

COTTON MEALY BUG, *PHENACOCCLUS SOLENOPSIS* TINSLEY – A REVIEW

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ABSTRACT

Mealy bug, *Phenacoccus solenopsis* Tinsley is a serious pest of cotton limiting the production and quality of fibre and lint. It is a polyphagous pest and multiply on different hosts like field crops, horticultural, fruit, vegetable and ornamental plants. They suck a large amount of sap from leaves and stems depriving plants of essential nutrients showing the symptoms like retarded growth, late opening of bolls and total drying of the plant. The yield losses due to the pest are estimated upto 50 per cent. Mealy bugs are cottony in appearance, small, oval, soft-bodied sucking insects covered with white mealy wax, which makes them difficult to eradicate. An individual mealy bug survived for 25-38 days. Effective control of the pest can be achieved through an integrated pest management approach. Field sanitation, uprooting of infested plants, dusting of methyl parathion 2 per cent or spraying of profenophos 50 EC or chlorpyrifos 25 EC or quinalphos 25 EC help to reduce the pest population. *Aenasius bambawalei* Hayat, *Anagyrus kamali* Mani, *Cryptolaemus montrouzieri* (Mulsant), *Chrysoperla carnea* (Stephens), *Verticillium lecanii* (Zimmermann) and *Beauveria bassiana* (Vuillemin) are the effective biological control agents in managing the infestation of the pest.

Key words: Cotton mealy bug, *Phenacoccus solenopsis*, Tinsley

INTRODUCTION

Cotton is an important commercial crop of our country that occupies enviable place. It contributes virtually 80 per cent of raw material to our textile industries i.e. the second largest employer after agriculture sector. The area under cultivation of cotton in India was 93.73 lakh ha. with the production of 290 lakh bales and an average productivity of 526 kg/ ha (Anonymous, 2009, a). Incidence of mealy bug (Homoptera: Pseudococcidae), which was considered to be a minor pest in rare cases, has now become a major threat to cotton production in several parts of the country. It is a polyphagous pest infesting many ornamental, vegetable and fruit crops. Dhawan *et al.*

(2007) reported three species of mealy bug damaging cotton crop i.e. *Phenacoccus solenopsis* Tinsley, *Ferrisa virgata* Cockerell and *Maconellicoccus hirsutus* Green. Among which, *P. solenopsis* is the dominant species on cotton (Anonymous, 2008, a). Severe losses are reported by the pest in Punjab (Dhawan *et al.*, 1980 and Dutt, 2007) and Gujarat (Muralidharan and Badaya, 2000). The pest has achieved a status of serious threat in Pakistan (Abbas *et al.*, 2005).

First records, host plants and nature of damage

Phenacoccus solenopsis Tinsley, a new pest of cotton in India was described originally from the U.S. in 1898 (Ben-Dov, 2004) and was reported for

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the first time from Florida on ragweed (Anonymous, 1978). The pest was found infesting *Solanum muricatum* Aitaon in Chile (Larrain, 2002) and tomato in Brazil (Mark and Gullan, 2005). The first known occurrence of *P. solenopsis* infesting cotton was recorded by Fuchs *et al.* (1991) in the USA. Arif *et al.* (2009) recorded the pest from 154 plant species of field, vegetables and ornamentals crops, including weeds, bushes and trees.

Adults and nymphs weaken the plants by sucking sap from leaves, twigs, stems and fruiting bodies. Growth of the plant is retarded. Flowers, buds, mature bolls and even leaves fall down. Bolls are deformed, fewer and smaller in size in affected plants. Honey dew secreted by the pest encourages the development of black sooty mould which adversely affecting the photosynthetic activity. Dhavan *et al.* (2007) has reported 30-40% losses in cotton yield due to the pest in Punjab. Jhala and Bharpoda (2008) in Gujarat reported 50% reduction in yields during 2006 due to the infestation of mealy bug.

Biology

According to Tanwar *et al.* (2007) described the biology of mealy bug, *P. solenopsis*. The eggs were 0.3 to 0.4 mm in length with the incubation period of 3-9 days. The crawlers were very mobile. In appearance, nymphs of both the sexes resemble female adults. Also, there were three nymphal instars in male while, four instars were observed in female. The average nymphal period was 22-25 days.

