Research

FOR FARMERS

WINTER — 1959

CANADA DEPARTMENT OF AGRICULTURE

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NOTES AND COMMENTS

Ability to make rapid and economical gains is an important measure of quality with meat animals. Livestock men appreciate the value of animals that will put on poundage quickly but it is not always easy to identify these superior individuals. Recent application of the Record of Performance tests to beef cattle may point the way to a general improvement in the rate of making beef, through the identification of those animals that make above-average gains. Early results from the tests have shown that for all the common beef breeds, the average male calf in good growing condition weighs 800 pounds at one year of age. But some individual calves weighed as much as 1,000 pounds at the same age and these rapid-gaining animals were not lacking in other qualities that are the mark of good beef type. Record of Performance tests serve to identify the fast-growing bulls and heifers within a herd. Since this trait is inherited, the ability to gain is passed on to their offspring and thus the average performance of the herd can be improved. Consistent use of rapid-gaining sires, and selection of females on the same basis, can mean more dollars for beef raisers.

* * *

In the see-saw battle between plant breeders and plant pests, neither side stays ahead for very long. Resistant varieties may hold the upper hand for a while but sooner or later a new strain of fungus or a more vigorous insect comes along and the war is on again. Fortunately these new threats are less serious now than they used to be. Science has advanced to the point where they can be forecast with reasonable accuracy and steps taken in time to circumvent them. During the past summer a new race of stem rust appeared for the first time on oats in eastern Ontario where all the commonly grown varieties proved susceptible. While the affected area was small, the new race could spread quickly and seriously damage this important crop. But plant breeders are already at work on the problem and sources of resistance to the new race have been found among the wild relatives of common oats.

* * *

One man's meat is another man's poison. A recent example of the truth of this old adage comes from New Zealand. Cape tulip, a native of South Africa, is an attractive plant that has been freely planted as an ornamental. But the plant is extremely poisonous. Moreover it is very prolific and, once escaped from gardens, could easily overrun farm lands to the danger of livestock. Already there are several known infestations in New Zealand. Cape tulip is not a problem in this country where it probably could not survive, but the incident serves as a reminder that no precaution should be overlooked to prevent the introduction of such unwelcome visitors.

Cover *Photo*—Flock of Pilgrim geese, Central Experimental Farm, Ottawa. Males are white, females gray. (See page 10: "Has the Goose a Future?")

Author injecting Nemagon into soil around cucumber plants to alleviate damage from root-knot nematodes.

Soil Sterilization by Chemicals

C. D. McKeen

MOST glasshouse growers practice intensive cropping with a minimum of rotation. This leads to a build-up of organisms some beneficial, but others undesirable such as damping-off pathogens, nematodes, and organisms that cause root degeneration. If glasshouse cropping is to remain profitable, these detrimental components of the soil must be either eliminated or reduced periodically. Since crops grown or started under glass have a relatively high cash value, the grower can usually afford to apply adequate remedial measures.

In the eyes of both the scientist and the enterprising grower, steam maintains its unchallenged position at the head of the list of agents used for soil sterilization. However, the relatively high cost of steaming and the small operator's lack of facilities have promoted the search for other means of sterilizing the soil. Soil fumigants and other chemicals have been developed that offer alternative means of solving the problem. Several of them act not only as fungicides but are also effective against weeds, nematodes, and insects.

Dr. McKeen is a specialist in vegetable diseases at the Science Service Laboratory, Harrow, Ont.

The requirements of the ideal soil-treating chemical are somewhat exacting. A broad spectrum of action is necessary, along with quick performance, rapid dissipation from the soil, and absence of toxic residue. None of the chemicals investigated so far possess all these attributes but a few have been found to meet some of the requirements satisfactorily.

Methyl Bromide

Our tests at Harrow show methyl bromide to have the broadest action and the widest suitability as a soil fumigant for use under Canadian conditions. It is sold in Canada as Dowfume MC-2 (98 per cent methyl bromide and 2 per cent chloropicrin). Because methyl bromide is odorless, yet extremely poisonous, a small amount of chloropicrin (tear gas) is included in the Dowfume MC-2 product to serve as a warning agent. Methyl bromide destroys most of the soil-borne fungi and bacteria, as well as nematodes, insects and most of the weed seeds. It will not destroy tobacco mosaic virus residing in plant debris, although at the usual dosage rates it destroys two other soil-borne viruses occasionally encountered in glasshouse soils.

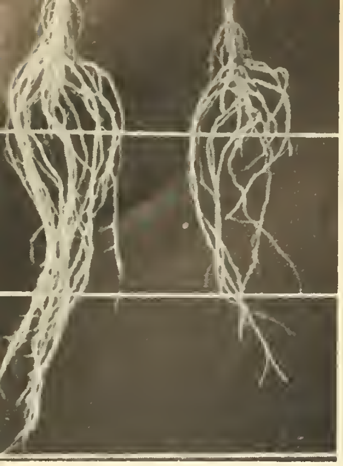
The Department's researchers at Harrow are making considerable progress in soil sterilization of seedbed and glasshouse soils using two long-established agents —heat and chemicals. Information gained has been put to commercial use in the Harrow-Leamington area and in many other parts of Canada.

Now that methyl bromide has been sufficiently tested, its application in many seedbeds can be recommended. Since it is highly volatile, it must be confined by plastic or other gas-proof cover during the fumigation period. At soil temperatures about 50°F the gas penetrates the soil quickly and accomplishes the desired effect within 48 hours. After treatment a delay of two days before seeding and four days before setting plants is necessary to allow the residual gas to escape from the soil. Its wide range of action together with its rapid dissipation after fumigation makes methyl bromide the best available substitute for steam.

Chemicals often produce undesirable side effects and methyl bromide is not an exception. Ornamental crops such as snapdragon and carnation are sensitive to slight traces of bromides and consequently cannot be grown in soil treated with methyl bromide. Cauliflower and celery show slow seedling growth in treated soil.

Chloropicrin

Chloropicrin is also a useful soil fumigant. It is a good fungicide and we have found it particularly effective against *Verticillium* sp., an omnipresent soil fungus. It is less effective than methyl bromide against weeds and nematodes. However, chloropicrin possesses



Two-month-old cucumber roots. Soil (left) treated with Vapam before planting; no treatment (right.)

Cucumbers. Soil (left) treated with Thiram (TMTD); no treatment (right).

the distinct advantage of doing a moderately good job, where only a water seal is used to retard its escape. The effectiveness of the treatment can be increased by confining the gas by means of a gas-proof sheet, but the additional labor and difficulty involved discourage growers from using them in their large glasshouse beds.

Other Fumigants

Within the last five years two new chemicals that promise to be useful in treatment of glasshouse soil beds have been formulated, namely, Vapam (sodium N-methyl dithiocarbamate dihydrate) and Mylone (3, 5-dimethyltetrahydro-1, 3-5, 2H thiodiazine-2-thione). At Harrow we have found Vapam useful as a fungicide, nematocide and herbicide. It is applied as a drench and is followed immediately with a water seal. Since it is highly soluble in water, care has to be taken not to apply too great a volume of water and thereby carry the chemical too deep into the soil. On the other hand, if insufficient water is used, the chemical may escape too rapidly. Vapam decomposes fairly rapidly to form a volatile gas of striking biological activity. This gas must not be allowed to come into contact with growing crops in adjacent greenhouse compartments.

