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Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network

RESEARCH ARTICLE BIOSCIENCE RESEARCH, 2021 18(4): 3334-3338. **OPEN ACCESS**

Bio-Efficacy of extensively used Pyrethroid, Neonicotenoid and Carbamate insecticides against jassid on Sunflower

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Pakistan spends a lot of money for import of edible oil which poses a burden on national exchequer. The country is witnessing a boom in oilseed crop cultivation since last four years. Thus, share of Sunflower cultivation among oilseed crops is increasing in Pakistan. But, insect pest infestation is a major concern for the farmers. Resistance in insects to different insecticides is increasing due to injudicious use of insecticides to control insect pests. Present study was conducted to find the most effective insecticides among the most commonly used ones from Neonicotinoids, Carbamates and Pyrethroid groups to effectively manage Jassid (*Amrasca biggutula*) population. Insecticides were applied on field population. Pre and post treatment insect population data were recorded. Experiment was repeated thrice. The maximum mortality (97.40%) was expressed by Bifenthrin followed by Nitenpyram (96.58%), Imidacloprid (94.69%) and Carbosulfan (82.35%). Insecticide from Pyrethroid group was the most effective followed by Neonicotenoid and Carbamate groups. The most effective insecticides can be included in IPM program to effectively manage Jassid, as alternatives to each other with the aim of evasion from development of resistance to insecticides.

Keywords: Sunflower, Bifenthrin, Nitenpyram, Carbosulfan, Jassid

INTRODUCTION

Sunflower (*Helianthus annus* L.*)* is one of the most important oilseed crop. Sunflower oil is widely used in edible products, paints and cosmetic products (Dake, R. B., and Bhamare, V. K. 2019). Total cultivation area of sunflower in 2005 was above 23.31 million hectares globally which produces 29.90 million tones seed (Shirshikar, 2005). The highest recorded area of sunflower was 26.21 million hectares all over the world in 2016 (Soare, E., and Chiurciu, I. A. 2018). The total sunflower area sown in Pakistan in FY 2019-20 was 0.257 million acres with the production of 0.133 million tones seed and 0.051 million tones oil (POBD 2019-20). Sunflower seed possesses 35-55 % oil contents with an average production of 1315 kg per hectare (PARC 2010).

The production and yield of sunflower is affected due to different biotic and abiotic factors which include climatic change, poor cultural practices, diseases and insect pests (Aftab et al. 2020). Mostly, cutworm, cotton aphid, green stink bug, cabbage semilooper, jassid, whitefly, yellow flower thrips and saw toothed beetle damage the

crop (Bakhetia et al. 1997).American boll worm known as Capitulum borer/ head moth, hairy caterpillars, cabbage semilooper, green stink bugs, dusky bugs, jassid and whitefly cause significant yield losses (Kakakhel et al. 2000).

Jassid is one of the most destructive pests of sunflower. It is a sucking pest which sucks sap from underneath of the leaf. Adult jassid can bear size of about 2.6 mm in length. Jassid body is yellowish green in color and wings are transparent (Jayasimha, G.T 2012). Jassid infestation causes severe loss in yield because its starts damaging the crop since seedling stage. It sucks cell sap from leaf which causes burning of leaf margins which terminates plant growth (Dake, R. B and Bhamare, V. K. 2019). Jassids have broad host range of crops and both nymphs and adults damage the crop by de-saping them and they also act as vectors by transmitting different viral diseases in the crop (Rawat RR and Sahu HR 1973).

Jassid can be controlled by several methods. The most efficient and environment friendly control method is through natural enemies. Chrysoperla carnea, lady bird beetle, spiders and other predators prey on nymphs as well as adults of Jassid. The other method of managing jassid is through resistant varieties (Helen Tsatsia and Grahame Jackson 2010).

Many insecticides are recommended to control jassid in sunflower. But most of them don't give effective result against jassid due to development of resistance against particular insecticides (Dake, R. B., and Bhamare, V. K. 2019). Some new insecticides are being applied for effective control of pests. It is need of the hour to monitor the susceptibility level of insecticides in Jassid so that we may be able to develop or adopt strategies which may efficiently control the particular insect pest population.

This experiment was conducted to evaluate the efficacy of four different insecticides against jassid on sunflower that which insecticide is more effective against jassid.

MATERIALS AND METHODS

Sowing of sunflower hybrid; ORISUN-516 was completed at farm area of Oilseeds Research Institute (ORI), Ayub Agricultural Research Institute (AARI), Faisalabad in spring season of the year 2021. Agronomic field operations such as weeding, hoeing, irrigation and fertilizer application were done during the complete cropping season, on need basis. Five plants from each treatment were randomly selected, tagged and data regarding Jassid population were recorded before application of insecticides. (Zubair et al. 2018; Ali et al. 2019). Tested insecticides were applied in three replicates (Table 1). After the application of treatments, mortality data were recorded at 24-hour, 48-hour, 72-hours and after one week of treatment time intervals. The experiment was repeated thrice to conform the findings. Percentage mortality of Jassid was calculated by using the formula:

Mortality (%) = ((Pre-Treatment Population – Post-Treatment Population) / Pre-Treatment Population) × 100

The relevant data was tabulated and analyzed using Statistix 8.1 statistical software. Analysis of variance was constructed and treatments' mean comparisons were made through Least Significant Difference (LSD) test.

