

Effect of weather variables on whitefly (*Bemisia tabaci* Gennadius) population in development of potato apical leaf curl virus disease

MANOJ KUMAR and ANIL GUPTA

Department of Plant Pathology, CCS Haryana Agricultural University, Hisar-125004, India

Corresponding author Email: manojbuswal@gmail.com

ABSTRACT

Potato apical leaf curl virus disease (PALCVD) is an important disease in early sown potato crop transmitted by whitefly (*Bemisia tabaci*). The studies pertaining to impact of weather variables on population of *B. tabaci* and PALCV disease incidence on seven potato cultivars (Kufri Pushkar, Kufri Bahar, Kufri Pukhraj, Kufri Badshah, Kufri Khyati, Kufri Surya and Kufri Sadabahar) were conducted during 2012-13 and 2013-14. Results showed that the mean *B. tabaci* population was highest in the last week of October which varied from 24 to 85 white flies per plant. Thereafter, the population of *B. tabaci* decreased gradually with the fall in both maximum and minimum temperatures. Kufri Bahar variety had least *B. tabaci* population on all dates of observation. It was found that *B. tabaci* population (vector) was directly proportional to PALCVD. The pooled data showed that maximum temperature, minimum temperature, evening relative humidity and wind speed were the important contributing weather variables which could predict the vector populations by 57 per cent.

Keywords: Weather parameters, disease incidence, PALCVD, potato, whitefly

India is the third largest producer of potato (*Solanum tuberosum* L.) in the world during 2012-13. Potato crop occupied 19.99 lakh hectares with a production of 45.24 lakh tonnes tubers (Anonymous, 2013). Many factors play important role in deciding the productivity and quality of potato tubers, and disease is one of them. In Haryana state, severe yield losses due to potato apical leaf curl virus disease (PALCVD) have been reported in potato and infection due to this disease was up to 100 per cent in susceptible varieties of potato (Lakra, 2002). Potato plants infected with PALCVD showed chlorotic blotching, crinkling, mosaic, apical leaf curling and stunting (Garg *et al.*, 2001). The very high population of *B. tabaci* during October and November, led to high apical leaf curl incidence in potato crop (Lakra, 2010). The temperature in the range of 26-32°C and relative humidity of 60-70 per cent are optimal for whitefly development (Traboulsi, 1995). The positive correlation of whitefly with temperature and negative correlation with humidity in potato crop (Bhatnagar, 2007). The whitefly population was negatively correlated with rainfall (Bashir *et al.*, 2001) but the information on their role in this disease development in potato is scanty. Therefore, studies were carried out keeping in view the importance of the weather variables and population of *B. tabaci* in development of the PALCVD in potato.

MATERIALS AND METHODS

The present investigation on the effect of weather variables on *B. tabaci* population and in development of PALCVD in potato was carried out in the field by planting the crop during two seasons. Seven potato varieties (Kufri Pushkar, Kufri Bahar, Kufri Pukhraj, Kufri Badshah, Kufri Khyati, Kufri Surya, and Kufri Sadabahar) were planted in split-plot design in 1st week of October in 2012 and 2013. The plots were not given any protective spray and disease was allowed to occur on the plants. The *B. tabaci* population was recorded by counting it at weekly interval on ten tagged randomly selected plants by observing ten compound leaves selected from different positions, *i.e.*, bottom, middle and top of the plant in each replication. The observations were taken early morning hours on all seven varieties and the mean value of *B. tabaci* population was calculated on all potato varieties on per plant basis. The per cent incidence on apical leaf curl virus disease was observed by counting the number of plants showing apical leaf curl symptoms along with the total number of plants in each plot as per formulae of McKinney (1923). Whereas, the weekly data on weather variables *viz.*, maximum temperature (Tmax), minimum temperature (Tmin), morning relative humidity (RHm), evening relative humidity (RHe), wind speed (WS), sun shine hour (SS), and rainfall (Rain) was obtained from

Table 1: Whitefly population and per cent incidence of PALCVD under different cultivars of potato at Hisar (Pooled of 2012 and 2013)

Variety	31 th Oct.		7 th Nov.		14 th Nov.		21 th Nov.		28 th Nov.		5 th Dec.		12 th Dec.		19 th Dec.	
	WFP	PALCVD	WFP	PALCVD	WFP	PALCVD	WFP	PALCVD	WFP	PALCVD	WFP	PALCVD	WFP	PALCVD	WFP	PALCVD
K. Pushkar	54±1.1 (7.35)	0	48±2.3 (6.92)	10	35±1.5 (5.91)	20	32±2.0 (5.65)	25	28±1.5 (5.29)	35	17±1.7 (4.11)	35	09±1.5 (2.97)	40	03±1.5 (1.89)	40
K. Bahar	24±2.5 (4.88)	0	17±1.5 (4.11)	0	11±1.1 (3.31)	0	09±1.1 (2.99)	0	06±0.5 (2.44)	0	05±0.5 (2.22)	0	02±0.5 (1.38)	0	00±0 (1)	0
K. Pukhraj	63±2.3 (7.93)	0	62±2.5 (7.87)	20	57±2.6 (7.55)	25	47±1.5 (6.85)	30	31±1.7 (5.56)	35	19±2.0 (4.34)	45	09±1.5 (2.98)	55	04±0.5 (2.23)	55
K. Badshah	46±1.7 (6.77)	0	38±2.0 (6.15)	10	21±1.7 (4.57)	10	17±2.0 (4.11)	20	14±1.7 (3.77)	20	10±1.7 (3.14)	20	06±1.1 (2.43)	30	02±1.1 (1.65)	30
K. Khyati	85±1.5 (9.21)	10	83±2.3 (9.11)	20	75±1.5 (8.66)	35	64±2.5 (7.99)	50	47±2.6 (6.85)	65	32±2.3 (5.65)	80	15±1.5 (3.86)	90	05±0.5 (2.44)	90
K. Surya	36±1.7 (5.99)	0	34±1.5 (5.83)	10	28±1.7 (5.29)	15	23±2.3 (4.78)	20	15±1.7 (3.85)	20	10±1.5 (3.14)	25	05±0.5 (2.23)	25	00±0 (1)	25
K. Sadabahar	48±2.0 (6.92)	0	45±1.1 (6.71)	20	35±1.5 (5.91)	30	23±1.5 (4.79)	35	16±2.0 (3.98)	35	10±1.1 (3.15)	35	07±0.5 (2.64)	50	02±0.5 (1.72)	55
C.D (p=0.05)	0.48		0.50		0.47		0.60		0.63		0.55		0.62		0.70	

