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# Evaluation of a new ready mixed insecticide (Buprofezin 15% +Acephate 35% WP) against BPH (*Nilaparvata lugens* (Stal)) and WBPH (*Sogatella furcifera* (Horvath)) of rice in West Bengal

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**ABSTRACT**

*Brown plant hopper and white backed plant hopper emerged as the major sucking pest due to selection pressure. Being having potent adaptability to develop resistance against sole insecticides it is a present demand to formulate a mix formulation with different target specificity. Field experiments were conducted during boro season of 2012 and kharif season of 2013 in experimental plots of Bidhan Chandra Krishi Viswavidyalaya, West Bengal to evaluate the efficacy of ready mixed insecticide (buprofezin 15% +acephate 35% WP) @ 1000, 1250 and 1500 ml ha$^{-1}$ against BPH (Nilaparvata lugens) and WBPH (Sogatella furcifera) of Rice. Buprofezin 15% + acephate 35% WP @ 1500 ml ha$^{-1}$ was found as best effective insecticide against BPH and WBPH during both experimental seasons with highest reduction against the test insects. It was found that buprofezin 15% + acephate 35% WP @ 1500 ml ha$^{-1}$ showed tremendous result over other treatments. No population of brown plant hopper was recorded after 10 days of second spray during boro season of 2012, while during kharif of 2013 only 4.33 nos. of brown plant hopper was recorded during 10 days after second spray, and no infestation was recorded from 5 days after third spray. Similarly in case of WBPH buprofezin 15% + acephate 35% WP @ 1500 ml/ha also recorded no infestation from 5 days onwards after third spray. The pre mix formulation of buprofezin 15% + acephate 35% WP @ 1500 ml ha$^{-1}$ showed potentiation over the sole effect of acephate and buprofezin.*

***Keywords*:** Acephate, BPH, buprofezin, rice, WBPH

Rice (*Oryza sativa*) is one of the most important food crops in the world and forms the staple diet of billions of people. In India it accounts for more than 40 per cent of the total food grain production. Annually rice is grown in 44.6 million ha under 4 major ecosystems: irrigated (21 million ha), rainfed lowland (14 million ha), rainfed upland (6 million ha) and flood prone (3 million ha) (Siddiq, 2006). Among the numerous abiotic and biotic stresses that affect rice yield, insects are the major constraint in the production of rice throughout the world. Over 800 insect species have been identified damaging either standing or stored rice (Grist and Lever, 1969). Fletcher (1920) listed 35 species including 10 serious one feeding on paddy in India. Pathak and Dhaliwal (1981) estimated that insects are responsible for more than 30 per cent yield losses in Asia. Several species which once were considered minor pests are now considered as major like brown plant hopper, white backed plant hopper, green leaf hopper and leaf folders. Brown plant hopper appeared as a sporadic pest in India during 1958 and 1962 but most severe outbreak occurred in Kerala at the end of 1973 followed by Andhra Pradesh and Tamil Nadu during 1974 (Koya, 1974). By 1975, considerable damage was reported from 10 states including Andhra Pradesh, Bihar, Haryana, Karnataka, Madhya Pradesh, Orissa, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal. In India in most regions, the peak population is observed during the late rainy season from October to November. Another peak appears during the dry season from April to May in the regions where double cropping is widely practiced (Dale, 1994). In West Bengal, BPH has posed a serious threat in last twenty years due to wide spread expansion of area under cultivation of high yielding and early maturing improved cultivars. Insecticides are the only tool in the management of plant hopper that are reliable for emergency action when insect pest population approaches or exceeds the economic threshold, but it is now being quite difficult to tackle these insect with any single potent insecticide, therefore combination of two insecticides with different mode of action may be helpful.

## MATERIALS AND METHODS

Field experiments were conducted to evaluate the efficacy of new ready mixed insecticide Buprofezin 15% + Acephate 35% WP against BPH *(Nilaparvata lugens)*

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**Table 1: Effect of different treatment schedules of Buprofezin 15% +Acephate 35% WP on the population of BPH (*Nilaparvata lugens)* in rice after each spray (*boro*, 2012).**

| Sl. No. | Mean No. of BPH per ten hills before spray | Mean population of BPH at different intervals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after first spray | | | Days after second spray | | | Days after third spray | | |
| | | 1st | 5th | 10th | 1st | 5th | 10th | 1st | 5th | 10th |
| $T_1$ | 327 | 128.42 (11.38) | 100.85 (10.09) | 84.27 (9.23) | 83.90 (9.21) | 68.60 (8.34) | 56.00 (7.55) | 55.24 (7.50) | 53.10 (7.36) | 45.33 (6.81) |
| $T_2$ | 335 | 65.33 (8.14) | 35.23 (6.02) | 33.34 (5.86) | 32.84 (5.82) | 30.00 (5.57) | 12.33 (3.65) | 10.74 (3.43) | 8.38 (3.06) | 0.00 (1.00) |
| $T_3$ | 325 | 51.35 (7.24) | 29.25 (5.50) | 24.21 (5.02) | 23.00 (4.90) | 22.10 (4.81) | 0.00 (1.00) | 0.00 (1.00) | 0.00 (1.00) | 0.00 (1.00) |
| $T_4$ | 332 | 147.94 (12.20) | 105.88 (10.34) | 88.76 (9.47) | 86.17 (9.34) | 78.10 (8.89) | 72.15 (8.55) | 71.46 (8.51) | 51.75 (7.26) | 45.70 (6.83) |
| $T_5$ | 318 | 118.37 (10.93) | 90.58 (9.57) | 65.44 (8.15) | 64.34 (8.08) | 55.92 (7.54) | 48.86 (7.06) | 44.00 (6.71) | 35.05 (6.00) | 33.08 (5.84) |
| $T_6$ | 334 | 176.37 (13.32) | 122.1 (11.10) | 112.00 (10.63) | 111.88 (10.62) | 100.26 (10.06) | 78.35 (8.91) | 76.94 (8.83) | 72.64 (8.58) | 70.02 (8.43) |
| $T_7$ | 329 | 356.64 (18.91) | 379.34 (19.50) | 449.41 (21.22) | 454.68 (21.35) | 464.22 (21.57) | 477.71 (21.88) | 486.92 (22.09) | 500.41 (22.09) | 514.56 (22.71) |
| **LSD (0.05)** | **NS** | **0.99** | **0.62** | **0.89** | **0.97** | **0.86** | **2.70** | **2.55** | **2.11** | **1.58** |

