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Population Dynamics of *Phytoseiulus persimilis* on Rose Plantation in Relation to Abiotic Factors and Physio-Morphic Leaf Characters

[1]*Mukhtar Ahmed,* [1]*Bilal Saeed Khan,* [1]*M. Hamid Bashir,*
[2]*Muhammad Farooq,* [2]*Abdul Ghaffar and* [3]*Muhammad Rafiq Shahid*

[1]Department of Agricultural Entomology, University of Agriculture Faisalabad, Pakistan
[2]Entomological Research Institute, Ayub Agricultural Research Institute Faisalabad, Pakistan
[3]Cotton Research Institute, Faisalabad, Pakistan

Abstract: Mites of family Phytoseiidae have huge predatory potential and are good biocontrol agents for phytophagous mites belonging to the family Tetranychidae, Tarsonemidae, Eriophyidae, Tenuipalpidae and their eggs, so being used in Integrated Pest Management programs. The given study has been proposed to know the population dynamics of *Phytoseiulus persimilis* in relation to abiotic factors and Physio-morphic leaf characters on rose plantation. It has been conducted in the research area of *Rosa* project, Institute of Horticultural Sciences, University of Agriculture Faisalabad in RCBD during March to end of June 2013. The Results showed that the maximum mite population was observed during 3rd week of May while the minimum population was observed in 1st week of March and varied significantly during different weeks. It was observed that mite population varied in different portions of the rose plantation like as Middle portion > Lower portion > Upper portion and in months; May > June > April > March as well as in treatments; *Rosa centifolia* > Gruss-An-Teplitz >*Rosa indica*. Abiotic factors against mite population revealed that temperature showed highly significantly positive correlation with mite population whereas Relative Humidity (R.H) showed highly significantly negative correlation. Rainfall represented non-significant correlation with the mite population as it was low rainfall during whole course of study. Physio-morphic leaf characters against mite population revealed that leaf area showed positive correlation while moisture contents showed negative correlation against mite population. Thickness of leaf lamina represented highly significantly positive correlation with the predatory mite population.

Key words: Phytoseiidae · Faisalabad · *Rosa centifola* · *Rosa indica* · Weather parameters · IPM

INTRODUCTION

Rose has been considered as the flower of Prophet Muhammad (PBUH) in Iran as it has nice fragrance and globally, it has been considered as a symbol of affection and love [1]. The word rose has been originated from the 'Erose' that means 'The god of love' [2]. The member of the family Rosaceae, genus *Rosa*, has more than 200 species and about 18000 cultivars [3]. Roses had been and being used for worship and also in bouquets and garlands making. The rose's oil is being used in Ayurveda medicines, soft drinks, flavoring alcoholic liquor, perfuming soaps and cosmetic industry for the making of beauty products whereas rose water used in confectionary, eye lotions and medicines also. Gulkand is also being made through petals of roses. Different studies also discovered the anti HIV property of rose oil [4]. The king of flower is liked for its color and fragrance [5].

Roses are susceptible to different insect pests, mites and diseases that lessen flower growth, reduce quality and discourage rose gardeners [6]. Mites are tiny, microscopic creature belonging to the subclass Acari of the class Arachnida are amongst the oldest of the all terrestrial animals having fossils known from early Devonian about 400 million years ago [7]. A mite is not an insect but have close relationship with the insects and the spiders. Mites are yellowish green in color having black spots on all side of the body. Mites damage the crops by

Corresponding Author: Muhammad Farooq, Entomological Research Institute,
Ayub Agricultural Research Institute Faisalabad, Pakistan.

sucking out the sap of individual cells among a great variety of ornamental plants includes roses and causes small yellowish stippling on the host plant's foliage and very fine webbing can also be seen on leaves and stems [8]. The stability in temperature and humidity conditions that is best for plant growth generally favors the swift growth of this pest [9]. *Tetranychus urticae* maintains population at high level all through the year in many crops and cause a significant damage to tomato, strawberry, bean, pumpkin, melons, brinjal and much more in green house and outdoor crops [10]. Traditionally, acaricides are used for controlling *T. urticae* on the harvested and consumable products that results problems of residues and resistance to pesticides [11] this is the main reason for the need of establishment of biological control.

