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Research Article

EFFECT OF TEMPERATURE AND RELATIVE HUMIDITY ON POPULATION DYNAMICS OF WHITEFLY (BEMISIATABACI) (ALEYRODIDAE: HEMIPTERA) ON SOWING DATES OF COTTON CROP IN RAHIM YAR KHAN ZONE

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ABSTRACT

The cotton variety NAIB-787 was sown on different dates on the field area of Entomological section KhwajaFareed UEIT University in Punjab, Pakistan during kharif season of 2022. The experiment was conducted through randomized complete block *design* with three replications was used with five sowing dates (SD1 = 1st April, SD2 = 15th April, SD3 = 30thMay SD4 = 15thMay, SD5 = 30th May). The purpose of this study was how abiotic variables affect the population dynamics of the whitefly on different dates of sowing as whitefly is the major pest of cotton. Whitefly population was monitored on a weekly basis but mean value per month listed in table, data of relative humidity and temperature was taken from metrological department. The data indicated the significant effect of sowing dates on population dynamics of white fly. The sowing of crop was also important for the attack of whitefly. The early and timely sown cotton crop was less attacked by whitefly while the late sown crop was observed much attack of this pest. It was observed that there are positive correlation between whitefly (7.8 per leaf) and maximum temperature $50.1C^0$ while there was negative correlation between whitefly (1.22per leaf) and relative humidity (59.8%) when temperature not high than ($37.3C^0$). Whitefly population was observed high when temperature and relative humidity both are high because whitefly like warm and humid weather conditions. Overall, crop sown at normal dates in the month of April was less affected by infestation of whitefly then late sown crop in May. The results reviled that whitefly population remained low up to last week of June and there after increase gradually and reached its peak in the month of July and August and decline irrespective of sowing date. The population was recorded higher in late sown as compared to early sown crop throughout the season. This paper report would be helpful in developing efficient whitefly management strategies to get more production from cotton crop.

Keywords: Whitefly, Temperature, Humidity, Population Dynamics.

INTRODUCTION

Cotton is leading as a cash crop in Punjab widely known as White Gold.Cotton is most important commercial crop known as “king of natural fiber” and world over commonly referred as “white gold” which belongs to family Malvaceae and genus Gossypium. Cotton plays an important role in strengthening economy of 82 countries across the world [1]. It is the most important and economy dependent crop of Pakistan [2]. It contributes a huge share in the foreign exchange earnings and is important fiber crop [3]. Severe attack of insect pests like thrips, whitefly, jassids and disease like cotton leaf curl virus are the major crop limiting factors [4]. Pakistan is 5th largest producer of cotton in the world. Export of cotton and textile products have a share of around 60 percent in overall exports of the country. It contributes around 0.6 percent to GDP and 2.4 percent of the value added in agriculture. Over the last decade or so, area under cotton cultivation has been declined and replaced by its competing crops like sugarcane, maize, potato and rice. During 2021-22, the cropped area declined to 1,937 thousand hectares (6.8 percent) against last year’s 2,079 thousand hectares. Cotton production increased to 8.329 million bales (17.9 percent) against last year’s 7.064 million bales [5]. The insect pest infestation in cotton caused deterioration in lint quality and 10-40% losses in crop yield [6]. Amongst, several factors responsible for low productivity of cotton, menace caused by the insect-pests is a major one. Cotton hybrids and high yielding varieties are more susceptible to insect pests like bollworms and sucking pests. Cotton crop is subjected to damage by 162 species right from emergence till the final picking [7]. Introduction of Bt cotton technology solved the bollworm problem but continuous cultivation of Bt cotton has at some places led to increased incidence of sucking and other

