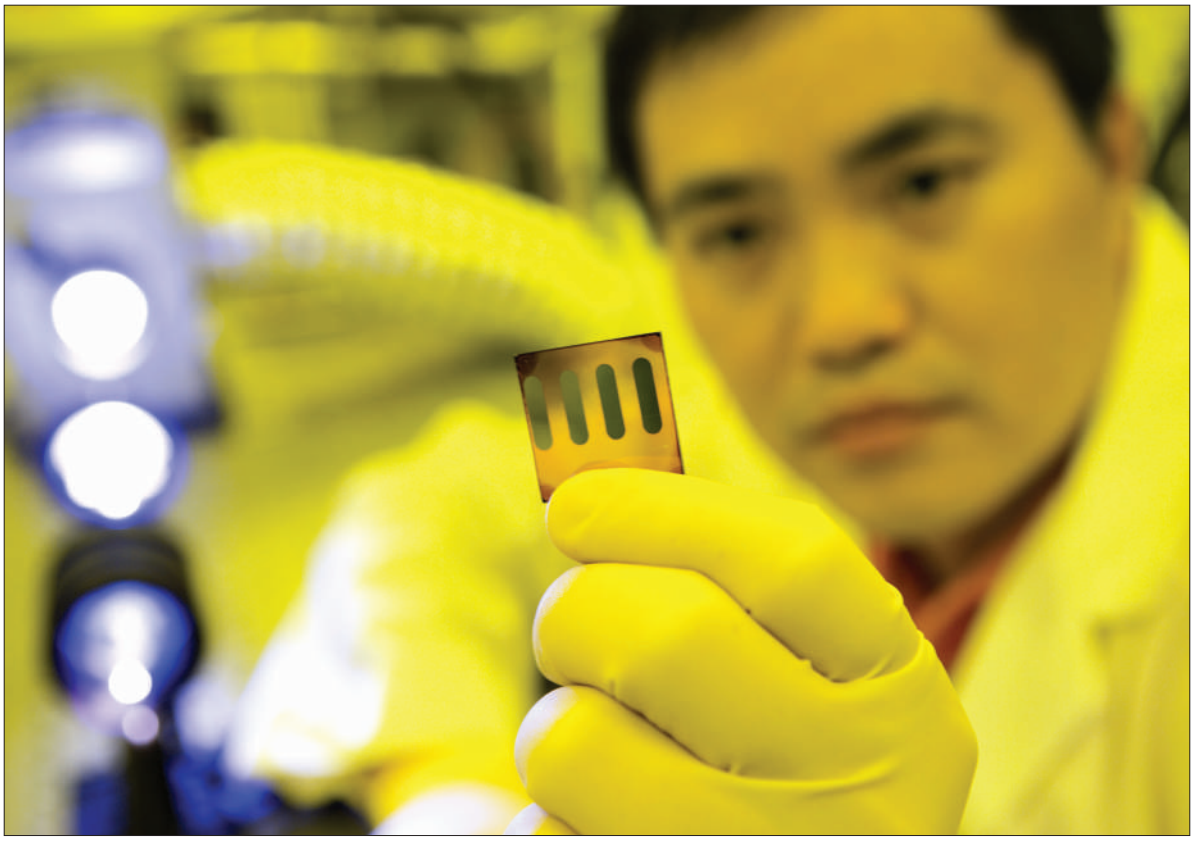

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Research Article

Comparative Efficacy of Novel Pesticides Against Jassid, *Amrasca biguttula biguttula* (Ishida) on Cotton Crop under Field Conditions at Khairpur, Sindh, Pakistan

