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COLLEMBOLA INJURING LEAVES OF MANGOLD SEEDLINGS.

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(PLATES XIV–XV.)

During investigations on the economic position of Collembola a significant attack on mangolds by one species of this group occurred at Rothamsted in the classical mangold field known as Barn Field. The particular species involved was *Bourletiella hortensis*, Fitch (*pruinus*, Tullb.). Although the economic position of Collembola has not, as yet, been fully established, this member of the order can claim priority in the list of previously reported economic species. The first British record of injury probably by this species is that of Miss Ormerod¹ in 1894, when she reported leaf damage to turnips in Scotland. Since then British records include as host-plants sweet peas, beans, radishes, lettuce, mangolds² and soy beans³. Reports from America confirm the economic position of this species, and in Canada Macnamara⁴ states "the list of plants it is known to injure reads like an index to a seedsman's catalogue: beans, beet, cabbage, cantaloupes, carrots, clover, corn, cucumber, kale, lettuce, mangolds, onions, peas, potatoes, radishes, rye, spinach, squash, tobacco, tomatoes, turnips, violets, watermelons, wheat, wild cucumber."

Records of damage to mangolds by this species have appeared in the Monthly Reports of the Ministry of Agriculture during the last few years. Several of these refer to the so-called disease known as "strangle" to which the mangold crop is liable at a stage of growth when the roots are well above ground. This damage, it appears, may be due to several causes, each with its specific difference, but *Bourletiella hortensis*, as previously recorded,⁵ is certainly one of the agents concerned.

The particular attack at Rothamsted occurred during the first week of June 1926, and was of the nature of leaf damage at a stage when the roots were not above ground. Barn Field, situated about 400 feet above sea-level, has a slight slope with a north aspect, and the soil is a heavy clay with a fair proportion of flints. This experimental field has grown mangolds continuously since 1876, when it was divided up into the present number of experimental plots varying in manurial treatment. Apart from an attack of *Atomaria linearis* (pigmy beetle) in 1922, the field has generally been free from serious insect damage.

The variety of mangolds Yellow Globe had been sown on 7th May 1926. A quantity of seed had been soaked in water and afterwards mixed with an equal amount of dry seed; the mixture was sown at the rate of 8 lb. per acre. This procedure ensures a double germination, which is frequently beneficial in the case of insect attack or of drought. This year the mangolds were sown on the ridge.

Nature of Damage.

The attack was reported on 31st May by Mr. C. Heigham, Farm Director, and investigations were immediately commenced. The field at this period was remarkably free from weeds. A search was made for wilting plants suggestive of attack by *Atomaria linearis*, but only a negligible number were found, together with a few isolated examples of the beetle.

Practically 100 per cent. of the mangold seedlings showed leaf damage (Pl. XIV, fig. 1). Flea-beetles were suspected of being the cause, but a careful search for these showed that they were almost entirely absent. Closer examination of damaged

plants and the surrounding soil, however, revealed the presence of enormous numbers of small black Collembola (springtails), the species being *Bourletiella hortensis*, Fitch (Pl. XIV, fig. 2). Practically every plant was infested with them (to give a farmer's expression of his observations, they were "smothered" with them). Examination with the hand lens permitted one to observe the damage being done. Doubt has been expressed from time to time regarding the ability of these small insects to cause such damage. Individually, this may not be possible, but the habit of this species of feeding in groups accounts for the comparatively extensive injury. This habit has been noted by the writer in a previous investigation in North Wales⁵ and was frequently noted in the present observations. The groups varied in number of individuals, but as many as 17 were observed busily engaged in enlarging a perforation. The curved damaged area of the plant on the right hand side of the lowest row in the illustration (Pl. XIV, fig. 1) was seen to bear 13 individuals along its border. This habit has evidently been formed owing to the attraction of exuding plant juices. It should be emphasised that the nature of the damage is two-fold, for in addition to the actual biting and enlarging of the damaged area, wounds are kept constantly open and excessive bleeding ensues.

Field Treatment.

The damage to the crop was such that it was necessary to carry out a method of control on a large scale. Observations were made at 6.30 a.m. on 1st June; the field conditions in the early mornings being more constant for comparative work. The soil was damp; the day bright, with a slight breeze blowing. The distribution of Collembola over the different experimental plots appeared to be proportional to the leaf area. Counts were taken on the dunged plot (No. 1). Attempts to count plant or leaf infestation proved unsatisfactory, since the Collembola jumped at the slightest disturbance. The following method was therefore adopted. A glass cylinder measuring $3\frac{1}{2}$ inches in diameter and 6 inches in height was placed quietly but quickly over a group of plants—four being the number aimed at. The Collembola on the plants were knocked off on to the soil within the cylinder. The numbers present on this unit area (approximately 9 sq. inches) were then counted by visualising the centre of the surface and counting in a clockwise direction along the "radius." Duplication, where necessary, was made by returning in an anti-clockwise direction. Twenty preliminary random counts were made with the following results—average numbers present per unit area 19.7, maximum 41, minimum 13. The average number per acre works out at about 1,500,000.

