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Host Preference of Red Pumpkin Beetle (*Aulacophora faveicollis)* Lucas (Chrysomelidae: Coleoptera) among different Cucurbits

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Abstract
Studies on the host preference of red pumpkin beetle *Aulacophora foveicollis* Lucas on four cucurbits species and the effect of temperature and relative humidity on its population under field conditions were conducted along with the impact of physical leaf characters on its population abundance during April to July 2014. Bottle gourd, cucumber, sponge gourd and squash were sown during 2014 from April to July in Peshawar valley. Out of four cucurbit species, cucumber and squash were found susceptible while bottle gourd was found to be resistant and sponge gourd was found to be moderately resistant in terms of population occurrence of the red pumpkin beetle. There occurred an increase in the number of beetle population from 1st till 5th week of the cropping season after which the population gradually declined. The peak infestation was recorded at a temperature of 38 °C and a relative humidity of 67% after which a decrease in population occurred with the rise in temperature and fall in relative humidity. It was also found that non significant negative correlation existed between the red pumpkin beetle population and trichome density and leaf area of the cucurbits and significant positive correlation occurred between the red pumpkin beetles and trichome length of cucurbits.

Keywords: Host preference, *Aulacophora faveicollis*, Cucurbits

1. Introduction
Cucurbits are grown in all tropical and subtropical countries of the world and form the most widely grown and important crops. Cucurbits, also known as vine crop family, include about 118 genera and 825 species. In Bangladesh, major vegetables grown in summer are cucurbits. [1]. Cucurbits are one of the main food crop in Pakistan as well. In India, a number of major and minor cucurbits are cultivated, which share about 5.6% of the total vegetable production. [2, 3]. Similar cultural operations are employed for almost all cucurbits and they are vulnerable to same diseases and pests. Cucurbits are attacked by a number of insect pests among which the most serious is red pumpkin beetle. Red pumpkin beetle (RPB), *Aulacophora foveicollis* (Lucas) is one of the most important constraints to cucurbit production capable of 30-100% yield loss [4]. It is the major pest and causes substantial damage to almost all cucurbits. Both larval and adult stages are injurious to the crop and cause severe damage to almost all cucurbits especially the seedling stage is subjected to intense damage by this pest which occurs throughout the year. They feed on the underside of cotyledonous leaves by chewing holes into them [5].

Currently the use of insecticides is the sole mean of controlling red pumpkin beetle. Non selective use of insecticides has not only aggravated the management, but has also created several adverse effects such as outbreak of secondary pests [6], pest resistance, and health hazards [7]. There has always been a search for alternative and environment- friendly methods of pest control such as biological control programs, physical and genetic control techniques. Successful incorporation of these control components into a pest management strategy requires proper information regarding occurrence and population dynamics of pest on varied hosts under varied agro-climatic conditions. Host plants greatly influence the activity of herbivores as well as of natural enemies through their physical and biochemical factors, thereby either encouraging or suppressing the pest population. Physical leaf characters such as trichomes, leaf area and surface waxes can have positive or negative effect on herbivores [8]. Similarly, the abiotic factors of environment also have a direct impact on population dynamics of insects through variation of survival, dispersal, developmental rates, voltinism and fecundity. Effects of such factors on population of target pest, therefore, must be considered before devising a management strategy.

A number of researchers have carried out different experiments to investigate the host preference of red pumpkin beetles among various cucurbits. According to Nath and Thakur (1965) [9], sponge gourd was found to be least preferred by red pumpkin beetle among the gourds, while they preferred bottle gourd the most. Khan and Hajela (1987) [10] determined that red pumpkin beetles preferred sweet gourd followed by cucumber, squash, sponge gourd and bottle gourd. Dillon and Sharma (1989) [11] observed that in both field and caged experiments red pumpkin beetle was significantly resistant to varietal differences in summer squash. Saljoqi and Khan (2007) [12] concluded that Two Cucumber varieties, F1-Beitalpha, SK Marketmore and two Squash varieties, Light Green Zucchini, Local Round Green were found more responsive to red pumpkin beetle whereas two Sponge Gourd varieties, RKS-6, RKS-7 and three Bottle Gourd varieties, DIK Round Green, SW Sweet Yellow and Bottle Gourd Long varieties were found somewhat vulnerable to the attack of the Red Pumpkin Beetle. Two Bitter Gourd varieties Jaunpuri, Jhalri were found comparatively more resistant to the red pumpkin beetle.

