HOST PREFERENCE OF RED PUMPKIN BEETLE (*Aulacophora foveicollis*,Lucas) ON DIFFERENT CUCURBITS

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CERTIFICATE

This is to certify that the thesis titled, "Host Preference of Red Pumpkin Beetle (*Aulacophora foveicollis*,Lucas) on Different Cucurbits" submitted to the Dept. of Entomology, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (M.S.) in Entomology** embodies the result of a piece of bona fide research work carried out by Md. SAGAR HASSAIN; Registration No.11-04693 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged by the Author.

Dated: June, 2013
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ABSTRACT

A field experiment was carried out to find out the host preference of red pumpkin beetle at the research field of Sher-e-Bangla Agricultural University, Dhaka, during March 2012 to June 2012. To find out the host preference of red pumpkin beetle (*Aulacophora foveicollis*) on different cucurbits. Eight cucurbitaceous plants(varieties) *viz.* Sweet gourd (*Cucurbita moschata*), Wax gourd (*Benincasa hispida*), Bottle gourd (*Lagenaria siceraria* Molina.) Cucumber (*Cucumis sativus*), Snake gourd (*Trichosanthes dioica*), Ridge gourd (*Luffa acutangula*), Sponge gourd (*Luffa cylindrica*) and Bitter gourd (*Momordica charantia*) were taken to conduct the experiment in Randomized Completely Block Design (RCBD) with three replications. Data were recorded from 4 day after sowing(DAS) to 64 DAS on number of plants pit^{-1}, damage of infested cotyledon(%), number of infested plants pit^{-1}, number of infested leaves plant^{-1}, total number of infested leaves plot^{-1}, damage of infested flowers(%) and damage of infested fruits(%). Sweet gourd cotyledon showed the maximum damage (45.00%) than that of other cucurbits at 9 DAS, all plants of sweet gourd pit^{-1} were infested by red pumpkin beetle. The highest leaf infestation (34.00) was observed at 64 DAS. The highest flower damage(%) plot^{-1} (27.33%) was also observed in sweet gourd at 54 (DAS), whereas the highest damage percentage of infested fruits plot^{-1}(36.67%) was also observed in sweet gourd at 64 DAS. Sweet gourd was found in highly preferred condition by RPB and bitter gourd was found in least preferred condition by red pumpkin beetle in this study.

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ABBREVIATIONS

AEZ	=	Agro-Ecological Zone
Agric.	=	Agriculture
Agril.	=	Agricultural
Anon.	=	Anonymous
ANOVA	=	Analysis of variance
BARC	=	Bangladesh Agricultural Researcher Council
BARI	=	Bangladesh Agricultural Research Institute
BAU	=	Bangladesh Agricultural University
BBS	=	Bangladesh Bureau of Statistics
CRD	=	Completely randomized design
DAS	=	Days after sowing
FAO	=	Food and Agriculture Organization
LSD	=	Least significant difference
RCBD	=	Randomized Complete Block Design
Viz.	=	Namely

CHAPTER I

INTRODUCTION

Bangladesh is a country where vegetable shortage is a common phenomenon. The consumption of vegetable in Bangladesh is about 50 g day^{-1} $capita^{-1}$ which is the lowest amongst the countries of South Asia and South Africa (Rekhi, 1997). But dietitian recommended a daily allowance of 285 g vegetable for an adult person for a balance diet (Ramphall and Gill, 1990). Here people have been suffering from inadequate supply of vegetables since decades. Total annual vegetable production of Bangladesh 1.6 million M tones in winter and 1.5 million M tones in summer season while the cultivated area of Bangladesh 0.47 million acres in winter and 0.65 million acres in summer season (BBS, 2012).

As a result, chronic malnutrition is often seen in Bangladesh. Of the total production, less than 25% is produced during Kharif season and more than 75% is in the Rabi season (Anon., 1993). The major vegetables are cucurbits and they play a prime role to supplement this shortage during the lag period (Rashid, 1993). But their cultivation is interfered by many insect pests. Among them, red pumpkin beetle (RPB) is the major pests and cause considerable damage to all cucurbitaceous crops (Butani and Jotwani, 1984; Yawalker, 1985).

There are several species of this pest reported from different parts of the world. In the adult stage RPB is generally a dark-orange colored oblong beetle of about 5-8 mm in length. They have special preference for the leaves of cucurbit plants except those of bitter gourd on which they have not been reported to feed on any appreciable extent. The commencement of their activity after winter generally corresponds with the early growing season of the spring crop of the cucurbit vegetables. The damage continues to be caused even in the later stages of the crop, but it is not so much serious as in the case of seedlings (Hassan *et al*., 2012). The larval stage of the pest also does considerable damage as it bores into the roots, stems and even the fruits on which the attack starts from the portion resting on the ground. The attacked plants wither and die and the affected fruits become unmarketable.

Among the various insect pests, cucurbit fruit fly viz., *Bactrocera* (Dacus) *cucurbitae* and *Bactrocera* (Dacus) *caudatus* are *Aulacophora foveicollis* (Lucas) is commonly found in Bangladesh (Alam *et al*., 1964). Other species like *Bactrocera cucurbitae*, *Bactrocera tou* and *Dacus ciliata* have been currently identified in Bangladesh of which *Dacus ciliata* is a new record. Red pumpkin beetle (RPB) is the second menacing pest of cucurbits which has been reported as the most destructive one by Butani and Jotwani(1984). The pest is common in the South-East Asia, Africa as well as in Mediterranean region towards west and Australia in the East (McKinlay *et al*., 1992). The beetles may kill cucurbit seedlings and sometimes the crops have to be re-sown of 3-4 times (Azim, 1996). It may cause up to 70% damage on leaves and 60% damage on flowers of cucurbits (Alam, 1969).

The red pumpkin beetle, *Aulacophora foveicollis* (Lucas) is a common, serious and major destructive insect pest of a wide range of cucurbitaceous vegetables and plays a vital role on their yield reduction. It is injurious to the crops and cause severe damage to almost all cucurbits (Hassan, 2012). Shivalingaswamy *et al*. (2008) reported that the maximum population of RPB was active in the month of May. They also reported that such increasing and decreasing trends in red pumpkin beetle population might be due to changes in food availability. Abe *et al*. (2002) reported that the difference in responses of the leaf beetle species to cucurbitacin is possibly related to the host range of the beetle species.

Besides, the adult red pumpkin beetles feed voracioulsy on the cucurbit leaf making irregular holes. They also attack cotyledons and flowers (Butani and Jotwani, 1984). They also reported that the RPB prefer young seedlings and tender leaves and the damage at these stages may even kill the seedlings. The grubs feed on roots and underground portions of host plants as well as fruits touching the soil and thus making such fruits unfit for human consumption. No statistical records are available on the actual loss of cucurbitaceous vegetables due to the attack of this pest. The pest, however, occurs throughout the year and causes severe damage to the crops, especially at the seeding stages (Alam, 1969).

Different cucurbit species cultivated together i.e., mixed cropping, supports a lower herbivore load than monocultures, One factor explaining this trend is that relatively more stable natural enemy population can persist in mixed cropping due to the more continuous availability of food sources and microhabitats. The other possibility is that specialized herbivores are more likely to find and remain on pure crop stands that provide concentrated resources and monotonous physical conditions (Altieri, 1994 and 1995). Every year huge quantity of cucurbit vegetable fruits are damaged by the attack of these pests. Among the cucurbits, the rate of infestation due to this pest may differ in various fruits. Some of them are very much preferred than the others. If we utilize most preferred one as a trap or a barrier crop then the target crop may escape infestation and avoid destruction by this menacing insect pests. The act of attraction for a particular plant is called host preference i.e., an acceptance of a host plant by an insect pest relative to other acceptable hosts. The reverse is likewise called non-preference crop as trap crop to ensure higher yield. Therefore, it needs to identify the less and the most preferred cucurbits to red pumpkin beetle

Reports on host preference of red pumpkin beetle to different cucurbit vegetables are scanty in Bangladesh or elsewhere. If the most preferred cucurbit fruit vegetable could be identified, it might be used as a trap or barrier crop to decrease infestation on target cucurbit vegetable. In view of the above fact, a research program was undertaken with the following objectives:

i. to evaluate the comparative damage caused by red pumpkin on different cucurbit vegetables and
ii. to identify the less and most preferred cucurbit vegetables to red pumpkin beetle on the basis of host preferences.

CHAPTER II
REVIEW OF LITERATURE

The red pumpkin beetle, *Aulacophora foveicollis* (Lucas) is a common, serious and major destructive insect pest of a wide range of cucurbitaceous vegetables and plays a vital role on their yield reduction. It is injurious to the crops and cause severe damage to almost all cucurbits. The study was conducted to find out the host preference of red pumpkin beetle, *Aulacophora foveicollis* (Lucas) among different cucurbit plants in the field of the Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka. For the purpose of this study, the most relevant information pertaining to origin, distribution, host preference, nature of damage of this pest and yield loss due to their attack are given on the following aspects:

2.1 Origin and distribution of red pumpkin beetle

Hutson (1972) reported that the red pumpkin beetle occurs on various cucurbits in Ceylon. Pawlacos (1940) stated *Raphidopalpa foveicollis* (Lucas) as one of the most important pests of melon in Greece. Manson (1942) reported it to occur in Palestine. Azim (1966) indicated that the red pumpkin beetle, *Aulacophora foveicollis* (Lucas), is widely distributed throughout all zoogeographic regions of the world except the Neo-arctic and Neo-tropical region. Alam (1969) reviewed that the red pumpkin beetle, *Aulacophora foveicollis* (Lucas), is widely distributed throughout the Pakistan, India, Afghanistan, Ceylon, Burma, Indo-China, Iraq, Iran, Persia, Palestine, Greece, Turkey, Israel, South Europe, Algeria, Egypt, Cyprus and the Andaman Island. Butani and Jotwani (1984) reported that the RPB is widely distributed all over the South-East Asia as well as the Mediterranean region towards the west and Australia in the east. In India, it is found in almost all the states, though it is more abundant in the northern states (Butani and Jotwani, 1984). According to York (1992), this insect pest is found in the Mediterranean region, Africa and Asia.

2.2 Host range of red pumpkin beetle

Alam *et al*. (1964) reported that bitter gourd, cucumber, snake gourd, sweet gourd, bottle gourd and many others plants are found to be seriously damaged by the red pumpkin beetle. He also indicated that melon, ribbed gourd, sponge gourd, snake gourd, cucumber, teasle gourd and kankri (*Cucumis utilissimus*) are also attacked by RPB in Bangladesh. Pradhan (1969) has reported that the RPB has a special preference for the leaves of cucurbit plants except those of the bitter gourd on which they have not been reported to feed to any appreciable extent.

Azim (1966) reported that the insect feeds on tomato, maize and lucerne besides cucurbits in Greece. In addition, the pest was recorded to attack forest trees like *Dalbergia latifolia*, *Michela champaca* and *Tectona grandis* in India. He also reported that this insect was found to feed on rice plants in Indo-China. Butani and Jotwani (1984) reported that this beetle is a polyphagous pest and prefers cucurbit vegetables and melons. However, some leguminous crops are found as their main alternate hosts. According to Rahman and Annadurai (1985), the RPB is particularly severe pest of pumpkins, muskmelons and bottle gourds, but it appears to be able to feed on any available cucurbits. They also reported that when cucurbits are absent, it is found feeding on other plant families.

According to Uddin (1996), *Aulacophora* sp. is a serious pest of sweet potato and cucurbits attacking cucumber, melons and gourds. Leaves of snake gourd plants at their flowering and fruiting stage were found to be severely damaged by a group of even more than 20 beetles per leaf at Bangladesh Agricultural Research Institute (BARI) farm, Joydebpur, Gazipur.

