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WHITEFLY (*ALEUROLOBUS BARODENSIS* MASK.) POPULATION DYNAMICS ON SUGARCANE IN PAKISTAN

NASIR MASOOD*, MUHAMMAD ASHFAQ*, AMJAD ALI, MUHAMMAD AHSAN* AND NAZIR JAVED*****

Department of Agricultural Entomology, Faculty of Agriculture,
University of Agriculture, Faisalabad-38040, Pakistan
E-mail: nasirmasood2004@yahoo.com

ABSTRACT

In the present study, three farmer's fields of sugarcane of 10-15 km radius in the vicinity of Chinar, Ashraf and Jamal Din Wali sugar Mills in Faisalabad, Bahawalpur and Rahim Yar Khan, respectively were selected to evaluate the whitefly *Aleurolobus barodensis* Mask., population dynamics. The distance between these localities was 450 to 500 km. The population (nymphs and adults) was recorded at fortnight intervals during 2008 and 2009 from April to December. The data were also correlated with the weather factors (temperature, humidity and rainfall). The results revealed that populations varied significantly (P<0.05) between periods and locations, it appeared during 2nd fortnight of June in district Faisalabad and Bahawalpur, while in district Rahim Yar Khan it appeared during 1st fortnight of July. The peak mean population was recorded on 1st fortnight of November in district Faisalabad (7.96/leaf) and Rahim Yar Khan (14.94/leaf), while on 2nd fortnight of October in district Bahawalpur (15.81/leaf). The district Rahim Yar Khan showed maximum population (4.61/leaf), while in the district Faisalabad it was low (2.48/leaf). The relative humidity had positive and significant (P<0.05) correlation with the population and it increased the population up to 42.3%, 43.8% and 35.9% in Faisalabad, Bahawalpur and Raheem Yar Khan districts, respectively and the trend of occurrence was found similar in 2008 and 2009.

Key words: Agroecological zone, spatio-temporal, sugarcane, weather parameter, whitefly

Proper crop growth is a prerequisite for increased yields, and various biotic factors such as pest infestation and abiotic factors like weather affect this growth and development (Thumar and Kapadia, 1995). In this regard, the agricultural researchers are trying to explore the techniques, which must be proficient, ecofriendly, clean and affordable to reduce the effect of pest infestation on crops. Biological, chemical and mechanical treatments are being used for better yield and to increase the efficiency and yield per hectare (Pandya, 2005). The spatiotemporal factors like temperature, rainfall and relative humidity affect the population dynamics of pests, which ultimately effect physiological, biochemical and yield parameters (Bahadar *et al.*, 2002).

Sugarcane (*Saccharum officinarum* L.) is an important cash crop in Pakistan and grown throughout the tropical and subtropical parts of the world. Sugarcane during their different growth stages are attacked by a number of insects which are major constraints in getting higher yield (Anonymous, 2006). . Among various sugarcane pests, the whitefly *Aleurolobus barodensis* Mask., is the most dreaded one causing direct as well as indirect damage. It is distinguished by its marked tendency for sucking sap from leaves and sometimes it becomes endemic to sugarcane. Its population flares up enormously under waterlogged and nitrogen deficient conditions. The adults are small, pale yellow about 3 mm long, ovate with black and greyish coating on the body. Only the nymphs are found underneath the leaves and cause the damage by sucking and making these pale and dry. Ultimately, the leaves turn black with development of fungus and render the crop unfit as fodder (Parsana *et al.*, 1995; Mann and Singh 2003; Ansari *et al.*, 2007).

Its management has become increasingly difficult with insecticides alone. Moreover, the indiscriminate use of these insecticides since past few decades has led to many serious problems like resurgence of minor pests, destruction of beneficial fauna and environmental pollution. There is a need to explore alternative methods to reduce the use of pesticide and

**Department of Entomology, Ayyub Agriculture Research Institute, Faisalabad-10104 (Pakistan); ***Department of Plant Pathology, Faculty of Agriculture, University of Agriculture, Faisalabad-38040 Pakistan.

their adverse effects on environment and human health. For this purpose integrated control strategy for sustainable management of this pest is inevitable (Thumar and Kapadia, 1994).

