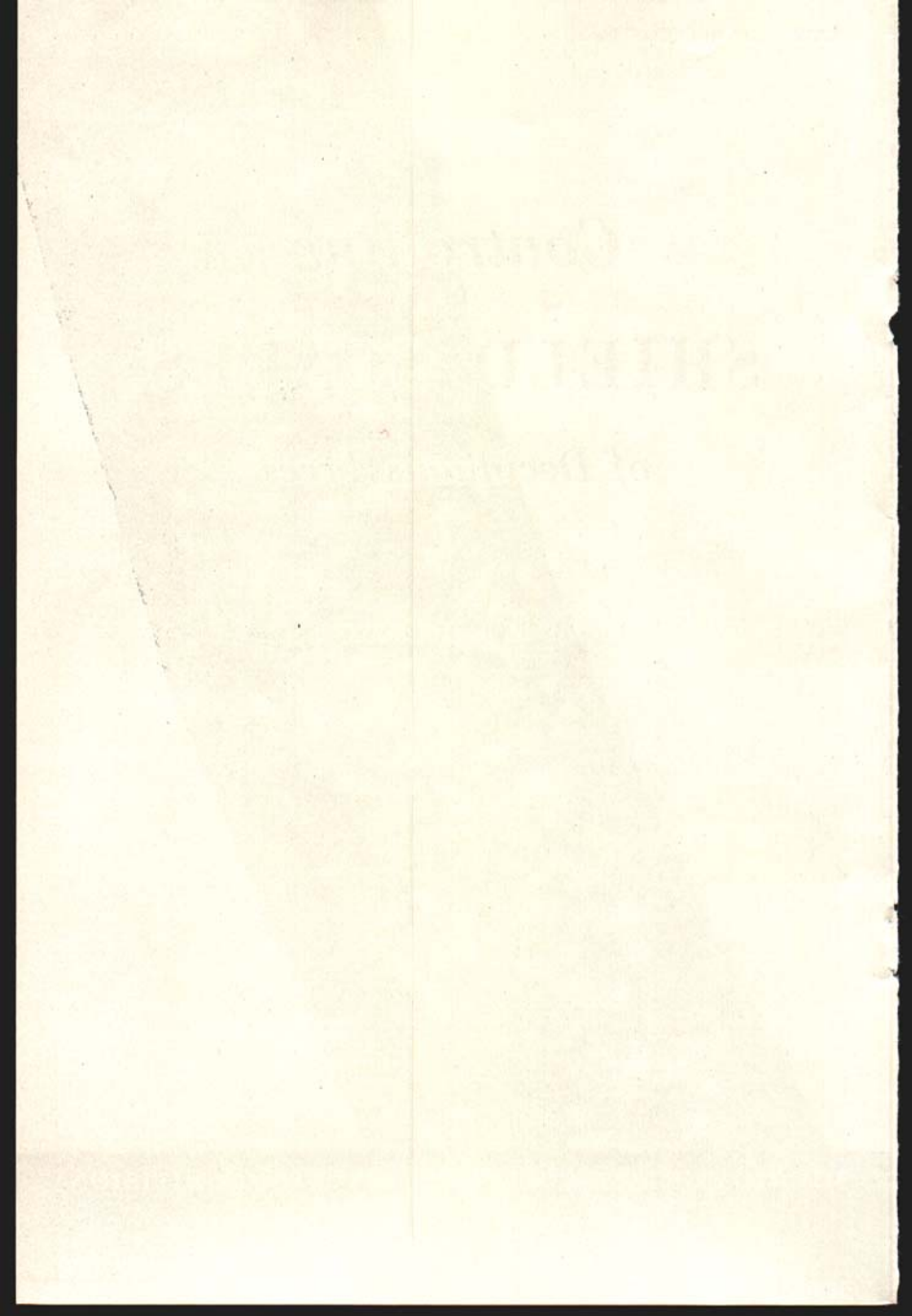


*Controlling*  
**SHIELD SCALES**  
*of Deciduous Trees*

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EAST LANSING



# CONTROLLING SHIELD SCALES OF DECIDUOUS TREES

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Shield scales secrete a covering consisting of wax and cast skins under which they complete their development. Each species constructs a characteristic shield. The female shield scales differ from the males in that they are two or three times larger than those of the male and they are ornamented with two moulted skins instead of one.