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Abstract

Background and Objective: Cotton is a food and fiber cash crop and its seeds are used for feeding to cattle and crushed for oil purpose, attached by many vigorous pests due to lush green. The main objective of this study was to control the cotton jassid pest through evaluation of different pesticides such as; Acetamiprid (Mospilan), Pyriproxyfen (Admril), Diafenthiuron (Polo), Acephate (Safate), Nitenpyram (Marasca) under field conditions at district Khairpur during, 2016. **Methodology:** The 5 pesticides/treatments were replicated 4 times whereas, the 6th treatment known as control plot was kept as un-sprayed. The data was taken on pre-treatment and the post-treatments; after use of pesticides on 24, 48, 72 h, 7th and 12th day, respectively. The reduction percent of jassid was evaluated through the Henderson and Tilton formula. One way ANOVA was used to find significant differences. **Results:** The results further indicated that the pesticide Nitenpyram was found more effective to the *Amrasca biguttula biguttula* (Ishida) that reduced 68.61% in all sprays followed by Acephate 58.75%, Acetamiprid 49.41%, Diafenthiuron 27.48% and Pyriproxyfen 23.61% when compared with control plot 1.83 mean percent. One way ANOVA showed the significant difference among all tested pesticides at $p<0.05$ level. **Conclusion:** It is concluded that the pesticide Nitenpyram provided better reduction against the cotton jassid under field conditions therefore, it is recommended to be applied at per time interval basis.

Key words: Sucking pest, jassid, cotton crop, Bt. variety, treatment, condition

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Cotton, *Gossypium hirsutum* (L.) is cash crop famously known as silver fiber and "white gold" in Pakistan[1]. Pakistan ranks 4th biggest cotton producer after USA, China and India however, national average per hectare yield is low, relatively[2] that contributed over 68% to send out profit[3]. It maintains million of the individuals for occupation, in farms, ginning factories, material mills, eatable oil and cleanser commercial enterprises therefore, rightly called the soul economy, on which Pakistan's economy is always dependent. The inclination wins more than 60% remote trade and runs greatest material and business of the livelihood in the country by giving work as well as crude material through 400 fabric mills, 1035 ginning industrial facilities and 5000 oil expellers, thus those millions of family need to cotton built commercial enterprises[4].

This crop is basically attached by an extensive variety of sucking pests in different phases of growth due to enrich of greenish leaves[5] up to 96 sucking pests[6] mostly, jassid, *Amarasca biguttula biguttula* (Ishida); whitefly, *Bemisia tabaci* (Gennadius); aphids, *Aphis gossypii* (Glover) and mealybug, *Phenacoccus solenopsis* (Tinsley)[7]. The cotton mealybug attacks on different cotton varieties that are also turned into major sucking pest of cotton crop in Sindh, Pakistan[8]. Cotton jassids necessitate known as standard sucking pest of cotton crop. Cotton yield becomes lesser, as low due to the increasing population of jassid[4] which contrasted with different cotton yields. Jassid, *Amrasca biguttula biguttula* (Hemiptera: Cicadellidae) a sucking pest alone causes 19% loss[9,5], 25-45%[10] reduction in cotton crop production. Jassid sucks the cell sap and reduces the photosynthetic area of the plant. Both nymphs and adults found harmful to the crop by injecting its toxic saliva into tissues[8].

Pesticides are the main intend to control huge scale infestation and sudden control of pests[11]. Pesticides were utilized interestingly as a part of 1950 in Pakistan to battle against of insect invasion. In 1954, imports of mixture pesticides added up to 254 t and in 1980 around 90% of the pesticides were utilized on cotton crop. That intends the majority of the 6.62 million sections of land utilized for development only for cotton crop and target was achieved due to pesticide use[12,13] in which the 83% of pesticides were used to control sucking pests for cotton fields. Traditional pesticides were also used for knockdown of the insects anyway the use of huge insecticides brought the control of cotton pests. Different scientists tried different sprays for control of cotton jassid and acquired different outcomes. Thus, Confidor and Mospilan took the greater part viable against jassid as well Mospilan and Actara supported exceedingly powerful against whitefly[14], whereas; the large amount about safety on whitefly and jassid have been recorded with effective to organophosphate (OPs) with pyrethroids groups in Pakistan[15,16]. The principle targets of the present investigation were to analyze the feasibility of different pesticides against sucking pest of cotton jassid, *A. biguttula biguttula* and to find out the most effective pesticide against this sucking pest under the field conditions for hot arid zone of taluka Gambat, district Khairpur, Sindh.

