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COLLISION OF PHYSICAL PLANT CHARACTERS IN THE DYNAMICS OF *Aulacophora foveicollis* Lucas.

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Economic loss causing pests of cucurbits also includes red pumpkin beetle. Damage of the beetle ranges between 35-75% at seedling stage while canopy infestation could be 15-75% depending on the canopy density. Wide host range of the beetle enlists Indian snap melon as host. Difference physical plant characters including leaf area, moisture contents, leaf sheath thickness and hair density were examined among ten different landraces (MLT, BHW, SHW, SRD, FSD, TTS, SHK, VH, HP, RYK) of Indian snap melon, named after the district of collection. Maximum mean population (8.06) and percent leaf infestation (15.46) per plant were recorded in Sheikhupura (SHK) landrace. Whereas, minimum mean population (5.56) and infestation (10.63) was recorded in landrace Bahawalpur (BHW) landrace. Leaf area, leaf moisture contents and leaf sheath thickness varied significantly among different landraces but leaf hair density does not varied significantly. Impact of leaf hair density was not calculated due to non-significant variations, all other factors respond positively to the beetle's population and infestation. Data was recorded on per plant basis both for population and percent leaf infestation. Data was collected on every 5th day beginning 15 days after sowing. Data was analyzed using Statistica 8.0 and compared using DMR test.
Keywords: Host preferences, physical plant characters, plant factors, red pumpkin beetle.

INTRODUCTION

Fruit and vegetable in Pakistan are important part of the country's economy as export return (Anonymous, 2009). These crops are attacked by many of pests and diseases which cause yield reduction (Foster, 2008). Vegetable pests include aphid, jassid, diamond back moth, pumpkin beetle, etc. Pumpkin beetles including the *Aulacophora hilaris* and *Aulacophora foveicollis* are major pests those attack cucurbits regularly (Foster, 2008). The beetle is a serious pest of the cucurbits due its mode of attacks. This pest attacks at every stage of the cucurbits and cause heavy losses to all cucurbits except bitter gourd (Saleem and Shah, 2010), damage to fruits also reported (Melamed-Madjae, 1960). If beetle attacks at seedling stage then crop needs to be re-cultivated. It feeds underside the cotyledonous leaves by biting holes into them (Chandravadana and Pal, 1983). Percent damage ranges from 15-70%, which gradually decreases as canopy increases (Saljoqi and Khan, 2007; Yamaguchi, 1983). Humidity favour to population development, survival of beetle at low temperature (Alikhan and Yousuf, 1985) and endemic host range make it calamity for cucurbits (Al-Ali *et al.,* 1982; Pal *et al.,* 1978). This pest is also resistant to some plant extracts (Pande *et al.,* 1987) that make it more suitable for crop losses. Varietal screening is one of suitable control measure used for the control of red pumpkin beetle (Dhillon and Wehner, 1991). A lot of plant factors those are responsible for the beetle's attack on cucurbits also include physical plant factors and chemical plant factors. Percentage increase /decrease in the plant nutrients concentration affect the beetle's population and infestation boost. Present studies were designed to determine the effect of leaf area, leaf sheath thickness, leaf moisture contents and leaf hair density plant characters on the population and infestation of red pumpkin beetle of ten different landraces of Indian snap melon against this menace of cucurbits.

MATERIALS AND METHODS

Ten different landraces of Indian snap melon were cultivated during growing season 2011 in Square #09, Institute of Horticultural Sciences, University of Agriculture, Faisalabad which were collected from different districts of Punjab. These landraces included Multan (MLT), Bahawalpur (BHW), Sahiwal (SHW), Sargodha (SRD), Faisalabad (FSD), Toba Tek Singh (TTS), Sheikhupura (SHK), Hasil Pur (HP), Vehari (VH) and Rahim Yar Khan (RYK). Names of each landrace was assigned based on the area of collection where these landraces produced and cultivated year after year. Sowing was done on 17 March 2011 and experiment was laid out according to Randomized Complete Block Design in three blocks whereas each block was acting as replicates. Plot size was 6m X 3m and each plot was separated apart from other with a distance of 3m.

