Karnataka J. Agric. Sci.,21(2), (231-233) : 2008

Utilization of Botanicals and Mycopathogens in the Management of Sucking Pests of Okra*

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(Received : August, 2007)

Abstract : A field experiment was conducted to find out the efficacy of certain botanicals and mycopathogens against okra leafhopper, *Amrasca biguttula biguttula* (Ishida) and aphid, *Aphis gossypii* (Glover) at Main Agricultural Research Station (MARS), Dharwad Karnataka during 2006-07. Results revealed that, among botanicals and mycopathogens, neem oil @ 2% was found effective in controlling the leafhopper population (1.41 and 4.11 leafhopper/ 3 leaves at 15 DAS of first and second spray, respectively) while NSKE @ 5% was found effective against aphid (2.10 and 5.22 aphids/ 3 leaves at 15 DAS of first and second spray, respectively). Among biorationals, NSKE proved to be the most economical treatment as realized by highest net returns (Rs. 6,418/ha). NSKE recorded highest C: B ratio of 1: 8.56 which was followed by oxydemeton methyl 25 EC (1: 8.37).

Key words: Management, botanicals, mycopathogens, okra, leaf hopper, aphid.

Introduction

Okra plays a vital role in the daily intake of our food. It has good nutritional value particularly high content of calcium (90 mg/100 g) and vitamin C (30 mg/100 g). There is a need to increase its production to eliminate disorders caused by dietary deficiencies prevalent among poor masses of our country. One of the limiting factors in production of okra is the damage caused by insect pests. Among them, leafhoppers and aphids are important pests in the early stages of the okra crop which desap the plants, make them weak and reduce the yield. Failure to control them in the initial stages was reported to cause yield loss to the extent of 54.04 per cent (Choudhary and Dadeech, 1989). An alternate pest control approach is required for the management of these pests.

Okra being a fresh vegetable that is harvested at regular interval, it is critical to evaluate safer alternatives like botanicals and mycopathogens which possess no residual toxicity, is best suited for vegetables like okra, where we use fresh vegetables for consumption. Earlier workers tested bio-efficacy of some of the indigenous materials against pests of okra (Jayakumar, 2002 and Dhanalakshmi, 2006) and reported their effect in reducing the pest population. Very meagre information is available on the effect of botanicals and mycopathogens against okra leaf hoppers and aphids. In this background, the present studies were carried out to evaluate the bio-efficacy of some of the botanicals and mycopathogens against okra leaf hoppers and aphids.

Material and Methods

The field trial was carried out at Main Agricultural Research Station, Dharwad during 2006-07 on variety Arka Anamika in a randomized block design with three replications. Treatments of NSKE @ 5%, neem oil @ 2%, pongamia oil @ 2%, azadirachtin @ 1 mil/l, *Vitex negundo* leaf extract @ 5%, *Verticillium lecanii* @ 1 g/l and *Metarhizium anisopliae* @ 1 g/l were tested in comparison with oxydemeton methyl 25EC @ 1.5 ml/l and untreated check (Table 1). Two sprays were imposed on need basis. Observations on aphids and leaf hoppers were recorded one day before and 1, 5, 10 and 15 days after spraying, on five randomly selected plants covering three leaves, one each from top, middle and bottom portion of the plant. Fruit yield was also recorded. The data were subjected to statistical analysis. Gross returns were calculated by multiplying total yield with the market price of the produce. Cost of cultivation and cost of treatment impositionwere deducted from the gross returns, to find out net returns and C : B ratios.

Results and Discussion

Population of leafhoppers before the first spray was non-significant with a population range of 6.13 to 7.13 leafhoppers/3 leaves (Table 1). After a day of treatment imposition, among botanicals and mycopathogens, neem oil recorded least count of 1.13 leaf hoppers/3 leaves, which proved equally effective as that of chemical treatment, oxydemeton methyl (0.91 leaf hoppers/3 leaves) followed by pongamia oil (1.53 leaf hoppers/3 leaves), azadirachtin (1.60 leaf hoppers/3 leaves) and *V. negundo* (1.90 leafhoppers/3 leaves). At 5 DAS, neem oil registered least leafhopper population (1.01 leafhoppers/3 leaves) which was on par with pongamia oil and azadirachtin (1.40 and 1.51 leaf hoppers/3 leaves. respectively). Ten days after spraying, lowest population was recorded in oxydemeton methyl (0.62 leaf hoppers/3 leaves) and neem oil (0.90 leaf hoppers/3 leaves) followed by pongamia oil (1.31 leaf hoppers/3 leaves), *V. lecanii* (1.34 leafhoppers/3 leaves), azadirachtin (1.59 leaf hoppers/3 leaves) and *V. negundo* (1.61 leafhoppers/3 leaves). However, all the treatments were significantly superior over untreated control. At 15 days after spraying neem oil recorded least leafhopper population (1.41 leafhoppers/3 leaves) and found on par with pongamia oil, azadirachtin, *V. negundo*

