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Efficacy of insecticides against rice tungro disease and its vector (*Nephotettix Virescens*) under glasshouse conditions

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ABSTRACT

Six insecticides spray were evaluated by taking one highly susceptible 'T(N)1' and another resistant cultivar, 'Vikramarya', under glasshouse conditions. Among the insecticides, buprofezin (@1.6 g/L) and imidacloprid (@ 0.25 ml/L) controlled the insect vector population fully without any RTD infection in T(N)1 after one and five days of treatment. These were significantly superior over than rest of the treatments. The spray of difenthiuron and dinotefuron @ 0.2 % concentration were found effective significantly in controlling the insect vector population (94 %) and decreasing the RTD infection of 75 %. In rice cultivar, Vikramarya, buprofezin (@1.6 g/L), imidacloprid (@ 0.25 ml/L), dinotefuran (@ 2 g/L), difenthiuron (@1.2 ml/L) full control of insect and no RTD infection at one and five days after treatment.

Key words: Imidacloprid, Insecticides, Leaf hopper vector, Rice, Rice tungro.

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important food crop of the world and is an ideal model crop plant due to its small genome size, extensive genetic resources and ease of transformation with other cereal crops. An average daily consumption of rice provides 20-80 % of dietary energy and 12-17% of dietary protein for Asians. It is cultivated all around the world including more than 100 countries, except the region of Antarctica. Rice tungro disease (RTD) is a major constraint in production of rice (*Oryza sativa* L.) not only in India but in all South and Southeast Asia. In Andhra Pradesh, rice tungro disease (RTD) has been reported to occur in almost all the popular rice cultivars grown in Khammam, East Godavari, Ranga Reddy, West Godavari, Medak, Nalgonda, Nellore, Chittoor and Prakasam districts. Management of tungro virus disease can be achieved through vector control (Shukla and Anjaneyulu, 1980; Satapathy and Anjaneyulu, 1984; Satapathy and Anjaneyulu, 1990; Rabbi *et al.* 1993; Vinod *et al.* 2010). Insecticides is seen to be essential in order to successfully control *N. virescens*, especially after the outbreak of another grass hopper, *Nilaparvata lugens* (Stal), following which regular spraying in most of the countries was recommended in huge quantities, with up to six applications per year suggested, regardless, of the level of pest infestation (Teng, 1994). Vector control through the application of insecticides is the most commonly practiced method of controlling rice virus disease spread, since the use of antiviral chemicals has not been successful (Heinrichs, 1979). The present study was undertaken to evaluate the effects of six insecticides on two rice cultivars under green house conditions for controlling the rice tungro disease.

MATERIALS AND METHODS

A glasshouse experiment was conducted at Indian Institute of Rice Research Rajendranagar, Hyderabad during 2013- 14. Six insecticides Buprofezin (@1.6 g/L), Dinotefuran (@ 2 g/L) Acephate (@1.33 g/L), Imidacloprid (@ 0.25 ml/L), Monocrotophos (@ 1.6 ml/L) and Difenthiuron (@1.2 ml/L)were evaluated to find their ability to prevent rice tungro virus infection and causing vector (*N. virescens*) mortality. The insecticides were sprayed at different concentration to T(N)1 plants of 30 days plant raised in galvanized iron trays under green house condition. There are three replicates (for each insecticides), each consisting of 20 plants. The insecticides treated plants were inoculated individually by two viruliferous leaf hoppers (*N. virescens*) per plant with the galvanized iron cages at 1 and 5 days after treatment (DAT). Equal number of untreated plants in each trial was also inoculated as control. The insect were made by viruliferous by feeding their on T(N)1 diseased plants for two days. Since the virus does not require an inoculation the insect were used for inoculation immediately after the acquisition feeding period. Observations were recorded for vector mortality 48 h after caging and also for the number of infected plants at 20 days after inoculation. The name of the doses of six insecticides *viz.*, Buprofezin (0.16%), Dinotefuran (0.2%) Acephate (0.133), Imidacloprid (0.25%), Monocrotophos (0.16 %) and Difenthiuron (0.12%) were used as foliar spray under glasshouse conditions.

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RESULTS AND DISCUSSION

Among the insecticides, buprofezin (@1.6 g/L) and imidacloprid (@ 0.25 ml/L) reduced the insect vector population by 100% with 0% RTD infection in highly susceptible T(N)1 at one and five days after treatment (1 & 5 DAT) and found significantly superior over all other treatments. These were followed by difenthiuron (@1.2 ml/L) and dinotefuron (@ 2 g/L) concentration were found on par with each other in controlling the insect vector population (94%) with corresponding decrease in RTD infection of 75%, respectively in both the insecticide sprayed pots. The next best treatments were, acephate (@1.33 g/L) which recorded 92.5% and monocrotophos (@ 1.6 ml/L) recorded 86.5% insect mortality with reduced RTD infection of 15.0 % and 17.5 % were recorded. In the present study, application of insecticides resulted in significant insect vector mortality and reduced incidence of tungro infection as compared to the untreated inoculated control (Table 1). The results also revealed that insecticides mainly affects on disruption of virus acquisition and transmission resulting in insect vector control and rice tungro disease incidence.

