CONTROL OF LEAF BLISTER MITE IN APPLE ORCHARDS.

P. J. PARROTT.
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* Riverhead, N. Y.
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BULLETIN No. 306.

CONTROL OF LEAF BLISTER-MITE IN APPLE ORCHARDS.

P. J. PARROTT.

SUMMARY.

Conspicuous spotting of foliage by the leaf blister-mite is general throughout the apple growing areas of western New York. The continued attacks of this pest for successive years affect unfavorably the growth of the trees in the worst infested orchards, and, while the losses are not easily measured, crop yields are unquestionably being reduced in proportion to the severity of the infestation and according to the character of the management of the orchard.

The mite spends the winter under the bud scales and it is most susceptible to treatment during the late fall when the majority of leaves have dropped or during the spring before the new foliage appears. The efficient remedies for the blister-mite are the lime-sulphur wash, oil emulsions and miscible oils. Orchards that are regularly sprayed with these mixtures are not subject to injuries by the mite.

Comparative tests of the boiled lime-sulphur wash, the homemade concentrated lime-sulphur wash, and two commercial preparations gave equally satisfactory results. One application of either of these sprays has practically prevented spotting of foliage by the mite.

With the increased availability of the sulphur sprays these are now practicable remedies for the treatment of apple orchards for the blister-mite. In employing these remedies for this purpose, a plan of spraying well adapted for the treatment of apple trees is an application of a sulphur wash as the buds are swelling and before the leaves appear, followed by the usual second and third applications of the bordeaux mixture in their proper season.
INTRODUCTION.

The general spotting of apple foliage by the leaf blister-mite has for several years been of annual occurrence. By reason of its conspicuous work in apple orchards, the mite is now regarded by our fruit growers as a pest of growing importance to the fruit interests of this State. With the exception of the San José scale, there has been no insect for the past three years which has generally attracted more attention or which has provoked more discussion among growers in western New York, as to its probable destructiveness to apple trees and as to the more efficient methods of control, than has this mite.

The appearance of the blister-mite in the apple orchards of this State was announced in Bulletin 283, which directed the attention of fruit growers to the effectiveness of oil emulsions, miscible oils and the home-made lime-sulphur wash for its control. Since the distribution of this bulletin, the Station has continued its experiments, especially those to determine the value of various sulphur sprays for the treatment of the mite, as a basis for more complete directions to orchardists who should desire to spray for this pest. While special treatments for the mite have been made by relatively few orchardists, the opinion is generally expressed that it would pay to spray rather than to take further chances with the worst infested orchards. According to the reports of fruit growers, spraying for the mite will be quite generally practiced in many localities this coming spring.

ECONOMIC IMPORTANCE OF MITE.

DISTRIBUTION AS AN APPLE PEST.

The work of the mite is now quite common throughout the apple-growing sections of western New York. It has been very conspicuous in the orchards generally in Orleans, Monroe, Genesee, Wayne, Livingston, Ontario, Yates, Seneca and Steu-
ben counties. Badly diseased leaves have been received by the Station from apple orchards at Pattersonville in the Mohawk Valley and from Delmar, Voorheesville and Schodack Landing in the Hudson Valley. Mr. Percy Huested, a State nursery inspector, has also noted apple trees with the leaves much spotted by the mite at Preston Hollow in the Catskills.

Injuries to apple foliage have been recognized in Massachussetts and Pennysylvania. Mr. E. Cyrus Miller, Haydenville, Mass., informs us that the mite has been quite a serious pest in apple orchards in his vicinity and at Leyden. Prof. H. A. Surface of the Pennsylvania Department of Agriculture states that spotting of apple foliage by the mite occurs in practically all portions of Pennsylvania. It seems to be generally distributed but is overlooked or is not recognized by fruit growers. Mr. W. J. Schoene, while engaged in nursery inspection in Illinois, recognized the work of the mite in apple orchards in the southern part of that state but Dr. Forbes has written me that its injuries have not been of sufficient importance to attract attention. Prof. T. D. Jarvis of the Ontario Agricultural College has also reported outbreaks of the blister-mite in apple orchards in the Province of Ontario, Canada.

It is a pest wherever pears are grown, and is probably widely distributed on apples, although its work on apple foliage seems not to be as common as on pears or as destructive as it is at present in the leading areas of apple production of western New York.

