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The Lily Weevil, a Potentially Serious Pest in the Pacific Northwest

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INTRODUCTION

During the summer of 1935 certain lily-bulb producers in Coos County, Oreg., reported that weevil larvae were injuring bulbs of the Easter lily (*Lilium longiflorum* Thurb), and serious losses were expected as a result of the infestations. Investigations prompted by these reports disclosed that the insect involved was *Agasphaerops nigra* Horn. Little information was available concerning this weevil, and in view of its apparent economic importance studies were begun of the insect and its biology, and of means to prevent injury. Although the results reported here are incomplete in some respects, the potential importance of the lily weevil as a pest justifies the presentation of the available information, so that growers may avoid serious losses.

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HISTORY

Agasphaerops nigra was originally described in 1876 by Horn.[2] Pierce,[3] in 1913, described a specimen received from Oak Point, Wash., submitted by M. A. Yothers, as *Panscopus (Phymatinus) sulcirostris*, but Buchanan,[4] in 1927, stated that *Panscopus sulcirostris* Pierce was a synonym of *Agasphaerops nigra*. The only published record of economic damage is an account by Wickham[5] of an infestation on *Lilium pardalinum* Kellogg at Quamichan Lake, Vancouver Island, British Columbia, in 1916. No mention was made of injury to the bulbs by the larvae.

NATURE OF INJURY

Both adults and larvae feed on lily plants and the injury they cause may be grouped under three types, as follows: (1) The adults eat

[2] LeConte, J. L., and Horn, G. H. THE RHYNCHOPHORA OF AMERICA NORTH OF MEXICO. Amer. Phil. Soc. Proc. 15, 455 pp. Philadelphia. 1876. (See pp. 24-25.)

[3] Pierce, W. D. MISCELLANEOUS CONTRIBUTIONS TO THE KNOWLEDGE OF THE WEEVILS OF THE FAMILIES ATTELABIDAE AND BRACHYRHINIDAE. U. S. Natl. Mus. Proc. 45:365–426. 1913. (See pp. 392–393.)

[4] Buchanan, L. L. A REVIEW OF PANSCOPUS (COLEOPTERA: OTIORHYNCHIDAE). Wash. Ent. Soc. Proc. 29:25–36, illus. 1927.

[5] Wickham, H. F. AN INTERESTING OTIORHYNCHIDAE WEEVIL FROM VANCOUVER ISLAND (COLEOPTERA). Canad. Ent. 52:134–135. 1920.

Figure 1.—Rounded notches in the edges of Easter lily leaves, eaten by adults of the lily weevil (*Agasphaerops nigra*).

shallow, crescent-shaped notches on the edges of the foliage (fig. 1)—a feeding only slightly detrimental to the plants but furnishing an indication of the presence of the insects; (2) the larvae feed in the underground parts of the stems and (3) in the bulbs, both types of injury being very serious in their effect. Some small larvae apparently feed on the surfaces of the stems without making any effort to burrow within (fig. 2). These, while still small, either reach the bulbs or succumb to natural influences. Others very distinctly eat their way through the outer stem wall, at or below the soil surface, or at times even a little above, and tunnel up and down within the pithy interior (fig. 3). The stem often is completely severed by such feeding, and the bulb, failing to receive plant food which is necessary for development, practically ceases growth.

The larvae frequently complete their development in their burrows, which are more or less filled with frass (fig. 4). The stem tissue seems to be preferred by the larvae to bulb tissue. In older plants, with correspondingly large stems, more larvae have been found attacking stems than bulbs. The more extensive injury noted on bulbs of smaller

FIGURE 2.—An elongated, scarred area on the underground stem of an Easter lily plant caused by feeding of an immature larva of the lily weevil.

and younger plants is possibly due to the failure of the smaller stems to furnish sufficient food for the larvae.

FIGURE 3.—Underground stem of an Easter lily plant sectioned to reveal the frass-filled burrows made by immature larvae of the lily weevil feeding inside the stem.

