

# FIELD EFFICACY OF AN INSECT GROWTH REGULATOR, BUPROFEZIN 25 SC AGAINST PLANTHOPPERS INFESTING PADDY CROP

P. S. SHERA\* AND P. S. SARAO<sup>1</sup>

\*Department of Entomology, Punjab Agricultural University, Ludhiana -141 004, INDIA

<sup>1</sup>Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana -141 004, INDIA

e-mail: psshera@pau.edu

## KEYWORDS

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**\*Corresponding author**

## ABSTRACT

Field efficacy of buprofezin 25 SC @ 625, 750 and 875 ml/ha against brown planthopper (BPH) and whitebacked planthopper (WBPH), infesting paddy crop revealed that after 3 days of spray, BPH and WBPH count in all buprofezin doses were significantly inferior as compared to standard checks, imidacloprid 17.8 SL and chlorpyrifos 20 EC. However, at 7 and 10 DAS, buprofezin @ 750 and 825 ml/ha were found to be at par with imidacloprid and were significantly effective than chlorpyrifos. The reduction in BPH population after 7 and 10 days of spray was 81.23 and 86.55 % in buprofezin @ 825 ml/ha as against 77.85 and 85.18 % in its lower dose (750 ml/ha), 80.45 and 75.29 % in imidacloprid and 73.28 and 67.29 % in chlorpyrifos, respectively. Buprofezin @ 750 and 825 ml/ha resulted in 79.02 and 82.96 % reduction in WBPH at 7 DAS and 86.51 and 88.18 % at 10 DAS, respectively. The yield increase over control was 15.27 and 16.50 % in buprofezin @ 750 and 825 ml/ha, respectively. It may be concluded buprofezin @ 750 and 825 ml/ha can be viable option to already recommended neonicotinoids and organophosphate insecticides against BPH and WBPH in rice crop.

## INTRODUCTION

Rice is essentially crop of warm and humid environment conducive to survival and proliferation of many insect pests. More than 100 species of insects have been reported to ravage the rice crop, of these 15-20 are considered to be economically important (Heong and Hardy, 2009). The overall losses due to insect damage in rice have been estimated to be 25 % (Dhaliwal *et al.*, 2010). Among sucking insect pests, brown planthopper (BPH), *Nilaparvata lugens* (Stål) (Homoptera: Delphacidae) and whitebacked planthopper (WBPH), *Sogatella furcifera* (Horvath) (Homoptera: Delphacidae) are the most economically important on rice crop (Singh *et al.* 2002). Severe attack causes, "hopper burn" symptoms in the field (Horgan, 2009). Farmers mostly rely on insecticides for their management. However, indiscriminate use of insecticides has led to many problems like elimination of natural predators, environmental pollution (Balakrishna and Satyanarayana, 2013), resistance and resurgence (Krishnaiah *et al.*, 2006).

High selection pressure has led to evolution of resistance to insecticides especially neonicotinoids in both BPH and WBPH in Asian countries (Krishnaiah *et al.*, 2006; Wang *et al.*, 2008; Gorman *et al.*, 2008; Lakshmi *et al.*, 2010; Matsumura and Morimura, 2010; Ling *et al.*, 2011 and Su *et al.*, 2013). So there is need to explore the possibility of utilizing eco-friendly and effectual chemicals with novel mode of action which can fit idyllically in IPM programme against hoppers in rice agroecosystem. A new approach towards this step is use of insect growth regulators (IGR's) for the management of insect

pests. Among these, buprofezin (2-*ter*-butylimino-3-isopropyl-5-phenylperhydro-1, 3, 5-thiadiazin-4-one), developed by Nihon Nohyaku, Japan (Kanno, 1987) is a chitin synthesis inhibitor, which acts specifically on sucking pests. It has been used effectively against various sucking insect pests such as whitefly on cotton (Gogi *et al.*, 2006 and Sontakke *et al.*, 2013), planthopper on rice (Wang *et al.*, 2008), jassid on brinjal (Yadav and Raghuraman, 2014) and mealybug on grapes (Balikai, 2002 and Muthukrishnan *et al.*, 2005) and cotton (Dhawan *et al.*, 2012). However, its effectiveness against BPH and WBPH on rice crop is still lacking. Keeping in view, the economic importance of these planthoppers on rice crop, the present study was undertaken with the objective to assess the efficacy of buprofezin 25 SC at different doses against BPH and WBPH under field conditions. This study will enhance the choice of farmers to select the insecticides from different groups for the effective management of planthoppers on rice crop.

