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Efficacy of advanced insecticides against sucking pests of okra

Shivani Suman, RK Choudhary, Sakshi Saxena, Naveen and Nishikant Yadav

Abstract
The present investigation was carried out in randomized block design (RBD) during *kharif* 2019 at experimental site of research field, College of Agriculture, Indore (M.P.). Efficacy present investigation was carried out in randomized block design (RBD) during *kharif* 2019 of different advanced insecticide against okra pests 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. Treatment afidopyropen 50 g/l DC @ 1000 ml/ha and abamectin 1.9% EC @ 987 ml/ha were the better group of best treatment and found to be least effective but significantly superior to control.

Keywords: *Abelmoschus esculentus*, abamectin, afidopyropen, *Amarasca biguttula biguttula*, *Aphis gossypii*, *Bemisia tabaci*

1. Introduction
Okra [*Abelmoschus esculentus* (L.) Moench] is the most important vegetable of family Malvaceae. The leaves of okra are utilized for planning of medications to reduce inflammation. Because of adequate level of iodine content, the utilization of products of okra can be considered as a solution for the goiter. India positions second regarding vegetable production in the world with the production of around 187474 thousand MT yet it possesses the first position in okra production. In India, area under okra is 528.4 thousand ha, alongside production of 6146 thousand MT, and productivity 11.6 MT/ha. In Madhya Pradesh, area, production and productivity of okra is 40.12 thousand ha, 536.73 thousand MT, 13.38 MT/ha, individually (Anonymous, 2017) [1].

Insect pests are the principle bottleneck in development of this yield. In general, the overall damage due to insect pests accounts to 48.97% loss in fruit yield (Subbireddy *et al*., 2018) [8]. In case of sucking pests jassids, *Amarasca biguttula biguttula* (Hemiptera: Cicadellidae) attacked during both nymph and adult life stages on the undersurface of leaves by sucking the cell sap. During feeding they inject venomous saliva into plant tissues and attacked leaves turning yellow, twist downwards, desiccated and fall down. Aphids, *A. gossypii* (Hemiptera: Aphididae) are infrequently considered as a major pest of okra. The nymph and adult are found in enormous numbers and they suck the sap from different parts of the plants. Profoundly infested leaves become yellow, get twisted, distorted and dried up causing serious reduction in yield. It likewise help in developing sooty mould on the leaves by emitting honey dew which adversely influences the cycle of photosynthesis. Whiteflies, *Bemisia tabaci* (Hemiptera: Aleyrodidae) nymph and adult likewise suck the cell sap from the leaves. The affected leaves are curled and dried. The affected plants show an undersized growth.

The current investigation depends on the assessment of efficacy of some advanced insecticides for example Afidopyropen, Abamectin, Tolfenpyrad, Spirotetramat, and Imidacloprid. The method of activity of this various insecticides are unique. A major advantage of these new products is that they works as one shot solution for more than one target pests also reducing the cost of crop protection. The current examination will be undertaken with the accompanying objectives to evaluate the efficacy of advanced insecticides against jassid and aphid pests of okra.

2. Material and Methods

The field experiment was carried out during *kharif* season 2019 at Research Centre of RVSKVV, College of Agriculture Indore, Madhya Pradesh. An experiment was laid out in Randomized Block Design (RBD), with eight treatments and three replication. The healthy seeds of okra were sown manually at 5 cm depth on 16th July 2019 at a row distance of 45 cm and plant to plant of 30 cm apart. For conducting studies on efficacy of some new insecticides against sucking pests i.e. jassids (*Amrasca biguttula biguttula* Ishida), aphids (*Aphis gossypii* Glover) and whitefly (*Bemisia tabaci*) of okra, the data was recorded at the morning times. All the molecules under study were applied as foliar spray using Knapsack sprayer. To determine the efficacy of formulations, three spray of insecticides on okra crop was applied. First spraying was carried at Economic Threshold Level of insects and second and third subsequently at 15 days interval. Observation on jassid, aphid and whitefly were taken at one day before spraying (Pre-treatment) and 3, 7, and 15 days after spray from each plot on 2 top, 2 middle and 2 bottom leaves from 5 randomly selected plants. Treatment details given in the table 1.

