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ROLE OF HOST AND TEMPERATURE ON THE FEEDING AND OVIPOSITION BEHAVIOUR OF RED PUMPKIN BEETLE *Aulacophora foveicollis* (LUCAS)

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ABSTRACT

The research was carried out in the field and laboratory of the Department of Entomology, Bangladesh Agricultural University, Mymensingh during December, 2011 to October, 2012 on the effect of host and temperature on oviposition and food consumption of red pumpkin beetle (RPB), *Aulacophora foveicollis* (Lucas). Three cucurbitaceous vegetables viz. sweet gourd (BARI Misti Kumra-1, BARI Misti Kumra-2 and Local Misti Kumra), bitter gourd (BARI Karola-1, Taj Karola-88 and Local Karola) and bottle gourd (BARI Lau-3, BARI Lau -4 and Local Lau) were selected to conduct this research. Host plants had the clear role on the feeding of red pumpkin beetle. Due to feeding of *A. foveicollis*, the highest percentage of weight loss of leaf was recorded from sweet gourd among the selected cucurbits while Local Misti Kumra was found the most preferred host by beetle considering their feeding efficacy compared to other varieties. Results also showed that temperature had a profound effect on the oviposition and food consumption by *A. foveicollis* while 30^{o}C was the optimum temperature both for oviposition and food consumption for all selected cucurbits and their varieties.

Key Words: Role, Host, Temperature, Feeding, Oviposition, Behaviour, Red pumpkin beetle

INTRODUCTION

Cucurbits are one of the most important vegetables in Bangladesh principally cultivated in summer season during the scarcity of other vegetables. Cucurbits form the largest group of vegetables where the bottle gourd, sweet gourd, bitter gourd, ridged gourd, sponge gourd, teasel gourd, white gourd, ash gourd, cucumber are cultivated as major vegetable in Bangladesh. Cucurbits have a good nutritive value as well as medicinal value. All the cucurbits have a good market value which encourages the farmer to cultivate gourds in large scale. The total area of cucurbit crops is around 81,720 hectares and the total production is about 3,08,096 tons (CRDS, 2010). Although cucurbits are summer crop but some of them can be grown throughout the year because of their photo insensitiveness. The climate of Bangladesh is favourable for growing most of the vegetable crops specially cucurbits.

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Cucurbit production is severely affected by a number of insect pests such as red pumpkin beetle, cucurbit fruit fly, epilachna beetle etc. Among them red pumpkin beetle, *Aulacophora foveicollis* (Lucas) is one of the major constraint to its production capable of 30-100% yield loss (Alam, 1969; Gupta and Verna, 1992 and Dillon *et al.,* 2005) especially at seedling stage (Rajak, 2001). It is polyphagous in nature and attacks more than 81 plant species including bottle gourd, sweet gourd, bitter gourd, ridged gourd, sponge gourd, teasel gourd, white gourd, ash gourd, cucumber, squash, water melon, etc. and a wide range of fruit crops (Doharey, 1983). In Bangladesh, red pumpkin beetle, *A. foveicollis* causes severe damage of cucurbitaceous vegetables (Alam, 1969; Azim, 1966 and Butani and Jotwani, 1984).

This pest is widely distributed all over the South-East Asia as well as the Mediterranean region towards the West and Australia in the East (Butani *et al.,* 1984). The adult beetle is red, oblong and approximately 6-8 mm long and lays its eggs at the base of the cucumber stem. After hatching young grub feed on roots, underground stem, stem and fruits touching to the soil as a result plant become wilted causing direct damage to the newly developed seedlings (Narayanan, 1960). The adult beetles feed voraciously on the leaf lamina making irregular holes (Butani and Jotwani, 1984). They also attack anthers, pollen, stigma and ovary rendering the flowers incapable of fruiting. The beetles also injure fruits, producing characteristic circular bands of injury which help in rotting and subsequent attack of diseases of the fruits. The pest, however, occurs throughout the year and causes severe damage to the crops especially at seedling stage (Rajak, 2001).