Data collection: Data regarding varietal screening was based on population and infestation of red pumpkin beetle. The population of adult red pumpkin beetle was calculated as population/plant and similarly infestation was calculated as % leaf infestation/plant. Data was recorded on each 5th day interval beginning 15 days after sowing. Statistica 8.0 software was used for statistical analysis of the obtained data, while means were compared using DMR test.

Physical plant factors:

Leaf area (cm^2): Five leaves from five randomly selected plants of each landrace were taken for the determination of leaf area. Then the mean of the area was calculated. Leaf area was calculated using L1-3000 A portable area meter.

Thickness of leaf sheath (μm): Three plants randomly selected from each plot and five randomly selected leaves from each plant were taken to determine thickness of leaf sheath. Cross sections of leaves were cut with the help of a fine razor and thickness of leaf lamina was determined from tip, middle and axial portion of each leaf with the help of an ocular micrometer under a Carl Zeiss binocular microscope.

Leaf moisture contents (%): Three samples of 10g of leaf were taken from each landrace and cleaned with muslin cloth. They were then weighed and placed in a drying oven at 100±5°C for 12 hours. Dry matter of the leaves were weighed and again placed in the oven for six hours. After six more hours samples were removed from the drying oven and weighed. This process continued until weight remained constant. Moisture contents was calculated by using formula below;Moisture (%)

Leaf hair density (cm^2): Five leaves from each of five randomly selected plants from each plot were picked from the field in the month of May. Each leaf examined near tip, near petiole and center of the leaf by a binocular stereomicroscope. The number of hairs on the leaf sheath were counted in one cm^2 area. For this purpose, an iron dye of one cm^2 was used and number of hairs was counted by an ocular micrometer.

RESULTS

Impact of leaf area of different landraces was calculated positive on population/ plant of red pumpkin beetle as shown in figure above. As leaf area of the landrace goes on increase the population of red pumpkin also goes on increasing and relationship was quite strong. Similar trend was worked out of leaf area on the percent leaf infestation caused by red pumpkin beetle but it was stronger as compared to the

Table 1. Combined analysis of variance of the data regarding different physical plant characters of different landraces (MLT, BHW, SHW, SRD, FSD, TTS, SHK, HP, VH, RYK).

S.O. V.	D. F.	Leaf area (cm^2)		Thickness of leaf sheath (μm)		Leaf moisture (%)		Leaf hair density (cm^2)	
		M.S.	F. Ratio	M.S.	F. Ratio	M.S.	F. Ratio	M.S.	F. Ratio
Landraces	9	5218	16.83**	0.47	9.47*	123.9	2.18^{ns}	7.3	1.2^{ns}
Replication	2	666	2.15^{ns}	0.049	0.98^{ns}	90.2	1.59^{ns}	8.4	1.38^{ns}
Error	18	310		0.050		56.6		6.1	

* Significant, ** Highly significant, ns Non significant, P≤ 0.05.

Table 2. Comparison of the mean values of the data regarding different physical plant characters of different landraces (MLT, BHW, SHW, SRD, FSD, TTS, SHK, HP, VH, RYK).

Landraces	Leaf area (cm^2)/ 5 leaves	Thickness of leaf sheath (μm)	Moisture (%)	Hair density (cm^2)	Population /plant	% leaf infestation/plant
MLT	352.43± 12.10 cde	0.80 ± 0.07 de	69.6 ± 4.8 b	73.06 ± 1.58 a	6.15 ± 0.60bcd	12.3 ± 0.47bcd
BHW	340.50 ± 7.77 e	0.73 ± 0.17 e	68.46 ± 5.38 b	73.76 ± 1.14 a	5.56 ± 0.49d	10.63 ± 1.18d
SHW	375.40 ± 6.00 bcd	1.46 ± 0.059 bc	80.18 ± 5.02 ab	74.9 ± 1.06 a	6.92 ± 0.32abcd	12.73 ± 0.69abcd
SRD	384.56 ± 8.06 bc	1.45 ± 0.13 bc	81.1 ± 4.45 ab	70.93 ± 1.6 a	7.03 ± 0.23abcd	13.16 ± 1.01abcd
FSD	447.63 ± 11.62 a	1.80 ± 0.10 ab	84.43 ± 4.40 a	70.93 ± 1.31 a	7.61 ± 0.59ab	14.56 ± 0.98ab
TTS	436.36 ± 8.70 a	1.61 ± 0.173 abc	84.23 ± 3.17 a	71.06 ± 1.47 a	7.33 ± 0.46abc	14.03 ± 0.58abc
SHK	449.06 ± 5.88 a	1.97 ± 0.058 a	85.66 ± 4.49 a	70.71 ± 1.67 a	8.06 ± 0.54a	15.46 ± 0.77a
HP	345.33 ± 13.45 de	1.52 ± 0.18 bc	71.16 ± 3.92 ab	73.4 ± 1.47 a	5.9 ± 0.34cd	11.36 ± 0.89cd
VH	388.76 ± 12.83 b	1.58 ± 0.14 abc	80.9 ± 4.73 ab	70.96 ± 1.53 a	7.31 ± 0.36abc	13.73 ± 0.98abc
RYK	365.2 ± 15.91 bcde	1.19 ± 0.11 cd	80.3 ± 3.92 ab	70.8 ± 1.53 a	6.34 ± 0.65bcd	12.53 ± 0.63bcd