*Part of M. Sc. (Agri.) thesis submitted by the senior to the University of Agricultural Sciences, Dharwad - 580 005, India.

and *V. lecanii* (1.90, 1.70, 1.66 and 1.66 leaf hoppers/3 leaves, respectively). The leaf hopper population was non-significant among different treatments a day before imposition of second spray. The neem oil once again proved its superiority among botanicals and mycopathogens by keeping leafhopper population below ETL (2 nymphs/leaf) upto 15 days after spraying (Table 1). Population of aphids a day before the imposition of first spray was non-significant, among different treatments (Table 2). A day after first spray, the standard chemical check oxydemeton methyl (1.60 aphids/3 leaves) was on par with NSKE (2.06 aphids/3 leaves), followed by neem oil and azadirachtin (3.11 and 3.39 aphids/3 leaves, respectively). At 5

Table 1. Efficacy of botanicals and mycopathogens against leaf hoppers on okra

Treatments	Dosage (%)	Number of leaf hoppers/3 leaves									
		I spray					II spray				
		1 DBS	1 DAS	5 DAS	10 DAS	15 DAS	I DBS	I DAS	5 DAS	10 DAS	15 DAS
T1- NSKE	5	6.73^{a}	2.46^{bc}	2.04^{bc}	2.10^{b}	3.53^{b}	10.43 ^{a}	7.01 ^{bc}	6.30^{bc}	5.60^{bc}	5.91^{c}
		(2.68)	(1.72)	(1.58)	(1.61)	(2.00)	(3.29)	(2.73)	(2.60)	(2.46)	(2.52)
T2 - Neem oil	2	6.76^{a}	1.13^{f}	1.01 ^{de}	0.90^{ef}	1.41^{de}	11.57 ^{a}	5.90^{cd}	4.90^{cd}	3.90^{de}	4.11 ^{de}
		(2.69)	(1.27)	(1.21)	(1.18)	(1.39)	(3.47)	(2.52)	(2.32)	(2.09)	(2.14)
T3 - Pongamia oil	2	6.70 ^{a}	1.53^{c}	1.40^{cde}	1.31 ^{de}	1.90^{d}	10.60^{a}	6.11 ^{cd}	5.30^{cd}	5.00^{cd}	5.00^{ed}
		(2.68)	(1.41)	(1.3 7)	(1.33)	(1.54)	(3.32)	(2.56)	(2.40)	(2.35)	(2.34)
T4 - Azadirachtin 5%	0.1	7.13 ^{a}	1.60^{e}	1.51 ^{cde}	1.59^{cd}	1.70^{d}	10.73 ^{a}	6.30^{cd}	5.11 ^{cd}	4.21 ^{cde}	4.90^{cd}
		(2.75)	(1.44)	(1.39)	(1.44)	(1.48)	(3.34)	(2.60)	(2.36)	(2.16)	(2.32)
T5- *Vitex negundo*	5	6.86^{a}	1.90^{de}	1.60^{cd}	1.61 ^{cd}	1.66^{d}	10.41^{a}	5.90^{cd}	5.01^{cd}	4.80^{cd}	5.20^{c}
		(2.70)	(1.54)	(1.44)	(1.44)	(1.47)	(3.29)	(2.52)	(2.33)	(2.28)	(2.14)
T6 - *Verticilium lecanii*	0.1	6.86^{a}	2.27^{ed}	1.91^{be}	1.34 ^{de}	1.66^{d}	10.51 ^{a}	7.90^{b}	5.91^{bc}	5.31^{cd}	5.41^{c}
		(2.70)	(1.66)	(1.54)	(1.34)	(1.47)	(3.31)	(2.91)	(2.80)	(2.43)	(2.43)
T 7 - *Metarhizium anisopliae*	0.1	6.13^{a}	2.86^{b}	2.71^{b}	2.01^{bc}	2.71^{c}	10.37^{a}	8.01^{b}	7.40^{b}	7.02^{b}	7.33^{b}
		(2.56)	(1.83)	(1.79)	(1.57)	(1.78)	(3.29)	(2.89)	(2.52)	(2.70)	(2.79)
T8 - Oxydemeton methyl	0.15	6.86^{a}	0.91 ^{f}	0.83^{e}	0.62^{f}	1.21^{e}	10.80^{a}	5.10^{d}	4.01^{d}	3.11 ^{e}	3.90^{e}
		(2.70)	(1.18)	(1.15)	(1.04)	(1.30)	(3.36)	(2.36)	(2.12)	(1.89)	(2.09)
T9 - Untreated control		6.16^{a}	5.23^{a}	5.24^{a}	5.60^{a}	7.21^{a}	11.17 ^{a}	11.30^{a}	11. 70^{a}	12.01^{a}	11.91 ^{a}
	-	(2.55)	(2.39)	(2.39)	(2.46)	(2.57)	(3.41)	(3.43)	(3.49)	(3.53)	(3.51)
CV (%)	-	8.75	4.80	9.35	5.90	5.06	5.17	5.41	6.34	6.72	4.82

