



STUDIES ON MEALY BUG, *PHENACOCOCCUS SOLENOPSIS* TINSLEY ON TRANSGENIC COTTON IN NORTH INDIA

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ABSTRACT

Fifty species of plants of taxonomic identity belonging to 20 families from field crops (4), fruits crops (5), ornamental crops (4), plantation crops (7), vegetable crops (9) and weed plants (21) were recorded as host of mealy bug. The studies conducted during 2007 and 2008 on its population dynamics revealed that the pest appeared on cotton immediately after sowing from other weed hosts and remained active throughout the cotton season. The peak infestation of *P. solenopsis* was recorded in August-September on cotton during both years. A low (1-10) to medium (10-20 ants /plant) grade population of ants were recorded on cotton plants infested with mealy bug. Seven predators and two parasitoids have been recorded feeding on mealy bug. Out of 14 insecticides tested profenofos @ 1250 ml, monocrotophos @ 1250 ml, chlorpyrifos @ 3000 ml, quinalphos @ 2000 ml, acephate @ 2000 g, thiodicarb @ 625 g and carbaryl WP @ 2500 g/ ha were found effective as spot sprays.

Key words: *Phenacoccus solenopsis*, infestation, host range, natural enemies, insecticides

Introduction of transgenic cotton, has suppressed the bollworms population in cotton ecosystem and as such the number of insecticidal sprays reduced from 15 to 3 coupled with the absence of competition from the primary pest. Certain changes in the environment led to the appearance of the mealy bug in cotton which has become a serious pest. In 2005, this pest was reported on cotton in Pakistan. Although the mealy bug was reported on cotton in 1980 in Punjab (Dhawan *et al.*, 1980) but the species was *Maconellicoccus hirsutus* Green and at some of places *Ferrisia virgata* (Cockerell) was also recorded on cotton. *Phenacoccus solenopsis* Tinsley, originated in USA in 1898 (Williams and Willink, 1992) was reported on cotton in India. *Phenacoccus solenopsis* Tinsley appear on Bt-cotton in Bathinda of Punjab in 2006 in small patches but in 2007 it became a serious pest of Bt cotton (Monga *et al.*, 2009). The pest has been reported attacking many field, fruit, vegetable, ornamental and weed plants. Host range of mealy bug as well as its population dynamics has been recorded on cotton crop along with the efficacy of various insecticides for its management.

MATERIALS AND METHODS

The mealy bug *P. solenopsis* Tinsley infested area was regularly visited to find out its host range during 2007 and 2008. The weed plants, plantation crops,

ornamental crops, field crops, vegetable crops and fruit plants adjoining the infested cotton crop were critically observed for the presence of mealy bug. The plants with mealy bug were identified and recorded for its host range. Simultaneously the population of mealy bug was recorded on 5.0 cm stem portion of the infested and tagged cotton plants to find its peak period of infestation as well as its population dynamics. Mealy bug infested plants were brought to the laboratory for recording the number of natural enemies (predators and parasitoids). The preserved specimens of natural enemies of unknown taxonomical identity, found associated with mealy bug were sent to Division of Entomology, IARI, New Delhi for their identifications. Similarly at each observation while recording data on mealy bug number and infestation, the population of ants found on cotton plants was also recorded and graded as nil (no ant), low (1-10 ants), medium (11-20 ants) and high (>20 ants). The activity of ants was also recorded continuously in the mealy bug colony to find out the kind of association between the ant species and mealy bug. Insecticides of different groups *i.e.*, carbaryl 50 WP, thiodicarb 75 SP, monocrotophos 36 WSC, profenofos 50 EC, quinalphos 25 EC, chlorpyrifos 20 EC, triazophos 40 EC, ethion 50 EC, deltamethrin 2.8 EC, cypermethrin 10 EC, endosulfan 35 EC, acetamiprid 20 SP and nimbecidene were applied to study their efficacy against mealybug and compared with control (where only water was applied as spray).

The fields having mealy bug infestation were identified and 5 plants per replication tagged and the number of mealy bug from 5.0 cm central portion of the plant was counted before spray. The observations after 48, 72 and 96 hrs of spray were recorded to find out the number of surviving individuals. The spray was applied with the help of knapsack sprayer. The per cent reduction in mealy bug population was calculated and the data were analyzed statistically.