FIGURE 4.—Underground portion of an Easter lily plant with stem sectioned to reveal extensive injury by a lily weevil larva, which is still present in the lower part of the stem.

Some larvae feed for a time within the stem and then move downward to the bulb. Feeding in the bulbs by small larvae is at first confined to individual bulb scales, but as the larvae increase in size, they extend their tunneling through several scales (fig. 5). Although all parts of the bulb are subject to attack, the greater portion of the feeding observed has been on the lower part of the outer scales. The smaller bulbs are naturally the more seriously damaged (fig. 6). The damage to a larger bulb is largely a matter of appearance unless it has been infested by several larvae. Stem bulblets are occasionally injured, and one may be practically consumed by a single larva.

FIGURE 5.—Damage to an Easter lily bulb by lily weevil larvae, natural size.

FIGURE 6.—Small Easter lily bulb seriously injured by lily weevil larvae, × 2.

ECONOMIC IMPORTANCE

The infestation which Wickham[6] discussed was probably rather severe, but the planting involved only a few thousand bulbs. In discussing it he stated that there was every likelihood that the species might reappear as a pest of some importance along the northern Pacific Coast.

In one planting in southwestern Oregon where the injury has been serious, about 10 percent of the plants were attacked in 1935. This planting was in 3 sections. In the section containing 1-year-old bulbs (bulblets planted the previous season) the infestation was light, very scattered, and estimated at about 2 percent. In the 2-year-old bulbs there was a very heavy infestation, concentrated particularly along the first 10 rows adjacent to the south edge. Nearly every plant in the first 3 rows was infested, but the infestation decreased toward the center

[6] See footnote 5, p. 2.

of the plot and was light in the northern half of this block. In the 3-year-old bulbs the infestation was almost negligible.

The bulbs from these three sections were replanted in 1935 in another section of the field, all in one block. In 1936 infestation was present along the outer edge, but bulb damage was materially lower than in 1935, owing in large measure to control efforts.

It seems apparent that the weevil population can develop rapidly in cultivated plantings if no control efforts are made. The concentration of desirable host plants combined with the extensive egg-laying capacity of the females is very favorable to a rapid increase in population.

DISTRIBUTION

The relatively few records available indicate that this species occurs throughout the coastal region of the Pacific slope from northern California to British Columbia (fig. 7). The specimens which Horn described were collected at Mendocino, Calif., which is the most southerly location recorded. E. C. Van Dyke stated in correspondence (January 17, 1937) that only four specimens were present in the collection of the California Academy of Sciences. Two of these were from Humboldt County, Calif., one collected about 1898 or 1899 by Harold Davis without further locality data, the other at Green Point (near Redwood Creek) June 11, 1916, by F. E. Blaisdell. The third specimen was collected near Marshfield, Oreg., June 11, 1936, by Van Dyke, and the fourth was an exchange specimen received from Victoria, British Columbia, probably from the Quamichan Lake infestation. W. W. Baker collected one adult at Brookings, Oreg., on May 2, 1934, and reports that he received an adult of this species collected at Corvallis, Oreg., on May 8, 1937, by S. E. Crumb, Jr., and one from K. M. Fender collected at Boyer, Oreg., on June 7, 1937. The authors have collected a number of specimens at Brookings, and the weevil has been very plentiful in Coos County, Oreg.

In Washington State two localities of infestation have been reported—namely, the Columbia National Forest and Lake Cushman.[7] One specimen in the collection of the Washington State College is labeled Coupeville, Whidby Island, April 30, 1898. The specimen described by Pierce from Oak Point, Wash., was collected on April 30, 1910. No records are known of the occurrence of this insect in British Columbia other than at Quamichan Lake, Vancouver Island.

[7] See footnote 4, p. 2.

FIGURE 7.—Distribution of the lily weevil in the Pacific States and British Columbia. Localities where the weevil has been reported are indicated by dots.

