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EFFICACY OF SPRAY SCHEDULE AGAINST MAJOR PESTS OF OKRA *(ABELMOSCHUS ESCULENTUS)*

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ABSTRACT

The investigations on "Efficacy of spray schedule against major pests of okra" was carried out at research farm, Department of Entomology, (Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani) Maharashtra-India during *Kharif* 2024. The Parbhani kranti variety was used for the study. The significant difference among the effect of different treatments spray schedule against mite and okra fruit and shoot borer indicated that all the treatments were found to be significantly superior in recording minimum number of mite and okra shoot and fruit borer over untreated control. The results indicated that the effect of different treatments of spray schedule after all the sprays revealed that the lowest mite pest population was observed in the plots treated with *Metarhizium anisopliae* > *Bt* powder > tolfenpyrad 15% EC. This was closely followed by Pongamia seed extract 5 % >*Bt* powder > cyantraniliprole 10.26 OD, NSKE 5 % >*Bt* powder > spinosad 45 EC and *Lecanicillium lecanii*>*Bt* powder > isocycloseram 9.2% DC. Other effective treatments included Biomix >*Bt* powder > fluxametamide 10% EC and *Beauveria bassiana*>*Bt* powder > broflanilide 20% SC. All these treatments recorded significantly lower populations compared to the untreated control, in pooled data.
The pooled data on average percentage of fruit borer infestation on an okra fruit number basis, indicated that all treatments performed significantly better than the untreated control. Among the tested treatments, the most effective was the spray schedule involving T_5–NSKE 5 % >*Bt* Powder > spinosad 45 EC, which recorded the lowest fruit infestation. This was closely followed by T_6 – Pongamia seed extract 5 % >*Bt* Powder > cyantraniliprole 10.26 OD, and T_4 – Biomix >*Bt* Powder > fluxametamide 10% EC. Next in effectiveness was the treatment T_2 – *Metarhizium anisopliae*>*Bt* powder > tolfenpyrad 15 % EC, showing 8.47 % infestation, followed by *Lecanicillium lecanii* >*Bt* Powder > isocycloseram 9.2 % DC (8.82 %) and *Beauveria bassiana*>*Bt* powder > broflanilide 20% SC (9.13%). Though moderately effective, these treatments still performed significantly better than the untreated control.
***Keywords*:** Okra *Abelmoschus esculentus*, Mite, Okra shoot and fruit borer, Spray Schedule.

Introduction

Okra *(Abelmoschus esculentus)*, also known as lady's finger, is a widely cultivated vegetable in tropical countries, particularly in India, Nigeria, Pakistan, Cameroon, Iraq, and Ghana. Although it is not commonly grown in Europe and North America, the vegetable has gained popularity in these regions due to its high nutritional value, including significant amounts of Vitamin A, folic acid, carbohydrates, phosphorus, and magnesium. Okra is known by various local names across the globe, such as lady's finger in England, gumbo in the United States, guino gumbo in Spanish, guihero in Portuguese, and bhindi in India. It is commercially grown in countries like India, Turkey, Iran, Western Africa, Yugoslavia, Bangladesh, Afghanistan, Burma, Japan, Malaysia, Brazil, Ghana, Ethiopia, and the southern United States. In India, major okra-producing states include Uttar Pradesh 700 thousand tonnes, Bihar 788 thousand tonnes, West

Bengal 862 thousand tonnes, Andhra Pradesh 1184 thousand tonnes, Karnataka 600 thousand tonnes, and Assam 500 thousand tonnes (Anonymous, 2022-23).

Ripe okra seeds are roasted, ground, and used as a coffee substitute in some regions. The mature fruits and stems, rich in crude fiber, are used in the paper industry. Extracts from the seeds are also considered an alternative source of edible oil, with a pleasant taste and a high concentration of unsaturated fats such as oleic and linoleic acids. The seed oil content is approximately 40%. Okra is valued for its medicinal properties, particularly in treating genito-urinary disorders, spermatorrhoea, chronic dysentery, ulcers, and hemorrhoids. In developing countries like India, where malnutrition is prevalent, vegetables like okra play a crucial role in addressing dietary deficiencies. Currently, vegetables account for only 8 to 10 percent of the typical Indian diet, which is primarily vegetarian. Increasing vegetable consumption could help alleviate the reliance on cereals, particularly for vulnerable populations.

