

Original Research Article

<https://doi.org/10.20546/ijcmas.2022.1108.027>

Efficacy of New Generation Insecticides with their Economics against *Bemisia tabaci* (Gennadius) Infesting *Bt* cotton in Field Condition

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ABSTRACT

Keywords

Cotton, Bt, Whitefly, *Bemisia tabaci*, insecticides

Article Info

Received:
02 July 2022
Accepted:
31 July 2022
Available Online:
10 August 2022

The present investigation on bioefficacy of insecticide against *Bemisia tabaci* infesting *Bt* cotton in field condition was carried out at Cotton Research Station, Junagadh Agricultural University, Junagadh during *kharif*, 2020-21 & 2021-22. Considering the efficacy and yield, afidopyropen 50 g/l DC 0.010 % found the most effective treatment over rest of the treatments as it occupied the first rank with yield (2538 kg/ha). The next best treatments were pyriproxyfen 10 + bifenthrin 10 EC 0.024 % with yield (2332 kg/ha), and pyriproxyfen 10 EC 0.020 % with yield (2195 kg/ha) stood in the second and the third position in yield and efficacy. Based on ICBR, the result among different treatments indicated that the pyriproxyfen 10 + bifenthrin 10 EC 0.024 % gave the highest incremental cost benefit ratio of 1:14.80. The next in order being pyriproxyfen 10 EC 0.020 % (1:12.35), afidopyropen 50 g/l DC 0.010 % (1:8.52).

Introduction

Cotton, which has been reputed as the king of fibre, is one of the momentous and important cash crops exercising a profound influence on the economics and social affairs of the world.

Any other fibre crop cannot be compared with cotton for its fibre quality. The word "cotton" is derived from the Arabic word "*al qatan*" and is popularly known as "White Gold". In India, the

cotton crop is grown over an area of 120.69 lakh ha with a production of 362.18 lakh bales and a productivity of 510 kg/ha. A crop has a pride of place in the farming of Gujarat's Agriculture.

The economy of the entire state is very much dependent on the success or failure of this cash crop. In Gujarat, the cotton crop is grown over an area of 22.55 lakh ha with a production of 80.96 lakh bales and a productivity of 610 kg/ha (Anon., 2022). Whitefly causes serious damage to *Bt* cotton and

hence, insecticides are used to manage them effectively. But several new insecticides are registered, which may use effectively to manage and reduce the chance of resistance development against them.

Materials and Methods

A field experiment on the different spray schedules against *B. tabaci* was conducted at the Cotton Research Station, JAU, Junagadh during *kharif*, 2020 and 2021.

Application of treatment

All the chemicals were applied in the form of foliar spray with the help of a knapsack sprayer (15-litre capacity). For deciding the quantity of spray fluid required per plot, the control plot was sprayed with water and determined the required spray fluid. Spray fluid was prepared by mixing the measured quantity of water and chemicals.

The necessary care was taken to prevent the drift of pesticides to reach the adjacent plots. Care was also taken to rinse the sprayer thoroughly before and after each spray with soap water to avoid contamination from treatment to treatment. The first spray was carried out at the time of the substantial population of sucking pests, followed by the second & third sprays 15 days after the first spray.

Method of observation

To evaluate the efficacy of different chemicals, five plants were selected from the net plot area of each plot and tagged. A pre-treatment counts a day before and post-treatment counts at 1, 3, 5 and 7 days after application of spray (DAS) were recorded.

The methodology for recording the whitefly pest population was observing three leaves from the upper, middle and lower portion of each tagged plant and the data on the whitefly pest population obtained was transformed into suitable transformation and analyzed statistically.

Yield and economics

To ascertain the effect of different insecticides based on yield, the harvested seed of cotton was weighed separately from each net plot. The yield was converted on a hectare basis. The per cent increase in yield over control was calculated by using the following formula (Pradhan, 1969).

$$\text{Yield increased (\%)} = 100 \times \frac{T - C}{C}$$

Where,

T = Yield from treated plants (kg/ha)

C = Yield from untreated plants (kg/ha)

The cost-benefit ratio (CBR) and net return of each insecticide used were worked out for each treatment. For this purpose, the gross realization was worked out to compare the economics of the insecticidal treatments.

Results and Discussion

The data on different periods *i.e.*, before, one, three, five and seven days after sprays were pooled over years and the data of the first spray indicated that all the experimental plots showed non-significant variation concerning the number of whitefly per three leaves per plant. The pooled data (Table 1 & Fig. 1) on the number of per plant after one day of the first spray revealed that afidopyropen 50 g/L DC 0.010 % was found significantly superior [3.19/three leaves] and found at par with pyriproxyfen 10 + bifenthrin 10 EC 0.024 % [4.40/three leaves]. The next effective group of the treatments was pyriproxyfen 10 EC 0.020 % [4.90/three leaves] and flonicamid 50 WG 0.015 % [6.34/three leaves]. The treatments diafenthiuron 50 WP 0.060 % [7.69/three leaves] along with acephate 50 + imidacloprid 1.8 SP 0.104 % [8.95/three leaves] and spinetoram 11.7 SC 0.010 % [9.26/three leaves] were also moderately effective in reduction of whitefly

population. A more or less similar trend was observed during three, five and seven days after the first spray.