Shield scales are more or less stationary for the greater parts of their lives, most species losing their motile powers a few hours after they leave the mother shield. The development of shield scales is somewhat complicated. The male passes through four stages of development: egg, nymph, pupa, and adult. The mature individual is a fragile creature with two wings, two pairs of compound eyes, six legs, but no mouthparts. Its existence as an adult is brief, a few hours at most. The female, on the other hand, does not go through a resting stage and after the first moult loses her eyes, antennae and feet, but retains her mouthparts and may live for several months.

Some shield scales are general feeders, while others are restricted to certain host plants or to host plants belonging to the same family. Some species give birth to young and usually produce several broods each year, while other species reproduce by means of eggs and in this northern range seldom produce more than one annual generation each year or two at most. The species which give birth to young are more easily killed by contact sprays than those depositing eggs.

The following are the more destructive shield scales common on trees and shrubs in Michigan:

## SAN JOSE SCALE (*Aspidiotus perniciosus*)

The San Jose scale attacks a wide variety of host plants including something over 250 different trees and shrubs. Apple, Japanese quince, pear, mountain ash, ash, elm, birch, hawthorne, poplar, and linden are among the preferred host plants. The flat, gray shields are thin and the cast skin on the male shield is surrounded by a depressed ring. This peculiarity differentiates this scale from its near allies.

There are three or four generations a year in this latitude. The females give birth to young in place of laying eggs. The population increases rapidly, each female giving birth to from 200 to 600 young in a lifetime. Winter is passed as a half-grown individual under the shield on the bark.



Fig. 1. San Jose scale. (Greatly enlarged.)

Fruit, foliage, and bark are attacked. On the fruit and foliage and on tender bark bright red, orange and even purplish tinge may surround the scale. This species perceptibly weakens the host plant and often kills individual branches. Where allowed to develop unchecked it is capable of killing healthy trees within two or three years.

**Control**—A dormant application just before growth starts of either lime-sulphur (1 gallon in 8 gallons of water) **in small quantities, 1 $\frac{1}{3}$  quarts in 3 gallons**, or an oil spray. Either a miscible oil or an oil emulsion may be used. A spray with 3-per cent actual oil (3 gallons in 100 gallons of water) **in small quantities, 1 $\frac{1}{2}$  cups to 3 gallons**, will give control.

**Allies of the San Jose Scale**—The following are the common allies of the San Jose scale infesting Michigan trees and shrubs: The Putnam's scale, *A. ancylus*, the English walnut scale, *A. juglans regiae*, and the European fruit scale, *A. ostreaeformis*. Usually the allies of the San Jose scale are of little or no importance under Michigan conditions and control measures are seldom necessary for any of the group except for the San Jose. However, the other species often confuse the issue because they are similar in appearance to the San Jose, and it is often desirable to distinguish between the species.

Of the allies of the San Jose, the Putnam's scale is of less importance under Michigan conditions. Its host list is more restricted than that of the English walnut scale and the rate of reproduction is much lower. In the south it is an economic problem on peaches, in Michigan it has been collected in a number of deciduous trees including

soft maple, apple, beech, and black locust. The infestation is confined to the twigs and branches where the bark is thin. The young arrange themselves star-like around the mother shield. There are seldom more than a dozen in a colony, often fewer. The species has many natural enemies.

The English walnut scale is capable of killing weakened trees or lowering the vitality of healthy trees. It is usually more destructive to city trees. The infestation is confined to the thin bark, and the young cluster about the mother scale, often piling up one on top of the other. The ratio of reproduction is greater than that of the Putnam's scale and the economic importance is correspondingly greater. The English walnut scale attacks a number of deciduous trees and shrubs, among which are: ash, apple, locust, maple, walnut, boxelder, elm, cottonwood, currant, pear, peach and plum. It has many natural enemies and on shade trees it is seldom necessary to apply a spray.