**EFFECTS ON CROP YIELDS.**

The actual damage to apple orchards by the mite cannot be accurately determined, and figures on the effects of its attacks on crop yields are largely conjectural. Not infrequently injuries by the mite have been confused with the work of other destructive agencies. The unfavorable conditions of some orchards, said to be damaged by the mite, may be more justly charged to several contributory causes, such as poor drainage and injuries by winter and by various insects and spraying mixtures.
Orchards that are subject to an adverse environment, through lack of fertility, improper methods of tillage or droughty conditions of weather, usually show very plainly the effects of the mite, while closely adjoining plantings, which are grown in well drained, fertile soil and given the needed tillage to stimulate a vigorous growth, may largely outgrow injuries by the first attacks in the spring and produce good yields. During 1908 it was quite generally observed that timely rains favored the development of new foliage and in spite of early fears of losses by the mite, apples were abundant and of uniformly larger size than for several years.

Fruit growers whose trees have been much infested believe that the mite has caused more or less dropping of the young fruits, and that the general infestation of the foliage lowers the vitality and productiveness of the trees and injures the leaf and fruit buds for the next year's crop. In badly infested orchards, especially where other conditions have not been favorable, the mite has unquestionably influenced unfavorably the production of crops, as the foliage could not be diseased to such a degree without the vitality of the trees being affected. This influence, while not easily measured, has undoubtedly in a good many orchards been important, but in general there has been a tendency to overrate the actual damages by the mite.

EXPERIMENTS IN CONTROLLING THE LEAF BLISTER-MITE.

The experiments described under this heading were undertaken by the Station in its own orchards or in co-operation with several fruit growers who had desired to spray for the blister-mite. All of the orchards, preceding the spraying tests, were badly infested with the mite and they afforded excellent opportunities for determining the relative merits of the different spray mixtures, and of demonstrating to fruit growers on a commercial scale efficient methods for controlling this pest. Each orchard is discussed separately and it has been intended
to give in condensed form an accurate idea of the conditions and results of the experimental operations.

**Orchard I.**

As has been the experience of fruit growers generally in Ontario County, the Station apple orchard has also been infested with the leaf blister-mite. In 1906 pimpling of young apples and blistering of leaves were very conspicuous, especially on several trees of the variety Williams, which were for two years badly affected and have apparently sustained important injuries. During that year, 250 varieties were recorded as showing more or less of the work of the mite. Some of the leading commercial varieties which had their foliage badly diseased were the Baldwin, Rhode Island Greening, Sutton, Fall Pippin, Ben Davis and King. The work of the mite was largely confined to the younger apple orchard which comprises 6 acres and contains 218 trees.

In this orchard, experiments have been made to determine the comparative merits of sulphur washes, oil emulsions and miscible oil for the control of the leaf blister-mite. In the spring of 1907 the orchard was divided into three areas, and each area has been treated with the same spraying mixture for the past two years. For purposes of comparison some applications of each insecticide were made in the fall but the larger proportion of the spraying has been done in the spring when the buds are swelling, ending when the tips of the young leaves began to make their appearance. The sulphur wash was prepared after the standard formula while a commercial preparation of this mixture was employed at a dilution of one part to nine parts of water. Miscible oil was used at the rate of one gallon diluted with nine gallons of water, while the kerosene emulsion contained 15 per ct. of oil.

In addition to spraying entire blocks, comparative tests of these remedies have been made on individual trees, which were among the worst infested on the Station grounds. Each tree was divided into thirds, fourths or fifths, according to the number of
mixtures tested, and provision was also made for checks. To confine a particular treatment to the portion of the tree desired and to avoid re-treatments while applications of the various remedies were being made on other parts, cloth screens were employed in all of these operations.

Results on mite.—The first year's applications of these remedies destroyed a large percentage of the mites. During the summer of 1907, the work of the mite on the sprayed trees was very slight as compared with that of the previous year or that on the checks. None of the trees was completely free but enough of the mites were killed to prevent the pimpling of young apples and to protect a large percentage of the foliage from injury. The applications in the fall of 1907 and the spring of 1908 were equally effective and the foliage in this orchard, with the exception of a few leaves on an occasional twig, was generally very clean. The smaller tests also indicated that, if the applications are equally thorough, there is very little difference in the effectiveness of the different sprays. The results of these experiments show conclusively, also, that the blister-mite is never likely to cause important injuries in orchards that are well sprayed each year with a sulphur wash or oil emulsions as is required for the proper treatment of the San José scale.

