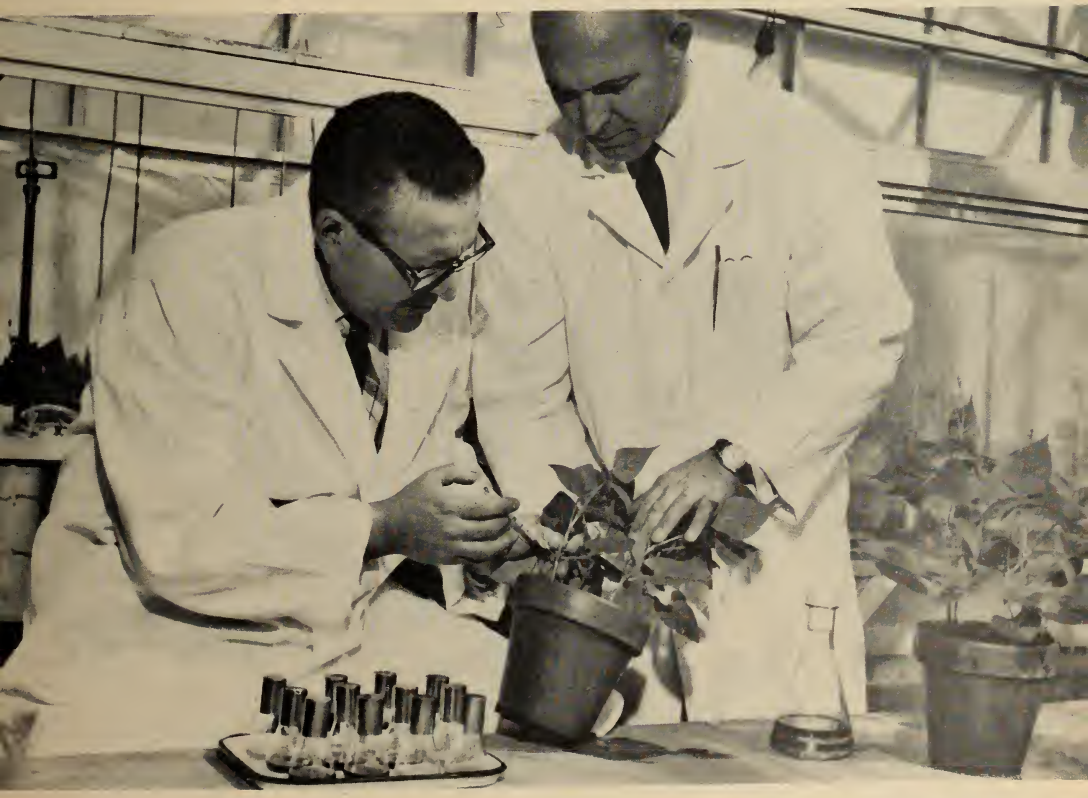
Research FOR FARMERS

SUMMER—1964



CANADA DEPARTMENT OF AGRICULTURE

Research
FOR FARMERS

CANADA DEPARTMENT OF AGRICULTURE
Ottawa, Ontario

HON. HARRY HAYS — *Minister*
S. C. BARRY — *Deputy Minister*

NOTES AND COMMENTS

Can buffering stop steers suffering? You will probably ask yourself this question as you read Dr. Nicholson's article, "Sodium Bicarb for Acid Indigestion in Steers", which begins on page 3. In one experiment he reports that steers fed the unbuffered ration consumed 20.43 lb. of feed and gained 3.44 lb. per day. But when the ration was buffered with 3% sodium bicarbonate the feed consumption and gain averaged 23.24 and 3.64 lb. per day, respectively. "Although the feed conversion was not improved by buffering the ration," Dr. Nicholson writes, "the gain made by the steers had a higher energy value. That is, they deposited a greater proportion of fat to lean in their body weight gain. When the carcass weights were corrected to equal fat content, there was a difference of 58 lb. in the corrected carcass weights in favor of the steers fed the buffered ration."

* * *

In discussing the distance of cross-pollination in grasses, Dr. R. P. Knowles (p. 4) tells of a golden-yellow plant of bromegrass found by chance at Saskatoon which has been put to use in studying pollen dispersal. In his article, he refers readers to an illustration (Fig. 2) which shows the marked difference between yellow and normal green plants. This difference is also evident in the seedling stage. "We can," relates Dr. Knowles, "grow large numbers of seeds and make determinations within two weeks, as shown in Fig. 3. When natural green plants are completely pollinated by yellow plants, 50% of the seedlings are yellow and 50% are green. The percentage of yellow seedlings found in a green stock is consequently doubled to give the percentage contamination." Studies of contamination in bromegrass are continuing.

* * *

Erratum note: With reference to the article, "Smudge of Durum Wheat" by H. A. H. Wallace which appeared in our Spring '64 issue, the illustration was inadvertently reversed thus rendering the caption incorrect. To set the record straight, the parenthesized words (left to right) should now read (right to left).

Vol. 9 **No. 3**

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Contributions should be addressed to the Secretary, Editorial Board, Information Division, Canada Department of Agriculture, Ottawa.

***Cover Photo:* Inoculating bean plants with fuscous blight in greenhouse (see story, page 6). Dr. V. R. Wallen (left) and Dr. M. D. Sutton, Plant Research Institute, Ottawa, Ont.**

Sodium Bicarb for Acid Indigestion in Steers

J. W. G. Nicholson

In 4-month experiment, yearling Hereford steers consumed an average of 23.24 lb. of a buffered, all-concentrate ration and gained 3.64 lb. per day.

FOR several years, animal research at the CDA Experimental Farm, Nappan, N.S., has been concerned with factors that influence the utilization of all-concentrate rations—those composed entirely of grains and supplements without any high-fiber roughages. Although it has been demonstrated that feeding all-concentrate or high-starch rations to cattle can be practical under certain conditions, there are still some problems to be solved.