The fecundity of mealy bug was observed as 310-625 eggs/ female with average of 470 eggs/ female. 98-239 nymphs were observed in an ovisac. The incubation period was 4-6 hours. Mating period lasted for 10-45 minutes and the reproduction occurred 8-14 days after mating. The male nymphal period of 13-17 days was reported. The adult female was 4-5 mm long, oblong in shape. Male have no functional mouthparts and survived for 3-5 days. While, female adult survived for 30-48 days (Av. 40.7 days) (Anonymous, 2008, b).

According to Akintola and Ande (2008), the eggs were yellowish in colour and about 150-600 eggs were found in an ovisac. The egg period was recorded of 6-9 days. The nymphs were yellow or pink in colour. There were 3 nymphal instars in male, while, 4 in female. The 4th instar in male was immobile. In the adult stage, male was winged and female was wingless. The 1st instar nymph was oblong in shape and yellow in colour. It was devoid of mealy scale cover and hence conspicuously orange. The length varied from 11.07 to 13.47 mm (Av. 12.27 ± 1.20 mm) with the body width of 0.11 to 1.37 mm (Av. 0.74 ± 0.63 mm). It lasted for 6 days. The 2nd instar nymph was oblong in shape, yellow in colour with lack of mealy wax secretion. The length varied from 11.82 to 14.22 mm (Av. 13.02 ± 1.20 mm) with the body width of 7.39 to 8.69 mm (Av. 8.02 ± 0.63 mm). It lasted for 8 days. The 3rd instar nymph was oblong in shape and dark yellow in colour with white cottony substance covering the entire body. The length varied from 12.50 to 14.97 mm (Av. 13.77 ± 1.20 mm) with the body width of 8.49 to 9.75 mm (Av. 9.17 ± 0.63 mm). It lasted for 10 days. The female were oblong in shape and light to dark yellow in appearance. The body length ranged from 15.61 to 18.01 mm (Av. 16.81 ± 1.20 mm) with the body width of 10.33 to 11.59 mm (Av. 10.96 ± 0.63 mm).

Radadia *et al.* (2008) stated that the eggs of *P. solenopsis* were light yellow or whitish yellow in colour. Also, the eggs were laid in an ovisac and average 150-600 eggs were found in a single ovisac. The incubation period of the eggs was 6 to 9 days. The nymphs were yellowish or pinkish in colour. There were 3 nymphal instars in female, while male had 4 nymphal instars. The adult female was covered with white puffy waxy coating layer and showed two-dark stripes on the body. A pair of wings was observed in male adult with 2 tail like appendages. Dhawan and Saini (2009) reported that the egg of the pest was pale yellow in colour, oval in shape and was very minute. The length varied from 0.34 to 0.40 mm (Av. 0.37 ± 0.03 mm) with the width of

0.16 to 0.20 mm (Av. 0.17 ± 0.02 mm). The incubation period was 1-2 days (Av. 1.4 ± 0.5). The 1st instar nymph was oblong, yellow, devoid of mealy scale with the length and width of 0.71 to 0.75 mm (Av. 0.73 ± 0.01 mm) and 0.43 to 0.49 mm (Av. 0.47 ± 0.03 mm), respectively. Also, two caudal filaments on tip of the abdomen were noticed. The 1st instar nymph lasted for 4-6 days (Av. 4.6 ± 1.1). The 2nd instar nymph was oblong, pale yellow and body lacked mealy waxy secretions. The length and width observed were 1.0 to 1.5 mm (Av. 1.3 ± 0.29 mm) and 0.51 to 0.55 mm (Av. 0.53 ± 0.02 mm), respectively. Eyes were very clear at this stage, like red spot. Also, tip of the abdomen was protruded and has two caudal filaments. The 2nd instar nymph lasted for 4-6 days (Av. 4.8 ± 1.1) for female and 4-5 days (Av. 4.7 ± 0.6) for male. The 3rd instar nymph was dark yellow and oblong. White, puffy waxy coating over the dorsal surface was observed with light dark stripes on dorsal side. The length and width observed were 2.1 to 2.6 mm (Av. 2.4 ± 0.2 mm) and 1.1 to 1.3 mm (Av. 1.2 ± 0.1 mm), respectively. Also, two caudal filaments on tip of the abdomen were noticed. The 3rd instar nymph lasted for 5-7 days (Av. 6.2 ± 0.9) for female and 6-8 days (Av. 7.0 ± 1.0) for male. The adult female was oblong, light to dark yellow, wingless and yellowish body is largely obscured by powdery white wax. Eighteen pairs of short waxy filaments existed around the body. The length and width observed were 4.1 to 4.7 mm (Av. 4.4 ± 0.24 mm) and 2.8 to 3.0 mm (Av. 2.9 ± 0.01 mm), respectively. While, the adult male was smaller than female, pale brown in colour with delicate and elongated body. The length and width observed were 0.99 to 1.1 mm (Av. 1.0 ± 0.01 mm) and 0.25 to 0.26 mm (Av. 0.25 ± 0.01 mm), respectively. One pair of mesothoracic wings was observed in male with wing expanse of 0.43 to 0.45 mm (Av. 0.44 ± 0.01 mm). The adult periods lasted for 13-17 days (Av. 14.8 ± 1.6) for female while, it was 1-2 days (Av. 1.6 ± 0.5) for male. The pre-oviposition, oviposition and post-oviposition period of the pest were 3-5 days (Av. 4.4 ± 0.4), 8-9 days

