Indian Journal of Entomology 85(2): 476-479 (2023) DoI. No.: 10.55446/IJE.2021.381

EFFICACY OF BOTANICAL FORMULATIONS AGAINST COCONUT RHINOCEROS BEETLE *ORYCTES RHINOCEROS*

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ABSTRACT

Field efficacy of botanical cakes and insecticides when evaluated in coconut against the rhinoceros beetle *Oryctes rhiniceros* L., revealed that leaf damage reduced to 9.5% with botanical cake and paste. Palms treated with chlorantraniliprole 0.4% GR (10.5%) and neem cake admixed with sand (11.5%) were also effective compared to control (40.0%) at 30 months after treatment (MAT). The leaf damage was significantly low (14.2%) in chlorantraniliprole 0.4%GR treated palms, and the next best was botanical cake and paste (15.2%). The palms treated with the botanical cake and paste revealed the least spear leaf damage of 15.0%, compared to that of chlorantraniliprole 0.4% GR (18.5%) and naphthalene balls (20.0%). The overall mean spear leaf damage was significantly lower in chlorantraniliprole 0.4% GR treated palms (40.4%) followed by palms treated with naphthalene balls (42.9%) and botanical cake and paste (44.4%) compared to control (78.9%).

Key words: *Oryctes rhinoceros*, coconut, botanical formulations, juvenile palms, leaf damage, spear leaf, chlorantraniliprole, botanical cake and paste, weed extracts

Coconut (*Cocos nucifera* L.) is one of the major plantation crops in India. Among the various insect pests causing damage to coconut, rhinoceros beetle (*Oryctes rhinoceros* L.) is a serious pest in South East Asia (Bedford, 1980). It causes serious damage in juvenile coconut palms in the age group of one to six years. The adults upon emergence go in search of crown region of juvenile palms during night for feeding, remaining in the breeding sites during day time. The adult beetle also causes injury to the juvenile palms by boring into the spear leaf, spathe and young petioles and eating away the growing spindle leads to the 40-45% failure in the seedling establishment (Josephrajkumar et al., 2015). Damaged spear leaf is prone to breakage and drying up and exhibit 'V' shaped cuts on the leaf lamina when unfurls. Repeated attacks results in stunted growth or mortality of the juvenile palms (Hinckley, 1966; Chandrika et al., 2018). Of late, the pest was found boring into the immature tender nuts causing yet another route of feeding when the spear leaf is protected (Josephrajkumar et al., 2019; Chandrika et al., 2018). In majority of the cases, rhinoceros beetle attack leads to infestation by red palm weevil, fungal infections, etc. (Sharadraj and Chandramohanan, 2013; Josephrajkumar et al., 2015) causing death of the juvenile coconut palms (Molet, 2013).

This pest could be kept under check by using varied options including cultural, mechanical, biological and chemical control measures. Recently, ICAR-Central Plantation Crops Research Institute (ICAR-CPCRI), Regional Station, Kayamkulam, Kerala developed a botanical cake and paste using hexane and methanolic extracts from weed plants (*Clerodendrum infortunatum* L. and *Chromolaena odorata* (L.) to safeguard juvenile palms from rhinoceros beetle attack (CPCRI, 2016). Earlier studies on management of rhinoceros beetle using biorationals revealed that application of oil cakes of neem (*Azadirachta indica* A Juss.) or marotti (*Hydnocarpus wightiana* Bl.) in powder form @ 250 g mixed with equal volume of sand, thrice a year during May, September and December to the base of three leaf axils surrounding spear leaf is an effective prophylactic method against rhinoceros beetle and red palm weevil (Chandrika et al., 2001). Placement of botanical cake

developed by ICAR-CPCRI @ 10 g was found effective during monsoon phase (Josephrajkumar et al., 2015). The botanical cake and paste formulated from botanicals is easy to handle and apply, ecofriendly and compatible with other IPM methods. With this background the present study was carried out to evalaute the field efficacy of CPCRI-botanical cake and paste against the rhinoceros beetle infesting juvenile coconut palms.

