Research
FOR FARMERS

SPRING-1957

Parasites, Predators and Poisons

Probing the Secrets of Stone-Fruit Viruses

Livestock and Poultry Feeds from the Sea

What's Happening to Flax

Orchard Grass Gaining in Popularity

CANADA DEPARTMENT OF AGRICULTURE

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Ottawa, Ontario

Rt. Hon. JAMES G. GARDINER, *Minister*
J. G. TAGGART, C.B.E., *Deputy Minister*

NOTES AND COMMENTS

The never ending search for better varieties keeps plant breeders busy. Heavier yield, improved quality, greater resistance to disease and insect attack, or better regional adaptability are some of the characters sought in the development of new varieties. Amongst recent introductions of the Department are two oat varieties, Shield and Fundy, and a new soybean, Crest. Shield, an early, disease-resistant sort selected at the Kapuskasing Experimental Farm, matures about a week ahead of Ajax and is particularly well adapted to northern and eastern Ontario and adjacent areas of Quebec. Fundy, an offspring of Ajax and Abegweit, ripens two to three days ahead of Ajax, yields almost as well as Abegweit but has better straw. It is adapted to Maritime areas where earliness is important. Both these oat varieties are being distributed for sowing this spring. Crest soybean is a promising variety that does well in southern Manitoba. Richer in oil content than varieties now grown in the area, Crest yields well and carries its lower pods well above the ground, facilitating harvesting.

* * *

It sometimes happens that a variety developed for use in a certain area gives unexpectedly good results in other distant areas. Selkirk wheat, for example, was bred for use in the rust area of Manitoba and eastern Saskatchewan but it is showing promise in many parts of Eastern Canada. Parkland barley, designed for growing on the prairies has shown up so well in eastern tests that it is being distributed in the East this spring. Still another variety, Abegweit oats, a maritime favorite produced at the Charlottetown Experimental Farm, has gone west and is now recommended for the Peace River district of Alberta.

* * *

Cattle ranching may never again take over the western plains but recent results have shed new light on the possibilities of pasture as a competitor of wheat in the West. An experiment in progress at the Melfort Experimental Farm in northeastern Saskatchewan for the past two years showed an average advantage of nearly $12.00 per acre over wheat grown on summerfallow. Pastures seeded to mixtures of alfalfa and brome grass or alfalfa and intermediate wheat grass, grazed by yearling steers, produced gains worth a net value of $32.90 per acre. Wheat grown on fallowed land of the same type gave an average net return of $21.40 per acre.

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Our cover picture shows flax test plots at the Central Experimental Farm at Ottawa. See story on page 12.

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PARASITES PREDATORS and POISONS

A New Approach to an Old Problem in Orchard Pest Control

A. D. Pickett

THE widespread belief that all insects are bad insects is both incorrect and unfortunate. This is particularly so in the case of tree fruits where pest control is essential yet where fruitfulness depends on cross pollination, largely by insects. With annual and biennial crops, rotations may be useful in cutting off the food supply of pests and so providing a measure of control. But with tree fruits which may be maintained in the same location for 50 or more years this is not possible. Thus in orchards the pest problem must be dealt with on a long-term basis and in a way that will control destructive insects yet maintain beneficial ones.

To help understand their role in the economy of an orchard we may divide insects into three general classes. First, there are the destructive species which either directly damage the fruit, or attack the tree or its foliage in such a way as to interfere with its fruitfulness or the appearance or quality of the fruit. Second, there are beneficial insects, the pollinators as well as the parasites and predators that destroy pests. Third, there are innocuous kinds neither directly beneficial nor injurious. Some of these may be indirectly beneficial in that they serve as prey for beneficial species and thus help to maintain substantial populations of the latter.

All species of animals have the capacity to reproduce at a rate higher than is required to maintain a steady population. As the population of any species increases beyond the optimum the hazards of its existence increase. In some cases the food supply may be the limiting factor; protective hibernating sites may not be numerous enough; excessive numbers may result in attacks by predators that normally do not feed on them; or disease organisms may start epidemics that would not be supported by normal populations.

Above: Predacious bug feeding on a caterpillar.
Below: Author examining apples with hand lens for predacious insects.

Many other hazards are encountered by high populations that are not operative at what are regarded as normal levels. Although the factors that tend to provide limits to the density of a species do not operate uniformly, and their mechanisms are imperfectly known, they are nevertheless real. This becomes evident when we destroy these factors, either unwittingly or by design. Natural control mechanisms may of course allow the density of pest species to rise to the point where economic damage may be severe; but we must realize that man's welfare is not the only factor with which nature may be concerned.

The relative importance of the various mechanisms that limit animal populations is in dispute. It is probable that these vary widely from species to species or from place to place, and broad generalizations may be misleading. Nevertheless, rather intensive field studies at Kentville supported by 30 years of personal field observations have led me to believe that biological control agents, such as parasites and predators, are extremely important factors in preventing insect outbreaks. In fact the extensive use, in recent years, of pesticides that are highly destructive to a wide range of species including parasites and predators have created

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almost as many problems as they have solved.

About 20 years ago Dr. W. S. Hough of Virginia discovered that the codling moth had developed resistance to lead arsenate. This appeared to be an adequate explanation for the difficulties experienced by fruit growers in controlling codling moth in most apple and pear growing districts. Futhermore, the fact that the multiplication of resistant strains of insects may be encouraged by the intensive use of chemicals misled fruit growers and entomologists alike into thinking that the failure of previously satisfactory control measures could be accounted for on this basis. However, studies here and elsewhere have shown conclusively that the destruction of parasites and predators may be a more important factor in creating pest outbreaks than is the establishment of strains of pests that are resistant to pesticides. The problem becomes still more complex when both phenomena occur at the same time. This is the situation that developed in connection with the codling moth when a combination of sulphur fungicides and lead arsenate destroyed many important natural enemies of the moth and, at the same time, promoted the development of a strain resistant to the insecticide.

