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TWO GRAIN INSECTS.

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The Wheat-Straw Worm.

(*Isosoma tritici* Riley.)

So much is heard of the Hessian Fly in Kansas that injuries to the wheat by other similarly working pests are likely to be attributed to the Fly. Among these other injurious wheat insects the Wheat-straw Worm (*Isosoma tritici*) is not the least important.

Last year the presence of this wheat pest was reported to us from about one-fourth of the counties of the state, the insect being especially prevalent in Central and Western Kansas. Some information concerning the pest was given from our laboratory to the state newspaper press during the summer. The object of the present bulletin is to call attention again to the presence of this pest and to suggest certain available remedies.

The Wheat-straw Worm has been recognized as an insect injurious to wheat only since 1880, but observations by various investigators, notably, Dr. C. V. Riley, Mr. F. M. Webster and Prof. S. A. Forbes, have pretty fully revealed its life history. The insect belongs to the family *Chalcididae* of the order *Hymenoptera*, and is of the same genus, *Isosoma*, as the Joint Worm, which also infests wheat. The *Chalcids* are minute four-winged flies, mostly parasitic upon other insects. A few, however, as the *Isosomas*, are plant-eating, and themselves suffer from the attacks of the parasitic species of their own family.

The life history of this pest is, briefly, as follows: In March and April adults issue from the last year's wheat-straws, either in stubble or volunteer or in the stack, and lay their eggs on the tender leaves of the growing wheat. The larvae, on hatching, burrow into the stem, pupate, and soon mature, the adults emerging in the latter part of May and early part of June. These adults lay their eggs in the now maturing wheat, and another brood of destructive larvae hatches. These larvae pupate in the straws either in stubble or stack before winter, and pass the winter in the pupal stage. The following spring the adults

appear and a new cycle is begun. The insect is thus two brooded.

The injury to the wheat occurs while the insect is in the larval stage. The larvae are provided with strong jaws with which they gnaw the fibre of the stem near a node or joint, arresting the proper flowing of the sap to the head. As a consequence the heads are prevented from filling out, and they ripen prematurely. The wheat plant itself is often stunted in growth. The larvae occur in all parts of the stem but according to our observations (confirming those of Messrs. Riley and Forbes) most often, by far, in the straw just above the second node or joint below the head. In a bunch of straws received last fall from Russell county over seventy-five per cent. of the straws were infested. In these straws 40 per cent. of the pupae were found above the first node below the head; 50 per cent. above the second node and 10 per cent. elsewhere.

In all cases the pupae were found very close to, if not quite at the node. When not ensconced in a gnawed-out cell in the tough fibre of the node, they lay just above the node, never below; and the heads of the pupae invariably were directed toward the top, *i. e.*, the head end of the straw. This small sheaf of wheat from Russell county (field of M. E. Banks) has been kept in the laboratory over winter. A recent examination of twenty straws from the sheaf revealed the presence of several adults lying quietly in the pupal cells. These adults were prematurely emerging, hastened by the warm temperature of the laboratory. In these straws were also observed a few half eaten and dried larval remnants, doubtless the remains of parasitized individuals. The parasites of the Wheat straw Worm will be mentioned in a later paragraph.

In the plate the various stages of the Wheat straw Worm are illustrated. It is with the insect in its larval or pupal form that the farmer will make acquaintance. No swelling of the stem betrays the presence of the pest, as is the case with the Joint Worm. The failure of heads to fill out, or a stunting of the plants, will be the only external indications noticeable.

It is an easy matter, however, to determine the presence of the pest. Straw from the suspected field should be gathered

and split down the middle line: the larva if present will be found as a small white grub (see Fig. 1, b), in the straw, probably near a node. Or, if the examination is made near the time of the emergence of the adult, the pupa will be found snugly lying in its cell (see Fig. 1, b). But if the discovery is made only in the growing wheat, no immediate remedy is at hand. It is, however, in the fall and winter that the importance of a careful search for the insect becomes apparent, as at these times effective means are available for combating the insect pest. Straws from the stubble and from the stack should be carefully inspected. In fall and winter, as already indicated in the brief life history sketch, the insect is in the pupal stage, and will be found in the straws as shown in the plate. The pupa rests in its hidden retreat awaiting the warm days of early spring to emerge and oviposit on the growing wheat. The present, then, is the time for action. The stubble of all infested fields should be destroyed by burning or otherwise, and all remnants of straw stacks in which the pest has been found should be burned before March 1 or *immediately thereafter*. By reference to the plate it will be noted that the adult *Isosoma* is wingless. It has been found that only about five out of every one hundred individuals possess wings. This is an additional factor in making possible a successful war upon the pest. As the adults emerge from stack or stubble in the spring they must of necessity have a very restricted range within the limits of which the eggs for the next brood will be laid. Thus an additional incentive to individual work on the part of the farmer is created, as it lies within the power of each farmer to almost insure the riddance of the pest from his wheat field. Simple rotation of crops is evidently an effective measure, as, if the emerging adults from last year's straw find no growing wheat in which to rear their broods the insect will be starved out.