The severity as well of extent of damage is dependent on biotic and abiotic factors such as host preference, oviposition behavior, nature of food consumption, environmental conditions etc. According to Gupta and Verma, 1992 and Dhillon *et al.*, 2005, depending on the environmental conditions and susceptibility of the crop species, the extent of damage by red pumpkin beetle varies between 30 to 100%. To manage this serious pest it is necessary to study the effect of host and temperature on the feeding and oviposition of red pumpkin beetle. But information on this topic is scanty. Therefore, the current study was planned to investigate on the red pumpkin beetle with the following objectives:

i. to measure the food consumption of the beetle among different crops and varieties of cucurbits in the laboratory
ii. to investigate the effect of temperature on the feeding and oviposition of the adult beetle

MATERIALS AND METHODS

Experiments were conducted in the laboratory of the Department of Entomology, Bangladesh Agricultural University (BAU), Mymensingh during December, 2011 to October, 2012. The test plants of three cucurbitaceous vegetables such as sweet gourd (BARI Misti Kumra-1, BARI Misti Kumra-2 and Local Misti Kumra), bitter gourd (BARI Karola-1, Taj Karola-88 and Local Karola) and bottle gourd (BARI Lau-3, BARI Lau -4 and Local Lau) were grown in the field laboratory, Department of Entomology with maintaining all recommended agronomic practices to conduct the research work for which the quality seeds were collected from Bangladesh Agricultural Research Institute (BARI), Gazipur and seed stores of Mymensingh town.

To estimate the food consumption, two adult beetles were released in each petri dish containing a leaf each of nine varieties. Three petri dishes were maintained for each variety. Fresh leaves of plants were supplied daily. The cut end of leaf petiole was provided with water soaked cotton pad to prevent withering of leaf. Food consumption was determined by measuring the weight loss of consumed leaf by the beetle using an electric balance. This experiment was carried out up to seven days. Weight loss of leaf was calculated as percentage. Percentage weight loss was calculated by deducting the % weight loss of fresh leaf from the eaten leaf by the beetle. Pooled means for three crops calculated from the mean values of three varieties of each crop.

To study the influence of temperature on the food consumption and oviposition of the beetle, experiments were conducted at three distinct temperatures viz. 15°C, 25°C and 30°C on three nine varieties of cucurbitaceous vegetables with three replications for each in the laboratory using an incubator. Two adult red pumpkin beetles (male + female) were released in each Petri- dish with leaves as food and then these petri dishes were put inside the incubator. The experiment was replicated three times. The quantity (mm^2) of food consumed by adult beetles per day was measured using square millimeter graph paper simultaneously the number of eggs laid on each variety was counted.

Data obtained from different experiments were analyzed using a statistical package program MSTAT-C and the mean values were ranked by Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Role of different hosts on food consumption of red pumpkin beetle

Role of different crops

Food consumption of red pumpkin beetle varied significantly on leaves of different cucurbit crops (Table 1). Due to feeding of red pumpkin beetle the highest percentage of weight loss was recorded on sweet gourd (13.68%) and the lowest was recorded on bitter gourd (3.14%) where the moderate weight loss was recorded on bottle gourd (7.97%). Percentage weight lost due to beetle feeding indicated that host plants had some effect on the food consumption of red pumpkin beetle.

Role of different varieties

Percentage weight loss of leaves due to the feeding of red pumpkin beetle on nine selected varieties showed that the highest percentage of weight loss was on Local Misti Kumra (15.34%) followed by BARI Misti Kumra-1 (12.92%) and BARI Misti Kumra-2 (12.78%) whereas the lowest percentages of weight loss was (2.85%) on BARI Karola-1 followed by Local Karola (2.95%) and Taj Karola-88 (3.62%) due to feeding of red pumpkin beetle (Table 2). Therefore, it can be concluded that cucurbit varieties influenced the food consumption of red pumpkin beetle.

Table 1. Percentage of weight loss of leaf among three cucurbit crops in laboratory

Crop	Percentage weight loss of leaf day^{-1}
Sweet gourd	13.68[a]
Bitter gourd	3.14[c]
Bottle gourd	7.97[b]
Mean	8.26
± SE	3.04
LSD value	2.07
Level of significance	0.01
CV (%)	10.67

Means followed by common letters are not significantly different

Table 2. Percentage of weight loss of leaf among nine cucurbit varieties in laboratory

Crop	Variety	Percentage of weight loss of leaf day^{-1}
Sweet gourd	BARI Misti Kumra-1	12.92[b]
	BARI Misti Kumra-2	12.78[b]
	Local Misti Kumra	15.34[a]
Bitter gourd	BARI Karola-1	2.85[d]
	Taj Karola-88	3.62[d]
	Local Karola	2.95[d]
Bottle gourd	BARI Lau-3	8.45[c]
	BARI Lau-4	7.62[c]
	Local Lau	7.85[c]
Mean		8.27
± SE		1.54
LSD value		1.51
Level of significance		0.05
CV (%)		10.67

Means followed by common letters are not significantly different

Present findings reveal that the daily food consumption of red pumpkin beetle was highly influenced by the hosts. Therefore, it can be concluded that both the crops and varieties have profound role on the food consumption of red pumpkin beetle. This result was in agreement with the observation with Hasan *et al.,* 2012; Khan *et al.*, 2011 and Rajak, 2001 but differed from the finding of Begum, 2002.