Wartime research initiated the development of many valuable pesticides, including DDT, BHC., parathion, and a host of others. All of these have given outstanding performance in the initial control of pests, although, on the other hand, they are detrimental to the majority of the beneficial species. The problem facing research workers is how to resolve this anomaly—how can we use pesticides so that satisfactory control will be achieved without creating additional hazards through the destruction of beneficial species?

In Nova Scotia we have attempted two lines of approach. First, we have made an effort to select pesticides that are the least destructive to beneficial species and, second, we have studied the timing of applications and the minimum dosages required of the pesticides in current use. Much more work on all aspects of these problems is required but we can

Cocoon of a parasite attached to the cankerworm from which the parasite emerged.

report substantial progress from both lines of attack.

The Nova Scotia grower today is able to maintain, and in many cases improve, the standard of quality of his fruit at a lower cost for spray chemicals than he could ten years ago despite the general increase in prices of pesticides. Sulphur, dormant oils, dinitros, chlorinated hydrocarbons, and organo-phosphates have been greatly reduced or entirely eliminated from the spray schedules during this period. Sulphur has been replaced by glyodin, captan, or the organo-mercuries and the insecticides by nicotine sulphate and ryania. The latter is used principally for the control of the codling moth for which it is highly effective, but at the same time it is innocuous to many beneficial species.

In respect to timing and dosage, lead arsenate is not so harmful to beneficial species when used late in the season as in the early sprays and, therefore, it may be used against such pests as the apple maggot. Also, it has been found that DDT may be successfully used at the rate of one or two ounces per 100 gallons of spray for the control of cankerworms, tent caterpillars, and fruitworms. At this low rate it reduces some of the beneficial species but does not eliminate them. And where only one application is used during the season the population will soon recover.

Where growers have been following an intensive chemical control program for some years the beneficial species are likely to be pretty well eliminated, especially if such a program has been carried on in a large area. In such cases, the pest species have usually increased much more rapidly than the beneficial ones and severe damage may result before a balance can be established. In order to avoid this, population trends of both pest and beneficial species must be studied by competent observers and if the pests get out of hand sprays designed to reestablish a balance must be used. In Nova Scotia this has been found to be both possible and practical but time, patience, intelligence, and an appreciation of the intricacies of nature are required to make a success of this approach. I am convinced, however, that research workers will never be able to write a reliable, foolproof schedule that will be economical, and give the protection desired on the basis of chemical control alone. Enough problems have already arisen to convince the most ardent chemical control enthusiast of this, and the sooner we learn what compromises have to be made between biological and chemical control the sooner will we develop dependable and economical control programs.

Entomologists collecting and recording predacious insects which were jarred from foliage onto tray.

Portable field growth cabinet for winter injury studies, designed and built by Field Husbandry Division, Ottawa.

J. W. White,
R. M. Holmes,
W. Kalbfleisch,
G. W. Robertson

WINTER INJURY RESEARCH

New Portable Growth Cabinet May Shed Light on Problem

To facilitate study of the relation between winter conditions and plant injury, agricultural engineers at the Central Experimental Farm, Ottawa, have pioneered the construction of a field growth cabinet. This cabinet provides summer conditions during the winter on field plots five feet square. It is portable, with four walls and a roof but no floor or base.

When operated in the field, the air temperature in the cabinet can be maintained at 70 degrees, while the outside temperature may range to 35 degrees below zero. A ceiling panel of 34 fluorescent tubes provides sufficient light for plant growth. The design of the cabinet includes provision for automatic electrical devices to control lights, temperature, and ventilation. In addition, the lights can be adjusted to increase or decrease intensity and the light panel can be lowered to near the ground level when required.

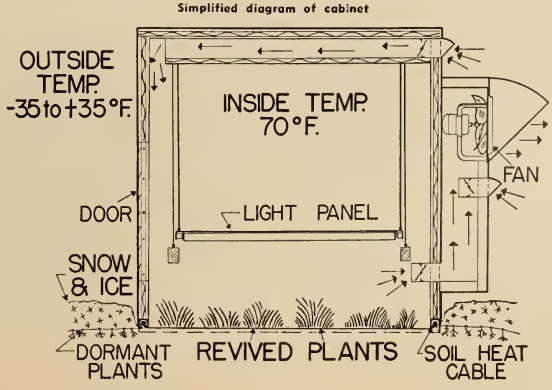
Thermostatically controlled electric heaters maintain the temperature at any desired level. Around the base of the cabinet a soil heating cable keeps the soil warm near the edge of the structure. An exhaust fan removes excess moisture and supplies fresh air for plant growth. A side compartment contains electrical switches and ballasts for the lights.

When the cabinet is placed over a plot in winter, it melts the ice and snow, thaws the soil, and the walls settle one inch into the ground. Heat supplied within the field cabinet warms the soil to 50 degrees or more and thereby stimulates plant growth. Since this cabinet is portable it can be moved from plot to plot at selected times during the winter. When the plants that have survived have been studied at one location, the cabinet can be moved to a new plot for another test.

Through studies made possible by this growth cabinet it is hoped to isolate the factor or factors responsible for winter-killing of field crops. Such basic information could indicate the advisability of adopting cultural practices that minimize the danger, or of breeding varieties less susceptible to the particular factor involved.

Again, if the factors responsible for winter injury can be isolated, a study of weather records over past years might indicate that these factors recur so frequently in particular districts as to make certain crops uneconomical. It is hoped, too, that the portable growth cabinet may yield information that will throw light on some of the problems encountered in the development of northern agriculture.

Simplified diagram of cabinet



Messrs. White and Kalbfleisch are Agricultural Engineers and Holmes and Robertson are Meteorologists—all with the Field Husbandry Division, Central Experimental Farm, Ottawa.

PENICILLIN

Poses Dairy Processing Problems

C. K. Johns

PENICILLIN does a good job of killing the organisms causing mastitis in dairy cattle. This is especially true with the most common type, *Streptococcus agalactiae,* which is responsible for chronic contagious mastitis. Consequently, it is widely used for this purpose the world over.

