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CONTROL OF THE JAPANESE BEETLE ON FRUIT AND SHADE TREES [1]

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INFESTED AREA AND TREES ATTACKED

The Japanese beetle is a serious pest of fruit and shade trees in the eastern part of the United States. It has spread rapidly since its first discovery in this country in 1916, and now the area comprising southern and central New Jersey, eastern Pennsylvania, and northern Delaware is generally infested. Outside this area local colonies and isolated beetles have been found in New England and in other Eastern States as far south as South Carolina, and as far west as Missouri.

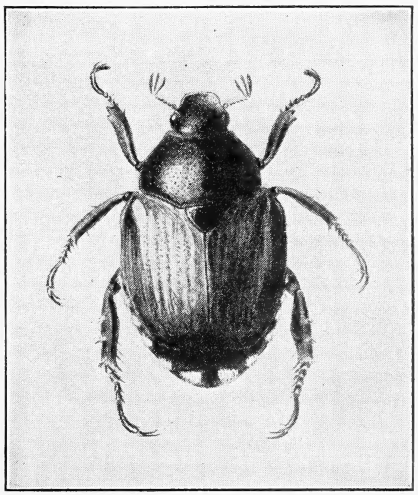

Figure 1.—The Japanese beetle. About four times natural size.

This brilliant green beetle with reddish-brown wing covers and white spots on its abdomen (fig. 1) feeds on a large number of plants. It has a marked preference for the foliage and fruit of apple, peach, plum, quince, cherry, raspberry, and blueberry, and the foliage of grapes. It rarely injures dewberries or the Black Diamond variety of blackberries, but occasionally attacks certain other varieties of blackberries. Pears are

[1] This circular is a complete revision of Circular 237 as originally issued and supersedes Circular 317, Protection of Orchard and Shade Trees and Ornamental Shrubs from Injury by the Japanese Beetle. The control of the Japanese beetle on ornamental shrubs is now treated in Circular 401, Control of the Japanese Beetle and Its Grub in Home Yards. Other available publications relating to the Japanese beetle are as follows: Circular 332, General Information about the Japanese Beetle in the United States; Circular 403, Preventing Injury from Japanese and Asiatic Beetle Larvae to Turf in Parks and Other Large Areas; and Miscellaneous Publication 201, revised, Traps for the Japanese Beetle and How to Use Them.

seldom attacked. Among the shade trees, it is especially fond of linden, chestnut, horsechestnut, sassafras, and elm. Buttonwood, willow, birch, Lombardy poplar, Norway maple, and certain varieties of oak are occasionally attacked. The beetle rarely feeds on the foliage of most maples, ash, magnolia, mulberry, sweetgum, tupelo (sour gum), tuliptree, hackberry, and beech. As a rule conifers are untouched, although occasionally the needles of larch and of bald cypress are injured.

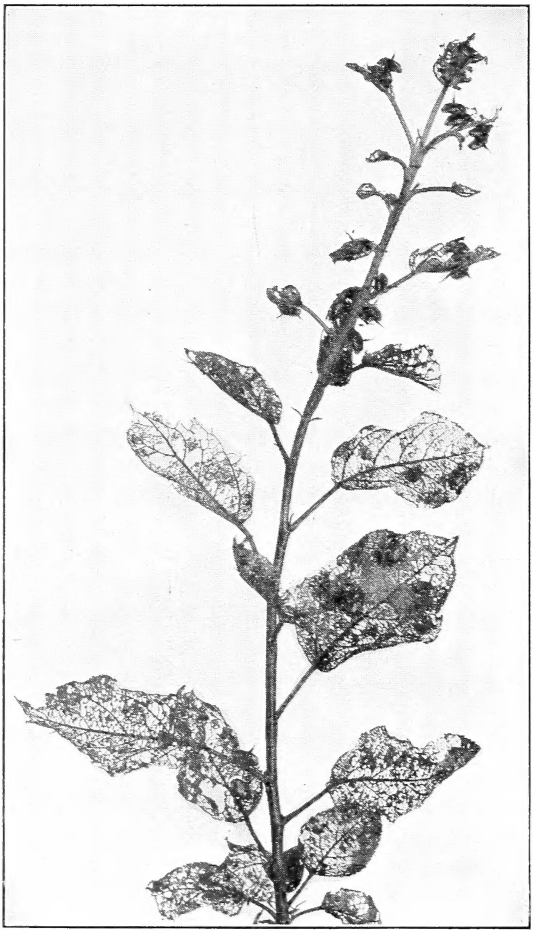

FIGURE 2.—Injury by the Japanese beetle to the foliage of apple.

