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Compatibility of different pesticides against aphids and thrips on cotton

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Abstract
Studies were conducted to evaluate compatibility of different pesticides against aphids and thrips of cotton at Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeth, Akola during 2018-2019 with twelve treatment and three replications. Overall, three sprays were carried out and thus, the data o *Bt* ained revealed that, newer molecule flonicamid 50% WG + copper oxychloride 50% WP was found promising to managed the aphid population followed by flonicamid 50% WG. The application of fipronil 5% SC + copper oxychloride 50% WP effectively minimized the incidence of thrips population followed by fipronil 5% SC. However, during the present studies no deleterious effect of pesticidal treatments were observed on population of natural enemies. Moreover, all the test chemicals in combination with copper oxychloride 50% WP had not caused any phytotoxic symptoms on cotton crop.

Keywords: Aphids compatibility, cotton, pesticides, thrips

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 of 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* (Ishida); thrips, *Thrips tabaci* (Linn); aphids, *Aphis gossypii* (Glovar) 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 [5].
Apart from this, the diseases like Grey mildew, Alternaria leaf spot and Bacterial blight are also posing threat to cotton cultivation. It requires large number of chemical sprays for managing insect pests and diseases. It is often economical and convenient to apply a mixture of two or more pesticides when a wide range of pests are to be managed. 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 scare. If compatible insecticides and fungicides mixture is used in combination it may be cheaper to the farmer and such combination become useful for the control of both insect pests and diseases without loosing their efficacy individually. Keeping this in mind present study was carried out to evaluate compatibility of different pesticides against sucking pests of cotton and to find out most cost effective pesticidal treatment.

2. Material and Methods
Field trial was conducted on the field of Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Kharif* season of 2018-2019. The experiment was laid in Randomised Block Design in three replications and twelve treatments including control with a view to evaluate compatibility of different pesticides against aphids and thrips 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 combination with copper oxychloride 50% WP. Observations on the population of aphids and thrips were recorded from five randomly selected plants per each of the net plot. Pre-treatment population was taken 24 hrs before the application of treatments and post treatment count 3, 7, 10 and 14 days after each spray. First spray was applied at the incidence of pest and

subsequent sprays were given at 15 days interval. Similarly, data were also collected on the natural enemies. The observations on phytotoxicity symptoms i.e. injury to leaf tip and leaf surface, wilting, vein clearing, necrosis and epinasty and hyponasty were made in each of the net plot at 1, 3, 7, 10 and 14 days after treatment (Rajeshwaran *et al*., 2004) [9]. The data o *Bt* ained from field experiments was analysed in randomized block design (RBD) (Gomez and Gomez, 1984) [3].

3. Results and Discussion

3.1 Efficacy against aphids

The results of the present investigation revealed that, the lowest population of aphids was recorded in flonicamid 50% WG + copper oxychloride 50% WP (1.13/leaf) after first spray (Table 1). This treatment was found at par with flonicamid 50% WG (1.24), diafenthiuron 50% WP (1.38), diafenthiuron 50% WP + copper oxychloride 50% WP (1.48), spiromesifen 22.9% SC + copper oxychloride 50% WP (1.99) and (Acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP (2.23). Whereas, the treatments acephate 50% + imidacloprid 1.8% SP (2.39), spiromesifen 22.9% SC (2.45), fipronil 5% SC + copper oxychloride 50% WP (2.82) were found statistically at par with fipronil 5% SC (3.03).

Application of flonicamid 50% WG + copper oxychloride 50% WP (0.33), flonicamid 50% WG (0.37), diafenthiuron 50% WP + copper oxychloride 50% WP (0.49), diafenthiuron 50% WP (0.54), acephate 50% + imidacloprid 1.8% SP (0.79), (acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP (0.88) and fipronil 5% SC (1.01) were the superior most, recording 0.33, 0.37, 0.49, 0.54, 0.79, 0.88 and 1.01 aphids per leaf, respectively after second spray (Table1). Next in order, the treatment with spiromesifen 22.9% SC (1.10), fipronil 5% SC + copper oxychloride 50% WP (1.16) and spiromesifen 22.9% SC + copper oxychloride 50% WP (1.22) were found to be effective showing aphid population in the range of 1.10 to 1.22 aphids per leaf. Whereas, aphid population was not observed at the time of 3rd spray.

