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EVALUATION OF SPRAY SCHEDULES OF DIFFERENT INSECTICIDES AND BOTANICALS AGAINST PESTS OF CHILLI

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ABSTRACT

A field experiment on evaluation of spray schedules of different insecticides and botanicals against insect and mite of chilli was taken during *kharif* 2009–2012 at Agriculture Research Station, Ladol in randomized block design with five treatments and four replications. The spray schedule SIII (comprising NSKE 5%, trizophos 40 EC @ 25 ml/ 10 lit., dicofol 18.5 EC @ 15 ml / 10 lit. and acetamiprid 20 SP 1 g / 10 lit. of water) registered the lowest population of thrips, white fly and mite at three and seven days after spray and consequently, the lowest leaf curl intensity in SIII (2.08, 3.24 and 5.15 per cent at 50, 75 and 100 days after transplanting, respectively). The lowest fruit damaged was also recorded in spray schedule SIII (2.59%) with the highest fruit yield (6342 kg/ha) of green chillies.

Key words: Chilli, thrips, white fly, mite, leaf curl, insecticide, botanicals

INTRODUCTION

Chilli, *Capsicum annum* L. is cultivated for uses as vegetables, spices, pickles and for export purposes. In India, chilli is cultivated in 0.95 million hectares and the production is 9,45,000 tonnes per annum (Fageria *et al.*, 2003). Chilli crop suffers from several foliage and sucking pests which are responsible for low yields. Among the sucking pests, white fly (*Bemisia tabaci* Genn.) and thrips (*Scirtothirps dorsalis* Hood) are serious production constraints. Several pesticide spray schedules are recommended for the management of these pests in India. Keeping in view the, emphasis being given to the use of insecticide and botanical spray schedules suitably acceptable in pest management programmes, the present investigation was made to evolve spray schedules, using insecticides and plant products.

MATERIALS AND METHODS

A field experiment on evaluation of spray schedules of different insecticides and botanicals against insect and mite pest of chilli was taken during *kharif* 2009–2012 at Agriculture Research Station, Sardarkrushinagar Dantiwada Agricultural University, Ladol in randomized block design with five treatments and four replications using the variety Gujarat Chilli–1. Each plot measured 6.0m × 3.0m; spacing between and within rows were maintained at 60cm and 60cm, respectively. All the recommended agronomical practices were adopted. The spray schedules consisted of the following treatments:

Spray schedule–trizophos 40% EC @ 25 ml/10 lit., wettable sulphur 50 WP @ 40 g / 10lit., imidacloprid 17.8 SL@ 5 ml / 10 lit., wettable sulphur 50 WP @ 40 g / 10 lit. and acephate 75 WS@ 15 g / 10 lit. of water.

Spray schedule II–azardirachtin @0.0005%, nikunchhi @1% Neem oil @ 0.5% + 0.1% soap solution.

Spray schedule SIII–NSKE 5%, trizophos 40 EC @ 25ml / 10 lit., dicofol 18.5 EC @ 15 ml / 10 lit. and acetamiprid 20 SP 1g / 10 lit. of water.

Spray schedule IV–nikunchhi 1%, propargite 57 EC @ 20 ml / 10 lit., neem oil 0.5% + 0.1% soap solution, wettable sulphur 50 WP @ 40 g / 10 lit. of water.

Spray schedule SV– was kept as untreated control. Foliar application of respective insecticides and botanicals was given as per schedule using a manually operated knapsack sprayer. First application was made at an economic threshold level of 1 thrips/ leaf, whereas, subsequent sprays were conducted at an interval of 10 days.

Five plants were selected randomly from each plot and the population of thrips, white fly and mites were counted from three leaves (top, middle and bottom) of each selected plant one day prior to each spray and after 3 and 7 days of spray (DAS). Finally, mean population of thrips, white fly and mites per leaf was worked out at three and seven days after spray. Number of plants showing the symptoms of leaf curl disease per plot was also recorded at 50, 75 and 100 days after transplanting of chilli and per cent leaf curl disease intensity was worked out. The data were subjected to statistical analysis with the transformation to arc sine values. Per cent fruit borer damage in chilli was also worked out and fruit yield of green chilli from each net plot was recorded and analyzed.