If penicillin confined its activity to destroying mastitis organisms, everyone would be happy; but unfortunately, it is not sufficiently selective in its action. The lactic acid streptococci, essential to the production of cheese, buttermilk, etc., are also very susceptible to penicillin. Even one part of penicillin in 30 million parts of milk may be enough to cause trouble, and trouble has been reported from all the major dairying countries. The illustration shows a rather extreme case. This cheese, made from milk containing penicillin, is so badly affected as to be unsalable. In other cases the bulk starter for cheesemaking fails to develop sufficient acid, or cultured buttermilk or cottage cheese is spoilt through a lack of acid development. Consequently dairymen are concerned over this problem, especially since the dosages recommended for treating mastitic quarters have risen steadily.

Practically all the penicillin introduced into the udder comes out in the milk. The concentration is greatest at the milking following treatment, falling off with each succeeding milking. Where it is carried in an oil or an ointment base, the release of penicillin into the milk is retarded, and it can be detected in the milk for a number of days after treatment.

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For practical purposes, however, it is usually considered that after the sixth milking the concentration of penicillin will be too low to cause trouble.

If those using penicillin and other antibiotics to combat mastitis always followed directions, there would be no cause for concern. The law requires that the label of any antibiotic sold for the treatment of mastitis shall carry a warning to the effect that *milk from treated quarters should not be used for human consumption or marketed for the making of cheese for at least 72 hours after the last treatment.* Unfortunately, this warning is frequently ignored. Because milk from a treated quarter usually *looks* normal shortly after treatment, many milk producers assume that it *is.* This is definitely not the case. Besides the trouble penicillin may cause in cheesemaking, small concentrations of penicillin in milk are dangerous to humans. Penicillin is not destroyed by pasteurization, or even by boiling, and people drinking milk containing it may, if they are sensitive, show a reaction which could in some cases be fatal.

What can be done to meet this problem? In some countries, penicillin is available only through a veterinarian. When he treats a cow with it, the veterinarian is required by law to notify the plant to which the milk is normally shipped. In North America, where there are no such restrictions on the sale of penicillin and other antibiotics for the treatment of mastitis, reliance must be placed chiefly on informing farmers of the problem. If farmers realize that it is bad business all round to ship milk from treated quarters within the 72-hour period, there will be little trouble from penicillin in milk. In Wisconsin, a campaign carried on for some years by extension workers from the University appears to be bearing fruit. Samples picked up there by the U.S. Food and Drug Administration last year showed a much lower incidence of penicillin than did those from states where no such campaign had been carried on.

If the appeal to reason fails, it may be necessary to resort to sterner measures. Public health authorities in Canada and in the United States regard milk containing any detectable amount of penicillin or other antibiotic as being adulterated, and legal action may be taken against anyone shipping such milk. If the reasons for prohibiting the shipping of milk containing antibiotics were better known, probably few milk producers would run the risk of court action and condemnation of their milk through failure to follow the directions. No effort should be spared, therefore, to get the full story to each milk producer.

Cheese made from milk: (I) free from penicillin, (II) containing penicillin.

(Photo courtesy of Miss H. R. Chapman, National Institute for Research in Dairying, Shinfield, Berkshire, England.)

Electron micrograph of necrotic ring spot virus, purified by the n-butonol method. (30,000 X)

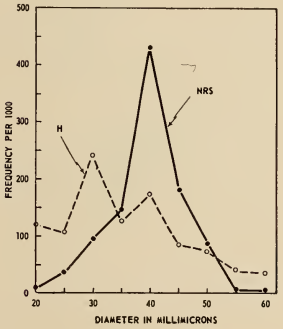
Probing the Secrets of Stone-Fruit Viruses

Electron microscope proving useful research tool in providing reliable, faster supplemental methods of detecting latent infections

R. S. Willison

STONE fruits, like other crops, are menaced by virus diseases. Peach yellows, the first such disease known, has been reported in outbreak form from time to time since 1791, although its virus origin was not recognized until about 50 years ago. Similarly the effects of other stone-fruit virus diseases were observed for many years before their cause was known. Indeed the existence of plant viruses was not suspected until 1892. Besides, the stone-fruit viruses, unlike many of those attacking other plants, are not easily transmitted mechanically. The life-span of the tree fruits and the necessity of their vegetative propagation add further to the seriousness of the problem and to the complexity of its solution.

In the late 1930's, the demonstration that cherry yellows and sweet cherry mottle leaf were virus infections sparked a widespread interest in the problem.



Above: Particle size distributions in extracts prepared by differentiol centrifugation from cucumber leaves healthy (H) and infected with necrotic ring spot virus (NRS).

Below (pairs left to right): Shock symptoms of necrotic ring spot on sour cherry; green ring mottle on sour cherry; and cherry yellows on sour cherry.

Since that time many virus diseases affecting cherries, plums and peaches have been found and investigated. It seems likely that the flood crest of discoveries of "new" virus diseases in stone fruits has passed, although there may be more to come. Attention is now turning increasingly towards a better understanding of the known diseases and the viruses that cause them.

Major problems center around diagnosis in relation to the detection of the diseases in the orchard, and the development and maintenance of virus-free stocks. Diagnosis is comparatively simple in cases where symptoms or their after-effects are definite and persistent, for example with peach yellows in peach, prune dwarf in Italian prune, or some of the mottle-leaf diseases of sweet cherry. The effects of such diseases are usually so obvious that affected trees can be recognized and either rogued from the orchard as useless or rejected for purposes of

Dr. Willison is a specialist in virus diseases of stone fruits and is attached to the Department's Plant Pathology Laboratory at St. Catharines, Ont.

propagation. With other diseases, diagnostic symptoms are either transient, as with cherry yellows in sour cherry, or non-recurrent as with most forms of necrotic ring spot in sour cherry and peach. Trees with this type of disease appear to be normal at the time bud-sticks are collected and are often propagated unwittingly in the nursery.

Diagnosis is also complicated by the fact that most of the viruses causing recognizable diseases in some species or varieties of stone fruits can be carried more or less latent in others. Latent infections are important in the orchard chiefly as a potential menace to nearby susceptible varieties. In the nursery, they are of even greater significance because many of them cause both a marked reduction in the "take" of buds or grafts and a lack of vigor and uniformity in the budded stock.