Taking into consideration these facts, the present study was conducted to find out

- preferred host of the red pumpkin beetle among different cucurbits and
- to correlate population of red pumpkin beetle with leaf characters and also with the abiotic factors of environment i-e temperature and humidity.

2. Materials and Methods

The study on host preference of red pumpkin beetle *Aulacophora foveicollis* (Lucas) was carried out on four different cucurbits i.e, cucumber (Green cucumber), squash (Marro kaddu), sponge gourd (Black tori) and bottle gourd in New Developmental Farm, NDF, The University of Agriculture, Peshawar from April to July during 2014. These cucurbits were grown using randomized complete block design (RCBD) with three replications. The plots were prepared as raised beds and plot size for each of the treatments was kept as 3.35 meter×2.74 meter with six plants of each treatment, three on each side of the plot. The inter plot distance was kept at 1 meter and plant to plant distance of 0.5 meter. Three plants per treatment of each replication were checked and number of red pumpkin beetles was recorded. The temperature and relative humidity (RH) were recorded date wise (dates on which the data was recorded) using a digital metrological instrument under unsprayed condition. For studying leaf characters twelve randomly selected leaf samples per treatment were used to study leaf characters. Trichome density per 1 square centimeter from the leaf lamina and trichome length were recorded under stereo zoom microscope Model (SMZ, Nilkon 745T) with 5.01 MP inbuilt camera. Leaf area was recorded with the help of leaf area meter (LICOR). The data collected on different parameters was subjected to statistical analysis. In case where the differences were significant, the means were further assessed for differences through least significant differences (LSD) test. SAS and SPSS software was applied for computing ANOVA and LSD as well as correlation.

3. Results and Discussion

Host preference of red pumpkin beetle on different cucurbits depending on number of beetles found per plant at 11 weeks interval:

The results obtained on host preference of red pumpkin beetle on different cucurbits depending on number of beetles found per plant at 11 weeks interval have been given in the Table 1. It is evident that the red pumpkin beetle infested all cucurbits however the population trend had been significantly different among all the hosts and was also significant during the time interval. The interaction of crop species with time interval was also significant as shown in Fig 1. There occurred a gradual increase in the population density of red pumpkin beetles from first upto fifth week of cropping period i-e from 25th of April to 23rd of May. The population density of red pumpkin beetle was more on cucumbers followed by squash and the lowest number of beetles were recorded on bottle gourd followed by its number on sponge gourd in the first, second, third and fifth week after germination. In the fourth week, however, the highest population of red pumpkin beetle was sustained by squash followed by cucumber and the minimum number of beetles was recorded on bottle gourd followed by sponge gourd. The population of red pumpkin beetles reached its peak during the fifth week of cropping season. After fifth week, a gradual decline occurred in the number of red pumpkin beetles. The highest number was recorded on cucumbers followed by squash, sponge gourd and bottle gourd in the sixth, seventh, eighth, ninth, tenth and eleventh week of the cropping season. After 11th week, no beetles were recorded on all the hosts and the beetle population reached zero. Pooled mean on the population of red pumpkin beetles on four different hosts indicated that the most preferred and favorite host of red pumpkin beetle was cucumber followed by squash. The least preferred host was bottle gourd followed by sponge gourd. The bottle gourd hosted negligible population of beetles; however sponge gourd supported somewhat greater number of red pumpkin beetles as compared to bottle gourd. Similarly, pooled mean on the population of red pumpkin beetle during time interval of one to eleven weeks i-e from 25th of April to 4th of July showed that maximum population of this pest was recorded in the fifth week of germination i-e 23rd of May and lowest population was recorded in the eleventh week of cropping period i-e 4th of July. These results were in conformity with those reported by Saljoqi and Khan (2007) [12] who reported higher number of beetles on squash followed by cucumber; however this difference was reported to be insignificant. The minor difference might be due to the fact that hybrid seeds were used in the in the present study whereas they used two varieties of each host in their experiment. These results were also in conformity with those presented by Khan (2012) [1] who reported that red pumpkin beetle preferred muskmelon followed by cucumber and sweet gourd. Had the previous researcher not used musk melon in his experiment, the beetle would have had cucumber as its first choice. In the present study, bottle gourd was the least preferred host which was in agreement with the findings of Mehta and Sindhu (1992) [13] who reported bitter gourd to be significantly resistant whereas bottle gourd was considered resistant. As bitter gourd was not used in the present study, therefore the results showing bottle gourd to be resistant against red pumpkin beetle could be deemed as quite appropriate.

