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# EFFECTS OF SOME MORPHOLOGICAL LEAF CHARACTERS OF SOME VEGETABLES WITH INCIDENCE OF PREDATORY MITES OF THE GENUS *AGISTEMUS* (STIGMAEIDAE: ACARINA)

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**Abstract**

Vegetables, being a major source of micronutrients, form the largest group of plants consumed by man. Summer vegetables are the most liked seasonal vegetables in Pakistan. The cultivation of vegetables on 224.6 thousand ha yielded 2880.3 thousand tones, which is considered low. The attack of insect and mite pests is the most important factor, amongst the others, which causes significant loss to the yield. Mites due to phytophagous nature are endorsed with tremendous distribution potential. Bio-control agents are increasingly used in controlling different insect and mite pests because of pest resistance to chemicals and pesticide hazards to consumers especially in vegetables. Predatory mites of genus *Agistemus* play pivotal role in controlling phytophagous mites and small soft bodied insects. Morphological plant characters influence the ability of predatory mites to suppress the population of different crop pests. Therefore, the present study was conducted to determine the role of morphological plant characters viz., leaf area, leaf hair density, thickness of leaf lamina and hair length of different vegetables such as tomato, okra, bitter gourd and brinjal against the incidence of predatory mites of the genus *Agistemus* in four different localities of Punjab. The maximum population of the mite was observed on tomato (4.01 mites per leaf), which was followed by brinjal (3.6 mites per leaf), bitter gourd (2.40 mites per leaf) and okra (1.1 mites per leaf). Leaf area, leaf hairiness, thickness of leaf lamina and hair length had shown negative correlation with *Agistemus* population. However, other leaf characters may also be responsible in mite population fluctuation but all the factors worked in compliment and hence affect the relative abundance of the mite.

## Introduction

Mites of the family Stigmaeidae and Phytoseiidae are predominantly predator of different plant feeding mites (tetranychid, tenuipalpids and eriophyid) and small insect pests like aphid, whitefly, thrips and scales. (Ehara, 1985; Gupta, 1985). These are increasingly being used as bio-control agents of phytophagous mites in crops, fruit trees, vegetables, ornamentals, wild and forest plantations. Keeping in view the economic importance of stigmaeid mites, the family has been a subject of intensive taxonomic, biological and ecological study. Stigmaeidae has many genera out of which genus *Agistemus* is of great significance in controlling phytophagous mites and also small soft bodied insects and their eggs. Yousaf *et al*., (1982) observed *Phytoseius gossipi* and *Agistemus exsertus* preying effectively on immature stages of *Tenuipalpus granati* and *Tetranychus urticae*. In China Zhang & Kong (1986) found that *Phytoseius fallacies* gave encouraging results in controlling *Tetranychus viennensis* in apple orchards. Schicha (1987) reported that *Phytoseius deleoni* was found feeding on *Panonychus citri*. Bolckmans *et al*., (2006) reported that *Amblyseius swirskii* is a new breakthrough in

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biological control of whitefly in different vegetables. By virtue of the predatory habits, the Stigmaeid mites of genus *Agistemus* has gained a great economic importance as bio-control agent and can successfully be used in IPM. Biological control is becoming inevitable for the control of insect and mite pests due their increased resistance to chemicals (Campos & Omoto, 2002; Cranham & Helle, 1985). Pesticides create health hazards and pollution problems while biological control agents are safe environmental friendly and give long lasting control. Vegetables are worst damaged by many phytophagous mites especially spider mite and different insect pests like aphid, whitefly and thrips. Fotedar (1978) reported that *Tetranychus cucurbitae* damage many vegetable like cabbage, brinjal, cucumber, potato and pumpkin. Predatory mites of genus *Agistemus* play pivotal role in controlling phytophagous mite and soft bodied insects in different vegetables. We should avoid the use of pesticides in vegetables as much as possible because these are directly consumable commodities. In this regard, the use of bio-control agents is of immense significance for the control of different vegetable pests.

