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Bio-efficacy of *Millettia pinnata* oil soap in the suppression of brinjal fruit and shoot borer, *Leucinodes orbonalis* Guenee

P. Jeevitha*, K. M. Sreekumar, B. Ramesha, C.K. Yamini Varma and N.K. Binitha

Department of Agricultural Entomology, College of Agriculture, Padannakkad, Kerala, 671314, India. Email: jeevithadpi9@gmail.com; sreekumar.km@kau.in; b.ramesha@gmail.com; yamininavami@gmail.com; binitha.nk@kau.in*

ABSTRACT: A field experiment to evaluate the efficacy of pungam (Millettia/Pongamia) oil soap at four different concentrations against brinjal fruit and shoot borer (BFSB), *Leucinodes orbonalis* Guenee and its effect on spiders of brinjal field revealed that application of 3% pungam oil soap brought down fruit damage to minimum level (12.94% on 7 days after third spray) followed by chlorantraniliprole 18.5% SC (0.3 mL/L), 2, 1 and 0.6% pungam oil soap and neem oil soap 0.6%. Efficacy of chlorantraniliprole persisted up to 14th day of spray followed by pungam oil soap. None of the botanical or chemical pesticides found to influence the spider population until seven days. After 14 days of application soap solution either alone or with pungam oil increased spiders over the control whereas 14 DAS it was minimum in standard check.

KEY WORDS: BFSB, pongamia, botanicals, spiders, chlorantraniliprole

INTRODUCTION

Brinjal, *Solanum melongena* L. is one of the principal vegetables crops in the country. India ranks second in brinjal production with 12.80 MT of production (NHB, 2018). The destructive pest of brinjal is fruit and shoot borer (BFSB), *Leucinodes orbonalis* G. (Lepidoptera: Crambidae) which causes enormous yield loss. As high as 70-92 per cent yield loss has been reported in India (Rosaiah, 2001). The pest is also reported to cause 47.6-85.8 per cent fruit damage and 3.3-68.9 per cent flower damage in India (Patnaik, 2000). Rising concerns on adverse impact of insecticides necessitates the development of environmentally safe and sustainable pest control. Pongam/karanj oil is one such eco-friendly biocide which can be used against wide range of pests. Pungam/pongam/Indian beech/ karanj, *Millettia pinnata* (L.) Pierre is a multipurpose tree, particularly valued for its oil which is derived from their seeds (27 - 40% oil). The toxicity of karanj oil against pests is mainly attributed to furanoflavones such as karanjin, pongapin, kanjone, diketone pongamol *etc*. (Bringi, 1987). A field experiment was undertaken to evaluate the efficacy of pungam (Millettia/ Pongamia) oil soap at four different concentrations against brinjal fruit and shoot borer (BFSB), *Leucinodes orbonalis* Guenee and its effect on spiders.

MATERIALS AND METHODS

Pungam oil soap was made as per the technology used for 'Ready To Use neem oil garlic soap', the botanical released by KAU (Varma, 2018). To

* Author for correspondence

prepare the pungam oil soap, 55 g of caustic soda mixed in 100 ml of water and kept for 4 h was blended thoroughly in to solution made of 55g soap stone powder mixed in one litre pungam oil and kept for solidification. pH of the pungam oil soap solution prepared was 10.5 and the saponification value of the oil was 194 mg KOH/g of oil. Neem oil soap 0.6% and two new generation insecticides were also included as treatments to compare the results of pungam oil soap.

The experiment was carried out on brinjal variety 'Surya' under randomised block design (RBD) with eight treatments (Table 1) and three replications at Instructional farm II, Karuvachery, College of Agriculture, Padannakkad. Brinjal seeds were sown in pro trays and one-month old seedlings were transplanted in a plot of 3.4 X 2.8m^2 size each with the spacing of 60 X 60 cm. The treatments imposed in the experiment include; chlorantraniliprole 18.50% SC (Spray I and III) and thiamethoxam 25% WG (Spray II) (T_1); pungam oil soap 3% (T_2); pungam oil soap 2% (T_3); pungam oil soap 1% (T_4); pungam oil soap 0.6% (T_5); neem oil soap 0.6% (T_6); soap solution 0.5% (T_7) and control (T_8).