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HOSTS

The food preferences of this weevil seem to be confined to a limited number of genera in the family Liliaceae. Concerning the specimen described by Pierce from Oak Point, Wash., Yothers [8] stated, "The specimen had been taken from a lily plant, but what kind and whether it was doing any harm our correspondent did not say."

The weevils discussed in Wickham's account [9] were from *Lilium pardalinum*. For the other records of occurrence no mention of host association is available.

In 1937 adult weevils were collected at the bases of plants of *Fritillaria lanceolata* Pursh and *Disporum* sp. and in 1939 and 1940 in southern Oregon, close to *F. lanceolata,* which exhibited considerable notching of the leaves. Foliage of both species is readily eaten by caged adults. Leaves from numerous species and varieties of lilies were voraciously eaten by adults in cage tests.

Very young larvae (first instars) confined in shell vials fed readily on bulbs of *Fritillaria lanceolata,* on rhizomes of *Disporum oreganum* (S. Wats.) Benth. and Hook., and also on pieces of the underground stems of both plants, as well as on lily bulb scales and stems. It seems likely that these are natural hosts for larvae as well as for adults. *Fritillaria* is not uncommon throughout the known distribution range of the weevil, and two species of *Disporum* are rather common in moist, partly shaded woods areas throughout the Pacific Northwest.

Native species of lilies are present but not necessarily common throughout the known distribution range. Adults have been collected in association with wild lily plants, and leaf, stem, and bulb injury frequently has been encountered which appeared typical of that caused by this insect (figs. 8 and 9). Larvae found in native bulbs of *Lilium occidentale* Purdy and *L. columbianum* Hanson in southwestern Oregon have been determined by W. H. Anderson as *Agasphaerops nigra.*

In the plantings of cultivated lilies, where infestation has been observed, *Lilium longiflorum,* the Easter lily, has been the principal type of lily grown, and this species is apparently well liked by the weevils. There has been no reason to consider that any species or variety of true lilies is immune to attack.

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[8] YOTHERS, M. A. BUD WEEVILS AND OTHER BUD-EATING INSECTS OF WASHINGTON. Wash. Agr. Expt. Sta. Bul. 124, 43 pp., illus. 1916. (See p. 27.)

[9] See footnote 5, p. 2.

FIGURE 8.—Wild *Lilium columbianum* plant with weevil feeding notches on foliage and bulb damaged by larvae of the lily weevil.

FIGURE 9.—Native bulbs of *Lilium columbianum* injured by lily weevil grubs.

In contrast, caged weevils consistently refused to eat foliage of the following species which were offered to them:

Lily family (Liliaceae):
- *Agapanthus africanus* (L.) Hoffmgg., blue lily of the Nile
- *Allium* sp., onion, ornamental forms
- *Asparagus officinalis* L., garden asparagus
- *Calochortus* sp., startulip
- *Camassia quamash* (Pursh) Greene, camas
- *Convallaria majalis* L., lily-of-the-valley
- *Eremurus robustus* Regel, fox-tail lily (giant desertcandle)
- *Erythronium* sp., dog-tooth violet
- *Galtonia candicans* Decne, summer-hyacinth
- *Maianthemum bifolium* var. *kamtschaticum* (Gmel.) Jeps., wild lily-of-the-valley
- *Muscari botryoides* (L.) Mill., grape-hyacinth
- *Smilacina* sp., false Solomonseal
- *Streptopus amplexifolius* (L.) DC., twistedstalk
- *Trillium ovatum* Pursh, trillium
- *Tulipa* sp., tulip

Amaryllis family (Amaryllidaceae):
- *Narcissus* sp., daffodil
- *Vallota purpurea* Herb., Scarboro lily

Iris family (Iridaceae):
- *Iris* sp. (bulbous iris)

