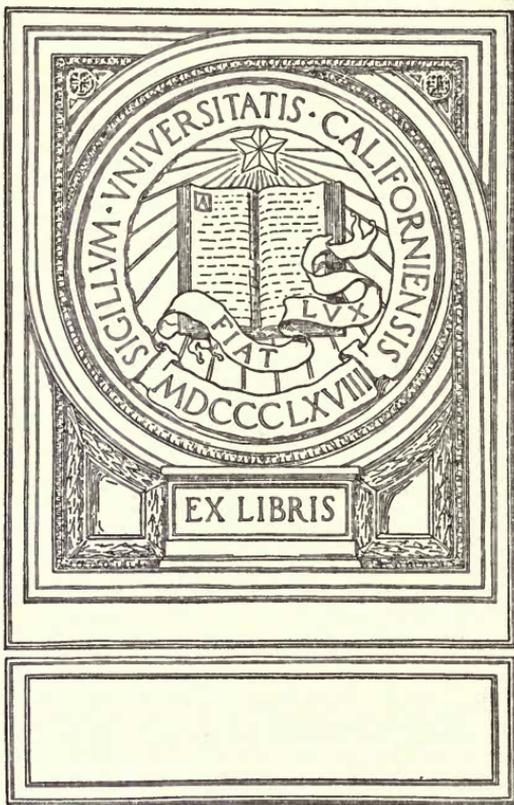


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# **Insect Pests of Tobacco in Southern Rhodesia.**

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By RUPERT W. JACK, F.E.S., Government Entomologist.

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## Insect Pests of Tobacco in Southern Rhodesia.

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By Rupert W. Jack, F.E.S., Government Entomologist.

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Tobacco in Southern Rhodesia is not as yet attacked by insect pests to an extent equal to what appears to be the case in some other countries. Comparing our condition with parts of the tobacco growing area of the United States of America, we may congratulate ourselves that we have no "hornworm," no "true budworm," and no "flea beetle" to contend with. At the same time, there are several pests in this country which do not occur in the United States, whilst certain pests common to the two countries are at least as destructive in this territory as across the water. It is really astonishing to observe the number of insects that will eat tobacco, and it is owing purely to the tremendous vitality of the plant that the aggregate damage is not greater. The most troublesome pests, from their general prevalence, are the cutworms, especially in the seed-beds. The stem borer (*Phthorimaea heliopa*) and the so-called "wireworms" sometimes cause serious and unexpected losses in the field. The root gallworm (*Heterodera radicolica*) is a serious tobacco pest occurring in the territory, but as yet only once reported as affecting tobacco. To avoid the introduction of this trouble into tobacco lands calls for watchfulness on the part of the growers.

The writer owes it to himself to state that the following notes on the pests of tobacco in Southern Rhodesia are very incomplete, as comparatively little time has been available for

the study of these insects up to the present, whilst the number of new forms not recorded as pests in other countries renders the task of investigation a labour of some years.

CUTWORMS.—This name originated in the United States of America, the term “ worm ” being erroneously applied to caterpillars generally, and the full name referring to the insect’s habit of severing the stems of plants close to the ground. In England these insects are called “ surface caterpillars,” and this name is more legitimate than the other, but crisp and euphonious terms have a way of establishing themselves, and it would be useless to attempt to dislodge the name “ cutworm ” from general use in this country. The Cape Dutch call these insects “ mest-wurmen,” but the name is also applied to the whitish grub of certain beetles, many of these grubs feeding in manure. The name “ mest-wurmen,” as applied to the insects under discussion, is, of course, absolutely incorrect; because, in the first place, they are not worms, and, secondly, they do not in the usual way feed on manure. As they are, however, likely to abound wherever a rank and succulent vegetation exists, they are common enough on the borders of manure heaps.

Cutworms are the caterpillars of a number of different species of night-flying moths of inconspicuous brown or grey colouration. In Southern Rhodesia there are several species more or less injurious. Six species have already been separated out at the Agricultural Laboratories, and no doubt there are more that will come to light in time. One of the commonest species, *Agrotis segetis*, known in England as the “ turnip moth,” is figured on the plate. Another, *A. ypsilon*, the “ greasy cutworm,” is also figured, and appears to be especially fond of tobacco seed beds.

In general, the habits of cutworms are simple. The gravid female moth selects a situation amongst suitable vegetation, and deposits her eggs on the stems of plants or on some convenient object near by. The eggs hatch in a few days. In India the eggs of the “ greasy cutworm ” are reported to hatch in as little as one and a half days, but the time taken by most species is usually considerably longer. The young larvæ enter the soil, where they mostly lie concealed during the day, feed-



CUTWORM MOTH (AGROTIS SEGETIS).



CUTWORM MOTH (AGROTIS SP.).



Cutworms (Agrotis segetis)  
Life Size



Caradrina exigua  
Life Size.



Caradrina exigua Life size  
a Moth b.c. Caterpillar.  
d Head of caterpillar. e f Eggs.

From U.S.A. Dept. Agric. Bull. 33.



Opisotrum aequale

Actual Length.





The Tobacco Miner Moth  
(*Phthorimaea operculella*)



Tobacco Miner Larvae.



Stem Borer Moth  
(*Phthorimaea helopa*)



Large Cricket.  
Life Size.



