

Research Article

Efficacy of botanical extracts and panchagavya against bhendi shoot and fruit borer, *Earias vittella* (Fab.)

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ABSTRACT: Shoot and fruit borer, *Earias vittella* (Fab.) is commonly encountered and economically important insect pest on okra (bhendi). Experiments were carried out to investigate the antifeedant and mortality activities of panchagavya alone and in combination with plant extracts against *E. vittella* in the laboratory and to evaluate the effectiveness in the field during rabi and kharif 2017 at C. Mutlur, Chidambaram. This study assessed five binary botanical extracts mixture with panchagavya used *in vitro* which included extracts containing panchagavya, neem leaf extract (NLE) 5%, *Prosopis* leaf extract 5%, *Calotropis* leaf extract 5%, Pungam oil 3% and NSKE 5%. Fruit disc no-choice methods were performed in a laboratory using bhendi fruit to determine the antifeedant activity and per cent mortality. Results indicated that all binary mixtures showed antifeedant activity and highest recorded was in NLE (5%) + panchagavya (3%) (65.11%) and was on par with NSKE (5%) (64.84%) and the highest mortality was recorded in panchagavya (3%) + NSKE (5%) (83.33%) followed by pungam oil 3% + panchagavya 3% (66.67%) and NLE 5% + panchagavya 3% (53.33%). Field studies indicated that highest per cent reduction of *E. vittella* was recorded in panchagavya (3%) + Neem Seed Kernel Extract (NSKE) (5%) treated plot followed by pungam oil 3% + panchagavya 3% and Neem Leaf Extract (NLE) 5% + panchagavya 3%. The field studies demonstrated that NSKE 5% in combination with panchagavya were effective in the management of *E. vittella* and could be an effective alternative to synthetic pesticides.

KEY WORD: Antifeedant, bioassays, botanicals extract mixture, *Earias vittella*

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INTRODUCTION

Vegetables constitute an important item of our food, supplying vitamins, carbohydrates and minerals needed for a balanced diet. Their value is important especially in under developed and developing countries like India, where malnutrition abounds (Masood Khan *et al.*, 2001). Among them vegetable crops grown in India, bhendi *Abelmoschus esculentus* (L.) Moench or okra or lady's finger belongs to the family Malvaceae and the origin of bhendi is Africa.

Among the various biotic and abiotic stresses that constrain the successful cultivation of bhendi crop, attack by insect pests are most important. More than hundred insect species have been reported as pests of bhendi (Santoshkumar *et al.*, 2013). Insect pests such as leaf hopper, aphid, white fly, shoot and fruit borer and spider

mite, are considered as serious in in bhendi. Among them, shoot and fruit borer, *Earias vittella* (Fab.) is a major pest causing severe damage to crop (Shitole and Patel, 2009). This noctuid pest cause more than 50% loss in cotton and bhendi (Archunan *et al.*, 2018) and 69% on bhendi alone in various parts of India. *E. vittella* alone is reported to cause 13.8 to 41.6 per cent net yield loss in bhendi (Rai *et al.*, 2010).

The use of chemical insecticides is not advisable in bhendi crops due to toxic residue deposition in fruits. Hence it is advisable that locally available botanical extracts with panchagavya can be used in combination for the management of *E. vittella*. In the present study locally available botanical extracts were tried in combination with panchagavya for the control of shoot and fruit borer in bhendi.

MATERIALS AND METHODS

Efficacy of botanicals extracts mixture with panchagavya against shoot and fruit borer, *Earias vittella* (Fab.) on bhendi under lab conditions

Preliminary antifeedent and mortality activities of panchagavya alone and in combination with plant extracts were studied using fruit disc no choice method. The following were the treatments, T1- Panchagavya 3% + Neem leaf extract (NLE) 5%, T2- Panchagavya 3% + *Prosopis* leaf extract (PLE) 5%, T3- Panchagavya 3% + *Calotropis* leaf extract (CLE) 5%, T4- Panchagavya 3% + Pungam oil 3%, T5- Panchagavya 3% + NSKE 5%, T6- Panchagavya 3% (alone), T7- control.

