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RESEARCH ARTICLE

Field efficacy of different modules prepared by using combination of biopesticides and synthetic insecticides against okra shoot and fruit borer

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ABSTRACT

The yield data on marketable fruits recorded in various treatments revealed that highest yield of 36.56 q/ha was recorded in module M_9 (cypermethrin 10 EC 0.005 per cent followed by NSKE 5 per cent followed by custard apple leaf extract 10 ml aqueous solution L^{-1}) followed by module M_5 (deltamethrin 0.09 per cent, followed by Neemazal 4ml L^{-1} followed by soapnut 10 ml aqueous solution L^{-1}) (36.29 q/ha), followed by module M_8 (Profenofos 50 EC 0.05 %, followed by NSKE 5 % then garlic and chilli extracts 10 ml aqueous solution $^{-1}$) (36.11 q/ha), followed by M_4 (endosulfan 35 EC (0.06%) followed by *B thuringiensis* var. *kurstaki* @ 1.5 g L^{-1} followed by custard apple leaf extract 10 ml aqueous solution L^{-1} (35.72 q/ha) and M_3 (endosulfan 35 EC (0.06%) followed by *B thuringiensis* var. *kurstaki* @ 1.5 g L^{-1} followed by Serni leaf extract 10 ml aqueous solution L^{-1}) (35.06 q/ha) which were at par with module M_9.

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INTRODUCTION

Okra [*Abelmoschus esculentus* (Linn.) Moench] is one of the most important vegetables grown in tropical and sub-tropical parts of the world. It belongs to the family Malvaceae. Okra is subjected to the attack of as many as 72 insects and non-insect pests in the country (Rawat and Saha, 1973).The okra shoot and fruit borer caterpillar initially bores the growing shoot and later on the buds and fruits. It feeds on internal contents. In case of severe infestation, complete fruit is deshaped, hollowed and filled with humus like excreta. The pest directly affects green fruit yield as well as seed yield on maturity. It inflicts qualitative and quantitative losses in seed yield. Kadam (1993) reported that, shoot and fruit borer alone causes 66.28, 46.45 and 69.04 per cent loss in fruit yield in crops sown in summer, *Kharif* and *Rabi* seasons, respectively with an average loss of 60.69 per cent in absence of plant protection umbrella.

Application of insecticides is generally practiced by the farmers for higher gains, but its injudicious use has created many problems. Sole reliance on chemical control leads to problems of pesticide resistance, resurgence of minor pests, pesticide residues, destruction of beneficial fauna and environmental pollution. Under such circumstances, the use of botanical insecticides in pest management is considered as ecologically viable proposition which overcome the above mentioned problems (Adilakshmi *et al.,* 2008). Though some primary work has been done on recording the pests infesting okra in Konkan region and their control by various ways, the work on the use of ecofriendly methods has not been properly studied so far. Also with the increasing emphasis from the environmentalists to apprehend the use of chemical pesticides, the present study was undertaken.

MATERIALS AND METHODS

The experiment was conducted on Horticulture farm, Department of Horticulture, College of Agriculture, Dapoli in Randomized Block Design with three replications and ten treatments. Arka Anamika variety was used for the experiment. The treatment details were as follows :

Method of recording observations :

The pre-count observations were recorded one day prior to application of treatments and post-treatment observations were recorded at 3, 7, and 14 days after each spray.

Initially the observations were recorded on shoot infestation. Later, the observations were recorded both on shoots as well as flower buds and fruits. The per cent infestation was worked out on the basis of healthy and infested fruits on number basis. The weight of healthy and infested fruits from ten randomly selected plants was recorded at each observation and data thus obtained were converted into per cent infested fruit and analyzed statistically. The per cent infestation of okra shoot and fruit borer recorded at 3, 7 and 14 days of each spray was pooled and presented as relative efficacy of respective spray. The yield obtained from the blocks of various treatments was recorded separately after categorizing it into damaged and healthy and analyzed statistically.

RESULTS AND DISCUSSION

The relative efficacy of predefined modules consisting of bio pesticides, botanicals and chemical pesticides were evaluated under the field conditions for the management of shoot and fruit borer, *E.vittella* infesting okra during *Rabi* season of 2009-2010 are presented below :

Relative efficacy of different modules against okra shoot and fruit borer, *E.vittella* on number basis :

The study on overall efficacy of modules tested in present investigation is given in Table 1.

