WINTER 1978
HIVER 1978

The importance of weather to agriculture is graphically presented in the Agroclimatic Atlas of Canada. See story P. 26

L'Importance de la température en agriculture est représentée de façon graphique dans l'Atlas agroclimatique du Canada. Article en page 26

CANADA AGRICULTURE

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Agriculture Canada

WORLD FOOD SITUATION

FRANK SHEFRIN

Nous connaissons l'ampleur du problème, les ressources nécessaires et les quantités approximatives. Il nous faut cependant démêler les problèmes nombreux, complexes et apparentés qui freinent le taux de croissance de la production alimentaire des pays en voie de développement. Il nous faut aussi débrouiller la multitude de solutions proposées de façon à retenir celle qui s'applique à chaque problème.

Since the end of World War II, opinions about the magnitude of the world food situation have swung like a pendulum between pessimism and optimism. In 1945 the problem was rehabilitation of agriculture in war-devastated countries, and formulation of agricultural policies that would bring stability and prosperity to farmers all over the world. However, as surpluses began to accumulate in North America in the early 1950's, it seemed that getting rid of the surpluses was more of a problem than shortages.

There was a wave of optimism. It appeared that the world was on the verge of a food breakthrough. But by the mid-1960's, U.S. acreage controls, food aid programs, unfavorable weather in a number of countries, as well as increased exports by major suppliers, reduced the surpluses. In 1966, world grain stocks were down, mainly as a result of greatly expanded imports by India and the USSR. A pessimism crept in. More and louder statements were being made about the impending shortages.

By 1972, any optimism that prevailed in the previous decade gave way to widespread anxiety. The world food situation in 1973 was the most difficult since the years immediately following the war. Supplies were down. We had a World Food Conference to work out an international program to increase food production, to improve human nutrition.

Agriculture production, especially grains, recovered in 1975-76, and food production was at a record level by 1976-77. The strong demand, short supplies and higher prices led to substantial increase in grain production, especially in North America which now provides about 80% of the world grain exports. The larger crops in these two years have restored world cereal stocks that had been drawn down for three consecutive years.

I would say that we are now in a period of cautious optimism.

What about the future? Can we reduce the magnitude of the world food problem?

Over the next decade, the world has to feed between four and five billion people. Too many of these people will have very low incomes, be living in poverty and be unemployed. Most of the 115 developing countries will continue to face food shortages. The food problem and the food solution will vary among these countries. It is not enough to

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increase the production of food. Much of the food produced is not what is eaten by the poor or malnourished. They cannot afford to buy this food. There must be increases in food production in the poorer countries and by the small farmers, so that imports of food will not exceed their means of paying. Thus, the food must be produced where it is needed and get to those who need it.

The developing countries will continue to be under continuous pressure to meet the increasing demand for food at least at the current per capita food availability level, and, preferably at a higher level. Increased production by itself will not solve problems of a more equitable food distribution and of chronic malnutrition. Just to stay at the present per capita rate of food production in these countries could require an annual investment in agriculture of about $20 billion, of which 60 to 70 percent will have to originate in the developing countries, unless there is a substantial increase in the volume of capital assistance. In addition, these countries may have to spend, annually, billions of dollars on food imports, until they are able to narrow the gap between their production and their demand.

They will continue to be heavily dependent on food aid. Work will have to be found in the developing countries for the many millions of unemployed in the rural areas who, at present, are not contributing to production or have the means to buy food. International aid for the agriculture sector in developing countries has to be given higher priority. A greater effort will have to be made by both developed and developing countries to ensure that the impact of food programs to increase production reaches the poorest people, the small farmer and the landless worker, as well as those who are relatively better off.

The developed countries will, in turn, have to expand their food production to help meet the growing global food requirements, especially those of the developing countries. Their policies for expanding their own agricultural production have to be consistent with the needs of the developing countries to expand their indigenous production. The developed countries will have to continue to provide a substantial volume of food, especially grain on a concessional or grant basis. More important, the developed countries will be expected annually to substantially increase the flow of funds to the developing countries for investment in agriculture.

We know the magnitude of the problem. We know what resources are needed and the approximate volume. But we still have to untangle the many complex and interrelated problems retarding the rate of increase in food production in developing countries. We also have to untangle the multitude of solutions being proposed so that we can apply the solution to the problem. ■

World Food Program activities use food aid for specific projects related to agricultural production or rural people. In this WFP/FAO photo, a demonstrator shows Mexican villagers how to use WFP supplies.

WHAT CANADIANS HAVE TO SAY ABOUT WORLD FOOD

Voici quelques déclarations de Canadiens sur le sujet à un colloque organisé par l'Institut agricole et la Société royale du Canada tenu à l'Université Carleton à Ottawa en août 1977.

Here are excerpts from a symposium on the subject, sponsored by the Agricultural Institute of Canada and the Royal Society of Canada at Carleton University, Ottawa, in August 1977.

THE FORGOTTEN FAMILIARS

The typical aid program is simply too big, too remote, too irrelevant to the daily lives of the majority of families in the Third World. Decisions to initiate and implement the vast majority of aid programs are made with little if any decision-making input from the rural population.

World food production most certainly can be increased by getting down to the forgotten familiars — the rural families and their immediate needs. The first move is to recognize the factors causing the present imbalance. I call your attention to six of these factors: the need for potable water; for basic tools; for fuel wood; for midwives; and for large scale efforts to eradicate or control endemic debilitating diseases.

When Canada faces up to the continuing challenge of these basic problems in much of the Third World and directs its efforts accordingly, then and only then, will we begin to fulfill our responsibilities as an affluent and humanitarian nation. Then and only then can we afford the luxury of moving into the desirable but less immediate large-scale but long-range development projects.

Helen C. Abell
Stouffville, Ontario

THE POLITICS OF FOOD

The focus now must shift from establishing agriculture as a priority subject among development strategies to defining what strategy for rural and farm development can be implemented most effectively. It is now that a sustained and vigorous political will to grow more food is most needed. To succeed in doing so requires time and patience and, above all, the pressure of a continuous resolve.

In an increasing number of developing countries the politician will be aided in his resolve by the rise of fledgling farm organizations giving voice to the economic and social interests of cultivators.

In increasing measure, farmers are building their own associations and organizations to act as political lobbies and economic bargaining units to secure these off-farm supplies and services. In time, these groups will become major factors in the play of national politics.

W. David Hopper
International Development
Research Centre, Ottawa

AGRICULTURAL RESOURCES

Despite the neglectful waste of our good agricultural land, it is theoretically possible by the turn of the century to triple Canada's grain production. This could be done by increasing considerably the acreage planted in grain crops on existing farmland, by providing incentives to farmers to intensify their production through the increased use of fertilizers and chemicals for weed control, and by bringing into production our unclaimed 20 million hectares of potential crop land.

Needless to say, this will not happen by the turn of the century, nor should it. The capital costs of claiming the 20 million hectares of potentially arable land which are of low fertility would be enormous. The annual management, fertilizer and other input costs would also be immense. The crops produced would be modest in quantity and marginal or submarginal in profitability. The food produced would be in the middle of the North American continent, thousands of miles from where it would be needed, and the food, like any other commodity that is costly to produce, would have to be paid for.

As an alternative, I suggest that the Canadian government through International Development Research Centre or Canadian International Development Agency, make available to developing countries sums of money equivalent to the cost of bringing sizeable areas of potential Canadian lands into food production. Such allocations would then be used to bring into crop production land areas with the agricultural potential of the Indus-Ganges-Brahmaptura Plain of North India. By the investment of Canada's future land development dollars in developing countries, a wide range of objectives would be produced where most needed, while investment income, economic stimulation, and

employment opportunities thus provided would help the developing nations to gain as quickly as possible their economic takeoff. Such a re-direction of land development dollars would contribute significantly towards long-term solutions — which must ultimately be resolved only in the developing countries.

Leonard H. Shebeski
University of Manitoba

LA CAPACITÉ DE PRODUCTION

Il faudra maintenir en tout temps une distinction réelle entre nos projets simples destinés à augmenter la capacité de production, projets qui normalement se développent dans le secteur rural, et les véritables projets de développement rural. Je suis d'avis qu'il faudrait continuer à concentrer nos efforts sur le premier type, en essayant chaque fois quand c'est possible de les insérer, soit dans une politique alimentaire nationale, ou même dans des plans régionaux de développement rural mis sur pied et dirigés par le gouvernement récipiendaire quand de tels plans existent déjà.

Rolland P. Poirier
Agence canadienne de
Développement international

CANADA'S ECONOMIC POTENTIAL

The serious economic circumstances Canadian agriculture faces in cost competitiveness have come on top of a serious prolonged imbalance in the protection offered the manufacturing and service sector. This has resulted in higher input costs to agriculture and serious effects on the labor, land and capital markets — a situation unlike that faced by competitors.

What is at stake is the survival of our agriculture-food industries. Canada's economic potential must first be based on the opportunities to improve the competitive cost structure of the industry.

Deterioration in world food export performance is associated with a number of factors:

1. Steady growth in Canada's food imports, 2/3 of which are supplementary commodities, i.e. imports similar to or the same as agricultural commodities purchased commercially in Canada.
2. A relatively poor agriculture and food output growth over the past 15 years, well below food demand growth in Canada, and well below the growth of many developing countries. Over recent years, excluding some weather variations, food output appears to have stabilized.
3. There has been almost no growth in overall resource productivity in agriculture during the past 15 years (.07% per year).

There is a serious need for improvement and development of this country's underdeveloped rural communities, and agricultural and food resources.

Gordon A. MacEachern
Agricultural Economics
Research Council of Canada

MOBILIZING CANADA'S RESOURCES

Unless rising costs are met through increased efficiency our standard of living will decline. This will reduce Canada's capacity and will to provide aid. Exports will decline as prices rise and resistance to imports will increase as foreign competition expands. This is as true in protected segments of agriculture as in other parts of the economy. As these events occur, growth in the developing countries will be restricted further.

