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## Compatibility of different pesticides against leafhoppers and whiteflies on cotton

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### Abstract

Studies were conducted to evaluate compatibility of different pesticides against leafhoppers and whiteflies of cotton at Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2018-2019 with twelve treatment and three replications. Overall, three sprays were carried out and thus, the data obtained revealed that, diafenthiuron 50% WP + copper oxychloride 50% WP was found promising to managed the leafhopper and whitefly population followed by diafenthiuron 50% WP. The highest seed cotton yield was obtained from diafenthiuron 50% WP + copper oxychloride 50% WP (15.80 q/ha) followed by diafenthiuron 50% WP (14.89 q/ha). On the basis of economics, flonicamid 50% WG proved to be the most economically viable treatment followed by diafenthiuron 50% WP.

**Keywords:** Compatibility, copper oxychloride, diafenthiuron, leafhopper, pesticides, whitefly

### 1. Introduction

Cotton is the most important cash crop in India. It plays a dominant role in the industries and agricultural economy of the nation, contributes 1/3rd of total foreign exchange earning of India [6]. Due to assured protection against bollworms in *Bt* cotton hybrids the area under *Bt* cotton is increasing day by day but at the same time sucking pests has emerged as major threat for cotton growers causing heavy yield losses. Among the sucking pests, leafhopper, *Amrasca biguttula biguttula* (Ishida); thrips, *Thrips tabaci* (Linn); aphids, *Aphis gossypii* (Glover) and whiteflies, *Bemisia tabaci* (Genn.) are the important pests from seedling stage and cause heavy losses in tune of 21.20 to 22.86 per cent [7].

At the same time various diseases are also causing economical losses in cotton cultivation. For effective management of the insect pests and diseases requires frequent applications of chemical sprays which increases the cost of cultivation. In general farmers apply insecticides and fungicides together for the control of insect pests and diseases to reduce the cost of plant protection. Mixture of two pesticides may produce greater insecticidal action than the sum of the individual components by synergism [4]. It has been proposed that pesticide mixtures may delay the onset of resistance developing in pest populations [2].

It has been reported that Diafenthiuron in combination with carbendazim and copper oxychloride were found to be more effective in reducing the sucking pest population and foliar diseases incidence in cotton [3]. It is a common practice of farmers to use pesticides and their mixtures most frequently without consideration of compatibility and efficacy. The information available on novel insecticides in combination with fungicides that are commonly used by farmers against insect pests and diseases is very scarce.

If compatible insecticides and fungicides mixture is used in combination it may prove cheaper and such combination become useful for the control of both insect pests and diseases without losing their efficacy individually. Keeping this in mind present study was carried out to evaluate compatibility of different pesticides against sucking pests viz; leafhoppers and whiteflies of cotton and to find out most cost effective pesticidal treatment.

### 2. Materials and Methods

Trial was conducted on the research farm of Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Kharif* season of 2018-2019. The experiment was laid in Randomized Block Design with three replications and twelve treatments including control with a view to evaluate compatibility of different pesticides against leafhoppers and whiteflies of cotton (AJEET 155 BGII). The pesticidal treatments included fipronil 5% SC, spiromesifen 22.9% SC, flonicamid 50% WG, diafenthiuron 50% WP, acephate 50% +

imidacloprid 1.8% SP and their combinations with copper oxychloride 50% WP. Periodical observations were undertaken to record the incidence of sucking pests viz., leafhoppers and whiteflies on three leaves selected from top, middle and bottom canopy of five randomly selected plants per each of the net plot to monitor the buildup of sucking pest population for effective treatment spray. The treatment spray was initiated at the time of incidence of these pests. In all three sprays were undertaken at 15 days interval. The pretreatment observations were recorded at 24 hours before the application of spray. Whereas, the post treatment observations were recorded at 3, 7, 10 and 14 days after each treatment spray. Seed cotton yield obtained at each picking from each net plot was recorded. Total yield was worked out. Yield of seed cotton in q/ha was calculated in order to compare the effect of different treatments. As per Gomez and Gomez (1984) [5], the data obtained during the course of investigation was converted to appropriate transformations and was subjected to statistical analysis to test the level of significance. At the end “Incremental Cost Benefit Ratio” based on total seed cotton yield in terms of rupees, cost of treatments, labour charges and cost of application was calculated at the prevailing market rates during the period of experimentation in order to evolve cost effective treatment against these sucking pests of cotton.