The present findings are in conformity with Meghana *et al*. (2018) [7]. Who reported effectiveness of flonicamid 50% WG, fipronil 5% SC and diafenthiuron 50% WP against cotton aphids. Similarly, Boda and Ilyas (2017) [1]. Reported that spiromesifen 240 SC and fipronil 5 SC were the most effective in reducing population of cotton aphids. Whereas, Bontha and Mallapur (2017) [2]. observed lower population of aphids in diafenthiuron 50% WP and diafenthiuron 50% WP + copper oxychloride 50% WP.

3.2 Efficacy against thrips

Amongst the various treatments, fipronil 5% SC + copper oxychloride 50% WP recorded minimum thrips population (9.85 thrips/leaf) after first spray (Table 1) and found at par with fipronil 5% SC (10.58), diafenthiuron 50% WP + copper oxychloride 50% WP (11.75), diafenthiuron 50% WP (12.32), flonicamid 50% WG (12.57) and flonicamid 50% WG + copper oxychloride 50% WP (13.45). Whereas, acephate 50% + imidacloprid 1.8% SP, spiromesifen 22.9% SC, (acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP and spiromesifen 22.9% SC + copper oxychloride 50% WP appeared as next best treatments and found at par with each other with population range between 14.07 to 14.34 thrips/leaf.

Amongst the different pesticides tested, application of fipronil 5% SC (4.94), fipronil 5% SC + copper oxychloride 50% WP (5.27), diafenthiuron 50% WP (5.79), diafenthiuron 50% WP+ copper oxychloride 50% WP (6.05), flonicamid 50% WG (6.22), flonicamid 50% WG + copper oxychloride 50% WP (6.41), acephate 50% + imidacloprid 1.8% SP (6.88) and (acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP (7.20) proved equally effective in recording minimum thrips population at different intervals of observations after second spray (Table 1). Whereas, the treatment with spiromesifen 22.9% SC + copper oxychloride 50% WP (7.62) and spiromesifen 22.9% SC (7.71) were found moderately effective.

The results on the efficacy of various treatments against thrips after third spray (Table 1) revealed that, fipronil 5% SC + copper oxychloride 50% WP recorded the minimum population of thrips (0.45/leaf). However, this treatment was found statistically equal with fipronil 5% SC (0.53), diafenthiuron 50% WP (0.60), diafenthiuron 50% WP + copper oxychloride 50% WP (0.61), flonicamid 50% WG (0.78), flonicamid 50% WG + copper oxychloride 50% WP (0.87), acephate 50% + imidacloprid 1.8% SP (0.90), (acephate 50% + imidacloprid 1.8% SP) + copper oxychloride 50% WP (0.95), spiromesifen 22.9% SC (1.14) and spiromesifen 22.9% SC + copper oxychloride 50% WP (1.21).

The findings on the efficacy of fipronil 5% SC and flonicamid 50% WG are in confirming with those of earlier worker, Surwase *et al*. (2017) [11]. Who noticed lowest population of thrips with the treatment of fipronil 5% SC followed by flonicamid 50% WG. Whereas, Bontha and Mallapur (2017) [2]. Reported effective control of thrips on *bt* cotton with Diafenthiuron 50%WP and diafenthiuron 50% WP + copper oxychloride 50% WP.

3.3 Effect on natural enemies

The data on the cumulative effect of spraying on natural enemies (Table 1) indicated that there were no significant differences among the treatments in respect to population of natural enemies. However, numerically more number of natural enemies was observed in untreated control plot. The present results revealed that, all the treatments under the investigation proved less detrimental to the predatory fauna like spiders, chrysopids and coccinellids in cotton ecosystem. Similar findings were reported by Naik *et al*. (2017) [8]. Who noticed that, in second spray diafenthiuron 50 WP recorded highest population of coccinellid. Whereas, the population of spider was significantly high level in plots treated with fipronil 5 SC (0.89 spider/plant). They further concluded that, insecticides *viz*., diafenthiuron 50% WP, fipronil 5% SC, spiromesifen 22.9% SC and flonicamid 50% WG were found safer to natural enemies. However, the workers like Jeer *et al*. (2017) [4]. Evaluated various doses of acephate 50% + imidacloprid 1.8% SP and concluded that, all the doses of this insecticide were found safer to natural enemies (i.e. *Cyrtorhinus lividipennis* and spiders) in rice ecosystem. Similar findings were also reported by Bontha and Mallapur (2017) [2]. Who noticed that, diafenthiuron 50% WP in combination with copper oxychloride 50% WP were found to be safer towards natural enemies in cotton ecosystem.

