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THE PEPPER WEEVIL
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THE PEPPER WEEVIL[1]

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The Bureau of Entomology and Plant Quarantine in Cooperation with the California Agricultural Experiment Station

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ECONOMIC IMPORTANCE

The pepper weevil (*Anthonomus eugenii* Cano) (fig. 1) is a serious pest of peppers (*Capsicum* spp.) wherever they are grown in the Southwest, especially in southern California, Texas, and New Mexico. In California, where the industry is the largest, it has caused losses to growers amounting to 50 percent of the crop in some years; in Texas heavy losses have been experienced every few years since 1904; and in southern New Mexico there have been serious losses periodically for several years.

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[1] *Anthonomus eugenii* Cano; order Coleoptera, family Curculionidae. Also called the chili weevil, and in Mexico the "barrenillo."

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[3] The authors' thanks are due to A. G. Böving, of the Division of Insect Identification of the Bureau of Entomology and Plant Quarantine, for drawing the larva and pupa and assisting with the larval description, and to Mrs. M. F. Benson, Division of Truck Crop and Garden Insects of the same Bureau, for drawing the larval mouth parts. Acknowledgments have been made in the text to those who have assisted in determining material.

Prior to 1923, when the pepper weevil was first reported in southern California, from 8,000 to 10,000 acres in this State alone were devoted to pepper growing, and the crop was valued in excess of $1,000,000 annually. In southern New Mexico about 3,000 acres of peppers are grown each year.

During 1924 and 1925 the average loss from weevil damage in California was light, ranging from none in many fields to 50 percent in 1 or 2 small fields. In 1926, following a mild winter, the loss to the industry was estimated at 50 percent, or about $500,000. In many fields the crop was a total loss by midseason, and in others it was common to harvest only one-fourth ton per acre where 5 tons were expected. In 1927, following a severe winter, the weevil appeared late and in small numbers, and the average loss was estimated at less than 15 percent. In 1928, following a mild winter, infestations were again heavy, and the average loss was about 25 percent, with a range of damage, in the fields examined, from less than 1 to 75 percent. The losses would have been heavier had not control measures been practiced by a large number of growers. In the hope of reducing these losses, a laboratory was established in southern California, and a thorough study has been made of this insect and of the injury that it causes.

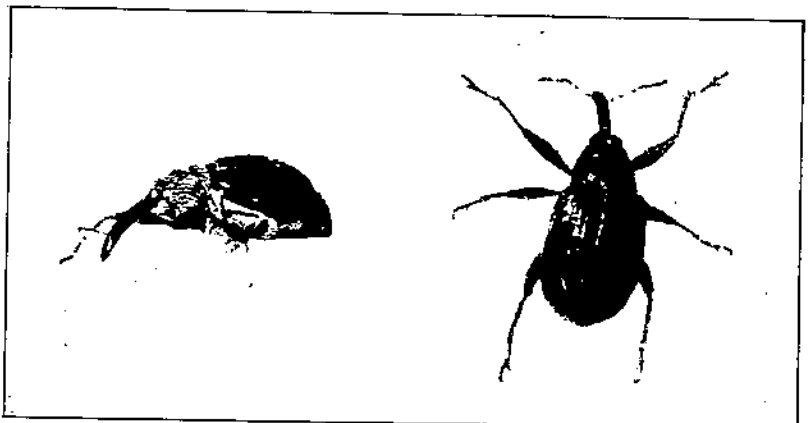

FIGURE 1.—Two views of the pepper weevil (*Anthonomus eugenii* Cano), ×10.

DISTRIBUTION

A survey in California in 1924 showed the weevil to be present in Los Angeles County near La Habra, Puente, Pomona, Norwalk, Long Beach, Alhambra, and San Fernando; in Orange County near Fullerton, Anaheim, Garden Grove, Santa Ana, and Costa Mesa; in Riverside County in the city of Riverside; and in San Bernardino County at Chino. At the end of the 1925 season no additional distribution points were noted. The season of 1926 was characterized by very heavy infestations, and the weevil spread to San Onofre, Bonsall, and Vista in San Diego County. In 1927 infestations were discovered at Fontana, San Bernardino County; at Saticoy, Ventura County; and at El Cajon, La Mesa, and Oceanside, and in the Mission Valley, of San Diego County. By the end of the season of 1928 weevil infestations were common in all the pepper-growing sections of the counties of Los Angeles, Ventura, San Bernardino, Riverside, Orange, and San Diego.

In Texas the pepper weevil has been reported from the counties of Kendall, Bexar, La Salle, Cameron, Kerr, Kleberg, Hidalgo, Harris, Atascosa, and El Paso. In New Mexico it has been reported from the counties of Eddy, Otero, Dona Ana, Luna, Hidalgo, Grant, Sierra, Chaves, Socorro, and Bernalillo.

In 1927 the weevil was reported from Douglas, Ariz., approximately 1½ miles north of the Mexican boundary, but there are no other reports of its occurrence in Arizona.

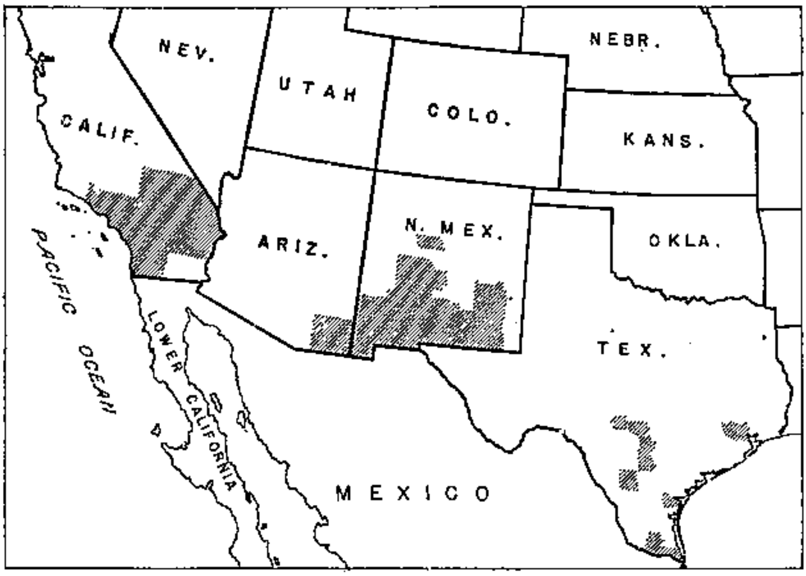

FIGURE 2.—Distribution of the pepper weevil in the Southwestern States.

Reports of the occurrence of the pepper weevil in Mexico indicate that it may be found in the States of Zacatecas, San Luis Potosi, Jalisco, Guanajuato, Durango, Sonora, Sinaloa, Morelos, Vera Cruz, Guerrero, and Oaxaca.

The pest made its appearance in Honolulu, Hawaii, early in 1933, and has been found widely spread on the island of Oahu.

A map of the distribution of the pepper weevil in the Southwest is shown in figure 2.

HISTORY

The first published record of the pepper weevil as a pest of peppers appeared in 1894, when Cano (*2*)[4] described it as *Anthonomus eugenii*, from Guanajuato, Mexico. In 1903 Champion (*3*) described it as *A. aeneotinctus*, giving its habitat as Guanajuato, Tupataro, Sayula, Jalapa, Orizaba, and Amula, Mexico.

[4] Italic numbers in parentheses refer to Literature Cited, p. 26.

The earliest record of the occurrence of the pepper weevil in the United States was made in 1904, when Walker (*13*) reported sweet peppers collected at Boerne, Tex., to be infested with a species of *Anthonomus* determined by Schwarz as *A. aeneotinctus* Champ. Walker briefly discussed the habits of this species and the seriousness of its damage to peppers, and gave a short general description of its different stages. According to pepper growers in that locality, the pepper weevil had been noticed there during the two preceding seasons and had caused "a loss of more than one-third of the crop each year." In 1907 Pratt (*12*) reported that many truck growers at San Antonio, Tex., had given up the growing of peppers on account of the destructiveness of the weevil the preceding year, and that in one field this pest had attacked fully 80 percent of the pods. Pratt expressed the opinion that the pepper weevil had been introduced into the United States from Mexico. It seems that peppers grown in Mexico and shipped to several localities in Texas were reshipped and sold as grown in this State. If these peppers had become infested in Mexico, the insect might easily have been introduced into the United States in this manner. According to Pratt, pepper weevils had been collected at Tlahualilo, Durango, Mexico.