Mylone has been formulated as a powder and as such has the distinct advantage over many fumigants of being easily sprinkled over the surface of soil and cultivated in to the proper depth. Although not exhibiting as wide biologic activity as Vapam it affords a respectable measure of control of root rot in glasshouse cucumber crops. Tests are in progress to determine its applicability to tomatoes. It gives good control of the root-knot nematode. The biologic action of Mylone results from its volatilization to produce a gas toxic to many soil inhabiting microorganisms.

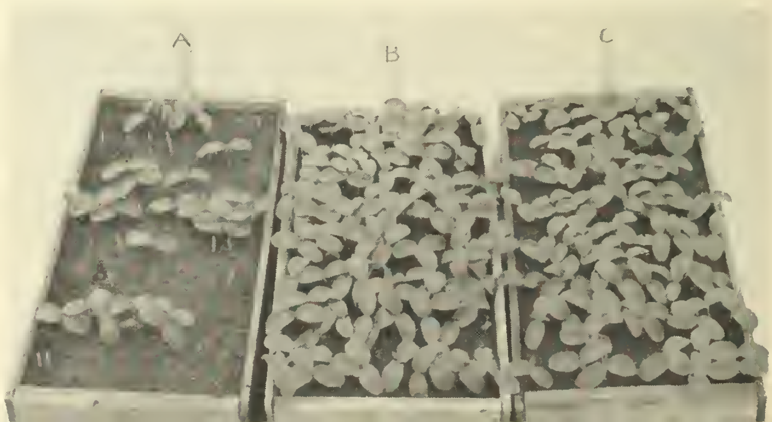
Whereas chemicals such as vapam and mylone do not accomplish anything approaching a complete sterilizing action they are valuable because they reduce the population of most unwanted microorganisms, at least for a time, and thereby bring crops through critical periods of slow growth when pathogens make their greatest advances. At Harrow these beneficial effects have been most pronounced during the winter months when sunlight is minimum.

Occasionally a complete sterilization of the soil is regarded as unnecessary and the grower is satisfied to destroy only one or two of the most harmful components. Today, a limited number of chemicals are available for such purposes. Formaldehyde, while not an effective nematocide or herbicide, is a good soil fungicide. It is applied as a drench (dust formulations have been discontinued) and a time lapse of at least five to seven days is required to allow the gas to dissipate and the soil to dry before seeding. Thiram (tetramethylthiuramdisulphide) controls such damping-off fungi as *Pythium* sp. and *Aphanomyces* sp., and when worked into the soil in seedbeds is effective in reducing seedling diseases of many vegetables. Terrachlor (pentachloronitrobenzene) is highly toxic to certain fungi, particularly *Rhizoctonia,* another commonly encountered damping-off pathogen. However, because of specific phytotoxic responses we cannot give these fungicides blanket approval for use on all vegetable and ornamental crops.

Satisfactory chemicals are now available to the glasshouse grower who wishes to apply a nematocide between crops or even to standing crops. Before planting, soil injection of DD (a mixture of dichloropropane and dichloropropene) has been shown to be the most reliable and effective treatment against the root-knot nematode, and growers welcome the "high color" in greenhouse cucumbers after this treatment. Ethylene dibromide, a nematocide widely used in the field in the southern United States, has proved unsatisfactory in glasshouses. Two chemicals, more recently formulated, being sold in Canada as Nemagon and Fumazone (1-2 dibromo-3-chloropropane), can be injected around growing plants with nematode-infested roots and, when used thus, have been found to prolong the life of an unthrifty and fading cucumber crop for as long as two months.

In the light of the foregoing it is obvious that the treatment and fumigation of soils for control of disease is not static. It has become a special subject of research, and every year sees progress in combating plant pathogens in the soil and thereby increasing the productivity of glasshouses in Canada.

Muskmelon seedlings. A. No treatment (toothpicks mark positions of removed dead seedlings). B. Soil treated with methyl bromide. C. Steam sterilized soil.



Fungicides for the Apple Orchard

G. C. Chamberlain

THE Canada Department of Agriculture laboratory at St. Catharines is the center for testing fungicides used in the apple orchard. New materials are continually being developed and these must be carefully evaluated before they can be recommended to growers. Manufacturers of agricultural chemicals spend large sums of money in pesticide research and development. They maintain laboratories, greenhouses, and experimental areas to test the biological effectiveness of promising materials, investigate the residual toxicity, and develop methods of residue analysis acceptable to the health authorities. Every material that meets the requirements is compared with standard products under field conditions at our St. Catharines laboratory.

Before a fungicide is registered for sale in Canada, the manufacturer provides information as to its effectiveness when used according to directions and its compatability with a wide range of other pesticides. Adverse effect, if any, on tree vigor, yield, quality, and finish of fruit and any special value or weakness will influence its final adoption or rejection by the growers.

The search for an ideal fungicide for the control of apple scab has been going on for many years. The first great advance began in the thirties with the development of the organic fungicides as substitutes for the traditional copper or sulphur sprays. One of the earliest that we tested was ferbam. It and other carbamates proved more effective against secondary (conidial) infections than against primary (ascosporic) inoculum, and as a result they have been used mainly in split schedules or for cover sprays. Ferbam has been especially valuable in orchards near red cedars because, unlike the sulphurs, it is effective against apple rust. It can be combined with other fungicides to control both scab and rust where the latter is a problem.

Others of the many organic fungicides that we have tested are captan, dichlone, and glyodin. Scab control and fruit quality are consistently good in orchards sprayed with captan. It is a good protectant and, as it has some eradicant value, the timing of the applications in relation to rain periods is not so critical. After rain in an orchard that has not been well protected, scab development can be checked by captan if it is applied within 24 hours of the beginning of an infective period. Even after a longer interval the fungicide will be effective if temperatures are low (50°F. or below) during the wet period. Dichlone is comparable to captan as a protectant and as an eradicant. Glyodin, a liquid fungicide, has ranked below captan in the tests but has been superior to the sulphurs. Like sulphur it is only a protectant and applications must be carefully timed for best results. Growers using glyodin in a full schedule have had good yields of high-quality fruit.

The organic mercurials were introduced at about the same time as captan and glyodin. Because of their proved eradicant value they are recommended for use as emergency fungicides in the primary infection period when it has not been possible to maintain the full protectant schedule, or when there has been excessive weathering of protectant residues by lengthy or heavy rains. Mercurials are not valued as protectants and they should not be used beyond the petal-fall stage because of the probability of toxic residue on the fruit.

Very recently we have been giving attention to fungicides prepared by combining a protectant with an eradicant, using each at half the ordinary rate. Combinations of glyodin, sulphur, or carbamate with an organic mercurial have been tested and appear to have particular value in wet seasons.

Although organic fungicides have vastly improved scab control they have little or no value against powdery mildew. This fungus disease, previously of little importance in Ontario, has been

(Concluded on page 14)

The author is a Plant Pathologist at the Department's Plant Pathology Laboratory, St. Catharines, Ont.

Early Tests at St. Catharines

In 1928 when the laboratory began testing spray schedules in their own orchard, growers were dependent on bordeaux and lime-sulphur for scab control. These were good fungicides but bordeaux gave a rough finish to the fruit, and lime-sulphur injured the foliage and reduced yields.

