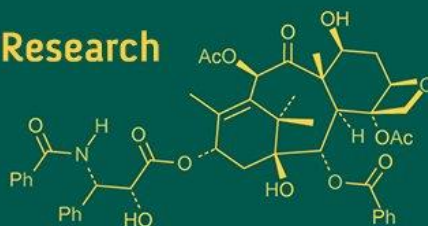


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; 10(4): 589-591
www.biochemjournal.com
Received: 02-02-2026
Accepted: 05-03-2026

Shravya Savithri K
Department of Entomology
College of Agriculture,
University of Agricultural
Sciences, Dharwad,
Karnataka, India

Prakash HT
Department of Entomology
College of Agriculture,
University of Agricultural
Sciences, Dharwad,
Karnataka, India

Eco-friendly management of shoot fly, *Atherigonna approximate* Malloch in pearl millet

Shravya Savithri K and Prakash HT

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i4h.8229>

Abstract

Field experiment on the eco-friendly management of shoot fly, *Atherigonna approximate* Malloch in pearl millet was undertaken at the Regional Agricultural Research Station, Vijayapura, Karnataka, during *Kharif* 2022-23. In the present findings, it was found that chemical insecticides proved to be significantly superior and most efficacious treatment in reducing the shoot fly infestation. Maximum percentage of reduction of shoot fly, *A. approximate* dead hearts over control was cypermethrin 10 EC @ 0.5 ml/l (68.73%), which showed better control of shoot fly over other treatments. The next best treatment was emamectin benzoate 5% SG @ 0.2 g/l (68.00%) followed by malathion 5% D @ 8 kg/acre (60.04%). Among botanicals, NSKE 5% (52.84%) followed by and agniastra 3% (46.17%) reduced dead heart percent. In microbials, *Lecanicilium lecanii* (2×10^8 CFU/ml) @ 2 ml/l (48.23%) was effective.

Keywords: Pearl millet, shoot fly, *Atherigonna approximate*, eco-friendly management, insecticides

Introduction

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is the most important cereal crop after rice, wheat, maize and sorghum. It is the staple food for 90 million poor people and widely grown on 30 million ha in the arid and semi-arid tropical regions of Africa (>18 million ha) and Asia (>10 million ha), accounting for half of the world's millet production. It is used as a staple food for humans and as fodder and feed in the livestock sector. It is also used in industries such as alcohol and fuel, starch, and the processed food sector (Anon., 2018). A 100 grams of bajra contain energy (360 calories), protein (12 g), fat (5 g), minerals (2 g), fibre (1 g), carbohydrate (67 g), calcium (42 mg), phosphorus (242 mg) and iron (8 mg). Its grains have high densities of zinc and iron (Rai *et al.*, 2008) [10].

In India, pearl millet is cultivated in an area of 6.84 million ha with a productivity of 1430 kg/ha and a production estimate of 9.78 million tonnes (Anon., 2022) [4]. The major pearl millet growing states are Rajasthan, Uttar Pradesh, Haryana, Gujarat and Madhya Pradesh, which contribute 90 percent of total production in the country (Anon., 2021 a) [2]. In Karnataka, it is called "Sajje" and grown in an area of 0.22 million ha with an annual production of 0.29 million tonnes having productivity of 1303 kg/ha. (Anon., 2021 b) [3]

Due to the introduction of high-yielding varieties, insect pest problems have also increased simultaneously. The distribution and damage of insect pests vary from location to location. Worldwide, at least 150 insect species are recorded as feeding on millets (Nwanze and Harris, 1992) [8]. However, Prem Kishore and Solomon (1989) [9] provided a list of approximately 25 species of potential insect pests in India's pearl millet-based cropping systems. Natarajan *et al.* (1973) [7] reported *Atherigona* spp. as one of the major insect pests of pearl millet in India. The female shoot fly lays eggs singly on the under surface of leaves. After hatching, the larvae move to the growing point and cut the central leaf, resulting in the production of a dead heart. Infestation normally occurs 1-4 weeks after the seedling emergence stage. Kishore (1989) [9] reported about 23.3 to 36.5 percent grain losses and 37.5 percent fodder losses by shoot fly. However, the tillers are also attacked under high shoot fly pressure (Anon., 1988) [1]. Chemical control is required when infestation levels are extremely high to prevent significant crop losses. Hence, in the present study some microbials, botanicals, and chemicals were taken to test their bio-efficacy against shoot fly.