MATERIALS AND METHODS

Location and pesticides application: The experimental field was conducted at Lakyari agricultural farm Saidi lower near Kamaldero, Taluka Gambat district, Khairpur, Sindh, throughout summer season, 2016 to check the efficacy of different five insecticides (Acetamiprid (Mospilan) 20 SP, Pyriproxyfen (Admril) 10.8 EC, Diafenthiuron (Polo) 500 SC, Acephate (Safate) 75 SP, Nitenpyram (Marasca) 10 SL) against sucking pest jassid, *A. biguttula biguttula* with respect on cotton crop. The cotton seeds (cv. Bt., 114) were sown on the ridges from starting with north to south on Randomized Complete Block Design (RCBD) with different treatments on measure about 841 m of every and each treatment. There were 5 treatments which were replicated 4 times under given (Table 1) whereas; the control plot was kept without using the pesticide.

Table 1: Pesticides with their toxicity used against cotton jassid under field conditions

Pesticides	Compounds	Dose per Acre	Name of the company	Dose per tank
Nitenpyram 10 SL (Marasca)	Neonicotinoid	200 mL	Agri Farm Services (Pvt.) Ltd.	25 mL
Acephate 75 SP (Safate)	Organophosphate	300 g	Rahim Bux Avari Enterprises (Pvt.) Ltd.	37 g
Acetamiprid (Mospilan) 20 SP	Neonicotinoid	200 g	Arysta (Pvt.) Ltd.	25 g
Diafenthiuron (Polo) 500 SC	Thiourea	200 mL	Syngenta (Pvt.) Ltd.	25 mL
Pyriproxyfen (Admril)10.8 EC	IGR	400 mL	Farmyard Manure Company (Pvt.) Ltd.	50 mL
Control plot	Without use of insecticides			

Agronomical practices: The plots were differentiated from one another by keeping space of 2 feet between treatments and replications. The separation was made with 18'' from ridge to ridge and 9'' to 12'' from plant to plant, individually. Agronomic practices such as; thinning and weeding was completed manually. After sowing the cotton seeds, the pre-emergence weedicide was used to control the un-wanted plants. The sprayer person was secured by mask on face, hand gloves wore on hands and clothing on whole body.

Pest appearance: When the sucking pests, jassids aggravated their introductory infestation sporadically, one month after germination, the jassid number have been arrived at toward Economic Threshold Level (ETL) i.e., 1-2 adults or nymphs of jassid/leaf[17]. The insecticidal spraying has been done with shoulder mounted backpack sprayer during that time to decrease the jassid number. Each and every pesticide was used at the field proposed rate/measurement. The number change observed naturally under control plot for the management about profitable insects like beneficial insects (predators and parasites).

Data collection: The data was taken at pre-treatment and post-treatment as; previously then afterward those spray, subsequently the information was taken and data gathered in preceding 24 h and then afterward 24, 48, 72 h, 7th day and 12th day from using of each spray. The sucking pest, jassids were counted at haphazardly for 3 steps/sides: 1 from top, 1 from center and 1 from base side of the plant, from 20 plants.

Data analysis: Thus; the information gathered have been subjected through the one way analysis of variance to examination of fluctuation and mean values compared with LSD test utilizing explanatory facts SXW software, 8.1 (USA) whereas; the reduction percentages of pesticides have been observed by utilizing (Henderson and Tilton)[18] formula:

$$\text{Corrected (\%)} = \left(1 - \frac{\text{n in Co before treatment} \times \text{n in T after treatment}}{\text{n in Co after treatment} \times \text{n in T before treatment}}\right) \times 100$$

where, n is insect population, T is treated population and Co is control population.

RESULTS

Jassid infestation under field conditions: The capability of pesticides have been assessed against jassid, *Amrasca biguttula biguttula* (Ishida) (Hemiptera, Cicadellidae) on cotton crop under field conditions cultivated at district, Khairpur, Sindh. Because of extreme heated molding climate, this district may be well-known to the growth of cotton crop and the date palm for the region over province, Sindh, Pakistan. The cotton jassid was found attacking on cotton leaves from beginning up the harvesting of the crop. Therefore, it has been essential to reduce this pest population through different insecticides with different doses at per interval basis.