In 1909 M. M. High reported the loss of an entire crop in the lower Rio Grande Valley in Texas from the ravages of this insect, but he failed to find the weevil again until 1913, when he observed a few specimens. In 1917 R. M. Halstead, San Luis Potosi, Mexico, sent several green peppers infested with weevils to the Bureau of Entomology of the United States Department of Agriculture, referring to them as a "serious menace to peppers." In 1921 J. M. Del Curto, of the Texas Department of Agriculture, reported that a weevil was destroying the pepper crop in the lower Rio Grande Valley, and that "in some instances the plague was so serious that the entire crop was lost." Specimens that he sent to the Federal Bureau of Entomology were determined as *Anthonomus eugenii*. Another note showing the presence of the pepper weevil in Mexico, and throwing light on its possible introduction from there into the United States, was furnished by the California Department of Agriculture. It states that "C. H. Vary at Los Angeles, in July 1922, took a number of specimens of *Anthonomus eugenii* Cano from a shipment of Mexican-grown peppers." In 1924 Charles H. Gable, San Antonio, Tex., reported the pepper weevil as a very serious pest and stated that the growing of peppers in that locality was usually abandoned after the middle of July because of the seriousness of the infestations.

The first authentic record of the pepper weevil's occurrence as a pest of peppers in California was made in 1923, when Campbell (*1*) reported heavy losses to growers of bell peppers at La Habra. About the same time the weevils were also found near San Juan Capistrano and in the San Fernando Valley. In 1924 infestations were found to be general over Orange and Los Angeles Counties. Pepper growers claim to have observed the injury for several years previously, describing the damage as "worminess" or "drop."

HOST PLANTS

The host plants of the pepper weevil are limited to genera of the Solanaceae, *Capsicum* (pepper) and *Solanum* (nightshade). The common varieties of the pepper, *C. annuum* L.,[5] the pimiento, tabasco, chili, and bell peppers, as well as *C. baccatum* L.[6] are very susceptible to weevil attack, but varieties bearing the thinner walled fruit suffer heaviest losses. The pepper weevil is common on black nightshade (*S. nigrum* L.)[7] (fig. 3) in pepper-growing areas of southern California, breeding in the berries and surviving on the abundant foliage of the perennial form *douglasii* during the winter. Other wild nightshades upon which the pepper weevil may occasionally be found when growing near infested pepper fields are

FIGURE 3.—Nightshade (*Solanum nigrum*), wild host of the pepper weevil.

S. xanti A. Gray, *S. umbelliferum* Esch., and *S. villosum* Mill. Adult weevils have also been found on two species of ornamental nightshade (*S. glaucum* Dunal and *S. aviculare* Forst.) during the winter. On several occasions two varieties of eggplant (*S. melongena* var. *depressum* Bailey and var. *esculentum* Nees) have become infested with the pepper weevil when growing near heavily infested pepper fields. From the standpoint of economic losses, the pepper is the most important host plant. Black nightshade is also important because it is continually a source of infestation of pepper fields.

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[5] Jones and Rosa (9) refer to Irish (1898) as listing the varieties of pepper in the United States under two species, *Capsicum annuum* and *C. frutescens*, and to Bailey (1924) as listing them all under one species, *C. frutescens*.

[6] This species grows wild in southern Texas and is cultivated to some extent there and in California. Determined as *Capsicum baccatum* by Mrs. R. E. McDonald.

[7] N. L. Gardner, curator, and W. W. Robbins, professor of botany, University of California, recognize only one species (*Solanum nigrum*) of black nightshade in California. Jepson (8) lists *S. nigrum* as the annual form and *S. douglasii* Dunal as the perennial form.

Other plants [8] of common occurrence in and near pepper fields which have been tested as hosts include *Amaranthus graecizans* L., *A. retroflexus* L., *Ambrosia psilostachya* DC., *Bidens pilosa* L., *Brassica* sp., *Chenopodium album* L., *Datura stramonium* L., *Daucus carota* L., *Helianthus* sp., *Lycopersicum esculentum* Mill., *Malva borealis* Wallm., *Medicago hispida* Gaertn., *M. sativa* L., *Melilotus indica* (L.) All., *Physalis ixocarpa* Brot., *Salix* sp., *Salsola kali tenuifolia* G.F.W. Mey., *Sonchus oleraceus* L., *Urtica urens* L., and *Zea mays* Com. The adult weevils fed sparingly for a few days on several of these plants, but egg laying was not observed in a single case. Eggs that were transferred to tomatoes and the pods of *Datura* sp. and potato failed to develop. Eggs and young larvae transferred to pods of *Physalis ixocarpa* developed in a number of cases.

FIGURE 4.—Pimiento pepper plants, showing pepper-weevil damage.

Cano (*2*) says that the pepper weevil may feed on corn, but the writers have been unable to compel adults to feed on young corn plants.

CHARACTER OF INJURY

The most important damage is the destruction of blossom buds and immature pods. (Figs. 4 and 5.) The crop may be entirely lost if the infestation is both severe and early. The stems and calyces of infested pods first turn yellow, and, as the grubs continue to grow, the stems begin to wither at their junction with the plant. The pods then turn yellow or prematurely red and fall from the plant. Very often they are malformed. In many cases the first sign of infestation that the grower notices is a few fallen pods, but by this time serious damage may be already done and within the next 10 days a large part of his crop may fall.

[8] Plants determined by N. L. Gardner, of the University of California, and Frank Pierson, of Pasadena, Calif.

FIGURE 5.—A heavily infested field of California chili peppers, showing concentration of infested pods at end of row where irrigation water has carried them. Infestations become very heavy on plants surrounding such places.

Even if a few infested pods remain on the plant and reach maturity, they are often marred by weevil exit holes (fig. 6). The feeding of the grubs within the pods causes the seeds and cores to turn

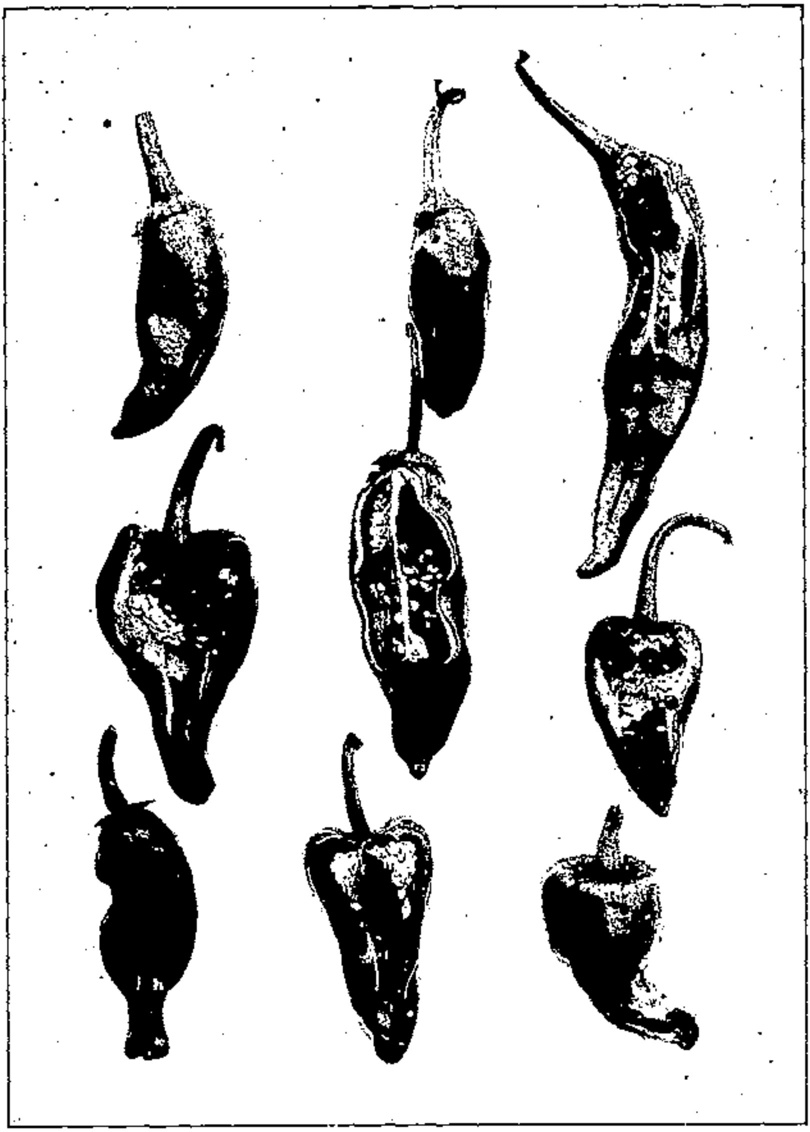

FIGURE 6.—Infested chili-pepper pods, showing larvae, typical blackened condition of seed core, and exit holes.

black, and often an entire core becomes a mass of decayed tissue and frass. Pods that appear to be sound may show this condition when opened (fig. 7).