NATURE OF THE INJURY

The Japanese beetle has mouth parts adapted for chewing. In general it consumes the tissue between the veins of the leaves and also eats portions of the blossoms and of the fruit. The leaves are skeletonized (figs. 2 and 3) and then turn brown and fall. The beetle prefers to feed on portions of the plant exposed to the direct rays of the sun. It usually begins on the upper and outer portions and works downward and inward (figs. 4 and 5). When the infestation is severe, even large trees may be completely defoliated within a few days. On fruit trees a partial second crop of leaves may be produced after the beetle has ceased feeding. This increases the likelihood of winter injury to the twigs, and the tree usually bears no fruit the following year. Repeated annual defoliation of trees weakens them and ultimately may cause their death.

Of the susceptible fruits, those that ripen early in the summer are most subject to attack. Very little feeding—only a few punctures in the skin—is sufficient to destroy the market value of the fruit, but at times beetles gather on ripening apples and peaches in

such large numbers as to cover the fruit completely and ruin it (figs. 6 and 7). The riper fruit is attacked first by the beetles, and when the infestation is relatively light the damage may be confined to such fruits.

HOW TO PROTECT THE TREES FROM INJURY

It is possible to protect the foliage and the fruit of many of these trees by maintaining a deposit of spray residue on all portions subject to attack, during the period when the beetles are flying. The spray residue largely repels the beetle and prevents excessive feeding, the protection being obtained primarily by making the tree nonattractive rather than by poisoning the beetle.

Diseased and poorly nourished trees are more susceptible to attack than those in a healthy condition. It is practically impossible to

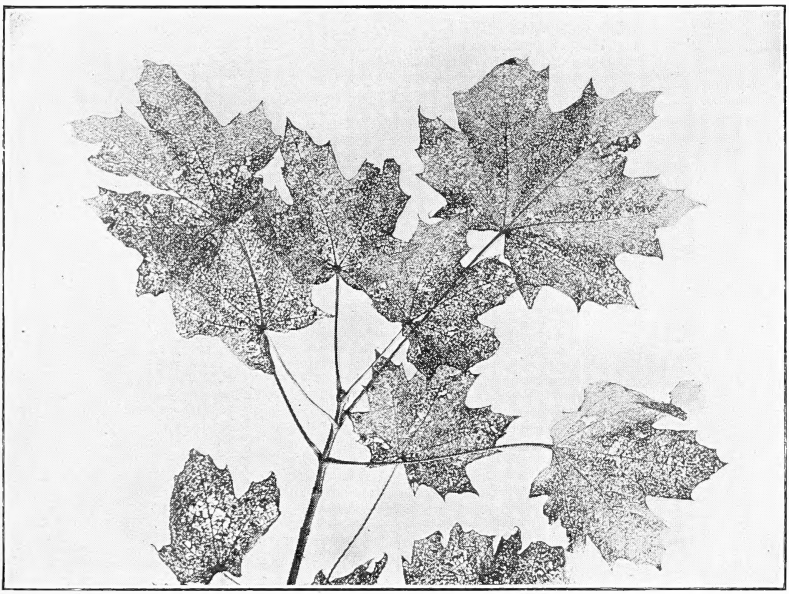

FIGURE 3.—Injury by the Japanese beetle to the foliage of Norway maple.

prevent the beetles from becoming established in orchards where brown rot and similar diseases are present. Orchards should be protected from plant diseases and insect pests other than the Japanese beetle by the regular spraying recommended for the various localities.

