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Efficacy of different insecticides for the better management of plant hopper in transplanted rice

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Abstract

The experiment was done for the evaluation of different insecticides i.e. T-2 (Acetameprid @ 312 gha^{-1}); T-3 (Imidachloprid @ 312 gha^{-1}); T-4 (Fipronil @1200 $mlha^{-1}$); T-5 (Thiamethoxam @ 60 gha^{-1}); T-6 (Buprofezin @ 1250 gha^{-1}); T-7 (Thiachloprid @ 500 $mlha^{-1}$) compared to T-1 (Control) used for controlling the populations of hopper at field area of Adaptive Research Station, Sialkot during Kharif 2014 and 2016. In our experiment all the insecticides performed better for the management of plant hopper populations after 10 days of spraying insecticides. Significant productive $tillersm^{-2}$ recorded in T-2 (284.33), T-7 (278.33), T-4 (278.33) compared to all other treatments. Significant (P<0.05) yield were found in T-2 (3.39 tha^{-1}) compared to all treatments, however maximum insecticide control recorded in T-4 (10.00) after 72 hours and T-4 (2.17) after 5 days and 1.13 after 10 days of spraying. Significant productive $tillersm^{-2}$ recorded in T-7 (322.32) and T-6 (317.33) with all other treatments but recorded non-significant tillers. Significant yield recorded in T-7 (4.36 tha^{-1}) compared to all treatments. The population of the hoppers reduced maximum in T-4 (9.17) after 72 hours and T-5 (3.78) after 5 days and T-4 (2.65), T-5 (2.75) 10 days after spraying insecticides. Significant (P<0.05) productive $tillersm^{-2}$ were recorded in T-7 (311.48) followed by T-6 (306.27). Significant (P<0.05) grain found in T-7 (24.45g) followed by T-4 (23.60g) compared to control i.e. T-1 (17.50). Significant (P<0.05) yield was found in T-7 (3.92 tha^{-1}) compared to all other treatments. All the insecticides showed better performance for the control of hopper in rice, however during 2nd year of the study revealed no hopper population was observed. Fipronil and Thiamethoxam found better performance for the control of hopper in the transplanted rice.

Keywords: basmati, better management, different, Efficacy, hopper, insecticides, transplanted, Sialkot

Introduction

Farming sector is crucial for the economic growth of Pakistan, food security, employment generation and poverty alleviation at the village rank. It added 19.2% to the Gross Domestic Product and afforded employment about 38.5% of the labour force. Sixty five to seventy percent of the population depended upon farming. Cultivated land, climate change, water scarcity, and large rural-to-urban migration of population and labor have reduced restrained growth rates. The adoption of new approaches may increase productivity in agriculture sector. The agriculture sectors performed grows about 2.77% against the target of 2.8%. Rice production increased by 13.6% from 7,414 million tonnes to 84,190,000 tonnes [1].

Rice, along with Pakistan, is the world's leading food and cash crop. Rice is the second most important staple food after wheat and the second most important export product after cotton. It contributes 3.5% to the added value of the agricultural sector and 0.7% to GDP. Rice production included basmati and crude rice, but in recent years, crude rice production has increased. The crop was planted on 3,335,000 hectares, an increase of 9.9% compared to the previous year's 3,034,000 hectares acreage. Record production growth of 8,419 million tonnes, up 13.6% from last year's 7,414 million tonnes [1]. Rice is a staple food in 30 countries, including 2.7 billion people in Asia [2, 3]. Rice productivity is strongly influenced by biological and abiotic factors. Over 100 species of insects are recognized as pests of this culture [4].

The insecticidal effect was found to be 92% to 74% 3-10 days after spraying the insecticide. The effectiveness and duration of the pesticide is longer than that achieved on day 5 with hand lance operated from a sprayer attached to the stretcher, with a small amount and high concentration spray pattern on unmanned aerial vehicles for a lifetime. It suggests that we have found an extension [5].

