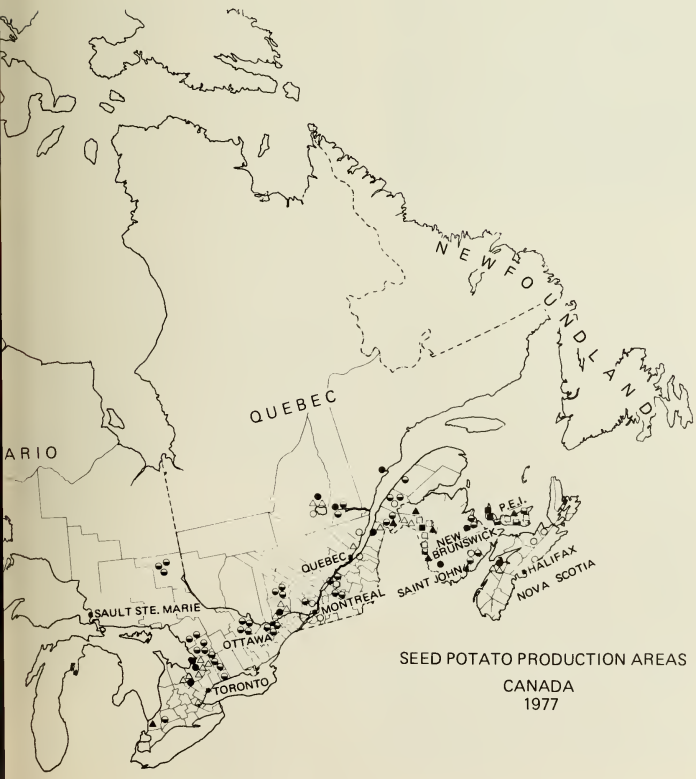
New Brunswick has also embarked on a program to eliminate bacterial ring rot from the province by making it mandatory for table-stock growers to plant only Certified seed.

The P.E.I. Potato Marketing Board Elite Seed Farm on Fox Island near Alberton produces the majority of the Elite I Grade available to growers in the province. Elite growers increase Elite seed from these basic seed lots under contract to the marketing board for sale to Island growers at an agreed price.

Nova Scotia does not have an Elite seed farm but arranges for three growers to carry some varieties, one of whom maintains the pre-Elite seed plots. Nova Scotia seed growers rely on N.B. and P.E.I. for nuclear stock as required.

Prince Edward Island's goal to achieve complete freedom from bacterial ring rot is believed closer to realization with the appointment of a Potato Disinfectant Administrator by the provincial department of agriculture. Increased use of the stem-cutting technique at the Elite seed farm and complete involvement of growers in detecting the disease and reporting it so proper sanitation measures can be carried out should soon eradicate the disease from the province.

In Quebec, the Elite seed farm at Manicouagan Centre specializes entirely in the multiplication of disease-free seed potatoes. Elite II seed stock from Manicouagan goes to members of the APPPTEQ (Quebec Association of Elite Potato Growers) for increase to Elite III and Foundation seed stock. These growers are



SEED POTATO PRODUCTION AREAS
CANADA
1977

largely located in the Lower St. Lawrence Valley at St. Arsene, Isle Verte and Trois Pistoles. The Coopérative Fédérée du Québec sells most of the seed produced by the APPPTEQ growers.

La Pocatière supplies the Manicouagan Centre with disease-free material from stock maintained in sterile cultures.

In addition to the service provided by the Quebec Elite seed farm, the Certification Section of the Plant Quarantine Division at La Pocatière provides selected growers in other parts of the province with cuttings that have been tested for bacterial ring rot and viruses.

The central seed potato production unit in Manitoba is the Elite Seed Potato Farm (ESPO) south of Portage la Prairie. This farm provides base stock for local growers to produce certified seed for commercial crop improvement purposes. Saskatchewan contributes to the Manitoba seed farm program and their growers purchase stocks from that source.

Alberta seed potato growers receive their base stocks from the Alberta Seed Potato Program managed by Alberta Agriculture.

Nuclear stocks (mother tubers) for the Alberta and Manitoba programs originate from the virus-free program at the Agriculture Canada Research Station, Vancouver. Manitoba has also received a number of plantlets from the virus laboratory at La Pocatière, Que.

In Alberta, tubers and stem cuttings are planted in isolated areas in plots harvested and maintained by Alberta Agriculture. The stocks are re-indexed and used for the following year's cutting program.

The Ontario Ministry of Agriculture and Food (O.M.A.F.) obtains Elite I stock of various varieties from other provinces. Selected growers under contract to O.M.A.F. multiply Elite stocks to produce Elite II and III grades. Foundation and Certified grades are produced by established reputable growers. These growers in turn sell to commercial growers or other buyers.

As part of the answer to the marketing challenge Potatoes Canada, or the Canadian Seed Export Agency, was formed in 1975. This organization, funded by a levy on major potato seed exporters in P.E.I. and N.B., promotes the sale of Canadian seed potatoes by:

— providing technical assistance to foreign buyers;
— conducting field trials abroad;
— training of foreign technicians in Canada; and
— assisting buyers in recipient countries.

In 1977, 27 000 ha (66,940 ac) of all classes of seed potatoes were inspected and passed by Agriculture Canada's Plant Quarantine Division. Forty-five different varieties were certified for variety performance and freedom from disease. Kennebec, Netted Gem, Sebago, Red Pontiac, Superior, Katahdin, Norchip, Norland, Green Mountain, Irish Cobbler, Belleisle and Keswick accounted for most of the acreage inspected. They met most of the demand for special seed and processing qualities on the domestic and export market. However, other varieties bred for more specific uses constantly challenge these established varieties.

The potato industry needs improved variety performance. It opens new markets for seed potatoes. Canada's Seed Potato Certification Program helps guarantee that performance by supplying growers with the varieties required to meet the quality standards of potato consumer products today.

