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BIOEFFICACY OF CARBOSULFAN 25 EC AGAINST APHIDS AND THRIPS OF COTTON

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ABSTRACT

A field experiment was carried out at the Agricultural Research Station-Banswara (Rajasthan) during *kharif*-2014 and 2015 to evaluate the efficacy of carbosulfan 25 EC against aphids and thrips of cotton**.** The various doses of carbosulfan 25 EC *i.e.*, 250, 312.5, 375 and 625g a.i. ha^{-1} (only for phytotoxicity test) along with standard checks *i.e.*, fipronil 5 EC, thiamethoxam 25 WG and imidacloprid 17.8 SL were evaluated against aphids and thrips of cotton. The maximum per cent reduction in population of aphids and thrips was recorded in carbosulfan 25 EC @ 375g a.i ha^{-1} at 3 and 5 days after spray, respectively, and was statistically at par with carbosulfan 25 EC @312.5g a.i ha^{-1} during both the years. It was followed by fipronil 5 EC and thiamethoxam 25WG. The highest mean seed cotton yield of 1508 kg ha^{-1} was also recorded in carbosulfan 25 EC @ 375g a.i ha^{-1} followed by carbosulfan 25 EC @ 312.5g a.i ha^{-1}. Carbosulfan 25 EC did not cause any phytotoxicity symptoms to cotton crop.

Key Words: Bioefficacy, carbosulfan 25 EC, cotton, sucking insect pests.

INTRODUCTION

Cotton is an important cash crop playing a key role in the economy of Indian farmers. In India cotton is grown in an area of 118.81 lakh hectares with a production of 352 lakh bales (170 kgs) and productivity of 504 kg lint ha^{-1} as against world average production of 701 kg lint ha^{-1} (Anonymous, 2015-16). Cotton crop contributes about 80 per cent of the raw material to textile industry in the country providing livelihood for more than 100 million people, through production, processing, trading and marketing (Rakesh and Kathane, 1989). After the introduction of Bt cotton, the problem of bollworms has been solved to some extent and a significant change in cropping pattern in the cotton growing areas has been observed (Ahsan and Altaf, 2009; Abdullah, 2010). However, sucking pests have emerged as major threat for cotton growers and cause heavy yield losses. Among the sucking pests, jassids, *Amrasca biguttula biguttula* (Ishida); thrips, *Thrips tabaci* (Linn.); aphids, *Aphis gossypii* (Glover); and whiteflies, *Bemisia tabaci* (Genn.) are serious and cause losses to the tune of 21.20 to 22.86 per cent (Kulkarani *et al*., 2003; Satpute *et al.,* 1990 and Dhawan *et al.,* 1988); besides, acting as vectors for a number of viral diseases (Serader *et al.,* 1999). To manage these insect pests, a number of insecticides of different groups have been tested and considered under general recommendation for the management of these insects; however, due to high pest incidence levels, the cotton crop is subjected to increased pesticide applications, which have detrimental effects on the existing parasitic and predatory fauna. The present investigation was undertaken to evaluate the efficacy of new molecules against aphids and thrips infesting cotton.

MATERIAL AND METHODS

The field experiment was conducted at the Agricultural Research Station-Banswara (Rajasthan) during *kharif*-2014 and 2015 to evaluate the efficacy of carbosulfan 25 EC against aphids and thrips of cotton**.** The trial was laid out in randomized block design (RBD) with seven treatments and three replications. The different doses of carbosulfan 25 EC (250, 312.5, 375 grams active ingredient per hectare) were evaluated against aphids and thrips of cotton along with standard checks *i.e.* fipronil 5 EC, thiamethoxam 25 WG and imidacloprid 17.8 SL. Cotton hybrid Jai Bt BG II was dibbled at 90 × 45 cm spacing. The plot size was 6.0 m × 5.4 m. All recommended package and practices, except plant protection measures, was followed to raise the crop.