Table 1. Population of thrips/ leaf on chilli

Treatment	2009–10			2010–11			2011–12			2012–13			Pooled		
	PTC	3DAT	7DAT	PTC	3DAT	7DAT	PTC	3DAT	7DAT	PTC	3DAT	7DAT	PTC	3DAT	7DAT
SI	2.56 (6.09)	1.53 (1.85)	1.65 (2.25)	2.45 (5.51)	1.43 (1.55)	1.55 (1.93)	2.19 (4.33)	1.24 (1.05)	1.36 (1.35)	2.21 (4.40)	1.30 (1.20)	1.34 (1.30)	2.35 (5.08)	1.37 (1.41)	1.47 (1.70)
SII	2.41 (5.34)	1.88 (3.05)	2.14 (4.10)	2.16 (4.20)	1.83 (2.85)	1.92 (3.21)	2.09 (3.90)	1.54 (1.90)	1.67 (2.30)	2.17 (4.25)	1.80 (2.75)	1.83 (2.85)	2.20 (4.42)	1.76 (2.63)	1.89 (3.11)
SIII	2.45 (5.55)	1.43 (1.56)	1.54 (1.90)	2.19 (4.33)	1.31 (1.23)	1.39 (1.45)	2.12 (4.0)	1.20 (0.95)	1.26 (1.11)	2.08 (3.85)	1.43 (1.55)	1.45 (1.60)	2.21 (4.43)	1.35 (1.33)	1.40 (1.51)
SIV	2.31 (4.87)	1.81 (2.80)	2.09 (3.88)	2.14 (4.11)	1.54 (1.88)	1.59 (2.05)	2.23 (4.50)	1.35 (1.33)	1.53 (1.85)	2.18 (4.27)	1.53 (1.85)	1.56 (1.96)	2.21 (4.43)	1.55 (1.96)	2.87 (2.43)
SV	2.43 (5.45)	2.73 (6.97)	2.76 (7.15)	2.39 (5.25)	2.57 (6.11)	2.72 (6.91)	2.13 (4.05)	2.16 (4.20)	2.36 (5.11)	2.12 (4.0)	2.58 (6.20)	2.65 (6.50)	2.26 (4.68)	2.51 (5.87)	2.87 (6.41)
S.Em. ± T	0.08	0.05	0.05	0.05	0.05	0.04	0.09	0.05	0.07	0.08	0.07	0.05	0.04	0.03	0.03
Y × T													0.08	0.06	0.06
C.D @ 5%	0.27	0.17	0.17	0.17	0.15	0.14	0.28	0.16	0.22	NS	0.20	0.16	NS	0.08	0.09
Y × T													NS	NS	0.18
CV%	7.28	6.99	7.66	6.10	7.33	6.65	8.74	7.08	8.05	7.87	7.72	6.11	5.88	6.11	6.77

* Figures outside parenthesis arc sin $\sqrt{X+0.5}$ transformed values, while those in parenthesis are retransformed values

Table 2. Population of mite/leaf on chilli

Treatment	2009–10			2010–11			2011–12			2012–13			Pooled		
	PTC	3DAT	7DAT	PTC	3DAT	7DAT	PTC	3DAT	7DAT	PTC	3DAT	7DAT	PTC	3DAT	7DAT
SI	2.09 (3.90)	1.10 (0.73)	1.22 (0.99)	1.91 (3.15)	1.09 (0.69)	1.19 (0.93)	2.0 (3.50)	1.16 (0.85)	1.24 (1.05)	2.02 (3.60)	1.18 (0.90)	1.26 (1.10)	2.0 (3.53)	1.13 (0.79)	1.22 (1.01)
SII	2.14 (4.10)	1.26 (1.10)	1.34 (1.30)	2.10 (3.93)	1.19 (0.93)	1.28 (1.15)	2.12 (4.0)	1.22 (1.0)	1.30 (1.20)	2.15 (4.15)	1.20 (0.95)	1.34 (1.30)	2.12 (4.04)	1.21 (0.99)	1.31 (1.23)
SIII	2.06 (3.75)	1.19 (0.93)	1.30 (1.18)	1.90 (3.11)	1.04 (0.59)	1.15 (0.83)	2.02 (3.60)	1.14 (0.80)	1.22 (1.0)	1.92 (3.20)	1.11 (0.75)	1.18 (0.90)	1.97 (3.41)	1.11 (0.76)	1.21 (0.97)
SIV	2.12 (4.00)	1.24 (1.05)	1.33 (1.27)	2.05 (3.71)	1.17 (0.88)	1.27 (1.13)	2.04 (3.70)	1.20 (0.95)	1.28 (1.15)	2.03 (3.65)	1.22 (1.0)	1.32 (1.25)	2.06 (3.76)	1.21 (0.97)	1.29 (1.20)
SV	2.13 (4.05)	2.15 (4.15)	2.19 (4.33)	2.14 (4.10)	2.17 (4.21)	2.26 (4.61)	1.94 (3.30)	2.09 (3.90)	2.23 (4.50)	2.0 (3.50)	2.13 (4.05)	2.25 (4.60)	2.04 (3.73)	2.15 (4.07)	2.23 (4.51)
S.Em. ± T	0.05	0.04	0.03	0.05	0.03	0.03	0.06	0.03	0.04	0.07	0.04	0.05	0.03	0.02	0.02
Y × T													0.07	0.04	0.05
C.D @ 5%	0.16	0.14	0.11	0.16	0.12	0.11	0.18	0.09	0.12	NS	0.13	0.14	NS	0.06	0.07
Y × T													NS	NS	NS
CV%	6.75	7.57	6.21	7.23	6.88	7.25	6.08	6.70	7.77	6.73	6.51	6.27	5.93	6.15	6.88