ORCHARD II.

This orchard belongs to E. C. Green, Victor, and comprises about ten acres. There are 465 trees, which are thirty years of age. The leading varieties are Baldwin, Seek-No-Further, Wagner and Spy. The orchard has been systematically sprayed for the common insects and diseases and is regarded as one of the most attractive and productive plantings in the community. Originally the orchard was given very thorough cultivation but for the past two years it has been grown under the so-called sod-mulch method. This change seems to have been an unfortunate one; as the sod treatment, combined with the blister-mite and two comparatively dry seasons, has told seriously on the health of the trees.
The blister-mite did not attract the attention of the owner till 1905, when the foliage of nearly all of the trees was generally conspicuously spotted. During succeeding years the mites have continued to be abundant, especially on Baldwins, and owing to the unsatisfactory condition of the orchard during 1907, a co-operative experiment with this Station was undertaken this spring to demonstrate the value of the home-made concentrated lime-sulphur mixture for the control of the mite. The applications of this wash were made with a power sprayer during the week of April 5–11. At this date the buds were well swollen and were beginning to show green at the tips. The trees were thoroughly whitewashed by the one operation and no other treatments were made. The quantity of mixture used to each tree was seven gallons. A number of Baldwins were left unsprayed to serve as checks.

*Results on mite.*—The results of this treatment were among the most conclusive in the series of experiments. The difference in the conditions of the sprayed and unsprayed portions of the orchard was very striking. The foliage of the sulphur-treated trees was entirely free of mite injuries and made a very marked contrast with adjacent rows in the untreated parts of the orchard. Not only were the leaves free from diseased areas, but they seemed on an average, to be somewhat larger than those on the unsprayed trees. This may have been mainly due to the absence of curling, one of the results of the attacks of the mite. The sprayed trees appeared to have made a better growth and, consequently, to carry a heavier foliage, but this difference was perhaps more apparent than real. The leaves of unsprayed trees in this community generally showed very plain evidences of infestation with the blister-mite.

**Orchard III.**

This is the orchard of Wm. A. Laffer, Albion. It consists of 17 acres, bearing 260 trees, 45 years of age and 323 trees, 35 years old. The older trees have been largely grown in sod, which has been heavily manured, while the younger plant-
ing has been under thorough cultivation. Both plantings have yielded well for the past twelve years. The leading varieties are Baldwin, Greening, Russet, Spy, King and Twenty Ounce. The orchard has been regularly sprayed for the ordinary insects and plant diseases and has in all respects been given excellent care.

The mite made its appearance in destructive numbers for the first time in 1906 in the younger orchard, and in 1907 it was abundant in the older orchard. The varieties that have shown the work of the mite most extensively are the Baldwin and Giliflower. The owner estimates that the mite has caused a decreased yield in the younger orchard amounting to about 250 barrels each year. The condition of the foliage of the Giliflower was worse than that of the Baldwins and all of the fruit was of little value as it was much undersized. This was attributed to the work of the mite. For the treatment of the trees the home-made lime-sulphur wash and a commercial concentrated preparation of this mixture were employed. The applications were made during the week of April 13–20. The amount of wash applied per tree was ten gallons, which was larger than necessary because of the treatment of the trunks and large limbs. These could have safely been left unsprayed. A power sprayer was used to make the applications. Several Baldwins and a block of 23 Hubbardstons were left unsprayed as checks.

Results on mite.—The effectiveness of the sulphur wash for the control of the blister-mite in an old commercial apple planting was in none of the experiments more strikingly demonstrated than in this orchard. While there were occasional twigs that showed some affected leaves, the foliage generally was clean, and, as in other experiments, the appearance of the trees afforded a striking contrast with the condition of the checks, which as usual were abundantly infested with the mite. Mr. Lafier is so much impressed with the efficient qualities of the sulphur wash as an orchard spray that he has erected a steam cooking outfit, and plans to make one treatment of this
mixture each year during the dormant season in place of the usual application of the bordeaux mixture at that time. The home-made wash and the commercial concentrated preparations of the lime-sulphur wash were equally effective in controlling the blister-mite.

ORCHARD IV.