The pooled data (Table 2 & Fig. 2) after one day of the second spray showed that the efficacy of the treatment pyriproxyfen 10 + bifenthrin 10 EC 0.024 % [3.79/three leaves] was found highly significant to the rest of the treatments. The next group of the treatments afidopyropen 50 g/L DC 0.010 % [5.50/three leaves], pyriproxyfen 10 EC 0.020 % [5.99/three leaves] and flonicamid 50 WG 0.015 % [6.84 /three leaves]. The followed by treatments group was diafenthiuron 50 WP 0.060 % [8.13/three leaves] along with acephate 50 + imidacloprid 1.8 SP 0.104 % [8.69/three leaves] and spinetoram 11.7 SC 0.010 % [9.53/three leaves] and more or less similar trend was observed during three, five and seven days after the second spray.

For the third spray, the pooled data (Table 3 & Fig. 3) of the third spray observed that afidopyropen 50 g/L DC 0.010 % was found highly significant superior [3.94/three leaves] to the rest of the treatments after one day. The next treatments in efficacy were pyriproxyfen 10 EC 0.020 % [5.55/three leaves], flonicamid 50 WG 0.015 % [6.84/three leaves] and pyriproxyfen 10 + bifenthrin 10 EC 0.024 % [6.43/three leaves]. The treatments diafenthiuron 50 WP 0.060 % [7.28/three leaves] along with acetamiprid 20 SP 0.006 % [8.92/three leaves] were also found moderately effective. A more or less similar trend was observed during three, five and seven days after the third spray.

According to Ahmad *et al.*, (2014), the result showed that pyriproxyfen (80.14%) showed maximum mortality followed by imidacloprid (78.94%); acetamiprid (78.77); diafenthiuron (78.60%) and buprofezin (76.37%). Shaikh *et al.*, (2014); Bajya *et al.*, (2016); Kharel *et al.*, (2016) and Maity *et al.*, (2017) found that pyriproxyfen at higher doses was found to reduce the whitefly population to the tune of 68-73% in the seasons.

Swami *et al.*, (2018) revealed all among the treatments, Pyriproxyfen 10% EC @ 1250 ml/ha followed by Imidacloprid 17.8% SL 50 g a.i. @ 250 ml/ha was found the most effective to reduce the whitefly, *B. tabaci* population in chili crop during *kharif*, 2016 and 2017. Swathi *et al.*, (2018) and Navi *et al.*, (2021) concluded that the study indicated that spraying of pyriproxyfen 10% EW @ 200 g.a.i/ha has recorded significantly higher seed cotton yield (19.43 q/ha) with a maximum per cent reduction in whiteflies (95.28%), aphids (90.04%), thrips (98.78%) and leafhoppers (94.40%), respectively. Suman *et al.*, (2021) revealed that result revealed that afidopyropen 50 g/l DC @ 600 ml/ha was found to be most effective against jassid, aphid and whitefly. Next better treatment was afidopyropen 50 g/l DC @ 750 ml/ha followed by tolfenpyrad 15% EC @ 1000 ml/ha, afidopyropen 50 g/l DC @ 450 ml/ha, and spirotetramat 11.01% w/w + imidacloprid 11.01% w/w SC @ 500 ml/ha.

Hence the present findings are more or less similar and in agreement with the findings presented by earlier workers.

Yield and economics

The pooled data of the two years *i.e.*, 2020-21 and 2021-22 (Table 4 & Fig. 4) revealed that afidopyropen 50 g/l DC @ 0.100 % was found effective and recorded the highest 2538 kg/ha and which was at par with pyriproxyfen 10% + bifenthrin 10% EC @ 0.024 % (2332 kg/ha) and pyriproxyfen 10% EC @ 0.020 % (2195 kg/ha).

The other treatment recorded yield like, flonicamid 50% WG @ 0.015 % (1732 kg/ha), diafenthiuron 50 WP @ 0.060 % (1698 kg/ha), acephate 50% + imidacloprid 1.8% SP @ 0.085 % (1663), spinetoram 11.7% SC @ 0.009 % (1612 kg/ha) and least effective insecticides were acetamiprid 20% SP @ 0.008 % (1560 kg/ha) and spiromesifen 240 SC (22.9%) @ 0.029 % (1526 kg/ha) respectively over control (1320 kg/ha).

Table.1 Experimental details

1.	Location	Cotton Research Station, JAU, Junagadh.
2.	Season and Year	<i>kharif</i> , 2020 and 2021
3.	Design	RBD (Randomize Block Design)
4.	Variety	G. Cot. Hy-8 BG-II
5.	Replication	3
6.	Fertilizer	240:50:150 NPK kg/ha
7.	Plot size	Gross: 6.3 x 6.0 m ² Net: 5.40 x 3.60m ²
8.	Spacing	120 x 45 cm ²
9.	Seed rate	2-2.5 kg /ha

Table.2 Treatment details

Sr. No.	Treatment	Conc. (%)	Qty of formulated in g or ml/10 lit water	g a.i. /ha.	Qty of formulation kg or lit./ha
T ₁	Spinetoram 11.7% SC	0.010	08.50	50	0.425
T ₂	Pyriproxyfen 10% EC	0.020	20.00	100	1.000
T ₃	Afidopyropen 50 g/L DC	0.010	20.00	50	1.000
T ₄	Spiromesifen 240 SC (22.9%)	0.027	12.00	137	0.600
T ₅	Diafenthiuron 50% WP	0.060	12.00	300	0.600
T ₆	Flonicamid 50% WG	0.015	03.00	75	0.150
T ₇	Acetamiprid 20% SP	0.006	03.00	30	0.150
T ₈	Acephate 50% + Imidacloprid 1.8% SP	0.104	20.00	518	1.000
T ₉	Pyriproxyfen 10% + Bifenthrin 10% EC	0.024	12.00	120	0.600
T ₁₀	Control	-	-	-	-

