

Insects Affecting Commercial Jojoba Production in Arizona

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Introduction

Jojoba is a relatively new commercial crop in Arizona. In the past jojoba was touted as a relatively pest free crop. However, as fields mature and begin producing substantial crops growers have complained about various pests. This report details some of the pests and damages observed from observations and field experiences with commercial jojoba pests in southwest Arizona for the past three years.

Pests of Jojoba

Commercially grown jojoba is attacked by several species of insects and mites in Arizona. These pests damage jojoba by direct feeding on the seeds, defoliation of the jojoba plant, and by feeding on plant liquids and leaf tissue. Insects that damage developing jojoba seed in Arizona include two species of caterpillars (a cutworm species as yet undetermined and *Epinotia kasloana*, a moth with no common name) and Say's stink bug, *Chlorochroa sayi*. The cutworm and *E. kasloana* have similar biologies. Both have just one generation per year, at least in jojoba.

Insects that defoliate jojoba are the white-lined grasshopper, *Schistocerca albolineata*, and the jojoba looper, a caterpillar also known by the name *Anacamptodes obliquaria*. Other pests include thrips (*Scirtothrips ewarti* bailey) which feed on developing terminal growth, cowpea aphids, (*Aphis craccivora*) which colonize on terminal and stems, desert spider mites (*Tetranychus desertorum*) which feed on plant juices, and the leafhopper *Homolodisca lacerata*. The sequence of pests in jojoba through the year is presented below.

The first pest present during the calendar year that can damage jojoba is *Epinotia kasloana*. The adults of this species, which are slightly more than 1/3 inch long and dark-grey to brownish grey in color, generally lay eggs on the leaves in January or February, generally on male plants. Eggs are laid singular, are essentially colorless as first and then turn a light orange color. Caterpillars were found from mid-January to mid-May in a California study. These caterpillars are only 1/2 inch long when mature, light yellow except for the brown head area, and occasionally have a light red coloration along their topside. These caterpillars are usually found in pollen clusters but can also eat developing seeds, with damage appearing somewhat similar to that of the cutworms. Holes chewed into the sides of developing fruits will only be about 1/4 inch in diameter, however. These are smaller than the holes chewed into the fruits by the jojoba cutworm.

The adult cutworm moth generally lays eggs on the leaves in February and early March. The adult of this species is grayish and about 3/4 inch long, and does not have any distinctive markings. Cutworm eggs are laid in hexagonal groups of up to 200 on a single leaf, and are sometimes two layers thick. These leaves are usually 3-5 ft off the ground, medium to large in size, and generally have a vertical orientation. The eggs are white when laid, turning to a purplish color as the caterpillars develop inside before eating their way out. The caterpillars emerge from the eggs about 7 days after being deposited on the leaf.

The caterpillars upon hatching loop as they move, and look like loopers, as only three sets of prolegs (2 + 1)

are developed. The caterpillars appear purplish-grey to the naked eye, but are greenish-gray and have several very noticeable sclerotized (dark, hardened) disk shaped areas that each have a long seta (bristle) when observed under magnification. The head capsule is large, sclerotized and light brown in coloration. The caterpillars, after they hatch, eat what is left of the eggs which leaves the egg pattern visible on the leaf surface. Because no plant tissues have been observed to have been eaten by first instar caterpillars, it is believed that these caterpillars can only eat very soft plant material and need pollen to survive. These caterpillars also resemble loopers at this time by their ability to make silken strands from which they are able to hang down from surfaces.

This ability to loop and spin silk continues through at least the second instar. This instar is a light green color that has a non-bright white stripe down each side. This stage was noted attempting to feed through the side into developing seed, and also will readily feed on the styles, as this tissue is very tender. Penetration into the seed itself would probably be accomplished if the developing seed is tender.

As the cutworm caterpillars grow, they apparently lose their silk making abilities as well as their looping habits, but not their ability to bore into the sides of developing seeds. The loss of looping occurs as more prolegs are developed. The cutworms finally end up with 5 pairs of prolegs (4 + 1) and also change color patterns. What is thought to be the 3rd of apparently four instars (perhaps there are five) appears similar to an armyworm, being a darker green color than the 2nd instars, lacks the ability to loop, and has a noticeable bright white stripe down each side. Older 3rd instars (or 4th if 5 instars) appear similar but have several faint white stripes down the back which give it an off-green color. The last, and sometimes next to last, larval instar is not green in color, but is grey-brown. These caterpillars also have a pinkish-white small stripe down each side, and can be 1.75 inches long. In laboratory studies, these insects hide in the soil during the day and feed at night. It is not known if last larval instar cutworms will be in the jojoba or in the soil or both under field conditions.

Damage from these cutworms can be severe. The cutworms eat their way into a seed side and consume the contents. Damage is evidenced by a small to large hole in the seed side, depending upon the size of the caterpillar. These caterpillars are known to eat as many as 12 seeds during the last instar under lab conditions when the seeds offered them may not be as tender as those on jojoba plants. In additional lab studies 2nd instar caterpillars can eat at least 5, perhaps even 8 seeds, with these seeds not being the most tender fare. It is very possible based on these numbers that each cutworm could eat as many as 25-30 seeds or more during their lifetime. This may not actually be the normal situation however, as caterpillars up through the 3rd instar have been found feeding and hiding in the male flower clusters.