Observations on pest incidence were recorded from five fixed plants/plot, which were tagged after selecting

randomly for this purpose. The number of sucking pests (aphids and thrips) were recorded from three leaves (top, middle and bottom) per plant, before spray on 3rd, 5th and 10th day after spray. All the treatments were given twice (two sprays) except check. First spray was done at economic threshold level (ETL) and subsequent spray was given at fortnight interval. The per cent reduction in population of insect pests vis-a-vis control was computed using the method described by Henderson and Tilton (1955):

$$\text{Per cent reduction in population} = 100 \times \left[1 - \frac{T_a \times C_b}{T_b \times C_a}\right]$$

Where,

T_a = Number of insects after treatment

T_b = Number of insects before treatment

C_a = Number of insects in untreated check after treatment

C_b = Number of insects in untreated check before treatment

The reduction percentage figures were transformed into arc sine values and subjected to analysis of variance. The seed cotton yield was recorded plot wise at harvest and it was converted into kg ha^{-1} for analysis and comparison.

Visual observations on the phytotoxicity to the crop was rated using the criteria developed by Clay and Davison (1978) on a scale of 0 – 10 where; 0 represents no injury and 10 represents dead plants. The observations on the phytotoxicity symptoms *viz.* leaf injury, wilting, stunting, vein clearing, necrosis, chlorosis, epinasty and hyponasty on crop due to application of carbosulfan 25 EC @ 625g a.i. ha^{-1} were recorded at 1, 3, 5, 7, 10 and 15 days after spray using the scores shown in Table–1.

Table 1. Phytotoxicity visual rating scale

Score	Per cent phytotoxicity symptom
0	No phytotoxicity
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

Bio-efficacy against thrips: Before first spray, the population of thrips (Table 2-3) was uniform and no significant difference was observed among the treatments/plots during both the years. The significant maximum reduction in the population of thrips with a mean of 59.99 and 67.34; 52.62 and 62.71 per cent was recorded in carbosulfan 25 EC @ 1500 ml ha^{-1} at 3 and 5 days after first spray, respectively. It was statistically at par with lower dose of carbosulfan 25 EC @ 1250 ml ha^{-1} during the year 2014 and 2015. The minimum per cent reduction in thrips population 33.00 and 36.73; 36.37 and 41.52 were recorded in carbosulfan 25 EC @ 1000 ml ha^{-1} at 3 and 5 days after first spray during both years, respectively. At 10 days after spray, decreasing trend was recorded in reduction of the thrips population. A similar trend was also observed in second spray at 3, 5 and 10 days after spray (Table 3). The present findings are supported by Rajeswaran *et al*., (2005), who reported that applications of carbosulfan 25 EC @ 250 g a.i. ha^{-1} gave highest reduction in the cotton aphids, leaf hoppers and thrips population at 7 days after spray. Jat *et al*. (2015) also reported that carbosulfan 25EC @ 625 g a.i./ ha gave effective control of *Thrips tabaci* (Linn.) on cotton.

Bio-efficacy against aphids: The pre-treatment population of aphids (Table 4-5) did not vary significantly in all the treatments before first spray during the years 2014 and 2015. The highest reduction in population of aphids with mean of 55.87 and 67.72; 56.45 and 65.40 per cent was recorded in carbosulfan 25 EC @ 1500 ml ha^{-1} at 3 and 5 days after first spray that was statistically at par with lower dose of carbosulfan 25 EC @ 1250 ml ha^{-1} during both the years, respectively. Minimum per cent reduction in aphid population of 38.41 and 45.48; 38.31 and 42.46 was recorded in imidacloprid 17.8 SL@125 ml ha^{-1} at 3 and 5 days after first spray, respectively. At 10 days after spray, a decreasing trend was recorded in reduction of the aphid population. A similar trend was also observed in second spray at 3, 5 and 10 days after spray. *The findings of present investigation are in close agreement with the findings of Ali and Chinniah (1999) who reported that* two rounds of carbosulfan 25 EC (0.075%) at 15 days interval significantly reduced the population of cotton aphids (97.5%) and leaf hopper (84.5%) in field condition. Chinniah (2001) reported that bifenthrin (0.015 %) and carbosulfan (0.05 %) were most effective against aphids on okra. Jasmine *et al*. (2005) reported that carbosulfan 25 EC @ 250 and 300 g a.i ha^{-1} was found to be excellent in controlling the cotton aphid. Rajeswaran *et al*. (2005) also reported that three consecutive applications of carbosulfan 25 EC @ 250 g a.i.ha^{-1} at 15 days interval brought down the population