Officers in charge, Seed Potato Certification, Plant Quarantine Division, Agriculture Canada, are located in the following areas:

CHARLOTTETOWN,
Prince Edward Island

Research Station
KENTVILLE, Nova Scotia

Research Station
FREDERICTON, New Brunswick

427 Preston St.
OTTAWA, Ontario

Bayfield Mall
BARRIE, Ontario

Dominion Public Building
LONDON, Ontario

LA POCATIERE, Quebec

Federal Building
WINNIPEG, Manitoba

404 - 1825 McIntyre St.
REGINA, Saskatchewan

Federal Public Building
EDMONTON, Alberta

1415 - 1st Street S.E.
CALGARY, Alberta

Kingsway Plaza
BURNABY, British Columbia

■

CANADA OPTS OUT OF HYBRID WHEAT

D. R. SAMPSON

Les expériences sur le blé hybride ont révélé que la production de semence pose des problèmes et que les rendements grainiers dépassent rarement ceux des blés traditionnels. Le Canada a donc choisi, plus tôt cette année, d'abandonner son programme d'amélioration du blé hybride.

Dr. Sampson examines an experimental plot of wheat on the Central Experimental Farm in Ottawa.

During the early 1960's a wave of excitement spread through research stations around the world when Nebraska and Kansas breeders announced discoveries that made hybrid wheat seem practical. Many programs were initiated on hybrid wheat, with visions of revolutionary yield increases amounting to 20%. U.S. commercial seed companies such as DeKalb, Pioneer and Cargill invested millions. Agriculture Canada began feasibility studies — first at Winnipeg on spring wheat, then, in 1966, at Ottawa on winter wheat. The decision to switch the Canadian program to winter wheat was based partly on the knowledge that high yields of Ontario winter wheat could absorb the increased cost of hybrid seed better than the low yields of prairie spring wheat.

A little experience soon convinced many who jumped on the bandwagon to get off. By 1974 there were only 8-10 programs in the world based intensively on hybrid wheat. Commercial seed companies in the U.S.A. have marketed seed of several wheat hybrids but have had problems with seed production. Grain yields of hybrids seldom exceed those of conventional wheats. University breeding programs in the U.S.A. have ceased, only one program remains active. The British expect to discontinue their work on hybrid wheat at the Plant Breeding Institute, Cambridge, this year. The decision to end the Canadian work was reached on March 15, 1978. What did we learn in 12 years?

To go back to the beginning, in the 1950's Japanese scientists discovered that the cytoplasm of some primitive wheats, when bred to relatives of durum wheat, caused pollen sterility. This meant that hybrids could be mass produced by letting the wind carry pollen from a normal variety to stigmas of the male sterile wheat. A characteristic that is inherited through the cytoplasm is passed on to the next generation by the mother plant that produces the seed and not by the father plant that produces the pollen. Accordingly, in wheat the pollen sterility is inherited from the seed parent and its source is always known, unlike the genes that restore pollen fertility and come from the male parent with windblown pollen. The great achievement of American breeders in the early 1960's was to breed this sterilizing cytoplasm, along with the necessary fertility-restoring genes, into the common or bread wheat, *Triticum aestivum.*

Hybrid wheat seed production is complicated. Whereas a seed grower of ordinary self-pollinated common wheat has only one type of seed to grow for each variety, three types of seed must be maintained in order to reproduce a hybrid. The three are called A-, B- and R-lines. The B- and R-lines are self-pollinated and maintained like ordinary varieties. Seed of A-lines comes from the cross A × B, while the hybrid seed

Dr. Sampson is a wheat breeder at CDA's Ottawa Research Station.

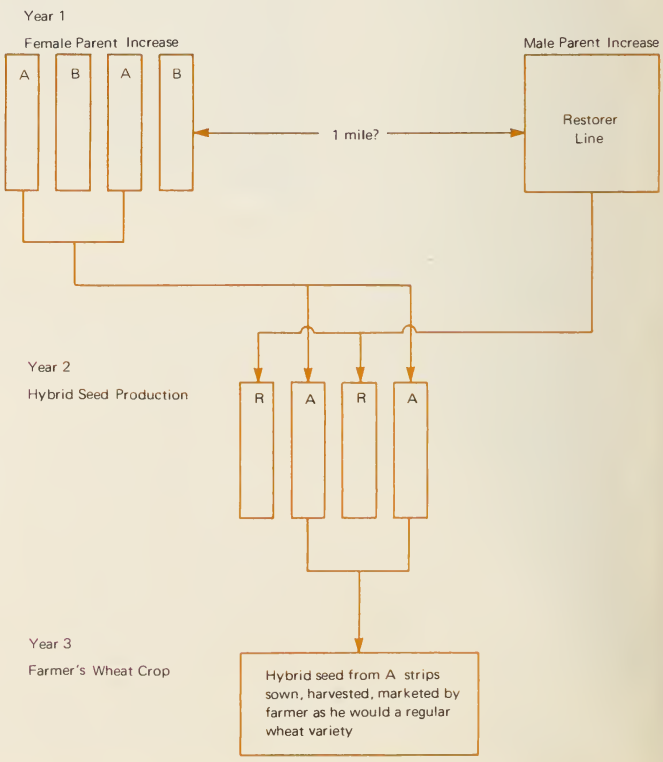
that the producer will sow comes from the cross A × R.

The A-line, or female parent has the pollen-sterilizing cytoplasm and so will not set seed until it receives windborne pollen from normal wheat. To breed true, the A-line should receive its pollen from a matched B-line. The matched A- and B-lines are made as nearly alike genetically as possible by back-crossing A × B for many generations. We have bred scores of A — B pairs at Ottawa; the procedure is simple but six to eight years are required. B-lines have normal cytoplasm, are reproduced like ordinary varieties and three of them are the well-known winter wheat varieties Talbot, Yorkstar and Fredrick. For a large-scale seed increase, one seeds one drill width strip of A, then one of B, then one of A, etc., alternately across the field. The A-strips must be harvested separately from the B-strips.

Seed harvested from the A-strips of an A-B field is hybrid seed in the sense that two parents were involved, but if a wheat grower sowed his farm with this seed he would have one spectacular failure. His entire crop would be sterile. This is where the third line, the R- or restorer line, comes to the rescue. It carries genes that restore pollen fertility to hybrids that have the sterilizing cytoplasm. The seed grower needs to drill alternating strips of A- and R-lines to produce the A × R *hybrid seed* that hopefully will give the wheat grower a bumper crop. Again the A-strips must be harvested separately from the R-strips.

