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Studies on the population dynamics of whitefly (*Bemisia tabaci*) in transgenic cotton varities

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Abstract

Whitefly, *Bemisiatabaci* (Gennadius) has become one of the disaster pest of cotton in Pakistan. Transgenic cotton varieties provide greater tolerance to insect pests but did not combat to this emergent threat. In present study, we assessed six transgenic cotton varieties (VH-383, FH-Lalzar, 3012, 3041, VH-402 & VH-189) under filed conditions for seasonal population dynamics of whitefly (WF).None of these variety set free from WF population throughout the crop extent but all varieties exhibited a significant difference in population over the months.WF Pop started to emerge during 4th week of June, population substantially increased and crossed the ETL (5 nymph/ adults, both per leaf) during last week of July. A considerable rise in Pop was observed during August to November with its ultimate value in August 2017. Two varieties 3012 (5.92) & FH-Lalazar (6.02) offered a significantly lower mean Pop per plant and two varieties VH-383 (7.78) &VH-189 (7.66) presented highest population. Correlation matrix exhibited that high humidity and low temperature were encourage the WF Pop. These findings would be supportive in the selection of varieties that have moderately advanced tolerance towards WF Pop and to ensure the appropriate management tactics at the right time as in consider the propensity of WF population throughout the crop duration.

Keywords: Population dynamics, Whitefly, Bt-cotton, insect

Introduction

For hundreds of decades cotton has been dynamic share of domestic agriculture. As it offers raw material for textile, fiber as export items, animal food and edible oil, has pillar in the economy of Pakistan. Pakistan's economy is heavily reliant on cotton and its derivatives (Sial et al., 2014.). According to cultivated area cotton persist the second chief cultivated crop in Pakistan after wheat that offers5.2% value addition and 1.0% in GDP of agriculture (GOP, 2017).Average cotton yield per hectare stay below average because of insect pest infestation, inappropriate fertilizer administration, water shortage and weed invasion (Rehman et al., 2017). Pest infestation is the main reason in low production of cotton that make growers to cultivate other competitive crops instead of cotton however, its ultimately causes sharp decline in the sowing area (GOP, 2017). The phloemsucking insect pests including thrips (*Thripstabaci*), jassid (*Amrascabiguttula*) and whitefly

(*Bemisiatabaci*) suck the cell sap and bring about 40-50 percent injury to the crop (Naqvi, 1976).

Whitefly, *Bemisiatabaci* (Gennadius) (Hemiptera: Aleyrodidae), is one of the most calamitous pests of worldwide economically important crops (Byrne and Bellows, 1992; Basit et al., 2012, Chintkuntla, 2015a; Islam et al., 2017). It is a prevalent pest that tremendously damages more than 600 plant species; by feeding on phloem, discharging honeydew and transmit more than200 plant viruses (Rami et al., 2003; Basit et al., 2012; Navascastillo et al., 2010; Iqbal et al., 2018).Transgenic cotton got unrivaled acclaim as it offershigh value fiber (Ahsan and Altaf, 2009) and resistance towards lepidopterous insect pests (Peshin et al., 2007; Arshad et al., 2011). Transgenic cotton comprises a gene of Bacillus thuringiensis (Bt) that induced Cry-protein andintake of Cry-toxin by larvaebring about midgut paralysis, breakdown of epithelium and leads to death within 48-72 hours (Gill et al., 1992). Its cultivation improved yield with reduced production cost, insecticide treatment and environmental adulteratison (James, 2002; Peshin et al., 2007; Dhillon et al., 2011; Qiao, 2015).But in recent years,Bt- cotton had no apparent effect on sucking insect pest (Wang et al. 2018). The phloem-sucking pest (*Bemisiatabaci*)got farmers attentions for its dire attack on cotton, for which they have implementrigorous control tactics chiefly relying on chemical control (Ahmad et al., 2002).Though, transgenic cotton remained incapable to offer resistance towards insects (Hofs et al., 2004).So, it is imperative to evaluate their response towards such calamitous pest since, cotton is the second foremost grown crop in the country. Current experiment was planned to evaluate the transgenic cotton varieties in field conditions to study population dynamics regarding to native climatic conditions. Findings will assist the growers to understand the trend of whitefly and its resolution in better way.

2. Materials and methods

2.1. Crop cultivation and land preparation

Seeds of Bt-cotton varieties (VH-383, FH-Lalazar, 3012, 3041, VH-402, VH-189) were collected from cotton research institute,Ayub Agriculture Research Institute, Faisalabad, Pakistan. Sowing were done by dibbing methodin the start of May 2018, under Randomized Complete Block Design (RCBD) with three replications at the Entomological Research Area, University of Agriculture, Faisalabad, Pakistan. Field was divided into 18 plots with 5m × 3m plot size and distance between plots was 1m. Plant-plant and row-row distance was 22.5 cm & 75 cm was maintained respectively. Manual weeding was experienced throughout the crop duration to avoid any struggle between crop and weeds for light, space, nutrients and water. Normal agronomic measures such as irrigation and fertilizer were provided during the season as per prerequisite of the crop and no plant protection measures were implemented to control the WF.