Elemental or wettable sulphurs caused much less injury but fell short of satisfactory control of scab. Their value depended on timely application and frequent coverage—not always possible in wet seasons.

Dry micronized and paste sulphurs succeeded the coarser wettable sulphurs. Greater adhesiveness made them more reliable, and the smaller particle size increased their efficiency. The dry micronized sulphurs and some specially processed paste sulphurs became widely used in Ontario, though they were not always effective. Like the coarser sulphurs they failed to control if application was delayed by rain and the trees were exposed to fresh infection. Surface-active wetting agents, stickers, and spreaders added to the sulphurs to improve control gave erratic results and these materials were not generally recommended. Recent products have proved to be more effective.

The green apple aphid (center) is attacked by several native insects such as the lacewing fly (larvae feeding on green apple aphid, left) and the lady-bird beetle (right) seen feeding on the green apple aphid.

Can Orchard Pests be Controlled Biologically in British Columbia?

The authors say there is little hope for completely effective biological control—but add that further work on selective insecticides, control of the codling moth by sterilization of the male insect, and the introduction of new parasites and predators may alter this outlook.

C. V. Morgan AND *N. H. Anderson*

BRITISH COLUMBIA fruit growers spend about $1.5 million annually for the control of insects and mites. Forty-five years ago the cost of controls represented approximately 20 per cent of a grower's cash returns, but today this figure has been reduced to about 15 per cent largely because of improved spray materials, more efficient methods of application, and a better understanding of the biology of orchard pests. In an effort to further reduce the cost, biological control is being studied at the Summerland Entomology Laboratory.

Although biological control has demonstrably aided the tree fruit industry, it does not appear to be so widely applicable in British Columbia as in certain other fruit growing areas. Chemical control, on the other hand, although a much more expensive practice, has been justified by its efficacy.

One reason that the B.C. grower has not, so far, adopted biological control very extensively is that the orchards and their surroundings favor the development of pest insects and mites rather than parasites and predators. Most of the fruit is grown in a semi-arid region, and the open, park-like forest is interspersed with sagebrush and bunch grass, an environment less suitable for potential parasites and predators than the hedge rows and copses of other fruit growing regions. Also, the hot, dry summers favor some major orchard pest insects more than the humid summers of other areas.

A successful program of biological control in apple orchards in British Columbia would ultimately mean control of the codling moth, the major pest in apple orchards. Over half the cost of insect control is chargeable to the codling moth, which if not controlled, destroys the crop. Attempts to suppress the codling moth by the introduction of natural enemies have been unsuccessful. Although one parasite has been established for over 20 years, it has had little effect on the level of codling moth infestations. Even in abandoned orchards practically all the fruit is destroyed year after year by the codling moth, though upwards of 30 per cent of the larvae may be killed by parasites. The reproductive potential of the codling moth, with its two to three broods per year, is apparently greater than that of any established parasite.

In Eastern Canada, where biological control of orchard pests has been practiced effectively by many orchardists, the growers still find it necessary to use insecticides for the control of the codling moth. But they have integrated the chemical control of the codling moth with biological control of other pests by the judicious use of selective insecticides such as ryania, which is nontoxic to parasites and predators.

Unfortunately, the more severe infestations of the codling moth encountered in British Columbia cannot be controlled with ryania

The authors are attached to the Department's Entomology Laboratories—Mr. Morgan at Summerland, B.C., and Mr. Anderson at Belleville, Ont. The former is specialist on orchard mites, the latter, fruit insect parasites and predators.

except at prohibitive cost and with harmful side-effects such as off-colored, down-graded fruit, and reduced yield. Until a more effective, selective insecticide is discovered, the fruit grower must rely on DDT and related materials for the control of codling moth.

There is some hope, however remote, in a new and unorthodox type of biological control that is being studied at the Summerland Entomology Laboratory. The underlying principle of this approach is that matings of fertile females with sterile males produce no offspring. In theory, if sufficient numbers of sterile males could be released the fertile males in time would be eliminated and the species would die out. Until this method is proved, or until a selective codling moth insecticide is discovered, far-reaching biological control is improbable in British Columbia orchards, not only for the codling moth but for other pests such as mites, soft scales, bud moths, and aphids.

For the last twelve years, DDT has offered the most effective and most economical means of controlling the codling moth in British Columbia. Although a tremendous boon to the apple and pear growers, DDT, however, unfortunately aggravated the development of certain other orchard pests. Severe infestations of orchard mites, such as the European red mite, the two-spotted spider mite, the yellow spider mite, the apple rust mite, and the brown mite are some of the orchard problems that have arisen coincident with the use of DDT. Some attribute the increased numbers of mites to the destruction of the predators that controlled them under natural conditions.

Parasitized woolly apple aphid. In recent years this aphid has declined in numbers, presumably as a result of increased activity of a parasitic insect introduced some years ago.

Undoubtedly a shifting of the so-called biological balance is partially responsible for some of these new problems; but work conducted at Summerland, and elsewhere, suggests that the balance is a highly complex one and that the present problem is, indeed, a manifestation of several interacting factors. Coincident with the use of DDT, a number of cultural and spraying practices were changed or modified. Conceivably these changes or modifications may have aggravated the problems of pest control quite as much as the reduction of predators by DDT.

For example, the change from rill irrigation to sprinkler irrigation and the increase in the use of chemical fertilizers including minor or trace elements contribute to the development of succulent and nutritious foliage that is particularly favored by mites. Also, during this period there was a change in two spraying practices that may bear on the problem: (1) dormant sprays which have some miticidal value, were, to a considerable degree, replaced by new insecticides applied in the spring or summer and (2) the seven to nine high-volume sprays of lead arsenate or cryolite, which washed off many mites, were replaced by only three to four sprays of DDT applied at much lower gallonage per acre. Finally, there is now evidence that DDT increases the numbers of mites either directly by affecting the mite itself, or indirectly, by affecting its nutrition through the physiology of the host plant.

In summary, there is little hope for completely effective biological control of insects and mites in British Columbia orchards. At the present time the fruit grower must use insecticides to control the codling moth, aphids, mites, scales and certain other pests. Further work on selective insecticides, control of the codling moth by sterilization of the male insect, and the introduction of new parasites and predators may alter this outlook. An integrated program of biological and chemical control might then offer a means of further reducing the cost of control.

Examples (left and right) of damage caused by larvae of the codling moth. Center: Larva of a parasite after devouring a larva of the codling moth. Parasite, while established, has had little effect on the level of codling moth infestations, the reproductive potential of the codling moth apparently being too great.

Left: Some of the 320 cattle that in one year were paralyzed by ticks in B.C.'s Nicola Valley.

Below: Portion of a 600-acre field which remained ungrazed by cattle because of heavy population of ticks. Adequately sprayed animals could have used this pasture and killed ticks.

Tick Paralysis

Kamloops Laboratory Probing Mystery

J. D. Gregson

IN British Columbia, during Easter, 1957, two hundred rangeland cattle were paralyzed from the bites of the Rocky Mountain wood tick. Another 120 animals fell victims the next day, and all the resources of a ranch's manpower and materials were thrown into the fight to save the remaining 400 cattle from a similar fate. Laborious de-ticking of the affected animals saved all but 30. In the same spring three persons were temporarily paralyzed by the tick. This brought the total of known human cases of tick paralysis in British Columbia to over 250; of these 28 died.