(Av. 8.2 ± 0.8) and 2-3 days (Av. 2.6 ± 0.6), respectively. The fecundity of the pest was 270-340 young ones/ female (Av. 308.6 ± 26.25). The total life of the female was 27-38 days (Av. 32.4 ± 4.4), while it was 16-23 days (Av. 20.5 ± 2.9) in male.

Kamariya (2009) studied the biology of *P. solenopsis* under laboratory condition and found that the female laid eggs in an ovisac of thin white cushiony pouch. The eggs were minute, oval in shape and light yellow or whitish yellow in colour. The average incubation period was 6.62 ± 1.71 days. The nymphal stage passed through three instars. The duration of the first (crawler), second and third instar nymphs were 4.82 ± 1.12 , 5.64 ± 1.14 and 6.42 ± 1.14 days, respectively. The total nymphal period was minimum 12 days and maximum 21 days with an average of 16.88 ± 2.11 days. The adults were oblong in shape and light to dark yellow in appearance. Adult female was covered with wax layer and showed two-dark stripes on the body and was wingless. The average pre-oviposition, oviposition and post-oviposition period were recorded as 4.32 ± 0.80 , 8.00 ± 0.82 and 2.72 ± 0.79 days, respectively. The average egg laying capacity of the female was 427.68 ± 86.69 eggs. The average longevity of female adults was 13 to 18 days with an average of 15.52 ± 1.42 days. The average total duration of life cycle of *P. solenopsis* female on cotton was minimum 25 days and maximum 36 days with an average of 31.12 ± 3.19 days.

Population Correlation

Lower temperature and higher humidity favored the build up of the pest (Anonymous, 2008, a). While, increase in humidity was positively correlated with the increase in incidence of mealy bug at Pakistan (Anonymous, 2008, b). Brar *et al.* (2009) revealed that the rain has great impact on the population of the pest. Dhawan and Saini (2009) found that weather conditions like temperature, relative humidity and rainfall showed positive effect on the insect biology and their incidence in field.

Jeyakumar *et al.* (2009) observed that the humidity favored the multiplication of the pest, but the intense rainfall adversely affects the spread and reduces the intensity.

Management

Cultural Control

Proper destroying of the uprooted infested plats, weed hosts and management of irrigation and fertilizers are the effective cultural methods to prevent the mealy bug infestation (Anonymous, 2008, a).

Chemical Control

Larrain (2002) evaluated acaricides and insecticides were for the control of mealy bug, *P. solenopsis*, respectively on sweet pepinos. The results showed that the pest effectively controlled by spraying with chlorpyrifos and carbofuran.

Shafqat *et al.* (2007) evaluated different groups of insecticides against mealy bug, *P. gossypiphilous* on cotton in field conditions and found that the recommended application rates of methomyl, profenofos and chlorpyrifos provided the best control: the lethal time studies proved their efficiency for better and timely control of this sporadic pest. In laboratory conditions, bifenthrin, profenofos and chlorpyrifos proved to be the best insecticides.