Biological control due to its inconsistency of results has not been broadly adopted up till now but is a best, friendly, safe for environment and economical approach for controlling insects and mite pests [12]. A large number of predatory mites belonging to the family Phytoseiidae, Stigmaeidae, Anystidae, Bdellidae, Cheyletidae and Cunaxidae feeds on phytophagous mites and small soft bodied insects as well as their eggs. Among different families of predatory mites, the mites belonging to family Stigmaeidae and Phytoseiidae have supreme significance for predation on different pests of crops. Phytoseiid mites are world widely distributed and are more effective biocontrol agent for phytophagous mites[9]. Aphids, scale insects, thrips, whitefly and other small arthropods are some of the insects that are controlled by this mite [13].

Plant structures can control the pest attack [14] as plant may form special structures that provide refuge to natural enemies of insects [15] or serve as alternate source of food [16]. Morphological characters can increase or decrease the pest attack and can also affect the performance of natural enemies [17].

Abiotic factor like temperature, wind velocity and relative humidity showed positive correlation, On the other hand rainfall has adverse effect on the population of mite while sunshine hours showed no effect [18].

The present study was conducted to explore the time for the incidence of predatory mites on roses, to check the effect of morphological leaf characters and the effect of abiotic factors on population dynamics of predatory mites, so that these mites could be employed further for effective biological control of harmful pests not only in Roses but in other crops also. The proposed study will lay future research basis in eco-biology of these mites and ultimately facilitates for assessment of their potential in integrated pest management (IPM) programs that finally help in decreasing the dependence on pesticides ensuring not only to diminish the burden on economy of nation but could also facilitate for the safe guard of environment and get rid of health hazards.

MATERIALS AND METHODS

The proposed study was conducted in the research area of *Rosa* project, Institute of Horticultural Sciences (HIS), University of Agriculture Faisalabad, Pakistan in Randomize Complete Block Design having three replications. Mite population was recorded on per leaf basis early in the morning at weekly intervals by dividing a single rose plant into top, middle and lower portions from each replication. Ten leaves were selected randomly from each selected portion (Upper, Middle and Lower) and mite population was counted. The data on Abiotic factors; temperature, relative humidity and rainfall was taken from the department of crop physiology, University of Agriculture Faisalabad. The data on Physio-morphic leaf characters was recorded by the below mentioned procedure;

Leaf Area (cm^2): From each replication, three plants were selected at random and the leaf area (cm^2) was calculated from upper, middle and lower leaves of each plant with the help of leaf area meter and the calculated values were multiplied by a correction factor of 0.68 to obtain proper results.

Thickness of Leaf Lamina (mm): Three plants was selected at random from each replication of each treatment and one leaf from upper, middle and lower portion of each selected plant was taken. A cross section of leaves was cut with the help of a fine razor and thickness of leaf lamina was determined from three different places of each leaf with the help of an ocular micrometer under a binocular microscope. The thickness of leaf lamina was multiplied by a microscope factor (9.8) to obtained proper results.

Moisture Percentage in Leaves: Three samples of 100 grams leaves from upper, middle and lower portions of three different plants was collected from each replication of each treatment. All the leaves was cleaned with muslin cloth, weighed, classified and kept in a drying oven, running at 70 ± 5° C. Before keeping in oven the leaves were dried in shade for two days. After leaves have been dried the moisture percentage was calculated.

Statistical Analysis: Data was analyzed by the use of stat package (Statistica) using 2 factor Randomized Complete Block Design and the Means was compared by Tuckey's HSD test at 5% level of probability. Simple correlation was worked out between mite population and leaf morphological characters viz., leaf area, thickness of leaf lamina and moisture percentage in leaf as well as with abiotic factors viz., temperature, relative humidity and rainfall.

RESULTS

Population of P. Persimilis During Different Months on Different Plant Portions: Mite population was observed during different weeks from 1st week of March to the last week of June and resulted that the mite population differs significantly. The maximum mite population was observed during 3rd week of May on the middle plant portion followed by lower and upper respectively in all of the treatments. The minimum population was observed in 1st week of March (Figures 1-3). Mite population trend was as follows:

Middle portion > Lower portion > Upper portion
May >June >April > March.

