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Population dynamics of insect pests on six okra varieties in Peshawar

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Abstract
Whitefly, *Bemisia tabaci* (Genn.) (Hemiptera: Aleyrodidae) and aphids, *Aphis gossypii* (Glov.), (Hemiptera: Aphididae) pose heavy threat to okra in Peshawar each year. For efficient control of insect pests of okra, study of its population densities is very important. In the present research work population densities of *B. tabaci* and *A. gossypii* were determined on six okra varieties in Peshawar in 2014. The experiment was conducted in Randomized Complete Block Design with three replications. The results revealed that overall mean density of *B. tabaci* was significantly higher on Malay (2.27 individuals/leaf) and lower on F1H (1.86 individuals/leaf). Overall mean density of the *A. gossypii* was significantly higher on Malay (2.13 individuals/leaf) and lower on Arizona (1.75 individuals/leaf). Population of both the pests peaked in June-July, 2014. The findings of the present research will lay down a base for developing efficient control strategies against the insect pests of okra in Peshawar.

Keywords: *A. gossypii, B. tabaci,* Okra, Population dynamics

1. Introduction

Okra (*Abelmoschus esculentus* L.) belongs to family Malvaceae or Mallow, which is locally known as Bhendi and Lady's finger worldwide. It is very popular summer vegetable for home gardening while it is also grown commercially throughout the world especially in Indo-Pakistan sub-continent. It is probably originated in Ethiopian region of Africa [1].

Okra is a widely cultivated vegetable crop within tropical and subtropical regions, for its immature pods which are consumed either fresh or after processing [2]. The immature pods are consumed as boiled vegetables. It is also dried and used as soup thickeners or in stews [3]. The green fruits are rich sources of vitamins, calcium, potassium and other minerals. Despite the nutritional value of this important vegetable crop, its optimum yields (2-3 tons/ha) and quality have not been attained in the tropical countries partly because of a continued water shortage and other climatic limitations. Okra plant require relatively average temperatures and unable to tolerate low and high temperature for long time. Okra is a high water crop which has notable drought tolerance [4].

In 2009 the total production of okra in Pakistan was 114.657 thousand tones and cultivated on an area of 15.081 thousand hectares, while in Khyber Pakhtunkhwa the total production was 18.156 thousand tones cultivated on an area of 2.126 thousand hectares [5].

Okra attracts a large number of insect pests including jassids, *Amrasca devastans* Dist. and *Amrasca biguttula* (Shirr.); aphids, *Aphis gossypii* (Glov.) cutworm, *Agrotis* spp. and mites *Tetranychus* sp. Among insect pests, aphids especially *A. gossypii* is considered one of the most important pest of okra [6]. The aphids are soft bodied insects which suck the cell sap from the leaves, secrete lots of honey dew on the leaves, hence, weakening the plants and reducing both quantity and quality of the fruits. In addition to okra, the aphids also feed on a variety of plants including the cucurbits, cotton, citrus fruits, strawberry, beans, beets, spinach, eggplant, asparagus, a number of ornamental plants and many weeds [7].

Host plant resistance is an important component of integrated pest management [8]. Highly resistant varieties will pressurize the pest population to select for resistance breaking strains. On the other hand, partial plant resistance will exert a lesser selection pressure on the pest population [9]. Moderate levels of resistance have many advantages in relation to IPM. Among the most desirable features of plant resistance from an ecological point of view are its specificity to a pest or complex of pest organisms, cumulative effect, persistence, harmony with the environment, ease of adoption and compatibility with other components in pest management. A partially resistant variety could provide the foundation open, with which other management measures could be built [10]. This can be used as an adjunct to other control measures and can interact well with other components of IPM, i.e. chemical and biological control measures [11].

In the past, no work has been conducted on the population dynamics of whiteflies and aphids on different available okra varieties in Peshawar, therefore, the present work was initiated to study thoroughly all these aspects for achieving the objectives.

2. Materials and Methods

2.1 Experimental layout

The experiment was conducted at the New Developmental Farm (NDF) of The University of Agriculture, Peshawar (UAP) during 2015. The experiment was laid out in Randomized Complete Block Design (RCBD). There were six treatments viz. Local Peshawari, Arizona, Malave, F1 Syngenta, Neelum Green and Baharati Kevri and a control. Each treatment was replicated three times. Each treatment measured 4 x 3.6 m^2. There were seven rows in each treatment and each row had 15 plants. Plant to plant and row to row distance was kept 12 cm and 60 cm, respectively. A buffer zone of 60 cm wide was kept between adjacent treatments to isolate them from one another. Uniform cultural practices including ploughing, irrigation, fertilizer and weeding were followed in each treatment.

