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Efficacy of Bio-rational insecticides against Perilla leaf moth on sweet basil (*Ocimum basilicum*)

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ABSTRACT

The present study was carried out during *kharif* 2016–18 at Agronomy Farm, Rajasthan College of Agriculture, MPUAT, Udaipur. The Perilla leaf moth, *Pyrausta panopealis* Walker (Lepidoptera: Pyralidae) is an important and major insect pest of sweet basil, therefore, ecofriendly bio-rational insecticides were evaluated against perilla leaf moth in the present experiment. The experiment was laid out in uniformly sized plots measuring 12 m^2 (4 m × 3 m) in Randomized Block Design containing six treatments and four replications. The treatment schedule comprised two sprayings, the first 15 days after transplanting and the second 45 days after transplanting. The different treatments, viz. *Azadirachta indica* oil (3%) followed by *Bacillus thuringiensis* (1.5 kg/ha); NSKE (5%) followed by Spinosad 45 SC (150 ml/ha); Azadirachtin 1500 ppm (1%) followed by Lambda Cyhalothrin 4.9 CS (1 L/ha); *Pongamia pinnata* oil (3%) followed by Cypermethrin 10 EC (0.005%); Nicotine Sulfate 40 S (0.02%) followed by Deltamethrin 2.8 EC (0.015%) and Untreated control. Among the treatments, the Azadirachtin 1500 ppm (1%) was most effective against perilla leaf moth at 3, 5 and 7 days after first spray. After second spray the Spinosad 45 SC (150 ml/ha) was superior treatment against perilla leaf moth at 3, 5 and 7 days; whereas, the *Azadirachta indica* oil (3%) followed by *Bacillus thuringiensis* (1.5 kg/ha) was least effective against perilla leaf moth at 3, 5 and 7 days after second spray during both the subsequent years.

Keywords: Basil, Bio-rational insecticides, *Cochlochila bullita*, Perilla leaf moth

Sweet basil, [*Ocimum basilicum* (L.)] is an annual, aromatic herb, belonging to the family Lamiaceae. Its origin is from the tropical regions of south-eastern Asia and it is widely grown as an aromatic crop and used as a culinary herb, spice, condiment, ornamental plant, seasoning and medicinal plant (Simon *et al.* 1990) in many countries of the world. Its extract can be used as a fungicide, botanical insecticide, antifeedant and in the preparation of food baits in agriculture (Stein and Klingauf 1990, Amresh *et al.* 2002, Ji *et al.* 2003). The economical important parts of *Ocimum* are mainly its leaves and tender parts of the shoots and seeds, which yield various essential oil which is extracted and used as flavoring agent in food, perfumery and pharmaceutical industries (Simon *et al.* 1990). Its oil contains a heterogeneous group of aromatic compounds, mainly monoterpenes, sesquiterpenes and phenols which are responsible for the characteristic pleasant odour and flavors (Pushpangadan and Bradu 1995). The flavour and smell of sweet basil variety is largely determined by the presence of chemical components like cinnamate, citronellol, geraniol, linalool, methyl chavicol, myrcene, pinene, ocimene and terpinol in the essential oil. The essential oil from sweet basil has antioxidants (Lee *et al.* 2005), antimicrobial (Koba *et al.* 2008), antifungal and insect repelling properties (Dube *et al.* 1989).

While the demand in the aromatic industry is increasing, there is a growing concern about improving the production and quality of sweet basil (Smitha *et al.* 2014). Sweet basil has been found to be infested by more than 30 species of insects and mites (Hamasaki *et al.* 1994, Dhiman and Datta 2013).The Perilla leaf moth, *Pyrausta panopealis* Walker (Lepidoptera: Pyralidae) is distributed in South-East Asia including China, Japan and India, and also in South America (Oh *et al.* 2010), however, in India the pest was observed and reported based on the light trap collection (Gurule and Nikam 2013, Raha *et al.* 2017). Keeping the economic and medicinal value of the sweet basil, ecofriendly bio-rational insecticides were evaluated against perilla leaf moth in the present experiment.