The detection of latent infections at present depends on indexing by budding or grafting the suspects to susceptible indicator hosts. These indexing procedures can become complex and space-consuming, particularly in large-scale operations with two or three indicator hosts. Moreover, a waiting period of about eight months is usually required before results can be recorded. Because of the need for reliable but faster supplemental methods of detecting latent infections, it was felt that the search for such methods could be furthered, directly or indirectly, if more were known about the nature and properties of the causal viruses.

Since most of the information on stone fruit viruses has been based on field studies of the induced diseases, a new approach was considered advisable. This was made possible by the advent of the electron microscope and the discovery of new laboratory techniques. Accordingly, in 1951, the Plant Pathology Laboratory at St. Catharines commenced an investigation of the physio-chemical properties of the viruses associated with the cherry-yellows group of diseases. The discovery by Wisconsin workers that some of these viruses could be mechanically transmitted to cucumber, provided a ready means of assaying the infectivity of plant extracts and of locating the virus during the process of separating it from other components of the expressed sap. The cherry-yellows group was chosen also because of its marked tendency to latency and because of obscure relationships between the virus agents causing the several symptom complexes. The group is characterized not only by the ability of the associated virus or viruses to infect cucumber, but also by shock symptoms of varying degrees of severity on sour cherry. On the other hand the group can be divided into at least five distinct diseases: cherry yellows, green ring mottle and necrotic ring spot of sour cherry, tatter leaf of sweet cherry, and prune dwarf. It remained to be decided whether the five diseases are caused by different strains of the same virus, by different complexes having the necrotic ring spot virus in common, or by different viruses.

Strap-shaped, "pebbled" leaves of Italian prune caused by prune dwarf.

Early attempts to purify the cherry yellows and necrotic ring spot "viruses" by chemical precipitation were unsuccessful, but, early in 1953, they were partially purified in viable form from cucumber by centrifuging at high and low speeds alternately. The resulting extracts proved to be satisfactory for electron microscopy even though they contained particles of non-virus origin. Since 1953, "viruses" associated with other diseases in the group have also been purified.

Purification from *Prunus* tissues is complicated by the presence of tannins or oxidized polyphenols that not only blacken the extracts but also precipitate and inactivate the virus. The difficulties caused by these interfering substances have been overcome. It is now possible to obtain final extracts that are colorless and slightly opalescent as well as infective, when flower petals are used as the virus source. Young peach leaves are equally suitable. Cherry leaves, on the other hand, contain quantities of mucilaginous pentosans, which are difficult to eliminate. The virus can be detected in the cherry leaf preparations by means of the electron microscope, but appears to be prevented by the mucilage from entering the plants used in the bioassay for infectivity.

Because non-virus elements are included in the virus preparations, electron microscopy of the stone-fruit viruses has had to include a parallel study of extracts similarly prepared from comparable healthy tissues. All preparations, whether from healthy or virus-infected sources, were found to contain particles approximately spherical in shape and in much the same size range. Each preparation, however, has its own characteristic particle size distribution pattern, determined from several hundred measurements per sample. Extracts of healthy cucumber leaves, cherry petals and peach leaves and petals have similar patterns, with a series of modes or peaks at 10mμ (millimicron) intervals. On the other hand, in extracts from similar sources infected with single viruses, particle sizes are distributed about a single mode representing between 40 and 50 per cent of the particles measured. Examples of normal and virus distributions are shown in the accompanying graph. By comparing the two types of distribution it is possible to estimate the proportion of non-virus particles in a given virus sample and to deduce the approximate size of the virus particles.

Each of the viruses examined so far, with two exceptions, has exhibited essentially the same size distribution pattern whether purified from *Prunus* or from cucumber sources. A given virus, however, may differ in size from other viruses even those associated with what appears to be the same dis-

(Concluded on page 11)

The affal from this catch will be manufactured into fish meal and other by-products. Investigations at Nappan show that special fish by-products, such as "fish silage", can be used to replace fish meal in a standard hog ration (right inset). Fish silage (left inset) has consistency of a heavy viscous liquid, and a dry matter content of about 25 per cent, which when neutralized with a finely ground limestone may be fed to animals and poultry. (Fishing boat photo courtesy N.S. Film Board.)

Livestock and Poultry Feeds From the Sea

T. M. MacIntyre

AND

C. D. T. Cameron

THE utilization of products of marine origin as feeds for livestock and poultry is a major part of nutritional investigations at the Experimental Farm, Nappan, Nova Scotia. The sea is capable of yielding a wealth of materials suitable for feeds, but Canadian scientists and farmers have been slow to realize their value.

Although the by-products of the fishing industry are now firmly established as superior sources of proteins, vitamins, minerals and other growth factors for livestock and poultry, not all fish meals are equal in nutritive value. Studies of 40 different samples of fish meal at Nappan reveal that the biological value varies considerably. Variations occur between meals made from different species of fish, between meals made from the same species of fish at different manufacturing plants, and, indeed, in the products of the same manufacturing plant at different times. The cause of this variation in protein quality has not yet been determined.

The authors are with the Experimental Farm, Nappan, N.S. Mr. MacIntyre is a specialist in Poultry Nutrition and Mr. Cameron is engaged in Livestock Nutrition and Breeding.

There are two principal types of fish meal, (1) oily fish meal produced from the so-called oily fish such as salmon, pilchard (sardine), tuna, mackerel, menhaden, and herring, which store their oils throughout their entire body, and (2) non-oily fish meal produced from such fish as cod, haddock, pollock, hake, and cusk which store their oils principally in the liver.

Other Types of Meal

In addition to these two principal types there are other meals produced in commercial quantities such as whale meal, shark meal, and shellfish meals. The use of whale and shark meal is limited and their nutritional value has not been fully assessed. Shrimp, crab, and lobster meals are being manufactured in limited quantities. They are high in ash and low in protein and are not so good a source of protein as fish meal. Since fish meal is not sold exclusively on a weight basis but on the basis of its protein (nitrogen) content, excessive bone, such as is found in shellfish, or excessive oil, as in oily fish, is undesirable.

