



BIO-EFFICACY OF CARBOSULFAN 25EC AGAINST SUCKING PESTS OF CUMIN

B. G. PRAJAPATI, N. R. PATEL AND A. U. AMIN

Seed Spices Research Station, S. D. Agricultural University, Jagudan-382 710, Dist. Mehsana, Gujarat, India
E-mail: prajapatibg58@gmail.com

ABSTRACT

A field trial was conducted at the Seed Spices Research Station, Jagudan for two consecutive seasons, *rabi* 2013-14 and 2014-15, to evaluate the effective doses of carbosulfan 25EC against aphids and thrips on cumin along with neonicotinoid group of insecticides. Eight treatments of carbosulfan 25EC @250g a.i./ha, carbosulfan 25EC @ 312.5g a.i./ha, carbosulfan 25EC @375g a.i./ha, carbosulfan 25EC @625g a.i./ha (only for phytotoxicity), thiamethoxam 25WG@ 25g a.i./ha, imidacloprid 17.8SL@ 25g a.i./ha, acetamiprid 20SP@10g a.i./ha and untreated control were evaluated against aphids and thrips in cumin. Among them, carbosulfan 25 EC each at 312.5 and 375g a.i./ ha were proved highly effective in controlling the aphids and thrips in cumin. Mean number of bio-agents *viz.*, coccinellids, syrphids, spiders and *Chrysoperla carnea* did not differ in different treatments during both the years of experimentation. Carbosulfan 25EC (375g a.i./ha) had obtained maximum seed yield of cumin(313kg/ha) as compared to untreated control(156kg/ha). Minimum avoidable loss (5.11%) in seed yield of cumin was observed in carbosulfan 25EC (312.5g a.i./ha), whereas, the highest percentage of avoidable losses in seed yield of cumin was observed in the non protected plots (50.16%) of cumin. The highest dose of carbosulfan 25EC (625g a.i./ha) did not produce any phytotoxicity symptoms on the treated crop.

Key words: Bio-efficacy, sucking pests, bio-agents, carbosulfan, phytotoxicity, cumin

INTRODUCTION

Cumin (*Cuminum cyminum* L.), an important spice crop, is mostly cultivated in the arid regions of Gujarat and Rajasthan states of India. The productivity of this crop is mainly constrained by important insect pests *viz.*, aphid, *Myzus persicae* Sulzer.; thrips, *Thrips tabaci* Lindeman.; green bug, *Lygus campestris*.; chalcid fly, *Systole albipennis* Walker.; gram pod borer, *Helicoverpa armigera* (Hubner) Hardwick and the brown wheat mite, *Petrobia latens*. Among these, the cumin aphid and thrips are important sucking pests in cumin growing regions. Cumin aphid causes serious damage at flowering stage of the crop by desaping the cell sap, as a result of which yellowing and curling of the leaves is exhibited at the initial stage, later the plants show stunted growth, and the inflorescence set few seeds that too are shriveled. Thrips cause enormous damage and the yield is adversely affected, both quantitatively and qualitatively. Carbosulfan belongs to the carbamate group of insecticide that acts by inhibiting the activity of acetylcholinesterase. It is a broad spectrum systemic insecticide with stomach and contact action; and is used

over a wide range of crops, *e.g.*, cotton, sugarbeet, potatoes, rice, citrus, maize, vegetables, sugarcane and coffee. During the present study, field efficacy of carbosulfan 25EC against aphids and thrips infesting cumin was tested for two consecutive seasons, *rabi* 2013-14 and 2014-15.

MATERIALS AND METHODS

A field experiment was laid out at the Seed Spices Research Station, Jagudan, Gujarat during *rabi* 2013-14 and 2014 -15 to evaluate the bio-efficacy of different doses of carbosulfan 25EC (250g a.i./ha, 312.5g a.i./ha, and 375g a.i./ha) together with neonicotinoid group of insecticides against the sap sucking insect pests for comparison; while, for phytotoxicity carbosulfan at 625g a.i./ha was tested. The trial was laid out in a randomized block design (RBD) with eight treatments and three replications (Table 1). The size of each plot measured 4.00m 2.40m. The variety Gujarat Cumin 4 was spaced at 30cm and all the recommended agronomic practices were adopted as per package of practices except insecticidal sprays.