Table.3 Bio-efficacy of different insecticides against whitefly, *B. tabaci* infesting cotton under field condition after the first spray

Sr. No.	Treatment	Pooled of two years for the first spray (2020-21 & 2021-22)				
		Mean number of whitefly /3 leaves / plant				
		Before spray	1 DAS	3 DAS	5 DAS	7 DAS
1	Spinetoram 11.7 SC 0.010%	2.96 (8.73)	3.04 (9.26)	3.01 (9.03)	2.99 (8.32)	2.88 (8.27)
2	Pyriproxyfen 10 EC 0.020%	2.88 (8.29)	2.21 (4.90)	2.11 (4.46)	2.04 (4.18)	1.88 (3.53)
3	Afidopyropen 50 g/L DC 0.010%	2.91 (8.48)	1.79 (3.19)	1.72 (2.95)	1.63 (2.67)	1.54 (2.38)
4	Spiromesifen 240 SC 0.027%	2.94 (8.66)	3.44 (11.85)	3.40 (11.56)	3.29 (10.80)	3.21 (10.31)
5	Diafenthiuron 50 WP 0.060%	3.06 (9.33)	2.77 (7.69)	2.73 (7.46)	2.67 (7.14)	2.54 (6.47)
6	Flonicamide 50 WG 0.015%	2.91 (8.47)	2.50 (6.34)	2.47 (6.12)	2.40 (5.77)	2.01 (4.02)
7	Acetamiprid 20 SP 0.006%	2.85 (8.11)	3.13 (9.81)	3.12 (9.71)	3.05 (9.29)	3.02 (9.11)
8	Acephate 50 + Imidacloprid 1.8 SP 0.104%	3.10 (9.60)	2.99 (8.95)	2.95 (8.71)	2.84 (8.05)	2.72 (7.41)
9	Pyriproxyfen 10 + Bifenthrin 10 EC 0.024%	2.96 (8.77)	2.09 (4.40)	2.01 (4.02)	1.90 (3.93)	1.79 (3.19)
10	Control	3.00 (9.00)	3.44 (11.80)	3.50 (12.27)	3.57 (12.72)	3.62 (13.07)
ANOVA						
	S.Em.±	0.10	0.10	0.09	0.10	0.08
	C.D. at 5 %	NS	0.30	0.27	0.29	0.23
	C.V. %	8.23	8.69	8.64	9.22	7.81
	Y	-	-	-	-	-
	S.Em.±	0.04	0.03	0.05	0.05	0.04
	C.D. at 5 %	NS	0.09	0.15	0.17	0.12
	YXT	-	-	-	-	-
	S.Em.±	0.14	0.13	0.13	0.12	0.12
	C.D. at 5 %	NS	NS	NS	NS	NS
1. DAS – Days after spray 2. NS = Non significant @ 5% 3. Figures in the parenthesis indicate retransform values, while outside are square root transformed values.						

Table.4 Bio-efficacy of different insecticides against whitefly, *B. tabaci* infesting cotton under field condition after the second spray

Sr. No.	Treatment	Pooled of two years for the second spray (2020-21 & 2021-22)				
		Mean number of whitefly / 3 leaves / plant				
		Before spray	1 DAS	3 DAS	5 DAS	7 DAS
1	Spinetoram 11.7 SC 0.010%	2.93 (8.59)	3.09 (9.53)	3.03 (9.20)	2.99 (8.94)	2.95 (8.72)
2	Pyriproxyfen 10 EC 0.020%	2.86 (8.15)	2.45 (5.99)	2.38 (5.66)	2.32 (5.39)	2.28 (5.19)
3	Afidopyropen 50 g/L DC 0.010%	2.89 (8.35)	2.35 (5.50)	2.23 (4.99)	2.17 (4.71)	2.12 (4.51)
4	Spiromesifen 240 SC 0.027%	3.09 (9.54)	3.46 (11.96)	3.41 (11.63)	3.37 (11.36)	3.34 (11.17)
5	Diafenthiuron 50 WP 0.060%	3.03 (9.20)	2.85 (8.13)	2.77 (7.66)	2.68 (7.20)	2.65 (7.00)
6	Flonicamide 50 WG 0.015%	2.96 (8.74)	2.62 (6.84)	2.55 (6.49)	2.42 (6.03)	2.40 (5.77)
7	Acetamiprid 20 SP 0.006%	2.89 (8.37)	3.21 (10.31)	3.16 (9.98)	3.11 (9.69)	3.08 (9.49)
8	Acephate 50 + Imidacloprid 1.8 SP 0.104%	3.48 (12.09)	2.95 (8.69)	2.89 (8.36)	2.85 (8.09)	2.81 (7.89)
9	Pyriproxyfen 10 + Bifenthrin 10 EC 0.024%	3.01 (9.04)	1.95 (3.79)	1.86 (3.47)	1.78 (3.17)	1.72 (2.95)
10	Control	3.26 (10.65)	3.56 (12.65)	3.60 (12.96)	3.70 (13.67)	3.75 (14.03)
ANOVA						
	S.Em.±	0.10	0.09	0.08	0.09	0.11
	C.D. at 5 %	NS	0.28	0.24	0.26	0.30
	C.V. %	8.03	8.27	8.69	7.96	8.59
	Y	-	-	-	-	-
	S.Em.±	0.03	0.04	0.05	0.03	0.04
	C.D. at 5 %	NS	0.12	0.15	0.09	NS
	YXT	-	-	-	-	-
	S.Em.±	0.16	0.14	0.16	0.12	0.13
	C.D. at 5 %	NS	NS	NS	NS	NS
1. DAS – Days after spray 2. NS = Non significant @ 5% 3. Figures in the parenthesis indicate retransform values, while outside are square root transformed values.						

