TAR DISTILLATE EMULSIONS FOR THE CONTROL OF THE BLACK CHERRY APHID

F. Z. HARTZELL
ABSTRACT

The black cherry aphid (*Myzus cerasi* Fabricius) is an important pest of certain varieties of sweet cherries grown in New York. Usually, sour cherries, such as Early Richmond, Montmorency, and English Morello, which are the varieties commonly grown, do not sustain serious injury.

Field experiments with five domestic brands of tar distillate emulsions were made to determine their insecticidal efficiency against the black cherry aphid. The tests were conducted in three of the principal cherry areas of the State; namely, the Ontario Plain, the Finger Lakes Region, and the Hudson Valley. All the applications were made during the spring when the cherry buds were in one or the other of the stages which have been designated as swollen-brown and green-tinge. One set of field tests was made during 1932 and the others during 1933.

During the first year tar distillate emulsions were used at a strength of 4 per cent, but during the latter season concentrations of 4, 5, and 6 per cent were tested. The sweet cherry varieties represented in the tests were Black Tartarian, Ida, Lyons, Napoleon, Schmidt, and Windsor, while observations on the effects of the treatments on buds and trees were also made on Montmorency, the leading sour kind. However, neither all the brands nor all of the various concentrations were tested on any one variety. The air temperature at the time of application varied from 40° to 60° F and the estimated wind velocities ranged from 3 to 20 miles per hour. Freezing temperatures occurred after every application, but in the different experiments these varied in extent of time and intensity as well as the number of days after treatment. In no instance was extreme low temperature in evidence after any of the spring applications.

In general, the efficiency of the treatments was very high and insignificant differences in results were observed between brands and various concentrations. No appreciable bud or twig injury occurred, altho the usual retardation in bud development was observed.

These results indicate that the 4 per cent concentration of tar distillate emulsion is a practical and economical mixture for the black cherry aphid. In view of the fact that tar distillates are experimental materials and also because they have not been tested extensively, tentative suggestions are given to guide those growers who may desire to use these mixtures for the control of this insect.
BULLETIN NO. 637

TAR DISTILLATE EMULSIONS FOR THE CONTROL OF THE BLACK CHERRY APHID

F. Z. HARTZELL
Associate in Research (Entomology)

INTRODUCTION

Recent years have witnessed increasing interest in sweet cherry culture, and at the same time there has been a growing appreciation of the influence of the aphid (*Myzus cerasi* Fabricius), since infestation of trees is often attended with stickiness and smutting of the leaves and fruit. The pest is also of economic importance to nurserymen during some seasons, since attacks by the insect cause stunting of the young trees. Interest in tar distillate sprays, particularly for the control of various species of aphids, suggested experiments with these materials to ascertain their value in combating the black cherry aphid.

The composition of these sprays and the probable fields of usefulness of the materials for the control of various fruit tree pests have been described with considerable detail in Bulletin No. 636 of this Station (4). The present publication presents the results of experiments with tar distillate sprays against the black cherry aphid and, so far as the data permit, gives directions relative to the employment of these materials for the treatment of cherry orchards.

HABITS OF THE APHID IN RELATION TO CONTROL

This aphid is of European origin, is found in Ontario and throughout most of the northern United States to Colorado, and is reported to occur in California (5, 9) and in Australia and New Zealand (11). In New York, winter is passed in the egg stage on cherry trees, the black, shining ova being deposited around the buds in the autumn. Some cherry trees put forth a considerable number of buds on the trunks and larger branches and such areas are usually severely infested during aphid years. Also the shoots which spring up about

---

1 Refers to Literature Cited, page 22.

2 The writer is indebted to the following growers for the use of their orchards and other facilities: B. J. Case and J. G. Case, Sodus; W. R. Clarke, Milton; and H. P. King, Trumansburg.
the base and on the ground underneath the trees frequently have numerous eggs deposited on them.

The time of hatching in relation to bud development appears to be variable. Slingerland and Crosby (10) claim that hatching occurs about the time the buds break, which accords with the writer's observations during the two seasons these experiments were in progress. On the other hand, Quaintance and Baker (7) state, "On account of their early hatching in the spring the young stem-mothers do not find leaf food available. They therefore attack the buds even before these show any signs of bursting. Sometimes the stem-mothers will feed in this manner for nearly a week before the buds begin to open." Possibly the host variety and climatic differences play a marked rôle in the hatching of this aphid and the apparently discordant claims may each be found to be true during different seasons or on certain varieties during the same season within the boundaries of this State.

All the aphids which hatch from the overwintering eggs are females and are called stem-mothers. They mature within 2 or 3 weeks and produce living young, all of which are also females. These latter develop even more readily than those of the first generation due, perhaps, to higher temperatures. It is claimed that individuals of the summer generations may reach maturity within a week and in some regions as many as 11 generations on cherry may develop by the end of July (7). Rapid multiplication usually occurs during spring and early summer, and frequently the infestation progresses from the lower limbs until all parts of the tree become infested with these black lice.