MATERIALS AND METHODS

The botanical cake and paste were developed at the ICAR-Central Plantation Crops Research Institute, Regional Station, Kayamkulam. The botanical cake was prepared using 10% hexane and methanolic extract of *C. infortunatum* L. and *C. odorata* (L.) and incorporated in the soap making process and moulded as a tablet. The paste was prepared using white grease and added with 10% cashew nut shell liquid and botanical extract of *C. infortunatum* and *C. odorata* made in a paste form. To evaluate the field efficacy of botanical cake and paste in juvenile coconut palms a trial was laid out in a farmer's field located in Angalakurichi village (10°29'26.5"N 76°59'01.8"E) of Anaimalai block, Coimbatore district, Tamil Nadu during 2016 to 2019 . The experimental field comprised Dwarf x Tall (GBDG x WCT) coconut hybrid that are six years old juvenile palms and have started bearing. The treatment details are: T_1: Botanical cake @ 10 g applied three times once in four months (February, June & October) + botanical paste @ 15 g/ palm applied three times once in four months (April, August & December), T_2: Neem cake + sand @ 150 g/ palm to be filled in the inner most leaf axils - once in four months (February, June & October), T_3: Placement of naphthalene balls in the inner most leaf axils @ 12 g/ palm - once in two months (February, April, June, August, October & December), T_4: Placement of chlorantraniliprole 0.4% GR @ 6 g per palm (in perforated sachets) in the inner most leaf axils - once in 4 months (February, June & October) and T_5: Control. The experiment was laid out in RBD design, with four replications and 20 palms/ treatment. The observations on rhinoceros beetle incidence in terms of leaf damage (No. of infested leaf x100/ total number of leaf) and spear leaf damage (Infested spear leaf x100/ total number of spear leaf) were recorded one day before the treatment. The post-treatment observations were recorded during March, June, September and December, every year. The experiment was conducted for two and half years. The data were analyzed using AGRES statistical package and mean data were compared using Least Significant Difference (LSD).

RESULTS AND DISCUSSION

There were no significant differences among the treatments at three months after treatment (MAT). The palms treated with chlorantraniliprole 0.4% GR registered the least leaf damage of 16.6%, followed by botanical cake and paste (17.1%) when compared to control palms (27.3%) at six MAT. The palms treated with botanical cake and paste recorded significantly lowest leaf damage of 9.50%, followed by chlorantraniliprole 0.4% GR (10.5%) and neem cake and sand-treated palms (11.5%) as compared to control palms (40.0%) at 30 MAT.

With regard to spear leaf damage, there was no significant difference among the treatments at three to twelve MAT. However, palms treated with chlorantraniliprole 0.4% GR and naphthalene balls registered least spear leaf damage of 50.0% and 55.0% respectively, as compared to 75.0% spear leaf damage in control palms at six MAT. At 30 MAT, a gradual and significant damage reduction was observed in all the treatments. The palms treated with botanical cake and paste recorded least damage of 15.0%, followed by chlorantraniliprole 0.4% GR (18.5%) and naphthalene balls-treated palms (20.0%) at 30 MAT. The overall means indicated that leaf damage and spear leaf damage was significantly lowest in palms treated with chlorantraniliprole 0.4% GR followed by botanical cake and paste treated palms compared to control palms (Table 1).

In a similar study, application of naphthalene balls @ 12 g/ palm in the leaf axil at the base of spear leaf safeguarded the juvenile coconut palms against rhinoceros beetle in Malaysia (Singh, 1987) and India (Sadakathulla and Ramachandran, 1990). Chandrika et al. (2001) reported that the application of neem cake in powder form @ 250 g admixed with equal volume of sand, thrice a year on the top most three leaf axils of coconut palm is an effective prophylactic method. Srinivasan and Shoba (2017), Josephrajkumar et al. (2012) and Wankhede at al. (2020) also reported that palms treated with chlorantraniliprole 0.4% GR, ICAR-CPCRI botanical cake @ 10g/ palm + paste @ 15 gram/ palm followed by naphthalene balls @12g/ palm are effective in different coconut growing belts. Thus, the present results agree with those of previous studies. Among the biorationals, palms-treated with ICAR-CPCRI botanical cake @ 10g/ palm + paste 15 g/ palm followed by naphthalene balls @12g/ palm are found effective. Thus, it is an ecofriendly alternative for

Table 1. Efficacy of botanical cake and paste for the management of rhinoceros beetle in coconut