Thus, except during short-run adjustment periods, we must recognize that the price of inefficiency will be disaster. Policies and programs in agriculture or elsewhere, designed to reduce output and efficiency in resource use must give way to allow, indeed force, resource adjustments to permit their efficient use, in Canada, as elsewhere. The world cannot afford the luxury of controlled or manipulated waste.

Elmer L. Menzie
University of Guelph

TRADE, AID AND FOOD RESERVES

So far as improving the usefullness of food aid is concerned, there is a widespread feeling that in future it should be used more systematically in the pursuit of three explicit objectives: to increase food production in recipient countries by accelerating agricultural and rural development; to alleviate hunger in specific target groups by sharply focused nutrition groups; and to improve security by helping developing countries build and maintain minimum stocks of basic foodstuffs.

At this juncture, there seems no chance that the international community will agree to set up a "security" reserve of the type envisioned by Secretary Kissinger in 1974, or proposed by the United States in the International Wheat Council in 1975. On the other hand, the chances of a revised International Wheat Agreement, to come into effect in July 1978, and having nationally owned stocks as the principal instrument of international grain price stabilization, seem much improved.

T. K. Warley
University of Guelph

IS WELFARE A RIGHT?

In 1975-76, 47 percent of Canadian food aid went to the World Food Program. Most WFP activities use the food aid concerned for specific projects which are predominantly related to agricultural production or rural people. However, Canada does not administer nor supervise individual WFP projects. But the principle is clear: WFP projects are presented for consideration, if approved they are subject to monitoring; and such assistance is earned, it is not provided as a right.

I do not favor all of Canada's food aid or development assistance in the agricultural sector being provided through multilateral agencies. There are many reasons and advantages for direct Canadian involvement in such activities. But is Canada in a position to put conditions such as those proposed on food aid? Probably not.

C. F. Bentley
University of Alberta

■

PACKERS BID FOR CARCASS BEEF

Des essais de ventes aux enchères ont été entrepris dans les parcs à bestiaux de Toronto en réponse à de nombreuses organisations de l'industrie du boeuf. Il y aurait donc lieu de mettre au point une méthode de vente aux enchères des bovins sur la base des carcasses.

"Most slaughter cattle marketed in Ontario now are sold on a liveweight basis," explains Harvey Cochran, chief of the markets and merchandising section in Agriculture Canada's livestock division. "However, some cattle are sold on a railgrade basis with the price being negotiated privately between the packer and the beef producer.

"In the last few years, many cattlemen and beef groups have called for a third option — selling cattle on a carcass basis under a competitive bidding system."

In 1975, the National Livestock Market Association forwarded a

There is no need for a shrinkage allowance when cattle are sold on a carcass basis.

...carcass payment

resolution to Agriculture Canada seeking a study of the feasibility of developing such a marketing method. Through the actions of Agriculture Canada, a committee was established representing producers, the Ontario Stockyards, commission agents, packers, and Agriculture Canada with the responsibility of designing and evaluating a marketing method. All agencies represented on the committee were active in the development of the marketing method. The committee organized six special sales at the Toronto stockyards in May and June 1977. About 1,200 steers and heifers were sold at these sales. Prices were competitive with those in the live sales the following day at the Toronto stockyards. (See Table)

A committee of representatives of packers, producers, commission firms, the Ontario Stockyards Board and the Meat Packer's Council determined the weight and grade differentials.

Packers are required to make full or partial payment by the close of business on the third day following the sale. Partial payment is based on a 50% yield of live scale weight times carcass price.

Producers receive a single payment from the commission agency immediately following receipt of the final settlement from the packer.

A penalty of one-half of 1% based on hot carcass weight is assessed to the packer on cattle not killed until Wednesday following the sale. Thereafter, the penalty increases to 1% per day.

The transfer of risk occurs at the stockyard's scale.

Beef producers consigned cattle for the special sales through commission agents at the stockyards. The cattle were sold in lots of 15 to 36 head. In the first two sales, bidding was based on hot carcass weight only. In the second two, bidding was based on both carcass weight and grade. Bids were for Canada A1 and A2 carcasses with specified discounts to be applied to cattle that didn't make the A1 or A2 grade. In the last two sales, producers were given a choice of selling by carcass weight or by weight and grade. Most of the farmers opted for selling by both weight and grade.

"Although we were a bit disappointed with the number of cattle offered for sale, the committee feels the trial sales were a success," Mr. Cochran says.

The Ontario Public Stockyards continued the special sales last fall (every Monday afternoon) on the same basis as the trials. Stockyards in the other provinces have watched the trials with interest and will be deciding whether such sales would be practical for them. Ontario, Saskatchewan and Alberta have passed legislation standardizing the procedures under which packing plants can buy cattle on a carcass basis.

Mr. Cochran says there are a few problems with the carcass sales. Lots of cattle must be identified, penned and handled separately. Colored ear tags have not proved

PARTIAL SUMMARY OF DATA COLLECTED FROM THE SIX SALES

Sale #	Producers Per Sale	No. of Cattle Sold	Per Sale Buyers	Average Yield-Steers	Average Carcass Price-Steers	Calculated Live Equivalent Price	Price Range A1 & A2 Steer Subsequent Day
1	8	235	7	58.9%	$73.25	$43.15	43 50 – 45.00
2	8	129	6	58.7%	73.17	42.95	42.00 – 43.50
3	7	118	3	58.4%	73.72	43.06	42.50 – 44.00
4	8	141	2	58.1%	73.45	42.65	43.00 – 44.50
5	14	346	6	58.2%	73.35	42.72	41.50 – 43 50
6	7	177	6	57.6%	73.98	42.62	42.50 – 44.00
Total		1,146	30				

practical to identify the animals because of the difficulty in inserting them at the stockyard. Sticky back tags do not always adhere to animal hides. The Livestock Division is looking for a better means of identifying the cattle.

Identification of the product is the weak link in the marketing method, the committee has found. In addition to the present known method of tagging, it is necessary to make sure that each lot of animals is penned and killed separately. Consequently, it appears that the minimum size of a workable lot is 12 animals. Because of this constraint, it seems also that the selling method should be limited to special sales.

Other problem areas requiring further clarification are listed as:

- deadlines for full payments and partial payments from packers to commission firms and from commission firms to producers;
- details on condemnation losses;
- the inclusion of cows in the method;
- the supervision of warm carcass weight.

States Harvey Cochran, "The special sales have advantages for the producer. Cattle can be delivered to the stockyards either Sunday or Monday morning because they are being sold on a carcass basis and there is no need for a shrinkage allowance. Producers receive an official federal government grading certificate and can see how their animals have been rated.

Individual terminal markets will have to assess the value of this type of auction sale relative to their own circumstances.

Terms and conditions of the trial sales have been publicized extensively by the Canadian Cattlemens' Association, the Ontario Cattlemens' Association and the Farm Press. Producers consign their cattle by contacting the commission firm of their choice.

Over 50% of the participants in the Ontario Public Stockyards trial were regular patrons of the stockyard. Continued success of the method will depend on further interest and support from beef producers. ■

POTATOES — A CHOICE OF VARIETY

DONALD A. YOUNG

On compte 48 variétés homologuées de pommes de terre de semence au Canada. Huit d'entre elles seulement sont d'importance nationale. Les autres satisfont aux exigences de régions géographiques spécifiques, montrent une résistance aux maladies dans les situations difficiles et présentent une diversité horticole qui élargit l'intérêt porté à cette culture. De nouvelles variétés pourront éventuellement percer grâce à leurs qualités particulières.

All segments of the Canadian potato industry are demonstrating more interest in new varieties.

That the Canadian potato producer has high expectations of breeding programs is indicated by comments that are frequently received by breeders:- "when are you going to breed a variety to replace Netted Gem" – "we would have no more consumer complaints if you could breed a variety resistant to bruising". Whether such comments reflect realistic expectations or not is a matter of debate. The old varieties tend to linger on in spite of the fact that new varieties, superior in various ways to the older ones, have been introduced. Netted Gem,

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the leading variety in the United States, was introduced prior to 1900 but its use still continues to grow. Bintje, the leading variety in the Netherlands, was introduced in 1910.

Probably in no other crop is the choice of variety affected to such an extent by factors external to the farm on which the crop is grown. In the Maritime provinces variety choice is often conditioned by the potential of a seed market, even though the crop may or may not be sold as seed. The Netted Gem is demanded almost exclusively for frozen French fry production and as a result is grown rather extensively in some parts of the country where it is not well adapted. In central Canada, the availability of seed often affects variety selection.

Historically, new varieties do not move rapidly into acceptance within the trade. It is a major task for many growers to change variety. Seed is costly, heavy, and perishable. New potato varieties are rarely advertised and promoted in the same manner as many other crop plants. Furthermore, each variety requires special management to optimize production and it takes time to learn this management. It is often easier for seed growers to grow the old varieties than to risk producing a new variety of uncertain demand. Rarely does seed of a new variety bring a significant premium.

Even a strong seed certification program, and Canada has one of the best in the world, tends to reduce the demand for new varieties. A certification system that works well often controls various disease problems and diminishes the demand for the disease resistance of newer varieties. In addition, the entry of a new variety into, and its multiplication within a modern certification system is a time-consuming task. There are limits to the number of varieties the provincial seed farms can handle efficiently.

In spite of these seemingly negative factors, all segments of the Canadian potato industry are demonstrating an increasing interest in new varieties. As the industry matures, as the requirements of our processing, table and seed customers become more sophisticated, and as we search for a solution to disease problems, the choice of variety becomes increasingly important. Probably never again will we have varieties such as Kennebec and Netted Gem that are grown extensively across very wide geographic areas. An example of a new potato variety introduced to meet a requirement in a limited geographic area is *Nipigon*. This variety was licensed in 1976 specifically to meet a need in the Thunder Bay area. Although tested extensively in other parts of Ontario, Quebec and Atlantic Canada, this variety showed little promise. On the other hand, Nipigon has excelled in the Thunder Bay area in terms of yield and appearance, and it was licensed at the request of the industry in that area.