The first treatment was with paraffin-soaked sacks, which were trailed behind a flat horse-roller. Observations after treatment revealed the repellent effect of the paraffin, since few Collembola were observed on the plants and those on the soil were extremely active. Heavy rain fell during the night and the following day, and counts were taken again at the same hour on 3rd June, when atmospheric conditions were somewhat similar. It was very evident that the repellent effect of the paraffin had been washed off by the rain, for 20 counts gave an average of 21 (max. 44, min. 10) individuals per unit area.

On 4th June a further attempt at control was made. The ability of the Collembola to jump was made use of and the method adopted was that of catching the insects on tarred sacks, particulars of which will be described later. This method of actually seeing the number of insects killed more or less obviated the necessity of controls and permitted uniform treatment of the whole area, which was essential on the experimental field. Sixty random counts made previous to the treatment gave the following results: Average, 26 (max. 55, min. 13) individuals per unit area.

Examination of the tarred sacks after use revealed enormous numbers of Collembola. For demonstration purposes it was decided to replace a tarred sack

by one coated with white varnish. Although, perhaps, this was not so successful as the more adhesive tar, the "catch" which was observed after treating two rows (one-eleventh of an acre) convinced even the previously sceptical farm-workers that their efforts were a great success. A portion of the painted sack is illustrated (Pl. XV, fig. 1). The number of flea-beetles caught was very low, thus confirming the observations regarding the comparative scarcity of these pests. Slight rain fell during the evening, and further counts were made in the early morning of 5th June, when the soil was damp, and bright, still, conditions prevailed. A very marked reduction in the numbers of the Collembola was apparent and was confirmed by the following results of 40 counts of individuals per unit area—average 5.4 (max. 19, min. 0). The presence of a little tar on some leaves suggested that there was a repellent effect in addition to the numbers removed.

Another 40 counts of individuals per unit area were made at the same hour on 7th June; the results were as follows: Average, 8.4 (max. 15, min. 2). Although it was possible to find a few individuals on the plants after treatment, no instance of the habit of collective feeding was observed. The young mangolds grew very favourably, the leaf damage being obviously reduced to a minimum. In the opinion of the Farm Director, a continuance of the full attack for another day or two would have destroyed the great majority of the young plants and so have led to a complete failure of the crop. In so far as this was prevented and the surviving plants were given an opportunity to recover and to develop new leaf areas, the treatment may be said to have saved the crop.

In improvising apparatus to deal with this pest, farm implements naturally received first consideration. The best of several attempts, and the one used successfully on Barn Field, was that seen on the right in Plate XV, fig. 2. It consists of two Planet hoes fastened together by long crossbars covering two ridges in width. A sack, tarred over the region 9 inches from the bottom, was hung so that the tarred surface just trailed above the two ridges. A similar sack, hanging perpendicularly, was placed behind. It would have been possible for one man to work this, but two proved more effective. The contrivance was pushed—this method being essential owing to the habit of Collembola of jumping when disturbed by a shadow. The sacks were re-tarred at intervals. The cost of the treatment was approximately 1s. 6d. an acre. Other contrivances used included two bicycles fastened side by side by long axles on which the sacks were hung. A Jacob's seed barrow was also adapted. While the latter covered 5 rows and thus reduced the cost to 8d. an acre, difficulty was experienced, especially against a strong wind, in keeping it horizontal.

It was felt desirable, however, to have a machine which could be worked by a boy and which might be useful in the case of other attacks by springtails or by flea-beetles. In making this machine it was necessary to bear in mind that Collembola can jump to a height of 2-3 inches, and also that while some jump on the approach of a shadow, others require to be touched. In its final form, as seen on the left of Plate XV, fig. 2, it consists of a pair of old bicycle wheels with an iron axle 25-27 inches long. Two L-shaped brackets—adjustable for different heights of ridges and for level ground—are bolted to the axle, the horizontal arms (20 inches) project forwards and hold on the underside an arch-shaped wooden box. A piece of strong string or thin wire hangs loosely across the inside of the archway and thus trails over the plants just in front of the sacking which forms the back of the arch. The entire box and sacking are smeared with tar or other adhesive substance. This can be best done when the machine is turned over on one wheel. The whole contrivance is pushed by means of a fairly long handle; the roof of the box is kept horizontal at a height of 2-3 inches from the soil. If necessary this implement can be enlarged by increasing the length of the axle and the number of boxes. The cost for the single arrangement worked by a boy is about 1s. an acre.