2.2. Data recording and statistical analysis

Data were collected early in the morning at weekly interval. Five plants from each replicate were selected at random to count the adults of WF from upper, middle and lower portions of each plant (Cheema and Nasreen, 1999; Akhtar et al., 2004). Mean population was used to evaluate the varietal response towards WF Pop and use an indicator for control strategies. Meteorological data (temperature, humidity and rainfall data) were obtained from Pakistan meteorological department, Islamabad. Correlation were calculated to investigate the possible influence of weather parameters on WF Pop.Statistix 8.1 software was used to analyze the data with analysis of variance (ANOVA) and least significance (LSD) test at 5% probability level.

3. Results and discussion

Results exhibited statistically significant difference in WF Pop among all cotton varieties and no variety set free from WF Pop during the crop extent. However, weekly data indicated that WF started to appear during the last week (4^{th}) of June and Pop remained under threshold level till the 2^{nd} week of July (Fig. 1b).Similarly, commencement of WF was observed in the cotton field in the month of June in India(Kalkal, 2011) and (Janu and Dahiya, 2017). It increased substantially during 3^{rd} and 4^{th} week of July (Fig. 1b) by crossing ETL (5 nymph/adults or both per plant) (Anonymous, 2015) and cross the ETL during August (Fig. 1c). Abro et al. (2004), Purohit et al., (2006), and Roomi et al., (2014) also reported the confined activity of WF during August and September which in line with our results. Pop decreases in the last week of August to November but remain above ETL (Fig. 1c, d, e and f).Due to wet conditions adult WF Pop decreases after 12-16 Weeks of age (Kirti and Sharma, 2001). Mean monthly Pop was exhibited in (fig. 2) that explicitly revealed the growing tendency of WF from July-November. It alsoexplains the significant level of mean WFPop of all varieties per month. During June-July, WF Pop persisted below ETL and drastically started to increase in August but remained below ETL (4.8/leaf) in 3041.During September minimum Pop was observed in 3041 (7.3/leaf) and FH-Lalazar (7.1) while highest mean Pop (11.1/leaf) was recorded in VH-383. Whereas, during October decrease in WF Pop was observed in all cotton varieties but overall Pop remain above ETL. Minimum Pop was recorded in FH-Lalazar (7.4) and 3012 (7.4) while VH-189 (10.1) gave maximum WF Pop.Similarly, in November, all varieties were harbored with dire attack of WF Pop however, minimum Popwas recorded in 3012 (7.2) while maximum Pop was observed inVH-189 (11.3) and VH-402 (10.1). It is obvious that high WF Popcan hasten dire damage to cotton and might be responsible for up to 50% decrease in boll formation. Moreover, 33.3% more lint was produced from bolls of vigorous plant than bolls obtained from infested plants.

