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Compatibility of Profenofos with selected agro-chemicals on Bt cotton

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Abstract
Experiments were conducted to assess the emulsion stability revealed that out of four chemicals tested namely, carbendazim, copper oxychloride, NAA, and $MgSO_4$ with profenofos 50 EC at 2 ml litre^{-1}, none of these products produced creaming matter or sediment, more than 2.0 ml at the top or bottom of the 100 ml cylinder. The results confirmed physical stability of these agro-chemicals with profenofos 50 EC. A field trial was conducted to evaluate the bioefficacy of combinations of profenofos 50 EC with selected Agro-chemicals, as foliar application on 90 days old Bt cotton against sucking pests and foliar diseases. The lowest mean population of aphids (5.87 3 leaves^{-1}), leafhoppers (6.78 3 leaves^{-1}), thrips (6.44 3 leaves^{-1}), whiteflies (3.54 3 leaves^{-1}) and mirid bugs (1.26 five squares^{-1}) were recorded in profenofos 50 EC @ 2 ml + carbendazim 50WP @ 1.0 g with (47.70, 40.23, 64.95, 43.89 and 72.96) high % reduction over control, respectively. Treatments, profenofos in combination with carbendazim (36.30) and copper oxychloride (28.77) were recorded high % disease over control along with the alone fungicidal treatments against Alternaria blight and Bacterial blight, respectively. Profenofos in combination with carbendazim and copper oxychloride were found to be more effective in reducing the sucking pests population and foliar diseases incidence, but significantly reduced the natural enemies (coccinellids, chrysopids and spiders) in proving their harmfulness. All the tested treatments had not caused any phytotoxic symptoms on 90 days old Bt cotton crop.

Keywords: Compatibility, combinations, profenofos, sucking pests, diseases and cotton

1. Introduction
Cotton (*Gossypium hirsutum* L.), popularly known as "the white gold", is an important commercial fibre crop grown under diverse agro-climatic conditions around the world. Introduction of second generation Bt cotton has given solution to the bollworm complex to the larger extent but at the same time they are susceptible to most of the sucking pests *viz.*, aphid, leafhopper, thrips, whitefly and mirid bug, which occupied major pest status and contributed to lower yields. Apart from this, the diseases like Alternaria leaf spot and Bacterial blight are also posing threat to cotton cultivation. It requires large number of chemicals and sprays for managing different pests. It is often economical and convenient to apply a mixture of two or more pesticides and nutrients when a wide range of pests or maladies are to be managed at a time. This saves time, labour and cost which are the three major but scarce inputs in agricultural systems nowadays [1]. Incompatibility may cause loss of effectiveness, poor application and also phytotoxicity. Chemical incompatibility occurs when the material breaks down in to different compounds or when the products chemically combine to produce another, which involves deactivation and may result in complete or partial failure. Hence, knowledge on the chemical compatibility is necessary to be familiar with the efficacy of mixed chemicals in managing insect pest and diseases in field condition. In this background, experiments were designed to know the compatibility of a newer insecticide, profenofos 50 EC with other agro-chemicals against sucking pests, foliar diseases and natural enemies on Bt cotton.

2. Materials and Methods
2.1. Emulsion stability test
Profenofos 50 EC was subjected to physical test for emulsion stability either alone or after mixing with fungicides or fertilizer or growth regulator such as carbendazim, copper oxychloride, NAA, and $MgSO_4$. Emulsion stability test was carried out for profenofos alone and for the combination products as prescribed by Indian Standard specifications [2]. Standard hard water was prepared by dissolving 0.304 g anhydrous calcium chloride ($CaCl_2$) and 0.139 g magnesium chloride ($MgCl_2$) in one liter of distilled water. This solution had hardness equivalent of 342 ppm calcium carbonate and was used to prepare the insecticide test solutions. To such formulated insecticide suspension (30 ml), 30 ml of either of the proposed combination chemical (carbendazim or copper oxychloride or NAA or $MgSO_4$) was added

separately and transferred to a clean dry graduated cylinder and the volume was made upto 100 ml with standard hard water. The mixture was shaken well and kept in a thermostat at 30±1°C for 1 h without any disturbance. The observations were taken visually on the formation of creaming matter or sediment not exceeding 2.0 ml at the top or bottom of the 100 ml cylinder, respectively which was considered as the criteria for the compatibility.