This machine has also been used with success against flea-beetles, but a slight adaptation is necessary. It was found that while numbers were caught on the inside, especially the roof, of the archway, others jumped and alighted on the top of the box. A piece of 3-ply wood, smeared with the adhesive substance, was therefore fixed in a slanting position on the top of the box. In this way the number of flea-beetles caught was considerably increased. Certain differences in treatment of the two pests should be noted: Flea-beetles jump higher than *Collembola*; and while bright, sunny, dry weather is ideal for flea-beetles, dull, warm and damp weather is more favourable for springtails.

Before passing to laboratory experiments it should be added that other local reports of similar attacks have been received, and a crop of mangolds at Woburn is stated to have suffered considerably from *Bourletiella hortensis*. Other host-plants noticed in the field include grousel, goosefoot and red-shank.

Laboratory Observations.

Observations in the field by the Farm Director, the writer, and others were so convincing that it seemed unnecessary to prove, by controlled experiments, the ability of *B. hortensis* to cause such damage. Pots with insect-free soil were, however, set up in the insectary and Yellow Globe mangolds sown. The pots were covered with large glass cylinders, the tops of which were closed by fine muslin. After the seedlings had appeared, specimens of *B. hortensis* were collected in the field and transferred to the experimental pots; control pots were kept. It was at once apparent that this species disliked caged conditions, for they became very active, jumping and moving about rapidly and eventually congregating on the muslin on the top of the cage. This they did to a certain extent throughout the experiment. After two days, however, the young mangolds were seen to be attacked, and perforations similar to those observed in the field were visible on the leaves. Specimens of these leaves are figured in the middle row in Plate XIV, fig. 1. The extent of the damage is not nearly so marked as was the case in the field, and at least two reasons can be assigned for this. The unsettled condition of the *Collembola* under caged conditions prevented the collective habit of feeding, so that no instance of this habit, which largely accounts for the extensive damage in the field, was observed. Further, under these experimental conditions the damaged areas caused by the insects quickly dry up and there is no attraction by exuding plant juices.

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References.

1. ORMEROD, E. A. (1895). 18th Rept. of Observations of Injurious Insects, 1894, pp. 110-114.
2. THEOBALD, F. V. (1911). "Springtails" (*Collembola*). Their economic importance, with notes on some unrecorded instances of damage.—1er Congrès Internat. Entom. Bruxelles, 1910. Vol. ii, Mémoires, pp. 1-18.
3. CORBETT, G. H. (1913). Economic importance of the Family Sminthuridae, with notes on an attack of *Bourletiella hortensis* (Fitch) on Soy Beans.—Agric. Students' Gazette, Cirencester, xvi, pt. 4, pp. 128-130.
4. MACNAMARA, C. (1924). Food of *Collembola*.—Canadian Entomologist, lvi, pp. 99-105.
5. DAVIES, W. M. (1925). Springtails attacking Mangolds.—Jl. Ministry Agric., xxxii, no. 4, July 1925.