Timeliness and thoroughness in the application of the repellent sprays are very important. As a general rule, and especially in localities where the beetles are very numerous, the first sprays should be applied when the beetles begin to appear in the vicinity, before they become established on the plants. In localities where the infestation is not so dense, the first application may be delayed until the beetles begin to appear on the plants to be protected. In the heavily infested

localities, however, if the spraying is delayed until beetles appear on the trees, it is often difficult to prevent injury. In Burlington County, N. J., the first application should be made the latter part of June; it should be made somewhat earlier in localities farther south and somewhat later in localities farther north than Burlington County.

To obtain satisfactory protection, all portions of the trees must be kept covered with the spray (fig. 8), as any unprotected portion of

FIGURE 4.—Horsechestnut injured by the Japanese beetle.

the foliage, blossom, or fruit will be selected by the beetle for attack. The spraying must be more thorough than is sometimes done for the control of other orchard and shade-tree pests. Figure 9 illustrates the type of deposit necessary to obtain protection from the Japanese beetle. If heavy rains occur after the application, it may be necessary to repeat the spray.

To apply the sprays properly to fruit and shade trees and to high ornamental shrubs power-spraying equipment is necessary. The high-pressure equipment in general use for the control of other insects and diseases has been employed with satisfactory results.

RECOMMENDATIONS FOR DIFFERENT TREES

The sprays recommended in this circular have been tested for several years and have been found to be the most satisfactory for pro-

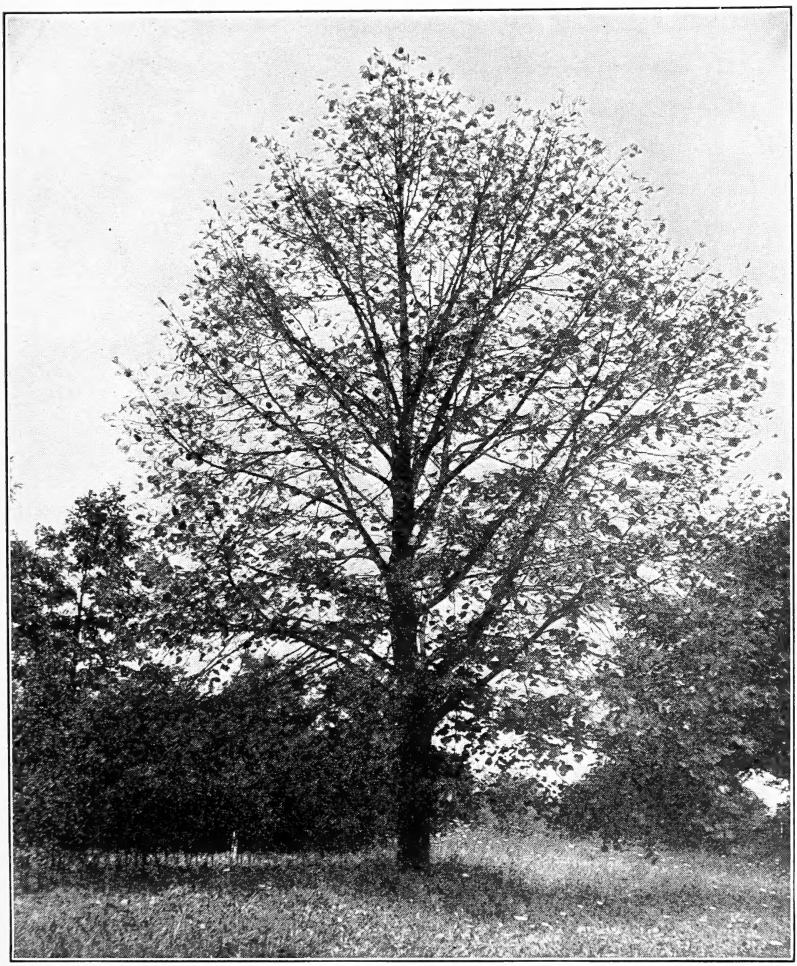

FIGURE 5.—Linden injured by the Japanese beetle.

tecting the trees in connection with which they are mentioned. All the sprays leave some residue on the fruit at the time of harvest. Any visible spray deposit should be removed from the fruit by suitable washing or wiping equipment, as it may interfere with marketing. If

a spray containing a poison has been used, this removal must be particularly thorough.