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pests in the recent years [8]. Among them whitefly is considered as the most devastating pest which has become obnoxious pest now. It has been positioned one of the most serious agricultural pests in many areas of the world in recent decades [9]. Whitefly causes significant damage to crops through phloem feeding, induction of phytotoxic disorders, excretion of honeydew and most importantly, transmission of plant viruses [10]. It can transmit more than 15 viruses that cause almost 40 plant diseases [11]. Among the viral diseases, cotton leaf curl virus (TLCV) has emerged as the most important gemini viral disease [12]. The whitefly is one of the most economically important pests of cotton in many tropical and sub-tropical regions [13]. Currently its host range has crossed 600 plant species including cotton, vegetable, ornamental plants and several other agriculture crops [14]. In the last three decades, however, whiteflies have gained the status of a key pest with a global footprint. The adults are tiny (1 mm long) insects that feed on phloem sap. Weather parameters like temperature, relative humidity, sunshine and rainfall were played limiting factors for the buildup of whitefly population [15]. The female whitefly has been reported to lay 18.10–86.0 eggs on different cotton genotypesunder Indian Punjab conditions [16]. The first instar nymph is the only mobile nymphalstage. The total life cycle is completed in 24–44 days. In the subtropics, about 11 generations can occur during the growing season (April–October) on cotton [17]. Whitefly population was significantly and positively correlated with temperature [18]. The pest *Bemisiatabaci*can reach high populations in cotton fields and cause extensive damage that may manifest itself in three forms [19]. Sucking insect pests reported to cause 21.20 to 22.86 per cent reduction in seed cotton yield [20]. Hence, Bt cotton requires control measures for sucking pests. Use of chemicals is an essential part of integrated pest management in crop protection measures [21]. Neonicotinoids are among the most effective insecticides for the control of sucking insect pests. Non selective use of pesticides leads to water pollution, soil degradation, pest resistance and resurgence and ozone depletion [22]. Whitefly population has significant negative correlation with maximum and minimum temperature while positive correlation with relative humidity and rainfall [23]. Direct damage through plant sucking and the loss of nutrients, production of honeydew that contaminates the lint directly and soils the cotton through the growth of black fungi and by transmitting viral diseases. Whiteflies develop rapidly in warm weather, and population can build up quickly in situations where natural enemies are destroyed and weather is favorable. Heavy and prolonged periods of rain can substantially reduce population of whiteflies and observed that dry conditions were more favorable for *B. tabaci* than high precipitation [24, 25]. reported that the presence of whitefly was year round and showed negative response to high temperature and rainfall and also reported that the atmospheric humidity, temperature and rainfall influence the population dynamics of whitefly both nymph and adult stages of this pest suck the sap from under surface of the leaves and secrets honey dew which causes sooty molds and hamper the photosynthesis activities [26-28]. Whitefly is also act as a vector of Cotton Leaf Curl Virus (CLCV) disease in cotton crop.

MATERIALS AND METHODS

To check the effect of different sowing dates on incidence of whitefly on Bt cotton NIAB-787, the experiments were laid out at KFUITfarms Entomological section, Khwajafareed University of Information and technology RahimYar Khan Punjab, Pakistan. The experiment was sown in kharif year 2022 with the Bt cotton variety NIAB-787 sown at normal sowing of cotton from 1st week of April and last sowing was in the last week of May in randomized complete block design (RCBD) with three replications. Pool data of Bt cotton variety NIAB-787 was used for the study. The agro-metrological data of minimum and maximum temperature and relative humidity (RH) were obtained from the agro-metrological observatory of (50.1C^o, `22.1C^o and 60.4%). The population of whitefly was estimated through pest scouting from 20 plants randomly selected in each plot, take population of adult and nymph from 1st plant from upper portion, mid and lower portion in this way we take data from 5 leaves in same manner were used to estimate whitefly population and converting to mean population by averaging them. The observation on population of adult and nymph population of whitefly were recorded at weekly intervals from the month of May to October before 10 am but data mean taken as per month. The mean population data obtain from various date of sowing were subjected to simple correlation analysis with metrological parameter, maximum and minimum temperature and relative humidity. Data was analyzed statically by M State software and simple correlation was worked out between the population of whitefly and weather parameter (max, mini and relative humidity) was calculated by least significant difference (LSD) test at 5% probability level [29, 30].