Feeding punctures in the pods do not materially damage peppers intended for drying, but they appear as dark specks at the bottom of depressed areas and lower the quality of fruit used green or for canning. In the latter case the punctures appear as black spots when the peppers are cooked.

Damage to blossom buds is similar to that done to pods, the larvae within the bud causing it to fall. Unless weevils are very numerous, however, this natural pruning is not serious, since the plant always sets many more buds than are needed to produce a normal crop and these are lost even when not infested. Feeding punctures in the buds cause them to drop.

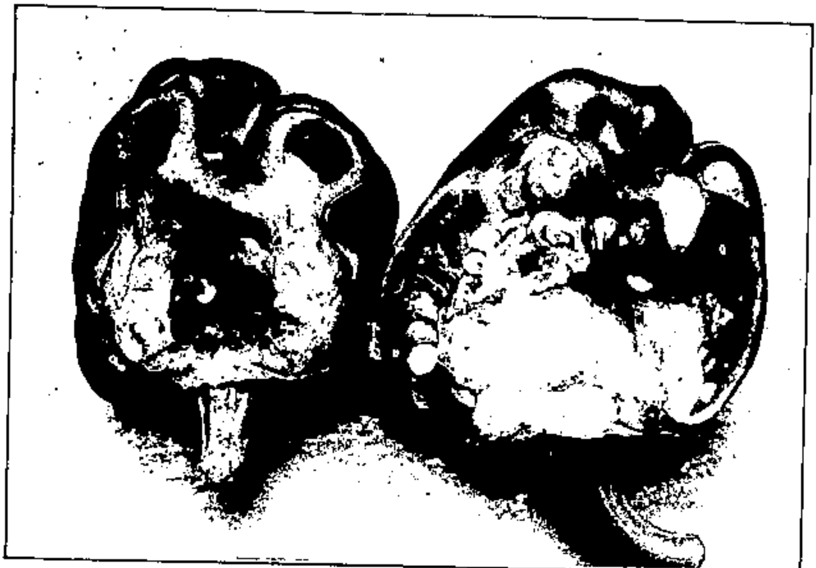

FIGURE 7.—Injury to bell-pepper pods by the pepper weevil.

Buds and immature pods are susceptible to weevil attack at any time, but weevils are unable to puncture mature pods because of the resistant character of the epidermis. In favorable localities the first fruit matures before the weevils become numerous, and sometimes good yields result in spite of heavy infestation later in the season. Late crops and those intended for winter production are often entirely destroyed.

DISSEMINATION

Dissemination is accomplished by flight during the active season and on warm days during the winter. The weevils have been observed in flight in every month of the year. The transportation of infested peppers, picking sacks, and young pepper plants has been known to introduce the pepper weevil into new localities. On three occasions adult weevils were known to have been carried about 15 miles on the windshield of an automobile.

SOURCES OF FIELD INFESTATION

The earliest infestations of the newly planted pepper fields in the spring generally originate from nightshade growing along ditch banks, fence rows, at the edge of wooded areas (fig. 8), or around buildings, or from pepper plants that have lived through the winter (fig. 9), and they usually begin in the part of the field nearest one of these situations. In the season of 1928, early infestations in 18 out of 20 locations were traced directly to nightshade or to old pepper

FIGURE 8.—Nightshade as a source of infestation at the edge of a eucalyptus grove.

fields, and in 1929, 14 out of 18 early infestations were traced directly to nightshade. Later infestations are due largely to dissemination of the insects from the first fields to become infested.

The degree of infestation is easily correlated with the relative number of weevils overwintering in each locality. Weevils have been observed breeding in nightshade berries throughout the growing season, and their flight into pepper fields had some effect on the progress of infestations.

Another source of field infestations is the seed bed. Weevils infesting seed beds, which are usually under cloth, have been known to complete one generation by the time the plants were ready to be transplanted. When the plants are distributed the weevils may be scattered.

FIGURE 9.—Infested pepper field in which eggs were found in buds on February 20, 1931. The average winter population in this field is one adult per plant.

PROGRESS OF AN INFESTATION IN A PEPPER FIELD

In a pepper field the normal infestation, based on the number of punctured buds and pods (referred to as "forms"), is not more than 1 percent when the first buds have formed. The percentage may increase in proportion to the number of weevils entering the field. The infestation gradually spreads over the entire field and then increases in intensity until sometimes it is almost impossible to find an uninfested immature pod. An infestation may or may not be uniform in intensity throughout the field. Figure 10 illustrates the progress of an infestation by showing the characteristic curve representing pepper-weevil increase. The percentages were calculated from counts of infested and uninfested forms in representative 1/3-acre plots in two fields, 3 plots in field 1 and 2 plots in field 2. A total of 30 plants at 9 different points were examined in each plot. The number of forms counted at each examination ranged from 828 to 6,768.

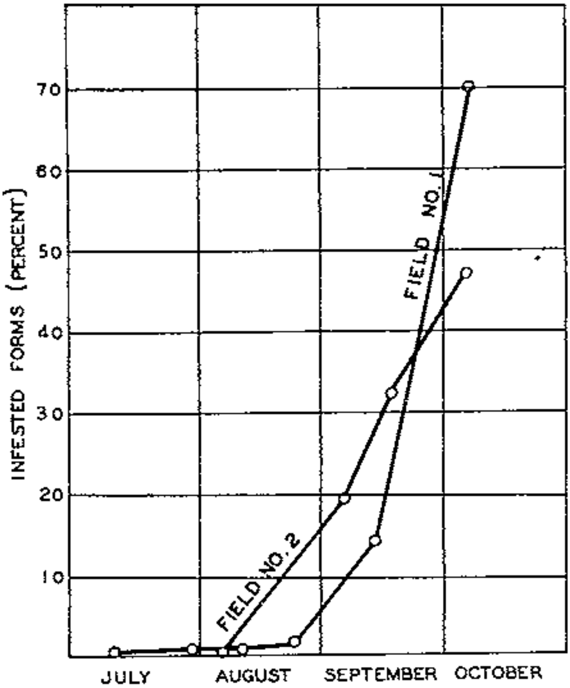

FIGURE 10.—Progress of pepper-weevil infestation in two fields.