DESCRIPTION OF THE STAGES

The Adult

The adult of the lily weevil (fig. 10) ranges in length from 5/16 to 7/16 inch, and in width from 1/8 to 3/16 inch. The body of the weevil is black, with slight shininess or sheen, and the legs are black. The insect has a long, conspicuous beak which has an enlarged tip. There are irregular pearl-colored markings, composed of small scales, on various parts of the body, particularly on the wing covers and prothorax. The slight body sheen and the pearl-colored markings are often obscured by dust and soil which collect on the body of the weevil. Numerous pimplelike protuberances are present on the wing covers and prothorax, and these give the weevil a roughened appearance. There is a slight constriction of the head, just behind the large, bulging eyes, and the eyes appear to be placed on the base of the beak rather than on the globular (or main) part of the head (fig. 11).

In the territory where the lily weevil occurs it may be confused with the black vine weevil (*Brachyrhinus sulcatus* (F.)). The lily weevil is less robust and a little smaller than the black vine weevil. The beak of the lily weevil is longer and more slender, and the tip is enlarged or swollen. The black vine weevil is brownish black and has indistinct

markings which are composed of patches of tiny yellow hairs. These characters are usually sufficient to make the black vine weevil readily distinguishable from the lily weevil.

FIGURE 10.—The adult lily weevil (*Agasphaerops nigra*): *A*, Dorsal view; *B*, lateral view. Both × 10.

THE EGG

The elongate-oval eggs (fig. 12) are pale yellowish white and shiny when inserted into the leaf tissue. Three or four days afterward they change to a glistening black. Occasionally eggs were noted which did not become completely black, but turned gray with the ends darker

FIGURE 11.—Dorsal view of beak and head of an adult lily weevil, × 12.

than the central portion, but these appeared to hatch normally. The egg is approximately one-twentieth of an inch long (1.2 mm.).

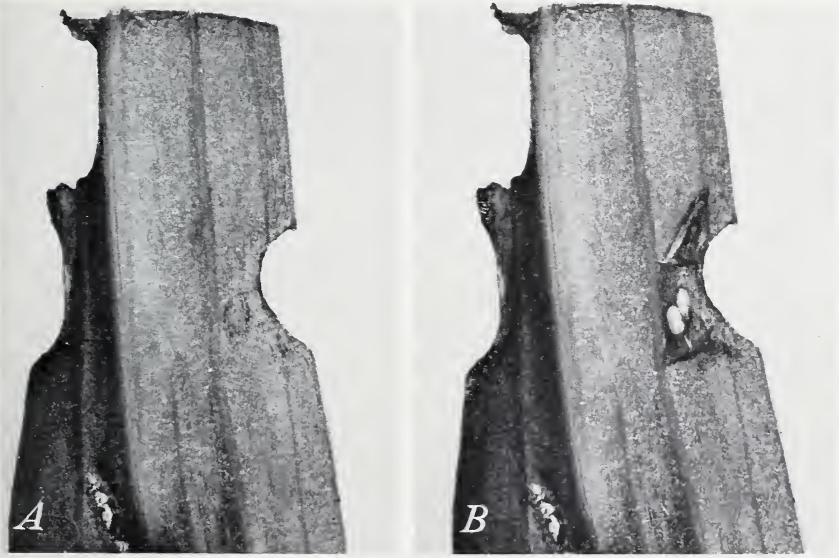

FIGURE 12.—Eggs of the lily weevil: *A*, A small, raised, blisterlike spot indicates where eggs have been inserted under the leaf epidermis; *B*, the same leaf with the epidermis pulled away to reveal two eggs.

The Larva

The larvae (fig. 13) have the typical weevil form, are legless, and, after the earlier stages, are slightly arched or curved. The body has numerous folds and wrinkles, mostly transverse. It is creamy white in the later stages, but in the earlier stages is slightly tinged with pink. During the feeding periods the alimentary canal is outlined by the darkened food content, evident through the slightly transparent body wall. The larval head is strongly sclerotized, and its glistening chestnut-brown color contrasts with the light color of the body. Fully developed larvae are from 3/8 to 7/16 inch long.