* Figures outside parenthesis arc sin $\sqrt{X+0.5}$ transformed values, while those in parenthesis are retransformed values

Table 3. Population of whitefly/ leaf on chilli

Treatment	2009–10			2010–11			2011–12			2012–13			Pooled		
	PTC	3DAT	7DAT	PTC	3DAT	7DAT	PTC	3DAT	7DAT	PTC	3DAT	7DAT	PTC	3DAT	7DAT
SI	1.28 (1.15)	0.92 (0.36)	1.02 (0.55)	1.22 (1.0)	0.89 (0.30)	0.98 (0.48)	1.24 (1.05)	0.83 (0.20)	0.89 (0.30)	1.20 (0.95)	0.80 (0.15)	0.86 (0.25)	1.23 (1.03)	0.85 (0.25)	0.93 (0.39)
SII	1.30 (1.20)	1.10 (0.73)	1.20 (0.95)	1.26 (1.11)	1.05 (0.61)	1.12 (0.77)	1.20 (0.95)	1.02 (0.55)	1.11 (0.75)	1.24 (1.05)	1.09 (0.70)	1.18 (0.90)	1.25 (1.07)	1.06 (0.64)	1.15 (0.79)
SIII	1.27 (1.13)	0.83 (0.19)	0.91 (0.34)	1.24 (1.05)	0.81 (0.17)	0.89 (0.30)	1.22 (1.0)	0.80 (0.15)	0.86 (0.25)	1.26 (1.11)	0.84 (0.21)	0.90 (0.31)	1.24 (1.06)	0.82 (0.18)	0.89 (0.30)
SIV	1.39 (1.45)	1.12 (0.77)	1.22 (1.00)	1.32 (1.25)	1.10 (0.71)	1.24 (1.05)	1.18 (0.90)	1.06 (0.63)	1.10 (0.71)	1.41 (1.50)	1.20 (0.95)	1.14 (0.80)	1.32 (1.27)	1.11 (0.76)	1.17 (0.89)
SV	1.38 (1.41)	1.44 (1.60)	1.50 (1.78)	1.34 (1.30)	1.41 (1.51)	1.47 (1.69)	1.20 (0.95)	1.26 (1.11)	1.41 (1.50)	1.36 (1.35)	1.50 (1.75)	1.56 (1.95)	1.32 (1.25)	1.41 (1.49)	1.49 (1.73)
S.Em. ± T	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.04	0.03	0.05	0.05	0.04	0.02	0.02	0.02
Y × T													0.04	0.04	0.04
C.D @ 5%	0.13	0.12	0.13	0.13	0.10	0.10	0.13	0.10	0.09	NS	0.17	0.14	0.06	0.06	0.06
Y × T													NS	NS	NS
CV%	6.65	7.70	7.31	7.13	6.24	6.06	7.25	7.17	6.90	8.48	9.45	8.07	5.97	6.33	6.05

* Figures outside parenthesis arc sin $\sqrt{X+0.5}$ transformed values, while those in parenthesis are retransformed values

