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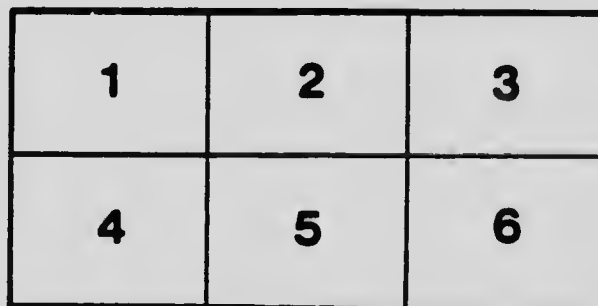
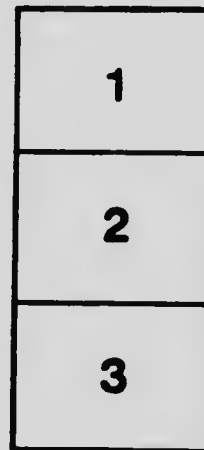
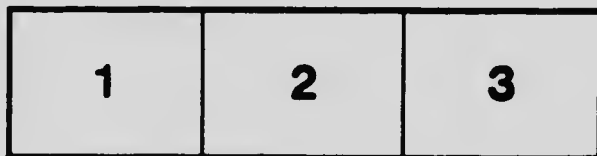
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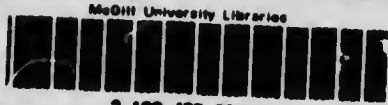
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C. GORDON HEWITT, DOMINION ENTOMOLOGIST.



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SPRAYING FOR INSECTS AFFECTING APPLE ORCHARDS IN NOVA SCOTIA

BY

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Agricultural College, Truro, N.S.*

CIRCULAR No. 8

Published by direction of Hon. **TIN BURRELL**, Minister of Agriculture, Ottawa, Ont.

OTTAWA

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1916

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OTTAWA, November 30, 1916.

To the Honourable,
The Minister of Agriculture,
Ottawa.

Sir,—I have the honour to submit for your approval Entomological Circular No. 8, entitled "Spraying for Insects Affecting Apple Orchards in Nova Scotia" which has been prepared by Mr. George E. Sanders, Field Officer in charge of the Entomological Laboratory at Annapolis Royal, N.S., and Prof. W. H. Brittain, Provincial Entomologist for Nova Scotia.

This circular contains the results of spraying experiments carried on in Nova Scotia during the last two years together with notes on the control of certain insects affecting apples and pears that are prevalent at the present time. The "Spray Calendar" given in Circular No. 7 has been revised in accordance with the results of later work.

The efforts that we have been making to secure the adoption of more and better spraying have met with very gratifying success, as the superior marketable value of clean fruit of good quality is convincing the fruit growers that they cannot afford either not to spray or to spray carelessly. The distribution of the Circular will help to improve the production of more and better fruit not only in Nova Scotia, but in the Maritime Provinces generally.

I have the honour to be, sir,

Your obedient servant,

C. GORDON HEWITT,

Dominion Entomologist.



SPRAYING FOR INSECTS AFFECTING APPLE ORCHARDS IN NOVA SCOTIA.

Insect and fungous pests have increased in numbers during the past few years and will doubtless continue to do so in the future. To keep pace with this increase, new methods and materials are constantly being discovered and put into practice. Accordingly, as time goes on, the profits that will accrue to those who spray intelligently will continue to increase.

Only a short time ago one of the most successful orchardists in the Valley, on being told of a new pest said, "Let them come. When we get plenty of pests, the poor sprayers and non-sprayers will be driven out of the business and I shall be making more profits than ever." This grower's observation made in Nova Scotia from present conditions, is borne out by orchard experience elsewhere. In Ontario the good grower has made more profit from peaches since the advent of the San José Scale than ever before, and the same may be said regarding apples in the State of Illinois.

The history of the various fruit-growing districts in America is practically the same, wherever recorded. First, there is a period of clean orchards, few pests, good crops and good prices. Then there comes a period of heavy planting, with numerous pests introduced on nursery stock. These pests increase with the congestion of the orchards and, accordingly, there comes a period of lighter crops. Since, however, the aggregate production is greater, the price is forced down. This is followed by a period of heavy production with low prices, causing neglect of some orchards and no profits from those neglected, while the well-cared for orchards bear well and are profitable. The fourth period brings the elimination of the careless orchardist, together with larger profits than ever before to the grower who took proper care of his trees.