2.2 Population dynamics of whiteflies and aphids

The population of whiteflies and aphids on six okra cultivars was weekly counted on three randomly selected leaves, i.e. one each from top, middle and bottom of the ten randomly selected plants in each treatment, avoiding the boarder rows.

2.3 Statistical analysis

The data recorded for each parameter was analyzed statistically by using Statistix 8.1 Software and means were separated by using Fisher Protected Least Significance Difference Test at 5% level of significance [12].

3. Results and Discussion

3.1 Population density of *B. tabaci*

The results in table 1 showed that mean density of the *B. tabaci* in week1 and 7 that was significantly higher on Bharati Kaveri with 0.81 and 3.37 individuals/leaf, respectively. In week 2, 4, 13 and 14 density of the pest was significantly higher on Malay with 1.38, 4.20, 2.13, 0.5 individuals/leaf, respectively. Mean density of the whitefly in week 3, 10 and 12 was significantly higher on Local Peshawari with 3.34, 4.37, 2.46 white flies/leaf, respectively. In week 5 and 11 density of the pest was significantly higher on F1 Syngenta with 0.80 and 4.86 individual/leaf. The mean density of pest in week 6, 8, 9 was significantly higher on Arizona with 2.53, 2.49, and 4.47 individual/leaf, respectively. Overall mean density of the pest was significantly higher on Malay with 2.27 individuals/leaf and lower on Neelum Green (1.86 individuals/leaf).

Table 1: Mean density of *B. tabaci*/leaf on six okra varieties in Peshawar in 2014.

Variety	Mean density of *B. tabaci*/leaf in week														Overall Mean
	W1 (13/5)	W2 (20/5)	W3 (27/5)	W4 (3/6)	W5 (10/6)	W6 (17/6)	W7 (24/6)	W8 (1/7)	W9 (8/7)	W10 (15/7)	W11 (22/7)	W12 (29/7)	W13 (5/8)	W14 (12/8)	
Local Peshawari	0.58 a-f	1.26 v-c	3.34 d-k	3.62 b-i	0.19 c-f	1.55 s-b	2.42 k-t	1.40	2.87 h-p	4.37 abcd	3.99 a-g	2.46 k-s	1.41 t-b	0.01 f	2.11 ab
Arizona	0.72 z-f	1.12 w-e	3.22	2.51 j-r	0.72 z-f	2.53 j-r	2.02 n-w	2.49 j-r	4.47 abc	3.25 e-l	2.61 h-r	2.20 j-r	2.06 o-x	0.22 b-f	2.15 ab
Malav	0.74 z-f	1.38 t-b	2.85 h-p	4.20 a-f	0.47 b-f	1.85 o-y	1.74 q-z	2.62 h-q	4.62 bc	3.42 c-k	3.06 g-n	2.20 m-w	2.13 o-x	0.50 b-f	2.27 a
F1-Syngenta	0.72 z-f	1.21 v-d	2.50 j-r	3.14 f-m	0.80 a-f	2.39 k-u	1.10 w-e	1.86 o-y	2.36 k-u	4.28 a-e	4.86 a	2.80 n-v	1.77 o-x	0.15 def	2.14 ab
Neelum Green	0.60 a-f	0.92 x-f	2.35 k-u	2.56 i-r	0.62 y-f	1.73 q-z	1.76 q-z	1.62 q-a	3.67 b-h	3.37 d-k	3.35 d-k	2.07 n-v	1.40 q-a	0.07 c-f	1.86 b
Bharati Kaveri	0.81 y-f	1.34 u-b	2.91 h-o	3.13 f-m	0.38 b-f	1.33 u-b	3.37 d-k	2.47 k-s	3.17 f-l	3.56 b-j	3.12 g-m	1.78 n-w	1.83 p-y	0.10 ef	2.09 ab
LSD	0.70	1.21	2.86	3.20	0.53	1.90	2.07	2.08	3.52	3.71	3.50	2.25	1.77	0.17	

Means in columns followed by different letters are significantly different at 5% level of significance (LSD test).

The whitefly population increased during first four weeks and then population decreased due to rainfall. Our results were in agreement with those of some earlier researchers who reported that white fly population decreases due to high rainfall [13, 14]. The population of whitefly increased with the increase in temperature and humidity in weeks 9 - 12, which is comparable to those of [13] who mentioned that whitefly population increased with temperature and humidity. Whitefly population was present throughout the growth of crops [15] and its population increased from June to October [16]. But our results are in contrary to those of [17] who stated that whitefly appeared on okra after germination and was present till maturity of the crop and with two peaks (2nd week of December 2004 and 1st week of January 2005).