The pungam oil soap at 30, 20, 10 and 6g per litre were used to prepare 3, 2, 1 and 0.6% oil soap solutions and knapsack sprayer was used for spraying. Three sprays were given at 28th January, 25th February and 15th April 2020 during morning hours to avoid drift. Five representative plants (among 12 plants) were selected and tagged for taking observations. Fruit infestation by BFSB was recorded as per cent fruit damage and spiders was recorded as population count (per five plants) at

Table 1. Fruit damage by BFSB, *Leucinodes orbonalis* in different treatments

Treatments	Mean % of infested fruits *					
	First application		Second application		Third application	
	7 DAS	14 DAS	7 DAS	14 DAS	7 DAS	14 DAS
Chlorantraniliprole 18.5 SC 0.3 ml/l - 1st & 3rd application & Thiamethoxam 25 WG 0.2g/l - 2nd application	16.92 (24.17) ^{c}	18.38 (25.37) ^{b}	38.14 (37.60) ^{cd}	64.23 (53.27) ^{bc}	30.36 (33.32) ^{cd}	34.49 (35.92) ^{de}
Pungam oil soap 3%	15.66 (23.25) ^{c}	16.28 (23.49) ^{b}	22.17 (28.04) ^{d}	32.77 (34.82) ^{d}	12.94 (20.93) ^{e}	30.95 (33.76) ^{e}
Pungam oil soap 2%	15.77 (23.38) ^{c}	20.36 (26.80) ^{b}	29.52 (32.86) ^{cd}	38.06 (38.09) ^{d}	24.91 (29.77) ^{d}	37.54 (37.77) ^{de}
Pungam oil soap 1%	20.51 (26.88) ^{c}	21.81 (27.49) ^{b}	30.63 (33.60) ^{cd}	40.30 (39.42) ^{d}	31.53 (34.12) ^{cd}	39.73 (39.07) ^{cd}
Pungam oil soap 0.6%	22.64 (28.29) ^{bc}	25.26 (29.83) ^{b}	42.61 (40.72) ^{bc}	49.10 (44.48) ^{cd}	38.98 (38.57) ^{c}	47.84 (43.76) ^{c}
Neem oil soap 0.6%	29.78 (32.85) ^{b}	57.71 (49.70) ^{a}	61.64 (51.81) ^{a}	80.51 (64.76) ^{ab}	67.51 (55.36) ^{b}	85.94 (68.29) ^{b}
Soap solution 0.5%	31.25 (33.98) ^{b}	44.90 (42.03) ^{a}	57.04 (49.08) ^{ab}	76.18 (61.19) ^{ab}	70.27 (57.26) ^{b}	85.08 (67.51) ^{b}
Control	46.52 (43.00) ^{a}	60.03 (50.82) ^{a}	64.22 (53.36) ^{a}	84.26 (68.24) ^{a}	82.77 (65.70) ^{a}	93.57 (75.37) ^{a}
C.D.(*P*=0.05)	8.78	17.80	17.00	17.20	12.80	6.91

* Mean of five observations; Means superscripted by same letters are not significantly different at 0.05
Figures in parentheses indicates arc sine transformed values; DBS- Day Before Spray; DAS- Days After Spray

weekly intervals after spray (7th and 14th day). The data on per cent fruit damage were analysed after arc sine transformation (angular transformation) and the spider population count was analysed after square root transformation by analysis of variance (ANOVA). Web Agri Stat Package (WASP) software was used to analyse the data.

RESULTS AND DISCUSSION

BFSB damage was significantly reduced by the application of pungam oil soap 3% with only 15.66 per cent fruit damage on seven days after first spray (DAFS) (Table 1) which was on par with pungam oil soap 2% (15.77%), chlorantraniliprole 18.5 SC @ 0.3 ml/l (standard check) (16.92%) and pungam oil soap 1% (20.51%). Pungam oil soap at 0.6% showed 22.64 per cent fruit damage which was significantly different from neem oil soap 0.6% and soap solution 0.5%. The lowest BFSB infestation was observed in pungam oil soap 3% on 14 DAFS also followed by standard check, 2, 1 and 0.6% pungam oil soap. The efficacy of neem oil 0.6% decreased on 14th day of application which was on par with soap solution 0.5% and control.