Mean marked by similar letter do not vary significantly from each other by DMR Test at P≤0.05

relationship observed in case on population as shown in the Figure 1b.

Role of leaf sheath thickness on red pumpkin beetle population per plant was calculated positive. Population of red pumpkin beetle goes on increasing as the thickness of leaf sheath increases in different landraces of Indian snap melon and vice versa. Role of leaf thickness was quite similar on percent leaf infestation as observed in case of role on population per plant. Percent leaf infestation caused by red pumpkin beetle decreases as the thickness of leaf sheath decreases and positive relation was observed.

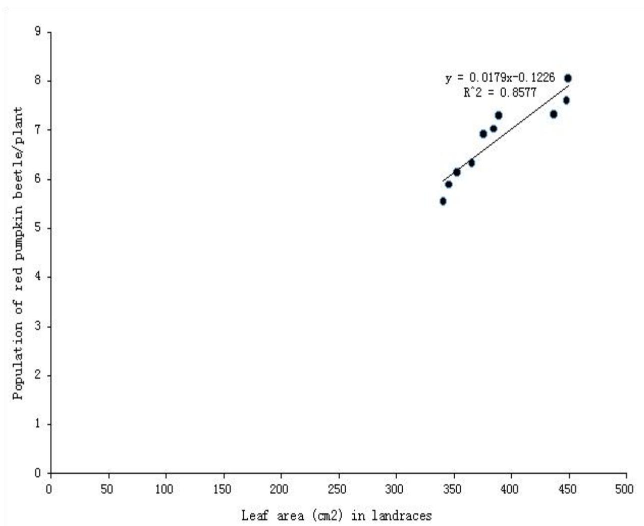

Figure 1a. Role of leaf area of different landraces of snapmelon on population of red pumpkin beetle

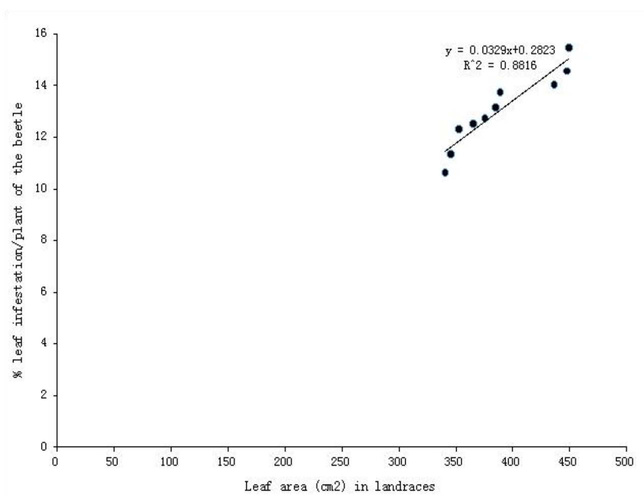

Figure 1b. Role of leaf area of different landraces of snapmelon on infestation caused by red pumpkin beetle.