One factor which could have harmful effects is the large amount of acids produced in the rumen from these high-starch rations. The bacteria in the rumen convert much of the feed consumed by the animal into volatile acids; mainly acetic, propionic and butyric acids. With roughage rations this bacterial fermentation proceeds slowly and the acids are absorbed or neutralized by the alkaline buffers, phosphates and bicarbonates, secreted in the saliva. Ruminant animals secrete saliva continuously, but the rate of flow is increased during eating and rumination. Cattle being fed high-roughage rations spend considerably more time eating and ruminating, with a concomitant higher secretion of saliva, than animals fed all-concentrate rations. This led us to investigate the effect of adding buffers to all-concentrate rations based on barley.

In early experiments at Nappan, mixtures of sodium bicarbonate, potassium carbonate and ground limestone were fed up to a level of 9% of the ration. Some of these rations contained limited amounts of hay. The animals were tied up twice a day for feeding and were not allowed to eat at other times. Under these conditions, feed intake and rate of grain were low and the addition of buffers did not have any beneficial effect.

Sampling rumen contents of a rumen-fistulated steer to determine effect of adding buffers to all-concentrate rations on conditions within the rumen.

In another experiment, the animals were allowed continuous access to an all-concentrate ration composed mainly of rolled barley. Feed consumption and rate of gain were much higher. Steers fed the unbuffered ration consumed 20.43 lb. of feed and gained 3.44 lb. per day. When the ration was buffered with 3% sodium bicarbonate the feed consumption and gain averaged 23.24 and 3.64 lb. per day, respectively. Although the feed conversion was not improved by buffering the ration, the gains made by the steers had a higher energy value. That is, they deposited a greater proportion of fat

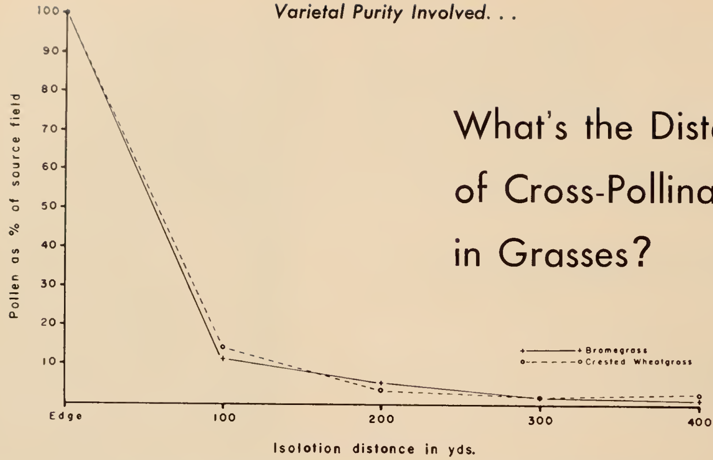
Continued on page 14

Dr. Nicholson is an animal nutritionist with the CDA Experimental Farm, Nappan, N.S.

Varietal Purity Involved. . .

What's the Distance of Cross-Pollination in Grasses?

R. P. Knowles



Pollen distribution around fields of bromegrass and crested wheatgrass.

THE distance to which grasses distribute their pollen is important in maintaining varietal purity. Seed growers cannot expect to keep varieties of cross-pollinated grasses pure if wild strains of the same grass contaminate fence lines and roadsides. The problem can be especially serious when a new variety is brought into an old seed-growing area where other varieties are still grown. We are breeding new varieties of grasses at the CDA Research Station, Saskatoon, Sask., and, therefore, are giving much attention to problems of maintaining strain purity.

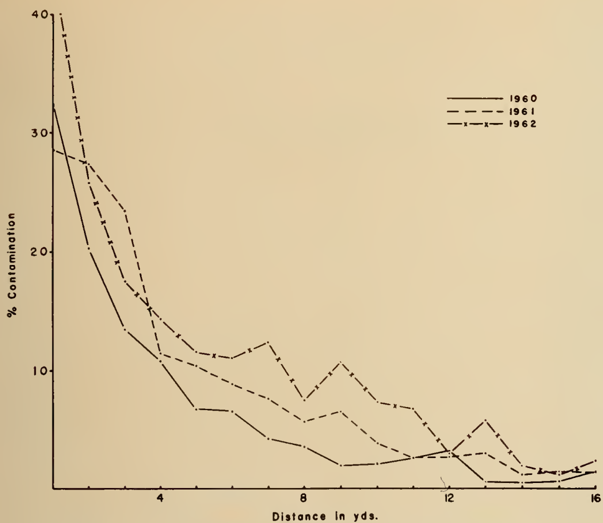
One of the simplest ways of measuring contamination is to study the pattern of pollen distribution. We generally do this by attaching small greased plates on wind vanes placed at various distances around a source field. Each day after flowering, the number of pollen grains on the plates are counted under a microscope. Figure 1 shows the relative amounts of pollen of bromegrass and crested wheatgrass caught downwind from fields of bromegrass and crested wheatgrass. It appears that there is a fairly rapid drop in amounts of pollen as distance is increased, but at 100 yards there is still sufficient to cause serious contamination. Fortunately, each field produces pollen of its own and so is "self-shielded" against contamination to some extent.

For critical studies of contamination, we have to use strains with distinctive genetic markers. Corn is a useful tester crop because of the numerous marker genes available. In corn, these characters may be detected soon after pollination as the developing kernel may have a particular color depending on the pollen source. Largely on the basis of corn studies, the isolation distances for Certified and Foundation fields of grasses have been set at 50 yards and 200 yards, respectively.

A golden-yellow plant of bromegrass found by chance at Saskatoon has been put to use in studying pollen dispersal. Figure 2 illustrates the marked difference between yellow and normal green plants. This difference also is evident in the seedling stage. We can grow large numbers of seeds and make determinations within two weeks, as shown in Figure 3. When natural green plants are completely pollinated by yellow plants 50% of the seedlings are yellow and 50% are green. The

Mature plants of bromegrass with yellow type (left) and normal green (right).

