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Food Preference in the Cabbage Bug *Eurydema ornatum* (L.) (Heteroptera: Pentatomidae)

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Abstract.- The food preference of *Eurydema ornatum* (L.) (Heteroptera: Pentatomidae) was determined in six cultivated plants belonging to Cruciferae; white cabbage, broccoli, cauliflower, brussels sprouts, red cabbage and radish. Experiments were conducted at 25±1ºC, 55±5% relative humidity with a 16 h light : 8 h dark photoperiod in the laboratory. The results indicated that significant difference was seen in nympal stage, adult stage and together with nympal and adult stages. While the most preferred plant was found as white cabbage, the lowest preference was seen in brussels sprouts in nympal stage. On the other hand, while white cabbage and cauliflower were found the most preferred plants, the lowest preference was seen in brussels sprouts in adult stage. When the nympal and adult trials was evaluated together with, white cabbage was found the most preferred plant and brussels sprouts was found the lowest preferred plant.

Key words: *Eurydema ornatum*, food preference, white cabbage, broccoli, Brussels sprouts, cauliflower, red cabbage, radish.

INTRODUCTION

The cabbage bug, *Eurydema ornatum* (L.) (Heteroptera: Pentatomidae), is distributed over large parts of the Palearctic Region, especially Europe and the Mediterranean countries (Lodos, 1982; Rosca and Popov, 1982; Aukema, 1993). *E. ornatum*, an oligofag species, is especially found on wild or cultivated cabbages (Cruciferae) (Lodos *et al*., 1978; Lodos, 1982; Aukema, 1993; Fent and Aktac, 1999; Ozder and Kilincer, 1999; Safarova, 2000).

The bug damages crops with their piercing/sucking mouthparts by injecting digestive enzymes into the crop which helps liquify plant tissues for easy extraction by the bug and by feeding on the plant juices or the (developing) seeds. Nymphs as well as adults feed by sucking leaves, blooms and developing seeds. Many punctures may cause the complete yellowing of leaves and pods. Young plants heavily attacked may die. Furthermore, plants are also contaminated with the bad scent of the bug (Lodos, 1982).

The bug has five nymphal stages. Adults hibernate in cracks or crevices in the soil, trees or walls, under stones or fallen leaves. Adults become active as soon as mild temperatures occur, they copulate and oviposition starts 3-5 weeks later. Eggs are attached to the underside of the leaves in two rows 8-12 eggs in each oviposition. Recently hatched nymphs stay closed to the egg shells. After the 1st instar they gradually disperse (Lodos, 1982).

Several fauna studies on *E. ornatum* were seen in literature from different countries (Rosca and Popov, 1982; Aukema, 1993; Safarova, 2000; Aukema, 2003; Derjanschi and Péricart, 2005; Nau, 2005; Slade *et al.*, 2005). Moreover, several studies have been concentrated on its damage and control methods (Bonnemaison, 1965; Khan *et al.*, 1991; Eilenberg *et al.*, 1992; Biever *et al.*, 1994).

On the other hand, studies indicated that *E. ornatum* has also been subjected to the biological control programme of *Eurygaster integriceps* Put. (Het., Scutelleridae), which is the most important pest of wheat. There are reports that the egg parasitoid, *Trissolcus* spp. (Hymenoptera: Scelionidae) can be reared on the eggs of both hosts in the laboratory. *T. semistriatus* Nees was obtained from eggs of *E. integriceps* and *E. ornatum* in nature and reared in both hosts in the laboratory (Suntsova and Shirinyan, 1974; Laraici, 1979; Oncuer and Kivan, 1995). Although these results showed that emergence rate of *T. semistriatus* from eggs of *E. ornatum* was very low and *E. integriceps*

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is more suitable host than *E. ornatum* for the propose of rearing the parasitoid, *T. semistriatus*, Kivan (1998) emphasized that the existence of *E. ornatum* eggs in nature was very considerable sutiation in order to be continued existence of *T. semistriatus.*

Kıvan and Kilic (2000) reared *E. ornatum* on seeds of radish, red cabbage, white cabbage, oilseed rape, garden cress and cauliflower seeds, and they suggested that seeds of garden cress and radish could be used as food sources for mass production of *E. ornatum*.