Okra attracts a large number of insect pests including leafhoppers, *Amrasca devastans*. and *Amrasca biguttula(Shirr.)*; aphids, *Aphis gossypii* (Glov.) cutworm, *Agrotis spp*. and mite *Tetranychus sp*. Among insect pests, aphids especially A. *gossypii* is considered as a one of the most important pest of okra (Dhaliwal, 2004). The aphids are soft bodied insects which suck the cell sap from the leaves, secrete lots of honey dew on the leaves, hence, weakening the plants and reducing both quantity and quality of the fruits. In addition to okra, the aphids also feed on a variety of plants including the cucurbits, cotton, citrus fruits, strawberry, beans, beets, spinach, eggplant, asparagus, a number of ornamental plants and many weeds (Atwal, 1994). Okra crop is susceptible for pest infestation from early stage to maturity. Among the wide array of insect pests infesting okra crop, the sucking pests such as aphid, leafhopper and two species of whitefly are reported to be quite serious during all stages of the crop growth (Channabasavanna, 1981). Therefore, it is necessary to study the effect of different insecticides and bio pesticides evaluate them in spray schedules for formulating effective and economical management strategies of insect pests.

Materials and Methods

The present investigation was conducted at the research farm, Department of Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during the *Kharif* season of 2024, in Randomized Block Design with seven treatments. For recording the number of mite pest population, five plants were selected randomly in each plot and were tagged. Observations were recorded on three leaves, from the top, middle and bottom of five tagged plants in each plot. The first observation was recorded 1 day before treatment as a pretreatment count and post-treatment observations were recorded on the 3rd, 7th, and 14th day after each spraying. Data thus obtained was analyzed statistically and presented for interpretation of the results. For recording observations of shoot and fruit borer, from each plot five plants was selected randomly and labeled. As soon as the infestation of pest on shoot was initiated, the observations on total number of shoots and number of infested shoots after first spray and fruit infestation after second and third spray of five observational plants from each treatment and replication wise was recorded. Population pre-treatment observations were recorded from the 24 hours before application of treatments and observation recorded on 3rd, 7th and 14th days after spraying from each observation plants. The incidence of okra fruit and shoot borer was recorded in terms of mean percent infestation on number basis.

Table 1: The details of the treatments in spray schedules

Sr. No.	**Treatment**		
	1st spray	**2nd spray**	**3rd spray**
1)	*Beauveria bassiana*	*Bt* powder	Broflanilide 20% SC
2)	*Metarhizium anisopliae*	*Bt* powder	Tolfenpyrad 15% EC
3)	*Lecanicillium lecanii*	*Bt* powder	Isocycloseram 9.2 % DC
4)	Biomix	*Bt* Powder	Fluxametamide 10% EC
5)	NSKE 5 %	*Bt* Powder	Spinosad 45 EC
6)	Pongamia seed Extract 5%	*Bt* Powder	Cyantraniliprole 10.26 OD
7)	Untreated Control		

Results and Discussion

An experiment was conducted in *Kharif*2024 to evaluate spray schedule against Okra major pest such as mite and fruit and shoot borer. In all three sprays were undertaken with different treatment at each time to constitute spray schedule, the data in respect of population major pest of okra was recorded one day before spraying (DBS) and 3, 7, and 14 days after spraying (DAS) and analysed statistically and results are summarized as below.