Table 2. Bio efficacy of different insecticides against thrips during *kharif*-2014

Treatments and Dosage	PTP	Per cent mean reduction in population of thrips					
		1st spray			2nd spray		
		3 DAS	5 DAS	10 DAS	3 DAS	5 DAS	10 DAS
T_1= Carbosulfan 25 EC@ 250g a.i. ha^{-1}	36.67	35.06	37.30	36.22	38.18	40.43	39.77
(1000 ml ha^{-1})	[6.06]	(33.00)	(36.73)	(34.92)	(38.21)	(42.06)	(40.92)
T_2= Carbosulfan25EC @ 312.5g a.i. ha^{-1}	37.00	49.34	53.46	52.86	51.75	54.68	53.39
(1250 ml ha^{-1})	[6.08]	(57.54)	(64.55)	(63.55)	(61.68)	(66.57)	(64.44)
T_3= Carbosulfan 25 EC@ 375g a.i. ha^{-1}	37.33	50.76	55.15	54.44	52.51	55.64	54.67
(1500 ml ha^{-1})	[6.10]	(59.99)	(67.34)	(66.17)	(62.96)	(68.15)	(66.55)
T_4= Fipronil 5 EC @ 100g a.i. ha^{-1}	36.33	45.82	50.95	49.88	46.29	51.44	50.47
(2000 ml ha^{-1})	[6.03]	(51.42)	(60.31)	(58.48)	(52.24)	(61.14)	(59.49)
T_5= Imidacloprid17.8 SL@ 25g a.i. ha^{-1}	35.00	39.32	42.60	41.13	41.86	45.97	45.23
(125 ml ha^{-1})	[5.91]	(40.16)	(45.81)	(43.27)	(44.53)	(51.69)	(50.41)
T_6=Thiamethoxam25WG@ 25g a.i. ha^{-1}	36.00	42.24	44.37	42.98	44.71	47.34	45.95
(100 g ha^{-1})	[5.99]	(45.19)	(48.89)	(46.47)	(49.49)	(54.08)	(51.65)
T_7= Untreated check	37.67	-	-	-	-	-	-
	[6.11]						
S. Em. ±	-	1.56	1.17	1.00	1.20	1.23	1.11
CD at 5%	NS	4.67	3.48	2.98	3.57	3.68	3.31

PTP= Pre-treatment population/3leaves; Figures in brackets [] are square root transformed values; Figures in parentheses are retransformed per cent values;
DAS= Day/days after spray; NS=Non significant

Table 3. Bio efficacy of different insecticides against thrips during *kharif*-2015

Treatments and Dosage	PTP	Per cent mean reduction in population of thrips					
		1st spray			2nd spray		
		3 DAS	5 DAS	10 DAS	3 DAS	5 DAS	10 DAS
T_1 = Carbosulfan 25 EC@ 250g a.i. ha^{-1}	33.67	37.09	40.12	39.12	42.23	43.88	42.32
(1000 ml ha^{-1})	[5.80]	(36.37)	(41.52)	(39.80)	(45.18)	(48.04)	(45.33)
T_2= Carbosulfan 25 EC@ 312.5g a.i. ha^{-1}	34.00	45.83	49.31	48.45	51.97	54.00	53.50
(1250 ml ha^{-1})	[5.83]	(51.45)	(57.50)	(56.01)	(62.04)	(65.46)	(64.62)
T_3 = Carbosulfan 25 EC@ 375g a.i. ha^{-1}	34.33	46.50	52.37	51.33	53.36	56.36	54.94
(1500 ml ha^{-1})	[5.86]	(52.62)	(62.71)	(60.96)	(64.39)	(69.30)	(67.00)
T_4 = Fipronil 5 EC@ 100g a.i. ha^{-1}	32.67	42.92	48.23	47.20	49.34	51.65	50.32
(2000 ml ha^{-1})	[5.71]	(46.38)	(55.63)	(53.83)	(57.54)	(61.50)	(59.23)
T_5 = Imidacloprid 17.8 SL @ 25g a.i. ha^{-1}	32.00	40.98	43.17	42.16	42.85	44.25	42.55
(125 ml ha^{-1})	[5.66]	(43.00)	(46.81)	(45.05)	(46.26)	(48.69)	(45.74)
T_6 =Thiamethoxam 25WG @25g a.i. ha^{-1}	33.00	41.46	45.42	44.55	49.17	51.47	50.02
(100 g ha^{-1})	[5.74]	(43.83)	(50.73)	(49.21)	(57.26)	(61.20)	(58.71)
T_7 = Untreated check	34.00	-	-	-	-	-	-
	[5.83]						
S. Em. ±	-	1.15	1.27	1.20	1.17	1.52	1.46
CD at 5%	NS	3.45	3.78	3.58	3.50	4.52	4.34

