

important. While the San José is very much less virulent than formerly, the quantity of lime sulphur applied to control it each year is very considerable; and more spraying is done to control the apricot scale than ever before.

Of the parasites discussed, two—*Scutellista cyanea* and *Cryptochætum icerya*—have been introduced. Of the Coccinellids mentioned all have been introduced. While it should not be claimed that these parasitic and predatory insects are not of considerable service, yet if they are to be judged rigidly on results in commercial orchards, they cannot be rated very highly. The writer thoroughly believes in making all possible use of natural enemies to control injurious species, but at the same time he cannot concur in the belief that most scale insects in California are so controlled.

TEST SPRAYINGS FOR THE GLOOMY SCALE (CHRYSO- PHALUS TENEBRICOSUS COMST.)

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The Gloomy Scale is the most important insect enemy of shade trees in North Carolina, and is well distributed over all this State south and east of the mountains. Its importance is due to two factors: the enormous rapidity with which it breeds and the fact that it is all but completely confined to the soft maples which have been so largely used for shade purposes in our cities and towns. The following tabulated results of careful tree to tree inspection of the maples in portions of Raleigh and Red Springs will serve to make this clear.

RALEIGH. NEWBORN AVENUE AND EDENTON STREET

Name of Tree	Total number of trees	Not infested	Infested	
			Slightly	Badly
Silver Maple.....	18	5	4	9
Red Maple.....	39	13	9	17
Sugar Maple.....	98	98	0	0
Norway Maple.....	3	3	0	0
Box Elder.....	1	1	0	0

RED SPRINGS. MAIN STREET AND ADJACENT LAWNS

Name of Tree	Total number of trees	Not infested	Infested		
			Slightly	Moderately	Badly
Silver Maple.....	28	0	9	8	11
Red Maple.....	6	0	1	4	1
Southern Red Maple.....	1	0	1	0	0
Sugar Maple.....	1	1	0	0	0

These results have been verified by more or less extensive inspections in all of the larger towns of the State, and while a few hard maples have been found infested with the Gloomy Scale, our inspections would show that hard maples are at least highly resistant to the attacks of this scale. We have frequently found a hard maple entirely free from Gloomy Scale growing between two soft maples which were dying from its attacks. This suggests that the present condition will naturally correct itself in time, because people will cease to plant the quick growing soft maples and set in their stead the slow growing resistant hard maples. In this connection the following list of host plants which have come under our own observation is given:

Apple. (*Pyrus malus* L.) Several young trees growing under the overhanging branches of badly infested red maples found slightly infested.

Red Maple. (*Acer rubrum* L.) Generally infested.

Silver Maple. (*Acer saccharinum* L.) Uniformly and badly infested.

Sugar Maple. (*Acer saccharum* Marsh.) A few scattering individuals found infested, mostly very slightly.

Box Elder. (*Acer negundo* L.) A few infested.

Buckeye. (*Æsculus glabra* Willd.) Slightly infested.

Japanese Chestnut. (*Castanea sativa*.) Badly infested.

Sycamore. (*Platanus occidentalis* L.) Slightly infested

Water Oak. (*Quercus nigra* L.) A single tree slightly infested.

White Oak. (*Quercus alba* L.) A few trees slightly infested.

Iron-wood. (*Carpinus caroliniana* Walt.) A single badly infested tree.

Willow. (*Salix* sp.) A small badly infested tree found along a stream in Lincoln County.

Cottonwood. (*Populus deltoidea* Marsh.) Slightly infested tree.

American Elm. (*Ulmus americana* L.) Slightly infested.

When our attention was first called to the destructive work of the Gloomy Scale, it was our belief that home-made lime-sulphur (15-15-50 or 15-15-30) or kerosene emulsion at 15, 20 or 25 per cent oil would effectively control it, therefore during 1908 and 1909 various experiments were tried as follows:

Home-made Lime-sulphur (15-15-50). Trees were sprayed in mid December and late February. Some benefits but not a satisfactory remedy.

Home-made Lime-sulphur (15-15-30). Trees were sprayed in mid December and the trees did better after the spraying, but it was not a satisfactory remedy.

