



## EVALUATION OF INSECTICIDES AND BOTANICALS AGAINST SEED WASP, *SYSTOLE ALBIPENNIS* WALKER INFESTING FENNEL

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### ABSTRACT

Evaluation of different insecticides and botanicals against the seed wasp, *Systole albipennis* Walker infesting fennel was undertaken during *kharif* 2011-12 to 2013-14 at Seed Spices Research Station, Jagudan in a randomized block design with nine treatments replicated thrice. Damage due to seed wasp was lowest (5.77%) in thiamethoxam 25WG (0.0084%) at three and seven days after each of the two sprays. The plots sprayed with acetamiprid 20SP (0.004%) had registered 10.30 and 10.87 per cent seed wasp damage at three and seven days after second spray, respectively. The seed wasp damage at harvest was also recorded the least (7.78%) in the treatment of thiamethoxam 25WG (0.0084%) and it was followed by acetamiprid 20SP (0.004%) with 11.19 per cent damage. The plots sprayed with thiamethoxam (0.0084%) recorded the highest seed yield of fennel (2260kg/ha) followed by acetamiprid (0.004%) with 2054kg/ha; however, acetamiprid (0.004%) treated plots gave maximum benefit cost ratio (PCBR= 1:33.10).

**Key words :** Insecticides, Botanicals, Fennel, Seed wasp, *Systole albipennis* Walker

### INTRODUCTION

Fennel, *Foeniculum vulgare* L., an important seed spice crop is infested insect pests right from germination to harvesting and also during the storage. Among them, seed wasp or seed midge or chalcid fly or seed perforator, *Systole albipennis* Walker is found to infest fennel (Gupta, 1962; Singh and Baswasna, 1984; Patel *et al.*, 1986; Butani and Mittal, 1989 and Agrawal *et al.*, 2004). It belongs to the family Eurytomidae of order Hymenoptera. The wasp is phytophagous and the female wasp lay eggs in the embryo of grain and developing larvae feeds inside the grain and destroys the embryo and/or endosperm consequently. The larvae pupate inside the grain and adults emerge from the stored grains by making hole during storage. The infestation due to this pest is the highest in fennel among all the seed spices and is reported to be 40 per cent. Presently, no information is available on different insecticides as well as botanicals to manage the seed wasp under field conditions. Keeping these points in view, the present experiment on field evaluation of different insecticides including botanicals was planned to manage seed wasp infesting fennel in North Gujarat Agro-climatic Zone.

### MATERIALS AND METHODS

A field experiment was conducted at Seed Spices Research Station, Jagudan during *kharif* 2011-12 to 2013-14 using the variety Gujarat Fennel 2 in RBD with nine treatments replicated thrice. The treatments consisted of NSKE 5%, cartap hydrochloride 50SP @ 0.15%, spinosad 45SC @ 0.01%, abamectin 1.9EC @ 2ml/lit., Neem based formulation 1500ppm @ 3ml/lit., acetamiprid 20SP @ 0.004%, thiamethoxam 25WG @ 0.0084%, acephate 75SP @ 0.075% and untreated control. Two foliar sprays were applied, first at peak appearance of the seed wasp and subsequent spray was made at 10 days of the first spray. The seeds present on earmarked umbels was thoroughly checked with the help of magnifying glass (10x) to see the seed wasp damage. Seeds having either insect exit hole on the seeds or seed wasp damage (appearance of black spot) was considered as damaged seeds due to the pest. Observations on number of damaged seeds per umbel were recorded on three pre-tagged umbels per plant from five earmarked plants per plot. The pre-treatment seed infestation due to seed wasp was recorded one day before sprays and post-treatment seed infestation was recorded after 3 and 7 days of sprays. These data were analyzed for its statistical interpretation with due transformation. At

harvest, a representative sample of 200 seeds per plot was studied to find out the per cent infestation (Singh and Baswana, 1984). The seed yield of fennel from each net plot was also recorded and economical analysis of different treatments were made and finally residual analysis was also made.

## RESULTS AND DISCUSSION

The infestation levels of seed wasp of fennel in different years before treatment application has been detailed out in Table 1.