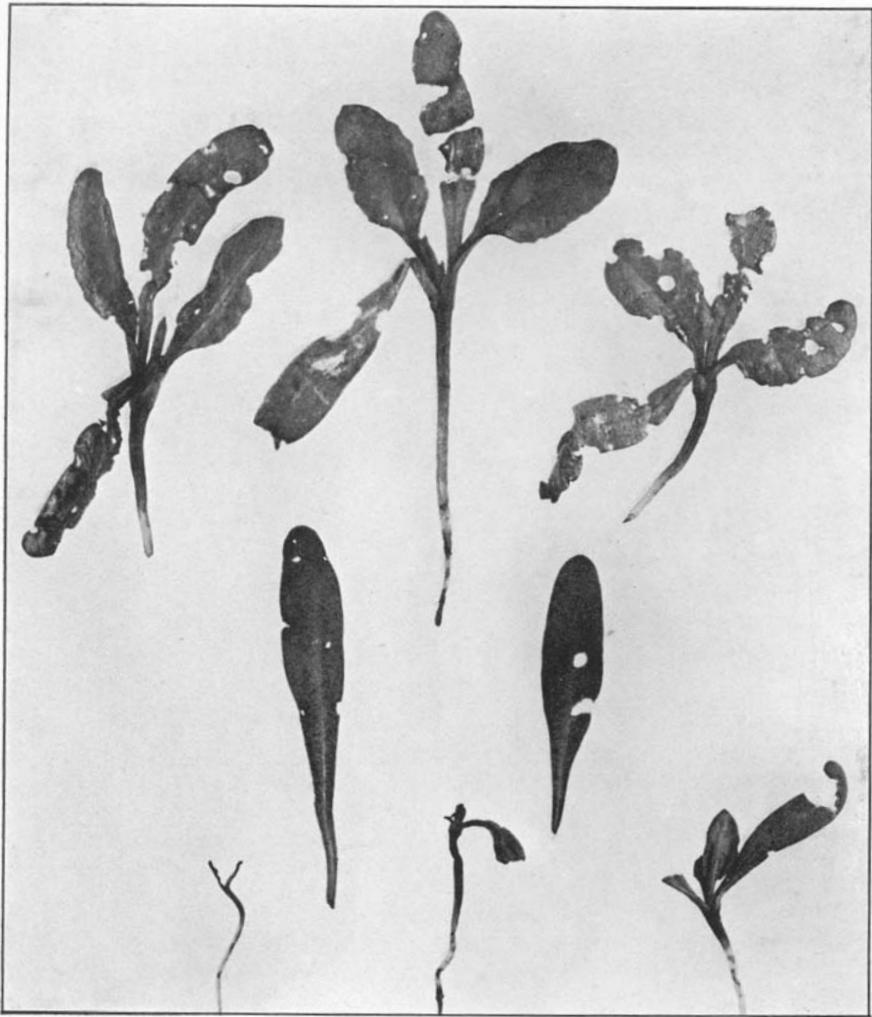


Fig. 1. Damaged mangolds taken during an attack by *B. hortensis*.

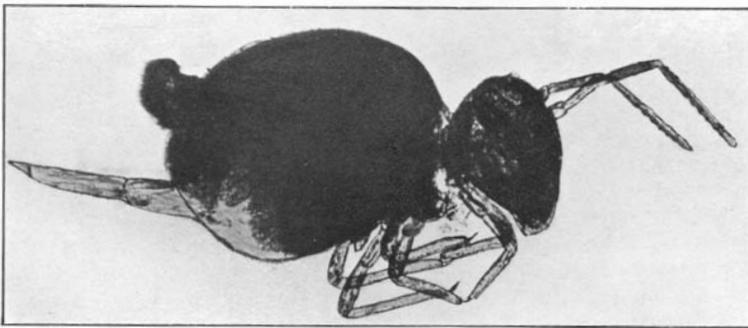


Fig. 2. *Bourletiella hortensis*, Fitch (*pruinus*, Tullb.) \times 500.

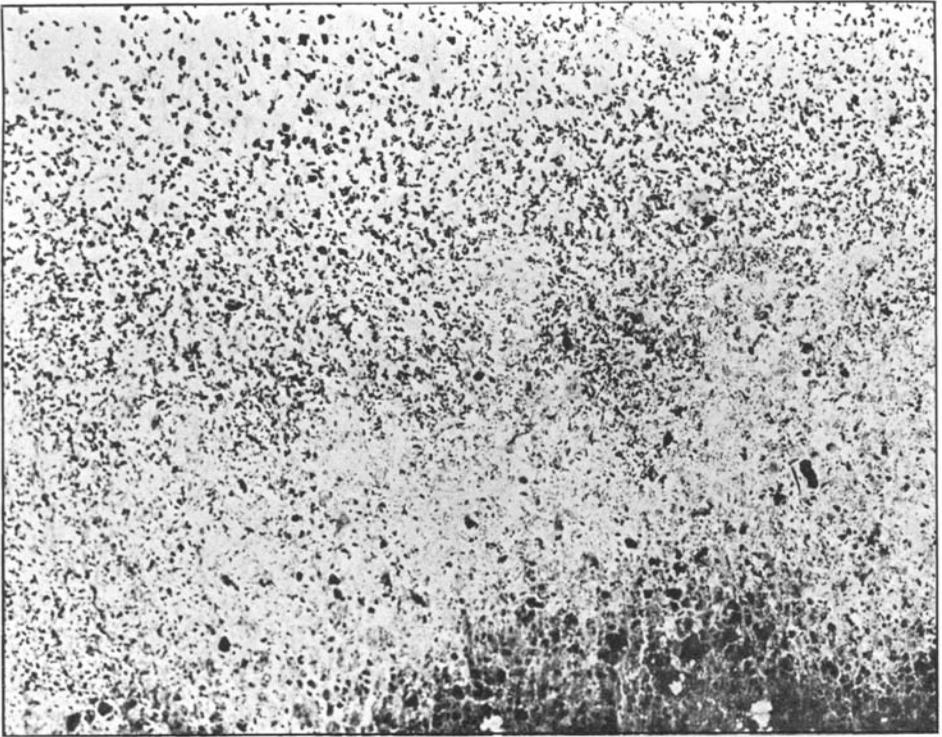


Fig. 1. Portion of painted sack used in control, showing great numbers of trapped *B. hortensis*.



Fig. 2. *Right.* Improvised machine carrying tarred sacks, effective in trapping *B. hortensis*.

Left. Machine recommended for use against springtail attack, and easily adapted for flea-beetles.