RESULTS AND DISCUSSION

It was observed from the data presented in (Table 1). That the whitefly population was present on the crop throughout the cropping season as whitefly is the major pest of cotton. Temperature and relative humidity was significantly affect the population of cotton whitefly as it likes warm and humid weather conditions. There is positive relationship between temperature and whitefly population as temperature increases the population of whitely increases. The following study was checked out from the month of April to September 2022 when population of whitefly was observed on cotton crop. It was observed that population of whitefly was on its peak during the month of July and August when temperature and relative humidity also high. In April June and September the temperature was bit less and population of whitefly was observed little less. The sowing of crop was also important for the attack of whitefly. The early and timely sown cotton crop was less attacked by whitefly while the late sown crop was observed much attack of this pest. Whitefly was initially observed on the crop 30 days after sowing with population density of 6.1 per five leaves when sown on 1st April and increased with the advancement of crop growth and reached up to 39.9 per five leaves on sowing at 15th of April. The data showed that when crop sown on 1st April whitefly population (6.1) lowest at this date of sowing but the next sowing dates observed more attack of whitefly as the temperature and relative humidity increases. When the crop sown on 1st of April the maximum whitely observed in the month of July i.e 18.4 with a maximum temperature of 49.3C^o and relative humidity 52.5% as mentioned in table.1. As when the crop sown on 15th of April the maximum whitely observed in the month of July i.e 39.9 with a maximum temperature of 50.1C^o and relative humidity 59.7%. When the crop sown on 30th of April the maximum

Table 1. Effect of weather parameters on different date of sowing on the population dynamics of whitefly in cotton.

Sowing date	Date of observations	Maximum temperature (C^o)	Minimum temperature (C^o)	Relative humidity (%)	Mean Population/ 5leaves
1-4-2022	1-5-22	37.3	23.2	59.8	6.1
	1-6-22	48.5	27.4	57.7	15.7
	1-7-22	49.3	28.6	52.5	18.4
	1-8-22	39.8	26.5	54.6	14.5
	1-9-22	38.7	25.4	58.3	13.2
	1-10-22	36.5	23.4	60.4	6.7
15-4-2022	15-5-22	45.3	24.3	57.6	18.7
	15-6-22	48.9	27.3	58.7	27.5
	15-7-22	50.1	30.5	59.7	39.9
	15-8-22	43.2	27.4	53.7	28.4
	15-9-22	39.3	26.2	55.4	22.3
	15-10-22	36.7	22.5	57.6	12.4
30-4-2022	30-5-22	46.3	25.3	55.7	22.3
	30-6-22	48.6	27.3	58.7	27.6
	30-7-22	49.5	28.3	50.1	39.4
	30-8-22	48.3	26.3	52.6	36.5
	30-9-22	38.6	22.1	55.7	27.8
15-5-2022	15-6-22	45.3	26.3	57.7	18.7
	15-7-22	49.7	29.3	59.8	34.5
	15-8-22	43.2	25.3	53.6	32.5
	15-9-22	41.2	27.4	55.4	29.7
	15-10-22	37.6	24.2	50.7	9.8
30-5-22	30-6-22	47.3	26.5	53.2	22.8
	30-7-22	48.3	29.3	55.4	28.5
	30-8-22	46.2	25.3	56.7	25.4
	30-9-22	41.2	23.2	57.8	17.6

Table 2. Correlation coefficient and regression equation between weather parameters (X) and mean number of *Bemisia tabaci* per five leaves (Y).

Weather parameters	Correlation coefficient (r)	Regression coefficient (b)
Maximum temperature (C^o)	-0.513^*	0.668
Minimum temperature (C^o)	-0.321^*	-1.021
Relative humidity (%)	0.652^*	0.032

whitely observed in the month of July i.e 39.4 with a maximum temperature of 49.5C^o and relative humidity 50.1%. When the crop sown on 15th of May the maximum whitely observed in the month of July i.e 34.5 with a maximum temperature of 49.7C^o and relative humidity 59.8%. Followed by last sowing on30th of May the maximum whitely observed in the month of July i.e 28.5 with a maximum temperature of 48.3C^o and relative humidity 55.4%. In the month of May temperature high but humidity low that's why population of whitefly decreases but in the month of July and August temperature and humidity increases that's why population of whitefly increases. The present findings on the population fluctuation of whitefly, *Bemisiatabaci*on cotton are in agreement with the result that whitefly were present throughout the growing period in the cotton field It also found that population of whitefly gradually increased with environmental temperature and humidity up to a certain age of cultivated crop and then declined with increasing age of the crop [31, 32]. The present results are also in conformity with the findings of other workers [33]. The correlation analysis between weather parameters and the mean number of whitefly has been summarized in (Table 2). The data revealed that all the weather parameters (temperature and humidity) highly influenced the Whitefly population. The correlation coefficient (r) was computed as -0.513^*, -0.321^*, 0.652^* for max-temperature, min-temperature, and relative humidity respectively. The weather parameters were found to contribute around 49.53 per cent impact on population of *Bemisiatabaci* when acted together. This finding is in partial agreement with the results that whitefly population has significant negative correlation with maximum and minimum temperature while positive correlation with relative humidity [23]. It was reported that negative correlation with both maximum and minimum temperature and wind speed while positive correlation with mean relative humidity [34].