Hence, the present study is focused on the spatiotemporal aspects of its population dynamics in sugarcane in different ecological regions of Pakistan (Rahim Yar Khan, Bahawalpur and Faisalabad) in 2008 and 2009.

MATERIALS AND METHODS

In the first part of the experiment, 50 commercially grown varieties were selected in 2008 and 2009 and experiments conducted in farmer's fields around Jamal Din Wali Sugar Mills (Rahim Yar Khan), Ashraf Sugar Mills (Bahawalpur) and Chinar Sugar Mills (Faisalabad). The population data (Nymph and adult) was recorded in the vicinity of these sugar mills from 10-15 km radius throughout the crop season at fortnightly intervals from April to December through the randomly selected twenty tillers from each field of an area of one hectare from each locality. In the second part of the study conducted in 2010, total 9 varieties (comparatively 3 resistant, 3 susceptible and 3 intermediate were sorted out from 2008 and 2009 results).

The data were analyzed statistically following RCBD with means compared by DMR Test and through simple correlation (r). The combined effect of the factors like temperature, relative humidity and rainfall on the population of whitefly was measured by using a multiple Linear Regression Equation $Y = a+b2x_2+b2+2+b2x_2$…… where population of the insects was taken as the Response Variable (Y) and the following 'predictor' variables were used to represent the equation. Here X_1= Maximum temperature for every 15 days, X_2 = Minimum temperature for every 15 days; X_3 = Average mean temperature for every 15 days , X_4= Average relative humidity for every 15 days and X_5= Total rainfall (mm) for every 15 days

RESULTS AND DISCUSSION

The result revealed that the different spatiotemporal conditions significantly affected the whitefly populations. The population was found significant at 95% confidence interval of mean at different dates of observation and locality (Table 1). It is evident from the results that population of whitefly appeared on 2nd fortnight of June in district Faisalabad and Bahawalpur and on 1st fortnight of July in district Rahim Yar Khan (Table 2, 3). In district Faisalabad an increasing trend was observed from 2nd fortnight of June to 1st fortnight of November and the population reached its peak (7.96 /leaf. The population in district Bahawalpur increased from 2nd fortnight of June to 2nd fortnight of October and reached its peak (15.81/leaf). Similarly, in District Rahim Yar Khan, the population started in 2nd fortnight of July and reached its peak in 1st fortnight of November (16.94/leaf). In general, the decreasing trend was observed thereafter in all districts- 1st fortnight of December it was 3.09, 2.43 and 2.08/leaf in districts Faisalabad, Bahawalpur and Rahim Yar Khan, respectively. Rahim Yar Khan District showed maximum population i.e., 4.61/leaf; Faisalabad showed minimum population i.e., 2.48/leaf.

Table 1. ANOVA of the whitefly populations in different districts and periods- 2008

Source of Variance	D.F.	F. Value	Probability
Replications	2	11.42 **	0.00
Dates of Observation (D)	15	107.80 **	0.00
Districts (D)	2	34.41 **	0.00
D X D	30	6.55 **	0.00
Error	94		

CV = 34.93%; ** = Sgnificant at $P<0.01$.

The simple correlation values and multiple linear regression analysis along with coefficients (R^2) between populations vs weather factors (temperature, rainfall and humidity) at different localities is given in Table 4 and 5. These reveal that conditions of temperature, rainfall and humidity in the 2nd fortnight of October is significantly related with populations. In general, the significant decreasing trend was observed thereafter on the subsequent periods until 2nd fortnight of November. From these it was found that the period from last week of September to third week of October is the most favorable one for the whitefly.