Lobster meal is the only shellfish meal of importance in Canada. A large quantity of refuse from lobster canning operations is available annually along the Atlantic coast. At the factory lobster refuse is normally separated into four sections; head, brisket, tail, and large claws. These vary in protein and ash content and a meal made from each section of body waste was compared with meals made from various combinations of these. It was found that the large claws were very high in ash and should be left out of lobster meal. A meal made from the brisket, head, and tail sections was a good source of protein for chickens and about equal in value to soybean oil meal.

Besides their use in protein feeds, shellfish make a contribution to animal nutrition by supplying calcium to the ration. Oyster shell has been used for many years as a source of calcium for hens. Work at Nappan has shown that clam shells and limestone are equal to oyster shells as a source of calcium for growing chickens and laying hens. Limestone which is used in large quantities as a source of calcium in animal feeds is largely of marine origin.

Waste Problem

In spite of the fact that fisheries by-products generally have been shown to be valuable sources of proteins, minerals, and vitamins, a vast quantity of fish offal and viscera is still considered waste by our fishing industry. This waste occurs in filleting, fish meal, and fish oil processing plants. Much fish is cleaned at sea and the guts thrown overboard. In many cases small filleting plants do not have volume enough to warrant setting up drying facilities and the offal is wasted. Material in solution or suspension in the liquor ("stick water") obtained on cooking and pressing fish in the drying and oil recovery processes is frequently wasted. The liver residue from the manufacture of fish liver oils is rarely recovered.

In an effort to salvage these materials research has been directed toward the use of undried products. "Stick-water" is concentrated to about 50 per cent solids and sold as "condensed fish solubles", a product rich in B vitamins and other growth factors. To preserve fish offal at small filleting plants without drying, a method has been employed using sulphuric acid as a preservative. The result is "fish ensilage", a heavy viscous liquid with a dry-matter content of about 25 per cent, which when neutralized with finely ground limestone may be fed to animals. This material is stable for months and may be fed to hogs and poultry as the only source of animal protein.

Fish Silage Affects Flavor

In trials at Nappan, fish silage was fed to hogs with the grain mixture in the growing and finishing rations, the required amount of limestone being added at the time of feeding. This material was readily accepted and the animals that received a daily silage allowance sufficient to balance the protein in the grain mixture made rapid and efficient gains. Pigs that received all the silage they would consume gave unsatisfactory results. There was some evidence of an off flavor in carcasses of hogs that received fish silage to the time of slaughter, Trials are in progress to determine the period of growth during which fish silage may be fed without affecting the flavor of the meat.

Studies with chickens show that fish silage may be fed from one day old to maturity. With chickens over four weeks of age the silage is most conveniently fed free choice. It was found that chickens and hens would eat sufficient silage to satisfy their protein requirements when fed silage free choice, with a feed mixture low in protein. There was some evidence of a fishy flavor from the flesh of chickens fed fish silage, but no off odor or flavor was noted in eggs laid by hens fed fish silage. Until the results of further studies are available it is recommended that the feeding of fish silage be discontinued at least one week before the birds are slaughtered.

Dried Viscera and Liver Meal

Two new by-products of the fishing industry—dried fish viscera, and fish liver meal—are being investigated, as sources of protein, vitamins and other growth factors. Dried fish viscera is high in nitrogen most of which is in the form of peptides and amino acids rather than proteins. Fish liver meal is lower in protein than fish meal but is rich in B vitamins. Feeding trials on these products now under way at Nappan indicate that they are both valuable sources of protein.

Fish Oils

Fish oils and fish liver oils are important sources of vitamins A and D for livestock and poultry. The first such product used as a source of vitamins was cod liver oil. For many years other fish oils and fish liver oils were produced and sold for industrial use rather than as a source of vitamins. Investigations have shown that such fish oils as pilchard (sardine), salmon, tuna, herring, dogfish, halibut, swordfish, and menhaden, are good sources of vitamins A and D. A destearinated by-product of the manufacture of medicinal fish oils not generally used in the feeding industry because of its high melting point has been fed to chickens at Nappan and was found to be a good source of fat as well as vitamins.

Seaweed Meal

In addition to fish, there is another less well known product of marine origin, seaweed meal. There is a vast supply of seaweed available and investigations have shown this to have some value as a feed for livestock. Seaweed meal has properties that make it unique among feeds. It is laxative, contains vitamins and a wealth of

Seaweed exposed at low tide. Nappan nutritionists report that chickens can tolerate up to 10 per cent of seaweed meal in the ration as a substitute for ground oats but only as an addition to a balanced ration. Pigs showed no significant difference in growth rate or carcass quality between those receiving comparable rations with or without seaweed meal. (Seaweed photo courtesy N.S. Research Foundation.)

trace elements and is a valuable addition to a deficient diet. However, its effect on a well-balanced diet is difficult to estimate. Seaweed meal is generally sold as a tonic and general stimulator and as such it appears to have some value, but scientifically this is difficult to prove.

The value of seaweed meal for chickens and pigs has been investigated at Nappan. It was concluded from three large-scale experiments with laying hens that seaweed meal fed at the rate of 2.5 and 10 per cent of the ration had little effect on the performance of laying hens from the point of view of mortality, egg production, eggshell strength, hatchability and body weights. When growing chickens were fed a ration containing seaweed meal substituted for ground oats at the 2.5, 5 and 10 per cent levels, the differences in final body weights were not significant but at the 20 per cent level chick growth was slower. It was concluded that chickens can tolerate up to 10 per cent of seaweed meal in the ration as a substitute for ground oats but only as an addition to a balanced ration. A trial on the value of seaweed meal for growing and finishing hogs involving 72 pigs showed no significant difference in growth rate or carcass quality between the pigs receiving comparable rations with or without seaweed meal or between hogs receiving 2, 4 or 6 per cent of this product in the ration. At the 6 per cent level, the results indicated that no mineral supplement was necessary.