2.2. Biological compatibility: A field trial was conducted to evaluate the bioefficacy of combinations of profenofos 50 EC with fungicides or fertilizer or growth regulator, as foliar application on Bt cotton. The experiment was laid out in a Randomized Block Design (RBD) at Main Agricultural Research Station, Dharwad during *kharif*, 2014-15 season. The experiment consists of 11 treatments replicated thrice (Table 1). A cotton hybrid, RCH-2 Bt susceptible to insect pests and diseases was choosen and raised in plots of 5.40 x 2.70 meters with 90 x 60 cm row to row and plant to plant spacing. Crop was raised by following package of practices. For the experiment spraying was carried out using hand operated pneumatic knapsack sprayer with 500 litres of spray fluid ha^{-1} at 90 days after sowing. The population of sucking pests *viz.,* nymphs and adults of aphids, leaf hopper, thrips and whiteflies were recorded from ten randomly selected and tagged plants in each replication. In each plant, three leaves (top, middle and bottom) were considered for observation. Similarly, the counts on mirid bug population on 5 squares per plant were recorded on 5 randomly selected plants. The observations were made prior to spraying, 3, 7 and 14 days after spraying. The insecticide thiamethoxam was selected as a standard for further comparison. The observations were recorded on 5 plants on number of fruiting branches per plant in case of NAA and $MgSO_4$ treatment combinations. In the fungicide combination treatments, the observations were made on diseases like Alternaria leaf spot and Bacterial blight at 0-4 disease rating scale on 5 plants. Then these grades were converted into per cent disease indices (PDI) by using the formula [3]

$$PDI = \frac{\text{Sum of numerical ratings x 100}}{\text{Total number of leaves observed x Maximum disease grade}}$$

The observations were made prior to spraying, 3, 7 and 14 days after spraying. Means of observations 14 days after spray were stated in Table 4. The data obtained from field experiments was analysed in randomized block design (RBD) [4]. The mean values were separated using Duncan's Multiple Range Test (DMRT) [5].

2.3. Phytotoxic (plant) compatibility test: The observations were made at 3, 7 and 14 days after treatment on randomly selected 5 plants in each plot on phytotoxicity at 0-10 scale (Table 2) on following symptoms *i.e.* injury to leaf tip and leaf surface, wilting, vein clearing, necrosis and epinasty and hyponasty [6] on 90 days old Bt cotton.

3. Results and Discussion

The results on the investigations carried out to study the physical stability in terms of emulsion stability revealed that out of agro-chemicals tested namely, carbendazim, copper oxychloride, NAA and $MgSO_4$ with profenofos 50EC, none of these products produced creaming matter or sediment, more than 2.0 ml at the top or bottom of the 100 ml cylinder. The results confirmed the physical stability of profenofos 50 EC with selected agrochemicals. The findings of the present study are in agreement with the findings of Ahila devi and Prakasam [7] reported that the physical compatibility of Azoxystrobin 25 SC was highly compatible commonly used with insecticides *viz.,* profenphos, dichlorvos, monocrotophos, carbaryl, dimethoate, triazophos and quinalphos.

The experimental results of investigations carried out on the evaluation of biological compatibility of profenofos with fungicides or fertilizer or growth regulator was assessed against sucking pests and foliar diseases and the results are as follows.