CONCLUSION

The results indicated the significant effect of sowing dates on population dynamics of white fly. The sowing of crop was also important for the attack of whitefly. The early and timely sown cotton crop was less attacked by whitefly while the late sown crop was observed much attack of this pest. It was observed that there are positive correlation between whitefly (7.8 per leaf) and maximum temperature 50.1C^0 while there was negative correlation between whitefly (1.22per leaf) and relative humidity (59.8%). When temperature not high than (37.3C^0). Whitefly population was observed high when temperature and relative humidity both are high because whitefly like warm and humid weather conditions. The results reviled that whitefly population remained low up to last week of June and there after

increase gradually and reached its peak in the month of July and August and decline irrespective of sowing date. The population was recorded higher in late sown as compared to early sown crop throughout the season.

REFERENCES

1. CICR, 2015. CICR Vision 2030. Central Institute for Cotton Research.
2. Sahito, H.A., Lanjar, A.G., Nahiyoon, A.A., Khajjak, A.S., Memon, S.A., and Mal, B., (2011). Seasonal occurrence of phenacoccus solenopsis tinsley (hemiptera: pseudococcidae) and its natural enemies on different varieties of cotton crop. *Pak. J. Entomol. Karachi*., 26: 17-24.
3. Nazir, A., Khan, M.H., Khan, G.Z., and Muhammad, T., (2011). Provision of supplemental food for the conservation of beneficial insects in cotton field. *Pak. J. Entomol. Karachi*., 26: 95-100.
4. Anonymous, (2013). Economic survey of Pakistan. Ministry of food, agriculture and livestock. Islamabad. 17-18.
5. Anonymous, (2022). Economic survey of Pakistan", Ministry of Food and Agriculture, Islamabad. 21.
6. Gahukar, R.T., (2006). Improving the conservation and effectiveness of arthropod parasitoids for cotton pest management. Outlook. Agric., 35: 41-49.
7. Manjunath, T.M., (2004). Bt cotton in India: The technology wins as the controversy wanes. In *63rd Plenary Meeting of International Cotton Advisory Committee (ICAC) Meeting, Mumbai*, 28.
8. Nagrare, V.S., Kranthi, S., Biradar, V.K., Zade, N.N., Sangode, V., Kakde, G., and Kranthi, K.R., (2009). Widespread infestation of the exotic mealybug species, Phenacoccus solenopsis (Tinsley) (Hemiptera: Pseudococcidae), on cotton in India. *Bull. Entomol. Res*., 99: 537-541.
9. Lu, Y., Bei, Y., and Zhang, J., (2012). Are yellow sticky traps an effective method for control of sweetpotato whitefly, Bemisia tabaci, in the greenhouse or field?. *J. Insect. Sci*., 12: 113.
10. Dalton, R., (2006). Whitefly infestations: the Christmas invasion. *Nature*., 443: 898-901.
11. Pan, H., Chu, D., Yan, W., Su, Q., Liu, B., Wang, S., and Zhang, Y., (2012). Rapid spread of tomato yellow leaf curl virus in China is aided differentially by two invasive whiteflies. *PloS. One*., 7: 34-817.
12. Haider, M.S., Tahir, M., Evans, A.A.F., and Markham, P.G., (2007). Coat protein gene sequence analysis of three begomovirus isolates from Pakistan and their affinities with other begomoviruses. *Pakistan J. Zool*., 39: 165-170.
13. Block, KR., (1982). Geminivirus diseases. Plant. Dis., 66: 266-270.
14. Oliveira, M.R.V., Henneberry, T.E., and Anderson, P., (2001). History, current status, and collaborative research projects for *Bemisia tabaci*. Crop. Prot., 20: 709-723.
15. Marabi, R.S., Das, S.B., Bhowmick, A.K., Pachori, R., and Sharma, H.L., (2017). Seasonal population dynamics of whitefly (*Bemisia tabaci* Gennadius) in soybean. *J. Entomol. Zool. Stud*., 5: 169-173.
16. Butter, N.S., and Vir, B.K., (1991). Response of whitefly, Bemista tabaci Genn. to different cotton genotypes under glasshouse conditions. *Indian. J. Entomol*., 53: 115-119.
17. Aneja, A.K., (2000). Studies on the biology of cotton whitefly *Bemisiatabaci* (Gennadius) on American cotton, *Gossypiumhirsutum* (Linnaeus). Punjab Agricultural University, Ludhiana.
18. Kalkal, D., Lal, R., Dahiya, K.K., Singh, M., and Kumar, A., (2015). Population dynamics of sucking insect pests of cotton and its correlation with abiotic factors. *Indian. J. Agric. Res*., 49: 432-436.
19. Ohnesorge, B., and D, Gerling., (1986). *Bemisiatabaci*-ecology and control. *Agric. Ecosystems. Environ*., 17: 1-152.
20. Satpute, U.S., Patil, V.N., Katole, S.R., Men, V.D., and Thakare, A.V., (1990). Avoidable field losses due to sucking pests and bollworms in cotton. *J. Appl. Zool. Res*., 1: 67-72.
21. Mohyuddin, A.L., Jillani, G., Khan, A.G., Hamza, A., Ahamad, I., and Mahmood, Z., (1997). Integrated pest management of cotton pests by conservation, redistribution and augmentation of natural enemies in Pakistan. *Pakistan. J. Zool*., 29: 393-398.
22. Naeem, M., Farid, A. Khan, M.H. and Ali S.K., (2012). Laboratory studies on the comparative effect of neem oil (*Azadirachtaindica*) and insecticides on *Trichogrammachilonis* (Ishii). *Pak. J. Entomol. Karachi*., 27: 33-38.
23. Indirakumar, K., Devi, M., and Loganthan, R., (2016). Seasonal incidence and effect of abiotic factors on population dynamics of major insect pests on brinjal crop. *Int. J. Plant Prot*., 9: 142-145.
24. Muhammad, R., Abdul, G., and Muhammad, A., (2008). Population dynamics of whitefly (*Bemisia tabaci*) on cultivated crop hosts and their role in regulating its carry-over to cotton. *Int. J. Agric. Biol*., 10: 577-580.
25. Eichelkraut, K., and Cardona, C., (1989). Biology, mass rearing and ecological aspects of the whitefly, *Bemisiatabaci* (Gennadius) (Homoptera: Aleyrodidae) as a pest of bean. *Turrialba*. 39: 55-62.
26. Salinas, M.D., and Sumalde, A.C., (1994). Life history, seasonal abundance and host range of the wooly whitefly, Aleurothrixus floccosus (Maskell)(Homoptera: Aleyrodidae). In *25. Pest Management Council of the Philippines Anniversary and Annual Scientific Meeting, Cagayan de Oro City (Philippines), 3-6 May 1994.* PMCP. 29.
27. Horowitz, A.R., (1984). Life table analysis of the tobacco whitefly Bemisia tabaci (Gennadius) in cotton fields in Israel. *Acta. Ecologica*., 5: 221-233.