The Ottawa program under Dr. A. G. Plessers (retired in 1974) tested the several parts of the hybrid wheat system and found that they worked in our area. Many cytoplasmic male sterile lines were produced; a few restorer lines gave excellent restoration; a few hybrids gave high yields, and wind pollination was effective in producing hybrid seed. In fact the Ottawa area had one distinct advantage over U.S. hybrid wheat seed-producing areas such as Kansas. Our cooler temperatures allowed stigmas to live 2-3 days longer, thus increasing their chance of being cross pollinated. This advantage was partly offset by a high incidence of ergot.

A serious difficulty was that most of our A-lines had a few fertile plants. These contaminants could not be recognized and removed until after they had shed some pollen. By then that pollen had already contaminated next year's A-line seed. Presumably the original source of contamination was R-line pollen blown in from a distant field. We



used isolation distances of 305 m or more between A-line and R-line nurseries, but one U.S. seed company which experienced the same problem has gone 1.6 km from other fields of wheat. This is a disturbing development because isolation distances of that magnitude are not practical for the pedigreed seed producers of Ontario.

But the greatest obstacle to breeding hybrid wheat is the lack of an efficient method to breed for pollen restoration. It appears to take at least 3 doses of R genes to restore fertility to a hybrid, which means that the R-line parent has to have 6 doses. There is no technique now for distinguishing one R gene from another; hence our task is comparable to breeding for stem rust resistance, for example, without being able to distinguish races of rust. Further, it is not possible to determine visually whether an R-line plant has 3, 4, 5, 6 or more R genes — all will result in good pollen. Each R plant selection has to be crossed laboriously by hand to an A-line and the progeny grown and examined.

It goes without saying that both A and R parents of a successful hybrid have to have strong straw, disease resistance, and milling and baking quality so that the hybrid crop can be grown and marketed at a profit. Some of our A-lines qualify but the best available R-lines lodge, mildew and have neither bread nor pastry quality. A breeding program of 10 to 15 years duration might correct those deficiencies; but then again it might not.

In summary, a 12-year feasibility study showed that the biological components for producing hybrid wheat are available. More work is required on isolation distances for seed production. Breeding pastry-quality winter wheat hybrids for southern Ontario requires more years and resources than the uncertain results warrant. ■

ALFALFA CUBES FOR DAIRY CATTLE

L. J. FISHER

Les résultats de certaines expériences donnent à penser que l'addition de cubes de luzerne à l'ensilage de maïs au moment de l'ensilage plutôt qu'à celui de l'alimentation elle-même, est de nature à accroître la teneur en matière grasse du lait, l'efficacité de conversion de la matière sèche et la digestibilité de la ration totale.

Alfalfa cubes have several advantages over hay as a source of forage in rations for lactating cows. They can be handled by mechanized feeding systems, they require less labor and storage space and the cubing process can be used to synthesize complete feeds.

In addition, alfalfa cubes, because of their high protein content, provide an ideal supplement for corn silage. Frequently in the Fraser Valley and on Vancouver Island, corn silage has to be ensiled when it contains less than 25% dry matter, resulting in high seepage losses and poor fermentation. Under these conditions alfalfa cubes added to the low dry-matter corn silage at ensiling time provides the dual benefit of reducing seepage losses and increasing the protein content. An experiment was conducted at CDA's Agassiz Research Station to determine if adding alfalfa cubes at the time of ensiling would have any detrimental influence on the use of the corn silage-alfalfa cube mixture.

Alfalfa cubes added at the rate of 130 kg/1000 kg increased dry matter content of the ensiled corn from 30.8% to 38.6% and the protein content from 8.6% to 12.7% (Table 1). A switchback trial consisting of two experimental periods 35 days long separated by a 7-day changeover period was used to compare cubes added at ensiling time with cubes added at feeding

Dr. Fisher is a dairy cattle nutritionist at CDA's Agassiz, B.C., Research Station.

TABLE 1. DRY MATTER CONTENT AND CHEMICAL COMPOSITION OF RATION COMPONENTS

	No. of samples	DM %	Protein	Acid Detergent Fibre % of	Lignin DM
Corn-alfalfa cube silage					
as fed	4	38.6	12.7	31.9	6.8
as ensiled	10	30.8	8.6	36.2	6.3
Corn silage					
as fed	4	32.0	8.9	33.5	5.5
as ensiled	10	32.2	8.5	30.4	5.5
Alfalfa cubes	4	86.3	20.4	35.6	8.2
Grain mixture	8	88.1	20.3*	10.9	2.8

*Protein content calculated from Table values NRC NAS.

TABLE 2. INFLUENCE OF ALFALFA CUBE FEEDING SYSTEM ON DRY MATTER INTAKE AND BODY WEIGHT CHANGE

	BW change kg/35 days	Grain intake kg/day	Silage + cube intake kg/day	Forage DM intake % of BW	DM digest %
Corn-alfalfa cube silage	+27.3	6.51	12.52	2.26a	68.1a
Corn silage + 3.64 kg cubes	+23.0	6.51	11.78	2.16b	65.4b
Standard Error of mean	±5.24	–	±0.223	±0.039	±0.71
F	0.24	–	3.57	4.58	–

Means within columns with different superscripts are significantly different at a probability of ($P>0.05$)

TABLE 3. EFFECT OF SYSTEM OF FEEDING ALFALFA CUBES WITH CORN SILAGE ON MILK YIELD AND COMPOSITION

	Milk yield kg/day	Fat		Protein %	Lactose %
		%	g/day		
Corn-alfalfa cube silage	29.10a	3.18a	918a	3.00	5.18a
Corn silage + 3.64 kg alfalfa cubes	29.92b	2.70b	814b	3.01	5 26b
Standard Error of mean	±0.22	±0.10	±34	±0.025	±0.017
F	6.69	10.44	4.75	0.015	9.67

Means within columns with different superscripts are significantly different at a probability of ($P>0.05$).

time by measuring the performance of 16 cows in early lactation.

Regardless of treatment, all cows consumed an average of 3.6 kg of cubes/day. Cows fed the corn-alfalfa cube silage ate more total forage dry matter and gained more in body weight (Table 2) than those fed the alfalfa cubes with the corn silage. Milk yield and percent milk lactose were greater ($P<0.05$) for cows fed alfalfa cubes plus corn silage compared with those fed corn-alfalfa cube silage (Table 3); but milk fat percent and yield of fat were considerably greater ($P<0.05$) for cows fed corn-alfalfa cube silage.