Sable, a very early round white introduced in 1964 has replaced Warba as the major first early in Nova Scotia and New Brunswick. A seedling, *F67072*, that is presently in the final stages of evaluation throughout eastern Canada is also a first early, of higher quality than Sable, with resistance to several virus diseases, and appears more widely adapted than Sable. Its introduction will depend on the outcome of the 1977 trials.

The first introduction from the Canadian potato breeding program, *Keswick* (1950), is an early-sizing, medium-maturing variety of high table quality. It has ranked about fifth in terms of seed acreage in New Brunswick and tenth overall in Canada for many years. Keswick is grown extensively in home and market gardens in the Maritime provinces, and comprises approximately 60% of the 'non-commercial' potato acreage in New Brunswick.

Batoche, introduced in 1976 by the breeding group on the Prairies is a smooth, high-yielding, attractive red-skinned variety that appears to do well on the irrigated land of southern Alberta as well as the non-irrigated areas of Manitoba. Indications are that Batoche probably has a wide adaptability:- it has done well in trials in the three Maritime provinces and has also caught the eye of several visiting seed-buying delegations.

It is unfortunate from the consumer point of view that to date the potato marketing system does not accommodate retail sale by variety name. The Netted Gem, because of its distinctive shape and russet skin, is the only variety recognized by most consumers. The splashed red and white color bred into the new variety *Tobique* will also make it readily identifiable. Interest has been expressed in eastern Canada in attempting to market top-quality potatoes by variety name in special retail packs. Belleisle is a late-maturing, round white, bruise-resistant potato with exceptional boiling and baking quality introduced in 1974. In evaluation trials Belleisle has done well in Prince Edward Island, New Brunswick and Ontario, and has shown much promise in market tests conducted in Montreal and Toronto. Belleisle quality reminds many of the old variety Green

Mountain, and the way potatoes used to taste. During 1977, Belleisle will be evaluated extensively in New Brunswick for late fall use as a variety for manufacture into frozen French fries.

Tobique is the most recent introduction from Canada's breeding effort, with seed stocks reaching commercial growers for the first time in 1977. This variety is unique in that it is high yielding, has good table quality, makes good chips, and is resistant to Verticillium wilt and potato virus Y. Tobique is of particular interest to potato chippers who are using Kennebec. Its chipping quality is equivalent, and because of its earlier maturity, Tobique can be harvested sooner than Kennebec, and thus avoids the low soil temperature in the fall that so often causes dark chip color. In addition, Tobique is quite resistant to Verticillium wilt, a disease that has limited Kennebec production in some areas. Tobique will be grown in association with chip manufacturers in Nova Scotia, New Brunswick, Quebec, and Ontario during the 1977 growing season.

It requires a minimum of 12, and usually 15 years, from the time a breeder makes a cross between two selected parents until a seedling from that cross can be introduced as a new variety. The parents of the new varieties of the early 1990's are being chosen today. Although the exact variety requirements of the '90s cannot be accurately predicted, we do know that high-yielding potential, good table and processing characteristics, and disease resistances will continue to be of importance. On occasion breeders may even anticipate a requirement. Although the golden nematode is not found in mainland Canada, there is a rare possibility that it might become established in our major potato-growing areas over the next 20 years. Already breeding for resistance to the golden nematode is being included in the breeding program, and Canadian varieties with resistance to this pest can be available in 5 years' time, hopefully before the nematode itself has become established.

During the period 1973-76, Canada exported yearly in excess of 2,000,000 cwt of seed potatoes. This is a significant quantity considering the value of these potatoes and the fact that it accounts for over 20% of the country's total seed potato production. In the fall of 1976, a joint venture between the Research Branch and the Canadian Seed Potato Export Agency (Potatoes Canada) saw Canadian varieties and seedlings tested for the first time on a systematic basis in 23 different countries in many parts of the world. The breeders hope to meet the challenge of this export market.

At the present time there are 49 varieties licensed for sale as seed potatoes in Canada. Probably only 8 of these can be considered as major varieties of national importance. The others meet the requirements of specific geographic areas, carry disease resistances for problem situations, and offer horticultural diversity that broadens the interest in the crop. This group of varieties, adapted to Canadian conditions, gives potato producers a proven resource from which to select when a change in variety is indicated by disease or market conditions. ■

SO YOU HAVE NEVER HEARD OF A 'BIONIC COW'

GLENN H. COULTER

Les éleveurs de boivins de boucherie n'ont pas pu profiter autant de l'insémination artificielle qui l'ont fait les producteurs laitiers à cause de la difficulté de détecter les vaches en chaleur dans les parcours. Les chercheurs de la Station de Lethbridge étudient la physiologie de l'oestrus et de l'ovulation chez les bovins par l'empoi d'instruments de radiotélémétrie qui permettront aux éleveurs de contrôler leurs troupeaux dans les pâturages libres et de compter moins sur le contact visuel ou physique.

Why has artificial insemination (AI) not been used extensively by Canada's beef industry? AI has resulted in tremendous gains in our dairy cattle. But only 5.4% of our national beef herd was bred artificially in 1976 compared to 53.5% of the dairy herd. The number of beef cows bred artificially in 1976 actually declined 116,051 from the previous year. The difference is a result of management systems. Dairy herds are usually confined to the barn or nearby pasture. Cows are closely observed for estrus.

Breeding of beef cattle is usually restricted to a 1- to 2-month interval after the cattle are on pasture. Cattle may range over hundreds of acres with little or no access to handling facilities. More labor is required to check for estrus, move the cattle to breeding shutes, and actually inseminate them. AI is often not economically feasible. The decline in use of AI in 1976 was probably due to cattlemen cutting costs because of the depressed beef industry.

Dr. Coulter is a reproductive physiologist at the Agriculture Canada Research Station, Lethbridge, Alberta.

A prototype ear-tag/transmitter used for monitoring brain temperatures in cows. The end of the wire is the sensor that is inserted into the ear canal.

Scientists are investigating two possible solutions to the high cost of using AI in beef cattle. One approach is synchronization of estrus, so that a group of cows will come into estrus at about the same time. This can be accomplished through the injection of drugs such as prostaglantin $F_{2\alpha}$ or its analogs, or the removal of progesterone-like implants. Rather than having to check each cow for estrus after synchronization, many scientists now recommend breeding at a specified time interval after the injection or withdrawal of synchronizing agents. These techniques have considerable potential but are not without their problems. Apparently a high level of nutritional management is required to obtain fertility comparable to breeding at natural estrus. Again, cost is a problem. Although a substantial reduction is expected, the present price of many synchronizing agents may discourage widespread use.

An alternative to synchronization is the development of automated, near labor-free devices to detect estrus. Scientists in a number of countries have now developed hand-held probes that measure the conductivity of vaginal secretions of cattle and other domestic species. These probes can accurately determine the onset of estrus whether or not the characteristic behavioral signs are exhibited. This type of instrumentation has potential in dairy and beef herds under confined housing conditions, but will be of little benefit to the rancher who needs assistance in estrus detection under range conditions.

At the Lethbridge Research Station, we are studying the physiology of estrus and ovulation in cattle. The results may eventually be applied to the development of totally automated methods for detecting estrus and ovulation electronically. This would permit cattlemen to monitor their herds 24 hours per day without close visual or physical contact. Experiments are being conducted using radio telemetry instrumentation designed and built under the Research Branch's Contract Program on Reproductive Physiology by Mr. H. A. Baldwin of Sensory Systems Laboratory, Edmonton, Alberta. Small radio transmitters with sensory probes are either placed surgically deep in the body to measure changes in reproductive organ temperature, or attached to the ear with a sensory probe running into the ear canal to measure brain temperature. The sensory probes can accurately measure changes in temperature as small as 0.01°C. Temperature information is transmitted continuously by radio signals to the laboratory where it is received, decoded, and recorded both in a graphic and digital form. From these data, it is expected that a change or sequence of changes in temperature will be identified that are specific to estrus and ovulation. Limited research already published on sheep and humans indicates some temperature changes are associated with the estrus and menstrual cycle of these species.

The author testing the signal from an ear-tag/transmitter.

If physiological parameters such as temperature are found to be reliable, more practical instrumentation for field use will be investigated using the principals of an electronic identification and temperature monitoring system previously developed by Mr. Baldwin. Such a system would use a Doppler radar transmitter-receiver similar to those used in traffic control as the base unit and the passive transmitter on the animal.

Although this research is in the preliminary stages and not yet directed towards the development of instrumentation for field use, it may not be too long before 'bionic cows' are commonplace. ■

PRODUCTION DE 3 VARIÉTÉS DE FRAISES PLANTÉES SUR BILLON ET À PLAT

R. DRAPEAU et F. DARISSE

The strawberry varieties Veestar, Redcoat and Guardsman have been planted during 3 years on a ridge of earth and on a flat bed to observe their respective yield. The ridge planting had no influence on yield, although on given years, cv. Redcoat and Guardsman have slightly outproduced the alternate method but not to a significant level. Veestar generally outyielded the other varieties in either methods.

Malgré le nombre impressionnant de publications sur la culture du fraisier, on retrouve pratiquement aucun travail précis sur la régie de la plantation. Le Ministère de l'Agriculture du Québec (1) décrit les travaux d'entretien d'une fraisière implantée et qui sont le binage après plantation, le billonnage et le paillage à l'automne. Le billonnage consiste à ramener le sol sur le rang de façon à obtenir une plate-bande bombée à la fin de la saison. Le meilleur système de plantation pour l'Est du Canada est celui de planter en rangs nattés (2).

Le but de ce travail était de vérifier si la plantation des fraisiers sur billon de 15 à 20 cm de hauteur pouvait contribuer à augmenter le rendement de trois variétés de fraises comparativement à un semis conventionnel sur terrain plat.