The cumulative effect of all the sprays indicated that the module M_4 composed of endosulfan 35 EC (0.06%) followed by *B. thuringiensis* var. *kurstaki* @ 1.5 g L^{-1} followed by Maharukh leaves extract 10 ml aqueous solution L^{-1} recorded lowest fruit infestation of 15.89 per cent. However, the module M_3 (endosulfan 35 EC 0.06 per cent followed by *B. thuringiensis* var. *kurstaki* @ 1.5 g L^{-1} followed by Serni leaf extract 10 ml aqueous solution L^{-1}), module M_9 (cypermethrin 10 EC 0.005 per cent followed by NSKE 5 per cent followed by custard apple leaf extract 10 ml aqueous solution L^{-1}) , module M_5 (deltamethrin 0.09 per cent, followed by Neemazal 4 ml L^{-1} followed by soapnut 10 ml aqueous solution L^{-1}), module M_8 (Profenofos 50 EC 0.05 per cent, followed by NSKE 5 per cent then garlic and chilli extract 10 ml aqueous solution L^{-1}) composed of alternate spray of chemical and bio pesticides had also recorded nearly low fruit infestation (16.11, 16.92, 16.38 and 17.02 per cent, respectively) comparable with module M_4.

Relative efficacy of different modules against okra shoot and fruit borer, *E. vittella* on weight basis :

The study on overall efficacy of modules tested in present investigation is given in Table 2. The cumulative effect of all the sprays indicated that the module M_9 (cypermethrin 10 EC 0.005 per cent followed by NSKE 5 per cent followed by custard apple leaf extract 10 ml aqueous solution L^{-1}) , module M_8 (Profenofos 50 EC 0.05 %, followed by NSKE 5 % then garlic and chilli extract @ 10 ml aqueous solution L^{-1}), module M_5 (deltamethrin 0.09 per cent followed by Neemazal @4ml L^{-1} followed by Soapnut 10 ml aqueous solution L^{-1}), M_4 composed of endosulfan 35 EC (0.06%) followed by *B thuringiensis* var. *kurstaki* @ 1.5 g L^{-1} followed by custard apple leaf extract 10 ml aqueous solution L^{-1} and M_3 (endosulfan 35 EC (0.06%) followed by *B thuringiensis* var. *kurstaki* @ 1.5 g L^{-1} followed by Serni leaf extract 10 ml aqueous solution L^{-1})

Table A : Details of the modules tested for management of okra shoot and fruit borer

Modules	1st spray/application	2nd spray	3rd spray
M_1	Imidachloprid 70 WS 10 g kg^{-1} seed treatment	*Beauveria bassiana* 5g L^{-1}	NSKE 5%
M_2	Imidachloprid 70 WS 10 g kg^{-1} seed treatment	*Beauveria bassiana* 5g L^{-1}	Custard apple leaf extract @ 10 ml aqueous solution L^{-1}
M_3	Endosulfan 35 EC @ 0.06%	*B. thuringiensis* sub sp *kurstaki* @ 1.5g L^{-1}	Serni leaf extract @10 ml aqueous solution L^{-1}
M_4	Endosulfan 35 EC @ 0.06%	*B. thuringiensis* sub sp. *kurstaki* @1.5g L^{-1}	Maharukh leaf extract @ 10 ml aqueous solution L^{-1}
M_5	Deltamethrin 1.8 EC 0.09%	Neemazal 4 ml / L	Soapnut fruit extact10 ml aqueous solution L^{-1}
M_6	Lamda cyhalothrin 5 EC 0.005%	Kajara seed powder @ 0.5g L^{-1}	Karanj oil @10ml L^{-1}
M_7	Carbaryl 50 WDP 0.1%	Karanj oil @10ml L^{-1}	Madanphal fruit extract @ 10 ml aqueous solution L^{-1}
M_8	Profenofos 50 EC 0.05%	NSKE 5%	Garlic and chilli extract @ 10 ml aqueous solution L^{-1}
M_9	Cypermethrin10 EC 0.005%	NSKE 5%	Custard apple leaf extract @ 10 ml aqueous solution L^{-1}
M_{10}	Water spray	Water spray	Water spray

composed of alternate spray of chemical pesticides , biopesticides and botanicals have recorded low fruit infestation (17.07, 17.15, 17.20, 17.36 and 17.88 per cent fruit infestation, respectively) and were at par with each other.

Above results revealed that integrated approach consisting of alternate use of chemical pesticides, bio pesticides and botanical can be adopted for the management of okra shoot and fruit borer to reduce the chemical pesticide load on the crop and to decrease residue in okra fruits.

Effect of different modules on yield of okra crop :

The yield data on marketable fruits recorded in various treatments are presented in Table 3. Results revealed that highest yield of 36.56 q/ha was recorded in module M_9 (cypermethrin 10 EC 0.005 per cent, NSKE 5 per cent and custard apple leaf extract 10 ml aqueous solution L^{-1} as first, second and third spray, respectively) followed by module M_5 (deltamethrin 0.09 per cent, Neemazal 4ml L^{-1} and soapnut 10 ml aqueous solution L^{-1}) (36.29 q/ha), followed by module M_8 (Profenofos 50 EC 0.05 %, NSKE 5 % then garlic and chilli extract 10 ml aqueous solution L^{-1}) (36.11 q/ha), followed by M_4 composed of endosulfan 35 EC (0.06%) followed by *B thuringiensis* var. *kurstaki* @ 1.5 g L^{-1} , custard apple leaf extract 10 ml aqueous solution L^{-1} (35.72 q/ha) and M_3

