

Worms in Prunes

damage in the 1950 season result of attacks by several pests

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Larva of the bud moth.

Damage to prunes in the 1950 season involved the bud moth, the fruit tree leaf roller, the orange tortrix, the peach twig borer, and the codling moth.

Due to the severity of the damage caused by the bud moth—*Spilonota ocellana* D. & S.—in the Santa Clara Valley, many growers and packing house representatives in other areas of the state attributed prune damage to the bud moth but surveys made in the major prune-growing counties disclosed other insects responsible for the damage.

Typical bud moth injury is the attachment of a leaf to a prune with silk, and very shallow feeding holes on the prune beneath the attached leaf.

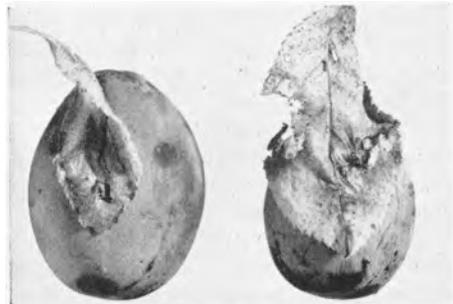
This point in the identification of the bud moth—the characteristic leaf stuck to a prune—has been overemphasized perhaps. Any injury to a green prune will result in production of gum, and if a leaf is nearby, there is a good possibility that the leaf will stick to the prune, giving the impression that the leaf has been deliberately attached by the bud moth larva.

In addition to the attached leaf, the presence of frass-covered tubes, overlaid with silk, on the undersides of the leaves, is the most characteristic sign of bud moth. No other pests attacking prunes construct such a shelter on the leaves.

At present, the bud moth in California is restricted to Santa Clara, San Benito, Santa Cruz, Alameda, Napa and Sonoma counties.

Orange Tortrix

The orange tortrix—*Argyrotaenia citrana* (Fernald)—is an omnivorous feeder



Bud moth injury to prunes.

on many California fruits—including prunes.

This pest overwinters on prune trees as larvae, in nests constructed on twigs or in mummified fruit on the trees. There are several generations each year, with the maximum populations in June and July.

Orange tortrix larvae are straw-colored or light green with a brown head capsule. They feed on the leaves and fruit and will penetrate deep into prunes—sometimes to the pit—and considerable gumming results. They characteristically attack clustered fruits.

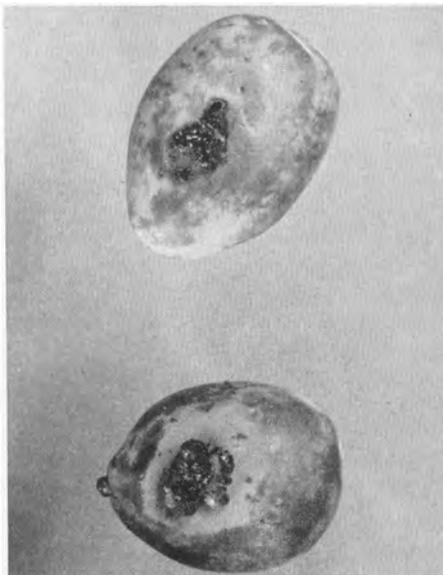
Typical damage signs are large holes in the side of the fruit with copious quantities of gum present.

The larva is usually in or near the attacked fruit. When disturbed they wriggle backwards and drop to the ground on a thread of silk. They seek protection in a leaf or in leaves webbed together with silk.

The orange tortrix is distributed in the same counties as the bud moth and has not been found in the interior valley.

Fruit Tree Leaf Roller

The fruit tree leaf roller—*Archips argyrospila* Walker—is another pest which attacks a large number of California deciduous fruit trees.



Injury to prunes caused by the peach twig borer.

The insect overwinters on the trees as eggs located in white patches on the twigs and limbs. Larvae emerge in the spring and roll up the leaves, feeding from within this protection.

There is only one generation a year, and damage is over by May or June.

The young larvae often emerge during blossom time and feed on the bloom, webbing it together with silk. Larvae of this insect are dark green in color with a black head capsule. When disturbed, they—like the larvae of the orange tortrix—wriggle backwards and descend on a thread of silk.