After complete feeding these cutworms make earthen cells in the soil to pupate. This generally occurs in the top two inches of soil under the plant. How long pupation lasts or when the adults emerge is not yet known. Empty earthen cells were found in November in jojoba fields, but it is not known if this is from the adult moths emerging or from mechanical breakage of the cells. Under lab conditions (cooler than summer field conditions) adults emerged in early March, almost one year after pupating.

Thrips (*Scirtothrips ewarti*) are cigar shaped, 1/16 inch long and pale colored. Two species of thrips are commonly found in Arizona jojoba, including the damaging *Scirtothrips ewarti* and the larger, darker, non-damaging western flower thrips, *Frankliniella occidentalis*, generally found in association with the male flower clusters. Damage by *Scirtothrips ewarti* thrips can occur from mid-March on and is characterized by small stunted misshaped leaves, and plant growth appears to be stopped when heavy populations of this thrips are present. This is due to the rasping and removal of outer leaf and stem surfaces by the thrips when they feed, leaving scarred tissues unable to grow and expand behind. Thrips are present in early March inside developing fruits that have not yet been pollinated. The relationship between thrips feeding and yield reduction is not yet known.

Another seed pest is Say's stink bug. The adult is a bright green, 1/2 inch long, shield shaped insect with three small pale spots on the triangular shield shaped area between the wings. Purplish colored adults are often taken in the winter. Female stink bugs lay whitish colored, barrel shaped eggs in clusters of up to 15 on jojoba,

although groups of two and three eggs are often found on foliage closest to the ground. Newly emerged nymphs are black with several light colored linear markings across the abdomen. The last of the five nymphal stages is green, has black antennae, green legs and has a light colored border around the abdomen. In 1989 nymphs were found hatching from eggs laid in jojoba as early as March 28th. The largest infestation is expected after the desert weed hosts dry up and the population moves into jojoba. This is usually in late April or early May.

Both the nymphs and adults feed on the developing seeds by inserting their proboscises and withdrawing the free liquids from inside the seed. The feeding punctures are often observed as tiny white dots on the outside of the seeds. This occurs in young seeds having a high liquid content and is due to the liquid solidifying on the seed exterior. These feeding sites later turn brown and enlarge in area, probably as a result of the stink bug saliva or from bacteria/fungal organisms introduced on the bug's proboscis. Damage to young seeds results in their complete destruction and a hollow seed. Feeding upon older seeds results in a brownish seed area where the bug's mouthparts had been inserted. As the seeds mature and harden, the stink bug can no longer withdraw nutrients and damage the seed. This safety point generally occurs in mid-to late May but would be expected to be earlier with jojoba that was early irrigated.

Desert spider mites, Tetranychus desertorum, also damage jojoba. These reddish colored mites generally start their infestation near the soil and work upward. Feeding damage by the mites appears as small yellow marks on and in the leaves. This is a result of the mite mouthparts being inserted into the plant and the cell contents being removed. These mites also leave reddish colored debris on the leaves where they have fed, which is probably cast skins and dust caught on their webbing. Plants that are stressed by salts, moisture, and/or feeding damage by thrips, are more susceptible to infestation and rapid mite colonization.

Cowpea aphids, Aphis craccivora, are small and dark, almost appearing black, and are found in colonies on new terminal growth. These aphid are generally controlled by parasitic wasps and by the immature stages of syrphid flies. Cowpea aphids generally do not cause damage in established jojoba stands, but may be problems in nurseries.

The jojoba looper, Anacamptodes obliquaria, is a looping caterpillar as the name implies. When small, it is grey with many faint whitish lines running the length of the body. Older caterpillars are more of a grey-green color closely matching the coloration of the jojoba foliage. Caterpillars are approximately 1 inch long when mature and feed on tender leaves. Small black fecal droppings beneath the row are an indication that loopers are active. The brown pupa is usually formed in the soil under the row. The first generation of loopers begins appearing in early March. Several generations occur during the year.

A looper that is brownish-red in color with several light "barkish" appearing markings that run the length of the body has also been found. This looper also has one slight ridge across its upper side on about the 2nd or 3rd abdominal segment. Whether this is another looper species or another form of the jojoba looper is not known.

The adult jojoba looper moth has a wing span of about 3/4 inch, is predominantly grey in color with several black markings running from the body towards the wing tip, and has several other color contrast markings. Adults have been collected in early March but peak adult flight occurs much later. Adults are active in the extreme late afternoon into the night. At least two generations apparently occur with activity seen in early spring through June while tender growth is still available.

In May, nymphs of the white lined grasshopper become active. They feed and continue to mature through September, when most of the egg laying occurs. Adults grasshoppers are about 2 inches long, have blue eyes, and are green in color with a white line down the back where the wings meet. Damaged jojoba can be almost devoid of foliage where these insects have fed, resulting in increased frost susceptibility. Large amounts of fecal material often accumulate beneath the row when grasshopper populations are active. Another insect present throughout the growing season is the leafhopper, Homalodisca lacerata. This 3/8 inch long reddish colored insect is often seen on the stems. Although not thought to be a problem in Arizona yet, it has been reported

as a pest from Mexico. The damage done by this insect is unknown, but feeding sites are thought to be the stems where it inserts its proboscis and removes plant fluids. It has been known to be a vector of plant diseases such as Pierce's disease of grapes.