EARLIER STUDIES

In Germany, as early as 1875, experiments were conducted on the use of marine products for feeding sheep, and after 1890 a meal made from fish residue was used for feeding cattle. Not until 1915, however, were experiments begun at the Central Experimental Farm, Ottawa, to investigate the possibility of using fish meal in animal and poultry feeds. Fish meal was first used as a feed for swine and poultry at Nappan, Nova Scotia, about 1920.

Despite significant progress made in the utilization of products of the sea as feed for livestock and poultry, there is still a vast store of food material awaiting development. New fishing and processing methods and techniques offer a continuous challenge to the fisheries industries and livestock feeders. The testing and development of uses for these new products is an important part of nutrition investigations at the Nappan Experimental Farm.

Probing the Secrets of Stone-Fruit Viruses . . . (*from page 8*)

ease. For example, of four necrotic ring spot viruses isolated from cherry, one is of the order of 30mμ in diameter, two of 35mμ and one of 40mμ. Two other necrotic ring spot strains, originally occurring in Lombard plum and peach respectively, are also in the 40mμ group. A prune dwarf virus that is latent in Damson and sour cherry has 30mμ particles, whereas another prune dwarf strain found latent in sweet cherry, but occasionally causing very mild yellow symptoms in sour cherry, has 40mμ particles. If particle size is any criterion of virus identity, each disease in the cherry-yellows group is caused by its own distinct virus or viruses. There has been no evidence that the necrotic ring spot virus is a common factor.

The particle content of mixed infections also supports the view that several viruses are involved in the cherry-yellows group of diseases. Petal extracts were prepared from young trees of known virus content that had been reinoculated with other known viruses. So far 22 different paired combinations have been examined. In each case where two viruses of different particle size were expected, both were detected in the distribution pattern. Where the two viruses were of the same size, there was a single augmented peak in the distribution curve.

It would therefore appear that infection with one virus of the group does not protect a tree against reinfection with another. Consequently there is no guarantee that an orchard planted out with young trees carrying a mild latent infection, such as necrotic ring spot, will not become infected later with a more serious disease, such as cherry yellows or green ring mottle. Reinfections of this type have been observed from time to time in orchard surveys.

Virus infections, latent or otherwise, can be detected by electron microscopy and, in many cases, by infectivity tests with purified preparations. Typical virus distributions have also been observed in preparations known to contain virus but that could not be demonstrated to be biologically active. It should therefore be possible to use these methods to supplement ordinary indexing procedures. Large-scale indexing by these means would not be practicable, but they could be used in special cases, for example, to check the health status of the bud-wood and rootstock seed sources to be used in establishing and maintaining virus-free foundation stock.

* * *

White Grub Forecast

Outbreaks of white grubs are in prospect this spring over much of Ontario and adjacent areas of Quebec, warns G. H. Hammond of the Entomology Division. Heavy damage to sod, grains and root crops may be expected unless effective control measures are applied.

For cultural control, double-disk twice, then plow not over 4 inches deep; two further diskings at right angles will give good control at a time when the grubs are in the subsurface feeding zone.

For chemical control use DDT, BHC, aldrin, dieldrin, chlordane or heptachlor applied to the surface at recommended rates per acre and worked into the soil several inches deep. For permanent sod, apply in early spring and water in if necessary.

With valuable crops or on new sod land it may be well to use both cultural and chemical control methods. Cultural control is cheaper and is the only choice where no suitable applicators are available for large-scale application of chemicals.

Harvesting a 5,000-acre crop of flax on the Vee Bar Vee Ranch, Wardlow, Alta. in 1956.
(Photo courtesy N. B. Seward, Jr., Superintendent.)

WHAT'S HAPPENING TO FLAX

W. G. McGregor and A. G. Plessers

Flaxseed is Canada's chief oilseed crop, and within the last few years flax has risen in popularity because of an active market for linseed oil and the difficulties of marketing wheat and coarse grains. The position of flaxseed, however, is being constantly affected by new synthetic products and the exploitation of inferior oils. If flaxseed is to hold its own in a competitive market, production costs must be reduced by developing better varieties and by improving yield, quality, and cultural methods.

The variety picture has changed markedly over the years. Farmers not only have a choice now between late and early maturing types, but between varieties within these two categories. Varieties available include the late maturing sorts—Redwood, Rocket, and Norland—and the early maturing varieties—Marine, Sheyenne, and Raja. The response of these types to date of seeding has been checked by carefully conducted experiments. Based on experimental tests and the experience of farmers, early maturing varieties are better adapted to late planting than late maturing varieties. These varieties occupied 66 per cent of the flax acreage in Manitoba in 1956, and may be grown even more extensively when the new variety Raja, distributed in 1955, becomes better known. Raja has yielded well in most areas of the Black Soil zone of Manitoba and eastern Saskatchewan and appears well suited to delayed planting.

In Alberta, Redwing, a variety susceptible to flax rust, still predominates particularly in the northern areas, and damage caused by rust has increased from year to year. Unfortunately Raja, which is rust resistant and usually matures as early as Redwing, does not appear to be suitable for this area. Yields have been low and Raja seems more sensitive than Redwing to variations in light and temperature. The problem of securing a high yielding early maturing rust-resistant variety to replace Redwing in this area remains to be solved. Promising new hybrids incorporating rust resistance and earliness are under test.

The 1956 crop established a record yield of over 11 bushels of flaxseed per acre, but this could undoubtedly be improved. Research has indicated many ways in which this might be accomplished. Weeds are among the most common causes of low yields, but with the timely use of new herbicides this problem can be minimized. Experiments also show that flax responds to nitrogen fertilizers. Since improved herbicides can effectively control weeds, the application of fertilizers without seriously increased weed competition is now practical. Poor stands also lower yields, but this can be overcome by treating the seed with fungicidal compounds to improve germination.

Present-day plant breeding rests mainly on the hybridization of well-chosen parents to produce the new combinations from which we select high yielding varieties. These varieties may contain a number of strains showing considerable variation as to yield and quality. Selections of Raja made in 1952 showed a range in oil content of over 5 per cent and variations in iodine number of as much as 7 points. This suggests several possibilities for improving the variety. One of these selections is now being exploited by reconstituting the variety with strains superior in yield and quality.

