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BIO-ECOLOGY AND MANAGEMENT OF ARECANUT SCALE, *PARASAISSETIA NIGRA* (NEITNER) AND MEALYBUG, *DYSMICOCCUS BREVIPES* (COCKERELL)

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ABSTRACT

Populations of *P. nigra* and *D. brevipes* were higher during summer (March-May, 2002). However, the populations of both the pest species remained low during the rainy and winter season (July-December). Similar trend was noticed with their natural enemies *viz.*, *Anagyrus sp.*, *Cryptolaemus montrouzieri* (Mulsant) and *Scymnus sp.* The fecundity of both *P. nigra* and *D. brevipes* was high during summer months with a maximum of 183.24 ± 37.52 and 136.20± 28.09 no./female, respectively. *Parasaissetia nigra* reproduced parthenogenetically; there being no males, with a total life cycle of 75.24 days. *Dysmicoccus brevipes* had three nymphal instars in female, while, the males had three nymphal and one pupal instar. *Oecophylla smaragdina* Smith was the major ant species associated with *P. nigra* and *D. brevipes* on arecanut. Among the different insecticides and plant products tested against P. nigra and D. brevipes, neem oil at 3 per cent was effective upto 21 days (5.23no./ nut), as compared to standard check chlorpyriphos (10.53 no./nut). From the study it was clear that neem oil is a suitable substitute in controlling *P. nigra.* Similarly, neem oil at 3 per cent significantly reduced the population of *D. brevipes* (1.07 no./nut) which is at par with pongamia oil at 3 per cent (1.13 no./nut) when compared to untreated check (4.53 no./nut).

Key words: Arecanut, Bioecology, Management, Mealybugs, Scales.

INTRODUCTION

Arecanut (*Areca catechu* L.) is an important cash crop in India. The economic produce is the fruit called 'betel nut' and is used in several socio religious ceremonies in India. Its cultivation is concentrated in southwestern and northeastern regions (upto an elevation of 1000 MSL) of the country. In India, arecanut is mainly grown in Karnataka, Kerala, Assam and West Bengal in an area of 1.74 lakh hectares with a production of 2.33 lakh tones. In recent years the area is also extended to Tamil Nadu, Maharastra and Andhra Pradesh. More than 10 million people are depending on this crop for their livelihood In Karnataka state, Shimoga, Dakshina Kannada, Davangere, Tumkur, Chickmagalur and Uttara Kannada are the important districts where arecanut is extensively grown. These districts nearly comprise 81.20 per cent of the total area and 83.28 per cent of the total production of arecanut in the state (Anand *et al.*, 2012; Nair and Menon, 1963).

Arecanut palm is infested by more than 90 species of insect and non insect pests. While the pest attack on fruits and inflorescence causes direct crop losses, attack on vegetative parts like leaves, stem and roots causes indirect crop loss. Of the many insect pests, the attack by root grubs (*Leucopholis* lepidophora B). (Scarabaeidae: Coleoptera), spindle bug, inflorescence caterpillars and mites were seen to be more prominent on arecanut (Nair and Menon, 1963; Shivanna *et al.*, 2011). Among lesser known insect species of arecanut includes the coccids (scales and mealybugs), which occupy an important place with possibilities of becoming potential the major pests. In the early stage of the crop, scales and mealybugs suck sap from leaves thereby inhibiting the growth and in the later stage they interfere with pollination and photosynthesis thereby severely affecting the yield of arecanut.