Plant morphological characters play a significant role in influencing the ability of predators to suppress the population of different crop pests (Dicke, 1998). The physico-morphic leaf characters may either have negative or positive influence on the pest population as well as their natural enemies (Krips *et al*., 1999). Different plant leaf characters like leaf area, leaf hair density, length of leaf, leaf thickness play a significant impact in the searching capability and population of the natural enemies including predatory mites (Croft *et al*., 1999; Cedola *et al*., 2001). According to Krips *et al*., (1999), the walking speed of *Phytoseiulus persimilis* (Phytoseiidae: Acarina) was found the highest on the cultivars with lowest leaf hair density. The leaf hair density may hinder the searching ability of predators and parasites (Ricci & Capelletti, 1998). Leaf texture also influences the predatory mite population. It affects the development and reproduction of predatory mites of family Stigmaeidae and Phytoseiidae (Saber & Momen, 2005). Hard and thick leaf surfaces make it more inconvenient for the predatory mites to maintain grip, thus making their movement difficult (Skirvin & Fenlon, 2001). The above mentioned studies depicted that plant morphology play an important role in influencing the searching ability of predatory mites. Therefore, the present study was conducted to determine the role of physico-morphological plant leaf characters viz., leaf area, leaf hair density, thickness of leaf lamina and length of hairs of different vegetables such as, tomato, okra bitter gourd and brinjal influencing the ability and population of predatory mites of the genus *Agistemus.*

## Materials and Methods

The present study was carried out in order to check the influence of vegetable plant morphology on the population of mites of the genus *Agistemus* on four different vegetables viz., tomato, okra, bitter gourd and brinjal. The data regarding mite population was recorded on per leaf basis from randomly selected plants thrice during the cropping season in four different localities of Punjab, Pakistan Viz., Burewala, Faisalabad, Toba Tek Singh and D.G. Khan. Different vegetable plant characters viz., leaf area, leaf hair density, thickness of leaf lamina and length of leaf hairs were recorded during the course of study. The Leaf area was measured by leaf area meter. Leaf hair density ($cm^2$) was recorded by using an iron made dye of one $cm^2$ under binocular microscope from three different leaves randomly selected from each of three different vegetable plants. Thickness of leaf lamina was also measured by ocular micrometer after making the fine

slices of the leaf lamina. Length of leaf hairs was measured with the help of ocular micrometer after pealing off hairs with fine razor and making their temporary slides. Finally the mean population of *Agistemus* mite on different vegetables was compared by using Duncan's Multiple Range Test. The contribution of morphological plant characters towards abundance of mite population was estimated through simple correlation.

**Results and Discussion**

The results showed that *Agistemus* mite population significantly varied on different vegetables (Table 1 & Fig. 1). The maximum *Agistemus* mite population per leaf was found on tomato (4.1), which was followed by brinjal (3.6), bitter gourd (2.4) and okra (1.1). Different morphological plant characters viz., leaf area, leaf hair density, thickness of leaf lamina and length of leaf hairs showed significant differences in different vegetables under study (Table 2). Leaf area was found maximum in okra (293.55 $cm^{-2}$) while minimum in tomato (84.43 $cm^{-2}$) as given in Table 2. Leaf hair density was recorded maximum on bitter gourd (264.50 $cm^{-2}$) which was followed by okra (243.21 $cm^{-2}$), brinjal (208.19 $cm^{-2}$) and tomato (193.42 $cm^{-2}$) as given in Table 2. Similarly, maximum leaf thickness was observed in case of okra (274.77 µm) while it was minimum in tomato (211.16 µm) as shown in Table 2. Maximum leaf hair length was recorded in okra (322.84 µm) while the shortest length was recorded in case of tomato (130.08 µm) as shown in Table 2. These results can be compared with those of Krips *et al*., (1999), Croft *et al*., (1999), Cedola *et al*., (2001) and Saber & Momen (2005).

The results in the correlation matrix (Table 3 & Fig. 6) revealed plant leaf area also showed significant negative correlation with *Agistemus* mite population (r =-0.951). The small leaf area is normally ideal for the predatory mites because they need not to cover long distance in order to capture their prey. There would be minimum number of possible contacts between predator and prey in case of large leaf area. The present results are the same as given by Krips *et al*., 1999.

The results in Table 3 & Fig. 6 revealed that leaf hair density has non-significant negative correlation with *Agistemus* mite population (r = -0.771). These results showed that *Agistemus* mites did not prefer hairy leaves, which create hindrance in finding their prey. Hairy leaves also restrict the movement of mite. Same type of results were reported by Krips *et al*., (1999) who is of the opinion that walking speed of *Phytoseius persimilis* (Phytoseiidae: Acarina) was the highest on the cultivars with the lowest leaf hair density. According to Price *et al*., (1980) the leaf features such as hairiness can hinder the searching of predators and parasites. Similar results have been reported by Ricci & Capelletti (1998).

Leaf thickness is also very important factor influencing *Agistemus* mite population and showed significant negative correlation with the mite population (r = -0.981). The results agree with Saber & Momen (2005) who reported that leaf toughness and thickness are very important factors, which affect the reproduction and development of phytoseiid mite population.

