Research
FOR FARMERS

WINTER — 1958

'New Look' in Orchard Sprayers

Strawberry Viruses

Breaking Northern Bush Soils

Quality in Processed Vegetables

Tree Farm Pest Problems

Beef Production with the Brahman Cross

Estimating Grazing Capacity on Western Rangelands

CANADA DEPARTMENT OF AGRICULTURE

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Ottawa, Ontario

HON. DOUGLAS S. HARKNESS, *Minister*
J. G. TAGGART, C.B.E., *Deputy Minister*

NOTES AND COMMENTS

Sweet clover without objectionable coumarin is now a reality with the introduction of the variety "Cumino" developed at the Canada Department of Agriculture Research Laboratory, Saskatoon, and licensed last November. More than ten years of careful work went into the making of the new variety, with interspecific crossing and selection both playing a part. While Cumino has good agronomic characters its chief advantage will be its almost complete freedom from coumarin. This substance, present in varying degrees in most sweet clovers, causes the undesirable "melilot taint" when the clover volunteers in wheat fields, and results in much wheat being downgraded on that account. Indirectly, coumarin causes losses of livestock because it interferes with clotting of the blood and may induce fatal bleeding from trivial wounds.

* * *

Average production figures for the country as a whole usually show up rather poorly in comparison with the best yields. A striking example of the spread between average and top yields comes from the Eastern Co-Operative Test conducted during the past season at the Charlottetown Experimental Farm. The mean yield in the test was 116.2 bushels per acre while one strain yielded at the rate of 142 bushels per acre. In sharp contrast, the average yield per acre of oats for all Canada was about 35 bushels. Between these two extremes there seems to be ample room for raising the average through the use of new varieties, better cultural practices, or both.

* * *

Orchard spraying has come a long way since the day when the grower dragged a barrel along the tree rows on a stoneboat and applied the spray mixture with a hand pump. Along with so many other agricultural operations, spraying has responded to mechanization. From the first primitive engine-driven, horse-drawn outfits we have advanced through various stages to the self-propelled, concentrate sprayers described by Dr. Marshall in this issue. Marshall's work in connection with the development of this new spraying technique puts Canada in the forefront of progress along this line. A fuller account of the accomplishments and the patient research behind them is given in a new publication now on the press. Those who are interested can read the story in Publication 1020, "Concentrate Spraying in Deciduous Orchards". Copies will be available shortly from the Queen's Printer, Ottawa, at a price of one dollar per copy.

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***Cover Photo*—In the Chemistry Division's radioactive counting room laboratory, Dr. B. B. Migicovsky (left) discussing preparation of radioactive samples with Dr. K. W. Neatby, Director, Science Service.**

(See story page 16.)

One-side concentrate sprayer.

Twa-side concentrate sprayer with fiberglass-plastic tank.

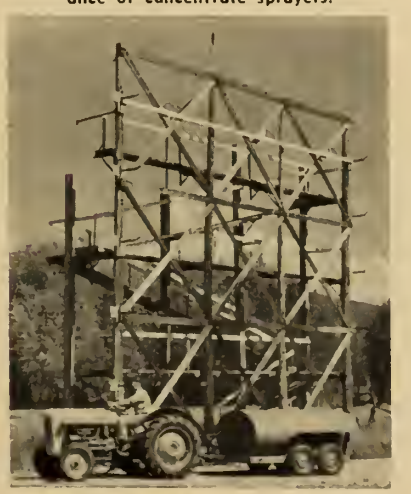
The 'New Look' in Orchard Sprayers

James Marshall

DURING the last ten years a significant change has taken place in orchard spraying methods in British Columbia. Fruit growers have become aware that insecticides and fungicides can be applied effectively without the use of large quantities of water and for this reason, 'concentrate sprayers' are replacing the high-volume equipment that has been in use since the turn of the century. An efficient concentrate sprayer is a high-velocity, one-man machine capable of distributing a pesticide throughout large fruit trees with sufficient uniformity to control insects, mites, and diseases as safely and effectively as good, high-volume spraying, but without causing spray drip.

While concentrate sprayers are now being produced in various models by more than a score of manufacturers, Canadian machines are of two types, and both are made in British Columbia's Okanagan Valley. They are characterized by their light weight, their high-velocity (90 to 120 m.p.h.) axial-flow blowers, high-pressure pumps, and tungsten carbide nozzle components. One of the machines is equipped with something new in sprayer design, a fiberglass-plastic tank. Optional equipment on the other is a stainless steel tank. The purpose of these special tanks is to eliminate corrosion and scaling, and consequent nozzle plugging. The manufacturers of both machines work in close association with the Entomology Laboratory at Summerland, B.C.

Spray frame used to assess performance of concentrate sprayers.



British Columbia fruit growers have a choice of either one-side or two-side concentrate sprayers with tanks of 150 to 250 gallons capacity. Travelling at a speed of one mile per hour in a 30-foot tree spacing, these machines spray from 3 to 5 acres at a single tank filling and are capable of spraying from 15 to 30 acres per day, depending on whether they have one-side or two-side delivery, and on the type of orchard. In Great Britain and Europe, concentrate sprayers driven by tractor power-take-off appear to be giving satisfactory results. In British Columbia it has been found necessary to equip the machines with their own power plants because, in hilly orchards, the light, wheeled tractors in general use are incapable of simultaneously hauling and powering a fully-loaded sprayer.

The new method of spraying, as distinct from the old high-volume procedure, requires from 3 to 75 imperial gallons of spray liquid per acre instead of from 300 to 1,500 gallons. The essential

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point about the method is that there is no drip from fruit or foliage; drip results in wastage of spray chemicals, unnecessary contamination of soil, and unnecessary danger of spray injury.

Concentrate spraying has a weakness in its tendency to cause over-spraying and spray spotting of lower branches, and under-spraying of upper branches, particularly in large trees. An associated characteristic is its tendency to produce a 'shadow effect', that is an excessive spray deposit on surfaces facing the machine, and an insufficient deposit on surfaces facing away from the machine.

Investigations at Summerland have shown that these shortcomings can be corrected by chemical means. If a special type of surface-active compound, or "surfactant", is added to the concentrate spray liquid, the appearance and performance of the spray deposit are radically altered. Spray spotting is eliminated, the amount of spray chemical deposit in the treetops is increased, and shadow effect is greatly reduced. Control of such orchard bugbears as apple scab and codling moth is much improved.