APPLES

EARLY APPLES

The foliage of early-ripening apples may be protected by spraying with 3 pounds of aluminum sulphate and 20 pounds of hydrated lime to 100 gallons of water. In preparing this spray the aluminum sul-

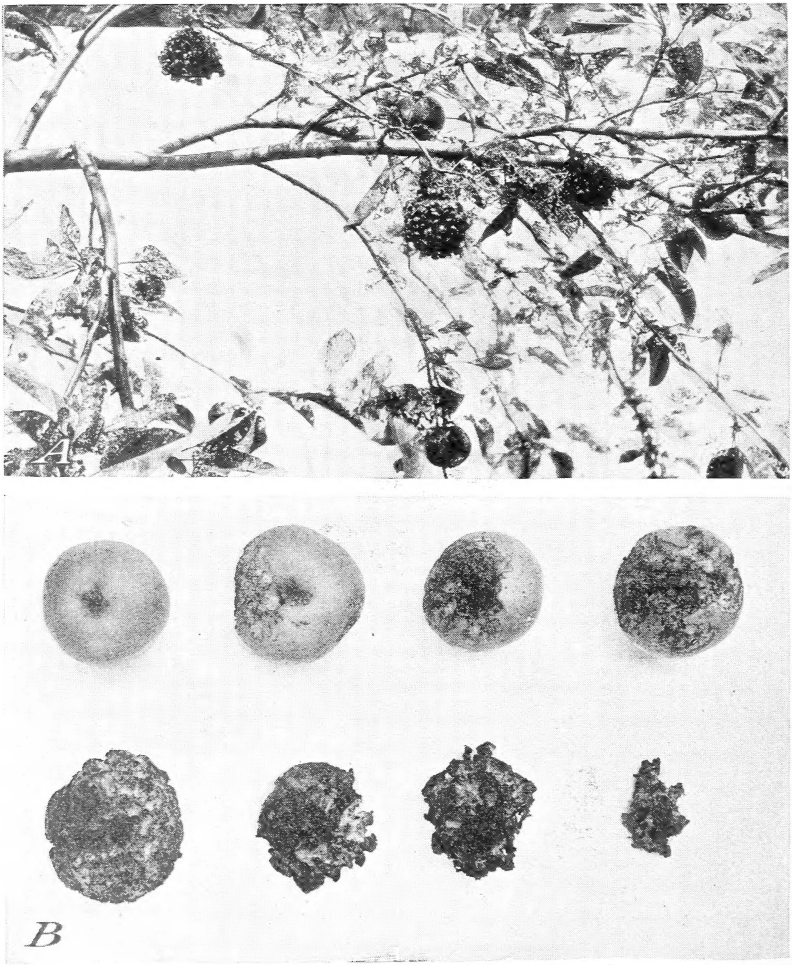

FIGURE 6.—Japanese beetles feeding on apple: *A*, Beetles attacking fruit; *B*, extent of damage.

phate is dissolved in 2 gallons of water and a thin paste is made of the lime. The aluminum sulphate solution is added to the water in the spray tank while the agitator is running, followed by the hydrated-lime paste.

Two or three applications of this combination may be necessary to obtain adequate protection to the foliage, depending on the density of the beetle population in the vicinity of the orchard. The second