Kerosene Emulsion (25 per cent oil). Trees were sprayed in late February. Not a satisfactory remedy, for practically no scale were killed.

Kerosene Emulsion (20 per cent oil). Same as for 25 per cent oil.

Kerosene Emulsion (15 per cent oil). Trees sprayed in early May. No benefits derived from this spraying.

After these home-made remedies had proven so entirely unsatisfactory, we determined to try all of the better known commercial preparations during 1910. A number of home-made preparations were also tried. Most of these mixtures have been previously recommended for the San José scale, but had been abandoned for the home-made lime-sulphur wash. These experiments were divided into three groups. The first series of trees (I) were sprayed in late December while the trees were dormant. The second series of trees (II) were sprayed in late February while the sap was rising and just when the buds were beginning to swell. The third series (III) were sprayed in early May while most of the first brood of young were crawling about or had just settled on the limbs.

The results of these experiments are given herewith.

COMMERCIAL

Insecticides	Strength	Time		
		Winter I	Spring II	Summer III
Scalecide.....	1-8 1-10 1-12 1-50	excellent excellent very good	excellent excellent	poor
Orchard Brand soluble oil.....	1-5 1-8 1-10 1-50	excellent excellent good	excellent good	
				fair

COMMERCIAL—Continued

Insecticides	Strength	Time		
		Winter I	Spring II	Summer III
Orchard Brand lime-sulphur.....	1-5 1-8 1-10 1-25	fair poor poor	poor poor	very poor
Scaleoil.....	1-8 1-10 1-30 1-40	good good		poor poor
Grasselli's lime-sulphur.....	1-5 1-8 1-10 1-25	fair fair poor	fair poor	poor
Sherwin-Williams lime-sulphur.....	1-8 1-10 1-25		fair poor	poor
Sherwin-Williams soda-sulphur.....	1-25			poor
Rex lime-sulphur.....	1-10 1-25		fair	poor
Target Brand scale destroyer.....	1-8 1-10 1-12 1-40	excellent very good good	excellent good	poor
Spray-on.....	1-10 1-12 1-50		excellent excellent	fair
One-for-all.....	1-8 1-25		very good	poor
Bowker's lime-sulphur.....	1-5 1-8 1-35	fair fair	fair fair	fair
Bowker's tree soap.....	1 lb. to 1 gal. water			fair
Whale Oil soap (Good's potash No. 3).....	1 lb. to 1 gal. water			fair
Bowker's insect emulsion.....	1-15			poor
Niagara Brand lime-sulphur.....	1-8 1-10 1-25		good fair	poor
Scale clean.....	1-10 1-12 1-30		excellent good	poor

COMMERCIAL—*Concluded*

Insecticides	Strength	Time		
		Winter I	Spring II	Summer III
Scalime	1-5 1-8 1-25		poor poor	fair
San-U-Zay	1-10 1-12 1-30		excellent good	poor
Bogart's sulphur compound	1-5 1-8 1-25		fair fair	fair
Pratt's carboline	1-25			fair

Home-made

Pure Kerosene, tested for its killing properties	poor	tree killed	
Kerosene emulsion: 40%	fair	fair	
50%	fair	fair	
60%	fair	tree killed	
30%			poor
Cotton Oil emulsion (Cooley's formula)	fair	fair	
Linsced Oil emulsion (Cooley's formula)	fair	fair	

Carbolic Kerosene Emulsion

1 lb. soap,
30 gals. water,
3 gals. kerosene,
3 gals. carbolic acid (crude).

Kerosene emulsion made as usual with the addition of the carbolic acid, and the whole thoroughly emulsified. III poor.

The trees used for these experiments were inspected and the relative state of their infestation was ascertained as carefully as possible before commencing the spraying. After the trees were sprayed, they were inspected at intervals of two or three months for a year and a half. In this way we were able to determine not only the immediate effects upon the trees, but also the results on the tree as a whole. In making our inspection more attention was paid to the relative benefits to the whole tree than to careful counts and estimates of the per cent of scale killed.

