

FLAX CATERPILLARS IN KENYA COLONY, WITH SPECIAL REFERENCE TO THE LIMITATIONS OF THE ROPING METHOD OF COMBATING THEM.

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Caterpillars on flax in Kenya Colony are farm pests of the first rank. They belong to more than one species, but the one most commonly reared from material from the field is *Phytometra (Plusia) orichalcea*, F.; *Heliothis obsoleta*, F., is also met with.

Caterpillars have been reported from all the chief flax-growing districts of the country: the Kikuyu district, including Kabete, Kyambu, Limuru and Thika, and the districts of Nakuru, Lumbwa and the Uasin Gishu. Near Kericho, which is wetter and colder than Lumbwa, from farms up to within a distance of six miles from those of the Lumbwa area, which have suffered badly, caterpillars have been reported, but no serious damage has been done. Mr. T. J. Anderson, the Government Entomologist, has taken the moths of *Phytometra orichalcea* in the Trans-Nzoia district far from European cultivation.

The caterpillars have a wide range of food-plants. In East Africa they have been found to attack, in addition to flax, Canadian Wonder beans, potatoes, rape and other crucifers, as well as weeds.

The attack on the flax crop may take place at any stage, from the time the crop is only just above the ground up to the time of pulling. In its early stages the crop may be eaten up completely. In the later stages the seed-bolls are especially attacked. In a bad attack on the partly grown crop all the leaves and the tops of the stems are consumed, all that remains being the stripped stalks. When the caterpillars are less numerous a frequent form of damage is that the growing-point at the apex of the plant is killed and several weak secondary stems are thrown out. This results in shortening of the fibre and irregularity in the ripening of the seed.

The damage caused by flax caterpillars has been very serious, and many fields have been destroyed. There have been heavy losses in each of the three years 1918, 1919 and 1920, the worst reports having been received during the last year. Most of the damage is done from May to August, following the long rains, in the main growing season, but outbreaks have also occurred in the season following the short rains, which are due from October to December.

The life-history of *Phytometra orichalcea* was worked out in the laboratory at Kabete during the months of June to August, 1918, comparatively cool months. Eggs were deposited on the leaves or stems of the plants provided. The cocoons were spun on the host-plants, several leaves or stems being bound together. The caterpillars were fed on the weed *Galinsoga parviflora*. Little variation was found in the length of the life-cycle of different individuals. The average times for the different stages were:—

Egg	...	...	...	...	...	...	...	...	10 days.
Caterpillar (hatching to spinning cocoon)	...	...	...	...	...	...	...	...	41 days.
Cocoon (spinning to emergence of moth)	...	...	...	...	...	...	...	...	30 days.

Eggs were laid a day or two after the emergence of the moths, making the length of the life-cycle, from egg to egg, about twelve weeks.

The caterpillar stage lasting, as it does, about six weeks, there is some little time for the detection of the pest while the caterpillars are still small. The large caterpillars are quite conspicuous, but the younger ones harmonise so well with their surroundings that unless a careful search be made they may easily be overlooked.

At least eight species of parasites, some Hymenopterous, some parasitic flies, have been reared from material from the field at Kabete.

Little success in controlling the caterpillars has been obtained by spraying. In May 1919 a number of spraying experiments were carried out in which strong Paris green did produce some results. The Paris green was used at the high rate of 3 lb. to 40 gallons. This was combined with (a) soap, (b) resin-washing-soda sticker, (c) lime, (d) lime and sticker. With these four plots were sprayed side by side, and subsequently some small dead caterpillars were found, the caterpillars in the field being mostly only about half-grown. Dead caterpillars could not be found on unsprayed control areas. About ten days after spraying there was a great difference between all these four plots and adjacent control areas. On the Paris green plots little damage could be seen as one looked across the field; on the controls the caterpillars had retarded the growth considerably. A sharp line was seen between sprayed area and control. Later, the weather being damp, the control areas caught up with the sprayed parts of the field.

At other times spraying experiments with Paris green against larger caterpillars have not met with success. One planter, who did not supply full data, reported success with Paris green and lime, but the position is that one cannot recommend spraying to planters.

The method of combating the caterpillars by "roping" was devised by Mr. J. McDonald, a Lumbwa settler, whose description is now quoted:—

"A rope, 40 yards long and about one inch in diameter, held by a boy at each end, is dragged through the flax, the infested area being gone over from three to six times a day. If necessary more than one rope is kept in action at once. The rope should not be held too tightly. The boys use the same tracks each time and very little mechanical injury will have been done to the crop. The method is continued for several days, until the caterpillars have disappeared."

Here it is interesting to note, though the principle is not the same, that Dutt* in India, speaking of the caterpillars of *Phytometra orichalcea* in peas, says, "Dragging a rope, moistened with kerosine and turpentine, over the crop drives away the caterpillars. Even if they go into the neighbouring fields the crop is saved."

This roping method of Mr. McDonald's has been tried by quite a number of flax-growers. Their reports have varied. Some have said it was entirely successful, others that it was no use. Success, however, was reported in a sufficient number of cases to suggest that the method was of some value, and a week on farms in the Nakuru district, in June 1920, gave the opportunity of applying the tests to this method now described.

The method adopted was to obtain an index of the number of caterpillars in a flax field where roping was in progress and then, four days later, to obtain another index of the numbers present as a test of the result of roping. These numerical estimates were made by walking slowly through the flax and counting the number of caterpillars seen in five minutes, several such counts being made on each occasion. The counts were made by the same people each time, in the same part of the field, and at the same time of the day.