Here in Nova Scotia we are still in the third period of our existence as a fruit-producing region. In Nova Scotia, at the present time, large plantings are yearly coming into bearing and over periods of years we are producing large quantities of fruit. In most cases this fruit has been grown at a profit, but in almost every district orchards can be found that are not producing so barrels, but which, if properly cared for, should produce 1,000. Thirty years ago, such neglected orchards were possibly among the most heavy-bearing of the district. Insect pests and fungous diseases were not as common then as now. The pests increased, while the soil and cultivation in the orchards probably remained the same. The crop decreased in both quality and quantity as the years went on, while the neighbours who sprayed secured more and more apples every year. As a result of observing numerous orchards year after year throughout the Annapolis Valley, and by considering fully the value of fertilizing, cultivation and pruning, one is forced to acknowledge that thorough spraying is important to the health and production of an orchard than any or all factors combined. In other words, the success of the apple growers of the Annapolis Valley, both individually and collectively, depends more upon thorough and intelligent spraying than upon any other treatment they can give their orchards.

With a view to improving spraying methods and making sprays which seemed dangerous and defective, safe and profitable, spraying methods and materials have been studied carefully, and the spray calendar printed herewith, gives, in concise form, the best mixtures and methods as shown by the investigations of the writers.

APPLYING THE SPRAY.

The cost of spraying material, including both poison and fungicide diluted ready for the trees, is between 75 cents and \$1 per hundred gallons. The cost of applying this from \$1.50 to \$2 per hundred gallons. For this reason economies affecting the application of the spraying material are of greater importance to the grower than economies affecting the spraying solution. We have endeavoured to work out the solutions, so that the tree may be drenched with any of the sprays as recommended in the spray calendar without any harmful results. For the greatest economy and efficiency in controlling all pests we would recommend at least 200 pounds pressure and high capacity nozzles, so that the nozzle may be passed rapidly over the tree and still enough spray will come through it to thoroughly drench every portion covered.

TUSSOCK MOTH AND CANKER WORM.

These two insects are still on the increase in the Valley, and will undoubtedly do serious damage to many orchards during 1917. The secret of controlling both, lies in poisoning the insect as soon as possible after it emerges from the egg. The canker worm emerges three or four days before the blossoms open and where they are present, special attention should be paid to the spray immediately before the blossoms open.