Our observations are in accordance with Thumar and Kapadia (1994) who reported that CO-419, CO-740, CO-775 and COC-671 varieties were susceptible. Similarly, Parsana et al. (1995) evaluated the performance of 24 varieties for resistance/ susceptibility against *A. barodensis* and reported that

Table 2. Whitefly population in farmer's fields in districts of the Punjab, Pakistan -2008

Dates of Observation	Month	Interaction (LSD=2.07, SE=0.73)			Means (LSD=1.19, SE=0.42)
		Faisalabad	Bahawalpur	Rahim Yar Khan	
2nd fortnight	April	0.00 o	0.00 o	0.00 o	0.00 f
1st fortnight	May	0.00 o	0.00 o	0.00 o	0.00 f
2nd fortnight	May	0.00 o	0.00 o	0.00 o	0.00 f
1st fortnight	June	0.00 o	0.00 o	0.00 o	0.00 f
2nd fortnight	June	0.08 o	0.06 o	0.00 o	0.05 f
1st fortnight	July	0.10 o	0.62 o	0.20 o	0.31 f
2nd fortnight	July	0.16 o	0.84 mno	0.12 o	0.37 f
1st fortnight	August	0.73 no	0.61 o	2.12 lmno	1.15 f
2nd fortnight	August	2.33 klmno	1.99 lmno	4.28 hijkl	2.87 e
1st fortnight	September	3.21 ijklm	4.70 ghijk	5.72 fgh	4.54 d
2nd fortnight	September	4.67 ghijk	7.95 ef	9.19 e	7.27 c
1st fortnight	October	5.59 ghi	12.53 cd	12.28 d	10.13 b
2nd fortnight	October	6.87 fg	15.81 ab	14.52 bc	12.40 a
1st fortnight	November	7.96 ef	9.54 e	16.94 a	11.48 a
2nd fortnight	November	4.88 ghij	5.10 ghij	6.24 fgh	5.40 d
1st fortnight	December	3.09 jklmn	2.43 klmno	2.08 lmno	2.53 e
Means (LSD= 0.51, SE=0.18)		2.48 c	3.89 b	4.61 a	

The similar letters in columns denote significant differences by DMR Test at P = 0.05.

Table 3. Whitefly population in farmer's fields in districts of the Punjab, Pakistan- 2009

Dates of Observation	Month	Interaction (LSD=2.07, SE=0.73)			Means (LSD=1.18, SE=0.43)
		Faisalabad	Bahawalpur	Rahim Yar Khan	
2nd fortnight	April	0.00 o	0.00 o	0.00 o	0.00 f
1st fortnight	May	0.00 o	0.00 o	0.00 o	0.00 f
2nd fortnight	May	0.00 o	0.00 o	0.00 o	0.00 f
1st fortnight	June	0.00 o	0.00 o	0.00 o	0.00 f
2nd fortnight	June	0.08 o	0.06 o	0.00 o	0.05 f
1st fortnight	July	0.11 o	0.62 o	0.20 o	0.31 f
2nd fortnight	July	0.15 o	0.85 mno	0.11 o	0.38 f
1st fortnight	August	0.72 no	0.62 o	2.11 lmno	1.16 f
2nd fortnight	August	2.32 klmno	2.00 lmno	4.26 hijkl	2.89 e
1st fortnight	September	3.19 ijklm	4.72 ghijk	5.69 fgh	4.56 d
2nd fortnight	September	4.66 ghijk	7.96 ef	9.20 e	7.26 c
1st fortnight	October	5.57 ghi	12.55 cd	12.26 d	10.15 b
2nd fortnight	October	6.86 fg	15.82 ab	14.51 bc	12.41 a
1st fortnight	November	7.98 ef	9.52 e	16.96 a	11.46 a
2nd fortnight	November	4.89 ghij	5.09 ghij	6.26 fgh	5.38 d
1st fortnight	December	3.10 jklmn	2.41 klmno	2.11 lmno	2.51 e
Means (LSD= 0.52, SE=0.17)		2.48 c	3.90 b	4.6 a	

The similar letters in columns denote significant differences by DMR Test at P = 0.05.