Dr. Knowles is in charge of grass breeding at the CDA Research Station, Saskatoon, Sask.



Decrease in contamination of bromegrass at various distances from contaminant source.

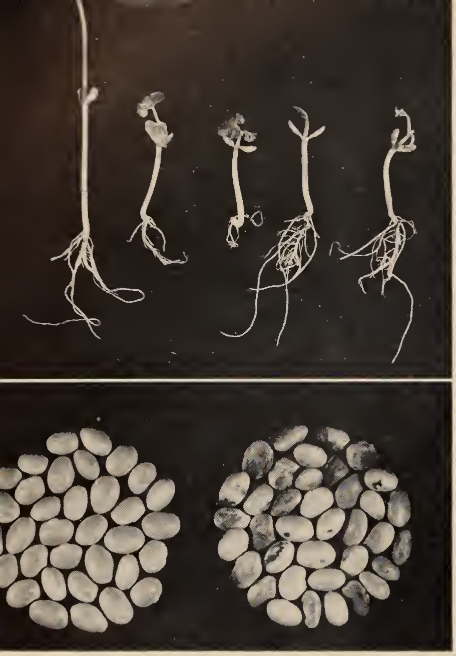
percentage yellow seedlings found in a green stock is consequently doubled to give the percentage contamination.

A study was made in 1960-62 of the amounts of cross pollination when small fields of yellow and green bromegrass were grown side by side, that is, with no distance isolation. The yellow type was planted to the west of the green type as prevailing winds are westerly. Figure 4 shows the degree of contamination of green by yellow. It is evident that at 16 yards there was a marked drop in contamination of green by yellow. This contrasts sharply with the curve of pollen distribution in Figure 1 which dropped more slowly. Another green plot was planted to the south of the yellow plot but with an intervening distance of 11 yards between plots. In 1961, when winds were from the north during flowering, the contamination was 29% at the edge of the green plot. Sixteen yards within this green plot contamination was still 1%. Obviously, greater isolation distances are necessary to maintain strain purity.

We established a new arrangement of plots in 1963 using greater isolation distances. Plots of green bromegrass were spaced 67 yards to the north, south, east, and west of a one-acre planting of yellow brome. This distance was made slightly greater than that used for Certified seed production because of the general field layout. At the northeast, southeast, southwest, and northwest positions green strains were planted at 200 yards distance from the yellow plot. This is the distance recommended for Foundation seed production. Plantings were only moderately well established in 1963 so that we could only make preliminary observations. However, a plot to the east at 67 yards showed contamination values as follows: (a) edge—5.8%, (b) 1 yard inside green plot—3.1%, (c) 2 yards inside green plot 0.8%, (d) 7 yards inside green plot—1.2%, and (e) 22 yards inside green plot—0.0%. The seriousness of edge contamination is shown in this test.

These studies of contamination in bromegrass will be continued for several years. This will allow testing with various weather conditions at flowering time, especially wind speeds. We plan to conduct a similar test in crested wheatgrass using grey-green and bright green head types. Slower progress is anticipated here as the two types must be grown out to the heading stage before head color can be determined.

Bromegrass seedlings grown under high light intensity and 50-60°F. temperatures for determination of seedling color.



Upper: Healthy bean plant (left) and 4 diseased plants; _Lower:_ Healthy seeds (left) and diseased seeds.

FUSCOUS BLIGHT

A Widespread Bean Disease of Economic Importance to Ontario

V. R. Wallen

AND

M. D. Sutton

FUSCOUS BLIGHT of field beans has recently been found to be the principal bacterial disease of field beans in southwestern Ontario. In studies by the Plant Research Institute in 1961, we first isolated the bacterium causing this disease (*Xanthomonas phaseoli* var. *fuscans*) from an infected plant in a field and again in 1962 from a seed sample of Sanilac beans from southwestern Ontario. Since then, we have examined 135 samples from this area of Michelite, Sanilac and Seaway seed and 50 of them were internally infected with the pathogen. Prior to the above findings only one report of the disease in Canada had occurred. Although common and halo blight were considered to be the main bacterial bean diseases of this area none of the above samples were infected with halo blight and only three samples had common blight. Since then we have discovered fuscous blight to be an important disease of beans in other areas of Ontario.

Recognizing the Disease

Fuscous blight, despite its occurrence in epidemic proportions, has not been recognized until recently because its symptoms resemble so closely those of common blight. Seed, leaf and pod symptoms are similar, the only characteristic difference between the two diseases being a tendency for stems to form reddish brown streaks that swell and crack when infected with fuscous blight.

Our research has revealed that fuscous blight is seed-borne and seed is the means of initiating an epidemic in the field through the production of diseased seedlings that serve as a source of primary inoculum but is also the means of disseminating the pathogen into fields free of the pathogen.

In our studies we found fuscous blight responsible for losses both in lower yield and poor quality seed. Infected seed show lowered germination and produce infected seedlings that serve as focal points for the spread of the disease. Heavily infected pods produce fewer, smaller seeds of low quality. Seed quality is influenced by the production of discolored seeds and costly electric eye sorting devices must be used to eliminate diseased seeds.

The fact that fuscous blight is now widespread in the bean crop

Young plants (left) grown from diseased seeds and from healthy seeds (right).

Dr. Wallen is Head and Dr. Sutton a plant pathologist, Environmental Phytopathology Section, CDA Plant Research Institute, Ottawa.

in Ontario, particularly in the variety Sanilac, indicates that the disease has been present for a few years at least. In our plant pathogenicity tests, we have shown that the varieties Sanilac and Michelite have more resistance to common blight than fuscous blight. These two varieties have therefore inadvertently provided susceptible hosts for the increase of fuscous blight organisms, while at the same time the common blight organism has diminished in intensity and importance.

Isolation and Identification of Pathogen

At the Plant Research Institute, Ottawa, we have developed two techniques for the isolation and identification of the pathogen in bean seed. In the first method seeds are placed on nutrient agar in Petri dishes after surface sterilization. The seeds are incubated for six to eight days at 27°C. The causal organism grows out of the seed and is recognized by the production of a characteristic pigment.