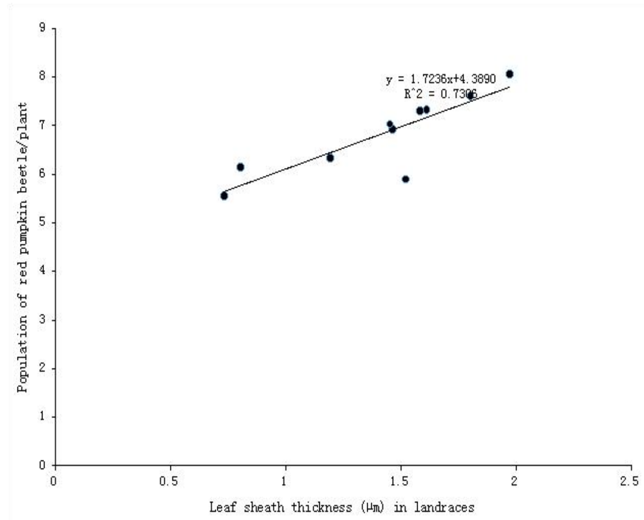

Figure 2a. Role of leaf sheath thickness of different landraces of snapmelon on population of red pumpkin beetle.

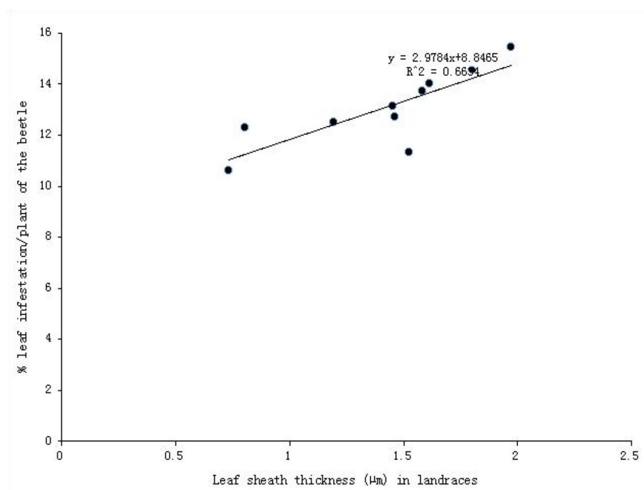

Figure 2b. Role of leaf sheath thickness of different landraces of snapmelon on infestation caused by red pumpkin beetle.

Response of leaf moisture contents on red pumpkin beetle population per plant was interacted positively. Red pumpkin beetle population goes on increasing as the leaf moisture contents increases in different landraces of Indian snap melon and vice versa. Role of leaf moisture contents was quite similar on percent leaf infestation as observed in case of role on population per plant. Percent leaf infestation caused by red pumpkin beetle decreases as leaf moisture contents decreases and positive relation was observed.

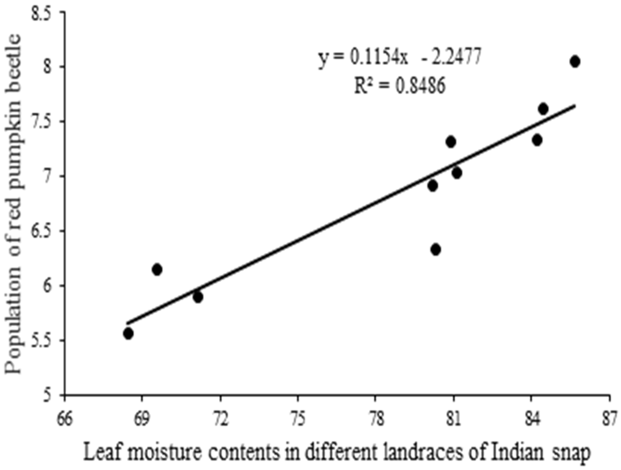

Figure 3a. Role of moisture contents of different landraces of snapmelon on population of red pumpkin beetle.

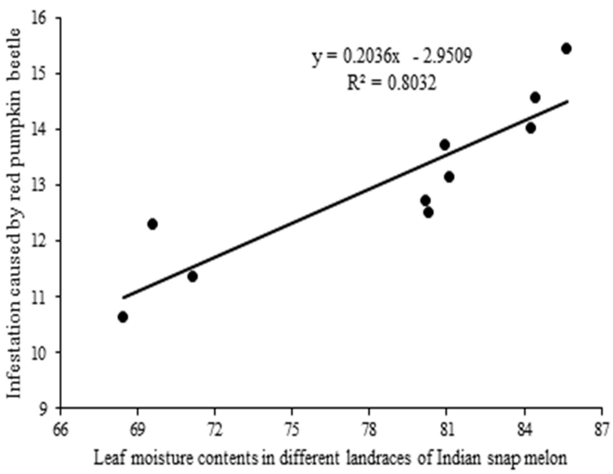

Figure 3b. Role of Moisture contents of different landraces of snapmelon on infestation caused by red pumpkin beetle.