Larvae of fruit tree leaf roller attack prunes early in the season, causing shallow holes in the fruit. By harvest, the feeding area will have scabbed over. This shallow scabbed area is indicative of leaf roller attack. Since they are not present during July and August, there is no danger of confusing their attack with other prune-feeding insects.

Fruit tree leaf roller is present in all the prune-growing counties in California, but was especially severe this season in Colusa and Yolo counties.

Peach Twig Borer

The peach twig borer—*Anarsia lineatella* Zeller—has been responsible for much of the damage attributed to bud moth in the interior valley prune-growing areas of California.

The twig borer overwinters as a very small larva in hibernacula constructed beneath the bark in the crotches of twigs and branches. A small pile of frass in the

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Codling moth damage to prunes.

FUNGI

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parently independent of the drying power of the air, and can get their water supply from the host plant.

Powdery mildews as a group are low-temperature, shade-loving, dryness-tolerating fungi, though they show some differences among themselves with respect to all these characters.

Temperature and Light

Confusing information about the epidemiology of fungi and about the weather has led some people to believe that powdery mildews, like most foliage fungi, are favored by wet weather. In truth, powdery mildew is more abundant on roses and several other plants in the San Francisco Bay area than in the hotter, sunnier, and drier interior valleys of California. This difference in disease is sometimes attributed to the favorable effect on powdery mildews of the higher humidity of the Bay area. A more likely explanation is that it is the higher temperature and higher light intensity of the interior valleys, and not the lower humidity, which limits the development of rose mildew.

Light, temperature, and humidity may interact with each other. Thus an incoming high fog will lower the light intensity, lower the temperature, and increase the relative humidity. In such a case the light intensity may be reduced to about one fourth that of full sunlight, while temperature is changed to a much smaller extent, and humidity to a still less extent.

Factors Studied

The effect of different environmental factors on a disease may be studied under controlled conditions where each factor may be separately and safely analyzed. Such controlled environmental studies have been carried on, in part.

With humidity and light constant and favorable, a rise in temperature above 82° F will suppress most powdery mildews; and the degree of suppression is proportional to the rise in temperature and the time of exposure.

Similarly, with humidity and temperature, constant and favorable, an increase in light intensity may suppress powdery mildew. But with light and temperature constant and favorable, it has never been possible to suppress any powdery mildew by lowering the relative humidity.

While the environmental relations of powdery mildews are by no means adequately understood, the present status of available knowledge is that high light intensity and high temperatures may be limiting factors, but low relative humidity never is.

Another possible source of confusion is the believed similarity between powdery and downy mildews. To many people, mildews are a group of diseases, whether powdery or downy. The downy mildews are definitely favored by wet weather, and have generally received more publicity. This may be why the belief prevails that powdery mildews are also favored by wet weather. Actually downy and powdery mildews are only very distantly related, less closely so than bread mould—*Rhizopus*—and downy mildews. It is possible to separate these two groups of fungi merely by the difference in their moisture relations. When cucumber plants were inoculated simultaneously with spores of both downy and powdery mildew and the plants left on a dry greenhouse bench and with no water on the leaves, only the powdery mildew developed. When similarly inoculated plants were sprayed with water, incubated overnight in a moist chamber and then syringed heavily in the morning, downy mildew developed luxuriantly, but there was only a trace of powdery mildew.

Control

Fortunately most, if not all, powdery mildews are easily controlled with some form of sulfur, and sulfur is also used for the control of other plant diseases.

The importance of powdery mildews in California is further evidenced by the fact that California uses about 40,000,000 pounds of sulfur as a fungicide per year, mostly for the control of grape powdery mildew. This is about one third of the total sulfur used as a fungicide throughout the United States.

Sulfur can not be used on some crops. It is highly injurious to cantaloupes and other cucurbits at high temperatures, and sulfur residues are objectionable on canned products.

For cases where sulfur is undesirable, a number of other less efficient fungicides can be used. Some of these are dinitro capryl phenyl crotonate, copper sulphate, and the dicyclohexylamine salt of dinitro-cyclohexylphenol. Each of these also has the objectionable character that plant injury will result from overdosage.