The length of hair also showed highly significant negative correlation with *Agistemus* mite population (r = -0.999) which means long hairs are not preferred by predatory mites. Long hairs also create hindrance in searching efficiency and ability of *Agistemus* mite and they have to move a considerable distance in search of their prey. The results are inline with those given by Krips *et al*., (1999).

**Table 1. Mean population of mites of genus *Agistemus* per leaf on different vegetables.**

| Vegetables | Mean population of mite/leaf |
|---|---|
| Tomato | 4.1a |
| Okra | 1.1d |
| Bitter gourd | 2.4c |
| Brinjal | 3.6b |

*Means sharing different letters are significantly different at 5% level of significance.

**Table 2. Morphological leaf characters of different vegetables.**

| Vegetables | Leaf area ($cm^2$) | Hair density ($cm^2$) | Thickness of leaf lamina (µm) | Hair length (µm) |
|---|---|---|---|---|
| Tomato | 84.43d | 193.42d | 211.16d | 130.08d |
| Okra | 293.55a | 243.21b | 274.77a | 322.84a |
| Bitter gourd | 203.44b | 264.50a | 244.96b | 229.16b |
| Brinjal | 173.45c | 208.19c | 216.23c | 149.40c |

**Table 3. Correlation matrix of *Agistemus* mite population per leaf with leaf area, hair density, thickness of leaf lamina and length of hairs in different vegetables.**

| Vegetables characters | Leaf area | Hair density | Thickness of leaf lamina | Hair length |
|---|---|---|---|---|
| Correlation coefficient | -0.951* (0.022) | -0.771ns (0.185) | -0.981* (0.005) | -0.999** (0.000) |

Note: The values in parenthesis show p-value
** = Highly significant
* = Significant
ns = Non-significant

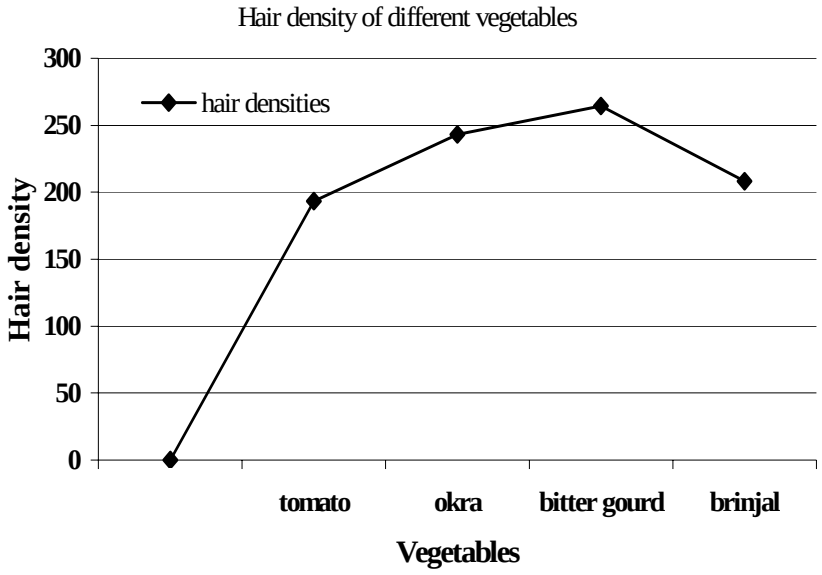


Fig. 1. Mean population of predatory mite of genus *Agistemus* on different vegetables.

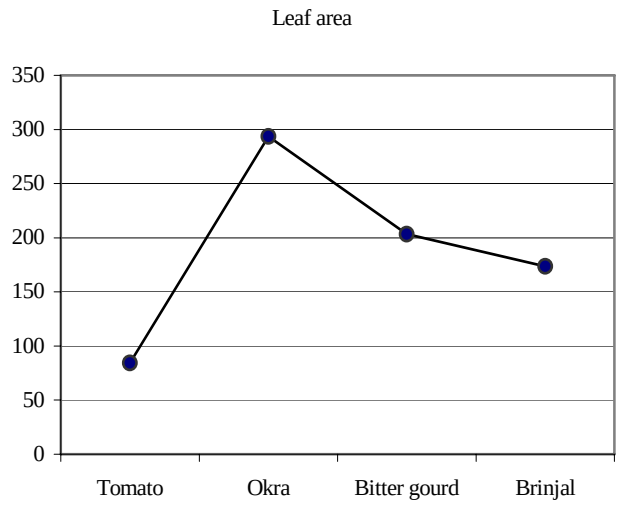


Fig. 2. Leaf area of different vegetables.