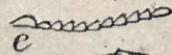
a



b



c



e



d

—The Cigarette-beetle. a, larva; b, pupa; c, adult; d, side view of adult; e, antenna—all greatly enlarged; e, still more enlarged. (After Chittenden, U. S. Dept. Agr.)



ing at night. The time taken by a larva to attain full growth varies with the season of the year and the quantity of food available. A number of larvæ of one species, bred from egg to pupa in the laboratory with abundant food and moisture, began to change to pupæ on the thirty-eighth day, and had practically all changed by the fortieth day. On the other hand, cutworms are quite capable of fasting altogether for several weeks, and taking up the thread of their development again after this period, so that the duration of the larval stage is very variable indeed.

The pupa or chrysalis stage is passed in the earth. Most species construct cells of earth bound together by some gummy substance which hardens on drying. These cells doubtless serve to shield the pupa from sudden changes in temperature and from contact with water. The duration of the pupal stage is very variable. In India, where the "greasy cutworm" has been studied in some detail, the pupal period is given at from ten days to a month. In this country, one species has varied from about twelve days to about six weeks, whilst another took twenty days. *A. segetis* has been found to vary from a fortnight to thirty-eight days in the pupal stage. The pupal stage in general is longer in winter than in summer.

The female moth lays a large number of eggs. In the case of *A. segetis*, as many as 1,700 have been counted from a single female.

*Preventive Measures.*—Preventive measures must aim at two things: (1) to see that the seedbeds are free from cutworms when the seed is sown, and (2) to prevent them from becoming infested after the plants are above ground. To ensure the former, the beds should first of all be thoroughly burnt over with wood or dry tobacco stalks. This is usually done in Southern Rhodesia, but burning the beds alone is not sufficient owing to the presence of cutworms in the surrounding ground. To get rid of these, the use of poisoned bait is recommended. This is an old and well-known method of destroying cutworms, and several different formulæ are used. A formula recommended in the United States of America consists of:—

Molasses ... ..	2 quarts.
Paris green ... ..	1 lb.
Wheat bran ... ..	50 lbs.

The bran should be made into a mash, of the consistency of porridge, with the molasses and sufficient water. The Paris green should then be thoroughly stirred into the mash. Maize may be substituted for bran and arsenate of lead for Paris green.

The Mally formula recommended in the Cape Colony is as follows :—

Arsenite of soda ... ..	1 lb.
Treacle or black sugar ... ..	8 lbs.
Water ... ..	10 gallons.

The arsenite should be dissolved in about a pint of boiling water and added to the treacle or sugar solution. Arsenite of soda is a cheaper and more rapidly effective poison than Paris green. This solution can either be used to make up a mash with bran or meal, or, if any greenstuff is available, it can be chopped up finely, wetted with the poison, and distributed broadcast but very thinly over the ground. The poisoned bran or meal is usually distributed in spoonfuls about the ground, and it remains moist and attractive longer if placed under a piece of board or anything that will keep the sun off. It is possible that maize meal is not quite such a good medium as bran to carry the poison, but the meal is present on every farm, whilst the bran, which is also a rather more expensive material in this territory, would have to be purchased specially. Cutworms will eat sweetened meal quite readily when fresh, and in cage experiments have shewn little preference for either bran or meal. The chief drawback to meal is that it dries up into a very hard and solid mass. The use of chopped greenstuff, of course, lessens the expense considerably, but unfortunately greenstuff is very scarce on most farms in September, when the seed beds are being prepared. If irrigation is being practised, or an early crop is being grown on naturally moist ground, greenstuff will be the cheapest material to use. There is, of course, no difficulty in growing a quantity of lettuce or other hardy vegetable to furnish greenstuff for baiting purposes.

It must be borne in mind that tobacco seed beds in the months of October and November constitute an attractive array of succulent vegetation, when succulent vegetation is scarce elsewhere, and that cutworms are likely to be attracted thither from some distance round. It is advisable, therefore, to clear

the ground for some distance round the beds, say 30 yards in all directions, and to bait this ground thoroughly before sowing. If the beds are in a rich vlei, as they usually are, the surrounding veld is liable to contain cutworms in September and October. The clearance will leave a wide margin over which the cutworms would have to travel to reach the seed beds.

