J.Biol.Control, 7 (2), 75-80, 1993

Studies on Mealybugs and their Natural Enemies in Ber Orchards

M. MANI
Division of Entomology & Nematology
Indian Institute of Horticultural Research
Bangalore - 560 089

ABSTRACT

Ber (*Zizyphus mauritiana* (L.)) has been found attacked by four mealybug species *viz.*, *Nipaecoccus viridis* (Newstead), *Planococcus citri* (Risso), *P.lilacinus* (Ckll.) and *Maconellicoccus hirsutus* (Green) around Bangalore. A total of 11 natural enemies on *N.viridis*, three on *P.citri* and two on *P.lilacinus* were recorded. Attempts were also made to use the exotic natural enemies like *Cryptolaemus montrouzieri* Muls. and *Leptomastix dactylopii* How. to suppress the mealybug population in ber orchards. The local parasitoids and predators appeared in large number and were mainly responsible for the suppresion of *N.viridis* and *P.citri* on ber.

KEY WORDS : Mealybugs, ber, parasitoids, predators

About 80 insect pests are known to attack ber (*Zizyphus mauritiana* (L.)) in India. Mealybugs in particular, posed serious threat to ber in recent years. Severe infestation of mealybugs and subsequent development of sooty mould affect the growth and fruiting capacity of ber and quality of fruits (Butani, 1973). These mealybugs are difficult to control with insecticides. On the other hand, they are more amenable for biological control by parasitoids and predators (Bartlett, 1977). The mealybugs on ber were kept under check by a complex of natural enemies in Iraq (El-Haidari *et al.*, 1976). In Jordan, *Anagyrus indicus* Shaffee *et al.* had been introduced to suppress the mealybugs on *Zizyphus* sp. (Meyerdirk *et al.*, 1988). However, not much work has been done so far to explore the possibilities of applying biocontrol agents in suppressing the mealybugs on ber in India. Studies were conducted to determine the mealybug species and their natural enemies and then attempts were also made to use exotic natural enemies to control the mealybugs on ber.

MATERIALS AND METHODS

Mealybug infested shoots and fruits were collected regularly from ber orchards around Bangalore, and placed over ripe pumpkins (*Cucurbita maxima* D.) in wooden cages (30 x 30 x 30 cm) in the laboratory. Parasitoids and predators that emerged in the cages were collected, preserved and sent to International Institute of Entomology, London, for identification.

The Australian mealybug destroyer *Cryptolaemus montrouzieri* Muls. (Coccinellidae, Coleoptera) was bred on mealybug-infested pumpkins in the laboratory as outlined by Chacko *et al.* (1978). The predatory beetles were released in August 1990 against *Nipaecoccus viridis* (Newstead) on ber at Block No.3 of I.I.H.R. Farm. Insecticidal applications were suspended during the experimental period. Malathion (5%) dust was also applied around the trunk in the soil for checking ants. About 10 trees were found infested with the mealybugs, and a total of 200

Contribution No. 101/92 of I.I.H.R.

beetles @ 20/tree was released. Subsequent to the release, the population, of mealybugs, *C.montrouzieri* and other natural enemies if any were observed at 15-day intervals on all the 10 trees. Five shoots of 30 cm length were removed from each tree and brought to the laboratory. After counting the live mealybugs and predators, the samples were kept over pumpkins in wooden cages to record the emergence of parasitoids and predators.

Release of the exotic parasitoid *Leptomastix dactylopii* How. (Encyrtidae, Hym.) was undertaken against *Planococcus citri* (Risso) in December 1990 in Block No.2 of I.I.H.R.Farm. The parasitoid was multiplied on laboratory-bred *P.citri* as described by Krishnamoorthy and Singh (1987). A total of 120 parasitoids (@ 30/tree) was released on 4 trees found infested with *P.citri*. On each tree, the sampling for the mealybug and its natural enemies was done on five randomly-selected shoots of 30 cm length. The activity of natural enemies was studied by collecting and keeping the mealybug-infested shoots over pumpkins in wooden cages for emergence of natural enemies at fortnightly intervals.