Effect of temperature on oviposistion of red pumpkin beetle

Among different crops

The egg laying performance on three cucurbits at different controlled temperatures varied significantly. The maximum number of egg was laid at 30^{o}C temperature followed by 25^{o}C and the lowest at 15^{o}C (Table 3). At 30^{o}C temperature, the maximum number of egg was

laid on the sweet gourd (19.89) followed by bottle gourd (14.78) and minimum egg was laid on the bitter gourd (8.89). At 25°C temperature, no egg was laid on bitter gourd whereas the highest number of eggs (17.0) was laid on sweet gourd followed by bottle gourd (11.11). At 15°C temperature, no egg was laid on bitter gourd by RPB and the highest (9.78) was found on sweet gourd followed by bottle gourd (7.67). Among three temperature 30°C was the optimum for the beetle oviposition where they laid maximum number of eggs.

Table 3. Effect of temperature on oviposition in incubator among three cucurbit crops

Crop	No. of eggs laid per day at different temperature		
	15°C	**25°C**	**30°C**
Sweet gourd	9.78[a]	17.00[a]	19.89[a]
Bitter gourd	0.00[c]	0.00[c]	8.89[c]
Bottle gourd	7.67[b]	11.11[b]	14.78[b]
Mean	5.81	9.37	14.51
± SE	2.97	4.98	3.18
LSD value	2.02	2.63	3.56
Level of significance	0.01	0.01	0.01
CV (%)	14.80	11.98	10.44

Means followed by common letters are not significantly different

Among different varieties

At 15°C in incubator, among nine varieties the highest egg was laid on BARI Misti Kumra1(10.67) followed by BARI Misti Kumra-2 (10.00) and Local Misti Kumra and Local Lau (8.67) which were statistically identical (Table 4). The lowest number of egg was laid on BARI Lau-4 (6.67) followed by BARI Lau-3 (7.67). No egg was laid on three bitter gourd varieties. At 25°C in incubator, the highest egg was found on Local Misti Kumra (20.67) followed by BARI Misti Kumra-2 (15.67) and BARI Misti Kumra-1 (14.67). The lowest number of egg was laid on BARI Lau-4 (10.33) followed by BARI Lau-3(11.00) and local Lau (12.00). No egg was found on three bitter gourd varieties at 25°C temperature. At 30°C in incubator, the highest egg was laid on Local Misti Kumra (23.67) followed by BARI Misti Kumra-2 (18.67) and BARI Misti Kumra-1 (17.33). The lowest number of egg was laid on Local Karola (8.00) followed by Taj Karola-88 (8.33) and BARI Karola-1 (10.33). Among three temperatures 30°C was found optimum for the beetle oviposition. This result agrees with the result of Das *et al.* (2012) where they stated that temperature had effect on the oviposition of epilachna beetle among different brinjal varieties.

Effect of temperature on food consumption of red pumpkin beetle

Among different crops

At 15, 25 and 30°C temperature the highest daily food consumption was recorded on sweet gourd which were 21.03 mm^2, 35.74 mm^2 and 52.84 mm^2 followed by bottle gourd on which

food consumptions were 14.35 mm², 17.55 mm² and 21.64 mm², respectively whereas the lowest food consumption per day at 15, 25 and 30°C temperature recorded on bitter gourd were 4.02 mm², 4.61 mm2 and 5.67 mm². The food consumption differed significantly among three cucurbit crops (Table 5). It was noticed that 30°C temperatures was congenial for food consumption by adult beetles.

Table 4. Effect of temperature on oviposition in incubator among nine cucurbit varieties

Crop	Variety	No. of eggs laid per day at different temperature		
		15°C	**25°C**	**30°C**
Sweet gourd	BARI Misti Kumra-1	10.67^{a}	14.67^{b}	17.33^{bc}
	BARI Misti Kumra-2	10.00^{ab}	15.67b	18.67^{b}
	Local Misti Kumra	8.67^{bc}	20.67^{a}	23.67^{a}
Bitter gourd	BARI Karola-1	0.00^{e}	0.00^{d}	10.33^{de}
	Taj Karola-88	0.00^{e}	0.00^{d}	8.33^{e}
	Local Karola	0.00^{e}	0.00^{d}	8.00^{e}
Bottle gourd	BARI Lau-3	7.67^{cd}	11.00^{c}	14.33^{c}
	BARI Lau-4	6.67^{d}	10.33^{c}	13.67^{cd}
	Local Lau	8.67^{bc}	12.00^{c}	16.33^{bc}
Mean		5.82	9.370	14.51
± SE		1.50	2.55	1.71
LSD value		1.47	2.637	3.561
Level of significance		0.05	0.01	0.01
CV (%)		14.80	11.98	10.44