RESULTS AND DISCUSSION

The presence of mealy bug was recorded on 50 hosts (Table 1) belonging to 20 families during 2007 and 2008. Garland (1998) recorded more than 76 families and over 200 genera as its EPPO region as hosts of mealy bugs. However, the population density was different on different hosts. The member of family Malvaceae (cotton, *Gossypium* spp.; okra, *Abelmoschus esculentus*; peeli buti, *Abutilon indicum*; kanghi buti, *Sida* spp. *Hibiscus rosa sinensis*; hollyhock, *Althaea* spp) along with *Parthenium* spp and *Helianthus* spp harbored maximum mealy bug.

Mani (1989) recorded Malvaceae as the most preferred one for *Maconellicoccus hirsutus* (Green).

The weekly data recorded for mealy bug indicated its infestation with the onset of cotton season. However, a low profile population was recorded when surroundings are weed free but the fields having a large number of mealy bug infested weeds adjoining to it were heavily infested and its population was high. The peak population was recorded during August - September in 2007 and 2008 (Fig. 1). The maximum population of 33.6 and 38.96 per 5 cm central shoot was recorded in August followed by September (31.75 and 26.56) and October (32.13 and 20.31) during 2007 and 2008, respectively. The population was less during 2008 as compared to 2007 because of unfavorable environmental conditions (long spell of rains). The activity of mealy bug was affected by the climatic conditions as reported by Nakahira and Arakawa (2006) where an increase in activity of *Phenacoccus solani* in Japan with increase in temperature was recorded.

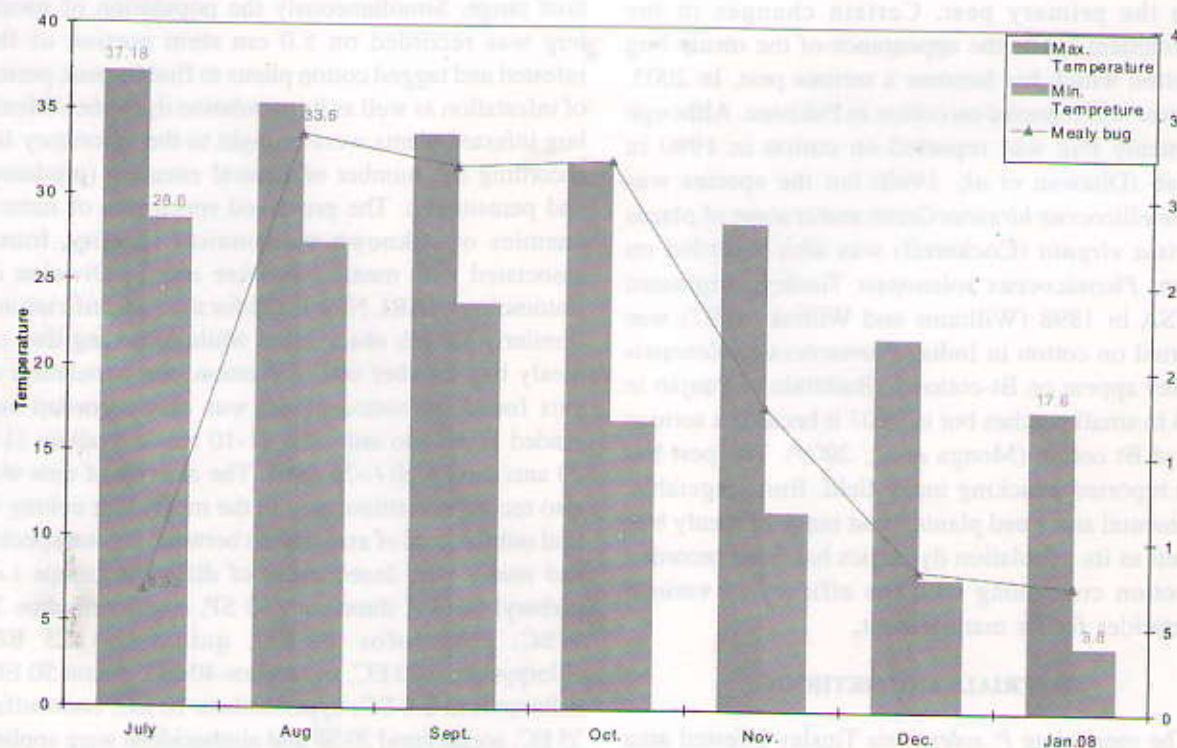


Fig. 1. Population dynamics of mealy bug in cotton

Table 1. Hosts of mealy bug in Sirsa (Haryana)