RESULTS AND DISCUSSION

The present investigation and the past literature revealed the incidence of 10 mealybug species (4 margarodids and 6 pseudococcids) on *Zizyphus* spp. in India and elsewhere (Table 1). Distribution of margarodids on ber was limited to North India and they were not collected during the survey. Among the four pseudococcids recorded in the present survey, *Nipaecoccus viridis* (Newstead) was observed in severe form. Eventhough this mealybug species was reported earlier on ber in Gujarat (Shah *et al.*, 1981), it was not recorded on ber in other parts of India including Karnataka. *Planococcus lilacinus* (Ckll.), noted earlier by Tandon and Verghese (1987) on ber, was also collected during our survey. The present record of both *P.citri* (Risso) and *Maconellicoccus hirsutus* (Green) appeared to be new on ber in India. However, *M.hirsutus* has been reported on *Zizyphus* sp. in Egypt (Hall 1926). In the present study, *P.citri* was noticed to be quite serious on a few ber trees While *M.hirsutus* was of minor importance in

Table 1. Mealybugs recorded on *Zizyphus* spp.

Species	Family	Country/Locality	Reference
Drosicha stebbingi Green	Margarodidae	India (Rajasthan)	Varshney (1985)
D.mangiferae (Green)	"	" "	Pruthi and Batra (1960)
Drosichiella tamarindus Green	"	" "	Butani (1973)
Perissopneumon tamarindus Green	"	" (Rajasthan, Punjab & Haryana)	Butani (1973)
Maconellicoccus (=*Phenacoccus*) *hirsutus* (Green)	Pseudococcidae	Egypt India (Karnataka)	Hall (1926), Present record
Nipaecoccus viridis (Newstead) (=*N.filamentosus* Ckll.)	"	Jordan India (Gujarat) India (Karnataka)	Meyerdirk *et al.* (1988) Shah *et al.* (1981) Present record
Planococcus citri (Risso)	"	India (Karnataka)	Present record
P.lilacinus (Ckll.)	"	" "	Tandon and Verghese (1987), Present record
Pseudococcus sp.	"	U.K.	Barnes (1935)
P.hibisci	"	Egypt	Hall (1921)

Table 2. Natural enemies of mealybugs on ber around Bangalore during 1990-91

Mealybug species	Natural enemy	Family and order
Nipaecoccus viridis	*Anagyrus agraensis* Saraswat (= *A.indicus* Shaffe *et al.*)	Encyrtidae, Hymenoptera
	A. sp. nr. *almoriensis* Shaffee *et al.*	" "
	A. dactylopii (How.)	" "
	A.mirzai Agarwal	" "
	Alamella flava Agarwal	" "
	Gyranusoidea flava Shaffee et al.	" "
	Coccophagus sp.	Aphelinidae, Hymenoptera
	Chartocerus sp.	Signiphoridae
	Caxoxenus perspicax (Knab)	Drosophillidae, Diptera
	Trimmota coccidivora (Felt)	Cecidomyiidae, Diptera
	Spalgis epius Westwood	Lycaenidae, Lepidoptera
Planococcus citri	*Coccidoxenoides perigrinus* (Timberlake)	Encyrtidae, Hymenoptera
	Allotropa sp.	Platygasteridae, Hymenoptera
	Cryptolaemus montrouzieri Muls.	Coccinellidae, Coleoptera
P.lilacinus	*Aprostocetus purpureus* (Cam.)	Eulophidae, Hymenoptera
	S.epius	Lycaenidae, Lepidoptera
Maconellicoccus hirsutus	-	

the field, caused severe damage to the young ber plants in glass houses.