During the late spring and early summer a marked variation in habits of the aphids may be observed. Some of the adults develop wings and migrate from the cherry trees, while other individuals retain the wingless condition and remain on the trees where they reproduce and continue the summer generations. By late summer the aphids decrease in numbers, sometimes to such an extent that none can be found on the trees.

Regarding the habits of the summer migrants, Ross (8), who first discovered that this aphid had an alternate host plant, found them in abundance on peppergrass (Lepidium apetalum Willdenow) and was successful in transferring and rearing them on several other plants belonging to the mustard family (Cruciferae), but was unable to prove that the aphids sought these latter plants under natural con-
ditions. Quaintance and Baker (7) state, “The winged forms migrate to peppergrass and other related plants and here they form colonies throughout the summer. The number that migrate varies in different parts of the country. In some regions there is a very distinct and complete migration, whereas in other places the wingless forms remain” on the cherries.

During the fall (usually in October) winged forms migrate from their alternate host plants to the cherry trees where the females bring forth living young which, when mature, are fertilized by the males and produce the overwintering eggs.

It is to be noted that one cannot accurately predict the infestation that will occur the following year by the number of aphids present on the trees during the late summer of the current year, even in an isolated orchard. Neither is it believed that thorough control of one season is apt to be reflected by few aphids on the same trees during the following spring. During any one season the extent of the fall migration of aphids to the trees from their alternate hosts determines largely the number of eggs that are deposited, at least if conditions for oviposition are favorable. At the present time the only method known for insuring protection against this pest is annual spraying.

VARIETAL SUSCEPTIBILITY AND NATURE OF INJURY

In New York, the black cherry aphid has shown a preference for sweet cherries, altho there is considerable variation in susceptibility to this insect. Among the leading commercial varieties, Black Tartarian, Napoleon, Schmidt, and Windsor appear to suffer the greatest damage from this aphid. Two lesser known kinds, Ida and Lyons, growing on the Station grounds, have been infested sufficiently to require protection. In marked contrast to the above varieties, Dike- man and Yellow Spanish, growing in close proximity to Windsor and Schmidt in the experimental orchards, were not seriously infested, altho Yellow Spanish usually was not as free from aphids as was Dike- man. In this State commercial varieties of sour cherries, especially Early Richmond, Montmorency and English Morello, appear to be attacked less frequently, and generally the injury is slight when infestation does occur. However, instances of severe damage to sour cherries have been observed here.

As an indication of how susceptibility to infestation by the black cherry aphid may vary in different regions, it is interesting to note
what Gillette (2) states regarding the varieties affected in Colorado, "No one in the department recalls seeing this species upon the sweet cherries—Royal Ann, Bing, Black Tartarian, Black Republican, etc., and we can recall but very few cases where it has been seen in any abundance upon the semi-acid cherries, the Dukes, but it is a common and, often, abundant louse upon the sour red cherries English Morello, Montmorency, Wragg and their like, on the eastern slopes of the mountains. It yields readily to the application of the contact insecticides as the leaves do not curl enough to give protection to the lice."

By the time the second generation has developed in New York, many of the cherry leaves may be badly curled and gradually more of the leaves are affected until the majority of them may show severe curling (Fig. 1). This injury not only affects the growth of the leaves, but may stunt twig growth and cause the fruit to be undersized and lacking in flavor. The most usual effect, however, is the coating of the leaves and fruit with honeydew, which is secreted by the aphids and on which a sooty fungus generally grows, thus causing the fruit to have a black, dirty appearance. Even if the fungus does not develop to any great extent the honeydew alone makes the fruit unattractive. In either event, during years of severe infestation, the value of the crop is considerably lessened and in extreme cases the sooty fungus makes the fruit practically worthless. In nurseries, damage to the leaves due to feeding by the aphids may be so severe as to stunt the young trees seriously.

USUAL CONTROL MEASURES

Control generally has consisted of an application of a contact spray shortly after the buds break, but some growers have experienced difficulty in securing commercial control by this means. It was due to such complaints that tests with tar distillate emulsions were made. In lieu of treatment, or when the degree of control is inadequate for the protection of the fruit, some growers remove the infested spurs before the stem-mothers begin to reproduce. Their experience indicates that this method is practical in many instances, the chief disadvantage being the removal of many spurs and considerable leaf surface which, if practiced for a number of seasons, may cause the trees to assume a scraggly appearance, especially if they are not making a reasonable degree of vigorous growth. Furthermore, this practice may not stop infestation sufficiently to secure adequate protection for the fruit.
COMPOSITION OF TAR DISTILLATE EMULSIONS AND THE BRANDS USED

The active ingredients of these mixtures consist, for the most part, of certain fractions secured by distillation of coal tar, generally known as coal tar creosote oils or tar oils. In some foreign brands practically all the active ingredients consist of tar distillates, while in
other European and in practically all domestic makes various proportions of creosote oil and petroleum oil are used, all of which are made miscible with water by means of various emulsifying agents. The petroleum oil is added with the aim, it is believed, of enhancing the keeping qualities of the emulsion during storage and for making the mixture effective against a greater variety of insect pests. Most commercial preparations contain about 80 per cent of tar oils and petroleum oils, the proportions of these two types differing greatly in the several brands. The remaining 20 per cent consists of water and emulsifying agents.  

