LABORATORY ASSESSMENT OF DAMAGE TO SWEDE, *BRASSICA NAPUS RAPIFERA*, BY WHEAT BUG *NYSIUS HUTTONI*

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ABSTRACT

Wheat bug (*Nysius huttoni* White) damage to swede (*Brassica napus rapifera* Metzger) seedlings was assessed in the laboratory. Wheat bug preferred stems to petioles and leaves for feeding, resulting in the damaged seedlings wilting and dying after heavy feeding. The degree of damage to swede seedlings increased with the development of stages from juvenile instars to adult, with adults usually causing death of the whole plant irrespective of insect gender. Increasing the density from 15, 30 to 50 wheat bug individuals significantly increased the severity of damage to the seedlings.

Keywords: Wheat bug, Lygaeidae, *Nysius huttoni*, damage, swede, *Brassica napus rapifera*.

INTRODUCTION

Wheat bug (*N. huttoni* White) is endemic to New Zealand, distributed throughout the country (Eyles and Ashlock 1969), and large populations are consequently found in the drier districts, such as South Canterbury and Central and North Otago (Gurr 1957). Wheat bug is best known for causing damage to wheat (Morrison 1939; Cressey *et al.* 1987; Every *et al.* 1989), and attacks wheat grains in the milk-ripe stage and causes sticky dough in wheat-flour (Morrison 1939; Blair and Morrison 1949; Gurr 1952; 1957). In the worst recorded outbreak in 1970, about 10,000 tonnes of wheat were damaged (Swallow and Cressey 1987).

Wheat bug has also caused serious damage to direct drilled brassicas in Maniototo and Central Otago (Ferguson 1994). It fed on the stems of swede (*B. napus rapifera* Metzger) seedlings, with up to 70% of immature plants being lost through wind breakage (Ferguson 1994). However, there has been no report on the relationship between wheat bug population size, developmental stages and severity of damage to brassica seedlings. Knowledge of this is important in decision making for pest control. This paper reports results from a laboratory study of such relationships on swede.

MATERIALS AND METHODS

Insects

Wheat bugs were maintained in the Entomology and IPM Laboratory at Massey University at $23 \pm 1^\circ\text{C}$, $60 \pm 10\%$ RH, with a photoperiod of 16L: 8D. Food for wheat bugs consisted of sunflower seeds, and stems and seeds of twin cress (*Coronopus didymus* (L.) Sm.). The breeding colony was housed in a clear plastic container (8.5 x 10 cm), with a 4.5 cm gauze covered hole in the lid for ventilation. A 6.5 cm long stick of cottonwool was provided as an oviposition site. Eggs were collected from the cottonwool stick and allowed to hatch in plastic petri dishes (9.0 x 1.3 cm).

Plants

Swede seedlings were grown in an unheated greenhouse and individually transplanted to the centre of a 4.0 x 5.5 cm pot at the cotyledon stage, and used in experiments at the 3-true leaf stage.

Observation containers

Thirty 7.0 x 18.0 cm transparent plastic containers were fitted at the base with a 7.0 x 8.0 cm plastic holder where a potted plant was placed. The container was covered with fine-mesh gauze (0.6 x 0.6 mm) for ventilation. Insects were released through a 1.5 cm diameter hole cut in the wall of the container 8.5 cm from the base and a door was used to close the hole. After the plant was transferred to the holder, a 3.0 mm soil layer was spread on the surface of the pot and compressed.

Plant damage assessment

The experiment consisted of 12 treatments including adult females and males, and 2nd and 4th instar nymphs of three different densities (15, 30 and 50 individuals) with 20 healthy plants as a control. There were 20 replicates per treatment. Newly emerged adults and newly moulted nymphs were separated and placed in glass vials (2.5 x 8.0 cm), and fed with swede seedlings for 2 d and starved for 24 h prior to the experiment. The wheat bugs for each treatment were then released into the observation container at 27 ± 1°C, 60 ± 10% RH for 48 h. After this time, the wheat bugs were removed, and the plant was placed in a fine-mesh gauze cage (100 x 85 x 20 cm) for 6 d. The control plants were treated in the same way but were free from wheat bugs.

The lengths of stems, petioles, true-leaves and cotyledons and the widths of the leaves and cotyledons (excluding the third true-leaves) were measured at 2 d intervals, starting immediately before the release of wheat bugs to the plant. A total of 5 measurements were made. For each measurement, lengths and widths of the plant parts were summed up to represent the overall plant growth. The sum of those parameters in the first measurement was taken as the base (zero growth) and any increase of the sum in subsequent measurements was treated as overall growth.

The life span of plants was decided by calculating the mean life span of leaves and cotyledons at 2 d intervals. A life index of 1, 2, 3 and 4 was used to represent that after damage the plant could live for 2, 4, 6 and 8 d, respectively. As the data were recorded for only 8 d from the release of wheat bugs to the plant, the plant might still be alive on the 8th day. Therefore, the index was recorded as 4 if the plant was dead on the 8th day and as 5 if it was still alive on that day. As a result, the mean index > 4 indicated that the plant was still alive after experiment.