Concentrate spraying is still too new for clear-cut evidence on the most suitable per-acre dosage. In Great Britain and Europe some researchers are confident that a dosage of 3 to 20 gallons per acre is sufficient. Others are equally confident that 50 gallons per acre is better. In British Columbia, where atmospheric humidity is low and evaporation of spray

Author (left) is consulted by a grower for advice on a pest problem.

droplets is rapid, present indications are that 50 gallons per acre is an optimum dosage. Such a dosage implies application by an efficient machine and, particularly in the control of apple scab and codling moth, the use of an appropriate surfactant in relatively high concentration.

Coincident with the development of the concentrate sprayer there appeared what is called the "semi-concentrate" sprayer, a machine that applies from about 125 to 250 gallons of spray liquid per acre. Semi-concentrate spraying involves fairly high concentration of spray chemical and results in spray drip. Consequently, since fruit and foliage injury are particularly prone to occur at the drip-point, semi-concentrate spraying is more hazardous than either high-volume spraying or concentrate spraying.

Semi-concentrate sprayers may be assembled from low-priced components. Doubtless the appeal of these machines is due as much to their relatively low cost as to the fact that, because of high output of liquid, they give the impression of doing a better job than concentrate equipment applying 75 gallons per acre, or less. The spray mist from a concentrate machine is not clearly visible unless viewed against the sun, and the lower the machine's output the less obvious is its performance.

The advance in orchard spraying methods began almost simultaneously in New York State and in British Columbia. Only in British Columbia, however, is concentrate spraying yet recognized as the standard spraying procedure, although the trend in that direction is becoming increasingly evident in most of the fruit growing areas of the world, particularly those of Great Britain, New Zealand, Australia, the Netherlands and Belgium.

Eventually it may be feasible, particularly in conjunction with the use of surfactants, to equip concentrate sprayers with cheap, centrifugal pumps developing a pressure of about 100 pounds per square inch. Research to that end is in progress at the Summerland Laboratory. Another current objective is to increase the rate of travel without increasing the size, or cost, of the machine. If these studies prove as fruitful as those that resulted in the development of the present-day concentrate sprayers the orchardist can look forward to further substantial savings in the cost of fruit production.

Effect of a surfactant on DDT spray deposit. *Left:* DDT plus surfactant. *Right:* DDT alone.

Strawberry plant on left appears to be healthy but actually is infected with the virus that has produced the serious disease in the indicator plant on right. (Variety is British Sovereign, the indicator, *Fragaria vesca*.)

STRAWBERRY VIRUSES

Disease-free Stock Assures Maximum Returns

Frances C. Mellor AND *R. E. Fitzpatrick*

ONLY by using plants known to be free from virus infection can the strawberry grower be sure of realizing maximum returns from his plantation. If virus-free plants are available, growers should use them to the exclusion of all others, even through they command a premium price.

Strawberries are susceptible to several different viruses. Some of these viruses and certain combinations of them cause recognizable diseases, but the majority produce no detectable symptoms. They do, however, lower the vigor of the plants and seriously reduce the yield of fruit. It is impossible to know the true virus content of a commercial plant from field inspection alone. To determine whether or not a plant is infected, it is necessary to transfer any viruses that may be present to some sensitive indicator species in which these viruses will produce characteristic symptoms. The indicator that has been most commonly used is the species *Fragaria vesca*, and in particular the clone of this species that originated in England and was used by workers at the East Malling research station.

The East Malling clone of *Fragaria vesca* is extremely sensitive to the viruses that are commonly found in commercial strawberries, but its use has one drawback—it is itself infected with a latent virus. Indeed it is the presence of this virus that seems to give it its special sensitivity to the other viruses. Fortunately this virus does not seem to be transmitted readily by insect vectors.

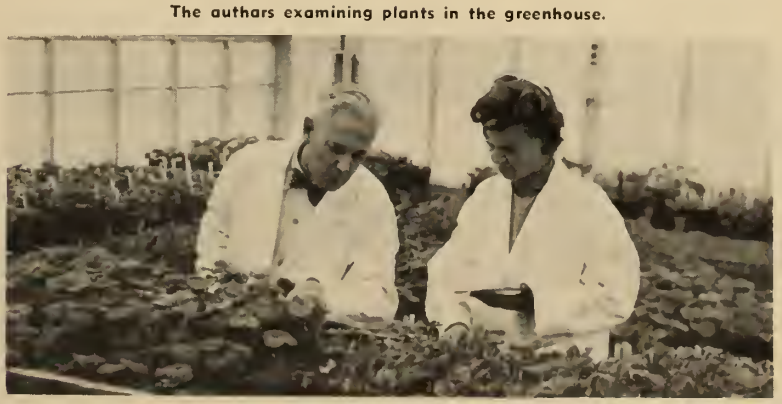
The combination of this latent virus with any of the other strawberry viruses produces much more serious effects both in *Fragaria vesca* and in commercial strawberries than does either virus alone.

There are two methods of transferring strawberry viruses from plant to plant. One is by grafting; the other is by using the natural insect vector, the strawberry aphid. The first method, grafting, will transmit all of the viruses, and this is the method usually followed. There are several variations of this method. The original one, which was to make tongue grafts between a stolon of the indicator and a stolon of the plant to be tested, is probably the one still most widely used. It has the disadvantage that, due to the possibility of the indicator carrying a virus, the plant that is being tested has to be discarded. This means that a daughter plant must be obtained from it before the graft is made, and this plant must be used for future propagation.

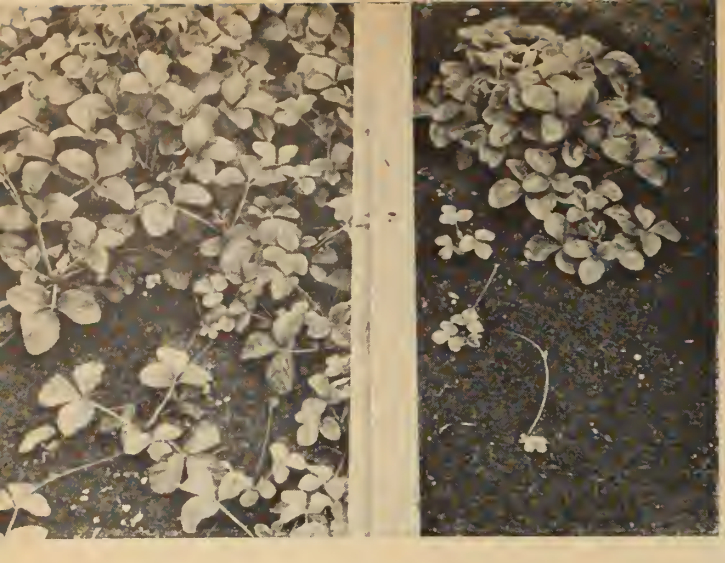
Recently a simpler method of grafting has been developed wherein a mid-leaflet of the indicator plant is cut away, the petiole split and the petiole with part of a leaflet from the plant to be tested is inserted in its place. This seems to work equally well and it prevents contamination of the plant under test.

