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Studying the involvement of phenotypic characters towards resistance of variant cucumber cultivars against phytophagous mites

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Abstract
Cucumber is an important vegetable crop, belongs to the family Solanaceae. In Pakistan, Cucumber crop is attacked by number of sucking pests, which ultimately reduce yield to a significant level. Among these, phytophagous mites are important, which cause losses to the Cucumber. The host plant characters affect the magnitude of losses by these pests. Therefore, experiment was conducted to find out the effect of different morphological plant characters, viz., number of leaf, leaf area, plant height, hair density and thickness of leaf lamina on six Cucumber varieties viz., Cucumis, Cucumber Salman, and Cucumber 72, Sialkot, Yousef and Punjab. The results showed that Cucumber Salman is a resistant variety against phytophagous mite and Yousef and Cucumber 72 are highly susceptible varieties. It can also be concluded that no single factor is responsible in mite population fluctuation but all the factors work in compliment with each other.

Keywords: cucumber, morphological characters, mites, resistance

1. Introduction
In Asia, the fourth most important vegetable crop is cucumber after tomato, onion and cabbage (Tatlioglu, 1993). The significant reduction in the yield of cucumber is due to the attack of insects and mite pests. The tremendous distribution potential of mites is due to the phytophagous nature of mites. Eriophyoidea, Tetranychoidea (Tetranychidae, Tenuipalpidae) are the important taxa of the phytophagous mites. The infestation in all the vegetables is due to the phytophagous mite e.g. the damage in cucumber, brinjal, cabbage and tomato occurs due to the *Tetranychuscucurbitae* [8].
The major damage of mites occurs on the leaf structure of plants due to the presence of higher population of mites on the surface of leaves and also due to the higher contents of nitrogen and thicker palisade mesophyll. Reproductive potential of the phytophagus mites is significantly affected by length of the leaf trichomes, leaf size, texture of leaf surface and contours [7, 11, and 16]. The mite pest population is also affected and restricted by leaf thickness and it has negative correlation with the mites [10].
The ability of the natural enemies to suppress the population of herbivores is greatly affected by different structures of plants [4, 5]. The supply of alternatives foods and shelter to the natural enemies occurs by the special structure of plants [19]. Species of natural enemies are also affected by these plant structures. The searching ability of the mites is also affected by the morphological features of plant leaves such as surface waxes, trichomes and hairiness [3].
The physical resistance factor is the higher thickness of the cuticle of the epidermis against the attack of mites [2]. The predominant predator and biocontrol agents of different plant feeding mites (tetranychid and eriophyid) and small insect pests like aphid, thrips and whitefly are the mites of the family Phytoseiidae and Stigmaeidae [6]. The prevalence of the predatory mites of the family Cunaxidae is largely controlled by the morphological plant characters as searching is a major factor [9]. Keeping this in view, the main objective of present study was to evaluate cucumber genotypes on the basis of different morphological plant characters against phytophagous mites.

2. Materials and methods
A pot experiment was conducted at research area in University College of Agriculture,

University of Sargodha to evaluate the role of morphological plant characters contributing towards prevalence and abundance of predatory mites during growing season 2013-2014. The experiment was performed in a Completely Randomized Design (CRD) using fifteen replications. Treatments for the experiments were six cucumber varieties i.e. V_1 (Cucumis), V_2 (Cucumber 72), V_3 (Cucumber Salman), V_4 (Yousaf), V_5 (Punjab) and V_6 (Sialkot). Each treatment was replicated fifteen times. There were total 90 experimental units. Cucumber varieties were sown in pots. The seeds of tested varieties were obtained from local market. The soil for pots was collected from nearby field research area. The soil was passed through 2 mm sieve to remove large stones and crop residues. 10 kg soil was filled in each pot. The pots were irrigated. When pots were in proper wet condition different cucumber varieties were sown in assigned pots as per layout plan. Five seeds were sown in each pot manually at suitable distance. All pots received the normally recommended agricultural practices of thinning, irrigation and mechanical weed control. Fertilizers were applied to each pot at recommended rate. After 15 days of germination thinning was done to keep single plant per pot. Crops were irrigated according to recommended numbers with the help of a shower. Weeding was done manually to keep the pots weeds free.

Data on per leaf adult and nymphal population of mite was recorded early in the morning for three times from each replication (pot) of each treatment during the cropping season. Each time mite population was recorded early in the morning. The population of mite was counted on leave randomly selected from upper, middle and lower portion of the plants. Hand lens was used to note the population of mites. Number of leaves, leaf area (cm^2), plant height (cm), leaf hair density (no. of hairs/cm^2) and thickness of leaf lamina (mm) were recorded using standard procedures to predict the causes of variations in growth of different varieties. The plant characters were recorded to correlate the mite population with these plant morphological characters.