This orchard belongs to C. Willard Rice, Seneca, and comprises six acres. The number of trees is 180 and they are about 40 years of age. The varieties are principally Baldwin, Greening and King. This orchard has been cultivated for the past eight years and treated with barnyard manure and chemical fertilizers. The yields have averaged about 400 barrels each year. Injuries to foliage by the mite have been noticed for four or five years, and the Greenings have been the variety most affected. The owner reports that the worst infested trees suffered more or less premature dropping of the foliage, and believes that this partial defoliation has retarded the growth of the trees. It is also thought that through the unsatisfactory condition of the leaves there have been some losses in the crop yields by the dropping of young fruits and the failure of the apples to attain full size.

For the treatment of the trees the home-made concentrated lime-sulphur wash, diluted with nine parts of water, was used, and the application was made on April 11. The buds were generally well swollen and many were beginning to show green at the tips. The spraying was carefully done; on drying, the trees appeared to be completely whitewashed. The quantity of mixture applied to each tree averaged from seven to eight gallons. Hand-power machinery was employed. Several trees of each variety were left unsprayed which served as checks.

Results on mite.—Judging from the condition of the foliage of the checks, the mites were not generally as abundant in this orchard as in the preceding year. The trees showed a marked variation in the quantity of diseased leaves; while some trees were quite seriously affected others were almost free of injuries or had only a small proportion of the leaves spotted by
the mite. These differences in the condition of the checks preclude an exact estimate of the benefits derived by the trees sprayed with the lime-sulphur wash. But in comparison with the checks the work of the mite on the sprayed trees was uniformly less conspicuous and there were none of those striking differences in the amount of infestation of the foliage so apparent on the untreated portions of the orchard. Spotting of the foliage was largely limited to occasional leaves or to clusters of leaves on widely separated branches. It is reasonable to suppose that while some other agency may perhaps have checked the work of the mite in certain parts of the orchard the uniform freedom of the sprayed block from injuries by the mite must be largely attributed to the treatment with the lime-sulphur wash. As noted in Orchard II it was also observed in this experiment that owing to the reduction in the quantity of diseased leaves, the foliage of the sprayed trees presented a more thrifty appearance, and the new growth was apparently more heavy than that on the checks.

VOLUNTEER EXPERIMENTS

While there is a widespread complaint of the unsatisfactory appearance of the foliage of apple trees through the work of the blister-mite, spraying has not generally been practiced for this pest. This has not been for the lack of desire, as owners of badly infested orchards are generally of the opinion that they would spray, if only they knew what spray to employ and were assured that the treatment would be profitable. The remedies that efficiently control the leaf blister-mite are comparatively untried sprays for the majority of our apple growers, who are not accustomed to spray for the scale; and they hesitate to adopt new spraying practices. Kerosene emulsion, it is true, is an old and well known insecticide but it has never been extensively employed, outside of the San José scale areas, as farmers dislike the bother of making it. Miscible oils are new insecticides and their merits and their uses are not generally recognized. The recent agitation concerning the San
José scale has made the lime-sulphur wash well known by name, but the reputation of this insecticide among fruit growers who are not familiar with the methods of preparing and handling it, is, usually, that the mixture is a disagreeable spray.

For the purpose of making available the experience of various orchardists and of pointing out what they have accomplished in their first efforts in spraying for the mite, in order to encourage others in a similar effort, it was thought desirable to include in this bulletin a discussion of the more important details of these operations. These are designated “volunteer experiments” as they have been largely planned and carried out by the fruit growers themselves. To them belongs the credit,—not to the Station. In compiling these experiments, the facts have been stated precisely as they were given to us; and, for purposes of accuracy, a copy of the manuscript discussing his experiment was also furnished to each orchardist for correction and approval.

For the sake of brevity the reports have been very much condensed but as far as possible the more important items needed to convey a fairly accurate description of the conditions and results of the experiments are given. The experiments are designated by numbers and are arranged in the order of their location, commencing with the Hudson Valley, and continuing through the leading apple growing counties of western New York.

EXPERIMENT NO. 1.

This experiment was undertaken by H. B. Vincent, Old Chatham, Columbia County. The orchard includes 30 acres, planted to 1200 trees, which vary from three to fourteen years of age. The leading varieties are Baldwin, Spy, Greening, Oldenburg and Boiken apples and Bartlett pear. The older trees are systematically sprayed with the bordeaux mixture and the orchard is tilled and grown in grass in short rotation. The blister-mite has been present in conspicuous numbers in the orchard for one year, when the Baldwins were most affected. It is not believed that important injuries were sustained by the outbreak.
An application of the lime-sulphur wash was made on March 18, and about five gallons were used for each tree. The blister-mite is reported to be not very injurious to apples in this community.