3.1. Sucking pests: The results of the present investigation revealed that the lowest mean aphid population (14 days after spray) was recorded in profenofos 50 EC @ 2 ml + carbendazim 50WP @ 1 g (5.87 aphids 3 $leaves^{-1}$) with 47.70 % reduction over untreated check. Similar trend was noticed in other treatments, profenofos 50 EC alone and its combinations with copper oxychloride 50 WP @ 2.0 g, NAA 20 ppm and $MgSO_4$ @ 10 g (6.24 to 6.35 aphids 3 $leaves^{-1}$ with 44.34 to 43.37 % reduction over control). The university check thiamethoxam 20 WG @ 0.2 g was shown the mean population (5.67 aphids 3 $leaves^{-1}$) with 49.44 % reduction over untreated check. The lowest mean population of leafhopper was recorded in profenofos 50EC @ 2 ml + carbendazim 50WP @ 1.0 g (6.78 leafhoppers 3 $leaves^{-1}$) with 40.23 % reduction over untreated check. Sequentially, the remaining treatments *i.e.*, profenofos 50EC alone and its combinations recorded mean leafhopper population of 7.00 to 7.53 leafhoppers 3 $leaves^{-1}$ with 38.33 to 33.63 % reduction over untreated check. Thiamethoxam 20 WG @ 0.2 g was shown the mean population (5.17 leafhoppers 3 $leaves^{-1}$) with 54.48 % reduction over untreated check. The treatment profenofos 50 EC @ 2 ml + carbendazim 50WP @ 1.0 g was noticed lowest mean thrips population (6.44 thrips 3 $leaves^{-1}$) with 64.95 % reduction over untreated check, followed by profenofos 50 EC alone and its combinations, which were significantly on par with each other in reducing the number of thrips population. The university check thiamethoxam 20 WG @ 0.2 g was shown the mean population (4.62 thrips 3 $leaves^{-1}$) with 74.87 % reduction over untreated check. The number of mean whiteflies population per three leaves and % reduction over control recorded in following treatments, profenofos 50 EC @ 2 ml + carbendazim 50WP @ 1.0 g (3.54 3 $leaves^{-1}$ and 43.89) followed by profenofos 50 EC alone @ 2 ml (3.76 3 $leaves^{-1}$ and 40.49), profenofos 50 EC @ 2 ml + copper oxychloride 50WP @ 2g (3.84 3 $leaves^{-1}$ and 39.17), profenofos 50 EC @ 2 ml + NAA @ 20 ppm (3.92 3 $leaves^{-1}$ and 37.98) and profenofos 50 EC @ 2 ml + $MgSO_4$ @ 10 g (4.02 3 $leaves^{-1}$ and 36.32) respectively (Table 4). But the university check thiamethoxam 20 WG @ 0.2 g was shown the mean population (1.58 whiteflies 3 $leaves^{-1}$) with 75.03 % reduction over untreated check. The lowest mean population of mirid bugs were recorded in profenofos 50 EC @ 2 ml + carbendazim 50WP @ 1.0 g (1.09 mirid bugs five $squares^{-1}$) with 72.96 % reduction over untreated check. Consecutively, the remaining treatments *i.e.*, profenofos 50 EC alone and its combinations were recorded mean mirid bug population of 1.11 to 1.17 mirid bugs five $squares^{-1}$ with 72.42 to 70.85 % reduction over untreated check. Thiamethoxam 20 WG @ 0.2 g was shown the mean population (2.21 mirid bugs five $squares^{-1}$) with 45.13 % reduction over untreated check. Whereas, all the non-insecticidal treatments were shown poor results in reducing the all sucking pest population. Profenofos 50 EC is showing synergistic action, when it combined with carbendazim in reducing sucking pest population in cotton field. The findings of the present study are in agreement with

the findings of Rohini [8] recorded that acephate 75 WP (@ 1.0 g litre^{-1}) was found to be the most effective treatment in reducing the mirid bug incidence followed by profenophos 50 EC (2.0 ml litre^{-1}), indoxacarb 14.5SC (0.5 ml litre^{-1}), buprofezin 25SC (0.5 ml litre^{-1}) and fipronil 5 SC (1.0 ml litre^{-1}). Prakash and Srivasthava [9] also found that profenophos 50 EC + 1 % salt at 1000 g a.i. ha^{-1} was found to be superior over other chemicals in reducing the mirid bug population.

3.2. Foliar diseases

The lowest % disease index of bacterial blight was recorded in copper oxychloride @ 2 g (20.94) followed by profenofos 50 EC @ 2 ml + copper oxychloride 50WP @ 2 g (21.45), carbendazim 50WP @ 1.0 g (22.53) and profenofos 50 EC @ 2 ml + carbendazim 50WP @ 1.0 g (23.12) with 30.46, 28.77, 25.19 and 23.23 % disease over control, respectively. The treatments, profenofos 50 EC @ 2 ml + carbendazim 50WP @ 1.0 g (18.45 and 36.30) followed by carbendazim 50WP @ 1.0 g (19.45 and 32.85), copper oxychloride 50WP @ 2g (20.18 and 30.33) and profenofos 50 EC @ 2 ml + copper oxychloride 50WP @ 2g (19.90 and 31.31) were recorded low mean % disease index and high percent disease over control respectively, in reducing the alternaria blight (Table 4). Whereas, the treatments, doesn't have fungicide or its combination shown poor results in reducing the bacterial blight and alternaria blight. The results are in agreement with the studies of Jagtap and his coworkers [10] reported that low disease incidence of bacterial blight was recorded in treatment copper oxychloride 0.25 % + streptocycline 100 ppm. carbendazim and copper oxychloride were found effective against *A. macrospora* [11].