Table.5 Bio-efficacy of different insecticides against whitefly, *B. tabaci* infesting cotton under field condition after the third spray

Sr. No.	Treatment	Pooled of two years for the third spray (2020-21 & 2021-22)				
		Mean number of whitefly / 3 leaves / plant				
		Before spray	1 DAS	3 DAS	5 DAS	7 DAS
1	Spinetoram 11.7 SC 0.010%	2.89 (8.35)	2.86 (8.15)	2.72 (7.39)	2.65 (7.03)	2.58 (6.64)
2	Pyriproxyfen 10 EC 0.020%	2.81 (7.91)	2.36 (5.55)	2.21 (4.90)	2.18 (4.73)	2.12 (4.51)
3	Afidopyropen 50 g/L DC 0.010%	2.85 (8.12)	1.99 (3.94)	1.77 (3.13)	1.65 (2.73)	1.59 (2.53)
4	Spiromesifen 240 SC 0.027%	3.05 (9.29)	3.36 (11.3)	3.24 (10.52)	3.26 (10.61)	3.24 (10.49)
5	Diafenthiuron 50 WP 0.060%	3.00 (8.97)	2.70 (7.28)	2.55 (6.51)	2.48 (6.14)	2.39 (5.72)
6	Flonicamide 50 WG 0.015%	2.92 (8.51)	2.62 (6.84)	2.53 (6.34)	2.39 (5.70)	2.31 (5.31)
7	Acetamiprid 20 SP 0.006%	2.86 (8.15)	2.99 (8.92)	2.86 (8.16)	2.79 (7.78)	2.70 (7.28)
8	Acephate 50 + Imidacloprid 1.8 SP 0.104%	3.44 (11.85)	2.96 (8.73)	2.82 (7.96)	2.80 (7.81)	2.72 (7.40)
9	Pyriproxyfen 10 + Bifenthrin 10 EC 0.024%	2.97 (8.80)	2.54 (6.43)	2.38 (5.66)	2.30 (5.29)	2.22 (4.91)
10	Control	3.21 (10.29)	3.44 (11.85)	3.63 (13.20)	3.68 (13.51)	3.72 (13.84)
ANOVA						
	S.Em.±	0.09	0.10	0.08	0.11	0.09
	C.D. at 5 %	NS	0.30	0.24	0.33	0.26
	C.V. %	7.75	8.08	9.27	10.77	8.52
	Y	-	-	-	-	-
	S.Em.±	0.02	0.05	0.03	0.04	0.04
	C.D. at 5 %	NS	0.15	0.09	0.12	NS
	YXT	-	-	-	-	-
	S.Em.±	0.10	0.13	0.14	0.16	0.13
	C.D. at 5 %	NS	NS	NS	NS	NS
1. DAS – Days after spray 2. NS = Non significant @ 5% 3. Figures in the parenthesis indicate retransform values, while outside are square root transformed values.						

Table.6 Bio-efficacy of different insecticides on yield of cotton under field condition.

Tr. No.	Treatment	Yield (kg/ha)			Yield increased over control (%)
		2020-21	2021-22	Pooled	
1	Spinetoram 11.7 SC 0.010%	1543	1680	1612	22.08
2	Pyriproxyfen 10 EC 0.020%	2058	2332	2195	66.23
3	Afidopyropen 50 g/L DC 0.010%	2435	2641	2538	92.21
4	Spiromesifen 240 SC 0.027%	1440	1612	1526	15.58
5	Diafenthiuron 50 WP 0.060%	1612	1783	1698	28.57
6	Flonicamide 50 WG 0.015%	1646	1818	1732	31.17
7	Acetamiprid 20 SP 0.006%	1475	1646	1560	18.18
8	Acephate 50 + Imidacloprid 1.8 SP 0.104%	1578	1749	1663	25.97
9	Pyriproxyfen 10 + Bifenthrin 10 EC 0.024%	2195	2469	2332	76.62
10	Control	1132	1509	1320	0.00
ANOVA					
	S.Em.±	252.08	234.44	240.07	-
	C.D. at 5 %	749.03	696.53	720.42	-
	C.V. %	9.45	7.82	8.59	-
	Y	-	-	-	-
	S.Em.±	-	-	28.51	-
	C.D. at 5 %	-	-	81.84	-
	YXT	-	-	-	-
	S.Em.±	-	-	90.15	-
	C.D. at 5 %	-	-	NS	-
NS = Non Significant @ 5%					

Table.7 Economics of different insecticides for the management of whitefly infesting cotton under field condition

Sr. No.	Treatment	Quantity of insecticide (kg or lit/ha)	Yield (Kg/ha)	Yield Increase over Control (Kg/ha)	Gross Income	Additional Income (RS)/ha	Cost of Treatment (Rs/ha)	Net Realization (Rs)	ICBR
1	Spinetoram 11.7 SC 0.010%	1.28	1612	291	116049	20988	19694	1293	1:1.07
2	Pyriproxyfen 10 EC 0.020%	3.00	2195	874	158025	62963	5100	57863	1:12.35
3	Afidopyropen 50 g/L DC 0.010%	3.00	2538	1217	182716	87654	10290	77364	1:8.52
4	Spiromesifen 240 SC 0.027%	1.80	1526	206	109877	14815	13200	1615	1:1.12
5	Diafenthiuron 50 WP 0.060%	1.80	1698	377	122222	27160	9974	17186	1:2.72
6	Flonicamide 50 WG 0.015%	0.45	1732	412	124691	29630	7875	21754	1:3.76
7	Acetamiprid 20 SP 0.006%	0.45	1560	240	112346	17284	2515	14769	1:6.87
8	Acephate 50 + Imidacloprid 1.8 SP 0.104%	3.00	1663	343	119753	24691	5160	19531	1:4.79
9	Pyriproxyfen 10 + Bifenthrin 10 EC 0.024%	1.80	2332	1012	167901	72840	4920	67920	1:14.80
10	Control	0.00	1320	0	95062	0	0	0	0