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Indiscriminate use of synthetic chemical insecticides in management of the scales and mealybugs has resulted in increased residual accumulation, particularly on nuts (Hussain, 1996; Jalaluddin., 1991). In recent past, plant products are gaining importance in the management of scales and mealybugs. To develop suitable control strategies for the management of scales and mealybugs on arecanut palm, detailed information on the seasonal incidence, life history parameters, association of ants and use of plant products in combating their problem is necessary. Hence, the present investigation was carried out to study bio-ecology and management of arecanut scale, *Parasaissetia nigra* (Neitner) and mealybug, *Dysmicoccus brevipes* (Cockerell)

MATERIALS AND METHODS

The present study encompasses four major areas such as , i) seasonal abundance of *Parasaissetia nigra* (Neitner) and *Dysmicoccus brevipes (*Cockerell) and their natural enemies ii) biology of arecanut scale, *P. nigra* and mealybug, *D. brevipes* iii) enumeration of ants associated with arecanut scale and mealybug and iv) evaluation of selected plant products and synthetic insecticides. Field studies were carried out in two arecanut gardens located at Abbalagere and Harakere village, near Zonal Research Station, Shimoga, during 2002. Laboratory studies were conducted at Department of Entomology, GKVK, Bangalore. Observations on seasonal incidence of *P.nigra* and *D. brevipes* were recorded at fortnightly interval for a period of one year. Bio-efficacy of selected insecticides and botanicals were tested against scales and mealy bugs. The treatments which are replicated thrice are as follows: 1)Monocrotophos (0.04%), 2) Dimethoate (0.03%), 3) Methyl parathion (0.05%), 4) Chloropyriphos (0.04%), 5) Neem oil (3%), 6) Pongamia oil (3%), 7) Mahua oil (3%), 8) Neemazal and 9) Untreated check control. Ten plants were randomly selected in each plot by tying with labels. A day before spraying i.e. Pretreatment count (PTC), 7 days, 14 days and 21 days after spraying/ treatment, observations on number of scales and mealy bug were recorded on selected plants. The efficacy was computed as reduction in number of scales and mealbugs as compared to untreated check control. The data on the mean of three replications were considered for statistical analysis and they were analyzed statistically (DMRT).

RESULTS AND DISCUSSION

Investigations on the seasonal incidence and biology of arecanut coccids *viz.*, arecanut scale, *Parasaissetia nigra* (Neitner) and mealybug, *Dysmicoccus brevipes* (Cockerell) which have been becoming serious pests of arecanut in major arecanut growing regions of Karnataka. In recent past, the studies on efficacy of some selected plant products and synthetic insecticides against these pest species were made during 2002-2003 in two separate arecanut gardens located at Abbalagere and Harakere, ZRS, Shimoga and laboratory experiments were carried out at Department of Agricultural Entomology, College of Agriculture, University of Agricultural Sciences, GKVK, Bangalore.

Studies on the seasonal incidence of arecanut scale, *P. nigra*, mealybug, D. *brevipes* and their natural enemies revealed the higher population of both *P. nigra* and *D. brevipes* during the period of December – July, 2002 and the peak was noticed during March- May. This could be attributed to higher temperature prevailing during this period which helped in faster multiplication of scale and mealybug (Table.1). Further, it is evident from the correlation studies that the maximum temperature was positively correlated with scale and mealybug populations. However, the population of both the pest species remained low in the rainy and following winter season (July- December) due to adverse effect

TABLE 1: Scales and mealybugs recorded on arecanut.

Species	Family	Status	Abundant on
Scales			
Parasaissetia nigra Niter	Coccidae	Major	Nuts and infloresence
Cerplastes rubens Maskell	Coccidae	Minor	Leaves, rarely on nuts and inflorescence
Aonidiella orientalis (Newstead)	Diaspididae	Minor	Nuts
Icerya aegyptiaca Douglas	Margarodidae	Minor	Nuts and infloresence
Mealy bugs			
Dysmicoccus brevipes Cockrell	Pseudococcidae	Major	Nuts, rarely on leaves and inflorescence

of low temperature on their multiplication. Similar trend was noticed with their natural enemies *viz.*, parasitoid *Anagyrus* sp., predators like, *Cryptolaemus montrouzieri* and *Scymnus* sp. where their activity was high during April and May as their multiplication was favoured by higher temperature and greater availability of mealybug population during that period. Similarly the population of helmet scale, *Saissetia caffeae* (Walker) showed a positive correlation with maximum temperature (Chatterjee *et al.*, 2000). However, it was also reported to exhibit a negative relationship with temperature, rainfall, sunshine and positive relationship with relative humidity (Anonymous., 1987).