Although *E. ornatum* can give huge damages to cultivated cabbage leaves, no literature is available about rearing enterprise of *E. ornatum* on cultivated cabbage leaves. Similarly, food preference of *E. ornatum* has not been studied up to now.

In order to fill these gaps, the food preference of *E. ornatum* was studied on leaves of different cultivated cabbage plants: broccoli (*Brassica oleracea* L. var. *italica*), Brussels sprouts (*Brassica oleracea* L. var. *gemmifera*), cauliflower (*Brassica oleracea* L. var. *botrytis*), red cabbage (*Brassica oleracea* L. var. *rubra*), cabbage (*Brassica oleracea* L. var. *capitata*) and radish (*Raphanus sativus* L.).

MATERIALS AND METHODS

Material

Eurydema ornatum adults were collected from the broccoli, cauliflower and cabbage fields in Bergama (Izmir-Turkey) in autumn before their overwintering stage. The collected individuals were maintained on cauliflower and cabbage plants covered with cages (23 cm x 30 cm) in the laboratory. The culture was kept at 25±1ºC, 55±5% relative humidity with a 16 h light: 8 h dark photoperiod.

Plants

In food preference experiments of *E. ornatum*, six plants from Cruciferae family were used. These are broccoli (*Brassica oleracea* L. var. *italica*), Brussels sprouts (*Brassica oleracea* L. var. *gemmifera*), cauliflower (*Brassica oleracea* L. var. *botrytis*), red cabbage (*Brassica oleracea* L. var. *rubra*), cabbage (*Brassica oleracea* L. var. *capitata*) and radish (*Raphanus sativus* L.).

Experiment design

The nymphal and adult food preferences of *E. ornatum* were examined in the six cultivated different plants. The nymphal food preference was tested in four different stages, (stage II, III, IV and V). The first instar nymphs weren't taken to evaluation. Because they are either on the eggs or around them as groups don't actively fed. The experiments were conducted in plastic containers with the size of 20 x 25 x 23 cm. Upper side of the containers were covered with a muslin cloth. At the bottom of the container, in a 6 cm diameter six holes which are equally distant to each others were opened. These holes were covered with a muslin cloth. With the help of opening small split on muslin cloth, a stem of a plant which has average 4-5 leaves was located into a container. Six different plants were located to one container with the same method. In order to prevent insect escaping, a piece of sponge was attracted to each splits on muslin clothes. Pure water was supplied to nymphs with the use of small pots. The water pot was covered with a stretch film and with the help of opening small split on stretch film, a filter paper was attached to the pot which was filled with pure water. Then the water pot was located at the bottom of each container. Before the experiment, all nymphs were starved 16 h, but feed by pure water rearing cages.

Adult food preference was also studied in four stages. These are female in preoviposition, female in oviposition; newly emerged male, and males and females without considering the age differences. Same size containers and same procedures were used as in nympal stage experiments.

All experiments were conducted at 25±1ºC, 55±5% relative humidity with a 16 h light: 8 h dark photoperiod in the laboratory. The experiments were conducted with 4 replications in both nympal and adult trials and 40 insects were used for each replications. After releasing the insects to the containers in both nympal and adult trials, the proportion of *E. ornatum* in plants, in water, out of plants and water, and dead insect was defined at four time intervals (1, 4, 8, and 24 h). However, only proportion of the insect in plants was evaluated in food preference experiments.

Table I.- The proportion of nymphal and adult stages of *Eurydema ornatum* in six different plants, in water, out of water and plants and dead insect.