The experiment was conducted by following the fruit disc no-choice method of Muthu *et al.* (2015). In each plastic Petri dish, a wet filter paper was placed to avoid early drying of the test materials. Ten 3rd instar larvae (pre starved for 12 hours) were introduced into each Petri dish containing five discs of bhendi fruit treated with prepared extracts. Three replications were maintained for each treatment. Per cent antifeedent activity and per cent mortality were calculated as per formula (Pazhanisamy, 2015) and is given below.

$$\text{Antifeedent activity} = \frac{\text{Consumption in Control} - \text{Consumption in treated}}{\text{Consumption in control}} \times 100$$

$$\text{Per cent morality} = \frac{\text{Observed mortality in treatment}}{\text{Total number of larvae released per treatment}} \times 100$$

Field efficacy studies

A field trial was carried out at C. Mutlur, Chidambaram in 2017 during rabi and kharif season by raising the variety Arka Anamika the experiment was laid out in randomized block design (RBD) with three replications, in 5 x 5 m plots having plant spacing of 45 x 30 cm. The treatments were,

- T1 Panchagavya 3% + Neem leaf extract 5%
- T2 Panchagavya 3% + *Prosopis* leaf extract 5%
- T3 Panchagavya 3% + *Calotropis* leaf extract 5%
- T4 Panchagavya 3% + Pungam oil 3%
- T5 Panchagavya 3% + NSKE 5%
- T6 Panchagavya 3% (alone)
- T7 Control

Treatment sprays were conducted in 45 and 55 DAS. Observation on larval population was made on five randomly selected plants from each treatment one day before and 3, 7 and 10 days after treatment. Based on the larval number at each spray application, per cent reduction in larval population was calculated. Percentages were transformed into arcsine values and subjected to statistical analysis. The per cent reduction in larval population over untreated check was calculated in both first and second round of spray (Pazhanisamy, 2015).

$$\text{Per cent reduction in larval population} = \frac{\text{Control plot} - \text{Treated plot}}{\text{Control plot}} \times 100$$

EXPERIMENTAL RESULTS

Bio efficacy of panchagavya alone and its combination of plant products against *Earias vittella* under lab condition

The results of lab studies revealed that there was substantial reduction in *E. vittella* population in all the treatments (Table 1, Fig.1 and Plate 1). Among the treatments, the highest per cent of antifeedant activity was recorded in NLE (5%) + panchagavya (3%) (65.11%) on par with NSKE (5%) (64.84%) followed by pungam oil (3%) + panchagavya (3%) (58.17%) and CLE 5%+ panchagavya (47.39%) compared to untreated check (3.99%) at 24 HAT. Bharati (2005) also who reported that high antifeedant property was noticed in NSKE in combination with panchagavya after 24 hours of treatment. Similarly, Umamageswari *et al.* (2008) reported that neem (*Azadirachta indica*) exhibited deterring and repelling activities against *E. vittella* in bhendi.

Among the treatments, the highest mortality was recorded in panchagavya (3%) + NSKE (5%) (83.33%) followed by pungam oil 3% + panchagavya 3% (66.67%) and NLE 5% + panchagavya 3% (53.33%). The least mortality was recorded on at PLE 5% + panchagavya 3% on par with panchagavya 3% alone at 72 HAT after the treatment (Fig. 1). The results are in conformity with Sajjan (2006) who recorded that maximum larval mortality on *Plutella xylostella* at 5th day after treatment with panchagavya (5%) + NSKE (5%) (98.89%) followed by NSKE (5%) + cow urine (10%) (95.45%) and panchagavya (3%) + NSKE (5%) (95.45%), respectively. Similarly, Bharati (2005) reported maximum larval mortality on *Spodoptera litura* with panchagavya + NSKE (80.17%). The result of lab studies concluded that application of panchagavya 3% + NSKE 5% effectively suppressed of *E. vittella* on bhendi

