CITRUS MEALY BUG (PLANOCOCCUS CITRI RISSO) MANAGEMENT - A REVIEW

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ABSTRACT

Mealy bugs are destructive to citrus causing severe losses in Peninsular and North-Eastern India. Apart from citrus, mealy bugs attack curry leaf plant, cotton, banana, coffee, cocoa, ginger, mango etc. The citrus plants of all the ages even the pruned young citrus seedlings in cage house and nursery besides grown-up trees are attacked by mealy bugs. Besides arresting the plant growth it also causes leaf and fruit drop. Various methods of control like mechanical, cultural, chemical, biological and use of pheromones and IGR’s which have been tried against the pest world over have been reviewed in this article. Development of forecasting models, working out ETL levels (location and species-wise), correlation of weather parameters with population dynamics etc. have been visualized as the future research strategies.

Mealy bugs pose a serious threat for the cultivation of many fruit crops. It occasionally attains epidemic forms in citrus. A total of nine mealy bug species are reported on citrus. Among them, Planococcus citri (Risso) is destructive causing severe losses to citrus in peninsular India (Mani and Krishnamoorthy, 1996) and North-East region (Pathak et al., 1999). P. citri is found to be economically important pest of Khasi mandarin in Meghalaya (Shylesha and Pathak, 1999) and Kinnow in Punjab (Arora et al., 1999). The incidence of the pest is observed in some pockets of Nagpur mandarin with low to medium level in central India (Kalidas and Shivankar, 1994). Lately, the pest has been gaining ground in the prime land of Nagpur orange i.e. Morshi, Paratwada Talukas of Amravati District (Shivankar and Rao, 2004 Personal observation).

HOST RANGE: The mealy bugs are known to feed on a number of plants, often not closely related to citrus. It is of common occurrence on curry leaf plant, Murraya koenigii Lin., Poinsettia spp. and other flowering plants (Abeel, 1976). It also attacks annona, arabica, robusta coffee, cotton, banana, carambola, cocoa, ginger and mango (Jayma and Ronald, 1992).

DAMAGE: The pest feeds on the new leaves, flowers, stem end of small fruits and also on the big fruits, making them drop prematurely. Heavy infestation is observed during the month of April-May. The citrus plants of all the ages even the pruned young seedlings in cage house and nursery, at joints of leaves or two branches besides grown up trees were found invariably attacked by the pest (Jadhav and Pujari, 1999).

Injuries like split bark along the stem of the declining trees appeared to be the preferred site of attack. Nymphs and females usually feed on underside of the leaves causing heavy damage to nursery and grown up plants. At times the citrus flowers do not set fruits due to severe infestation. The young berries are found dead before they grow turning black or dark red. The mealy bugs also excrete honey-dew on which a black mould grows which interferes with photosynthesis. Black ants also are attracted to the honey-dew and become a nuisance. The leaves appear crinkled due to its feeding. Horticulturally important feature, such as variegation can increase the abundance of the pest (Bindra, 1970; Mani and Krishnamoorthy, 1996).

SEASONAL INCIDENCE: In central India, the pest incidence was heavy during
February-May (74.89 to 100%) and low during monsoon August-October (57%). Heavy infestation during April-May causes more than 50% per cent fruit drop of Ambia (Shivankar and Shyam Singh, 2000). In NEH region, 2.95-74.3% infestation was recorded on various citrus species (Pathak et al., 1999). Tree strata (0-0.91, 0.92-1.83 and 1.84-2.74 m) or quadrant (N, E, S and W) has little effect on the population size of mealy bug and that fruit was the optimum sample unit for indexing population densities; underneath the calyx is the best place to search when there are extremely low population densities (Meyerdirk et al., 1981). The weather parameters viz., maximum and minimum temperatures, relative humidity and rainfall did not show any significant relationship with the mealy bug population (Mani and Krishnamoorthy, 1999).

**BIOLOGY:** The adult female is wingless, with a flattened thick body and short, waxy filaments along the margins covered with white mealy powder. They are found during January to April and descend down to the ground in April-May. The females lay yellow eggs in soil within ovisac. There may be 300-800 eggs in one mass. The eggs hatch in 10 to 20 days and the amber colour nymphs crawl out and start feeding by inserting their mouthparts in the lower surface of the leaves. A waxy white covering and filaments are soon formed on their bodies. A female nymph is full-grown in six to eight weeks with 3 moults. The male is winged, greyish in colour, midge-like with long antennae and has no mouthparts; consequently, it does not feed. The male nymphs spin cotton-like cocoons, two or three weeks after hatching and pupate before transforming themselves into winged adults with 4 moults, completing 3 overlapping generations in a year (Bindra, 1970).