3.4 Phytotoxic (Plant) compatibility

Results on the investigations conducted to find out the phytotoxic effects of these pesticide combinations on cotton

revealed that, all the test insecticides in combination with copper oxychloride 50% WP 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 cotton crop. The present results finds support in the work carried out by Bontha and Mallapur (2017) [2]. Who reported that Diafenthiuron in combination with copper oxychloride 50 WP at recommended doses had not caused any phytotoxic symptoms such as injury to leaf tip and leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty on 60 and 90 old cotton crop. Similarly, Stanley *et al*. (2010) [10]. Did not observed any phytotoxicity on cardamom due to the application of Diafenthiuron alone and its combinations with carbendazim.

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

Tr. No	Treatments	Average number of pest per leaf					Average population of predators (No / plant)		
		Aphids		Thrips			Coccinellids	Chrysopids	Spiders
		First Spray	Second Spray	First Spray	Second Spray	Third Spray			
1	Fipronil 5% SC	3.03 (1.98)*	1.01 (1.41)*	10.58 (3.35)*	4.94 (2.38)*	0.53 (1.23)*	0.59 (1.25)**	0.56 (1.24) **	0.54 (1.24) **
2	Spiromesifen 22.9% SC	2.45 (1.83)	1.10 (1.42)	14.16 (3.84)	7.71 (2.86)	1.14 (1.45)	0.59 (1.26)	0.52 (1.23)	0.58 (1.25)
3	Flonicamid 50% WG	1.24 (1.49)	0.37 (1.17)	12.57 (3.61)	6.22 (2.60)	0.78 (1.33)	0.55 (1.24)	0.54 (1.24)	0.60 (1.26)
4	Diafenthiuron 50% WP	1.38 (1.53)	0.54 (1.23)	12.32 (3.58)	5.79 (2.55)	0.60 (1.26)	0.58 (1.25)	0.54 (1.24)	0.56 (1.25)
5	Acephate 50% + Imidacloprid 1.8% SP	2.39 (1.81)	0.79 (1.33)	14.07 (3.81)	6.88 (2.74)	0.90 (1.38)	0.58(1.25)	0.57 (1.25)	0.53 (1.23)
6	Copper oxychloride 50% WP	6.56 (2.74)	4.50 (2.33)	21.77 (5.64)	12.25 (3.59)	3.88 (2.20)	0.57 (1.25)	0.55 (1.24)	0.62 (1.25)
7	Fipronil 5% SC + Copper oxychloride 50% WP	2.82 (1.92)	1.16 (1.45)	9.85 (3.23)	5.27 (2.43)	0.45 (1.20)	0.58 (1.25)	0.56 (1.24)	0.59 (1.26)
8	Spiromesifen 22.9% SC + Copper oxychloride 50% WP	1.99 (1.71)	1.22 (1.46)	14.34 (3.85)	7.62 (2.86)	1.21(1.47)	0.57 (1.25)	0.55(1.24)	0.58 (1.25)
9	Flonicamid 50% WG + Copper oxychloride 50% WP	1.13 (1.45)	0.33 (1.15)	13.45 (3.72)	6.41 (2.65)	0.87 (1.36)	0.61 (1.27)	0.56 (1.25)	0.57 (1.25)
10	Diafenthiuron 50% WP+ Copper oxychloride 50% WP	1.48 (1.56)	0.49 (1.21)	11.75 (3.51)	6.05 (2.59)	0.61 (1.26)	0.59 (1.26)	0. 52 (1.23)	0.58 (1.25)
11	(Acephate 50% +Imidacloprid 1.8% SP) + Copper oxychloride 50% WP	2.23 (1.73)	0.88 (1.36)	14.33 (3.84)	7.10 (2.77)	0.95 (1.39)	0.58 (1.25)	0.52 (1.23)	0.56 (1.25)
12	Untreated control	6.89 (2.80)	4.68 (2.37)	22.61 (5.82)	12.59 (3.62)	4.13 (2.26)	0.73 (1.31)	0.66 (1.29)	0.75 (1.31)
	F test	Sig	Sig	Sig	Sig	Sig	NS	NS	NS
	SE (m) ±	0.10	0.09	0.19	0.17	0.09	0.06	0.06	0.07
	CD at 5 %	0.29	0.27	0.55	0.47	0.28	--	--	--

*Figures in parentheses are corresponding square root transformation values. ** Figures in parentheses are corresponding $\sqrt{x} + 0.5$ transformation value

4. Conclusion

Thus, insecticides viz; flonicamid 50% WG, fipronil 5% SC and diafenthiuron 50% WP would be helpful in mitigating the sucking pests like aphid and thrips in *Bt* cotton, which are alarming in the present situation. 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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