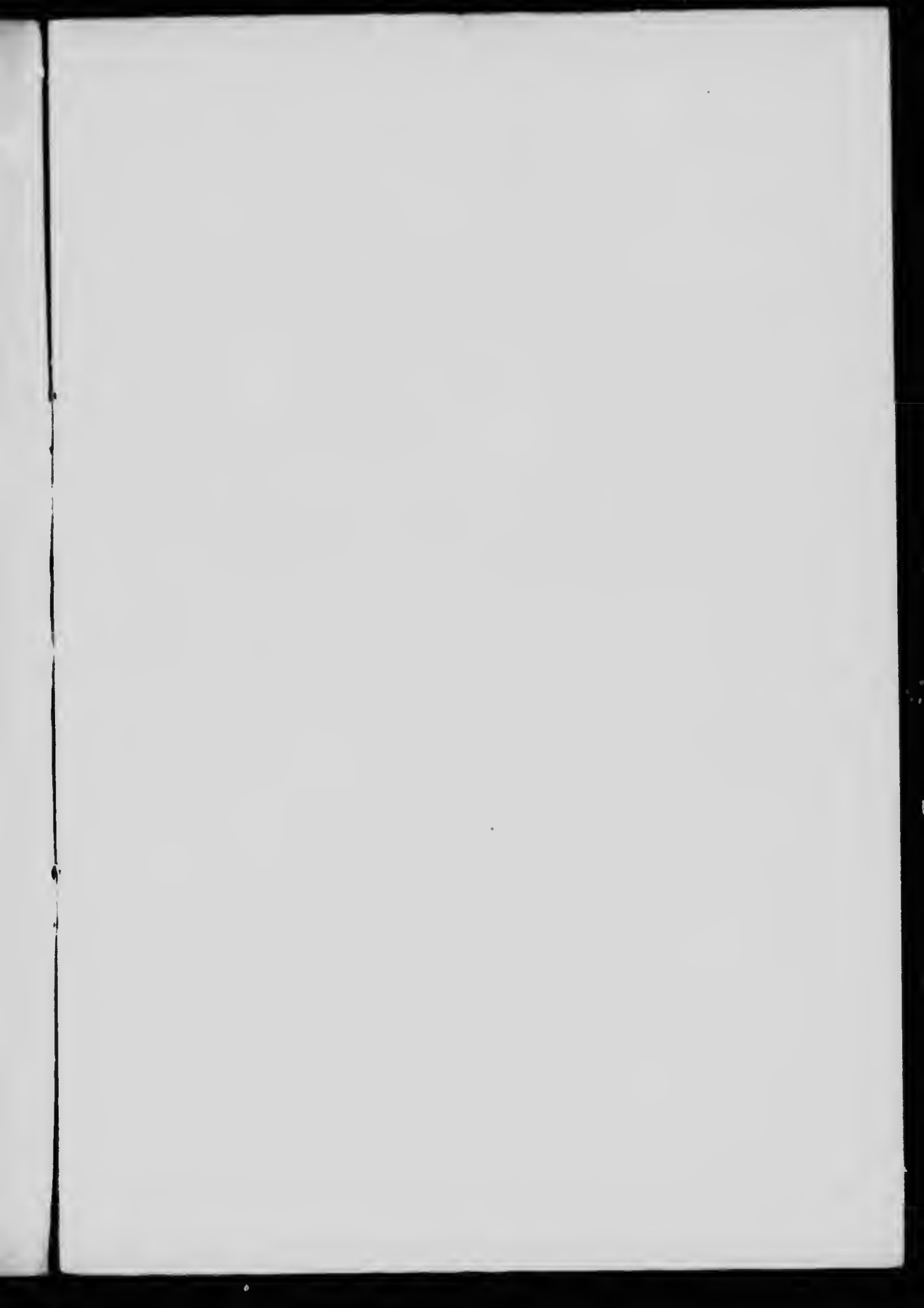
The Tussock Moth larvae emerge from the egg during the last few days of June and as they are present in greater or less numbers in practically every orchard in the Valley, special attention should be paid to the fourth or last summer spray. We would in no case recommend the omission of poison from the fourth summer spray in Nova Scotia during 1917.

THE CONTROL OF THE APPLE MAGGOT (*Rhagoletis pomonella*) BY ARSENICAL SPRAYS.

That the apple maggot can be controlled by timely applications of arsenical sprays has been abundantly demonstrated by our work during the past two years. There can be little doubt that the sprayings regularly applied in the ordinary well-kept commercial orchards, will keep this pest in control. Scattered cases of apple maggot have been found throughout the chief fruit-growing counties, namely Kings and Annapolis, and the pest occurs generally in the fruit of the hawthorn, but we have never found a severe infestation in an orchard that regularly received applications of arsenical sprays. Furthermore, we have reliable information to the effect that formerly the apple maggot was much more serious in several localities in Kings and Annapolis counties, but with the aid of arsenical spraying, the infestations gradually died out.

On the other hand we find that on both sides of the main fruit belt, in Hants, western Annapolis and Digby counties, there exist very severe infestations in many of the small orchards that have not been sprayed regularly, if at all. Many such infestations have been present for a number of years past, sometimes destroying the entire crop of the susceptible varieties and frequently a large proportion of even the more resistant sorts.

Experiments have shown that a light arsenical spray, applied when the first adult flies appear, and another about two weeks later, gives excellent results even in very wet seasons. In cases where the weather is dry during the latter half of July and August, one application is satisfactory. Any grower having a



Spray Calendar for Nova Scotia

W. H. BRITAIN
Agricultural College
TRURO, N.S.



FIRST SPRAY



SECOND SPRAY



THIRD SPRAY

FIRST SPRAY

Time:—When leaves about blossom clusters are showing green. For
Material:—Lime sulphur 1.009 sp. gr., or 3 gals. commercial strength
Application:—Drench thoroughly at 200 lbs pressure, using a drive
Pests Destroyed:—Apple Scab, Budmoth, Browntail Moth, Canker
100 gals.