Eight parasitoids and three predators were collected on *N.viridis* (Table 2). Among them, *Anagyrus* spp. and *Spalgis epius* Westwood were widespread and frequently collected. *A.agraensis* Saraswat, *A.almorensis* sp. nr. and *A.mirzai* Agarwal appeared to be new records on *N.viridis* in India whereas, *A.dactylopii* had been reported earlier on *N.viridis* infesting citrus in New Delhi (Subba Rao *et al.*, 1965) though not on ber. Even-though *Gyranusoidea flava* Shaffee *et al.* had been observed on other mealybug species (Hayat, 1986), the present work indicated *N.viridis* as a new additional host for *G.flava*. Yet another encyrtid *Alamella flava* Agarwal had been reported on *N.viridis* infesting guava and coffee (Hayat, 1986; Chacko and Singh, 1980) though not on ber. The presence of *Chartocerus* sp. and *Coccophagus* sp. also confirms the earlier records of Abbasi and Singh(1966). Three hyperparasites, namely *Promuscidea unfaciativentris* Girault (Aphelinidae), *Pachyneuron* sp. (Pteromalidae) and *Aprostocetus purpureus* (Cam.) (Eulophidae) were reared from the primary parasitoids of *N.viridis*.

Caxoxenus perspicax (Kanb), Triommato coccidivora(Felt) and S.epius observed on *N.viridis* are general predators of mealybugs reported on many occasions earlier in India. Two encyrtid parasites, namely *Cerchysius laticeps* Kerrich and *Coccidoctonus terebratus* Hayat *et al.* were also collected from the predators *C.perspicax and T.coccidivora,* respectively.

Table 3. Population of *Nipaecoccus viridis* and its natural enemies on ber following releases of *Cryptolaemus montrouzieri* in 1990

Date	Mealybug population (Mean ± S.D.)	Population of natural enemies (Mean ± S.D.)		
		Anagyrus spp.	*Cryptolaemus montrouzieri*	*Spalgis epius*
16th Aug.	128.5 ± 21.20	5.3 ± 3.14	-	1.4 ± 0.71
1st Sept.	105.3 ± 18.16	14.1 ± 4.62	1.3 ± 0.46	2.1 ± 0.65
15th Sept.	86.3 ± 9.47	18.3 ± 6.12	3.4 ± 1.37	2.9 ± 0.42
1st Oct.	6.8 ± 1.46	9.4 ± 2.75	4.5 ± 2.17	1.8 ± 0.30
14th Oct.	1.2 ± 0.32	6.3 ± 1.36	1.2 ± 0.72	0.9 ± 0.11

S.D. = Standard deviation

Both *Coccidoxenoides perigrinus* (Timberlake) and *C.montrouzieri* observed on *P.citri* infesting ber in the present study were also recorded earlier on *P.citri* infesting citrus, guava, etc., though not ber in India (Krishnamoorthy and Mani, 1988; Mani,1992). Natural enemy fauna on *P.lilacinus* was not very rich, and almost nil on *M.hirsutus* which was found attacked heavily by many parasitoids and predators on grapevine and other crops in India(Mani, 1987). It might be due to the effect of host plant.

Infestation on *N.viridis* was noticed in August at I.I.H.R. farm on 12 year-old trees of the variety Umran. Mean mealybug population was 128.5 prior to the suspension of insecticidal sprays and release of the predator *C.montrouzieri* (Table 3). The activity of the predator was observed throughout the study. Grubs were seen feeding on *N.viridis* 15 days after release and a maximum population of 4.5 grubs per sample was observed 45 days after release. The population of the local natural enemies especially *Anagyrus* spp. started building up attacking *N.viridis* heavily. By the first week of October, the mealybug population declined to very low level and subsequently the pest disappeared in 1991 and 1992. The effectiveness of *C.montrouzieri* against *N.viridis* infesting citrus and *Erythrina glauca* had been reported earlier (Tirumala Rao and David, 1958; Martorell, 1940). In the present study, local natural enemies took heavy toll of the mealybugs, and were also responsible for the suppression of *N.viridis* on ber. Similar reduction of *N.viridis* on coffee in India (Chacko and Singh, 1980) and citrus in Iraq (Abdul - Rasoul,1970) had been reported earlier.

