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The Sorghum Worm in Missouri

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The sorghum worm moth, with wings expanded.

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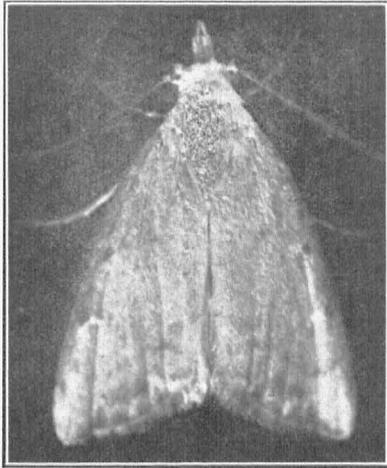


Fig. 2.—The sorghum worm moth, at rest.



Fig. 4.—Hibernating caterpillars.

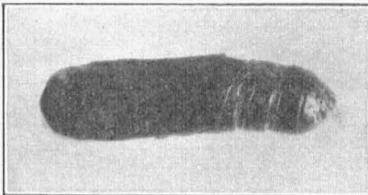


Fig. 5.—Pupa of sorghum worm.

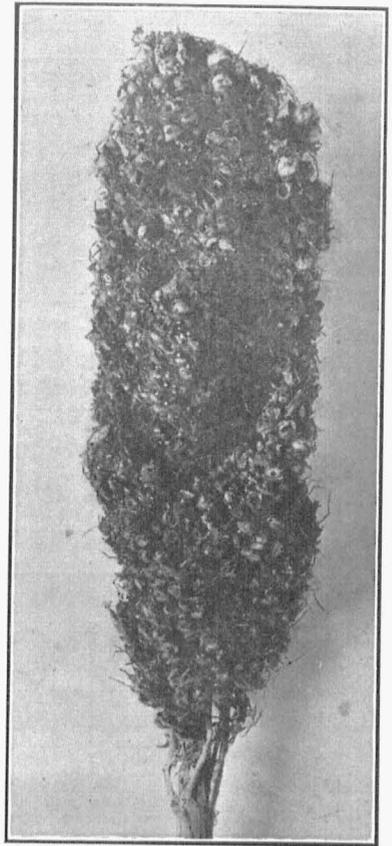


Fig. 3.—Grain sorghum head showing injury by sorghum worm.

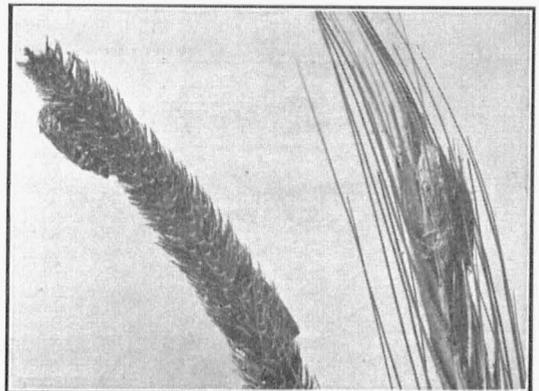


Fig. 6.—Sorghum worm cocoons on rye and timothy heads.

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In the southern part of the State the sorghums are an important grain and forage crop. They are being grown extensively as a substitute for corn in that part of the State. Approximately 200,000 acres with an average yield of 4,000,000 bushels of grain are grown each year in Missouri. Any insect pest, therefore, that threatens or seriously damages this crop will prove of great importance to Ozark agriculture.

Generally speaking, the grain sorghums are not seriously damaged by insect pests. Chinch bugs, grasshoppers, sorghum midge and plant lice may do considerable damage some seasons in more or less restricted areas. In 1921 a new menace of the grain sorghums appeared in destructive numbers over practically all of the state. It is a small woolly or spiny caterpillar known as the sorghum worm.† It has been known to science for many years, but prior to 1921 it was unknown as a pest in Missouri. It feeds on the developing grain and in 1921 completely destroyed the sorghum grain crop over thousands of acres and greatly reduced the yields where it was less abundant. In 1922 and again in 1923 it reappeared and did considerable damage in restricted localities.