With a view to evaluate the test chemical, two foliar application of respective insecticides were given by means of manually operated knapsack sprayer. First spray was made at threshold level of sucking pests *i.e.*, aphids as well as thrips and subsequent spray was applied at an interval of fifteen days. Population of aphids and thrips were recorded from five randomly selected plants per plot on three umbels per plant and mean number of aphids and thrips per umbel were

recorded at one day before spray and at 1, 5 and 10 days after each spray. Similarly, observations on bio-agents including *Chrysoperla*, coccinellids, syrphids and spiders before spray and 1, 5 and 10 days after each spray were recorded. These data were analyzed for its statistical interpretation with necessary data transformation so as to compare the efficacy of different treatments.

Table 1. Details of treatments evaluated against sucking pests of cumin at Jagudan

S.No.	Treatments	Dose/ha (ml/g)
1.	Carbosulfan 25EC @ 250g a.i./ha	1000ml
2.	Carbosulfan 25EC @ 312.5g a.i./ha	1250ml
3.	Carbosulfan 25EC @ 375g a.i./ha	1500ml
4.	Carbosulfan 25EC @ 625g a.i./ha	2500ml*
5.	Thiamethoxam 25WG @ 25g a.i./ha	100g
6.	Imidacloprid 17.8 SL @ 25g a.i./ha	125ml
7.	Acetamiprid 20SP @ 10g a.i./ha	50ml
8.	Untreated Control	-

*For phytotoxicity studies only.

The seed yield of cumin was recorded from each net plot at harvest and yield data were converted on a hectare basis. From these yield data, percentage of avoidable losses in seed yield of cumin due to sucking pest complex was worked out on the basis of seed yield by using the following formula suggested by Khosla (1977).

Avoidable loss (%) = $\frac{\text{Highest yield in best treatment} - \text{Yield in other treatment}}{\text{Highest yield in best treatment}} \times 100$

Observations on phytotoxicity symptoms *viz.*, leaf injury, wilting, vein clearing and necrosis (epinasty and hyponasty), yellowing and stunting were recorded up to 15 days after application of carbosulfan 25EC (625g a.i./ha). Observations were recorded on the basis of visual scores as shown in Table 2:

Table 2. Scores used for effect on crop health

Score	Crop response/Crop injury (%)
0	No adverse effect
1	1-10
2	11-20
3	21-30
4	31-40
5	41-50
6	51-60
7	61-70
8	71-80
9	81-90
10	91-100

RESULTS AND DISCUSSION

During the first year, carbosulfan 25EC @ 312.5 and 250g a.i./ha recorded the least population of aphids at all the intervals of observations. The population of aphids varied from 30.74 to 31.08 per plant before spray and the population was in the range of 10.06 (carbosulfan 25EC @ 375g a.i./ha) to 42.40 (untreated control) per plant at 10 days of first spray. Carbosulfan 25EC (375g a.i./ha) was significantly superior over the treatments of carbosulfan 25EC (312.5g a.i./ha), imidacloprid 17.8SL (25g a.i./ha), acetamiprid 20SP (20g a.i./ha), thiamethoxam 25WG (25g a.i./ha) and carbosulfan 25EC (250g a.i./ha). During the second spray, the higher and moderate dose of carbosulfan 25EC (375 and 312.5g a.i./ha) were effective in controlling cumin aphids and remained statistically at par with each other (Table 3).

During the second year of experimentation (Table 4), the population of aphids were recorded in the range of 24.40 to 25.51 per plant before spray and the population was in the range of 9.61 (carbosulfan 25EC @ 375g a.i./ha) to 36.83 (untreated control) per plant at 10 days of first spray. The dosages of carbosulfan 25EC (375 and 312.5g a.i./ha) were effective in controlling cumin aphids and remained statistically at par with each other. The same trend was also observed in second spray.

During *rabi* 2013-14, the population of thrips was ranged between 14.87 and 15.98 per plant before spray and the population was in the range of 4.65 (carbosulfan 25EC @ 375g a.i./ha) to 21.68 (untreated control) per plant at 10 days of first spray. Among various dosages of