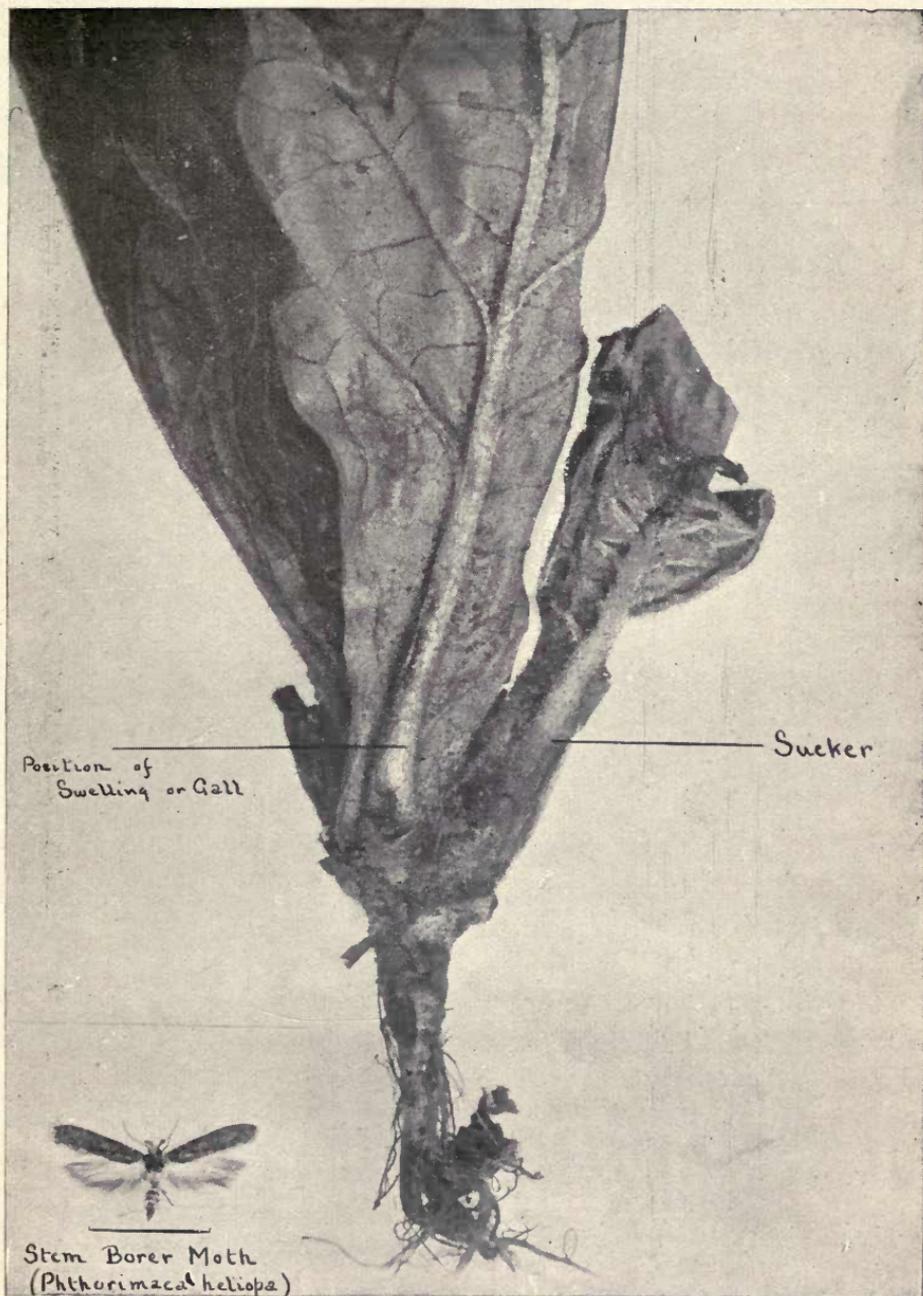
Whatever form of bait is used, it should be distributed towards evening to avoid the drying effect of the sun's heat. The bait is most effective the first night after distribution, and if the ground treated has been cleared for some little time, the cutworms will be hungry, and the great bulk should find the bait and poison themselves during the first night. The baiting can be repeated with advantage a week later.

To protect the beds from becoming infested with cutworms after the plants are above ground, the greatest care should be given to the soundness of the covering material, to its proper adjustment each night, and to the tightness of the bricks enclosing the beds. The aim is to exclude the adult moths, which are liable to be attracted by the array of green, to deposit their eggs on or about the plants. The plants are above ground in the seed beds for nearly seven weeks, whilst cutworm eggs hatch in from a week to ten days, and it has been found in the course of feeding experiments at Salisbury that the larvæ of one species attain the length of three-quarters of an inch in about seventeen days. They are then entering upon a very destructive period in their lives, and are capable of severing plants of some size. In twenty-eight days their length had reached one inch, and from this time forward for about eight days, when the insects began to pupate, their appetite was very voracious and their growth very rapid. It will be seen, therefore, that eggs laid on young plants produce cutworms that increase in size with the plants, and are big enough to sever the plants when nearing a condition of suitability for planting out. When it is remembered that a single female moth may lay upwards of seventeen hundred eggs, the desirability of excluding them from the seed beds is obvious. Cutworm moths are nocturnal in habit, so that the coverings of the beds need only be moth proof at night. A tour of inspection round the seed beds the last thing in the evening would repay the trouble. This method can hardly be relied upon to exclude all moths, as some are likely to find their way in through any opening that is left.

The great preventive measure in other countries is given as *clean cultivation*, especially as applied to keeping down the weeds during the time the crop is off the land. In this territory, however, the dryness of the winter usually ensures the absence of succulent vegetation from most tobacco lands between the months of May and November, except it be volunteer tobacco plants growing out from the ploughed-in stalks. These should always be destroyed, on account of several pests. As a matter of fact, cutworms are rarely very troublesome in the lands. Sometimes, however, naturally moist soil is used to secure an early planting, and if such a course is intended, care should be taken to keep the ground free from weeds during the winter, or the loss from cutworms may be considerable. The planter should always bear in mind that cutworm moths are on the wing in September, looking for succulent plants amongst which to deposit their eggs, and that if cutworms hatch and enter the ground, subsequent ploughing will destroy the available food, but not the cutworms themselves to any great extent, and that the tobacco plants, when placed in the ground, come as a welcome supply of nourishment to the hungry insects.

The land may, of course, be baited for cutworms, as already described, before planting out, or a spoonful of the bran or meal may be placed by each plant as a safeguard.

*Remedies.*—When cutworms are abundant in a tobacco seed bed full of plants, they are not by any means as easily destroyed as they are before the plants come up. There is an immense supply of succulent food everywhere, and, though the bait be distributed through the bed, its attractiveness does not extend probably beyond a few inches—hence the value of preventive measures. To get the best effect, it will probably be best to make up a bran or meal bait of arsenate of lead or Paris green, so as not to injure the plants, and distribute it abundantly through the beds, so that as many cutworms as possible will come into the sphere of its attractiveness. Arsenite of soda, being a soluble form of arsenic, is injurious to vegetation with which it comes into contact. This is about all that can be done if the cutworms are very small and attacking the young seedlings. Larger cutworms can easily be found by digging in the surface of the soil near the newly-severed plant. Natives usually have something in the nature of a special aptitude for this kind of work, and a few good “boys” are



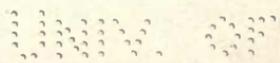
Insect Pests of Tobacco in Southern Rhodesia.  
Stem Borer Moth and Bored Plant.