**Seed wasp damage (%).** Three years' data individually, as well as the pooled data on damage of fennel seed wasp at three days after first spray are presented in Table 2. It can be revealed from the pooled data that the plots sprayed with thiamethoxam 25WG (0.0084%) registered the least seed wasp damage (5.77%) at three days after first spray, but it remained statistically at par with the treatments of acetamiprid 20SP (0.004%) and acephate (0.075%), which exhibited 7.73 and 9.37 per cent seed wasp damage at three days after first spray, respectively. The unprotected plots of fennel had registered the highest damage due to seed wasp (24.80%) at three days after first spray.

Similarly, three individual years as well as pooled data on damage of fennel seed wasp at seven days after first spray are presented in Table 2. The plots sprayed with thiamethoxam 25WG @ (0.0084) had registered the least seed wasp damage (5.77%) at seven days after first spray but it remained statistically at par with the treatment of acetamiprid 20SP (0.004%), which recorded 8.37 per cent seed wasp damage at seven days after first

spray. Acephate (0.075%) had registered 9.88 per cent seed wasp damage at seven days after first spray, whereas, unprotected plots of fennel had registered the highest damage due to seed wasp (26.50%) at seven days after first spray.

The three individual years as well as pooled data on damage of fennel seed wasp at three days after second spray are presented in Table 3. Tplots sprayed with thiamethoxam 25WG (0.0084%) had registered the least seed wasp damage (5.77%) at three days after second spray, but it remained statistically at par with the treatment of acetamiprid 20SP (0.004%), which exhibited 10.30 per cent seed wasp damage at three days after second spray. Acephate (0.075%) had exhibited 11.58 per cent seed wasp damage at three days after second spray. The unprotected plots of fennel had higher damage due to seed wasp (30.72%) in comparison to all the insecticides at three days after second spray.

Similarly, three individual years as well as pooled data on damage of fennel seed wasp at seven days after second spray are presented in Table 3. Again it could be observed from the pooled data that the plots sprayed with thiamethoxam 25WG (0.0084%) registered the least seed wasp damage (5.77%) at seven days after second spray and found significantly superior over rest of the treatments. Acetamiprid 20SP (0.004%) recorded 10.87 per cent seed wasp damage at seven days after second spray and stood second as far as damage caused by seed wasp is concerned. Acephate 75SP (0.075%) registered 12.87 per cent seed wasp damage at seven days after second spray, whereas, unprotected plots of fennel had registered the highest damage due to seed wasp (33.45%) at seven days after second spray.

**Table 1. Pre-treatment infestation by seed wasp of fennel in different years**

Treatments	Damage (%) before spray			
	2011-12	2012-13	2013-14	Pooled
1. NSKE 5%	17.05 (8.59)	15.03 (6.71)	14.65 (6.40)	15.58 (7.22)
2. Cartap hydrochloride @ 0.15%	16.90 (8.45)	15.62 (8.18)	14.45 (6.22)	15.66 (7.28)
3. Spinosad @ 0.01%	16.98 (8.53)	15.78 (7.39)	14.55 (6.31)	15.77 (7.39)
4. Abamectin 1.9EC @ 2ml/lit.	16.88 (8.43)	15.50 (7.13)	14.10 (5.94)	15.49 (7.14)
5. Neem based formulation 1500ppm @3ml/lit.	17.09 (8.63)	16.43 (8.00)	14.52 (6.28)	16.01 (7.61)
6. Acetamiprid @ 0.004%	17.02 (8.56)	15.44 (7.09)	14.25 (6.05)	15.57 (7.21)
7. Thiamethoxam @ 0.0084%	17.19 (8.73)	15.83 (7.44)	14.48 (6.25)	15.83 (7.43)
8. Acephate @ 0.075%	17.33 (8.87)	15.90 (7.49)	14.52 (6.28)	15.92 (7.55)
9. Untreated control	17.14 (8.68)	17.02 (8.58)	14.68 (6.43)	16.28 (7.85)
S. Em.±	0.11	0.46	0.39	0.20
C.D.at 5%	NS	NS	NS	NS
C.V.%	1.17	5.07	4.70	3.92
YXT				NS