Meanwhile, scientists were working to discover the means by which this tick was able to affect its hosts so drastically. In an attempt to explain why only certain ticks appeared capable of causing paralysis, or even how they caused it, researchers were collecting tick sputum in tubes the size of a pin, and spreading it over isolated nerve cells.

Yet, in spite of studies conducted in Europe, Africa, Australia, and North America, the exact cause of tick paralysis remains a mystery. We know that the continued bites of certain species of ticks may cause an ascending fatal paralysis in man and livestock; and that removal of the ticks usually brings about rapid and complete recovery. Presumably the causative agent is a toxin. Its isolation and analysis could lead to the finding of an antitoxin, could make a new drug

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Author (lower right) collects saliva from an engorged tick in search for the toxin that paralyzes humans and livestock. While studying microscopic slices of a tick's head, he was confronted with the apparition (upper right) wherein the tick appears to be grinning over the scientists' inability to solve its mysteries. *Below:* Male (right top) and unfed female Rocky Mountain wood tick. Female (left) that has engorged on the blood of her host. (Enlarged three times.)

available for medical use, and would contribute to the various theories of nerve functioning.

Recent advances in the studies of tick paralysis have largely been made at the Veterinary and Medical Entomology Laboratory at Kamloops, B.C. This is partly due to the fact that, for some unknown reason, the Rocky Mountain wood tick in this area appears to produce paralysis more readily than does the same species east of the Rockies or south of the Canadian border. Paradoxically, an eastern tick, the American dog tick, causes paralysis in southeastern United States, but not in Canada. The symptoms are believed to be caused by a failure of the host's nerve impulses to reach their respective muscles. The recent discovery that wild groundhogs and laboratory guinea pigs can also be paralyzed now makes a new series of susceptible hosts available for experimental study.

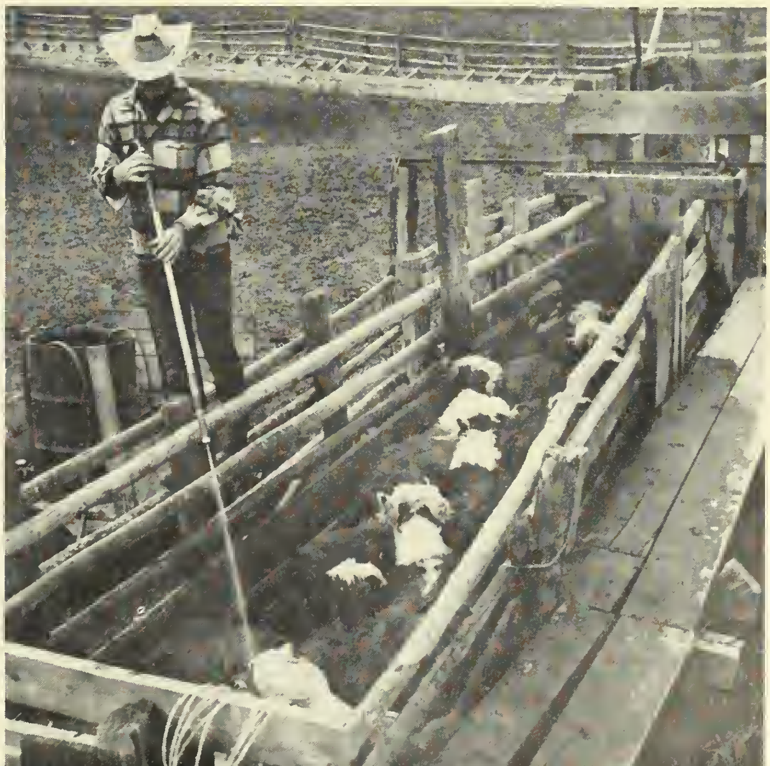
Linked with the study of the effect of the tick on its host are studies on the feeding mechanism of the tick itself. Observations made of microscopic slices of ticks' mouth parts, and slow-motion pictures of feeding ticks, have revealed that the tick does not burrow in, but cements itself to, the skin of its host, and that, once attached, it alternately sucks blood and pumps fluid into the tissues. So far all attempts to demonstrate a toxin in this fluid have failed.

The artificial rearing of ticks for year-round studies has revealed another problem; laboratory raised adult ticks appear to be unable to feed with the same facility as natural ones. They eagerly attach themselves to a host, but do not engorge as readily as 'wild' ticks. This has led us to suspect that climate plays some vital part in the 'conditioning' of ticks for their normal two months of spring activity, and may even play a part in the varying powers of the ticks to produce paralysis. Thus the laboratory studies are carried back to the field, and we find ourselves implicated with observations of tick habitats, and also with rodents, since the tick feeds on small animals during its two young stages.

Field studies are related directly to tick control, which, of course, is of primary interest to the rancher. Modern insecticides (more correctly known as acaricides in the case of tick control) have greatly advanced the methods of chemical control since the days of treating animals with creosote, lard, and crankcase oil. The best of the modern chemicals is benzene hexachloride, and a spray of Ortho W 10 BHC applied at the rate of 4 ounces per gallon of water to the head and shoulders has been found to protect cattle from the Rocky Mountain wood tick. Other materials will kill attached ticks but do not offer the residual protection for the active season of the adult tick. Dieldrin, applied at the rate of one pound per acre, will also kill ticks on vegetation, but this treatment is practical only for very local infestations. Although ticks in other countries have developed a resistance to certain acaricides, this has not been observed yet in Canada.

Complete elimination of ticks from an area, however, is difficult. For example, by marking ticks in nature with paint, we have found that about 8 per cent of one season's adults that have failed to find a host will remain dormant after their period of spring activity and reappear the following spring. Because of this, and the fact that the shortest period from egg to maturity is two years in nature, it is clear that control measures will not bring about immediate results. Also, because wild-life plays an important part in the maintenance of the tick, there is likely to be a residual population where ground cover permits the presence of rodents. Thus, to control ticks in a field, ranchers are urged to deliberately pasture the area with cattle that have been adequately sprayed. Not only will the available grasses be utilized and the rodent populations so reduced, but most adult ticks in the areas covered by treated cattle will be picked up and killed by the insecticide in the hair. These observations, together with the discovery that the tick population in a given locality may gradually increase or decrease, seemingly from factors that have involved the feeding and disposition of adult ticks, lend encouragement to the belief that tick populations can be effectively suppressed by control measures.

Cattle are protected from ticks by a spray of benzene hexachloride.



Day-old Pilgrim goslings, female dark colored, male light.

Food for Thought

As a meat bird the goose has a number of important advantages. It is the most rapid growing of the domestic species of poultry. It is a good forager, and pasture can be used to reduce the amount and the quality of the feed required. It is much more resistant to disease than chickens and turkeys, and mortality in growing and breeding flocks is generally much lower. It is extremely hardy, so that very inexpensive housing can be used in the winter and no housing is required in summer.

Has the Goose a Future?

Experiments at Ottawa Point Up Possibilities

J. R. Aitken

THE rapid expansion in poultry meat production in recent years has been based on the principle of growing birds as rapidly as possible and marketing at the end of the most rapid growing period to achieve maximum efficiency of feed utilization. Goose growers have not been caught up in this trend, possibly because it involves rearing the birds in confinement on a full feeding program.