During second spray also, application of pungam oil soap 3% resulted in minimum of 22.17 per cent fruit damage followed by pungam oil soap 2%, 1%, standard check- (thiamethoxam 25 WG) and pungam oil soap 0.6% at 7 DASS (days after second spray). The efficacy of neem oil soap 0.6% started to decrease from second spray onwards which was on par with control and soap solution 0.5%. Pungam oil soap 3% remained effective in reducing BFSB infestation on 14 DASS followed by pungam oil soap 2%, 1% and 0.6%. Control suffered maximum fruit damage. Neem oil soap 0.6% and soap solution 0.5% had damage on par with control. Standard check (thiamethoxam) showed 64.23 per cent mean fruit damage which was statistically on par with pungam oil soap 0.6%, soap solution 0.5% and neem oil soap 0.6%.

The per cent fruit damage was effectively reduced to 12.94% by pungam oil soap 3% on seventh day after third spray (DATS) which was followed by pungam oil soap 2%, standard check (chlorantraniliprole) and pungam oil soap 1%. Pungam oil soap 0.6% was on par with pungam oil soap 1% and standard check while standard check and pungam oil soap 1% were at par with pungam oil soap 2%. Neem oil soap was on par with soap solution. At 14 DATS, pungam oil soap 3% remained statistically superior over other treatments followed by standard check and pungam oil soap 2%. The highest BFSB infestation was recorded in control (93.57%). Pungam oil soap 1 and 0.6% were found to be statistically on par with each other. Soap solution and neem oil soap were less effective at 14 DATS.

Pungam oil soap at 3% reduced the fruit damage significantly in all the three sprays at seventh and fourteenth days after treatment application followed by 2, 1 and 0.6% pungam oil soap. Similar findings were given by Sahana and Tayde (2017) in which, next to the spinosad 0.1 ml/l (6.38%) and neem oil soap 3% (9.66%), pongamia oil 3% recorded minimum fruit infestation of 10.28. In the study conducted by Sureshsing and Tayde (2017), 3% pongamia oil was effective against BFSB in reducing the fruit damage with the mean fruit infestation of 11.57 and 12.40 per cent during second and third spray respectively. The present study can also be supported by the findings of Thomas and Sreekumar (2019) in which pongamia oil soap 2% reduced the bhindi shoot and fruit borer, *Earias vitella* incidence significantly followed by 1 and 0.6% pongamia oil soap in okra. Pongam oil soap 2% recorded highest efficacy against cowpea aphid, *Aphis craccivora* followed by 1% while neem oil soap 0.6 and pongamia oil soap 0.6% were on par with each other in vegetable cowpea (Sajay *et al*., 2020).

The major spider species observed in brinjal ecosystem were *Oxyopes assamensis, Peucetia viridana, Olios* sp. and *Thomisus projectus*. The spiders count was uniform in all the treatments at pre count as well as post counts except on fourteenth day after spray. Pungam oil soap at 0.6, 1, 2 and 3% and neem oil soap 0.6%, chlorantraniliprole and thiamethoxam were statistically uniform in harbouring spider population up to 7th day after treatment while on 14th day significant difference was observed during all the

Table 2. Relative abundance of spiders during field evaluation of pungam oil soap