DESCRIPTION

ADULT

Champion's description (*3, p. 169*) of this insect, which he called *Anthonomus aeneotinctus*, is as follows:

> Subovate, shining, nigro- or rufo-piceous, with a brassy lustre, the antennae (the club excepted), the base of the femora, the tibiae, and tarsi rufo-testaceous or testaceous; somewhat thickly clothed with coarse whitish or pale ochreous pubescence, which is denser on the scutellum and is sometimes here and there clustered into small fascicles on the elytra. Rostrum (♂) curved, moderately stout, a little longer than the head and prothorax, rugulosely punctate and obsoletely carinate, (♀) more elongate, the antennae in the ♂ inserted at about one-third, and in the ♀ at about two-fifths, from the apex. Prothorax transverse, narrowed and constricted in front, closely punctate. Elytra about one-half wider than the prothorax, subparallel at the base; deeply punctate-striate. Femora each with a small tooth; anterior and intermediate tibiae strongly sinuate within: tarsal claws with a long tooth.
>
> *Var.* The prothorax with three narrow vittae, and the elytra with alternate interstices in part, clothed with whitish, and the rest of their surface with ochreous, pubescence.
>
> Length 2½–3⅓, breadth 1¼–1⅗ millim. (♂ ♀).
>
> *Hab.* Mexico, Guanajuato (*Sallé*), Tupataro, Sayula, Jalapa (*Höge*), Orizaba, Amula (*H. H. Smith*).
>
> Very like *A. mexicanus*, and perhaps an extreme form of it, but a little larger and with the pubescence in fresh specimens nearly as dense as in *A. grandis*. The variety is represented by two females from Amula.

Champion later (*4*) acknowledged Cano's earlier description under the name *Anthonomus eugenii*.

The authors have considered it advisable to redescribe the insect, including characters that were omitted from earlier descriptions and noting certain variations.

Anthonomus eugenii Cano. Robust, subovate, convex, nigropiceous to nigrotestaceous, the integument strongly shining and often with a brassy luster; beak rufopiceous to nigropiceous, head nigropiceous, joints of antennae rufotestaceous, club piceous; legs varying from piceous, with bases of femora and apices of tibiae testaceous or rufotestaceous, to rufotestaceous with the tibiae somewhat darker and bases of femora nigrotestaceous; body clothed with gray or ochraceous, flat, scalelike hairs, densely on the elytral intervals, sterna, and flanks of the abdomen, very densely on the scutellum, and rather sparsely on the legs, prothorax, and head. Beak fairly stout, moderately curved, one-sixth longer than the head and prothorax, rugosely punctate, more strongly so basally, with a series of 5 faint carinae, 1 dorsocentral and 2 on each side, extending to or slightly beyond the insertion of the antennae. Head thick, convex, with sparse shallow punctures; eyes rounded, convex. Antennae fairly long, thin, the club oblong. Prothorax not strongly convex, strongly and densely punctate; one-third wider than long, slightly narrowed behind, base truncate; apex truncate, two-thirds as wide as base; sides subparallel to the anterior three-fifths, thence strongly converging, with a very slight constriction at the anterior fifth or sixth. Scutellum small, oblong-oval. Elytra strongly punctate-striate, the intervals appearing smooth, but minutely and sparsely punctulate beneath the scales, flat; together one-third wider at base than the base of the prothorax, one-third longer than wide; humeri prominent, rounded, sides subparallel to the middle, thence smoothly, evenly rounded, apices separately rounded; low, rounded protuberance on declivity of each elytron, just anterior to junction of third and eighth striae. Femora each with a small, acute tooth, those on the anterior femora longer and sharper. Anterior and middle tibiae sinuate within, posterior tibiae less so. Tarsi spongy beneath, rufotestaceous, tarsal claws black, each with a long tooth within. Length, exclusive of beak, 1.9 to 3.7 mm, averaging about 3 mm; width 1.1 to 2 mm, averaging 1.7 mm.

In most specimens that have emerged from pupae in capsules the elytra are completely clothed. In others there is a denuded area on each elytron. In young specimens this is small, extending from the posterior three-fifths to the posterior four-fifths and between the second and fourth striae. In older specimens it may be much enlarged, extending from the middle to the apical four-fifths and between the first or second and the seventh striae or even farther.

The adult pepper weevil is about 3 mm long and 1.5 to 1.8 mm wide. The size varies according to the food available for larval development. The thorax and wing covers are clothed with an ochraceous pubescence, but the derm may vary from light brown to black.

There are marked, though somewhat variable, differences between the secondary sex characters of the male and female. The characters which follow are, according to Dietz (*5, p. 178*), common to the Anthonomini and therefore applicable to the pepper weevil:

> Beak of female more slender and slightly longer than that of male, but usually less coarsely punctured and more shining. Antennae inserted slightly farther from tip in male, and beak when observed from above usually appearing to taper slightly from each end toward the middle. Abdomen of male showing eight distinct dorsal segments, terminal segment (pygidium) not being entirely covered by propygidium as in the female. Hind tibial mucro much broader in male than in female. The characters of the beak, however, are usually sufficient to determine the sex, when both are present.

THE EGG

Average length 0.53 mm. diameter 0.39 mm; pearly white when first laid but later yellow; usually oblong-oval, but sometimes having irregular shape of cavity in which it lies; shell smooth, shiny, flexible, and rather tough.

THE LARVA
(Figs. 11 and 12)

Mature larva about 6 mm long, cylindrical, and curved (fig. 11). Body white, although appearing gray when digestive tract is filled; head yellowish brown with brown margins and dark-brown mandibles. Prothorax slightly narrower than mesothorax or metathorax, which are almost as wide as first abdominal segments. No unusual arrangement of body areas, but limiting grooves shallow or absent. Prothorax with continuous dorsal sclerite carrying 7 setae on each side. Mesothorax and metathorax each showing 2 dorsal bulges, a prescutellar area (*ps*) and a fused scutoscutellar area (*sc-scl*); prescutellar area carrying 1 minute seta, scutoscutellar area 3 setae on each side; alar area (*a*) present, carrying 1 seta. Pedal lobes (*p*) distinct but not protuberant, each carrying 4 setae. First to fourth abdominal segments with 3 dorsal bulges each, a prescutal (*psc*), a scutal (*sc*), and a scutellar area (*scl*); rest of abdominal segments without distinct dorsal areas. Epipleural lobe (*e*) circular and large but poorly defined on all abdominal segments, the laterovertral furrow being almost indistinguishable. Hypopleural area (*h*) and sternal areas present but indistinct. Setae minute and usually broken off, but occasionally distinguishable on one or a few segments; distributed on each side as follows: 1 on prescutal, 3 on scutellar area, none

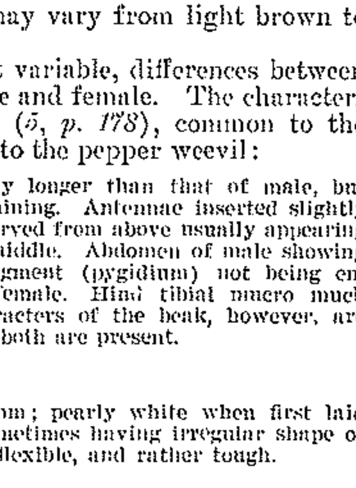

FIGURE 11.—Larva of *Anthonomus eugenii*, ×12.

on scutal. Posterior end of ninth abdominal tergum prolonged into a thick, rather short, conical projection; tenth abdominal segment wart-shaped, with large anal opening. Spiracles (fig. 12, *F*) small, biforous; spiracular opening (*o*) cup-shaped; air tubes (*t*) directed posteriorly, each tube with 5 or 6 annuli (*ann 1*, *ann 2*), and closing apparatus with 1 long and 1 short arm; 1 pair of spiracles on mesothorax, 8 on abdomen, all lateral and of equal size.