Table 1. Activity of panchagavya alone and in combination with plant products against *Earias vittella* under lab condition

Treatment	Per cent of Antifeedant activity*	Per cent Mortality*		
	24 HAT	24 HAT	48 HAT	72 HAT
T1 - Neem leaf extract 5% + panchagavya 3%	65.11 (53.86) ^a	13.33 (21.15) ^b	36.67 (37.25) ^a	53.33 (46.92) ^a
T2 - <i>Prosopis</i> leaf extract 5% + panchagavya 3%	36.13 (36.91) ^c	0.00 (0.29) ^c	6.67 (12.38) ^c	13.33 (21.15) ^{bc}
T3 - <i>Calotropis</i> leaf extract 5% + panchagavya 3%	47.39 (43.51) ^b	0.00 (0.29) ^c	23.33 (28.78) ^b	33.33 (35.22) ^b
T4 - Pungam oil 3% + panchagavya 3%	58.17 (49.75) ^{ab}	36.67 (37.23) ^a	46.67 (35.21) ^a	66.67 (54.78) ^b
T5 - Neem seed kernel extract 5% + panchagavya 3%	64.84 (53.66) ^a	40.00 (39.15) ^a	63.33 (43.08) ^a	83.33 (66.15) ^a
T6 - Panchagavya 3% alone	5.95 (14.08) ^d	0.00 (0.29) ^c	3.33 (6.36) ^c	6.67 (12.38) ^{bc}
T7 - Control check	3.99 (11.42) ^d	0.00 (0.29) ^c	0.00 (0.29) ^c	0.00 (0.29) ^c
SE(d)	2.767	2.659	5.472	4.512
CD (0.05%)	6.021	5.795	11.923	9.831

*Mean of three replications

Figures in parentheses are arcsine ($x + 0.5$) transformed values, mean in column followed by common letter are not significantly different at the 5 per cent level (DMRT), HAT- Hour after treatment.

Field efficacy of botanicals extracts mixture with panchagavya against shoot and fruit borer, *Earias vittella* (fab.) on bhendi

The results of field trials in rabi 2017 indicated that panchagavya 3%+ NSKE 5% showed highest mortality (61.26%) followed by panchagavya 3%+ pungam oil 3% (43.65%) and panchagavya 3%+ neem leaf extract (NLE) 5% (38.21%) at three days after first spraying. The results are in conformity with Sajjan (2006) who recorded that maximum larval mortality on *P. xylostella* at 5th day after treatment with panchagavya (5%) + NSKE (5%). At 7 DAT, panchagavya 3%+ NSKE 5% recorded significantly highest mortality (67.62%) followed by panchagavya 3%+ pungam oil 3% (57.81%) and panchagavya 3%+ NLE 5% (51.80%) whereas less mortality was noticed in panchagavya alone (3.22%) (Table 2)

At 10 DAT, low mortality was recorded with panchagavya alone (3.22%) and it was on par with panchagavya 3% + *Prosopis* leaf extract (PLE) 5% (3.84%). However there was moderate mortality seen with panchagavya 3% + *Calotropis* leaf extract (CLE) 5% (20.04%). The maximum mortality was recorded with panchagavya 3%+ NSKE 5% (55.40%) followed by followed by panchagavya 3%+ NLE 5% (47.12%) and panchagavya 3%+ pungam oil 3% (46.65%). Similar trends was noticed on second spray of panchagavya alone and in combination with plant products against *E. vittella*.

The results of the field trial showed that spraying of panchagavya 3% in combination with NSKE 5% was effective. The present finding are confirmatory with Bharati (2005) who reported that panchagavya in combination with NSKE was highly effective in the management the *Spodoptera* larvae on groundnut and soybean.



Plate 1. (L to R). Mortality of *Earias vittella* -panchagavya with oleander seed extract, panchagavya with neem leaf extract and panchagavya with neem seed kernel extract.