3.3. Natural enemies: The lowest population of natural enemies *viz.*, coccinellids, chrysopids and spiders were recorded in profenofos 50 EC @ 2.0 ml alone as well as in combination with carbendazim 50 WP @ 1.0 g, copper oxychloride 50 WP @ 2 g, NAA @ 20 ppm and $MgSO_4$ @ 10 g with high level negative impact compared to the all other treatments. The investigations are in line with the study of Nasreen and his associates [12] reported that profenofos and indoxacarb were showing toxic effect against chrysoperla under semi field and field condition (Table 4).

3.4. Yield and economics: The highest fruiting branches per plant mean values were recorded in NAA @ 20ppm (23.49) followed by profenofos 50 EC @ 2.0 ml + NAA @ 20 ppm (23.55), profenofos 50 EC @ 2.0 ml + $MgSO_4$ @ 10 g (22.51) and $MgSO_4$ @ 10g (22.34) with 13.28,13.50, 9.51 and 8.83 % increase over control, respectively (Table 4). Whereas, the treatments, doesn't have fertilizer or growth regulator or its combination shown poor results in increasing the fruiting branches per plant. The results of present study are in line with the investigations of Rajendran and his colleagues [13] reported that foliar application of NAA 40 ppm recorded higher number of sympodial branches plant^{-1}, bolls plant^{-1} and seed cotton yield. Foliar application of 1% $MgSO_4$ during flowering to boll development stage significantly resulted in higher seed cotton yield (2066 Kg ha^{-1}) [14]. In all the treatments, no phytotoxicity symptoms were observed on 90 days old Bt cotton. The highest yield per hectare was recorded in profenofos 50 EC @ 2.0 ml + carbendazim 50WP @ 1.0 g (15.74 q ha^{-1}) and profenofos 50 EC @ 2.0 ml + copper oxychloride 50WP @ 2 g (15.12 q ha^{-1}) found to be significantly superior over rest of the treatments but were on par among themselves, however, these treatments recorded 0.70 and 0.63 of benefit cost ratio's, respectively, which were higher than the treatment thiamethoxam 20 WG @ 0.2 g (13.92 q ha^{-1}) recorded 0.56 benefit cost ratio. Treatments, profenofos when sprayed in combination with carbendazim and copper oxychloride were found to be more effective against aphids, leafhoppers, thrips, whiteflies, mirid bugs, alternaria blight and bacterial blight with higher pest reduction values over control than when used alone or their combinations with NAA and $MgSO_4$. All the treatments (profenofos alone and its combinations) were showed negative effect on the natural enemies.

Results on the investigations conducted to find out the phytotoxic effects of these combination products on RCH-2 Bt cotton revealed that profenofos 50 EC @ 2.0 ml with the above agro-chemicals at recommended dose had not caused any phytotoxic symptoms such as injury to leaf tip and leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty on 90 days old cotton crop (Table 3). It might be the first report in studying the compatibility of profenofos 50 EC with selected agro-chemicals on Bt cotton in India.

Table 1: Treatments details

Sl. no	Treatments	Dosage (g/ml) per litre
1	Profenofos 50 EC	2 ml
2	Profenofos 50 EC + Carbendazim 50 WP	2 ml + 1 g
3	Profenofos 50 EC + Copper oxychloride 50 WP	2 ml + 2 g
4	Profenofos 50 EC + NAA	2 ml + 20 ppm
5	Profenofos 50 EC + $MgSO_4$	2 ml + 10 g
6	Thiamethoxam 20 WG	0.2 g
7	Carbendazim 50 WP	1.0 g
8	Copper oxychloride 50 WP	2 g
9	NAA	20 ppm
10	$MgSO_4$	10 g
11	Untreated check	-

Table 2: Phytotoxicity at 0-10 scale

Scale	Per cent phytotoxicity	Scale	Per cent phytotoxicity
0	No phytotoxicity	6	51-60
1	1-10	7	61-70
2	11-20	8	71-80
3	21-30	9	81-90
4	31-40	10	91-100
5	41-50		

Table 3: Phytotoxic compatibility of diafenthiuron 50 WP with selected agro-chemicals on cotton