Figures in parentheses are retransformed per cent values

**Table 2. Efficacy of different insecticides/ botanicals against seed wasp infesting fennel**

Treatments	% damage due to seed wasp at 3days after first spray				% damage due to seed wasp at 7days after first spray			
	2011-12	2012-13	2013-14	Pooled	2011-12	2012-13	2013-14	Pooled
1. NSKE 5%	21.46 (13.39)	29.52 (21.35)	22.48 (14.62)	24.49 (17.19)	22.48 (14.63)	30.27 (25.41)	23.30 (15.65)	25.08 (17.98)
2. Cartap hydrochloride @ 0.15%	19.91 (11.60)	22.55 (14.70)	15.97 (7.57)	19.47 (11.11)	20.49 (12.26)	23.70 (16.15)	15.87 (7.48)	20.05 (11.75)
3. Spinosad @ 0.01%	20.42 (12.17)	23.56 (16.08)	18.67 (10.23)	20.88 (12.70)	21.13 (13.00)	24.57 (17.29)	18.67 (10.23)	21.45 (13.38)
4. Abamectin 1.9EC @ 2ml/lit.	20.97 (12.81)	26.05 (19.29)	20.37 (12.11)	22.46 (14.60)	21.67 (13.64)	26.77 (20.29)	20.60 (12.38)	22.93 (15.18)
5. Neem based formu. 1500ppm @3ml/lit.	21.30 (13.20)	28.32 (22.50)	21.63 (13.59)	23.75 (16.22)	21.99 (14.03)	28.87 (23.31)	21.97 (14.00)	24.16 (16.75)
6. Acetamiprid @ 0.004%	17.93 (9.48)	19.22 (10.83)	11.27 (3.83)	16.14 (7.73)	18.49 (10.06)	20.73 (12.53)	12.90 (4.97)	16.83 (8.37)
7. Thiamethoxam @ 0.0084%	17.19 (8.73)	15.83 (7.44)	8.77 (2.33)	13.93 (5.77)	17.19 (8.73)	15.83 (7.44)	8.77 (2.33)	13.92 (5.77)
8. Acephate @ 0.075%	18.75 (10.37)	21.58 (13.53)	13.13 (5.15)	17.82 (9.37)	19.48 (11.12)	22.33 (14.44)	13.90 (5.77)	18.32 (9.88)
9. Untreated control	21.40 (13.42)	39.67 (40.75)	28.53 (22.81)	29.87 (24.80)	23.38 (15.75)	41.02 (43.09)	28.80 (23.21)	30.98 (26.50)
S.Em.±	0.11	0.43	0.42	1.79	0.23	0.47	0.45	1.68
C.D at 5%	0.30	1.28	1.25	5.37	0.70	1.41	1.36	5.04
C.V.%	9.60	2.94	4.04	2.89	1.89	3.14	4.30	3.11
YXT				0.99				1.09

Figures in parenthesis are retransformed percent values

**Table 3. Efficacy of different insecticides/ botanicals against seed wasp infesting fennel**

Treatments	% damage due to seed wasp at 3days after second spray				% damage due to seed wasp at 7days after second spray			
	2011-12	2012-13	2013-14	Pooled	2011-12	2012-13	2013-14	Pooled
1. NSKE 5%	25.17 (18.10)	31.33 (27.02)	24.70 (17.48)	27.07 (20.69)	29.25 (23.55)	31.90 (27.91)	25.47 (18.49)	28.87 (23.31)
2. Cartap hydrochloride @ 0.15%	21.63 (13.59)	26.70 (20.19)	16.87 (8.42)	21.73 (13.71)	25.51 (18.56)	27.43 (21.21)	18.60 (10.18)	23.85 (16.35)
3. Spinosad @ 0.01%	22.37 (14.49)	26.93 (20.51)	19.67 (11.35)	22.99 (16.54)	26.17 (19.45)	27.63 (21.50)	20.33 (12.07)	24.71 (17.48)
4. Abamectin 1.9EC @ 2ml/lit.	23.47 (15.87)	28.47 (22.71)	21.87 (13.87)	24.60 (17.32)	27.73 (21.65)	28.57 (22.88)	23.80 (13.91)	26.70 (20.19)
5. Neem based formu. 1500ppm @3ml/lit.	24.36 (17.01)	29.93 (24.90)	23.70 (16.17)	26.00 (19.21)	27.96 (21.99)	30.10 (25.15)	24.27 (16.90)	27.44 (21.23)
6. Acetamidrid @ 0.004%	20.04 (11.72)	22.53 (14.69)	13.60 (5.53)	13.60 (10.30)	21.11 (12.97)	22.82 (15.04)	13.83 (5.72)	19.25 (10.87)
7. Thiamethoxam @ 0.0084%	17.19 (8.73)	15.83 (7.44)	8.77 (2.33)	13.92 (5.77)	17.19 (8.73)	15.83 (7.44)	8.77 (2.33)	13.92 (5.77)
8. Acephate @ 0.075%	20.88 (12.70)	23.83 (16.32)	14.97 (6.67)	19.89 (11.58)	23.39 (15.77)	23.97 (16.50)	15.70 (7.32)	21.02 (12.87)
9. Untreated control	29.05 (23.58)	42.62 (45.85)	29.33 (24.00)	33.67 (30.72)	33.93 (31.17)	42.62 (45.85)	29.43 (24.15)	35.33 (33.45)
S.Em.±	0.14	0.54	0.40	1.29	0.27	0.53	0.37	0.97
C.D. at 5%	0.40	1.60	1.20	3.89	0.80	1.60	1.10	2.90
C.V.%	1.09	3.40	3.61	2.98	1.79	3.32	3.23	2.87
YXT				1.13				1.15