The European fruit scale (*A. ostreaeformis*) passes the winter as an immature insect under its shield. In the early spring it is difficult to separate the overwintering individuals of this species from those of San Jose. There are about two broods a season and the rate of increase is not nearly so high as the San Jose and the range of host plants is not nearly so extensive. A number of deciduous trees including currant, pear, plum, walnut and ash are among the preferred host plants.

#### OYSTER-SHELL SCALE (*Lepidosaphes ulmi*)

The oyster-shell scale infests the trunk, branches and twigs of various deciduous trees and shrubs. It has been taken on juniper as well as peony, dahlia and weeds growing in the vicinity of infested trees. It

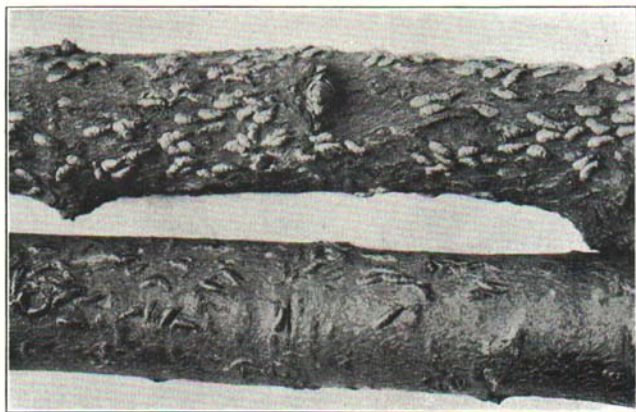


Fig. 2. Oyster-shell scale enlarged. Below "brown form," above "gray form."



Fig. 3. Dormant application for the control of scale insects on shade trees.

occasionally kills branches or even trees, particularly trees in low vigor. In this latitude there is one annual generation and winter is passed in the egg stage under the mother scale.

There are at least three distinct races of oyster-shell scale: the "brown race," common to apple, pear, plum, hackberry and horse chestnut, the "yellowish brown race" of birch and poplar, and the "gray-brown" or "gray race" of poplar, lilac, maple, birch, beech, willow, ash, and dogwood. Each race apparently adheres to its particular host list—for instance, the "brown race" of apple does not migrate to lilac and the "gray race" of lilac does not migrate to apple.

Both the "brown race" and the "yellowish brown race" are parasitized by several different hymenopterous insects, but no parasitized individuals of the "gray race" have been observed. The "gray race" hatches in the vicinity of East Lansing about June 10, and the "brown race" of apple about 10 days later.

**Control**—The oyster-shell scale is more difficult to control than is the San Jose. At least a 4-per cent oil is required to gain commercial control, but where the vigor of the tree permits, a higher concentration—for instance, a 6- or even 8-per cent oil is advised. Oil sprays cause less damage where properly applied.

Maple, beech, and the various nut trees, particularly weakened trees, have been considered susceptible to oil spray and for this reason the concentrations should be lowered to 3-per cent. Apply with pressure, leaving only a thin film on the bark, and do not allow the spray to puddle at the base of the trees. The results are more satisfactory where the application is made in the spring just before growth starts. The shock to the trees can be lessened by building up the vigor of

the trees with fertilizer and supplying an abundance of water. **The vigor of any tree has an important bearing on its tolerance to spray material** and an oil spray is more or less of a shock to any tree.

On lilacs and some shrubs judicious pruning is often sufficient to control oyster-shell. Except where lilacs are grown in tree form, it is advisable occasionally to cut them back shortly after the blooming period.

Where individual trees or bushes on the lawn are infested, it is practical to scrub the scales off with a stiff wire brush or an old broom. Whale oil soap, lye, or even a concentration of dissolved laundry soap will be satisfactory. This application can be made at any time of the year.