P. Persimilis Population During Different Weeks: The maximum mite population (4.15 mites/leaf) was observed during 3rd week of May and the minimum population (0.30 mites/leaf) was observed in 1st week of March. The minimum mite population was observed in the 1st week of March which increased significantly during different weeks but decreased during 4th week of April and then increased up to 3rd week of May and at last decreased gradually reaching to last week of June (Figure 4).

Overall P. Persimilis Population on Different Rose Species: Figure 5 depicted that maximum mite population was observed on *Rosa centifolia* (2.92 mites/leaf) followed by Gruss-An-Teplitz (2.34 mites/leaf). The minimum mite's population was observed on *Rosa indica* (1.67 mites/leaf).

Correlation Between Abiotic Factors and Mite Population: Correlation matrix between different Abiotic factors against mite population revealed that Temperature showed highly significantly positive correlation with mite population whereas Relative Humidity (R.H) showed highly significantly negative correlation. The Rainfall represents non-significant correlation with the mite population as it was low rainfall during whole course of study (Table 1).

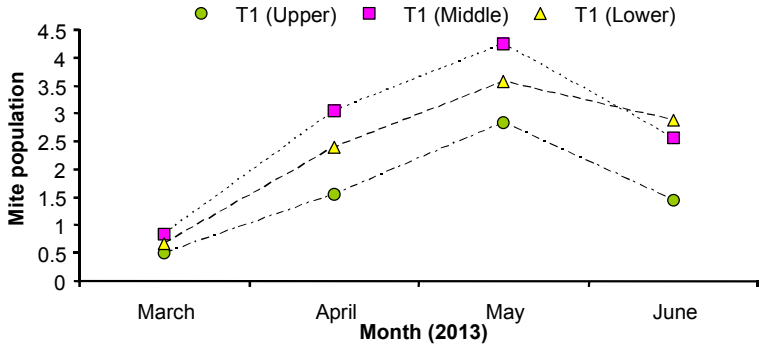

Fig. 1: Mite population on *Rosa indica*

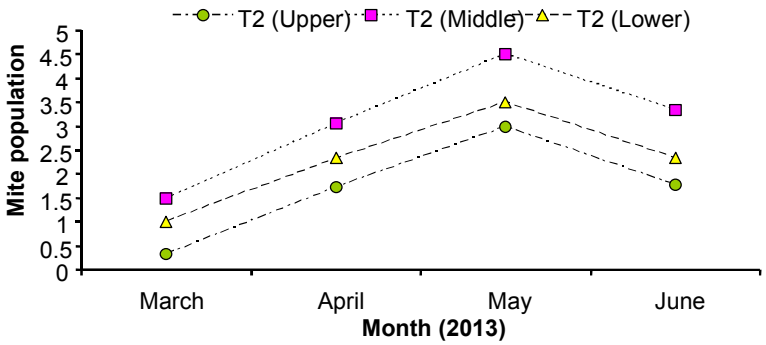

Fig. 2: Mite population on *Rosa centifola*

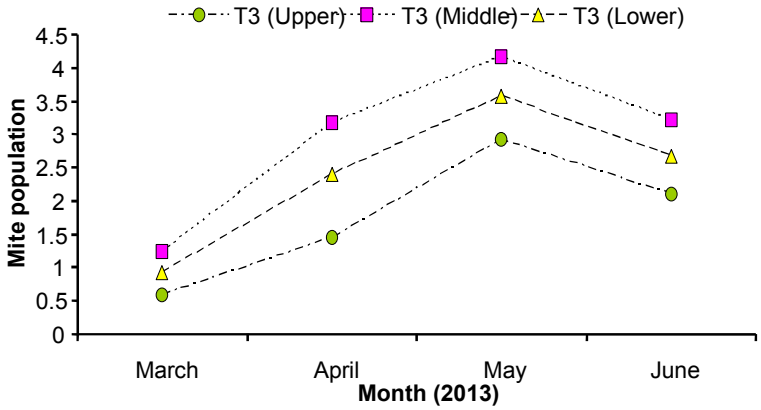

Fig. 3: Mite population on Gruss-An-Teplitz

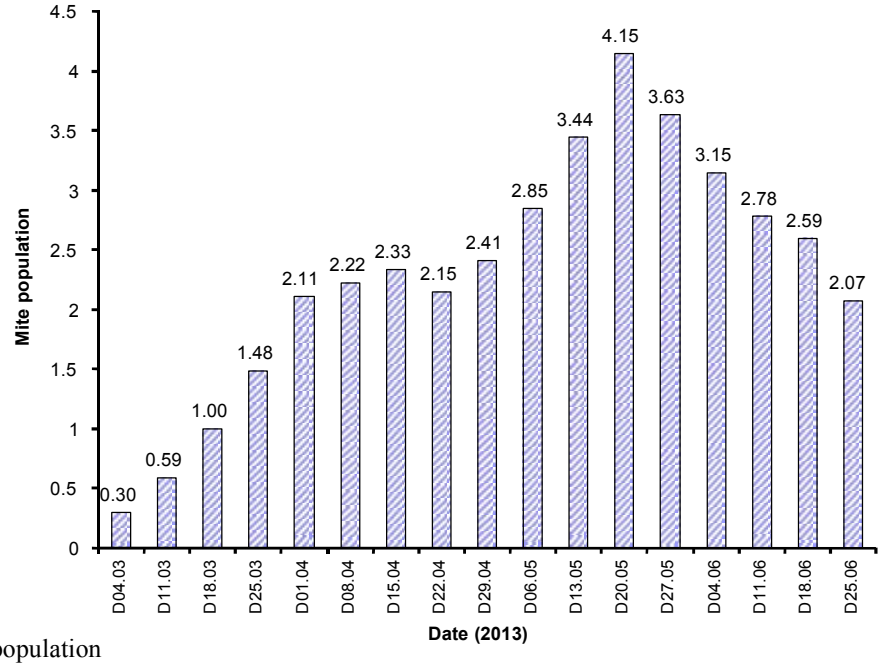

Fig. 4: Overall mite population

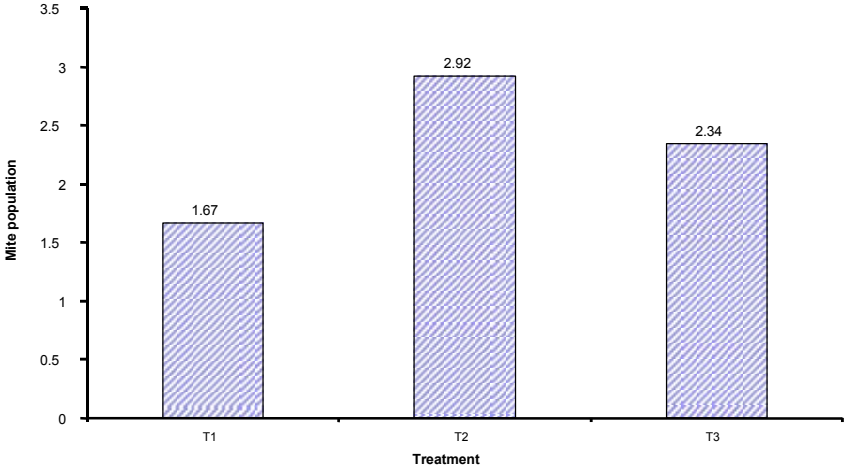

Fig. 5: Overall *P. persimilis* population on different Rose species

Table 1: Correlation between Abiotic factors and mite population

Abiotic factors	Mite Population
Temperature	0.814**
	0.000
Relative Humidity	-0.825**
	0.000
Rainfall	0.136
	0.602

Upper values indicated Pearson's correlation coefficient; Lower values indicated level of significance at 5% probability.

* = Significant (P<0.05);

** = Highly significant (P<0.01).

Table 2: Correlation between Physio-morphic leaf characters and mite population

Physio-morphic leaf characters	Population
Leaf area	0.238
	0.233
Leaf lamina Thickness	0.514**
	0.006
Moisture %age	- 0.290
	0.142

Upper values indicated Pearson's correlation coefficient; Lower values indicated level of significance at 5% probability.