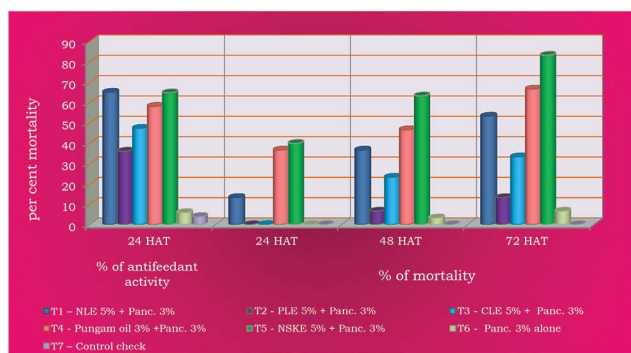


Fig.1. Studies on the efficacy of panchagavya alone and in combination with plant products against *Earias vittella* under lab conditions.

The results of secondary confirmatory field experiments conducted during kharif 2017 are presented in Table 3. The results showed that at three days after treatment (first spray) maximum mortality was observed in panchagavya 3% + NSKE 5% (50.05%) followed by panchagavya 3% + pungam oil 3% (44.73%) on par with panchagavya 3% + NLE 5% (43.56%). Shukla *et al.* (2003) showed that application of cow urine with neem leaf extracts had enhanced insecticidal activity against sucking pests and capsule borer of castor.

Similar trend of results was noticed in the second round spray of panchagavya and its combination. This might be due to more intake of food, as panchagavya might act as a

Table 2. Bio-efficacy of panchagavya alone and in combination with plant extracts against *Earias vittella* in bhendi under field conditions during rabi 2017 (preliminary)

Treatment	Dose per litre	PTC	Per cent reduction in larval population over control							
			First spray				Second spray			
			3 DAT	7 DAT	10 DAT	Mean	3 DAT	7 DAT	10 DAT	Mean
T1- Pan.3% + NLE 5%	5%	9.33	38.21 (38.11) ^{bc}	51.80 (46.04) ^a	47.12 (43.34) ^a	45.71	46.49 (42.99) ^a	49.53 (44.77) ^{ab}	49.83 (44.91) ^a	48.62
T2 – Pan.3% + PLE 5%	5%	8.67	3.84 (6.61) ^d	7.68 (13.23) ^c	3.84 (6.61) ^c	5.12	4.54 (7.42) ^c	9.09 (14.55) ^c	4.65 (7.41) ^c	6.09
T3- Pan. 3% + CLE 5%	5%	8.33	22.03 (27.64) ^c	33.33 (35.25) ^b	20.04 (26.33) ^b	25.13	26.03 (30.65) ^b	30.04 (33.16) ^b	28.11 (31.82) ^b	28.06
T4- Pan.3% + Pungam oil 3%	5%	9.67	43.65 (41.35) ^{ab}	57.81 (49.50) ^a	46.65 (43.07) ^a	49.37	48.97 (44.41) ^a	54.64 (47.67) ^a	51.44 (45.82) ^a	51.68
T5- Pan.3% + NSKE 3%	5%	9.33	61.26 (51.52) ^a	67.62 (55.33) ^a	55.40 (48.11) ^a	61.42	54.57 (47.62) ^a	63.55 (52.87) ^a	55.38 (48.10) ^a	57.83
T6- Pan. alone 3%	5%	10.3	0.00 (0.29) ^d	3.22 (6.04) ^{cd}	3.22 (6.04) ^c	2.15	0 (0.29) ^c	9.99 (15.28) ^c	0.00 (0.29) ^c	3.33
T7- Control	-	8.67	0.00 (0.29) ^d	0.00 (0.29) ^d	0.00 (0.29) ^c	0.00	0.00 (0.29) ^c	0.00 (0.29) ^d	0.00 (0.29) ^c	0.00
SE(d)			4.410	4.468	5.175		4.068	6.183	4.169	
CD (0.05%)			9.603	10.172	11.275		8.864	13.471	9.084	