The results may be summarised as follows:—

Field No. 1.—The seed-bolls were just forming on the flax. Caterpillars were quite numerous. Just a very few had formed cocoons. After four days roping with heavy ropes about an inch in diameter the caterpillars were only a quarter as numerous as when the first count was made. There were a few more cocoons than previously,

* Report of the Proceedings of the Second Entomological Meeting, held at Pusa on the 5th and 12th February 1917.

but the increase in their numbers was entirely insufficient to account for the reduction in the numbers of caterpillars. Some may possibly have pupated in the ground (but compare with Field No. 2).

Field No. 2.—This field was on the same farm as No. 1 and quite near to it. The flax was nearly ready for pulling. The caterpillars, which were especially attacking the seed-bolls, were rather less numerous than in Field No. 1, but they were rather older and many cocoons had already been spun. The field was treated in the same way as the other, but after four days no reduction was found in the number of caterpillars.

Field No. 3.—In this field on a neighbouring farm the flax was in flower. The caterpillars were about as numerous as in Field No. 1. The field had been gone over about six times a day, but instead of rope, reim (twisted hide) had been used, the reim being much less heavy than the rope used on the first two fields. The reduction in the number of caterpillars was about 35 per cent., as against about 75 per cent. on Field No. 1.

Field No. 4.—As a check on the counts in the above three fields, counts were made on another field, which had not quite reached the flowering stage, where the caterpillars were not very plentiful. They were of fair size, but no cocoons were found. This field was not roped. The number of caterpillars found after the four days' interval was almost identical with that found previously.

Field No. 5.—On this field of flax in flower there was a very bad outbreak. Many of the caterpillars were in the last stage and cocoons were very plentiful. On part of this field the flax had been badly stripped of leaves before the outbreak was observed, and roping started, but caterpillars, while less numerous, were still present in large numbers in other parts of the field, and in these parts not many cocoons were seen. After four days of roping, with ropes about an inch in diameter, dragged through the flax half a dozen times a day, the caterpillars were appreciably fewer than previously on part of the field where the crop had not been seriously damaged, but the roping had not prevented the badly stripped area from increasing in size.

In the last field, some observations were made in order to try to determine just in what way the roping may bring about a reduction in the numbers of the caterpillars. Dead or injured caterpillars on the ground are not objects which readily catch the eye, but when a search was made some injured caterpillars were found. One large caterpillar which could just wriggle a little was found, and an hour later it was unable to move, being apparently dead. Another caterpillar, not very large, was found on the ground, moving only just a little; it did not make any attempt to climb up a flax plant; several small ants, one after the other, were seen to tackle it single-handed, when it would wriggle, and each time they gave up the attempt; but after an hour and a quarter it was attacked by these ants in force and carried off. Other caterpillars, some larger, some smaller, were seen to be attacked by ants successfully. In an area of two square feet where particular search was made, six victims of ants were found. One, which the ants had been watched carrying-off, was found an inch and a half below the surface of the soil. Another, injured at the hind end, succeeded at the third attempt in escaping from its assailants up a flax stem, which it climbed about three inches, but there it hung helpless from a leaf. It was found that a big healthy caterpillar was able to escape, even when placed in an ant-run, but half-grown healthy caterpillars were overwhelmed and carried off by a crowd of ants. Very small caterpillars were several times found being carried by only a single ant.

Obviously, from the fact that great numbers of caterpillars are seen climbing up the plants after being knocked off by the rope, the great majority escape after any one passage of the rope, but if only a small percentage be mortally injured, or placed at the mercy of ants, the cumulative effect would explain how the roping method acts. Six per cent. of casualties each time the rope passes, is sufficient to explain the figures recorded for Field No. 1.

Another explanation of the action of the roping method which has been put forward, is that the caterpillars, becoming weary of being repeatedly knocked off the plants, migrate from the field. A watch was kept for such migration from the field under discussion, but caterpillars were only found crawling out of the field where the flax had been stripped of leaves right up to the edge of the field. Where the flax offered plenty of food, the caterpillars remained there. It seems probable that the roping method, in so far as it does reduce the number of caterpillars, acts not by driving them out of the field, but by bringing about their death in the field.

The conditions involved in the success or failure of this method seem, therefore, to be :—

(1) Kind of rope and frequency of roping.

A heavy rope has more effect than a light one. The more times the field can be gone over in a day the better. If caterpillars are present in sufficient numbers to do appreciable damage, once or twice a day would do little good.

(2) Size of the caterpillars.

On small caterpillars the roping method has an effect both directly, by injury, and indirectly, by placing them at the mercy of ants. On large caterpillars there is little effect by either means.

(3) Numbers of the caterpillars.

Against an outbreak in which the caterpillars were very numerous, I doubt the efficacy of this method, unless, possibly, roping were done more times a day than would be feasible on a farm. Very little success has been reported against bad outbreaks, and in the light of the field observations just recorded this is not surprising. For,

- (a) It appears that roping produces its effect by bringing about the death of only a small percentage of caterpillars each time the rope passes.
- (b) Unless the numbers of ants or other predators attacking the caterpillars on the ground are increased by immigration, the larger the numbers of caterpillars, the less potent proportionately will the ants be to reduce the numbers of the caterpillars.

These facts, I believe, explain the different reports on the roping method—some of success, some of failure—which have come to hand. If the caterpillars are big before roping is started, if their numbers are very large, if the rope is too light, or if it is not passed through the field often enough, failure may be expected. But if the caterpillars are small and not present in excessive numbers, roping, properly carried out, will, I believe, meet the case.

It will thus be seen that there are distinct limitations to the roping method, and it is, moreover, a laborious one. Undoubtedly, it will be replaced by something more effective, and at present flax-growers are paying attention to various mechanical devices invented by several settlers for removing the caterpillars from the crop, while the search for other methods is being continued by the Division of Entomology.