Note: 1. Labour cost: `500/ha/spray,
 2. Av. Market price of cotton: ` 72/kg,
 3. Quantity of water: 500 litre/ha/spray

Table.8 Comprehensive assessment on efficacy of various insecticidal treatments based on the ranking method

Sr. No.	Treatment	Rank for control of whitefly			Yield	Net Realization	Total rank	Overall Ranking
		1 st Spray	2 nd Spray	3 rd Spray				
1	Spinetoram 11.7 SC 0.010%	7	7	7	7	9	37	7
2	Pyriproxyfen 10 EC 0.020%	3	3	2	3	3	14	3
3	Afidopyropen 50 g/L DC 0.010%	1	2	1	1	1	6	1
4	Spiromesifen 240 SC 0.027%	9	9	9	9	8	44	9
5	Diafenthiuron 50 WP 0.060%	5	5	5	5	6	26	5
6	Flonicamide 50 WG 0.015%	4	4	4	4	4	20	4
7	Acetamiprid 20 SP 0.006%	8	8	8	8	7	39	8
8	Acephate 50 + Imidacloprid 1.8 SP 0.104%	6	6	6	6	5	29	6
9	Pyriproxyfen 10 + Bifenthrin 10 EC 0.024%	2	1	3	2	2	10	2

Fig.1 Effect of different insecticides on *B. tabaci* infesting cotton after the first spray (Pooled: 2020-21 & 2021-22)

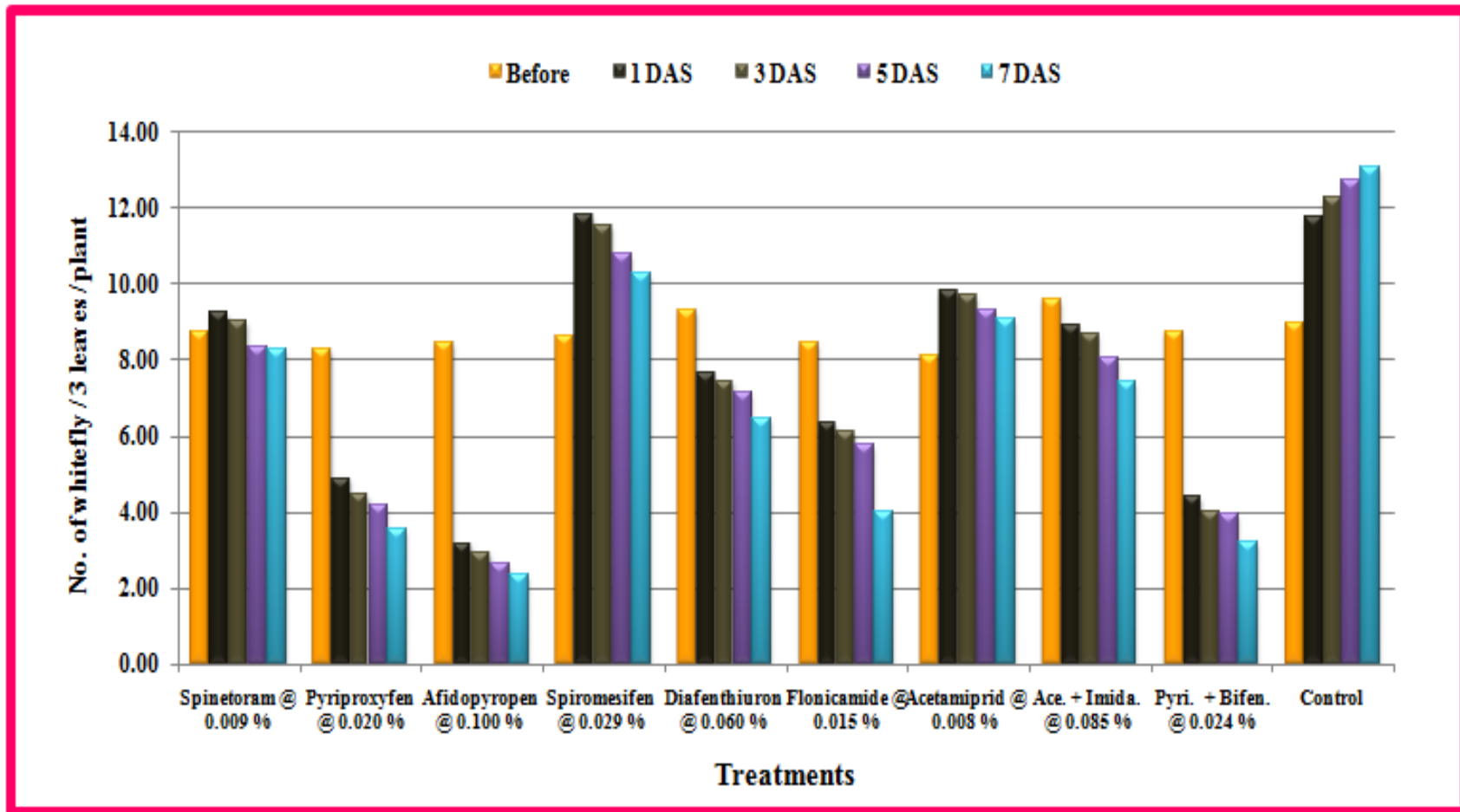


Fig.2 Effect of different insecticides on *B. tabaci* infesting cotton after the second spray (Pooled: 2020-21 & 2021-22)