The T_5 treatment with spray schedule with NSKE 5% found better for the management of mite of okra after first spray with lowest mean population and treatment with spray schedule T_3 *Lecanicillium lecanii*, T_2*Metarhizium anisopliae*and Biomix were the next best treatment and are at par with each other. In second spray *Bt* powder was commonly applied across all treatment hence results were statistically non-significant to alter the pest dynamics across the experiment plots except untreated control which recorded highest pest population following the second spray. In third spray T_6 treatment of cyantraniliprole 10.26 OD found better for the management of mite of okra with lowest mean and treatment T_2 tolfenpyrad 15% EC, T_4 fluxametamide 10% EC and T_3 isocycloseram 9.2% DC treatment were next best treatments and are at par with each other. For the management of Okra fruit and shoot borer Treatment T_5 Spinosad 45 EC found better with lowest mean percent infestation and treatment T_6 Cyantraniliprole 10.26 OD and T_4 fluxametamide 10% EC were the next best treatments and are at par with each other treatment in all the three sprays.

The pooled analysis of data across different time intervals and spray schedules (Table 2 and Fig 1) revealed that the lowest mite population was observed in plots treated with *Metarhizium anisopliae*>*Bt* powder > tolfenpyrad 15% EC, recording an average of 3.60 mites / 3 leaves. This was closely followed by Pongamia seed extract 5 % >*Bt* powder > cyantraniliprole 10.26 OD (3.67 mites /3 leaves), NSKE 5 % >*Bt* powder > spinosad 45 EC (3.78 mites /3 leaves) *Lecanicillium lecanii*>*Bt* powder > isocycloseram 9.2% DC (3.90 mites /3 leaves). These treatments were found to be the most effective in reducing mite infestation, showing significantly lower populations compared to the remaining treatments.

Other effective combinations included Biomix >*Bt* powder > fluxametamide 10% EC (2.19 mites/ 3leaves), and *Beauveria bassiana*>*Bt* powder > broflanilide 20% SC (4.28 mites /3 leaves) all of which significantly outperformed the untreated control, which recorded the highest mite population of (9.06 mites /3 leaves).

Naik, H.R. and Shekharappa (2009) reported that the use of *Metarhizium anisopliae* through oil-based and wettable powder formulations resulted in excellent suppression of major sucking pests such as mites, thrips, whiteflies, and leafhopper in okra. Their field and laboratory trials demonstrated 90–95% mortality, comparable to chemical standards, thereby establishing *M. anisopliae* as a promising biocontrol agent for sustainable pest management in okra.

Bajpai and Jeengar (2014) evaluated the efficacy of tolfenpyrad 15% EC against sucking pests in okra and reported that it provided effective suppression of mite populations, with over 80% reduction observed within 48 hours of application. The rapid knockdown effect and contact activity of tolfenpyrad make it a valuable tool for integrated mite management, especially under high infestation pressure.

The pooled data on average percentage of fruit borer infestation on an okra fruit number basis, as presented in table 3 and fig 2, indicated that all treatments performed significantly better than the untreated control. Among the tested treatments, the most effective was the spray schedule involving T_5 – NSKE 5 % >*Bt* Powder > spinosad 45 EC, which recorded the lowest fruit infestation at 7.03%. This was closely followed by T_6 – Pongamia seed extract 5 % > *Bt* Powder > cyantraniliprole 10.26 OD, with 7.65 % infestation, and T_4–Biomix>*Bt* Powder > fluxametamide 10% EC, which recorded 8.32 % fruit damage. Next in effectiveness was the treatment T_2 – *Metarhizium anisopliae*>*Bt* powder > tolfenpyrad 15 % EC, showing 8.47 % infestation, followed by *Lecanicillium lecanii* >*Bt* Powder > isocycloseram 9.2 % DC (8.82 %) and *Beauveria bassiana*>*Bt* powder > broflanilide 20% SC (9.13%). Though moderately effective, these treatments still performed significantly better than the untreated control, which recorded the highest fruit infestation at 15.32%.

Pachole *et al.* (2017) reported that spinosad 45 SC outperformed other treatments, achieving the lowest shoot (5.01%) and fruit (7.03%) infestation levels, and delivered the highest yield (197.22 q/ha) and cost–benefit ratio (1:5.92).