In the second method, aphids are allowed to feed on the plant to be tested and then transferred to the indicator plants. This method has the advantage that, by using a series of indicator plants and transferring the aphids at intervals, it is often possible to separate the viruses that persist in the insect for several days from those that do not. It has the disadvantage that it involves maintaining stock of virus-free aphids and, in

The authors examining plants in the greenhouse.



Dr. Fitzpatrick is Officer-in-Charge of the Plant Pathology Laboratory, Vancouver, B.C. Miss Mellor is a Specialist in virus diseases of small fruits.



The two strawberry plants above hove the same heat-labile, non-persistent virus; one on right has in addition the lotent virus from *F. vesca*. There are no symptoms but vigor is reduced.

addition, at least one important virus is not transmitted by the insects.

It should be emphasized that whatever method of testing is used, several tests should be made, preferably at different times, before a stock is passed as virus-free.

There are two groups of viruses that commonly occur in commercial strawberries without causing obvious symptoms. The first group contains those viruses that have been variously described in the literature as mottle, Virus 1, and Type 1. Different isolates produce symptoms in *F. vesca* ranging from mild mottling on the leaves to extreme dwarfing of the plant. However, they have certain characters in common. All are transmitted by the strawberry aphid. All are non-persistent, in that the aphid loses the ability to transmit them in about six hours after leaving the infected plant. All are heat-labile, in that infected plants can be freed of them, if they are kept at 100°F. for about 2 weeks. These viruses are referred to as the heat-labile, non-persistent group.

Viruses of the second group are also aphid-transmitted and non-persistent, but they are resistant to heat therapy. In the East Malling clone of *F. vesca* they produce a characteristic down-curling of the young leaves. In

Strawberry aphid, *Capitophorus fragaefolii*, is the insect mainly responsible for the spread of viruses.

the alpine variety of *F. vesca*, Baron von Solenmacher, they tend to produce vein-banding rather than mottling.

Neither the heat-labile viruses nor the vein-banding types, either separately or together, produce any symptoms on the commercial varieties. However, there is some evidence that at least some of them have a depressing effect on the vigor of the plants, and it has been proved beyond doubt that, in combination with certain other viruses, their effects can be very severe indeed. For example, the disease "Xanthosis" is caused by the combination of these viruses with another which is known as "mild yellow edge". This latter virus is not normally found by itself in the varieties grown in Canada, since most of these are already infected with the commoner types. The mild yellow edge virus can be separated from the others by making use of the fact that aphids which have been feeding on diseased plants, retain their ability to transmit it after they have lost their ability to transmit the other viruses in the complex.

Another complex that produces severe symptoms, in some commercial varieties at least, is the combination of the latent virus from the East Malling *F. vesca* with the vein-banding virus.

On the other hand, the combination of the *F. vesca* latent virus with the viruses of the heat-labile group, while having a marked effect on vigor and productiveness, does not produce any distinctive symptom and infected plants would pass as normal in field inspection.

The existence of a situation like this points up the importance of knowing the virus content of the stock that is to be used for propagation, and of testing the mother plants of such stock at frequent intervals by indexing them on suitable indicators.

Graft-indexing: A portion of leaflet and petiole from the plant under test is inserted into the split petiole of the indicator plant.

Using the Rome plow to work land cleared the previous season.

Methods of Breaking Northern Bush Soils

C. H. Anderson

OVER the past 30 years well over a million acres of new land have been broken in northern Alberta and British Columbia. Equipment for breaking new land has ranged all the way from the early horse-drawn moldboard plows to the heavy, power driven disk-type machines now becoming popular. In the past the settler had no reliable guide in his selection of machines. Now, however, research is in progress to provide authentic information concerning the best methods of breaking northern bush soils and preparing them for cropping. This project was drawn up at the Beaverlodge Experimental Farm, and in the same year was adapted to the needs of the Fort Vermilion area in the Lower Peace River Region.

Breaking treatments, undertaken at the Fort Vermilion Farm over the 1955, 1956, and 1957 seasons, were commenced in 1955 on land cleared of poplar and willow the previous year. Treatments involved several different applications of two types of equipment. (See box.)

The soil in the area studied has a very shallow humus layer underlain to a depth of 18 inches by fine sandy loam. This soil has no compacted layer, and as a result of its sandy nature absorbs moisture readily. The moldboard-plowed strips, where the dark organic matter has been turned down, are light in color, while the surface-worked strips are dark. The deep-plowed strips are lighter in color than the shallow-plowed strips.

Although it is too early to make any fine comparisons between the breaking treatments, certain trends are evident. Where the moldboard plow was used, particularly with the 10- to 12-inch depth, roots were well cut and covered. The standard 3-4 plow tractor equip-

The author is Superintendent of the Experimental Farm, Fort Vermilion, Alta.

PLOWS AND TREATMENTS

Moldboard plow

(1) plowed 4 to 6 inches deep in May and cropped the year broken

(2) plowed 4 to 6 inches deep in July

(3) plowed 10 to 12 inches deep in July

(4) plowed 4 to 6 inches deep in September

The moldboard plow used was the standard brush breaker. The width of cut was 24 inches but with the deeper plowing the actual cut was reduced to about 22 inches. Where root crowns up to 6 inches were encountered the coulter was effective in splitting the crown and the root was readily turned under. With larger crowns it was often necessary to stop and chop the tap roots before the plow could turn the stump out.

Rome plow

(1) surface worked in May and cropped the year broken

(2) surface worked in July and worked down

(3) surface worked in September and worked down

The Rome plow is in reality a large disk and in operation is not unlike the old disk harrow commonly used to work down prairie breaking. The 8-foot machine used has 28-inch disks serrated to cut more effectively, and weighs just under a ton. Additional weight may be provided in large pans situated directly over the disk assembly. When working, the angle of cut may be adjusted leaving an uncut portion in the center. The general practice is to lap each round to remove the uncut portion and to further work the disked area. Effective width of the machine is about three feet.

The Rome plow features sturdy construction.

ment can be depended upon to work down this land satisfactorily in succeeding seasons. Only slight regrowth is evident in the moldboard-plowed areas. With the moldboard plow a follow-up with the offset disk resulted in a fine seedbed. With the Rome plow two double plowings followed by the offset disk were required to leave the land in a comparable condition for seeding.

The Rome plow or disk is excellent for preparing land for cropping where abundant power is available, and where succeeding tillage operations can be accomplished with the heavy disk implements. With such equipment regrowth that follows surface tillage may be checked while solid unturned roots may eventually be chopped up and rotted down. Lighter tillage equipment cannot satisfactorily break down unturned roots and surface debris, and operators will continually encounter difficulty in working fields with such equipment.

