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OFF-SEASON AND CARRY OVER HOSTS OF *BEMISIA TABACI* IN NORTH INDIA

Yogesh Yele*, Surender Kumar Singh, Aditya Tanwar*** and Namita Poddar*****

*ICAR-National Institute of Biotic Stress Management, Baronda, Raipur 493225
**ICAR-National Centre for Integrated Pest Management, New Delhi 110012
*** Division of Entomology,
ICAR-Indian Agricultural Research Institute, New Delhi 110012
*Email: yogeshyele13@gmail.com (corresponding author)

ABSTRACT

The whitefly *B.tabaci* adult population was surveyed in protected and open field crops in north Indian states during off-season months of winter 2016-17, to know the off-season survival and carry over hosts in its hotspot areas. Crops grown under protected cultivation *viz.* tomato, brinjal, cucumber and rose harbored significantly more adults than crops grown under open field conditions. Crops like potato and mustard in open fields support survival and provide breeding sites in off-season. Natural enemy activities are low in winter and allows sustained population buildup. These crops also act as carryover hosts providing the required inoculum for later seasons.

Key words: *Bemisia tabaci*, off season, survey, carryover hosts, survival, population dynamics, protected and open fields, tomato, brinjal, cucumber, rose, potato, mustard

The whitefly, *Bemisia tabaci* Gennadius is a major pest causing an annual yield loss of $2 billion (Byrne and Bellows, 1991; Inbar et al., 2008) and it is also vector of several plant viruses (Jones, 2003). It has been listed among the top 100 invasive species of the world (IUCN). In the recent past, had been reported in the north Indian states like Punjab, Haryana and Rajasthan. The reasons for wide range adaptation of this pest include agronomic practices, pesticide usage, biotypes with distinct biochemical characteristics and host range (Costa and Brown, 1991; Perring, 2001). The indiscriminate insecticides usage has resulted in problem of resistance and resurgence (Rohini et al., 2012; Horowitz et al., 1988; Prabhaker et al., 1988; Nauen et al., 2002; Ahmad et al., 2002; Erdogan, 2008; Roditakis, 2009; Wang et al., 2010). As the *B. tabacci* does not have any diapausing stage for offseason survival during the winter season, survival on the alternate host is the only option, and the alternate hosts provide the inoculums during the start of new season. Whiteflies are present throughout the year continuously in north India due to the availability of wide range of crops. In summer it survives on cotton and for rest of the year, it feeds and breeds on other field crops. Several weeds also serve as hosts (Kranthi, 2015). The literature on survival of whitefly during the offseason is scanty. The present study evaluates its off- season survival, population dynamics and carryover hosts in the hotspot zones of north India.

MATERIALS AND METHODS

The cotton growing states viz., Punjab, Haryana were subjected to random roving fixed plot surveys during winter (December- February) in 2016-17. In 2015-16 outbreak, Abohar and Fazilka in Punjab were the hotspot areas, and these were included along with Bahadurgarh, Haryana known for protected vegetable production and open field cultivations. In total, three locations- Abohar and Fazilka (Punjab), Bahadurgarh (Haryana) and ICAR-IARI campus (New Delhi) were covered for monthly visits (Bahadurgarh and IARI- 3 visits; and Abohar and Fazilka- 2 visits). Field crops and protected cultivation were surveyed, and crops covered include: tomato, potato, brinjal, chilli, cucumber, mustard, radish and rose, using standard sampling method (Ellsworth et al., 1995) with slight modifications. Green house, polyhouse and net house and fields were visited, and all hosts surveyed, with observations made in the early hours. In fixed plot survey, sampling was done along a zigzag line moving over several rows and taking 5-10 steps before selecting a new plant. Randomly 10 plants in a plot were selected in a zigzag manner for sampling. The individual plants sampled were 3-5 m apart. The field borders and bunds were avoided to minimize the shadow and edge effect. One leaf each from upper, middle and lower canopy of the selected plants was observed. Leaf was carefully turned over by holding the petiole from single main

stem and whitefly adult present was counted. Data was recorded as adults/ three leaves. Mean values were calculated, and subjected to ANOVA with LSD (p = 0.05) using the statistical software SAS® version 9.2.