Although in repeated tests at Ottawa we have found that geese reared in confinement grow more rapidly than those on pasture, there are a number of advantages in pasture rearing: (1) geese on pasture are easier to manage, (2) they require less concentrate feed and a less complete and less expensive ration, and (3) the use of pasture eliminates the need for housing. For these reasons our experiments on the most efficient and economical methods of rearing geese for meat production have been concerned with the type and amount of feed required on pasture.

In the initial experiments on pasture-rearing the object was to grow the birds as rapidly as possible in accordance with the principle described above. However, it was found that when the geese were fed *ad libitum,* they did very little grazing, and consequently there was little or no saving in feed. Furthermore, in studies on the killing and dressing of geese at various ages, we found that the end of the most rapid growing period (approximately 12 weeks) coincided with the time when the feather condition was most unsuitable for dressing.

Under these circumstances, it appeared most logical to restrict feed during the initial period on pasture as a means of encouraging grazing and saving feed, and subsequently to full feed the birds for the minimum time required to bring them to market weight at 15 or 16 weeks of age, when feather condition permits clean plucking and pin feathers are no longer a problem. Subsequent experiments were, therefore, designed to obtain information on the most economical type of feed to provide geese during the initial and final periods on pasture, and on how much feed to provide in the period of restricted feeding.

It was discovered early that grain alone full fed to geese on

GROWTH AND FEED EFFICIENCY OF GEESE ON PASTURE

Growth period from 3 weeks**	Feeding Programs (Forty goslings per treatment)					
	(1) Grain restricted* from 3 to 12 weeks. Grain full fed from 12 to 17 weeks		(2) Grain restricted* from 3 to 12 weeks. Pellets full fed from 12 to 17 weeks		(3) Pellets full fed from 3 to 17 weeks	
	Gain in mean weight lb.	Feed required per lb. gain	Gain in mean weight lb.	Feed required per lb. gain	Gain in mean weight lb.	Feed required per lb. gain
3 to 12 weeks	2 0	6 8	2 16	6 3	7 60	5 3
3 to 14 weeks	3.29	6.6	5 30	4 0	8.00	5 9
3 to 16 weeks	3 64	8 0	6 80	3 0	8 36	6 8
3 to 17 weeks	3 91	8 4	7 70	4.7	9.07	6 7

*In Treatments 1 and 2, the geese were restricted to 1½ lb. of grain per bird per week.
**Up to 3 weeks of age the goslings were fed an identical starter ration, and at 3 weeks were released to pasture.

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pasture would not support growth as well as a complete confinement type ration. However, when the supplementary feed was restricted, the geese on grain compared much more favorably with those on the complete ration. Evidently when feed was restricted, the extra grass consumed compensated for the nutrient deficiencies of the grain. On the other hand, in order to force the geese to graze heavily, feed had to be restricted to the point where growth is retarded.

The precise degree of feed restriction to impose is, of course, dependent on the condition of the pasture. In our pasture experiments at Ottawa, range conditions have varied from poor to excellent. With Pilgrim geese, on good pasture, 1 pound of feed per goose per week up to six weeks of age, and 1½ pounds thereafter, promoted heavy grazing and retarded growth only moderately.

When pasture conditions are very poor, restriction of feed at these levels causes severe growth retardation, and consequently the period on full feed required to bring the birds to market weight is unduly prolonged. An example of this is illustrated in the results of the experiment shown in the accompanying table. In Treatments 1 and 2, the geese were restricted to 1½ pounds of grain per bird per week and they gained only 2 pounds in a seven-week period, while the full-fed birds in Treatment 3 gained over 7 pounds. After 12 weeks of age, the birds in Treatment 1 were full fed on grain and gained only 2 pounds in the next 5 weeks. The birds in Treatment 2 were full fed on pellets and gained over 5 pounds in the next 5 weeks. The pellets used in this experiment contained grain, fish meal, and meat meal and carried 16 per cent protein.

These results illustrate the need for more protein than is supplied by grain if rapid growth in the finishing period is to be obtained. Even so, the birds in Treatment 2 had been so severely retarded that they did not overtake the birds in Treatment 3 in the five-week finishing period. However, it is interesting to note that feed efficiency (pounds of feed per pound gain) was much superior in the birds on Treatment 2 and that even after severe retardation until 12 weeks of age, the geese retained their potential for rapid growth. This makes a program of restricted feeding followed by full feeding feasible.

Experiments currently in progress are designed to determine the minimum levels of protein, calcium, phosphorus, and salt required in the finishing ration. It has already been established that no more than 14 per cent protein is required and that no vitamin supplements are necessary when geese are on pasture.

Studies on the killing and dressing of birds reared on the above programs have shown that they carry a minimum of fat and that no special precautions must be taken to prevent over-fat birds. As a matter of fact, unless the feeding program was adequate, the birds frequently carried too little fat to produce good appearance when dressed.

Another phase of the nutrition program with geese has been devoted to determining their requirements for various nutrients during the 3- to 4-week brooding period when they are reared indoors and are completely dependent on the starting ration for their nourishment. In spite of their extremely rapid growth rate (approximately 1 pound gain per week in the case of Pilgrim goslings) it was found that they do not require more than 21 per cent protein in the diet. This compares with a requirement of 26 to 28 per cent protein for turkey poults and 22 per cent protein for broiler chicks.

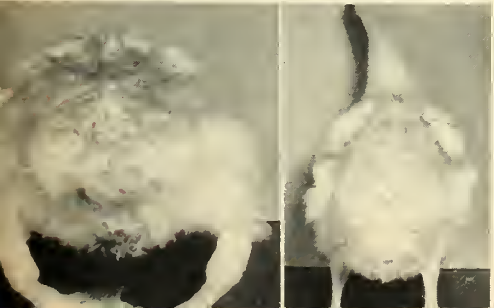
The calcium and phosphorus

(*Concluded on page 14*)

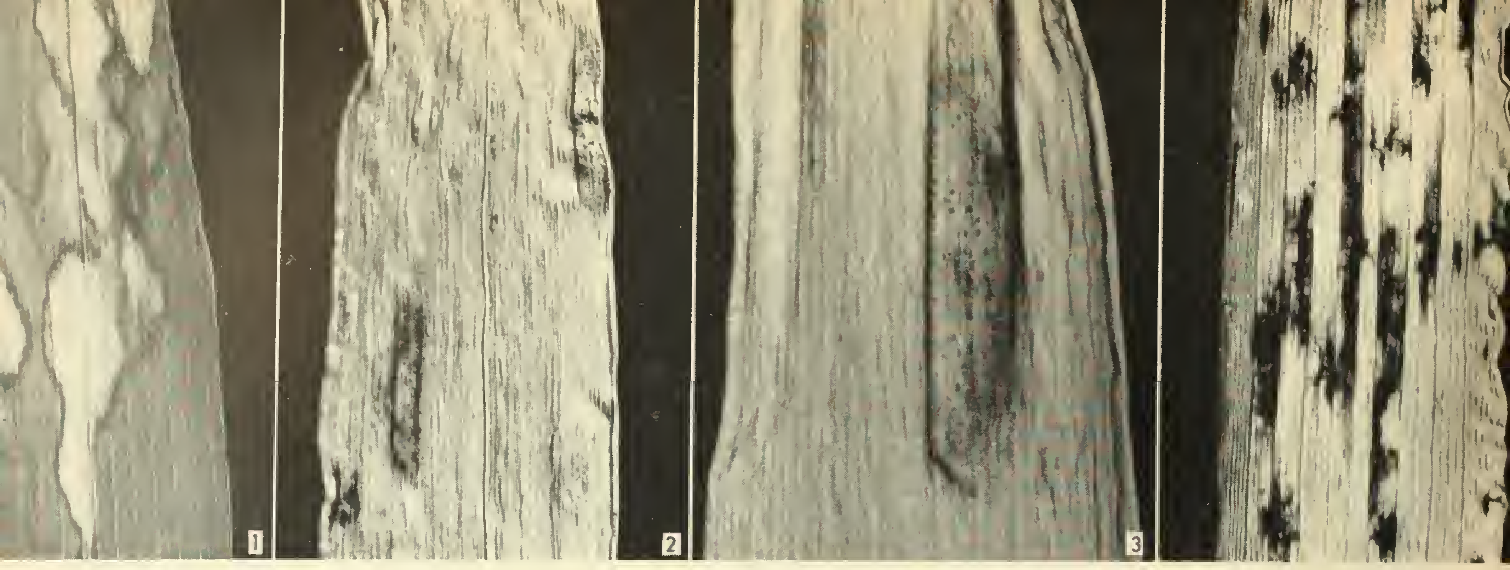
Can Goose Meat Compete?