Figures in parenthesis are retransformed per cent values

**Table 4. Seed wasp damage at harvest and seed yield of fennel in different treatments**

Treatments	% Seed wasp damage at harvest					Seed Yield (Kg/ha)			
	2011-12	2012-13	2013-14	Pooled		2011-12	2012-13	2013-14	Pooled
1. NSKE 5%	35.67 (34.00)	32.53 (33.78)	25.48 (18.50)	31.23 (28.45)		1187	1582	2058	1609
2. Cartap hydrochloride @ 0.15%	26.56 (20.00)	27.73 (21.65)	18.72 (10.30)	24.34 (16.99)		1494	1685	2263	1814
3. Spinosad @ 0.01%	28.96 (23.50)	27.9 (21.90)	20.57 (12.35)	25.82 (18.98)		1445	1662	2199	1769
4. Abamectin 1.9EC @ 2ml/lit.	31.31 (27.00)	29.30 (23.95)	24.12 (16.70)	28.24 (22.39)		1422	1597	2178	1732
5. Neem based formu. 1500ppm @3ml/lit.	33.52 (30.50)	31.13 (26.72)	24.80 (17.60)	29.82 (24.72)		1330	1587	2104	1673
6. Acetamiprid @ 0.004%	21.13 (13.00)	23.38 (15.73)	14.10 (5.94)	19.54 (11.19)		1735	1906	2521	2054
7. Thiamethoxam @ 0.0084%	20.69 (9.50)	17.43 (8.94)	10.42 (3.27)	16.18 (7.78)		1973	2029	2778	2260
8. Acephate @ 0.075%	23.97 (16.50)	24.97 (17.82)	15.77 (7.38)	21.57 (13.51)		1605	1849	2382	1945
9. Untreated control	44.91 (49.83)	43.40 (47.21)	29.80 (24.70)	39.37 (40.22)		1134	1453	1885	1491
S.Em.±	0.19	0.58	0.48	0.95		45	51	69	32
C.D.at 5%	0.60	1.70	1.40	2.84		135	153	207	97
C.V.%	1.10	3.49	4.10	2.96		5.29	5.16	5.29	5.34
YXT				1.27					NS

Figures in parenthesis are retransformed values

Table 5. Economical analysis of different treatments

Sr.No.	Qty. of insecticides (L/kg/ha)	Price of insecticides (Rs./ha)	Labour cost (Rs.)	Total cost of treatment (Rs./ha)	Yield (kg/ha)	Gross realization (Rs./ha)	Net realization over control (Rs./ha)	Net gain (Rs./ha)	PCBR
1.	50.000	1250	800	2050	1609	88495	6490	4440	1: 2.17
2.	3.000	3300	800	4100	1814	99770	17765	13665	1:3.33
3.	0.250	3000	800	3800	1769	97295	15290	11490	1: 3.02
4.	2.000	11000	800	11800	1732	95260	13255	1455	1: 0.12
5.	3.000	1200	800	2000	1673	92015	10010	8010	1: 4.01
6.	0.200	108	800	908	2054	112970	30965	30057	1: 33.10
7.	0.336	672	800	1472	2260	124300	42295	40823	1: 27.73
8.	1.000	600	800	1400	1945	106975	24970	23570	1: 16.84
9.	-	-	-	-	1491	82005	-	-	-

Price of fennel: Rs.55/kg ; NSKE: Rs.25/kg ; Cartap hydrochloride.: Rs. 1100/kg; Abamectin:Rs.5500/lit.