Large poplar crowns untouched by the Rome plow when the plots were worked in 1955 were still solid and showed no signs of rotting two years later. A follow-up with the heavy offset disk also failed to break down large stumps and roots. If fields are continually worked with heavy disk-type equipment these roots might eventually rot down, but this is extremely unlikely because of the dry climate in the area. The 8-foot Rome plow has a minimum power requirement equal to that of the largest wheeled tractors. Crawler-type tractors are preferable. Observations suggest that for best work the Rome plow should be heavily weighted and set at a slight angle. Full angle and no weight results in a rough plowing job. More root picking was required in the plots broken with the Rome plow as none of the roots or debris was covered. There has been considerable regrowth of poplar, willow, rose bushes, native grass and forbs in the surface-worked areas.

The cost of the two methods of breaking is comparable where the land has been cleared of light to heavy forest cover. However, where large open areas or areas with light scrub growth are to be broken the Rome plow is probably the more economical.

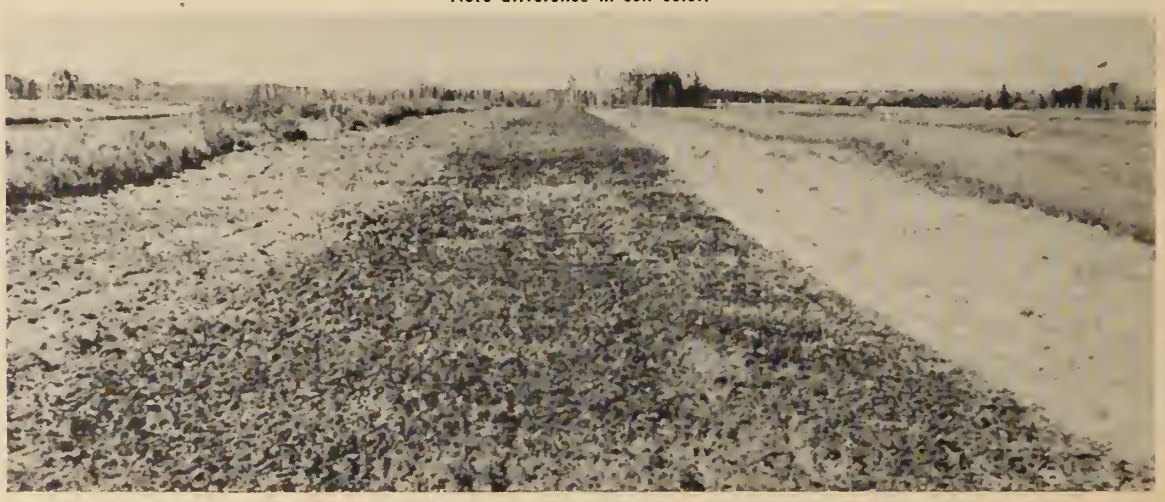
Following breaking the plots were uniformly worked down with a large offset disk, and cropping studies are now under way on the areas broken out of sod in 1955 and 1956. Three cropping systems are followed: continuous flax, three crops of flax followed by wheat, and three crops of flax followed by summerfallow.

To date there have been no distinct differences in crop growth attributable to any one breaking treatment, or to the season of the year at which breaking was accomplished. Preliminary results indicate that if spring breaking is completed sufficiently early to allow for seeding before the end of May, good returns can be expected with wheat and flax in the average season. The time factor naturally limits the acreage that can be spring broken for immediate cropping.

A further study is under way to determine the extent of growth of native grasses and forbs on land broken by various methods. This land will be used for alfalfa and grass seed production.

Many problems remain to be solved. Should the Gray Wooded soils be broken from the top down to conserve all available organic material? If the gray leached layer is brought to the surface will it crust against seed emergence and provide a sterile seedbed? Is deep plowing necessary to break up compacted layers that are present in many Peace River soils? It is hoped that continuing research will provide the answers to some of these questions.

Mid-season breaking. *Left to right:* Moldboard plow shallow; Rome plow (surface); and moldboard plow deep. Note difference in soil color.



QUALITY in PROCESSED VEGETABLES

Processing Characteristics of Southern Manitoba Canning Crops Studied

Tenderometer measures pea quality.

A. L. Shewfelt

QUALITY is the key to stabilized sales of processed vegetables in a highly competitive market. With a view to increasing grower returns in the eastern prairie region, the Morden Experimental Farm is assessing the processing characteristics of vegetables adapted to the area. Quality in the finished product is being studied by the Fruit and Vegetable Products Laboratory. Work is in progress with many crops but discussion here is confined to peas, snap beans, sweet corn, and tomatoes.

The quality characteristics that should be considered for each crop must be decided, and techniques to measure these characteristics developed. Quality in all vegetables begins with the seed and must be preserved through all the stages of growth and processing. Each vegetable crop must be suited to the soil and climate, and the varieties must be evaluated carefully. Unlike many agricultural crops, most vegetables are harvested while succulent and in a state of rapid growth. Although, from a yield standpoint, it is preferable to delay harvesting as long as possible, the peak of processing quality passes very quickly. This makes it necessary to establish requirements that balance out yield and quality. Furthermore, since most vegetables are highly perishable, the raw product should be processed promptly to avoid undue deterioration in quality. And, finally, every step in the processing operation must be examined for ways to protect the excellence of the end product.

Dr. Shewfelt is Food Technologist in charge of the Fruit and Vegetable Products Laboratory, Experimental Farm, Morden, Man.

Peas

Studies of pea varieties have shown that there is still room for improvement. In general, Wyola and the various strains of Perfection have done well in Manitoba, but they are not early varieties and are somewhat large and variable in seed size. Little Marvel has been one of the highest yielding early varieties in the area and has good color and flavor, but most of the peas are too large. Arctic Sweet, though relatively new, has shown considerable promise from the standpoints of earliness, yield, and ability to hold even maturity in the field. Its processing qualities have been slightly above average.

Quality control in peas depends largely on harvesting at the correct maturity for processing. As the peas mature, yield and quality increase up to a given point, then quality deteriorates rapidly due to toughness. The most reliable index of maturity of freshly harvested peas is the alcohol-insoluble-solids content, but its determination is too time-consuming for control use. The instrument most widely accepted in processing plants is the Tenderometer which measures the force required to shear completely a given volume of peas. In studies at Morden, the optimal harvest for canning occurred when the alcohol-insoluble-solids content of the peas was in the range of 12 to 14 per cent; the moisture content 79 to 80 per cent; and the tenderometer reading 100 to 200. When the optimal harvest stage was reached, the rate of change appeared to accelerate.