Many growers seriously considered abandoning the grain sorghums due to the destructive work of the pest in 1921. Since 1923 it has continued to do some damage but it has been more restricted in its distribution. In 1929 and again in 1930 the pest was destructive in some parts of Southeast Missouri. To assist the growers of grain sorghums in combatting the sorghum worm, the life habits of the pest and the injury it does have been carefully studied and recommendations on methods of controlling it are given in this report.

HISTORY OF THE SORGHUM WORM

The sorghum worm was first described by Riley* in 1882 from specimens received from Alabama. It was reported as doing damage at that time to grain sorghums. Since then the appearance of the insect has been reported on several occasions but never as a serious pest. In the fall of 1920, the presence of the pest, probably the forerunner of the 1921 outbreak, was reported from Arkansas. The mild winter of 1920-21 favored the pest and undoubtedly was one of the causes of the serious epidemic in the summer and fall of 1921.

In 1921 the worms appeared in epidemic proportions in fourteen counties and did considerable damage in twenty-five addi-

†*Celama sorghiella* Riley.

*Riley, C. V., *The Sorghum Web Worm*, Rept. U. S. Dept. Agriculture, pp. 187-189, Pl. II, Fig. 1, 1882.

tional counties. The heavy outbreak occurred in the southern half of the state though scattering outbreaks were reported from as far north as the Iowa line.

CROPS ATTACKED

The sorghum worm is most destructive to the grain sorghums. As a rule, kafir suffers most, though milo and feterita are also seriously attacked. Kowliana and Durra are not grown to any extent in Missouri and no definite records are available as to the extent of damage the pest does to these crops. However, it has quite a wide range of food plants and probably attacks them. As the season advances the succeeding broods of worms become heavier so that late maturing crops of grain sorghums suffer more than the earlier varieties or those seeded early. In many localities a late crop may have all the grain eaten out. Besides the grain sorghums, both sweet sorghums and broom corn are attacked quite seriously at times. In 1922 caterpillars of the early summer brood appeared in Southeast Missouri in great numbers on ripening rye and on the heads of timothy. In some fields of rye it did considerable damage. The caterpillars have also been found feeding on corn and on wild grasses. Our records to date show the pest to be confined to plants of the grass family and to be most destructive on the unripe seed of the grain and sweet sorghum. In the laboratory soft corn has been used successfully as food for the caterpillars.

EXTENT AND NATURE OF DAMAGE

The caterpillar feeds on the soft or maturing grain. It feeds by hollowing out the soft grains so that practically nothing is left of individual grains. On a severely infested head or even an entire crop as much as 70 to 80 per cent of the grain may be consumed by the caterpillars. In 1921 growers in 11 counties reported from 70 to 100 per cent of their seed crop destroyed by the pest.

The pest does not injure the forage for feeding purposes or sweet cane for sorghum productions since it attacks only the grain. In the case of broom corn, however, broom manufacturers report injury due to the boring of the larvae into the base of the tassels or brushes late in the fall. In the case of rye, considerable grain may be eaten where the infestation is severe though the actual loss here has not been determined.

The epidemic of 1921, according to conservative estimates, resulted in an actual loss to the farmers of the state of thousands of bushels of grain sorghum seed. Next to the chinch bug, which may destroy the crop outright, the sorghum worm, during seasons of heavy infestations, is the most important insect pest of the sorghum crops in Missouri. Similar damage occurred that year in Southeast Kansas and Northwest Arkansas.*

*J. A. Hyslop, Bul. 1103, U. S. Dept. Agri., 1922.

LIFE HISTORY

The sorghum worm is multiple-brooded. In Missouri it has apparently three broods each year. The activity of the pest between the first of July and the middle of August is still imperfectly known. The heavy damage to the grain sorghums is caused by the larvae between the middle of August and the middle of October.