Table 4. Correlation coefficients (r) between whitefly populations vs weather factors- 2008

Weather Factors	Localities			Average
	Faisalabad	Bahawalpur	Rahim Yar Khan	
Max. Temp (°C)	-0.364	-0.195	-0.231	-0.226
Min Temp (°C)	-0.447	-0.220	-0.202	-0.219
Av. Temp (°C)	-0.422	-0.226	-0.227	-0.244
Relative Humidity (%)	0.440	0.270	0.211	0.303 *
Rainfall (mm)	-0.465	-0.231	-0.151	-0.279

*Significant at $P<0.05$

Table 5. Multiple linear regression with coefficients of determination (R^2) between whitefly population vs weather factors

	Regression Equation	**R^2**	**Role (%)**
	Faisalabad		
Y =	4.478 – 0.6213 x1	0.133	13.3
Y =	9.0723 – 0.08483 x1 – 1.009 x2	0.201	6.8
Y =	9.4567 – 11.529 x1 – 15.649 x2 + 25.978 x3	0.219	1.8
Y =	- 24.4645 + 8.885 x1 + 20.345 x2 – 27.870 x3 + 1.689 x4	0.642	42.3
Y =	- 22.328 + 9.827 x1 + 20.484 x2–29.048 x3+1.5711 x4 – 0.0581 x5	0.658	1.6
	Bahawalpur		
Y =	3.132 – 0.2909 x1	0.038	3.8
Y =	5.3584 – 0.1151 x1 – 0.4999 x2	0.051	1.3
Y =	11.5766 + 11.852 x1 + 14.612 x2 -28.347 x3	0.126	7.5
Y =	- 31.1338 – 10.722 x1 – 9.131 x2 + 19.600 x3 + 3.7246 x4	0.564	35.9
Y =	- 40.0518 – 16.571 x1 – 16.106 x2 + 33.015 x3 + 4.437 x4 – 0.2007 x5	0.715	15.1
	Rahim Yar Khan		
Y =	3.3570 – 0.298 x1	0.053	5.3
Y =	4.4613 – 0.2223 x1 – 0.2412 x2	0.059	0.6
Y =	4.6309 – 0.1906 x1 – 0.1098 x2 – 0.2045 x3	0.059	0.00
Y =	- 6.4614 – 0.1911 x1 + 0.764 x2 – 3.1016 x3 + 2.5604 x4	0.418	43.8
Y =	- 10.29299 – 0.3182 x1 + 0.2142 x2 – 2.9148 x3 + 3.4166 x4 – 0.2606 x5	0.609	19.1
	Cumulative		
Y =	3.2624 – 0.3205 x1	0.051	5.1
Y =	4.7742 – 0.2038 x1 – 0.3416 x2	0.059	0.8
Y =	4.916 – 0.1068 x1 – 0.1176 x2 – 0.3601 x3	0.061	0.2
Y =	0.5581 – 0.2097 x1 + 0.1991 x2 – 0.8883 x3 + 0.7058 x4	0.244	18.3
Y =	0.9128- 0.2558 x1– 0.2386 x2 – 0.320 x3 + 0.6605 x4 – 0.0905 x5	0.279	3.5

x1= Maximum Temperature °C; x2 =Minimum Temperature °C; x3 = Average Temperature °C; x 4 = Relative Humidity (%); x5 = Rainfall (mm)

varieties CO-7527 and CO-86043 were resistant, while COM-84138 and CO-85246 were the most susceptible. The following studies including that of Mann and Singh (2003) who evaluated 32 sugarcane genotypes and Bahadar *et al*. (2002) who studied the behaviour of twenty new genotypes are some which corroborate with present observations.

The present observation that the population of whitefly reached a peak (3.93 nymphs cm2 per leaf) in the 1st week of October was found to be correlated with Thumar and Kapadia (1995) who reported that the nymph population was highest in the period between mid September to November (3.13 to 3.95 nymphs per $cm^{2)}$. The average nymphal and pupal population in a year ranged from 0.95-17.05 and 0.63-13.25, respectively. The peak activity was observed during July to December for nymphs and June to November for pupae and our findings were also found comparable with Pandya (2005).

The population appeared during 2nd fortnight of June in district Faisalabad and Bahawalpur, while in district Rahim Yar Khan it appeared during 1st fortnight of July. The trend was found to be same in 2008 and 2009, which might be due to similar weather conditions, because the humidity was found positively correlated with whitefly population.

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