Data collected on all parameters were analyzed statistically using Fisher's analysis of variance technique. Difference among varieties means were compared using Duncan's Multiple Range (DMR) test at 5% probability level. Simple correlation was worked out the plant morphological characters viz., number of leaves/plant, leaf area, plant height, leaf hair density and thickness of leaf lamina towards abundance of mite population.

3. Results and Discussion

The mean population of mite showed significant variations among varieties (Table 1). Maximum mite population (0.9 mite per plant) was recorded on variety cucumber salman followed by cucumis (0.87 mite per plant), Punjab (0.83 mite per plant), Sialkot (0.76 mite per plant) and cucumber 72 (mite per plant). Minimum mite population was recorded for variety Yousaf (0.63 mite per plant).

Table 1: Mean population per plant of mite on different cucumber varieties.

Variety	Mite population per plant
Cucumis	0.87 ab
Cucumber 72	0.69 d
Cucumber salman	0.9 a
Punjab	0.83 b
Yousaf	0.63 e
Sialkot	0.76 c

Means sharing different letters in columns are significantly different at 5% level of significance

3.1 Number of Leaves

Number of leaves is of great significance among the parameters that contribute towards final yield of a crop. Data regarding number of leaves is presented in table 2. Number of leaves were found to differ significantly among all tested varieties of cucumber. Maximum number of leaves (12.73) were recorded in variety Yousaf followed by Punjab for which number of leaves recorded were 11.92. Varieties Yousaf and Punjab were found to be statistically at par with each other. Minimum number of leaves (8.87) were found in variety Cucumis which was statistically similar to those of Cucumber salman (9.26) and Sialkot (9.11). Further analysis showed that mite population was negatively correlated with number of leaves (Table 3). Mite population decreased as the number of leaves increased. Cucumber variety Yousaf having maximum number of leaves per plant had less mite population (0.63 mite per plant) while variety Cucumis had highest mite population (0.9 mite per plant) due to having minimum number of leaves per plant.Similar results have also been reported by Shakoor *et al.* [16] who concluded that mite population decreased with increase in number of leaves per plant and plant height. The reason behind decreased mite population with increased number of leaves per plant is still unclear because no such comprehensive studies have been carried out yet.

Table 2: Plant morphological characters of different cucumber cultivars

Varieties	No. of leaves	Leaf area (cm^2)	Plant Height (cm)	Hairness (No. hairs/ cm^2)	Thickness of leaf lamina (mm)
Cucumis	8.87 c	49.35 cd	52.93 c	245.9 d	0.167 c
Cucumber 72	9.53 bc	64.42 b	69.67 b	257.7 b	0.190 b
Cucumber salman	9.26 c	41.08 d	40.33 d	234 e	0.137 d
Punjab	11.92 ab	52.92 bcd	59.13 c	250.2 c	0.175 c
Yousaf	12.73 a	80.560 a	80.27 a	268.2 a	0.204 a
Sialkot	8.87 c	49.35 cd	52.93 c	245.9 d	0.167 c

Means sharing different letters in columns are significantly different at 5% level of significance

Table 3: Correlation between mites population and plant morphological characters.

Varieties	No. of leaves	Leaf area (cm^2)	Plant Height (cm)	Hairness (No. hairs/ cm^2)	Thickness of leaf lamina (mm)
Cucumis	8.87	49.35	52.93	245.9	0.167
Cucumber 72	9.53	64.42	69.67	257.7	0.190
Cucumber salman	9.26	41.08	40.33	234.0	0.137
Punjab	11.92	52.92	59.13	250.2	0.175
Yousaf	12.73	80.560	80.27	268.2	0.204
Sialkot	9.11	56.53	43.13	254.6	0.184
Correlation Coefficient	-0.50789	-0.96539	-0.80969	-0.94887	-0.91666

