

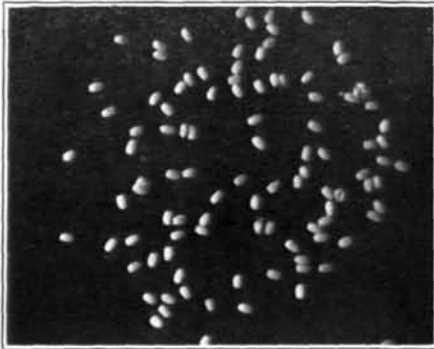
Sod Webworms and Their Control

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The serious and widespread injury to golf greens and lawns by sod webworms during the summer of 1931 aroused much curiosity as to the source of these worms, what they are, and measures for getting rid of them. They are present every year, but ordinarily not in sufficient number to attract attention. It was thought that their unusual abundance in 1931 was probably due to their gradual concentration in artificially-watered areas of grass during the recent dry summers and the unusually high survival of overwintering forms as a result of the mildness of the weather of the preceding winter. It may be that there will not be another such extensive outbreak for years. At any rate, during the summer of 1931 at least two very promising treatments were discovered for the prompt and effective control of these webworms should another outbreak occur.

Sod webworms are the larvae or young of certain small, whitish moths or millers frequently observed flying about over grass-covered areas, particularly during the early evening. There are some 60 to 80 kinds of webworms in the United States, all similar in both the young and the adult stages. The moths have a characteristic habit of folding their wings close about their bodies when at rest, this peculiarity having earned for the entire group the name "close-wing moths." Scientifically, they are known as members of the genus *Crambus*.



Eggs of the webworm moth (*Crambus teterrellus*)



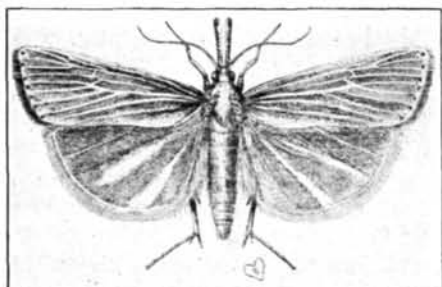
Pupa of bluegrass webworm (*Crambus teterrellus*)

Practically all of the webworms feed on grasses. Only about a dozen species, however, are of economic importance, the remainder either attacking unimportant wild grasses or occurring so rarely as never to become pests.

Their eggs resemble tiny cream-colored beads and are dropped at random by the female moths as they fly about over the grass. They fall among the grass stems and there hatch in a week or 10 days. The young worms feed on the grass leaves and start at once to form protective silken webs or nets; within these they remain during their larval life and from them derive the name "webworm." As the worms become larger they construct, close to the surface of the soil, little

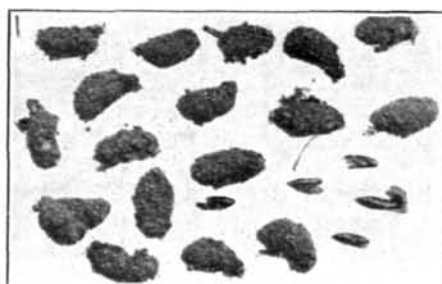
burrows or tunnels covered with bits of dirt, lined with silk, and reinforced with their excrement and with pieces of grass. They now cut off the blades of grass entirely and drag them into the burrows, where they feed in safety and at leisure.

When the larvae have completed their growth and become about three-fourths of an inch in length they leave their burrows and construct silken cocoons just beneath the surface of the soil. In these cocoons the worms change to the chrysalid or pupal stage. They may do this within a few days, or not for several months, depending on the species. The pupa is a narrowly oval, reddish-brown, helpless object which remains quiescent in the cocoon until the adult moth is fully formed. Usually in from 10 days to two weeks the moth emerges from the pupa or chrysalis and forces its way from the cocoon to the open air. Within a few minutes the moth's wings are spread and dried and it is ready to mate and thus beget a new generation.

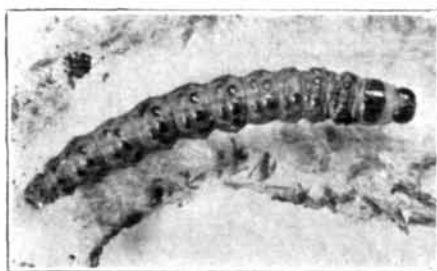


Adult of the black-headed sod webworm (*Crambus mutibilis*)

The adult moths live but a few days, and as they feed only on dew, it is in only the larval or worm stage that these insects are harmful. While the worms are small the injury resulting from their feeding is apt to pass unnoticed, but as they grow larger and begin to cut off entire blades of grass, the infested turf, where they are very numerous, takes on a ragged, patchy appearance, and large areas of it may be killed.



Cocoons and pupae of the striped webworm (*Crambus mutibilis*). Reduced



Caterpillar of the black-headed sod webworm (*Crambus mutibilis*). Enlarged $2\frac{1}{2}$ times

Severe injury may be caused in a few days' time when the infestation is heavy; hence immediate steps must be taken to effect control.

Natural enemies as well as weather conditions play a rather important part in the control of webworms. Sometimes the worms are quite heavily parasitized by small wasplike insects and by two-winged flies. These parasites lay eggs in or on the webworms. The small

maggots hatching from these eggs burrow into the bodies of their hosts, feed on their internal tissues, and eventually kill them. Birds, particularly robins, flickers, and blackbirds, are attracted to the infested areas in large numbers and eat many of the webworms. Chickens also have been observed to dig them up and eat them.