Table 1: Bio efficacy Treatment Details

S. No.	Treatment Details	Dose/ha		Water Volume (L/ha)
		g. a.i.	Formulation (ml)	
T_1	Afidopyropen 50 g/l DC	33.75	450	500
T_2	Afidopyropen 50 g/l DC	45.00	600	500
T_3	Afidopyropen 50 g/l DC	56.26	750	500
T_4	Afidopyropen 50 g/l DC	50.00	1000	500-750
T_5	Abamectin 1.9% EC	18.76	987	500-1000
T_6	Tolfenpyrad 15% EC	150	1000	500
T_7	Spirotetramat 11.01% w/w + Imidacloprid 11.01% w/w SC	60+60	500	500
T_8	Untreated control	-	-	-

3. Result and Discussion

The results of the study on the efficacy of advanced insecticides against sucking pests' population are presented in the given tables. On the basis of recorded data on jassids, aphid and whitefly population result showed that non- significant difference among different plots or treatments before 24 hours application of treatments, indicating more or less uniform distribution of the pest.

3.1 Jassids

The overall mean of three sprays represented in the Table 2 reveals that all the insecticidal treatments significantly reduced the jassid population as compared to control (35.67 jassids/ 6 leaves/ plant). Among the treatments, afidopyropen 50 g/l DC @ 600 ml/ha was found to be most effective as it recorded lowest jassid population (9.63 jassids/ 6 leaves/ plant). The next effective treatments were afidopyropen 50 g/l DC @ 750 ml/ha (12.28 jassids/ 6 leaves/ plant) followed by tolfenpyrad 15% EC @ 1000 ml/ha (15.09 jassids/ 6 leaves/ plant), afidopyropen 50 g/l DC @ 450 ml/ha (18.18 jassids/ 6 leaves/ plant), spirotetramat 11.01% w/w + imidacloprid 11.01% w/w SC @ 500 ml/ha (22.14 jassids/ 6 leaves/ plant). Treatment afidopyropen 50 g/l DC @ 1000 ml/ha (27.03 jassids/ 6 leaves/ plant) found at par with treatment abamectin 1.9% EC @ 987 ml/ha (30.81 jassids/ 6 leaves/ plant) was found to be least effective but significantly superior to control. Present findings are in line with the findings of Chen *et al*. (2018) reported that afidopyropen was found the effective against sucking pests and Lekha *et al*. (2018) reported that tolfenpyrad 15 EC were significantly superior over untreated control as it registered highest mean reduction of jassids. Patel and Sarkar (2019) [7] reported that statistically maximum efficacy (against jassids) and yield were observed in spirotetramat + imidacloprid.