Table 3: Mean aphid population in different treatments during *rabi* 2013-14

Treatments	1 st Spray				2 nd Spray			
	BS	1 DAS	5 DAS	10 DAS	BS	1 DAS	5 DAS	10 DAS
1. Carbosulfan 25EC @ 250g a.i./ha	5.59* (30.75)	3.33 (10.59)	3.87 (14.47)	4.55 (20.20)	5.43 (28.98)	3.45 (11.40)	3.88 (14.55)	4.21 (17.22)
2. Carbosulfan 25EC @ 312.5g a.i./ha	5.62 (31.08)	2.30 (4.79)	2.81 (7.39)	3.60 (12.46)	4.39 (18.77)	1.76 (2.60)	2.05 (3.70)	2.45 (5.50)
3. Carbosulfan 25EC @ 375g a.i./ha	5.60 (30.86)	2.00 (3.50)	2.76 (7.12)	3.25 (10.06)	3.83 (14.17)	1.47 (1.66)	1.72 (2.46)	2.09 (3.87)
4. Thiamethoxam 25WG @ 25g a.i./ha	5.61 (30.97)	3.32 (10.52)	3.74 (13.48)	4.47 (19.48)	5.40 (28.66)	3.49 (11.68)	3.76 (13.64)	4.12 (16.47)
5. Imidacloprid 17.8 SL @ 25g a.i./ha	5.62 (31.08)	3.78 (13.79)	4.59 (20.57)	5.03 (24.80)	5.43 (28.98)	3.61 (12.53)	4.19 (17.06)	4.77 (22.25)
6. Acetamiprid 20SP @ 10g a.i./ha	5.59 (30.74)	4.01 (15.58)	4.71 (21.68)	5.10 (25.51)	5.37 (28.34)	3.80 (13.94)	4.17 (16.89)	4.70 (21.59)
7. Untreated Control	5.62 (31.08)	5.83 (33.49)	6.19 (37.81)	6.55 (42.40)	6.61 (43.19)	6.70 (44.39)	6.94 (47.66)	7.07 (49.48)
C.D. (P=0.05%)	NS	0.29	0.33	0.37	0.41	0.30	0.33	0.36

* X + 0.5 are transformed values; Figures in parentheses are retransformed values; BS = before spray; DAS = Days after spray

Table 4. Mean aphid population in different treatments during *rabi 2014-15*

Treatments	1 st Spray				2 nd Spray			
	BS	1 DAS	5 DAS	10 DAS	BS	1 DAS	5 DAS	10 DAS
1. Carbosulfan 25EC @ 250g a.i./ha	5.04* (24.90)	3.01 (8.56)	3.57 (12.24)	4.28 (17.82)	5.16 (26.13)	3.20 (9.74)	3.84 (14.25)	4.24 (17.48)
2. Carbosulfan 25EC @ 312.5g a.i./ha	4.99 (24.40)	2.02 (3.58)	2.42 (5.36)	3.24 (10.00)	4.46 (19.39)	1.95 (3.30)	2.32 (4.88)	2.69 (6.74)
3. Carbosulfan 25EC @ 375g a.i./ha	5.10 (25.51)	1.90 (3.11)	2.33 (4.93)	3.18 (9.61)	3.96 (15.18)	1.69 (2.36)	1.98 (3.42)	2.36 (5.07)
4. Thiamethoxam 25WG @ 25g a.i./ha	5.08 (25.31)	2.97 (8.32)	3.55 (12.10)	4.23 (17.39)	5.13 (25.82)	3.22 (9.87)	3.64 (12.75)	4.10 (16.31)
5. Imidacloprid 17.8 SL @ 25g a.i./ha	5.03 (24.80)	3.66 (12.90)	4.28 (17.82)	4.86 (23.12)	5.39 (28.55)	3.98 (15.34)	4.44 (19.21)	4.79 (22.44)
6. Acetamiprid 20SP @ 10g a.i./ha	5.10 (25.51)	3.76 (13.64)	4.41 (18.95)	5.04 (24.90)	5.32 (27.80)	4.15 (16.72)	4.47 (19.48)	4.82 (22.73)
7. Untreated Control	5.08 (25.31)	5.30 (27.59)	5.66 (31.54)	6.11 (36.83)	6.33 (39.57)	6.45 (41.10)	6.63 (43.46)	6.84 (46.29)
C.D. (P=0.05%)		0.26	0.31	0.35	0.40	0.30	0.33	0.36

* X + 0.5 are transformed values; Figures in parentheses are retransformed values; BS = before spray; DAS = Days after spray