### 3. Results and Discussion

#### 3.1 Efficacy against leafhoppers

The results of the present investigation revealed that, after first spray lowest population of leafhoppers was recorded in diafenthiuron 50% WP + copper oxychloride 50% WP (0.74/leaf) (Table 1). This treatment was found at par with diafenthiuron 50% WP (0.82), flonicamid 50% WP (0.83), flonicamid 50% WG + copper oxychloride 50% WP (0.92), spiromesifen 22.9% SC + copper oxychloride 50% WP (1.18), spiromesifen 22.9% SC (1.19), (acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP (1.20), acephate 50% + imidacloprid 1.8% SP (1.22), fipronil 5% SC (1.49) and fipronil 5% SC + copper oxychloride 50% WP (1.66).

Whereas, after second spray amongst the different pesticides tested diafenthiuron 50% WP + copper oxychloride 50% WP (0.76), diafenthiuron 50% WP (0.80), flonicamid 50% WG + copper oxychloride 50% WP (1.00), acephate 50% + imidacloprid 1.8% SP (1.01), flonicamid 50% WG (1.10), (acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP (1.18) and spiromesifen 22.9% SC + copper oxychloride 50% WP (1.38) did not differ significantly in minimising the leafhopper population (Table 1). Whereas, fipronil 5% SC + copper oxychloride 50% WP (1.55), spiromesifen 22.9% SC (1.63) and fipronil 5% SC (1.85) appeared as next better treatments in this respect.

Similar trend of efficacy was noticed after third spray, application of diafenthiuron 50% WP + copper oxychloride 50% WP recorded minimum population of leafhoppers (0.56 leafhoppers/leaf) (Table 1) and found at par with diafenthiuron 50% WP (0.77), acephate 50% + imidacloprid 1.8% SP (0.91), flonicamid 50% WG + copper oxychloride 50% WP (0.95), flonicamid 50% WG (0.99) and (acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP (1.16). These were followed by Fipronil 5% SC + copper oxychloride 50% WP (1.39), spiromesifen 22.9% SC (1.43), fipronil 5% SC (1.55) and spiromesifen 22.9% SC + copper oxychloride 50% WP (1.56).

The present findings are in agreement with the studies of Kalyan *et al.* (2017) [6] who reported that diafenthiuron 50% WP were most effective against cotton leafhopper. Similar observations were also made by Sathyan *et al.* (2016) [11] who reported that diafenthiuron 50% WP as a most effective insecticide in controlling the leafhopper population and these were followed by the treatment of fipronil 5% SC, flonicamid 50% WG and spiromesifen 22.9% SC. Moreover, the earlier workers Bontha and Mallapur (2017) [3] reported that diafenthiuron 50% WP when sprayed in combination with copper oxychloride 50 WP exhibited additive action, found effective against cotton leafhoppers. Similarly, Boda and Ilyas (2017) [1] reported spiromesifen 240 SC and fipronil 5% SC effective against cotton jassids.

#### 3.2 Efficacy against whiteflies

Treatment with diafenthiuron 50% WP + copper oxychloride 50% WP, spiromesifen 22.9% SC, spiromesifen 22.9% SC + copper oxychloride 50% WP, diafenthiuron 50% WP, (acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP, acephate 50% + imidacloprid 1.8% SP, flonicamid 50% WG + copper oxychloride 50% WP, flonicamid 50% WG and fipronil 5% SC + copper oxychloride 50% WP proved effective in reducing the whitefly population at different intervals after first spray (Table 1) in which 0.54, 0.61, 0.67, 0.67, 0.90, 0.94, 0.98, 1.11 and 1.19 whiteflies/leaf were recorded, respectively. Whereas, fipronil 5% SC (1.44 whiteflies/leaf) appeared as next better treatments in this respect.

The results on the efficacy of various treatments against whiteflies after second spray (Table 1) showed that diafenthiuron 50% WP + copper oxychloride 50% WP (0.51), spiromesifen 22.9% SC + copper oxychloride 50% WP (0.63), diafenthiuron 50% WP (0.68), spiromesifen 22.9% SC (0.79), flonicamid 50% WG (0.86) and flonicamid 50% WG + copper oxychloride 50% WP (1.03) proved equally effective in recording minimum whitefly population at different intervals of observations. Whereas, the treatment with acephate 50% + imidacloprid 1.8% SP (1.28), fipronil 5% SC + copper oxychloride 50% WP (1.54), fipronil 5% SC (1.63) and (acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP (1.79) were found moderately effective. Whereas, after third spray, application of diafenthiuron 50% WP + copper oxychloride 50% WP (1.11), as well as diafenthiuron 50% WP (1.13), spiromesifen 22.9% SC (1.46), spiromesifen 22.9% SC + copper oxychloride 50% WP (1.58) and flonicamid 50% WG + copper oxychloride 50% WP (1.90) proved equally effective in recording minimum population of whiteflies at different intervals of observations (Table 1). Treatment with flonicamid 50% WG (2.13), acephate 50% + Imidacloprid 1.8% SP (2.47), (acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP (2.53), fipronil 5% SC + copper oxychloride 50% WP (2.58) and fipronil 5% SC (2.61) were found effective in descending order.