Treatments	Mixture	Phytotoxicity ratings					
		Leaf tip injury	Wilting	Vein clearing	Necrosis	Epinasty	Hyponasty
T_1	Profenofos 50 EC	0	0	0	0	0	0
T_2	Profenofos 50 EC + Carbendazim 50 WP	0	0	0	0	0	0
T_3	Profenofos 50 EC + Copper oxychloride 50 WP	0	0	0	0	0	0
T_4	Profenofos 50 EC + NAA	0	0	0	0	0	0
T_5	Profenofos 50 EC + $MgSO_4$	0	0	0	0	0	0
T_6	Thiamethoxam 20 WG	0	0	0	0	0	0
T_7	Carbendazim 50 WP	0	0	0	0	0	0
T_8	Copper oxychloride 50 WP	0	0	0	0	0	0
T_9	NAA	0	0	0	0	0	0
T_{10}	$MgSO_4$	0	0	0	0	0	0
T_{11}	Untreated check	0	0	0	0	0	0

Table 4: Biological compatibility of acetamaprid 20SP with selected agrochemicals against sucking pests, foliar diseases and natural enemies in cotton

Treatments	Aphids/ 3 leaves		Leafhoppers/ 3 leaves		Thrips/ 3 leaves		Whiteflies/ 3 leaves		mirid bugs/ 5 squares		Bacterial blight		Alternaria blight	
	Mean	PRC	Mean	PRC	Mean	PRC	Mean	PRC	Mean	PRC	PDI	PDC	PDI	PDC
Profenofos 50 EC	6.24 (2.60)b	44.34	7.00 (2.74)bc	38.33	6.92 (2.72)b	62.35	3.76 (2.06)b	40.49	1.11 (1.27)b	72.42	28.07 (31.98)a	6.80	26.78 (31.15)a	7.57
Profenofos 50 EC + Carbendazim 50 WP	5.87 (2.52)b	47.70	6.78 (2.70)bc	40.23	6.44 (2.63)b	64.95	3.54 (2.01)b	43.89	1.09 (1.26)b	72.96	23.12 (28.73)a	23.23	18.45 (25.43)a	36.30
Profenofos 50 EC + Copper oxychloride 50 WP	6.25 (2.60)b	44.32	7.25 (2.78)bc	36.12	7.09 (2.76)b	61.40	3.84 (2.08)b	39.17	1.14 (1.28)b	71.63	21.45 (27.58)a	28.77	19.90 (26.48)a	31.31
Profenofos 50 EC + NAA	6.30 (2.61)b	43.80	7.42 (2.81)bc	34.65	7.16 (2.77)b	61.06	3.92 (2.10)b	37.98	1.12 (1.27)b	72.26	27.67 (31.72)a	8.13	25.67 (30.43)a	11.40
Profenofos 50 EC + $MgSO_4$	6.35 (2.62)b	43.37	7.53 (2.83)bc	33.63	7.41 (2.81)b	59.68	4.02 (2.13)b	36.32	1.17 (1.29)b	70.85	27.99 (31.93)a	7.08	26.81 (31.17)a	7.47
Thiamethoxam 25 WG	5.67 (2.48)b	49.44	5.17 (2.38)c	54.48	4.62 (2.26)b	74.87	1.58 (1.44)c	75.03	2.21 (1.65)b	45.13	27.94 (31.89)a	7.24	26.85 (31.20)a	7.32
Carbendazim 50WP	9.79 (3.21)a	12.75	9.23 (3.12)ab	18.72	17.55 (4.25)a	4.51	5.81 (2.51)a	8.00	3.81 (2.08)a	5.42	22.53 (28.33)a	25.19	19.45 (26.16)a	32.85
Copper oxychloride 50WP	10.06 (3.25)a	10.29	9.49 (3.16)ab	16.37	17.88 (4.29)a	2.69	5.94 (2.54)a	6.02	3.88 (2.09)a	3.51	20.94 (27.22)a	30.46	20.18 (26.69)a	30.33
NAA	10.18 (3.27)a	9.29	9.53 (3.17)ab	16.01	17.92 (4.29)a	2.50	6.09 (2.57)a	3.56	3.95 (2.11)a	1.96	27.76 (31.78)a	7.83	27.28 (31.47)a	5.85
$MgSO_4$	10.28 (3.28)a	8.37	9.52 (3.16)ab	16.15	18.11 (4.31)a	1.48	6.21 (2.59)a	1.74	4.01 (2.12)a	0.49	28.35 (32.16)a	5.88	27.45 (31.58)a	5.26
Untreated check	11.22 (3.42)a	0.00	11.35 (3.44)a	0.00	18.38 (4.34)a	0.00	6.32 (2.61)a	0.00	4.02 (2.13)a	0.00	30.12 (33.27)a	0.00	28.97 (32.55)a	0.00
S. Em±	0.15		0.15		0.17		0.12		0.12		2.22		2.46	
CD(0.05)	0.47		0.47		0.54		0.39		0.39		6.98		7.76	
CV(%)	8.83		8.71		8.77		9.52		12.64		12.54		14.46	

Table 4 contd.....