Corresponding Author:
Shravya Savithri K
Department of Entomology
College of Agriculture,
University of Agricultural
Sciences, Dharwad,
Karnataka, India

Materials and Methods

For the eco-friendly management of major insect pests of pearl millet, the experiment was conducted at the RARS, Vijayapura during 2022-23. For this experiment, the pearl millet hybrid Krishna (DSBH-615) was sown with a spacing of 45 × 15 cm in a plot size of 3 m × 2.7 m. The field experiment was laid out in Randomized Complete Block Design (RCBD) with eight treatments and three replications comprising different insecticides along with untreated control.

Table 1: Treatment details eco-friendly management of major insect pests of pearl millet

Tr. No.	Treatment details	Dosage
T1	<i>Lecanicillium lecanii</i> (2×10 ⁸ CFU/ml)	2 ml/lit
T2	<i>Metarhizium rileyi</i> (2×10 ⁸ CFU/ml)	2 ml/lit
T3	NSKE	5%
T4	Agniastra	3%
T5	Cypermethrin 10% EC	0.5 ml/lit
T6	Malathion 5% D (Standard check)	8 kg/Acre
T7	Emamectin benzoate 5% S G	0.2 g/lit
T8	Untreated Control	--

Observations recorded

The treatments were imposed when major pest populations were at their peak. Pretreatment observations were taken the day before on five randomly selected pearl millet plants in each plot. Post treatment observations were recorded on one, three, five, seven and ten days after application. The percent reduction over control was worked out using the following formula,

$$\text{Percentage reduction over control} = \frac{\text{Pest population in control} - \text{Pest population in treatment}}{\text{Pest population in control}} \times 100$$

Statistical analysis

The statistical analysis of the data obtained from management trials was done by the Analysis of Variance (ANOVA). After analysis, data were accommodated in the table as per the needs of the objective for the interpretation of results. The differences in the observations among the different treatments were compared by following Duncan's Multiple Range Test (DMRT). The interpretation of data was done by using the critical difference value calculated at the 0.05 probability level.

Results and discussion

The results obtained from the present investigation as well as relevant discussion have been summarized here (Table 2). The pre-treatment observations revealed that, there were no significant differences in percent dead hearts due to shoot fly across the treatments and it ranged from 10.67 to 11.14 percent during one day before spray (DBS).

One day after spray, the percentage of dead hearts ranged from 6.51 to 14.35 percent. Among chemicals, the treatments cypermethrin 10 EC @ 0.5 ml/l and emamectin benzoate 5% SG @ 0.2 g/l, were found superior with the least dead heart percent of 6.51 and 7.06 which were on par with each other, followed by the treatment malathion 5% D @ 8 kg/acre with 8.24 percent dead hearts. Among botanicals, the maximum reduction in dead heart percent was recorded by NSKE 5% with 9.65 percent dead hearts and agniastra 3% with 10.59 percent dead hearts which were both on par. Among microbials, *Lecanicillium lecanii* (2×10⁸

CFU/ml) @ 2 ml/l was found effective with 10.75 percent dead hearts, and it was followed by *Metarhizium rileyi* (2×10⁸ CFU/ml) @ 2 ml/l was found with 14.12 percent dead hearts (Table 2).

Three days after spray, the percentage of dead hearts ranged from 6.35 to 17.18 percent. The treatment cypermethrin 10 EC @ 0.5 ml/l was found superior, with the lowest dead heart incidence of 6.35 percent and was on par with treatments emamectin benzoate 5% SG @ 0.2 g/l and malathion 5% D @ 8 kg/acre with 6.75 percent and 8.08 percent dead hearts which were on par with each other. Among botanicals, NSKE 5% with 9.49 percent dead hearts was followed by agniastra 3% with 10.43 percent dead hearts. Among microbials, *Lecanicillium lecanii* (2×10⁸ CFU/ml) at 2 ml/l had 10.35 percent dead hearts. The least effective treatment was *Metarhizium rileyi* (2×10⁸ CFU/ml) at 2 ml/l with 16.47 percent dead hearts, while the control plot had 17.18 percent dead hearts. Similar trend for shoot fly dead heart percent was observed at five days after spraying (Table 2).