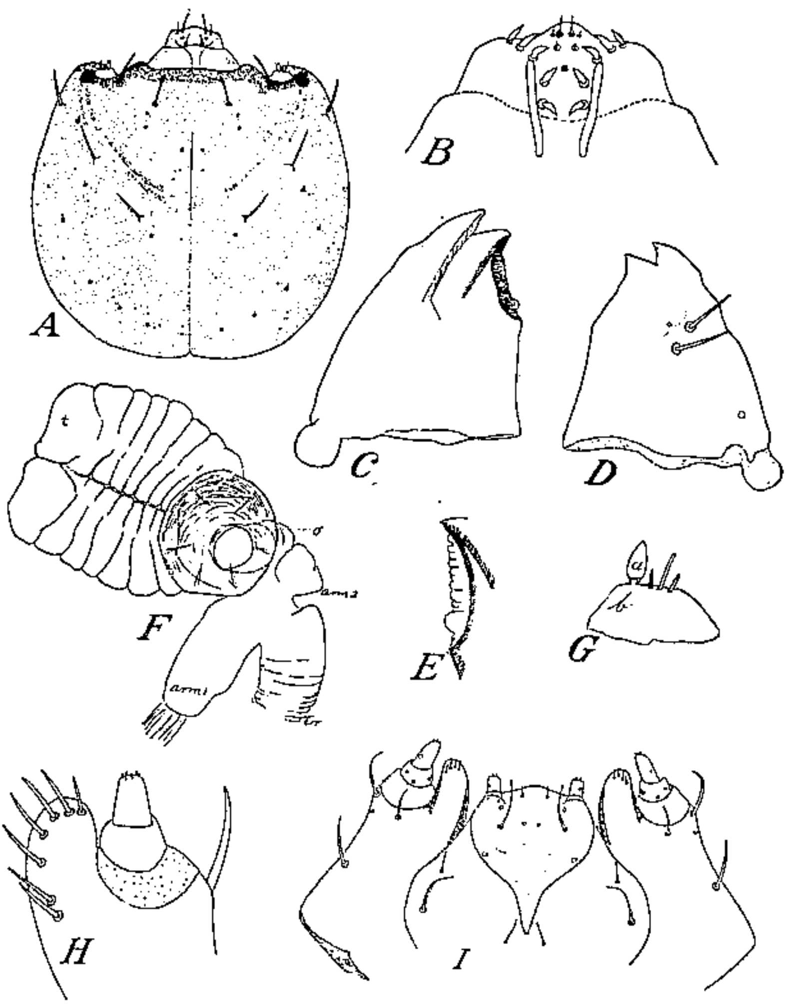

FIGURE 12.—Larval parts of *Anthonomus eugenii*: *A*, head capsule, dorsal view, ×72; *B*, epipharynx ×269; *C*, mandible, ventral view, ×176; *D*, mandible, dorsal view, ×145; *E*, finely crenulate margin of mandible, ×336; *F*, spiracle, ×366; *G*, antenna, ×369; *H*, maxilla and labium, ×125; *I*, maxillary lobe and palpus, ×232.

Head capsule (fig. 12, *A*) light amber, with margins, particularly anterior margin, much darker; head about as wide as long, sides rounded; epicranial and frontal sutures rather distinct; epicranial median suture about half length of cranium. Frons subtriangular, with distinct dark median line indicating carina running from posterior angle to about the middle; sutural margins irregularly sinuate; frons with 2 pairs of large setae, 3 pairs of small setae, and 1 pair of sensory spots. Ocelli large and distinct, immediately below the antennae, 1 on each side of head. Antenna (fig. 12, *G*) two-jointed; basal joint (*b*) dome shaped and carrying 3 small tactile hairs, middle one longest and about length of apical joint; apical joint (*a*) mammilate, elongate, somewhat pointed, and with a small cylindrical ring at base. Clypeus about three times as wide as long. Labrum broadly transverse, anterior margin showing 2 lateral lobes and 1 median lobe; posterior margin prolonged into a triangular projection and covered by clypeus; on each side with 2 well-developed setae near anterior margin, 1 of similar size at posterior margin, and 1 sensory spot.

Epipharynx (fig. 12, *B*) having (1) on each side a lateral group of 3 stout, elongate-ovate, curved, apically pointed setae, outer seta narrower than others, setae arranged in oblique series; (2) near anterior margin a paramedian triangularly arranged group of 3 setae, the anterior inner seta elongate and pointed, and the other 2 small and short; (3) inside anterior end of each epipharyngeal rod 2 setae, 1 in front of the other, both stout, somewhat curved, elongate-oval, and pointed. Mandibles (fig. 12, *C* and *D*) strong, subtriangular, with broad base and heavy condyle; apex provided with an apical and a subapical tooth; facing the buccal cavity with a hollow, gouge-shaped part having margin finely crenulate (fig. 12, *E*) and limited posteriorly by a semiglobular, rather distinct denticle. Maxillae (fig. 12, *I*) with cardo and stipes of shape, proportional size, and setal armature typical of curculionid larvae. Maxillary lobe or mala (fig. 12, *H*) reaching to middle of apical joint of palpus; dorsal and ventral surfaces smooth, lightly sclerotic; dorsal surface with a longitudinal row of 7 strong, slightly curved, slender setae; ventral surface at tip with 4 minute setae. Maxillary palpus (fig. 12, *H*) extending slightly beyond mala, two-jointed; proximal joint thick, subcylindrical, almost as long as cardo, bearing on ventral side 1 seta and 2 sensory punctures; distal joint fingerlike, bearing several terminal papillae. Subfacial area entire, subdivision into mental, submental, and maxillary articulating areas not marked; on each side 3 well-developed setae. Prementum posteriorly limited by an anteriorly concave, in the middle spearlike, sclerotization; 1 seta and 2 to 4 sensory punctures on each side. Labial palpus short, two-jointed, distal joint cylindrical, three times as long as wide, with several small terminal papillae; proximal joint very short; ligula bearing 2 small setae.

PUPA
(Fig. 13)

Length 3.5 to 4 mm, width 2 mm. Uniformly white when first formed. Head of moderate size, round, and bent completely below prothoracic shield, the entire anterior free margin of which is seen in ventral view of pupa. Eye cases of moderate size and distance between them less than width of beak. Beak long and slender, reaching nearly to posterior margin of metathoracic sternum. Antennae ventrally placed, geniculate, terminally reaching to lateral margins of pupa and on level with insertion of first pair of legs. Prothoracic shield large and dome shaped dorsally. Elytra, wings, and tarsal tips of third pair of legs all terminating at sixth abdominal segment; tips of wings not covered by elytra. Ninth dorsal abdominal segment much prolonged laterally sinuate, basally broad, apically sclerotic, and narrowly deeply cleft, with the apices of lobes not divergent, as described by Pierce (*10*, *p. 271*). All setae yellowish brown and of moderate size, those of the prothoracic tergum somewhat larger and more prominent. Setal arrangement as follows: On each side of head 1 seta near inner margin of eye case and above it, 1 seta at base of beak, and 2 setae in front of insertion of antenna. On each side of prothoracic tergum are inserted 3 anterior, marginal setae, all arising from tubercles; 2 paramedian setae, 1 more anterior than the other, both arising from tubercles, the more anterior seta with a minute setula inside its base; and

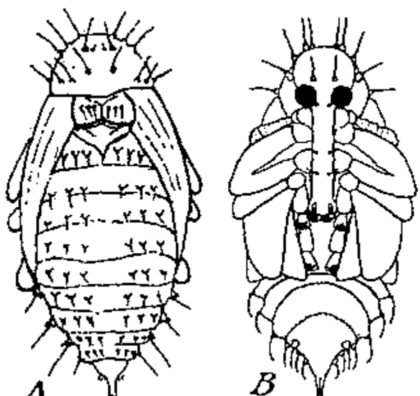

FIGURE 13.—Pupa of *Anthonomus eugenii*: *A*, dorsal view; *B*, ventral view. ×12.5.

3 setae in a transverse line exteriorly near the posterior margin, the distances between them about equal. On each side of the mesothoracic tergum are 3 small setae close together in a transverse line, and on each side of the metathoracic tergum are also 3 setae, similarly arranged in a transverse line, but larger than the corresponding mesothoracic setae and farther apart. On the abdominal segments are, on each side, 3 dorsal setae in a transverse line on the first to the eighth abdominal segments and 1 lateral seta on each pleurum of the first to the eighth abdominal segments. There are no setae on any abdominal sternum.

WEEVILS SOMETIMES MISTAKEN FOR THE PEPPER WEEVIL

Several weevils are found associated with the pepper weevil, and some of them resemble *Anthonomus eugenii* so closely that they are often mistaken for it. H. C. Fall has determined five of these weevils as follows: *A. ornatulus* Dietz, rarely found on peppers; *A. solani* Fall, occurring on nightshade; *Paragoges maculatus* Lec., occurring on sunflower and often on peppers; *Smicronyx* sp., breeding on pigweed and sometimes found on peppers; and *Desmoris constrictus* (Say), common on sunflower and often found on peppers.