Geese are seasonal egg layers, producing only for four or five months each spring. Their low egg production has meant high gosling cost. The breeding program at Ottawa has achieved considerable success in increasing egg production. The average production of geese in their first production year has been raised from 14 eggs to 34 eggs over a period of seven generations, an increase of approximately 140 per cent. This is considerably lower production than that of large type turkeys, but in the goose's favor it should be said that production increases during the second laying year and again in the third year. Furthermore, the effort that has been directed to increasing egg production in the goose is infinitesimally small compared with that devoted to turkeys or chickens. Still the results of the breeding program conducted at Ottawa prove that rapid progress can be made, and whether goose meat can be produced as cheaply as other types of poultry only time will tell.

Bowed leg condition (left) caused by a deficiency of niacin; normal (right).



Feeding time on a restricted feeding program.



Symptoms of the common leaf diseases of barley: (1) scald, (2) speckled leaf blotch, (3) enlarged speckled leaf blotch showing numerous small fruiting bodies, and (4) net blotch. (See also bottom page 13.)

Leaf Diseases of Barley

Costly to Growers

W. P. Skoropad

LEAF diseases of barley are numerous and often most conspicuous. Leaf blights reduce the carbohydrate - producing green surface of the plant, decrease vigor, and cause the grain to become shrivelled and light. In a yield trial across the Prairie Provinces in 1957, we found that a complex of leaf diseases reduced yields of barley by 1.8 to 14.4 bushels per acre. Quality as well as yield may be affected adversely, and malting barley may be reduced to poor feed grades.

Most of the leaf diseases are caused by fungi, but some are incited by bacteria, viruses or nonparasitic agencies. In all instances they evoke particular types of spots, blotches, streaks or stripes by means of which the disease may be recognized. Most parasitic fungi and bacteria, and in at least one known case a virus, can survive during the winter on plant debris or seed. This becomes an important factor in considering the cause of outbreaks of the disease and in the methods that can be used to control them.

One factor responsible for the increase of leaf diseases in the Prairie Provinces is the spectacular rise in barley acreage. The 1955 seeded acreage was more than double the 1935-39 average. This resulted in intensification of barley cropping with a consequent reduction in crop rotations. It also led to an extension of barley growing into regions where climatic conditions favored development of leaf diseases, such as, for example, the Peace River area of Alberta. In addition, increased interest in malting barleys resulted in the predominance of such varieties as Olli and Montcalm, both comparatively susceptible to common leaf diseases.

The barley seedling may be infected as it grows past the scald fungus on the lesion at the tip of the chaff.

Another factor in the increase of leaf diseases is the greater use of the combine harvester-thresher, coupled with present cultural methods. Leaf-inhabiting fungi survive on stubble, straw, and leaf fragments. The combine ensures a uniform distribution of these infested fragments over the field, and the shallow cultivation now usually practiced allows the plant debris to remain on or near the surface. This provides the microorganisms with excellent opportunities to infect the young seedlings shortly after they emerge from the soil.

Control measures for most of the parasitic leaf diseases are similar. The causal organisms are harbored in or on the seed, and all of them overwinter in barley residue in the field. Therefore, seed treatment, sanitation, and crop rotation are the main control measures. Crop rotation and an occasional deep plowing will reduce the amount of barley residue

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Spores of the causal fungi (numbers relate to those shown in cuts at top of page 12 and bottom of page 13): (1) *Rhynchosporium secalis*—see scald; (2) *Septoria passerinii*—see speckled leaf blotch; (4) *Helminthosporium teres*—see net blotch; (5) *Helminthosporium sativum*—see spot blotch; and (6) *Erysiphe graminis hordei*—see powdery mildew.

and will aid in decreasing the amount of inoculum which accumulates on or near the surface of the soil.

The ideal means of control of barley leaf diseases is to replace susceptible varieties with resistant ones. This is no doubt the most practical method considering the enormous amount of inoculum now present. Unfortunately, nearly all our agronomically acceptable varieties of barley are susceptible to all or most of the leaf diseases important in Canada. However, in most cases resistance does exist in otherwise undesirable barleys, and although this creates a special problem these resistance characters can be utilized by plant breeders.

Scald of barley is the most damaging leaf disease in this area and plant breeders recognized the need for resistant varieties. To aid them in their work we at the Edmonton Laboratory collected isolates of the causal fungus and made them available in pure culture. Hundreds of barley varieties were then screened under artificial conditions to find suitable sources of resistant genes. Barley breeders now have at least ten varieties with genes showing resistance.

Techniques for establishing a high incidence of scald under field and greenhouse conditions have been developed. Promising hybrid material is being screened and those resistant to scald are selected. Race studies have indicated variability in the pathogenicity of the causal fungus and work is in progress to determine reasons for this. The processes that lead to seed and seedling infection by this fungus have been discovered and control measures for these sources of infection have been partly worked out. We are hopeful that, with this close co-operation, leaf-disease-resistant barley varieties, acceptable agronomically, will soon be available to farmers.