There was little apparent effect of the feeding system on hematocrit percent, plasma glucose, calcium, phosphorus or magnesium, but feeding alfalfa cubes with corn silage at feeding time resulted in a higher level of urea nitrogen in the plasma than when corn-alfalfa cube silage was fed. The results of the digestibility trial demonstrated a marked increase in the dry matter and protein digestibility when cubes were added to corn silage at ensiling time rather than at feeding time (Table 2).

Results from this trial suggest that adding cubes to corn silage at ensiling time resulted in a higher milk fat test, greater efficiency of dry matter conversion, and increased digestibility of the total ration when compared with cubes added to corn silage at feeding time. The alfalfa cubes added to the corn silage at ensiling not only increased the quality of the corn silage, as indicated by the increased dry matter intake, but were used more effectively themselves as indicated by milk fat test and level of urea in the blood. The results of this experiment illustrated that the form in which the component is fed can influence the efficiency with which it is used. ■

REDUCING DROPLET DRIFT

R. GROVER

Il est possible de réduire la dérive des gouttelettes de pulvérisation au sol à moins de 2% du liquide éjecté, même à des vélocités du vent de 20 à 30 km/h, et ce, grâce à une combinaison judicieuse de plusieurs facteurs comme le volume, la pression et l'angle de pulvérisation. Pour ce qui est de la pulvérisation aérienne, les possibilités de dérive sont toutefois de l'ordre de 10 à 50% à des vélocités de 5 à 15 km/h, et dépendent du genre d'aéronef et de la vélocité des vents au moment de la pulvérisation.

Droplet drift potential can be from 10% to 50% at wind speeds of 5 to 15 km/h.

Droplet drift from ground sprayers can be reduced to less than 2% of the amount emitted, even at wind speeds of 20 to 30 km/h, by a judicious combination of several operational factors such as volume, pressure and angle of spray. However, with aircraft spraying, the droplet drift potential is in the order of 10% to 50% at wind speeds of 5 to 15 km/h and is dependent on the type of aircraft and the wind speed at the time of spraying.

These were some of the key findings from a joint project carried out by CDA's Regina Research Station and the Saskatchewan Research Council during the past 3 years.

A report published in Canada Agriculture in 1975 dealt with the performance of the three commonly used flat-fan nozzles on ground sprayers. The key findings of the first round of field trials indicated that reducing pressure from 275 to 200 kPa and increasing the volume sprayed from 55 to 110 L/ha reduced the droplet drift from ground sprayers by at least 50%. Since then the work has been expanded to test other nozzles and aircraft spraying.

Of the number of nozzles tested, the flat-fan 8002 and 8002 LP (low pressure) nozzles consistently gave the lowest droplet drift and the most satisfactory target coverage. The drift readings for all trials were taken 5 m downwind from the edge of the swath. The two 8002 nozzles operated at 205 and 105 kPa and 110 L/ha had a much lower droplet drift, potential than did the low-volume 650067 nozzle operated at 275 kPa and at 55 L/ha. Even at wind speeds of up to 30 km/h, the droplet drift potential was 2% or less with the 8002 nozzles and is 1% or less at wind speeds up to 15 km/h.

The droplet drift from agricultural aircraft can be more than 10 times that from ground sprayers, depending on the type of aircraft, wind speed at the time of spraying, and the volume of application. In a series of field trials, considerably

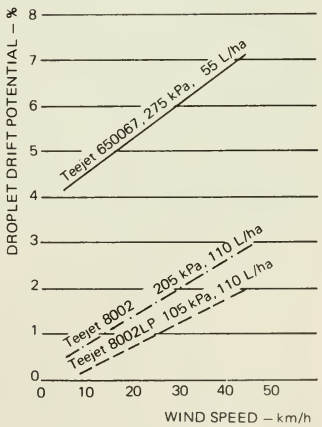


FIGURE 1. Droplet drift potential from three flat-fan nozzles mounted on ground sprayer at various wind speeds.

Dr. Grover is Head of Herbicide Behavior in the Environment Section at CDA's Regina, Sask., Research Station.

less initial drift occurred with the Piper Pawnee (by a factor of about 2 at 10 km/h wind) than with the Cessna Agwagon (Figure 2). Wind speed is a very important factor controlling the amount of droplet drift that occurs. Although differences in the size and travel speed of the two planes were considered to be the determining factors (Agwagon is bigger and operates faster than Pawnee), other parameters such as wing tip design, boom placement, etc., may also play some part in this difference.

When the volume of application was increased from 4-5 to 22.5 L/ha, the initial drift potential was reduced by 44% for the Piper Pawnee (Table 1). There was no effect of the application volume with the Agwagon. However, at a downwind distance of 30 m, the volume effect was discernable for both aircraft (Table 1). In the present trials the increase in volume was obtained by a combination of increased nozzle size as well as number. The volume effect may be more pronounced if the increase in volume were obtained by switching wholly to larger output nozzles while maintaining the same number.

Whichever machine is used, the data clearly show that aircraft spraying must be done carefully, especially when sensitive crops are in the vicinity, and then only when the wind speeds are minimal. ■

TABLE 1. EFFECT OF SPRAY VOLUME ON THE DROPLET DRIFT POTENTIAL FROM TWO AIRCRAFT AT 5 AND 30 m DOWNWIND FROM THE TARGET

Aircraft	Volume	Wind Speed	Drift potential[1] at 5 m	Drift potential[1] at 30 m
	(L/ha)	(km/h)	(%)	
Pawnee, Piper	5	10	18	8
	22.5	10	10	4
Agwagon, Cessna	4	10	34	16
	22.5	13	36	12

[1] Drift potential is defined as the airborne mass collected 5 m downwind of the edge of the spray swath.

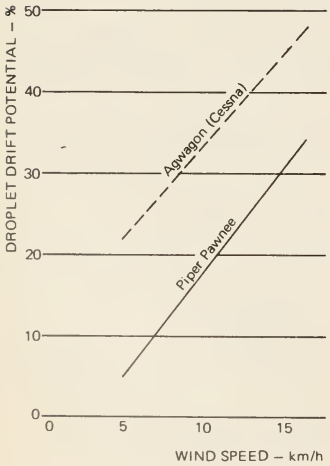


FIGURE 2. Droplet drift potential from two fixed-wing agricultural aircraft at application rate of 5 L/ha (low volume) and at various wind speeds.