*Results on mite.*—The applications of the lime-sulphur wash in this experiment proved very efficient, and with slight exceptions the foliage was entirely free of injuries by the mite.

**Experiment No. 2.**

This experiment was conducted by Berlin H. Wright, Penn Yan, Yates County. The orchard, of 4 acres, contains 100 Baldwins which are 20 years old. The usual spraying with the bordeaux mixture is practiced. The larger portion of the orchard has been tilled, and the foliage and fruit have been so superior to that of the untilled trees, that hereafter the entire planting is to be given thorough cultivation. Extensive spotting of the foliage by the mite occurred last year for the first time. The owner believed that the injuries to the leaves caused some fruits to drop and reduced the size of the mature apples, and thus lessened the crop yield. The trees were sprayed with the lime-sulphur wash in March and again in April. The mite is reported as increasing in destructiveness in this community.

*Results on mite.*—The applications of the lime-sulphur wash were very effective. No pimpling of young apples was detected and the foliage was practically exempt from spotting by the mite.

**Experiment No. 3.**

Conducted by B. J. Case, Sodus, Wayne County. The orchards comprise about 25 acres, planted to 640 trees, which vary in age from 26 to 55 years. The principal varieties are Baldwin, Greening, Twenty Ounce, Russet, King and Pound Sweet. The orchard is thoroughly sprayed, cultivated and fertilized, and bears well every year. The blister-mite has been noticed in conspicuous numbers for three or four years. The varieties that have shown the most spotting of the foliage are
Baldwin and Russet. The mite has caused important injuries. For the experiment 60 Baldwin trees of 27 years of age were sprayed with a commercial brand of concentrated lime-sulphur wash, diluted with twelve parts of water. A power sprayer was employed. The mite is gaining in importance in this community.

Results on mite.—The application of the lime-sulphur wash was very efficient. There was only an occasional spotted leaf, and the trees, on the whole, were practically clean. As noted in other experiments the sprayed trees presented a very thrifty appearance which showed up in marked contrast with the untreated portions of the orchard.

EXPERIMENT NO. 4.

Conducted by H. W. Stoddard, Pultneyville, Wayne County. The orchard has an extent of 2½ acres and consists of a miscellaneous lot of apples, of which Baldwin and Greening are the leading varieties. The usual spraying with bordeaux mixture is practiced, and with the exception of the past four years the trees have been thoroughly tilled since 1895. Conspicuous injuries by the mite were detected for the first time last year. Baldwins have been most affected. The mite has caused some damage to the orchard but the extent of injury is largely conjectural, because of other varying conditions. The lime-sulphur-salt wash was employed but it was only applied to one side of the trees, because of failure to obtain a favorable wind to complete the spraying. The treatment was made with a power pump on April 24, as the buds were breaking and about two and one-half gallons were applied to one side of each tree. The mite is becoming more destructive in this community.

Results on mite.—The application of the lime-sulphur-salt wash largely prevented spotting by the mite. The difference between the conditions of the sprayed portions of the trees as compared with the unsprayed portions and the checks was sufficient to indicate the utility of the sulphur wash for this pest.
EXPERIMENT NO. 5.

This was conducted by C. E. Taylor, Pulteney, Steuben County. The orchard comprises 3 acres, planted to 80 trees, which are 20 years old. The principal varieties are Greening, Northern Spy, Baldwin and Wagner. The orchard is given the usual spraying with bordeaux mixture, containing an arsenical poison, and has been tilled for the past two years. Injury to foliage by the mite was recognized for the first time in 1906. Baldwins have been most affected. In 1907 the mite was reported to be very destructive, causing nearly all of the leaves to fall before the fruit ripened. For the treatments, miscible oil, diluted with fifteen parts of water, was employed, and about six gallons of the spray was applied to each tree. The treatment was made on April 24, as buds were opening.

Results on mite.—Spotting of the foliage by the mite was very much reduced.

EXPERIMENT NO. 6.