Matériel et méthodes Sur un limon argilo-sableux, on a effectué la plantation des variétés Veestar (hâtive), Redcoat (mi-saison), et Guardsman (tardive), pendant trois années consécutives selon un dispositif partagé ("Split-plot") en 4 répétitions. Les parcelles étaient formées de 1 rang de 4.57 mètres de longueur sur 0.45 mètre de largeur, et dans un écartement de 1.22 mètre. La moitié des parcelles ont été établies sur billon alors que l'autre moitié était établie sur terrain plat, dit plantation conventionnelle. Avant la plantation, une fumure de 672 kg/ha de 8-16-16 a été incorporée au sol par hersage. A la plantation, les racines des plants ont été trempées dans une solution de démarrage de formule 10-52-17. Une fumure azotée au taux de 84 kg/ha de NH_4 NO_3 a été appliquée à 5 et 10 semaines après la plantation. La protection contre les insectes et les maladies a été obtenue de la pulvérisation d'un produit insecticide-fongicide à intervalles de 10-12 jours. Un paillage a été fait sur toutes les parcelles pendant la première semaine de novembre à chaque année.

Résultats et discussions Les productions 1973-74 pour la plantation 1972 (figure 1) montrent qu'il n'y a pas de différence significative entre les deux méthodes culturales. La moyenne des variétés pour la production 1974 a été significativement supérieure à celle de 1973. On observe que Guardsman, en 2e année de production, a produit quelque 900 kg/ha de plus que lorsqu'elle était plantée sur billon. Veestar, indépendamment des modes de plantation, a fourni un rendement beaucoup plus élevé que Redcoat et Guardsman.

La moyenne des deux années de production pour la plantation 1973 (figure 1) indique une différence significative de rendement entre la plantation sur terrain plat comparativement à celle sur billon. La production obtenue en 1974 de la plantation 1973 a nettement surpassé celle de 1975.

Redcoat et Veestar ont fourni un rendement significativement plus élevé que Guardsman.

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TABLEAU 1 PROFIL CLIMATIQUE DES SAISONS DE VÉGÉTATION CONCERNÉES

Mois	Années	Température moyenne °C	Précipitation mm	Insolation (heures)	Jours pluvieux nombre	Unités thermiques °F
Mai	1973	8.6	84.3	134.2	17	182.0
	1974	5.2	154.9	110.7	17	70.5
	1975	11.5	58.4	259.9	10	332.5
	1976	9.0	115.3	168.0	18	142.5
Juin	1973	16.4	113.3	234.6	17	581.0
	1974	15.7	52.1	237.5	15	556.0
	1975	17.5	79.8	239.3	15	594.5
	1976	16.9	51.1	289.0	9	358.1
Juillet	1973	17.5	138.4	257.6	22	726.0
	1974	17.6	86.0	206.9	13	669.5
	1975	19.1	122.9	191.6	15	759.5
	1976	16.8	120.4	207.0	16	369.1
Août	1973	18.0	174.8	187.0	18	704.0
	1974	16.0	105.9	233.5	12	587 5
	1975	16.4	56.9	256.2	10	610.5
	1976	15.8	100.1	206.0	15	335.7
Septembre	1973	10.5	72.1	160.3	17	275.0
	1974	8.7	124.7	131.7	13	184.0
	1975	10.8	122.2	99.2	16	607.1
	1976	9.4	46.2	166.9	9	143 2

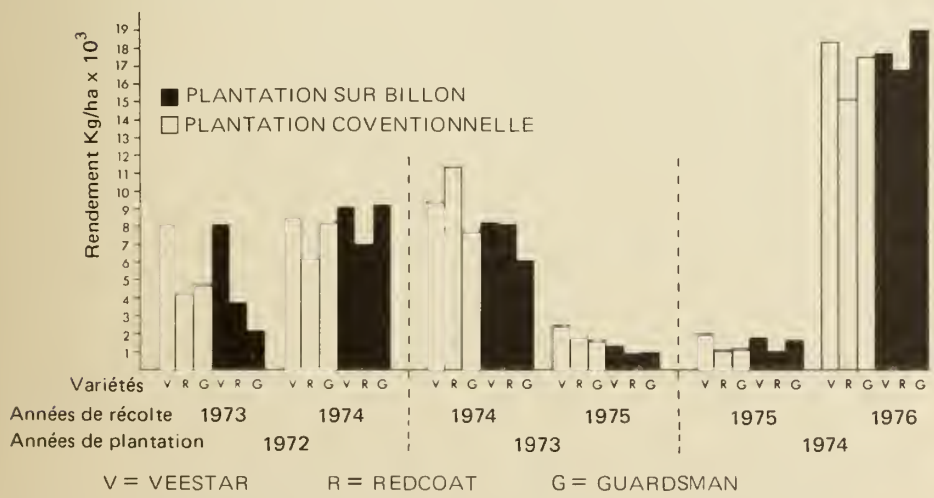

FIGURE 1. EFFET DE DEUX MODES DE PLANTATION SUR LE RENDEMENT DE TROIS VARIÉTÉS DE FRAISE.

Les rendements en 1975 pour la plantation 1974 (figure 1) sont du même ordre que ceux obtenus pour la plantation 1973 en cette même année. Cependant, la production de 1976 a été fortement supérieure à celle de 1975. La moyenne variétale nous indique aucune différence significative entre les modes de plantation. En 1975, la variété Guardsman a produit quelque 500 kg/ha de plus lorsqu'elle était plantée sur billon, alors qu'en 1976, les variétés Redcoat et Guardsman ont produit respectivement 1625 et 1457 kg/ha de plus en plantation sur billon, comparativement à la plantation classique.

La chute de rendement observée en 1975 est attribuable aux conditions climatiques défavorables à la production des fraises. En effet, au tableau 1 on constate que les mois de mai et juin 1975 ont été chauds et secs, avec respectivement 58,4 et 79,8 mm de pluie, 332,5 et 504,5 unités thermiques et une insolation respective de 259,9 et 239,3 heures; de plus, les températures moyennes ont été les plus élevées des 3 années de récolte avec respectivement 11,5, 17,5 et 19,1°C pour mai, juin et juillet. En 1976, le mois de mai a été pluvieux, totalisant 115,3 mm de pluie, suivi d'un mois de juin relativement sec et frais; ces conditions ont favorisé des rendements élevés.

Conclusion La plantation de fraisiers sur billon n'a pas favorisé une augmentation de rendement bien qu'à quelques occasions, la production de Redcoat et Guardsman ait été légèrement supérieure, sans être statistiquement différente. Par ailleurs, ce mode de plantation nécessite une préparation supplémentaire du terrain, ce qui augmente, le coût de production. ■

VALUE OF STRAW IN OVERWINTERING RATIONS

J. E. KNIPFEL

Les pailles de céréales peuvent être utilisées comme constituants majeurs du régime alimentaire des vaches ou des brebis pleines. Il est important que la ration soit faite sur la base des résultats des tests pour que les aliments contiennent les quantités de matières nutritives appropriées aux vaches et brebis. L'enlèvement de la paille des champs pour l'utiliser comme fourrage doit être accompagné de techniques de gestion destinées à conserver les propriétés du sol.

In Western Canada a huge reservoir of cereal straw accumulates following harvest each year. A number of proposals have been advanced regarding the use of this material as a feed for ruminants. In the drier portions of the Brown Soil Zone, such as Southwestern Saskatchewan, hay shortages are a frequent occurence as a result of insufficient precipitation, while cereal straw supplies appear to be more stable. Considerable use of cereal straw as a feedstuff for cattle and sheep has been made in this region, although in many instances rations based on straw have been nutritionally inadequate and have led to a variety of problems such as impaction of the forestomachs, pregnancy toxemia and specific nutritional deficiency diseases. A detailed knowledge of the potential of straw as a component of nutritionally adequate diets for the overwintering pregnant cow and ewe would be of great benefit in increasing the efficiency of utilization of cereal straw as a feed.

Any scheme which involves the removal of straw from croplands must be consistent with management practices which would maintain the condition of the soil. The proportion of straw which may be removed from cropland varies widely from area to area, and over much of the Brown Soil Zone the amount which can safely be removed may be very small. It must be borne in mind, nonetheless, that if an effort is made to return manure to the cropland, there needs to be no appreciable loss in soil organic matter, and in fact, there may be beneficial effects from crop residue removal and manure return. For example, if a maintenance diet for the overwintering cow contains 50% wheat straw, and the diet is 50% digestible, then for every unit of wheat straw removed from the land, an equal amount of manure should be available to put back on that land.

In Table 1 the compositions of feed and feces show that a slight decrease in the percentage of cellulose occurs upon passage of a straw based ration through an animal, while increases in the percentages of crude protein and phosphorus also occurred. The most important point to remember is that, particularly in the drier areas, if straw is to be removed from the land for animal feed, the manure must go back to the land.

A series of digestibility studies with pregnant ewes and cows have been carried out at the Swift Current Research Station over the past 4 years, to assess proportions of wheat straw which could be incorporated into diets for these animals, and the relative nutritive values of different types of cereal straws as ration components.

In Experiment 1 (Table 2), the inclusion of wheat straw (WS) in an alfalfa (A) diet decreased both Digestible Crude Protein (DCP) and Digestible Energy (DE) contents of the ration. Even when the A was diluted with 50% WS the DCP level remained well above suggested DCP requirements (National Research Council) for both the ewe and cow. The DE content of the diet was close to that suggested as a minimum requirement for the cow when 25% WS was added to A, while in the case of the ewe even 100% A was inadequate as a DE source during late pregnancy. This observation

TABLE 1 COMPOSITIONS OF FEED AND FECES FROM EWES FED STRAW BASED RATION.

	Feed	Feces
Crude Protein	8.0	9.4
Cellulose	34.4	32.8
Phosphorus	0.2	0.5

TABLE 2 CONTENTS OF DIGESTIBLE NUTRIENTS IN A VARIETY OF STRAW BASED DIETS FOR PREGNANT EWES AND COWS.