The second method that we developed involves the use of a bacterial virus known as a bacteriophage. This virus kills only the fuscous blight bacteria by dissolving them. When the virus is placed on bacteria growing on agar and small clear zones are produced, the organism is identified as *X. phaseoli* var. *fuscans.*

Control

Although we conducted field experiments only during the summer of 1963, we discovered certain facts regarding the number of infected seeds in a sample necessary to cause a general infection. In one experiment we found, for example, that despite presumably unfavorable temperatures and lower than normal rainfall during the early growing season, by September 1 the plots were generally infected even when the seed used for planting had contained only one infected seed in 200. We had assumed that under more favorable environmental conditions only a small number of infected seeds in a planting box could cause a general infection. We have found that seed treatment for the eradication of the pathogen is of doubtful value as the infection can be deep-seated within the seed; therefore standard seed treatments do not eradicate the pathogen. With such a small number of seeds necessary to start an infection, a treatment to be effective would have to eradicate all the infected seeds in the seed lot.

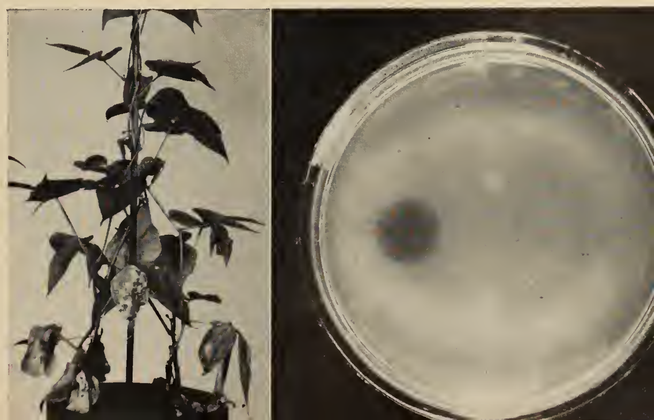
From our investigation it appears that the answer to producing crops free of the disease is through two approaches. The first is to produce breeder's seed under strict conditions of isolation, possibly in an area unfavorable for the disease, and to use only seed that has been demonstrated to be free of disease by field inspection and subsequent laboratory examination. After healthy seed has been produced at the breeder level, the number of germinations before the seed reaches the commercial market should be limited. In this manner a serious build-up of inoculum should not occur. The Canadian Seed Growers' Association has recently adopted this method for the production of registered bean seed.

The second approach to the problem is through the development of resistant varieties. We have recently developed a technique whereby large numbers of plants can be tested for their resistance to fuscous blight in the greenhouse. Two-week-old bean seedlings are grown in a mist bed. Spray-nozzles attached to copper tubing allow water to be sprayed on the plants at intervals. This keeps the plants in a succulent condition which is necessary for successful inoculation. The young plants are inoculated at the primary leaf node by means of a bacterial suspension that is introduced into the plant's vascular system by a hypodermic syringe. In this manner we have been able to test hundreds of varieties and selections for their resistance. Only a handful have shown a satisfactory degree of resistance; however some material is already available for breeding work and more material is yet to be examined. We are pleased to report that plant breeders are now using our technique to study bean breeding material for its resistance to fuscous and common blights of beans.

Our research has also revealed that the problem of breeding for resistance to fuscous blight is complicated because of the existence of pathogenic strains some being more virulent than others. Hence, it becomes necessary to find out the geographical distribution and the number of strains that exist in the bean growing areas of southwestern Ontario. We are now engaged in this work and have isolated bacteriophages from soil samples taken from the bean growing areas. We test these bacteriophages on all isolates of the pathogen. In this manner we hope to determine all strains of *X. phaseoli* var. *fuscans.*

In other experiments we are also investigating the effects of the environment. As temperature and humidity play an important role in determining the severity of the disease, knowledge of the optimum conditions for infection and spread of disease are important in the control of fuscous blight.

Left: Plants systemically infected with fuscous blight. Note leaf symptoms (also refer to front cover). _Right:_ Petri dish with _X. phaseoli_ var. _fuscans_ growing on nutrient agar. Dark zone indicates bacteria killed by bacteriophage particles.



Upper Left: Ranch, 2500 feet above far side of Fraser River, is isalated by 10 miles from nearest herds that cauld have dropped warble pupae. The open bench lands (1000-1500 feet high) make river inaccessible ta cattle; area shawn drains sa rapidly that cattle can be held far only short periads in fall and spring when same surface water or snaw is available. *Lawer right:* Corrals and cattle during actual treatment aperation at isolated ranch. Cattle warbles: lawer left, *Hypoderma lineatum* (De Vill.) and *H. bavis* (Linn.), upper right.

Can Cattle Warbles be Eliminated?

Editor's Note: The author has already given running accounts of his warble fly investigations at the CDA Research Station, Kamloops, B.C. in the Spring '60 and Fall '61 issues of *Research for Farmers*. In 1960, he discussed his findings on the bolus, injection and feed-additive methods of warble control and in 1961 reported on the 'pour on' method, emphasizing its practicability under range conditions. Now, in our Summer, '64 edition, he reports further knowledge of warble control as it pertains to systemic insecticides used with isolated cattle herds.

Six successive years of testing systemic insecticides for eradication of cattle warbles on an isolated B.C. Interior ranch reveal varied degrees of control—but eradication is still being sought.

G. B. Rich

SEVERAL systemic insecticides are now being commercially distributed and others are showing promise in experimental tests. Currently, these can be applied as sprays, pour-ons, feed-additives and injectables. In general, they have been shown to reduce warble infestations without undue hazard to the cattle if a single application is made between the time when fly activity ceases and grubs begin to appear in the backs of cattle.

