

Cotton Whitefly, *Bemisia tabaci* (Gennadius) upsurge: a concern for cotton growers in Haryana

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Summary

Survey on whitefly infestation in cotton were conducted across six districts of Haryana - Sirsa, Fatehabad, Hisar, Jind, Rohtak and Bhiwani from 2012 to 2015. A total of 618 farmer's fields were examined in July, August and September each year, with fields selected randomly at an interval of 8-10 km. In 2012, whitefly population remained below economic threshold (ET) in July and August, exceeding ET in only 5% of fields during September. In contrast, 2013 recorded higher infestations, with populations above ET in 8%, 28%, and 44% of fields in July, August, and September, respectively. Similar trends were observed in 2014 and 2015, with particularly high infestations in August, affecting 43% and 56% of fields, respectively. Increased humidity and reduced temperatures as a result of rains in late June appeared to favor whitefly proliferation. Notably, rainfall events—97.3 mm in mid-June 2013, 76.6 mm in June 2014, and 161 mm in June 2015 could have been the reason for rapid build-up of whitefly populations from July onwards in these years.

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Introduction

The cotton crop is closely associated with each and every Indian, as millions depend upon it directly as well as indirectly. In India, cotton is produced in three zones: the Northern zone comprising the states Punjab, Haryana and Rajasthan; the Southern zone comprising the states Andhra Pradesh, Karnataka and Tamil Nadu and the Central zone comprising the states Maharashtra, Madhya Pradesh and Gujarat. Almost 90 per cent of the cotton growing area in Northern India is restricted to 12 districts, namely Sirsa, Fatehabad, Hisar, Jind and Bhiwani in Haryana; Bhatinda, Muktsar, Fazilka, Faridkot and Mansa in Punjab and Sriganganagar and Hanumangarh districts in Rajasthan, respectively. After the introduction of Bt cotton hybrids in 2002, the problem of sucking insect pests increased and since 2013, the incidence of whitefly, *Bemisia tabaci* (Gennadius), has reached at an alarming stage in Haryana and posed a threat to cotton cultivation. Besides cotton, the whitefly is a devastating pest of other field crops, vegetables and ornamental plants throughout the tropical and subtropical regions of the world. It is a polyphagous pest and feeds on about 600 plant species (Oliveira et al. 2001).

Whitefly adults are tiny, moth-like insects and have two pairs of white wings. Adult whitefly feed and lay eggs on the new growth of plants. The first instar or crawler is the only mobile larval stage and becomes sessile throughout the remaining nymphal stages. Adults of whitefly do not fly very efficiently, but; once airborne, they can be transported quite large distances by the wind. Whitefly

causes damage to cotton crop in three ways, namely; direct damage, indirect damage and virus transmission (Berlinger 1986). Direct damage is caused via sucking of cell sap by nymphs and adults, resulting in leaf yellowing, leaf wilting, leaf drop and overall decline in growth of the plant. Indirect damage is caused through excretion of honeydew by nymphs and adults which serves as a substrate for growth of black sooty mould on leaves and bolls. The mould reduces photosynthesis and causes reduction in yield (Berlinger, 1986) and simultaneously, it affects quality as well. The third type of damage is caused by transmission of cotton leaf curl virus disease (CLCuD), which also causes significant yield losses if occurs in early stages of crop growth (Duffus 1987).

There has been a considerable change in the scenario of cotton whitefly in Northern India due to an increase in area under upland cotton and the replacement of the desi cotton with Bt cotton. Large-scale cultivation of high-yielding hybrids, which are highly susceptible to sucking pests, as excessive use of inputs like pesticides and fertilizer. The population build-up of this pest largely depends upon abiotic factors. Suitable abiotic factors enhance the proliferation of this pest very rapidly. The threat to natural environments and commercial crops from emerging insect-pests is growing, due to a changing environment and increased global trade (Brasier 2008; Pautasso et al. 2010; Pautasso et al. 2015; Rolania et al. 2023). In order to limit the negative impact of pest outbreaks, it is important to quickly understand their distribution and impact, so that management can be implemented in an expedient manner (Cunniffe et al. 2016; Potter et al. 2011). Therefore, field surveys and farmers feedback to detect and establish the distribution of pests are an important first step in this process.

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Materials and Methods

The present study was carried out during *kharif* season, 2012 to 2015, at CCS Haryana Agricultural University, Hisar (India). Survey of whitefly on cotton in different districts of Haryana viz. Sirsa, Fatehabad, Hisar, Jind, Rohtak and Bhiwani were conducted from 2012 to 2015. A total of 618 farmer's fields were surveyed in July, August and September during these years. Farmer's fields were observed randomly every 8-10 km. Observations were recorded on adult whitefly population by observing 20 plants selected randomly from each field. The underside of three leaves, one apical, one mid-plant and one leaf from lower part of each plant were inspected. The whitefly adult population was averaged and expressed as the number of adults/ leaves. Meteorological data were obtained from the Department of Agricultural Meteorology, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana (India). Graphical presentation of data was done by using OPSTAT software following the standard procedure.