SECOND SPRAY

Time:—When blossom buds are showing pink at tips. For Canker
soms open.
Material:—Lime sulphur 1.007 sp. gr., or about 2½ gals. to 100 gals. of
Application:—Drench thoroughly at 200 lbs pressure, using a drive
Pests destroyed:—Apple Scab, Budmoth, Browntail Moth, Canker
nicotine sulphate, ¾ pint to 100 gals., making sure that every in
tree must be banded with tree tanglefoot before spraying and

THIRD SPRAY

Time:—When blossoms fall.
Material:—Lime sulphur 1.006 sp. gr., or about 2 gals. to 100 gals. of
Application:—Use 200 lbs. pressure and a calyx nozzle.
Pests Destroyed:—Apple Scab, Pit Rot, Codling Moth, Fruit Worm
gals., using a drive nozzle as in previous sprays.

FOURTH SPRAY

Time:—Ten days to two weeks after the third spray.
Material:—{ First Choice.—Bordeaux 7 7-100, adding paste lead ar
Second Choice.—Lime sulphur 1.005, or 1½ gals. to 100
Application:—Use 200 lbs. pressure and a calyx nozzle.
Pests Destroyed:—Apple Scab, Pit Rot, Fruit Worms, Codling M
pillar, fall feeding Browntail Moth Caterpillars, etc.

FIFTH SPRAY

In very wet seasons a fifth spray may be necessary to control APPLE
in material and application. When Tussock Moth and Brow
is recommended.