Ration	Experiment	DCP	DE
100A	1	13.4	2.46
75A + 25WS		10.4	2.35
50A + 50WS		6.9	2.02
50A + 50BG	2	10.3	2.65
20B + 20A + 60WS		5.7	2.36
20B + 40A + 40WS		10.3	2.56
20B + 60A + 20WS		11.8	2.77
30B + 70WS		3.9	2.22
20B + 20A + 60WS	3	4.2	2.33
20B + 20A + 60BS		6.0	2.31
20B + 20A + 60DS		5.0	2.31
20B + 20A + 60OS		3.9	2.15
20B + 20A + 60PS		4.3	2.44
50A + 50BG		7.9	2.43
NRC (1975) requirements[1] for ewe			
(1st 15 weeks pregnant)		4.9	2.40
(last 6 weeks pregnant)		5.2	2.60
NRC (1976) requirements[1] for cow		2.8	2.32

[1]Minimum concentration of nutritive diet

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supports the recommendation that ewes be fed grain during the last 6 weeks of pregnancy, as proposed by many investigators.

Since the DE adequacy of the roughage diets was marginal or deficient when WS was included, Experiment 2 attempted to assess the effect upon DCP and DE content of using 20% Barley (B) and varying the proportions of A and WS in the diet (Table 2). All diets containing B, A and WS were adequate in DCP for the duration of pregnancy in the cow and ewe, and in DE for the cow. For the ewe, a mixture of 20B + 20A + 60WS was marginal in DE during early pregnancy and likely deficient in DE content during the last 6 weeks of pregnancy. The control diet of 50A + 50 Bromegrass (BG) was exceptionally high in DE content in comparison to that observed in Experiment 1 for 100A or in Experiment 3 for 50A + 50BG. The use of 30% B and 70% WS as a diet resulted in deficiencies of both DCP and DE for both the cow and ewe, when compared to suggested requirements.

A significant number of producers in Southwestern Saskatchewan utilize rations similar to those of the 30B + 70WS ration, which may account for at least some of the management problems commonly encountered by practicing Veterinarians, such as impaction.

Experiment 2 suggested that WS could be included as a large component of rations for the beef cow or ewe. The next step in studying straw utilization was to compare a number of different types of straws. It has been generally accepted that Oat straw (OS) > Barley straw (BS) > Wheat straws nutritionally, however our results showed OS to be the lowest of all the straws tested in Experiment 3 (Table 2) for both DCP and DE. Wheat straw (WS), and Pitic 62 utility wheat straw (PS) were lower in DCP than BS or Durum straw (DS), however PS appeared to contain higher DE than the other straw based rations. With the exception of the OS containing diet, DE contents were equal to or greater than the suggested DE requirement for the cow (NRC, 1976), while only the PS and 50A + 50BG diets were adequate in DE for the ewe during early pregnancy. DCP contents were adequate for the cow on all diets apparently, although for the ewe the diets containing WS, OS or PS were deficient with DS close to minimum requirements.

These experiments indicate that straw may be used in diets for the pregnant cow or ewe at substantial levels. Greater usage of straw is likely possible in the diet of the pregnant cow than in that of the ewe since suggested requirements for the beef cow are lower than those of the ewe.

Variation in the nutritional quality of straw may be quite large among different cereals, as shown in Experiment 3 (Table 2). Considerable variation in straw quality may also occur within a particular type of straw, as evidenced by the variation in DCP contents of the diet containing 20B + 20A + 60WS between Experiments 2 and 3. These results emphasize the importance of feed testing when attempting to formulate rations for the pregnant cow or ewe.

In summary, cereal straws may be used as a major component of the diet of the pregnant cow or ewe. It is essential that the ration be formulated on the basis of feed testing information to provide adequate levels of nutrients for the cow or ewe. The removal of straw from cropland for use as an animal feed must be coupled with management practices which will ensure maintenance of the soil condition.

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WHAT MAKES A GOOD SOIL INSECTICIDE?

K. S. McKINLAY and
R. E. UNDERWOOD

Depuis les restrictions apportées à l'utilisation des hydrocarbures chlorés, il reste peu de bons insecticides du sol. Des recherches sont nécessaires pour mettre au point de nouveaux matériaux de lutte contre les taupins et les rhizophages. Les travaux effectués à Saskatoon laissent supposer que les chercheurs ont des méthodes de laboratoire valables pour un examen rapide des possibilités des insecticides du sol qui puisse donner un réelle indication de leur efficacité en culture et permettre d'expliquer pourquoi certains composés sont efficaces et d'autres pas.

Wireworm larva boring its way into a potato These soil inhabiting insects can also cause serious damage by feeding on the roots of cereals.

The chlorinated hydrocarbon insecticides, such as lindane, aldrin, and heptachlor, were very effective in controlling wireworms or root maggots in the soil, either as seed dressings or as soil treatments. However, they were extremely persistent and gave rise to problems such as residues in crops or contamination of the environment.

As a consequence, the number of insecticides available for the control of insect pests in soil is limited. For example, only Dyfonate and chlordane are available for the control of wireworm in potatoes and only lindane as a seed dressing on cereals. It is therefore urgent to find new compounds for this use. There are two main requirements for research. Firstly, one needs a method for testing large numbers of insecticides quickly and cheaply. Secondly, if the tests are to be informative, the test must assess those characteristics of insecticides that are likely to make them effective in soil.

To get tests done in a reasonable time, large numbers of insects are required daily over a long period. And actual pests are difficult to rear in large numbers so, at Saskatoon, we use the fruit fly, *Drosophila melanogaster*, for test purposes. Hundreds of these can be reared in a single Mason jar, mainly on canned pumpkin. The life cycle is about 12 days.

The design of a laboratory test depends on your assumptions about the way soil insecticides work. We assumed that soil insecticides volatilise, spread through the soil as toxic vapor and, entering the insects with the air they breathe, kill them. Several things follow from this assumption. The insecticide must be sufficiently volatile to produce a toxic vapor but not so volatile that it is lost from the soil too rapidly to be effective. In addition, the insecticide in vapor form should not be absorbed too rapidly or destroyed by the soil. We use *Drosophila* to obtain relative measurements of volatility and soil penetration.

To measure the combined effects of inherent toxicity and volatility, measured amounts of insecticide are placed on the bottom of 3 in. x

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1 in. glass tubes and covered with a layer of cotton wool to prevent the insects coming into direct contact with the insecticide. Approximately 20 adult *Drosophila* are placed in each tube and the tube is closed with a foil-covered cork. A small dab of canned pumpkin is placed on each cork to serve as a food supply. The insects are held in a cabinet at 70°F for 24 hours before counting live and dead insects. In another set of tubes, the insecticide on the bottom is covered with ¼ in. of sieved, air-dried soil before covering with cotton wool. Movement of the insecticide vapor through soil is measured.

A range of dosages is used so that kill may be plotted on a graph against dosage, and the amount of insecticide needed to kill 50% of the test insects, the LD_{50}, calculated.

Table 1 shows the results of some of the tests which have been done so far.

It will be seen from Table 1 that aldrin vapor was about 7½ times as toxic as lindane in the absence of soil. However, when they had to pass through a layer of soil it was necessary to use equal amounts of each, 125 μgm active ingredient/tube, in order to obtain a 50% kill.

TABLE 1 VAPOR TOXICITY OF SEVERAL INSECTICIDES AND THE ABILITY OF THE INSECTICIDE VAPOR TO PENETRATE A LAYER OF SOIL.

	LD_{50}, μgm active ingredient/tube		
Insecticide	A. Without soil	B. With soil	B/A Ratio Ratio B/A
Aldrin	0.061	125	2049
Lindane	0.46	116	252
Dyfonate	0.18	360	2000
Diazinon	0.43	800	1860
Bay 92114	475	2100	4.4
GCA 12223	0.19	1000	5181

The adult flies are attracted by light and this makes it easy to move them from one container to another. Adult flies are moved from the rearing jars to holding jars every day and used when 24-48 hours old. Approximately 20 flies are put in each treatment tube.

Tube 1. Known amounts of insecticide are deposited on the bottoms of 3 in. x 1 in. tubes and covered with cotton wool in order to assess the insecticide's ability to volatilise and kill the insects as a vapor. *Tube 2.* Other tubes are prepared in the same way but the insecticide is covered with a layer of soil. This treatment is made to assess the ability of the insecticide vapor to move through the soil without being absorbed or detoxified by the soil. Tubes 3 and 4 are untreated checks.

This suggests that aldrin is absorbed by soil more than lindane. This is shown clearly by the ratios of quantity needed with soil, and without, 252 in the case of lindane and 2049 for aldrin.

In field trials, Dyfonate has been shown to control soil insects, but not as effectively as aldrin or lindane. Laboratory results indicate the same. The LD_{50} for Dyfonate with soil is 360 μgm/tube compared with only 125 for aldrin or lindane, indicating the inability of Dyfonate to penetrate soil. Without soil, Dyfonate was two to three times more toxic than lindane.

Diazinon was even more affected by soil. It was as effective as lindane in the absence of soil but the amount needed to penetrate the ¼ in. soil layer was nearly 8 times as much. A new compound being tested, Bay 92114, penetrated the soil very rapidly, ratio of soil to cotton wool 4.4, but had a very low vapor toxicity, LD_{50} 475 μgm/tube with cotton wool alone. By contrast, another new compound, GCA 12223, was as toxic as Dyfonate when covered with cotton wool only but was extremely poor at penetrating soil, LD_{50} with soil 1000 μgm/tube compared to 360 μgm/tube for Dyfonate and 116 μgm/tube for lindane. Diazinon was as toxic as lindane in the absence of soil but 800 μgm per tube had to be used to give a 50% kill through a soil layer whereas only 125 μgm of lindane per tube was needed. Diazinon has been found to be ineffective as a soil insecticide under field conditions.

The LD_{50}s for insecticides known to be effective soil insecticides under field conditions, aldrin, lindane and Dyfonate, were less than 400 μgm/tube with soil under the conditions of this test. Diazinon with

a soil LD_{50} of 800 μgm/tube has been shown to be ineffective in the soil. Thus present results suggest that we have a valid laboratory method for the rapid screening of potential soil insecticides that not only give a true indication of field performance but also suggests why some compounds are effective in the field and others not. ■

A small dab of pumpkin is placed on each cork to provide food for the test insects. Counts of living and dead insects are made 24 hours after commencing treatment.