The effects of the first spray indicated that, generally mean numbers of jassids have been observed at pre-treatment data collection when sprayed with Nitenpyram pesticide. The post-treatment information indicated that it was less effect after quit offering of spray on one day comparatively to the second day with huge reduction percentage of jassids. On 3rd day got lesser results as on 1st day, with respect to 7th day and around 12th day which indicated the generally decrease upto 84% for first spray, when compared for the control (un-sprayed) plot. The second pesticide Acetamiprid has been observed with the generally decreased the pest population followed by Acephate, Pyriproxyfen and Diafenthiuron with zero effective when compared to control plot with overall mean population (Table 2). The analysis of variance showed the significant difference among all pesticides ($DF = 5.24$, $F = 8.72$, $p = 0.001$) used to control the jassid at ($p<0.05$). Among these pesticides just, Nitenpyram gave the better results up to twelfth day after application against jassid in second spray.

The overall mean population of jassid was observed during the pre-treatment data collection in second spray which was higher but when cotton crop was sprayed with Nitenpyram insecticide, the post-treatment in order to insecticide that decreased huge population on 1st day. Thus, in 2nd day it was also observed with reduction percent up to 12th day which confirmed with the overall mean reduction 84% when compared with the control plot. Simultaneously, the second pesticide Acetamiprid has been observed followed by Acephate, Diafenthiuron and Pyriproxyfen as compared to control plot (Table 3), respectively. The analysis of variance showed the varied significant difference among all pesticides ($DF = 5.24$, $F = 13.0$, $p = 0.001$) used to control the jassid at ($p<0.05$).

The outcomes of the third spray indicated that the general mean number of jassids in pre-treatment data collection when sprayed Acephate insecticide, the post-treatment information indicated to decrease at 1st day spray. Thus, the 2nd day it was also reduced followed by 3rd, 7th and 12th day, which indicated the generally decrease 53% in third spray when compared with the control plot. The

Table 2: Overall mean and reduction at pre and post treatments of different pesticides against cotton jassid after 1st spray during, 2016

		Post-treatment					
Pesticides	Pre-treatment	24 h	48 h	72 h	7th day	12th day	Mean±SE and Reduction (%)±SE
Acephate	3.41	0.93	0.93	0.20	0.53	0.40	0.60±0.15
	Reduction (%)	64.16	39.10	88.42	63.52	46.04	60.25±8.57[a]
Diafenthiuron	2.20	0.86	0.53	1.66	1.43	0.73	1.04±0.22
	Reduction (%)	48.62	46.20	-48.97	-52.55	-52.64	-11.87±24.21[b]
Pyriproxyfen	4.13	2.53	2.00	2.26	1.20	0.26	1.65±0.41
	Reduction (%)	19.49	-8.14	-8.03	31.81	71.04	21.23±14.69[b]
Acetamiprid	2.53	0.76	0.60	0.13	0.26	0.33	0.42±0.12
	Reduction (%)	60.52	47.04	89.86	75.88	40.00	62.66±9.16[a]
Nitenpyram	2.20	0.13	0.01	0.13	0.13	0.20	0.12±0.03
	Reduction (%)	92.23	98.98	88.33	86.13	58.18	84.77±7.00[a]
Control plot	4.60	3.50	2.06	2.33	1.96	1.00	2.17±0.40[b]

Each value is a mean of 4 replications, Means in column followed by same letters are significantly different at p<0.05

Table 3: Overall mean and reduction at pre and post treatments of different pesticides

		Post-treatment					
Pesticides	Pre-treatment	24 h	48 h	72 h	7th day	12th day	Mean±SE and Reduction (%)±SE
Acephate	2.45	0.88	0.79	0.80	0.75	0.35	0.71±0.09
	Reduction (%)	56.08	48.02	51.69	63.13	76.02	58.99±4.95[b]
Diafenthiuron	2.91	0.80	0.46	1.65	1.25	0.68	0.97±0.21
	Reduction (%)	66.39	74.52	16.11	48.26	60.77	53.21±10.21[b]
Pyriproxyfen	3.65	2.36	1.20	2.26	1.20	0.26	1.46±0.39
	Reduction (%)	20.95	47.00	8.40	60.40	88.04	44.96±14.16[b]
Acetamiprid	2.88	0.93	0.69	0.33	0.93	0.65	0.71±0.11
	Reduction (%)	60.52	61.38	83.05	61.11	62.11	65.63±4.36[ab]
Nitenpyram	2.14	0.16	0.19	0.21	0.27	0.29	0.22±0.02
	Reduction (%)	90.86	85.69	85.48	84.80	77.25	84.82±2.18[a]
Control plot	3.24	2.65	2.01	2.19	2.69	1.93	2.29±0.16[c]