Figure 13.—Larva of the lily weevil, × 10.

The Pupa

The pupa is creamy white, and the various adult parts, such as legs, wings, beak, and antennae, become more and more evident, and numerous spines and setae become brownish as transformation progresses.

DEVELOPMENTAL HISTORY AND HABITS

General information concerning the development of the several stages of this insect has been obtained by frequent observations in the field supplemented by laboratory studies. In southern Oregon the eggs are deposited approximately throughout the month of May. These are inserted under the epidermis of the lower leaves of the plants singly or in groups of 2 or 3 (fig. 12). In the field, egg groups rarely contain more than 3, although caged weevils in the laboratory frequently deposited groups of 4 to 6 eggs. The laboratory tests indicated that the lower epidermis of a leaf was decidedly preferred to the upper, for 644 eggs were inserted through the lower epidermis

in comparison with 19 through the upper and 66 which were inserted in edges of the feeding areas. Eggs were found inserted under the lower epidermis in almost all instances observed in the fields. Records of eggs deposited in cages in the laboratory and kept at room temperature in covered glass dishes show an incubation period of 15 to 28 days, with most of the hatching occurring about 19 to 21 days after deposition.

The newly hatched larvae begin to feed immediately after emerging, and not infrequently in the leaf where they hatched, forming mines (fig.

FIGURE 14.—Mines in Easter lily leaves made by newly hatched larvae of the lily weevil.

14). Some leaf tissue is occasionally eaten, but the general tendency of the very young larvae appears to be to move toward the stem of the plant, which they enter or follow downward toward the bulb. Various types of feeding have been noted. Some larvae apparently feed on the outer part of the stem without any effort to burrow within (fig. 2). These probably reach the bulb while still small. Others very distinctly tunnel through the stem wall and feed within the pithy interior. Such entrance may be made in any part of the stem, usually below the soil surface (fig. 15), but even above the soil surface, in which case it is usually at a leaf axil (fig. 16). The stem bulblets are also attacked.

Fifty-eight young larvae found in 18 plants dug in southwestern Oregon on May 29, 1936, were located as follows:

Mining in leaves	6
In stem above soil line	14
In stem below soil line	20
In stem bulblets (below soil line)	7
In bulbs	11

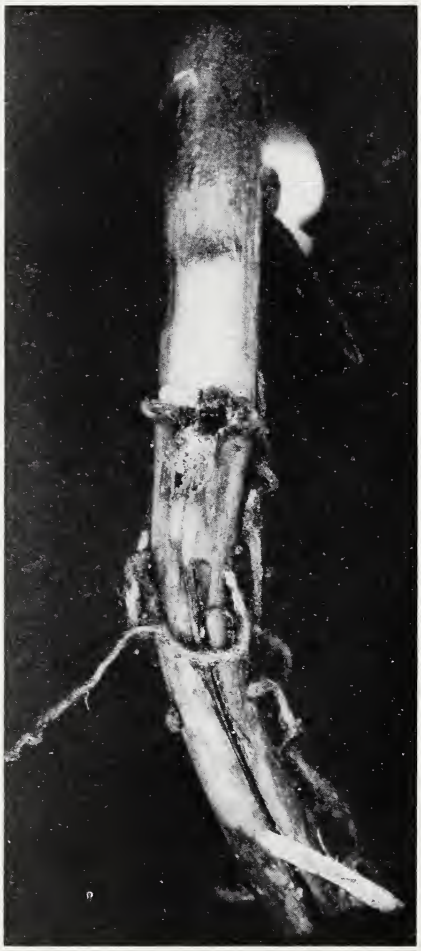

FIGURE 15.—Entrance point of a larva of the lily weevil in the underground stem of an Easter lily plant.