Category	Common Name	Scientific name	Family
Field Crops	Cotton	<i>Gossypium</i> spp.	Malvaceae
	Moong	<i>Vigna radiata</i>	Leguminosae
	Guar	<i>Cyamopsis tetragonoloba</i>	Leguminosae
Vegetable crops	Sorghum	<i>Solanum bicolor</i>	Graminae
	Okra	<i>Abelmoschus esculentus</i>	Malvaceae
	Brinjal	<i>Solanum melongena</i>	Solanaceae
	Chillies	<i>Capsicum annum</i>	Solanaceae
	Potato	<i>Solanum tuberosum</i>	Solanaceae
	Tomato	<i>Lycopersicon esculentum</i>	Solanaceae
	Round melon	<i>Citrullus vulgaris</i>	Cucurbitaceae
	Long melon	<i>Cucumis melo</i>	Cucurbitaceae
	Bitter gourd	<i>Momordica charantia</i>	Cucurbitaceae
	Ridge gourd	<i>Luffa acutangula</i>	Cucurbitaceae
Fruit crops	Guava	<i>Psidium guava</i>	Myrtaceae
	Grape	<i>Vitis vinifera</i>	Vitaceae
	Ber	<i>Zizyphus</i> spp.	Rhamnaceae
	Pomegranate	<i>Punica granatum</i>	Punicaceae
	Papaya	<i>Carica papaya</i>	Caricaceae
Ornamental crop plants	Marigold	<i>Tagetes patula</i>	Compositae
	Hibiscus	<i>Hibiscus rosa sinensis</i>	Malvaceae
	Hollyhock	<i>Athaea</i> sp.	Malvaceae
	Guldawdi	<i>Chrysanthemum</i> spp.	Asteraceae
Weed plants	Congres grass	<i>Parthenium hysterophorus</i>	Heliantheae
	Gutpatna	<i>Xanthium</i> sp	Asteraceae
	Bhakari	<i>Tribulus terrestris</i>	Zygophyllaceae
	Itsit	<i>Trianthema monogyna</i>	Aizoaceae
	Peeli buti	<i>Abutilon indicum</i>	Malvaceae
	Kangi buti	<i>Sida</i> sp	Malvaceae
	Makhra grass	<i>Acrchne racemosa</i>	Graminae
	Madhama	<i>Eleucine kegypracum</i>	Graminae
	Dhatura	<i>Datura fastuosa</i>	Solanaceae
	Safed bui	<i>Aerva sativa</i>	Amaranthaceae
	Aak	<i>Calotropis procera</i>	Asclepiadeceae
	Chirpati	<i>Physalis minima</i>	Solanaceae
	Wild radish	<i>Raphanus raphanistrum</i>	Brassicaceae
	Askand	<i>Withania somnifera</i>	Solanaceae
	Makoi	<i>Solanum nigrum</i>	Solanaceae
	Tandla	<i>Digera arvensis</i>	Amaranthaceae
	Puthkanda	<i>Achyranthes aspera</i>	Amaranthaceae
Jangli palak	<i>Rumex retroflexus</i>	Polygonaceae	
Jangli Surajmukhi	<i>Helianthus</i> spp.	Asteraceae	
Lantana weed	<i>Lantana camara</i>	Verbenaceae	
Doob grass	<i>Cynodon dactylon</i>	Graminae	
Plantation crops	Neem	<i>Azadirchta indica</i>	Meliaceae
	Peepal	<i>Ficus religiosa</i>	Moraceae
	Burgad	<i>Ficus indica</i>	Moraceae
	Acacia	<i>Acacia</i> spp.	Mimoseae
	Safeda	<i>Eucalyptus citriodora</i>	Myrtaceae
	Popalar	<i>Populus deltoide</i>	Falipaceae
	Mulberry	<i>Morus</i> spp.	Moraceae

