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EVALUATION OF COMPARATIVE EFFICACY OF BIOPESTICIDES AND CONVENTIONAL INSECTICIDES AGAINST SHOOT FLY DAMAGE ON MAIZE

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ABSTRACT

The current study was conducted to compare the efficiency of biopesticides and conventional insecticides against dead heart cause by shoot fly (%) on maize at the Entomology Research Farm, College of Agriculture, RVSKVV, Gwalior, M.P., during *Kharif* 2024 and *Kharif* 2025. For this study, 10 treatments and three replications were chosen with the DMRH variety 1410. Treatments include Spinosad 45% SC, Imidacloprid 17.8% SL, Chlorantraniliprole 18.5% SC, Acetamiprid 20% SP, Emamectin benzoate 5% SG, *Beauveria bassiana* (1×10^8 CFU/ml), *Metarhizium anisopliae* (1×10^8 CFU/ml), *Verticillium lecanii* (1×10^8 CFU/ml), Azadiractine (1500 ppm) and Control (water spray). Among the treatments Imidacloprid 17.8% SL (10.28%) significantly superior to the rest of the treatments. It was followed by Spinosad 45% SC (13.06%), Chlorantraniliprole 18.5% SC (15.83%), Emamectin benzoate 5% SG (16.39%), Acetamiprid 20% SP (19.17%). Next group of effective treatment was Azadiractin (1500 ppm) (22.50%) followed by *B. bassiana* (1×10^8 CFU/ml) (24.17%), *M. anisopliae* (1×10^8 CFU/ml) (26.39%) and *Verticillium lecanii* (1×10^8 CFU/ml) (28.61%). While in control it was (32.50%).

Key words: Shoot fly, Biopesticides, Conventional insecticides, Maize, Dead heart.

Introduction

Maize (*Zea mays* L.) is a cereal crop of the Gramineae (Poaceae) family that is among the most frequently farmed in the world. It is known as the “Queen of Cereals” due to its exceptional adaptability and high productivity among cereal crops (Singh and Jaglan, 2018). Maize first appeared in Central Mexico around 5000 BC and is today farmed in tropical, subtropical, and temperate areas. Maize is classified into various varieties, including dent corn, flint corn, pod corn, popcorn, flour corn, and sweet corn. Maize is grown on over 205 million hectares in over 165 countries worldwide, with a production of over 1,225 million tons and a productivity of around 5.88 tonnes/ha in 2024-2025 (FAO, 2024; USDA, 2024).

According to Suman et al. (2023), insect pests cause an estimated 31% reduction in maize production and 13.2% in annual economic losses. Only three important insect pests *C. partellus*, *S. inferens*, and *A. soccata* have been the subject of studies on the ecology and dynamics of maize pest populations. With this shift, the shoot fly, has emerged as one of the potential pests of maize crop. In contrast, sorghum shoot fly infestations ranged from 69 to 97%, with up to 20% loss in grain productivity and an estimated 77.7% decrease in yield (Kumar et al., 2016). Madhya Pradesh's agroclimatic conditions are ideal for the growth and spread of insect pests on maize. Farmers suffer enormous financial losses as a result of the pests continual presence, which reduces

yields and increases cultivation requirements. As a result, employing environmentally friendly and sustainable pest management approaches has become critical. Insect pests in maize can be effectively controlled with integrated pest management (IPM), which reduces environmental risks and keeps pest numbers below economic thresholds. Keeping the foregoing in mind, the current research on maize was carried out.

Material and Methods

The maize crop was sown on July 25th, 2024 and July 25th, 2025 using the DMRH - 1410 variety, at a spacing of 60 cm × 20 cm, with 10 treatments and 3 replications.

The first spray was initiated on the basis appearance of insect pests and second spraying was done at 15th day after first as proposed by Asawalam and Constance (2018). Pre-treatment observation of dead heart cause by shoot fly (%) on maize was recorded at one day before spray and post treatment observations were recorded at 3, 7 and 10 days after each spray on randomly selected plants per plot (Singh *et al.*, 2018). Dead heart caused by shoot fly (%) was count on randomly selected 10 plants per plot (Shah *et al.*, 2016).

$$\text{Percent dead heart} = \frac{\text{No. of plants with dead hearts}}{\text{Total no. of plants observed}} \times 100$$