The larvae develop rapidly and become full-grown early in September. At this season they leave the bulbs or stems and migrate downward in the soil to a depth of 10 to 18 inches, usually below the

plow-bottom line, where cells are formed in which the larvae pass the winter and spring. About July of the following year these transform to pupae and late in August or early in September to adults. These transformations take place in the larval cells, and the adults apparently remain there until the following spring. Late in March and early in April the adults move upward to the surface. The first adults in the lily plantings in southwestern Oregon have been observed late in March or early in April. The numbers of adults present increased rapidly

FIGURE 16.—Young larva of the lily weevil feeding in stem of an Easter lily just below leaf axil.

through April. At this season *Lilium longiflorum* plants were still low, hardly 6 inches high at the most, and the feeding crescents on the leaf edges were readily visible (fig. 17). Other insects may feed in a similar manner, so it is always desirable to collect specimens of the insects involved to be certain of their identity. The weevils feed rather voraciously at this time and are easily seen when they are eating. If disturbed they drop to the ground, remaining motionless there for several minutes. When not feeding they hide in the surface debris close to the stem of the plant. They do not burrow into the ground.

Mating pairs frequently are noted in the fields. Bright sunlight seems to have a deterring effect on adult activities, and it appears that on clear days the weevils are most active in the early morning and late afternoon.

FIGURE 17.—Appearance of feeding notches made by adults of the lily weevil on an Easter lily plant in earlier stages of growth.

Egg deposition on lilies does not begin until the end of April or early in May. This has been checked both by careful observation of the plants in the field and by observing adults caged in the laboratory. In 1936 adults were collected on April 9 and 20 and kept in glass dishes at the laboratory. Mating was observed frequently, but no eggs were deposited by either group until May 1, and both began to oviposit at the same time.

Similarly, in 1937 adults collected early in April did not deposit eggs at the laboratory until April 28. One female caged alone after she had mated began egg deposition on May 7 and deposited eggs every day from that date until July 18, except on June 26. No eggs were laid after July 18, the weevil dying on August 3. During this time a total of 479 eggs were laid, the maximum in any 1 day being 14.

In the fields it has been difficult to find adults after the middle of June, although an occasional individual might be located up to about July 1. Very little mortality occurred among the caged adults mentioned above until the middle of July, after which the weevils succumbed

rapidly, very few living after the end of that month, and those for only a few days longer.

The development of this insect is rather unusual because of the extended period of inactivity as fully developed larvae, pupae, and adults, extending the life cycle over a 2-year period. The first winter period is spent in the mature larval condition and the second winter as adults in the cells in the soil originally formed by the larvae. In the individual life cycle adults appear every other year. Thus where adults are present each season, they would represent two alternating broods. The seasonal developmental history under such conditions is shown diagrammatically in figure 18.