***Leaf area*:** Minimum leaf area (cm^2) among different landraces was calculated in BHW landraces (340.50) which differed significantly from other landraces. Maximum mean value of leaf area (cm^2) was calculated in TTS landraces (436.36) at par with FSD (447.63) and SHK (449.09) landraces. Percent leaf infestation of red pumpkin beetle per plant was 10.63 in BHW landrace and 15.46 in SHK landrace. The interaction of leaf area to the population of red pumpkin beetle per plant and percent leaf infestation per plant was positive. Maximum population per plant and infestation per plant was observed in the same variety (SHK) having maximum leaf area and vice versa.

***Leaf sheath thickness*:** Leaf sheath thickness varied significantly among different landraces of snap melon. Maximum leaf sheath thickness was calculated in SHK landrace (1.97) on mean basis and minimum leaf sheath thickness was calculated in BHW landrace (0.73). Maximum population of the beetle was observed in the SHK landrace (8.06) and minimum population per plant in BHW landraces (5.56). The interaction of leaf sheath thickness with the population of red pumpkin beetle per plant was positive. Similar trend with R^2 value 0.8816 was observed of red pumpkin beetle infestation and leaf sheath thickness.

***Leaf moisture contents*:** Difference of moisture contents in different landraces was present as compared with DMR test. Minimum moisture contents 64.46 (%) was observed in BHW landraces and similarly minimum population (5.56) was observed in the same landraces. Maximum population of red pumpkin beetle per plant was observed in landraces SHK landrace (8.36) and had maximum moisture contents. Similarly, percent leaf infestation per plant was maximum 15.46 in SHK landrace. Relationship of moisture contents to the red pumpkin beetle population and infestation was positive.

There was no significant difference of hair density among different landraces of snap melon. Therefore, the interaction of hair density to the population and percent leaf infestation of red pumpkin beetle per plant was not calculated.

Present studies are not in line but can be compared with the studies of Annadurai (1987) studied biochemical basis of host selection by the red pumpkin beetle among *L. acutangula*, *L. cylindrica* and *M. scabrella*. *M. scabrella*. Biochemical analysis revealed positive interaction with chlorophyll contents and negative with palmitic acid on the pest population. Chandravadana (1987) studied bio-chemical analyses of bitter gourd checked out the feeding deterrence basis of the plant against red pumpkin beetle and identified Triterpenoid as an active compound for the deterrence. Mehta and Sandhu (1992) studied cucurbitacin content in sponge gourd (0.177 mg/g) in response of red pumpkin beetle population reduction. Analyses revealed that correlations between insect injury and total sugars, phenols, orthodihydroxy phenols, flavonoids, and total free amino acids were positive but comparatively of lower order and Dhillon (1993) studied cucurbitacin B and E effect as feeding stimulants for the red pumpkin beetle, but can compared to their study because they study similar aspects.

DISCUSSION

Varietal resistance is one of the suitable options for the pest management in the current scenario of insect pests**.** Varietal resistance however may be aided or favoured by certain physical and plant characters (Chandravadana, 1987). Physical plant characters like leaf area, leaf density, leaf hair density, moisture contents etc. are the characters of interest for physical plant resistance. Present studies were designed to examine the presence of these plant characters and their role against red pumpkin beetle population and infestation. Landrace Sheikhupura (SHK) was most susceptible one showing maximum population (8.06) of red pumpkin beetle per plant and percent leaf infestation (15.46) per plant. Bahawalpur (BHW) landrace was resistant landrace having minimum population (5.56) and infestation (10.63).

Conclusion: Present studies were carried out to record the response of red pumpkin beetle population and percent leaf infestation with leaf sheath thickness, hair density and moisture contents. Population of red pumpkin beetle increases with the increase in the population of red pumpkin beetle and vice versa. Quite similar response was observed about the percentage leaf infestation of red pumpkin beetle.

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