Two treatments were worked out by entomologists of the United States Department of Agriculture during the summer of 1931, either of which promises to be both practical and efficient. Extensive tests were made with commercial pyrethrum extracts and home-made kerosene emulsion, both of which were found to be highly effective.

Two commercial pyrethrum extracts were used in these tests. One of these compounds, when used in dilutions as great as 1 fluid ounce to 5 gallons of water, gave a kill of practically 100 per cent. The other gave a kill of approximately 100 per cent when used in a dilution of 1 fluid ounce to 4 gallons of water. This latter compound, although costing less than the former, seemed to be less uniform and rather unstable. Some have reported unfavorable results from it. In these cases the extract may have lost its strength through its having previously been opened or through the finished solution's having been permitted to stand for several hours before being used. When using pyrethrum extracts it is imperative that the solution be made from freshly-opened stock and applied at once after being mixed. In our tests the solutions were applied with an ordinary sprinkling can or watering pot and about 1 gallon was required to treat 1 square yard of surface. Within a minute or two after the solution was applied the worms came on top of the turf and wriggled about, apparently in great discomfort, much as earthworms do after an application of corrosive sublimate. Soon their movements became more feeble, and within a few hours they died without going back into the grass. Expense is the chief objection to the use of pyrethrum extract in the control of webworms. At a cost price of \$17.50 a gallon for pyrethrum extract, the cost of material when the extract is used in a solution of 1 fluid ounce to 4 gallons of water will be about 3½ cents for a square yard of treated area, or about \$19.50 for a putting green of 5,000 square feet. However, these extracts are nonpoisonous and do not injure the grass. If good extract is obtained and it is properly applied, control is assured.

Several other artificial control measures are available. Some workers report good control with lead arsenate applied as outlined below; others report indifferent or poor results. In the course of experiments conducted by the Bureau of Entomology during the summer of 1931, the use of lead arsenate was carefully tested and a maximum kill of only 30 per cent was obtained. We, therefore, do not feel free to recommend lead arsenate. It may, however, be used as follows: dust the grass with lead arsenate at the rate of 12 ounces to 100 square feet (7½ pounds to 1,000 square feet); brush it into the turf with an old broom or similar instrument; wet the turf thoroughly with a direct stream from a hose, using at least 20 gallons of water to 100 square feet; allow the turf to remain unwatered for 48 hours. With lead arsenate costing 15 cents a pound, material for this treatment would cost about 1 cent for a square yard of treated area, or about \$5.50 for a putting green of 5,000 square feet. It is possible that the apparently good results reported by other investi-

gators were due in part to the fact that many of the worms had practically finished feeding at the time of the treatment. At such stage in their life the worms would begin pupation very shortly, this naturally reducing the number of feeding worms and making the treatment appear more beneficial than it really was. Some workers have recommended a spray of 2 pounds of lead arsenate in 15 gallons of water on 1,000 square feet of surface, applied with sufficient force to drive the mixture well down into the grass. The writer has had no experience with this latter method of control.

Excellent results were also obtained with kerosene emulsion. The formula for the stock solution was worked out so that it is satisfactory even in those cases where hard water must be used. Kerosene emulsion is cheap, comparatively harmless to handle, and easy to make by following the directions given below. Further tests may indicate some changes in the formula or treatment, but in our experiments the procedure given here killed practically all the worms without apparent injury to the grass.¹ A stock solution is prepared as follows: dissolve 1 pound of laundry soap in 1 gallon of boiling water; add $\frac{1}{2}$ gallon of kerosene; stir rapidly until a creamy emulsion is obtained. This stirring may be accomplished by pumping the mixture into itself through a spray pump or by churning in an inexpensive household butter churn. Small quantities have been prepared with an egg beater. For use as a spray, 1 part of this stock emulsion should be mixed with 50 parts of water and this mixture applied to the infested turf at the rate of about 1 gallon to a square yard (555 gallons to 5,000 square feet). In our tests it was applied with a sprinkling can. As in the case of the pyrethrum extracts, the worms came to the surface within a minute or two after the application was made and wriggled about until they died. This point is of interest, inasmuch as it gives the user definite and readily accessible information as to the intensity of infestation and the number of worms killed. The cost of materials for this treatment is about 1/6 cent for a square yard of treated area, or about \$1 for a putting green of 5,000 square feet.

From the standpoint of cost and effectiveness, kerosene emulsion seems to offer the most practical control for sod webworms in putting greens and lawns. The principal drawback, of course, is that many people do not want to go to the trouble of preparing the emulsion. To such the pyrethrum extracts offer a rather more costly but equally efficient substitute.

Soil erosion takes a huge toll of plant food. Recent estimates are that a total of 126,000,000 pounds of plant food are washed out of the fields of the United States every year. This is 21 times as much plant food as that which is used by the crops themselves.

Nitrogenous fertilizers leach out of the soil rapidly. It is therefore imperative that the supply of such fertilizers in the soil be replenished frequently and regularly.

¹As in the case of any new treatment, some care should be exercised in applying kerosene emulsion, since under somewhat different conditions than those to which Mr. Noble refers slight injury to the turf might result. Also care is necessary in preparing the emulsion to prevent the occurrence of fires.—EDITORS.