The authors are Flax Specialists with the Cereal Crops Division, Central Experimental Farm, Ottawa.

At one time flax wilt threatened to wipe out the crop. Thanks to the efforts of research workers, the cause was determined and resistant varieties developed. Today no farmer need fear flax wilt since all varieties recommended have good wilt resistance. However we must remain vigilant. All introductions and hybrids are passed through the wilt nurseries established at Ottawa, Winnipeg, Indian Head, or Saskatoon before they are advanced to yield trials.

Flax rust began to take a heavy toll in Canada in 1941. Plant breeders had anticipated this situation by locating sources of resistance and using this material in their breeding programs. Factors for resistance to all known races found in North America have been found and incorporated into our present varieties. The change-over from susceptible to resistant varieties in Manitoba and Saskatchewan is almost complete. According to 1956 statistics 90 per cent of the flax area was sown to resistant varieties.

The pasmo disease of flax has appeared in damaging proportions but usually it is not abundant until late in the season and by that time the crop is well advanced and escapes injury. Nevertheless, a continuous search is under way to discover effective sources of resistance. To date none has been found though certain varieties have a degree of tolerance to the disease. Our hopes lie in two programs; one to combine the different sources of resistance in a new stock or variety, and the other to create new factors for resistance by irradiation.

Fundamental studies are in progress on the genetics of resistance to rust and pasmo at the Cereal Breeding Laboratory in Winnipeg in co-operation with the Plant Pathology Laboratory. Crosses have been made to identify the genes conditioning reaction to rust and the range over which they give effective resistance. An attempt is also being made to identify the genes governing resistance to pasmo by testing their reaction to different isolates of the disease organisms.

Recently more emphasis has been placed on seed quality, especially with respect to high oil

Studies of comparative growth and development of flax varieties in the growth chamber, Cereal Crops Division, Central Experimental Farm, Ottawa.

content since this is the most valuable portion of the crop. The traditional use of linseed oil in protective coatings depends on the fact that it dries rapidly. Ability to dry has been measured by iodine value. In general, varieties high in oil content have been low in iodine number. However, the introduction of Rocket in 1947 and Redwood in 1951 proved that it is possible to combine high oil content and high iodine value in the same variety. A survey of the crop marketed during the past three years compared with a similar period before these varieties were available indicates that the average oil content has been raised by about 1 per cent and the iodine value by 5 points.

While oil content and iodine number remain a prime consideration, recent advances in technology have stressed the importance of studying the composition of the oil and the specific value of its fractions. Linseed oil contains a high percentage of linolenic acid, which is available only in limited amounts from other sources. In order to strengthen this characteristic by selection we now require in our analyses a measure of the acid components. To understand the inheritance of oil quality it is necessary to know the order in which the acid fractions are laid down. In co-operation with the Department's Chemistry Division, Rocket and Raja are being studied to verify the development of the acid fractions at progressive stages of the maturity of the seed.

* * *

Antibiotics Promising for Cereal Disease Control

Recent trials at Ottawa with antibiotics applied in low concentrations have given promising results in control of cereal disease. Using two rates, 100 and 200 p.p.m. in water solution, the antibiotic was applied at 25 gallons per acre, to plots of 16 oat varieties. One set of plots was sprayed at 10-day intervals, starting when the plants were 12 to 15 inches high. Another set received a single application at heading time. All plots were artificially infected with oat blotch but natural infection was relied on in the case of rust.

A general reduction in rust development was observed on all rust-susceptible varieties with the higher concentration of the antibiotic giving slightly better results and applications at 10-day intervals being more effective than the single application. Leaf blotch did not appear to be controlled by the antibiotic.

Some damage was noted but the plants eventually recovered and as a rule treated plots outyielded controls. Seed from treated plots germinated as well as that from unsprayed plants.

Further trials are planned.

Orchard Grass Gaining in Popularity

W. R. Childers

ORCHARD grass is becoming increasingly popular in the pasture and hay meadows of southern and southwestern Ontario and other areas of Canada where it is adapted. In the 1957 Ontario field crop recommendations over 50 per cent of the hay-pasture mixtures included orchard grass among the grass constituents. This is in marked contrast to the species recommendations for improved pastures in Eastern Canada published by the Forage Crops Division in 1938, when orchard grass was *not* included.

Promising potentials in orchard grass are its rapid regrowth after cutting or grazing and its excellent response to nitrogenous fertilizers. In addition farmers are recognizing its value as a drought-resistant grass in the hot dry summer period when pasture is at a premium. The main disadvantage of orchard grass is its tendency to winterkill in certain years when there is severe icing and inadequate snow cover. The major challenge to plant breeders, therefore, is the need to develop new varieties or strains with greater hardiness, while retaining nutritive value and disease resistance.

Dr. Childers is a Grass Breeding Specialist with the Forage Crops Division, Central Experimental Farm, Ottawa.

400 Introductions

Our most important forage grasses have been introduced from Europe and Asia. Orchard grass originated in the Eastern Mediterranean area and throughout the centuries has moved northward as greater winter hardiness became fixed in the species by the process of natural selection. When looking for new characteristics in grasses, therefore, the specialist turns to the older countries for new source material.

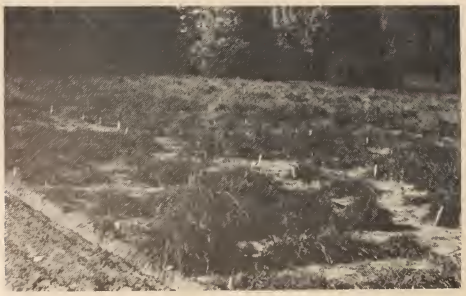
More than 400 introductions of orchard grass have been received at the Forage Crops Division during the last twenty years—from Universities, Botanical Gardens, and Plant Breeding institutions throughout the world. The samples are divided and sent to the experimental stations where orchard grass has been grown successfully in Canada. Each station must evaluate the behaviour of the introduction in the area served. Hercules, our most winter-hardy orchard grass variety, was selected from a sample of seed introduced from Manchuria. Material from the Baltic States has proved promising at Ottawa. Only a very small fraction of the samples introduced each year show any promise for use in this country. All are screened carefully, however, before they are rejected or utilized by our plant breeders.