Stage	Proportion (%)			
	In plants	In water	Out of plants and water	Dead
2 nd instar nymph	79.98	7.03	10.16	2.83
3 rd instar nymph	78.88	7.81	10.15	3.16
4 th instar nymph	86.39	5.93	6.09	1.59
5 th instar nymph	86.69	4.53	8.12	0.66
Females in preoviposition	89.35	4.37	6.28	0.00
Females in oviposition	91.53	4.84	3.43	0.20
Male (newly emergenced)	91.54	3.59	4.21	0.66
Male + Female	86.69	5.93	6.40	0.98

The one way ANOVA Module of SPSS/PC+ packet programme (SPSS 15.0 for Windows) was used to perform statistical analyses. The difference was accepted meaningful as statistical when the P value was calculated smaller than 0.05. Student-Newman-Keuls test was done to determine the food preference of *E. ornatum* in the related period to date.

RESULTS

The proportion of nymphal and adult stages of *Eurydema ornatum* in six different plants, in water, out of water and plants and dead insect was given in Table I. Results indicated that both nympal and adult stages of *E. ornatum* mostly preferred to the plants. When the proportion of food in nymph instars changed between 78.88% and 86.69%, the proportion of food on adult stages changed between 86.69% and 91.54%.

The results also indicated that no difference in the number of nymph and adult was observed in different time intervals. Therefore, in the subsequent statistical analyses the data for different time intervals in each nymph and adult application were pooled and regarded as one group. The food preference of nymphal and adult stages of *Eurydema ornatum* in six different plants was given in Table II.

All host plants were suitable for different nympal stages of *E. ornatum*. However, significant difference was seen among to six plants (df= 5; P= 0.000). White cabbage was found the most preferred plant in all nympal stages. This was followed by cauliflower, red cabbage, broccoli, radish and brussels sprouts, respectively (P≤0.05) (Table II).

Similarly, all these plants were suitable for adult trials. However, significant difference was seen among to six plants (df = 5; P = 0.000). White cabbage and cauliflower were found the most preferred plants among the six plants. This was followed by red cabbage radish and broccoli. The lowest preference was seen in brussels sprouts (P≤ 0.05) (Table II).

In order to evaluation of food preferences in nymphal trials, adult trials and together with both nympal and adult trials, the food preference scale developed by Karsavuran and Oncuer (1993) was used. With the use of the method, host preference was graded (Table III).

According to Table III, food preference in nymphal trials was arranged in order white cabbage, cauliflower, red cabbage, broccoli, radish and brussels sprouts. However, in adult trials, white cabbage and cauliflower were found the most preferred plants among the six plants. This was followed by radish, red cabbage broccoli and brussels sprouts, respectively. When the nympal and adult trials was evaluated together with, white cabbage was found the most preferred plant. This was followed by cauliflower and red cabbage, respectively. On the other hand, there was no significant difference between broccoli and radish, and the lowest preference was seen in brussels sprouts.

Table II.- The food preference of nymphal and adult stages of *Eurydema ornatum* in six different plants.