The brands used in the experiments and their manufacturers are as follows: Arbo, Koppers Products Co., Pittsburgh, Pa.; Barko, William Cooper and Nephews, Chicago, Ill.; Niagara Tar Wash, Niagara Sprayer and Chemical Co., Middleport, N. Y.; Tarolene, Central Chemical Co., Baltimore, Md.; and Tarzol, The Sherwin-Williams Co., Cleveland, O.

DESCRIPTION OF EXPERIMENTS WITH TAR DISTILLATE EMULSIONS

FIELD TESTS, 1932

The field tests were conducted in the orchards of J. G. Case which are located in Wayne County about 3 miles east-northeast of Sodus, 1 3/4 miles southwest of the village of Sodus Point, and about 1 mile south of Lake Ontario. The area planted to sweet cherries has an elevation\(^4\) of approximately 380 feet and occupies a portion of the somewhat flattened top of a north and south ridge. The greater part of the orchard has a very moderate south slope,\(^5\) while the west side has a moderate slope to the west. The soil occupied by the sweet varieties as well as that planted to Montmorencies is mapped as Worth loam (12) and was cultivated. The drainage is fairly good throughout most of the sweet cherry orchard, the exception being a small area on the south side where poor drainage has reduced the vitality of the trees to such an extent that

---

3 For a description of tar distillate emulsions, see Bulletin No. 636 of this Station.

4 Elevation refers to height above mean sea level.

5 Unless otherwise specified in this bulletin, the term "slope" refers to downward inclination or declivity in the direction stated.
some had died, while others were declining. Except for a small number of younger trees of various ages set to replace those that had died, all were about 15 years of age and the more vigorous were from 15 to 18 feet in height. In the south portion some of the trees were only 10 feet high, while others extended to 15 feet. There were about 200 bearing sweet cherry trees and the varieties included Napoleon, Schmidt, Windsor, and Yellow Spanish. The trees were exposed to wind at the north ends of the rows, but most of the trees were afforded some protection from the east, north, and west winds by the remaining trees. An apple orchard sheltered the trees on the south ends of the rows.

The sour cherry orchard was quite extensive and occupied the west slope of the ridge. The land in the portion where tests were made has a moderately steep slope which permits good drainage. The elevation varies from 370 to 380 feet. The trees were about 12 feet in height and moderately vigorous, all being of the variety Montmorency. Altho exposed to west winds, some shelter was afforded the sprayed block from south and north winds by the remaining trees, and it was considerably protected on the east by the sweet cherries on slightly higher ground.

The variety of sweet cherries that received treatment was Windsor. At the same time tests were made with tar distillate emulsions on a number of Montmorency trees infested with the cherry casebearer (Coleophora prunella Clemens), but which were not attacked by the black cherry aphid. Discussions of the latter variety of cherry in the field tests during 1932 and 1933 are included only to record the effect of the treatments on the buds.

Unfavorable weather and soil conditions delayed the application until April 21. By this time buds on Montmorency and Windsor were in the green-tinge stage. Since it was feared that tar distillate sprays would cause considerable bud injury and since the price outlook for sweet cherries was good but was very poor for the sour kinds, only 4 Windsor trees at the south end of the sweet

---

It seems desirable to name and describe the various stages of cherry buds. The names proposed and used in this publication are as follows: Dormant, the winter stage before perceptible swelling occurs; swollen-brown, the buds are swollen but the bud scales are entirely brown; and green-tinge, the bud scales of the swollen buds have a green color, usually with some trace of brown remaining, but no separation of the bud scales has occurred, that is, none of the leaf tips are in evidence.
cherry block were treated for the aphid and 26 Montmorency trees were sprayed for the control of the cherry casebearer.

The dilution used was 4 gallons of Barko in 96 gallons of water. Four Windsor and eight Montmorency trees were selected as checks. At the time of the application (April 21), the sky was cloudy with a very light north breeze, an estimated wind velocity of between 3 and 5 miles per hour, and the air temperature was about 60° F. A Boyce double spray-gun was used with the operator on the ground. The pressure was 300 pounds. Care was exercised to cover all parts of the trees, including crowns, trunks, and waterspouts, at one operation. Freezing temperatures occurred only twice after the application, the minimum temperature recorded at Rochester (13) being 32° and 30° F on April 24 and 27, respectively. The data taken June 7 and summarized in Table 1 indicate that excellent control of the black cherry aphid was secured, the insecticidal efficiency being calculated at 99.6 per cent. It should be noted that the check trees were very heavily infested. No bud or twig injury developed on the treated trees of either the Windsor or Montmorency variety, but some retardation in bud development occurred which was of no practical importance.