Vijayasree & Bai (2019) showed spinosad 45 SC @ 75 g a.i./ha reduced fruit borer damage by 44–83 % and yielded results comparable to newer insecticides like chlorantraniliprole and emamectin benzoate.

Choudhary *et al.* (2025) reported that cyantraniliprole 10.26 % OD, chlorantraniliprole 18.5

% SC, flubendiamide 480 SC, spinosad 45 SC, and other insecticides. Cyantraniliprole showed high efficacy in reducing *Earias vittella* infestation with substantial yield benefits.

Table 2: Evaluation of spray schedule against mite on okra (Pool data)

Tr. No.	Treatments	Mean no of Mite /3leaves				
			I^{s}Ω	II^{n}H	III≥H	Pooled
		BS	Spray	Spray	Spray	mean
T_1	*Beauveria bassiana*>*Bt* Powder > broflanilide 20% SC	4.43	2.80	3.87	6.17	4.28
		(2.21)	(1.79)	(2.33)	(2.58)	(2.23)
T_2	*Metarhizium anisopliae*>*Bt* powder > tolfenpyrad 15% EC	4.37	2.34	3.97	4.51	3.60
		(2.20)	(1.67)	(2.11)	(2.22)	(1.95)
T_3	*Lecanicillium lecanii* > *Bt* powder > isocycloseram 9.2 % DC	3.18	2.07	4.02	5.63	3.90
		(1.90)	(1.59)	(2.12)	(2.47)	(2.06)
T_4	Biomix >*Bt* Powder > fluxametamide 10% EC	4.4	2.86	3.96	5.04	3.95
		(2.21)	(1.82)	(2.41)	(2.35)	(2.19)
T_5	NSKE 5 % >*Bt* Powder> spinosad 45 EC	4.03	1.79	3.96	5.26	3.78
		(2.13)	(1.45)	(2.11)	(2.31)	(2.05)
T_6	Pongamia seed extract 5 % >*Bt* Powder > cyantraniliprole 10.26 OD	4.37	3.35	3.84	3.91	3.67
		(2.20)	(1.95)	(2.14)	(2.08)	(2.00)
T_7	Untreated Control	3.82	4.80	7.31	15.96	9.35
		(2.08)	(2.25)	(2.79)	(4.05)	(3.03)
	S.E.+		0.09		0.10	0.09
	CD 5%	NS	0.28	NS	0.30	0.21
	CV (%)		8.83		6.62	7.73

Table 3: Evaluation of spray schedule against *Earias vittella* on okra(Pool data)

Tr. No.	Treatments	Percent fruit infestation				
			I^{s}Ω	II^{n}H	III≥H	Pooled
		BS	Spray	Spray	Spray	mean
T_1	*Beauveria bassiana*>*Bt* Powder > broflanilide 20% SC	4.43	3.40	9.59	14.39	9.13
		(2.21)	(1.97)	(3.17)	(3.85)	(3.00)
T_2	*Metarhizium anisopliae*>*Bt* powder > tolfenpyrad 15% EC	4.37	2.77	9.62	13.02	8.47
		(2.20)	(1.80)	(3.17)	(3.66)	(2.88)
T_3	*Lecanicillium lecanii* > *Bt* powder > isocycloseram 9.2 % DC	3.18	3.12	9.68	13.67	8.82
		(1.90)	(1.90)	(3.18)	(3.75)	(2.94)
T_4	Biomix >*Bt* Powder > fluxametamide 10% EC	4.4	2.58	9.76	12.66	8.32
		(2.21)	(1.75)	(3.15)	(3.61)	(2.80)
T_5	NSKE 5% >*Bt* Powder> spinosad 45 EC	4.03	2.34	9.55	9.21	7.03
		(2.13)	(1.66)	(3.01)	(3.11)	(2.59)
T_6	Pongamia seed Extract 5% >*Bt* Powder > cyantraniliprole 10.26 OD	4.37	2.45	9.72	10.78	7.65
		(2.20)	(1.70)	(3.19)	(3.35)	(2.75)
T_7	Untreated Control	3.82	4.15	16.43	25.38	15.32
		(2.08)	(2.15)	(4.11)	(5.07)	(3.78)
	S.E.+		0.13		0.16	0.14
	CD 5%	NS	0.31	NS	0.49	0.21
	CV (%)		8.06		7.28	7.46