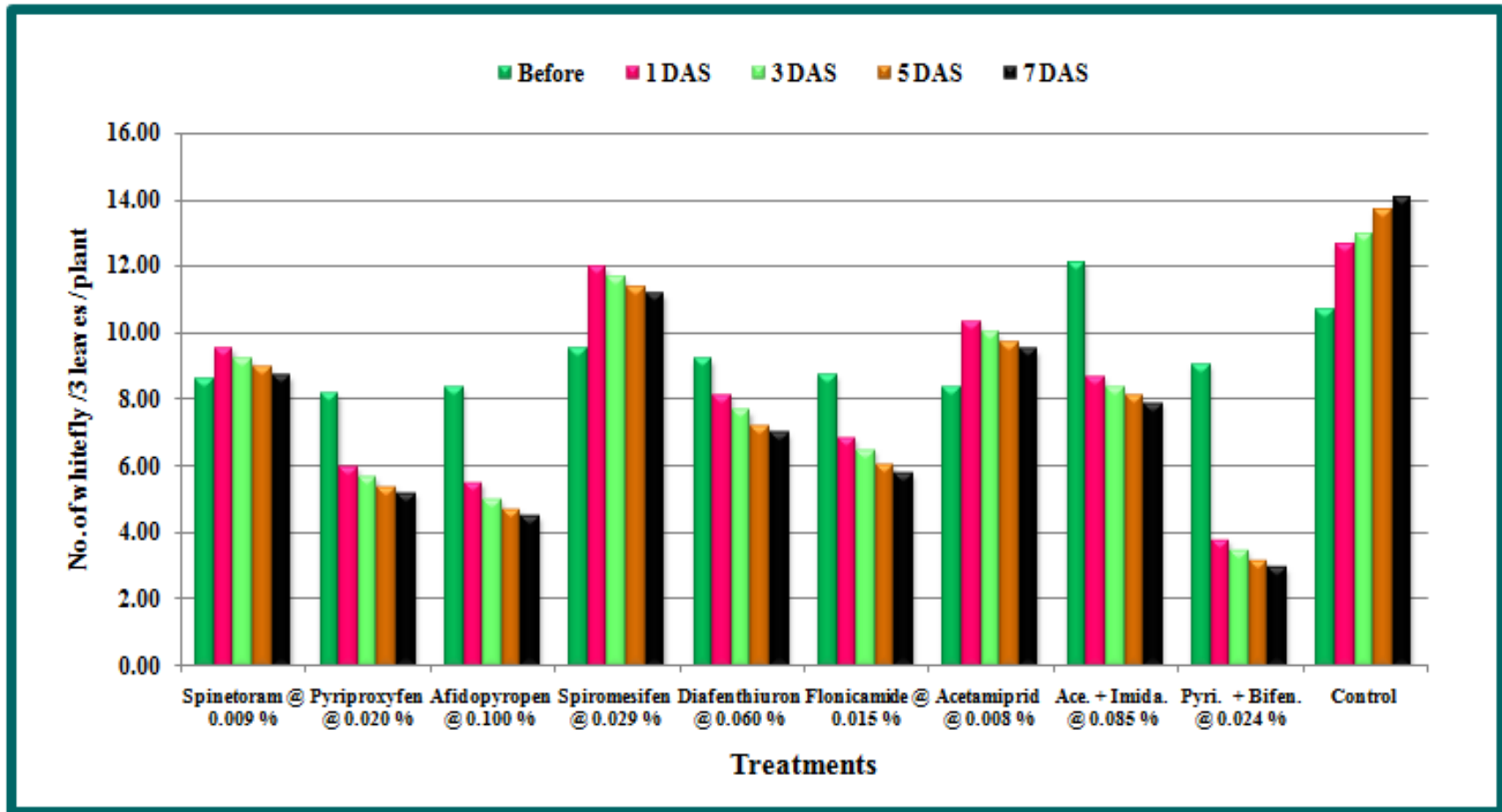


Fig.3 Effect of different insecticides on *B. tabaci* infesting cotton after the third spray (Pooled: 2020-21 & 2021-22)