FIELD TESTS, 1933

In 1933, field tests were conducted in three orchards, the owners and locations being as follows: J. G. Case, Sodus; H. P. King, Trumansburg; and in one of the Station orchards at Geneva. The object was to test several dilutions of all available domestic brands of tar washes on a number of varieties of sweet cherry for the purpose of determining the relative efficiency of the various mixtures on the black cherry aphid and the question of safety to the buds. Opportunity was also afforded to secure data and observations in plantings of two fruit growers who applied tar distillate emulsions for the control of this aphid, namely, Walter R. Clarke, Milton, and B. J. Case, Sodus.

In the J. G. Case and King orchards a sufficient number of trees was available to use the Latin square or chess board arrangement of plats (3), which tended to compensate for variation of infestation and vigor of trees. Due to this plat technic it is believed that differences in effects of the various brands and dilutions in a particular planting were not due to heterogeneity of infestation nor to influences of environment. Altho certain modifications were neces-
sary, which will be described under the individual orchards, the general plan of the chessboard used is shown in Fig. 2, in which each letter represents either a particular brand or dilution. While this plat arrangement does not place each treatment lengthwise of every other kind twice, it does reverse them systematically and places all four kinds in each quadrant. It compensates, also, for border effects in the entire group somewhat better than the arrangement just mentioned which may be visualized by considering the plats as extending lengthwise across the page. Sufficient trees of the same variety were not available for extensive tests in the Station orchard, so the trials were limited to several trees each of two varieties.

Orchard of J. G. Case.—The same orchard as previously described was used for the tests during 1933. Since it was intended to spray sweet cherries and the Montmorencies from the same tank of material, treatment was delayed until soil conditions would permit the hauling of the spray rig by a tractor on the land set to the sweet cherries. This was not possible until April 10 on which day the sky was clear with air temperatures between 45° and 55° F at the time of treatment. A rather brisk northeast breeze with a wind velocity estimated between 15 and 20 miles per hour caused a heavy drifting of spray to the leeward. This unfavorable condition as regards wind made difficult the treatment of trees near checks, especially those to the north of the latter, so that, regardless of the care exercised, considerable wetting of the check trees took place and prevented the most thorough treatment of trees to the windward of these. The spraying was not delayed longer because the weather forecasts indicated unfavorable conditions the following day and the buds had advanced to the green-tinge stage so that it was considered hazardous to make the application on a later date.

Originally the plan of the experiment considered the use of four brands of tar distillate emulsions, each to be used at concentrations of 4 and 5 per cent.7 Owing to the advanced stage of the buds it

---

7 Throughout this bulletin the concentration is given in percentage of stock emulsion by volume and not the actual amount of tar distillate in the spray mixture.
was decided to use only the 4 per cent concentration of each emulsion, the four brands being Arbo, Barko, Tarolene, and Tarzol. The modification of the chessboard arrangement of plats, the ideal of which is shown in Fig. 2, consisted of: (a) the use of two varieties, Napoleon and Windsor, each in two rows originally containing 17 trees each; (b) the selection of eight trees to serve as checks, four near the center and two near each end of the complete set of plats; and (c) the separation of two varieties by a row which contained trees of each kind which were also treated with the four brands but on which no aphid cluster counts were taken. However, observations of the effects of the mixtures on buds and twigs were made on these trees. Each plat on which counts were secured was one row wide and contained an average of three sprayed trees. The rows extended north and south. In all, 48 sweet cherry trees were treated and used for aphid data, while 8 untreated trees served as checks. In the Montmorency block there were 48 sprayed and 32 check trees.

The pressure maintained was 250 pounds and a Boyce double spray-gun was used with the operator on the ground, each tree being completely sprayed at one operation. About 6 gallons of spray per tree were used on the sweet cherry trees and 3 gallons on each Montmorency with the usual care to cover all parts completely.

During the latter part of the month freezing temperatures were recorded at Rochester (14), namely, 29°, 30°, 29°, and 27° F for April 22, 23, 26, and 27, respectively. It is probable, however, that the extreme low temperatures for the two latter dates did not prevail in the treated sweet cherries because the owner resorted to orchard heating on the Yellow Spanish variety. These trees were to the windward of the treated blocks which doubtless modified the temperatures in much of the latter area. It is doubtful whether this operation influenced the air conditions in the treated Montmorency block.