Table 2: Efficacy of advanced insecticides jassid infesting okra

S. No.	Treatment	Dose ml/ha	Mean Population of Jassid/ 6 leaves									Mean
			Pre-Treatment	Days after I spray			Days after II spray			Days after III spray			
				3	7	15	3	7	15	3	7	15	
T_1	Afidopyropen 50 g/l DC	450	34.17 (5.84)	21.50 (4.64)	22.25 (4.72)	25.00 (5.00)	20.00 (4.47)	16.00 (4.00)	18.00 (4.24)	15.25 (3.91)	13.65 (3.69)	12.00 (3.46)	18.18 (4.24)
T_2	Afidopyropen 50 g/l DC	600	31.08 (5.57)	31.08 (5.57)	15.50 (3.94)	12.00 (3.46)	10.5 (3.24)	8.5 (2.92)	10.00 (3.16)	6.25 (2.50)	4.50 (2.12)	3.50 (1.87)	9.63 (3.02)
T_3	Afidopyropen 50 g/l DC	750	31.33 (5.60)	31.33 (5.60)	18.50 (4.30)	16.00 (4.00)	12.50 (3.54)	11.00 (3.32)	13.35 (3.65)	10.00 (3.16)	7.65 (2.77)	4.50 (2.12)	12.28 (3.44)
T_4	Afidopyropen 50 g/l DC	1000	34.23 (5.85)	34.23 (5.85)	30.00 (5.48)	27.50 (5.24)	30.50 (5.52)	28.00 (5.29)	28.65 (5.35)	26.00 (5.10)	22.50 (4.74)	18.65 (4.32)	27.03 (5.18)
T_5	Abamectin 1.9% EC	987	36.33 (6.03)	36.33 (6.03)	33.20 (5.76)	31.25 (5.59)	32.50 (5.70)	31.25 (5.59)	36.00 (6.00)	28.45 (5.33)	25.50 (5.05)	23.60 (4.86)	30.81 (5.54)
T_6	Tolfenpyrad 15% EC	1000	31.67 (5.63)	31.67 (5.63)	20.00 (4.47)	19.00 (4.36)	15.00 (3.87)	13.50 (3.67)	16.65 (4.08)	12.00 (3.46)	10.50 (3.24)	8.20 (2.86)	15.09 (3.85)
T_7	Spirotetramat 11.01% w/w + Imidacloprid 11.01% w/w SC	500	31.88 (5.64)	31.88 (5.64)	22.25 (4.72)	21.50 (4.64)	26.00 (5.10)	22.50 (4.74)	27.00 (5.20)	20.50 (4.53)	17.00 (4.12)	15.50 (3.94)	22.14 (4.69)
T_8	Control	-	33.67 (5.80)	33.67 (5.80)	35.00 (5.92)	38.00 (6.16)	38.00 (6.16)	36.50 (6.04)	40.00 (6.32)	33.50 (5.79)	32.00 (5.66)	29.50 (5.43)	35.67 (5.97)
SEm ±			0.09	0.09	0.11	0.08	0.26	0.07	0.06	0.08	0.12	0.09	0.12
C.D.**			NS	NS	0.35	0.25	0.80	0.22	0.19	0.24	0.36	0.27	0.38

3.2 Aphids

Overall mean of all three spray populations of aphids given in Table 3. Result revealed that all the insecticidal treatments significantly reduced the aphid population as compared to control (27.75 aphid/ 6 leaves/ plant) fig 2. Among the treatments, afidopyropen 50 g/I DC @ 600 ml/ha was found to be most effective as it recorded lowest aphid population (4.92 aphid/ 6 leaves/ plant). The next effective treatments were afidopyropen

50 g/I DC @ 750 ml/ha (7.33 aphid/ 6 leaves/ plant) followed by tolfenpyrad 15% EC @ 1000 ml/ha (9.73 aphid/ 6 leaves/ plant). Treatment afidopyropen 50 g/I DC @ 450 ml/ha (12.75 aphid/ 6 leaves/ plant) found to be at par with treatment spirotetramat 11.01% w/w + imidacloprid 11.01% w/w SC @ 500 ml/ha (14.08 aphid/ 6 leaves/ plant). Treatment afidopyropen 50 g/l DC @ 1000 ml/ha (17.77 aphid/ 6 leaves/ plant) and abamectin 1.9% EC @ 987 ml/ha (21.82 aphid/ 6 leaves/ plant) were the better group of best treatment and found to be least effective but significantly superior to control. Present findings are in line with the findings of Harikoshi *et al*. (2019) reported that afidopyropen showed the highest insecticidal activity against aphids. Koch *et al*. (2019) [5] revealed that afidopyropen was effective against aphid and Chen *et al*. (2018) [2] also reported that afidopyropen was found the effective against aphids, similarly, Kalyan *et al.* (2014) [4] reported that tolfenpyrad, 150 and 125 a.i./ha were found superior for control of aphid population.

Table 3: Efficacy of advanced insecticides aphid infesting okra.