The systemics appear to have substantially increased the possibility of warble eradication. Application, particularly with pour-on formulations, is relatively rapid and economical. The period for effective application is sufficiently

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The author is a livestock insect specialist with CDA Research Station, Kamloops, B.C.

extensive to permit integration into almost all animal management patterns. The 'pour-on' is particularly suitable for range management as it is administered during the fall and early winter when even the freest ranging herds are usually gathered for calf-weaning beef marketing, herd-culling, etc.

Several projects have been undertaken to study the long-term results of systemic insecticides on warble infestations using either relatively isolated cattle herds or large area coverage. The author, for six successive years now, has been directing one of these projects on a British Columbia ranch isolated by at least 10 miles from places where the adjoining ranch herds could have dropped warble pupae. The adverse direction of the prevailing winds during the warble flight period, and the separation of this ranch from other herd areas by deep river canyons, would appear to increase the isolation of the herd. During the study period, the only importations into the herd of from 1000 to 1400 cattle have been replacement bulls and these have been treated on entrance into the herd.

During the ranging season, the dispersal pattern of this herd over a large and rugged area of semi-mountainous terrain makes special rounding-up for insecticide treatment impractical. The herd is gathered annually in early December for routine management purposes and is then redispersed in winter maintenance areas. Insecticide treatment has been applied during this annual herd gathering and has caused no disruption of management other than the short additional periods required for

Successes and Failures in Cattle Warble Elimination

Owner co-operation cannot be maintained unless techniques of control are compatible with cattle management practices.

Cattle warbles are mentioned in literature as early as the works of Virgil, 37 to 31 B.C. Nevertheless, little progress was made in their control, and the possibility of their eradication was not demonstrated until the present century. During the period 1915 to 1920, Carpenter and Hewitt eradicated warbles from the 500 native cattle on Clare Island, Ireland, by a laborious program of squeezing the grubs out of their cysts. During the 1920's, derris washes, and subsequently derris sprays, were found to be toxic to encysted warble grubs. McDonald eliminated grubs from the Island of Cyprus by a combined derris-wash and grub-squeezing program lasting from 1939 to 1945.

Derris was the first insecticide known to be effective against warbles and this discovery stimulated widespread optimism. In some areas, such as British Columbia, government agencies supplied derris to stockmen. Many large-area projects were set up with the objective of eradication in the central zones and many optimistic reports were published. However, by 1950 it was evident that the warble infestations had not been significantly reduced and the enthusiasm waned.

These various reports are very instructive concerning the requirements of warble control projects. The Clare Island and Cyprus reports illustrate the rapidity with which initial infestations can be reduced but that eradication may require a persistent and carefully supervised effort. The Clare Island report cites the difficulty in securing and maintaining full stock-owner co-operation and the level of infestation that can be maintained by either failure to treat all animals in the project area or by importation of infested animals into the area. The derris reports show that complete owner co-operation cannot be maintained unless the techniques of control are compatible with cattle management practices. This point is particularly important when working with range herds in British Columbia.

Summary of Isolated Herd Warble Grub Project Data.

Season	1957–1958		1958–1959		1959–1960		1960–1961		1961–1962		1962–1963	
Sample	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated
Number calves in sample	30	20	30	20	30	30	30	30	50	50	45	47
Number calves with grubs	28	11	21	10	13	4	16	3	17	4	2	0
Average grubs per calf	30.2	7.0	14.5	1.6	1.6	0.2	2.5	0.2	2.7	0.2	0.2	0.0
Maximum grubs in one calf	135	60	81	12	14	2	16	5	27	3	5	—
Post-treatment grub reduction (%)*	—	76.8	—	89.0	—	87.5	—	92.0	—	93.0	—	100.0
Annual grub reduction (%)**	—	—	52.0	—	94.7	—	91.7	—	91.0	—	99+	—

*On basis of mean infestations in treated and untreated samples.
**On basis of mean infestation in original untreated sample and each succeeding untreated sample.

treatment. During the first three years, a bolus or pill form of insecticide was administered orally with a balling gun and in all instances treatment was made during freezing temperatures. In the fifth year, a pour-on insecticide was applied when temperatures ranged from 0 to —8°F. During two of the six years, treatment was applied without interruption during intermittent snow squalls.

During each of the first and second years, a single calf died a few days after treatment, but the deaths could not be directly attributed to the treatments. In the third year two cows from penetration of the boluses into the tissues of the throat adjacent to the epiglottis. No casualties occurred in the next three years. Thus, during the treatment of 6500 animals only two casualties can be directly attributed to the treatment and these were caused by faulty application of the bolus form of insecticide.

In each of the six years, a group of randomly selected calves was marked and left untreated, and grubs were subsequently removed from them by squeezing at intervals throughout the period when grubs were in the backs. Similar randomly selected sample groups of treated calves have been marked and grubs similarly removed from them. These groups have provided the data shown in the accompanying table. Whenever possible, additional samples have been taken from adult animals and in all instances these have been in very close agreement with the data from the treated calf samples.

After the second year of treatment, the infestation in the untreated calf sample was reduced to 5 per cent of the original infestation, and to 1 per cent in the sixth year. Eradication has not been achieved and with our present knowledge of warble population dynamics this cannot be clearly explained. Our knowledge of warble flight patterns and ranges is not sufficient to determine whether or not the herd is completely isolated. Also our knowledge of warble reproduction and survival is not sufficient to determine whether the observed insecticide efficacies are sufficient to produce eradication. In a single-annual-generation insect such as this, it is as yet impossible to determine whether or not insecticide resistance may be developing, but continuation of the annual treatments should give some indicative data.

Thus, while it is still premature to predict the eradication of warbles by insecticide treatment, it would seem that considerable progress has been made toward their control. Our long-term investigation (now entering its seventh year) shows that complete eradication will be difficult to achieve but does indicate that economic control is possible—and studies are continuing with the isolated herd to determine minimum insecticide requirements.