PTP= Pre-treatment population/3leaves; Figures in brackets [] are square root transformed values; Figures in parentheses are retransformed per cent values;
DAS= Day/days after spray; NS=Non significant

Table 4: Bio efficacy of different insecticides against aphids during *kharif*-2014

Treatments and Dosage	PTP	Per cent mean reduction in population of thrips					
		1st spray			2nd spray		
		3 DAS	5 DAS	10 DAS	3 DAS	5 DAS	10 DAS
T_1 = Carbosulfan 25 EC@ 250g a.i. ha^{-1}	26.00	42.58	46.27	44.09	45.18	46.94	45.78
(1000 ml ha^{-1})	[5.10]	(45.78)	(52.21)	(48.40)	(50.31)	(53.38)	(51.36)
T_2= Carbosulfan25EC @ 312.5g a.i. ha^{-1}	26.00	46.80	54.41	52.18	50.99	53.38	52.18
(1250 ml ha^{-1})	[5.10]	(53.14)	(66.14)	(62.39)	(60.38)	(64.42)	(62.39)
T_3= Carbosulfan 25 EC@ 375g a.i. ha^{-1}	25.67	48.37	55.38	53.41	52.60	56.20	55.49
(1500 ml ha^{-1})	[5.06]	(55.87)	(67.72)	(64.47)	(63.12)	(69.05)	(67.90)
T_4= Fipronil 5 EC @ 100g a.i. ha^{-1}	25.00	44.47	49.10	47.52	48.66	52.10	50.93
(2000 ml ha^{-1})	[5.00]	(49.07)	(57.13)	(54.40)	(56.37)	(62.26)	(60.28)
T_5= Imidacloprid 17.8 SL@ 25g a.i. ha^{-1}	24.00	38.30	42.40	38.79	39.59	42.54	40.47
(125 ml ha^{-1})	[5.90]	(38.41)	(45.48)	(39.25)	(40.62)	(45.70)	(42.13)
T_6=Thiamethoxam 25WG@25g a.i. ha^{-1}	24.00	43.59	48.39	46.79	47.56	51.14	48.74
(100 g ha^{-1})	[4.90]	(47.55)	(55.90)	(53.13)	(54.46)	(60.63)	(56.51)
T_7= Untreated check	26.00 [5.10]	-	-	-	-	-	-
S. Em. ±	-	0.92	0.95	0.88	1.09	1.20	1.16
CD at 5%	NS	2.74	2.83	2.64	3.25	3.57	3.46

PTP= Pre-treatment population/3leaves; Figures in brackets [] are square root transformed values; Figures in parentheses are retransformed per cent values;
DAS= Day/days after spray; NS=Non significant

Table 5. Bio efficacy of different insecticides against aphids during *kharif*-2015