Means followed by common letters are not significantly different

Table 5. Effect of temperature on adult food consumption (mm²) in incubator among three cucurbit crops

Crop	Daily adult food consumption at different temperature (mm²)		
	15°C	**25°C**	**30°C**
Sweet gourd	21.03^{a}	35.74^{a}	52.84^{a}
Bitter gourd	4.02^{c}	4.61^{c}	5.67^{c}
Bottle gourd	14.35^{b}	17.55^{b}	21.64^{b}
Mean	13.13	19.29	26.71
± SE	4.95	9.03	13.85
LSD value	4.38	4.26	6.22
Level of significance	0.01	0.01	0.01
CV (%)	14.21	9.39	9.92

Means followed by common letters are not significantly different

Among different varieties

Daily food consumption of RPB differed significantly at various temperature among nine varieties of cucurbits (Table 6). At 15°C temperature among nine varieties of cucurbit the

highest daily food consumption was recorded on Local Misti Kumra (28.42 mm^2) followed by BARI Misti Kumra-2 (18.56 mm^2) and BARI Misti Kumra-1 (16.11 mm^2). The lowest food consumption by RPB was observed on the leaf of Taj Karola-88 (2.83 mm^2) followed by BARI Karola-1(3.42 mm^2) and local Karola (5.80 mm^2). The highest daily food consumption by RPB at 25 ^{o}C in incubator was obseved on the leaf of Local Misti Kumra (40.70 mm^2) followed by BARI Misti Kumra-1 (33.99 mm^2) and BARI Misti Kumra-2 (32.52 mm^2). The lowest food consumption by RPB in incubator was observed on the leaf of Taj Karola-88 (3.00 mm^2) followed by BARI Karola-1(4.92 mm^2) and Local Karola (5.89 mm^2). The highest daily food consumption by RPB at 30 ^{o}C in incubator was obseved on the leaf of Local Misti Kumra (65.90 mm^2) followed by BARI Misti Kumra-1(47.69 mm^2) and BARI Misti Kumra-2 (44.93 mm^2). The lowest food consumption was observed on the leaf of Taj Karola-88 (3.42 mm^2) followed by Local Karola (6.42 mm^2). It was noticed that 30^{o}C temperature was congenial for food consumption of adult beetles whereas 15 and 25^{o}C temperature were not as favorable as 30^{o}C temperature but insects were able to survive through feeding. This result was in agreement with the observation with Chaudry and Alikhan, 1990.

Table 6. Effect of temperature on adult food consumption (mm^2) in incubator among nine varieties

Crop	Variety	Daily adult food consumption at different temperature (mm^2)		
		15°C	**25°C**	**30°C**
Sweet gourd	BARI Misti Kumra-1	16.11^b	33.99^b	47.69^b
	BARI Misti Kumra-2	18.56^b	32.52^b	44.93^b
	Local Misti Kumra	28.42^a	40.70^a	65.90^a
Bitter gourd	BARI Karola-1	3.42^d	4.92^e	7.17^e
	Taj Karola-88	2.83^d	3.00^e	3.42^e
	Local Karola	5.80^d	5.89^e	6.42^e
Bottle gourd	BARI Lau-3	17.21^b	20.75^c	27.17^c
	BARI Lau-4	10.41^c	13.41^d	16.67^d
	Local Lau	15.42^b	18.48^c	21.08^{cd}
Mean		13.13	19.29	26.71
± SE		2.77	4.68	7.24
LSD value		4.39	4.26	6.22
Level of significance		0.01	0.01	0.01
CV (%)		14.21	9.39	9.92

Means followed by common letters are not significantly different

From the discussion, it is clear that host crops and their varieties had a great role on the food consumption of red pumpkin beetle. Among three crops and nine varieties sweet gourd and variety Local Misti Kumra had the highest effect on the highest food

consumption of red pumpkin beetle. Bitter gourd and the variety BARI Karola-1 had the lowest role on the food consumption of RPB. Temperature had a profound effect on the food consumption as well as oviposition of RPB. It was also found that 30ºC was found the optimum temperature for food consumption and oviposition for the beetle considering the selected cucurbits and their varieties.

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