*Figures in parentheses are square root transformed values, WFP- Whitefly population (Mean ±SE), PALCVD- Potato apical leaf curl virus disease

Table 2: Correlations coefficient between whitefly population with weather parameters (pooled for 2012 and 2013).

Variety	Tmax	Tmin	RHm	RHe	WS	SS	Rain
K. Pushkar	0.96**	0.86**	-0.08	-0.80*	-0.51	-0.12	-0.16
K. Bahar	0.97**	0.91**	0.09	-0.68	-0.40	-0.13	-0.17
K. Pukhraj	0.89**	0.83*	-0.13	-0.72*	-0.49	-0.28	0.03
K. Badshah	0.97**	0.93**	0.06	-0.68*	-0.38	-0.15	-0.20
K. Khyati	0.91**	0.80*	-0.17	-0.76*	-0.53	-0.21	-0.02
K. Surya	0.94**	0.86**	-0.10	-0.72*	-0.50	-0.23	-0.05
K. Sadabahar	0.94**	0.93**	-0.06	-0.65	-0.40	-0.31	-0.01

* Correlation is significant at the 0.05 level, ** Correlation is significant at the 0.01 level

agro meteorological observatory of Department of Agricultural Meteorology, C.C.S.H.A.U, Hisar. Correlation and multiple regression analysis were done to work out the relationship among *B. tabaci* population and weather variables. Regression analysis was performed by taking *B. tabaci* population as dependent variable and weather parameters as independent variables.

RESULTS AND DISCUSSION

Seasonal abundance of whitefly (*Bemisia tabaci*) population

Table 1 reveals that *B. tabaci* attacked all the seven potato varieties viz., K. Pushkar, K. Bahar, K. Pukhraj, K. Badshah, K. Khyati, K. Surya and K. Sadabahar. All the seven varieties tested showed that *B. tabaci* population varied from 24 to 85 white flies per plant in different varieties in last week of October in the pooled year (average of 2012 and 2013) when the average maximum temperature was 30.3 °C and minimum temperature was 13.6 °C. The population of *B. tabaci* decreased gradually with the fall in maximum and minimum temperature thus, in 2nd fortnight of December, there were few *B. tabaci* present in the crop. In all the varieties 31st October was found to be the actual date of appearance *B. tabaci* population and it is the only date where the peak population of *B. tabaci* was observed.

The per cent incidence of PALCVD on different potato cultivars show that population of *B. tabaci* was directly proportional to potato apical leaf curl virus disease as K. Khyati, which was having maximum number of whitefly (85) in initial tuber initiation stages of the crop growth, had more disease incidence (90%) and lesser in K. Pukhraj and K. Sadabahar (55%). Here, it is to be mentioned that although K. Bahar on 31st October had low whitefly population (24±2.5) which decreased gradually like the other varieties but reduction in number of *B. tabaci* was at a faster rate in

comparison to other varieties. No visible symptoms of the PALCVD appeared on K. Bahar throughout the crop growth. Varietal response to potato apical leaf curl virus is due to differential support to the *B. tabaci* population by these varieties and hence there exist direct relationship between the *B. tabaci* population and incidence of PALCVD.

Correlation and regressions

The correlation coefficient of *B. tabaci* population with different weather variables showed that Tmax and Tmin were significantly and positively correlated with *B. tabaci* population in all the varieties at 5 per cent level (Table 2). Evening relative humidity (RHe) has significant but negative correlation with *B. tabaci* population. RHm, WS, SS and rainfall had no significant correlation with *B. tabaci* population.

The multiple regression equation developed with pooled data over year and variety is given below:

$$Y = -128.95 + 8.20 \text{ Tmax} - 2.87 \text{ Tmin} - 1.36 \text{ RHe} - 4.83 \text{ WS} \\ R^2 = 0.57$$

where Y is denoted for whitefly population.

From the equation, it can be revealed that the weather parameter (Tmax, Tmin, RHe and WS) all together, contribute 57 per cent variation in the population of *B. tabaci* in potato.

CONCLUSION

It can be concluded that the results indicated that the appearance and buildup of whitefly vector for PALCVD were influenced by varieties, crop seasons, and weather. On the basis of regression analysis for whitefly population (vector) directly proportional to potato apical leaf curl virus disease on pooled data showed that Tmax, Tmin, RHe, and WS were the main contributing weather variables which could explain the vector populations by 57 per cent.

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