No bud injury was evident on any of the sprayed trees, altho the usual retardation in development was noted. Counts of infested clusters were made during the last week of May, a summary of the data being given in Table 1.

Since the number of aphids on the untreated trees did not indicate significant differences in susceptibility between Napoleon and Windsor, the results on the two varieties have been combined. Good commercial control was secured on all and excellent reduction of
### Table 1.—Data from Tests of Tar Distillate Sprays for the Control of the Black Cherry Aphid.

<table>
<thead>
<tr>
<th>Owner of Orchard</th>
<th>Variety</th>
<th>Number of Check Trees</th>
<th>Number of Sprayed Trees Used for Counts</th>
<th>Brand</th>
<th>Gallons in 100 Gallons Spray Mixture</th>
<th>Average Number Aphid Clusters</th>
<th>Percentage Efficiency Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Per sprayed tree</td>
<td>Per check tree</td>
<td></td>
</tr>
<tr>
<td>J. G. Case........</td>
<td>Windsor..........</td>
<td>4</td>
<td>4</td>
<td>Barko......</td>
<td>4</td>
<td>2.3</td>
<td>589.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1932 Trials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J. G. Case........</td>
<td>Napoleon, Windsor</td>
<td>8</td>
<td>12</td>
<td>Arbo.......</td>
<td>4</td>
<td>4.4</td>
<td>85.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Per sprayed tree</td>
<td>Per check tree</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td>3.4</td>
<td>96.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>0.3</td>
<td>99.7</td>
</tr>
<tr>
<td>W. R. Clarke.......</td>
<td>Black Tartarian, Windsor</td>
<td>3</td>
<td>10</td>
<td>Tarolene...</td>
<td>6</td>
<td>4.0</td>
<td>402.7</td>
</tr>
<tr>
<td>H. P. King.........</td>
<td>Schmidt.........</td>
<td>14</td>
<td>16</td>
<td>Niagara....</td>
<td>4</td>
<td>0.6</td>
<td>34.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Station............</td>
<td>Lyons..........</td>
<td>3</td>
<td>2</td>
<td>Tarolene...</td>
<td>5</td>
<td>24.5</td>
<td>203.7</td>
</tr>
<tr>
<td></td>
<td>Ida............</td>
<td>1</td>
<td>2</td>
<td>Tarolene...</td>
<td>5</td>
<td>1.0</td>
<td>53.0</td>
</tr>
</tbody>
</table>

* Omitting two trees that may have been improperly sprayed. (See text.)
† Omitting one tree that may have been improperly sprayed. (See text.)
‡ In the original computation the results were calculated to two decimal places in the two preceding columns so that errors due to rounding off of numbers would not affect the accuracy of the figures in this column.
aphids was effected on most of the sprayed trees. All brands would have given nearly the same efficiency had not three trees shown considerably more aphids than the others. From a study of the locations of the three unusual trees, it is believed that the lower efficiencies of the two brands were due largely to missing small portions of the trunks and larger limbs in an effort to avoid drift on the check trees. It will be recalled that the wind was unfavorable for experimental spraying. For this reason a summary of the data omitting the doubtful records is also given in Table 1 for the two brands concerned.

**Orchard of H. P. King.**—This orchard is situated near the southern boundary of Seneca County about 1 3/4 miles north-northeast of Trumansburg and about 2/5 mile west of Cayuga Lake which lies approximately 300 feet lower. The elevation of the land set to sweet cherries where the experiment was conducted varies approximately from 660 to 680 feet and has a moderately steep slope to the northeast. The soil is gravelly with excellent drainage and was in sod. Apparently no soil map of Seneca County has been published. The soils of Tompkins County, whose northern boundary lies about 1 mile south of the orchard, have been mapped (6). Judging from the soil arrangement in relation to topography in the two areas, it is believed that the soil set to cherries in this orchard would be considered as Groton gravelly loam.

The cherry trees were exposed to northeast, east, and southeast winds but were protected on the south and west by higher land having steep grades and set to orchards; on the northwest by woods about 40 feet high which adjoined the cherries. The variety on which data were taken was Schmidt, the trees being about 15 years of age and exceptionally vigorous. Of these, 73 were sprayed and 14 left untreated to serve as checks. After the plats were treated the remaining material in the tank was sprayed on a number of smaller trees among which were several large Black Tartarian and a number of Schmidt trees. Five treated trees of the latter variety in the third row to the west of the main experimental block also were used for records.

The main block consisted of five rows extending from southeast to northwest, each having originally about 16 trees. Each plat was one row wide and there were four plats in every row. Owing to missing trees near each end of the rows, the two interior plats consisted of three trees each while the end plats had from three to
five trees each. Thus there were 20 plats, 4 with the row and 5 across the rows. The modified Latin square arrangement, similar to that shown in Fig. 2, was laid out, except that there were four accessory plats, one in each column of plats, each of which contained a check tree. The remaining trees of every accessory plat were sprayed, each plat receiving a different mixture. For these reasons the general arrangement might be called a staggered chessboard. In addition to the four check trees just mentioned, seven Schmidt trees in the southerly half of the fourth row east of the main block and three trees of the same variety in the northerly end of the third row west of the chessboard were left unsprayed to serve as checks. This precaution was taken to preclude destruction of aphid eggs by spray drift.