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UP FOR REFERENCE

Scotia Apple Orchards for 1917

G. E. SANDERS
Dominion Entomological Laboratory
ANNAPOLIS ROYAL, N.S.



THIRD SPRAY



FOURTH SPRAY



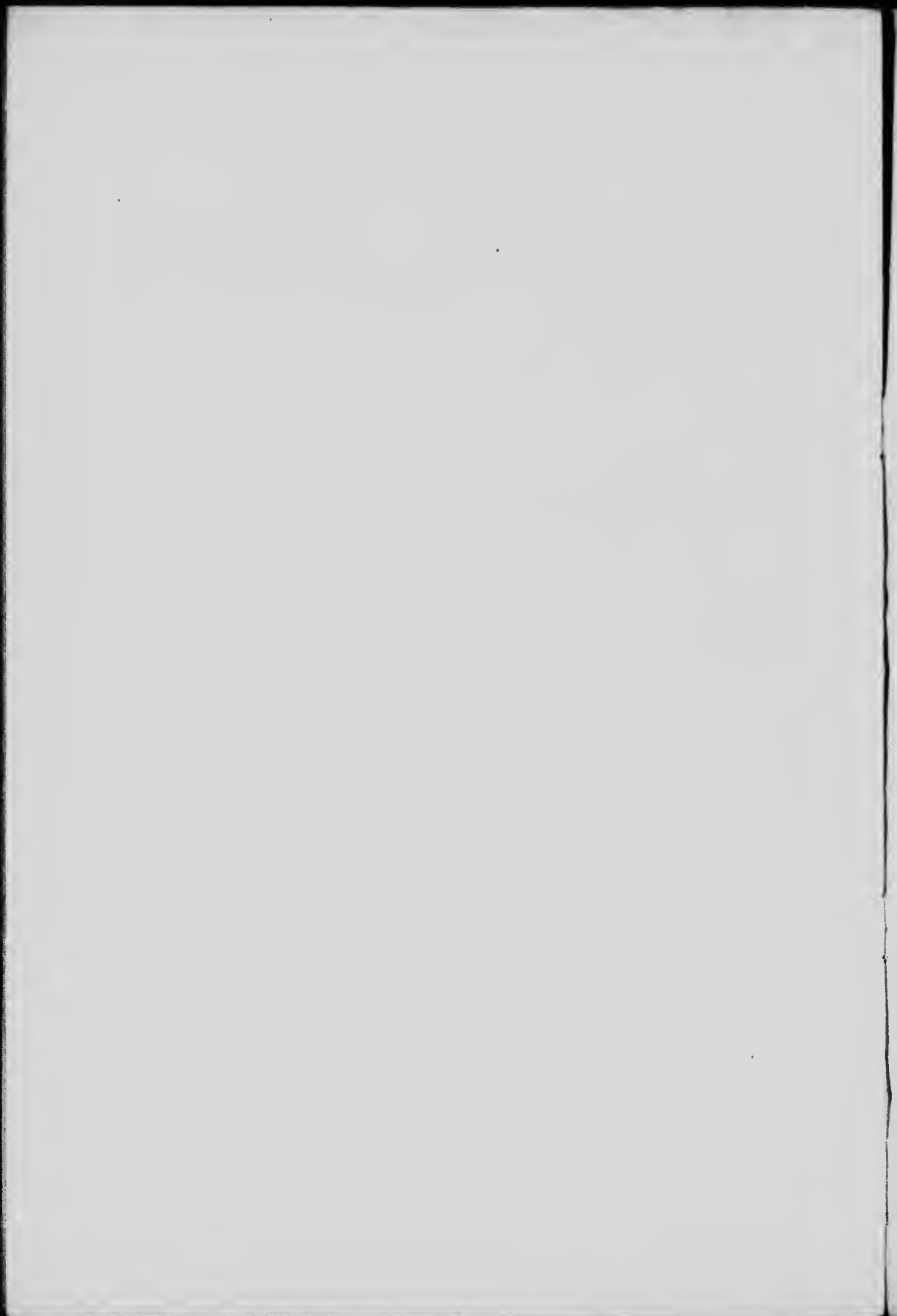
FIFTH SPRAY

green. For Canker Worm defer this spray for a few days.
dial strength to 100 gals. of water (1-33), adding powdered arsenate of lime, 2 lbs to 100 gals.
ng a drive nozzle.
n, Canker Worm, Tent Caterpillars, etc. If Aphids are present add nicotine sulphate, $\frac{3}{4}$ pint to
or Canker Worm apply slightly earlier; for Green Apple Bug, leave until just before the blos-
100 gals. of water (1-43), adding powdered arsenate of lime 2 lbs to 100 gals.
ng a drive nozzle.
n, Canker Worm, Fruit Worms, etc. If Green Aphis or Green Apple Bug is present, add
at every insect is covered with the spray. For very severe infestations of Green Apple Bug, the
spraying and kept clean cultivated until July 7th.

100 gals. of water (1-50), adding powdered arsenate of lime $1\frac{1}{2}$ lbs. to 100 gals.
Fruit Worms, Budmoth, etc. If Green Apple Bug is present add nicotine sulphate, 1 pint to 100
te lead arsenate 5 lbs. to 100 gals. or powdered arsenate of lime, 2 lbs. to 100 gals.
als. to 100 gals. of water (1-60), adding $1\frac{1}{4}$ lbs. powdered arsenate of lime to 100 gals. of water.

Codling Moth, Tussock Moth, Fall Webworm, Red-humped Caterpillar, Yellow-necked Cater-
col APPLE SCAB. This is applied ten days to two weeks after the fourth spray, and is the same
and Browntail Moth Caterpillars are present in injurious numbers, the application of this spray

ON APPLICATION TO EITHER OF THE ABOVE ADDRESSES.



severe infestation of this pest to deal with, can easily determine the time of emergence of the adult flies by placing a number of maggot-infested apples in a box or barrel containing a little earth. Some cheese-cloth can be tacked over the top of this receptacle and when the first flies appear the next July the spray should be applied.

For those who have not severe infestations to contend with, special sprays will rarely be necessary. The last summer spray should simply be deferred for a week or ten days later than ordinarily applied. Arsenate of lead (2 pounds to 40 gallons of water) will probably be the best poison to use for this pest on account of its superior sticking qualities. Arsenate of lime should not be used except in combination with lime sulphur, since, if used alone, it may cause very severe burning at this time.

For a more complete description of this pest consult Bulletin No. 8 of the Nova Scotia Department of Agriculture.

THE CONTROL OF THE GREEN APPLE BUG.

(*Lygus communis* var. *novascotiensis* Knight).

This pest is not amenable to the ordinary methods of control applicable to the various common orchard pests, with which we are accustomed to deal. Special methods must be employed to control it and work of an exceptionally careful nature carried out, or we cannot hope for success.