2.3 Host preferences and nature of damage of red pumpkin beetle

Khan (2013) studied to determine the biochemical composition of cucurbit leaves and their influence on red pumpkin beetle. Result revealed that the highest quantity of moisture was recorded in young leaf of bottle gourd (86.49%) and mature leaf of khira (87.95%). The lowest moisture content was obtained in young leaf of snake gourd (79.21%) and mature leaf of ribbed gourd (76.43%). The highest nitrogen content was found in young leaf (6.79%) of sweet gourd and in mature leaf (5.57%) of bottle gourd. The lowest percentage of nitrogen was found in young leaf (3.64%) of bitter gourd and in mature leaf (2.52%) of ribbed gourd. The highest quantity of total sugar was found in young leaf of bottle gourd (4.90%) and mature leaf of sweet gourd (4.76%). The lowest quantity of total sugar was found in young (2.03%) and mature leaves (2.09%) of bitter gourd. The highest quantity of reducing sugar was estimated from young leaves of musk melon (4.14%) and from mature leaves (4.01%) of sweet gourd. The lowest quantity of reducing sugar was in young (1.85%) and mature (1.83%) leaves of bitter gourd. Relationship of RPB population per leaf with the percent nitrogen, total and reducing sugar content of mature leaves of cucurbits was found positively correlated.

Khan *et al*. (2012) reported that the highest population of RPB was recorded in the month of May. In March, food availability was the lowest because plant were young. In May, plant growth was maximal covering largest canopy. In June, plants were at their senescent stage causing food scarcity. From the present study, it was also found that the highest incidence of pumpkin beetles was observed at around 9:00 am and 6:00 pm, while the lowest incidence was at 2:00 pm. The highest population of red pumpkin beetle on sweet gourd, cucummber, ribbed gourd and sponge gourd was recorded in the month of May.

Khan (2012) studied to find out preferred cucurbit host(s) of the pumpkin beetle and to determine the susceptibility of ten different cucurbits to the pest under field conditions. The results revealed that the most preferred host of the red pumpkin beetle (RPB) was muskmelon, which was followed by khira, cucumber and sweet gourd, and these may be graded as susceptible hosts. Bitter gourd, sponge gourd, ribbed gourd and snake gourd were least or non preferred hosts of RPB and these may be graded as resistant hosts. Other two crops, the bottle gourd and ash gourd were moderately preferred hosts of the insect and these may be graded as moderately susceptible hosts. According to his result, it indicate that the order of preference of RPB for ten tested cucurbit hosts was muskmelon> sweet gourd> cucumber > khira > ash gourd > bottle gourd > sponge gourd ≥ ribbed gourd ≥ snake gourd > bitter gourd.

Host preference of Red Pumpkin Beetle, *Aulacophora foveicollis* was studied by Khan *et al*. (2011) among ten cucurbitaceous crops (viz., sweet gourd, bottle gourd, ash gourd, bitter gourd, sponge gourd, ribbed gourd, snake gourd, cucumber, khira and muskmelon). At 1, 6, 12 and 24 hours after release (HAR), RPB population was found highest on sweet gourd. At 48 HAR the highest peak was found on muskmelon. The population of RPB on those two crops was significantly different only at 6 HAR. The populations of RPB on ash gourd, ribbed gourd, cucumber and khira ranged 1.00-3.33, 0.00-2.00, 0.67-1.67 and 0.00-2.00 per two plants, respectively. Three crops (Sweet gourd, musk melon and ash gourd) may be noted as highly preferred hosts of RPB. Bitter gourd was free from infestation and it was noted as non-preferred host. On khira and cucumber average population of RPB was 1.07-1.53 per two plants. On other cucurbits, population of RPB was less than one accordingly the highest percentage of leaf area damage per plant was observed on musk melon leaves followed by sweet gourd and ash gourd. The lowest percentage of leaf area damage was found on snake gourd followed by sponge gourd and bottle gourd. This insect showed different preference for various host species. Sweet gourd (pumpkin), *Cucurbita maxima* Duch. was the preferred host. In the present study sweet gourd and wax gourd were found to be the most preferred host of red pumpkin beetle and bitter gourd was found as non preferred host of RPB. The highest percentage of leaf area damage per plant was observed on sweet gourd leaves followed by wax gourd. The lowest percentage of leaf area damage per plant was on snake gourd leaves followed by sponge gourd and bitter gourd.

An experiment was conducted on the host preference of *Aulacophora foveicollis* Lucas (Coleoptera, Chrysomelidae) on melon *Cucumis melo*, snake cucumber *C. flexuosus*, cucumber *C. sativus* and bottle gourd *Lagenaria siceraria*. Descending order of host preference was *C. melo, C. sativus* and *L. siceraria* for both 1975 and 1978 seasons. Yet, the first three crops did not differ significantly in their preference from each other and, thus, can be regarded collectively as the beetle's first choice.

A field experiment was conducted by Shivalingaswamy *et al*. (2008) at Research Farm of Indian Institute of Vegetable Research, Variance during 2001-2002 (summer). Twenty seven diverse genotypes including some popular cultivars of bottle gourd were sown in plots (3 m x 2 m) with three replications. After 15 days of germination, the damage level in terms of damaged leaf area was recorded on newly "merging seedlings at 4-6 leaf stages. The findings indicated that none of the genotypes and cultivars was free from the infestation by red pumpkin beetle (Table 1). The average damage leaf area among test cultivars varied from 17.45% in VRBG-50 to 34.32% in NDBG-56. Only four cultivars that recorded less damage were VRBG-50 (17.45%), VRBG-48 (17.79), VRBG-43 (17.83%), VRBG-17 (18.31 %). On the other extreme, the cultivars manifesting greater susceptibility to the beetle damage were NDBG-56 (34.32%), PSPL (33.77%), DVBG-2 (1) (29.17%) and VRBG-46 (28.55%).

The relative abundance of Red Pumpkin Beetle, *Aulacophora foveicollis* L. on different cucurbitaceous vegetables was carried out by Saljoqi and Khan (2007) from the first week of May, 1998 up to the second week of August, 1998 in the Peshawar valley. Out of eleven varieties, Squash and Cucumber varieties hosted more population of Red Pumpkin Beetle during the cropping season. Two Cucumber (*Cucumis sativus*) varieties, F1-Beitalpha, SK-Marketmore and two Squash (*Cucurbita pepo*) varieties, Light Green Zucchini, Local Round Green were found susceptible to the attack of the Red Pumpkin Beetle and supported 8.48, 8.20, 8.52 and 7.29 mean number of Red

Pumpkin Beetle, respectively. Two Sponge Gourd (*Luffa scutannils*) varieties, RKS-6, RKS-7 and three Gourd (*Lagenaria siceraria*) varieties, DIK Round Green, SW Sweet Yellow and Bottle Gourd Long varieties were found moderately susceptible to the attack of the Red Pumpkin Beetle, on which 4.00, 4.50, 3.54, 5.47 and 3.56, average number of Red Pumpkin Beetle were recorded, respectively. Mean number of 0.12 and 1.02 of Red pumpkin Beetle were found on two Bitter Gourd (*Momordica charentia*) varieties Jaunpuri, Jhalri, respectively and found comparatively more resistant to the Red Pumpkin Beetle. The infestation of Red Pumpkin Beetle was high from May 7 to June 18, 1998, while from June 25 to August 13, 1998, the population gradually declined.

Host preference of eight cucurbit crops i.e., watermelon, long melon, cucumber, ridge gourd, bottle gourd, muskmelon, sponge gourd and tinda gourd against red pumpkin beetle, *Aulacophora(Raphidopalpa) foveicollis*(Lucas) was investigated by Mahmood *et al*. (2005). Long melon and muskmelon was the most favorable host and no plant reached to 5 true leaves stage after germination. Cucumber, watermelon, ridge gourd and tinda gourd were also preferred by red pumpkin beetle but the damage was not as severe as seen in muskmelon and long melon, bottle gourd was medium in preference while sponge gourd was the least preferred host as all plants reached to 5 true leaves stage after germination.

Host preference of red pumpkin beetle, *Aulacophora foveicollis* (Lucas) was studied by Deepak *et al*. (2004) on sixty-eight indigenous germplasm lines of cucumber during 2002. These germplasm lines were grown in randomized block design with three replications. Data were collected on infestation by red pumpkin beetle on plants at different stages like cotyledonary, true leaf, flowering and fruiting of crop. Eight germplasm lines (PCUC7, PCUC36, PCUC47, PCUC66, PCU99, PCUC102, PCUC108 and PCUC110) showed resistance against red pumpkin beetle. These genotypes may be for used in future resistance breeding in cucumber.

Ten cultivated species of cucurbit plants, i.e., sweet gourd (*Cucurbita maxima*) cv. Sitaphal, bottle gourd (*Lagenaria vulgaris L. siceraria*) cv. Lauki, cucumber (*Cucumis sativus*) cv. Kheera, melon (*Cucumis melo* var. *momordica* cv. Kakri or Phut), muskmelon (*Cucumis melo*) cv. Kharbooja, watermelon (*Citrullus vulgaris*) cv. Tarbuj, squash melon or round gourd (*Citrullus vulgaris* var. *fistulosus*) cv. Tinda, sponge gourd (*Luffa cylindrica*) cv. Ghai tori, ridge gourd (*Luffa acutangula*) cv. Kali tori and bitter gourd or balsam pear (*Momordica charantia*) cv. Karela were found to be hosts of *A. foveicollis*. Sitaphal was the most preferred and common host followed by Lauki. The pest has no preference for Karela (Jori and Johri, 2003b).

It was reported that *A. foveicollis* adults showed poor feeding response on ridge gourd (*Luffa acutangula* cv. Kali tori) and sponge gourd (*Luffa cylindrica*, *L. aegyptiaca* cv. *Ghai tori*) a higher preference on sweet gourd (*Cucurbita maxima* cv. Sitaphal), bottle gourd (*Lagenaria vulgaris L. Siceraria* cv. Lauki), cucumber (cv. Kerala) and muskmelon (*Cucumis melo* cv. Kharbooza), respectively (Jori and Johri, 2003a).

Begum (2002) studied on sweet gourd, ash gourd, sponge gourd, snake gourd and cucumber were screened against the fruit fly and red pumpkin beetle (RPB) to identify the less and most preferred cucurbit host and to evaluate their comparative damage on these hosts in an experiment conducted in the laboratory and field of the Department of Entomology, BSMRAU farm, Salna, Gazipur. The incidence of RPB was evident from early morning to sunset with the maximum number occurring within 8:00-9:00 am with the highest peak at 9:00 am on all the cucurbit plants. Their population gradually declined with abrupt fall to the lowest beetle density at noon up to 2:00 pm. The number of beetle density gradually increased with gradual progress of the daytime toward sundown to sunset. In the afternoon the maximum occurrence of RPB was observed within 5:00-6:00 PM with the highest peak at 6:00 PM. The overall results revealed that among the five cucurbits, sweet gourd was the most susceptible and highly preferred host of fruit fly and RPB and faced significantly severe damage compared to others. The highest degree of host preference of fruit fly and RPB for sweet gourd and damage severity found were followed by those obtained in ash gourd, sponge gourd and snake gourd. On the contrary, cucumber was recognized as less susceptible and less preferred host for both the pests with significantly lower damage inflicted.

Rajak (2001) studied on the host range and food preference of red pumpkin beelle, *A. foveicollis* Lucas revealed that 10 cucurbitaceous vegetables were its host range bitter gourd. Of major 11 cucurbitaceous crops, musk melon (*Cucumis melo* L.) was the most preferred food. It causes more damage to the crops in kharif season. Host preference of the red pumpkin beetle (*A. foveicollis*) among 11 cucurbitaceous crops sweet gourd (*Cucurbita moschata*), cucumber, bottle gourd (*Lagenaria siceraria*), watermelon, muskmelon (*Cucumis melo*), sponge gourd (*Luffa cylindrica* [*L. aegyptica*]), ash gourd (*Benincasa hispida*), ridge gourd (*L. acutangulla*), snake gourd (*Trichosanthes anguina* [*Trichosanthes cucumerina*]), pointed gourd

(*Trichosanthes dioica*), bitter gourd (*Momordica charantia*) the most preferred host was muskmelon. The least preferred was snake gourd, while bitter gourd was not preferred (Rajak, 2001).