S. No.	Treatment	Dose ml/ha	Mean Population of Aphid/ 6 leaves									Mean
			Pre-Treatment	Days after I spray			Days after II spray			Days after III spray		
				3	7	15	3	7	15	3	7	15	
T_1	Afidopyropen 50 g/l DC	450	30.08 (5.48)	18.25 (4.27)	14.50 (3.81)	16.00 (4.00)	13.50 (3.67)	11.20 (3.35)	13.25 (3.64)	10.30 (3.21)	9.25 (3.04)	8.50 (2.92)	12.75 (3.55)
T_2	Afidopyropen 50 g/l DC	600	30.17 (5.49)	8.50 (2.92)	6.50 (2.55)	9.00 (3.00)	6.50 (2.55)	4.00 (2.00)	5.25 (2.29)	2.00 (1.41)	1.50 (1.22)	1.00 (1.00)	4.92 (2.11)
T_3	Afidopyropen 50 g/l DC	750	30.58 (5.53)	13.00 (3.61)	8.50 (2.92)	10.45 (3.23)	9.00 (3.00)	6.55 (2.56)	8.00 (2.83)	5.00 (2.24)	3.25 (1.80)	2.25 (1.50)	7.33 (2.65)
T_4	Afidopyropen 50 g/l DC	1000	30.25 (5.50)	23.00 (4.80)	20.50 (4.53)	22.50 (4.74)	18.50 (4.30)	16.00 (4.00)	18.00 (4.24)	15.15 (3.89)	14.00 (3.74)	12.25 (3.50)	17.77 (4.20)
T_5	Abamectin 1.9% EC	987	31.33 (5.60)	28.00 (5.29)	23.50 (4.85)	25.00 (5.00)	24.00 (4.90)	21.00 (4.58)	22.50 (4.74)	20.00 (4.47)	17.00 (4.12)	15.35 (3.92)	21.82 (4.66)
T_6	Tolfenpyrad 15% EC	1000	30.75 (5.54)	15.50 (3.94)	12.00 (3.46)	13.00 (3.61)	11.00 (3.32)	8.00 (2.83)	9.50 (3.08)	7.00 (2.65)	6.10 (2.47)	5.50 (2.35)	9.73 (3.08)
T_7	Spirotetramat 11.01% w/w + Imidacloprid 11.01% w/w SC	500	30.00 (5.48)	20.00 (4.47)	14.00 (3.74)	15.50 (3.94)	15.50 (3.94)	12.50 (3.54)	14.75 (3.84)	13.50 (3.67)	11.50 (3.39)	9.50 (3.08)	14.08 (3.74)
T_8	Control	-	30.50 (5.52)	28.25 (5.32)	29.50 (5.43)	30.00 (5.48)	29.25 (5.41)	29.50 (5.43)	31.25 (5.59)	26.50 (5.15)	24.50 (4.95)	21.00 (4.58)	27.75 (5.26)
SEm ±			0.06	0.08	0.11	0.13	0.07	0.10	0.09	0.13	0.10	0.10	0.11
C.D.**			NS	0.25	0.33	0.40	0.21	0.30	0.27	0.41	0.32	0.32	0.34

3.3 Whitefly

On the basis of overall mean of third sprays (Table 4) all the insecticidal treatments significantly reduced the whitefly population as compared to control (24.30 whitefly/ 6 leaves/ plant). Among the treatments, afidopyropen 50 g/l DC @ 600 ml/ha was found to be effective among all the treatments as it recorded lowest whitefly population (3.22 whitefly/6 leaves/plant) was found to be most effective. Next better treatment was afidopyropen 50 g/l DC @ 750 ml/ha (5.16 whitefly/ 6 leaves/ plant) followed by tolfenpyrad 15% EC @ 1000 ml/ha (7.71 whitefly/ 6 leaves/ plant),itreatment afidopyropen 50 g/l DC @ 450 ml/ha (10.22 whitefly/ 6 leaves/ plant), spirotetramat 11.01% w/w + imidacloprid 11.01% w/w SC @ 500 ml/ha (12.46 whitefly/ 6 leaves/ plant) . Treatment afidopyropen 50 g/l DC @1000 ml/ha (15.48 whitefly/6/ leaves/ plant) and abamectin 1.9% EC @ 987 ml/ha (18.16 whitefly/ 6 leaves/ plant) were the next group of better treatment found effective and significant superior to control (24.30 whitefly/ 6 leaves/ plant). All the treatments were effective and significant superior to control.