Upper: **Boluses being administered to a cow on the isolated ranch. *Right:* Author, after a day of squeezing out grubs during spring break-up. *Lower:* Scientist applying 'pour-on'.**

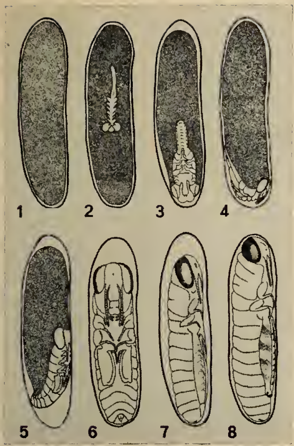


Fig. 2 Eight stages of development of an embryo within a grasshopper egg, from time it is laid until ready to hatch.

GRASSHOPPERS

Will Hatch When. . ?

How Age and Probable Date of Grasshopper Hatch Can Be Determined. Method Has Possibilities For Farmers' Use.

P. W. Riegert

THE old adage states, "To be forewarned is to be forearmed". To know beforehand when grasshoppers will hatch would certainly forearm the farmers against a potential outbreak of this pest.

Farmers will soon be able to determine for themselves when grasshoppers will hatch. At the CDA Research Station, Saskatoon, Sask., we have come up with a picture story showing the stages of growth of embyros within the grasshopper egg. By examining eggs and comparing the size and location of the embryos with the pictures, the age and probable date of hatch can be determined.

The procedure for preparing eggs for examination has been simplified. The necessary steps are shown in Fig. 1. First, the egg-pods are broken up and the individual eggs are freed from the attached pod material. They are then placed in alcohol (70% is ideal) for about one minute to remove the outer waxy covering. This allows the egg to become 'wet' in the second treatment, the bleach. Any good commercial or household bleach (Javex, Perfex, etc.) may be used. This treatment will remove the thick, outer "egg-shell", leaving the eggs quite translucent. The embryos within can be clearly seen, especially if examined with a low-power hand lens under a bright light.

We have also simplified the picture story of embryonic growth as shown in Fig. 2. The first four stages are seldom evident to the casual observer. These are the stages of growth that take place in the late summer and fall of the year before cold weather stops development. Fig. 2-1 is the newly laid egg with no embryo showing, just a bag of yolk. From here, growth and development proceeds until winter sets in and most eggs of the roadside or clear-winged grasshopper will then be at the stage shown in Fig. 2-4. In all these stages, the embryos are very small but generally quite distinct.

However, when spring arrives and growth is resumed, the embryos will enlarge, darken up a bit and become more distinct. Stage five in Fig. 2 shows the embryo revolving around one end of the egg and elongating. To the naked eye, this stage appears as a faintly colored image hanging from a big bag of yellowish yolk. If day time temperatures reach 70°F. it will still be about 3 weeks before these eggs will hatch.

Stage six of Fig. 2 shows that growth has proceeded much further. Many eggs of the stubble or migratory grasshopper and the two-striped grasshopper will have reached this stage of development in the fall of the year. Reddish-brown crescents can be seen on the head of the embryo. These are the first signs of pigmentation of the eyes. The embryo fills about three-quarters of the egg while the yolk is no longer visible as a bag apart from the insect, but is actually enclosed by and forms part of the back of the new grasshopper. If the egg is punctured, the yolk will ooze out as a heavy fluid. It will take a week or 10 days for eggs at this stage to hatch if air tem-

Concluded on page 14

The author is an entomologist at the CDA Research Station, Saskatoon, Sask.

Fig. 1 Steps in cleaning, clearing and examining eggs for embryological development to determine date of probable hatch.

New structure made of treated lumber.

Untreated, partly washed out, leaky, irrigation structure.

Author measuring lumber samples during expansion test.

How Effective Are Preservatives . . ?

Controlling Lumber Shrinkage in Irrigation Structures

K. Pohjakas

MANY irrigation structures made of untreated lumber fail soon after erection because seepage between boards washes away backfill material and weakens the structure to the point of failure regardless of the fact that the lumber is still quite sound.

What effect do wood preservatives have on the expansion of lumber used in irrigation structures? In a study at the Swift Current Experimental Farm, we considered the question as it pertained to irrigation structure design and lumber shrinkage control.

We treated fir lumber and plywood with four preservatives: creosote oil, pentachlorophenol, copper naphthanate, and copper sulphate. We used pressure treatment for creosote and pentachlorophenol; as for the other two preservatives, they were applied with a brush or by soaking the test sample in the solution.

Test samples were subjected to three cycles of alternate wetting and drying. The dimensions of the samples were measured twice during each cycle: after being oven dried, and again after being submerged in water for 7 days. The measured dimensional changes permitted calculation of the effect of various preservatives on the average expansion of lumber and plywood samples.

Our test results showed a reduction in expansion and shrinkage following treatment with oil base preservatives. We found that samples pressure-treated with creosote oil expanded only one-fifth as much as untreated lumber and plywood. Also the weight of pressure-treated samples varied less than 5 per cent during alternate wetting and drying. Even a brush treatment with creosote oil reduced the water absorption by 50 per cent. Surface treatments with water soluble preservatives were relatively ineffective, partly because only surface treatments were used to apply them and shallow penetration resulted from these treatments.

Low initial cost, light weight, and ease of fabrication are some of the desirable features of lumber. Treated plywood has proved to be a very suitable material for turnouts, checks, and flumes.

Little change occurs in the dimensions of a calibrated measuring structure made of treated lumber. This makes it possible to obtain accurate readings for many years. Our investigations also revealed that warping, surface checking and cracking are similarly less common in treated lumber and constitute additional advantages of pressure treatment.

The author is a specialist in drainage engineering with the CDA Experimental Farm, Swift Current, Sask.

Heads of Cypress wheat.

CYPRESS WHEAT

A new sawfly-resistant spring wheat, it is superior to its parents, Chinook and Rescue—each a good variety in themselves—and seed is now available to the farming public.

Hugh McKenzie

THE licensing on May 24, 1962, of Cypress, a new sawfly-resistant variety of wheat climaxed nearly 15 years of selection and testing. Cypress was developed through the coordinated efforts of the Project Group on Breeding Spring Wheats for the Prairie Region, to meet the needs of the dry prairie areas where sawfly and drought are serious hazards to wheat production.