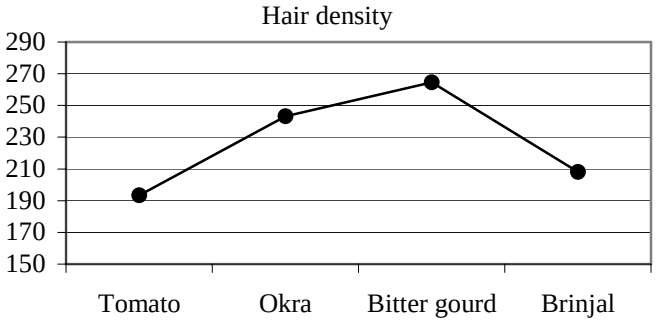


Fig. 3. Hair densities of different vegetables.

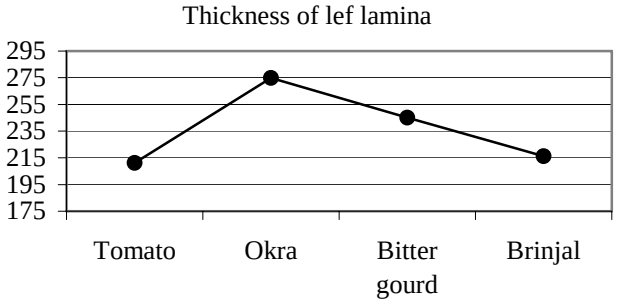


Fig. 4. Thickness of leaf lamina in different vegetables.

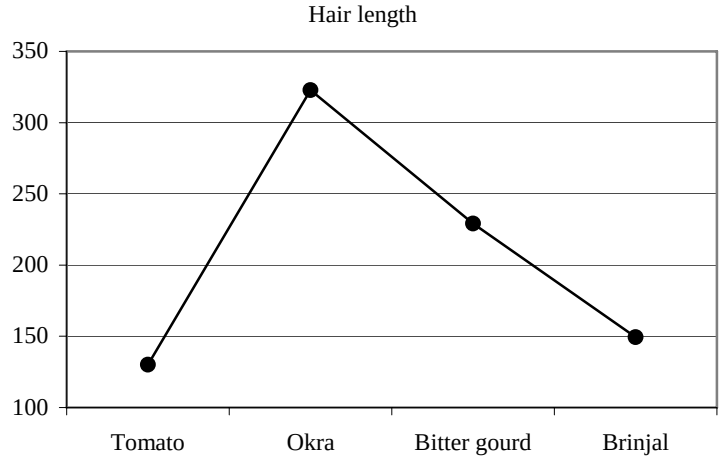


Fig. 5. Hair length of different vegetables.

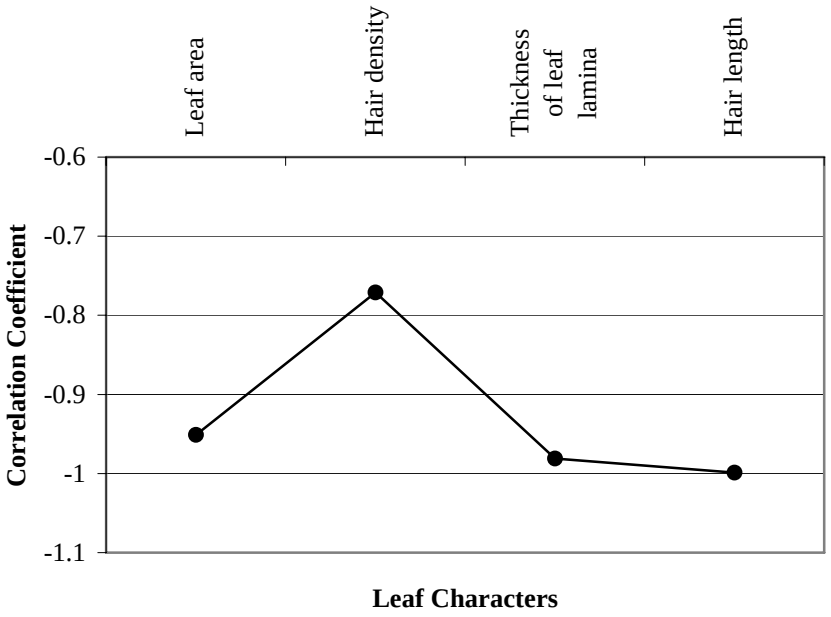


Fig. 6. Correlation Coefficients between mite population and plant characters.

It can be concluded that no single factor is responsible in mite population fluctuation but all the factors work in compliment with each other. The morphological plant characters are very important in affecting the movements of *Agistemus* mite during the search of its prey within the plant canopy. Therefore, it is suggested that relationship of morphological plant characters with predator should also be considered before using them in biological control programme.

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