Treatments	Leaf damage (%)											Mean
	Oct. 2016 (PTC)	Dec 2016 (3 MAT)	March 2017 (6 MAT)	June 2017 (9 MAT)	Sept. 2017 (12 MAT)	Dec. 2017 (15 MAT)	March 2018 (18 MAT)	June 2018 (21 MAT)	Sept. 2018 (24 MAT)	Dec. 2018 (27 MAT)	March 2019 (30 MAT)	
T_1 - Botanical cake @ 10g + paste @ 15g / palm	21.5 (27.6)	19.5 (26.2)	17.1 (24.1)	15.2 (22.9)	17.3 (24.6)	16.8 (24.2)	14.9 (27.6)	13.7 (21.7)	11.5 (19.8)	10.5 (18.9)	9.5 (18.0)	15.2 (23.0)
T_2- Neem cake+ sand @150 g / palm	20.3 (26.8)	19.6 (26.3)	18.7 (25.6)	17.3 (24.6)	18.5 (25.5)	17.9 (25.0)	16.7 (26.8)	15.5 (23.1)	13.4 (21.4)	13.1 (21.2)	11.5 (19.8)	16.6 (24.0)
T_3 -Naphthalene balls @12 g/palm	23.60 (29.1)	20.6 (27.0)	18.5 (25.5)	15.9 (23.5)	15.8 (23.4)	14.50 (22.4)	16.2 (29.1)	16.0 (23.6)	15.3 (23.0)	13.8 (21.8)	12.00 (20.3)	16.6 (24.0)
T_4 -Chlorantraniliprole 0.4% GR @ 6g/ palm	25.4 (30.3)	20.5 (26.9)	16.6 (24.0)	12.2 (20.4)	15.6 (23.3)	12.4 (20.6)	11.1 (30.3)	11.0 (19.4)	10.5 (18.9)	10.5 (18.9)	10.5 (18.9)	14.2 (22.1)
T_5 - Control	24.9 (30.0)	26.7 (31.1)	27.3 (31.5)	30.9 (33.8)	30.2 (33.3)	29.6 (33.6)	30.4 (30.0)	32.1 (34.5)	35.8 (36.8)	38.5 (38.4)	40.0 (39.3)	31.5 (34.1)
CD (p=0.05)	NS	NS	4.7	6.13	4.26	5.91	4.34	1.6	1.8	1.4	1.3	2.0
S.Ed.	0.7	0.9	1.2	2.1	1.7	1.9	2.1	0.7	0.8	0.6	0.6	4.4
Treatments	Spear leaf damage (%)											Mean
T_1 - Botanical cake @ 10g + paste @ 15g/ palm	85.0 (67.2)	75.0 (60.0)	70.0 (56.8)	70.0 (56.8)	45.0 (42.1)	30.0 (33.2)	25.0 (30.0)	25.7 (30.5)	20.5 (26.9)	20.2 (26.7)	15.0 (22.8)	44.4 (41.4)
T_2 - Neem cake+ sand @150 g/ palm	85.0 (67.2)	75.0 (60.0)	75.0 (60.0)	75.0 (60.0)	40.0 (39.2)	40.0 (39.2)	35.0 (36.3)	35.0 (36.2)	33.5 (35.3)	30.5 (33.5)	25.5 (30.3)	49.1 (45.0)
T_3 -Naphthalene balls @12 g/ palm	70.0 (56.8)	60.0 (50.8)	55.0 (47.9)	55.0 (47.9)	40.0 (39.20	45.0 (42.1)	30.0 (33.20)	30.0 (33.2)	28.7 (32.1)	20.7 (27.1)	20.0 (26.6)	42.9 (40.0)
T_4 -Chlorantraniliprole 0.4% GR @ 6g/ palm	75.0 (60.0)	60.0 (50.8)	50.0 (45.0)	50.0 (45.0)	35.0 (36.3)	40.0 (39.20)	30.0 (33.2)	25.0 (29.9)	23.5 (28.9)	20.2 (26.7)	18.5 (25.6)	40.4 (38.5)
T_5 - Control	70.0 (56.80)	75.0 (60.0)	75.0 (60.0)	75.0 (60.0)	70.0 (56.8)	75.0 (60.0)	80.0 (63.4)	80.0 (63.5)	82.6 (65.4)	85.5 (67.7)	90.0 (71.6)	78.9 (62.1)
CD (p=0.05)	NS	NS	4.7	NS	NS	21.8	21.2	2.7	1.6	1.7	1.5	2.6
S.Ed.	2.1	2.3	3.3	3.3	3.9	4.8	6.4	1.2	3.5	3.7	3.1	1.2

Figures in parentheses arcsine transformed values; MAT: Month After Treatment

the prophylactic management of the rhinoceros beetle in juvenile coconut palms.

ACKNOWLEDGEMENTS

The authors acknowledge the financial assistance given by the Indian Council of Agricultural Research for undertaking the project under ICAR-AICRP on Palms.

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(Manuscript Received: October, 2021; Revised: December, 2021;
Accepted: December, 2021; Online Published: April, 2022)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e21213