Treatments	Coccinellids/5 plants	Chrysopids/5 plants	Spiders/ 5 plants	Fruiting branches per plant		Yield (Q/ha)	Cost of cultivation*	Net returns	B:C Ratio
	Mean	Mean	Mean	Mean	PIC				
Profenofos 50 EC	0.68 (1.08)b	0.25 (0.87)b	0.47 (0.99)b	20.48	0.55	13.51	36900.00	18497.81	0.50
Profenofos 50 EC + Carbendazim 50 WP	0.69 (1.09)b	0.25 (0.87)b	0.44 (0.97)b	20.44	0.34	15.74	37950.00	26587.04	0.70
Profenofos 50 EC + Copper oxychloride 50 WP	0.73 (1.11)b	0.26 (0.87)b	0.48 (0.99)b	20.49	0.60	15.12	38072.00	23934.17	0.63
Profenofos 50 EC + NAA	0.69 (1.09)b	0.27 (0.88)b	0.49 (0.99)b	23.55	13.50	14.33	37273.50	21498.79	0.58
Profenofos 50 EC + $MgSO_4$	0.70 (1.10)b	0.27 (0.88)b	0.50 (1.00)b	22.51	9.51	13.79	37640.00	18882.63	0.50
Thiamethoxam 25 WG	1.56 (1.43)a	1.18 (1.30)a	1.61 (1.45)a	20.48	0.54	13.92	36500.00	20585.05	0.56
Carbendazim 50WP	1.70 (1.48)a	1.21 (1.31)a	1.81 (1.52)a	20.47	0.49	10.36	36550.00	5912.28	0.16
Copper oxychloride 50WP	1.71 (1.49)a	1.23 (1.32)a	1.82 (1.52)a	20.51	0.70	9.95	36672.00	4103.03	0.11
NAA	1.69 (1.48)a	1.24 (1.32)a	1.83 (1.53)a	23.49	13.28	9.40	35873.50	2651.88	0.07

$MgSO_4$	1.72 (1.49)a	1.22 (1.31)a	1.82 (1.52)a	22.34	8.83	8.92	36240.00	316.93	0.01
Untreated check	1.77 (1.51)a	1.30 (1.34)a	1.84 (1.53)a	20.37	0.00	8.57	35000.00	150.89	0.00
S. Em±	0.07	0.07	0.07	-	-	-	-	-	-
CD(0.05)	0.23	0.23	0.23	-	-	-	-	-	-
CV(%)	9.81	11.48	10.04	-	-	-	-	-	-

Mean = Mean of observations 14 days after spray; PRC = Percent Reduction Over Control; PDI = Percent Disease Index; PDC = Percent Disease Control; PIC = Percent Increase over Control; Figures in the parenthesis are √x + 0.5 transformed values. Means followed by same letter do not differ significantly by DMRT (P = 0.05); NS = Non Significant; Cost of cultivation: *-Including plant protection measures; Market price of cotton: 4,100/q; thiamethoxam □ 500/100g; carbendazim □ 105/100 g; copper oxychloride □ 293/500 g ; NAA □ 83/100 ml; $MgSO_4$ □ 74/1 Kg and profenofos □ 350/500ml, and dosage @ 0.2 g, 1.0 g, 2.0 g, 20 ppm (0.45 ml), 10 g and 2 ml per litre, respectively.

4. Conclusion

The results proved that all the test treatments were physically, biologically and phytotoxically compatible with each other. The treatments, profenofos + carbendazim and profenofos + copper oxychloride were found to be more effective in reducing the sucking pests population (especially mirid bugs) and foliar diseases in cotton without showing phytotoxicity. These combination treatments usage helps in managing different pests at a time, saves time and reduces labour cost. These two treatments (profenofos 50 EC @ 2.0 ml + carbendazim 50WP @ 1.0 g and profenofos 50 EC @ 2.0 ml + copper oxychloride 50WP @ 2 g) can be wished-for mirid bug and foliar diseases management in farmer's 90 day old cotton field.

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