Author evaluating parental clone of orchard grass.

Testing and Development

A new strain called Ottawa 100 is in the advanced testing stage.

Left: Orchard grass introductions showing lack of winter hardiness. *Right:* Selected adapted orchard grass showing uniform growth and survival.



The four component clones of this strain originated from introduced material from Sweden, New Zealand, and Estonia. These clones have been under study since 1949 and appear satisfactory for winter hardiness. They are more leafy and later maturing than existing adapted varieties under test and have considerable resistance to leaf diseases. In 1955 the total yield of protein was calculated for 10 varieties under test. Ottawa 100 was the highest yielder.

In the spring of 1956 seed of this strain was sent out to 21 Experimental Farms for testing in comparison with other Canadian and imported varieties. Results will be known this year.

Other Promising Strains

In addition to the above strain, other promising clones are in the preliminary testing stage. Hercules, a variety developed at Ottawa, and strain Number 1234, which originated at Cornell University, proved most winter hardy in a comparative yield test during the severe winter of 1949-50. Plants were selected from Hercules having greater resistance to leaf diseases than the parent variety, while others selected from strain Number 1234 were more leafy than the parent strain. These lines will be grown in an isolated block to provide seed, which in turn will be tested for yielding ability in comparison with a check variety.

Results have been obtained from comparative testing of four other desirable leafy clones in comparison with Hercules and Potomac, a variety originated at Beltsville, Maryland. Replicated plots from the four improved clones gave an average yield of 4,240 lb. of dry matter per acre, whereas the average of the two check varieties was 3,480 lb. These data, while representing only one year's results are encouraging and breeding research is continuing.

Orchard grass starts growth early in the spring, develops rapidly, and matures about two weeks earlier than timothy. Because of this rapid growth, farmers are finding orchard grass very valuable for grass silage where an early harvest may be taken and the fields left to produce aftermath for summer pasture. In this respect it is more versatile than timothy, which heads out and loses the ability to recover its vegetative growth. In 1955 when orchard grass and timothy were compared at Ottawa in pure stands with nitrogenous fertilizers added, the mean yield of dry matter of 10 orchard grass varieties during the period July 7 to August 31 was 805 lb., whereas for the same period the mean yield of 9 timothy varieties was only 405 lb. of dry matter. In midsummer the green fields of orchard grass contrasted sharply with the dried-up brownish fields of timothy.

Seed Production Problems

In orchard grass an antagonism exists between the characters of leafiness and seed production. As selections are made away from the coarse-stemmed commercial types, the ability to produce an abundance of seed is lost. Selection, therefore, has to strike a balance between these opposing characters so that quality remains high while the ability to produce seed conforms with the minimum requirements of the seed producer.

In Ontario it is extremely difficult to produce pedigree seed of orchard grass because of the invasion of couch grass in the seed meadows. If this happens it is impossible to separate the seeds in order to meet the standards of purity. However, plans are under way to produce adapted Canadian orchard grass seed in Britain where this problem does not exist. The seed may then be imported and sold in Canada under the Canadian pedigree name.

Pollination Presents Challenge

The fact that cross-pollination is the rule with forage grasses has significant implications in the production of new varieties. Cross-pollination provides new generations of plants that are highly variable in disease resistance, plant type, and height. This random exchange of pollen protects the variety against great losses from disease because, whereas one plant may be susceptible, neighboring plants, since they are of slightly different nature, may be unaffected. However, from the standpoint of increasing the yield of grass varieties, cross-pollination allows for the production of superior, average, and poor plants in varying proportions, and the total yield is a summation of all.

Another effect of cross-pollination is that once a superior variety has been synthesized, the possibility exists that succeeding generations may drift away from the high standard of the initial variety. It therefore becomes essential to re-select and keep a new variety under observation to ensure that it maintains its high standard of quality and disease resistance. There are no short cuts in grass breeding—and orchard grass is no exception.

Left: Promising selections of orchard grass are retained for seed production. *Right:* Polycross block of orchard grass showing eight similar maturing clonal lines randomized for cross-pollination.

Mobile laboratory "on location" in the Scandia district of Alberta.

Above: Dr. Oswald Peck, Ottawa, using facilities of the mobile lab in connection with the National Insect Collection. *Inset:* Interior of laboratory. *Below:* Dr. Peck and colleagues collecting those species of insects that are attracted to light at night.

Right: An alfalfa weevil larva and pupa (in cocoon). Larvae do greatest damage to first crop of alfalfa, feeding within the plant tips, on the upper leaves as they open, and then on the lower foliage, skeletonizing the leaves.

LAB ON WHEELS

THIS completely equipped "lab on wheels", having modern sleeping, kitchen, and laboratory quarters, is operated out of the Department's Science Service Laboratories at Lethbridge, Alta.

A generator supplies 110-volt AC current to light the trailer and operate the electronic temperature recording equipment. The refrigerator, stove, and auxiliary lights are powered by propane. The laboratory area has adequate bench space for examining specimens and is equipped with high- and low-powered microscopes, and bunsen burner attachments.

While "on location", the mobile lab is visited by other entomologists, such as Dr. Oswald Peck (left) who was doing work in connection with the Department's National Insect Collection. He is seen sorting a day's catch in the trailer's lab (note inset showing general view of laboratory), and, with two colleagues, collecting species of beetles, moths, and ichneumon flies that are attracted to light.

For the past several summers, this mobile lab has been used by Dr. G. A. Hobbs and his crew in studying the activities of leafcutter bees (RfF, Vol. 1, No. 1), which pollinate alfalfa and increase seed production, and of pest insects such as the alfalfa weevil which reduce crop yields. The weevil has recently invaded Canada from the south.

This illustrates that for certain detailed field studies it is often an advantage to take the laboratory to the insects.