RESULTS AND DISCUSSION

Bahadurgarh (Haryana): Whitefly incidence was observed in all the surveyed locations in protected as well as open field conditions, and in protected conditions it differed significantly in all months in cucumber, rose and tomato. During December, incidence was significantly higher in protected cultivation- rose (12.3), subsequently on tomato (8.5) and cucumber (1.9) (Table 1). In January this decreased on rose and tomato; it increased on cucumber. Thereafter the incidence decreased in February on rose (4.4), cucumber (4.3) and tomato (6.6). Chilli in protected cultivation was devoid of incidence.

In potato, brinjal, mustard and tomato under open field conditions, in December, the incidence on potato (6.3) and brinjal (7.2) was significantly higher than subsequent visits (Table 2); in January and Febraury incidence decreased significantly. Thus, under open field conditions in potato and brinjal, which serve as the alternate host for the off-season survival incidence was less. Surprisingly, mustard sown in areas nearby potato was observed supporting significant incidence, similar to those of Muhammad et al. (2008) in Punjab, Pakistan. On mustard, whitefly population was stable throughout the winter and change in population was non-significant across the visits.

Abohar (Punjab): Abohar and Fazilka are considered as the major cotton growing areas in Punjab and also the hotspot areas for whitefly (Kranthi, 2015). In Abohar, cucumber, brinjal and tomato under protected cultivation were observed, and in December, maximum incidence was on brinjal (6.9) in protected cultivation, which significantly reduced in January (Table 3). Under open field conditions, incidence differed significantly except in radish, initially significantly high incidence was on brinjal (16.1) which decreased to 3.80 later (Table 4); potato also had more incidence (12.3), which reduced to 3.1 later. In contrast, mustard and radish had more incidence in winter During mid December, late sown cotton was present in some fields and residual whitefly population was present at low level.

IARI, Pusa campus (Delhi): In Delhi, incidence was more on brinjal (6.2), tomato (4.7) and cotton (5.7) in early December (Table 5); and in January it reduced,

Table 1. Incidence of *B. tabaci* in three locations in N. India.

Months	Bahadurgarh (Haryana)								Abohar (Punjab)								Pusa campus (Delhi)							
	Protected				Open field				Protected				Open field				Open field							
	Rose	Potato	Mustard	Brinjal	Tomato	Cucumber	Tomato	Chili	Cucumber	Brinjal	Tomato	Cucumber	Potato	Brinjal	Mustard	Radish	Brinjal	Cotton	Tomato	Mustard
December	12.3	6.3	3.2	7.2	0	1.9	8.5	0	4.1	6.9	4.1	4.1	12.3	16.1	4	3.4	6.2	5.7	4.7	0
January	5	3.6	3.1	6.3	0	4.9	7.3	0	4.9	4.7	3.5	4.9	3.1	3.8	2.3	2.6	2.2	4	1.8	0
February	4.4	4.7	2.9	4	0	4.3	6.6	0									4.6	2.4	3.2	0
F(≤0.05)	39.06	4.99	0.34	6.49	-	12.28	2.76	-	1.21	4.37	1.98	1.21	67.06	124.2	6.83	1.82	27.636	15.813	11.519	-
P-Value	0.00	0.019	0.713	0.008	-	0.00	0.09	-	0.3	0.07	0.193	0.3	0.00	0.00	0.028	0.21	0.00	0.00	0.00	-
LSD	2.09	1.81	0.77	1.92	-	1.35	2.09	-	1.65	2.38	0.97	1.65	2.54	2.51	1.47	1.34	0.963	0.71	0.1	-

Mean of three leaves/ plants

and in February, incidence started again, but absent in mustard.

Muhammad et al. (2008) argued that, during winter, cotton whitefly continues to breed on field crops and vegetables at a slow rate. Among vegetables brinjal and potato carried majority of the pest populations during this period and play pivotal role in the carryover. Contribution of these hosts in the over wintering had been reported by Mohyuddin et al. (1989) from cotton growing areas of the Punjab, Pakistan. Brinjal, potato and tomato play major role in its carryover to cotton. Butler et al. (1986) observed that the winter crops and vegetables act as major source of carryover to summer crops especially from the U.S.A. Similar observations on these hosts in the carryover are available- Johnson et al. (1982) from Southern California, Melamed-Madjar et al. (1979) and Gerling (1984) from Israel, Nachapong and Mabbit (1979) and Mabbit (1978) from Thailand and Mohyuddin et al. (1989) from Pakistan.

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