Journal of Applied Horticulture, 15(2): 117-119, 2013

Studies on parasitoid complex of mealybug infesting grapes in Maharashtra

U. Amala*, D.S. Yadav and A.M. Bhosale

*Department of Entomology, National Research Centre of Grapes, Solapur Road, P.B. No. 3, Manjri Farm, Pune - 412 307, Maharashtra, India. *E-mail: amala_uday86@yahoo.co.in*

Abstract

Survey was conducted to investigate the parasitoid complex of mealybug infesting grapes in the vineyards during 2012 to 2013. The parasitized mummies of mealybugs were collected and held in the test tubes until the parasitoid emerged out. The emerged parasitoids were identified and preserved. Three encyrtid parasitoids *viz., Coccidoxenoides perminutus* Girault*, Anagyrus dactylopii* Howard*, Leptomastix dactylopii* Howard were found to effect parasitization of the mealybugs. *A. dactylopii* was found specific to pink hibiscus mealybug, *Maconellicoccus hirsutus*. *L. dacylopii* and *C. perminutus* were found parasitizing *Planococcus citri.* Percent parasitization of mealybug by *C. perminutus*, *A. dactylopii and L. dactylopii* was 56.25, 72.72 and 81.81 per cent, respectively during the peak incidence of mealybugs. Mean population of *C. perminutus A. dactylopii* and *L. dactylopii* were 6.3, 5.4 and 5.9 individuals per vine.

Key words: *Maconellicoccus hirsutus,* parasitization*, Leptomastix dactylopii*, Encyrtidae, *Anagyrus dactylopii,* mummies*, Planococcus citri, Coccidoxenoides perminutus*

Introduction

Mealybug is a major sucking insect pest causing serious threat to grapevine cultivation in India. Three different species of mealybug *viz.*, *Maconellicoccus hirsutus* Green, *Planococcus citri* Risso, *Nipheacoccus viridis* (Newstead) are known to cause infestation in grapes. Among these, *M. hirsutus* and *P. citri* cause significant economic damage to grapes (Mani, 1989; Tanwar *et al.,* 2007; Rajendran, 2009). The nymphs and adults of the mealybug sucks the sap from the trunk, cordons, aerial leaves, shoots, nodes, panicles, bunches and even roots. The insect injects its toxic saliva into the plant parts during feeding that result in malformation, crinkling and stunting of infested plant parts (Kairo *et al.,* 2000). The sugary honeydew excreted by the insect invites the growth of black sooty mould thereby affecting the photosynthetic ability of the leaves (Chong *et al.,* 2008). The sooty and sticky bunches harbouring the mealybugs and their white cottony wax masses are unfit for marketing as table grapes (Gonazlez- Goana *et al.,* 2010).

A number of natural enemies are known to attack vine mealybugs throughout the world. Many of the parasitoids are mealybug species specific while most of the predators are generalists. Few fungal pathogens are also known to infect in mealybugs in nature. Natural enemy complex is very rich on vine mealybugs in absence of insecticide sprays. Six parasitoids and seven predators have been associated with *M. hirsutus* in India. The parasitoids are *Anagyrus dactylopii* (Howard), *Allotropa* sp. nr. *japonica* Ashmead, *Gyranusoidea mirzai* (Agarwal), *Alamella flava* Agarwal, *Leptopilinia* sp. and *Chartocerus* sp. nr. *walkeri* Hayat. Among these, *A. dactylopii* were of considerable importance and reported to cause up to 70 % parasitism in nature (Mani *et al.,* 1987). The objective of the study was to investigate the parasitoid complex of mealybug infesting grapes in the vineyards.

Materials and methods

Survey on the natural enemy of mealybug was conducted at two different sites *viz.*, site 1 included experimental vineyards of National Research Centre for Grapes (NRCG), Pune (18° 29′ 41.68″ N, 73° 59′ 15.50 E) and site 2 included Bafna Farm (18° 33′ 7 ″ N, 74° 11′ 48″ E), Maharashtra to detect and quantify the natural enemies of mealybugs in the grapevine ecosystem. The natural enemy population was surveyed at an interval of two months in an area of one hectare plot for a period of one year. In each sampled vineyard, total twenty vines were selected which comprised block of four vines at the center and four each at all corners of the selected plot.