P. nigra was found to reproduce parthenogenetically; there being no males. *P. nigra* infesting arecanut had an incubation period of 6.44 days. Egg was light yellow in color, oval in shape measuring 0.3 mm length and 0.15 mm breadth. Crawlers crawl around mother's body in search of suitable place for feeding. *Parasaissetia nigra* had two nymphal instars; first and second lasting for 7.64 and 19.44 days, respectively. Adult female was dark black in color. Adult female lived for fairly longer period of 42.12 days with a range of 38-45 days. Adult female measures 5.00mm length and 3.00mm breadth. Total life cycle of *P. nigra* lasted for 75.24 days with a range of 67-83 days.

The scales remained low during rainy days and the following winter months. The low population might be due to slow rate of multiplication at low temperature. The present findings agree with the earlier report from Darjeeling, the population of *S. caffeae* was less during rainy days (Chatterjee *et al.*, 2000). The relative humidity also had a negative relationship and this justified the present findings. Only one species of parasite and two species of predators were observed on *P. nigra* during the present study. Of the reported natural enemies, *Aphytis* sp. and *Chilocorus nigrita* are the most important. Population of *Aphytis* increased with increase in the population of *P. nigra* and this is in agreement with the findings of Krishnamoorthy (1993). This could be due to the availability of ample density of host for their multiplication and also the increased temperature in summer months might have influenced its reproduction (Krishnamoorthy, 1993; Ghose, 1972). The population of *Aphytis sp.* was positively correlated with temperature and *P. nigra* population. This agrees with the findings of Chatterjee *et al.* (2000), Jalaluddin *et al.*, (1992) and Marin and Cisneros (1979), reported that, the per cent parasitization of *Saissetia* sp. was maximum during January (32%) and July (30%). *Aphytis* population was negatively correlated with relative humidity. Population of *Chilocorus nigritus* had significant positive correlation with maximum temperature. The population increased with scale population and it was positively correlated with the population of *P. nigra*. These findings are in accordance with the results of Krishnamoorthy (1993) and Jalaluddin (1986). Although, the populations of *Aphytis* sp. and *Chilocorus nigritus* had positive correlation with the scale population, their density was not sufficient enough to bring down the scale population that increased with temperature. Biology of *Dysmicoccus brevipes* revealed that there were three nymphal instars in female. Whereas, the males had three nymphal and one pupal instars. Number of young ones produced by a female ranged from 37 to 89. The total life cycle for male and female reared on coconut leaflets occupied 24.88± 2.2l and 25.38± 0.95 days, respectively. However, slight variation in the total life cycle of male and female (25.63 and 25.83 days, respectively) was observed when reared on pumpkin. Four species of ants *viz.*, *Oecophylla smaragdina* Smith, *Camponotus compressus* (Fab.), *Camponotus sericius* (Fab.) and *Monomorium floricola* Jerdon were attending on the aphids and scale, *P. nigra* on arecanut. Among them, *O. smaragdina* appeared to be the major one which influenced the scale population and also makes harvesting of nuts difficult. Association of ants with arecanut mealybug, *D, brevipes* was also studied. Totally, five species of ants *O. smaragdina*, *C. compressus*, *C. sericius*, *C. refuglaucus* and *Solenopsis geminata* Fab. were found to be associated with arecanut mealybug. Similarly, as observed in case of ants associated with *P. nigra*, here also *O. smaragdina* was predominant species influencing the mealybug population.