The present findings are in line with the findings of Kalyan *et al.* (2014) [4] reported that tolfenpyrad 15 EC were effective in controlling the population of whiteflies. While, Chen *et al*. (2018) [2] reported that afidopyropen was found the effective against sucking pests.

Table 4: Efficacy of advanced insecticides whitefly infesting okra.

S. No.	Treatment	Dose ml/ha	Mean Population of Whitefly / 6 leaves									Mean
			Pre- Treatment	Days after I spray			Days after II spray			Days after III spray		
				3	7	15	3	7	15	3	7	15	
T_1	Afidopyropen 50 g/l DC	450	26.00 (5.09)	17.95 (4.24)	11.15 (3.34)	13.55 (3.68)	11.00 (3.32)	8.00 (2.83)	8.75 (2.96)	8.25 (2.87)	7.15 (2.67)	6.20 (2.49)	10.22 (3.17)
T_2	Afidopyropen 50 g/l DC	600	28.50 (5.33)	6.50 (2.55)	4.00 (2.00)	6.00 (2.45)	4.45 (2.11)	2.00 (1.41)	3.00 (1.73)	1.50 (1.22)	1.00 (1.00)	0.50 (0.71)	3.22 (1.71)
T_3	Afidopyropen 50 g/l DC	750	27.50 (5.23)	9.58 (3.10)	7.50 (2.74)	8.10 (2.85)	6.00 (2.45)	4.00 (2.00)	5.00 (2.24)	3.25 (1.80)	2.00 (1.41)	1.50 (1.02)	5.16 (2.19)
T_4	Afidopyropen 50 g/l DC	1000	27.00 (5.19)	22.25 (4.72)	15.25 (3.91)	17.50 (4.18)	16.35 (4.04)	14.00 (3.74)	16.00 (4.00)	14.50 (3.81)	13.25 (3.64)	10.20 (3.19)	15.48 (3.92)
T_5	Abamectin 1.9% EC	987	28.17 (5.30)	25.23 (5.02)	18.50 (4.30)	20.00 (4.47)	19.00 (4.36)	16.50 (4.06)	18.50 (4.30)	17.25 (4.15)	15.50 (3.94)	13.00 (3.61)	18.16 (4.25)
T_6	Tolfenpyrad 15% EC	1000	28.67 (5.34)	13.50 (3.67)	9.00 (3.00)	11.00 (3.32)	9.25 (3.04)	6.00 (2.45)	7.25 (2.69)	7.25 (2.69)	3.50 (1.87)	2.60 (1.61)	7.71 (2.73)
T_7	Spirotetramat 11.01% w/w + Imidacloprid 11.01% w/w SC	500	26.42 (5.13)	19.63 (4.43)	13.00 (3.61)	15.20 (3.90)	13.50 (3.67)	10.25 (3.20)	12.25 (3.50)	12.00 (3.46)	9.25 (3.04)	7.10 (2.66)	12.46 (3.51)
T_8	Control	-	29.17 (5.4)	28.92 (5.38)	24.25 (4.92)	24.50 (4.95)	25.50 (5.05)	26.00 (5.10)	26.50 (5.15)	23.00 (4.80)	21.00 (4.58)	19.00 (4.36)	24.30 (4.92)
SEm ±			0.10	0.11	0.11	0.12	0.08	0.11	0.08	0.10	0.08	0.08	0.10
C.D.**			NS	0.34	0.35	0.37	0.26	0.34	0.26	0.30	0.24	0.25	0.32

4. Conclusion

Based on the findings of the present study, it can be inferred that the insecticide afidopyropen 50 g/l @ 600 ml/ha was found to be most effective against jassid, aphid and whitefly. Next better treatment was afidopyropen 50 g/l @ 750 ml/ha followed by tolfenpyrad 15% EC, afidopyropen 50 g/l @ 450 ml/ha, spirotetramat 11.01% w/w + imidacloprid 11.01% w/w SC @ 500 ml/ha. Treatment afidopyropen 50 g/l DC @ 1000 ml/ha and abamectin 1.9% EC @ 987 ml/ha were found to be least effective but significantly superior to control.

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