The vines were closely observed for the presence of different mealybug species and parasitized mealybug mummies. Parasitized mummies of mealybugs were randomly collected from the trunk, leaves and cordons. The collected mummies were brought to the laboratory (30 ^{o}C and 60 % RH) and kept in the Borosil glass test tubes plugged with cotton wool. The emerged parasitoids were collected and preserved in glass vials containing 70 % alcohol with proper labels. The percent parasitization was worked out as the ratio of the number of parasitized mealybugs with the total number of mealybugs. The number of adult parasitoids per vine were also recorded. General Linear Model was used to calculate the Analysis of Variance (ANOVA) and the treatment means were compared using Duncan Multiple Range Test (DMRT) at 5% level of significance (SAS, 2011).

Results and discussion

In the vineyards surveyed for the natural enemies, encyrtid parasitoids were recovered. They included *A. dactylopii*, *C. perminutus* and *L. dactylopii*. *A. dactylopii* and *C. perminutus* were found parasitizing the mealybug colonies at both the survey sites. The mean number of *C. perminutus* differed significantly

Table 1. Population (Mean ± SD) of parasitoids per vine recorded during 2012-2013

Survey Sites	*Mean number of C. perminutus per vine*			*Mean number of A. dactylopii per vine*		
	Sep 2012	Dec 2012	Mar 2013	Sep 2012	Dec 2012	Mar 2013
Site 1	1.7±1.06[a]	4.8±1.68[a]	6.3±2.40[a]	2.80±1.47[a]	0.8±0.79[b]	1.0±0.82[b]
Site 2	0.9±0.74[a]	1.1±0.74[b]	2.60±2.01[b]	1.3±0.67[b]	3.40±1.07[a]	5.40±2.63[a]
F value (1,18)	3.84	40.40	13.92	8.54	38.03	25.47
LSD (0.05)	0.0657 (Pr >F)	1.223 (P<0.0001)	2.0833 (Pr >F)	1.0781 (Pr >F)	0.8858 (P<0.0001)	1.8315 (P<0.0001)

Mean followed by same letter do not significantly differ from each other by DMRT (0.05)

Table 2. Per cent parasitization of mealybug recorded during 2012-2013

Survey Sites	Per cent parasitization of mealybug *C. perminutus*			Per cent parasitization of mealybug *A. dactylopii*		
	Sep 2012	Dec 2012	Mar 2013	Sep 2012	Dec 2012	Mar 2013
Site 1	27.27	31.25	56.25	26.67	54.54	66.67
Site 2	14.29	25.00	33.33	28.57	63.63	72.72

between the two survey sites ($F_{(1,18)}$ value = 40.40; P<0.0001). The percent parasitization of mealybug by *C. perminutus* was found maximum during the peak incidence of pink mealybug in grapes with a percent parasitization rate of 56.25 % (Table 2). The rate of parasitization by *A. dactylopii* was found highest (72.72 %) with a significant mean population of 5.40 adults per vine in the absence of ant colonies (P<0.0001).

L. dactylopii was found practically suitable for the biological control program of mealybug in grapes as they showed higher level of parasitization (81.81%) under field conditions (Table 3). Mahfoudhi (2009) reported that percent parasitization of mealybug, *Planococcus sp* by *A. pseudococci, C. peregrinus, L. dactylopii* was 80.3, 4.5 and 3 %, respectively. *L. dactylopii* and *C. perminutus* as predominant parasitoids of cocoa mealybug, *P. minor* have been reported by Francis *et al.* (2012). Biological control of mealybug using parasitoids like *Anagyrus* spp*., L. dactylopii* has been studied by Blumberg and Van Driesche (2001).