UNIVERSITY OF TORONTO





Insect Pests of Tobacco in Southern Rhodesia.  
Tobacco Miner Moth and Mined Leaf.





capable of ridding a considerable quantity of seed bed of cutworms in a short space of time, and of rendering the use of insecticides unnecessary. Each half-grown cutworm destroyed may be reckoned as a score or more of plants saved.

In the field, cutworms may be destroyed by hand as above, but here the plants are very much wider apart than in the seed beds, and the distribution of poisoned bait after the damage has commenced is of considerable value, and should be practised if necessary.

**STEM BORER.** (*Phthorimæa heliopa*. Lwr.)—This little insect is, without doubt, a native of South Africa, but it is also recorded as injurious to this crop in India. The moth is closely related to the tobacco miner, and is similar in size. It is, however, readily distinguished by its redder coloration. The larvæ of the two species are very much more difficult to identify. They are whitish caterpillars, often delicately tinted with pale green and pink. They reach a length of half an inch. The life history has not yet been followed in this country. Mr. Maxwell Lefroy gives the following short account of the life history in India:—"The moth lays a single egg on the leaf stalk, the emerging larva boring down through the leaf stalk to the stem in which it lives. Pupation takes place inside the stem, the full-grown larva preparing an exit hole through which the moth can escape." He adds, elsewhere:—"Apparently the pest is not injurious to healthy vigorous tobacco, but is worst in a season of drought." Experience in Southern Rhodesia points to the fact that serious damage usually occurs as the result of infestation of the seed beds. The moth is evidently on the wing very early in the season, for the seedlings are frequently attacked when quite small. The presence of the larva in the stem causes a swelling to form, and above this swelling the plant will not grow. Suckers grow out from beneath the swollen portion on the stem, but if unaided, practically no leaf worth reaping is produced.

Preventive measures lie in keeping the moths from the seedlings in the beds, by careful attention to the soundness and adjustment of the covers, especially at night, and in discarding seedlings shewing swellings when planting out. All volunteer tobacco plants growing on the lands about the seed beds and about the homestead should be destroyed during the winter, as they provide breeding places for the moth.

Remedial measures are not practicable in the general way, but it is said that if the plant is severed below the swelling, and all but the strongest suckers removed, a fair amount of leaf will be produced, provided the plant is young enough.

THE TOBACCO MINER OR SPLITWORM (*Phthorimæa operculella*).—This insect is closely related to the preceding, and it is a very difficult matter to distinguish between the larvæ of the two insects. The tobacco miner, however, chiefly attacks the leaves, and, although also found in the stems, is not known to produce any swellings. The insect is also a bad pest of potatoes, not only mining the leaves and stems of the plants, but boring the tubers. It thus possesses an alias in the form of the “potato tuber moth.”

The female moth lays her eggs singly on the plant. The eggs hatch in from six to ten days, and the young larvæ eat into the tissues. They eat out the substance of the leaves in irregular patches, leaving only the upper and lower skins. These patches are semi-transparent when the leaf is held up to the light, and the larvæ may commonly be seen inside the leaf. They have a habit of leaving old mines and starting new ones, and this habit is of some importance in connection with control measures. When full-fed the larva changes to a pupa inside the plant, the moth under favourable conditions emerging in about five weeks from the hatching of the egg. The time, however, depends upon the temperature.

As tobacco is not at present grown for the purpose of making cigar wrappers in Southern Rhodesia, the injury to the leaves is not of the same importance as it is in some other tobacco-growing countries. The lower leaves of the plant are chiefly attacked, and where priming is carried out, many of the infested leaves are removed. Much good leaf is, however, liable to attack, and it is no uncommon sight in the barn to see hundreds of these caterpillars hanging by threads from the drying leaves, or crawling rapidly over the ground in endeavours to escape the uncomfortable heat.

Preventive measures lie in covering the seed beds thoroughly at night, and in destroying the plants which might serve as breeding places for the moth during the winter. This insect also breeds in the common weed known as the thornapple or “stinkblaar” (*Datura stramonium*), and this should be destroyed as much as possible about tobacco lands.

Spraying the plants with arsenate of lead or Paris green would be likely to destroy many of the insects when starting new mines. In some parts of the United States it is the practice to send labourers through the fields to crush the larvæ inside the leaf tissue, but this is probably only done where the leaves are used as cigar wrappers.

“ WIREWORMS.”—The insects which go under this name in Southern Rhodesia are not true wireworms as the word is usually applied. The destructive wireworms of Europe and America are the grubs of “ click ” beetles or “ skipjacks,” belonging to the family *Elateridæ*. The grubs injurious to tobacco in this territory are the young of a family of soberly coloured beetles of the family *Tenebrionidæ*, which includes the “ tok-tokje ” beetles amongst others. These grubs have not yet been bred out to the adult stage, but there are probably several species involved. The grubs are of a slightly flattened sub-cylindrical form, light yellowish brown in colour, and may reach a length of two and three-quarter inches. They are armed with a formidable pair of jaws, with which they are able to sever tobacco stems of some thickness, thus destroying the plant. They are usually brought to light when the wilted plant is noticed and dug up. They attack the plants as soon as the field is planted, but are also reported to kill healthy plants in full growth.