Studies have also been made toward minimizing the effect of hard water on peas. The calcium and magnesium ions present in much of the ground and run-off waters in Manitoba combine with the pectin in the peas during processing and the canned product is toughened as a result. Addition of sodium hexametaphosphate (Calgon) to the blanching water 'softens' the water and thus prevents the damaging effect on texture. One pound of Calgon per 1,000 gallons of blanching water is required for each grain of water hardness.

Snap Beans

Both green and yellow snap beans are well adapted to soil and climatic conditions in southern Manitoba and yields are generally high. Studies on harvesting at 4-day, 6-day, and 9-day intervals

have shown that, while total yield was not affected greatly, quality for processing was much better with the shorter harvesting interval.

Content of seed was found to be one of the most practical methods for determining maturity of beans for processing. In general, the seed content of harvested beans ranged from 4 to 8 per cent by weight. Those with a seed content in excess of 6 per cent gave a low grade of canned product. Canning quality of the variety Rival was favored because of its consistently low seed content and firm fleshy pod.

Varieties varied substantially in ability to resist fiber development as the pods matured. Rival and Topcrop were superior varieties in this respect.

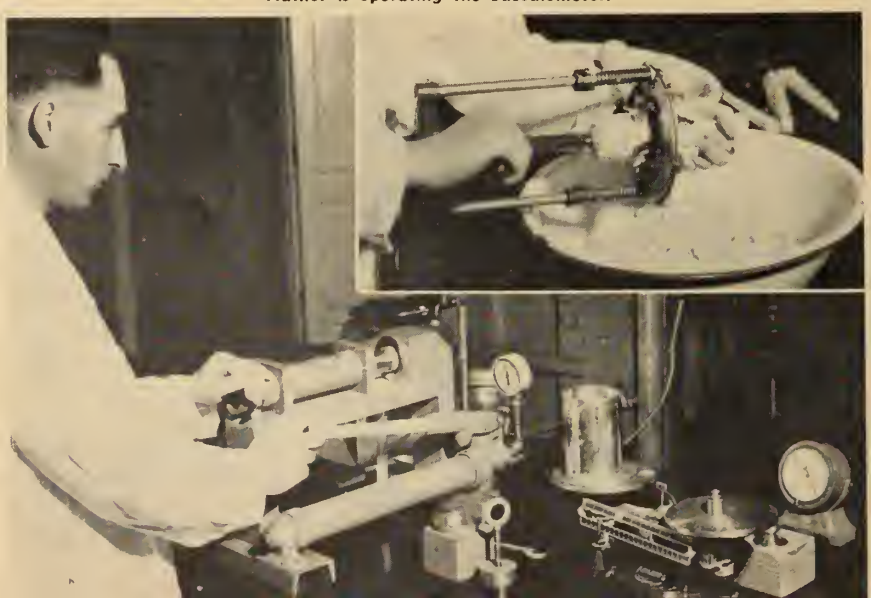
With yellow varieties, one of the main problems has been the retention of a bright uniform color in the canned product. It was found that the factors involved include the amount of chlorophyll pigment in the pods when harvested, the cleanliness of the raw product, the time and temperature of holding before processing, the blanching and cooking times, and the type of metal container used. Objective measurement and analyses of color are being used to provide a more precise basis for estimating the type and amount of color change introduced by each of these factors.

Sweet Corn

To obtain a detailed picture of the sweet corn varieties having commercial possibilities in the area, selected standard varieties and new introductions are being examined. The factors under study include earliness, rate of maturity development, ear size, cut-off percentage of kernel corn, depth and succulence of kernel, edible quality for canning and freezing, and content of alcohol-insoluble solids, moisture, and pericarp. Based on the results obtained, Carmelcross and Gold Rush have the best record for canning in Manitoba. Both are high yielding, and have ears that mature uniformly and provide corn of good canning quality. Seneca Arrow also yields well, and is superior in quality to the varieties mentioned but approaches the borderline for lateness. Golden Beauty is one of the more promising varieties for early-season processing. For frozen corn-on-the-cob the varieties Dorinny and Golden Bantam are much superior in texture and flavor to most varieties and are worthy of consideration despite their lower yield.

The precise determination of sweet corn maturity, as with peas, is vitally important in deciding the best harvest date. Both moisture and alcohol-insoluble-solids contents are reliable estimates of maturity but require several hours to determine. The rapid succulence test using a succulometer lacks desirable precision. Pericarp content provides an index of kernel toughness but varies with variety as well as maturity. In 1956 the harvested field yield of corn decreased slightly as optimal maturity was approached, but the yield of cut corn increased during the same period. At optimal maturity for cream-style corn, the moisture values for ten varieties ranged from 69.8 to 72.2 per cent. The corresponding range for alcohol-insolubles-solids content was 21.5 to 23.5 per cent; and that for pericarp content was 1.65 to 2.25 per cent.

Laboratory corn cutter (inset) is used to obtain representative sample of kernels preparatory to using the Succulometer (left) for measuring succulence of fresh corn for processing. Author is operating the Succulometer.



For processing, the "Manitoba" tomato has desirable size and smoothness. Taste panel (upper inset) prepares to rate flavor; lower inset shows technician operating a laboratory vacuum concentrator to prepare a tomato paste sample from the "Manitoba".

Tomatoes

Commercial production of tomatoes for processing in Manitoba holds considerable promise. One of the chief limitations is the cool weather that normally begins in mid-September and prevents full color development in the fruits during the latter part of the harvest season. Fruit color is very important in tomatoes for processing. So far, studies show that temperature of ripening is the most important single factor affecting color. What we need is earlier varieties that mature a larger yield of fruit before the cooler weather comes, or else strains that ripen more favorably at reduced temperatures. Since new instruments are now available for the objective measurement and analysis of color in tomatoes, it is possible to assess the advancement being made toward the desired goal. The varieties Meteor and Manitoba, developed at Morden Experimental Farm, have been distinct landmarks of progress.

Modified mist blower used in spray trials against the European pine shoot moth. Spray deposit is checked on cards attached to trees in test plot.

TREE FARM PEST PROBLEMS

Spraying for Insect Control Protects Farmer's Investment

J. J. Fettes

MILLIONS of trees have been established on plantations throughout Ontario in recent years. The objective in many instances has been the Christmas tree trade. In other provinces this activity has been matched both on old farm land and for the re-establishment of cut-over forests. The creation of a single-species stand in the plant world—as in the case of tree plantations—often sets the stage for the development of serious insect pest problems. If cultural methods of pest control fail then the tree farmer, to protect his investment, must resort to other methods of control.