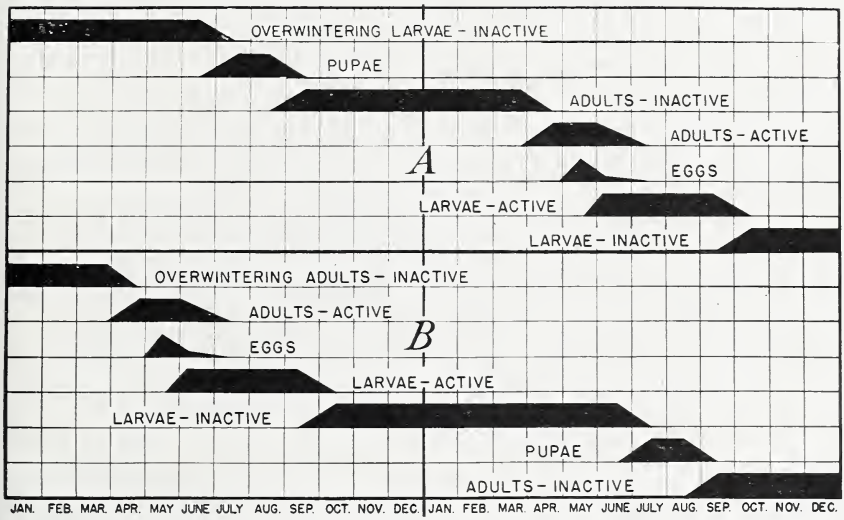

FIGURE 18.—Diagrammatic representation of the seasonal developmental history of the lily weevil where there are two alternating broods, *A* and *B*. The left-hand block represents any one year in which the insects of brood *A* are in inactive stages while those of brood *B* are active, and the right-hand block the following year in which brood *A* is active.

The investigations have not been sufficiently extensive to determine reasons for this extended period of inactivity. In the southwestern coastal area of Oregon, where the observations have been made, the climate is mild, with a minimum of frosts, and these rarely affect the soil. In the most severe weather ever experienced in that region the ground was frozen only 2 to 3 inches deep. Temperature, therefore, would not appear to be an important factor. Winter rains are occasionally heavy, and this might explain the migration of the larvae downward.

POSSIBLE MEANS OF SPREAD

The possibility of transporting larvae with bulbs moving in channels of trade has been considered. It has been noted that the larvae become

mature and leave the bulbs by the end of September. It would seem, therefore, that there would be little probability that bulbs harvested after September would be carrying larvae. Certain types of lily bulbs which would normally be harvested at an earlier season would be likely to carry any larvae infesting them if such bulbs were grown in an area where the weevil is present. Observations indicate that larvae do not leave the stems as early as they leave the bulbs, and therefore stems might constitute a definite hazard. Occasionally stems are sold or transported for propagating purposes, and special attention should be given to the possibility of their infestation in cases of such movement.

The ability of the insect to establish itself in regions other than those now known to be infested has not been determined. The present known range of distribution represents considerable variation in climatic conditions, so it is not at all improbable that the insect could become established in other localities.

The weevils are unable to fly, and therefore spread for any considerable distance would most probably be associated with transportation of the host plants.

CONTROL EXPERIMENTS

The interval of approximately 1 month between the time of the first appearance of the adults above ground and the deposition of eggs affords an excellent opportunity for successful control. At this time the active feeding of the weevils is a further advantage, and a stomach poison should be effective.

Lead arsenate was applied in both 1936 and 1937 in one planting of Easter lilies where the weevils were moderately prevalent. Two pounds of lead arsenate to each 50 gallons of water were used, with the addition of 1 pint of a sulfonated petroleum oil to serve as a spreader and adhesive. In 1936 the spray was applied with a knapsack sprayer on April 23 and May 3, 11, and 19. On May 29, entire plants were collected from the plot and dissected with care to determine the

TABLE 1.—*Comparison of weevil attack on Easter lily plants sprayed with lead arsenate and on unsprayed plants, Coos County, Oreg., 1936*

Evidences or phases of attack	Average per plant on —	
	Sprayed plants	Unsprayed plants
	Number	*Number*
Feeding notches on foliage	26.8	29.1
Eggs deposited in leaves	7.1	10.1
Larvae in leaves	.6	.3
Larvae in stems	.3	2.9
Larvae in bulblets	0	.6
Larvae in bulbs	.1	.7
All larvae	1.0	4.5

location and number of larvae. For comparison unsprayed volunteer plants from the area of the 1935 infestation were similarly examined. The results of these examinations are presented in table 1.

The amount of feeding in the 2 groups was not markedly different. More eggs were deposited in the leaves of the unsprayed plants. In the sprayed plants 7 larvae developed from 50 eggs, or 14 percent, while in the unsprayed plants 51 larvae developed from 111 eggs, or 46 percent.