The probability is that the eggs are laid in the natural veld, and that the insects attack tobacco because it happens to be the plant within their reach, and not because they have any natural preference for it, but that they thrive upon the diet is shewn by the fact that land is often found to be infested the second year as well as the first. Probably the insect takes more than one year to mature.

In rare cases the injury to tobacco by this pest may be severe, the crop being rendered altogether unprofitable. Usually, however, the insect is present in but small numbers, and the percentage of plants destroyed is quite inconsiderable.

So little is known about these insects, that it is not possible to recommend remedial measures. It is probable, however, that when other crops come to be grown in rotation with tobacco, injury by these insects may become a thing of the past. With the present system of growing tobacco for two years on one piece of land, and then allowing it to lie fallow for

several seasons, the tobacco will always be liable to attack. It may be mentioned that when the grubs are present in great numbers in the soil, they are very manifest during ploughing operations, and much good would doubtless result from the use of "boys" to collect and destroy them as they are brought to the surface. If the numbers are seen to be very great, however, the wisest course, if practicable, would doubtless be not to plant tobacco on that piece of land.

ROOT GALLWORM (*Heterodera radicolica*).—This is an important and dangerous pest which at the present time occurs very rarely in tobacco lands in Southern Rhodesia. It is, however, prevalent in several parts of the country in land that has been used for potatoes, and is likely to be introduced into tobacco lands if growers are ignorant of its dangerous nature, and the facility with which it may be transported, especially through the medium of infested seed potatoes.

The pest, and the injuries caused by it, are illustrated in the adjoining plate. The eggs are hatched within the swollen body of the female, who gives up her life in the process of reproduction. The young worms, shewn in the plate very greatly enlarged, are threadlike and provided at the anterior end with a spear-like instrument, which can be thrust out of the mouth opening and withdrawn. The newly-hatched worm is, of course, exceedingly minute, and not to be distinguished by the unaided eye. After wandering about on the plant tissues for some time, it comes to rest, and finally changes to an adult. The adult males remain slender, and measure about a twenty-fifth of an inch in length. The females swell up, and assume the shape shewn in the illustration. They become distended with eggs that hatch within their bodies.

Migration from plant to plant in the field is effected through the activity of the young worms, which may either voluntarily leave their host plant to seek a new home, or may be released into the soil by the decay and breaking away of the infested tissues of the plant. The young worms make their way into the rootlet of a new plant, by means of the piercing organ with which they are provided. In travelling from plant to plant, they seem to be much assisted by a soil of a sandy character, and it is usually such soils which become badly infested with the pest. As they are fond of damp ground, it is likely that many of the wet vleis of granite sand in different parts of

the territory may become infested, and that the pest will flourish greatly under the conditions there provided. This is unfortunate, because these useful vleys occur on many good tobacco farms, and are very liable to be planted with potatoes for an early crop. Seed potatoes are, without doubt, the chief agent by which gallworm is transported, although nursery stock may also play an important part. Once the pest has been introduced to a farm, it is liable to be carried about by farm implements, the boots and feet of labourers and others, including animals and birds, by flood water, by drains, by irrigation, and perhaps even by the wind. Once a suitable soil has become infested with gallworm, it is likely to remain so as long as suitable plants are provided for its use. The variety of plants attacked is very great, and includes nearly all the crops that can be grown profitably in Southern Rhodesia, with the fortunate exception of cereals, including maize. The damage done to the plants is due, in the main, to the irritation set up in the tissues, which stimulates the formation of swellings or galls. The thickening of the tissues of the root interferes seriously with the functions of the plant, causing a feeble growth, wilting and frequently death. Seeing that remedial measures against this pest are hardly practicable on tobacco lands in this territory, it is obvious that great care is necessary to prevent the introduction of the pest. As already mentioned, seed potatoes constitute the most likely vehicle by which the pest may be brought to the farm, and on this account a potato tuber shewing galls caused by a gallworm is shewn in the adjoining plate, in order to enable growers to recognise the trouble, and to discard such infested tubers for seed purposes. Every endeavour is made in South Africa to prevent the spread of this trouble with nursery stock by means of the Government inspection of nurseries. Burning the seed beds acts as a precaution against infestation of the transplants, and should always be carried out, in spite of the fact that some growers express doubts as to whether the work and expense involved are justified. Land that has become infested should be discarded for tobacco and planted to maize or another cereal for several seasons.

CATERPILLARS.—Two species of caterpillars have been reported as injurious to tobacco in Southern Rhodesia. One is *Laphygma (Caradrina) exigua*, a cosmopolitan pest known

in the Transvaal as the "pigweed caterpillar," and in the United States as the "beet army worm." The other species has not yet been ascertained, but from descriptions furnished it appears to be one of the "semi-looper" caterpillars. The looper caterpillars do not progress by crawling in the ordinary way, but by bringing the hinder part of the body up to the fore part and arching the back, and then taking a grip with the hinder pro-legs, extending the fore part to take a grip further on. They are sometimes called "measuring worms." The semi-loopers are more or less intermediate between ordinary caterpillars and loopers.

The eggs of *L. exigua* are laid in clumps upon the plant upon which the caterpillars feed, and are partially covered over with hair from the body of the parent. They hatch in about four to five days, and the caterpillars feed up rapidly, changing to pupæ in as little as twenty days. Pupation takes place in the ground, and in the warmer portion of the year the moths may emerge in from nine days. The caterpillars feed on the foliage of the plants, but may also eat the stems and parts of the roots.