After seven days of spray, the dead hearts percentage ranged from 5.65 to 20.71 percent. Among chemicals, the treatments cypermethrin 10 EC @ 0.5 ml/l and emamectin benzoate 5% SG @ 0.2 g/l were found to be superior with a lower dead heart incidence of 5.56 percent and 5.88 percent respectively. Treatment malathion 5% D @ 8 kg/acre was on par with them with 7.29 percent dead hearts. Among botanicals, NSKE 5% with 8.71 percent dead hearts, followed by agniastra 3% with 10.12 percent dead hearts. Among microbials, *Lecanicillium lecanii* (2×10⁸ CFU/ml) @ 2 ml/l was found with 9.41 percent dead hearts and it was followed by least successful treatment *Metarhizium rileyi* (2×10⁸ CFU/ml) @ 2 ml/l with 20.47 percent dead hearts. The control plot had 20.71 percent dead hearts. Similar trend for shoot fly dead heart percent was observed at ten days after spraying (Table 2).

In a nutshell, all the treatments reduced the percent dead heart caused by shoot fly. Among chemicals, synthetic pyrethroid cypermethrin 10 EC was most effective which act on sodium channels of nerve by affecting the electrical impulse transmission along the axons, followed by emamectin benzoate 5% SG belonging to avermectins which block the neurotransmitter, gamma amino butyric acid (GABA) at the neuro muscular junction. Then it was malathion 5% D being acetylcholinesterase inhibitor overstimulates the nerve cells and kills the insect. Among botanicals NSKE 5% acted as antifeedant and ecdysone inhibitor and it was followed by agniastra 3%. In microbials *Lecanicillium lecanii* (2×10⁸ CFU/ml) @ 2 ml/l showed somewhat lower percent mortality in of shoot fly larval populations because it took more time for this biopesticide to colonise and cause epizootics. *Metarhizium rileyi* (2×10⁸ CFU/ml) @ 2 ml/l was ineffective against shoot fly because it was not susceptible to the particular fungus as stated by Fronza *et al.* (2017).

The current findings are in line with findings of Balikai (2006) and Sandhu (2016) also recorded the application of cypermethrin 10 EC @ 0.05 kg a.i./ha at 6 and 12 DAE provided best control of shoot fly. Jambagi *et al.* (2022) reported that seed treatment with thiamethoxam 30 FS + one spray of cypermethrin 10 EC 0.5 ml/l and seed treatment with thiamethoxam 30 FS + one spray of emamectin benzoate 5 SG 0.2 g/l found superior with least incidence of percent dead hearts in the management of shoot fly A.

approximata in wheat. Which were in line with the present findings. Tandi and Bajiya (2013) ^[12] reported that, seed treatment with imidacloprid 600 FS @ 8.75 ml/kg seed

followed by spraying of NSKE 5% at 35 DAG effective against shoot fly and stem borer in pearl millet.

Table 2: Eco-friendly management of shoot fly, *Atherigona approximata* Malloch on pearl millet during Kharif 2022-23