GRASS, TREES, OR CATTLE

A. McLEAN, M. B. CLARK, D. E. WALDERN, and M. T. WALLACE

Après une coupe à blanc, le terrain peut être ensemencé de plantes fourragères indigènes et servir de pâturage aux bovins sans compromettre la régénération des conifères à condition que la charge soit raisonnable et que les périodes de pacage soient courtes. C'est ce qu'ont conclu les auteurs à la suite de recherches exécutées à Kamloops en Colombie-Britannique.

For many years burned-over areas of forested rangelands in interior British Columbia were protected from erosion by seeding to grass, mostly by air. With the increase in clearcut logging, ranchers and the Range Division of the British Columbia Ministry of Forests saw opportunities to use the disturbed areas for forage production. As a result, in the 1960s more than 29000 ha of clearcut, cut-over and burned-over forested rangeland were seeded to mixtures of grasses and legumes for pasture. Conflicts arose over the effects of grazing on the regeneration of tree species. Foresters claimed that poor tree regeneration occurred on many areas because of destruction of the trees through trampling and grazing by cattle and competition between tree seedlings and grass for moisture. The foresters' concern was understandable since they are obliged to see that cut-over areas are adequately restocked.

Drs. McLean and Waldern are research scientists at CDA's Kamloops, B.C., Research Station. Mssrs. Clark and Wallace are with the British Columbia Ministry of Forests.

To establish the place of seeding grass on clearcuts and determine the effect on tree regeneration, research was undertaken by the Research and Range Divisions of the Ministry of Forests and the Agriculture Canada Research Station at Kamloops. This research involved studying the effect of sowing and grazing bunch grasses upon the establishment, survival and growth of lodgepole pine and Engelmann spruce. Also determined were the volume of forage produced and used, and cattle weight gains under controlled grazing of seeded areas.

Results of the study suggest that where numbers of cattle and period of grazing are adequately controlled, damage to coniferous seedlings is negligible. Where numbers of cattle are in accord with a grazing permit but the period of grazing is too long, resulting in over-utilization of forage, damage to conifer seedlings is extensive.

In the study, there were also situations such as overly dense, naturally regenerating lodgepole pine stands where forage was over-utilized, usually as a result of poor cattle management, and large numbers of coniferous seedlings were killed or damaged.

But the number was often insignificant in relation to the mortality from natural causes. For example, on one site 72% of the seedlings died, but only 32% of that percentage was caused by cattle (see table). Despite the large proportion of tree seedlings that died on the above site, more than enough survived (i.e. 1,892) to produce a new forest. The ideal stocking rate on this forest type is considered to be about 640 stems per ha.

Generally, the presence of domestic grass had little effect on germination or survival of conifers (table), except where the stand of grass became overly dense. In cases where inhibiting effects were apparent, the competition from native vegetation was of as much consequence as the competition from domestic grasses.

Cattle graze on a clearcut logged area in British Columbia. Research has suggested that where numbers of cattle and period of grazing are adequately controlled, damage to coniferous seedlings is negligible.

Studies at five locations showed that seeded clearcut areas can yield two to four times more herbage than unseeded areas. Considerable year-to-year variations occurred on both seeded and unseeded areas. The average yields of seeded species were between 590 kg and 1540 kg per ha with a maximum of 2265 kg per ha. At all but one of the sites, the herbage yields increased pro-

gressively in each of the first five years. Experience on seeded wildfires in the district suggests that benefits can be expected to continue for up to 20 years following seeding before the tree canopy closes in. Similar longevity of grass stands can be expected on clearcut areas.

Grazing trials were conducted on 3 fields in one large clearcut in co-operation with Balco Forest Industries and the Frank Devick Ranch. The performance of calves and their dams was recorded on fields grazed from early July to mid-October. Length of season varied from year to year but the 4-year average was 104 days. Although some year-to-year variation occurred in animal gains over the season, trends and total gains were comparable. The 4-year average daily gains were 0.64 kg for calves and 0.13 kg for their dams. Using the average weight gains and stocking rates, the pasture returned 60 kg of beef/ha/yr. The above gains were less than normal for forested pinegrass range and likely resulted from heavy cattle stocking.

The stocking rates for the above fields averaged 0.73 ha per animal unit month (AUM) over four years. At this rate, the degree of use varied between 65% and 85% over limited periods of controlled grazing. The above stocking rate can be compared with a requirement of 4 to 6 ha/AUM, increases of from four to eight times, for cattle grazing pinegrass on forested range. The rate was considered heavy and was designed to reveal any damage to trees by livestock. Even at these rates damage to the coniferous reproduction was negligible. There was browsing on the shrubs, although aspen reproduction was not seriously repressed.

On another clearcut which had been planted to spruce and continuously grazed for four months, utilization reached 86% and 58% on seeded and unseeded portions respectively, and tree mortality averaged 11% with an additional 31% damaged. These levels were considered by foresters to be unacceptable to ensure adequate stocking of trees.

Damage to lodgepole pine and spruce is a result of repeated trampling rather than browsing. Clearcuts should be intensively grazed for only short periods of time. If there is a group of clearcuts in an area, grazing should be in a rotational system if possible, leaving the shrubs in some fields ungrazed in certain years for fall grazing by wild ungulates. Grazing is required to control any adverse effects of grass on conifers but poorly controlled grazing has an adverse effect on conifer growth.

Because domestic grasses such as timothy and orchardgrass develop faster than pinegrass in spring, clearcuts seeded to these species should be grazed early in the season where possible. Furthermore, since orchardgrass produces good regrowth in the fall, it is often possible to graze clearcuts containing this species again in late summer.

Forage yields can be significantly increased on clearcuts by seeding domestic grasses. Overstocking of lodgepole pine on some sites may be reduced by temporarily grazing heavily.

Light seeding rates are recommended to reduce early competition with tree seedlings, since most stands will thicken during the first 3 years following seeding. However, where it is desired to limit establishment of conifers and overstocking of trees, seeding rates should be heavier than the recommended 4 to 5 kg/ha. More legumes should be included in seed mixes with grasses for clearcuts to increase the level of nitrogen in the soil.

Forest and range managers must coordinate resource management planning to ensure that specific critical areas will receive the required attention. This way conflicts can be kept at a minimum, capability of the land to produce maintained, and the maximum number of compatible uses recognized. Soil and vegetation bases have to be maintained.