Treatments	Number of spiders/ 5 plants								
	First application			Second application			Third application		
	1 DBS	7 DAS	14 DAS	1 DBS	7 DAS	14 DAS	1 DBS	7 DAS	14 DAS
Chlorantraniliprole 18.5 SC 0.3 ml/l - 1st & 3rd application & Thiamethoxam 25 WG 0.2g/l - 2nd application	1.33 (1.34)	1.67 (1.28)	1.00 (1.00) c	2.33 (1.47)	3.67 (1.91)	3.33 (1.73) e	3.67 (1.86)	3.33 (1.82)	3.67 (2.04) c
Pungam oil soap 3%	0.67 (1.05)	2.00 (1.38)	2.33 (1.52) ab	3.33 (1.82)	4.00 (1.99)	7.33 (2.71) d	3.33 (1.76)	3.67 (1.91)	4.00 (2.12) bc
Pungam oil soap 2%	1.00 (1.22)	2.33 (1.49)	1.33 (1.14) bc	4.00 (1.89)	5.33 (2.28)	7.67 (2.77) cd	6.33 (2.47)	4.00 (1.99)	4.67 (2.27) abc
Pungam oil soap 1%	1.00 (1.22)	1.33 (1.14)	2.00 (1.38) bc	1.67 (1.28)	5.33 (2.23)	9.00 (3.00) bc	4.67 (2.00)	3.33 (1.82)	4.00 (2.12) bc
Pungam oil soap 0.6%	1.00 (1.22)	1.00 (1.00)	2.00 (1.38) bc	2.67 (1.48)	5.67 (2.26)	9.67 (3.11) ab	3.67 (1.91)	4.00 (1.99)	6.00 (2.55) a
Neem oil soap 0.6%	1.00 (1.22)	2.33 (1.49)	2.33 (1.52) ab	2.33 (1.47)	5.67 (2.35)	7.67 (2.76) cd	3.67 (1.75)	4.67 (2.15)	5.00 (2.34) ab
Soap solution 0.5%	1.33 (1.22)	2.33 (1.47)	4.00 (1.99) a	2.67 (1.58)	5.00 (2.19)	10.67 (3.21) a	6.33 (2.50)	3.67 (1.91)	4.33 (2.20) bc
Control	1.67 (1.46)	2.67 (1.58)	2.00 (1.38) bc	3.00 (1.67)	7.33 (2.70)	8.00 (2.82) cd	6.33 (2.50)	3.67 (1.91)	5.00 (2.32) abc
C.D.(*P*=0.05)	NS	NS	0.50	NS	NS	0.27	NS	NS	0.29

Means followed by similar alphabets do not differ significantly @ 0.05; Figures in parentheses denote square root transformed values; DBS- Day Before Spray; DAS-Days After Spray; NS – Non significant

three sprays (Table 2). The maximum spider population was recorded on 14 DAT in plots applied with soap solution 0.5% during first and second spray with 4.00 and 10.67 spiders per 5 plants respectively and on third spray, spider population was high in pungam oil soap 0.6% with 6.00/5 plants. Chlorantraniliprole on first and third spray (1.00 and 3.67 per plant) and thiamethoxam on second spray (3.33/plant) could support the lowest numbers of spiders when compared to botanicals however these treatments were also on par with control up to 7th day of spray. From the present study, pungam and neem oil soap found to be statistically on par with untreated control plot and soap solution in sustaining the spider population facilitating for a conclusion that pungam oil soap has no negative consequences on spider population even at 3% (Table 2).

Kumar *et al*. (2019) suggesting the safety of biopesticides on spiders including pungam oil reported non-significant difference between botanicals and chemical check in sustaining spider numbers with pongamia oil + detergent powder (10 ml/l) showing 1.3 per plant while the crude neem oil and control with 0.9 and 1.7 spiders/plant. Study conducted by Bhatt *et al*. (2018) in okra revealed that thiamethoxam 25%WG @ 25g a.i./ha and chlorantraniliprole 18.5% SC @ 25g a.i./ha were harmless to the spiders and resulting in 2.30 and 2.69 spiders/plant at spray I and 2.69 and 3.03 spiders/plant at spray II respectively.

The highest yield marked in standard check treated plants with 2058.44g/plant followed by pungam oil soap 3%, 2%, 1% and 0.6% with 1919.04, 1809.02, 1661.29 and 1507.75g /plant respectively. Reduced

leaf lamina size (phytotoxicity) was noticed in pungam oil soap 3% treated plants after second spray when the temperature reached 32-34^0 C however no change in yield was recorded.

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