MATERIALS AND METHODS

The present study was carried out during *kharif* 2016–18 at Agronomy Farm, Rajasthan College of Agriculture,

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MPUAT, Udaipur, located at 23.4°N Longitude and 75°E Latitude at an elevation of 579.5 MSL in Rajasthan. The climate of the region is subtropical, characterized by mild winters and hot summers that provide a safe and long growing season for most crops. The average annual rainfall of this tract ranges from 650 to 750 mm. During 2016–17 and 2017–18 the annual precipitation was 660.9 mm and 814.6 mm. The experimental field was prepared by ploughing once followed by cross harrowing and planking. Required quantities of manure and fertilizers were added in accordance with the package and practice of the zone. To raise healthy seedlings, seeds of recommended variety of sweet basil were sown in well prepared, raised (10–15 cm height) nursery beds using the seed rate of 125 g/ha. The nursery was raised in the first week of June each year during *Kharif* 2016–17 and 2017–18. Mature seedlings of sweet basil were transplanted after 4 weeks of seed germination when the plants attained a height of 10–15 cm. Recommended bio-rational insecticides including plant oils, bio-pesticides and bio-rational insecticides were evaluated for their efficacy against the perilla leaf moth of sweet basil during the two successive crop seasons of *Kharif*, 2016–17 and 2017–18. The experiment was laid out in uniformly sized plots measuring 12 m^2 (4 m × 3 m) in Randomized Block Design containing six treatments and four replications; in all, there were 24 plots. The row to row and plant to plant spacing for sweet basil was 60 cm and 40 cm, respectively. The treatment schedule comprised two sprayings, the first 15 days after transplanting and the second 45 days after transplanting. The different treatments, viz. *Azadirachta indica* oil (3%) followed by *Bacillus thuringiensis* (1.5 kg/ha), NSKE (5%) followed by Spinosad 45 SC (150 ml/ha), Azadirachtin 1500 ppm (1%) followed by Lambda Cyhalothrin 4.9 CS (1 L/ ha), *Pongamia pinnata* oil (3%) followed by Cypermethrin 10 EC (0.005%), Nicotine Sulfate 40 S (0.02%) followed by Deltamethrin 2.8 EC (0.015%) and Untreated control.

Observations on perilla leaf moth sampled by sondage method in which 10 plants were gently shaken to collect insects on an enamel tray with a piece of white cloth dipped in alcohol. The fallen insects were counted visually and collected. The vortis suction sampler was used once during mid-September for collecting these insect pests with a view have the collection of specimens. Observations were recorded for the numbers of insect pests per plant from 5 plants selected at random from each replicate one day before the insecticidal treatments and 3, 5 and 7 days after the treatments. The decrease or increase in numbers of insect pests after treatments in comparison to that in the control were estimated. The reduction in insect pests as a result of the spray treatments were computed by comparing with the pre-treatment population and expressed as a percentage using the method adopted by Henderson and Tilton (1955) after suitable transformation of the data. The data were subjected to analysis of variance using suitable mathematical/statistical procedures.

$$\text{Population Reduction (\%)} = 100 \left\{1 - \frac{\text{Ta.Cb}}{\text{Tb.Cb}}\right\}$$

where Ta, numbers of insects in the treatments after application; Tb, numbers of insects in the treatments before application; Ca, numbers of insects in the control after application; Cb, numbers of insects in the control before application.

RESULTS AND DISCUSSIONS

Perilla leaf moth: After the first spray, the pre-treatment population of perilla leaf moth (before first spray) did not vary significantly among the treatments and ranged from 3.50–4.00 Perilla leaf moth larvae/5 plants during *Kharif* 2016–17 (Table 1) and it was statistically at par among

Table 1 Efficacy of bio-rational insecticides against perilla leaf moth infesting sweet basil during *Kharif* 2016–17