The results were checked again on July 3. At this time every volunteer bulb (unsprayed) taken from the area of the previous year's planting was found infested and the stems practically consumed. In the sprayed planting samples were examined from 3 areas. In the northwest corner, where weevils had been numerous, 1 larva was found in 1 of 5 bulbs examined, and the stems were sound. In the northeast corner, with a similar adult population, 2 larvae were found in 1 stem and 1 in another, but no larvae were present in the bulbs, and the other 3 plants examined were uninfested. In the southeast corner, where weediness had somewhat hindered proper spray coverage, 4 stems of the 5 plants examined had been severed, and a larva was present in the other bulb. At digging time very few bulbs were found injured in comparison with the infestation in the plants of the previous year.

In 1937 the area of most serious adult infestation was a planting of bulblets made in 1935 and not dug in 1936. Spray applications of lead arsenate were made on April 17 and on May 10 and 22. On April 19, 51 adults were collected around the sprayed plants and held for observation in comparison with 133 adults collected at the same time from unsprayed volunteer plants some distance away. The former adults had only a 2-day feeding period on the poisoned foliage. A week later 39 percent of the weevils from the sprayed plants were dead, but only 3 percent of those collected about unsprayed plants had died.

Frequent observations by the grower through the spring added further evidence of the efficiency of the lead arsenate. Adults picked up under the sprayed plants were kept under close observation for periods of several days. Only a small percentage survived.

The several observations on the actual effect of the lead arsenate spray are indicative of its successful use. There were very few damaged bulbs in the sprayed plantings during the seasons of 1936 and 1937.

RECOMMENDATIONS FOR FIELD CONTROL

In the region of known distribution infestation by the lily weevil may be expected in cultivated lilies that are planted near brushy or uncultivated land where wild host plants are present. As soon as adult feeding (fig. 1) is evident on the foliage, late in March or early in April, the plants should be sprayed with lead arsenate. The lead arsenate

should be used at the rate of 2 pounds to 50 gallons of water to which has been added 1 pint of sulfonated petroleum oil to serve as a spreader and sticker. Other insecticides of the stomach-poison type would be effective, but lead arsenate is suggested because it is generally available. Whatever material is used, a suitable sticker such as sulfonated petroleum oil or sulfonated castor oil, is essential to keep the poison from washing off during rainy periods. Applications of the spray should be made as frequently as is necessary to keep the new growth covered with the poison. Ordinarily this requires a total of five applications of the spray at 10-day intervals, beginning late in March or early in April and extending to approximately the middle of May.

Plantings of lilies in infested territory should be so rotated that there would be at least a 3-year interval between lily crops on the same location.

SUMMARY

The lily weevil (*Agasphaerops nigra* Horn) has been found to be a potentially serious pest of Easter lilies in certain areas of the Pacific Coast States.

Adults feed on the leaves of lily plants and larvae feed in the stems and bulbs. Many species of lilies are acceptable hosts.

The species is known to be distributed along the Pacific coast from Vancouver Island, British Columbia, to the northern part of California.

The weevil may at times be confused with the black vine weevil (*Brachyrhinus sulcatus* (F.)).

The eggs are inserted in the epidermis of the lower leaves of the host plant. They are deposited in May and hatch in from 15 to 20 days.

The larvae attack the underground parts of the plants, stems, or bulbs, and become mature in the middle of, or late in, September, at which time they leave the stems or bulbs and form cells in the soil, usually about 10 to 15 inches below the surface. In these cells the larvae remain more or less inactive, transform to pupae the following summer, and change to adults late in the summer. The adults remain in the cells until the following spring. The life cycle covers 2 years.

Cultivated plantings of lilies which are close to brushy areas where native host plants are present are likely to suffer serious injury.

The extended interval between adult appearance and the beginning of egg deposition, during which the adults feed rather voraciously on lily foliage, permits the effective use of stomach poisons as control measures. Lead arsenate (2 pounds to 50 gallons of water) has been found effective. Whatever poison is used, a suitable sticker should be added to cause the material to adhere to the leaves satisfactorily.

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