This experiment was made under the direction of H. C. Pratt, Canandaigua, Ontario County. The orchard contains 12 acres and has 450 trees, which vary from 33 to 50 years of age. The orchard consists largely of Baldwin, Greening, King and Russet. The trees have been regularly sprayed and for the past five years until this season, when cultivation was practiced, the orchard has been seeded to a mixture of vetch, clover and orchard grass. Attention was first attracted to the work of the blister-mite in this orchard in 1907 when the leaves were quite badly diseased. The Baldwins have been more affected than other varieties. The foliage for this year was considerably injured and the fruit crop was small, but the owner reports that other factors had probably a greater influence in determining the yield. In the treatment of the trees a comparative test was made of the home-made lime-sulphur wash and a commercial preparation of this mixture. The treatment was made about April 15th and it is estimated that about eight gallons of either
mixture was used to each tree. A power sprayer was employed to make the applications. The mite is reported as not gaining in importance in the vicinity of this experiment.

Results on mite.—Both the home-made lime-sulphur wash and the commercial preparation of this mixture completely held the mite in check. From the conditions of the foliage in both blocks, these sprays were equally efficient, and seemed in all respects satisfactory remedies for this pest.

Experiment No. 7.

This experiment was made by H. L. Bulkley, Brockport, Monroe County. The orchard embraces seven acres, planted to 300 trees which are thirty-four years of age. The varieties that are largely grown are Baldwin, Twenty Ounce, King, Greening and Spy. The trees were not productive until 1896 when the owner commenced to spray and till the orchard regularly, and to apply fertilizers. With the exception of one year, good crops of fruit have been harvested annually. The blister-mite appeared in destructive numbers in the orchard in 1905, especially on the Baldwins and the Greenings, but less on the latter than the former. In 1907 the work of the mite on the fruit was noticed for the first time and about 10 per ct. of the crop was thought to be pimpled. The blister-mite was less abundant in 1908 than during the preceding year, but generally it is gaining in importance in this community as an orchard pest. The spray used this year for the treatment of the mite was the lime-sulphur wash and only about two gallons were applied to each tree, the applications being made on April 20–22 with a hand pump. Checks were left for comparison.

Results on mite.—Notwithstanding the small quantity of wash employed there was an appreciable reduction in the amount of affected foliage on the sprayed trees. The foliage was not entirely clean, but the appearance of the treated trees satisfied the owner that a more liberal use of this spray in season would prove an effective remedy for this pest.
EXPERIMENT NO. 8.

This experiment was conducted by Wm. J. Edmunds, Sweden, Monroe County. The orchard contains about 15 acres and comprises approximately 500 trees, which are about thirty-four years old. Many varieties of apples are grown but a large proportion of the trees are Baldwins. The farm has been managed by tenants, who have sprayed the orchard every year, and have endeavored to keep it well tilled. The trees have been productive. The blister-mite has been in injurious numbers in the orchard for the past three years and has been especially abundant on the Baldwins. Other varieties such as Ben Davis, Cooper Market and Bellflower have also shown more or less spotting of the foliage by the mite but usually the injuries have not been important. The owner believes that the mite has damaged his orchard, besides causing reduced fruit yields. A commercial preparation of the lime-sulphur wash, diluted with twelve parts of water, was sprayed on the trees during the last week in April. The mixture was applied with a hand pump.

Results on mite.—There was a marked difference between the foliage of the sprayed and unsprayed trees. The owner was convinced that a thorough application of the lime-sulphur wash in the spring affords efficient protection to the trees from the mite.

EXPERIMENT NO. 9.

This experiment was conducted by Roy P. McPherson, Le Roy, Genesee County. The orchard that was sprayed comprises seven acres, planted to 200 trees, which vary in age from 35 to 45 years. The more important varieties are King, Russet, Greening and Baldwin. The orchard has been cultivated almost continuously for the past ten years and has gradually increased in productiveness. The usual spraying with bordeaux mixture containing an arsenical poison has been practiced. The blister-mite made its appearance in conspicuous numbers in the orchard during the past two years, and the variety that has been most
affected is the Baldwin. The Kings and Greenings have usually been less injured. The owner believes that the diseased condition of the foliage has lessened his crop yields by causing the young apples to drop, and reducing the size of the mature fruit. The spray that was employed for the treatment of the trees was a miscible oil, diluted with fifteen parts of water. The treatment was given on April 7 and only one application was made. A power sprayer was used and the average quantity of mixture applied to each tree was five gallons. A number of trees were left as checks. The work of the mite was reported to be less prominent in this community than during the preceding year.