3.2 Leaf Area (cm^2)

Different cucumber varieties differed significantly with respect to leaf area (Table 2). Maximum leaf area (80.56 cm^2) was observed for variety Yousaf which was statistically different from all other varieties. Minimum leaf area (41.08 cm^2) was recorded for variety Cucumber salman. Correlation coefficient (Table 3) showed that leaf area showed negative correlation with mite population. Yousaf variety having maximum leaf area got lowest mite population (0.63 mite per plant) followed by Cucumis (0.87 mite per plant), Punjab (0.83 mite per plant), Sialkot (0.76 mite per plant) and Cucumber 72 (0.69 mite per plant). Cucumber salman got maximum mite population (0.9 mite per plants) because of having minimum leaf area. The results showed that leaf area is one of the most important parameter which have significant influence on mite population. Mite population is correlated negatively to large leaf area in crops while it is positively correlated with small leaf area. The reason behind this might be that in search of prey mite has to travel longer area due to which they have to be more in contact with leaf characters [10]. The results are in complete conformity with those of Afzal and Bshir [1]. They reported that leaf area showed negative correlation with cunaxid mite population. The negative ccorrelation between mite population and leaf area has also been reported by Shakoor *et al.* [16].

3.3 Plant height (cm)

The data pertaining plant height is given in table 2. Cucumber varieties differed significantly with respect to plant height. The variety Yousaf was ranked first in having maximum plant height (80.27 cm) which significantly from all other tested varieties of cucumber. Minimum plant height (40.33 cm) was recorded in variety Cucumber salman which did not differ significantly from Sialkot for which plant height was 43.13 cm. Plant height was correlated negatively with mite population per plant (Table 3). Mite population decreased as the plant height increased. The variety Cucumber salman having minimum plant height got maximum mite population (0.9 mite per plant) followed by Sialkot (0.87 mite per plant), Cucumis (0.83 mite per plant), Punjab (0.76 mite per plant) and Cucumber 72 (0.69 mite per plant). Minimum mite population (0.63 mite per plant) was recorded for variety Cucumber salman due to having lowest plant height. Similar results have also been reported by Shakoor *et al.* [16], who concluded that mite population decreased with increase in number of leaves per plant and plant height. The reason behind decreased mite population with increased number of leaves per plant is still unclear because no such comprehensive studies have been carried out yet.

3.4 Hair density (No. hairs/ cm^2)

Hair density was found to differ significantly among the cucumber varieties (Table 2). Regarding hair density maximum numbers of hairs were found in variety Yousaf with an average value of 262.2 (no. of hairs/cm^2). Minimum hair density was shown by cucumber salman with an average value 234 (no. of hairs/cm^2) followed by cucumis with an average value 245.9 (no. of hairs/cm^2). Data given in Table 3 revealed that the hair density had negative effect on mite population which shows that hairy crops causes suppression of mite population and create a hindrance to find their prey. Data regarding mite population minimum population (0.63 mite per plant) was observed in variety yousaf with higher hair density followed by the cucumber 72. Maximum mite population was observed in cucumber salman variety (0.90 mite per plant) due to having low resistance by hair density. Similar results were reported by Cedola *et al.* [3], who concluded that increased hairiness results in preventing Neoseiulus californicus from to build population and find their prey. Krips *et al.* [10] concluded that walking speed of Phytoseiuluspersimilis was found to be maximum on the cultivars which have lower leaf hair density. The reason for decreased mite population with increased leaf hairness might be as leaf hairs can hinder the searching of predators and parasites [13, 14] by mechanically hindering the movement of natural enemy.

3.5 Thickness of leaf lamina (mm)

Thickness of leaf lamina differed significantly among cucumber varieties (Table 2). Regarding thickness of leaf lamina maximum thickness of leaf lamina (0.204 mm) was recorded Yousaf followed by cucumber 72 with an average value of 0.190 mm. Minimum thickness (0.137 mm) was showed by variety cucumber salman. Further analysis by using correlation coefficient (Table 3) showed that the thickness of leaf lamina correlated negatively with mite population. Minimum mite population (0.63 mite per plant) was observed in variety Yousaf due to having maximum leaf lamina. Maximum mite population (0.9 mite per plant) was recorded in cucumber salman variety due to less resistance by hair density. The possible reason of decreased mite population might be that the hard surface of the leaves makes it more difficult for the mites to maintain grip and making it more difficult for the predator to move across these leaves [17]. The results are in complete agreement with those of Saber and Momen [15], who reported that leaf thickness and toughness are important factors affecting the reproduction and development of mite population. The results also agree with the findings of Martin *et al.* [12].

4. Conclusion

The ability of a predator to consume its prey within plant is one of the main aspects that need to be in consideration while developing effective biological control strategies. The movement of the predator within the plant canopy is mainly influence by the morphological features of the plants. The results presented here highlight the need to consider the plant morphological characters as an interactive and important part of bio-control strategies. Knowledge of plant-pest-natural enemy interactions is also important for integration of pest control.

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