baited area or in the non-baited area. Further, there was no indication that the maggot attack was more severe in any one part of the field over any other.

The first male flies appeared in the field on May 10th; the first females a few days later. The height of the oviposition period was not passed until June 6th. Eggs were laid in the field on May 19th, and continually from this date until August. The length of the larval period varied from sixteen to twenty-nine days and the pupal period from fourteen to twenty-six days. The earliest pupa formed was found on June 14th. Second-generation adults appeared on July 7th. The first generation of flies extended over a period between May 10th and July 7th; the second generation until August 23rd, after which time third-generation flies might be expected. Two generations occur and doubtless a third, but the life-history notes on the last generation have not been obtained with accuracy. A great many notes have been obtained on the habits of the fly and particular attention has been paid to temperatures and weather conditions.

OBSERVATIONS ON THE CONTROL OF THE ONION-MAGGOT (HYLEMYIA ANTIGUA).

BY M. H. RUHMAN.

Onions have been extensively grown in British Columbia for a number of years, particularly in the Okanagan Valley. In the year 1914 growers began to complain that cutworms were destroying their young plants. On investigation it was found that the onion-maggot was present and responsible for most of the trouble. This was most evident in small kitchen-gardens, the large commercial plantings not suffering sufficiently to attract attention. The few short gaps that did occur in the rows of onions were attributed to faulty seeding or cutworms. In the year 1915 growers began to get alarmed, as extensive injury was being done by the onion-maggot. The recommendations for control—i.e., the removal of infested plants in the middle of June and their destruction by boiling or burning, and the destruction after harvest of onion-tops and undersized onions, usually left on the field to be ploughed under—did not appeal to them and comparatively little was done to control the pest. The onion-maggot has now become so serious a menace that control measures must be undertaken or the growing of onions commercially must soon be discontinued.

The adult of the onion-maggot is a fly somewhat resembling the the common house-fly, a little smaller and more slender, but with proportionally larger wings, and is grey in colour. The life-history of the fly in British Columbia is not well known; the insect passes the winter in the pupal stage in the ground and occasionally in stored onions, in which they may have pupated. The adult fly emerges in the spring; the earliest Canadian record is of an adult captured in the third week in May at Ottawa (1). The number of eggs laid at one deposition may vary from

one to fifteen (2) and are laid at the base of the young plants or in the soil close to a plant. Later broods may lay them in the axil of the leaves when the plants are well grown. The incubation period of the eggs may vary from three to ten days (2 and 3), according to climatic conditions. The larval period (2) is completed in two to three weeks in green onions, onion-sets, and small-seeded onions, but in onions stored from the previous year may require from four to five weeks to complete their larval period. The pupal period (2) of the summer broods is from nine to sixteen days, with an average of eleven to twelve days. There are probably three broods of flies each season.

When the eggs are hatched the young larvæ immediately work their way down the plants and commence feeding, and as at this time, the end of May or early June, the onions are quite small, one larva may destroy a large number of plants, with the result that long stretches in each row of onions may be completely destroyed, making it unprofitable to continue cultivation. Later when the bulbs are forming a number of larvæ may be found in one bulb. The top of the onion in this case may be completely killed, but the lower part of the bulb may still continue to grow owing to the roots being uninjured.

The losses to the onion-growers occasioned by the maggot during the years 1917 and 1918 in the Okanagan Valley were very heavy, amounting to thousands of dollars. In some instances the crops were so badly injured during the early summer that it was unprofitable to continue cultivation and the crops were consequently ploughed under. It is well to state, however, that yields were also greatly interfered with by other conditions, such as wireworm attack and poor quality of imported seeds. So far as is known, this insect has no other host-plant, but to determine if this insect was able to complete its life-cycle on other food, Messrs. Severin & Severin (2) conducted a number of experiments. Freshly laid eggs were placed in contact with growing radishes, and it was found that the onion-maggot completed its life-cycle in twenty-nine to thirty-five days. A second experiment was tried by placing the eggs on fresh horse-droppings, with the result that the maggots completed their life-cycle in twenty-nine to thirty-one days; one maggot taking fifty-two days to complete its life-cycle. It is therefore evident that the fly can adapt itself to other food than the onion, but in a general way, under strictly natural conditions, most investigators agree that the onion-maggot attacks onions and no other crop.

Control.—A large and varied number of methods of control for the onion-maggot have been advocated at different times. Few of these appear to have been tested on a commercial scale. Many of them are too expensive to be considered, and a few of them, such as carbolic-acid emulsion, kerosene emulsion, and hellebore, are only useful in the kitchen-garden.