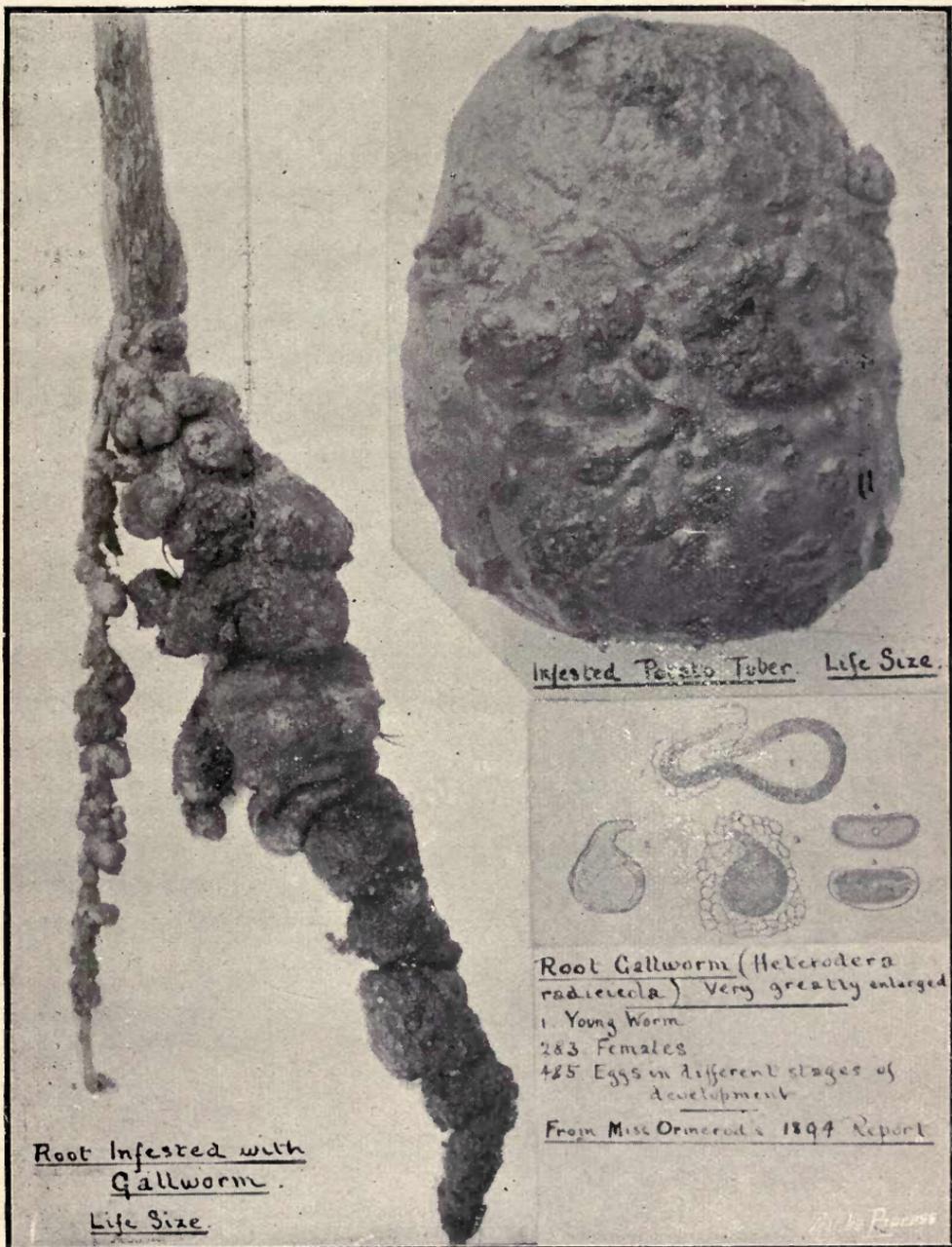
In ordinary years it has been found that these caterpillars can be kept under sufficiently by making the "boys" collect and destroy them during topping operations, but in certain seasons they appear in too great numbers to be left so long, and, in the absence of a supply of spray pumps, the whole labour on the farm has to be devoted to collecting and destroying the caterpillars. It, therefore, should pay the grower to keep a few pumps of the knapsack pattern on hand, in case of a bad invasion of caterpillars. In the parts of the United States where the "hornworms" constitute an annual tax on the production of leaf, machines for distributing dry Paris green and for spraying are a necessary part of the grower's outfit. Knapsack pumps may be purchased in Rhodesia for from 65s. upwards.

Probably the most suitable spray is:—

Paris green, 1 lb.

Fresh slaked lime, 2 lbs.

Water, to 160 gallons.



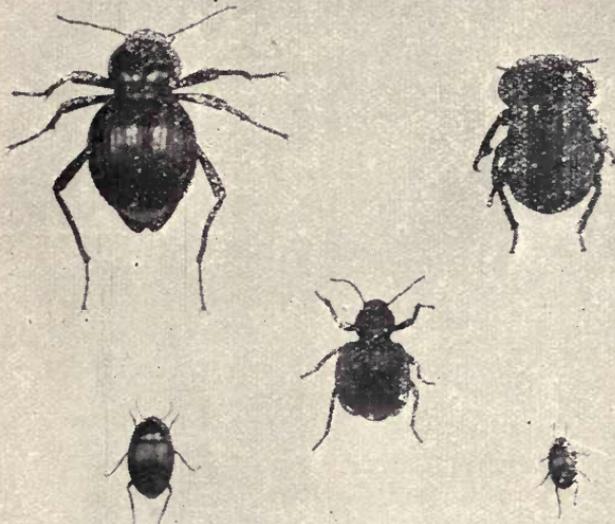
Root Infested with Gallworm.  
Life Size.