Cypress is an improvement over its parents Chinook and Rescue—over the former in resistance to both sawflies and shattering, over the latter in baking quality. Furthermore, it compares favorably with these two good older varieties in yield, bushel weight, 1000 kernel weight, height, straw strength and maturity. Added to this is the attractive appearance of the grain sample of Cypress, a desirable characteristic for the export market.

The sawfly problem arose before the turn of the century. Being a native of the prairie grasses, the sawfly was present to attack wheat crops when farming commenced on the prairies. During the first quarter of this century, the wheat acreage increased rapidly with an accompanying increase in sawfly populations. The problem was further aggravated by the advent of strip farming because sawfly damage is heaviest along field margins. During the 'thirties' losses were estimated to be as high as 20,000,000 bushels in some years.

A number of solutions of the problem were attempted but the one that was ultimately to prove most successful was the production of resistant varieties. To begin with, the variety S-615, which is solid-stemmed and resistant to sawflies, was obtained by Kemp from New Zealand. A large breeding program was then initiated at Swift Current to incorporate the sawfly resistance of S-615, into new varieties.

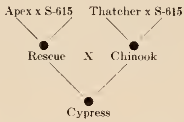
Unfortunately, however, the program was hindered by the poor milling and baking characteristics of the new hybrids because the S-615 parent contributed not only its sawfly resistance to the hybrids but also its poor quality character-

Sawfly-resistant hybrids are standing erect while sawfly-susceptible hybrids have been almost completely cut.

The author is a cerealist with the CDA Research Station, Lethbridge, Alta.

istics. Many thousands of hybrids had to be discarded because of major or even minor quality defects. But eventually the program was successful and two sawfly-resistant wheats were developed—the variety Rescue licensed in 1946, followed by Chinook in 1952.

While both varieties are now filling an important need in agriculture, efforts have been continued on the production of newer and better varieties. After many more crosses had been made, it was one between Rescue and Chinook that resulted in the new variety, Cypress. This is its pedigree:



The cross between Rescue and Chinook was made in 1947 at the Experimental Farm, Swift Current, Sask. The breeding work was transferred to Lethbridge in 1949. During the early generations, the population was subjected to selection for desirable agronomic characteristics and resistance to sawflies. During later generations the number of lines was reduced as a result of replicated trials carried on for five years at Lethbridge, Alta. and Swift Current, Regina, and Scott, Sask. Cypress was included in the Co-operative Spring Wheat Yield Trials for four years, 1958-1961, inclusive. Milling and baking quality was evaluated at the Genetics and Plant Breeding Research Institute in Ottawa for eight years and at the Grain Research Laboratory, Winnipeg, for four years.

Author examining wheat plant.

The subsequent Cypress seed increase program, handled through the Canada Department of Agriculture Seed Office, Winnipeg, was highly successful. The seed was increased from 200 pounds to 116 bushels during the 1961-62 winter in California and further increased to 4,000 bushels in Canada in 1962. From the 1963 increase, an estimated 80,000 to 100,000 bushels of Cypress seed should be available to the farming public before the spring of 1964.

Grasshoppers will Hatch When . . . ? *from page 11*

peratures rise to 70°F. and days are sunny.

When the embryo nearly fills the whole egg, as seen in stage seven of Fig. 2, it is within 2 to 3 days of hatching. The reddish eyes are quite clearly seen and the yolk is completely enclosed by the membranes of the back. Some black markings can usually be seen on the legs. When the pigmentation on the legs is very distinct, as seen in stage eight of Fig. 2, the whole body may be 'peppered' with dark markings also. It fills the egg to bursting and is ready to hatch at any time. In fact, the outer membranes can be removed at this stage and the new insect will pop out intact, without loss of body fluid or yolk.

Many factors, other than temperature, can influence the rate of development and the subsequent date of hatching. Eggs laid in sandy soil will develop faster than those laid in heavier loams because the soil will warm up quicker and the eggs will get the benefit of the higher incubation temperatures. The cooling effect of wet soil will retard development, as will the shading effect of dense vegetation. However, the above schedule is fairly accurate under conditions of 70°F.

For every day in which the air temperature is above 80°F. the date of hatching may be accelerated by about one-half day.

In the spring of 1963 eleven Agricultural Representatives, in various parts of Saskatchewan, examined eggs at weekly and semi-weekly intervals and forecast the date of hatch based on the development of the embryos. This proved so successful that we feel sure that farmers can do the same if provided with the plate of figures shown in Fig. 2.

Sodium Bicarb for Acid Indigestion in Steers . . . *from page 3*

to lean in their body weight gain. When the carcass weights were corrected to equal fat content, there was a difference of 58 lb. in the corrected carcass weights in favor of the steers fed the buffered ration.

We observed in the experiments with all-concentrate rations that the animals would frequently eat the wood shavings and sawdust used for bedding. In one experiment, half the animals were allowed to eat their bedding, and the other half prevented so as to determine what effect this had on performance. Those that ate their bedding had slightly higher rates of gain and feed consumption, but dressing percentage was slightly less so that there was little difference in carcass weight. In this case, the consumption of bedding had no measurable effect on animal performance.

While these feedlot studies were going on, we conducted experiments with rumen-fistulated steers to determine what effect the buffers had on conditions within the rumen. We discovered that the buffers decreased rumen acidity and increased buffering capacity. Samples taken at various times show this effect was greatest shortly after feeding, when the rate of rumen fermentation would be highest. The addition of buffers to the ration also resulted in a lower proportion of acetic acid in the volatile fatty acids of the rumen

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Do Fungicides Affect Apple Yields?