Where water under pressure is available and only a few medium-sized trees and shrubs are infested, it is possible to wash thousands of individuals off by thorough application of water. Since hatching may be prolonged over a period of time, it is advisable to repeat the application frequently (48- or 72-hour intervals), from the first week in June to the first week in July.

Scrubbing a tree with lye-water or drenching it down with water under pressure is practical for the man with a few trees; on a larger scale, the only satisfactory method of application is with a high pressure sprayer.

#### SCURFY SCALES

Among the scurfy scales the following infest Michigan trees and shrubs: Scurfy scale of willow, *Chionaspis salicis-nigrae*, scurfy scale of apple, *C. furfura*, scurfy scale of dogwood, *C. corni*, scurfy scale of elm, *C. americana*, and the euonymus scale, *C. euonymi*.

The term "scurfy scale" was used originally as the common name for *Chionaspis furfura*. The name was particularly appropriate since in

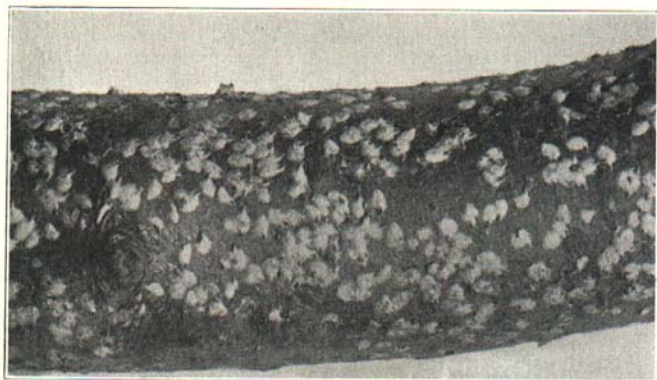


Fig. 4. Scurfy scale of apple. (Enlarged about 3 times.)



Fig. 5. Scurfy scale of willow.

this species the shield is thin, and after it is exposed to the weather for several months it becomes wrinkled, roughened, collects dust and soot, giving the infested bark a dirty scurfy appearance. Recently, however, the term "scurfy scale" has been expanded to include the near relatives of the scurfy scale of apple.

The scurfy scale of apple (*Chionaspis furfura*) seems to prefer fruit trees but it infests something over 40 different host plants. Apple, pear, cherry, quince, currant, hawthorne, crabapple, choke-cherry, Japanese quince, ash, willow, mountain ash, horse chestnut and black walnut are among its common host plants. The infestation is usually restricted to this tree bark, though occasionally some individuals may establish themselves on the fruit.

In orchards or on plantings the infestation is usually scattered and is, as a rule, more or less restricted to individual trees. On mature trees little or no injury is apparent. Young trees or trees recently transplanted may be killed or their growth so stunted that the tree fails to develop properly.

**Control**—*Chionaspis furfura* is not of economic importance in orchards or nurseries where the regular spray program is followed. It can be controlled with 4-per cent oil applied in the spring when the tree is dormant. On ornamental plantings careful pruning will often reduce an infestation.

The scurfy scale of willow (*Chionaspis salicis-nigrae*) is confined to willow and poplar. The infestation is usually restricted to the thin bark. Death of trees is seldom due to the activities of this insect alone, though the insect is capable of killing individual limbs and it does decidedly lower the vitality of the host tree. The shields are firm



and glistening white so long as they remain on the tree. When control measures are required, those recommended for the control of the scurfy scale of apple are suggested.

The scurfy scale of dogwood (*Chionaspis corni*), is restricted to dogwood. This scale seems to be preferred by different hymenopterous parasites and an infestation is seldom of long duration. The scale responds to the same control measures suggested for *Chionaspis furfura*.

The scurfy scale of elm (*Chionaspis ulmi*), is restricted to elm. The American elm is the preferred host plant, though other varieties may be attacked. The scale is capable of killing young trees or trees recently transplanted; also, it often kills limbs of mature trees, thus detracting from the symmetry of the tree. A 4-per cent oil spray applied the spring before growth starts will control this species.