FOOD HABITS

Adult weevils prefer buds and tender pods of peppers, but in the fall and winter when these are not available they feed upon the leaves, and they have been known to subsist on the bark of green stalks near the ground. They also feed upon the buds, berries, and foliage of nightshade, and on the buds, flowers, and pods of eggplant. Both male and female weevils feed by eating holes in the pods or buds. These holes are similar to the egg punctures made by the females, except that they are often considerably larger.

The larva, upon hatching from the egg, begins feeding on the surrounding tissue, confining its activity to a single bud or pod. Larvae may feed and develop in the wall of the pepper pod, but they are more often found in the seed and seed core. If the food supply becomes exhausted before normal development is complete, the larva either dies or transforms to a dwarfed adult. Adults have been observed to emerge from buds not larger than a normal weevil, in which case the weevils were unusually small.

SEASONAL ACTIVITY

The weevils spend the winter on nightshade or on such pepper plants as live through the winter. There seems to be a definite migration to and concentration upon nightshade in the fall (table 1). The weevils feed upon the nightshade foliage until the berries begin to develop, which is usually in April but may be as early as February, and then oviposit in the berries. One or two generations may develop in nightshade berries before peppers are large enough to accommodate developing larvae. In the laboratory weevils have been known to oviposit in the small blossom buds of nightshade and the eggs to develop into tiny adults. In areas where peppers are grown as a winter crop the weevils are active on them continuously, though breeding may be considerably reduced during the colder months.

TABLE 1.—*Occurrence of the pepper weevil on nightshade and pepper plants during winter and early spring*[1]

Date	Weevils on pepper plants	Weevils on nightshade plants	Date	Weevils on pepper plants	Weevils on nightshade plants
1927–28	*Number*	*Number*	1929–30	*Number*	*Number*
December	183	[2]	November	66	80
January	438	[2]	December	41	[2]
February	221	1,382	January 3	130	[2]
April 2	[3]	2,000	January 23	75	781
April 20	[3]	576			

[1] The nightshade and pepper plants from which these records were taken were in the same locality. Counts were made by beating the plants over a course screen with a bag beneath. Fifty pepper plants and the equivalent amount of nightshade foliage were taken as units.
[2] No count made.
[3] No pepper plants available.

Overwintering pepper plants in favorable situations may set buds throughout the winter, and the weevils may oviposit in these buds very early in the spring. In 1931 buds containing eggs and larvae were found on such plants as early as February 20 (fig. 9).

In the newly planted pepper fields the first buds begin to set when the plants are about 8 to 10 inches high (fig. 14). This may be as early as the middle of May, but is usually in June. From this time on, the plants are capable of being infested, and weevils moving from the nightshade and old pepper fields during the spring flight find these plants and oviposit in the buds. Later, when the young pods begin to develop, these also are attacked.

FIGURE 14.—Young pepper plant at time first buds are setting.

There is probably some movement back and forth between peppers and nightshade during the summer. Some weevils are present on nightshade throughout the summer, and it is probable that a portion of these remain there and oviposit in the berries throughout the year. In situations where the nightshade has become infested from adjacent pepper fields, and where no peppers were nearby the following season, weevils are known to have survived into the second fall; but since the nightshade was destroyed during the second winter, there are no data indicating how much longer they might have survived.

The relation between the period of pepper-weevil activity and that of host development is shown in figure 15.

WINTER SURVIVAL AND ITS RELATION TO THE HOST PLANTS

Adult weevils may be found on overwintering pepper plants throughout the winter. They become active on warm days, sometimes even taking flight. When the weather is cold, they crawl into protecting crevices or under dry leaves at the base of the plants. In such fields larvae and pupae could be found in green pods during the winters of 1925–26 and 1927–28, and until March of 1926 and 1928 (table 2).

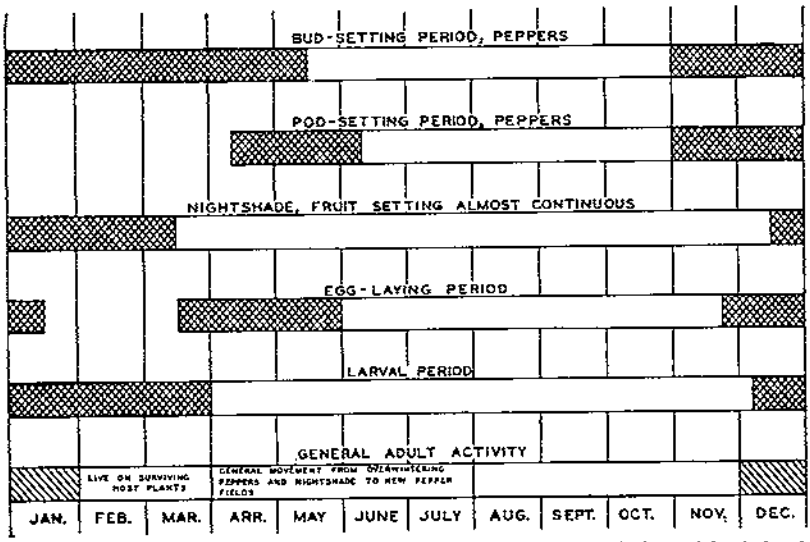

FIGURE 15.—Relation between period of pepper-weevil activity and that of host development. (Blank spaces on horizontal bars indicate period when the activity mentioned always exists. Simple hatching or shading indicates period of adult movement from peppers to nightshade. Cross-hatching indicates period when condition mentioned may or may not exist because of variations in seasonal and weather conditions.)

TABLE 2.—*Occurrence of stages of the pepper weevil on pepper plants in Orange and Los Angeles Counties, Calif., during the winter*

Date	Pods examined	Adults	Larvae	Pupae	Total, all stages
	Number	*Number*	*Number*	*Number*	*Number*
December 1924	71	31	107	99	237
January 7, 1925	68	11	10	21	42
January 29, 1925	95	0	1	2	3
November 1927	134	20	27	135	182
December 19, 1927	70	13	99	33	145
January 6, 1928	10	0	2	2	4
January 20, 1928	18	0	8	7	15
February 8, 1928	17	6	6	1	13
February 20, 1928	58	5	11	3	19
March 10, 1928	10	0	3	2	5

In the absence of overwintering pepper plants, nightshade is the only host in which the insect can survive the winter. At Norwalk, Calif., during the winter of 1927, weevils were very numerous on nightshade, 30 adults having been collected from a plant only 14 inches high. Pepper fields nearby were damaged 75 percent the following summer.

True hibernation of the pepper weevil has not been observed in southern California. During the winters of 1927–28, 1928–29, and 1929–30, experiments were undertaken to test further the possibility of hibernation. At 15-day intervals during the fall and winter 3 or 4 cages of 48-cubic-foot capacity covered with weevil-tight screen (fig. 16) were set up at the laboratory and filled to a depth of 1 foot with dry grass, leaves, cut pepper plants, dry weeds, or cornstalks, or were placed over living pepper or nightshade plants. In addition, 2 or more cages representing each of these conditions were put out in or near pepper fields each month during the winter. From 100 to 200 adult weevils collected from the field were put in each cage. The presence of weevils on the screen was noted every 4 days until the following July. Only weevils in those cages containing the living nightshade or pepper plants survived until the spring crop of plants was large enough to infest. Survival was determined

FIGURE 16.—Hibernation cages for the pepper weevil.

by examining the material in the cages or by counting the adult weevils attracted to fresh pepper plants set in the cages in June. In some of the cages that were left standing all summer, weevils continued to breed on nightshade until November. Continuous breeding was observed under field conditions during the same period.

The weevil may become inactive for short periods, and it has been known to survive for 60 days in hibernation cages without its natural host plants, although the percentage survival for this period was very low.

The relation between winter survival and the presence of host plants was tested further during the winter of 1932–33. During November and December, 25 or more weevils were placed in each of several small cages, together with green twigs of one of the host plants or of the weeds previously mentioned as being common in the locality, and in a few cages weevils were placed without food. Under normal insectary conditions no weevils survived more than 22 days without food, but at a temperature of 40° to 42° F. some weevils lived for as long as 32 days. On the nonhost plants the longest period of survival was 39 days. On the host plants, however, where suitable food was continuously available, from 4 to 20 percent of the weevils were still alive on May 1, after more than 5 months.