Tr. No.	Treatment	Dose (g or ml/l)	Dead heart (%)							Percent reduction over control
			1 DBS	1 DAS	3 DAS	5DAS	7DAS	10 DAS	Mean	
T ₁	<i>Lecanicilium lecanii</i> (2x10 ⁸ CFU/ml)	2	10.98 (19.35)	10.75 (19.14) ^b	10.35 (18.77) ^c	10.12 (18.55) ^c	9.41 (17.87) ^b	8.71 (17.16) ^b	9.87	48.23
T ₂	<i>Metarhizium rileyi</i> (2x10 ⁸ CFU/ml)	2	11.06 (19.42)	14.12 (22.07) ^c	16.47 (23.94) ^d	17.88 (25.02) ^d	20.47 (26.90) ^c	24.39 (29.60) ^c	18.67	2.06
T ₃	NSKE	5%	10.82 (19.21)	9.65 (18.10) ^b	9.49 (17.94) ^{bc}	8.86 (17.32) ^{bc}	8.71 (17.16) ^{ab}	8.24 (16.68) ^{ab}	8.99	52.84
T ₄	Agniastra	3%	10.90 (19.28)	10.59 (18.99) ^b	10.43 (18.84) ^c	10.27 (18.70) ^c	10.12 (18.55) ^b	9.88 (18.32) ^b	10.26	46.17
T ₅	Cypermethrin 10% EC	0.5	10.67 (19.06)	6.51 (14.78) ^a	6.35 (14.60) ^a	5.88 (14.04) ^a	5.65 (13.75) ^a	5.41 (13.45) ^a	5.96	68.73
T ₆	Malathion 5% D	8 kg/Acre	10.82 (19.21)	8.24 (16.68) ^{ab}	8.08 (16.51) ^{ab}	7.76 (16.18) ^{ab}	7.29 (15.67) ^{ab}	7.06 (15.41) ^{ab}	7.62	60.04
T ₇	Emamectin benzoate 5% SG	0.2	10.74 (19.14)	7.06 (15.41) ^a	6.75 (15.05) ^{ab}	6.12 (14.32) ^{ab}	5.88 (14.04) ^a	5.65 (13.75) ^a	6.29	67.00
T ₈	Control		11.14 (19.50)	14.35 (22.26) ^c	17.18 (24.48) ^d	18.59 (25.54) ^d	20.71 (27.07) ^c	24.47 (29.65) ^c	19.06	
	S.E.m.±	-	0.87	0.81	1.01	1.01	1.17	1.41		
	C.D (P = 0.05)	-	NS	2.47	3.07	3.06	3.54	4.27		
	C.V (%)	-	7.84	7.67	9.30	9.36	10.75	12.72		

*Figures in parentheses are $\sqrt{(x + 0.5)}$ transformed values. Means followed by same alphabet in a column do not differ significantly (0.05) by DMRTNS: Non-Significant; DAS: Days After Spraying.

Conclusion

Pearl millet is an important crop grown in North-Karnataka and it is prone to attack of some insect pests. Shoot fly is a major grain yield limiting factor that causes damage when the sowing is delayed and late sown crops are most affected. Unfortunately, suggested insecticides for controlling insect pests cannot be afforded by pearl millet farmers, and their use is not economically viable at the current level of production. From the present study it was evident that, eco-friendly management is effective against shoot fly. The chemical insecticides viz., cypermethrin 10 EC @ 0.5 ml/l, emamectin benzoate 5 SG @ 0.2 g/l and malathion 5% D @ 8 Kg/acre recorded significantly less infestation. Among the botanicals, NSKE 5% and agniastra 3% showed better control. Among microbials, *Lecanicilium lecanii* (2x10⁸ CFU/ml) @ 2 ml/l was effective.

References

- Anonymous. Insect and other animal pests of millets. India: ICRISAT; 1988.
- Anonymous. Directorate of Millets Development: project coordinator review. 2021a.
- Anonymous. Agricultural statistics at a glance. Directorate of Economics and Statistics, Department of Agriculture, Ministry of Agriculture & Farmers Welfare, Government of India; 2021b.
- Anonymous. Directorate of Economics and Statistics, Department of Agriculture, Ministry of Agriculture & Farmers Welfare, Government of India; 2022.
- Balikai RA. Bio-ecology and management of sorghum shoot fly, *Atherigona soccata* Rondani. Int J Agric Sci. 2006;2(2):644-646.
- Fronza E, Specht A, Heinzen H, de Barros NM. *Metarhizium (Nomuraea) rileyi* as biological control agent. Biocontrol Sci Technol. 2017;27(11):1243-1264.
- Natarajan US, Raja VDG, Selvaraj S, Anavaradham L. Extent of damage caused by shoot fly (*Atherigona*

approximata) on pearl millet hybrids. Madras Agric J. 1973;60:584-585.

- Nwanze KF, Harris KM. Insect pests of pearl millet in West Africa. Rev Agric Entomol. 1992;80:1132-1185.
- Prem Kishore, Solomon S. Research needs and future strategies for controlling insect pest problems on bajra-based cropping system. Seeds Farms. 1989;15(1):23-28.
- Rai KN, Gouda CLL, Reddy BVS, Sehgal S. The potential of sorghum and pearl millet in alternative and health food uses. Compr Rev Food Sci Food Saf. 2008;7(1):340-352.
- Sandhu GS. Evaluations of management components against shoot fly in sorghum. Ann Plant Prot Sci. 2016;4:67-70.
- Tandi BL, Bajiya RS. Management of shoot fly and stem borer in pearl millet. Indian J Appl Entomol. 2013;27:73-75.