As previously mentioned the Wheat straw Worm was especially prevalent last year in Central and Western Kansas. Farmers in the wheat counties of this portion of the state should immediately inspect the straws in their stacks, and if the insect is found should burn all left over straw. Because of the many reports received last year from Barton, Russell, Osborne, Rice, Ellsworth, Rush and Lincoln counties, it is undoubtedly advis-

able that *all* stubble and remaining straw in these counties be burned.

It is the especial object of this bulletin to call the attention of Kansas wheat growers to the work which should be done *now*. There should be no delay in destroying infested straw, as in a few weeks, if not days, the adults will be emerging from the straws. Not only will immediate action on the part of the farmers be certainly valuable with reference to next July's harvest, but it will do much toward ridding the state of this pest for future years. For in the Wheat-straw Worm we have to deal with a pest which by concerted action on the part of those interested may be kept thoroughly in control, or even completely stamped out.

NATURAL REMEDIES.

In the economy of insect life natural remedies for overwhelming numerical development of injurious species play a most important part. As energetically as the Hessian Fly preys upon Kansas wheat, quite as energetically do several minute *Chalcid* parasites prey upon the Fly. And so with the Wheat-straw Worm. Prof. Webster has noted at least six insect parasites of the Wheat-straw Worm. The most efficient of these and the only one which we have so far observed in Kansas is a small *Chalcid* known as *Eupelmus allyni*, French. This efficient friend of the farmer is shown in Fig. 2 of the plate. Examination of twenty five stubble straws just received (Feb. 23) from the field of Mr. Andress in Rush county shows 14 straws infested by the Wheat-straw Worm, of which infested straws the *Eupelmus* has been bred in and escaped from eight. The *Eupelmus* escapes through a small hole which it gnaws in the stem near a node. It has four well developed wings and may easily find its way from field to field. Its eggs are laid after the larvae of the Wheat-straw Worm have hatched, and the larvae of the parasite as soon as hatched feed upon the helpless Straw Worm larvae or pupae. By the middle of September the parasite has matured and escaped from the straw. Thus the burning of the straw in winter not only kills the unparasitized and living Wheat straw Worms but it does not destroy the helpful parasites. Here another favoring factor exists in our fight against the pest. By being aware of the life history of the *Eupelmus* and by taking advantage of our knowledge we work in conjunction with a most effective natural enemy of the Straw Worm.

The Angoumois Grain Moth.

(*Gelechia cerealella* Oliv.)

This insect is one of the pests which attack stored grain, especially wheat and corn. It is a most formidable pest in the South, but its injuries are less severe as we go north. It has been reported to us this winter from several places in Kansas, and it may come to be, if it is not already, a serious pest in Kansas granaries and bins. In the South there are as many as eight generations in a year; in Massachusetts there are but two, according to Harris. In Kansas probably four or five broods are produced in a year. Because of this rapid multiplication the insect may do much damage in a short time.

The adult insect is a small moth about one-fourth of an inch in length from head to tips of closed wings, and about one-half an inch from tip to tip of expanded wings.

It is not, of course, in the adult or moth stage that the insect commits its depredations, and the presence of the pest will be more readily determined by an examination of the grain kernels for larval or pupal forms than by a search for the moths. In infested grain many kernels will be found each having a small but conspicuous hole. Many kernels may be attacked, however, which do not show these holes. Some of the suspected grain should be thrown into water, when the infested kernels will float. The inside starchy portion of the kernels has been eaten away by the "grub" or larva, leaving only a shell of greater or less thickness. Mr. F. M. Webster in the appendix to the twelfth report of the Illinois State Entomologist (1882), and Mr. H. E. Weed in Bulletin No. 17 of the Mississippi Agricultural and Mechanical College, Experiment Station, have discussed the life history and habits of the pest, and to these reports we are indebted for information.

The moths fly about at night, lay their eggs either on the

standing grain in the field or on the stored grain in bins and cribs. The eggs are generally deposited at the base of the kernel so that the larva or "grub" on hatching makes its entrance hole at the base of the kernel. This hole is usually filled with excreta so that it is not noticeable. The larva burrowing its way into the kernel lives on the starchy part of the grain and after some time changes from the active, devouring "grub" into the quiescent pupa or chrysalis. Just before this change the exit hole is made at the opposite end of the kernel from the entrance hole. This orifice is conspicuous and is the one referred to as betraying infested grains. Soon after, the pupa changes into the perfect moth which escapes by the hole prepared for it and proceeds to the laying of another lot of eggs.