Experience of grape growers has shown that if sulfur of grapes is followed by a heavy rain, mildew may develop quite rapidly if no more sulfur is applied. This is sometimes interpreted to indicate that the rain greatly stimulated the activity of the powdery mildew. A more likely explanation is that the rain washed off the protective coating of sulfur.

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form of a chimney is a characteristic sign of the peach twig borer hibernaculum. On rough prune bark, the hibernaculae are very difficult to see, and it is almost impossible to find them during the winter months.

Larvae emerge during the bloom period and feed on the blossoms and developing fruit. A second generation appears in May and it is this generation that causes the major damage to the prunes.

There may be a third generation which will attack the ripening prunes.

Twig borer larvae characteristically bore a cluster of holes into the flesh of the fruit, usually on the side. They do not penetrate very deep, but occasionally will go as far as the pit. They move from one fruit to another, causing considerable damage. Wherever prunes are in clusters, large numbers of fruits will be attacked.

The damage may be distinguished from that of the orange tortrix by the number of holes in a single fruit, instead of the one large hole characteristic of orange tortrix damage.

The twig borer larvae are similar to the bud moth larvae in appearance but the presence of light intersegmental rings on its body distinguish it.

In the 1950 season, peach twig borer was a pest in Colusa, Glenn, Butte, Sutter and Yolo counties where it was mainly responsible for damage attributed to the bud moth. It was also present—but not damaging—in the coastal prune-growing areas.

Codling Moth

Codling moth—*Carpocapsa pomonella* Linn—is not a primary pest of prunes, but in the 1950 season it did damage in at least two orchards in Sutter County but was not reported from any other prune-growing area.

The codling moth in peaches in Sutter County probably accounts for its presence in prunes in that county.

Codling moth larvae may be distinguished by the white or pinkish body with a black head capsule. Its damage on the fruit is quite distinct as there is a mass of gum, mixed with frass, exuding from a single entrance hole. The larvae penetrate the fruit to the pit and usually feed on the meat of the pit.

Tussock moth, cankerworm, tent caterpillar and red humped caterpillar attack prunes, but occur sporadically and vary from season to season.

These pests are primarily leaf feeders and are easily identified. They are not classed as major pests although infesta-

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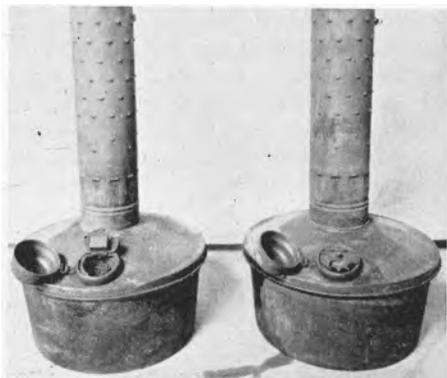
HEATERS

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The graph shows that during the first 10 hours after cleaning—a period representing only one night of fairly heavy firing—the smoke output increased by 50% for two of the kinds tested and increased fourfold with the third kind.

The curve for the Hy-Lo 230A with standard regulator indicates no further increase in smokiness after about 15 hours of operation. This limit, which is well over one gram per minute, occurs only because soot accumulations during this time build up to the maximum amount that will adhere to the covers and stacks. After this point has been reached, the soot falls into the bowl to contribute to the sludge residue or is carried away by the stack gases as fast as it is formed.

The superiority of automatic regulators over standard regulators, as indicated by the lower and upper curves on the smoke graph, may result in part from the automatic control of the starting draft. More probably, however, it is due to improved design of the regulating device. The introduction of air through the smaller regulating holes, the reduction of air leakage around the edges of the regulator, and the uniform burning rates obtainable with this device are all factors which tend to reduce the soot accumulations and the corresponding smokiness.



Two views of automatic regulator. Left, regulator is open, ready for lighting. Thermostat is in the small housing visible on the regulator plate. Right, plate has been closed by hand immediately after lighting, but thermostat holds it up off of seat during two- to three-minute warming-up period.