Results and Discussion

A survey conducted during 2012 showed that the whitefly population was below economic threshold (ET) in July and August, and it was above ET in 5 per cent fields only in September. However, during 2013 to 2015, whitefly population was noticed above ET in July, August and September (Table 1 & Figure 1). In 2013 whitefly population was above ET in 8, 28 and 44 per cent fields in July, August and September, respectively. Similarly, whitefly was observed above ET in all three surveyed months during 2014 and 2015. However, a higher percentage of whitefly-infested fields (43 and 56 %) having the population above economic threshold was observed in the month of August, during 2014 and 2015, respectively. In September whitefly infested cotton fields were 37 and 15.8 per cent during 2014 and 2015, respectively. It is probably because of the heavy damage

that occurred during the month of August, as most of the fields gave a blackish appearance.

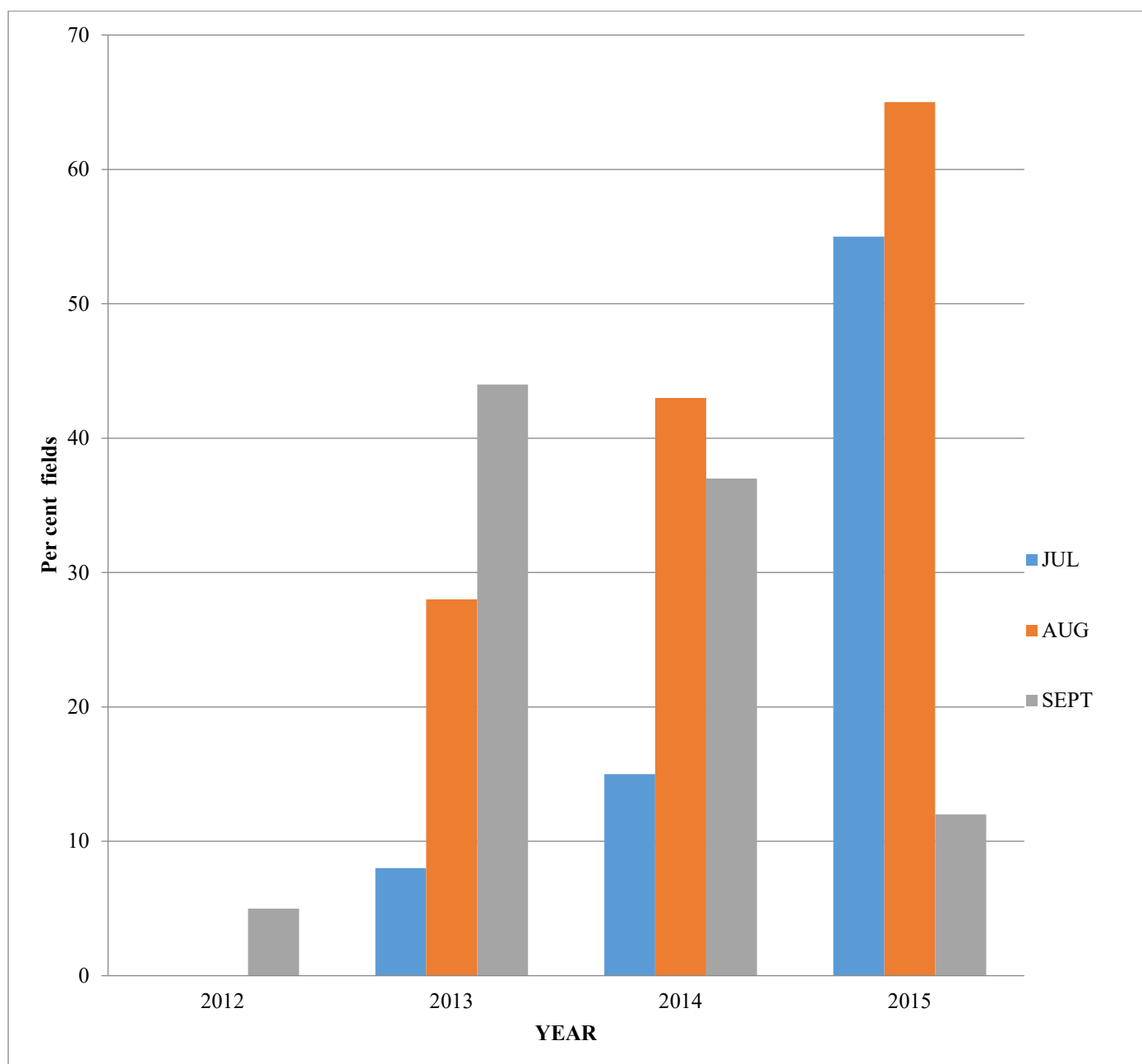
Rainfall pattern in different weeks in the month of June (Table 2) showed that during 2012 the total rainfall was 26.50 mm whereas, during 2013, 2014 and 2015 the total rainfall was 97.30, 71.60 and 161 mm, respectively. Therefore, rains during the second fortnight of June appeared to be one of the reasons for whitefly outbreak in July onward during 2013, 2014 and 2015. Increased humidity and lowering of temperature as a result of rains during second fortnight of June appear to have favoured whitefly multiplication during this period (Fig. 2). Heavy rains (97.3 mm) during middle of June in 2013 and frequent rains during June, 2014 (76.6 mm) and 2015 (161 mm) could have been the reason for upsurge of whitefly population during July onwards in these years. Rainfall increases the relative humidity and decreases the maximum temperature. Due to these favourable conditions whitefly infestation occurred in the early stage of the crop which resulted heavy loss in cotton production. Rolania *et al.* (2018) reported that the population build-up of whitefly on cotton crop had a significant positive correlation with relative humidity and a significant negative correlation with maximum temperature. Mehra and Rolania (2017, 2020) conducted field experiment on cotton whitefly and found that whitefly had a significant positive correlation with morning relative humidity. The similar negative effect of maximum temperature and positive effect of morning and evening relative humidity with whitefly population was reported by Janu and Dahiya (2017). Yadav *et al.* (2025) reported that high relative humidity favoured the whitefly population. Kaur *et al.* (2021) revealed that rainfall in small amounts helps in increase of whitefly population. However, any heavy rainfall event, caused a reduction in the population of whitefly.