The application was made April 5, the air temperature being about 50° F with a clear sky. A light north breeze, with a wind velocity estimated at between 3 and 7 miles per hour did not cause the spray to drift badly, altho some wetting of trees to the leeward did occur. The buds were in the swollen-brown stage. Two brands of tar distillate emulsions, Tarolene and Niagara, were used, each at 4 and 5 per cent concentrations. A pressure of 200 pounds was maintained and a single nozzle spray-gun was used with the operator on the ground. Each tree was completely sprayed at a single operation with the care described previously using an average of 5 gallons of spray mixture per tree. Freezing temperatures succeeding the date of spraying were recorded for Ithaca (14) as follows; 31°, 28°, 26°, 25°, 31°, 28°, 30°, and 32° F for April 12, 13, 22, 23, 26, 27, and 28 and May 5, respectively. It is believed that somewhat similar temperatures prevailed in the orchard on these dates since the location of the weather instruments at Ithaca is only 12 miles distant and about 200 feet higher than the orchard but in the same physiographical region. Moreover, the Geneva records (14) for these dates are almost the same, altho distant about 30 miles and about the same elevation as the orchard.

Counts of infested clusters were made May 26, the summarized data of which are given in Table 1. It will be noted that excellent control of the black cherry aphid was secured and that the differences in efficiency between the 4 and 5 per cent mixture of the same brand are so small as to be scarcely significant. Moreover, the variation in effectiveness of the two brands at a given dilution is practically negligible. No appreciable injury occurred to the buds of treated
trees of Schmidt, Black Tartarian, or any of the odd varieties present, altho some retardation in development was noticed during the spring.

*Station orchard.*—This Ontario County orchard is situated about \( \frac{1}{3} \) mile northwest of the city line of Geneva and about 2\( \frac{3}{4} \) miles west-northwest of Seneca Lake. The soil planted to cherries has an elevation of about 610 feet and is practically level, with a very slight slope to the north. The drainage is moderately good, due to tiling, and the trees are of average vigor. The soil is mapped as Dunkirk silty clay loam (1) and is cultivated. The treated trees had a height of about 18 feet and were considerably sheltered from the wind on all sides by the remainder of the orchard. In addition, the ground rises 44 feet to a low north and south ridge 940 feet west of the cherries, all the slope being covered with moderate-sized bearing trees. This is a variety orchard of different fruits, 21 years of age, so the number of trees of any one kind is small.

The varieties Ida and Lyons were used for the tests, two trees of each kind being sprayed on April 14 with Tarolene at the rate of 5 gallons in 95 gallons of water. The day was cloudy with a brisk south wind estimated at from 13 to 18 miles per hour and an air temperature of 60° F when the treatment was made. The entire tree was sprayed at one operation using about 6 gallons of mixture. A pressure of 350 pounds was maintained and a single nozzle spray-gun was used, care being taken to wet the entire tree, including trunk, lower limbs, crown, and sprouts on the ground. The buds were between the swollen-brown and the green-tinge stages. The rows extended north and south. One tree of Ida to the north of those treated and three trees of Lyons, two to the south and one to the north of those sprayed were not treated and served as checks. The tree to the north in each case was buffered from spray drift by an intervening tree.

The Station records (14) for temperatures at or below freezing subsequent to the application are as follows: 30°, 27°, 31°, 28°, 28°, and 32° F for April 22, 23, 26, 27, and 28 and May 5, respectively. The location of the weather instruments is about one-half mile distant and at almost the same elevation as the orchard. No injury to buds or twigs occurred on the sprayed trees. Counts of aphid clusters were made on June 23, a summary of the data being given in Table 1. It will be noted that, altho all the trees were sprayed from the same tank of mixture by the same operator,
excellent control is indicated for the variety Ida and somewhat less efficient results were secured on Lyons, altho in the latter case good commercial control was effected.

Orchard of W. R. Clarke.—In the experiments previously described, the spraying was done by the writer or under his immediate supervision. The field trials about to be described were planned and executed entirely by the owner who reported the results of his observations to the Entomological Division of this Station. Since the orchard is in Ulster County, at the writer's request, F. G. Mundinger of this Staff, but located at Poughkeepsie, made the aphid cluster counts. The orchard lies about 1 mile southwest of Milton and about 1 1/4 miles west of the Hudson River. The land has an elevation of approximately 450 feet and has a steep easterly slope, which provides excellent drainage. The soil apparently has not been mapped but is known locally as clay and was cultivated. Altho exposed to east winds, the cherry trees have moderate protection from the wind in other directions due to surrounding orchards and higher ground to the west. The varieties were Black Tartarian, Schmidt, and Windsor, a total of 110 trees being treated. The trees were very large, having heights between 30 and 35 feet.