In our research program on logging clearcuts, we are examining grasses and legumes to optimize forage quality and yield to extend the grazing season. This research is conducted in conjunction with a program to develop grazing management systems for these clearcut areas. ■

TABLE 1. MORTALITY OF TREE SEEDLINGS, PROPORTION ATTRIBUTED TO CATTLE, AND LEVEL OF STOCKING OF TREE SEEDLINGS ON 4 SEEDED AND UNSEEDED AREAS FOUR YEARS AFTER TREATMENT.

	Area			
	1	3	4	5
Total mortality of tree seedlings (%):				
Seeded	7	49	72	65
Unseeded	5	69	53	49
Proportion of mortality caused by cattle (%):				
Seeded	27	46	32	49
Unseeded	30	29	20	56
Level of stocking of tree seedlings (number of trees per hectare):				
Seeded planted	3880	1892	3052	
Unseeded planted	1705	6110	5609	

Area 1 values represent the survival of planted stock. Values of areas 3, 4 and 5 represent stocking levels of natural regeneration.

IMPROVING SWINE PRODUCTIVITY

J. I. ELLIOT

Pour élever artificiellement les porcelets, il faut leur fournir les anticorps que leur apporteraient normalement le colostrum et le lait, jusqu'au moment où ils pourront fabriquer eux-mêmes leurs anticorps endogènes. Le sang de porc vendu dans les abattoirs renferme des anticorps semblables à ceux du colostrum. Des porcelets ont été nourris avec des aliments d'allaitement contenant 25% d'anticorps de porc.

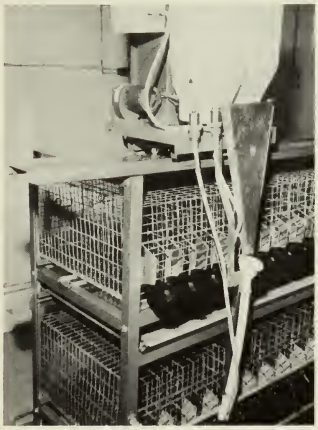
Sows are more efficient at giving birth to piglets than they are at nursing them to weaning age. Twenty percent of the pigs born alive fail to survive the preweaning period. In the national swine herd of 500,000 sows, this mortality represents a loss of 1.5 million piglets a year.

When piglets die prematurely, producers lose not only an individual animal, but some of the cost of housing, feeding and breeding the sow as well. Anything that can be done to reduce the loss of piglets obviously will greatly improve the efficiency of the swine industry.

The primary causes of piglet mortality have been related to the general condition of the sow and piglets at time of birth, and to the number of piglets in the litter and the sow's capability to nurse them.

Disease is not a major primary cause of piglet mortality. Piglets that die may reveal disease symptoms to which their susceptibility was increased by their condition at birth, the condition of the sow as outlined previously or an environmental breakdown.

The newborn piglet is an immunological virgin, totally dependent on the sows' colostrum and later milk for antibodies that confer passive immunity to disease. The ability of the piglet to respond to disease challenge by endogenous production of antibodies does not begin to develop until approximately 3 weeks of age. These interrelationships are illustrated in Figure 1.



Specialized automatic feeding unit runs along on top of individual feeding cages, and was used in experiments to rear piglets independently under non-isolated conditions.

Past attempts to raise piglets independently prior to 14 days of age have been unsuccessful except under sterile conditions — impractical from a production standpoint. Attempts to provide passive disease immunity artificially have also been unsuccessful, mainly because the antibody source was not administered for a sufficient period of time. To rear piglets away from the sow one must supply antibodies in amounts that simulate those normally received from the sow's colostrum and milk, until they begin to produce their own (Figure 1).

Antibodies similar to those in sows' colostrum and milk are present in porcine blood, readily available at abattoirs. Since pigs slaughtered at large abattoirs have been exposed to a cross-section of diseases, their serum antibodies reflect this wide exposure.

Serum antibodies can be isolated from porcine abattoir blood, purified, concentrated, mixed with condensed milk and spray dried. The resulting product, comprising approximately 25% porcine antibodies (immunoglobins), can be incorporated into milk replacers and fed to piglets.

TABLE 1. COMBINED RESULTS OF EXPERIMENTS TO TEST THE EFFICACY OF SERUM-DERIVED IMMUNOGLOBINS IN PREVENTING PIGLET MORTALITY

Treatment	Number of piglets at			Percent survival to	
	Birth	21 days	56 days	21 days	56 days
Control[1]	113	18	—	16.0	—
Field trials[2] (University of Saskatchewan)	344	312	—	90.8	—
Establishment of minimal disease herd[2] (Animal Research Institute)	466	418	400	89.6	85.8

[1]Piglets received milk replacer only.
[2]Piglets received milk replacer supplemented with immunoglobins to provide 10 g/kg BW on day 1 and 2 g/kg BW on days 2-10.

Dr. Elliot is Chairman of CDA's Swine Nutrition Program, Animal Research Institute, Ottawa.

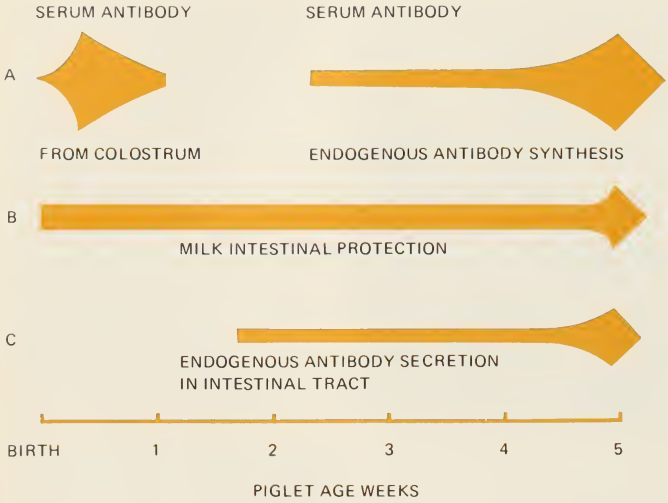


FIGURE 1. Simple scheme showing the interrelationship of serum antibodies A, milk antibodies B, and endogenous antibody production, A and C, contributing to protection of the piglet in early life (Adapted from: Porter, P. 1973. Vet. Rec. 92:658-664).