The natural enemies recorded in cotton field from May onwards are *Coccinella septempunctata* (Linnaeus), *Cheilomenes sexmaculata* (Fabricius), *Brumoides suturalis* (Fabricius), *Chrysoperla carnea* (Stephens), *Cryptolaemus montrouzieri* Mulsant, *Scymnus coccivora* Ramakrishna Ayyar and *Pharoscygnus flexibilis* (Mulsant). These were predated on mealy bug with the onset of infestation, but their maximum abundance was recorded in October when the population density of mealy bug was very high. *C. montrouzieri* was recorded as potential predator of *M. hirsutus* by Smith *et al.* in 1997 in Australia. During July 2008, a parasitoid known as *Aenasius bambawalei* Hayat was recovered from the mummified bodies of mealy bug collected from the experimental area at Sirsa. Another parasitoid *Paranathrix tachikawai* was also recovered from the mummified bodies but its population was too low.

A low (1-10 ants) to medium (11-20 ants) level population of ants were recorded on the mealy bug infested plants. Interestingly no activity of predator was observed in mealy bug colonies having high level population of ants.

The trials conducted to study the efficacy of various insecticides against mealy bug revealed that at all the

locations sprays were effective (Table 2). Of the insecticides, profenophos (93.33%) followed by monocrotophos (88.87%), acephate (81.19%), carbaryl (80.55%), thiodicarb (78.20%), chlorpyrifos (69.44%) and quinalphos (57.32%) were six best treatments. Similarly in Pakistan (Shafat *et al.*, 2007) and experiments conducted at Bathinda (Singh and Dhawan, 2009), profenophos and chlorpyrifos were found effective.

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Table 2. Per cent reduction in mealy bug population after application of insecticides in cotton**

S. No.	Treatment	Dosage (g or ml/ha)	Per cent reduction in mealy bugs/ 5 cm central shoot/ plant* over before spray population (hours after spray)		
			48	72	96
1	Carbaryl 50 WP	2500	36.24 (37.0)	40.33 (39.40)	80.55 (63.80)
2	Acephate 75 SP	2000	38.55 (38.40)	41.16(39.90)	81.19 (64.30)
3	Ethion 50 EC	2000	49.67 (44.80)	32.03 (34.40)	42.22 (40.50)
4	Triazophos 40 EC	1500	43.36 (41.10)	26.08 (30.70)	49.43 (44.70)
5	Quinalphos 25 EC	2000	59.55 (50.50)	55.55 (48.20)	57.32 (49.20)
6	Chlorpyrifos 20 EC	3000	58.05 (49.60)	59.72 (50.60)	69.44 (56.40)
7	Profenophos 50EC	1250	64.35 (53.30)	65.55 (54.00)	93.33 (75.00)
8	Deltamethrin 2.8EC	400	48.78 (44.30)	27.43(31.60)	27.78(31.80)
9	Methyl Parathion 50EC	1250	40.72 (39.60)	29.95(33.10)	24.56 (29.70)
10	Monocrotophos 36 SL	1250	63.35 (52.70)	55.15 (47.90)	88.87 (70.40)
11	Thiodicarb 75 WP	625	36.67 (37.20)	55.32 (48.00)	78.20 (62.20)
12	Nimbecidene	750	49.72 (44.80)	31.94 (34.40)	18.74 (25.60)
13	Thiomethoxam 25WG	100	39.67 (38.00)	32.11 (34.50)	18.35 (25.30)
14	Endosulfan 35 EC	2500	32.03 (34.40)	25.82 (30.50)	08.91 (17.40)
15	Control		04.26 (11.80)	11.30 (19.60)	19.48 (26.20)
	CD (P = 0.05)		08.88	08.24	09.85
	CV (%)		20.00	19.88	15.55

*Figures in parentheses are arc sine transformations

** Pooled data of 2006-07 and 2007-08 crop season

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