Host preference of *R. fovicollis* (*A. fovicollis*) among 8 plants: Wax gourd, Bottle gourd, Bitter gourd, Cucumber, Watermelon, Ridge gourd, Sweet potato, Muskmelon were the most preferred by the pest in multiple choice tests, In no choice test, water melon, cucumber and *L. siceraria* were most preferred by the pest but *M. charantia* was not preferred (Vandana *et al*., 2001).

Abe *et al*. (2000) reported that the difference in responses of the three leaf beetle species to cucurbitacins is possibly related to the host range of these three beetle species. *A. femoralis* feeds on various cultivated and wild cucurbitaceous plant, but the other two beetles are specialized to their native host plants and scarcely feed on other cucurbitaceous plant species. *A. lewisii* depends on sponge gourd, genus *Luffa*, *A. nigripennis* uses *Trichosanthes cucumeroides* and *T. kirilowii* as hosts. In the cucurbitaceae, cucurbitacin contents differ among plant species, plant part and growth stage. The cucurbitacin concentrations in the leaves possibly vary, as cucurbitacin contents differ among plant species, plant part and growth stage. Therefore, *A. femoralis* and *A. lewisii* probably respond to various concentrations of cucurbitacins contained in their host plant leaves. This is the first report of a cucurbitaceous feeding leaf beetle which was scarcely affected to feed by cucurbitacins. These results also suggest that *A. nigripennis* select their cucurbitaceous host plant without depending on the cucurbitacins and are stimulated to feed by other substances in the host plant leaves.

The host preferences of the red pumpkin beetle, *Aulacophora foveicollis*, and the melon fruit fly, *Dacus cucurbitae* (*Bactrocera cucurbitae),* were studied by Singh *et al*. (2000) using different cucurbits during the summer of 1997 in India. Observations on the density of red pumpkin beetles per leaf and percentage infestation on the vines, leaves and flowers of cucurbits were made every morning, while observations on the melon fruit fly were made weekly. Observations of the host preferences of the red pumpkin beetle ranked bitter gourd (*Momordica charantia)* as least preferred, cucumber, muskmelon, bottle gourd (*Lagenaria siceraria)* and pumpkin as medium in preference, round gourd (*Citrullus lanatus* var. *fistulosus)* and long melon (*Cucumis utilissimus)* as highly preferred and watermelon as the favourite host. The percent of fruit damage by the melon fruit fly was under 50% in all cases. However, percentage damage was significantly highest on watermelon (28.55%) and bitter gourd (31.27%).

Investigators observed that host preferences of the red pumpkin beetle ranked bitter gourd (*Momordica charantia)* as least preferred, cucumber, musk melon, bottle gourd (*Lagenaria siceraria)* and pumpkin as medium in preference, round gourd (*Citrullus lanatus)* and long melon (*Cucumis utilissimus*) as highly preferred and watermelon as the favourite host (Singh *et al*., 2000). Host preference of *R. foveicollis* (*Aulacophora foveicollis*) was studied and found that muskmelon was the most preferred host, while bitter gourd (*Momordica charantia)* was the least preferred (Sharma, 1999).

Eben *et al*. (1997) tested in feeding choice and no-choice assays for their preference for bitter (Cucurbitacin-containing) over non-bitter (without cucurbitacins) cucurbits, and for one of the two primary types of cucurbitacins with three *Acalymma* and five *Diabrotica* (Chrysomelidae: Luperini) species. All species significantly preferred the bitter over the non-bitter cucurbits (*C. pepo* L. var. crookneck) in the test offering a choice between cucurbitacin B-containing plants (*C. pepo* L. var. ambassador) and no cucurbitacin containing plants. Six species significantly preferred cucurbitacin E-containing plants.

Cucurbitacin B-containing plants were signifciantly preferred over cucurbitacin E-containing plants. The strong preference for bitter cucurbitacin containing host plants by all species included in this study support the original hypothesis that generalist *Diabrotica spp*. should prefer bitter cucurbits. They results partially support the hypothesis that specialist *Acalymma spp*. should not show a strong preference for bitter cucurbit hosts. The three *Acalymma* and the five *Diabrotica* species tested, significantly preferred ‘cuc B’ over ‘no cuc’ bosts. The ready acceptance of ‘no cuc’ cotyledons by two of the specialist species. *A. blomorum* and *A. fairmairei*, partially support the original hypothesis that *Acalymma spp*. should not depend as *Diabrotica spp*. on cucurbitacins for the acceptance of cucurbits as host plants.

Guruswamy *et al*. (1995) conducted an experiment under free choice condition where *cucumis melo* var. *utilissimus* Duth. and Full. were the most preferred cucurbit which recorded the highest leaf area consumption (102.38 cm^2). The beetle consistency after 24, 48 and 72 hours consumed the highest amount of leaf. *Mamordica charantia* L. recorded the least amount of leaf area consumption (2.13 cm^2) after 24, 48 and 72 hrs. of release. Under no-choice conditions, *Cucumis melo* L. leaves were consumed to the maximum extent (48.19 cm^2) compared to the minimum consumption of *Citrullus lanatus* (Thumb.) (8.63 cm^2). *Cucumis melo* var *utilissimus* Duth. and Full. stood next but was statistically on par with *Cucumis melo* L. in leaf consumption (43.31 cm). *Luffa acutangula* (L) and *Mamordica charantia* L. were the next least preferred plants. These results have been confirmed under field cage conditions where *Cucumis melo* L. and *Cucumis melo* var. utilissimus.

The incidence of the red pumpkin beetle, *Aulacophora foveicollis* (Lucas), on three cucurbits remained throughout the crop growing season which was reported by Thapa and Neupane (1992). Infestation was high on watermelon (6-24 adults/plant) followed by bottle gourd (4-19 adults/plant) and pumpkin (5-10 adults/plant). Among ten species of cucurbits tested in seedling stage under free-choice condition, bitter gourd seedlings were completely free from the beetle damage while muskmelon (80.63% damage) and long melon (71.69% damage) were highly preferred and snake gourd (7.63% damage) and ash gourd (13.88% damage) seedlings were the least preferred. Bottle gourd, cucumber, sweet gourd, sponge gourd and water melon were of intermediate types. Among the various insecticidal sprays evaluated on watermelon seedlings, synthetic pyrethroids (deltamethrin at 0.004%, cypermethrin at 0.012%, and fenvelerate at 0.01%) were effective in controlling the beetle (8.188-96.88% mortality) for about a week. Water melon seed soaking with carbofuran (Furadan 3 G) @ 1 g a.i./L was found effective for only two days after germination, while its application as soil treatment @ 0.12 – 0.36 g a.i./plant was the most effective as indicated by high mortality of beetle and minimum feeding damage for about three weeks.

The damaged roots and infested underground portion of stems start rotting due to secondary infection by saprophytic fungi. The young fruits of such vines dry up. Infested fruits become unfit for human consumption. Ground-spreading cucumber plants grown in experimental plots at BARI farm in April, 1986 were found to be killed entirely with dried-up vines, leaves, flower and fruits due to severe damage of underground roots by the grubs of the RPB.

Roy and Pande (1990) investigated the preference order of 21 cucurbit vegetables and noted that bitter gourd was highly resistant to the beetle, while the sponge gourd and bottle gourd were moderately resistant; muskmelon and cucumber were susceptible to the pest. They also observed that banana squash, muskmelon and bottle gourd were the preferred hosts of the adults, while cucumber, white gourd/ash gourd, chinese okra, bitter gourd, snake gourd, watermelon and sponge gourd achieved the second order of preference to the beetle, *Aulacophora foveicollis*.

Mehta and Sandhu (1989) studied 10 cucurbitaceous vegetables and noted that bitter gourd was highly resistant to the RPB, while sponge gourd and bottle gourd were resistant. The cucumber, muskmelon and water melon were moderately resistant to the pest.

An analysis of the host plant relationships with respect to the red pumpkin beetle, *Raphidopalpa foveicollis* Lucas is presented by Rahman and Annadurai (1985) based on the role of receptors involved in host selection, the quantitative food utilization on different cucurbitaceous host plants and the biochemical parameters involved in food plant selection. Orientation of the beetles towards the host plants appeared to be profoundly affected when the receptors present on the antennae and mouthparts were ablated or coated. Though significant differences were observed with regard to the quantity of food ingested among different host plants, ingestion of food was higher for mature leaves and flowers compared to young and senescent leaves. Accordingly, mature leaves and flowers showed high nitrogen and proteins, low sugars, moderately high phenols and narrow *C/N* ratio compared to other plant parts. The chemosensory receptors present on the antennae and mouthparts were also studied using scanning electron microscope.

Fifteen crop plants were evaluated by Hwa-Jen Teng *et al*. (1984) to determine performance and host preference of adult banded cucumber beetles (BCB), *Diabrotica balteal. a* Le Conte. They prefer broccoli, cauliflower (Cruciferae), potato, bell pepper and tomato (Solanaceae), bush bean, hyacinth bean, soybean, and peanut (Leguminosac), sweet corn (Graminae), beet (Chenopodiaceae), and three varieties of sweet potato (Convolvulaceae). In no-choice tests, greatest fecundity and longevity occurred on broccoli, cauliflower, and potato, even though equal or greater amounts of leaf tissue were consumed on soybean, three varieties of sweet potato, bell pepper, bush bean, and tomato. No eggs were laid on sweet corn, peanut, or hyacinth bean. In multiple·choice tests, broccoli, bell pepper, cauliflower, and bush bean were more preferred for feeding by BCB adults than potato and the other plants, but BCB adults laid most eggs on potato, tomato, sweet corn, bush bean, and 'Morado' (sweet potato). Elytral color remained yellow for adults feeding on the legumes and on beet, but on the other plants the elytra turned green among various percentages of adults.

Butani and Jotwani (1984) have reported that the adult beetles feed voraciously on leaf lamina making irregular holes. They prefer young seedlings and tender leaves and the damage at this stage may even kill the seedlings. Butani and Jotwani (1984) have also reported that the female RPB lays eggs in the moist soil usually around the host plant. On hatching, the grubs feed on the roots and underground portion of host plants as well as fruits touching the soil.

CHAPTER III
MATERIALS AND METHODOLOGY

Host suitability of red pumpkin beetle (*A. foveicollis*) on eight cucurbitaceous plants was determined in the field of the Sher-e-Bangla Agricultural University farm, Sher-e-Bangla Nagar, Dhaka. The details of the materials and methods of this research work were described in this chapter as well as on experimental materials, site, climate and weather, land preparation, experimental design, lay out, data collection on plants number, damage of infested cotyledon, leaf, flower and fruit of these cucurbits within the study period were also discussed. Overall discussion about experimental methods was carried out under the following headings and sub-headings:

3.1 Description of the experimental site

3.1.1 Location and time

The present research was conducted at the research field of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka during the period from March 2012 to June 2012. The experimental area is located at 23.74^0 N latitude and 90.35^0 E longitudes with an elevation of 8.2 m from the sea level (Khan, 1997).

3.1.2 Soil

The soil of the experimental area was to the general soil type series of shallow red brown terrace soils under Tejgoan series. Upper level soils were clay loam in texture, olive-gray through common fine to medium distinct dark yellowish brown mottles under the Agro-ecological Zone (AEZ- 28) and belonged to the Madhupur Tract (UNDP and FAO, 1988). The selected plot was above flood level and sufficient sunshine was available having irrigation and drainage system during the experimental period. Soil samples from 0-15 cm depths were collected from experimental field. The analyses were done from Soil Resources Development Institute (SRDI), Dhaka. The experimental plot was also high land, fertile, well drained and having p^H 5.8. The physicochemical property and nutrient status of soil of the experimental plots are given in Appendix 1.

3.1.3 Climate and weather

The experimental area is situated in the sub-tropical climatic zone and characterized by heavy rainfall during the months of March to October (Kharif Season) and scanty rainfall during the rest period of the year (Biswas, 1987). The Rabi season (October to March) is characterized by comparatively low temperature and plenty of sunshine from November to February (SRDI, 1991). The detailed meteorological data in respect of temperature, relative humidity and total rainfall recorded by the Weather Station of Bangladesh, Sher-e-Bangla Nagar, Dhaka during the period of study have been presented in Appendix II.