3.2 Population density of *A. gossypii*

The results in table 2 showed that mean density of the *A. gossypii* in week 1, 8, 11 was significantly higher on F1-Syngenta with 1.75, 1.83, 4.29 individuals/leaf. In week 2, 3, 12 density of the pest was significantly higher on Malay with 1.38, 1.08, 3.30 individuals/leaf. In week 4, 5, 9, 10, 13 density of aphids was significantly higher on Local Peshawari with 3.61, 4.11, 2.29, 2.62, 0.60 aphids/leaf. Mean density of pest in week 6 was significantly higher on Neelum Green (6.69 individual per leaf). In week 7 the density of aphids was significantly higher on Bharati Kaveri (1.27 individuals/leaf). In week 14 no aphids were recorded on all the okra varieties. Overall mean density of the pest was significantly higher on Malay (2.13 individuals/ leaf) and lower on Arizona (1.75individuals/leaf).

Table 2: Mean density of aphids/leaf on six okra varieties in Peshawar in 2014.

Variety	Mean density of Aphids/leaf in														Overall Mean
	W1 (13/5)	**W2 (20/5)**	**W3 (27/5)**	**W4 (3/6)**	**W5 (10/6)**	**W6 (17/6)**	**W7 (24/6)**	**W8 (1/7)**	**W9 (8/7)**	**W10 (15/7)**	**W11 (22/7)**	**W12 (29/7)**	**W13 (5/8)**	**W14 (12/8)**	
Local Peshawari	0.87 a-j	1.62 p-d	2.69 h-q	3.61 d-j	4.11 def	4.79 bcd	0.90 z-j	1.35 t-h	2.29 l-x	2.62 h-s	2.13 m-y	0.45 c-j	0.61 d-j	0.00j	2.00 ab
Arizona	0.97 y-j	1.53 q-f	2.12 m-z	2.46 j-u	3.27 e-m	5.99 ab	0.99 y-j	1.20 v-j	1.21 v-j	1.64 p-d	2.11 m-z	0.61 d-j	0.40 e-j	0.00j	1.75 b
Malav	1.20 v-j	1.64 p-d	3.30 e-m	2.99 f-n	4.00 d-g	5.47 bc	1.12 w-j	1.46 r-g	2.51 i-t	2.33 k-w	2.39 j-v	1.08 b-j	0.38 f-j	0.00j	2.13 a
F1-Syngenta	0.77 a-j	1.75 o-c	2.66 h-r	2.79 g-p	3.69 d-i	4.31 cde	1.10 x-j	1.83 n-b	0.98 y-j	1.91 n-b	4.29 cde	0.35 e-j	0.13 g-j	0.00j	1.90 ab
Neelum Green	0.79 a-j	1.58 p-e	2.55 i-t	2.90 f-o	3.79 d-h	6.69 a	1.03 y-j	1.19 v-j	1.43 s-h	0.91 y0j	2.31 k-x	0.42 a-j	0.31 d-j	0.00j	1.85 ab
Bharati Kaveri	0.72 a-j	1.69 o-d	2.54 i-t	3.45 e-l	3.53 e-k	5.74 ab	1.27 u-i	0.87 a-j	2.11 m-z	1.93 y-j	3.46 e-l	0.25 e-j	0.13 h-j	0.00j	1.98 sb
	0.89 fg	1.64 de	2.64 c	3.03 c	3.73 b	5.50 a	1.07 f	1.32 ef	1.75 de	1.89 d	2.78 c	0.52 gh	0.33 hi	0.00 i	

Means in columns followed by different letters are significantly different at 5% level of significance (LSD test).

Aphids' infestations started on okra varieties in the mid of May. It fluctuated and reached to its peak in middle of June (week 6) and decreased due to rainfall in week 7. Aphids' population also decreased when the crops reached to maturity. Our results are comparable to those of some earlier researchers. Aphids' population increased from 1st to 4th week [18]. Aphids' complete their life cycle in 1st to 4th week interval, after this population of aphids decreased [19]. Newly born aphids in a week produce mostly up to 5 offspring per day in 30 days and at week 7 the population of aphids' decreases due to rainfall [20]. Rainfall can decrease the aphids' population [21]. Population of aphids was maximum in first week of July [22], which was similar to the present findings. The present results were different from those of some earlier researchers [21, 23, 24]. They suggested that aphids' population was high in May, August and September, but in our experiments high population was recorded in June-July.

4. Conclusion

B. tabaci and *A. gossypii* were found major pest of all the okra varieties in Peshawar. Their population density was consistently present on all the six okra varieties. Population density of *B. tabaci* and *A. gossypii* peaked in June-July months of the growing season of the crop. Mean density of *B. tabaci* and *A. gossypii* was significantly higher on Malay with 2.27 and 2.13 individuals/leaf than the other cultivars, respectively. The findings of the present research might be used in the control of the two pests on okra crop in Peshawar.

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