In the present study the females of *P. nigra* produced maximum number of eggs during summer months which reached its peak (183.24 ± 37.52) during the second fortnight of May, 2002

at which the maximum temperature was 34.74^{0}C as compared to the lowest of 56.12 ± 21.08 during second fortnight of September 2001 wherein the maximum temperature was 31.6^{0}C indicating that fecundity of arecanut scale was positively related with temperature. Similar trend was also noticed with arecanut mealybug where the fecundity was highest (136.20 ± 28.09/female) during the second fortnight of April, 2002 and lowest (66.28 ± 11.64/female) during second fortnight of June, 2002.

Results on efficacy of some selected insecticides against arecanut scale and mealybug were presented in Table 2 and 3 were significant, indicating differential efficacy of the treatments imposed. Among the different insecticides tested, neem oil at 3 per cent was effective upto 21 (5.23/ nut) days, as compared to standard check chloropyriphos (l0.53/nut) and untreated control (15.36/nut) (Table 2). Similarly, as noticed with scale population the neem oil at 3 per cent had significantly reduced the arecanut mealybug population (1.07/ nut) which is statistically on par with pongamia oil at three per cent (1. 13/nut) as against untreated control (4.53/nut) (Table. 3). The reduction in scales and mealybugs was due to the efficacy of neem oil and pongamia oil. These results are in confirmation with the results reported earlier by Nair and Menon (1963), Hussain, (1996) and Daniel (2003). From the study it is clear that neem oil can be a substitute for other synthetic insecticides in controlling arecanut scale and mealybug as it is eco-friendly.

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TABLE 2: Efficacy of selected synthetic insecticides and botanicals on arecanut scale.

Treatments	No. of scales/nut			
	PTC	7 DAT	14 DAT	21 DAT
Monocrotophos 0.04%	14.93	8.77^b	9.77^c	10.67^c
Dimethoate 0.03%	14.80	8.07^a	5.77^a	8.37^b
Methyl parathion 0.05%	14.87	8.10^a	8.13^b	8.73^b
Chloropyriphos 0.04%	14.87	8.77^b	9.63^c	10.53^c
Neem oil 3%	14.83	11.00^c	5.37^a	5.23^a
Pongamia oil 3%	14.80	11.60^d	8.37^b	8.80^b
Mahua oil 3%	14.83	12.27^e	8.27^b	8.73^b
Neemazal	14.80	13.13^f	8.30^b	8.73^b
Control Untreated check	14.90	15.30^g	15.40^d	15.36^d
F-Test	NS	*	*	*

Note: Means followed by the same letter in a column are not statistically significant at 5 percent level by DMRT: * Siginificant: PTC: Pretreatment count, DAT: Days after treatment; NS: Non-significant.

TABLE 3:Efficacy of selected synthetic insecticides and botanicals on arecanut mealybug, *Dysmicoccus brevipes* (Cockerel).

Treatments	No. of mealybugs/nut			
	PTC	7 DAT	14 DAT	21 DAT
Monocrotophos 0.04%	5.23	3.27^a	4.47^{bc}	5.03^b
Dimethoate 0.03%	5	3.73^b	2.9^a	4.57^b
Methyl parathion 0.05%	5.2	3.93^{bc}	4.77^{cd}	5.13^b
Chloropyriphos 0.04%	4.87	3.3^a	4.23^b	4.93^b
Neem oil 3%	4.97	3.97^{bc}	2.97^a	1.07^a
Pongamia oil 3%	4.97	4.03^c	5.03^d	1.13^a
Mahua oil 3%	4.93	4.17^c	4.77^{cd}	5.13^b
Neemazal	5	4.47^d	4.83^{cd}	5.17^b
Control Untreated check	5.17	4.73^d	4.9^d	4.53^b
F-Test	NS	*	*	*

Note: Means followed by the same letter in a column are not statistically significant at 5 percent level by DMRT: * Siginificant: PTC: Pretreatment count, DAT: Days after treatment; NS: Non-significant.

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