3.2 Experimental materials

Eight different cucurbitaceous vegetable were used for this study and the seeds of these crops were collected from BADC, Jessore. These cucurbitaceous crops and their scientific names were as follows:

CV: Sweet gourd (*Cucurbita moschata* Duch.)

CV: Wax gourd (*Benincasa hispida* thund.)

CV: Bottle gourd (*Logenaria siceraria* M.)

CV: Cucumber (*Cucumis sativus* L.)

CV: Snake gourd (*Trichosanthes dioica* Roxb.)

CV: Ridge gourd (*Luffa acutangula*,L.)

CV: Sponge gourd (*Luffa cylindrical*,L.)

CV: Bitter gourd (*Momordica charantia*,L.)

3.3 Experimental design and layout

The experiment consisted of eight vegetable of cucurbitaceous and was laid out in Randomized Complete Block Design (RCBD) with three replications. Experimental plot was sub-divided into three blocks where two pits were in each plots. Thus there were 24 (3 × 8) pits altogether in the experiment. The size of each plot was 3.0 m × 2.5 m. The treatments (Cucurbit vegetable) of the experiment were randomly distributed in the experimental plots.

3.4 Land preparation and fertilizer applicaiton

Power tiller was used for the land preparation of the experimental field. Then it was exposed to the sunshine for 7 days before to the next ploughing. Thereafter, the land was ploughed and cross-ploughed to obtain good tilth. So, the experimental plot was well prepared. The size of the experiment plot was 3.0 m × 2.5 m with an inter column distance of 1 m and row to row distance 1.5 m. Three pits of 30 cm × 30 cm × 20 cm size were dug in each plot with a circular arrangement at a distance of 1 m between pits. Cowdung and fertilizer were applied as recommended (Rashid, 1993) for cucurbits at the rate of 10000, 69, 60 and 60 kg of cow dung, N, P and K ha^{-1}, respectively. The half of cow dung, TSP and MP and one third of urea were applied as basal dose during land preparation. The remaining cowdung, TSP and MP were applied in the pit 15 days before seed sowing. The rest of urea was top dressed after each flush of flowering and fruiting in three equal splits.

3.5 Seed sowing

Seeds of these cucurbits were sown in each pit by hand on 06 April, 2012.

3.6 Data collection

For evaluation of target parameters, data on different parameters were recorded for red pumpkin beetle infestation attacking those cucurbit vegetable crops, cotyledon, leaves, flower and fruits. Details of the data recording procedures are explained under the following sub-headings:

3.6.1 Number of plants pit^{-1}

Number of plants pit^{-1} was counted by visual observation and their mean number pit^{1} was recorded at 4 days after sowing and their mean were calculated by MS-Excel computer program.

3.6.2 Damage of infested cotyledon (%)

Damage of infested cotyledon was recorded at 4 and 9 days after sowing. Mean percent of damage of infested cotyledon was calculated on the basis of the total number of damaged cotyledon divided by the total number of infested cotyledon by RPB and then multiplied by 100. It was expressed by the following formula:

$$\text{Damage of infested cotyledon (\%)} = \frac{\text{Number of damaged cotyledon}}{\text{Total number of cotyledon}} \times 100$$

3.6.3 Number of infested plants pit^{-1}

Data on infested plant pit^{-1} was recorded at 5 days interval which was started from 4 DAS and continued up to 64 DAS. Mean number of infested plan pit^{-1} was calculated on the basis of the total infested plants of the replicated three pits divided by the total plants (no.) of the replicated three pits.

$$\text{Number of infested plant (\%)} = \frac{\text{Number of infested plant}}{\text{Total number of plant}} \times 100$$

3.6.4 Number of infested leaves plant^{-1}

Data on leaf infestation plant^{-1} was recorded at 5 days interval which was started from 4 days after sowing and continued up to 64 DAS. Mean number of infested leaves plant^{-1} was calculated on the basis of the total infested leaves of the selected plants divided by the total number of leaves of the selected plants.

3.6.5 Number of total infested leaves plot^{-1}

Data on total number of leaves infestation plot^{-1} was recorded at 4, 9, 14, 19, 24, 29, 34, 39, 44, 49, 54, 59 and 64 days after sowing. Mean number of total infested leaves plot^{-1} was calculated on the basis of the total infested leaves of the whole plants plot^{-1} divided by the total leaves (infested and healthy) of the whole plants plot^{-1}.

3.6.6 Damage of infested flowers (%)

First flowering was recorded at 52 days after sowing. Data on infested flowers were recorded at 54 days after sowing. Mean percentage of infested flowers was calculated on the basis of the number of damaged flowers divided by the total number infested flowers and then multiplied by 100. It was expressed by the following formula:

$$\text{Damage of infested flowers (\%)} = \frac{\text{Number of infested flowers}}{\text{Total number of infested flowers}} \times 100$$

3.6.7 Damage of infested fruits (%)

The data on damage of infested fruits was recorded at 59 and 64 days after sowing (two times). Mean percentage of damaged of infested fruits was calculated on the basis of the total number of damaged fruits divided by the total number infested fruits and then multiplied by 100. It was expressed by the following formula:

$$\text{Damage of infested fruits (\%)} = \frac{\text{Number of damaged fruits}}{\text{Number of total infested fruits}} \times 100$$

3.7 Statistical analysis

The data obtained from experiment on various parameters were statistically analyzed in MSTAT-C computer program (Russel, 1986). The mean values for all the parameters were calculated and the analysis of variance for the characters was accomplished and means were separated by Duncan's Multiple Range Test (DMRT) and the significance of difference between pair of means was tested by the Least Significant Differences (LSD) test at 5 % levels of probability (Gomez and Gomez, 1984).

CHAPTER IV

RESULTS AND DISCUSSION

The experiment was conducted to investigate the host preference of red pumpkin beetle (*Aulacophora foveicollis*) on different cucurbit vegetables under field condition at Sher-e-Bangla Agricultural University, Dhaka. The results have been shown in tables 1 to 4, figures 1 to 3. A detailed discussion on the presented results and possible interpretations are given in this chapter under the following sub headings:

4.1 Effect of host preference of red pumpkin on different cucurbit vegetables

4.1.1 Number of plants pit^{-1}

Average number of plants pit^{-1} was counted at 4 days after sowing (DAS) as affected by red pumpkin beetle where it was found that the cucumber plants had maximum (2.00 pit^{-1}) and bottle gourd, ridge gourd and bitter gourd had similar number of plants pit^{-1}(1.33 pit^{-1}). Among other cucurbitaceous vegetables, such as sweet gourd, wax gourd, snake gourd and sponge gourd also showed identical number of plants pit^{-1} (1.67 pit^{-1}) after 4 days of sowing (Fig. 1). So, the mean range of plants plot^{-1} was 1.33 to 2.0. Mean number of plants plot^{-1} were counted by visual observation and their mean values were adjusted by MS Excel program.

4.1.2 Percent damage of infested cotyledon

Red pumpkin beetle (RPB) attacking eight cucurbit vegetables were attacked and the percent damage of infested cotyledon after 4 days of sowing and analysis of variance of percent damage of infested cotyledon indicated that those was significantly influence on red pumpkin beetle attack. The damage range of infested cotyledon was 6.67 to 31.67% (Appendix III and Fig. 2). From the Fig. 2, it was found that the maximum damage of cotyledon (31.67%) by red pumpkin beetle infestation was observed in sweet gourd while bottle gourd showed statistically comparable damage by RPB on cotyledon (26.67%) at 4 days after sowing (Fig. 2). Similarly, wax gourd had the damage of 21.67% of infested cotyledon while bitter gourd recorded the lowest damage (6.67%) by RPB infested cotyledon. The percentage of infested cotyledon of cucumber and snake gourd (15.00%), ridge gourd (13.33%), sponge gourd (10.00%) by RPB was statistically similar.

Percent infestation of cotyledon of RPB attacking eight cucurbit vegetables were also observed at 9 DAS which showed significant variation among cucurbit vegetables (Fig. 2). Among the RPB infested cucurbit vegetables, sweet gourd was severely infested by RPB as well as higher damage of cotyledon (45.00%) was observed which was followed by bottle gourd, wax gourd and cucumber and they were statistically identical (40.00, 36.00 and 35.00%, respectively). Among the other cucurbit vegetables infestation, snake gourd, ridge gourd, sponge gourd and bitter gourd were statistically similar in respect of percent damage of cotyledon by RPB (25.00, 23.33, 19.00 and 15.00%, respectively).

These results revealed that the variation in cotyledon infestation among the cucurbit vegetables was found due to the deviation in infestation by RPB. These results showed that the sweet gourd was most suitable host of RPB while bitter gourd was the least suitable host for RPB among the cucurbit vegetables under this field condition. Similar variation was also obtained by Khan (2012) who found that bitter gourd was the least preferred of RPB among ten tested cucurbit vegetables where the mean in order of preference of RPB was muskmelon> sweet gourd> cucumber > khira > ash gourd >

bottle gourd > sponge gourd ≥ ribbed gourd ≥ snake gourd > bitter gourd. This finding was also supported by, Hossain (2012) and other researchers in home and abroad where they reported that the bitter gourd was the least suitable host for RPB.

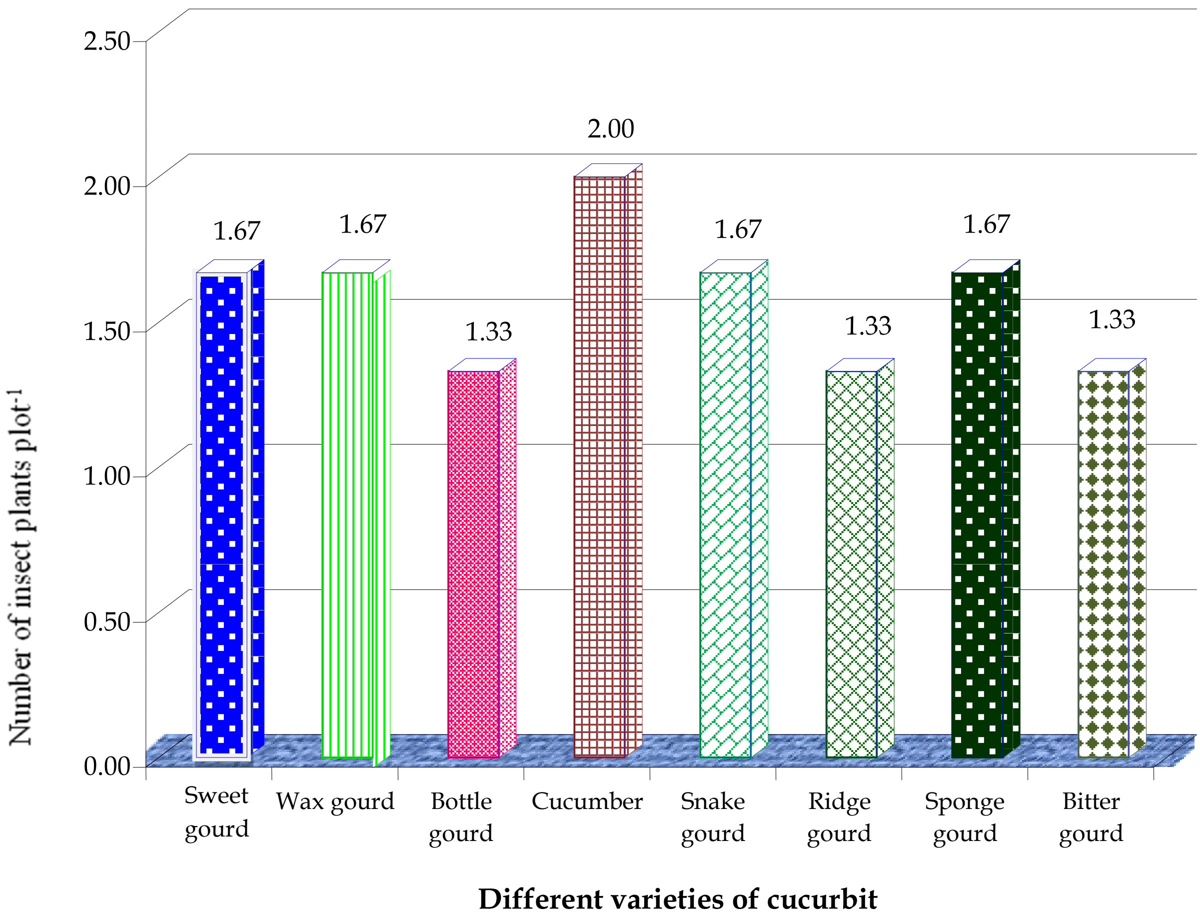

Fig. 1. Suitability of different cucurbit vegetables as host plant for red pumpkin beetle and number of plants plot^{-1} at four days after sowing.