## MATERIALS AND METHODS

### Experimental site

Field experiments were conducted under irrigated field conditions during 2012 and 2013 at Rice Research Area of Department of Plant Breeding and Genetics, Punjab Agricultural University (PAU), Ludhiana. Ludhiana is situated in the central plain zone of Punjab at 30°54' North latitude and 75°48' East longitude at an altitude of 247 m above the mean sea level.

### Raising of nursery bed

The rice variety PR 114 was sown on well-prepared seed beds on 22<sup>nd</sup> and 20<sup>th</sup> May during 2012 and 2013, respectively. The nursery was raised as per agronomic practices of PAU Package of Practices for *kharif* (summer) crops (Anonymous, 2012, 2013) under unsprayed conditions

### Transplanting

The 30 days old seedlings were transplanted at a rate of 2 seedlings/ hill on 22<sup>nd</sup> and 20<sup>th</sup> June during 2012 and 2013, respectively. The row-to-row spacing was 20 cm and plant-to-plant spacing was 15 cm. All the agronomic practices like weed control, fertilizer application, and irrigations were followed as per PAU recommendations (Anonymous, 2012, 2013).

### Insecticidal treatments

Buprofezin 25 SC was evaluated @ 625, 750 and 875 ml/ha for the control of BPH and WBH along with imidacloprid 17.8 SL @ 100 ml/ha and chlorpyrifos 20 EC @ 6250 ml/ha as standard checks and untreated control. All the treatments were replicated thrice in a randomized block design (RBD) in a plot size of 21.60 and 20.88 sq. m during 2012 and 2013, respectively. All the insecticides were applied with manually operated knapsack sprayer using 250 litres of water per ha.

### Pest sampling

The observations were recorded on 5 hills selected at random from each treatment replications before spray and after 3, 7 and 10 days of spray. For counting the number of individuals of BPH and WBPH, each hill was tilted and tapped 2 or 3 times at the base and the planthoppers fallen on water were counted (Heinrichs *et al.*, 1981). The % reduction in planthoppers population over control was calculated using Henderson and Tilton (1955) formula:

$$\% \text{ reduction over control} = \frac{1 - [T_a \times C_b] \times 100}{[T_b \times C_a]}$$

- $T_a$  : Population after treatment in treated plot  
 $T_b$  : Population before treatment in treated plot  
 $C_a$  : Population after treatment in control plot  
 $C_b$  : Population before treatment in control plot

### Grain yield

Grain yield on plot basis was recorded after harvesting/ threshing of the crop manually and expressed as q/ ha.

### Data analysis

The data pertaining to population count of planthoppers were statistically analyzed with analysis of variance (ANOVA). The significance of differences were tested by F-tests, while the significance of differences between treatment means were compared using least significant difference (LSD) at 5 % probability level (Gomez and Gomez, 1984). All the data were checked for normality before subjecting to analysis. Data lacking normality were transformed using square root transformations.

## RESULTS

All the insecticidal treatments were significantly superior to the untreated control in reducing the population of BPH and WBPH infesting rice crop during both 2012 and 2013 cropping seasons.

### BPH population

Before spray, the population count of BPH varied from 10.70 to 12.17 and 16.10 to 16.47 per hill during 2012 and 2013, respectively in different treatments with non-significant differences in both years. During 2012 (Table 1), the mean BPH count recorded 3 days after spray (DAS) in different buprofezin 25 SC dosages, viz. 625, 750 and 825 ml/ ha varied from 7.23 to 8.47 per hill and was significantly inferior to standard checks, imidacloprid 17.8 SL (3.30/ hill) and chlorpyrifos 20 EC (4.73/ hill). However, at 7 DAS, significantly lower population was recorded in higher dose (825 ml/ ha) of buprofezin 25 SC (2.40/ hill) and it was at par with imidacloprid 17.8 SL (2.47/ hill) and buprofezin 25 SC @ 750 ml/ ha (3.00/ hill). The population count of BPH after 10 days of spray was also significantly lower in buprofezin 25 SC @ 825 ml/ha (2.07 / hill) and it was at par with its lower dose, i.e. 750 ml/ ha (2.27/ hill). Both these doses were significantly superior to standard checks in reducing the population of BPH. However, significantly higher BPH population was recorded in untreated control in all the observations (11.20 to 14.20/ hill).