Technically known as *Nilaparvata lugens*, the brown plant hopper (BPH) is a typical sap-sucking rice insect that causes significant crop loss around the world, especially in Asian countries, southern China and Pakistan [6-9]. Damage caused by BPH usually occurs late in rice growth and causes significant yield losses in most rice-producing countries. At this time, the leaves on the roof of the rice overlap, so spraying crops using a conventional land sprayer is not practical. In addition, it is difficult to invade and control the lower center of the rice canopy where plant hoppers can be seen [7, 10-12]. The present study has been planned to evaluate diversified insecticides available in the local market for the best management of the populations of hopper in transplanted rice at Adaptive Research Station, Sialkot Punjab-Pakistan.

Materials and Methods

The trials were performed to assess the efficacy of different insecticides i.e. T-2 (Acetameprid @ 312 gha^{-1}); T-3 (Imidachloprid @ 312 gha^{-1}); T-4 (Fipronil @1200 $mlha^{-1}$); T-5 (Thiamethoxam @ 60 gha^{-1}); T-6 (Buprofezin @ 1250 gha^{-1}); T-7 (Thiachloprid @ 500 $mlha^{-1}$) compared to T-1 (Control) was used for the best management of plant hoppers in the transplanted rice at Adaptive Research Station, Sialkot during Kharif 2014 and 2016. The fertilizers were applied as recommended dose i.e Diammonium Phosphate and Potassium Sulphate broadcasted manually in the rice field just before planking [13]. However, the basmati nursery transplantation was done

manually on July 30th each year. The herbicide acetachlor @ 250 $mlha^{-1}$ was sprayed onto the paddy fields using a shaking flask 3 days after nursery transplantation and the water level up to 3 inches was monitored for 20 days. Zinc Sulphate 21% in crystalline form @ 25 $kgha^{-1}$ and fertilizer was broadcasted manually in the form of urea fertilizer @ 250 $kgha^{-1}$ thirty five days and seventy five days after transplantation. No any type of insecticide was broadcasted and or sprayed accept sprayed these treatments in the experiment. The recommended dose of fungicide was sprayed to the standing rice crop for the best management of diseases. All the agronomic and plant safety measures have been stored consistent to keep away from any biasness. Different insecticides were sprayed at booting stage of rice crop with knap sack hand sprayer using recommended quantity of water according to protocol which was pre approved from the house of Punjab Agriculture Department. The data of plant hopper populations were recorded before and after 24 hours, 72 hours, 5 days and 10 days of spraying these insecticides and also compared to control. The yield parameters regarding number of productive tillers per square meter, thousand grain weight (g) and yield (tha^{-1}) were recorded according to recommended procedure [14]. The data was statistically analyzed statistically by using analysis of variance technique at 5% level of probability [15].

Results and Discussion

The populations of plant hopper were found minimum in T-6 (15.00) followed by T-7 (15.67) and in T-5 (16.00) compared to T-1 (21.00) after twenty four hours after spraying the treated insecticides (Table 1). Similar trend regarding populations of hopper recorded after 72 hours and five days after spraying insecticides. All the insecticides showed better performance against populations of plant hopper after 10 days of spraying insecticides. Significant (P<0.05) productive $tillersm^{-2}$ were recorded in T-2 (284.33), T-7 (278.33), T-4 (278.33) compared to all other treatments. Significant (P<0.05) yield was recorded in T-2 (3.39 tha^{-1}) compared to all treatments. The lowest productive tillers, thousand grain weight and yield were recorded in T-1 (234.33), 18.40 g and 2.61 tha^{-1} during 2014.