Some of the special difficulties which have to be met in any attempt to control this pest are as follows:—

1. The insect is of the "sucking" type and can only be destroyed by a contact poison applied directly to its body.
2. The young insects are very active and have a wonderful ability to hide themselves in inaccessible places.
3. In spraying badly infested trees there will be a large drop of insects to the ground, which after spraying will reascend the trees.
4. The hatching period is spread over a considerable time, commencing several days before the blossoms open and continuing, though at a greatly reduced rate, through the blossoming period.
5. The adults are strong flyers and are attracted to pears from infested apple trees near at hand.

CONTROL.

The following methods intelligently applied will keep this pest in control:—

1. Thoroughly prune all infested trees so that all parts will be readily accessible to the spray.
2. Where the infestation is severe, band with tanglefoot to prevent the reascent of those insects that have fallen to the ground. Likewise the grass and weeds in the orchard must be altogether eradicated, so that nothing is present beneath the tree to serve as food for such insects.
3. Apple trees should be sprayed with nicotine sulphate (Black Leaf 40) just before the blossoms open and again, if necessary, just after they fall. In the case of very light infestations one spraying before the blossoms, without band-

ing, will give satisfactory control if timed correctly and applied with care and thoroughness. To control the pest on pears, it must first of all be destroyed in the near-by apple trees, since much of the damage done to pears is from bugs flying from such trees. If the pear trees are infested by the immature bugs, one spray immediately before the blossoms fall is usually sufficient.

4. A very heavy, drenching, driving spray is necessary. Use a drive nozzle and a pressure of at least 200 pounds. Follow up each limb individually and spray it from every angle.

NOTE.—For a full description of this pest see Bulletin No. 7, Nova Scotia Department of Agriculture.

LIME SULPHUR INJURY.

During the season of 1915 many observations were made and a number of experiments conducted to determine the effect of the lime sulphur spray on the crop of fruit. Good evidence was obtained that in many cases serious reduction in the crop resulted from using lime and sulphur too strong, but where the danger point occurred and when the most injury was effected were not determined. In 1916 a series of experiments was conducted in the orchard of Mr. F. H. Johnson, Bridgetown, N.S., to determine the strength at which lime and sulphur caused burning and at what period it did the most damage.

These experiments, carried on carefully in a very even block of Wagner apple trees, gave the following information. Trees sprayed three times or with sprays Nos. 2, 3 and 4, as shown in this spray calendar, with lime and sulphur in the following different strengths: 1.004 sp. gr. (equivalent to 1 gallon of concentrated commercial lime and sulphur solution to 75 gallons of water); 1.005 sp. gr. (equivalent to 1 gallon of concentrated commercial lime and sulphur solution to 60 gallons of water); and 1.006 sp. gr. (equivalent to 1 gallon of concentrated commercial lime and sulphur solution to 50 gallons of water); in combination with ordinary paste arsenate of lead, 5 pounds to 100 gallons, showed very little, if any, injury so far as reduction of the crop was concerned. Trees sprayed three times or with sprays Nos. 2, 3 and 4 as shown in the spray calendar, using lime and sulphur in the following strengths: 1.007 sp. gr. (equivalent to 1 gallon of concentrated commercial lime and sulphur to 43 gallons of water), and 1.008 sp. gr. (equivalent to 1 gallon of concentrated commercial lime and sulphur to 37½ gallons of water), in combination with ordinary paste arsenate of lead, 5 pounds to 100 gallons, lost at least 85 per cent of the crop set, the drop taking place just after the application of the fourth spray. Trees sprayed three times with lime and sulphur in the strengths: 1.009 sp. gr. (equivalent to 1 gallon of concentrated commercial lime and sulphur to 33 gallons of water), and 1.010 sp. gr. (equivalent to 1 gallon of concentrated commercial lime and sulphur to 30 gallons of water), combined with ordinary paste arsenate of lead, 5 pounds to 100 gallons, lost practically the entire crop set, in one case one-half of one per cent and in the other two and one-half per cent of the crop set remained after the drop which followed the application of the fourth spray.