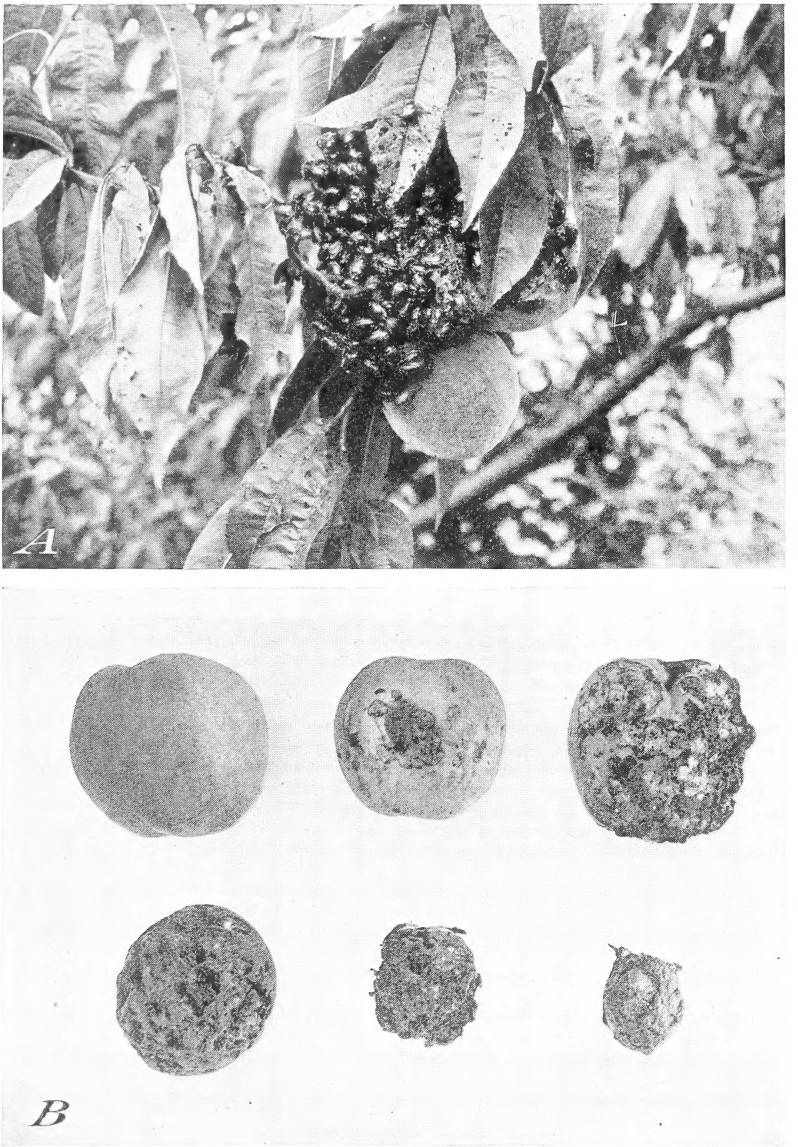

FIGURE 7.—Japanese beetles feeding on peach: *A*, Beetles attacking fruit; *B*, extent of damage.

application should follow the first after an interval of 7 to 10 days, and the third should be made just before the height of the beetle season.

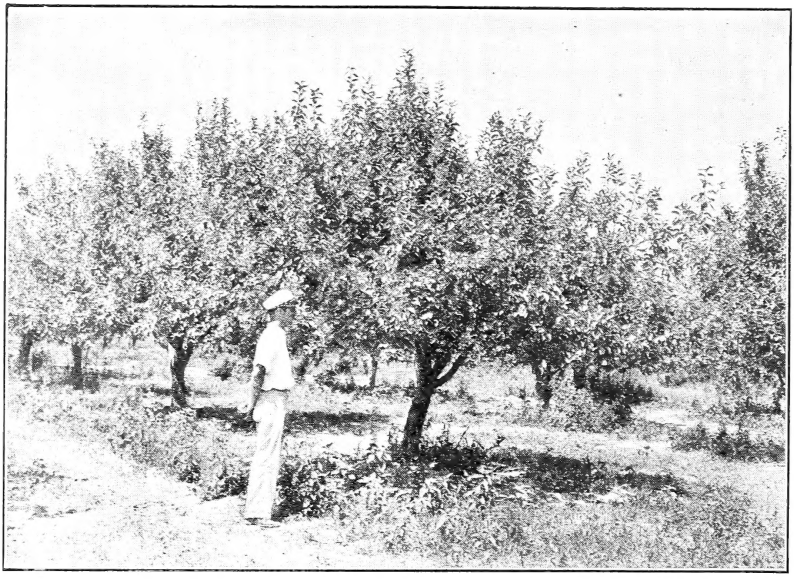

FIGURE 8.—Sprayed apple trees protected from damage by the Japanese beetle.