During 2013 also, significantly lower population was recorded in imidacloprid (5.40/ hill) followed by chlorpyrifos 20 EC (7.23/ hill). Buprofezin 25 SC at all dosages was significantly inferior to standard checks after 3 days of spray (Table 2). However, at 7 DAS, the population was significantly lower in buprofezin 25 SC @ 825 ml/ha (4.40/ hill) and it was at par with imidacloprid 17.8 SL (4.77/ hill) and buprofezin 25 SC @ 750 ml/ha (5.23/ hill). Similarly, buprofezin 25 SC @ 825 ml/

**Table 1: Field efficacy of Buprofezin 25 SC against BPH infesting paddy crop during *kharif* 2012**

Treatments	Dose(ml/ha)	Mean population of BPH (no./ hill)			
		Before spray	3 DAS	7 DAS	10 DAS
Buprofezin 25 SC	625	10.70	8.47(3.07)	4.37(2.32)	4.27(2.29)
	750	11.17	7.90(2.98)	3.00(1.99)	2.27(1.80)
	825	10.70	7.23(2.87)	2.40(1.84)	2.07(1.75)
Imidacloprid 17.8 SL	1000	10.77	3.30(2.07)	2.47(1.86)	4.80(2.40)
Chlorpyrifos 20 EC	2500	12.17	4.73(2.39)	4.13(2.27)	6.80(2.78)
Untreated control	-	10.77	11.20(3.48)	12.53(3.67)	14.20(3.89)
LSD (p=0.05)		NS	(0.42)	(0.30)	(0.43)

Figures inside parenthesis are corresponding square root transformed values, those outside are original values; DAS – days after spray

**Table 2: Field efficacy of Buprofezin 25 SC against BPH infesting paddy crop during *kharif* 2013**

Treatments	Dose(ml/ha)	Mean population of BPH (no./ hill)			
		Before spray	3 DAS	7 DAS	10 DAS
Buprofezin 25 SC	625	16.30	12.07(3.61)	7.70(2.94)	7.37(2.89)
	750	16.47	11.17(3.48)	5.23(2.50)	4.20(2.27)
	825	16.10	10.63(3.41)	4.40(2.32)	3.53(2.13)
Imidacloprid 17.8 SL	1000	16.43	5.40(2.51)	4.77(2.40)	4.60(2.36)
Chlorpyrifos 20 EC	2500	16.23	7.23(2.86)	5.90(2.62)	6.70(2.77)
Untreated control	-	16.03	19.23(4.50)	24.00(5.00)	28.73(5.45)
LSD (p=0.05)		NS	(0.34)	(0.27)	(0.32)

Figures inside parenthesis are corresponding square root transformed values, those outside are original values; DAS – days after spray

**Table 3: Field efficacy of Buprofezin 25 SC against WBPH infesting paddy crop during *kharif* 2012**

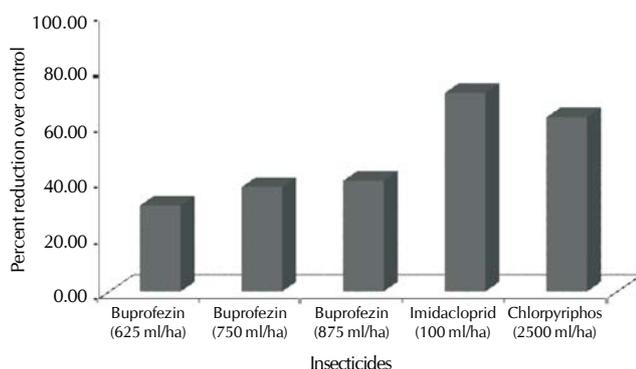
Treatments	Dose(ml/ha)	Mean population of WBPH (no./ hill)			
		Before spray	3 DAS	7 DAS	10 DAS
Buprofezin 25 SC	625	7.97	5.40(2.52)	3.07(2.02)	3.03(2.01)
	750	7.63	4.80(2.40)	2.00(1.73)	1.60(1.61)
	825	8.10	4.57(2.35)	1.80(1.67)	1.47(1.57)
Imidacloprid 17.8 SL	1000	8.83	2.30(1.82)	1.83(1.68)	3.13(2.03)
Chlorpyrifos 20 EC	2500	7.77	3.93(2.21)	3.47(2.11)	4.20(2.28)
Untreated control	-	8.10	9.07(3.16)	10.47(3.38)	11.03(3.46)
LSD (p=0.05)		NS	(0.51)	(0.32)	(0.32)