Powdered arsenate of lime, used in the strength of two pounds to 100 gallons with lime and sulphur in sprays 2, 3 and 4, proved in all cases much safer than the lead arsenate, lime sulphur combinations. Arsenate of lime in dilutions of from 1.004 to 1.007 sp. gr. (equivalent to 1 gallon of concentrated commercial lime and sulphur to 75 and 43 gallons of water respectively) of lime and sulphur gave no definite reduction in the crop of fruit, although the latter combination with arsenate of lead gave very definite reduction in the crop. Arsenate of lime, used in the strength of 2 pounds to 100 gallons of lime sulphur in the following

strengths: 1.008 sp. gr. (equivalent to 1 gallon of concentrated commercial lime and sulphur to 37½ gallons of water), 1.009 sp. gr. (equivalent to 1 gallon of commercial concentrated lime and sulphur to 33 gallons of water) and 1.010 sp. gr. (equivalent to 1 gallon of concentrated commercial lime and sulphur to 30 gallons of water), gave 75, 80 and 85 per cent reduction in the crop set respectively; this is not so great a reduction in the set as from the same dilutions of lime and sulphur when used with arsenate of lead. Arsenate of lime when used alone will cause serious injury. When used in very dilute spray mixtures it will sometimes cause a little burning, if the full strength is used; in the spray calendar, therefore, as the strength of lime is reduced with each succeeding spray, the quantity of arsenate of lime is correspondingly diminished.

The period at which the injury that removes the set takes place is a most important point. From last year's observations and this year's experiments it has been shown definitely that the apple stem is most tender about two weeks after the blossoms fall. Lime sulphur 1.009 sp. gr. (equivalent to 1 gallon of concentrated commercial lime and sulphur to 33 gallons of water) used immediately before the blossoms opened caused no reduction from the normal crop yield, the same strength used immediately after the blossoms fell gave very little, if any, reduction in set, but used two weeks after the blossoms it caused 85 per cent of the fruit to drop in a few days. The period of greatest danger from too strong lime and sulphur is from ten days to two weeks after the blossoms fall.

Bordeaux mixture used, according to the 4-4-40 formula, two weeks after the blossoms fell caused no drop of the fruit and only three per cent of the Wagner apples on the tree on which it was used showed slight russetting. Bordeaux used immediately after the blossoms caused severe russetting and it should never be used on smooth skinned varieties until the down or pubescence drops off the young fruit and the skin of the fruit becomes smooth.

After the results were taken from the orchard, it was decided that the ideal spray was lime and sulphur and arsenate of lime twice before the blossoms opened, and dilute lime and sulphur and slightly less arsenate of lime, immediately after the blossoms fell, followed two weeks later by weak Bordeaux mixture which, at that period, caused little russetting.

Later, it was found that Mr. Wheelock Marshall, of Beaconsfield, Annapolis county, had practically followed this plan and that it had resulted in an ideal crop of apples. No tree in the orchard showed any trace of crop reduction through spray injury. No appreciable leaf injury or russeted apples occurred in the orchard, and a count of Gravensteins showed them to be 99 per cent free from apple scab. The spray calendar which had been devised from the results of two years of laboratory work and small experiments was thus fortunately tried out in a large and practical way, with entire success by Mr. Marshall, in his orchard in Beaconsfield.

The results of our experiments which we have here briefly described, refer to results obtained in the Annapolis Valley during the past two years. It should be noted that, in all the experiments the trees used were heavily drenched with the spraying solution. This resulted in more injury than would have been the case had only a light spraying been given.

TABLE FOR DILUTING LIME SULPHUR.

The following table will be found useful by orchardists using home-made lime sulphur solutions; by its use they may be sure of the strength they are using. Hydrometers for testing may be purchased from any large firm dealing in drugs, etc. In reckoning the dilution, use the specific gravity column and

divide the figure to the right of the decimal, by the specific gravity dilution required. For example, if the concentrate tests 1.240 sp. gr. and a 1.008 dilution is required, divide 240 by 8, which equals 30, so that the dilution should be 1 to 30.

The sprays referred to by number are the same as in the spray calendar in this circular.

The table is not worked out to fractions of gallons, but to the nearest full number, and should cover any strength of lime and sulphur obtained, either commercial or home-boiled. By using this table the grower can readily determine the correct strength to use without calculation.

TABLE FOR DILUTING LIME SULPHUR.