Insect pests have made serious inroads into tree plantations, sometimes wiping out the results of years of care and substantial investment. The White Pine Weevil, by killing tree leaders, has rendered many white pine plantations useless. The Red-headed Pine Sawfly has killed hundreds of acres of red pine. The European Pine Shoot Moth has so seriously deformed red and Scots pine in southern Ontario that continued planting is no longer recommended in the infested areas. Recently, local but serious outbreaks of the Pine Root-collar Weevil totally eliminated Scots pine stands which were almost ready for the Christmas tree trade.

Early in the spring White Pine Weevil adults emerge from overwintering sites to duff below the trees. Before laying eggs on slits in the tree leaders they feed on the tender bark of the leaders. Satisfactory protection has been achieved by spraying the leaders with a long lasting insecticide such as DDT so that the adults will come in contact with the poison at the time of adult activity.

The Red-headed Pine Sawfly which infests young red pine principally emerges as an adult in late spring or early summer. The females soon mate and deposit eggs in rows of slits made along the red pine needles. Upon hatching, the larvae proceed to feed on the foliage. This insect is sometimes difficult to control because of the long period of adult emergence and egg hatching. Sprays applied when the first larvae appear are often not effective against larvae which hatch several days after application. Tests with spray timing showed that thorough spraying when the early larvae are well advanced eliminates the entire population.

The most troublesome control problem encountered has been with the European Pine Shoot Moth. The larvae hatch in midsummer and bore into and feed in the needles of the host pine. This may be any of the hard pines in southern Ontario, both native and introduced. In late summer, they enter a bud where they pass the winter. In spring the larvae again enter an undamaged bud and feed, boring from one bud to another, and completing the larval period in a partly elongated shoot. The shoot is either killed outright or is deformed. Throughout the feeding period the larvae are well protected within needles, buds or shoots and present a difficult control problem. Intensive study and observation indicate that there is a period of exposure at the time of larval hatching when the newly hatched larvae usually wander for a short time before entering a needle. A persistent insecticide applied just prior to this vulnerable period proved relatively successful and resulted in satisfac-

In the laboratory, author (left) discussing insecticide deposit samples. Magnified drop stains on screen provide information on spray break-up.

Dr. Fettes is Head, Chemical Control Section, Forest Biology Division, Ottawa.

tory but incomplete control. Some larvae may never expose themselves but bore into a needle immediately upon hatching. Improved methods and formulations are being sought. Penetration of the feeding sites by poison may be the answer to the problem.

The Pine Root-collar Weevil has probably been common on native pine species in Ontario for a long time without causing noticeable damage. When tracts of land were planted to Scots pine, the weevil found food more to its liking and populations have developed to epidemic proportions. The problem of protection for the trees was approached from several directions. Soil fumigation killed the resident insects but gave no lasting protection. Insecticides introduced into the soil were successful but were costly to inject. Further investigation showed that insecticide applied to the duff and soil around the trees did not kill the resident population but did kill the adults emerging from the soil and protected the trees from further infestation. Test plots now show three years of excellent protection with one application.

Many agencies are interested in protecting trees and much good work has been done by both Federal and Provincial groups. The Forest Biology Division is concerned with the problems of forest and plantation insects and with developing chemical formulations and application techniques to protect plantations. Details concerning recommended treatments of pests discussed in this article may be obtained by writing to the Division. Occasionally methods developed by others are applicable to Canadian or local conditions but usually they either have to be adapted to our conditions or entirely new methods have to be developed. Such methods demand a complete understanding of the habits and life histories of the insects so that control methods may be applied where and when the insects are most vulnerable.

* * *

Erratum

In the Fall, 1957, issue of "Research for Farmers", the photo caption in the Ferguson Tomato article on page 11 read... "Depth from 2.00 to 2.59 inches; average 2.89 inches". This average should have read 2.32 inches.

Adapt Farm Hammermill for Powdering Dry Ice

Frozen Semen Distribution Facilitated

D. J. Cooper, D. G. Hickman, W. Kalbfleisch

DRY ice used in the storage and shipment of frozen bull semen gives better temperature control when processed into a powder. A laboratory mill has now been developed to powder the ice.

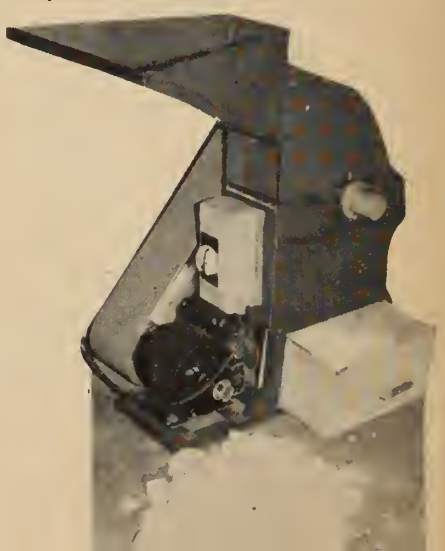
In the frozen bull semen project at the Central Experimental Farm, bull semen is processed in heat sealed ampoules by lowering the temperature uniformly in an agitated alcohol bath at a specific rate. The ampoules are shipped to Experimental Farms in different parts of the country. Shipping periods may be up to 48 hours and during this time the semen must be maintained at or below 100°F.

While apparatus for cracking ice is readily available, no known laboratory equipment was suitable for powdering dry ice. Various types of ice-crushing machines commonly used for cracking ice produced too large particles and lacked adequate capacity. Larger laboratory mills, food choppers, grain grinders, and hammermills were tested. Some of these machines were too costly, some produced too fine a powder causing a high evaporation loss, and others produced too large particles. From the standpoint of cost, capacity, particle size of powdered ice, and adaptability for laboratory use, a small farm hammermill was found to be very satisfactory. This mill has twenty swinging hammers designed to operate at 3,300 r.p.m. and when used to grind grain requires 3 to 7½ h.p.

In adapting this machine for powdering dry ice the speed was lowered to 1,375 r.p.m. and the power reduced to 1 h.p. Other modifications were the removal of the blower fan and the installation of a collection pan under the rotor. When using a 3/16-inch screen the capacity of the mill is 22 pounds of dry ice per minute. Ice particles vary in size from 1/64 inch to 1/16 inch, with the major portion in the 1/16-inch to 1/32-inch range. Evaporation loss is 8 pounds for a 50-pound block of dry ice. The block is broken up before being fed into the hammermill and 50-pound quantities can be handled at a time.

This machine represents a moderate investment of approximately $250 but it is a necessary tool in handling semen in the artificial breeding program.

D. J. Cooper and W. Kalbfleisch are Agricultural Engineers, and Dr. Hickman is a Dairy Cattle Breeding Specialist—all at the Central Experimental Farm, Ottawa.