Besides the advantages of the automatic regulator which have already been mentioned—elimination of the follow-up man, less increase in smokiness over a given period of time, and more uniform burning rates within a group of heaters—lazy-flame heaters equipped with this device are easier to extinguish because of the tight-fitting cover over the regulator parts.

It is evident from the results indicated by the graph, as well as from general field observations, that frequent cleaning of

even the better lazy-flame heaters is absolutely essential if smoke outputs are to be kept at a minimum. These heaters should not be operated for more than 10 to 12 hours without cleaning; some of them, such as the Hy-Lo 230A with standard regulator, require even more frequent cleaning.

Cleaning Heaters

The simple cylindrical stacks of the lazy-flame heaters are readily cleaned by running a wire brush through them, but the stack should first be removed in order to avoid pushing the soot deposits into the bowl.

When heaters are equipped with internal chimneys—which extend downward from the stack opening inside of the bowl—covers can be cleaned only after removal. This should be done after every 25 to 30 hours of operation. Whether or not the covers are removed, the openings in the chimney should be cleaned with a stick or brush at the time the stacks are cleaned. Most combustion-chamber heaters are more difficult to clean because the stacks and combustion chambers need to be disassembled. However, these heaters need to be cleaned just as frequently as the lazy-flame types.

If heaters do not have internal chimneys, the covers should be cleaned while the stacks are off by reaching through the stack opening with a scoop or ladle with which the soot may be scraped off, caught and most of it removed from the bowl. Downdraft tubes may need cleaning occasionally, as smokiness is increased if the slots become plugged with soot.

Since the sludge residue formed in the bowls cannot normally be burned by lazy-flame or other ordinary bowl-type heaters, it decreases the effective fuel capacity of the bowls and hence must be disposed of from time to time. The amount of sludge formed depends somewhat upon the characteristics of the fuel and to a great extent upon the quantity of soot which is allowed to fall into the bowl. In general, the sludge accumulations will amount to 5% to 8% of the total quantity of oil burned, which means that after a heater has been operated for 50 to 60 hours at one-half gallon per hour, the accumulated sludge will have reduced the effective bowl capacity by about two gallons, as well as wasting considerable amounts of oil.

The sludge can be burned in special heaters or in Return-Stack heaters. Otherwise, it must be hauled from the orchard and dumped in a dry wash or other suitable place or burned at some central location.

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tions may occur in any of the prune-growing areas of California.

Regular seasonal spray programs are not required for these pests as they may be present one year but not the following year.

Control

There is one spray which will control all the possible pests that can attack prunes.

Bud moth and orange tortrix may be controlled with a jacket spray of either DDD at two pounds per 100 gallons of water, or parathion at 1½ pounds of 25% material per 100 gallons of water. This jacket spray should be followed with a June spray of the same materials.

If bud moth alone is the problem, the dosage of parathion can be reduced from 1½ to one pound per 100 gallons. The jacket spray of either material will control fruit tree leaf roller as well as tussock moth, canker-worm, and tent caterpillar which may be present.

Twig borer may be controlled with a petal fall spray of DDT, two pounds per 100 gallons of water. This spray should not be delayed until late jacket as the twig borers pupate during this period and control may not be obtained.

A petal fall application of DDT will also control fruit tree leaf roller. If the petal fall spray is missed, twig borer can be controlled in May with a spray of basic lead arsenate four pounds per 100 gallons of water.

The May spray should be timed to the emergence of the second brood of twig borer, which is evidenced by wilted twigs. This twig wilting is not distinct on prunes, so the spray should be timed with the May spray applied to peaches and almonds for twig borer control.

The third generation of twig borer in prunes may be checked by the use of a 30-70 lead arsenate sulfur dust, but considerable damage will have already occurred by this date. In addition, the broods become overlapping later in the season, and complete control is not possible.

Codling moth, since it is a minor pest of prunes, should be handled as it occurs. If it is necessary to treat for codling moth on prunes in May, a spray of four pounds of basic lead arsenate per 100 gallons of water should be used, with timing dependent upon bait pan catches. DDT could be used, but there is a possibility of spider mite build-up if DDT is used that late in the season.

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