Moderate infestation of *P.citri* was observed only on four out of 32 ber trees in December 1990. The mealybug population ranged from 186 to 263 with a mean of 242.5 per sample. Initial samples revealed the absence of *L.dactylopii* but *C.peregrinus* and *C.montrouzieri* were observed in December. The activity of *L.dactylopii* was seen only a month after the release, and continued upto the end of February 1991 (Table 4). The local parasitoid *C.peregrinus* had emerged in large numbers and a maximum of 40.3 per sample was observed in the second week of February. In the present study, *C.peregrinus* rather than *L.dactylopii* was mainly responsible for the control of *P.citri*. In citrus orchards infested with *P.citri, C.peregrinus* played a major role in checking the mealybug populations (Anonymous, 1992). Recovery of *L.dactylopii* was comparatively low mainly due to the limited distribution of *P.citri* on a very few plants. However, *L.dactylopii* had given excellent control of *P.citri* on citrus (Manjunath, 1985), coffee (Bhaskara Reddy *et al.*, 1988) and guava (Mani, 1992).

Table 4. Population of *Planococcus citri* and its natural enemies on ber following releases of *Leptomastix dactylopii* in 1990-1991

Date	Mealybug population (Mean ± S.D.)	Population of natural enemies (Mean ± S.D.)		
		Leptomastix dactylopii	Coccidoxenoides peregrinus	*Cryptolaemus montrouzieri*
18th Aug.	242.5 ± 36.34	0.0	3.6 ± 2.17	1.2 ± 0.50
1st Sept.	184.3 ± 24.26	0.0	5.9 ± 2.45	2.1 ± 0.85
17th Sept.	168.7 ± 16.64	3.1 ± 1.40	10.3 ± 3.40	1.8 ± 0.74
4th Oct.	147.4 ± 20.17	3.5 ± 3.12	12.7 ± 4.16	0.8 ± 0.05
17th Oct.	82.7 ± 10.54	10.3 ± 2.40	40.2 ± 8.18	1.4 ± 0.42
27th Feb.	6.8 ± 4.92	4.3 ± 1.74	28.3 ± 6.82	0.4 ± 0.24

S.D. = Standard deviation

ACKNOWLEDGEMENTS

The author is thankful to the Director, I.I.H.R., Dr.B. Prasanna Kumar and Dr.R.D.Rawal for providing field facilities. Technical assistance rendered by Mr.G.L.Pattar is gratefully acknowledged.

REFERENCES

ABBASI, Q.A. and SINGH, Y. 1966. Further record of parasites of *Nipaecoccus vastator* Maskell (Homoptera, coccidae) from India. *Indian J.Ent.*, **28**, 408-410.

ABDUL - RASOUL, M.S. 1970. Notes on *Nipaecoccus vastator*(Maskell) (Coccidae), a pest of citrus trees and various plants. *Bull. Iraq Nat. Hist. Mus.*, **4**, 105-106.

ANONYMOUS, 1992. Annual Report of All India Coordinated Research Project on biological control of crop pests and weeds for the year 1991-92, pp.339.

BARNES, H.F. 1935. Some new coccids causing gall (Cecidomyidae). *Bull. ent. Res.*, **26**, 525-530.

BARTLETT, B.R. 1977. Pseudococcidae. In "Introduced parasites and predators of arthropod pests and weeds. A world Review". *USDA Agric. Handbook* No. 480, pp 137-169.

BHASKARA REDDY, K., PRAKASAH, C.B., KUMAR, A.C. and BHAT, P.K. 1988. Colonisation and establishment of *Leptomastix dactylopii* How. on an estate in Uppergiris, Chikmagalur. *J. Coffee Res.*, **8**, 73-77.

BUTANT, D.K. 1973. Insect pests of fruit crops and their control. *Pesticides*, **7**, 33-35.