Table 5. Mean population of thrips in different treatments during *rabi* 2013-14

Treatments	1 st Spray				2 nd Spray			
	BS	1 DAS	5 DAS	10 DAS	BS	1 DAS	5 DAS	10 DAS
1. Carbosulfan 25EC @ 250g a.i./ha	3.92 (14.87)	2.64 (6.47)	3.07 (8.92)	3.08 (8.99)	4.04 (15.82)	2.61 (6.31)	2.89 (7.85)	3.18 (9.61)
2. Carbosulfan 25EC @ 312.5g a.i./ha	4.00 (15.50)	1.65 (2.22)	1.90 (3.11)	2.37 (5.12)	3.01 (8.56)	1.40 (1.46)	1.53 (1.84)	1.86 (2.96)
3. Carbosulfan 25EC @ 375g a.i./ha	4.05 (15.90)	1.49 (1.72)	1.85 (2.92)	2.27 (4.65)	2.99 (8.44)	1.28 (1.14)	1.47 (1.66)	1.79 (2.70)
4. Thiamethoxam 25WG @ 25g a.i./ha	4.06 (15.98)	2.65 (6.52)	3.01 (8.56)	3.26 (10.13)	3.79 (13.86)	2.54 (5.95)	2.71 (6.84)	3.00 (8.50)
5. Imidacloprid 17.8 SL @ 25g a.i./ha	3.98 (15.34)	2.86 (7.68)	3.02 (8.62)	3.31 (10.46)	4.01 (15.58)	2.63 (6.42)	3.01 (8.56)	3.31 (10.46)
6. Acetamiprid 20SP @ 10g a.i./ha	3.92 (14.87)	3.05 (8.80)	3.25 (10.06)	3.61 (12.53)	1.09 (0.69)	3.09 (9.05)	3.33 (10.59)	3.67 (12.97)
7. Untreated Control	3.96 (15.18)	4.10 (16.31)	4.41 (18.95)	4.71 (21.68)	4.41 (18.95)	4.57 (20.38)	4.67 (21.31)	4.91 (23.61)
C.D. (P=0.05%)	NS	0.21	0.24	0.25	0.30	0.22	0.24	0.26

* X + 0.5 are transformed values; Figures in parentheses are retransformed values; BS = before spray; DAS = Days after spray

Table 6. Mean population of thrips in different treatments during rabi 2014-15

Treatments	1 st Spray				2 nd Spray			
	BS	1 DAS	5 DAS	10 DAS	BS	1 DAS	5 DAS	10 DAS
1. Carbosulfan 25EC @ 250g a.i./ha	4.59* (20.57)	2.88 (7.79)	3.40 (11.06)	3.68 (13.04)	3.88 (14.55)	2.63 (6.42)	3.12 (9.23)	3.45 (11.40)
2. Carbosulfan 25EC @ 312.5g a.i./ha	4.57 (20.38)	2.00 (3.50)	2.29 (4.74)	2.61 (6.31)	2.79 (7.28)	1.35 (1.32)	1.75 (2.56)	2.01 (3.54)
3. Carbosulfan 25EC @ 375g a.i./ha	4.59 (20.57)	1.85 (2.92)	2.21 (4.38)	2.52 (8.85)	2.71 (6.84)	1.18 (0.89)	1.59 (2.03)	1.86 (2.96)
4. Thiamethoxam 25WG @ 25g a.i./ha	4.61 (20.75)	2.96 (8.26)	3.25 (10.06)	3.58 (12.32)	3.76 (13.64)	2.54 (5.95)	2.98 (8.38)	3.31 (10.46)
5. Imidacloprid 17.8 SL @ 25g a.i./ha	4.61 (20.75)	3.16 (9.49)	3.51 (11.82)	3.74 (13.49)	3.97 (15.24)	2.86 (7.68)	3.25 (10.06)	3.68 (13.04)
6. Acetamiprid 20SP @ 10g a.i./ha	4.61 (20.75)	3.35 (10.72)	3.54 (12.03)	3.81 (14.02)	4.20 (17.14)	3.14 (9.36)	3.51 (11.82)	3.91 (14.79)
7. Untreated Control	4.62 (20.84)	4.73 (21.73)	4.92 (23.71)	5.19 (26.44)	4.80 (22.54)	5.11 (25.61)	5.46 (29.31)	5.74 (32.45)
C.D. (P=0.05%)	NS	0.24	0.26	0.28	0.30	0.23	0.26	0.29

* X + 0.5 are transformed values; Figures in parentheses are retransformed values; BS = before spray; DAS = Days after spray

Table 7. Effect of different insecticides on mean population of natural enemies during rabi 2013-14 and 2014-15