Table 1. Per cent cotton fields with whitefly adult population above economic threshold in cotton growing areas of Haryana during 2012-15

Year	Month	Field surveyed (No.)	Per cent infested fields with whitefly population at above Economic Threshold
2012	July	20	0
	August	21	0
	September	50	5.0
2013	July	78	8.0
	August	21	28.0
	September	51	44.0
2014	July	49	15.0
	August	41	43.0
	September	45	37.0
2015	July	29	37.9
	August	116	56.1
	September	97	15.8

Table 2. Rainfall pattern in different weeks in the month of June, 2012-15 at Hisar

Standard week	Total rainfall (mm) in different year			
	2012	2013	2014	2015
May 28-June 3	10.5	0.0	9.0	0.0
June 4-10	0.0	0.0	0.0	0.0
June 11-17	0.0	97.3	37.5	40.4
June 18-24	15.0	0.0	10.6	51.6
June 25-July 1	1.0	0.0	14.5	69.0
Total	26.5	97.3	71.6	161.0

**Figure 1.** Whitefly adult population above ET during 2012, 2013, 2014 and 2015

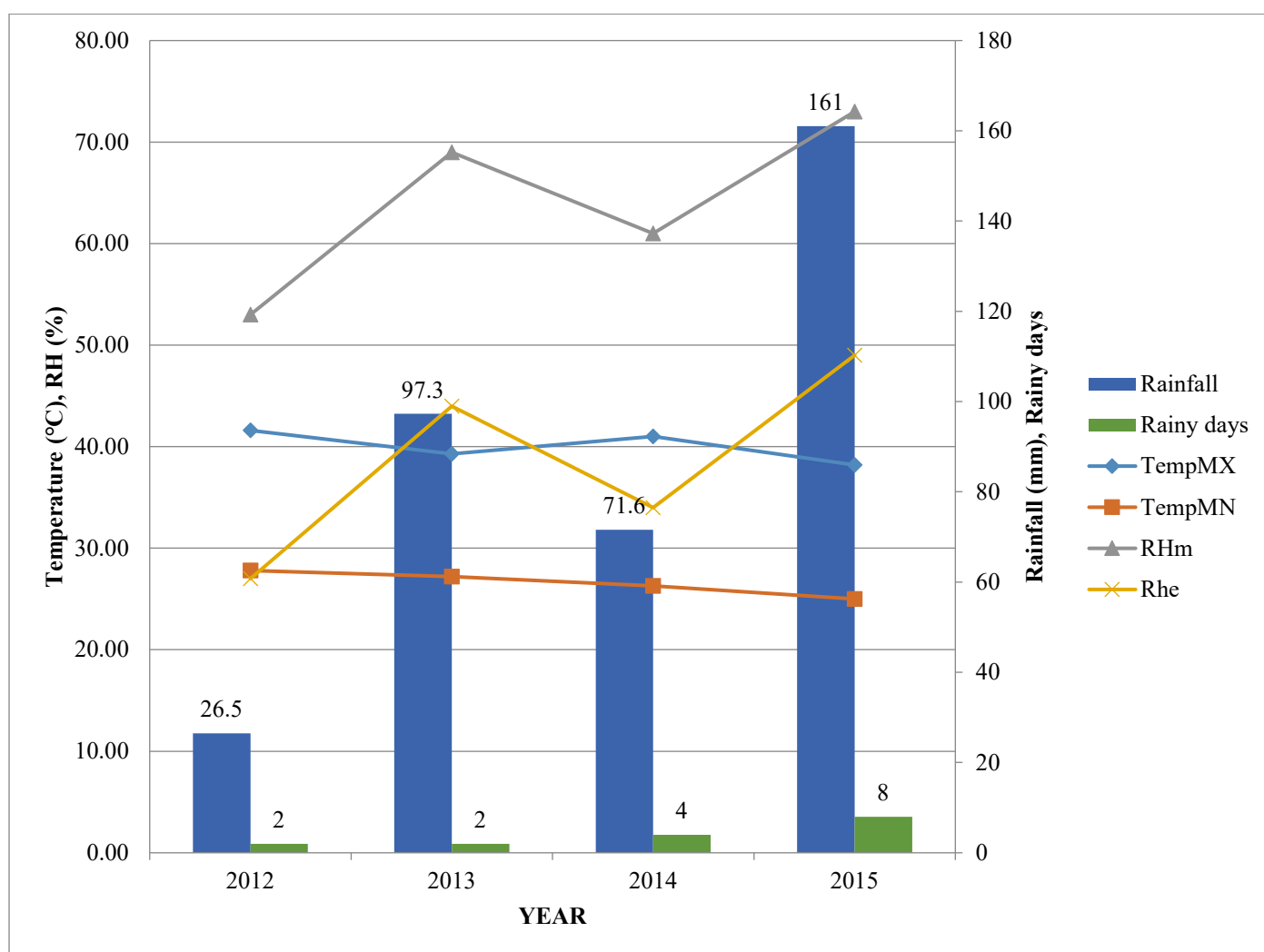


Figure 2. Weather parameters during June, 2012, 2013, 2014 and 2015

Feedback from field surveys

During the surveys it was found that whitefly damage was more in late-sown cotton as compared to timely sown. It was also found that indiscriminate use of insecticides, faulty spray technology, alternate host plants (weeds: tall morning glory, pigweed, Abutilon, carrot weed and wild radish & vegetable crops; mainly cucurbits, okra and brinjal) prior to cotton season and water-stressed crops were more damaged. Stressed plants have been reported to invite more insects as a result of increased concentration of mobile nitrogen in leaves, particularly amino acids (Brodbeck et al. 1990). The amino acid and salt receptors are necessary to phytophages because their foods often contain only small amounts of these nutrients (Haack & Slansky 1987; Mattson & Scriber 1987). Increased nitrogen availability results in amplified insect growth, fast development, raised survivorship and fecundity therefore increased abundance and damage (Mattson & Haack 1987). For effective management of this pest, crop