DBS - Day before spraying DAS - Days after spraying
Means followed by same letter do not differ significantly by DMRT (P = 0.05) NSKE - Neem seed kernel extract
Figures in the parenthesis are $\sqrt{x + 0.5}$ transformed values

Table 2. Efficacy of botanicals and mycopathogens against aphids on okra

Treatments	Dosage	Number of aphids/3 leaves									
		I spray					II spray				
	(%)	1 DBS	1 DAS	5 DAS	10 DAS	15 DAS	1 DBS	1 DAS	5 DAS	10 DAS	15 DAS
T1- NSKE	5	6.13 ^{a}	2.06^{e}	1.21 ^{e}	1.00^{de}	2.10^{e}	20.91 ^{a}	10.31^{c}	7.93^{c}	4.44^{e}	5.22^{de}
		(2.57)	(1.60)	(1.29)	(1.22)	(1.59)	(4.60)	(3.17)	(2.88)	(2.21)	(2.32)
T2 - Neem oil	2	6.03 ^{a}	3.11 ^{d}	1.94^{d}	1.48^{cd}	3.71^{cd}	21.03 ^{a}	10.92^{c}	8.63^{c}	4.79^{de}	5.73^{cde}
		(2.55)	(1.87)	(1.56)	(1.40)	(2.05)	(4.63)	(3.37)	(3.01)	(2.29)	(2.49)
T3 - Pongamia oil	2	5.82 ^{a}	3.95^{c}	2.19^{d}	1.67^{c}	5.12^{b}	21.92 ^{a}	12.03^{bc}	9.11^{c}	5.61^{de}	6.94^{cde}
		(2.51)	(2.10)	(1.63)	(1.47)	(2.36)	(4.72)	(3.53)	(3.09)	(2.4 7)	(2.70)
T4 - Azadirachtin 5%	0.1	5.82 ^{a}	3.39^{cd}	2.11^{d}	1.50^{cd}	4.00c	20.29 ^{a}	12.42^{bc}	8.94^{c}	4.93^{de}	6. 13^{cde}
		(2.51)	(1. 96)	(1.60)	(1.40)	(2.11)	(4.56)	(3.59)	(3.07)	(2.33)	(2.57)
T 5 - *Vitex negundo*	5	5.90 ^{a}	4.12^{c}	2.17^{d}	2.11^{c}	5.13^{b}	22.04 ^{a}	13.11^{bc}	9.34^{bc}	5.79^{d}	7.34^{bcd}
		(2.53)	(2.14)	(1.62)	(1.61)	(2.36)	(4.74)	(3.68)	(3.14)	(2.51)	(2.79)
T6 - *Verticilium lecanii*	0.1	6.13 ^{a}	4.97^{b}	3.16^{c}	2.10^{c}	3.10^{d}	21.72 ^{a}	15.93^{-}	10.46^{bc}	7.91^{c}	8.17^{bc}
		(2.57)	(2.34)	(1.91)	(1.61)	(1.89)	(4.67)	(4.05)	(3.31)	(2.90)	(2.94)
T 7 - *Metarhizium anisopliae*	0.1	6.12 ^{a}	5.11 ^{b}	4.14^{b}	4.13^{b}	5.12^{b}	21.93 ^{a}	16.19^{b}	11.33^{b}	10.43^{b}	10.13^{b}
		(2.57)	(2.36)	(2.15)	(2.15)	(2.36)	(4.73)	(4.08)	(3.44)	(3.31)^{b}	(3.26)
T 8 - Oxydemeton methyl	0.15	6.00 ^{a}	1.60^{e}	0.73^{f}	0.79^{e}	1.52^{e}	21.22 ^{a}	10.01^{c}	4.36^{d}	2.31^{f}	4.53^{e}
		(2.54)	(1.44)	(1.1 0)	(1.13)	(1.41)	(4.66)	(3.23)	(2.20)	(1.67)	(2.24)
T9 - Untreated control	-	6.03 ^{a}	6.10 ^{a}	6.94 ^{a}	7.34 ^{a}	6.61 ^{a}	20.94 ^{a}	21.02 ^{a}	20.67 ^{a}	22.13 ^{a}	23.43 ^{a}
		(2.55)	(2.56)	(2.72)	(2.79)	(2.66)	(4.62)	(4.63)	(4.60)	(4.75)	(4.89)
CV (%)	-	6.93	5.14	6.16	7.09	5.14	6.48	7.97	5.70	5.18	9.33