The fruit fly, *Drosophila melanogaster*, is a very convenient insect for laboratory studies because a complete life cycle takes only 10 to 12 days. Hundreds may be raised in a single Mason jar on a diet consisting mainly of canned pumpkin.

WEATHER-BASED SELECTION OF TRACTOR SIZES

J. A. DYER and W. BAIER

Les agrométéorologistes d'Agriculture Canada ont créé une technique de simulation informatisée utilisant les estimations journalières de l'humidité du sol, et destinée à l'étude, au cours des années, de la fréquence des jours de printemps durant lesquels le tracteur peut servir dans les champs.

Today's successful farmer must be able to take advantage of a rapidly increasing agricultural technology. The most dramatic example of this is the selection of farm machinery. Although tractors are put to many uses on a farm, purchasing the correct size is most important in spring planting. Often very large tractors are necessary to complete planting as early as possible to make the best use of the growing season.

A knowledge of the risk of soil and climatic factors interacting to limit field work time is critical in tractor selection. This article demonstrates the use of weather-based estimates of field workday probabilities through computer simulation of farm situations.

Field Work Time The time available for doing field work in spring depends on tractability, which is the ability of the soil to support machinery. Researchers have found that when plant available water has been depleted by 5% to 10% in the top 3 to 4 inches, the soil is firm enough to support most farm machinery traffic.

The soil moisture content at different soil depths can be estimated

from climatological data. A computer simulation technique using these daily soil moisture estimates for studying the year to year occurrence of spring days with adequate tractability for field work has been developed by agrometeorologists of Agriculture Canada*. Workday estimates given in Table 1 illustrate expectations of workdays for 3 sites, for light and heavy soils and for probability levels of 50% to 80%. Caution should be used in reading these values, as they are based on simulated conditions for wide soil texture ranges.

Horse Power Selection Agencies such as Canfarm use computer packages designed to aid farmers, on an individual farm basis, to select the horse power levels which best suit their particular needs. A simple version of such a model is used here to demonstrate how farm size, regional geographical factors such as soil type, stoniness and topography, as well as climate affect the power level needed to complete timely planting.

This model considers plowing, discing and seeding during spring. Horse power is computed from the width of each implement required to work the specified acreage in the time available at speeds of 4 to 6 mph. The model can give horse power ratings for each one or pair of the three operations as if a tractor were available for each job. Its main feature however, is its ability to minimize the power needs for all three operations together, assuming only one tractor to be available. The lowest horse power possible is chosen by making optimum use of the work time available through a time budgeting procedure. Work time is assigned to each operation from the total work time available by the computer in different combinations until the one which requires the least power is found. This combination is also the one which brings all three horse powers as near as possible to being equal.

Table 2 gives some supporting data for three representative runs of the program in which 8, 12 and 16 spring workdays are assumed. A typical eastern Canadian farm is considered with 100 acres, relatively stone free, medium textured soil and flat topography. The farm is assumed to be a one tractor operation.

Figure 1 shows the optimum horse power levels which result when the model is applied to the Belleville region, using workday numbers given in Table 1. A typical farm from an upland area with sandy textured, moderately rocky soil and rolling topography, and a typical lowlands farm with stone free, clay soil and flat topography were as-

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TABLE 1 NUMBER OF WORKDAYS AVAILABLE IN SPRING WHICH CAN BE EXPECTED NO LATER THAN THE DATES SPECIFIED AT THE PROBABILITY LEVELS INDICATED.

	New Westminster, B.C.		Belleville, Ont.		Kentville, N.S.	
	50%	80%	50%	80%	50%	80%
May 12						
Heavy Soil	8	0	11	5	5	0
Light Soil	23	16	23	19	20	15
May 19						
Heavy Soil	12	3	14	7	9	2
Light Soil	28	22	28	23	24	19
May 26						
Heavy Soil	18	7	20	9	14	5
Light Soil	34	27	33	29	30	24

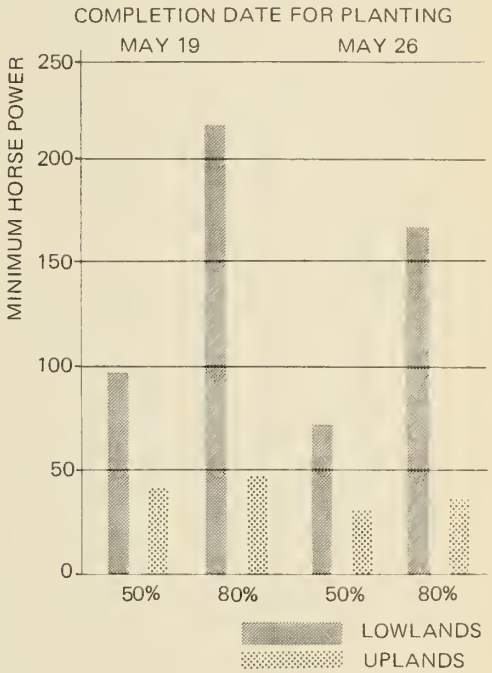
The analysis was based on 45 years of weather records stored in the Agrometeorology Data Bank.

TABLE 2 OUTPUT FROM THE TRACTOR SIZING MODEL GIVING IMPLEMENT WIDTHS, TIME USED IN EACH OPERATION AND THE MINIMUM HORSE POWER (HP) REQUIRED BY EACH MACHINERY COMPLEMENT BASED ON AN EIGHT HOUR WORKDAY.

hp	Total days	Plow (mold board)	Disc Seeder		
		5 bottoms*	13 ft	14 ft	widths
80	8	4	2	2	days
		3 bottoms*	10 ft	9 ft	widths
48	12	6.5	2.5	3	days
		2 bottoms*	7 ft	6 ft	widths
32	16	8	3.5	4.5	days

* 16 inch plow bottom width and 8 inch plowing depth are assumed.

OPTIMUM TRACTOR SIZES, BY HORSE POWER RATINGS FOR A ONE TRACTOR FARM, BASED ON PLOWING, DISCING AND SEEDING IN SPRING FOR THE BELLEVILLE, ONTARIO AREA.



sumed. In both cases 200 acres were worked.

Figure 1 demonstrates that in order to be assured of timely planting during most years (80%) rather than just the average years (50%), appreciably more pulling power is required. An earlier completion date for planting also means higher power requirements. The results show soil type to be the most important factor, affecting both the work time available, and the power needed to pull implements.

Actual use of this model by farmers should involve a professional farm planning consultant since all practical aspects of planting machinery requirements could not be considered here. For instance, no machine break-down time is allowed for. It also assumes that the user can select the correct level of certainty on which to base his farm plan. The power minimizing procedure requires that the optimized widths and the allotment of work time will be adhered to. However, whether workday estimates like those in Table 1 are used in conjunction with computer models or directly by agricultural extension workers, this study does illustrate the importance of these data and provides some guidelines for their use. ■

EARLY WEANING OF DAIRY CALVES

K. A. WINTER

Les recherches effectuées sur les veaux au cours de la dernière décennie ont montré qu'il était possible de les sevrer des aliments liquides plus tôt qu'on ne le pensait auparavant. Les veaux sevrés à 3 semaines et à qui on donne du colostrum fermeté, peuvent passer aux aliments solides sans lait entier vendable ni aliment d'allaitement coûteux, ou très peu.

The first 2-3 months are said to be the most critical period of a calf's life. Proof of this lies in the mortality rate at this time. Some herds may suffer losses of ⅓ to ½ of their calves during early calfhood and in many cases this is a result of inadequate feeding and management practices. This article presents alternate feeding and management practices which may be useful in some situations and suggest that the basis of some of our current calf management concepts are not valid.

Research during the last decade has shown that weaning calves off liquid feeds may take place at much earlier ages than previously thought possible. Early weaning, 5 weeks of age or less, may provide several benefits. Firstly, expensive liquid feeds such as whole milk and milk replacer are replaced with less costly grain-based calf starter mixtures. Secondly, the problem of digestive scours caused by overfeeding of liquids may be reduced by switching to dry feeds at an earlier age. Thirdly, dry feeding of calves is less labor consuming. Feeding utensils do not require washing and sanitizing after each feeding and there is no measuring and mixing as with milk replacer.

Early weaning, 5 weeks of age or less, may provide several benefits.

The older concept that liquid feeding was necessary for 8-10 weeks appears to be based on the theory that there was no significant development of rumen function until the calf was about 12 weeks old. However, researchers have shown that rumen fermentation may commence as early as one week when calves are exposed to dry feed. Work at this Station has shown that

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calves weaned onto dry feed at 5 weeks of age were able to utilize urea nitrogen as the only source of supplementary protein in calf starter ration. This indicates an active rumen fermentation in these calves at 5 weeks of age.

In the course of several studies with calves weaned at 5 weeks of age, it was observed that some calves ate appreciable amounts of calf starter ration during the milk feeding period. These aggressive eaters usually started eating dry feed at an early age and a few actually refused milk at about 4 weeks of age. Because a few calves showed this ability to adapt to dry feed at an early age, several studies were conducted to determine at what age all calves could be safely weaned onto dry feed.

In our first experiment Ayrshire calves were weaned at 2, 3 and 5 weeks of age. No marked differences in rate of growth were observed as a result of weaning at 2, 3 or 5 weeks of age. There was little or no setback from the abrupt weaning at 2 or 3 vs. 5 weeks and similar growth performance was noted up to 12 weeks of age. Probably, the most significant observation was that one calf weaned at 2 weeks of age refused to eat dry feed and had to be returned to milk feeding in order to survive. Similarly, in another trial with Holstein bull calves weaned at 2 weeks of age, several calves did not adapt to dry feed at 2 weeks of age and had to be returned to milk feeding.