Results and Discussion

Over all mean of two sprays during *Kharif* 2024 dead heart caused by shoot fly (%) in all the treatments was significantly superior than control plot (32.78%). Lowest population of dead heart caused by shoot fly (%) was recorded with Imidacloprid 17.8% SL (8.89%) significantly superior to the rest of the treatments. It was followed by Spinosad 45% SC (11.67%), Chlorantraniliprole 18.5% SC (14.44%), Emamectin

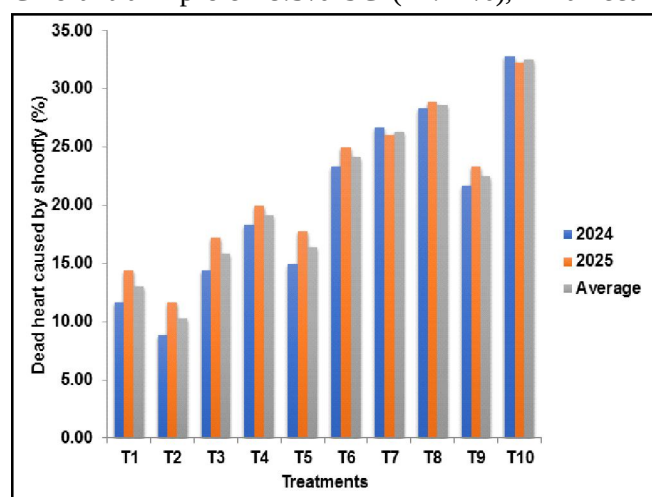


Fig. 1: Dead heart caused by shoot fly (%) under treatments during *Kharif* 2024 and *Kharif* 2025.

Table 1: Treatment Details.

Treat. Code	Treatment	DP
T ₁	Spinosad 45% SC	200ml
T ₂	Imidacloprid 17.8% SL	250ml
T ₃	Chlorantraniliprole 18.5% SC	200ml
T ₄	Acetamiprid 20% SP	100 gm
T ₅	Emamectin benzoate 5% SG	200gm
T ₆	<i>Beauveria bassiana</i> (1×10 ⁸ CFU/ml)	1500ml
T ₇	<i>Metarhizium anisopliae</i> (1×10 ⁸ CFU/ml)	1500ml
T ₈	<i>Verticillium lecanii</i> (1×10 ⁸ CFU/ml)	1500ml
T ₉	Azadiractine (1500 ppm)	2000ml
T ₁₀	Control (water spray)	500 litre
DP: Doses of pesticides (per ha)		

benzoate 5% SG (15.00%), Acetamiprid 20% SP (18.33%). Next group of effective treatment was Azadiractin (1500 ppm) (21.67%) followed by *B. bassiana* (1×10⁸ CFU/ml) (23.33%), *M. anisopliae* (1×10⁸ CFU/ml) (26.67%) and *Verticillium lecanii* (1×10⁸ CFU/ml) (28.33%) which was at par with each other.

Over all mean of two sprays during *Kharif* 2025 dead heart caused by shoot fly (%) in all the treatments was significantly superior than control plot (32.22%). Lowest population of dead heart caused by shoot fly (%) was recorded with Imidacloprid 17.8% SL (11.67%) significantly superior to the rest of the treatments. It was followed by Spinosad 45% SC (14.44%). Next effective treatment was Chlorantraniliprole 18.5% SC (17.22%) which was on par with Emamectin benzoate 5% SG (17.78%) and next was Acetamiprid 20% SP (20.00%). Next group of effective treatment was Azadiractin (1500 ppm) (23.33%) followed by *B. bassiana* (1×10⁸ CFU/ml) (25.00%), *M. anisopliae* (1×10⁸ CFU/ml) (26.11%) and *Verticillium lecanii* (1×10⁸ CFU/ml) (28.89%).

The data on the overall mean bio efficacy (Table 2, Fig. 1) of various insecticidal treatments of both years indicated that all insecticidal treatments demonstrated significantly greater effectiveness compared to the untreated control. The pooled mean computed from overall mean of *Kharif* 2024 and *Kharif* 2025 indicated that the dead heart caused by shoot fly (%) varied between 10.28% and 28.61% in insecticide-treated plots, in contrast to the untreated control plot, which exhibited the highest count (32.50%). Among the treatments Imidacloprid 17.8% SL (10.28%) significantly superior to the rest of the treatments. It was followed by Spinosad 45% SC (13.06%). Next effective treatment was Chlorantraniliprole 18.5% SC (15.83%) which was on par with Emamectin benzoate 5% SG (16.39%) and next was Acetamiprid 20% SP (19.17%). Next group of

Table 2: Average mean for dead heart cause by shoot fly (%) and per cent reduction over control under biopesticides and conventional insecticides during *Kharif* 2024 and *Kharif* 2025.