Infested Potato Tuber. Life Size.

Root Gallworm (*Heterodera radicum*) Very greatly enlarged  
 1 Young Worm  
 283 Females  
 425 Eggs in different stages of  
Development  
 From Miss Ormerod's 1894 Report

Tobacco Pests of Southern Rhodesia.  
Root Gallworm.





Some Beetles which Chew Tobacco  
Plants. (All Life Size.)



Life Size

Tobacco "Wireworm" Dorsal View.



Life Size

Tobacco "Wireworm." Lateral View







This will not render the resulting tobacco poisonous or inferior in any way, but it will probably be best not to spray within a fortnight of reaping the leaf, thus leaving a wide margin for safety.

THE BUDWORM. *Chloridea obsoleta* (*Heliothis armiger*).

—This is a cosmopolitan insect that attacks a variety of crops, including cotton, maize, tomato, etc. In America it does damage to tobacco by eating into the opening buds, and later by attacking and boring into the seed capsules. The insect occurs in Southern Rhodesia, but injury to the buds has not been observed, and injury to seed capsules, although common enough, is at present of no great moment, as seeds are not collected in this country. The reason for the immunity of the buds is not apparent. It may be that the insect has not yet contracted the habit, but may do so later, or that its enemies are more effective here than overseas. It is noteworthy that it has not yet been observed in the tassels of maize or in tomatoes within our borders, although these are its favourite feeding places in America and in Cape Colony. The remedy for "budworms" used in America is a mixture of a half teaspoonful of Paris green with a quart of finely ground maize meal. This is sprinkled on the buds from a can perforated like a pepper canister, and renewed frequently, especially after heavy rains.

BETLES.—Several species of beetles eat the foliage and gnaw the stalks of tobacco in this territory, especially when newly planted. The beetles are very dissimilar in appearance, but almost all belong to one family, the *Tenebrionidæ*. The beetles of this family are very lacking in popular names, the "tok-tokje" being probably the most familiar to South Africans. Beetles belonging to the following genera have been observed or reported to damage tobacco:—*Zophosis*, *opatum*, *gonocephalum*, *psammodes* (tok-tokje), *dietha* and *anomalipus*. Of these, the most to be feared are *zophosis* and *opatum*. These beetles will apparently gnaw any part of the plant within reach; they are not, however, provided with feet adapted to clinging to aerial foliage. It is probable that the damage is done almost entirely to newly-set-out plants, which are naturally in a checked condition, or to plants suffering from drought. Strong freely-growing plants appear to be almost exempt from attack, or at least to noticeable injury. It has been noted

that deeply-set plants, of which the growing heart is well underground, escape serious damage even where the beetles are abundant and hungry for food. The beetles eat the exposed part of the plant, which consists of the ends of a few leaves, but do not burrow more than about half-an-inch underground. The general opinion is that the deeply-set plants grow quite well once a good start has been obtained, and, although in going over a field shortly after planting, half the plants may appear to be missing, a few weeks later the grower may be able to congratulate himself on an excellent stand. Plants of which the heart is above ground are apt to be severed through the stems, and are then of little use, for although a plant may grow up from a sucker, the resulting leaf is likely to be disappointing.

The use of grass dipped in cutworm poison is efficacious in destroying opatrum, and has been reported to be effective against zophosis. All these beetles are fond of sweets, but the larger species are probably best destroyed by hand if they prove troublesome. Opatrum has a propensity for gathering under heaps of rubbish, and by placing heaps of inflammable rubbish about the fields, many of the beetles may be destroyed by burning in the earlier part of the dry season. The genera of the beetles figured in the plate, reading from left to right, are psammodes (tok-tokje), anomalipus, dietha, and zophosis (2 species).

**LARGE CRICKET.**—This insect is sometimes a troublesome pest of tobacco. It is undoubtedly chiefly associated with this crop because of its preference for light, sandy soils, and not because of any special preference for tobacco. The adult insect is shewn in its natural size in one of the plates. The adult or fully-winged form has been collected from December to March, but immature forms, in which the wings are not fully developed, also do damage.

The insect's mode of attacking plants is to sever the leaf and drag it to its burrow. In order to get the leaf into its burrow, it is rolled up in a way that stimulates speculation as to how the operation is performed. The cricket seems to lurk within the rolled leaf in the ground, and can be dug out easily enough inside its self-made house.

The following poisoned bait is reported to be effective against this pest in the Transvaal :—3 lbs. bran, green grass or lucerne,  $\frac{1}{2}$  lb. sugar or treacle, and one dessertspoonful arsenite

of soda or Paris green. As a rule, however, they are dug out by hand. The natives are fond of these crickets for eating purposes, and take kindly to the work of capturing them.

GRASSHOPPERS.—Several species of grasshoppers attack the tobacco in the seed beds and in the field, mostly in the earlier part of the season. When serious, they can be destroyed by spraying, as for caterpillars, with an arsenical preparation. Transplants can be dipped in poison as far as the roots as a protective measure.