Treatments and Dosage	PTP	Per cent mean reduction in population of thrips					
		1st spray			2nd spray		
		3 DAS	5 DAS	10 DAS	3 DAS	5 DAS	10 DAS
T_1= Carbosulfan 25 EC@ 250g a.i. ha^{-1}	21.00	41.23	45.14	42.22	45.57	48.30	47.10
(1000 ml ha^{-1})	[4.58]	(43.43)	(50.25)	(45.15)	(50.99)	(55.74)	(53.65)
T_2= Carbosulfan 25EC@ 312.5g a.i. ha^{-1}	21.00	46.76	51.36	50.03	51.31	53.79	51.75
(1250 ml ha-^{1})	[4.58]	(53.08)	(61.00)	(58.73)	(60.92)	(65.11)	(61.66)
T_3= Carbosulfan 25 EC@ 375g a.i. ha^{-1}	22.00	48.71	53.97	52.67	52.24	55.82	53.97
(1500 ml ha^{-1})	[4.69]	(56.45)	(65.40)	(63.23)	(62.50)	(68.43)	(65.40)
T_4= Fipronil 5 EC @ 100g a.i. ha^{-1}	22.00	44.33	48.52	47.62	47.26	50.91	49.22
(2000 ml ha^{-1})	[4.69]	(48.84)	(56.13)	(54.57)	(53.94)	(60.24)	(57.33)
T_5= Imidacloprid17.8 SL@ 25g a.i. ha^{-1}	20.00	38.24	40.66	38.81	40.52	42.92	41.52
(125 ml ha^{-1})	[4.47]	(38.31)	(42.46)	(39.28)	(42.21)	(46.37)	(43.94)
T_6=Thiamethoxam 25WG@25g a.i. ha^{-1}	20.00	43.01	47.61	46.00	46.65	49.68	48.07
(100 g ha^{-1})	[4.47]	(46.53)	(54.55)	(51.74)	(52.88)	(58.14)	(55.35)
T_7= Untreated check	23.00 [4.80]	-	-	-	-	-	-
S. Em. ±	-	1.32	1.34	1.52	1.47	1.30	1.21
CD at 5%	NS	3.93	3.99	4.53	4.39	3.87	3.61

PTP= Pre-treatment population/3leaves; Figures in brackets [] are square root transformed values; Figures in parentheses are retransformed per cent values;
DAS= Day/days after spray; NS=Non significant

Table 6. Mean seed cotton yield (kg ha-[1]) in the different bio-efficacy treatments

S.No.	Treatments	Dosage (ml or g ha^{-1})	Seed cotton yield (kg ha^{-1})		
			2014	2015	Mean
1.	T_1 = Carbosulfan 25 EC @ 250g a.i. ha^{-1}	1000 ml	362	2084	1223
2.	T_2 = Carbosulfan 25EC @ 312.5g a.i. ha^{-1}	1250 ml	543	2306	1425
3.	T_3 = Carbosulfan 25 EC @ 375g a.i. ha^{-1}	1500 ml	573	2442	1508
4.	T_4 = Fipronil 5 EC @ 100g a.i. ha^{-1}	2000 ml	472	2208	1340
5.	T_5 = Imidacloprid 17.8 SL @ 25g a.i. ha^{-1}	125 ml	398	1899	1149
6.	T_6 =Thiamethoxam 25 WG @ 25g a.i. ha^{-1}	100 g	400	2146	1273
7.	T_7 = Untreated check	-	292	1431	862
	S. Em. ±		115.50	250.77	
	CD at 5%		110.0	286.0	

of aphids, leaf hoppers and thrips. Daffalla and Ismail (2015) also evaluated the efficacy of carbosulfan and thiamethoxam against insect pests of potato and reported that both the treatments effectively reduced aphid population.

Phytotoxicity: The data on phytotoxicity symptoms (Table 9-10) revealed that carbosulfan 25 EC did not cause phytotoxic symptoms on crop in any form (injury to leaf tips and leaf surface, wilting of plants, vein clearing, necrosis, chlorosis, epinasty and hyponasty) even when sprayed @ 625g a.i. ha^{-1} (2500 ml ha^{-1}). There were no visual symptoms of phytotoxicity on cotton up to 15 days in test doses of carbosulfan 25 EC**.** The present findings are in agreement with the work of Rajeswaran *et al*. (2004) who reported that carbosulfan 25 EC did not cause any phytotoxicity to crop.

Effect on seed cotton yield: The maximum mean seed cotton yield of 573 and 2442 kg ha^{-1} was recorded in carbosulfan 25 EC @ 1500 ml ha^{-1} during the year 2014 and 2015, respectively; however, it was statistically at par with fipronil 5 EC @ 2000 ml ha^{-1} and thiamethoxam 25 WG @ 100g ha^{-1} during both the years (Table 6).