Table 1 showing efficacy of different insecticides on population of plant hoppers at different intervals, yield parameters in transplanted rice during 2014

T	Population of Plant hopper				No. of productive tillers m^{-2}	Thousand grain weight (g)	Yield (tha^{-1})
	24 hours	72 hours	5 days	10 days			
T-1	21.00 ±0.58a	22.00 ± 0.58a	21.33 ± 0.33a	20.67 ± 0.33a	234.33 ± 7.68d	18.40 ± 0.47c	2.61 ± 0.03c
T-2	17.00 ± 0.58a	10.33 ± 0.88c	5.67 ± 0.88c	0b	284.33 ± 2.19a	26.20 ± 0.21a	3.39 ± 0.02a
T-3	18.33 ± 0.88ab	14.33 ± 0.88c	10.67 ± 0.88b	0b	255.33 ± 2.60c	23.39 ± 0.61b	3.31 ±0.01ab
T-4	16.67 ±0.33bc	11.00 ± 0.58bc	7.00 ± 0.58c	0b	278.33± 1.76a	25.15 ± 0.09a	3.38 ± 0.04ab
T-5	16.00 ±0.58bc	11.00 ± 0.58	7.00 ± 0.58c	0b	275.33 ± 5.36ab	24.95 ± 0.06a	3.31 ± 0.02ab
T-6	15.00 ± 0.58bc	9.67 ± 0.88c	6.00 ± 0.58c	0b	258.00 ± 2.52bc	22.98 ± 0.14b	3.30± 0.01ab

T-7	15.67 ± 0.88c	10.00 ± 0.58c	5.00 ± 0.58c	0b	278.33 ± 2.40a	22.92 ± 0.14b	3.28 ± 0.01b

Whereas T (Treatment); T-1 (Control); T-2 (Acetameprid @ 312 gha^{-1}); T-3 (Imidachloprid @ 312 gha^{-1}); T-4 (Fipronil @1200 $mlha^{-1}$); T-5 (Thiamethoxam @ 60 gha^{-1}); T-6 (Buprofezin @ 1250 gha^{-1}); T-7 (Thiachloprid @ 500 $mlha^{-1}$)

Plant hopper populations were recorded in T-5 (18.00) followed by T-1 (17.92) and T-2 (16.92) twenty four hours after spraying the insecticides. Maximum insecticide control was recorded in T-4 (10.00) after 72 hours; 2.17 after 5 days and 1.13 after 10 days of spraying. Significant (P<0.05) productive $tillersm^{-2}$ recorded in T-7 (322.32) and T-6 (317.33) with all other treatments (Table 2), however significant (P<0.05) yield was recorded in T-7 (4.36 tha^{-1}).

Table 2 showing efficacy of different insecticides on population of plant hoppers at different intervals, yield parameters in transplanted rice during 2016

T	Population of Plant hopper				No. of productive tillers m^{-2}	Thousand grain weight (g)	Yield (tha^{-1})
	24 hours	72 hours	5 days	10 days			
T-1	17.92 ± 0.22ab	19.00 ± 0.63a	19.33 ± 0.79d	19.33 ± 0.79a	243.98 ± 1.59d	20.06 ± 0.31c	3.39 ± 0.02e
T-2	16.92 ± 0.30bc	13.67 ± 0.30bc	7.88 ± 0.12b	5.60 ± 0.27bc	263.83 ± 1.02c	22.69 ±0.12b	3.87 ± 0.06d
T-3	16.83 ± 0.22c	14.33 ± 0.22b	8.10 ± 0.11b	6.40 ± 0.65b	268.05 ± 0.79c	22.78 ± 0.11b	3.91 ± 0.03d
T-4	16.58 ± 0.30c	10.00 ± 0.08e	2.17 ± 0.46c	1.13 ± 0.23d	307.15 ± 2.03b	24.24 ± 0.06a	4.11 ± 0.03bc
T-5	18.00 ± 0.14a	10.33 ± 0.08e	6.78 ± 0.27b	4.21 ± 0.20c	301.73 ± 2.90b	24.04 ± 0.05a	4.00 ± 0.02cd
T-6	16.67 ± 0.08c	11.17 ± 0.22de	7.17 ± 0.22b	4.66 ± 0.17bc	317.33 ± 1.23a	23.99 ± 0.03a	4.23 ± 0.04ab
T-7	16.25 ± 0.14c	12.48 ± 0.13cd	6.67 ± 0.52b	3.93 ± 0.10c	322.32 ± 1.77a	24.69 ± 0.14a	4.36 ± 0.03a