The pest winters in the almost fullgrown larval stage. These molt once in the spring and feed for a few days before pupating. In 1930 larvae which passed the winter in tin and pasteboard boxes in an outside basement entrance at Columbia were brought into the laboratory and given orchard grass and blue grass heads May 2 and they molted on May 6, fed, pupated May 13, and emerged on May 21. They lived for about two weeks but left no offspring. Hibernating larvae in the upper part of broom corn stalks taken at Perryville, Missouri in January 1924 remained in the larval stage until June 10 and, without receiving food, one had pupated and was found destroyed by ants and dermestids on June 25.

In 1922 larvae were found feeding and damaging rye and timothy heads at Cape Girardeau, Missouri on June 8. In the laboratory these began to emerge as moths June 14 and some emerged as late as July 3. It is believed that these represent the first summer brood, emerging from worms which lived through the winter. These, likewise, produced no offspring. No records are available on the activity of the pest from July 3 until worms begin to attract attention on grain sorghums in late August. However, the moths seems to be short-lived and a midsummer brood probably occurs before the heavy damage from the worms begins to show up late in August and during the fore part of September. In 1921, moths were reared from August worms during the first half of September and their offspring continued to feed through October, passing the winter as nearly mature worms.

In case no midsummer brood occurs then there is only the June-July brood of moths and the early September brood of moths, with the offspring damaging the crops in the fields from August 15 to about October 15. However, so far as control measures are concerned, it should be remembered that the nearly fullgrown worms live through the winter on the crop or near it and that the heaviest damage is done to late crops in September.

Riley reported moths emerging in "late July or early August a week or more after the spinning of the cocoons" in case of larvae

received from Southern Alabama in 1881. These probably correspond to a mid-summer brood in Missouri.

Moth.—The moth varies considerably in size, but averages about 14 mm. in wing expanse. Riley reported average wing expanse of 9.3 mm. It is a white moth blotched with yellowish-brown and black. Near the costal margin of the fore-wing are three distinct patches or tufts of elevated brownish scales, the third about two-thirds the distance from the base. The costal margin is clothed with brown and scattered black scales, except for four spots of white toward the tip. The distal margin of the fore-wing, and for some distance basad, is blotched with brown, black and gray-colored scales. Between the third elevated patch of brown scales and the tip of the wing is a distinct snowy patch with a central speck of brown. White scales also blotch the darker distal area. Behind the third elevated brown patch and extending forward and outward is an irregular band or blotch of brown. The white scales at the base of the fore-wings gradually grade into yellowish-white scales toward the apex. The lower surface of the fore-wings is covered with gray scales, except for a small area at the base and a strip along the anal margin which are white. The hind wings are snow-white above and below, except for scattered gray scales below near the costal margin and a small spot of dark scales beyond the middle.

The body and legs are largely clothed in white, but blotched with brown and darker scales. The antennae are yellowish-brown and the eyes dark brown.

Egg.—The egg is spherical, flattened at the poles, beautifully sculptured and averaging .35 mm. in diameter and about half this in height. It may be found attached to sorghum heads or to grain.

Larva.—The newly hatched larva appears like a tiny woolly worm and measures about .5 mm. Each of the eight tubercles on each segment apparently has but a single bristling hair in the first instar. The tubercles in the first instar are inconspicuous. Some of these hairs are longer than the body. In the second instar this single long hair on each tubercle is replaced by a number of shorter spiny hairs. With the later instars the hairs on most of the tubercles disappear and are replaced by increasing numbers of shorter spines. Each tubercle is a veritable palisade of short spines which prove to be real poison spines. Farmers repeatedly complain that these hairs or spines cause irritation to the skin of their faces and necks when they cut the cane fodder. O. C. McBride, formerly of this department, volunteered to test out the poisonous nature of the spines with the result that he developed on the forearm a typical case of irritation and swelling similar to that produced by other spiny caterpillars.