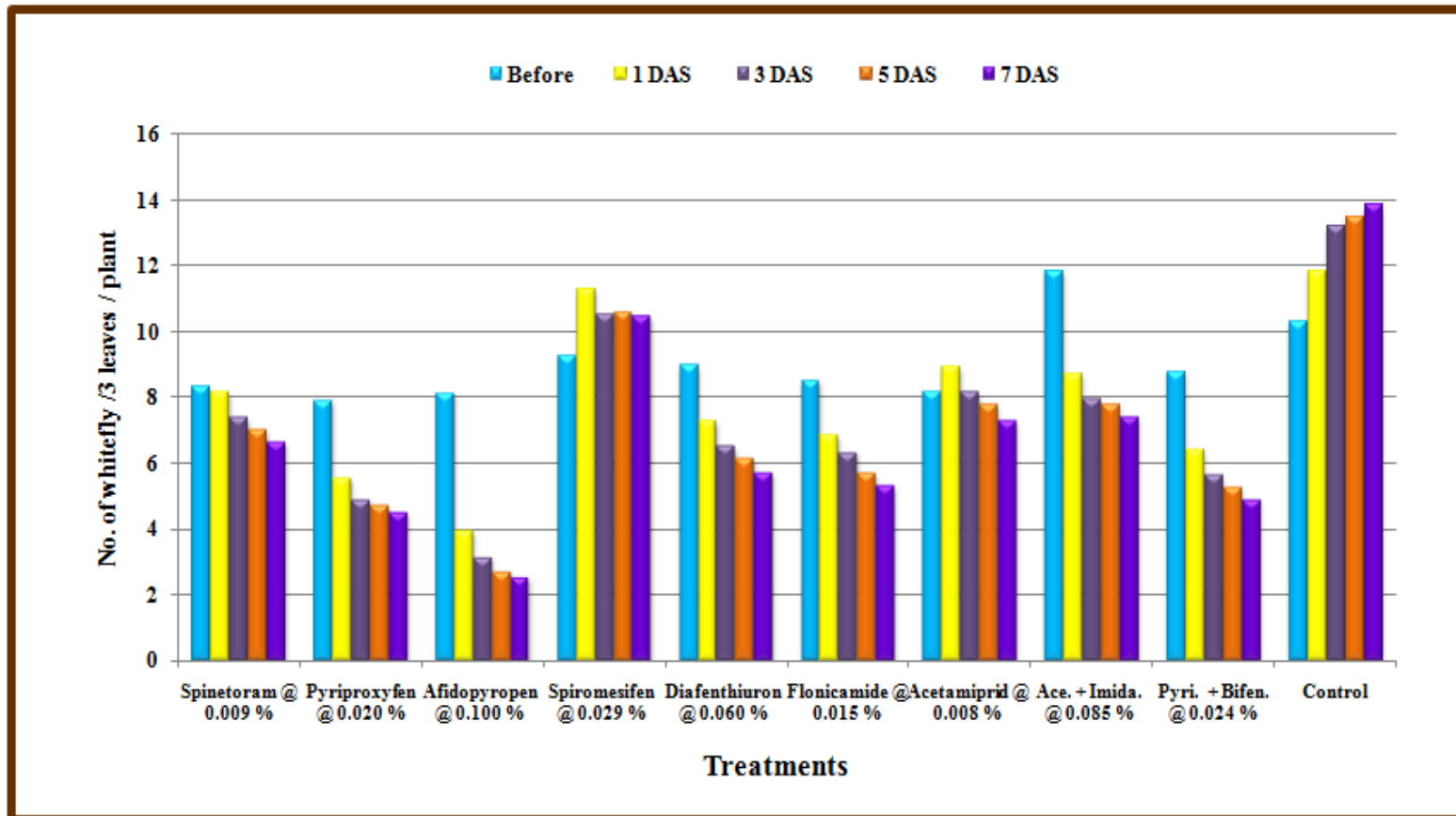
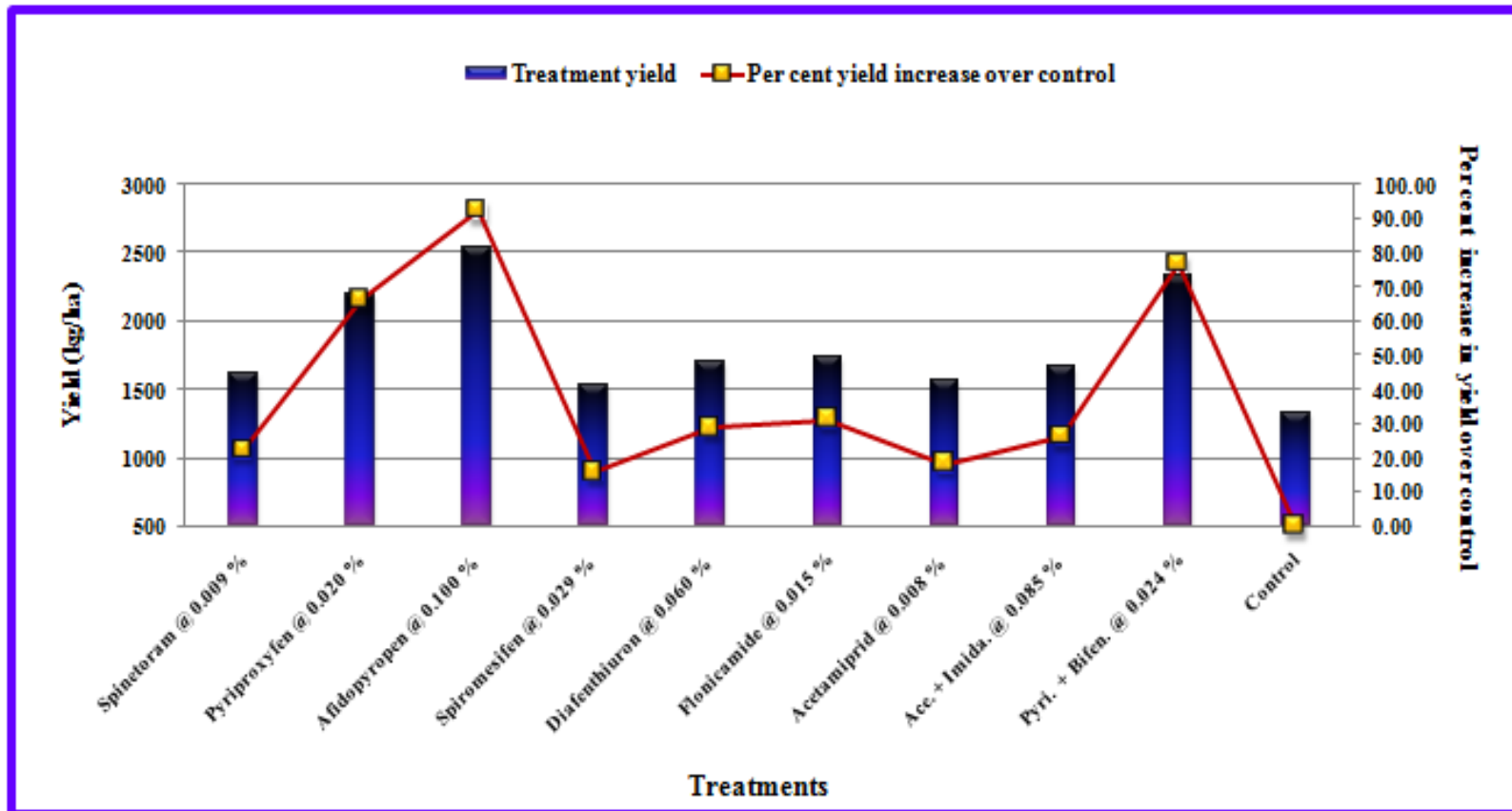