Stage	The proportion in plants (%) [1,2]						F
	Broccoli	Brussels sprouts	Cauliflower	Red cabbage	White cabbage	Radish	
2 nd instar nymph	7.65±0.80 d (0.00-12.50)	1.25±0.45 e (0.00-5.00)	22.03±1.05 b (15.00-30.00)	13.90±1.42 c (5.00-25.00)	28.75±1.79 a (17.50-45.00)	6.40±1.11 d (0.00-15.00)	76.487
3 rd instar nymph	10.15±1.33 cd (0.00-20.00)	0.93±0.44 e (0.00-5.00)	21.09±1.75 b (7.50-35.00)	13.75±1.75 c (0.00-30.00)	25.15±1.10 a (17.50-35.00)	7.81±1.40 d (0.00-20.00)	41.729
4 th instar nymph	11.40±0.94 cd (2.50-17.50)	1.09±0.45 e (0.00-5.00)	23.75±1.11 b (12.50-30.00)	14.06±1.38 c (5.00-25.00)	27.34±1.57 a (17.50-40.00)	8.75±0.94 d (2.50-12.50)	74.505
5 th instar nymph	10.46±1.71 d (0.00-27.50)	1.87±0.53 e (0.00-5.00)	21.87±1.47 b (12.50-35.00)	15.78±1.15 c (5.00-22.50)	27.03±1.44 a (20.00-37.50)	9.68±1.11 d (0.00-17.50)	49.158
Female in preoviposition	9.68±1.32 b (0.00-17.50)	1.25±0.45 c (0.00-5.00)	24.37±1.65 a (12.50-37.50)	13.59±1.20 b (5.00-25.00)	28.59±2.42 a (15.00-50.00)	11.87±1.28 b (0.00-20.00)	43.978
Female in oviposition	12.81±0.96 b (7.50-20.00)	2.18±0.59 c (0.00-7.50)	25.15±1.19 a (15.00-32.50)	13.43±1.11 b (7.50-17.50)	24.37±1.34 a (15.00-32.50)	13.59±0.99 b (7.50-20.00)	64.729
Male (newly emergenced)	8.43±1.36 b (0.00-17.50)	1.25±0.39 c (0.00-5.00)	30.00±1.40 a (20.00-42.50)	11.09±1.29 b (0.00-17.50)	28.90±1.62 a (17.50-40.00)	11.87±1.19 b (0.00-17.50)	83.043
Female+Male	12.65±1.05 b (2.50-20.00)	2.81±0.64 c (0.00-7.50)	23.90±2.15 a (7.50-35.00)	9.84±1.19 b (0.00-15.00)	27.65±1.77 a (20.00-50.00)	9.84±1.17 b (0.00-17.50)	44.048

[1] Within lines, means followed by the same letter do not differ significantly ($p \leq 0.05$).
[2] Figures are values ± S.E.; in parentheses, the range of minimal and maximal values.

Table III.- The food preference of nymphal trials, adult trials and both nympal and adult trials of *Eurydema ornatum* in six different plants.

Stage	Broccoli	Brussels sprouts	Cauliflower	Red cabbage	White cabbage	Radish
2 nd instarnymph	4	6	2	3	1	5
3 rd instar nymph	4	6	2	3	1	5
4 th instar nymph	4	6	2	3	1	5
5 th instar nymph	4	6	2	3	1	5
Total	**16**	**24**	**8**	**12**	**4**	**20**
Female in preoviposition	5	6	2	3	1	4
Female in oviposition	5	6	1	4	2	3
Newly emergenced male	5	6	1	4	2	3
Female+Male	3	5	2	4	1	4
Total	**18**	**23**	**6**	**15**	**6**	**14**
General total	**34**	**47**	**14**	**27**	**10**	**34**

DISCUSSION

A limited studies was realized about food preference of *Eurydema ornatum* on seeds of Cruciferae (Atalay and Caglayan, 1990; Kivan and Kilic, 2000). However, this is the fist study about food preference of *E. ornatum* on cultivated cabbage leaves. It was concluded that these laboratory

observations can provide useful information on the food preference of nympal and adult *E. ornatum* in six cultivated plants belonging to Cruciferae. In general, cultivated plants belonging to Cruciferae such as white cabbage, broccoli, cauliflower, brussels sprouts, red cabbage and radish are growing together with the same field, and *E. ornatum* can be very harmful on these plants. Therefore, food preference should be taken into consideration in control methods of *E. ornatum*. The results showed that white cabbage and cauliflower were found the most preferred plants. This means that the most damage was given to these plants in mixed planting. Thus, in pesticide application especially in seedling stages, these food preference should be evaluated in order to decrease the damage.

On the other hand, it was also concluded that these laboratory observations can provide useful information for the biological control programme of *Eurygaster integriceps*, which is the most important pest of wheat. When the rearing of *E. ornatum* which is the secondary host of the egg parasitoid, *T. semistriatus* is put on the agenda, the hosts plants of *E. ornatum* which are belonging to Cruciferae may gain importance. This means that food preference of *E. ornatum* should be evaluated in order to rear *T. semistriatus* in laboratory conditions. However, in order to confirm that detailed biological studies on effect of host diets at tritrophic levels should be realized.

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