Similar results were also obtained by earlier worker, Patel *et al.* (2010) [10], who stated that diafenthiuron 50% WP provided significantly better control of *Bemisia tabaci* on cotton. While Kalyan *et al.* (2017) [6] noticed, effective control of whiteflies with application of diafenthiuron 50% WP, flonicamid 50% WG and fipronil 5% SC. Similarly, Surwase *et al.* (2017) [12] reported that fipronil 5 SC were effective for reduction of whitefly population on cotton. These were followed by flonicamid 50 WG and spiromesifen

22.9% SC. The earlier worker Boda and Ilyas (2017) <sup>[1]</sup> concluded that, Spiromesifen 240 SC was found more superior in reducing whiteflies population on cotton.

### 3.3 Effect on seed cotton yield

The maximum seed cotton yield of 15.80 q/ha was obtained from diafenthiuron 50% WP + copper oxychloride 50% WP followed by diafenthiuron 50% WP (14.89 q/ha) and these treatments were significantly superior over rest of the treatments. Next effective treatments were flonicamid 50% WG + copper oxychloride 50% WP, spiromesifen 22.9% SC + copper oxychloride 50% WP, flonicamid 50% WG, spiromesifen 22.9% SC, (acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP, fipronil 5% SC + copper oxychloride 50% WP, acephate 50% + imidacloprid 1.8% SP and fipronil 5% SC. Lowest yield was recorded in the treatment copper oxychloride 50% WP (8.02 q/ha) and untreated control (7.72 q/ha).

The present findings on seed cotton yield finds support in the work carried out by Nemade *et al.* (2017) <sup>[9]</sup> who obtained maximum seed cotton yield (1681.02 Kg/ha) from flonicamid 50% WG @ 75 g a.i./ha followed by flonicamid 50% WG @ 100 g a.i./ha (1627.31 Kg/ha) and difenthiuron 50 WP (1222.84 Kg/ha). Similarly, Kalyan *et al.* (2017) <sup>[6]</sup> also recorded maximum seed cotton yield in difenthiuron 50 WP (3101 kg/ha). Similar results were also reported by Bontha and Mallapur (2017) <sup>[3]</sup> who recorded highest seed cotton per

hectare in treatments of diafenthiuron 50 WP @ 0.6 g + carbendazim 50 WP @ 1.0 g (19.07 q/ha) and diafenthiuron 50 WP @ 0.6 g + copper oxychloride 50 WP @ 2g (18.18 q/ha) followed by diafenthiuron 50 WP alone.

### 3.4 Incremental cost benefit ratio in various treatments

The economics of treatment sprays (Table 2) indicated that application of flonicamid 50% WG proved to be the most economically viable treatment with maximum ICBR (1:4.2). While diafenthiuron 50% WP emerged as the second best treatment with ICBR of (1:3.1). The other treatments like acephate 50% + Imidacloprid 1.8% SP, flonicamid 50% WG + copper oxychloride 50% WP, diafenthiuron 50% WP + copper oxychloride 50% WP, spiromesifen 22.9% SC, (acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP, fipronil 5% SC and spiromesifen 22.9% SC + copper oxychloride 50% WP appeared next in this respect. The treatment with fipronil 5% SC + copper oxychloride 50% WP found to be comparatively less economical exhibiting ICBR of 1:0.4. Bontha and Mallapur (2017) <sup>[3]</sup> recorded 0.91 of benefit cost ratio due to application of diafenthiuron 50 WP in combination with copper oxychloride 50 WP. Similarly, Kalyan *et al.* (2017) <sup>[6]</sup> obtained maximum net profit of Rs. 51,381/ha in difenthiuron 50 WP @ 300g a.i./ha, followed by flonicamid 50 WP@ 100g a.i. (Rs.46,772) and fipronil 5 SC @ 100g a.i. ha (Rs.43,900) in cotton.