A. dactylopii and *L. dactylopii* prefered the third instar and pre-adult stages of mealybugs. The results were in agreement with the findings of Cadee *et al.* (1997). Walton and Pringle (2004) also reported *Anagyru*s sp*., L. dactylopii and C. perminutus* as more frequently recorded natural enemies of *P. ficus* in the vineyards. Biological control of mealybug using these parasitoids was well established by Roltsch *et al.* (2006) who reported that release of parasitoids *Anagyrus kamali* Moursi, *Gyranusoidea indica* Shafee and *Allotropa* sp. nr. *Mecrida* (Walker) over a 5-year period resulted in a progressive decline of mealybug density to noneconomic levels. *Coccidoxenoides peregrinus* in combination with other species of encyrtids was found to be the potential biological control agent of citrus mealybug, *P. citri* in India (Mani, 1994).

C. perminutus was also recovered from the parasitized mummies of spherical mealybug, *Nipheacoccus viridis* infesting grapes and cotton mealybug, *Phenacoccus solenopsis* infesting *Hibiscus rosa-sinensis* in the vicinity of the vineyards. *Anagyrus* species near *pseudococci* (Girault) and *Coccidoxenoides perminutus* (Timberlake) (Hymenoptera: Encyrtidae) are tiny solitary koinobiont endoparasitoids of the vine mealybug, *Planococcus ficus* (Signoret) (Hemiptera: Pseudococcidae) (Islam and Copland, 1997). *C. peregrinus,* a new parasitoid of *P. citri,* was reported by Krishnamoorthy and Mani (1988). Hence the ecological host range of the parasitoid includes *M. hirsutus*, *N. viridis* and *P. solenopsis*. The identified parasitoids are well documented against

Table 3. Parasitoid, *L. dactylopii* associated with mealybug, *Planococcus citri* in grapes

Location	Date of Observation	*Leptomastix dactylopii*	
		Mean number per plant	Parasitization (%)
Site 2	Oct 2012	1.10±0.74	60.00
	Jan 2012	2.18±1.32	75.00
	Mar 2013	5.9±0.87	81.81

mealybugs and commercial formulations are available in India for augmenting their population under vineyards so as to maintain balance between pest natural enemy population (Rahiman *et al.,* 2010; Smith, 1991). The ubiquity in the occurrence of parasitoids is a positive signal to develop biological control measures against mealybug in the vineyards. The role of native parasitoids in the suppression of mealybug in coffee has been reported by Reddy *et al.* (1990).

The occurrence of parasitoids in fairly good numbers might be due to the good viticulture practices that favored the survival and multiplication of the beneficial insects in the vineyards. The higher population of the parasitoids was noticed in the plots with comparatively higher mealybug incidence during the previous years. The persistence nature of the parasitoids in the vineyards is an important factor to provide sustainable control of mealybug populations. Reduced use of insecticides might be the pre-disposing factor that resulted in the maximum impact of the parasitoids over the mealybugs. The vineyards served as a place of self-multiplication of the natural enemies over the hosts thereby providing consistent control of mealybugs. Mealy bug can be controlled by the parasitoids to some extent in sustainable pest management programs. Hence there is need to conserve these parasitoids in the native environment.

Acknowledgement

We gratefully thank Dr. S. Manickavasagam, Professor, Department of Entomology, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India for the identification of *Anagyrus dactylopii*.

References

Blumberg, D. and R.G. Van Driesche, 2001. Encapsulation rates of three encyrtid parasitoids by three mealybug species (Homoptera: Pseudococcidae) found commonly as pests in commercial greenhouses. *Biol. Cont.,* 22: 191-199.

Cadee, N., J.M. Jacques and V. Alphen, 1997. Host selection and sex allocation in *Leptomastidea abnormis*, a parasitoid of the citrus mealybug, *Planococcus citri*. *Entomol. Exp. Appl.,* 83(3): 277-284.

Chong, J.H., A.L. Roda and C.M. Mannion, 2008. Life history of the mealybug, *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae), at constant temperatures. *Environ. Entomol.,* 37(2): 323-332.