28. Horowitz, A.R., (1986). Population dynamics of Bemisia tabaci (Gennadius): with special emphasis on cotton fields. Agric. *Ecosyst. Environ*., 17: 37-47.

29. Anonymous, (1986). MSTATC Microcomputer Statistical Programme. Michigan State University Michigan.

30. Steel, R.G.D., Torrie, J.H., and Dicky, D.A., (1997). Principles and procedures of statistics a biometrical approach. McGraw Hill Book International Co.

31. Arnal, E., Debrot, E., Marcano, R.M., and Manlagne, A., (1998). Population fluctuation of whiteflies and its relation to tomato yellow mosaic in one location in Venezuela. *Fitopatol. Venez*., 6: 21-26.

32. Latif, M.A., and Akhter, N., (2013). Population dynamics of whitefly on cultivated crops and its management. *Int. J. Bio-Resour. Stress Manag*., 4: 576-581.

33. Acharya, V.S., and Singh, A.P., (2007). Effect of dates of sowing on incidence of whitefly, Bemisia tabaci on cotton. *J. Cotton Res*., 21: 242-247.

34. Anjali, M., Singh, N. P., Mahesh, M., and Swaroop, S., (2012). Seasonal incidence and effect of abiotic factors on population dynamics of major insect pests on Brinjal crop. *J. Environ. Res. Dev*., 7: 431-435.