Spirotetramat 150 OD @ 625 ml/ ha and spirotetramat 12% + imidacloprid 36% 480 SC @ 200 ml/ ha recorded the reduction of 75.1% and 72.5% in the population of mealy bug at Hisar (Anonymous, 2008, a). Imidacloprid 200 SL @ 360 ml/ ha, spirotetramat 150 OD @ 160 and 230 ml/ ha, imidacloprid 200 SL @ 540 ml/ ha and spirotetramat 150 OD @ 625 ml/ ha were found consistently effective against mealy bug and brought down the population by 44.0, 40.9, 38.1, 37.2 and 32.4%, respectively at Faridkot (Anonymous, 2008, a). While, spirotetramat 12% + imidacloprid 36% @ 300 ml/ ha, spirotetramat 150 OD @ 625 ml/ ha and spirotetramat 12% + imidacloprid 36% @ 200 ml/ ha were effective against cotton mealy bug at Surat (Anonymous, 2008, a).

Bhatt *et al.* (2009) observed that methomyl 0.08% was found significantly superior against the mealybug infesting bidi tobacco, followed by profenophos 0.1% and carbaryl 0.2% at Anand (Gujarat). Deora *et al.* (2009) found that thiodicarb (larvin) @ 0.25 gm/ 100 ml and profenophos (curacron) @ 0.50 gm/ 100 ml were more effective against mealy bug on cotton.

Kamariya (2009) revealed that methyl parathion 0.05 per cent was found the most effective and economic insecticide for the control of mealy bug, *P. solenopsis* on cotton with 87 to 99 per cent mortality followed by profenophos 0.1 per cent and dimethoate 0.03 per cent. In laboratory, the highest toxicity with longer persistency was found in methyl parathion 0.05 per cent followed by profenophos 0.1 per cent, chlorpyrifos 0.05 per cent, quinalphos 0.05 per cent and malathion 0.1 per cent.

Singh and Dhawan (2009) revealed that profenophos 50 EC, acephate 75 SP, thiodicarb 75 WP, chlorpyrifos 20 EC, quinalphos 25 EC and carbaryl 50 WP @ 500 ml, 800 g, 250 g, 2000 ml, 800 ml and 1000 g per acre were significantly effective against the pest.

Biological Control

Biological control is considered the most effective long-term solution because the bio-agents are self perpetuating and continue to attack the mealy bug.

a) Parasites: In India, *Aenasius bambawalei* Hayat, *Anagyrus kamali* Mani, *Leptomastix dactylopi* Howard and *Promuscidea unfasciaticentris* Girault are important parasites of the mealy bug (Tanwar *et al.*, 2007, Radadia *et al.*, 2008 and Saroja *et al.*, 2009).

Moore (1988) revealed that among the natural enemies used against mealy bugs (Psudococcidae), parasitoids have been the most successful agents, especially those of the family Encyrtidae. Use of natural enemies against mealy bug was described by Morais (1995). He suggested

that *A. kamali* is suitable for release in the Caribbean. *A. bambawalei* was found to be most effective parasite with maximum of 42.20 per cent parasitism (Anonymous, 2009, b).

b) Predators: *Brumus suturalis* Fabricus, *Chelomenes sexmaculatus* Fabricus, *Cryptolaemus montrouzieri* (Muslant) and *Chrysoperla carnea* (Stephens) are most common predators (Tanwar *et al.*, 2007 and Radadia *et al.*, 2008).

Moore (1988) stated that despite the frequent use of predators, only the coccinellid, *C. montrouzieri* can be considered successful. Sattar *et al.* (2007) found that the *C. carnea* mostly preferred the first instar nymphs of the mealy bug and consumed upto 1604 mealy bugs per day.

c) Pathogens: *Verticillium lecanii* (Zimmermann), *Metarrhizium anisoplae* Metschnikow and *Beauveria bassiana* (Vuillemin) are most effective fungal pathogens of the pest (Tanwar *et al.*, 2007 and Radadia *et al.*, 2008).

Kulkarni and Mote (2003) reported that the *V. lecanii* at 2, 3, 4, 5 and 6 g/lit of water was effective for the control of mealy bugs. According to Ujjan and Saleem (2007), *M. anisoplae* is able to infect the adult mealy bugs within 2 days and show 90% mortality. *M. anisoplae* strain Ma 1912 reduced the egg hatching up to 60%. *M. anisoplae* @ 2000 ml/ ha was found very effective to control the pest at Rahuri (Maharashtra) (Anonymous, 2008, a).

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