ecosystems must be managed with suitable crop diversification. Devi et al. (2020) observed that the activity of *Trichogramma* spp. and *Encarsia* spp. were found to be greater in cotton intercropped with sesame or pigeonpea. Habitat manipulation strategies using intercrops should be integrated with the farm landscape spatially and

temporally to benefit parasitoids and predators for natural biological control of insect pests. Yellow sticky traps insect-counts comply with the four criteria of effective sampling of reliability, relevance, representativeness and practicality as described by Binns et al. (2000). Therefore, farmers were advised to plant yellow sticky traps @ 5 traps per 100 sq metre, appropriate spray methods must be used to ensure that the spray fluid covers the under-surface of leaves, fields and vicinity must be kept weed free, develop an area-wide management strategy with neighbours, as whitefly is a migratory pest. For best long-term results, botanicals like nimbecidine, neem oil, soap sprays should be used to menace this pest and safe guard the future of our crops. Husman & Jech (1998) conducted an area-wide community-based program for the management of whitefly. They observed that coordination and technical information dissemination relative to area-wide practice should be implemented for sound entomological Integrated Pest Management (IPM) principles.

Conclusion

The findings of this study revealed that rains during the second fortnight of June appeared to be one of the reasons for whitefly upsurge in the month of July onward during 2013, 2014 and 2015. During the survey, it was also found that several factors, namely, delay in sowing

of cotton crop, susceptible Bt hybrids, indiscriminate use of insecticides, faulty spray technology, multiplication of the pest on alternate host plants (vegetables and weeds) before cotton season and favourable weather conditions may be responsible for the whitefly outbreak.

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