Among the six insecticides evaluated against rice green leaf hopper (*Nephotettix virescens*) and RTD infection in resistant rice cultivar Vikramarya revealed that Buprofezin (@1.6 g/L), imidacloprid (@ 0.25 ml/L), Dinotefuran (@ 2 g/L), Difenthiuron (@1.2 ml/L) showed 100% insect mortality and 0% RTD infection at 1 and 5 DAT. Where as Acephate (@1.33 g/L) and Monocrotophos (@ 1.6 ml/L) showed 100% reduction in insect vector population with 0% RTD infection at 1 DAT, where as 95% and 98% reduction in vector control and 5% and 10% reduction in RTD infection was observed at 5 DAT. Where as in control 6 and 10% tungro infection observed at 1 and 5 DAT and 6.5 and 10% insect mortality observed at 1 and 5DAT. However, all the insecticides sprays were found effective in controlling the vector population and reduction of rice tungro infection (Table 2).

The variation in the efficacy of the insecticides in susceptible and resistant cultivars were earlier were observed by Shukla and Anjaneyulu (1980). Control of virus diseases through insecticides is mainly dependent upon the nature of the virus and vector relationship, transmitting agents and their feeding behaviour and the distribution of the virus particles in the host. Most of the leafhopper borne persistent viruses remained in the phloem tissues and the insects take a comparatively longer time to acquire and transmit them. They also require an incubation period in the insect vectors. The insecticidal control of these virus diseases is relatively easier than those of aphid borne non persistent viruses. Rabbi *et al*. (1993) reported that monocrotophos was effective under greenhouse conditions only.

However tungro virus transmitted by the leafhoppers has an unique virus vector relationship, non persistent, transitory (Ling and Tiongco, 1977) does not

Table 1: Efficacy of insecticides against RTD incidence and mortality of insect vector *N. virescens* on Rice cultivar T(N)1 .

Treatment	Rice tungro incidence (%)			Insect vector mortality (%)		
	1 DAT	5 DAT	Mean	1 DAT	5 DAT	Mean
Buprofezin @1.6 g/L	0.0(4.06)	0.0(4.06)	0.0	100(89.95)	100(85.95)	100
Dinotefuran @ 2 g/L	5.0(12.88)	10.0(18.38)	7.50	98(82.05)	90(75.95)	94
Acephate @1.33 g/L	10.0(18.42)	20.0(26.52)	15.0	96(78.72)	89(74.14)	92.5
Imidacloprid @ 0.25 ml/L	0.0(4.06)	0.0(18.38)	0.0	100(85.95)	100(85.95)	100
Monocrotophos @ 1.6 ml/L	15.0(12.76)	20.0(26.55)	17.5	88.0(69.80)	85.0(68.48)	86.5
Difenthiuron @1.2 ml/L	5.0(12.88)	10.0(18.40)	7.5	98.0(82.33)	90.0(75.95)	94.0
Untreated inoculated control	90.0(71.62)	90.0(17.66)	90.0	4.8(12.65)	5.0(12.79)	4.9
SEm ±	1.00	1.47		1.69	1.30	
CD at 5%	2.16	3.15		3.63	2.77	

DAT ; Days after treatment, Figures in parenthesis indicate arc sine transformed values.

Table 2: Effect of insecticides on incidence of RTD and mortality of insect vector *N. virescens* on Rice cultivar Vikramarya.

Treatment	Rice tungro incidence			Insect vector mortality		
	1 DAT	5 DAT	Mean	1 DAT	5 DAT	Mean
Buprofezin @1.6 g/L	0.0(4.06)	0.0(4.06)	0.0	100(85.95)	100(85.95)	100
Dinotefuran @ 2 g/L	0.0(4.06)	0.0(4.06)	0.0	100(85.95)	100(85.95)	100
Acephate @1.33 g/L	0.0(4.06)	5.0(12.88)	2.5	100(85.95)	95(77.00)	97.5
Imidacloprid @ 0.25 ml/L	0.0(4.06)	0.0(4.06)	0.0	100(85.95)	100(85.95)	100
Monocrotophos @ 1.6 ml/L	0.0(4.06)	10.0(18.38)	0.0	100(85.95)	98(82.05)	100
Difenthiuron @1.2 ml/L	0.0(4.06)	10.0(4.06)	7.5	100(85.95)	98(85.95)	99
Untreated inoculated control	6.0(12.42)	8.0(16.32)	8.0	6.5(17.78)	10.0(18.37)	8.25
SEm ±	0.87	1.05		6.07	1.56	
CD at 5%	1.91	2.32		6.15	3.35	

DAT ; Days after treatment, Figures in parenthesis indicate arc sine transformed values.

require any incubation in the insect vector like that of aphid born viruses and is a phloem borne virus. Hence insecticidal control of rice tungro disease has special importance in the field of plant virology. Insecticides protected the rice plants upto 35 days old against the insect vector and limiting their number and rice tungro infection. The efficacy of the newer molecule, Buprofezin in controlling leaf hopper population in rice was reported earlier by Shashank *et al.* (2012) where as the efficacy of the imidacloprid in reducing the insect vector population and rice tungro virus infection was earlier reported by Lenka *et al.,* (2011). The present findings are in agreement with the results of the earlier workers.

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