*Figures in parentheses are angular transformed values

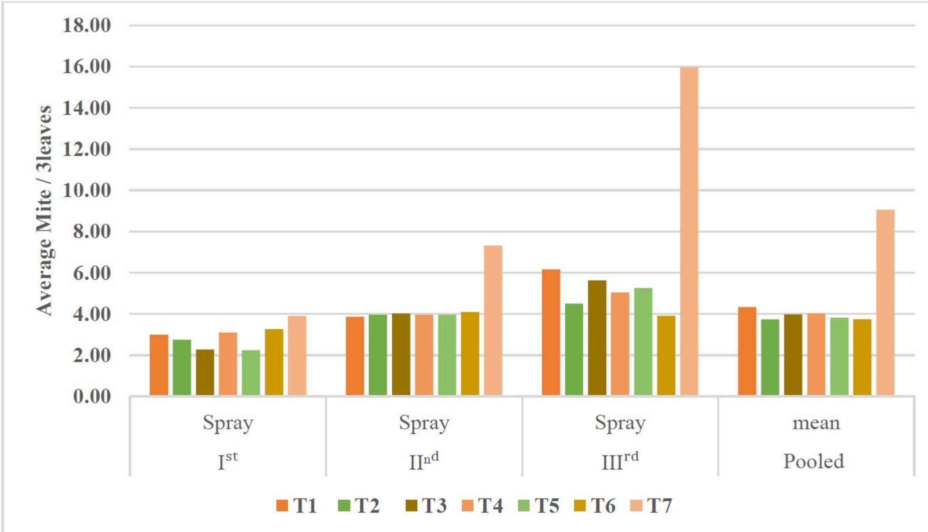

Fig. 1: Evaluation of spray schedule against okra mite (Pooled data *Kharif* 2024)

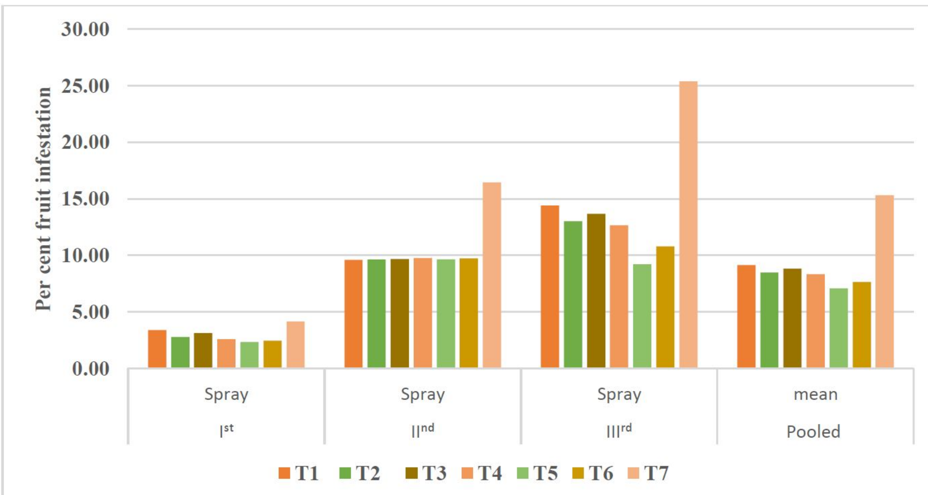

Fig. 2: Evaluation of spray schedule against *Earias vittella* (Pooled data *Kharif* 2024)

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Author Contribution Statement

Jadhav V.S. Jayewar N.E. and B.B. Gaikwad conceptualized and designed the study, conducted the study, analyzed the data, and authored the report under the supervision of Jayewar N.E.

Conflict Of Interest

No conflict of interest.

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