Table 1: Insecticides

Sr. No.	Common Name	Mode of Action	Formulation	Dose per Acre
1.	Imidacloprid	Nicotinic acetylcholine receptor (nAChR) competitive modulators Nerve Action	20% EC	250 ml
2.	Nitenpyram	Nicotinic acetylcholine receptor (nAChR) competitive modulators Nerve Action	25% SP	100g
3.	Carbosulfan	Acetylcholinesterase (AChE) inhibitors Nerve action	20% EC	500ml
4.	Bifenthrin	Sodium channel modulators Nerve action	10% EC	100ml

RESULTS AND DISCUSSION

Data recorded after 24 hours of treatment revealed that Bifenthrin gave the maximum mortality (88.31%) followed by Imidacloprid (79.65%), Carbosulfan (60%) and Nitenpyram (49.57%). It is also revealed that none of the insecticide shared means with any other (Table 2). Imidacloprid, Nitenpyram and Carbosulfan shared means to some extent which favors the claim that these three insecticides have non-significant difference in mortality except bifenthrin which did not share mean with any of the tested insecticide.

Same situation was witnessed when data recorded after 48 hours of treatment. Bifenthrin (96.10%) showed maximum mortality followed by Imidacloprid (84.07%), Carbosulfan (72.94%) and Nitenpyram (65.81%). There was significant difference among the mortality caused by Nitenpyram and Bifenthrin. On the other hand, Imidacloprid, Nitenpyram and Carbosulfan shared common means to some extent like the mortality caused by these insecticides after 24 hours of treatment. Table 2 also explains that there was the same trend in mortality (%) by these all insecticides after 24 and 48 hours of treatment.

When data was recorded after 72 hours of treatment, it was expressed that efficacy of bifenthrin somehow decreased as compared to the mortality she caused after 48 hours of treatment. Other three insecticides caused significantly greater mortality and all the insecticides fell into same group as all four insecticides share common means.

Data recorded after 72 hours of treatment revealed that maximum mortality was caused by Bifenthrin (97.40%) followed by Nitenpyram (96.58%), Imidacloprid (94.69%) and Carbosulfan (82.35%) which is the minimum mortality (%) after 7 days of treatment. Carbosulfan caused significantly different mortality as compared to the other insecticides which share common mean among them after 7 days of treatment.

Dake and Bhamare, V. K. (2019) tested different insecticides and found that Imidacloprid when applied at 0.003 % concentration, it gave 77.61 % mortality after seven days of treatment. These results differ from the current study results, might be due to difference in concentrations.

Asif et al. (2016) evaluated different insecticides against Jassid and reported that Imidacloprid 200 SL at the dose rate of 100 ml/acre gave 66.66 percent mortality while Nitenpyram gave 70.83% mortality followed by bifenthrin (55.83%) and Carbosulfan (50%) mortality, 7 days after treatment.

Aslam et al. (2004) tested various insecticides against Jassid and found that Imidacloprid gave maximum mortality 94.86% followed by Bifenthrin (28.22%) and Carbosulfan (-33.67%). Such huge difference in mortality caused by Bifenthrin and Carbosulfan indicates that their test population was resistant to these insecticides.

Data recorded after 72 hours of treatment revealed that maximum mortality was caused by Bifenthrin (97.40%) followed by Nitenpyram (96.58%), Imidacloprid (94.69%) and Carbosulfan (82.35%) which is the minimum mortality (%) after 7 days of treatment. Carbosulfan caused significantly different mortality as compared to the other insecticides which share common mean among them after 7 days of treatment.

Table 2: Comparison of Means of Mortality (%) caused by Insecticides

			Mortality (%)			
Sr. #	**Insecticides**	**B.T**	**24 HAT**	**48 HAT**	**72 HAT**	**7 DAT**
1	Imidacloprid	113	79.65 bc	84.07 bc	87.61 b	94.69 c
2	Nitenpyram	117	49.57 ab	65.81 b	89.74 b	96.58 c
3	Carbosulfan	85	60.00 abc	72.94 bc	88.24 b	82.35 b
4	Bifenthrin	77	88.31 c	96.10 c	83.12 b	97.40 c
5	Control	66	-6.06 a	-16.67 a	-28.79 a	-37.88 a
	LSD @ 5%		13.36	11.32	4.25	2.78

CONCLUSION

All the tested insecticides effectively managed the Jassid population even after seven days of treatment. Maximum percent mortality was caused by Bifenthrin, Nitenpyram, Imidacloprid and Carbosulfan. It is need of the hour that we should manage the Jassid population in Sunflower by spraying insecticides having different mode of action every time. Thus, we can control Jassid in an effective manner without leading towards the development of insecticide resistance over a short period of time.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

AUTHOR CONTRIBUTIONS

SA, MZ, MKM and AIJ designed and performleed the experiment. MZ, MKM, HQ and KH wrote the manuscript. MAQ and SS analyzed the data. SA and TM proofread the final version of the manuscript. All others authors also read and approved the final version.

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