In a third experiment with Holstein and Ayrshire calves, weaning ages of 17, 21, 24, 28 and 35 days were compared. Again, little difference was observed in animal performance between the weaning age treatments. There was no marked effect on the growth curve immediately after weaning and appreciable feed consumption was initiated within 1 to 2 days after weaning. A problem was encountered with several calves weaned at 17 days of age that refused to consume dry feed, but not at 3 weeks or older. The feeding of fermented colostrum and whole milk were compared as well in this experiment and identical calf performance was observed with the two liquid feeding treatments.

In these experiments mortality which occurred during the first 7-10 days after early weaning generally was associated with the weaning of calves while afflicted with scours or other calfhood illness. It appears that the calf which is not in good health is less able to cope with the stress of early (3 week) weaning. In the case of a calf afflicted with some calfhood problem it appears unwise to wean at 3 weeks but rather to retain the animal on liquid feed until the calf is in good health.

These experiments have demonstrated several points in calf rearing which are not entirely in agreement with present recommendations. It is apparent that calves may be weaned successfully onto dry feed as early as 3 weeks of age. In case of aggressive eaters of dry feed they may be weaned as early as 2 weeks of age. Abrupt weaning does not appear to have a deleterious effect on the calves even when weaned at 3 weeks of age. There is little or no setback when healthy calves are weaned at this age. Calves which consumed very little calf starter up to 3 weeks of age were observed to consume adequate amounts in the week after weaning so they suffered little or no setback in growth.

It was concluded that 3-week weaning can offer a useful alternative in early calfhood rearing when for economic reasons or labor shortage a dairyman does not wish to continue liquid feeding. Such early weaning would appear to combine well with the feeding of fermented colostrum. In many cases the dam produces enough colostrum and milk during the first 6-8 milkings to carry the calf for 3-4 weeks. The calf is then weaned onto dry feed with little or no feeding of saleable whole milk or expensive milk replacer. These calves can be moved at an earlier age out of the individual pens recommended for housing young calves into less costly group housing facilities.

In conjunction with the adoption of early weaning, dairymen may be persuaded to provide a better plane of nutrition beyond the first several months of the calf's life. Veterinarians and dairy extension specialists still indicate that "empty belly disease" and nutritional deficiencies are found all too frequently in young dairy calves and that calf rearing is the weakest phase of many dairy operations. If replacement heifers are to be brought into production at 24 months of age, a healthy well grown calf is essential. Through this new approach to early calfhood feeding the producer may be more receptive to an improved feeding and management program during the first year of the calf's life. ■

AGROCLIMATIC ATLAS

S. K. O'HARA

Un Atlas agroclimatique du Canada conçu par la Section d'agrométéorologie de l'Institut de recherches biologiques et chimiques est distribué par les services d'information d'Agriculture Canada à Ottawa. Des cartes en couleur y montrent la répartition des données calculées relatives aux facteurs climatiques et autres qui présentent une certaine importance pour l'agriculture canadienne.

Janet Cummings, cartographic draftswoman, Cartography Section, Soil Research Institute, scribing lines on an agrometeorological map.

A recently published Agroclimatic Atlas of Canada was prepared by the Agrometeorology Section of the Chemistry and Biology Research Institute, Agriculture Canada. The colored maps show the distribution of derived data concerning climatological and other factors important to Canadian agriculture. The "derived data" are indices obtained from techniques developed earlier for interpreting the effects of weather and climate on plants and soils.

The techniques used to obtain the soil data were developed by staff members of the Agrometeorology Section. The information on the maps is unique because the Canada-wide distributions that are presented are not available elsewhere. They are intended to supplement traditional climatic maps.

The first two series of maps deal with soil moisture and air temperature on a probability basis. As indicated by the 1:5,000,000 scale, the maps provide an overview for all Canada and will be useful when comparisons of general conditions over relatively large areas are undertaken. The Atlas should be of value to federal and provincial planning agencies dealing with the effect of weather and climate on crops and soil.

International agencies dealing with the global assessment of resources will find the Atlas useful. The Atlas is not designed to pinpoint the situation at a specific location but to give the areal value for each parameter discussed.

Seven hundred localities with an observation period sufficient to establish long-term averages make up the data base for the maps. Numbers on the maps show the stations where data was collected. These localities are identified and the procedures described in Technical Bulletin 81, Agrometeorology Research and Service Section.

The techniques used in the preparation of the first 17 maps were developed during the 1960's and applied to the climatological normals for 1931-60. Later studies have shown that the normals for 1941-70 do not differ significantly from those for a decade earlier. The difference did not warrant redoing the calculations with the climatological data for 1941-70.

Each map has its own text and reference and is independent of the rest of the Atlas. The maps can be detached if desired. The Atlas has been designed as a continuing project. The numbering on the maps and the binding were designed so that additions can be made to any section. New sections can be added as techniques for deriving data are

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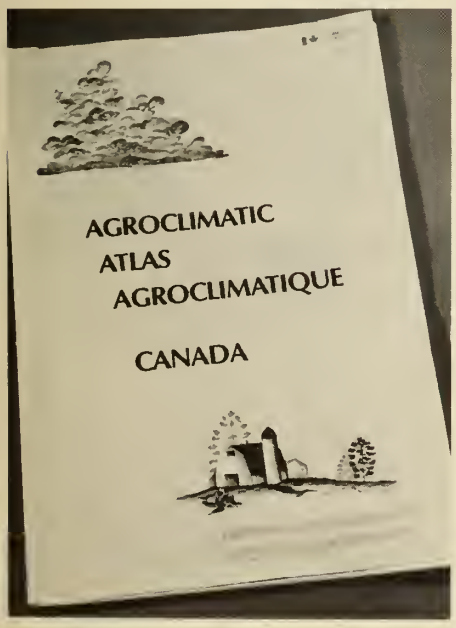
W. K. Sly (left) and Dr. W. Baier of the Agrometeorology Research and Service Section examine the atlas. Mr. Sly prepared the maps for the atlas and Dr. Baier planned and coordinated the project.



Agriculture Canada's new Agroclimatic Atlas measures 25 in. x 18 in. and contains 17 colored maps of derived climatological data.

developed and their application on a countrywide scale becomes warranted.

Because the maps for the Atlas are based on newly-determined derived data, they are not duplications of maps available elsewhere. The information they provide supplements that given by maps of observed climatic data. Maps of the latter type have been prepared, on numerous occasions for various areas and at various map scales and projections.

The Cartography Section of the Soil Research Institute of Agriculture Canada is responsible for the design and cartographic preparation of the Atlas. The Directorate of Map Production, Surveys and Mapping Branch, Department of Energy, Mines and Resources did the lithography. The Agroclimatic Atlas is available on request from the Information Division, Agriculture Canada, Ottawa.

Distribution maps showing the following information appear in the Atlas:

1.1 Annual potential evapotranspiration, 50% probability.
1.2 Seasonal potential evapotranspiration, 50% probability.
1.3 Seasonal water deficits, 50% probability.
100 mm (3.9 in.) storage; consumptive use, factor, 1.00
1.4 Seasonal water deficits, 10% probability.
100 mm (3.9 in.) storage; consumptive use factor, 1.00
1.5 Seasonal water deficits, 50% probability.
25 mm (0.98 in.) storage; consumptive use factor, 1.00
1.6 Seasonal water deficits, 10% probability.
25 mm (0.98 in.) storage; consumptive use factor, 1.00
1.7 Climatic moisture indices.
2.1 Average dates of last spring freeze of 0°C (32°F), derived data.
2.2 Average dates of first fall freeze of 0°C (32°F), derived data.
2.3 Average freeze-free period, 0°C (32°F) base, derived data.
2.4 Dates of last spring freeze of 0°C (32°F), 10% probability, derived data.
2.5 Dates of first fall freeze of 0°C (32°F), 10% probability, derived data.
2.6 Average dates of last spring freeze of −2°C (28°F), derived data.
2.7 Average dates of first fall freeze of −2°C (28°F), derived data.
2.8 Average freeze-free period, −2°C (28°F) base, derived data.
2.9 Dates of last spring freeze of −2°C (28°F), 10% probability, derived data.
2.10 Dates of the first fall freeze −2°C (28°F), 10% probability, derived data. ■

ERADICATION OF RUBUS VIRUSES

FRANCES C. MELLOR and
RICHARD STACE-SMITH

Le virus est envahissant et lorsque des cultures comme les framboisiers ou les ronces communes sont reproduites végétativement, il se transmet aux nouveaux plants. Pour prolonger la vie productive des cultures de longue durée telles que les framboisiers, il faut établir la plantation avec des plants exempts de virus. Deux techniques sont utilisées pour éliminer les virus des framboisiers: le traitement thermique et les boutures méristématiques.

All plants are susceptible to infection by viruses, often introduced by aphids or other insect vectors. The virus becomes systemic in the plant and when the crop is vegetatively propagated, like raspberry and brambles, the virus is carried along in all the plants arising from suckers or rooted tips.

Some viruses cause distinct symptoms so that infected plants are easily detected and discarded. Others, however, cause no obvious symptoms although they often decrease vigor and productivity. These are known as latent viruses and they are common in raspberry and blackberry cultivars. They are usually detected by transmission to sensitive indicator plants such as cucumber and *Chenopodium quinoa* for sap transmissible viruses, and black raspberry seedlings for the aphid-transmitted viruses. If a second virus is introduced into a plant that carries a latent virus, it may cause symptoms, or it too may remain symtomless, but hasten the decline of the plant. Multiple virus infections are often responsible for the "running out" of a previously valuable cultivar.

Miss Mellor and Dr. Stace-Smith are plant virologists at the Agriculture Canada Research Station, Vancouver, B.C.

To prolong the productive life of long-lived crops like Rubus species it is essential to start with virus-free planting stock. Developing such virus-free material involves eliminating one or more viruses from cultivars that are completely infected.

Two techniques are commonly used to eliminate viruses from infected plants: heat treatment and meristem culture. A few viruses are so heat-labile that an infected plant can be completely cured by subjecting it to about 37 C for 1 or 2 weeks. Of the viruses that infect Rubus species, only black raspberry necrosis virus can be completely eradicated by simple heat treatment. The second technique, meristem culture, exploits the fact that viruses sometimes do not survive in the tip excised from an infected plant, and a plant developed from the meristem (growing point of the shoot) may be virus-free. For meristem culture, tips less than 1 mm long are aseptically removed from the infected plant, and incubated in an artificial medium until shoot and roots develop.