THE CIGARETTE BEETLE (*Lasioderma serricornis*).—Stored tobacco in Rhodesia is very much subject to attack by this cosmopolitan insect. The whole life of the beetle is passed in the tobacco, and, under favourable conditions, the rate of increase is very rapid. Bales of tobacco may be ruined if left to themselves for a season or two. Cigarettes and cigars are also attacked. The different stages of the insect are shewn in the plate very much enlarged. This pest, of course, concerns the manufacturer rather than the grower, as the latter rarely wishes to hold his stock longer than necessary. The beetle can be destroyed by fumigation for 24 hours with carbon bisulphide, at the rate of 1 lb. to 1,000 cubic feet of space, but bales need to be opened up to enable the gas to penetrate. This gas is poisonous, and, when mixed in certain proportions with air, highly explosive, so its use calls for caution.

TRIBOLEUM CONFUSUM.—This is usually a pest of grain, meal and other stored products, and it occurs over the greater part of the inhabited world. Rhodesia is apparently the only country where this pest has been recorded as attacking tobacco. It seems likely that the attack is generally dependent upon the proximity of infested grain or meal to the tobacco. The insect has not been found to breed in tobacco, but to attack it freely enough in the adult or beetle stage. Remedial measures that apply to the cigarette beetle will be effective in the case of triboleum.

TOBACCO AS AN INSECTICIDE.—Tobacco has a considerable value as an insecticide. It is used as a fumigant for greenhouses, in the form of snuff for dusting on the plants and as an infusion. It is effective against plant lice, thrip and other soft-

bodied insects. It is one of the earlier insecticides, and is increasing in popularity to-day. Some years ago its use was not much recommended on account of the difficulty of preparing a wash, etc., containing a given quantity of the active insecticidal constituent, namely nicotine. At the present time, however, there are a number of extracts on the market in which the proportion of nicotine is fairly constant, and by diluting these a reliable wash can be obtained. The home-made wash is very unreliable. It is usually prepared by soaking tobacco stalks and waste in water, at the rate of one pound of tobacco to one gallon of water, for several days. The water should not be boiled, as this drives off some of the volatile nicotine, and so weakens the wash. The darker and stronger the tobacco, the better the wash. In South Africa tobacco wash is recommended for use against the following important insect pests amongst others :—Woolly aphid on apple trees, green aphid on peach trees, black aphid on orange trees, cabbage aphid, black peach aphid, bean and pea aphid and onion thrip.

**MOSAIC DISEASE.**—One of the most common diseases of growing tobacco is called "calico," or "mosaic" disease, because of the mosaic-like appearance of the light and green portions of the leaf. The disease causes the leaf to grow more rapidly near the veins than elsewhere, and thus become wrinkled and corrugated. A portion, or all of the plant, may be affected. Slightly diseased leaves are worthless as wrappers, and highly diseased leaves are of no value for any purpose. For many years the nature of this disease has been a mystery, and has been variously regarded as due to a fungus, as the result of an excess or deficiency of minerals in the soil, as produced by bacteria or induced by faulty drainage. Dr. Woods, of the United States Department of Agriculture, who has carefully investigated the disease, has arrived at the conclusion that it is due to none of the generally supposed causes, but that it is "due to defective nutrition of the young dividing and rapidly growing cells, due to a lack of elaborated nitrogenous reserve food, accompanied by an abnormal increase in activity of oxidising enzymes in the diseased cells." These are the same enzymes that prove so beneficial in the fermentation process later. The enzymes are liberated by the decaying plants or roots, and, if in excess, may enter the roots of young plants set

in the same soil, and induce a diseased condition, from which the plant will never completely recover. Plants with injured roots are more than commonly susceptible to attack.

The sowing of seed on fresh or burned plant beds, the avoidance of injury to roots in transplanting or in cultivation, and the making of conditions favourable to a steady, even growth, appear at present to be the only things within reach of the planter for the prevention or moderation of this condition.

Seed from diseased plants should not be saved, for, while the disease may not be carried in this manner, still an inherited tendency to this condition may be transmitted.

“FROG EYE,” OR LEAF SPOT.—This disease is also called “white speck,” because of its appearance in the form of small white specks in the tissue of the leaf. It appears to a certain extent in nearly all tobaccos, and does not do any large amount of damage. A few years ago cigar tobacco with this specking was in demand, but the style changed as soon as it was found possible to artificially produce this marking on any leaf. It is supposed by some to be caused by too much water at the tap root, and by others to be due to the presence of an excess of potash in the soil. It does not appear, however, that it is due to either of these causes, and is probably bacterial in its nature. This specking must be differentiated from the small white specks due to sun burning where there has been a particle of sand upon the leaf. No successful treatment is yet known.

TOBACCO MILDEW.—The most prevalent and injurious disease of tobacco in Southern Rhodesia is that which is variously termed by the planters “mildew,” “mould,” or “white rust.” This disease makes its appearance in the form of a white, downy growth on the leaves, usually attacking the lower leaves of the plant first of all. It flourishes especially under conditions of dampness, crowding and insufficient air: hence it is generally more prevalent on Turkish leaf than on Virginian, but Virginian is also attacked to a serious extent. When it has once put in an appearance it spreads rapidly under favourable conditions, and if not checked is liable to ruin a considerable quantity of leaf. Leaves attacked by this fungus are quite useless for curing, and it is waste of time to reap them. They are said to turn black in the curing barn.

The usual method of checking the spread of the trouble is to remove and destroy the infested leaves as soon as noticed, and a sharp watch should be kept for them. This tends to check the dissemination of spores, which would otherwise be produced in great numbers and be carried to fresh plants. This method is stated to be effective as a rule, and is perhaps the most economic in a country where labour is cheap.

There is little doubt that spraying with one of the standard fungicides would be effective in checking the fungus, but the writer is not in possession of information concerning the use of fungicides on tobacco plants, and it is possible that copper salts would have an injurious effect on the final product.