Such a product has been prepared on a trial basis and has been successfully field tested in Saskatchewan by Dr. B.D. Owen and at the Animal Research Institute, Ottawa. Survival of piglets removed from the sow, either at birth or by hysterectomy, and receiving the immunoglobin at a simulated colostral level of 10 g/kg bodyweight on day 1, and a simulated later milk level of 2 g/kg bodyweight on days 2-10, is given in Table 1. Survival of control piglets receiving no immunoglobin was very low while that of piglets receiving the immunoglobin was as good as or better than sow-reared piglets. Performance of piglets reared by this technique (Table 2) at the Animal Research Institute has been better than the industry average. Mortality is usually high among low birth-weight piglets, but with this technique there is a survival rate of 75% and performance is approximately equivalent to those of normal birth-weight (Table 2).

It is evident from the data presented that piglets can be reared independently under non-isolated conditions. However, specialized housing and feeding equipment, a temperature of 30°C for the first week of the piglet's life, and a high management awareness are required.

The technique, although requiring refinements and a commercially available product, has the potential to significantly improve the efficiency of Canadian swine production. A swine producer might go completely to zero weaning using once-bred gilts marketed after producing one litter; a producer might rear orphans or piglets in excess of teats; or a large producer might remove all low birthweight piglets and improve his production performance.

From a strictly research standpoint virtually nothing is known about the nutritional requirements or growth potential of the neonatal piglet. As long as the sow nursed piglets such knowledge was not essential and difficult to obtain. Definition of nutrient requirements and the limits of growth potential using the new technique could, over the next few years, lead to further improvements in swine productivity. ■

TABLE 2. PERFORMANCE OF HYSTERECTOMY-DERIVED PIGLETS ARTIFICIALLY REARED

	Weight kg			Age at 90 kg
	Birth	21 days	56 days	days
All piglets	1.24	4.20	18.90	148
Low birthweight piglets	0.76	3.39	16.06	158

MARKERS TO MONITOR INSECT ACTIVITIES

W. H. FOOTT

Les chercheurs doivent faire preuve d'ingéniosité et d'imagination pour marquer les insectes à des fins d'observation. Certains ont déjà utilisé, entre autres, des radio-isotopes, de la poudre fluorescente, du vernis à ongle, de l'encre de Chine et des peintures à l'huile pour observer les mouvements des insectes.

Insects are difficult to follow because of their small size and ability to fly. About the only way to examine their habits is to mark certain individuals so their movements can be observed. Entomologists have used a number of markers to differentiate the migration habits, flight range, population density and longevity of specific species.

An ideal marking method must satisfy several conditions: (1) There should be no observable effect on an insect's ability to walk and fly, its normal behavior, or its longevity. (2) The lifespan of the marker may vary. In some instances marked insects have to be identified many days or weeks later; in other studies markers of short duration are satisfactory. (3) Observations in daylight are usually sufficient, but sometimes markers must also be seen at night. (4) The method should be simple enough that large numbers can be captured, marked and released without excessive labor, and preferably without elaborate equipment.

Early methods required little equipment but considerable labor. In one case, one leg of every insect was amputated before release. While the investigator probably exaggerated when he stated that "no permanent injuries resulted," it did appear that the amputation had no effect on the insect's activities. In another procedure colored silk threads were tied around the constricted portion of the body. The silks remained in place for months on the sheep ked.

Sap beetles in centre have been marked with phosphorescent powder and are easily distinguishable from unmarked beetles above and below them.

Various types of paints and dyes have been tested, including radiator paint, oil paints, oil-soluble dyes, fingernail polish, India ink, model airplane dope, aluminum paint, colored lacquers, speedball inks, mixtures of pigments, shellac, alcohol, and others. On a few occasions an atomizer has been used to spray dyes on groups of insects. Mostly, however, it is necessary to hold each insect between one's fingers while the marker is applied to a specific part of the body, usually the thorax or wings. Instruments used to apply markers included camel's hair brushes, fine wire, toothpicks, pointed sticks, felt pens, needles, etc. One investigator designed a self-marking device for moths. Pupae were placed in a darkened box with a cone at one end through which emerging moths crawled in order to reach the light. A wick extending from a bottle of dye was held in the cone as the moths crawled over the wick they were marked with dye. By feeding water, syrup or milk in which dyes are dissolved, insects can be marked without individual handling. For positive identification of marked insects it is often necessary to dissect or squash each insect.

Methods have been developed to mark insects released on different days, from different locations, or treated in different ways. By using two or more colors and different areas of the wings or body, it is possible to have many combinations. Actual numbers can be assigned. For example LF121 could mean that the insect had one colored spot, two colored spots and one colored spot, respectively, on three areas of the left forewing. Another system has one color representing each of the 10 digits. Units are represented by a dot of the proper color on the left rear of the thorax, tens by a dot on the right rear, hundreds by a dot on the left front, and thousands by a dot on the right front of the thorax. A similar system could be used on the abdomen.

Following the Second World War, radioisotopes became available to biologists to tag insects. The advantages of using these materials include ease of application, minimal manipulation of specimens, persistence, and ease of recognition with proper equipment. For example, large numbers of insects can be made radioactive by putting an isotope in their diet (house flies), spray-

Dr. Foott is Head of the Entomology Section at CDA's Harrow, Ont., Research Station.

ing it on their food (grasshoppers), placing it in their rearing medium (mosquitoes), or immersing them in the isotope itself (wood-boring insects). If insects are captured in traps or in sweep nets the contents can be examined with a portable Geiger counter to detect radioactivity and thereby reveal the presence of treated forms. In some instances insects can be approached close enough to be detected with a Geiger counter without recapture. A disadvantage in the use of isotopes is that great care must be taken when handling them.

Investigators have obtained interesting information with radioactive insects. In one study they located wood-boring insects beneath the bark of trees for approximately 2 weeks following treatment. In another study, scientists were able to trace the beetle's movements from pieces of radioactive metal attached to wireworms in the soil. With flying insects, tagged mosquitoes were captured 2 miles away, blow flies 8 miles away, and houseflies 12 miles away from their release points. Stable flies moved 5 miles in less than 2 hours. Population density can be estimated through the release of a known number of tagged insects. The ratio of untagged to tagged forms recaptured later gives some idea of the natural population.