Figures inside parenthesis are corresponding square root transformed values, those outside are original values; DAS – days after spray

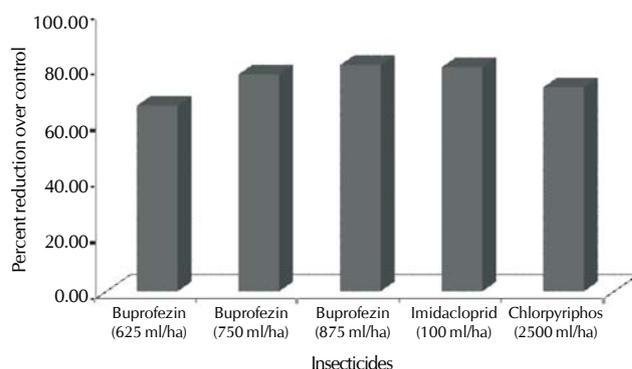
**Table 4: Field efficacy of Buprofezin 25 SC against WBPH infesting paddy crop during *kharif* 2013**

Treatments	Dose(ml/ha)	Mean population of WBPH (no./ hill)			
		Before spray	3 DAS	7 DAS	10 DAS
Buprofezin 25 SC	625	8.70	6.03(2.65)	3.37(2.07)	2.77(1.93)
	750	8.57	5.40(2.51)	2.23(1.77)	1.40(1.54)
	825	8.73	4.90(2.43)	1.77(1.65)	1.27(1.50)
Imidacloprid 17.8 SL	1000	9.10	2.77(1.92)	1.70(1.63)	1.47(1.57)
Chlorpyrifos 20 EC	2500	8.73	3.40(2.09)	2.33(1.82)	1.87(1.69)
Untreated control	-	9.00	9.97(3.31)	10.80(3.43)	12.70(3.70)
LSD (p=0.05)		NS	(0.38)	(0.44)	(0.34)

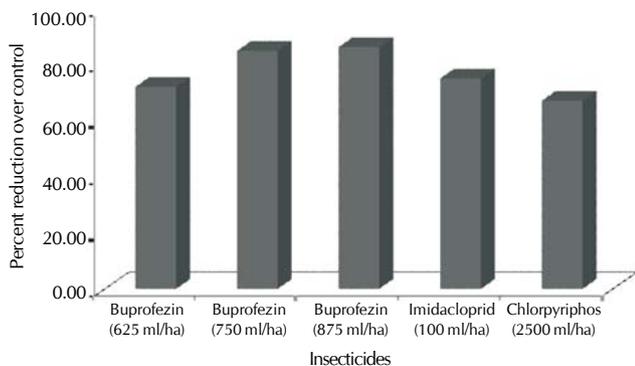
Figures inside parenthesis are corresponding square root transformed values, those outside are original values; DAS – days after spray

**Figure 1.1: Mean reduction in BPH population over control 3 days after spray (2012 and 2013)**

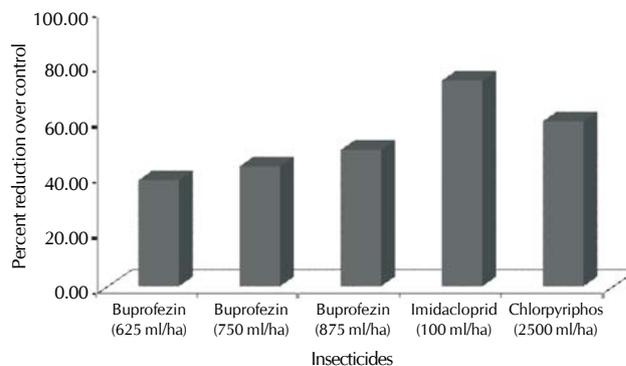
ha (3.53/ hill) and 750 ml/ha (4.20 ml/ha) were at par with imidacloprid 17.8 SL (4.60/ hill) in reducing the BPH population at 10 DAS, but were significantly better than chlorpyrifos (6.70/ hill). The population of BPH was significantly higher in untreated control (19.23 to 28.73/ hill). Based on the pooled mean of two years, reduction in population of BPH over control in buprofezin at different doses