By this method virus-free plants of many species have been developed, but culture techniques and media have not yet been devised for successful nutrient culture of meristems of Rubus species. Even loganberry and blackberry, whose tips root so readily in the field, respond very poorly to culture in artificial media, and development of plantlets in culture is rare.

Virus-free plants can be developed from infected Rubus by combining the two techniques. After a prolonged period at 35-40 C, shoot cuttings much larger than those used for meristem culture may be virus-free and these can be propagated by dusting them with rooting hormone and planting them in damp sand until roots appear.

Young, vigorous plants are the most suitable for heat treatment and subsequent propagation, preferably rooted cuttings 2 to 3 months after planting in 10 cm peat pots of friable soil. The porous nature of peat pots provides good drainage, aeration of the soil, and evaporation with consequent cooling of the soil, all of which contribute to the longevity of plants at high temperature.

The temperatures and duration of heat treatment vary; success depends on striking a balance between the heat tolerance of plant and virus. There is considerable variation in heat tolerance, even between cultivars of a single species, but

A 9 cm pot of sand accommodates 16-20 small raspberry cuttings.

Raspberry cuttings, 2, 5 and 9 weeks after planting in soil.

those that fail to survive at 37-40 C for a period sufficient for virus elimination can usually be treated successfully either by subjecting them to longer periods at 35 C, or acclimatizing them to high temperatures by first growing them at 35 C for several weeks before subjecting them to the higher temperature.

Viruses vary even more than the plants in their heat tolerance. Black raspberry necrosis virus is usually eradicated completely after 10-14 days at 37 C while raspberry bushy dwarf virus is eliminated from the smallest cuttings only after 2 months or more at 37 C or above.

The brambles are easily propagated from cuttings. During heat treatment, new shoots become progressively more slender, internodes very short, leaves small and simplified. After prolonged treatment, a 6 mm shoot tip may provide up to 12 nodal cuttings. To minimize the chance of including virus-infected tissue in the cutting, the smallest possible cutting is propagated. Each consists of a shallow, longitudinal, elliptical slice of the stem, 3-5 mm long, with a dormant axillary bud and one leaf from which most of the blade has been removed. The percentage rooting of such cuttings is good, sometimes 100%. The proportion of resulting plants that are virus-free depends on the duration of the heat treatment and the heat sensitivity of the virus. Cuttings taken from near the shoot tip usually root sooner than those from older nodes, and, with some viruses, are more apt to be virus-free. By this method viruses have been eliminated from loganberry, blackberry, boysenberry and Youngberry.

The same method serves to eliminate viruses from infected raspberry although, ordinarily, raspberries are difficult to propagate from shoot cuttings. As with the brambles, the growth habit of raspberry changes during heat treatment. Axillary growth becomes profuse; new shoots become progressively more slender, with very short internodes; and leaves become very small, and often simplified. Cuttings taken during heat treatment may consists of 1-2 mm of the stem tip with two or three folded leaves, or nodal cuttings similar to those from the brambles. After prolonged treatment the nodal cuttings can be exceedingly small and yet include the leaf and dormant axillary bud that are requisite for survival and growth. Moreover, cuttings taken from plants during heat treatment root much more readily than comparable cuttings from non-treated plants.

Up to 90% of the cuttings taken from raspberry plants grown at 37-40 C for 4 weeks or more develop into rooted plants. The proportion of virus-free plants among the survivors varies with the virus, but 2 or 3 months heat treatment is sufficient to eliminate even the most heat tolerant viruses from the majority of the cuttings. ■

ECHOES FROM THE FIELD AND LAB

ECHOS DES LABOS ET D'AILLEURS

ONTARIO BOARS In trials conducted at Stirling, Scotland, the progeny of five Yorkshire boars from the Ontario Swine A.I. Association Stud in Woodstock were compared with the progeny of 12 selected Large White (Yorkshire) boars from British A.I. boar studs.

Under uniform feeding and housing conditions, the Ontario boars did slightly better than their British brothers in almost every category, especially backfat thickness.

The Ontario boars' progeny did especially well when fed ad lib (full fed). The Ontario A.I. boars were bred to Large White x Landrace sows, using frozen semen. The British Large White boars were bred to a similar group of dams, using fresh semen.

WINDBREAKS DYING Whole windbreaks of Plains Cottonwood trees are dying in the irrigated areas around Lethbridge. The relatively short-lived trees were planted 70 years ago when Dr. W. H. Fairfield of Agriculture Canada's then Lethbridge Experimental Farm, now Research Station, encouraged the planting of trees around farmsteads and fields.

Imported nursery stock was not dependably winterhardy, so a native species, the Plains Cottonwood, was transplanted from riverbottoms of the region.

The problem now is that the dead or dying trees are not being replaced.

PIÉGEAGE D'INSECTES DANS LES VERGERS La culture des pommes demande déjà un si grand nombre de pulvérisations contre la travelure, qu'il faut éviter d'en faire d'inutiles contre les insectes. Certains d'entre eux ont d'ailleurs des cycles qui varient au cours de la saison.

Afin de dresser un inventaire des populations de certains de ces insectes, une équipe de chercheurs de la Station de Saint-Jean place depuis quelques années des pièges à insectes dans une dizaine de vergers de la région de Montréal.

Ces pièges contiennent une phéromone sexuelle synthétique qui attire les insectes d'une espèce déterminée. Il ne reste alors aux scientifiques qu'à dénombrer les insectes de chaque espèce et à évaluer leurs populations.

Si les pommiers sont en danger, on recommande alors aux pomiculteurs d'appliquer un insecticide.

Ces mesures de contrôle s'étendent du début du printemps à la fin septembre. Les espèces piégées sont la mouche de la pomme, la pyrale de la pomme, la tordeuse du pommier, la tordeuse à bandes obliques, la tordeuse à bandes rouges et le petit carpocapse de la pomme.

En plus de fournir de précieuses informations sur le cycle vital de ces espèces, cette technique permet d'éviter les traitements superflus qui détruisent les insectes utiles. C'est donc une solution écologique et économique aux problèmes causés par ces ravageurs.

FIRST BOAR Alberta Agriculture has purchased its first boar for the provincial artificial insemination (AI) unit at Leduc. The animal is a Lacombe boar and was purchased at the monthly record of performance (ROP) sale at the new ROP test station near Nisku from Jurgen Preugschas of Mayerthorpe for $825. The boar has an index of 133 and a backfat depth of 19.9 mm. His average daily gain while on test was 1.13 kg and his feed conversion rate was 2.4 kg feed per kg of gain. Alfred Wahl, assistant supervisor of swine breeding with Alberta Agriculture, says the boar has excellent conformation, good depth and exceptionally strong legs. It is expected that the AI centre, which is almost completed, will have 20 boars, representing the Yorkshire, Lacombe, Duroc, Landrace and Hampshire breeds, when it is in full operation in late 1978.

LA PRODUCTION DE CONCOMBRE Le recouvrement du terrain avec un film clair de polyéthylène 0.004 mm a permis d'obtenir un rendement supérieur à un semis sur terrain nu, au cours d'un essai d'une durée de 4 ans. L'efficacité du paillage du terrain a varié avec les conditions annuelles de production et s'est traduit par des hausses de rendement allant de 1,8 à 78%. Cependant, le traitement n'a pas permis une pérode de récolte plus longue. La dimension des concombres n'a pas été influencée par le paillis apporté.

GREENING OF ESTEVAN The barren wilderness resulting from strip-mining for coal in the Estevan area of Saskatchewan is beginning to show signs of life. As a result of a joint project by Agriculture Canada's Swift Current Research Station and the Saskatchewan Power Corporation, trees and wildlife are filtering back into the area.

The soil in the mining area was almost inert because, as soil was scooped up to expose the coal, the topsoil ended up in a pile beneath near-sterile subsoil.

To reclaim the land, the Corporation levelled the peaks of the piles of soil. Scientists at the Research Station recommended planting streambank wheatgrass and what fertilizer to apply. Seeding began in 1972.

Grasses and forage crops now are thriving as are some crops and trees. Water has filled the valleys and small lakes have been stocked with trout.

The Corporation has reclaimed about 700 acres of mined land in the past six years, and has accelerated its program to reclaim about 400 acres per year.

SECONDARY ELEMENT Decreased sulphur content in many commercial fertilizers may eventually cause sulphur deficiency and decreased yields in Quebec and some other parts of Canada where the soils are naturally low in sulphur.

Scientists at Agriculture Canada's Research Station at Ste-Foy, Que., are cultivating alfalfa and barley in two soil types found in Quebec farming areas. The researchers are adding sulphur-enriched fertilizers to the soils.

Generally speaking, the sulphur has increased yields in the tests and has improved the ability of the plants to use nitrogen, potassium and phosphorous provided by commercial fertilizers.

CHEESE PRODUCTION Canadian cheesemakers are stepping up their production of specialty cheeses to meet a growing demand for these non-cheddar varieties.

Last year they produced 105 million pounds of specialty cheeses, up 16 per cent from the 1975 level. The 64 different kinds of cheeses ranged from soft camemberts to pungent limburgers, with mozzarella accounting for more than half the total specialty cheese production.

Agriculture Canada's dairy division has conducted a fact-finding survey of all specialty cheese manufacturers across the country as part of its responsibility to advise on programs affecting the industry.

EUROPEAN CORN Corn hybrids from northern Europe will appear in southern Alberta next summer as a result of a scientific mission organized by Agriculture Canada.

A team of Agriculture Canada scientists visited northern European countries last year to look at breeding material and gather data on European corn management practices.

Corn breeding material will now be exchanged and next summer European hybrids will be grown and evaluated in Alberta.

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IF UNDELIVERED, RETURN TO SENDER EN CAS DE NON-LIVRAISON, RETOURNER À L'EXPÉDITEUR