DBS - Day before spraying DAS - Days after spraying
Means followed by same letter do not differ significantly by DMRT (P = 0.05) Figures in the parenthesis are $\sqrt{x + 0.5}$ transformed values
NSKE - Neem seed kernel extract

days after spraying, among botanicals and mycopathogens, NSKE was found to be promising (1.21 aphids/3 leaves) followed by neem oil, pongamia oil, azadirachtin and *V. negundo.* Observation at 10 days after spraying revealed that oxydemeton methyl recorded lowest aphid population (0.79 aphids/3 leaves) and found to be on par with NSKE (1.00 aphid/3 leaves followed by neem oil and azadirachtin. At 15 DAS, pest population started increasing in all the treatments. The chemical treatment and NSKE were found to be significantly superior over rest of the treatments (1.52 and 2.10 aphids/3 leaves, respectively). However, all the treatments stood significantly superior over untreated control. The aphid population was non-significant among different treatments a day before imposition of second spray. A similar trend in the efficacy of different treatments was maintained as that of first spray.

The yield data on efficacy of various treatments revealed that, among botanicals and mycopathogens, all the treatments stood on par with each other (Table 3). However, neem oil recorded highest yield (41.11 q/ha) followed by NSKE (40.21 q/ha) and azadirachtin (40.11 q/ha) while all treatments proved their superiority over untreated check (22.04 q/ha).

Higher efficacy of neem oil on leaf hopper may be due to feeding deterrence in addition to mortality. The antifeedant property of neem has been discovered by Pradhan *et al.* (1962). The higher efficacy of neem oil followed by pongamia oil against the leaf hoppers is in line with Rosaiah (2001) who reported that neem oil @ 2 per cent found significantly superior by recording least leaf hopper population followed by pongamia oil.

The higher efficacy of NSKE against aphid as revealed in the present study is in line with the findings of Kabir and Mia (1987), who reported that NSKE @ 5% found effective against mustard aphid. Bhavani Sankar Rao (1991) reported that neem oil @ 1 % showed 63% reduction in aphid population over untreated check. The superiority of oxydemeton methyl in reducing okra leafhopper and aphid population is in accordance with Jayakumar (2002) and Dhanalakshmi (2006), who reported that although botanicals and indigenous materials were effective in reducing okra sucking pests, they were inferior to oxydemeton methyl.

With respect to cost effectiveness of botanicals and mycopathogens NSKE proved to be the most economical treatment as realized by highest net returns (Rs. 6418/ha), followed by neem oil (Rs. 61 88/ha) and azadirachtin (Rs. 6088/ ha). However, chemical treatment registered highest net return (Rs. 8075/ha) over all other treatments (Table 3). NSKE recorded highest C: B ratio of 1: 8.56 which was followed by oxydemeton methyl 25 EC (1: 8.37).

Table 3. Effect of botanicals and mycopathogens on the yield and economics of okra

Treatments	Dosage (%)	Fruit yield (q/ha)	Gross returns (Rs.lha)	Protection cost (Rs/ha)	Net returns (Rs.lha)	C:B ratio
T_1- NSKE	5	40.21 ab	32,168	750	6,418	1: 8.56
T_2 - Neem oil	2	41. 11 ab	32,888	1700	6,188	1: 3.64
T_3 - Pongamia oil	2	39.57ab	31,656	1700	4,956	1: 2.92
T_4 - Azadirachtin 5%	0.1	40.11 ab	32,088	1000	6,088	1: 6.09
T_5 - Vi/ex negundo	5	34.50b	27,600	600	2,000	1: 3.33
T_6 - Verticilium lecanii	0.1	37.57ab	30,056	700	4,356	1: 6.22
T_7 - Metarhizium anisopliae	0.1	34.50b	27,600	700	1,900	1: 2.71
T_7 - Oxydemeton methyl	0.15	42.55a	34,040	965	8,075	1: 8.37
T_9 - Untreated control	-	22.04c	-	-	-	-

Neem seeds - Rs. 6/kg
Neem oil Rs. 60/1
Labour charge Rs 50/day
Cost of cultivation - Rs 25,000/
Pongamia oil- Rs. 60/1
Azadirachtin - Rs. 1 000/1
V. lecanii - Rs. 200/kg
Metarhizium anisopliae - Rs. 200/ kg
Oxydemeton methyl - 31 O/Iit
Selling price of okra Rs. 8/kg

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