Below: Department's agricultural engineers have adapted a small farm hammermill for powdering dry ice. Mill will handle 50-pound quantities efficiently with no undue wear on the hammers or screen. Left: Insulated shipping container in which ampoules of bull semen are packed in powdered dry ice.

Left to right: Brahman × Angus crossbred heifers; Brahman × Hereford heifers; Brahman × Shorthorn heifers.

Beef Production with the Brahman Cross

H. F. Peters

STUDIES are in progress at the Range Experimental Farm, Manyberries, Alberta, to obtain information on the adaptability of Brahman crossbreds to Canadian range conditions. Brahmans have performed well on southern ranges of the United States, both as purebreds and in crossbreeding, but there has been serious doubt as to whether they would be adaptable to the colder, more northerly ranges of Canada.

The Zebu, imported from India and known in America as the Brahman, is genetically distinct from the British breeds of beef cattle and is appropriately considered a different race. Brahmans and British breeds of beef cattle inter-breed freely and the crossbreds are normally fertile. Because of the genetic diversity between Brahmans and British breeds of beef cattle, a substantial degree of hybrid vigor might be expected in the cross.

The crossbreds produced at Manyberries were the offspring of three Brahman bulls imported from California and bred to Hereford, Angus, and Shorthorn cows. The crossbred females were retained and bred to Hereford bulls. Grade Herefords were kept as a control herd. The present evaluation of the Brahman cross is based on the performance of 161 half-Brahman (first-cross) and 98 quarter-Brahman cattle born from 1951 to 1957.

The first-cross animals were significantly heavier than Herefords at birth, weaning, 18 months, and 30 months of age. The Brahman × Angus and Brahman × Shorthorn crossbreds were heavier than the Brahman × Hereford crossbreds at weaning, but the three groups of crossbreds did not differ consistently in weight at birth, 18 months, or 30 months of age. The quarter-Brahman calves out of first-cross cows had an even greater advantage over the Herefords in weaning weight than the crossbred calves had in the first phase of the experiment.

The breeding of yearling heifers is not a general practice under range conditions since heifers calving as two-year-olds often require assistance at calving and losses of both the heifer and the calf are common. At the Manyberries Farm the breeding of yearling heifers has been practised since 1953 and complete records of losses and assistance rendered at calving have been kept. None of the half-Brahman crossbred heifers have required assistance at calving, either at two years of age or at any subsequent calving.

The cattle in the Manyberries experiments are raised under range conditions. Calves receive a daily allowance of 2 to 3 pounds of concentrates from weaning (November 1) until spring, and

Concluded on page 15

The author is Superintendent of the Range Experimental Farm, Manyberries, Alta.

BODY WEIGHTS AND CARCASS APPRAISAL OF HEREFORD AND BRAHMAN CROSSBRED STEERS SHIPPED OFF-GRASS AT 2½ YEARS OF AGE—1956 AND 1957.

	No. of steers	Average				No. of carcass grades[3]		
		Weight before shipping (lb.)	Chilled carcass weight (lb.)	Dressing percentage[1]	Area of eye muscle[2] (sq. in.)	B	C	D_1
1956								
Hereford	9	1009	502	53.1	9.8	2	5	2
Brahman × Hereford	9	1173	644	57.4	11.6	3	6	
Brahman × Angus	9	1099	604	57.2	10.4	5	4	
Brahman × Shorthorn	6	1140	628	57.3	11.2	3	3	
1957								
Hereford	19	993	496	54.5	9.6	1	12	6
Brahman × Hereford	7	1123	593	57.8	10.1	—	7	
Brahman × Angus	9	1150	617	59.2	11.0	1	7	1
Brahman × Shorthorn	4	1159	621	59.2	10.5	—	4	

[1] Based on live weights taken at the packing plant.
[2] Adjusted for differences in carcass weight.
[3] B = Good, C = Commercial, D_1 = Utility.

Left: Sheep on fescue prairie in the foothills of the Rockies. Carrying capacity of this range about two acres per sheep or 10 to 15 acres per cow for the summer grazing period. *Below:* Point-quadrat frame. Variations of the frame include more pins and upright styles.

Estimating Grazing Capacity on Western Rangelands

J. B. Campbell

RANGELAND crops provide more than half the food supply for grazing livestock in the Prairie Provinces. Cattle and sheep provide an estimated one quarter of the agricultural income of the area. It has been computed that the 55 million odd acres of range, much of it unsuited to any other use, contributes more than $160 million annually to the national income. The 4,750,000 cattle and 550,000 sheep, together with some 500,000 horses, now grazing this acreage comprise a light load during years of good growth. However, during dry years they would constitute an extremely heavy load so that a satisfactory method of estimating grazing capacity becomes important.

Early efforts to estimate carrying capacity by measuring grass cover involved the use of cross-wired, meter-square frames. These were carried along prelocated transects and at regular intervals were placed on the ground and the density of cover measured and recorded. When the need for a better method became apparent the point-quadrat method was devised to measure the cover and a procedure was developed that estimated the grazing capacity with reasonable accuracy. The point-quadrat instrument (see accompanying illustration) is a simple frame from which pointed pins extend. If the point of a pin touches the crown of a plant, or a stem below its first node, that hit is recorded as vegetation; when bare ground is touched nothing is recorded. This instrument not only estimates the total ground cover, but also the proportion of each plant species in the association. From 2,000 to 4,000 points are examined for each site, and the data calculated in terms of percentage cover for each species. The original instrument had 10 pins a decimeter apart; the frame used at present has 36 pins on 1-inch centers.

Yields are calculated from the point-quadrat data. Each species has a yield index per unit stand which was determined from a clipping study conducted over many years. Yields calculated by this method are always higher than clipped yields during years of poor growth, and always lower than the actual harvest during years of good growth. Partial records from two sites are presented in the table to illustrate the calculation procedure.

The point-quadrat data also established approximate bound-

CALCULATED YIELDS FROM SHORT-GRASS AND FESCUE PRAIRIE SITES*

Association and Species	Percentage Cover	Yield Index per 1 per cent cover	Yield in lb. per acre
Short-grass Prairie			
Blue grama	6.5	16.5	107.5
Common spear grass	1.7	50.0	85.0
Wheat grass	1.1	65.0	71.5
June grass	0.5	48.0	24.0
	9.8	—	288.0
Fescue Prairie			
Rough fescue	7.5	97.0	727.5
Oat grasses	2.1	58.0	121.8
Wheat grass	1.1	65.0	71.5
June grass	0.3	48.0	14.4
	11.0	—	935.2

*Details of the point-yield method of estimated grazing capacity are given in Canada Department of Agriculture Publication 738, "An Ecological and Grazing Capacity Study of the Native Grass Pastures in Southern Alberta, Saskatchewan and Manitoba".