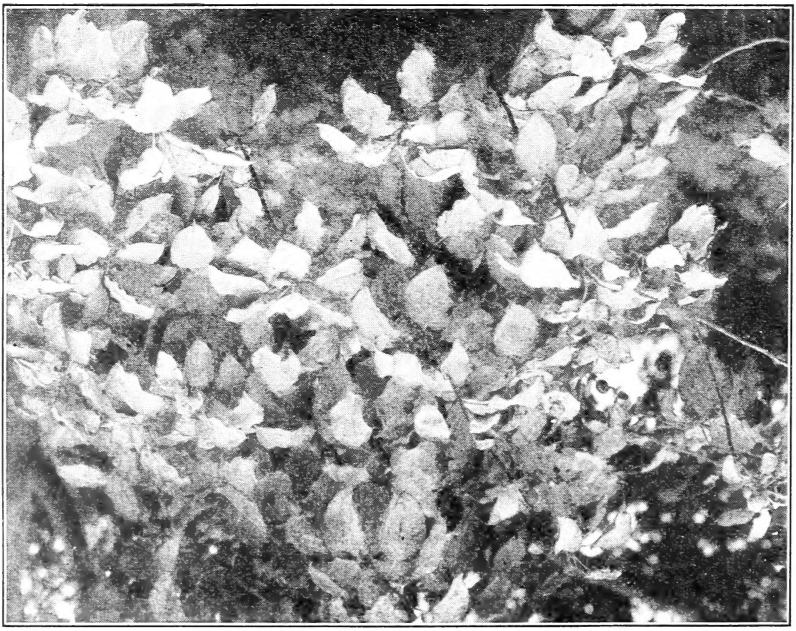

FIGURE 9.—Foliage well sprayed with lime and aluminum sulphate. This figure illustrates the deposit necessary to obtain protection from the Japanese beetle.

Fruit of early-ripening apples can be protected by this spray only when the most careful orchard sanitation is practiced. Prematurely ripening or diseased fruit should be removed from the trees, as such fruit is attacked by the beetles even when thoroughly coated with the spray residue, and when these apples are consumed the beetles begin to feed on the sound fruit. All apples on the ground should also be removed, as their odor attracts beetles to the trees under which they are lying.

There will generally be some residue left on the fruit at the time of harvest. Although this material is nontoxic, it should be removed by the usual commercial wiping or washing equipment.

LATE APPLES

Late apples can be protected by spraying with the lime-aluminum sulphate combination or with 6 pounds of acid lead arsenate, to which is added a suitable sticker, in 100 gallons of water. The use of 4 pounds of wheat flour to each 6 pounds of lead arsenate has been found to be one of the most satisfactory ways of increasing the adhesiveness of lead arsenate to fruit and foliage. If, however, other stickers or spreaders, such as cold-water-soluble powdered skim milk or a safe summer oil, have been used previously in the spray schedule, these materials may be substituted for the flour. Two pounds of powdered skim milk should be used to 6 pounds of lead arsenate. When oil is used, enough should be added to give the diluted spray an oil content of from 0.5 to 0.6 percent. The use of summer-oil emulsion with lead arsenate after the first of July may cause difficulty in removing the residue at harvest time, and therefore should be considered only by growers equipped with effective washing machinery. When an application of lead arsenate is made for the control of the codling moth at the time when the spray for the Japanese beetle would normally be applied, the latter may not be necessary, but one or two additional applications of these sprays may be needed to give adequate protection throughout the season of beetle activity.

Since the residue on the fruit is not a factor with nonbearing apple trees, other stickers may be substituted for the flour when young stock is to be sprayed. Satisfactory results have been obtained with 1½ pints of light-pressed fish oil.[2] The oil should be added after the lead arsenate is in suspension in the water. One application usually gives protection for the season in areas of moderate infestation, but two applications are generally necessary in heavily infested areas.