This experiment gives further proof that, under conditions as they exist in southern California, the pepper weevil cannot survive the winter unless pepper, nightshade, or eggplant is present, a fact that is the basis of control measures which are discussed later.

LIFE CYCLE

LONGEVITY

The pepper weevil probably lives for 3 or 4 months under natural conditions. Laboratory-reared females mated and kept for oviposition records have lived as long as 135 days, the average being 78.7 days (table 3). The males, in most cases, lived slightly longer. One female, kept on nightshade in the laboratory through the winter, lived for 316 days, and deposited fertile eggs up to a few days before her death. No weevils lived more than 150 days on pepper under summer weather conditions.

TABLE 3.—*Length of adult life and oviposition period of 25 females in the laboratory*

Date emerged	Date mated	Date first egg	Length of adult life	Length of oviposition period	Eggs deposited
1926			*Days*	*Days*	*Number*
May 16	May 19	May 22	103	95	587
May 17		do.	58	53	403
May 23		May 29	128	121	418
May 28	June 3	June 6	110	97	382
Do	do.	do.	56	46	192
June 4	June 8	June 12	93	70	192
June 7	June 9	June 11	88	84	590
June 9	June 14	June 15	21	16	72
June 13	June 15	June 19	135	129	584
Do	do.	June 17	116	112	413
June 14	June 14	do.	24	21	66
June 20	June 22	June 24	24	21	112
July 15	July 21	July 25	28	19	74
1927					
July 18	July 18	July 22	83	79	372
July 20	July 22	July 24	93	89	444
Do	July 21	July 25	91	87	634
Do	do.	July 26	122	105	546
July 21	July 22	July 24	75	72	328
July 25	July 27	July 28	91	88	335
Do	do.	do.	59	56	281
Aug. 13	Aug. 16	Aug. 18	114	109	503
Aug. 19	Aug. 25	Aug. 27	66	58	402
Do	do.	do.	66	58	336
Sept. 11	Sept. 20	Sept. 23	85	76	231
Sept. 16	do.	Sept. 21	39	34	28
Average			78.7	72.2	341
Average number of eggs laid per day per female					4.7

MATING

Mating usually takes place about 2 days after emergence and may be repeated several times. The males are very active, and one male is capable of fertilizing a number of females. One mating is sufficient to insure fertility of the female during her entire life.

OVIPOSITION

The interval between mating and oviposition is usually not more than 2 days in midsummer, but it may be as long as 8 days early in the spring or in the fall.

The eggs are laid singly beneath the surface of the bud or pod at varying depths or, rarely, on the surface. The usual place of oviposition, in the case of the bud, is in an anther, where the newly hatched larva has easy access to the immature pollen as its first food. In the case of the pod, the egg may be placed anywhere inside the wall of the fruit or, in the thicker walled varieties, in the wall itself.

Before depositing an egg the female walks around over the bud or pod to select a suitable spot. She makes a puncture by pushing in first one mandible and then another, and then inserts the beak, usually to the eyes, and enlarges the cavity. The hole prepared, she deposits an egg and covers the puncture with a clear, light yellow fluid, which soon hardens, sealing the hole, and turns brown and finally black. The whole operation normally takes from 2 to 4 minutes.

The length of the oviposition period and the number of eggs deposited by 25 females in the laboratory are shown in table 3. Occasionally a female will deposit 20 or more eggs in 48 hours.

Egg counts were obtained in the laboratory by supplying females with sprigs of buds or pods in which to oviposit. Every other day fresh material was placed in the cage and the old material was removed for examination. Buds and pods that were found to be punctured were opened and examined for eggs.

Temperature is probably the principal controlling factor in oviposition. Ovulation ceases in most females during the winter, probably very soon after the first frosts, when there are no longer any pepper buds or pods or nightshade berries in which to oviposit. During the winter of 1927–28 and the spring and fall of 1928 a number of weevils were collected in the field and the females dissected. Of females collected during the winter and early spring, very few showed any development of the ovaries. A few, however, were shown to be capable of laying eggs throughout the winter. Ovulation and oviposition were resumed in the spring, as soon as pepper buds or nightshade berries were available. Experiments both in the greenhouse and in the insectary in March and April showed that a temperature of 60° F. sustained for 4 or 5 days will cause the ovaries to develop, even when there is no material in which to oviposit. When pepper buds or nightshade berries are placed in the cage, they act as a stimulating factor at lower temperatures. The presence of male weevils seems to act as an inhibiting factor. In San Diego County, where the average temperature is somewhat higher than in Orange and Los Angeles Counties, development continues throughout the winter, eggs and immature stages having been found at all seasons.

INCUBATION PERIOD

The duration of the incubation period was determined by placing fertile females on pods, allowing them to remain for an hour, and beginning with the third day thereafter making frequent examinations of the pods until newly hatched larvae were found. This period was found to be from 3 to 5 days, with an average of 4.3 days.

A day or so before the egg hatches, the mandibles become visible through the eggshell as two brown spots, and, as the time of hatching approaches, the larva may also be seen.

LARVAL DEVELOPMENT

The newly hatched larva measures from 0.8 to 1.5 mm in length, averaging 1 mm. The head is disproportionately large, almost white, and the mandibles are dark brown, tipped with black. The body is shining white. Feeding is begun within 1 to 4 hours after hatching, depending on the temperature. If in a pod, the larva usually works its way into the mass of young seeds; if in a bud, it feeds on the immature pollen. The first molt occurs when the larva is 1 to 4 days old, or an average of 1.7 days.

Immediately after molting the larva swells, becoming from 1.3 to 2.6 mm, or an average of 1.9 mm, long. The head is light yellow, still disproportionately large, and the mandibles are dark brown or black. The larva continues feeding until ready for the second molt, which takes place from 1 to 5 days, or an average of 2.2 days, after the first. A very incomplete cell is sometimes constructed in which the larva undergoes this molt.

Shortly after the second molt the larva is from 2.2 to 5 mm in length, averaging 3.3 mm. Feeding is resumed and continued for from 1 to 7 days, averaging 3.5 days.

The third-stage larva forms a pupal cell by excavating an oval cavity and lining it with excrement, probably supplemented by a secretion from the anal glands. This material is taken in the mandibles from the anus and plastered on the walls of the cavity, where it is subsequently smoothed by the movements of the larva. It soon hardens, becoming strong, though rather brittle. When the cell is finished, the larva rests awhile and the body becomes shorter and greater in diameter. The contents of the intestines having been voided, the larva is shining, semiopaque white. The prepupal stage lasts from 1 to 8 days, averaging 4.9 days.

The larvae are sensitive to light and especially to the outside air. When a pod is opened, they burrow down among the seeds and into the placenta of the pod. They are pugnacious at all times, biting at anything that disturbs them, frequently even attacking and devouring one another. During the prepupal period the larvae keep the pupal cells closed, and if these are opened for observation they are repaired at once.

DEVELOPMENT WITHIN THE PUPAL CELL

When first formed, the pupa is shining, semitransparent, and white. The tip of the abdomen rests upon a cushion of the cast-off larval skin. A few hours after pupation the eye spots begin to show a light yellow tinge. After 2 or 3 days the eyes become dark, the beak light yellowish brown near the apex and black at the tip, and the apical half of the elytra and apical joints of the antenna dark gray. The pupal stage lasts from 3 to 6 days, averaging 4.7 days.

EMERGENCE OF THE ADULT

When it reaches the adult stage, the pepper weevil is light brown. It usually remains in the pupal cell for several hours until it becomes fully colored and active. From 3 hours to 4 days may elapse before it emerges from the pod or bud. The buds, having a thin outer coating, offer little resistance to the weevil's emergence, whereas more effort is required to penetrate the tougher skin of the pepper pods. In emerging from the pod or bud the weevil cuts a clean, round hole. Feeding begins immediately after emergence, preferably upon the buds or tender pods.

SEX RATIO

Observations were made during every month of the year on 3,016 weevils. The percentage of males ranged from 45.3 in October to 72.9 in April, being higher than the percentage of females in nearly all months.