**MANAGEMENT**

**MECHANICAL AND CULTURAL:**
1) Pruning of affected shoots during winter, opening up of the canopy from the centre to allow sufficient sunlight interception below the canopy
2) Destruction of ant colonies in the orchards as they act as the carriers of mealy bugs to their feeding sites
3) Raking the soil around trunk during summer months helps in the desiccation of eggs and exposing the mealy bugs to natural enemies
4) Sticky band of 7-8 cm should be smeared around the trunk at about 0.5 meter height from ground during second week of December since it traps the ascending nymphs; these bands should be renewed whenever necessary
5) Debarking and destruction of the harbouring population also helps in checking the pest (Shivankar and Shyam Singh, 2000). Smearing an adhesive material around the trunk can be combined with other methods into the integrated mealy bug management (Michelakis et al., 1995).

**TOLERANCE:** On screening citrus germplasm against mealy bug, three micro propagated varieties in Meghalaya viz., Assam lemon (Citrus limon), Satkara (C. macroptera) and Pumelo (C. grandis) were found to be highly resistant to P. citri (2.95% to 17.72% leaf infestation), which can be used as rootstock in multiplication programmes. Two more varieties namely, Soh bitara (C. sinensis) and Sweet lime (Sour mutant) (C. limettioides) were moderately resistant (20.65% to 30% leaf infestation). Indian wild orange, C. indica shows moderate susceptibility. The varieties Jaintia lemon C. limon, Khasi papeda C. latipes, Adajamir C. assamensis, Volkamer lemon C. volkameriana, Khasi mandarin C. reticulata and Sohmyndong C. jambhiri are highly susceptible to P. citri and suffered 61.2% to 74.3% foliage infestation (Pathak et al., 1999).

**CHEMICAL:** The intervention threshold for P. citri on Nagpur mandarin was reported to be 5 - 10% infested fruits in summer and 15% infested fruits in autumn (Shyam Singh et al., 2002). Spraying of dimethoate @1.5 ml + kerosene oil @ 2.5 ml
in 1 litre of water or Carbaryl @ 1 ml +
Kerosene oil @ 1 ml or Malathion @ 2 ml in 1
litre of water checks mealy bugs effectively.
Spraying with chlorpyrifos 0.05%, Carbaryl
0.1 % or fenitrothion 0.05% (Jadhav et al.,
1997) and also with 2 ml of dichlorvos + 25g
of fish oil resin soap/ litre water resulted in
75% reduction in mealy bug population. Since
the pest harbours under the loose bark,
debranching followed by pasting with chlorpyrifos
and methyl parathion (both at 4 ml/lit) helps
in minimizing the pest population (Mani and
Krishnamoorthy, 1996). Crawler settlement on
the plant was reduced by Carbaryl swabbing
(1%) undertaken for trunk borer management
(Shylesha and Pathak, 1999).

Citrus oil mixed with chlorobenzilate
is effective against first-instar nymphs of the
pseudococcid in an integrated control
programme (Meyerdirk et al., 1981). Neem
oil and pongamia oil (both at 4%) are effective
against P. citri (Hessian et al., 1996).

**BIOLOGICAL:**

*Anagyrus sp.*, *Bleaursmis insularis* (Cam.), *Diversinervus sp.*, *Tetra stichus sp.*, *Microterys sp.*, *Cryptochaetus sp.*, *Scymnus coccivora* Ayar, *Rillus pallidicollis* Mst., *Nephus sp.*, *Chrysopa sp.*, *Micraspis cardoni* (Wse.), *Pseudaspimemus uttani* Kap., *Cryptolaemus montrouzieri* Mls. and *Spalgis epius* Westwood were recorded in Kodagu, Karnataka (Singh, 1990). *Coccidoxenoides peregrinus* (Timberlake) were recorded in Karnataka (Singh, 1990). *Coccidoxenoides peregrinus* (Timberlake) (Krishnamoorthy and Mani, 1989b), *Mallada boninensis* (Okamoto), *Plesiachrysa lacciperda* (Kimmins), *Anisochrysa basalis* (Walker) and *Chrysoperla carnea* (Steph.) were recorded in Karnataka. In Assam, *C. montrouzieri* and *Entomophthora fumosa* Speare were observed on P. citri (Chowdhury and Majid, 1954).