Table 4. Per cent fruit damage and yield of chilli in different treatment

Treatment	2009–10		2010–11		2011–12		2012–13		Pooled	
	Percent fruit damage	Yield q/ha	Percent fruit damage	Yield q/ha	Percent fruit damage	Yield q/ha	Percent fruit damage	Yield q/ha	Percent fruit damage	Yield q/ha
SI	10.45 (3.29)	27.40	10.15 (3.11)	51.11	9.46 (2.70)	81.25	9.37 (2.65)	83.0	9.85 (2.93)	60.69
SII	12.15 (4.43)	21.75	11.54 (4.05)	42.30	11.39 (3.90)	73.61	10.94 (3.60)	75.25	11.50 (3.99)	53.22
SIII	9.73 (2.86)	29.15	9.11 (2.55)	54.60	9.28 (2.60)	82.63	8.81 (2.35)	87.30	9.06 (2.59)	63.42
SIV	11.54 (4.00)	22.95	11.09 (3.70)	44.45	10.21 (3.15)	75.13	10.78 (3.50)	76.50	10.91 (3.58)	54.75
SV	17.90 (9.45)	18.65	17.46 (9.0)	34.40	18.48 (10.05)	63.88	19.32 (10.95)	62.0	18.14 (9.86)	44.73
S.Em. ± T	0.33	1.07	0.30	0.83	0.29	1.62	0.41	1.15	0.22	1.06
Y × T									0.44	2.12
C.D @ 5%	1.03	3.31	0.95	2.57	0.89	4.99	1.29	3.59	0.62	3.01
Y × T									NS	NS
CV%	6.44	8.97	7.17	7.66	6.43	6.88	6.99	7.35	6.14	6.21

* Figures outside parenthesis are percentage transformed angular values

Table 5. Per cent leaf curl disease in chilli

Treatment	2009–10			2010–11			2011–12			2012–13			Pooled		
	50 DAT	75 DAT	100 DAT	50 DAT	75 DAT	100 DAT	50 DAT	75 DAT	100 DAT	50 DAT	75 DAT	100 DAT	50 DAT	75 DAT	100 DAT
SI	10.02 (3.03)	11.77 (4.16)	14.26 (6.07)	9.11 (2.51)	11.03 (3.66)	14.0 (5.85)	8.19 (2.03)	11.06 (3.68)	12.98 (5.05)	7.81 (1.85)	9.98 (3.0)	12.66 (4.80)	8.78 (2.35)	10.95 (3.62)	13.47 (5.44)
SII	11.71 (4.12)	14.39 (6.18)	16.45 (8.02)	10.94 (3.60)	13.62 (5.55)	15.71 (7.36)	10.04 (3.04)	12.53 (4.71)	14.57 (6.31)	11.54 (4.0)	14.18 (6.0)	16.69 (8.25)	11.05 (3.69)	13.68 (5.61)	15.85 (7.48)
SIII	9.13 (2.52)	11.09 (3.70)	14.03 (5.88)	8.17 (2.02)	10.17 (3.12)	13.11 (5.15)	7.06 (1.51)	9.19 (2.55)	11.90 (4.25)	8.72 (2.30)	10.94 (3.60)	13.37 (5.35)	8.27 (2.08)	10.34 (3.24)	13.10 (5.15)
SIV	12.34 (4.56)	15.23 (6.98)	18.69 (10.27)	11.56 (4.02)	14.50 (6.28)	17.55 (9.09)	10.94 (3.58)	13.91 (5.78)	16.96 (8.51)	12.04 (4.35)	15.40 (7.05)	17.56 (9.10)	11.71 (4.12)	14.76 (6.62)	17.69 (9.24)
SV	14.28 (6.09)	19.52 (11.17)	26.09 (19.35)	13.58 (5.52)	18.98 (10.58)	23.03 (17.98)	13.20 (5.12)	17.50 (17.50)	23.61 (16.04)	14.83 (6.55)	20.27 (12.0)	27.28 (21.0)	13.97 (5.82)	19.06 (10.69)	25.0 (18.59)
S.Em. ± T	0.33	0.61	0.56	0.33	0.46	0.48	0.30	0.32	0.40	0.41	0.49	0.56	0.180	0.262	0.25
Y × T													0.360	0.524	0.513
C.D @ 5%	1.04	1.89	1.74	1.02	1.43	1.47	0.95	1.01	1.24	1.28	1.52	1.73	0.51	0.74	0.72
Y × T													NS	NS	1.45
CV%	6.77	8.54	6.33	6.24	6.80	8.27	6.35	7.53	6.05	7.48	6.93	6.36	6.10	6.43	6.21

*Figures outside parenthesis are percentage transformed angular value

RESULTS AND DISCUSSION

Thrips: The population of thrips significantly varied from 1.33 to 5.87 per leaf in pooled mean of different spray schedules at 3 days after spray with minimum (1.33 thrips/ leaf) under spray schedule–III, which was at par with the spray schedule–I (1.41 leaf), followed by the schedule–IV (1.96/leaf) and maximum in control (5.87/ leaf). Similar trend was also observed at 7 days after spray (Table 1). Similar results were recorded by Rajashri *et al.* (1991) and Prajapati and Agalodiya (2011).