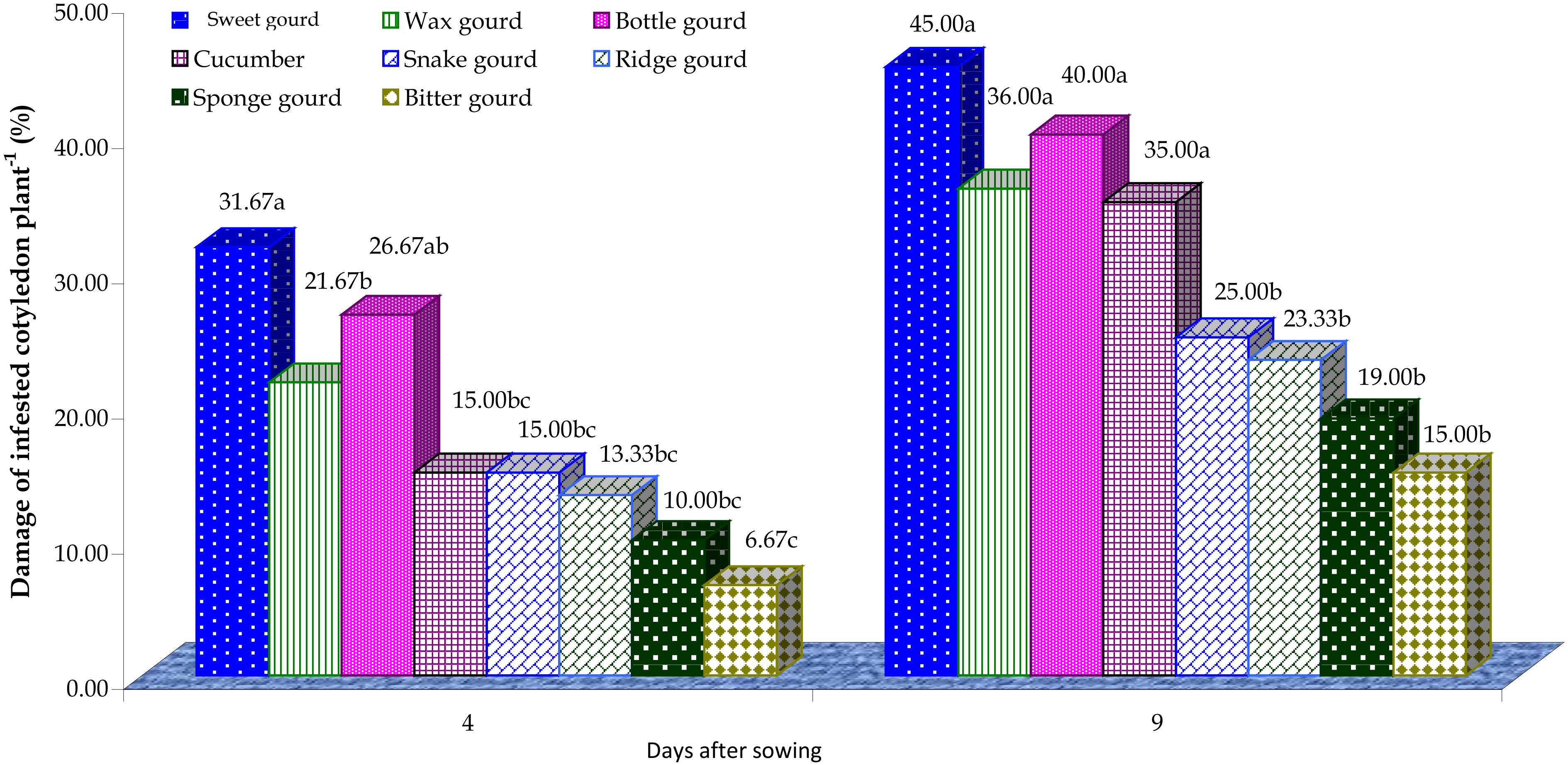

Fig. 2. Suitability of different cucurbit vegetables as host plant for red pumpkin beetle and the percent damage of infested cotyledon at four and nine days after sowing.

4.1.3 Number of infested plants pit^{-1}

Mean number of infested plants of cucurbit vegetables infested by red pumpkin beetle were determined at 5 days interval which started from 4 days after sowing and continued up to 64 days after sowing (Appendix IV and Table 1). Table: 1 indicate that the red pumpkin beetle infested plants pit^{-1} didn't differ significant among the cucurbit vegetables. These results revealed that all the plants of cucurbit were statistically similar level of infestation by red pumpkin beetle which indicated that all the cucurbit vegetables were equally preferred by red pumpkin beetle. However, sweet gourd had numerically higher infestation among cucurbitaceous vegetables while bitter gourd showed lower infestation during study period.

4.1.4 Number of infested leaves plant^{-1}

The preferences of red pumpkin beetle for different cucurbit vegetables have been evaluated on the basis of mean percentage of leaf infestation plant^{-1} at 5 days interval which started from 4 days after sowing and continued up to 64 days after sowing. Red pumpkin beetle highly preferred to sweet gourd and resulted in the highest leaf infestation on it at different days after sowing (Appendix V and Table 2).

At 4 days after sowing, leaf infestation among cucurbitaceous vegetable differ significantly where sweet gourd and bottle gourd showed statistically similar leaf infestation (1.33) while rest of the vegetables showed statistically different leaf infestation. However, bitter gourd had the lower infestation (0.33) among them.

The level of infestation of leaves (no.) on different cucurbit vegetables was significantly influenced by RPB at 9 DAS where sweet gourd encountered the maximum leaf infestation (2.0) plant^{-1} while statistically similar leaf infestation was found in both bottle gourd and wax gourd (1.67). Among other vegetables of cucurbit, bitter gourd and sponge gourd recorded the similar leaf infestation (0.33) and they had least number of infestations on leaf (Table 2).

Similarly, leaf infestation by RPB showed significant variation at 14 DAS where sweet gourd recorded the maximum leaf infestation (4.33) while bottle gourd showed statistically similar leaf infestation (4.00). This was followed by wax gourd (3.33). Among other cucurbits, bitter gourd and sponge gourd showed the similar but least leaf infestation (1.0).

Leaf infestation had also significantly the higher (7.00) in sweet gourd while bottle gourd and wax gourd showed statistically similar leaf infestation (6.67) at 19^{th} day of sowing. Rest of the vegetables of cucurbit showed statistically similar but least leaf infestation. However bitter gourd had comparatively lower infestation of leaf (3.67). Almost similar effect of RPB was also observed at 29 DAS.

Leaf infestation was also significantly influenced by RPB at 29 DAS where sweet gourd, wax gourd and bottle gourd had statistically higher leaf infestation (8.67, 8.67 and 8.00, respectively) while snake gourd, ridge gourd, sponge gourd and bitter gourd showed statistically similar leaf infestation (5.33, 5.00, 5.00 and 4.33, respectively). However, cucumber leaf infestation number was 6.33 and this was statistically comparable to both higher and lower leaf infestation (Table 3).

At 34 days after sowing, sweet gourd and wax gourd had statistically identical and significantly higher leaf infestation (9.67 and 9.33, respectively) by RPB among cucurbit vegetables while sponge gourd and bitter gourd were also showed significantly similar but significantly lower infestation of leaf (both similar of 5.67).

Leaf infestation was also significantly influenced by RPB at 39 DAS where sweet gourd further recorded the higher infestation of leaf (11.0) by RPB while RPB was less attractive to bitter gourd and had lower leaf infestation (Table 2).

Similar effect was also observed at 44 DAS where sweet gourd encountered the higher leaf infestation (12.67) while wax gourd (11.00) and bottle gourd (11.33) were not statistically similar. Among other RPB attacking cucurbit vegetables, the infestation of leaf was lower (7.67) in bitter gourd while cucumber, snake gourd, ridge gourd and sponge gourd also showed almost similar level of infestation (9.00, 9.33, 8.00, 8.33, respectively) cucumber, snake gourd and sponge gourd were statistically identical (Table 2).

Number of leaf infestation plant^{-1} was also observed at 54 DAS where RPB attacking vegetables showed the significant variation (Table 2). Leaf infestation had numerically higher in sweet gourd (15.33) wax gourd (15.00), bottle gourd (15.00) and cucumber (12.67) but these levels were statistically similar between wax gourd and bottle gourd. Similarly, Number of leaf infestation plant^{-1} in sponge gourd and bitter gourd were statistically identical (both similar 11.00) at 54 DAS.

In another observation at 59 DAS, sweet gourd had the maximum infestation (15.67) among the RPB infested cucurbit vegetables and it was followed by wax gourd, bottle gourd, cucumber, and ridge gourd where the level of wax gourd, bottle gourd, cucumber, ridge gourd were statistically identical. On the other hand, sponge gourd and bitter gourd had statistically similar but lower infestation of leaf (12.00) at 59 DAS.

Number of leaf infestation at 64 DAS indicated that sweet gourd further recorded the higher infestation of leaf (17.00) compared to other plants of cucurbit vegetables which was followed by bottle gourd (16.67) and wax gourd (16.33) and these levels of bottle gourd and wax gourd were statistically identical. Similarly, lower level of infestation (12.33) was obtained in bitter gourd, sponge gourd, ridge gourd, gourd and cucumber (13.67) they were statistically similar (13.67).

From the above observation it was indicated that the leaf of sweet gourd was more preferred by RPB and the least preferred was the bitter gourd. However, leaf infestation $plant^{-1}$ significantly increases with increasing DAS. These results also revealed that the RPB had a special preference for the leaves of sweet gourd but bitter gourd was least preferred. These results also indicated that the comparative host preferences of RPB chronologically were sweet gourd > bottle gourd > wax gourd > cucumber > snake gourd > ridge gourd > sponge gourd > bitter gourd (Table 2). These results were agreed with those of Khan (2012) who reported the order of preference as muskmelon> sweet gourd> cucumber > khira > ash gourd > bottle gourd > sponge gourd ≥ ribbed gourd ≥ snake gourd > bitter gourd on the basis of leaf area damage $plant^{-1}$. Host preference of Red Pumpkin Beetle, *Aulacophora foveicollis* was studied by Khan *et al*. (2011) among ten cucurbitaceous vegetables (viz., sweet gourd, bottle gourd, ash gourd, bitter gourd, sponge gourd, ribbed gourd, snake gourd, cucumber, khira and muskmelon) where bitter gourd was free from infestation and it was recorded as non-preferred host. In his study, sweet gourd and musk melon were found to be the most preferred host of red pumpkin beetle and bitter gourd was found as non preferred host of RPB. As a result, the highest percentage of leaf area damage per plant was observed on musk melon leaves followed by sweet gourd and ash gourd and the lowest percentage of leaf area damage per plant was on snake gourd followed by sponge gourd and bottle gourd. Similar observation were also reported by Hassan *et al*. (2012) who also found that the red pumpkin beetle, *Aulacophora foveicollis* (Lucas) equal the highest leaf feeding on sweet gourd and the lowest leaf feeding was on the bitter gourd. Similarly, Shivalingaswamy *et al*. (2008) also found that the mean damage leaf area among tested cultivars varied from 17.45% in VRBG-50 to 34.32% in NDBG-56.