PEACHES

EARLY PEACHES

Peaches that ripen in July can be protected by spraying with 3 pounds of derris, containing 4 percent of rotenone, and 3 pounds of rosin residue emulsion in 100 gallons of water, provided the orchard sanitation suggested under Early Apples is practiced. Derris may

[2] Fish oil with a saponification value of 190 to 198, a specific gravity of 0.927 to 0.933 at 15° C., an iodine number of 139 to 193, and free-fatty-acid content of less than 5 percent, should be used.

be obtained from insecticide dealers. Rosin residue is the sticky resinous material that remains in the stills after the distillation of rosin. It is available on the market in three grades and may be obtained from dealers in naval stores.[3]

A 50-percent emulsion of rosin residue is prepared as follows: 4 pounds of casein is dispersed in about 45 pounds of water to which 12 ounces of ammonium hydroxide (specific gravity 0.90) has been added; 50 pounds of rosin residue is added slowly with violent agitation, which is continued until the material becomes emulsified. This emulsion can be diluted without difficulty with hard, cold water. In preparing this spray, the rosin-residue emulsion is added to the water in the spray tank, and a thin paste of the derris is poured into the mixture.

The first application of the spray should be made when the beetles first appear in the orchard. Subsequent applications should follow at intervals of 7 to 10 days, the number necessary being dependent upon the degree of infestation.

LATE PEACHES

The fruit of varieties ripening at the same time as or later than Hiley is seldom eaten by the beetle, but the foliage of late-ripening varieties is often severely injured, and, unless protected, the fruit may be of poor quality. The foliage on these varieties and on young trees that have not come into bearing can be protected with the lime-aluminum sulphate spray. Because of the objectionable residue left by this spray, not more than two applications should be made. Under no circumstances should the trees be sprayed after July 15, as considerable residue will be on the fruit at the time of harvest.

PLUMS

The spray of derris-rosin residue emulsion is recommended for early-ripening varieties, and that of hydrated lime-aluminum sulphate for the late varieties.

CHERRIES

The cherry crop is usually harvested before the Japanese beetle appears in sufficient numbers to injure the foliage or fruit. After the fruit is harvested, an application of 6 pounds of lead arsenate and 4 pounds of flour in 100 gallons of water is recommended for the protection of the foliage. When leaf spot or yellow leaf is present in the orchard, 2½ gallons of commercial lime-sulphur solution should be added to the mixture. It may be necessary to repeat the application 2 or 3 weeks later.

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[3] The physical constants of the grade of rosin residue most satisfactory for use in peach sprays are as follows:

Melting point	°C	30
Specific gravity at 25° C		1.03
Viscosity, Saybolt, at 100°	seconds	100–200
Acid number		50–75
Saponification number		89
Unsaponifiable	percent	50
Petroleum-ether soluble	do	3.8
Volatile with steam at 230°	do	25–35

GRAPES

Bearing and nonbearing grapevines can be protected by spraying thoroughly with 6 pounds of lead arsenate and 4 pounds of flour in 100 gallons of water, or with 20 pounds of hydrated lime and 3 pounds of aluminum sulphate in 100 gallons of water. The Japanese beetle does not feed on the fruit. The spray should be directed downward from above to avoid excessive residue on the fruit at the time of harvest, but every leaf should be covered. Where it is the practice to use 8–12–100 bordeaux mixture [4] on the grapes the latter part of June, lead arsenate without the flour may be added. Additional applications of these sprays are usually necessary to protect the new growth that develops after the first application.

SMALL FRUITS

As there is no satisfactory procedure for removing the spray residue from raspberries, blackberries, and blueberries without causing damage to the fruit, the bushes should not be sprayed until after the crop is harvested. The lead arsenate and flour or the lime-aluminum sulphate mixture may then be applied to protect the foliage.

SHADE TREES

The foliage of shade trees that are subject to attack by the Japanese beetle can be protected by spraying with 6 pounds of acid lead arsenate and 4 pounds of wheat flour or 1½ pints of light-pressed fish oil in 100 gallons of water. The lead arsenate spray, being a stomach poison, may be of additional value in controlling other leaf-feeding insects, but sometimes it is objectionable when applied in close proximity to residences. In such cases the lime and aluminum sulphate mixture is recommended. These spray residues adhere well to the foliage, but it may be necessary to make a second application 2 or 3 weeks after the initial treatment.

WARNING

Lead arsenate is poisonous to horses, cattle, and sheep. Animals should not be permitted to graze on or beneath trees, shrubs, or vines that have been sprayed with this material.

[4] Copper sulphate, 8 pounds; hydrated lime, 12 pounds; water, 100 gallons.

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