Treatments	1 st Spray				2 nd Spray			
	BS	1 DAS	5 DAS	10 DAS	BS	1 DAS	5 DAS	10 DAS
1. Carbosulfan 25EC @ 250g a.i./ha	2.64	2.26	2.30	2.06	2.10	2.22	2.16	2.00
2. Carbosulfan 25EC @ 312.5g a.i./ha	2.52	2.31	2.45	2.02	2.32	2.40	2.32	2.05
3. Carbosulfan 25EC @ 375g a.i./ha	2.66	2.46	2.50	2.10	2.40	2.56	2.44	2.10
4. Thiamethoxam 25WG @ 25g a.i./ha	2.45	2.39	2.42	2.12	2.36	2.48	2.32	2.14
5. Imidacloprid 17.8 SL @ 25g a.i./ha	2.40	2.26	2.33	2.08	2.50	2.64	2.16	2.02
6. Acetamiprid 20SP @ 10g a.i./ha	2.30	2.20	2.32	2.10	2.42	2.50	2.22	2.00
7. Untreated Control	2.45	2.42	2.48	2.02	2.33	2.45	2.36	2.06
C.D. (P=0.05%)	NS	NS	NS	NS	NS	NS	NS	NS

Natural enemies include: *Chrysoperla*, Coccinellids, Syrphids and Spiders

carbosulfan 25EC, the higher dose *i.e.*, 375g a.i./ha was found to be superior to the rest of the treatments. Similar trend was also observed in 1, 5 and 10 days after both of the sprays (Table 5).

Initially, the population of thrips varied from 20.38 to 20.84 per plant and the population was in the range of 6.31(carbosulfan 25EC @ 312.5g a.i./ha) to 26.44 (untreated control) per plant at 10days of first spray during *rabi* 2014-15. The population of thrips ranged between 2.96 (carbosulfan 25EC @ 312.5g a.i./ha) and

32.45 (untreated control) per plant at 10days of second spray. Among the various dosages tested, the moderate and higher dosages of carbosulfan 25EC proved to be superior over the rest of the treatments (Table 6).

Population of major natural enemies, *viz.*, coccinellids, syrphids, spiders and *Chrysoperla* species were recorded during the period of study; however, the mean number of natural enemies did not differ among the different insecticides as well as untreated control during both the years (Table 7).

Table 8. Seed yield of cumin (kg/ha) at harvest in different treatments (2013-14 & 2014-15)

S. No.	Treatments	Dose/ha (ml/g)	Seed yield of cumin (kg/ha)			Avoidable loss (%)
			2013-14	2014-15	Mean	
1.	Carbosulfan 25EC@ 250g a.i./ha	1000ml	196	259	228	27.15
2.	Carbosulfan25EC @312.5g a.i./ha	1250ml	280	315	297	5.11
3.	Carbosulfan 25EC@ 375g a.i./ha	1500ml	293	333	313	0.0
4.	Thiamethoxam 25WG@ 25g a.i./ha	100g	242	275	259	17.25
5.	Imidacloprid17.8 SL@ 25g a.i./ha	125ml	207	235	221	29.39
6.	Acetamiprid 20SP @ 10g a.i./ha	50g	218	207	213	31.95
7.	Untreated control	-	132	180	156	50.16
S. Em. ±			5.90	6.80	11.49	-
C.D. (P=0.05%)			18.30	21.10	39.76	-

The seed yield data on cumin (Table 8) reveal that carbosulfan 25EC (375g a.i./ha) gave maximum seed yield of cumin (313 kg/ha) as compared to the other treatments with the lowest seed yield in untreated control (156kg/ha). The minimum avoidable losses in seed yield of cumin was observed in carbosulfan 25EC @ 312.5g a.i./ha (5.11%), followed by that for thiamethoxam 25WG @ 25g a.i./ha (17.25%), carbosulfan 25EC@ 250g a.i./ha (27.15%), imidacloprid17.8SL @ 25g a.i./ha (29.39%), and acetamiprid 20SP@ 10g a.i./ha (31.95%). The highest avoidable loss was observed in the untreated plots of cumin (50.16%).

Observations recorded for phytotoxicity symptoms (leaf injury, wilting, vein clearing and epinasty and hyponasty on the crop due to application of carbosulfan 25EC (625g a.i./ha) upto 15 days after the spray showed no visible phytotoxicity symptoms as per scores shown in Table 2.

The present findings are similar to the findings of Pachundkar *et al.* (2013), who reported carbosulfan 25EC (0.025%) to be effective against thrips of cluster bean. Patel *et al.* (2002) observed that carbosulfan 25EC (0.05%) was effective in controlling cumin aphid under north Gujarat conditions. More or less similar observations on supremacy of carbosulfan 25EC against

aphid were also reported by Patil and Patel (2013) in isabgol crop.

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