Each value is a mean of 4 replications, Means in column followed by same letters are significantly different at p<0.05

Table 4: Overall mean and reduction at pre and post treatments of different pesticides

		Post-treatment					
Pesticides	Pre-treatment	24 h	48 h	72 h	7th day	12th day	Mean±SE and Reduction (%)±SE
Acephate	2.06	0.66	0.46	0.73	0.80	0.26	0.58±0.10
	Reduction (%)	54.52	58.79	34.60	41.60	77.33	53.37±7.40[a]
Diafenthiuron	2.86	2.40	0.80	0.40	2.23	1.46	1.46±0.39
	Reduction (%)	-19.13	48.38	74.19	-17.25	8.29	18.90±18.43[bc]
Pyriproxyfen	3.53	1.40	1.73	1.93	2.43	0.60	1.62±0.30
	Reduction (%)	43.70	9.56	-0.90	-3.51	69.47	23.66±14.21[abc]
Acetamiprid	2.80	1.73	0.73	0.46	1.33	1.33	1.12±0.23
	Reduction (%)	12.29	51.89	69.68	28.57	14.67	35.42±11.08[abc]
Nitenpyram	2.06	0.40	0.73	0.66	0.90	0.46	0.63±0.09
	Reduction (%)	72.44	34.60	40.87	34.30	59.88	48.42±7.60[ab]
Control plot	4.06	2.86	2.20	2.20	2.70	2.26	2.44±0.14[c]

Each value is a mean of 4 replications, Means in column followed by same letters are significantly different at p<0.05

second pesticide namely; Nitenpyram also provided better results that reduced huge jassid population followed by Acetamiprid, Pyriproxyfen and Diafenthiuron when compared with control plot (Table 4). The analysis of variance showed the significant difference among all pesticides (DF = 5.24; F = 2.84; p = 0.0377) used to control the jassids at (p<0.05), respectively.

The outcomes of the fourth spray indicated that the mean population of jassid was evaluated in pre-treatment when fourth spray was done of Diafenthiuron insecticide, the post-treatment data collection results indicated that did not provide the better results with no any mortality found on 1st day spray. But at the 48 h reduced the pest population which was continued toward the 3rd, 7th and for 12th day that indicated the generally decrease up to 62% when compared with the control plot. Due to that some abiotic factors observed effecting at 1st day of spraying. The second pesticide Acetamiprid was evaluated for the generally

diminished followed by Acephate, Nitenpyram and Pyriproxyfen with no mortality when compared with control plot for overall mean population (Table 5). The analysis of variance showed the significant difference among all pesticides (DF = 5.24, F = 3.15, p = 0.0251) used to control the jassid at ($p<0.05$). Among these pesticides just Diafenthiuron gave the better results up to twelfth day after application against jassid.

The effects of the overall sprays indicated that the general mean populations of jassid observed in pre-treatment when sprayed for Nitenpyram insecticide as shown in (Table 6), the post-treatment indicated that the 76% reduced on 1st day spray. Thus, the second day it was observed 62% reduction followed by 3rd day 69%, 7th day 67% and 12th day 66% decreased which demonstrated the general reduction 68% in different sprays when compared with control (un-sprayed) plot. The second pesticide Acephate observed for the general reduction 58% followed by Acetamiprid 49%, Diafenthiuron 27% and Pyriproxyfen 23% when compared for control plot (Fig. 1). The analysis of variance showed the significant

Table 5: Overall mean and reduction at pre and post treatments of different pesticides