How to Recognize Leaf Diseases

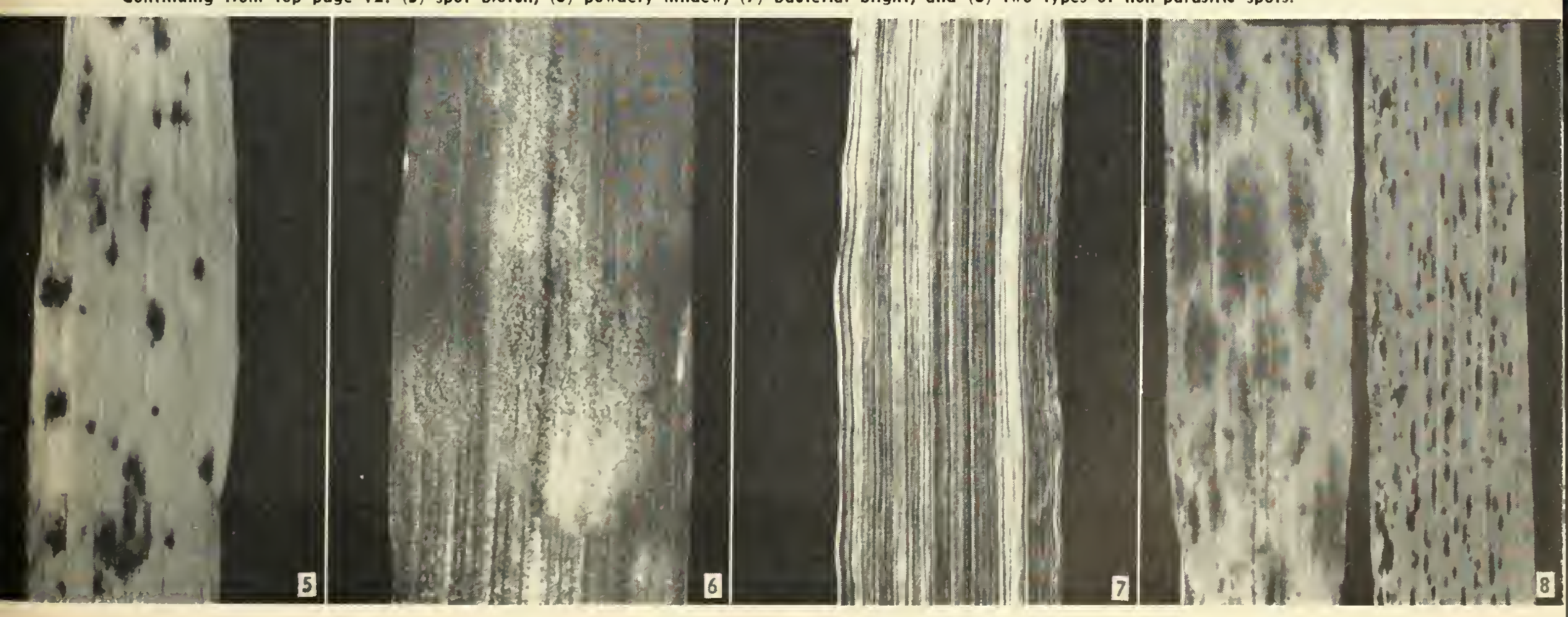
Of the many different diseases of barley leaves caused by fungi, four are troublesome in Western Canada. These are scald, speckled leaf blotch, net blotch, and spot blotch.

SCALD is important chiefly in the northwestern barley areas of the Prairie Provinces, attacking plants from the seedling to the pre-heading stage. Most conspicuous on the leaves, it also appears on the sheaths, seed, and awns as oval or lens-shaped spots, which at first are water-soaked and gray-green. These areas dry rapidly to become light gray in the center with a definite dark brown margin. As the season progresses the diseased areas weaken and shredding of the leaves occurs. A cool growing season favors the disease.

SPECKLED LEAF BLOTCH is prevalent generally but recently has been particularly important in Manitoba. It attacks all parts of the barley plant above ground. During the early stages of growth, the disease is most prevalent on the leaves, producing a straw-like discoloration on which are borne numerous small black fruiting bodies, thus the common name, speckled leaf blotch of barley. Later the disease spreads to sheaths and culms, giving the plant a dirty grayish appearance.

NET BLOTCH is widely distributed in our barley regions. Some of the most severe infestations in recent years have occurred in

Continuing from top page 12: (5) spot blotch, (6) powdery mildew, (7) bacterial blight, and (8) two types of non-parasitic spots.

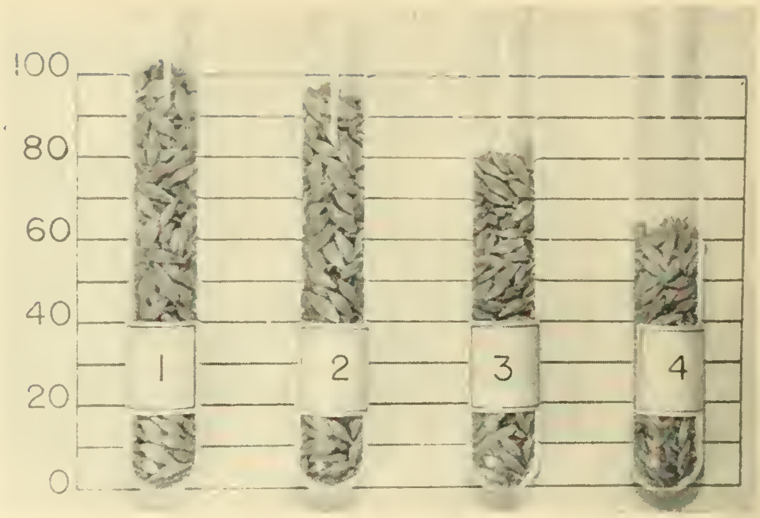


northern Saskatchewan. The blotches appear first as brownish patches which later develop irregular darker brown lines that give the blotch its characteristic netted appearance. Older blotches usually become uniformly brown and lines forming the net are visible only on the margins of the blotch.

SPOT BLOTCH is caused by one of the common root-rot fungi. Leaf infections develop under warm, moist conditions, and damage may be severe. The disease is most important in the eastern part of the Prairies. Dark brown, round to oblong spots with definite margins frequently fuse to form blotches that may cover large areas of the leaf blade and leaf sheath. Infected leaves dry out and mature early. Unlike most other leaf-spotting fungi, spot blotch can attack wheat, rye, and many grasses as well as barley.

The only troublesome bacterial leaf disease of barley is bacterial blight. It is widely distributed and occasionally depresses yield significantly, as it did in south central Manitoba in 1953. Infected plants develop glossy, long narrow stripes on the leaves. These stripes, which appear first as pale green areas, later become water-soaked and exude small drops or a film of a sticky bacterial substance which dries to a thin flaky layer. During later stages the disease is recognized by translucent areas that are easily observed when the leaf is held up to the light. This is a seed-borne disease, but the bacterium may also be carried over winter on barley remains or infected grasses. The disease is favored by wet weather, and is spread by rain and insects.

In addition to the above leaf diseases there are those that are caused by viruses (RfF, Winter '57). Unbalanced supplies of available minerals in the soil, hereditary factors, and unfavorable weather may also cause leaf disorders. An example of this is the physiologic brown spot which can be mistaken for spot blotch.



Effect of leaf scald on the yield of barley grown in the greenhouse. The degree of pre-heading injury was: (1) none, (2) light, (3) moderate, and (4) severe.

Has the Goose a Future? . . . *from page 11*

requirements have been investigated extensively. The calcium requirement ranges from 0.4 per cent to 0.6 per cent of the diet, depending on the season. With advancing season, the requirement appears to rise. This compares with the 1 per cent level recommended for chicks, and studies are under way to try and explain this species difference. Not more than 0.4 per cent total phosphorus in the diet is required, of which one-half is in inorganic form. This again is considerably lower than the 0.6 per cent recommended for chicks.

In repeated tests with a vitamin D-free diet, using goslings hatched from a normal breeding flock, we could find no evidence of a need for vitamin D. These goslings were reared in a windowless house with no exposure to sunlight. Only when an adverse calcium-phosphorus ratio was employed, or when the goslings were obtained from breeding geese fed a diet free of vitamin D, was it possible to demonstrate a deficiency. It therefore appears that under practical conditions there is no need for the addition of vitamin D to a goose starting ration.