**Figure 1.2: Mean reduction in BPH population over control 7 days after spray (2012 and 2013)**

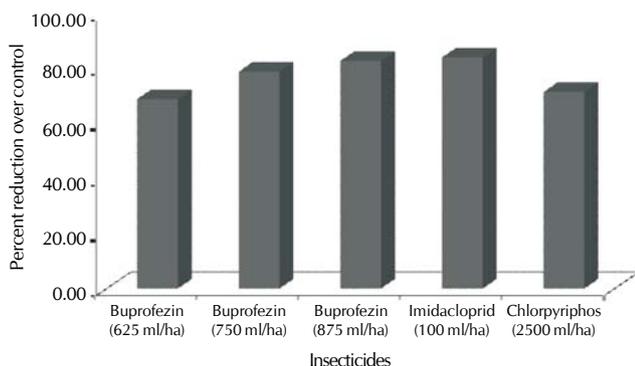
was comparatively more in imidacloprid 17.8 SL (71.57 %) and chlorpyrifos 20 EC (62.75 %) as compared to all doses of buprofezin 25 SC (31.08 to 39.99 %) after 3 days of spray (Fig. 1.1). However, at 7 DAS (Fig. 1.2) and 10 DAS (Fig. 1.3), it varied from 66.67 to 81.23 and 72.25 to 86.55 %, respectively as compared to imidacloprid 17.8 SL (80.45 and 75.29 %) and chlorpyrifos 20 EC (73.28 and 67.29 %).



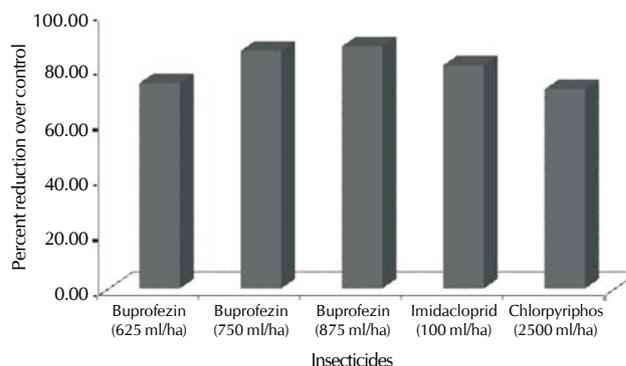
**Figure 1.3: Mean reduction in BPH population over control 10 days after spray (2012 and 2013)**



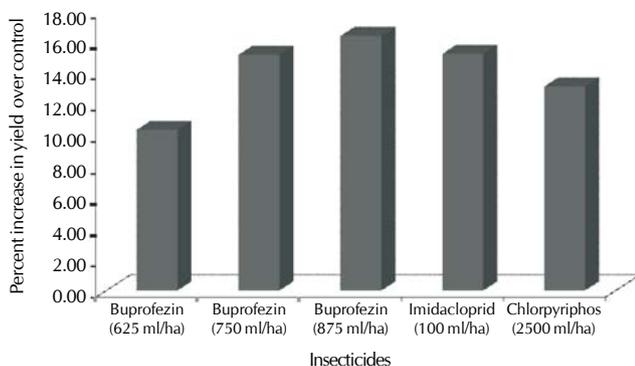
**Figure 2.1: Mean reduction in WBPH population over control 3 days after spray (2012 and 2013)**



**Figure 2.2: Mean reduction in WBPH population over control 7 days after spray (2012 and 2013)**



**Figure 2.3: Mean reduction in WBPH population over control 10 days after spray (2012 and 2013)**



**Figure 3: Mean increase in paddy yield over control (2012 and 2013)**

**WBPH population**

The mean WBPH population in different treatments before spray varied from 7.63 to 8.10/ hill in 2012 and 8.57 to 9.10/ hill in 2013 with non-significant differences during both years. During 2012 (Table 3), after 3 days of spray, lowest WBPH population was recorded in imidacloprid 17.8 SL (2.77/ hill), being at par with chlorpyrifos 20 EC (3.40/ hill). The population in plots treated with buprofezin varied from 4.57 to 5.40 per hill. All buprofezin doses were inferior to imidacloprid 17.8 SL after 3 days of spray but were at par with chlorpyrifos 20 EC. After 7 days of spray, buprofezin 25 SC @ 825 ml/ha recorded lowest population (1.80/ hill) and it

was at par with imidacloprid 17.8 SL (1.83/ hill) and buprofezin 25 SC @ 750 ml/ ha (2.00/ hill). Similarly, at 10 DAS, significantly lower WBPH count was recorded in buprofezin 25 SC @ 825 ml/ha (1.47 / hill) and it was at par with its lower dose of 750 ml/ ha (1.60/ hill). Both these doses were significantly better than imidacloprid 17.8 SL (3.13/ hill) and chlorpyrifos 20 EC (4.20/ hill) in reducing the population of WBPH. Significantly higher WBPH population was recorded in untreated control (9.07 to 11.03/ hill).