Roughly speaking "excellent" in the above report means above 95

per cent of the scale killed. "Very good" means from 90 to 95 per cent of the scale killed. "Good" means from 85 to 90 per cent. "Fair" means from 75 to 85 per cent. "Poor" means from 50 to 75 per cent. "Very poor" means less than 50 per cent. In our experience too much dependence cannot be placed on counts of a thousand scale unless they are drawn carefully from all portions of the tree. Careful observations have shown that the normal mortality of the Gloomy Scale varies from nothing to more than 90 per cent on different parts of the same tree, so that it would be possible for one to count a thousand scale on an untreated tree and estimate that it had done better than a tree which had been carefully sprayed with the best mixture known at the present time. Careful inspections show that the critical points for inspection purposes are the bases of the new growth and protected crotches. However a successful treatment always makes itself evident in the appearance and general vigor of the tree, the growth of the new wood and the expansion of the bark. The critical inspections, however, were the ones made in late May when practically all of the young of the first brood had settled and become permanently attached to the branches. The pale grayish young were then very conspicuous among the old black scales and their relative abundance at that time indicated very clearly the number of old scale that were still alive,

From the above tests it seems safe to conclude that any of the soluble oils at 1 to 8 or 1 to 10 are satisfactory remedies for the Gloomy Scale if used while the tree is dormant, one application being sufficient for several years where the scale is slight or moderate. Where the scale is bad two or more applications are advisable. Better results were obtained where the tree was sprayed twice in the same year than where it was sprayed only once.

None of the commercial lime sulphur washes were as satisfactory for controlling the Gloomy Scale as the soluble oils. This we believe is accounted for by the fact that the dorsal scale of this insect is thicker and applied more closely to the ventral scale than is the case in the San José scale. Our observations would lead us to believe that the oils owe their superior killing powers to the fact that they remain moist much longer than the lime-sulphur preparations and are thereby enabled to creep in between the dorsal and ventral scales. The corrosive lime-sulphur washes do not seem to be able to penetrate the thick dorsal scale of this insect. Some of the lime-sulphur washes gave fair results and if spraying for the Gloomy Scale could be repeated year after year, as in the case of the San José scale, they might be recommended. But with shade trees this is usually not practicable.

None of the spring applications were at all satisfactory, and it was

impossible to see that any of the trees sprayed in the spring had been benefited to any marked degree. This we believe is due to the fact that the breeding period of the Gloomy Scale is quite protracted and while the weaker spray mixtures which can be used in the summer without injuring the leaves will kill the young unprotected scale, they are not strong enough to kill the old scale which later gives birth to more young.

Nothing in this report, however, is to be construed as having any bearing upon the value of the various mixtures tried as San José scale remedies.

The writer acknowledges his indebtedness to Mr. S. C. Clapp, field inspector of this office, for his assistance in inspecting the sprayed trees.

THE PYRALID (OMPHALOCERA DENTOSA GROTE), A PEST OF BARBERRY HEDGES

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On August 12th, 1908, Dr. F. P. Gulliver of Norwich, Conn., sent to the station some curious black and white caterpillars which were feeding upon the leaves of common barberry, *Berberis vulgaris* Linn. This plant, though introduced from Europe, has become naturalized in New England and is far more common in Connecticut than the native species *B. canadensis* Pursh. The writer was away on a vacation, and his assistant, Mr. Walden, who was in charge of the department, not recognizing the caterpillars, wrote to Doctor Gulliver asking him to send more material, which he kindly did. The writer examined the caterpillars on his return September 1st, but they were entirely unfamiliar to him. In his experience of fourteen years in the State he had not at that time ever seen the species before. A few specimens were inflated, and the others placed in the breeding cages for the purpose of rearing the adults, but none were obtained. The following season the insect was not observed by any one connected with this office.

In 1910, however, this insect was more abundant than previously, and a number of caterpillars were found feeding upon not only the common barberry, *B. vulgaris* and its purple-leaved form, but also on the Japanese barberry, *B. thunbergii* D. C. which is used rather extensively for hedges, though not as commonly as California privet and on another species of barberry. Enough material was secured in 1910 to enable us to rear the adults, and both sexes were obtained.

During the annual task of inspecting nurseries the work of this