Certain other insect pests attack stored grain, and while the attacks of all are similar and the remedies for all practically the same, it will be of interest to the farmer to become acquainted with the specific forms.

If the grain is infested by the Grain Moth there will be apparent upon examining a split-open kernel, (See Fig. 3, a, b, c, d, e) either one or more small, white, brown-headed worms with nine pairs of legs, or a brown, mummy-like pupa or chrysalis with wing pads, long antennae or feelers and legs closely pressed against the body. The two large black eyes are plainly visible in the pupa. Or, there may be found the perfect moth with folded wings ready to emerge from the kernel.

The accompanying figures with explanations will assist the farmer and miller to recognize this pest in its various stages.

REMEDIES.

Fortunately effective remedies are at hand for the attacks of these stored grain pests. In 1876 Dr. C. V. Riley called attention to the use of Bisulphide of Carbon on a large scale as an insecticide, and this substance may be effectually used against the Grain Moth. Bisulphide of Carbon is sold at retail by druggists for about twenty five cents a pound, but it may be bought for considerably less when got in larger quantities. It is an extremely volatile liquid, and the insects are killed by its vapor. It is necessary therefore that it be so applied that the vapor may penetrate all through the bin of grain.

The grain to be treated should be in a tight bin. If the grain is not stored in tight bins, such a bin should be constructed, and the grain treated in it in successive portions. If the grain is wheat or oats or shelled corn a long tube open at both ends but carrying within it a snugly fitting rod should be thrust into the grain until one end of the tube is near the center of the bin. The rod should now be withdrawn and a quantity of the Bisulphide of Carbon should be poured into the tube, the rod having been withdrawn. About one ounce of liquid to each hundred pounds of grain in the bin should be used. Finally, the tube should be withdrawn, the liquid being left in the center of the grain mass.

Another recommended method of applying the insecticide is that of soaking with it a ball of cotton fastened to the end of a pole. The soaked cotton may now be pushed into the grain. Two or three applications of this kind in different places in the bin will effectually destroy all insect life in the bin. If the corn is in the ear, a convenient method of application is to pour the Bisulphide of Carbon into small open dishes, setting these dishes about on the corn. Or the surface of the stored corn may be sprinkled with the liquid. The Bisulphide is heavier than air, so that it falls down into the bin.

Great care must be taken that no lighted lamps, cigars, or burning material shall come near the Bisulphide of Carbon or near places where it has been used until the vapors have passed entirely away. The liquid is highly inflammable and explosive. No danger, however, need exist if proper care be taken. Grain treated with Bisulphide of Carbon is not injured at all by the insecticide. The bad odor passes off in a few days.

We shall be glad to receive notes or drawings regarding the life and habits of the Wheat-straw Worm and the Green Moth from any Kansas observers.

H. T. Snow,

U. S. Entomologist.

EXPLANATION OF PLATE.

(Figures mostly greatly enlarged: hair lines at side denote actual size).

Fig. 1. Wheat-straw Worm (*Isosoma tritici*), *a*, (original) wheat straw containing pupa; *b*, (after Riley) larva; *c*, (original) pupa; *d*, (after Riley) adult.

Fig. 2. *Eupelmus allyni*, *a*, parasite of Wheat-straw Worm (original).

Fig. 3. Angoumois Grain Moth (*Gelechia cerealella*), *a*, external appearance of infested grain of corn; *b*, grain split open showing pupa within; *c*, grain split open showing larva within; *d*, infested wheat grain, split open, larva within; *e*, infested wheat grain, external appearance; *f*, pupa; *g*, adult; *h*, larva.



FIG. 1.

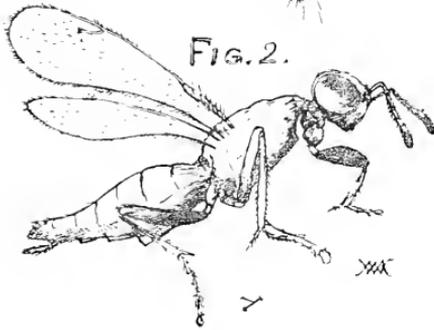
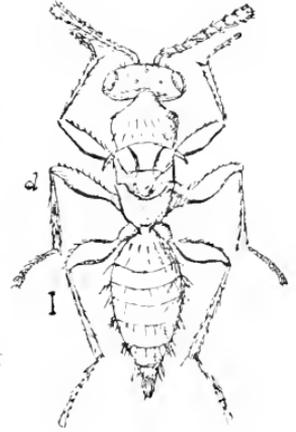
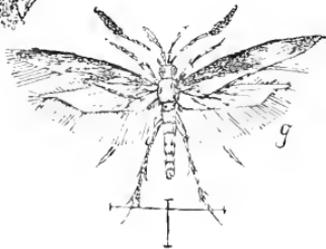


FIG. 2.



FIG. 3.



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Two grain insects.

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