Treatment Schedule	Mean population reduction (%)							
	1st Spray				2nd Spray			
	PTP	3rd DAS	5th DAS	7th DAS	PTP	3rd DAS	5th DAS	7th DAS
Azadirachta indica oil (3%) followed by *Bacillus thuringiensis* (1.5 kg/ha)	3.50	45.15 (50.26)	46.76 (53.07)	43.64 (47.62)	8.00	40.50 (42.18)	44.13 (48.49)	41.16 (43.31)
NSKE (5%) followed by Spinosad 45 SC (150 ml/ ha)	4.00	48.38 (55.89)	49.39 (57.63)	46.73 (53.01)	7.25	61.40 (77.09)	63.83 (80.55)	61.03 (76.54)
Azadirachtin 1500 ppm (1%) followed by Lamda Cyhalothrin 4.9 CS (1 L/ ha)	3.50	50.82 (60.08)	53.48 (64.59)	49.25 (57.39)	8.00	59.20 (73.79)	61.10 (76.64)	57.69 (71.43)
Pongamia pinnata oil (3%) followed by Cypermethrin 10 EC (0.005%)	3.75	42.71 (46.01)	45.96 (51.68)	42.84 (46.24)	7.75	54.42 (66.14)	56.85 (70.09)	53.57 (64.73)
Nicotine Sulfate 40 S (0.02%) followed by Deltamethrin 2.8 EC (0.015%)	3.50	41.75 (44.34)	42.57 (45.76)	37.77 (37.52)	8.25	56.14 (68.96)	58.34 (72.46)	54.31 (65.97)
Untreated control	3.75	-	-	-	7.50	-	-	-
SEm ±	0.41	1.93	1.85	2.19	0.49	2.27	2.05	2.68
CD(P=0.05)	NS	5.92	5.68	6.73	NS	6.95	6.30	8.22

Figures in parentheses are retransformed per cent values. PTP, Pre-Treatment Populations; DAS, Days After Spray.

treatments. The maximum per cent mean reduction in the population of perilla leaf moth was recorded in the treatment schedule Azadirachtin 1500 ppm (1%) with 60.08, 64.59 and 57.39% mean reduction at 3, 5 and 7 days after spray respectively. The response was statistically at par with treatment schedule of NSKE (5%) at 3, 5 and 7 days after spray with 55.89, 57.63 and 53.01% mean reduction respectively. The minimum per cent mean reduction in the population of perilla leaf moth at 3, 5 and 7 days after spray was recorded in the treatment schedule Nicotine Sulfate 40 S (0.02%) with 44.34, 45.76 and 37.52% mean reduction respectively; however, it was found at par with *Pongamia pinnata* oil (3%) which was observed 46.01, 51.68 and 46.24% mean reduction at 3, 5 and 7 days after spray respectively. After the second spray, the pre-treatment population of perilla leaf moth (before the second spray) did not vary significantly among the treatments ranging from 7.25–8.25 larvae/5 plants during *Kharif* 2016–17 (Table 1). The maximum mean reduction in the population of perilla leaf moth at 3, 5 and 7 days after treatment was recorded in Spinosad 45 SC (150 ml/ha) with the reduction values being 77.09, 80.55 and 76.54%, respectively; which was at par with Lambda Cyhalothrin 4.9 CS (1 L/ ha) with reduction values 73.79, 76.64 and 71.43% at 3, 5 and 7 days after spray. The minimum mean reduction (42.18, 48.49 and 43.31%) was recorded in the treatment of *Bacillus thuringiensis* (1.5 kg/ ha) after 3, 5 and 7 days of spray, respectively.

The resultant data of the first spray, 2017–18 are presented in the Table 2. The observation showed that pre-treatment population of perilla leaf moth ranged from the 11.75–13.00 larvae/5 plants and did not vary significantly among different treatments. After 3, 5 and 7 days of treatments, the maximum mean reduction in perilla leaf moth population (61.16, 65.01 and 59.69%) were recorded in Azadirachtin 1500 ppm (1%), respectively; which was significantly superior over all the rest of treatments. The minimum mean reduction in perilla leaf moth population was recorded in Nicotine Sulfate 40 S (0.02%) with the population reduction values were 45.03, 46.38 and 40.03%; whereas it was at par with the treatment schedule of *Pongamia pinnata* oil (3%) with mean reduction of 47.29, 50.09 and 44.81% at 3, 5 and 7 days after spray, respectively. During second spray, 2017–18, the pre-treatment population of perilla leaf moth (before the second spray) did not vary significantly among the treatments ranging from 12.75–14.50 larvae/5 plants (Table 2). The maximum mean reduction in the population of perilla leaf moth at 3, 5 and 7 days after treatment application was recorded in Spinosad 45 SC (150 ml/ha) with the reduction values of79.67, 82.34 and 77.67%, respectively followed by Lambda Cyhalothrin 4.9 CS (1 L/ ha) with per cent mean reduction 74.60, 76.17 and 72.59% at 3, 5 and 7 days after spray respectively. The minimum mean reduction was recorded in *Bacillus thuringiensis* (1.5 kg/ha) after 3, 5 and 7 days of spray with the population reduction values being 41.28, 47.05 and 42.84% followed by treatment schedule of Cypermethrin 10 EC (0.005%) with mean reduction being 65.04, 69.09 and 62.73% respectively.