**Table 1:** Effect of pesticides alone and in combination on cotton pests

Tr. No	Treatments	Average number of pest per leaf					
		Leafhoppers			Whiteflies		
		First spray	Second spray	Third spray	First spray	Second spray	Third spray
1	Fipronil 5% SC	1.49 (1.56)	1.85 (1.69)	1.55 (1.59)	1.44 (1.56)	1.63 (1.61)	2.61 (1.89)
2	Spiromesifen 22.9% SC	1.19 (1.46)	1.63 (1.62)	1.43 (1.55)	0.61 (1.27)	0.79 (1.34)	1.46 (1.56)
3	Flonicamid 50% WG	0.83 (1.34)	1.10 (1.44)	0.99 (1.40)	1.11 (1.44)	0.86 (1.36)	2.13 (1.76)
4	Diafenthiuron 50% WP	0.82 (1.34)	0.80 (1.34)	0.76 (1.32)	0.67 (1.29)	0.68 (1.29)	1.13 (1.45)
5	Acephate 50% + Imidacloprid 1.8% SP	1.22 (1.49)	1.01 (1.41)	0.91 (1.37)	0.94 (1.38)	1.28 (1.50)	2.47 (1.85)
6	Copper oxychloride 50% WP	3.53 (2.16)	4.25 (2.25)	3.66 (2.15)	3.06 (2.01)	3.48 (2.11)	5.74 (2.56)
7	Fipronil 5% SC + Copper oxychloride 50% WP	1.66 (1.60)	1.55 (1.58)	1.39 (1.52)	1.19 (1.47)	1.54 (1.59)	2.58 (1.88)
8	Spiromesifen 22.9% SC + Copper oxychloride 50% WP	1.18 (1.46)	1.38 (1.53)	1.56 (1.59)	0.67 (1.29)	0.63 (1.27)	1.58 (1.59)
9	Flonicamid 50% WG + Copper oxychloride 50% WP	0.92 (1.37)	1.00 (1.41)	0.95 (1.39)	0.98 (1.39)	1.03 (1.42)	1.90 (1.69)
10	Diafenthiuron 50% WP + Copper oxychloride 50% WP	0.74 (1.31)	0.76 (1.32)	0.56 (1.24)	0.54 (1.24)	0.51 (1.23)	1.11 (1.44)
11	(Acephate 50% +Imidacloprid 1.8% SP) + Copper oxychloride 50% WP	1.20 (1.48)	1.18 (1.47)	1.16 (1.46)	0.90 (1.37)	1.79 (1.66)	2.53 (1.86)
12	Untreated control	3.69 (2.15)	4.34 (2.31)	3.83 (2.18)	3.23 (2.05)	3.53 (2.14)	6.00 (2.63)
	F test	Sig	Sig	Sig	Sig	Sig	Sig
	SE (m) ±	0.09	0.08	0.09	0.08	0.08	0.09
	CD at 5%	0.27	0.24	0.27	0.24	0.25	0.27

Figures in parentheses are corresponding square root transformation values

**Table 2:** Incremental cost benefit ratio for different treatments

Sr. No.	Treatments	Plant protection cost (Rs./ha)	Yield of Seed cotton (q/ha)	Yield increase over control (q/ha)	Cost of increased yield over control (Rs./ha)	Net gain over control (Rs./ha)	ICBR	Rank
1	Fipronil 5% SC	8154	10.91	3.19	17386	9232	1:1.2	VIII
2	Spiromesifen 22.9% SC	10242	12.79	5.07	27632	17390	1:1.7	VI
3	Fonicamid 50% WG	5940	13.36	5.64	30738	24798	1:4.2	I
4	Diafenthiuron 50% WP	9450	14.89	7.17	39077	29627	1:3.1	II
5	Acephate 50% + Imidacloprid 1.8% SP	4380	10.93	3.21	17495	13115	1:3.0	III
6	Copper oxychloride 50% WP	5970	8.02	0.30	1635	-4335	-1:0.73	XI
7	Fipronil 5% SC + Copper oxychloride 50% WP	12594	11.02	3.30	17985	5391	1:0.4	X
8	Spiromesifen 22.9% SC + Copper oxychloride 50% WP	14682	13.41	5.69	31011	16329	1:1.1	IX
9	Fonicamid 50% WG + Copper oxychloride 50% WP	10380	14.31	6.59	35916	25536	1:2.5	IV
10	Diafenthiuron 50% WP + Copper oxychloride 50% WP	13890	15.80	8.08	44036	30146	1:2.2	V
11	(Acephate 50% + Imidacloprid 1.8% SP) + Copper oxychloride 50% WP	8820	11.74	4.02	21909	13089	1:1.5	VII
12	Untreated control	-	7.72	-	-	-	-	-

Labour charges for one spray/ha. @ Rs. 230/ labour / day, 2) spray pump charges/ha. @ Rs. 50/ day/ pump 3) price of seed cotton @ Rs. 5450 /q

#### 4. Conclusion

Thus, insecticides viz; diafenthiuron 50% WP and fonicamid 50% WG would be helpful in mitigating the sucking pests like leafhoppers and whiteflies in Bt cotton and also gave higher yield. Moreover, compatibility of test insecticides with fungicide proved to be non-phytotoxic on cotton and proved compatible. Therefore these chemicals could be included in Integrated Pest Management Programme as a promising component without any negative effect on crops and natural enemies.

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