Similarly during 2013 (Table 4), all tested dosages of buprofezin 25 SC were inferior to standard checks in reducing the population of WBPH at 3 DAS. Significantly lower WBPH population was recorded in imidacloprid 17.8 SL (2.77/ hill) and it was at par with chlorpyrifos 20 EC (3.40/ hill). At 7 DAS, all the insecticidal treatments were at par with each other, but significantly superior to untreated control. After 10 days of spray, buprofezin 25 SC @ 825 ml/ha (1.27/ hill) recorded lowest WBPH population and it was at par with buprofezin 25 SC @ 750 ml/ha (1.40/ hill) and imidacloprid 17.8 SL (1.47/ hill). In all the observations, the population of WBPH was significantly higher in untreated control (9.97 to 12.70/ hill).

Based on the pooled mean, buprofezin at different doses resulted in 38.46 to 49.47 % reduction in WBPH population at 3 DAS as compared to 74.63 and 59.84 % in imidacloprid 17.8 SL and chlorpyrifos 20 EC, respectively (Fig. 2.1). However, the reduction in WBPH population at 7 and 10 DAS was comparatively more in buprofezin 25 SC @ 750 and 825 ml/ha as against imidacloprid 17.8 SL and chlorpyrifos 20 EC (Fig. 2.2 & 2.3).

## Paddy yield

The paddy yield in all the insecticidal treatments was significantly higher than the untreated control. Based on pooled mean (2012 & 2013), the yield increase over control in buprofezin 25 SC @ 625, 750 and 825 ml/ha was 10.40, 15.27 and 16.50 %, respectively as against 15.33 % in imidacloprid 17.8 SL and 13.21 % in chlorpyrifos 20 EC (Fig. 3).

## DISCUSSION

The present study reports the efficacy of buprofezin tested at different dosages under field conditions and was compared with already recommended insecticides. Buprofezin 25 SC (750 and 825 ml/ha) was found to be at par with standard check, imidacloprid 17.8 SL, but better than chlorpyrifos 20 EC at 7 and 10 DAS. However, all the three buprofezin dosages were significantly inferior as compared to standard checks at 3 DAS. Similarly, Hegde and Nidagundi (2009) also reported that buprofezin did not significantly reduce BPH and WBPH population 3 days after treatment as compared to thiamethoxam 25 WG and imidacloprid 17.8 SL whereas at 10 days after treatment, it significantly mitigates the planthopper population. This may be due to its mode of action, as it inhibits the chitin biosynthesis and insect fail to ecdyse resulting in death during molting to next instar (Uchida *et al.*, 1985 and Ishaaya, 2001).

The present studies also corroborate with findings of Bhavani (2006) and Shashank *et al.* (2012) who also reported that buprofezin 25 SC @ 200 g a.i./ha (800 ml/ha) was effective in suppressing BPH and WBPH populations. The superiority of buprofezin for the control of *N. lugens* under field trials has also been observed earlier by Kanno *et al.* (1981) and Kajihara *et al.* (1982). Heinrichs *et al.* (1984) and Macatula *et al.* (1988) have also reported the effectiveness of buprofezin against nymphs of *N. lugens*, *S. furcifera* and *Nephotettix virescens* (Distant). Wang *et al.* (2008) reported buprofezin to be effective against *N. lugens* with very low risks to environment and human beings. However, a resistance management program with rotation of buprofezin and other pesticides has been suggested to delay or slow down development of resistance. The insecticidal activity of buprofezin has also been reported against other sucking pests such as whitefly, jassid and mealybugs (Muthukrishnan *et al.*, 2005; Gogi *et al.*, 2006; Patel *et al.*, 2010; Dhawan *et al.*, 2012; Sontakke *et al.*, 2013 and Das and Islam, 2014).

From the present results, it may be concluded that buprofezin 25 SC @ 750 and 825 ml/ha rendered effective control of BPH and WBPH on rice crop. This IGR will enhance the choice of farmers in selecting the insecticides from different groups and can play an important role as an alternative to neonicotinoids and organophosphates already recommended for the control of planthoppers.

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