Whereas T (Treatment); T-1 (Control); T-2 (Acetameprid @ 312 gha^{-1}); T-3 (Imidachloprid @ 312 gha^{-1}); T-4 (Fipronil @1200 $mlha^{-1}$); T-5 (Thiamethoxam @ 60 gha^{-1}); T-6 (Buprofezin @ 1250 gha^{-1}); T-7 (Thiachloprid @ 500 $mlha^{-1}$)

The results showed that the selected plots were found with homogenous hopper populations in the field recorded non-significant (P>0.05) populations in all treatments. Maximum populations of hoppers were recorded in T-4 (9.17) after 72 hours; T-5 (3.78) after 5 days; T-4 (2.65), T-5 (2.75) 10 days after spraying insecticides (Table 3). Significant (P<0.05) productive $tillersm^{-2}$ were recorded in T-7 (311.48) followed by T-6 (306.27). Significant (P<0.05) grain weight found in T-7 (24.45g) followed by T-4 (23.60g) compared to T-1 (17.50), however the maximum yield was recorded in T-7 (3.92 tha^{-1}) compared to all treatments.

Table 3 showing efficacy of different insecticides on population of plant hoppers at different intervals, yield parameters in transplanted rice during 2016

T	Population of Plant hopper				No. of productive tillers m^{-2}	Thousand grain weight (g)	Yield (tha^{-1})
	24 hours	72 hours	5 days	10 days			
T-1	16.33 ± 0.33a	16.33 ± 0.33a	17.5 ± 0.29a	17.50 ± 0.29a	243.07 ± 4.02d	19.14 ± 0.21d	3.13 ± 0.03e

T-2	16.50 ± 0.76a	10.83 ±0.44ab	9.75 ± 0.52b	8.27 ± 0.14b	297.25 ± 1.5 b	22.13 ±0.04c	3.64 ± 0.03c
T-3	16.17 ± 0.44a	11.00 ± 3.83ab	9.67 ±0.51b	7.07 ± 0.37c	285.59 ± 2.99c	22.13 ± 0.30c	3.41 ± 0.05d
T-4	16.16 ±0.36a	9.17 ± 0.22b	9.67 ± 0.51b	2.65 ± 0.08f	295.85 ± 2.19bc	23.60 ± 0.17b	3.56 ± 0.03c
T-5	16.75 ±0.14a	10.08 ± 0.22ab	3.78 ±0.11d	2.75 ± 0.25ef	301.67 ± 0.65ab	23.13 ± 0.04b	3.66 ± 0.03bc
T-6	16.67 ±0.30a	10.58 ± 0.46ab	6.53 ± 0.15c	3.72 ±0.11e	306.27 ± 1.41ab	23.09 ± 0.02b	3.79 ± 0.01ab
T-7	16.75 ± 0.14a	10.92 ± 0.22	7.00 ±0.14c	5.28 ± 0.12d	311.48 ± 2.32a	24.45 ± 0.08a	3.92 ± 0.02a

Whereas T (Treatment); T-1 (Control); T-2 (Acetameprid @ 312 gha^{-1}); T-3 (Imidachloprid @ 312 gha^{-1}); T-4 (Fipronil @1200 $mlha^{-1}$); T-5 (Thiamethoxam @ 60 gha^{-1}); T-6 (Buprofezin @ 1250 gha^{-1}); T-7 (Thiachloprid @ 500 $mlha^{-1}$)

All the sprayed insecticides showed their better performance for the control of plant hopper in rice during first year of application. Fipronil and Thiamethoxam found better performance for the control of hopper in the transplanted rice in the Sialkot area. These results are in line with the researchers who reported the better performance of insecticides [16]. The results in our experiment showed that hopper controlled through the insecticide applications were in line with the researchers who reported the similar recommendations in their experiments [10]. Our results are in line with the scientists who found that hopper caused massive losses in rice fields who reported similar results in their experimental fields [17].

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