Results on mite.—As compared with the checks there was a marked reduction in the amount of infestation of the foliage of all the sprayed trees. The treated Baldwins were estimated to be about as one-quarter as badly infested as the checks, while the Kings and Greenings showed a much greater measure of protection.

EXPERIMENT NO. 10.

This experiment was made by Wm. L. Bradley, Pavilion, Genesee County. The orchard comprises 6 acres, planted to 250 trees, which are 33 years of age. The more important varieties are Northern Spy, Baldwin and Colvert. The orchard has been regularly sprayed and is worked with a disk harrow each year.Spotting of the foliage by the mite has been recognized in this orchard since 1903. The Baldwins have been the most conspicuously infested of the varieties. It is stated that the attacks of the mite affected the growth of the trees and reduced crop yields. Kerosene and crude oil emulsions, made with whale oil soap and diluted with ten parts of water, were used for the treatment of the orchard, and about three gallons of spray were applied to a tree. The treatment was made on April 14 with a power sprayer. The blister-mite was less numerous this year than in 1907, but its work is still noticeable in many orchards in this vicinity.
Results on mite.—Following the applications of the oil emulsions very little spotting of the foliage by the mite was noticed in the experimental block. It is intended to repeat this treatment this spring.

EXPERIMENT NO. 11.

Conducted by Charles I. Herrington, Warsaw, Wyoming County. The orchard that was sprayed contains ten acres, and the principal varieties of apples are King, Baldwin, Russet and Greening. The orchard is now tilled but a portion of it has been in sod until the past year. Spraying with bordeaux mixture has been practiced for three years. The mite made its appearance in destructive numbers on the trees in 1907. The Baldwins have shown the most spotting of the foliage and about forty trees of this variety in the lowest portion of the orchard have sustained considerable damage. Other varieties similarly located present a much better appearance, so that it is believed by the owner that the unfavorable condition of the Baldwins is not to be entirely attributed to drainage. The trees were sprayed during the first part of April with a commercial preparation of the lime-sulphur wash, and about one and a half gallons of this spray were applied to each tree. The blister-mite is becoming more destructive in this community, especially in orchards that are not receiving careful attention.

Results on mite.—The applications of the lime-sulphur wash reduced the amount of spotting of the foliage. The owner believes that spraying for successive years with this mixture will efficiently control the blister-mite.

SUMMARY AND CONCLUSIONS.

The results of these experiments have shown very conclusively that the leaf blister-mite is not a difficult pest to combat, and that it can be efficiently controlled by sulphur sprays, miscible oils and home-made oil emulsions. The use of these remedies for the treatment of the mite was discussed in Bulletin 283, and subsequent experiments have confirmed their usefulness
for this purpose. On the basis of the experiments described, there is nothing to add with regard to the employment of oil emulsions for the mite, but the merits of the sulphur sprays for the treatment of this pest should be more fully presented than has heretofore been possible.

In the experiments with the sulphur sprays, comparative tests were made of the common lime-sulphur wash, a home-made concentrated mixture, and two commercial concentrated preparations of the lime-sulphur wash. Very satisfactory results were obtained in every orchard in which they were employed, and there was apparently no appreciable difference in the effectiveness of the various preparations on the mite when they were used under similar conditions. The measure of protection actually obtained showed, as would naturally be expected, some slight variations in the various orchards, which were probably due, largely, to differences in the standards of spraying of the fruit growers. In every test all trees that were thoroughly treated with a sulphur spray showed, in comparison with the checks, a marked diminution in the numbers of the mites, which in several instances resulted in almost complete destruction. The results show very plainly that one application during the dormant season, or as buds are bursting, affords efficient protection to the trees, and that the mite is not ever likely to be of importance in orchards that are annually sprayed with the lime-sulphur wash, a practice now common in many localities in this State where the scale threatens.