* = Significant (P<0.05);

** = Highly significant (P<0.01)

Correlation Between Physio-Morphic Leaf Characters and Mite Population: Correlation matrix between different physio-morphic leaf characters against mite population revealed that leaf area showed positive correlation against mite population while moisture contents showed negative correlation. Thickness of leaf lamina represents highly significantly positive correlation with the mite population (Table 2).

DISCUSSION

Phytoseiulus *persimilis* population varied during different periods of the year. Mite population was observed during different weeks from March to end of June and resulted that the mite population differs significantly. The results of this study indicated that maximum mite population (4.15 mites/leaf) was observed during 3rd week of May and minimum population (0.30 mites/leaf) was recorded in 1st week of March. These results are favored by Pal *et al.* [19] who stated the peak of *Tetranychus cinnabarinus* in May and June. Ho and Chen [20] surveyedthat *T. cinnabarinus* reached at its peak two times; the first occurred in May and July while second peak observed in September and October. Similarly, Shaw and Devroy [21] noticed that *T. neocaledonicus* population rapid development in May and declared as the most suitable month for it growth.

The results of the given study revealed that the maximum mites population was observed on the middle plant portion followed by lower and upper respectively in all of the treatments. These results are supported by findings of Rai *et al*. [18] who revealed that *T. urticae* gives feeding preference to the leaves of bottom canopy and then to the middle canopy. Roopa [22] mentioned that amongst three various levels of plant canopy, middle canopy holds maximum density of mites (50.75 per 4cm^2 leaf area) after that bottom canopy (49 per 4cm^2 leaf area) and then top canopy (23.65 per 4cm^2 leaf area).

Inoue [23] stated that the mite population varies from a very intense in one field and none in neighboring field.

Different treatments viz., *Rosa indica*, *Rosa centifolia* and Gruss-An-Teplitz has been selected for study the predatory mite population. The overall maximum mite population was observed on *R. centifolia* (2.92 mites/10 leaves) followed by Gruss-An-Teplitz (2.34 mites/10 leaves). The minimum mite's population was observed on *R. indica* (1.67 mites/10 leaves). It means population varied as: *R. centifolia* > Gruss-An-Teplitz > *R.indica*.

Correlation matrix between different Abiotic factors against mite population revealed that temperature at each level showed highly significantly positive correlation with mite population whereas relative humidity (R.H) showed highly significantly negative correlation. Rainfall represents non-significant correlation with the mite population as it was low rainfall during whole course of study. Similar findings have been reported by Pal *et al*. [19] who stated that the population increases directly by temperature of air but mite population affected adversely by maximum humidity as well as by high rainfall. Mishra *et al.* [24] also observed similar trend of abiotic factors reported positive correlation among temperature and mite population. Tang *et al*. [25] reported that Phytoseiid mites can tolerate adverse climatic conditions such as high summer temperature or low winter temperature. Prasanna [26] revealed mite population and weather parameters correlation was significant when maximum temperature (Positive) and relative humidity at dawn and dusk (Negative) whereas non-significant to temperature as well as rainfall when were minimum.

Correlation matrix between different Physio-morphic leaf characters against mite population revealed that leaf area showed positive correlation against mite population while moisture contents showed negative correlation.

It showed that thickness of leaf lamina represents highly significantly positive correlation with the mite population. Physio-morphic leaf characters influences the predatory mite's ability in suppression of the different crop pests populations. Many scientists presented similar results including [27] who reported that different leaf characters of plants like leaf area, leaf thickness, leaf length and hair density plays considerable impact on the searching capacity and population of the natural enemies includes predatory mites. Plant structures can control the pest attack as plant may form special structures that provide refuge to natural enemies of insects [15] or serve as alternate source of food [16]. Morphological characters can increase or decrease the pest attack and can also affect the performance of natural enemies [17].

It was noted that a single factor is not responsible for controlling mite population, so relationship of biotic and abiotic factors as well as Physio-morphological plant characters with predator population must be considered in biological control programs.

CONCLUSION

The proposed study will lay future research basis in eco-biology of these mites and ultimately facilitates for assessment of their potential in IPM programs that finally help in decreasing the dependence on pesticides ensuring not only to diminish the burden on economy of nation but could also facilitate for the safe guard of environment and get rid of health hazards.

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