Correlation of red pumpkin beetles population with physical leaf characters of cucurbits:

Table 1: Population of red pumpkin beetle expressed per plant on four cucurbits during 11 weeks interval from April to July during 2014.

cucurbits	Intervals (weeks)											Mean
	1	2	3	4	5	6	7	8	9	10	11	
Bottle gourd	0.11	0.66	0.83	0.67	0.22	0.17	0.28	0.22	0.17	0.17	0.00	0.32 d
Cucumber	4.11	4.16	5.72	5.72	7.99	4.44	3.66	3.61	4.05	2.44	0.89	4.26 a
Sponge gourd	2.00	1.72	1.61	1.44	1.44	1.44	1.00	1.11	1.11	1.22	0.28	1.31 c
Squash	3.72	3.55	4.55	6.89	5.77	3.28	2.72	2.55	2.50	1.83	0.83	3.47 b
Mean	2.49 c	2.53 c	3.18 b	3.68 a	3.68 a	2.33 c	1.92 d	1.87 d	1.96 d	1.42 e	0.50 f	(0.31)
Lsd (0.05)	(0.86)	(0.7)	(0.98)	(0.82)	(0.49)	(0.87)	(0.50)	(0.52)	(0.71)	(0.5)	(0.52)	(0.19)

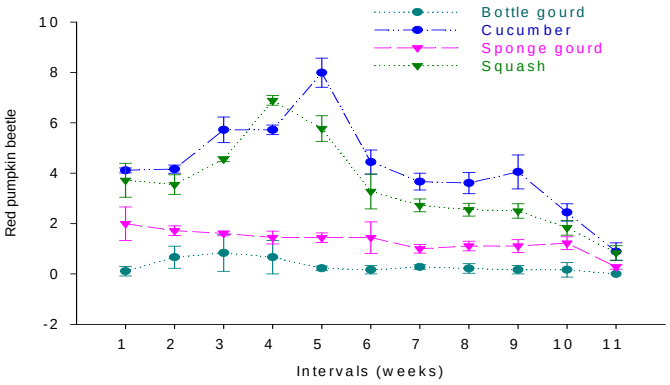

Fig 1: Population trend of red pumpkin beetle on four cucurbits during 11 weeks interval from April to July during 2014.

The morphological plant characters *viz*., trichomes density, trichome length and leaf area were recorded and their relationship with red pumpkin beetle population was investigated. Number of hair was found to differ significantly among the plant species. Maximum mean number of hair were present on squash (1234.4) followed by bottle gourd (994.7), sponge gourd (558.3) and cucumber (295.2) hair//cm2. Maximum mean length of hair was recorded on squash (0.41 mm) followed by cucumber (0.38 mm), bottle gourd (0.15 mm) and sponge gourd (0.15 mm). Maximum leaf area was found in bottle gourd (249.24 cm2) followed by squash (228.62 cm2), sponge gourd (195.49 cm2) while minimum leaf area was recorded in cucumber (102.68 cm2). (Table 2). Data given in Table 3 revealed that the leaf trichomes had non significant negative effect on beetle population. Cucumber having lowest number of trichomes exhibited greater number of beetles. Squash had the highest number of trichomes but it hosted a higher number of beetles after cucumber. Bottle gourd also had a higher number of trichomes after squash and it sustained a negligible beetle number. Sponge gourd exhibited a less number of trichomes per square centimeter but conversely it had a less number of beetles infesting it. Trichome length showed significant positive correlation with beetle population. Squash and cucumber had the longest trichomes and sustained highest number of pest population whereas bottle gourd and sponge gourd having shortest trichome lengths maintained negative correlations with the pest population. Leaf area showed non significant negative correlation with beetle population. Cucumber having small leaf area supported maximum beetle population whereas bottle gourd having the largest leaf area had less incidence of beetles. Squash had a larger leaf area as compared to sponge gourd but it supported a large number of beetles as compared to sponge gourd which hosted a small number of beetles. These results were contradictory to those put forward by Ali *et al.*, (2012) [14] who reported negative correlation between plant characters of brinjal and jassid population. Saeed *et al* (2008) [15] and Afzal and Bashir (2007) [16] also reported significant negative correlation between mite population and leaf characters of certain summer vegetables. In the present study, the non significant negative correlation of beetle population with leaf area (cm2), trichome number (/cm2) and significant positive correlation of beetles with trichome length could be due to the fact that red pumpkin beetles are hard bodied insects as compared to jassids and mites which are soft bodied insects and arthropods. Therefore trichome abundance or length is likely to have a negative impact on jassids and mites abundance as compared to beetles. Furthermore, jassids and mites are crawling insects and arthropods therefore they have to search or travel a larger area in search of their prey or food whereas red pumpkin beetle is a flying insect and use its wings to search for its food and displace itself from one place to another. For this reason, leaf area had a non significant negative impact on beetle's population.