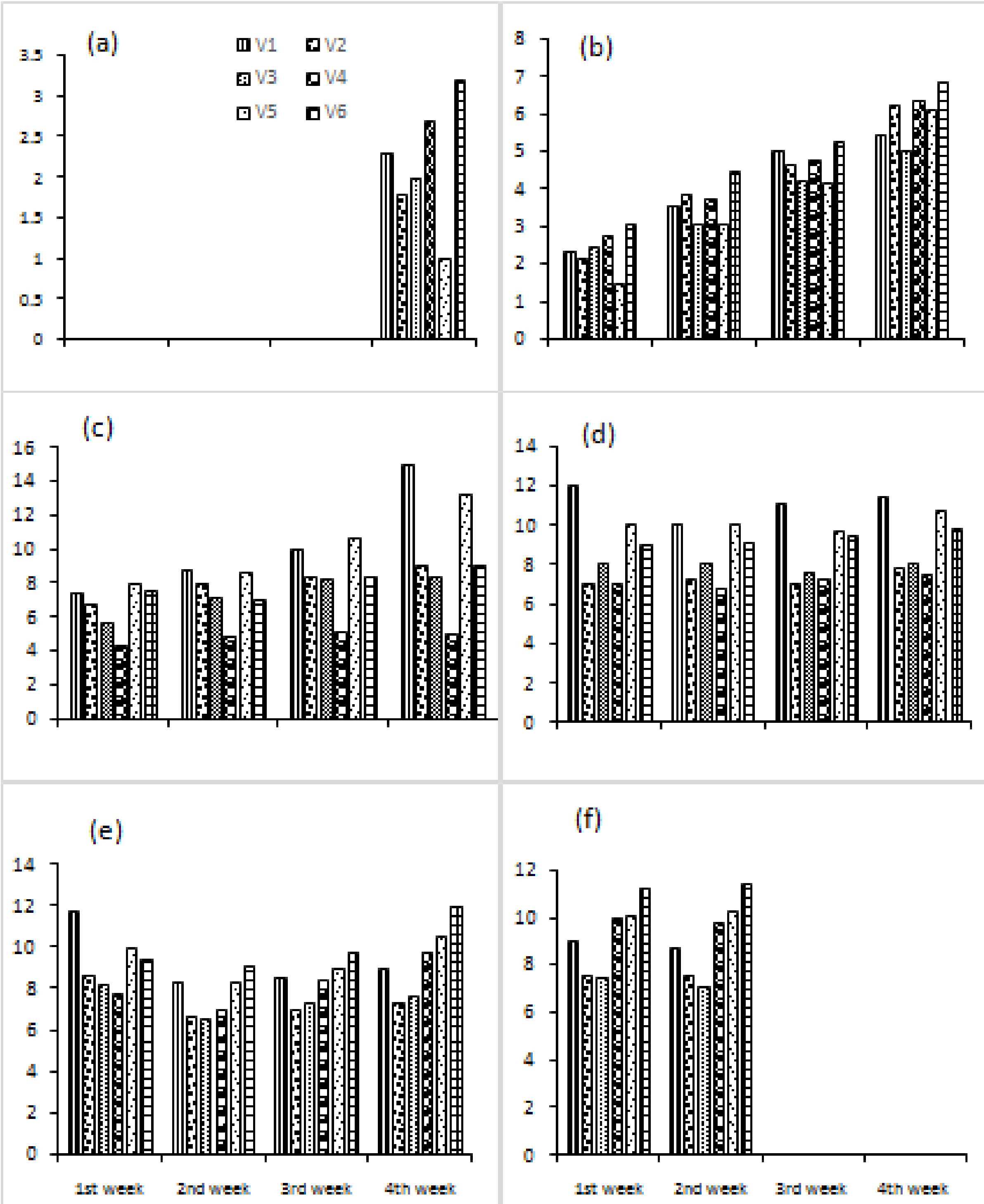

Fig.1. Weekly population trend of WF (a) June(b)July (c)August(d)September (e)October(f) November 2017.

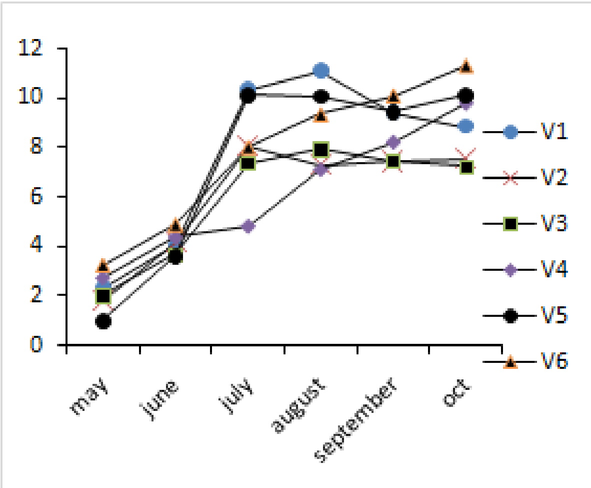

Fig.2: Monthly trend of White Fly population during June-Oct.

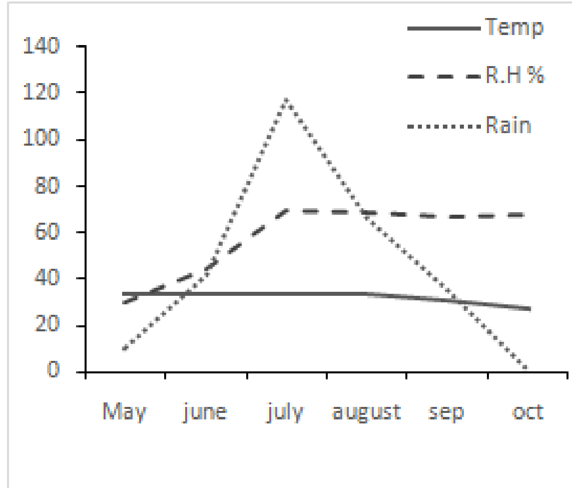

Fig.3: Metrological data (rain, temperature, humidity) during June-October.

Table 1 presented correlation matrix, explains that WF Pop have non-significant negative correlation with temperature and positive significant correlation with relative humidity and rain fall.

	Temperature	Relative Humidity %	Rain
VH-383	-0.261	0.975**	0.975**
Sign	0.617	0.00	0.001
FH-Lalazar	-0.401	0.996**	0.996**
Sign	0.431	0.00	0.002
3012	-0.383	0.993**	0.988**
Sign	0.453	0.00	0.00
VH-3401	-0.791	0.872*	0.786
Sign	0.061	0.12	0.064
VH-402	-0.431	0.997**	0.978**
Sign	0.394	0.00	0.001
VH-189	-0.701	0.921**	0.865
Sign	0.121	0.005	0.062

** Correlation is significant at the 0.01level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

4. Conclusion

Whitefly population was observed in all varieties throughout the crop duration and no variety sound to be resistant against whitefly. However, results depicted that among all, 3012 and FH-Lalazarfound comparatively better against whitefly. These results will help the farmer to choose the varieties with relatively low population dynamics andunderstanding the infestation trend of whitefly on cotton will also help to adopt the management strategies at right time.

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