The vitamin A requirement of goslings has been found to be approximately the same as that for chicks, whereas the riboflavin requirement is somewhat higher. When a diet deficient in niacin is fed, growth depression occurs followed by the bowed leg condition as illustrated. These symptoms do not occur when the niacin content of the diet is 20 mg. per pound or more.

Fungicides for the Apple Orchard . . . *from page 5*

damaging orchards where organic fungicides have replaced the sulphurs. Modifying the spray program by including a small amount of sulphur may solve the problem. Some progress has already been made in developing materials specific against powdery mildew, and we have tested a few at St. Catharines. No matter what means may later be adopted to control this disease, the fungicides now used on apples must be evaluated for their effectiveness against both apple scab and powdery mildew.

The spray calendar for apples in Ontario is reviewed each year and its recommendations are based on the results of practical field tests. For scab the calendar emphasizes the protectant program but suggests the use of the eradicant organic mercurials under special circumstances early in the season. It is axiomatic that good control of primary infection simplifies the subsequent protection of the fruit.

R.O.P. Moves with the Times

Changes in Policy Stress Life-time Production and More Accurate Comparisons Between Cows for Sire Appraisal

Dairy cattle improvement through production testing, is taking on new significance as a result of recent changes in the methods of operation. Shifting of emphasis from the single, high production record to lifetime production records on a whole herd basis has enhanced the value of the records. Adoption of modern techniques has facilitated the processing of the information so that production records can be made available much more quickly than in the past.

The Record of Performance test (R.O.P.) started out under rules that enabled a breeder to enter selected cows in his herd to be tested in a 365-day period. Milk weights were recorded daily and authenticated by periodic visits by an R.O.P. inspector. To qualify in R.O.P., a cow had to produce a standard amount for her age and produce a calf within 15 months. A 305-day test with an annual calving requirement was introduced in the 1920's and is now in more common use.

In the last ten years there have been noteworthy changes in this testing policy. The inspectors' visits were reduced from two days to one, thus enabling more herds to be enrolled and greater frequency of inspection. Breeders were required to present whole herds for test, thus making available information on both good and old animals, and permitting a greater degree of selection or culling to improve the herd. Most important of all was the adoption of Breed Class Averages (B.C.A.) as a method of appraising the productivity of a dairy cow.

The B.C.A. are determined by the various breed associations and the standards are based on actual production records of cows over a number of years. Under the testing method currently in use, a cow is indexed for her production expressed as a percentage of the average for her breed and age. The average 305-day production of a six-year-old Holstein cow on twice-a-day milking is 11,903 lb. milk and 437 lb. fat. One that produces 12,877 lb. of milk and 476 of fat would have a B.C.A. of 108 for milk and 109 for fat. The B.C.A. system enables heifers to be compared with mature cows. Naturally, the mature cow is expected to produce more but reference to B.C.A. indices will show up the superior individuals.

To provide help in formulating policies for the testing program, the Department has established an Advisory Board with members drawn from breed association officers, professors of animal science at the colleges and universities, together with departmental officials. Recent recommendations of the Advisory Board called for basic changes in R.O.P. policy: (a) to enable greater emphasis on life-time production and (b) to enable much more accurate comparisons between cows to be made for sire appraisal or herd improvement purposes. The first recommendation meant that more complete records would have to be taken; the second that the records must be kept in such a manner as to facilitate their interpretation and use.

To meet the first recommendation it was necessary to re-assess the periods on which records were kept. It was felt that the truly great cow is one that freshens every year and produces a quantity of milk to old age, rather than one that has a few very large records with lengthy dry periods between. Previously the production of less than 182 days was not credited, nor was the production recorded *after* 365 days. In order to give credit for life-time production provision was made for the complete lactation to be credited.

The second recommendation has been met by having all permanent records kept on mechanical office equipment. When a final lactation report is sent in to Head Office the pertinent information is punched and the lactation certificate is produced by the mechanical equipment. Through the use of punch cards it is now possible to show previous records in addition to the one just completed. Tabulations are made in such a way that it is possible to compare the performance of cows within a herd or between herds.

No bull in use today at an Artificial Insemination Unit is without R.O.P. testing credentials. This is the first requisite of selection. The new tabulating techniques make accurate records of ancestry and progeny more readily available and more easily interpreted. Every effort is now being made to use the testing information to prove sires that are used artificially.

Prolific — Antelope — Dominant — Tetra Petkus

Improving our Winter Rye Varieties

A. G. O. Whiteside

IMPROVEMENT of winter rye varieties grown in Canada has been brought about mainly by introduction from other countries, selection of superior strains, and widespread testing under Canadian conditions. We have relied on introductions mainly from Continental Europe where, unlike Canada, rye has been an important bread grain for centuries. At many institutions in that region the breeding of rye is given high priority and it is from these programs that we obtain new varieties for trial in this country. A continued search for new types is being made and many new varieties have been introduced recently from Russia where climatic conditions are similar to those in Canada. Small lots of seed are increased under isolation and those of promise are fed into the uniform variety testing trials.

From 1938 to 1942 a collection of winter rye varieties was tested in uniform trials at several Experimental Farms in Western and Eastern Canada. In 1954, uniform trials both in Western and Eastern Canada were organized under the Associate Committee on Plant Breeding and the Eastern Canada Cereal Testing Committee, respectively, with Swift Current and Ottawa co-ordinating the tests. In these studies new varieties have a wide range of climatic conditions to give expression to their good or bad characteristics, and varieties suitable for different areas have been revealed.

More recently a Project Group on Breeding Winter Rye for the Prairie region was organized. It involves the Canada Department of Agriculture Experimental Farms at Swift Current and Lethbridge and the Universities of Saskatchewan and Alberta. Plant breeders at the four institutions meet periodically to review progress at each institution and to discuss methods of procedure in a co-ordinated effort of rye improvement. In this region, winter hardiness is most important and this, along with improvements in yield per acre and in quality of grain, is stressed. Rye breeding requires a different method of approach than that used for wheat, oats, or barley owing to the open-pollinated nature of its flowering habit, and thus special isolation procedures are needed to carry on an adequate hybridization program.

Of the varieties now grown in Canada, Dakold, selected in North Dakota and introduced to Western Canada by the University of Saskatchewan proved to be the best winter rye variety for the prairie region owing to its exceptional winter hardiness. It held this position until 1953 when Antelope was selected by the University from a Swedish variety, Crown. Unlike Crown, Antelope excelled in winter hardiness and is an improvement over Dakold in yield and kernel appearance. Petkus, developed in Germany, and Sangaste in Estonia, are two recently licensed varieties that have a place in areas of the Prairies where the extra winter hardiness of Antelope or Dakold is not required. Under these conditions they will give better yields and produce larger and more uniform grain.

In Eastern Canada, several varieties have been grown. Rosen, followed by Imperial and Horton, have been good varieties. Horton, a selection made by Macdonald College, has the characteristic of beginning growth early in the spring and has been an important variety in the tobacco areas in a rotation of rye and tobacco. Tetra Petkus, a tetraploid rye developed in Germany has found favor in Ontario, especially on rich soils. It has stiff, coarse straw and very large kernels. Dominant, a variety bred in Holland, has given excellent yields in the Eastern Canada Co-operative Test, especially at Nappan, Nova Scotia. It has large kernels of fine appearance and its straw is shorter and stronger than the straw of the older varieties, Horton and Imperial. Dominant was licensed for sale in April, 1958.

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