		Post-treatment					
Pesticides	Pre-treatment	24 h	48 h	72 h	7th day	12th day	Mean±SE and Reduction (%)±SE
Acephate	1.93	0.33	0.06	0.26	0.06	0.03	0.15±0.06
	Reduction (%)	38.87	85.18	16.24	19.17	44.43	40.78±12.36^{ab}
Diafenthiuron	2.13	0.66	0.13	0.06	0.01	0.01	0.17±0.12
	Reduction (%)	-10.77	70.91	82.49	87.79	83.22	62.73±18.58^{a}
Pyriproxyfen	1.20	0.46	0.26	0.20	0.06	0.05	0.21±0.08
	Reduction (%)	-37.04	-3.28	-3.62	-30.00	-48.96	-24.58±9.14^{c}
Acetamiprid	1.46	0.20	0.53	0.06	0.01	0.01	0.16±0.10
	Reduction (%)	51.03	-73.04	74.45	82.19	75.51	42.03±29.25^{ab}
Nitenpyram	1.66	0.60	0.46	0.20	0.03	0.01	0.26±0.12
	Reduction (%)	-29.22	-32.09	25.09	53.01	78.46	19.05±21.98^{abc}
Control plot	2.86	0.80	0.60	0.46	0.11	0.08	0.41±0.14^{bc}

Each value is a mean of 4 replications, Means in column followed by same letters are significantly different at $p<0.05$

Table 6: Overall mean and reduction at pre and post treatments of different pesticides against jassid on cotton crop under field conditions during, 2016

		Post-treatment				
Pesticides	Pre-treatment	24 h	48 h	72 h	7th day	12th day
Acephate	2.46	0.70	0.56	0.50	0.54	0.26
	Reduction (%)	57.14	51.16	58.33	56.68	70.45
Diafenthiuron	2.53	1.18	0.48	0.94	1.23	0.72
	Reduction (%)	29.75	59.30	23.83	4.07	20.45
Pyriproxyfen	3.13	1.69	1.30	1.66	1.22	0.29
	Reduction (%)	18.68	10.90	-8.72	23.09	74.10
Acetamiprid	2.42	0.91	0.64	0.25	0.63	0.58
	Reduction (%)	43.36	43.26	78.82	48.63	33.00
Nitenpyram	2.02	0.32	0.35	0.30	0.33	0.24
	Reduction (%)	76.14	62.83	69.55	67.76	66.79
Control plot	3.69	2.45	1.72	1.80	1.87	1.32

Each value is a mean of 4 replications, Means in column followed by same letters are significantly different at $p<0.05$

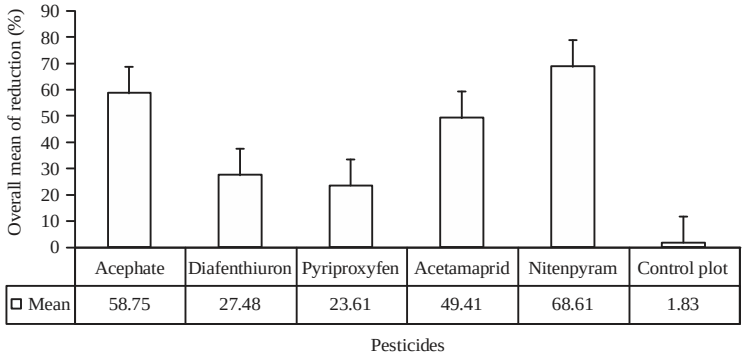

Fig. 1: Overall Mean±SE of different pesticides against cotton jassid during season

difference among all pesticides (DF = 5.24, F = 10.8, p = 0.001) used to control the jassid at ($p<0.05$). Among these pesticides just Nitenpyram and Acephate gave the better results up to 12th day after application against jassid.

DISCUSSION

The research study was conducted in summer season at district Khairpur, region Sukkur, Sindh during, 2016. The population variance of jassid, *A. biguttula biguttula* on cotton field was observed from seedling up to the harvesting of crop. In beginning as plant borne 5-7 leaves, gradually the highest population observed after 35 days and the spray was done to control this nuisance pest. The results are concurrence with the population of *biguttula* stayed least from 20-30th June, however expanded unexpectedly in the consequent weeks and reached up to (6.56 per leaf) on 10th August. Population of the pest declined and changed till the end of the cropping season[17]. The different sprays were also evaluated for the controlling of jassid and obtained different results such as; at the viability of neonicotinoids and conventional pesticides on cotton crop in 2002 and 2003 against, *Amarasca devastans* (Dist.)[19]. Diafenthiuron, acetamiprid, Imidacloprid and thiamethoxam exhibited greatest mortality and demonstrated the best in decreasing jassid population beneath ETL (1-2 per leaf) up to seven days post application in both the years. The new class of pesticides which is known as neonicotinoids for the most items like; Imidacloprid, Thiacloprid, Acetamiprid and the Thiamethoxam are surely controlling to sucking pests of cotton[20,21]. In worry with the neonicotinoid characterization additionally reported that Imidacloprid gave an effective action to exasperate with the nicotinic acetylcholine receptors of the sensory system of the pests[22].