TOTAL TIME OF DEVELOPMENT

The total time of development from egg to adult during the summer, as determined by laboratory experiments, ranged from 16 to 23 days, the average being 20.9 days. If the time between emergence and oviposition is added, a complete generation from first egg to first egg during the summer averages about 25 days.

Over the entire active season, which is from the middle of April to the last of October, the length of a complete generation varies, being from 22 to 46 days, with an average of 32.1 days (table 4).

TABLE 4.—*Length of time required for development from egg to adult and from egg to egg*

Date egg laid	Total period egg to adult	Total period egg to first egg	Date egg laid	Total period egg to adult	Total period egg to first egg
	Days	*Days*		*Days*	*Days*
Apr. 15, 1926	38	43	Aug. 12, 1926	18	22
Apr. 22, 1926	23	31	Aug. 20, 1927	22	32
Apr. 24, 1926	23	29	Aug. 21, 1927	26	32
May 20, 1926	24	29	Aug. 28, 1927	25	29
May 27, 1926	22	28	Sept. 15, 1927	25	33
May 27, 1926	24	28	Sept. 20, 1927	26	34
May 28, 1928	24	31	Sept. 23, 1927	23	32
June 23, 1926	26	35	Sept. 27, 1927	32	39
June 28, 1928	22	28	Oct. 27, 1927	36	46
July 21, 1927	24	28	Oct. 28, 1927	36	46
July 22, 1927	28	35			
July 23, 1927	21	26	Average	25.5	32.1
July 23, 1927	23	20			
July 26, 1927	24	31	Minimum	18	22
July 26, 1928	24	30	Maximum	38	46

Table 5 gives the duration of the various stages of 11 pepper weevils reared in the laboratory during the summer.

Such factors as excessive dryness and excessive moisture tend to retard, and in some cases prevent, development. During the hot weather infested buds are especially subject to drying, and pods that fall to the ground and lie exposed to the sun often become dry before the weevil can complete its development. Pratt (*13*) mentions the rotting of the pods as a factor in control. There is no doubt that there is some mortality from this cause where irrigation is practiced, because the fallen pods are washed to the lower end of the row where the excessive moisture causes them to rot quickly (fig. 5). Larvae that are fully grown, however, have been known to complete development even in completely decayed pods.

TABLE 5.—*Duration of stages of 11 pepper weevils reared in the laboratory*

Date egg laid	Egg stage	First instar	Second instar	Third instar	Prepupal stage	Pupal stage	Period from formation of adult to emergence from host	Total period of development
	Days	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*
July 6	5	1	2	2	6	5	1	22
Do.	3	2			6	5	2	22
Do	3	2			6	5	1	21
Do	4	2			6	6	1	23
Do.	4	2		2	8			23
July 12.	4	1	3	5	2	4	1	20
Do	4	2	2	3	4	4	1	20
July 19	5	1	2	4	1	4	0	17
Aug. 2	5			2	5	6	2	23
Do	5	1			3	5	0	19
Aug. 1	5	2	2	3	4	3	2	21

NUMBER OF GENERATIONS

The number of generations varies according to the season. Observations in the insectary showed, in 1926, a maximum of 8 generations (data from 52 pairs); in 1927, only 5 generations and a partial sixth (data from 45 pairs); in 1928, 7 and a partial eighth (data from 32 pairs); and in 1929, a maximum of 7 generations (data from 18 pairs). The minimum number of generations is 2 or 3, owing to the long life of the adults. In San Diego County, where peppers are grown all the year, weevil development may be continuous.

There is considerable overlapping of generations under field conditions. Overwintering adults may live until midsummer, and adults of the first generation have been known to remain active the entire season.

NATURAL ENEMIES

Parasites of the pepper weevil listed by Pierce, Cushman, and Hood (*11*) include *Pediculoides ventricosus* Newport, *Catolaccus hunteri* Crawford, and *Bracon mellitor* Say. In California at least two undetermined hymenopterous parasites were found to be very common in 1928. These attacked the weevil larvae in pepper buds as external parasites, but they have never been found attacking them in the pepper pods. In a few cases an undetermined mite has been found on the bodies of the adults.

CONTROL MEASURES

INSECTICIDES

Numerous experiments carried out over a period of 5 years showed that calcium arsenate in dust form applied at the rate of 8 to 10 pounds per acre at intervals of 5 to 7 days was the most satisfactory insecticide for controlling the pepper weevil. The use of this material is objectionable, however, because of the necessity of removing the arsenical residue before the peppers are sold. Moreover, its continued use, especially if started early, may favor an aphid infestation (7). Various fluorine dusts, including sodium fluoaluminate (synthetic cryolite), potassium fluoaluminate, and barium fluosilicate, were even more toxic to the pepper weevil than calcium arsenate, but they all caused plant injury and reduction in yield (6). Because of complications of this kind, control investigations are being continued.

DESTRUCTION OF HOST PLANTS

Inasmuch as the pepper weevil has been found to survive the winter only on pepper or nightshade plants, and early infestations have usually been traced to overwintering pepper plants or to nightshade nearby, it was believed that the insect could be controlled if the host plants were destroyed.

A campaign was therefore undertaken in Orange County, Calif., to have growers disk and plow their pepper fields soon after harvest was completed, in any case not later than January 15, and in addition to destroy all nightshade plants along fences, roads, ditch banks, around sheds, and so forth. For 3 years wherever this practice has been fairly faithfully carried out no serious general infestation has occurred. Infestations of damaging proportions have, in most cases, been traced to undestroyed nightshade.

In view of these results and also of the difficulties in the use of arsenical and fluorine insecticides, cultural control by the destruction of old pepper fields and nightshade plants during the winter is the best remedy now known for keeping the pepper weevil in check.

SUMMARY

The pepper weevil causes serious damage to peppers in the Southwest, especially in California, Texas, and New Mexico. It is well distributed over the pepper-growing areas of southern California, southern New Mexico, and southeastern Texas, and occurs also in Arizona, Mexico, and the island of Oahu, Hawaii. It was described from Mexico in 1894, made its first appearance in the United States in Texas in 1904, in California in 1923, and in Hawaii in 1933.

The host plants are confined exclusively to varieties of pepper, nightshade, and eggplant.

Damage from pepper-weevil attack is from destruction of blossom buds and immature pods.

Dissemination is accomplished by flight of the insect and transportation of infested material. Newly planted pepper fields become infested either from overwintering nightshade or from old pepper fields. The degree of infestation increases in proportion to the number of weevils entering the field. An infestation spreads gradually and may or may not be uniform over the field.

The adult and immature stages of the pepper weevil are described.

Adults feed on buds or tender pods of the pepper, but when these are not available they feed on tender foliage. They feed also on nightshade berries and foliage. Larvae feed on the contents of the bud or pod, or in the pod wall, of the pepper.

Adult weevils spend the winter on nightshade or old pepper plants, being active on warm days. A true hibernation has not been observed in California, and in order for the weevils to survive the winter one of its host plants must be present. Migration to pepper fields begins in May or June at about the time the first buds form. Some weevils continue to breed on nightshade.

The adult lives for 2 or 3 months in the summer, but overwintering individuals may live as long as 10 months.

Mating occurs soon after adult emergence, and oviposition begins from 2 to 8 days later. The eggs are laid singly in pepper buds or pods.

In the laboratory the oviposition period ranged from 16 to 129 days, and during this time from 28 to 634 eggs were laid. Temperature directly affects ovulation and oviposition. Growth is rapid, the total time of development from egg to adult being 16 to 23 days in the summer and 22 to 46 days in the spring and fall. All stages except the adult stage are passed within the bud or pod. The adult emerges from the pod by cutting a clean round hole. The proportion of males ranged from 45 to 72 percent, usually with an excess of males.

In different years maxima of 5 to 8 generations were found.

Natural enemies are of little importance in checking a pepper-weevil infestation.

Calcium arsenate gave satisfactory control, but this material cannot be recommended because of the possibility of an arsenical residue. All fluorine dusts caused plant injury. Destruction of all pepper plants after harvest and cleaning up of nightshade plants in the vicinity proved to be the best method of keeping the pepper weevil in check.

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