The Euonymus scale (*Chionaspis euonymi*), infests bittersweet as well as both deciduous and evergreen euonymus. It thrives in warm climates and in the past it has been of little or no importance in Michigan, though occasional infestations have been recorded.

The female shield is brownish-gray, very similar in color to the oyster-shell scale. They are obscure and often escape detection until they become numerous enough to cause considerable damage. The male scales are typical *Chionaspis*.

There are at least two annual broods. The infestation may become severe enough to kill larger patches of the vine and where climbing euonymus is attacked the dead areas may prove unsightly.

**Control**—A 3-per cent dormant oil will control the scale if applied in the spring before growth starts. This will cause the leaves to drop

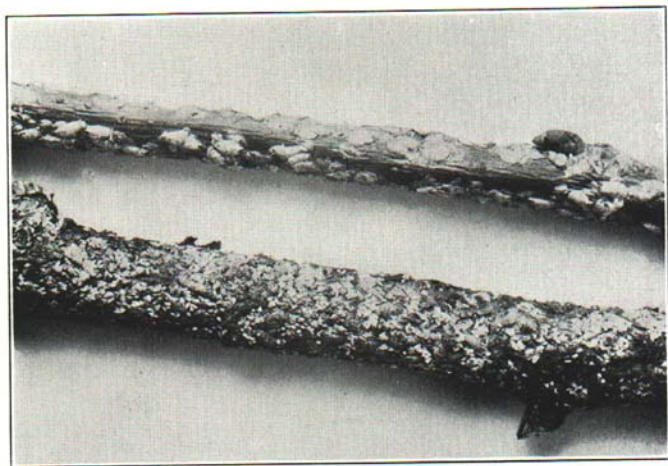


Fig. 6. Elm scale. Small twig shows the female scales, the larger twig both male and female scales.



Fig. 7. *Euonymus* scale.

prematurely, but they will be replaced as the season progresses. Often judicious pruning alone will hold an infestation in check.

#### ROSE SCALE (*Aulacaspis rosae*)

The rose scale is a pest of brambles. It occurs on rose, blackberry, raspberry, and dewberry. The species is of little economic importance, since it is restricted in its distribution largely to brambles growing in

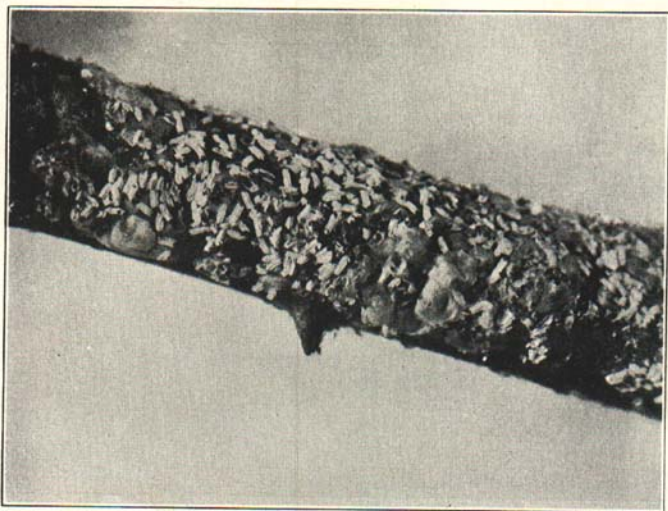


Fig. 8. Male and female of the rose scale, *Aulacaspis rosae*.

damp shaded locations, and as a usual thing the infestation is restricted to one or two canes. Often the infestation is so heavy that the canes appear whitewashed.

There are two generations each year, and the species passes both as partly grown individuals and in the egg stage. The young appear in early June and in August.

Both the male and the female shields are glistening white. The male shields are small, elongated, with a terminal cast skin. It has three longitudinal ridges. The female scale is circular with the cast skins more or less central.