**Predators:** The exotic natural enemy,
Australian ladybird beetle, *Cryptolaemus
montrouzieri* (Mls.) is used (20/plant) against
mealybugs (P. citri, *Nipaecoccus viridis*,
*Maconellicoccus hirsutus* Green) attacking acid
lime, lemon and mandarins in Karnataka and
Tamil Nadu (Mani and Krishnamoorthy, 1996).

C. montrouzieri consumed an average of
3330.6 eggs of P. citri. Eggs of mealybug as
well as other stages are essential in the diet
for successful development of the predator
(Oncuer and Bayhan, 1982). The number of
eggs laid by C. montrouzieri was largest at
20°C which decreased progressively with
increase in temperature. It was multiplied and
released @ 30/plant for the suppression of
the spherical mealybug, N. viridis on acid lime
(Mani and Krishnamoorthy, 1999). The
chrysopids, *Mallada boninensis* (Okamoto)
Chrysopa lacciperda (Kimmins) [*Plesiochrysa
lacciperda*], *Anisochrysa basalis* (Walker) [M.
basalis] and *Chrysoperla carnea* (Steph.) can
be used to control pseudococcids, P. citri
(Krishnamoorthy and Mani, 1989a).

**Parasitoids:** P. citri is usually attacked
by two encyrtid parasitoids, the exotic
Leptomastix dactylopii Howard and the
indigenous, *Coccidoxenoides peregrinus*
(Timberlake). However, *C. peregrinus* is more
abundant causing 10-30% parasitism (Mani,
1994). Although, the encyrtid attacks other
mealybugs, development was successfully
completed only on P. citri. All nymphal instars,
including crawlers and both sexes, are attacked
(Krishnamoorthy and Mani, 1989b). *N. viridis*
is also attacked by the cryptid, *Anagyrus
agraenis* Saraswat, *L. dactylopii* and *A. mirzai*
Agarwal. The impact of these natural enemies
on the population of spherical mealybug was
moderate (Mani and Krishnamoorthy, 1999).
A parasitic wasp, *Prosopatella perniciosi* (Tower)
has been successfully established in Kashmir
where it has given fairly effective control of P.
citri.

A parasitoid, *L. dactylopii* was
introduced into India in 1983 on mandarins.
It became established within 2 months causing
up to 100% parasitism (Krishnamoorthy and Singh, 1987). Both the adult beetle and larva feed voraciously on all stages of mealybugs but it does not do well in severe winter. The parasitoid could disperse over a distance of 5 km from the release site (Mani, 1994). Field release of the parasitoid, L. daeziolii @ 5000-7000 adults/ha gave complete control of P. citri within 3-4 months (Krishnamoorthy and Mani, 1994). It is able to control P. citri but has to be released periodically since it cannot survive in winter (Longo and Benfatto, 1982).

**PHEROMONES:** Synthetic pheromone [(1R-cis)- 2, 2-dimethyl -3-(1-methylethenyl) cyclobutyl methyl acetate] at doses of up to 19 mm g/108 cm3 on discs of filter paper in petri dishes elicited positive responses from males, but higher doses resulted in reduced response. The half-life of the synthetic sex pheromone of P. citri in the field was about 2 weeks with the maximal male catches by the doses of 400-700 mg (Hefetz and Tauber, 1990).

**IGR:** Buprofezin, an insect growth regulator, showed strong ovicidal activity resulting in over 80% inhibition of egg hatch and 91 - 99% nymphal mortality (Mendel et al., 1991).

**FUTURE LINE OF RESEARCH**

Studies on identification of hot spots for citrus mealy bugs and working out location wise/crop wise economic threshold/action threshold levels is the need of the hour. Correlation of weather parameters and pest population is an important pre requisite for preparing pest forecasting model based on which pest incidence can be predicted, so that an effective pest management strategy can be planned in advance to prevent the pest reaching an action threshold level. Indepth studies on hyper parasitism as well as tri-trophic interactions help in understanding the general equilibrium level of insect pest-natural enemy complex. A detailed comprehensive study regarding various combinations of pest management tactics including cultural, mechanical, chemical, biological would help in evolving IIM schedule for citrus mealy bugs. Development of molecular markers for the resistant cultivars/root stocks against citrus mealy bug is the pre requisite in the development of mealy bug resistant transgenic citrus plants which is an important aspect of future study.

**REFERENCES**


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