Table 1. Host preference of RPB on different cucurbit vegetables as host plant at different days after sowing(Two plants pit^{-1})

Different cucurbits	Number of infested plants plot^{-1} at different days after sowing												
	4	**9**	**14**	**19**	**24**	**29**	**34**	**39**	**44**	**49**	**54**	**59**	**64**
Sweet gourd	1.33	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Wax gourd	0.67	1.00	1.33	1.00	1.33	1.33	1.33	1.33	1.33	1.33	1.67	1.67	1.67
Bottle gourd	0.67	1.33	1.67	1.33	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67
Cucumber	0.67	1.00	1.33	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67
Snake gourd	1.33	1.00	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
Ridge gourd	0.67	1.00	1.00	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67
Sponge gourd	0.33	1.00	1.00	1.00	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
Bitter gourd	0.67	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE±	**0.11**	**0.10**	**0.11**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**
LSD	**0.82**	**0.60**	**0.76**	**0.58**	**0.73**	**0.73**	**0.73**	**0.73**	**0.73**	**0.73**	**0.72**	**0.72**	**0.72**
Level of sig.	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 2. Host preference of RPB on different cucurbit vegetables as host plant at different days after sowing(Two plants pit^{-1})

Different cucurbits	Number of infested leaves plant^{-1} at different days after sowing												
	4	**9**	**14**	**19**	**24**	**29**	**34**	**39**	**44**	**49**	**54**	**59**	**64**
Sweet gourd	1.33 a	2.00 a	4.33 a	7.00 a	7.67 a	8.67 a	9.67 a	11.00 a	12.67 a	13.67 a	15.33 a	15.67 a	17.00 a
Wax gourd	0.67 b	1.67 a	3.33 ab	6.67 a	8.00 a	8.67 a	8.67 ab	8.00 bcd	11.00 abc	13.00 ab	15.00 ab	15.33 ab	16.33 ab
Bottle gourd	1.33 a	1.67 a	4.00 a	6.67 a	7.33 a	8.00 a	9.33 a	10.33 ab	11.33 ab	13.00 ab	15.00 ab	15.33 ab	16.67 ab
Cucumber	0.67 b	1.33 ab	1.67 bc	4.33 b	4.00 b	6.33 ab	7.00 abc	9.67 abc	9.00 bcd	10.00 abc	12.67 abc	13.67 abc	13.67 bc
Snake gourd	0.67 b	1.00 ab	1.67 bc	4.00 b	4.67 b	5.33 b	6.00 bc	7.33 cd	9.33 bcd	10.67 abc	11.33 bc	12.33 bc	12.67 c
Ridge gourd	0.67 b	1.00 ab	1.67 bc	4.00 b	4.67 b	5.00 b	6.33 bc	7.00 cd	8.00 cd	9.67 bcd	11.33 b	12.67 abc	12.33 c
Sponge gourd	0.67 b	0.33 b	1.00 c	4.00 b	4.33 b	5.00 b	5.67 c	7.00 cd	8.33 bcd	9.33 cd	11.00 c	12.00 c	12.33 c
Bitter gourd	0.33 b	0.33 b	1.00 c	3.67 b	4.00 b	4.33 b	5.67 c	6.67 d	7.67 d	8.67 d	11.00 c	12.00 c	12.33 c
SE±	**0.11**	**0.16**	**0.27**	**0.30**	**0.34**	**0.37**	**0.35**	**0.36**	**0.38**	**0.44**	**0.48**	**0.40**	**0.47**
LSD	**0.62**	**0.86**	**0.84**	**1.16**	**1.14**	**1.31**	**1.45**	**1.54**	**1.65**	**2.30**	**2.91**	**2.46**	**2.50**
Level of sig.	**	**	**	**	**	**	**	**	**	**	**	**	**

In a column, means followed by the same letter(s) are not significantly different at 1% level of probability by Duncan's Multiple Range Test (DMRT).

4.1.5 Number of total infested leaves plot^{-1}

Like the previous observation this was done to observe whether any variation in the total leaf infestation by RPB on different cucurbit vegetables with increasing age and growth of the plant. The probable variation of the RPB attack with the progress of growth period was also determined. So, the occurrence of RPB infestation on eight different cucurbits was observed for 5 days beginning from 4 DAS and continued up to 64 DAS. The mean number of total infested leaves plot^{-1} on each cucurbit vegetable is presented in Table 3. The result presented in Table 3 revealed that there was significant variation in total number of leaf infestation plot^{-1} at all days of data recording and found that sweet gourd was the most preferred and bitter gourd was least preferred by RPB (Table 3).

Total number of leaf infestation plot^{-1} determined at 4 DAS indicated that sweet gourd was significantly preferred host of RPB and recorded (2.67) total leaves plot^{-1}. The leaf infestation was absent in sponge gourd and bitter gourd probably due to its earlier stage. However, statistically similar results were also obtained in ridge gourd and snake gourd (Table 3).

Leaf infestation by RPB was also significantly varied at 9 DAS. The most preferred host of RPB was in sweet gourd (2.67) on the basis of total leaf infestation at 9 DAS. This was closely followed by wax gourd, bottle gourd, cucumber, snake gourd, ridge gourd and they showed statistically similar leaf infestation plot^{-1}. Another two cucurbit plants such as sponge gourd and bottle gourd were also recorded statistically similar but lower in respect of total leaf infestation (0.33) at 9 DAS.

At 14 DAS, the total number of infested leaf plot^{-1} was significantly varied where sweet gourd further encountered the maximum leaf infestation (6.67 plot^{-1}) while bottle gourd, wax gourd, cucumber and snake gourd were statistically similar to attract RPB. However, the preference of RPB for wax gourd, cucumber and snake gourd were statistically identical. The lowest infestation (1.30) by RPB was found in bitter gourd which was statistically significant to that of with sponge gourd (1.33) at 9 DAS.

In another observation at 19 DAS, infestation of red pumpkin beetle was significantly varied on total number of infested leaves plot^{-1} (Table 3). From the table 3, it was appeared that the host preference of cucurbit leaves attack had more (14.0) in sweet gourd at 19 DAS and this which was statistically differed from other cucurbits vegetables. Rest of seven vegetables of cucurbit was statistically identical recorded that lowest infestation RPB on leaves plot^{-1}. However, bitter gourd was least preferred host found at 14 DAS (4.00 leaves plot^{-1}).

The number of total infested leaves plot^{-1} was significantly differed at 24 and 34 DAS. Among the vegetables of cucurbit, the maximum number of total infested leaves plot^{-1} (16.00 and 19.33) was observed in sweet gourd at 24 and 34 DAS, respectively whereas this was followed by bottle gourd (9.67 and 11.00, respectively). Among other vegetables of cucurbit, the minimum number of total infested leaves plot^{-1} (5.33 and 8.00) was found in bitter gourd which was statistically similar to that of wax gourd, cucumber, snake gourd, ridge gourd and sponge gourd at 24 and 34 DAS, respectively (Table 3).

At 29 DAS, number of total infested leaves plot^{-1} varied significantly by the infestation of RPB while sweet gourd obtained the maximum infested leaves plot^{-1} (17.33). Among other cucurbits, bottle gourd, cucumber, wax gourd and snake gourd showed statistically identical level of infestation and was second higher infestation of leaves (10.33, 9.33, 9.00 and 8.67, respectively). Similarly, bitter gourd recorded the lowest infestation of leaves plot^{-1} (5.67) which was also statistically identical to that of sponge gourd and ridge gourd (8.00 and 8.33, respectively) at 29 DAS (Table 3).

Analysis of variance data regarding the infested leaves plot^{-1} showed significant variation due attacking deviation of RPB (Appendix VI and Table 3). Among the cucurbitaceous vegetables, the higher infestation of leaves plot^{-1} was occurred (22.00) in sweet gourd while bitter gourd and snake gourd showed statistically identical but the lowest infestation of leaves plot^{-1} (9.67 and 10.33, respectively). Rest of the vegetables of cucurbit such as wax gourd, bottle gourd, cucumber, ridge gourd and sponge gourd (11.00, 12.33, 12.33, 11.33, and 11.67, respectively) had statistically identical but second higher level of infestation (Table 3).

Leaf infestation was also significantly varied by the attacking preference of RPB at 44 DAS while the highest preference of RPB was found when attacking sweet gourd (25.33) at 44 DAS. This was followed by wax gourd, bottle gourd, cucumber, snake gourd and ridge gourd where they showed statistically identical level of infestation (total leaves plot^{-1}). Infestation on sponge gourd and bottle gourd were also recorded statistically similar with lower total leaf infestation (0.33) at 44 DAS.

At 49 DAS, infestation by red pumpkin beetle differed significantly on total number of infested leaves plot^{-1} (Table 3). As a result, the host preference of

RPB for cucurbit leaves was more (14.00 and 27.33) in sweet gourd which was statistically different from other cucurbits. Among other vegetables of cucurbit the lowest infestation of cucurbit leaves plot^{-1} was in bitter gourd which showed least preference for RPB.

Analysis of variance of number of total infested leaves plot^{-1} different significantly among the cucurbit vegetables due to deviation of infestation by red pumpkin beetle at 54 and 59 DAS (Table 3). Among the vegetables of cucurbit, the total infested leaves plot^{-1} had more (30.67 and 31.33) at 54 and 59 DAS, respectively recorded in sweet gourd. This was followed by wax gourd, bottle gourd, cucumber, snake gourd and ridge gourd where they showed statistically identical infestation of total leaves plot^{-1}. Sponge gourd and bottle gourd were also recorded statistically similar but lower total leaf infestation of 15.00 and 15.33 at 54 and 59 DAS, respectively (Table 3).

A significant variation was also observed on number of total infested leaves plot^{-1} as infested by RPB at 64 DAS (Table 3). Significantly the highest total infested leaves plot^{-1} (34.00) was found in sweet gourd which differed statistically in other plants of cucurbit. Table 3 also indicated that the total infested leaves plot^{-1} was statistically identical among other plants of cucurbits; however, bitter gourd showed comparatively the lowest total infestation of leaves plot^{-1} (16.33) at 64 DAS.

These results indicated that the total number of infested leaves plot^{-1} significantly varied due to attack of RPB on the plants of cucurbit where leaf infestation was gradually increase from initial stage (4 DAS) to harvest stage (64 DAS). It was also indicated that the leaves of sweet gourd were seriously infested and found to be the most suitable host of RPB while least infestation and least suitable host was the bitter gourd. This which might be due to higher preference of RPB for the leaves of sweet gourd plants. So, among the cucurbit vegetables sweet gourd plants proved to be the most preferred host in respect of total infested leaves of plot^{-1}. On the other hand the bitter gourd showed preferred least preference of RPB. So, the sweet gourd plants were the most suitable and bitter gourd was the least suitable host of RPB among the cucurbit vegetables. Similar variation among cucurbits were also found by Khan (2012) where order of preference of RPB as hosts were muskmelon> sweet gourd> cucumber > khira > ash gourd > bottle gourd > sponge gourd ≥ ribbed gourd ≥ snake gourd > bitter gourd on the basis of leaf area damage plant^{-1}, Khan *et al*. (2011) reported that bitter gourd was free from infestation and it was noted as non-preferred host for RPB. Similar observation were also obtained by Hassan *et al*. (2012) who also found that red pumpkin beetle, *Aulacophora foveicollis* (Lucas) highly preferred sweet gourd and lowest preference for bitter gourd.