**Control**—Prune out infested canes late in the fall or early spring. Open up the planting to permit the sun to penetrate and in this way prevent reinfestation. A dormant application of lime-sulphur (1 to 8) or a 3-per cent oil spray before growth starts in the spring is recommended where pruning is not desirable.



Fig. 9. Dormant application for the control of scale insects on nursery stock.

### GENERAL CONTROL MEASURES

Shield scales have ceased to be a problem in well sprayed orchards, where a regular spray program is followed. Most growers now apply a dormant oil spray when either scale or mite is present. On the home lawn, with its variety of deciduous trees and shrubs, in parks or on ornamental plantings the problem is different. Usually the scales are well established and the host tree may be half dead before the insects are detected. The loss on small plantings is often greater, owing to the lack of equipment and the difficulty of obtaining the proper insecticides in small quantities.

Shield scales infesting deciduous trees and shrubs are controlled in the same way as scale insects attacking fruit trees, for, in many instances, the same species of insects are involved. It is, however, one thing to spray an orchard or a large planting, using quantities of material applied with a power sprayer giving 500 to 800 pounds pressure, and attempting to control the same insect on shrubbery using the same material applied with a small hand sprayer. In the following discussion regular orchard practices are recommended with suggestions as to how these practices may be modified to protect a few trees or shrubs.

Dormant oil sprays for the control of scale insects give the best results. Dormant lime-sulphur is recommended for control of certain



Fig. 10. Estate sprayer. An efficient, convenient machine for insect control on estates and small plantings.

species of shield scales which winter over partly grown, or soft scales protected by impervious coating, or those secreted into cracks or crevices in the bark. Contact sprays are practical, particularly on ornamentals, when an infestation is discovered during the growing season, if the spray is so timed as to kill the young before they become established.

**Oil Sprays**—There are two types of oil sprays, miscible oils and oil emulsions. The miscible oils are largely proprietary and the oil emulsions are usually home-made. Convenience and cost are usually the deciding factors in making the decision which type of oil to use. Where only a few trees are to be sprayed the money saved by using a home-made preparation will be lost in the inconvenience of preparing the home-made emulsion. **See page 15 for precautions to be observed when using either oil emulsion or miscible oil.**

**Miscible Oils**—Miscible oils are combinations of mineral oils with some material or materials that make them mix with water. The concentrated preparation looks like oil and contains little water. When added to water, a milky white emulsion is formed. Since each proprietary brand has certain peculiarities and since all manufacturers are constantly changing their formulae, it is necessary in each instance to follow the maker's directions.

**Oil Emulsion**—Oil emulsions are dormant oils. They may be either commercial preparations or home-made. They are prepared by mixing oil and water by means of an emulsifying agent, such as casein spreader, bordeaux, with a mechanical device to churn the oil into fine particles and leave the oil suspended in water. Of the home-made oil emulsions, bordeaux oil emulsion is one of the best for the control of scale insects on shade trees.

**Bordeaux Oil Emulsion**—To prepare a 4-per cent bordeaux oil emulsion, use the following proportions in 100 gallons of water:

Water .....	4 gallons
Copper sulphate (stock solution) .....	1 quart
Hydrated lime (stock solution) .....	1 quart
Oil .....	4 gallons

Place 4 gallons of water in a clean, empty spray tank. Start the engine and strain the copper sulphate stock solution (4 ounces copper sulphate dissolved in 1 quart of water) into the water; then add the hydrated lime (6 ounces mixed in 1 quart of water), last, add the oil.

Any oil having approximately 100 seconds viscosity (Saybolt at 100 degrees F.) and 60-70 per cent unsulphonated residue should be satisfactory.

Emulsify by pumping the combination at high pressure (at least 250 pounds) through the spray gun or nozzle back into the tank, continue to pump the emulsion until it is creamy and there is no evidence of free oil.