Professor Sanders (4), having determined that the pre-oviposition period of the female fly covered a period of ten to fourteen days, thought it feasible to prepare a poison bait that would attract the adult fly during the pre-oviposition period. Accordingly, experiments on a commercial scale were

conducted by the Professor and others in Wisconsin between 1913 to 1916. The bait used was the Sanders formula, 5 grammes sodium arsenite dissolved in 1 gallon of boiling water, to which is added ½ pint of molasses. This bait was applied as a spray with a small compressed-air sprayer altered to give a coarse spray, or might be applied by a whisk-broom, the operator walking up and down the fields about every twelfth or fourteenth row and releasing a quantity of spray at every four paces. In this manner about 3 gallons of the bait were applied to 7 acres about twice a week. The first application was made as soon as the onions came up and were continued until the later part of June. From the end of May the amount of spray applications was doubled. From the end of June to the end of August a series of fly-traps were used to test various modified baits. Of the baits tried, the Sanders formula with the addition of sliced onions proved 300 times more attractive than other baits tested. A further experiment was tried by distributing the bait in pie-tins at the rate of fifteen to twenty-five tins per acre. The amount of success obtained with these baits in the field did not come up to expectations, being attributed to continuous rains. Mr. T. J. Headlee, of New Jersey, where similar tests had been made over two years under drier conditions, states that very satisfactory results were obtained. In the Okanagan Valley in the spring of 1918, owing to the heavy loss in the onion-crop the previous year, a local grower was induced to try the poison-bait method to protect his crop. He was instructed to distribute tin pie-plates at the rate of twenty to the acre, and to prepare the poison by dissolving ¼ oz. of sodium arsenite in 1 gallon of boiling water and to add to this ¼ pint of molasses. This bait was placed in the plates and renewed weekly. Frequent visits were paid to this field to observe results. Early in June it was found that, owing to our dry conditions, the renewal of the bait once weekly was insufficient owing to the rapid evaporation of the water, and dishes were found to be quite dry one or two days after the bait had been placed in them; it was therefore found necessary to renew the baits daily during the months of June and July.

The adults of the onion-maggot were found to be attracted freely to the bait when moist, but none were observed near dry or partly dry dishes. Instead of renewing the bait daily, water was added to keep it moist, fresh bait being only distributed weekly. The result was that considerable infestation was noticed in the middle of June. It was then suggested that a second thinning of the crop be undertaken and that infested onions be removed and burned. Owing to the acreage under consideration and the expense of a second thinning, also because there was considerable doubt on the part of the grower as to the final results, the work was undertaken on 5 acres of the crop which consisted of home-grown seed, and was more vigorous than the balance of the crop which was sown to imported seed. The work was carefully done and the poisoned bait continued; by the middle of July the rethinned onions were showing a perfect stand and the poisoned bait was soon after discontinued. The harvested crop from the 5 acres of

rethinned onions was estimated to average 24 tons per acre; the balance of the field was a total loss.

From the observations made on the experiment the following conclusions were drawn: The fresh bait was attractive to the fly. Where the plates had been allowed to dry no flies were attracted to the poisoned molasses remaining. Instead of weekly renewal of the bait as suggested by the Wisconsin experiments, it was found that daily renewal was necessary under our dry conditions. Instead of daily renewal of the bait, water was added to the plates to replace evaporated moisture; this possibly was not done until after the bait was so dry that the water would not mix readily with the poisoned molasses; consequently the flies were able to obtain moisture from the bait without absorbing the poison. In the middle of June infestation was found to be very heavy, and the second thinning appears to be mainly responsible for the excellent crop obtained, the cost of which was certainly warranted, but careful work is necessary to make the thinning a success.

In the spring of 1919 experiments will be conducted to find, if possible, a more attractive bait; also methods of application more suitable to our dry conditions in relation to the life-history will be tested.

References.

(1) Gibson & Treherne, Ent. Branch, Ottawa, Bul. 12.
(2) Severin & Severin, Jour. Econ. Ent., Vol. 8, 1915, p. 342.
(3) Donald J. Caffrey, Ent. Rept., Connecticut, 1911, p. 287.
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SOME NOTES ON THE TENT-CATERPILLAR.

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During the past summer the tent-caterpillars have been attracting the attention of every one in and around the Cities of Vancouver and Victoria, and judging from the supply of egg-masses to be seen at the present time this pest may be expected in even greater numbers in 1919 unless control-work is undertaken in a thorough and systematic manner. These caterpillars must not be confused with another destructive species, the fall web-worm (**Hyphantria sp.**), which were also very abundant in Vancouver and the Lower Fraser Valley last year, but which appear much later in the season, usually about the end of July, after the tent-caterpillars have disappeared.

Two distinct species of this insect occur in British Columbia — the common or orchard tent-caterpillar (**Malacosoma pluvialis**) and the forest tent-caterpillar (**M. disstria var. erosa**). Their life-histories, habits, and control are quite similar, however, and they will be treated together in this