Another popular marker is fluorescent powder. For many years certain materials were known to possess the property of fluorescence under ultraviolet light (UV), but only recently has this phenomenon been widely adapted for commercial use. Fluorescent powders are safe to use and they and their detection equipment are inexpensive. In many instances no equipment is required to make the desired observations. Thousands of insects can be marked within a few minutes by placing them in a paper bag with a small amount of powder and shaking the bag to ensure that all forms are marked. It is often possible to make both daytime and nighttime observations.

There are numerous examples of practical applications for these powders. In studies with face flies it was difficult to get close enough to cattle with a Geiger counter to detect flies tagged with radioisotopes. When fluorescent powders were used the flies could be seen 15 m away in daylight. Powders were used with success to study fowl ticks in poultry houses. Markings lasted for more than a year on ticks in the laboratory and at least 6 weeks on ticks released and later recovered from poultry houses. Apple maggot flies were detected at night in an orchard through the use of a UV light on an extension cord. In boll weevil studies some marked insects placed in wooded hibernation quarters during January were readily detected with a UV light 3½ months later when captured on flight screens. It was also found that the glow from a weevil could be seen through a young cotton leaf. I used fluorescent powders in the investigation of a beetle that infests canning tomatoes. Small numbers of beetles could detect and infest hampers with cracked tomatoes placed 300 m from a release point within 2 hours. I am using these powders in a study of the European corn borer.

The foregoing discussion of methods for marking insects and other arthropods, though far from complete, will give some idea of how investigators use their ingenuity to obtain important and interesting data on the activities of insects. ■

ECHOES
FROM THE FIELD AND LAB

ECHOS
DES LABOS ET D'AILLEURS

FLUID MILK USE DOWN In the European Community (EC) last year, the use of fluid milk declined by about 2%. In the United Kingdom a consumption subsidy was phased out, a factor in that country's 3½% decrease, but the French, Irish and Danes increased their consumption. Annual per capita fluid milk consumption in the EC is about 100 kg/yr compared with about 120 kg/yr in Canada.

CATTLE MARKETING HANDBOOK Agriculture Canada's livestock division has published an 84-page handbook of quick reference facts to help cattlemen in their day-to-day marketing decisions.

The Canadian Cattle Marketing Handbook outlines the markets information available from the department, explains terms used in the livestock markets reports and lists telephone numbers farmers across the country can use to get current market prices and other information.

Cattle producers who want a copy of the handbook can get it by contacting the nearest regional livestock division office or by writing to: Livestock Division, Agriculture Canada, Ottawa, Ont., K1A 0C5.

DEMAND FOR GOAT MEAT A meat-type goat farm has been started in Alberta to meet the demand from ethnic groups for high-quality goat meat. Richard Schafer says he plans to get two litters a year through selective breeding and special management techniques. Meat-type goats are obtained by crossing three or four dairy goats in a selective breeding program, so the new industry will provide dairy goat producers with a new market for their surplus breeding stock.

FACE FLY TRAPS Face fly numbers have been reduced by as much as 70% in experiments at the Beltsville Agricultural Research Center in the United States. Traps, built of 20" × 30" triangles joined at the top to form a pyramid, are painted white (the color found to attract the most flies) and covered with clear plastic and then a sticky substance. Scientists are trying to treat the traps with pesticides that would kill the flies when they land and eliminate the need to change the plastic every few days when they've become covered with flies.

SAVE ENERGY Increasing energy costs will continue to improve the practicality of minimum tillage systems provided they are agronomically sound, says Wayne Lindwall, a tillage engineer at CDA's Lethbridge, Alta., Research Station. Although zero tillage reduces energy inputs, it is still not economical for most farmers to eliminate fallow tillage because the best herbicides are too expensive.

Canadians drink about 120 kg/capita of milk a year.

Crop yields, or energy outputs, for reduced tillage and zero tillage systems used at the Research Station were 16% and 9% higher, respectively, than those from the conventional tillage system. The ratios of total energy output to input were 6.8:1, 11.0:1 and 17.4:1 for the conventional, reduced and zero tillage systems respectively.

NEW CROPS Interest in alternate crops is growing as a way to provide cash, extend rotations, spread out the work load or clean up weeds, says Neal Holt of CDA's Indian Head, Sask., Experimental Farm. Special crops such as mustard, sunflowers, field peas, lentils, fababeans, canary grass and buckwheat have produced well at Indian Head and require no special equipment. More information on the management practices for specific alternate crops is available from the Experimental Farm at Indian Head; the Special Crops Specialist, Saskatchewan Department of Agriculture, Regina; or from contracting companies.

HOME LAWNS Variety is important when mixing turfgrass species for home lawns, says D. K. Taylor of CDA's Agassiz, B.C., Research Station. Some varieties such as Highlight may be so aggressive that they crowd out competing Kentucky bluegrasses in simple mixtures. The use of Boreal in mixtures gives a better survival of both species, but perhaps a more disease-resistant variety such as Pennlawn should be chosen, he says.

SHOPPING GUIDELINES Shopping For Food and Nutrition is a new publication that provides practical guidelines on shopping wisely for food and nutrition. It explains Canada's Food Guide, what various nutrients contribute to one's health, and which nutrients are found in which foods. There are tips on saving money when food shopping and charts explaining how long food can be kept on the shelf, in the refrigerator and in the freezer. Colorful drawings brighten the 32 pages. A joint effort by Agriculture Canada and Health and Welfare Canada, Shopping for Food and Nutrition is available free in English or French from either Information Services, Agriculture Canada, Ottawa K1A 0C7, or from Information Directorate, Health and Welfare Canada, Ottawa K1A 0K9.

NORTHERN ANIMAL AGRICULTURE Studies at the University of Alberta, although incomplete, suggest that bison and yak are slightly superior to cattle in digestive efficiency of low-quality forages. This superiority may be useful in exploiting marginal lands of the north. However, the digestive advantage was offset by an inferior use of digested energy for maintenance or gain compared with confined cattle. Bison adapted to severe cold (−30 C) better than yak which, in spite of their long hair coat, were not markedly superior to cattle in cold tolerance.

INFORMATION
Edifice Sir John Carling Building
930 Carling Avenue
Ottawa, Ontario
K1A 0C7

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