Similarly, the present investigation, Olson and Bidlack (2008) evaluated selected pest control treatments, consisting of hand removal, horticultural oil, pyrethrum and *Bacillus thuringiensis* var. kurstaki (Bt) against insect pests of sweet basil, *Ocimum basilicum* (L.). They reported that though *Bt*. was the best treatment for controlling lepidopteran pests, the innate ability of sweet basil to discourage herbivory could be sufficient when insects are not abundant. The larvicidal effect of ten on-the-market environment friendly agricultural materials was evaluated against the Perilla leaf moth (*P. panopealis*) indicating that 7 out of the 10 materials tested caused more than 90% mortality of the Perilla leaf moth caterpillars within 12 h (Hyung *et al.* 2010). Similar

Table 2 Efficacy of bio-rational insecticides against perilla leaf moth infesting sweet basil during *Kharif*, 2017–18

Treatment Schedule	Mean population reduction (%)							
	1st Spray				2nd Spray			
	PTP	3rd DAS	5th DAS	7th DAS	PTP	3rd DAS	5th DAS	7th DAS
Azadirachta indica oil (3%) followed by *Bacillus thuringiensis* (1.5 kg/ha)	12.25	45.75 (51.31)	47.70 (54.71)	44.20 (48.60)	13.50	39.98 (41.28)	43.31 (47.05)	40.88 (42.84)
NSKE (5%) followed by Spinosad 45 SC (150 ml/ ha)	11.75	47.74 (54.77)	48.65 (56.35)	46.49 (52.60)	12.75	63.20 (79.67)	65.15 (82.34)	61.80 (77.67)
Azadirachtin 1500 ppm (1%) followed by Lamda Cyhalothrin 4.9 CS (1 L/ ha)	13.00	51.45 (61.16)	53.73 (65.01)	50.59 (59.69)	13.25	59.74 (74.60)	60.78 (76.17)	58.43 (72.59)
Pongamia pinnata oil (3%) followed by Cypermethrin 10 EC (0.005%)	12.25	43.45 (47.29)	45.05 (50.09)	42.02 (44.81)	13.75	53.75 (65.04)	56.22 (69.09)	52.37 (62.73)
Nicotine Sulfate 40 S (0.02%) followed by Deltamethrin 2.8 EC (0.015%)	11.75	42.15 (45.03)	42.92 (46.38)	39.25 (40.03)	14.50	56.31 (69.24)	59.02 (73.50)	54.86 (66.87)
Untreated control	12.00	-	-	-	13.00	-	-	-
SEm ±	0.76	1.43	1.58	1.61	0.79	2.28	1.96	2.09
CD(P=0.05)	NS	4.39	4.85	4.95	NS	6.98	6.02	6.41

Figures in parentheses are retransformed per cent values. PTP, Pre-Treatment Populations; DAS, Days After Spray.

work on sweet basil pest management showed that foliar application of *Bacillus thuringiensis* (1 kg/ha) recorded better management of the leaf eating caterpillar population (2.27 caterpillars per plant), followed by application of EPN @5000 IJS/litre (2.60 caterpillars per plant) and neem oil @1 per cent (3.0 caterpillars per plant) as against 8.67 leaf eating caterpillars per plant in untreated control (Anonymous 2017).

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