Table 3. Effect of different cucurbit vegetables as host plant of red pumpkin beetle on number of total infested leaves plot^{-1} at different days after sowing

Different cucurbits	Total number of infested leaves plot^{-1} at different days after sowing												
	4	**9**	**14**	**19**	**24**	**29**	**34**	**39**	**44**	**49**	**54**	**59**	**64**
Sweet gourd	2.67 a	2.67 a	6.67 a	14.00 a	16.00 a	17.33 a	19.33 a	22.00 a	25.33 a	27.33 a	30.67 a	31.33 a	34.00 a
Wax gourd	1.00 ab	2.00 ab	4.00 abc	8.67 b	7.67 b	9.00 ab	10.00 b	11.00 ab	13.00 ab	16.33 b	19.33 ab	20.33 ab	21.33 bc
Bottle gourd	1.33 ab	2.00 ab	5.67 ab	6.67 b	9.67 ab	10.33 ab	11.00 ab	12.33 ab	15.33 ab	18.00 b	21.67 ab	23.33 ab	23.33 bc
Cucumber	0.67 ab	2.00 ab	3.00 abc	6.67 b	6.67 b	9.33 ab	10.33 b	12.33 ab	13.00 ab	15.67 b	18.67 ab	20.33 ab	21.00 bc
Snake gourd	0.33 b	1.00 ab	2.67 abc	6.33 b	7.67 b	8.67 ab	9.33 b	10.33 b	14.00 ab	14.67 b	19.00 ab	20.67 ab	20.67 bc
Ridge gourd	0.33 b	1.00 ab	1.67 bc	5.00 b	7.00 b	8.33 b	9.33 b	11.33 ab	13.33 ab	14.00 b	18.67 ab	19.67 ab	20.67 bc
Sponge gourd	0.00 b	0.33 b	1.33 c	4.33 b	6.33 b	8.00 b	9.67 b	11.67 ab	11.33 b	13.00 b	15.33 b	17.00 b	17.00 b
Bitter gourd	0.00 b	0.33 b	1.00 c	4.00 b	5.33 b	5.67 b	8.00 b	9.67 b	11.33 b	13.00 b	15.00 b	15.33 b	16.33 b
SE±	**0.21**	**0.23**	**0.45**	**0.68**	**0.75**	**0.83**	**0.86**	**1.00**	**1.17**	**1.26**	**1.44**	**1.46**	**1.53**
LSD	**1.20**	**1.22**	**2.25**	**3.14**	**3.93**	**4.51**	**5.03**	**6.20**	**7.21**	**8.26**	**10.02**	**10.30**	**10.40**
Level of sig.	**	**	**	**	**	**	**	**	**	**	**	**	**

4.1.6 Percentage of infested flower plot^{-1}

Damage of infested flower was recorded after flowering at 54 DAS which was significantly differed among the various cucurbit host plants in respect of host preferences of RPB. The results on mean (%) of infested flower damage at 54 DAS range from 13.33 to 27.33% which significantly reduced the fruit yield (Appendix VII and Table 4). In this Table, the higher percentage of flower damage plot^{-1} (27.33%) was observed in sweet gourd which was followed by the second higher damage (25.00) of infested flower in wax gourd and bottle gourd (25.00%) and they were statistically similar. Among other cucurbitaceous plants, bitter gourd and sponge gourd showed statistically identical but lower damage of infested flower plot^{-1} (13.33%). That was also statistically similar to that of ridge gourd and snake gourd (15.00 and 15.67%, respectively). Cucumber recorded medium level of flower damage of infested flower (16.67%). These results revealed that sweet gourd flower was highly preferred by RPB than that of other cucurbitaceous vegetable plants. But the bitter gourd recorded the lowest preference for RPB repeles RPB. These results indicated that the maximum RPB had attraction for sweet gourd and thereby cause higher damage. The host preferences of the red pumpkin beetle, *Aulacophora foveicollis*, was also conducted by Singh *et al*. (2000) where density of red pumpkin beetles per leaf and percentage infestation on the vines, leaves and flowers of cucurbits were made every morning, while host preferences of the red pumpkin beetle ranked bitter gourd (*Momordica charantia)* as the least preferred and long melon (*Cucumis utilissimus)* as highly preferred and water melon as the favourite host. Karim (1992) also reported the similar observation and found that the leaves, flower and fruits were killed due to severe damage of underground roots by the grubs of the RPB.

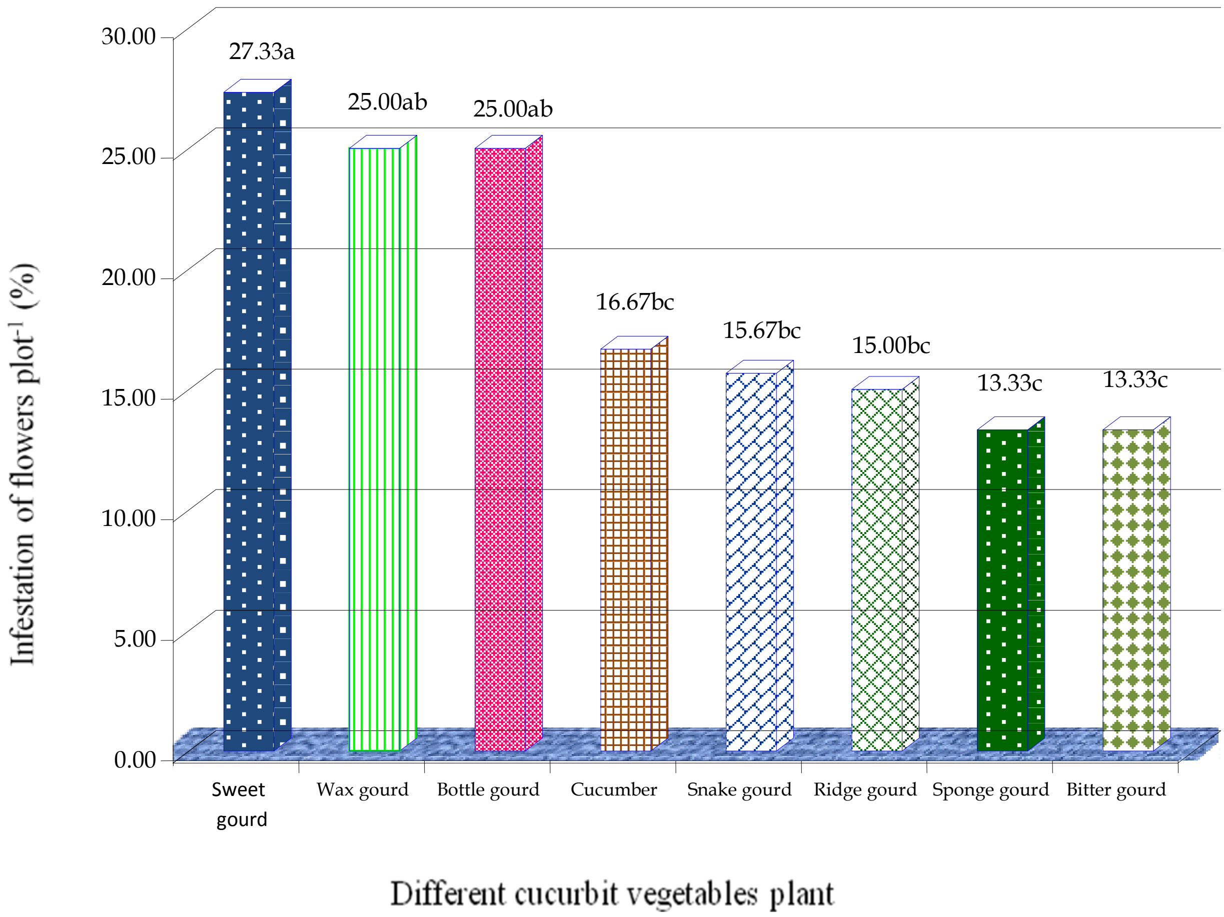

Fig. 3. Effect of different cucurbit vegetables as host plant of red pumpkin beetle on percent damage of infested flower plot^{-1} at 54 days after sowing.

4.1.7 Percentage of infested fruit plot^{-1}

Analysis of variance on damage of infested fruits plot^{-1} (%) varied significantly by the infestation of RPB (Appendix VII). The results on mean (%) of infested fruit damage plot^{-1} due to red pumpkin beetle at 59 and 64 DAS of different cucurbit vegetables are shown in Table 4. This Table reveals that at 59 DAS, the maximum damage of infested fruits plot^{-1} (31.67%) due to RPB infestation was obtained in sweet gourd. This was statistically similar to those of bottle gourd (30.00%) and wax gourd (29.00%) but significantly different from those of cucumber, snake gourd, ridge gourd, sponge gourd and bitter gourd. However, the lowest damage of infested fruits plot^{-1} (15.00%) was recorded in bitter gourd which was statistically identical with that of cucumber (16.67%), snake gourd (16.67%), ridge gourd (16.67%) and sponge gourd (15.67%) at 59 DAS. Statistically similar results were also observed at 64 DAS or fruiting stages of crop. As a result, sweet gourd, bottle gourd and wax gourd showed statistically higher damage of infested fruits plot^{-1} (36.67, 36.67 and 33.33%, respectively) while bitter gourd, sponge gourd, ridge gourd, snake gourd and cucumber observed the statistically lower damage of infested fruits plot^{-1} (15.00, 15.67, 16.67, 17.33 and 18.33%, respectively) at 64 DAS (Table 4).

Damage of infested fruits by red pumpkin beetle may also depend on the availability of RPB and also the cucurbit host performance in the habitat. The observation on damages of infested fruits in this study indicated that the highest number of flower as well as maximum fruits was initiated in sweet gourd. The highest damage of infested fruits by RPB at all fruiting stages of sweet gourd might be due to the most host preference of RPB for this gourd. The host preferences of *Aulacophora foveicollis* was studied by Singh *et al*. (2000) where red pumpkin beetles infested plant of bitter gourd and water melon showed the higher percentage of fruit damage (31.27 and 28.55%, respectively) due to its higher effective population on it. Similarly, Karim (1992) reported that the damage of infested fruits was occurred due to severe damage of underground roots by the grubs of the RPB (Karim, 1992).

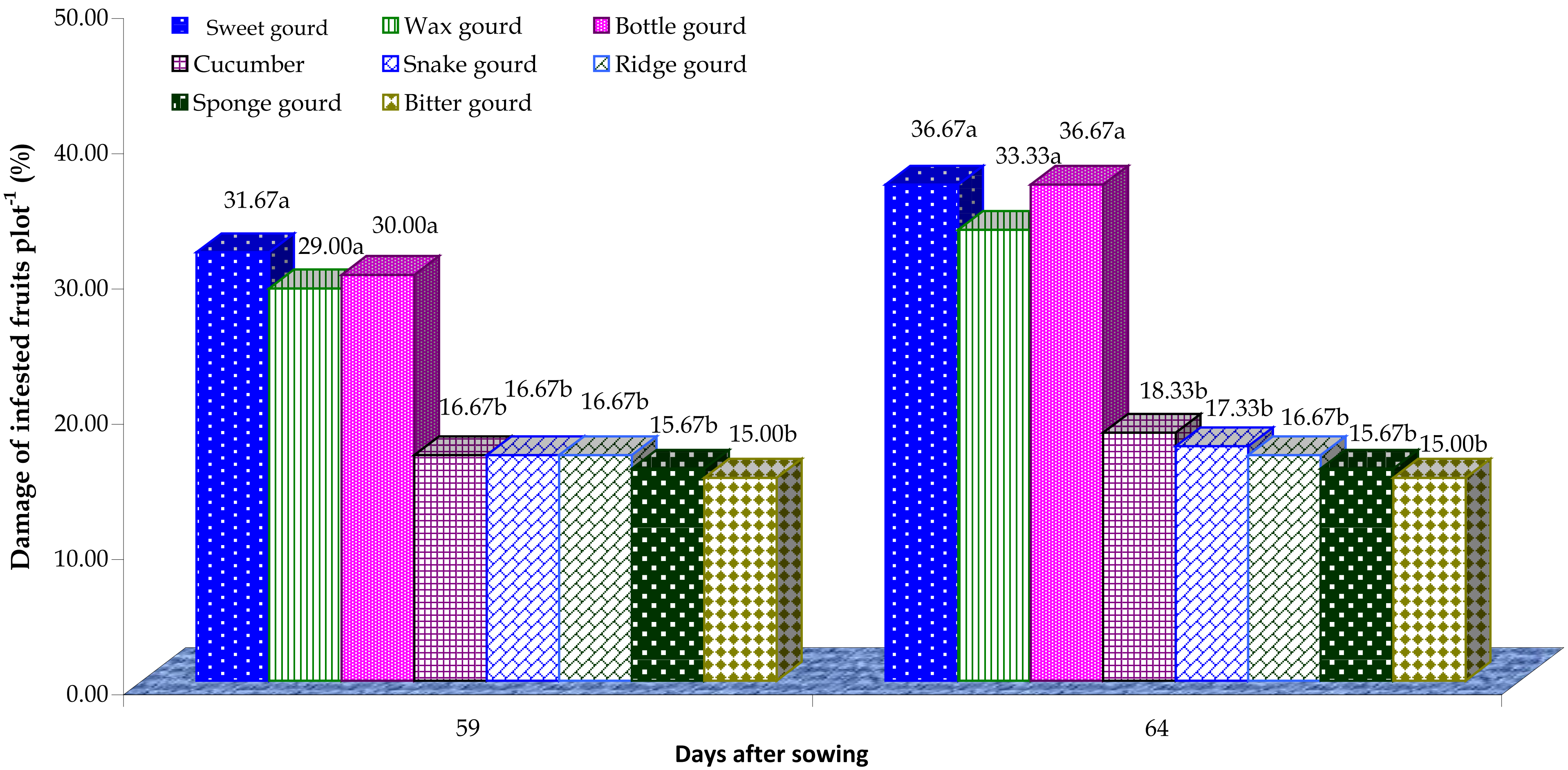

Fig. 4. Effect of different cucurbit vegetables as host plant of red pumpkin beetle on percent damage of infested fruits plot^{-1} at 59 and 64 days after sowing

From the above results, it could be concluded that the sweet gourd plant was highly attractive to red pumpkin beetle to cause higher damage of cotyledon, maximum infestation of plants plot^{-1}, and leaves plant^{-1} and plot^{-1}. Damage of infested flowers and infested fruits plot^{-1} were also recorded in highly the RPB attacking plant of sweet gourd. Therefore, it was clear that sweet gourd would be highly preferred host of red pumpkin (RPB) among other cucurbit vegetables in this study. However, bitter gourd was considered as the least preferred host of RPB due to its probability repelling tendency against RPB.