The application was made on April 12, the sky being clear with the wind so light that it was not difficult to treat the entire tree at one operation, which was the method used on all sprayed trees. The air temperature was about 40° F at the time of application. The buds were in the swollen-brown stage. Tarolene was used at the rate of 6 gallons in 94 gallons of water, an average of 15 gallons being applied per tree with a spray-gun in the hands of an operator on the ground and at a pressure of 350 pounds. Judging from heavy infestation on the check trees and the high degree of control secured, the owner did a most excellent job of spraying. Three unsprayed trees of the same variety but from 150 to 200 feet south of the main block served as checks.

The weather records at Poughkeepsie (14) show freezing temperatures on dates succeeding the application as follows: 30°, 30°, 29°, 32°, 28°, 30°, and 32° on April 13, 20, 23, 27, and 28 and May 4 and 8, respectively. Altho Poughkeepsie is only 4 miles distant and in the Hudson Valley, the weather instruments have an elevation of 80 feet or about 370 feet lower than the orchard. For this reason the minimum temperatures in the crowns of the sprayed
trees may have been different from those just given. Evidently no extremely low temperatures prevailed.

The aphid cluster counts were made on 3 checks and on 10 sprayed Black Tartarian and Windsor trees June 6, the summarized data being given in Table 1. It will be noted that the control calculated from the data is 99.0 per cent. No bud or twig injury occurred which is of interest because the concentration of the tar distillate emulsion was higher than that used in any of the other experiments.

*Orchard of B. J. Case.*—This is another orchard where the planning and execution of the field tests were made by the owner. The planting is located in Wayne County, 1¼ miles north-northwest of Sodus and 1¾ miles south of Lake Ontario. The land has an elevation of approximately 360 feet and, except for stream courses, has a gentle slope to the west. The soil is mapped as Dunkirk fine sandy loam (12) and has good drainage. The trees were in sod since most of them were planted along a lane and were between 15 and 20 feet in height, 12 years of age, and vigorous. They were exposed to the wind from all directions. The variety was chiefly Schmidt, a few Windsors also being in the test. The application was made during early April when the buds were in the swollen-brown stage. The trees were sprayed on one side with the wind and a few days later were completed when the wind had changed to the opposite direction. The pressure maintained was 300 pounds and a spray-rod equipped with four cyclone nozzles, commonly called a quad, was used. The material was Niagara Tar Wash at a concentration of 4 per cent.

The trees were examined by the writer on May 31 and the absence of aphids was noted. Unfortunately, no check trees were left so the degree of aphid control could not be calculated. However, about one-half of a tree near a house was not treated for fear of injuring the paint and also on one tree a portion back of a telephone pole was missed. In both instances a considerable number of aphid clusters were found, thus indicating that a thorough treatment had been given and a high degree of efficiency secured on the sprayed trees or portions thereof. The fact that no twig or bud injury developed is the chief reason for discussing the tests on this farm. It will be noted from the records given in connection with the preceding orchards that the sprayed trees were not subjected to very low temperatures after treatment.
RESULTS OF EXPERIMENTS

It is to be noted that the field tests for the control of the black cherry aphid by means of tar distillate emulsions were conducted in three of the principal cherry-growing areas of the State, namely, the Ontario Plain, the Hudson Valley, and the Finger Lakes Region. Trees of different degrees of vigor situated on soils varying from moderately light to heavy with excellent, fair, and poor drainage were used. In one respect the conditions were quite similar in that all the orchards in which tests were made had nearly the same elevation and were in rather close proximity to moderate or large bodies of water which latter position may have modified the climate sufficiently to have prevented sudden and extreme changes in temperature, especially after the treatments were made.

The varieties included Black Tartarian, Idar, Lyons, Napoleon, Schmidt, and Windsor of the sweet sorts, while the sour kinds were represented by Montmorency which was not infested by aphids but by the cherry casebearer. The stage of the buds at time of treatment varied from swollen-brown to green-tinge. The brands of tar distillate emulsions were as follows: 4 per cent Arbo, Barko, Niagara, Tarole, and Tarzol; 5 per cent Niagara and Tarole; and 6 per cent Tarole. Pressure ranged from 200 to 350 pounds and the applications were made with different kinds of spray-guns and with a quad, that is, a spray rod with four cyclone nozzles. In most instances the entire tree was completed at one operation, while in one case the trees were sprayed with the wind on one side and later, when the wind had changed, were treated from the opposite side.