On the basis of two years study, it is concluded that carbosulfan 25 EC @ 375g a.i. ha^{-1} was very effective in controlling population of aphids and thrips and can be an effective option for the cotton growers.

REFERENCES

Abdullah, A. 2010. An analysis of Bt cotton cultivation in Punjab, Pakistan using the Agriculture Decision Support System (ADSS). *Agri-Bio Forum*, **13**: 274-287.

Ahsan, R. and Z. Altaf. 2009. Development, adoption and performance of Bt cotton in Pakistan: A review. *Pakistan Journal of Agricultural Sciences,* **22**: 73-85.

Ali, K.A. and Chinniah, C. 1999. The bio efficcacy of carbosulfan 25 EC (Marshal) against pests of cotton, Gossypium hirsutum. Pestology, ***23****: 62.64.*

Anonymous, 2015-16. http://cotcorp.gov.in/current-cotton.aspx?pageid=4

Chinniah, C. 2001. Evaluation of acaricides and insecticides against the spider mite and aphid on bhendi. *Madras Agriculture Journal,* **87**: 483-486.

Clay, D.V. and Davison, J.G. 1978. An evaluation of sand culture techniques for studying the tolerance of fruit crop to soil-acting herbicides. *Weed Research*, **18:** 139-147.

Daffalla, E.Y. and Ismail, S. 2015. Efficacy of certain insecticides (carbosulfan and thiamethoxam) on some potato insect pests. *Global Journal of Cassava and Potatoes Research,* **1**: 12-15.

Dhawan, A.K., Sidhu, A.S. and Simwat, G.S. 1988. Assessment of avoidable loss in cotton (*Gossypium hirsutum and G. arboreum*) due to sucking pests and bollworms. *Indian Journal of Agricultural* Sciences, **58**: 290-92.

Henderson, C.F. and Tilton, E.W. 1955. Tests with acaricides against the brown wheat mite. *Journal of Economic Entomology*, **48**: 157-161.

Jasmine, R.S., Chandrasekaran, S., Kuttalam, S. and Jayakumar, R. 2005. Field efficacy of carbosulfan 25 EC (Marshal) against *Aphis gossypii* Glover infesting brinjal. *Journal of Plant Protection and Environment*, **2**: 33-37.

Jat, B.L., Dahiya, K.K. and Sharma, S. 2015. Bioefficacy of carbosulfan against thrips, *Thrips tabaci* (Linn) on cotton. *Journal of Insect Science*, **28**: 35-38.

Kulkarni, K.A., Patil, S.B. and Udikeri, S.S. 2003. Status of sustainable IPM of cotton pests: A scenario in Karnataka: In proceedings of National symposium on sustainable insect pest management. ERI, Loyola Collage, Chennai.

Rajeswaran, J., Santharam, G. and Chandrasekran, S. 2004. Studies on compatibility and phytotoxicity of carbosulfan 25 EC with certain agrochemicals on cotton. *Journal of Entomological Research,* **28**: 247-252.

Rajeswaran, J., Santharam, G., Kuttalam, S. and Chandrasekaran, S. 2005. Biological compatibility of carbosulfan with methyl demoton, carbendazim, magnesium sulphate and their effects on sucking pests of cotton. *Annals of Plant Protection Sciences*, **13**: 27-33.

Rakesh, R.C. and Kathane, T.V. 1989. Cotton marketing federation and export of cotton in India (1980-81 to 1987-88). *Cotton Development,* **18**: 1-18.

Satpute, U.S., Patil, V.N., Katole, S.R., Men, U.B., Bhagwat, V.R. and Thakare, A.Y. 1990. Avoidable losses due to sucking pests and bollworms in cotton. *Journal of Applied Zoological Research*, **1**: 67-72.

Seradar, S., Ulrich, K. and Nedim, U. 1999. Development and fecundity of *Aphis gossypii* Glover (Homoptera: Aphididae) on three malvaceae hosts. *Transaction of Journal of Agriculture and Forestry*, **23**: 637-43.