Table 2: Physical leaf characters of four different cucurbits hosts.

Crop Species	Parameters				
	Trichome density(/cm2)	Trichome length (mm)	Leaf area(cm2)	Beetle population	Average Yield (/plot)
Bottle gourd	994.7 b	0.157 b	249.2 a	0.27 d	17.78a
Cucumber	295.2 d	0.387 a	102.7 c	3.60 a	9.36 d
Sponge gourd	558.3 c	0.157 b	195.5 b	1.11 c	10.93c
Squash	1234.4 a	0.413 a	228.6 ab	2.94 b	15.93b
Lsd	87.1	0.043	38.1	0.28	1.28

Means in columns followed by different letter(s) are significantly different at 5 % level of significance.

Table 3: Correlation between Red Pumpkin beetle population and physical leaf characters.

Parameters	Pearson correlation				
	Trichome density (/cm2)	Trichome length(mm)	Leaf area (cm2)	Beetle Population	Average Yield(/plot)
Trichome No.	1				
Trichome length	0.05	1			
Leaf area	0.92**	0.07	1		
Population	-0.26ns	0.93**	-0.23ns	1	
Yield	-0.90**	-0.19	0.76**	-0.50	1

ns =non significant
**= significant correlation

Interaction of population trend of red pumpkin beetles with temperature and relative humidity:

The data on interaction of temperature and relative humidity with population of red pumpkin beetle was recorded during a time interval of 11 weeks from 25th of April to 4th of July. The mean temperature recorded during first, second, third, fourth, fifth, sixth, seventh, eighth, ninth, tenth and eleventh week of cropping period were 32 °C, 37.5 °C, 34 °C, 30.5 °C, 38.5 °C, 40 °C, 41 °C, 40 °C, 40 °C, 40 °C, 41 °C respectively. The mean relative humidity recorded during first, second, third, fourth, fifth, sixth, seventh, eighth, ninth, tenth and eleventh week of cropping period were 69%, 43%,61%, 68.5%, 66.5%, 54%, 50%, 58.5% and 64% respectively. Fig 2 shows the interaction of population with temperature and relative humidity on bottle gourd, cucumber, sponge gourd and squash respectively. There occurred a gradual increase in beetle population with the advancement in temperature and relative humidity. On bottle gourd maximum mean beetle population was recorded in the third week (0.83) during which temperature was 34 °C and RH was 61%. Maximum beetle population was sustained by squash (6.89) at a temperature of 30.5 °C and RH 68.5% in the fourth week whereas on cucumber maximum population (7.99) was recorded in the fifth week at a temperature of 38.5 °C and RH 61%. After fifth week, there had been a gradual decline in pest population. On sponge gourd the population was greater at first week (2.00) when the temperature was 32 °C and relative humidity was 69%. From the next week onward, a gradual decline occurred in beetle population with the advancement in temperature and decrease in relative humidity. No beetle was recorded after eleventh week when temperature was 41 °C and relative humidity was 64%. Minimum beetle population (0.88) was recorded in eleventh week when temperature was 41 °C and relative humidity was 64%. Minimum beetle population on all cucurbits i-e bottle gourd, cucumber (0.88), sponge gourd (0.28) and squash (0.83) was recorded in eleventh week when temperature was 41°C and relative humidity was 64%. Overall results indicated that the two major abiotic factors of the environment i-e temperature and relative humidity had a significant effect on the red pumpkin beetle population throughout the cropping period. The maximum population was recorded at a combination of moderate temperature i-e around 30-38 °C and high relative humidity i-e around 60-69% whereas minimum population was found at a high temperature around 40-41 °C and low relative humidity of 50-58%. These results were in agreement with those reported by Khan *et al* (2012) [1] who also reported the highest population of red pumpkin beetle in the month of May. The monthly variations in populations of red pumpkin beetle on their preferred cucurbit hosts (Fig. 2) might be due to temperature and relative humidity fluctuation in the months of April, May, June and July. During the present study, temperature range was from 30-42°C while relative humidity was within the range of 40-70%. It is concluded from this experiment that 30-38 °C was the most favorable temperature and 60-70% relative humidity was most favorable for pest to build up its population. These results were in conformity with Saljoqi and Khan (2007) [12] who concluded that 19-37 °C and 30-82% Relative humidity was among the most favorable conditions for pest prevalence. These results were also in agreement with those of Al Ali *et al.,* (1982) [17] who reported that beetles completely disappeared throughout July and a temperature higher than 35 °C seemed to be lethal or semi lethal for the beetle. On the other hand, beetles were found capable of surviving wide range of relative humidity.