The attention of fruit growers is for the first time called to the merits of the home-made concentrated lime-sulphur wash, which is deserving of more extensive tests under farm conditions for spraying for the mite. This method of compounding a sulphur spray by orchardists is still in the experimental stage and probably some slight changes will be made in the future as regards the proportions of lime and sulphur and the amount of dilution. It is a convenient method of preparing a sulphur spray and is destined to be put to important uses. This mixture has two distinct advantages over the old formula: It may
be prepared in concentrated solutions, to be diluted as needed; and it has no coarse sediment to clog the nozzles and to cause the rapid wearing out of the packing, lining and other parts of the pump. However, its employment for orchard treatment, except for the blister-mite, should be largely tentative as its utility for other pests has not been so thoroughly established. This mixture and the commercial preparations now enable many of our fruit growers to use a sulphur wash, who for the reasons given have refrained from using this spray, prepared by the old method.

SULPHUR SPRAYS AND DIRECTIONS FOR THEIR USE.

THE BOILED LIME-SULPHUR WASH.

**Formula.**

Lump lime.............................. 20 pounds  
Sulphur.................................. 15 pounds  
Water.................................. 50 gallons

Place the lime and sulphur in the cooking receptacle containing about fifteen to twenty gallons of water. Stir the mixture frequently and boil for one hour. Add water to make the required amount of wash and strain through a fine brass wire strainer into the spraying tank. Applications should be made while the wash is warm.

HOME-MADE CONCENTRATED LIME-SULPHUR WASH.

**Formula.**

Lump lime.............................. 60 pounds  
Sulphur.................................. 125 pounds  
Water.................................. 50 gallons

Slake the lime in the cooking receptacle and stir in the sulphur, which has been made into a thin paste with water. Add enough water to make about forty-five gallons of mixture, which should be boiled for one or more hours. After the cooking is completed allow the wash to stand until the sediment has settled to the bottom, when the clear, brownish liquid should be
drawn off. To this add water if needed to make the required fifty gallons of concentrated solution.¹

For use, dilute the concentrated sulphur solution at the rate of five gallons of the liquid to forty-five gallons of water. To every barrel of 50 gallons capacity of the diluted spray, add from ten to fifteen pounds of lime, made into a paste. The addition of the lime is not necessary, but by its use the trees are given a whitewashed appearance, which enables farmers to judge better of the thoroughness of their spraying. This mixture may be used immediately after cooking, or may be barreled, to be drawn on as occasion requires. A greater dilution than that recommended may perhaps be employed in spraying for the mite. The mixture prepared after this formula does not leave as heavy a deposit on the trees as the ordinary boiled lime-sulphur wash, but in spraying for the mite this difference is immaterial. To avoid the loss of sulphur, the sediment that remains after drawing off the concentrated solution should be boiled over again with fresh lime and water, and the liquid used to start fresh preparations or for purposes of dilution. For this formula we are indebted to Prof. A. B. Cordley of the Oregon Experiment Station who has employed it in his experiments with sulphur sprays for the treatment of trees in foliage.

COMMERCIAL PREPARATIONS OF LIME-SULPHUR WASH.

During the past year, a number of these preparations have appeared on the market. Two of the most widely advertised have been quite extensively tested in various Station experiments with the blister-mite, and at the strength employed, one part to nine parts of water, have proven very efficient remedies. A number of volunteer experimenters have reported equally satisfactory results. Fruit growers who have heretofore re-

¹The concentrated solution gives a reading of about 25° on a Beaumé hydrometer. Fruit growers are advised to use this instrument in order to test their preparations. A Beaumé hydrometer costs 75 cents and can be purchased from Eimer & Amend, 205 Third Ave., New York City, and from other dealers in druggists' supplies.
frained from using the lime-sulphur wash for the mite, because of the trouble of making and the expense of a suitable cooking outfit, may now use one of the commercial brands. Usually some lime paste should be added to these preparations, as, without it, it is difficult to tell how thoroughly the applications have been made.

**DIRECTIONS FOR APPLYING SULPHUR WASHES FOR BLISTER-MITE.**

Applications of the lime-sulphur wash may be made in the fall after the majority of leaves have fallen or in the spring until the buds commence to break and to show the tips of the young leaves. Treatment should not be made later than this as the sulphur sprays are very destructive to the tender foliage and the mites may have gained entrance into the leaves, where they would be beyond the reach of the mixtures. If it is desired to treat the trees in the spring, the usual spraying at this time with the bordeaux mixture is unnecessary. By following this plan the work of spraying for the mite is greatly simplified, and for this reason it is generally preferred by orchardists. Liberal quantities of the sulphur wash should be applied and the trees after treatment should have the appearance of being completely whitewashed.