Treat. Code	Treatments	Dosage/ha (ml/g)	MDHS			ROC (%)		
			2024	2025	Average	2024	2025	Average
T ₁	Spinosad 45% SC	200ml/ha	11.67(19.96)* ^{af}	14.44(22.32) ^g	13.06(21.15) ^g	64.05 ^b	55.18 ^b	59.61 ^b
T ₂	Imidacloprid 17.8% SL	250ml/ha	8.89(17.32) ^g	11.67(19.93) ^h	10.28(18.65) ^h	72.73 ^a	63.77 ^a	68.25 ^a
T ₃	Chlorantraniliprole 18.5% SC	200ml/ha	14.44(22.32) ^e	17.22(24.49) ^f	15.83(23.42) ^f	55.74 ^c	46.58 ^c	51.16 ^c
T ₄	Acetamiprid 20% SP	100 gm/ha	18.33(25.34) ^d	20.00(26.54) ^e	19.17(25.95) ^e	43.51 ^d	37.9 ^d	40.7 ^d
T ₅	Emamectin benzoate 5% SG	200gm/ha	15.00(22.78) ^e	17.78(24.92) ^f	16.39(23.85) ^f	53.78 ^c	44.83 ^c	49.3 ^c
T ₆	<i>Beauveria bassiana</i> (1×10 ⁸ CFU/ml)	1500ml/ha	23.33(28.86) ^c	25.00(29.98) ^c	24.17(29.43) ^d	28.48 ^e	22.37 ^f	25.42 ^f
T ₇	<i>Metarhizium anisopliae</i> (1×10 ⁸ CFU/ml)	1500ml/ha	26.67(31.07) ^b	26.11(30.71) ^c	26.39(30.90) ^c	18.2 ^f	18.95 ^f	18.58 ^g
T ₈	<i>Verticillium lecanii</i> (1×10 ⁸ CFU/ml)	1500ml/ha	28.33(32.13) ^b	28.89(32.50) ^b	28.61(32.32) ^b	13.44 ^f	10.35 ^g	11.9 ^h
T ₉	Azadiractin (1500 ppm)	2000ml/ha	21.67(27.73) ^c	23.33(28.86) ^d	22.50(28.30) ^d	33.24 ^e	27.55 ^e	30.39 ^e
T ₁₀	Control (water spray)	500 litre/ha	32.78(34.89) ^a	32.22(34.57) ^a	32.50(34.74) ^a	-	-	-
	SEm ±	0.53	0.34	0.55	-	-	-	-
	CD at 5%	1.57	1.02	1.75	-	-	-	-

MDHS: Mean of dead heart cause by shoot fly (%); ROC: Reduction in over control. *Figures in the parentheses are arcsine transformed values, DMRT test - Means followed by different letters are significantly different

effective treatment was Azadiractin (1500 ppm) (22.50%) which was at par with *B. bassiana* (1×10⁸ CFU/ml) (24.17%). Least effective treatment was *M. anisopliae* (1×10⁸ CFU/ml) (26.39%) followed by *Verticillium lecanii* (1×10⁸ CFU/ml) (28.61%). The current findings are validated by Sonalkar *et al.*, (2018) who discovered that the treatments imidacloprid 70% WS exhibited a substantial difference in reducing shoot fly infestation. Parmar *et al.*, (2023) discovered that imidacloprid 600 FS followed by a foliar spray of chlorantraniliprole 20 SC at 35 DAG, was an effective treatment for shoot fly control.

Conclusion

Results revealed that treatment Imidacloprid 17.8% SL significantly superior with the rest of the treatments. It was followed by Spinosad 45% SC and Chlorantraniliprole 18.5% SC. A significantly higher per cent of reduction the dead heart caused by shoofly (%) was recorded in the treatment Imidacloprid 17.8% SL followed by Spinosad 45% SC.

Declaration: There are no conflicts of interest, according to the authors.

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