These results were also the same as those reported by Chaudhry and Khan (1990) [18] who noted that relative humidity of 70% was optimal for the development and duration of various stages of the beetles (*Aulacophora foveicollis*).

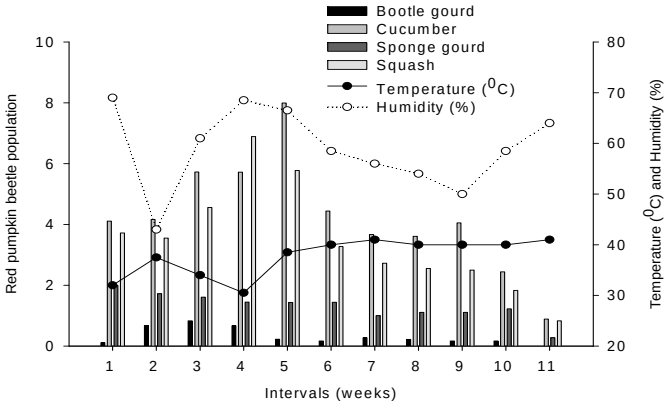

Fig 2: Relationship of red pumpkin beetles with temperature and relative humidity on bottle gourd, cucumber, sponge gourd and squashes.

4. Conclusion and Recommendation

From the present research it may be concluded that there is a significant variation for host preference of red pumpkin beetle among different cucurbits. The most preferred host of red pumpkin beetle was cucumber and was graded as the most susceptible host. Bottle gourd was least or non preferred hosts of red pumpkin beetle and these may be graded as resistant hosts. The incidence of red pumpkin beetles began in the month of April immediately after the germination of cucurbits which increased thereafter and reached to maximum in the fifth week of May. The population gradually lessened thereafter and eventually disappeared from the field in the beginning of July. Maximum number of beetles was present at a temperature of 38 °C and 67% relative humidity. The population of red pumpkin beetle decreased with the advancement in temperature and decrease in relative humidity. There was non significant negative correlation of beetle population with the trichome density and leaf area of cucurbits and significant positive correlation with the trichome length. Further investigations regarding influence of biochemical factors of cucurbit hosts on red pumpkin beetle is strongly recommended. For this purpose antibiosis and antixenosis tests in the laboratory could lead to interesting results besides ensuring the most as well as the least preferred hosts. Such investigations may potentially contribute towards devising an IPM strategy for red pumpkin beetles on cucurbits. Furthermore, the singling out of the most desirable cucurbit host plant could lead to its use as a trap or barrier crop for reducing infestation on target cucurbits. In addition to this, in mixed cropping system this favorite cucurbit crop may be grown as one of the component crops to sustain higher pumpkin beetle load as compared to other cucurbits.