Table 1 : Relative efficacy of different modules against okra shoot and fruit borer, *E.vittella* (on number basis)

Modules	Per cent fruit infestation			Pooled mean
	I spray	II spray	III spray	
M_1	34.46 (35.94)*	27.48 (31.51)	18.87 (25.69)	26.94 (31.05)
M_2	35.0 (36.27)	24.73 (29.73)	21.67 (27.70)	27.14 (31.24)
M_3	16.20 (23.57)	15.45 (22.99)	16.68 (24.04)	16.11 (23.53)
M_4	16.43 (23.79)	14.99 (22.59)	16.25 (23.70)	15.89 (23.36)
M_5	15.51 (23.05)	16.58 (23.85)	17.06 (24.31)	16.38 (23.74)
M_6	15.58 (23.12)	23.00 (28.61)	21.46 (27.56)	20.01 (26.43)
M_7	20.67 (26.99)	21.32 (27.43)	23.56 (29.01)	21.85 (27.81)
M_8	17.41 (24.57)	17.53 (24.66)	16.12 (23.63)	17.02 (24.29)
M_9	16.42 (23.77)	16.71 (24.08)	17.63 (24.78)	16.92 (24.21)
M_{10}	38.16 (37.94)	34.53 (35.98)	35.76 (36.71)	36.15 (36.88)
S.E.±	1.22	0.99	0.60	0.94
C.D. at 5 %	3.62	2.93	1.77	2.77

Figures in parentheses are arcsine transformed values

Table 2: Relative efficacy of different modules against okra shoot and fruit borer, *E.vittella* on weight basis

Modules	Per cent fruit infestation			Pooled mean
	I spray	II spray	III spray	
M_1	32.57 (34.56)*	24.18 (29.44)	18.49 (25.43)	25.08 (29.81)
M_2	33.50 (35.42)	23.54 (29.01)	21.49 (27.59)	26.18 (30.67)
M_3	19.27 (27.00)	16.36 (23.82)	18.01 (24.46)	17.88 (25.09)
M_4	19.99 (26.66)	15.52 (23.18)	16.58 (23.99)	17.36 (24.61)
M_5	19.27 (27.00)	15.89 (23.49)	16.44 (23.87)	17.20 (24.79)
M_6	18.69 (25.58)	25.68 (30.42)	21.65 (27.73)	22.01 (27.91)
M_7	23.06 (27.89)	25.46 (30.29)	23.78 (29.17)	24.20 (29.12)
M_8	19.64 (26.31)	16.76 (24.15)	15.06 (22.82)	17.15 (24.42)
M_9	19.54 (26.22)	16.35 (23.84)	15.32 (23.02)	17.07 (24.36)
M_{10}	39.86 (39.92)	35.85 (36.77)	36.96 (37.44)	37.56 (38.04)
S.E.±	0.52	0.56	0.59	0.57
C.D. at 5%	1.21	1.67	1.76	1.55

*Figures in parentheses are arcsine transformed values

(endosulfan 35 EC (0.06%) , *B. thuringiensis* var. *kurstaki* @ 1.5 g L^{-1} and Serni leaf extract 10 ml aqueous solution L^{-1}) (35.06 q/ha) and were at par with module M_9.

Table 3 : Effect of different modules on yield of okra

Modules	Marketable fruit yield q/ha
M_1	30.18
M_2	31.14
M_3	35.06
M_4	35.72
M_5	36.29
M_6	34.00
M_7	32.25
M_8	36.11
M_9	36.56
M_{10}	24.72
S.E.±	0.64
C.D. at 5%	1.91

The present findings confirm the results of Hegde (2004) who reported that use of garlic and chilli extracts and NSKE (5%) alternated with cow urine (10%) were superior in reducing damage caused by okra shoot and fruit borer and increasing the yield. The present findings also confimed with those of Kaur (2002) who reported that the marketable fruit yield was highest in the treatment cypermethrin 30 g a.i. /ha. Effectiveness of deltamethrin 2.8 EC was confimed with those of Chiranjeevi (1999). He reported that deltamethrin recorded significantly higher yield of marketable fruits and lowest per cent fruit damage. The present findings of *B. thuringiensis* var. *kurstaki* @ 1.5 g L^{-1} confirm the results of Desai and Kapadia (2009) and Patel and Vyas (2000). They reported effectiveness of *B. thuringiensis* var. *kurstaki* against shoot and fruit borer and increase in fruit yield. Similarly effectiveness of NSKE (5%) was reported by Alagar and Sivasubramanian (2006) in reducing the fruit damage by *E. vittella* and increase in yield of okra.

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