Pan-Panchagavya, NLE-Neem leaf extract, PLE- *Prosopis* leaf extract, NLE- Neem leaf extract, CLE-*Calotropis* leaf extract, NSKE-Neem seed kernel extract, NSKE- Neem seed kernel extract

PTC = Pre – treatment Count, DAT = Days after treatment

* Mean of three replications, Figures in parentheses are arcsine ($x + 0.5$) transformed values, means in column followed by a common letter are not significantly different at the 5 per cent level (DMRT)

Table 3. Bio-efficacy of panchagavya alone and in combination with plant extracts against *Earias vittella* in bhendi under field conditions during kharif 2017

Treatment	Dose per litre	PTC	Per cent reduction in larval population over control							
			First spray				Second spray			
			3 DAT	7 DAT	10 DAT	Mean	3 DAT	7 DAT	10 DAT	Mean
T1-Pan.3% + NLE 5%	5%	7.67	43.56 (41.29) ^a	49.28 (44.58) ^{ab}	48.33 (44.04) ^a	48.33	43.32 (41.15) ^a	50.58 (45.33) ^{ab}	43.44 (41.22) ^{ab}	45.78
T2-Pan.3% + PLE 5%	5%	7.33	11.53 (16.28) ^b	7.68 (13.32) ^c	7.68 (13.32) ^c	8.96	7.14 (12.83) ^b	7.14 (12.83) ^c	3.57 (6.56) ^c	5.95
T3-Pan. 3% + CLE 5%	5%	8.33	35.74 (36.71) ^a	35.68 (36.71) ^b	28.62 (32.25) ^b	33.34	31.61 (34.14) ^{ab}	35.61 (36.57) ^b	24.06 (29.23) ^b	30.42
T4-Pan.3% + Pungam oil 3%	5%	9.33	44.73 (41.98) ^a	57.16 (49.14) ^{ab}	49.99 (44.99) ^a	50.62	43.9 (41.48) ^a	51.36 (45.78) ^{ab}	45.05 (42.46) ^{ab}	46.77
T5-Pan.3% + NSKE 3%	5%	8.67	50.05 (45.03) ^a	67.69 (55.14) ^a	56.96 (49.00) ^a	58.23	49.39 (44.65) ^a	63.16 (52.72) ^a	53.91 (47.24) ^a	55.48
T6-Pan. alone 3%	5%	6.67	9.09 (14.55) ^b	4.55 (7.41) ^c	0.00 (0.29) ^c	4.55	3.84 (6.81) ^{bc}	3.84 (6.81) ^{cd}	4.33 (7.23) ^c	4.03
T7-Control	-	7.33	0.00 (0.29) ^c	0.00 (0.29) ^c	0.00 (0.29) ^c	0.00	0.00 (0.29) ^c	0.00 (0.29) ^d	0.00 (0.29) ^c	0.00
SE(d)			6.115	6.644	4.057		5.222	5.507	5.536	
CD (0.05%)			13.327	14.476	8.839		11.390	11.999	12.062	

Pan-Panchagavya, NLE-Neem leaf extract, PLE- *Prosopis* leaf extract, NLE- Neem leaf extract, CLE-*Calotropis* leaf extract, NSKE-Neem seed kernel extract, NSKE- Neem seed kernel extract

PTC = Pre – treatment Count, DAT = Days after treatment

* Mean of three replications, Figures in parentheses are arcsine (x + 0.5) transformed values, means in column followed by a common letter are not significantly different at the 5 per cent level (DMRT)

phagostimulant as it contains milk derivatives. Mudigourda *et al.* (2009) reported that Panchagavya + NSKE treated field recorded very low incidence of sorghum shoot fly (*Atherigona soccata*) and gave highest yield of 14.16 q/ha. Hence results of present investigation concludes that panchagavya in combination with NSKE was proved was highly effective in managing the *E. vittella* on bhendi and this treatment can be best used under organic farming.

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