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6. References

1. Khan MMH, Alam MZ, Rahman MM, Miah MI, Hossain MM. Influence of Weather factors on the incidence and

distribution of red pumpkin beetles infesting cucurbits. Bangladesh Journal of Agricultural Research 2012; 37(2):361-367.
2. Butani DK, Jotwani MG. Insects in Vegetables. Periodical Expert Book Agency. Vivek-Vihar, Delhi, India, 1984; 356.
3. Yawalkar KS. Vegetable Crops of India. Agri-Horticultural Publishing House: Nagpur, India, 1985; 374.
4. Dhillon MK, Naresh JS, Singh R, Sharma NK. Evaluation of bitter gourd (*Momordica charantia* L.) genotypes for resistance to melon fruit fly, *Bactrocera cucurbitae*. Indian Journal of Plant. Protection 2005; 33(1):55-59.
5. Khan MMH, Alam MZ, Rahman MM. Host preference of red pumpkin beetle in a choice test under net case condition. Bangladesh Journal of Zoology 2011; 39(2):231-234.
6. Hagen, KS, Franz JM. A history of biological control. pp. 433-467. *In*: Smith, R.F., Mittler, T.E. and Smith, C.N. (eds.). History of Entomology. Annual Rev. Inc., Palocetto, California, 1973; 872.
7. Bhaduri, M, Gupta DP, Ram S. Effect of vegetable oils on the ovipositional behaviour of *Callosobruchus maculatus* (Fab.). Proc. 2nd Intl. Symp. On Brouchids and Legumes (ISLB-2) held at Okyayamace (Japan), 1989, 81-84.
8. Krips OE, Kleijn PW, Willems PEL, Gols GJZ, Dicke M. Leaf hairs influence searching efficiency and predation rate of the predatory mite *Phytoseiulus persimilis* (Acari. Phytoseiidae). Exerimental Applied Acarology 1999; 23(2):119-131.
9. Nath P, Thakur MR. Evaluation for red pumpkin beetle resistance in gourds. Indian Journal of Horticulture 1965; 22(3-4):330-339.
10. Khan MZ, Hajela KP. Studies on *Aulacophora foveicollis* Lucas (Coleoptera: Chrysomelidae)-Food preference and extent of damage. Indian Journal of Entomology 1989; 49(4):457-459.
11. Dillon NPS, Sharma BR. Relationship between field and cage assessments for resistance to red pumpkin beetle in summer squash. Euphytica 1989; 40:63-65.
12. Saljoqi AUR, Khan S. Relative abundance of the red pumpkin beetle, *Aulacophora foveicophora* lucas, on different cucurbitaceous vegetables. Sarhad Journal of Agriculture 2007; 23(1):109-114.
13. Mehta PK, Sandhu GS. Cucurbitacins and other biochemicals in relation to cucurbits susceptibility to red pumpkin beetles. Proceedings of the Indian National Science Academy 1992; 58(6):371-376.
14. Ali M, Ashfaq M, Akram W, Sahi ST, Ali A. The physio-morphic characters of the brinjal (*Solanum melongena* l.) plant and their relationship with the jassid (*Amrasca biguttula biguttula* (ishida) population fluctuation. Pakistan Journal of Agricultural Science 2012; 49(1):67-71.
15. Saeed B, Afzal M, Bashir MH. Effects of some morphological leaf characters of some vegetables with incidence of predatory mites of the genus *Agistemus* (Stigmaeidae: acarina) Pakistan Journal of Botany 2008; 40(3):1113-1119.
16. Afzal M, Bashir MH. Influence of certain leaf characters of some summer vegetables with incidence of predatory mites of the family Cunaxidae. Pakistan Journal of Botany 2007; 39(1):205-209.
17. Chaudry ZA, AliKhan MA. Effects of temperature and relative humidity on the development and fecundity of the red pumpkin beetle *Aulacophora foveicollis* Lucas (Chrysomelidae Coleoptera). Indian Journal of Entomology 1990; 52(2):274-278.
18. Al-Ali AS, Al-Neamy IK, Alwan MS. On the biology and host preference of *Aulcophoras faveicollis* Lucas (Coleoptera, Galerucidae). Journal of applied entomology 1982; 94(1-5):82-86.