Weather conditions were considerably varied. In some instances the sky was cloudy, in others clear; wind velocities varied from nearly a calm to approximately 20 miles per hour; while air temperatures ranged from 40° to 60° F. Altho freezing temperatures occurred for a number of nights during the latter part of April and in several areas during early May, exceptionally low temperatures (10° to 20° F) were not experienced after any of the applications.

With all the variable factors mentioned above, excellent control of the black cherry aphid was secured in all instances except one when the reduction might be called good since commercial control was secured. Moreover, no bud injury was produced on the treated
trees, which result is of importance because of the low vigor of some of the trees, the rather high concentrations used in certain instances, and the advanced stage of the buds in a number of orchards. The fact that in no instance did severe lowering of temperature occur after treatment leaves undecided the question of how such conditions might affect cherry buds sprayed with tar distillate emulsions, especially if the buds were in the green-tinge stage at time of application. Fall applications of these sprays were not tested on cherry trees.

SUMMARY

In New York the black cherry aphid causes considerable loss on certain varieties of sweet cherries but usually is not a pest of importance on sour kinds. It is claimed that in Colorado the sour varieties suffer the greatest infestation, while the sweet sorts are seldom attacked.

The life history and habits of the insect have been reviewed and attention was called to the fact that the species passes the winter in the egg. It is against this stage that spraying with tar distillate emulsions is directed. Field tests with these materials were conducted during 1932 and 1933. Only one orchard was used in 1932 when Barko (4 per cent) was applied. The experiments were enlarged during 1933 when three orchards were sprayed by the writer. In addition, counts or observations were made in two plantings where the growers had made tests of these materials. Two of the orchards were on the Ontario Plain, two in the Finger Lakes Region, and one in the Hudson Valley. All were at similar elevations and near moderate to large bodies of water. The soil varied from clay to gravelly loam, some orchards being in sod, others under cultivation.

The varieties on which the tests were made included Black Tartarian, Ida, Lyons, Napoleon, Schmidt, and Windsor for sweet cherries and Montmorency for the sour kinds, altho the latter was not infested with aphids but gave opportunity to observe the effects of the treatments on buds and trees. Some orchards were sprayed when the buds were in the swollen-brown stage, others when the buds had advanced to the green-tinge stage.

Two plantings had sufficient trees of the same variety to use modified Latin square arrangements of plats. In one the brands Niagara and Tarolene were used, each at concentrations of 4 and 5
per cent; in the other the concentration was 4 per cent and the brands tested were Arbo, Barko, Tarolene, and Tarzol. In a grower's test at Milton Tarolene (6 per cent) was applied.

The fact that no appreciable bud or tree injury developed, coupled with the excellent results in controlling the black cherry aphid with all dilutions and with all brands, leads to the belief that in tar distillate emulsion carefully made and properly applied, the cherry growers have a reasonably safe and effective material for the control of this insect in addition to other measures previously employed. The orchardist now has the opportunity of extending the spring spraying season, if he so desires, by treating a portion of his planting with tar distillate emulsion while the buds are in the swollen-brown stage and spraying the remainder with nicotine sulfate just after the buds break.

It should be noted that all the applications were made in the spring and that no data have been produced to indicate whether or not fall applications of tar distillates are safe on cherry trees. Likewise no opportunity was afforded to test the effects of severe freezing temperatures subsequent to treatment.

DIRECTIONS FOR USING TAR DISTILLATE EMULSIONS

Rather extensive directions regarding the care to be used in selecting, storing, mixing, and using tar distillate emulsions have been given in Station Bulletin No. 636. These may be briefly summarized for use against the black cherry aphid, as follows:

1. Select a material that will mix well with the water used for spraying. Protect the emulsions from freezing temperatures. Stir or otherwise mix thoroly the material before taking the stock emulsion from the container. Place about three times as much water as stock emulsion in the spray tank and, with agitator running, add the emulsion slowly and direct the spray-gun on the mixture until a creamy emulsion with the water has been produced, after which the remaining water should be added.

2. Protect the hands and face when handling tar distillates and while spraying cover team with waterproof blankets. Keep men and team out of the spray drift by taking advantage of the wind.

3. Use a concentration of 4 gallons of stock emulsion in 96 gallons of water and make the treatment of each tree very thoroly. If there are no air currents spray the entire tree at one operation.
If air currents are strong spray with the wind and complete treatment of the tree when the wind changes, being careful to leave no portion of the tree unwetted by the spray.

4. Make applications in the spring while the buds are in the dormant state or not later than the swollen-brown stage, when the temperature is 45° F or higher and when there is little likelihood of freezing temperatures for at least a day following spraying. It is not known to what extent these limits as regards bud stage and temperature can be exceeded with safety. The grower who attempts to spray at lower temperatures or when a sudden freeze is expected or at more advanced stages of buds than the swollen-brown condition should realize that he is taking chances that may result in serious injury to buds or wood.

LITERATURE CITED