Mite: It is evident from the Table 2 that minimum population of mite was recorded in spray schedule–III (0.76/ leaf) which was at par with spray schedule–I (0.79/ leaf) is pooled mean at 3 days after spray. The spray schedule–II and IV were at par with each other and the population of mite recorded was 0.99 and 0.97/ leaf, respectively. A similar trend was also found at 7 days after spray in both the years. Similar records were made by Prajapati and Agalodiya (2011). Earlier workers (Rao *et al.*, 1983 and Ahmed *et al.*, 2000) also reported that chilli is heavily damaged by mite.

White fly: The pooled results showed that the population of white fly was recorded minimum at 3 days after spray, which significantly differed among different spray schedules with minimum under spray schedule–III (0.18/ leaf) followed by spray schedule–I (0.25/ leaf). In remaining spray schedule II and IV it varied from 0.64 to 0.76 per leaf. Similar trend was found during 3 years. Giraddi *et al.* (2001) reported the efficacy of these against sucking pest of chilli.

From the results, it can be inferred that the minimum population of thrips, mites and white fly was noticed at 3 days after spray and differed significantly among different spray schedules. The spray schedule–III was effective to reduce the population of these pests.

Fruit damage: The 3 year pooled data (Table 4) on fruit infestation showed that different spray schedule varied significantly in their impact on fruit infestation. The results indicated significantly lower fruit damage in spray schedule–III (2.59%), which was at par to spray schedule–I (2.93%). The fruit damage in spray schedule–II and IV were 3.99 and 3.58% per cent, respectively and maximum was observed in spray schedule–V (9.86%). Similar trend were also observed during all the years. Manisegaran *et al.* (1995) and Prajapati and Agalodiya (2011) reported similar findings.

Yield: The mean yield of marketable chilli fruits differed significantly in pooled as well as individual year results (Table 4). Pooled results revealed that the spray schedule–III gave the highest yield of chilli fruits (63.42 q/ha), which was at par with spray schedule–I (60.69 q/ha) and was effective to protect the crop against pests. The spray schedule–II and IV gave 53.22 and 54.75 quintals per hectare yield of chilli fruits, respectively. The minimum yield was recorded in control spray schedule (44.73 q/ha).

Leaf curl disease: The results presented in Table 5 reveal that all the spray schedule were significantly superior over the control in reducing the leaf curl disease in chilli during all the years at 50, 75 and 100 days after transplanting. The minimum per cent of leaf curl infested plants were observed in spray schedule–III (5.15%) which was at par with spray schedule–I (5.44%) and maximum infested plants were in control spray schedule (18.59%) at 100 days after transplanting.

Table 6. Economics of different treatments

Treatments	Yield (q/ha)	Yield increased over the control	Increase in income over control	Cost of treatment (Rs/ha)	Net Gain (Rs/ha)	ICBR
SI	60.69	15.96	12768	3060	9708	1:3.1
SII	53.22	8.49	6792	1725	5067	1:2.9
SIII	63.42	18.69	14952	2410	12542	1:5.2
SIV	54.75	10.02	8016	2275	5741	1:2.5
SV	44.73	–	–	–	–	–

Labour charges: Rs. 100/day. Price of chilli fruit Rs. 8/kg, Trizophos 640/L, Wattable sulphur 100/kg, Imidacloprid 1400/L, Acephate 680/kg, Azardirechtin 267/L, Dicofol 420/L, Acetamiprid 1400/kg, Propargite 225/L

Table 7. Residue analysis report

S. No.	Sample type	Pesticide detected	Results (ppm/ppb)	MRL ppm	Limits of quantitation	Waiting period (days)
1.	Treatment	Trizofos	0.05 ppm	0.2	0.05	30
2.	Control	"	ND	–		–
3.		Dicofol	–	–	–	15
4.		Acetamiprid	–	–	–	3

Economics: The spray schedule–III was the best with highest ICBR (1:5.2), which was followed by spray schedule–I (1:3.1), spray schedule–II (1:2.9) and the spray schedule–IV (1:2.5) table 6.

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