Add water to fill 100-gallon tank and apply. Keep the agitator in operation until the tank is empty and be certain that the concentrated emulsion is out of the hose before applying any spray to foliage.\*

Where a dormant oil emulsion is recommended a 4-per cent actual oil is usually sufficient, though in some instances 6- and even 8-per cent have been used against oyster-shell scale. Many species can be controlled with a 3-per cent oil.

Where a home-made dormant oil containing 4-per cent actual oil is used, take 4 gallons of the stock emulsions to 100 gallons of water (2 gallons to 50 gallons, 1½ pints to 5 gallons). Where a 3-per cent oil is required, use 3 gallons of the 3-per cent oil emulsion to 100 gallons of water (1½ gallons to 50 gallons or 1½ cups to 3 gallons).

To calculate oil spray dilutions, multiply the number of gallons of dilute spray to be made by the percentage of oil desired in the diluted spray and divide the results by the percentage of oil in the stock

\*For other methods of preparing home-made oil emulsions see Michigan State College Extension Bulletin 154.

emulsion—for instance, to obtain 100 gallons of dilute spray containing 3-per cent oil from a stock emulsion containing 90-per cent oil:

$$\frac{100 \times 3}{90} = 3.22$$

gallons, the amount of prepared emulsions per 100 gallons required to give a 3-per cent oil spray.

**Lime-sulphur**—Lime-sulphur in use today is a commercial preparation and tests around 33 degrees Baumé. It is considered here only as a dormant spray and is recommended in the amount of one part of lime-sulphur in 8 parts of water, (in small amounts  $2\frac{1}{4}$  quarts to 5 gallons). For best results apply with a pressure sprayer.

An application of lime-sulphur gives trees a whitewashed appearance. Also it stains paint, stone work, or stucco. It is, therefore, not advisable to use lime-sulphur where the spray may drift and cause damage. For this reason it is best adapted for a nursery spray or where infested trees are growing in a planting at a distance from buildings.

**Contact Sprays**—Contact sprays for the control of scale insects are largely emergency sprays and while, if properly timed, they may accomplish an immense amount of good, they seldom effect a complete control. The young of most species of scale insects continue to hatch over a protracted period of time and unless a series of applications, (at 48- to 72-hour intervals), are made over a period of a week or 10 days, it is evident that it would be impossible to kill more than a small number of the individuals from any one brood with one application.

Contact sprays applied during the growing season have not given satisfactory control of shield scales. When the application can be made late in the season a 2-per cent summer oil may give a good kill, but there is danger of injury if the temperature rises above 85° F. before the spray dries.

**Soap**—Of the summer sprays perhaps the safest are the soaps. There are a number of different types of soap on the market; their insecticidal applications being largely that of emulsifiers or activators. Where commercial brands are recommended for contact sprays, follow the directions of the manufacturer. Certain soaps, like whale oil soap, have long been used as contact sprays and perhaps of all sprays recommended these are the most satisfactory for use with small hand sprayers where there is little or no pressure.

Whale oil soap as a dormant spray should be used at the rate of 2 pounds to 1 gallon of water, or for summer application use 1 pound to 5 gallons of water. Where potash is present some burning may follow.

**PRECAUTIONS TO BE OBSERVED IN USING OIL SPRAY**

Soft maple and nut trees have generally been considered susceptible to oil. Where such trees have been weakened by insects or from other causes they are particularly susceptible to oil sprays. Water trees thoroughly for a period before and after spraying and use fertilizer in season.

1. **Clean sprayer thoroughly before applying an oil spray.**
2. Never apply an oil spray at a time when there is a possibility of snow or when there is danger of the temperature falling below 40° F. before the spray dries.
3. **Be sure the emulsion is perfect**, that no free oil has separated out and is floating on top before applying the spray.
4. When using a proprietary preparation follow the directions of the manufacturer.
5. It is always advisable to apply oil sprays with a power sprayer, using 400 to 800 pounds pressure.
6. Apply only a thin even film of oil to trunk and limbs. Additional oil will be wasted and will injure the tree.
7. Be sure the spray hose is free of any stock emulsion before starting to spray.

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