CHAPTER 5
SUMMARY AND CONCLUSION

Experiment was conducted at the Research Field of Sher-e-Bangla Agricultural University, Dhaka. During the period from March 2012 to July 2012 the study on host suitability of red pumpkin beetle (*A. foveicollis*) on eight cucurbitaceous plants. the research consists of eight cucurbitaceous plants (varieties) *viz.* sweet gourd, wax gourd, bottle gourd, cucumber, snake gourd, ridge gourd, sponge gourd and bitter gourd. The seeds of these varieties were collected from the BADC, Jessore. The experiment was laid out in single factor Randomized Completely Block Design (RCBD) method with three replications. Data were recorded on number of plants pit^{-1}, damage of infested cotyledon (%), number of infested plants pit^{-1}, number of infested leaves plant^{-1}, number of total infested leaves plot^{-1}, damage of infested flowers (%) and damage of infested fruits (%), statistical analysis was done by the MSTAT-C package program and the means were compared by DMRT at 5% level of probability. Red pumpkin beetle as a host suitability among the cucurbitaceous plants affected significantly on the whole parameters except number of infested plants pit^{-1} at all the data recording period during study and number of plants plot^{-1} at 4 DAS where analysis not done on number of plants pit^{-1}. However, cucumber produced maximum plants (2.00 plot^{-1}) and bottle gourd, ridge gourd and bitter gourd produced similar minimum average plants (1.33 plot^{-1}) among cucurbits.

Damage of infested cotyledon had also significantly influenced by RPB where sweet gourd took the maximum damage of infested cotyledon at 4 DAS (31.67%) and at 9 DAS (45.00%) while bitter gourd observed the lowest damage (6.67%) of red pumpkin infested cotyledon. Number of infested leaves plant^{-1} were affected significantly due to the effect of RPB where sweet gourd recorded the maximum leaf infestation and bitter gourd showed the lower infestation at all the DAS except 24 DAS where wax gourd observed the maximum leaf infestation (8.00) however sweet gourd and bottle gourd were statistically identical. As a result, sweet gourd took the maximum leaf infestation (1.33, 2.00, 4.33, 7.00, 8.67, 9.67, 11.00, 12.67, 13.67, 15.33, 15.67 and 17.00) at 4, 9, 14, 19, 29, 34, 39, 44, 49, 54, 59 and 64 DAS, respectively whereas bottle gourd showed statistically identical infestation at 4, 9, 14, 19, 29 and 34 DAS (1.33, 1.67, 4.00, 6.67, 8.00 and 9.33, respectively) and wax gourd at 9, 19 and 29 DAS (1.97, 6.67 and 8.67, respectively). In contrast, bitter gourd recorded the minimum leaf infestation (0.33, 0.33, 1.00, 3.67, 4.00, 4.33, 5.67, 6.67, 7.67, 8.67, 11.00, 12.00 and 12.33) at 4, 9, 14, 19, 24, 29, 34, 39, 44, 49, 54, 59 and 64 DAS, respectively whereas it was also statistically identical with sponge gourd at 4, 9, 14, 19, 24, 29, 34, 54, 59 and 64 DAS, respectively. It was also statistically identical with cucumber, snake gourd, ridge gourd and sponge gourd at 4, 19 and 24 DAS while snake gourd, ridge gourd and sponge gourd at 29 and 64 DAS.

Similarly, number of total infested leaves plot^{-1} was similar.

Damage of infested flower at 54 DAS and fruits plot^{-1} at 59 and 64 DAS was significantly influenced by the RPB as host suitability of cucurbits. The higher percentage of flower damage plot^{-1} (27.33%) was observed in sweet gourd which statistically differed from other cucurbits however it was statistically followed by the wax gourd and bottle gourd. Among other cucurbitaceous plants, bitter gourd, sponge gourd, ridge gourd and snake gourd showed statistically identical lower damage of infested flower plot^{-1} (13.33, 13.33, 15.00 and 15.67%, respectively). Damage of infested fruits plot^{-1} had also maximum (31.67 and 36.67%) in sweet gourd at 59 and 64 DAS, respectively whereas it was statistically similar to those of bottle gourd (30.00 and 36.67%, respectively) and wax gourd (29.00 and 33.33%, respectively). In contrast, the lowest damage of infested fruits plot^{-1} was recorded in bitter gourd at 59 and 64 DAS.

From the above results, it could be summarized that the sweet gourd had highly attack by red pumpkin beetle in case of the higher damage of cotyledon, maximum infestation of plants pit^{-1} and leaves plant^{-1} and plot^{-1}. RPB had preference to attack the sweet gourd as well as higher damage of infested flowers and infested fruits plot^{-1}. So, therefore, it was establish that the sweet gourd would be highly preferable or host of red pumpkin beetle (RPB) among other cucurbits in this study. Similarly, bitter gourd least preferences as a suitable host of RPB in case of bitter guard performs lower regarding to studied host preference parameters.

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APPENDICES

Appendix I. The morphological, physical and chemical properties of the experimental land

A. Morphological properties of the soil

Constituents	Characteristics
Location	Farm, Sher-e-Bangla agricultural university, (SAU), Dhaka
Soil Tract	Madhupur
Land type	high land, fertile, well drained
General soil type	Slightly acidic in reaction with low organic matter content
Agro-ecological zone	“AEZ-28” of Madhupur Tract
Topography	Fairly level
Soil colour	Dark grey
Drainage	Moderate

B. Physical properties of the soil

Constituents	Results
Particle size analysis	
Sand (%) (0.0-0.02 mm)	21.75
Silt (1%) (0.02-0.002 mm)	66.60
Clay (%) (<0.002 mm)	11.65
Soil textural class	Silty loam
Color	Dark grey
Consistency	Grounder

Report obtained from the mechanical analysis of the initial soil sample done in the Soil Resources Development Institute (SRDI), Dhaka.

C. Chemical composition of the initial soil (0-15 cm depth)

Constituents	Results
Soil pH	5.8
Organic matter (%)	1.30
Total nitrogen (%)	0.101
Available phosphorus (ppm)	27
Exchangeable potassium (me/100 g soil)	0.12

Methods of analysis

Texture	Hydrometer methods
pH	Ptentiometric method
Organic carbon	Walkely-Black method
Total N	Modified kjeldhal method
Soluble P	Olsen method ($NAHCO^3$)
Exchangeable K	Flame photometer method (Ammonium)

Report obtained from the mechanical analysis of the initial soil sample done in the Soil Resources Development Institute (SRDI), Dhaka.

Appendix II. Monthly air temperature, rainfall, relative humidity and sunshine hours during the growing season (March 2012 to July 2012)

Month	Year	*Air temperature (^{O}C)			**Rainfall (mm)	*Relative humidity (%)	** Sunshine (hrs)
		Maximum	Minimum	Average			
March	2012	29.63	16.67	23.51	18.1	73.16	141.8
April	2012	25.52	15.70	20.61	19.2	75.55	142.8
May	2013	24.92	13.46	19.19	19.8	78.16	160.4
June	2013	28.77	15.33	22.05	20.3	83.57	223.4
July	2013	30.93	18.95	24.94	21.2	86.10	265.1

* Monthly average and ** Monthly total

Source: SPARSO, Weather Station, Agargoan, Dhaka-1207.

Appendix III. Analysis of variance (mean square) for percentage of damage of cotyledon at different days after sowing

Source of variation	Degrees of freedom	Damage of infested cotyledon (%) at different DAS	
		4	9
Replication	2	40.625	207.292
Factor A	7	216.667**	343.327**
Error	14	46.577	81.006

**= Significant at 5% level of probability

Appendix IV. Analysis of variance (mean square) for number of infested plants at different days after sowing

Source of variation	Degrees of freedom	Number of infested plants plot^{-1} at different days after sowing												
		4	**9**	**14**	**19**	**24**	**29**	**34**	**39**	**44**	**49**	**54**	**59**	**64**
Replication	2	0.292	0.375	0.292	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.167	0.167	0.167
Factor A	7	0.375ns	0.47ns	0.381ns	0.423ns	0.286ns	0.286ns	0.286ns	0.286ns	0.286ns	0.286ns	0.28ns	0.28ns	0.28ns
Error	14	0.339	0.185	0.292	0.173	0.268	0.268	0.268	0.268	0.268	0.268	0.262	0.262	0.262

ns= not significant

Appendix V. Analysis of variance (mean square) for number of infested plants at different days after sowing

Source of variation	Degrees of freedom	No. of infested leaves plant^{-1} at different days after sowing												
		4	**9**	**14**	**19**	**24**	**29**	**34**	**39**	**44**	**49**	**54**	**59**	**64**
Replication	2	0.375	1.042	1.167	0.542	0.042	2.542	1.542	0.875	2.042	0.875	0.292	0.5	0.167
Factor A	7	1.976**	1.143*	5.429**	6.327**	9.214**	9.5**	8.423**	8.708**	9.714**	11.238**	11.524	7.661	13.524**
Error	14	0.28	0.375	0.357	0.685	0.661	0.875	1.065	1.208	1.375	2.685	4.292	3.071	3.167

* and ** = Significant at 5% and 1%, level of probability respectively

Appendix VI. Analysis of variance (mean square) for number of infested plants at different days after sowing

Source of variation	Degrees of freedom	Number of total infested leaves plot^{-1} at different days after sowing												
		4	9	14	19	24	29	34	39	44	49	54	59	64
Replication	2	0.542	2.667	1.625	0.542	2.042	19.542	11.625	11.542	23.042	16.625	33.042	39.5	27.542
Factor A	7	2.375*	2.262*	12.738**	31.089**	33.851**	34.833*	37.327*	45.976**	61.786**	66.19**	71.994**	69.905**	88.946**
Error	14	0.732	0.762	2.577	5.018	7.851	10.351	12.863	19.494	26.375	34.673	50.994	53.833	54.875

* and ** = Significant at 5% and 1%, level of probability respectively

Appendix VII. Analysis of variance (mean square) for percentage of infested flower at 54 DAS and fruits at 59 and 64 DAS

Source of variation	Degrees of freedom	Damage of infested flower plot^{-1} (%) at 54 days after sowing	Damage of infested fruit plot^{-1} (%) at different days after sowing	
			59	64
Replication	2	98.792	155.167	155.792
Factor A	7	102.071**	162.071**	294.899**
Error	14	12.696	15.357	16.935