The data for plant growth were analysed using ANOVA. A Kruskal-Wallis test (Chi-square approximation) was applied to analyse the data of the plant life index. The null hypothesis was that there was no significant difference in the plant life indices and plant growth measurements between the insect life stages and between the insect densities.

RESULTS

Wheat bug preferred stems to petioles and leaves for feeding. In this study about 60% of feeding occurred on stems. With heavy feeding on the petioles, the feeding punctures resulted in rough surface of the petiole and the leaves began to wilt. Adults repeatedly fed on the same sides of the second true leaves, resulting in net-like and withered leaves.

The overall growth of swede seedlings after damage was significantly slower with the increase of density at each life stage of wheat bug ($F = 211.3$, $df = 3$, $P < 0.001$; Fig. 1). However, 2nd instar nymphs significantly reduced the growth rate of plants only when the density reached 30 individuals. At each density level, adults reduced the growth rate of plants significantly more than 4th instar nymphs which had significantly more adverse effect on plant growth than 2nd instar nymphs ($F = 162.7$, $df = 3$, $P < 0.001$; Fig. 1). Adult-damaged plants stopped growing 2 d after being damaged. However, there was no significant difference in the damage caused by adult females and males. Fifty 4th instar nymphs and 15 adults resulted in similar levels of damage. The mean degree of damage was significantly different between insect densities at each life stage ($F = 104$, $df = 3$, $P < 0.001$; Table 1 in rows). Adult densities of 30 and 50 individuals made no significant difference to plant damage. For nymph stage, at least 30 4th instar and 50 2nd instar nymphs were needed to cause significant damage to plants. The mean degree of damage significantly increased with the development of the insect from the nymph to adult stage at each insect density ($F = 83.28$, $df = 3$, $P < 0.001$; Table 1 in columns). Adults were significantly more damaging to plants

than nymphs at each density level. However, there was no significant difference between adult females and males. The 4th instar nymphs started to cause significant damage to plants at density of 30 individuals, but were only significantly more damaging than the 2nd instar nymphs when the density reached 50 individuals.

FIGURE 1: Growth of swede seedlings damaged by different life stages of wheat bug at different insect densities. Columns with the same letters are not significantly different.

TABLE 1: Means $\pm$ S.E. of plant life indices damaged by different life stages of wheat bug at different insect densities¹.

	Density of wheat bug				df	F value	P value
	Control	15	30	50			
Female	4.97 $\pm$ 0.03a α	3.56 $\pm$ 0.35b α	2.31 $\pm$ 0.25c α	1.95 $\pm$ 0.35c α	3	42.44	< 0.001
Male	4.97 $\pm$ 0.03a α	3.61 $\pm$ 0.39b α	2.28 $\pm$ 0.36c α	1.85 $\pm$ 0.30c α	3	45.87	< 0.001
4 th instar	4.97 $\pm$ 0.03a α	4.59 $\pm$ 0.19ab β	4.32 $\pm$ 0.28b β	3.38 $\pm$ 0.36c β	3	16.68	< 0.001
2 nd instar	4.97 $\pm$ 0.03a α	4.81 $\pm$ 0.12ab β	4.67 $\pm$ 0.11ab β	4.56 $\pm$ 0.18b γ	3	4.41	< 0.01
Df	3	3	3	3			
F value	0	11.32	48.77	32.68			
P value	1	< 0.001	< 0.001	< 0.001			

¹ Means followed by the same English letters in rows and the same Greek letters in columns were not significantly different.

DISCUSSION

Damage to swede seedlings by wheat bug was caused by directly sucking and loss of plant sap after feeding. Gurr (1957) stated that feeding punctures were made around the stems of seedlings at ground level and caused a cankerous growth of the tissue. This interfered with the sap flow and often resulted in the collapse of the plant.

The degree of damage usually depends on the number of insect pests present and their development stage (Dent 1991). Eyles (1965) assessed wheat bug damage on seedlings of five brassica species and concluded that the resultant damage by either adults or nymphs, was much the same and their effect on each species was similar. However, the present study did not support his conclusion, and showed that adults were significantly more damaging than immature stages at any density level. This is common in many other insect species. For example, in a study of wheat yield loss caused by cereal aphids, Wratten *et al.* (1979) found that three 4th instar nymphs inflicted the same damage as one adult.

The degree of damage on swede seedlings increased with the development from nymph to adult stage; but no difference could be detected between adult female and male, suggesting that both sexes consumed similar quantities of swede seedling sap. Adult-damaged plants stopped growing 2 d after fed upon by 15 individuals, suggesting that 15 adults can severely affect plant growth.

Compared with the control, adults and 4th instar nymphs significantly reduced the growth rate of plants at the density of 15 individuals, and 2nd instar nymphs at density of 30 individuals, indicating that the degree of damage was directly related to the developmental stages and density of wheat bug. This information may be important for calculation of economic threshold for wheat bug on swede seedlings.

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