Beaume Scale.	Specific Gravity Scale.	First Spray 1.000 sp. gr.	Second Spray 1.007 sp. gr.	Third Spray 1.006 sp. gr.	Fourth Spray 1.005 sp. gr.
35½	1.320	1 to 36	1 to 46	1 to 53	1 to 64
34½	1.310	1 to 34	1 to 44	1 to 51	1 to 62
33½	1.300	1 to 33	1 to 43	1 to 50	1 to 60
32½	1.290	1 to 32	1 to 41	1 to 48	1 to 58
31½	1.280	1 to 31	1 to 40	1 to 47	1 to 56
31	1.270	1 to 30	1 to 39	1 to 45	1 to 54
30	1.260	1 to 29	1 to 37	1 to 43	1 to 52
29	1.250	1 to 28	1 to 36	1 to 42	1 to 50
28	1.240	1 to 27	1 to 34	1 to 40	1 to 48
27	1.230	1 to 25	1 to 33	1 to 38	1 to 46
26	1.220	1 to 24	1 to 31	1 to 37	1 to 44
25½	1.210	1 to 23	1 to 30	1 to 35	1 to 42
24½	1.200	1 to 22	1 to 29	1 to 33	1 to 40
23½	1.190	1 to 21	1 to 27	1 to 32	1 to 38
22½	1.180	1 to 20	1 to 26	1 to 30	1 to 36
21½	1.170	1 to 19	1 to 24	1 to 28	1 to 34
20½	1.160	1 to 18	1 to 23	1 to 27	1 to 32
19½	1.150	1 to 17	1 to 21	1 to 25	1 to 30
18½	1.140	1 to 15	1 to 20	1 to 23	1 to 28
16½	1.130	1 to 14	1 to 19	1 to 22	1 to 26
15½	1.120	1 to 13	1 to 17	1 to 20	1 to 24

BORDEAUX MIXTURE.

Ordinary Bordeaux mixture, somewhat weaker than ordinarily used, is recommended for the last summer spray on account of its better sticking qualities, as well as on account of the fact that the ordinary Bordeaux does not burn the stems of the fruit and cause dropping of the young apples at this time. We have found that 7 pounds of copper sulphate and 7 pounds of lime (stone) to 100 gallons of water is practically harmless as far as the foliage and fruit are concerned, when used two weeks after the blossoms fall or later. The use of Bordeaux immediately after the blossoms fall will result in severe russetting, while the use of Bordeaux just before the blossoms will also result in slight russetting of the fruit.

We find that almost any of the common poisons can be used with a greater degree of safety with Bordeaux mixture than alone. There seems to be no object in using Paris green on account of its high cost at the present time and danger from injury. Arsenate of lime, two pounds to 100 gallons, makes a very satisfactory poison with Bordeaux mixture, but the best poison for use on the apple is probably paste arsenate of lead. We tested out various poisons many times with Bordeaux and, with only one exception, the paste arsenate of lead remained in suspension longer than any other poison used with Bordeaux.

In regard to lime, the fresher and cleaner the stone lime the better are the results. For those not inclined to go to the trouble of slaking lime, the commercial hydrated lime is a convenient and satisfactory substitute. It is sold in powdered form and can be stored for weeks in the air without deterioration. For the greatest speed and ease in making Bordeaux mixture we would recommend the following formula:—

In a cask or tank dissolve 1 pound of copper sulphate to each gallon of water the tank contains. This is the stock solution and it may be made up several days in advance of spraying. Seven gallons of stock solution should be placed in the spray tank for each 100 gallons capacity. The tank should then be filled up and 1 pound of hydrated lime added for each gallon of stock copper sulphate solution contained. The agitator should then be started and the poison added. The spray is now ready to go on the trees.

SPRAYING NOTES.

Measure your spray tank. Too many people think that they have a 100 gallon spray tank, when it holds only 80 imperial gallons.

Sixteen cents sprays a barrel of apples four times.

Spraying increases the quantity of apples at least 80 per cent.

Spraying increases the value per barrel of apples, tree run, by 70 per cent.

Spraying causes the foliage to remain healthy and the leaves to be retained late in the fall. The blossom of the following year depends largely on the tree retaining its leaves until well into November.

Do not use too strong a spray mixture.

Do not use arsenate of lime alone. Use it with lime sulphur or Bordeaux mixture.

When using a poison alone, use lead arsenate.

Call on, write to, or telephone the writers of this circular at any time, in regard to spraying problems.