Kentville researchers compare effect of four different spray schedules on apple tree performance

R. G. Ross

THE long-term effect of different fungicides on apple yield, tree growth, fruit size, etc., has received little attention in studies on fungicides for the control of diseases. These factors assume importance now that the recommended fungicides all provide essentially complete control of diseases. Since 1959, a block of mature McIntosh apple trees at the CDA Research Station, Kentville, N.S., has been used to compare the effect of four different spray schedules on the performance of apple trees. It was particularly suitable for this purpose since data had been taken on the performance of each tree since planting and the spray program had always been the same for the entire orchard.

The various fungicides used with the concentration per 100 gallons of water for pre-cover and cover sprays were:

1. Captan (Captan 50W), 2 lb., 1.5 lb.
2. Dodine (Cyprex 65W), $\frac{3}{4}$ lb., $\frac{3}{4}$ lb.
3. Dichlone (Phygon XL), $\frac{1}{2}$ lb., $\frac{1}{4}$ lb.
4. PMA (Erad-phenyl mercury acetate, 10%), $\frac{1}{2}$ pint in pre-cover and captan, 1.5 lb. in cover applications.

Eight or nine sprays, usually consisting of five pre-cover and three or four cover sprays, were applied each year.

The accompanying figure shows the average fruit yield of the apple trees for a five-year pre-treatment period and the yields following the introduction of the four different fungicide programs. There were no significant differences between the plot yields for the pre-treatment period whereas, differences in yield were significant in each year of the test. It is quite obvious that the highest yields were obtained with captan followed by dodine, PMA-captan and dichlone. The average per cent increase in yield per tree for the four treatment years compared to the five-year pre-treatment period for each fungicide was: captan 40%, dodine 31%, PMA-captan 18% and dichlone 7%.

Following these differences in yields, we examined our data on tree growth, bloom and fruit size to see if these factors were responsible. The fungicides had little effect on tree growth as measured by increase in trunk cross-section. Throughout the experiment most trees had a full bloom although in 1961 and 1962, occasional trees in the dichlone plots had a light bloom. In general, the fungicides

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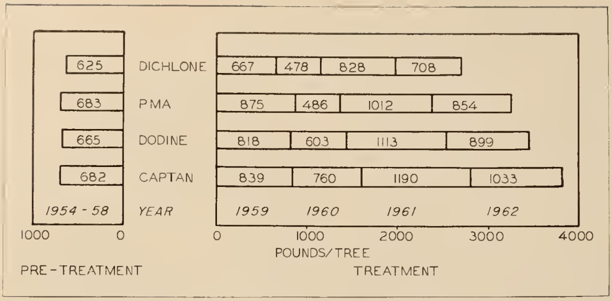
Dr. Ross is Head of the Plant Pathology Section, CDA Research Station, Kentville, N.S.



Yields of apple trees sprayed with different fungicides.

had little effect on bloom but there was a highly significant difference in fruit size every year. Apples sprayed with dichlone were almost identical in size to those spraked with captan, whereas the apples from the PMA-captan plots were always larger. The comparative size of the dodine-sprayed apples varied from year to year. The larger apples with PMA indicates a thinning effect since fewer apples would be present on these trees. Workers in the United States have also obtained larger apples with mercury sprays. This thinning effect is not too important on mature trees but with young apple trees mercury sprays often cause serious reductions in yield. Apparently dichlone was detrimental to the physiology of the trees. It produced apples the same size as those from the captan plots but there were fewer of them without the increase in size encountered with PMA.

We also took records on the amount of color on the apples from the various treatments but this did not vary between treatments. Appearance of attractiveness is probably as important as the amount of color present. The treatments containing captan produced the best fruit finish. Dichlone-sprayed apples were much less attractive with some roughness present. Dodine injured about three per cent of the apples in two years of the test but the conditions under which this injury occurred are not known.

All four fungicides have been extensively tested and used for apple scab control. We found that they vary in their protectant and eradicant or after-rain properties so that the comparative control obtained, particularly for early scab, depends somewhat on the timing of the applications in relation to apple scab infection periods. PMA is usually regarded as a poor protectant fungicide but in these tests it gave excellent control of early scab when applied in a regular spray schedule. Dodine was the most effective fungicide for scab control giving good control of both early and late scab. Captan was only fair for late scab control and dichlone was ineffective against this type of scab.

As a result of these fungicide tests it can be said that the yields of apple trees are definitely influenced by the fungicide schedule used. This factor should be considered by the apple grower when deciding on a spray schedule. The fungicide that gives the greatest yields should be used whenever possible. Of course, it is not always possible to use the same fungicide throughout the spray season. As stated before, the various fungicides have different properties and advantages and these must be considered in choosing a spray program.

As with most investigations, this test leaves some pertinent questions unanswered. In Nova Scotia, dichlone is not normally used in the cover sprays. Is it detrimental to yields if used only in pre-cover applications? In this test dodine was used at a slightly higher dosage than is now recommended. Would yields with dodine at a lower dosage be equal to those obtained with captan? At the present time the entire orchard is being sprayed with captan to determine if there are any carry-over effects from the fungicide treatments.

—	Captan	Dodine	Dichlone	PMA—captan
% increase in yield	40%	31%	7%	18%
Size of fruit	about same size as with dodine		fewer, same size as with captan	fewer with PMA but larger than with captan
Appearance of fruit	best finish	about 3% injury	rough, less attractive	—
Apple scab control (a) early	good control	good control	—	excellent
(b) late	fair control	good control	ineffective	—

Sodium Bicarb . . .

Continued from page 14

fluid. This was considered a desirable change as acetic acid is thought to be used less efficiently than the other volatile fatty acids by fattening cattle.

The effects of adding 3% sodium bicarbonate to the ration were not all beneficial. The bicarbonate supplement increased the incidence and severity of bloat which became a problem during the last month of a 4-month experiment. The buffers also seemed to increase the incidence of kidney lesions which we have observed consistently when animals were fed high-concentrate rations.

The practical significance of this observation is questionable as the kidney lesions do not seem to be related to animal performance. It does, however, underline the fact that there are still problems to be solved before the all-concentrate feeding of beef cattle can be unconditionally recommended.