Francis, W.A., T.K. Moses, A. Kairo, L.A. Roda, E.O. Liburd and P. Polar, 2012. The passion vine mealybug, *Planococcus minor* (Maskell) (Hemiptera: Pseudococcidae) and its natural enemies in the cocoa agro - ecosystem in Trinidad. *Biol. Cont.,* 60: 290-296.

Gonzalez- Gaona, E., G.S. Martinez, A. Zhang, J.L. Gutierrez and F.C. Sosa, 2010. Validation of two pheromonal compounds for monitoring pink hibiscus mealybug in Mexico. *Agrociencia,* 44(1): 65-73.

Islam, K.S. and M.J.W. Copland, 1997. Host preference and progeny sex ratio in asolitary koinobiont mealybug endoparasitoids, *Anagyrus pseudococci* (Girault) inresponse to its host stage. *Biocontrol Sci. Technol.,* 7: 449-56.

Kairo, M.T.K., G.V. Pollard, D.D. Peterkin and V.F. Lopez, 2000. Biological control of the hibiscus mealybug, *Maconellicoccus hirsutus* Green (Hemiptera: Pseudococcidae) in the Caribbean. *Integ. Pest. Mgt. Rev.*, 5: 241-254.

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

Mahfoudhi, N. 2009. Survey of mealybugs (Hemiptera: Pseudococcidae) and their natural enemies in Tunisian vineyards. *African Entomol.,* 1: 154-160

Mani, M. and T.S. Thontadarya, 1987. Population dynamics of the mealybug *Maconellicoccus hirsutus* (Green) and its natural enemies in the grapevine ecosystem. *J. Biol. Cont.,* 1: 93-97.

Mani, M. 1989. A review of the pink mealybug - *Maconellicoccus hirsutus* (Green). *Insect Sci. Appl.,* 10(2): 157-167.

Mani, M. 1994. Recovery for the indigenous *Coccidoxenoides peregrinus* and exotic *Leptomastix dactylopii* on *Planococcus citri* in lemon and acid lime orchards. *Biocont. Sci. Technol.*, 4: 49-52.

Rahiman, P.A., R.N. Prakash and C.K. Vijayalakshmi, 2010. Field evaluation of coffee mealy bug parasitoid, *Leptomastix dactylopii* (How.) in Wayanad district of Kerala, India. *Gregor Mendel Foundation Journal*, 1: 62-67.

Rajendran, T.P. 2009. Integrated pest management-Policy directions in the context of climate change. *Proc. Nat. Symp. IPM Strategies to Combat Emerging Pests in the Current Scenario of Climate Change*. (V.V. Ramamurthy, G.P. Gupta and S.N. Puri (eds), Pasighat, Arunachal Pradesh, 28-30 January, 2009, p 8-13.

Reddy, K.B., K. Sreedharan, C.B. Prakasan and P. K. Bhat, 1990. Role of indigenous natural enemies in the integrated management of sucking pests of coffee. *J. Plt. Crops.,* 20 (Supplement): 115-122.

Roltsch, B.J., D.E. Meyerdirk and R. Warkentin, 2006. Classical biological control of the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green), in southern California. *Biological Cont.,* 37: 155-66.

SAS Institute, 2011. PROC user' manual, version 9.3 ed. 2011, SAS Institute Cary, NC.

Smith, D. 1991. The use of *Leptomastix dactylopii* Howard (Hymenoptera: Encyrtidae) to control *Planococcus citri* (Risso) (Hemiptera: Pseudococcidae) in custard apples in Queensland. *General Appl. Entomol.,* 23: 3-8.

Tanwar, R.K., P. Jeyakumar and D. Monga, 2007. Mealybugs and Their Management. National Centre for Integrated Pest Management, New Delhi.

Walton, V.M. and K.L. Pringle, 2004. A survey of mealybugs and associated natural enemies in vineyards in the western Cape Province, South Africa. *S. Afr. J. Enol. Viticult.,* 25: 23-25.

Received: May, 2013; Revised: May, 2013; Accepted: May, 2013