In the later instars the tubercles are all very conspicuous, but the dorsal and lateral ones are the largest. The spiny armors on the tubercles in the later instars meet and mingle, providing a very effective protection when the head is turned under. Besides the palisades of spines, certain of the tubercles continue to carry long hairs. In the last instar each lateral tubercle carries a long hair while the first pair of dorsal, the first and second pairs of dorso-lateral, the last pair of dorsal, and the last pair of dorso-lateral tubercles also have extra long hairs.

There are apparently five instars, the larvae living through the winter in the fourth or next to last instar. They feed and molt once in the spring after completing their winter hibernation.

The very young caterpillars are greenish-black but they turn lighter as they mature. In the last instar they may vary from lemon to reddish-yellow, striped with darker streaks along the tubercles. These stripes may vary from reddish brown to black.

The caterpillars do not spin very much silk in the sorghum heads and they are very sluggish, hiding inside the head of sorghum when not feeding. Riley reported them very active and completely webbing up the sorghum heads. In breeding jars they line up along the edge of the lid when at rest. The worms which are prepared to pass the winter are found within the heads, behind the blades on the grain sorghums, or they may burrow tunnels into the pith of broom corn.

They pass the winter without spinning a cocoon. It was thought that perhaps the mild winter of 1920 was responsible for the heavy infestations of 1921 and that they could not withstand cold winters. In 1929 they survived in tin and pasteboard boxes in an outside basement entry, in spite of a temperature as low as 16° F. below zero. Seventy per cent of the caterpillars were alive on March 6, 1930.

Pupa.—The pupa is 9 mm. long and 2.5 mm. in diameter, cylindrical, rounded cephalad and caudad, brown in color, and darker dorsally. It is protected by a rather feeble oval cocoon attached to the inner parts of the head of sorghums or to rye or timothy heads. The cocoon is made of silk and plant debris.

PARASITES

Four species of parasitic Hymenoptera have emerged in the breeding jars. These were identified by A. B. Gahan of the Bureau of Entomology as, first, a new species of *Apanteles*, second, *Catolaccus aeneoviridis* Girault, probably a parasite of *Apanteles*, third, *Trichogramma minuta* Riley, an egg parasite, and fourth, *Eupelmus popa* Girault. This latter species probably emerged from the sorghum midge, adults of which appeared in the breeding jar.

CONTROL MEASURES

Chemical control of this pest is impractical, so far as present knowledge of insecticides is concerned. Fortunately, however, there are a number of simple farm practices which the grower can use in controlling the pest and protecting the crop. Perhaps first and foremost is the timing of the seeding of the crop so that most of the grain will be past the soft attractive stage before the heavy swarms of worms appear in September. Growers have found that the early seeded fields and the early maturing varieties show little or no injury, while late crops may have practically all the grain destroyed. Seed the crop, therefore, just as early as possible and hasten its maturity through careful soil management and by cultivation. To supplement this means of protecting the crop, the grower should try to dispose of all the fodder and unthreshed grain heads before spring since the pest passes the winter, to a considerable extent at least, in and on the crop. Pasturing the sorghum fields in the winter, in order to further eliminate hibernating worms on blades or residue of the crop, will also prove helpful. Plowing infested fields after the crop is removed in the fall or early winter and the burning of fence rows and adjoining waste areas will help further to eliminate the hibernating caterpillars.

While the pest has proven its ability to withstand severe winters, it seems certain that the 1921 outbreak was due in large part to the mild winter of 1920-21 and the warm spring and summer following. Hyslop* has shown that in Missouri, Kansas and Arkansas, where the outbreak was most intense, the winter temperature ranged about 4° or 5°F. above normal while the spring and summer temperatures stood slightly above normal. At the same time, the rainfall was below normal with rainy periods in March and April and dry periods during January, February, May and July. Sudden epidemics of unusual pests are usually traceable to favorable climatic conditions. While the pest has not continued as a real scourge in Missouri since it came under observation in 1921, it is a pest capable of inflicting very serious losses to the grain sorghum crop and each grower, particularly in the southern part of the state, should do all that is possible each year to keep the pest under control and to protect his grain sorghum crop.

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*Bulletin 1103, U. S. Dept. Agri., 1922.