Among different control measures, the compound control of sucking pest is fast and speedy one. It is fundamental to search out as awesome substitute. Nitenpyram gave the better results among every one of the pesticides, Acephate, Acetamiprid, Diafenthiuron and Pyriproxyfen in first and second spray while, in third Acephate (Safate) and in fourth Diafenthiuron (Polo) gave the preferable results to other pesticide[23]. Whereas, it was also evaluated the same kind of pesticides against sucking complex of cotton crop (whitefly) at same located area and found these pesticides effectively controlling under the field conditions[24]. A sudden decline in the viability of the pesticides at seventh and twelfth day after spray was also observed. The pesticide sprays at 48 h after spray demonstrated better lessening of the jassid population when contrasted with the 7th and 12th day after spray. The jassid diminished by the pesticides remained comparatively affected yet Nitenpyram, Acephate, Acetamiprid and Diafenthiuron were factually similar in their ability against jassid on cotton crop. These results are in similar with those who reported that acephate was efficient control against jassid[25]. These results also support the discoveries that acephate was found the most effective against sucking pest[26]. The chemical control is one of the quick strategies and takes a vital role in (IPM) strategy to decrease the pest to the cotton crop[27]. In the present research study; it was noticed to check the better results of these pesticides. It is seen through these findings that transgenic cultivars were observed to be powerless on the grounds that the sucking complex particularly; jassids were observed on the cotton crop[28].

Perhaps, sometime the climatic changes may support to flare up this vicious pest of cotton crop consequently, at the feasibility of neonicotinoids and conventional pesticides on cotton crop in 2002 and 2003 against, *A. devastans* (Dist.). Diafenthiuron, Acetamiprid, Imidacloprid and thiamethoxam exhibited greatest mortality and demonstrated the best in decreasing jassid population beneath ETL (1-1.5/leaf) up to seven days post application in both the years[18]. The explorations of the research discoveries are in concurrence that considered Bt., variety of cotton crop had no any resistance system to defend jassid pest as well[29] either there is Bt. or non Bt., both were attached by the jassid pest voraciously[30]. Throughout information gathering it was observed that the jassid had an immediate relative effect to the temperature and RH% along these lines, the converse impact of rainfall. The results of the research study are nearly affirms to the essentially negative relationship with the pest and temperature and altogether positive connection at the morning relative humidity however; negative to the rainfall[31,32]. In addition, the temperature and relative humidity supports the jassid pest population change[33,34]. Further, the temperature increased and produced positive impact and relative humidity where as the rainfall gave the negative impact as well under cotton field conditions[35].

CONCLUSION

The jassid found to be most vulnerable insect pest in cotton crop to suck the sap from juicy parts of the plant throughout its lush greenish from beginning up to harvesting. The results further indicated and concluded that the pesticide Nitenpyram was found more effective followed by Acephate, Acetamiprid, Diafenthiuron and Pyriproxyfen when compared with control plot. One way analysis of variance showed the significant difference among all tested pesticides at ($p<0.05$).

SIGNIFICANCE STATEMENTS

- The main significance of the research study was to control the major pest of cotton jassid through different insecticides because there are so many factors those are associated with the less production, one of them is major jassid cotton pest in Pakistan
- There are so many benefits have been derived from the pesticides usage to save the any agriculture crop because it is the main source of economy, domestic animals, livelihood and aim to research was to save the major crop through proper insecticide
- Cotton jassid sucks the cell sap and reduces the photosynthetic area of the plant, both nymphs and adults found harmful to the crop by injecting its toxic saliva into tissues therefore, it was necessary to use the novel insecticides against this pest
- The jassid parasite was confirmed in upcoming cotton season, these endo parasite eggs were never been reported previously
- This biological control strategy will bring newness to control the jassid pest under cotton field conditions and will lessen the indiscriminate use of insecticides

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