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Mixed-grass prairie; carrying capacity about 15 acres per cow for a six-month grazing season.

aries of the different grass associations. In southeastern Alberta and southwestern Saskatchewan, blue grama grass dominates an association known as short-grass prairie; its grazing capacity ranges from 20 to 40 acres per cow per season. In the foothills of the Rocky Mountains, the Cypress Hills, and in the northeastern corner of the Prairie, the grass cover consists largely of fescues, oat grasses, and wheat grasses, and produces enough feed on 6 to 18 acres to carry a cow during the summer. Dr. E. H. Moss of the University of Alberta suggested the name "fescue prairie" for this association. The true-grass prairie association is found in the northeastern section of the prairies and is characterized by the presence of little and big bluestem, Indian grass, cord grass, spear grasses, and wheat grass. True-grass prairie has a carrying capacity ranging between 4 and 20 acres per cow season. Because large sections of both the fescue and true-grass prairies have been invaded by poplar and willow, both regions are often referred to as the "Park Belt" or "Grove Belt". Mixed-grass prairie is the natural cover of the central prairie region. Spear grass and wheat grasses are the dominant species but species from all other associations may be present in considerable quantities. The carrying capacity of mixed-grass prairie will range from 15 to 25 acres per cow per season.

Many factors have an important bearing on capacity. Early research showed the value of providing a carryover. In other words 'don't graze all that grows'. Protection during May and early June results in more feed being provided during midsummer. When it was realized that the introduced crested wheat grass grew rapidly during the early spring and produced palatable forage at that season of the year, stockmen seeded considerable acreages to this hardy grass for spring pasture. Distance between stock-watering sites influences utilization, because cattle prefer to graze within 1¼ mile of water. Well-placed salting sites, fences, and shelters add to animal health and comfort, and make for easy handling of cattle. Research has demonstrated the value of these practices, and stockmen generally are following them in whole or in part to use and conserve grass, and thus maintain a balanced range economy.

As more knowledge of the rangeland becomes available, new problems become apparent. Whereas spring pasture is needed in the southern prairies to complement the native grass, supplementary autumn pasture is equally important for the northern parkland and forest regions. Because the climate is variable, and because grass production is associated with summer rainfall, there is still the problem of estimating the increase of carrying capacity during good growth seasons, and its decrease when the rain doesn't come. The inclusion of a drought-tolerant legume would improve the quality of midsummer forage, and the development of the new creeping-rooted types of alfalfa, such as Rambler, may fill this gap.

Brahman Crossbreds for Beef . . . *(from page 13)*

yearlings receive the same allowance of concentrates from the onset of severe winter weather until March. However, all the animals graze on winter range and receive roughage only when deep snow or cold weather prevents grazing. The first-cross and Hereford steers born in 1954 and 1955 were maintained under these conditions until 2½ years of age and shipped off-grass for slaughter in the fall of 1956 and 1957. The table (page 13) gives the average body weights before shipping and some of the carcass information obtained on these steers. The carcass appraisal was made by graders of the Department's Marketing Service.

The Brahman crossbred steers carried more finish, had a higher dressing percentage, and because of finish, graded slightly higher than the Herefords. The data showed only slight differences between breed groups in proportion of carcass weights in the various cuts of beef. Shrinkage during shipment was slightly less with crossbreds than with Herefords.

Area of 'eye' muscle (*longissimus dorsi*) cross-section at the 12th rib is a heritable trait and gives some indication of the amount of muscling in a carcass. In this experiment, there was a positive, linear relationship between area of eye muscle and carcass weight—area increased by 0.0145 square-inch for each increase of one pound in carcass weight. The Brahman crossbred steers still exceeded the Herefords significantly in area of eye muscle even after correcting for differences in carcass weight.

No information on feedlot performance of Brahman crossbreds was obtained in the Manyberries experiment. In some experiments conducted in the United States, Brahman crossbred cattle have gained less per day in the feedlot than Hereford cattle. When raised under the conditions prevailing at Manyberries, Brahman crossbreds appear to be more nervous in confined quarters than cattle of the British breeds. This might affect their performance in the feedlot. There are also hazards in trying to winter purebred cattle of this race in Canada, at least under range conditions, and little is known about their regularity of reproduction in northern climates.

The crossbreds raised in this experiment represent a very small sample of the Brahman population. Consequently, although the data obtained at Manyberries indicated that the Brahmans may constitute potentially useful genetic material, further work is needed before their general use can be recommended.

"Lead castle" for storing radioactive materials.

Radioactive Tracers in Agricultural Research

LITTLE is known about the mode of action of vitamin A and its remarkable growth effects. Radioactive carbon dioxide ($C^{14}O_2$) generated in apparatus shown (top right) is taken up by cereal seedlings and incorporated into the pigment B-carotene. When B-carotene labeled with carbon^{14} is fed to a rat (middle) it is almost completely converted to vitamin A in the intestinal wall before absorption. It is therefore possible, by studying the carbon^{14} content of tissues, to determine the distribution of vitamin A, or breakdown products of vitamin A, in the body. Dr. D. H. Laughland of the Chemistry Division records data which may shed light on the biochemical role of vitamin A.

Bottom: Carbon^{14} is also being used by the Horticulture Division to demonstrate that apples are capable of carbon dioxide fixation. Horticulturist W. R. Phillips (left) prepares apples for treatment by carbon isotope C^{14}. Chemist N. Allentoff is ready to instal the generator apparatus containing radioactive material. Acid is added to the radioactive carbonate thus generating radioactive carbon dioxide ($C^{14}O_2$) to which the apples are exposed in the glass container. The exposed apples are analyzed and the amount of CO_2 that has been used is measured by Geiger counter equipment (see Front Cover). The practical implications are that this process enables stored fruit to manufacture metabolic substrates and thus add to or conserve its own reserves.

Other tracer investigations by departmental scientists include the use of:

Carbon^{14} in studies of the mode of synthesis of cholesterol and the development and multiplication of insect viruses; Calcium^{45} to follow the movement of calcium through the animal body and study factors affecting its metabolism; Calcium^{45} and Rubidium^{86} in studies of deterioration in yellow birch; Phosphorus^{32} to elucidate the precise function of the hormones thyroxin and insulin in their effect on the growth of animals; Phosphorus^{32} in studies of flight range and dispersal habits of mosquitoes and black flies; Cobalt^{60} to study responses of wireworms and cutworms to moisture, temperature and food without disturbing the larvæ; to study the dispersal and rate of movement of young grasshoppers; and to locate "tagged" beetles and learn about the searching ability of imported predators.