CHACKO, M.J., BHAT, P.K., ANANDA RAO, L.V., DEEPAK SINGH, M.B., RAMANARAYANAN, E.P. and SREEDHARAN, K. 1978. The use of the lady bird beetle *Cryptolaemus montrouzieri* for the control of coffee mealybugs. *J. Coffee Res.*, **8**, 14-19.

CHACKO, M.J. and SINGH, M.B. 1980. A note on the natural control of *Nipaecoccus viridis* on coffee in India. *J.Coffee Res.*, **10**, 63-64.

EL-HAIDARI, H.S., AZIZ, F.I. and WHAHAB, W.A. 1976. Activity of predators and parasites of the mealybug, *Nipaecoccus vastator* (Maskell) in Iraq. *Yearbook of pl. Prot. Res.*, Iraq for 1974-76, pp. 41-46.

HALL, W.J. 1921. The *Hibiscus* mealybug, *Pseudococcus hibisci* (Hemip.). *Bull. Soc. Ent. d'Egypt* Cairo, **XIV**, 17-29.

HALL, W.J. 1926. The *Hibiscus* mealybug, (*Phenacoccus hirsutus* Green) in Egypt in 1925 with notes on the introduction of *Cryptolaemus montrouzieri* Muls. *Minist. Agric. Egypt. Bull.*, **7**, 15 pp.

HAYAT, M. 1986. Family Encyrtidae. *Oriental insects*, **20**, 67-137.

KRISHNAMOORTHY, A. and MANI, M. 1988. *Coccidoxenoides peregrina*, a new parasitoid of *Planococcus citri* in India. *Curr. Sci.*, **58**, 466.

KRISHNMOORTHY, A and SINGH, S.P. 1987. Biological control of citrus mealybug, *Planococcus citri* with an introduced parasite, *Leptomastix dactylopii* in India. *Entomophaga*, **32**, 143-148.

MANI, M. 1987. A review of the pink mealybug, *Maconellicoccus hirsutus* (Green). *Insect Sci. applic.*, **10**, 157-167.

MANI, M. 1992. Effectiveness of the exotic parasitoid *Leptomastix dectylopii* in the control of *Planococcus citri* in guava orchards. *Insect Sci. applic.* (In press).

MANJUNATH, T.M. 1985. *Leptomastix dactylopii* in India. *Biocont. News Inform.*, 6, 297.

MARTORELL, L.F. 1940. Some notes on forest entomology. *Caribean forester*, 1, 23-24.

MEYERDIRK, D.E., KHASIMUDDIN, S. and BASHIR, M. 1988. Importation, colonisation and establishment of *Anagyrus indicus* (Hym.: Encyrtidae) on *Nipaecoccus viridis* (Hom.: Pesudococcidae) in Jordan. *Entomophaga*, 33, 229-237.

PRUTHI, H.S. and BATRA, H.N. 1960. Some important fruit pests of North West India, *ICAR, Bull.* No.80, 113 pp.

SHAH, A.M., PATEL, C.B., and PATEL, V.J. 1981. Ber, a new host record of mealybug, *Nipaecoccus vastator* (Mask.) in Gujarat. *Indian J. Ent.*, 43, 453-454.

SUBBA RAO, B.R., SANGWAN, H.S., ABBASI, Q.A., SINGH, Y. and KSEERSAGAR, A.M. 1965. New records of hymenopterous parasites of *Nipaecoccus vastator* (Maskell) (Homoptera, Coccidae), a serious pest of citrus spp. from India. *Indian J. Ent.*, 27, 109-110.

TANDON, P.L. and VERGHESE, A. 1987 New insect pests of certain fruit crops *Indian J. Hort.*, 44, 121-122.

TIRUMALA RAO, V. and DAVID, L.A. 1958. The biological control of coccid pest in South India by the use of beetle, *Cryptolaemus montrouzieri* Muls. *Indian J. agric. Sci.*, 28, 545-552.

VARSHNEY, R.K. 1985. Outbreak of giant mealybug, *Drosicha stebbingi* (Green) in West Rajasthan (Hemiptera : Margarodidae). *Curr. Sci.*, 54, 884-885.