Spinosad: Rs.12000/lit ; Neem based formulation:Rs. 400/lit.; Acetamiprid:Rs. 540/kg

Thiamethoxam: Rs.2000/kg ; Acephate:Rs. 600/kg; Labour cost: Rs. 200/day

**Seed wasp damage (%) at harvest.** At harvest, a representative sample of 200 seeds per plot was studied to find out the per cent infestation due to seed wasp in fennel. The three individual years as well as pooled data on seed yield of fennel are presented in the Table 4. Perusal of the results on seed wasp damage at harvest differed significantly in all the three individual years as well as in pooled analysis. The seed wasp damage at harvest was also recorded the least (7.78%) in thiamethoxam 25WG (0.0084%) and it remained statistically at par with acetamiprid 20SP (0.004%), which registered 11.19 per cent seed wasp damage at harvest. The treatments of cartap hydrochloride 50SP (0.15%) and spinosad 45SC (0.01%) remained at par with each other and registered 16.99 and 18.98 per cent seed wasp damage at harvest, respectively as compared to unsprayed plots of fennel (40.22%). Similar results were also reported by Butani and Mittal (1989) as well as Krishnakant *et al* (2013).

**Seed yield of fennel (kg/ha).** Perusal of the results (Table 4) reveal that the seed yield of fennel differed significantly in all the three individual years and in pooled analysis. Plots sprayed with thiamethoxam 25WG (0.0084%) obtained the highest seed yield of fennel (2260kg/ha) and it was closely followed by acetamiprid 20SP (0.004%) with a seed yield of 2054kg/ha. The lowest seed yield of fennel (1491kg/ha) was harvested from the unprotected plots of fennel.

**Economics.** Economics of different insecticides against seed wasp was worked out considering prevailing market price of seed yield of fennel and cost of different treatments including labour charges (Table 5). The gross realization, net realization and protection Cost Benefit Ratio (PCBR) were also worked out for different treatments.

Looking to the economic analysis of different treatments, acetamiprid 20SP (0.004%) treated plots gave maximum benefit (PCBR= 1:33.10) followed by thiamethoxam 25WG (0.0084%) (PCBR= 1: 27.73). Overall, thiamethoxam 25WG (0.0084%) treated plots had registered the least damage due to seed wasp after both sprays and seed wasp damage at harvest. It also exhibited the highest seed yield of fennel followed by acetamiprid 20SP (0.004%); however, acetamiprid 20SP (0.004%) treatment gave the maximum profit followed by thiamethoxam 25WG (0.0084%).

**Pesticide Residue Analysis.** Pesticide Residue Analysis made at Jagudan (Table 6) revealed that thiamethoxam 25WG (0.0084%) registered BDL (Below Detection Limit) residues i.e., < 0.005 ppm, which is lower than the standards of EU (0.05ppm), CODEX (0.01 ppm) and Japan (5.0 ppm); while, acetamiprid 20SP (0.004%) exhibited 0.03 ppm residue, which is lower than the

**Table 6. Pesticide residue analysis in different treatments in fennel**

Treatments	Results (ppm)	LoD (ppm)	LoQ (ppm)	Maximum Residue Limit (ppm)		
				EU	CODEX	Japan
Acetamiprid 20SP @ 0.004%	0.03	0.005	0.010	0.1	0.01	5.0
Thiamethoxam 25WG @ 0.0084%	BDL*	0.005	0.010	0.05	0.01	5.0
Untreated control Acetamiprid 0.004%	ND**	0.005	0.010	0.1	0.01	5.0
Thiamethoxam 0.0084%	ND**	0.005	0.010	0.05	0.01	5.0

BDL \*- Below Detection Limit ND\*\*- Non Detected

standards of EU (0.1 ppm) and Japan (5.0 ppm). Looking to the economical analysis as well as pesticide residue analysis of different treatments, both the treatments of thiamethoxam (0.0084%) and acetamiprid (0.004%) were effective, economic and had less insecticide residues than the MRL values quoted by EU, CODEX and Japan. Hence, thiamethoxam 25WG (0.0084%) at 3.36gm/10lit or acetamiprid 20SP (0.004%) at 2g/10lit can be recommended for managing seed wasp in fennel.

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