Fig.4 Effectiveness of various insecticidal treatments against whitefly on cotton yield



Economics of different insecticidal treatments

The economics of various treatments was worked out on the basis of average market price of cotton, and management cost, which includes price of insecticides and labour charges. Thus, Incremental Cost Benefit Ratio (ICBR) values for each treatment was worked out and summarized in Table 5. The result showed that there was considerable difference in ICBR values among the different insecticidal treatments.

The result among different treatments indicated that the pyriproxyfen 10 + bifenthrin 10 EC 0.024 % gave the highest incremental cost benefit ratio of 1:14.80. The next in order being pyriproxyfen 10 EC 0.020 % (1:12.35), afidopyropen 50 g/l DC 0.010 % (1:8.52), acetamiprid 20 SP 0.006 % (1:6.87), acephate 50 + imidacloprid 1.8 SP 0.104 % (1:4.79), flonicamid 50 WG 0.015 % (1:3.76), diafenthiuron 50 WP 0.060 % (2.72), spiromesifen 240 SC 0.027 % (1:1.12) and spinetoram 11.7 SC 0.010 % (1:1.07).

Maximum net realization of ₹77,364/ha was obtained from the treatment of afidopyropen 50 g/l DC 0.010 % followed by pyriproxyfen 10 + bifenthrin 10 EC 0.024 % (₹67,920/ha), pyriproxyfen 10 EC 0.020 % (₹57,863/ha), flonicamid 50 WG 0.015 % (₹21,754/ha), acephate 50 + imidacloprid 1.8 SP 0.104 % (₹19,531/ha), diafenthiuron 50 WP 0.060 % (₹17,186/ha), acetamiprid 20 SP 0.006 % (₹14,769/ha), spiromesifen 240 SC 0.027 % (₹1615/ha) and spinetoram 11.7 SC 0.010 % (₹1293/ha). Looking to the results of afidopyropen 50 g/l DC 0.010 %, pyriproxyfen 10 + bifenthrin 10 EC 0.024 % and pyriproxyfen 10 EC 0.020 % against whitefly were found superior in all different parameters as yield, efficacy and economics.

Overall effectiveness of various insecticides based on ranking

The effectiveness of afidopyropen 50 g/l DC 0.010 %, pyriproxyfen 10 + bifenthrin 10 EC 0.024 % and

pyriproxyfen 10 EC 0.020 % against whitefly were found superior in all different parameters as yield, efficacy and economics.

So this purpose, all the treatments were evaluated by utilizing overall rank methods by individual rank in descending order of their effectiveness for different parameters studied. These ranks of individual parameters under study were summed up and re-ranked (Table 6). From the table, it can be seen that afidopyropen 50 g/l DC 0.010 % was found most effective treatment over the rest of the treatments as it occupied the first rank. The other best treatment were pyriproxyfen 10 + bifenthrin 10 EC 0.024 % and pyriproxyfen 10 EC 0.020 % stood in the second and the third position in overall ranking including ICBR. While spiromesifen 240 SC 0.027 % could not provide satisfactory protection against whitefly and stood in the lowest position.

Considering the efficacy and yield, afidopyropen 50 g/l DC 0.010 % found the most effective treatment over rest of the treatments as it occupied the first rank with yield (2538 kg/ha). The next best treatments were pyriproxyfen 10 + bifenthrin 10 EC 0.024 % with yield (2332 kg/ha), and pyriproxyfen 10 EC 0.020 % with yield (2195 kg/ha) stood in the second and the third position in yield and efficacy. Based on ICBR, the result among different treatments indicated that the pyriproxyfen 10 + bifenthrin 10 EC 0.024 % gave the highest incremental cost benefit ratio of 1:14.80. The next in order being pyriproxyfen 10 EC 0.020 % (1:12.35), afidopyropen 50 g/l DC 0.010 % (1:8.52).

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How to cite this article:

Kaneria, P. B., M. F. Acharya, K. D. Shah and Khanpara, A. V. 2022. Efficacy of New Generation Insecticides with their Economics against *Bemisia tabaci* (Gennadius) Infesting Bt cotton in Field Condition. *Int.J.Curr.Microbiol.App.Sci*. 11(08): 254-269. doi: <https://doi.org/10.20546/ijcmas.2022.1108.027>