*Figures in parentheses are square root transformed value.*

**Table 1a: Effect of different treatment schedules of Buprofezin 15% +Acephate 35% WP on per cent reduction/ increase in BPH (*Nilaparvata lugens)* on rice after each spray (*boro*, 2012)**

| Sl. No. | Mean No. of BPH per ten hills before spray | Mean% reduction/increase in BPH population at different intervals | | | | | | | | | Overall mean % reduction/ increase in BPH population |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after first spray | | | Days after second spray | | | Days after third spray | | | |
| | | 1st | 5th | 10th | 1st | 5th | 10th | 1st | 5th | 10th | |
| $T_1$ | 327 | 63.99 | 73.41 | 81.25 | 81.55 | 85.22 | 88.28 | 88.66 | 89.39 | 91.19 | 82.55 |
| $T_2$ | 335 | 81.68 | 90.71 | 92.58 | 92.78 | 93.54 | 97.42 | 97.79 | 98.33 | 100.00 | 93.87 |
| $T_3$ | 325 | 85.60 | 92.29 | 94.61 | 94.94 | 95.24 | 100.00 | 100.00 | 100.00 | 100.00 | 95.85 |
| $T_4$ | 332 | 58.52 | 72.09 | 80.25 | 81.05 | 83.18 | 84.90 | 85.32 | 89.66 | 91.12 | 80.68 |
| $T_5$ | 318 | 66.81 | 76.12 | 85.44 | 85.85 | 87.95 | 89.77 | 90.96 | 93.00 | 93.57 | 85.50 |
| $T_6$ | 334 | 50.55 | 67.79 | 75.08 | 75.39 | 78.40 | 83.60 | 84.20 | 85.48 | 86.39 | 76.32 |

WBPH *(Sogatella furcifera)* infesting Rice (*cv.* IET 4094; Khitish ) at Instructional Farm of Bidhan Chandra Krishi Viswavidyalaya, West Bengal during *boro* season of 2012 and *kharif* season of the year 2013. The whole experiment was laid out in randomized block design with 6 treatments ($T_1$- Buprofezin 15% + Acephate 35% WP @ 1000 ml/ha, $T_2$- Buprofezin 15% + Acephate 35% WP @ 1250 ml/ha, $T_3$- Buprofezin 15% + Acephate 35% WP @ 1500 ml/ha, $T_4$- Acephate 75 SP @ 1000 g/ha, T5- Buprofezin 25 SC @ 800 ml/ha, $T_6$- Imidacloprid 17.8 SL @ 125 ml/ha); replicated thrice along with control. Three sprays at 10 days interval were given when pest population reached ETL level (5-10 insect hill$^{-1}$) with knapsack sprayer at high volume @ 500 l ha$^{-1}$. Observation was recorded on before spray as well as 1, 5 and 10 days after each spray from ten hills and thereby after square root transformation the efficacy of the insecticides ascertained.

**Table 2: Effect of different treatment schedules of Buprofezin 15% +Acephate 35% WP on the population of BPH (*Nilaparvata lugens)* on rice after each spray (*kharif*, 2013)**

| Sl. No. | Mean No. of BPH per ten hills before spray | Mean population of BPH at different intervals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after first spray | | | Days after second spray | | | Days after third spray | | |
| | | 1st | 5th | 10th | 1st | 5th | 10th | 1st | 5th | 10th |
| $T_1$ | 345 | 98.97 | 84.53 | 66.59 | 65.55 | 60.72 | 51.88 | 51.06 | 48.3 | 46.12 |
| | | (10.00) | (9.25) | (8.22) | (8.16) | (7.86) | (7.27) | (7.22) | (7.02) | (6.86) |
| $T_2$ | 322 | 56.03 | 41.22 | 31.35 | 30.88 | 23.51 | 10.46 | 9.89 | 0.00 | 0.00 |
| | | (7.55) | (6.50) | (5.69) | (5.65) | (4.95) | (3.39) | (3.30) | (1.00) | (1.00) |
| $T_3$ | 315 | 37.49 | 33.39 | 20.48 | 19.56 | 17.33 | 4.33 | 3.96 | 0.00 | 0.00 |
| | | (6.20) | (5.86) | (4.63) | (4.53) | (4.28) | (2.31) | (2.23) | (1.00) | (1.00) |
| $T_4$ | 337 | 121.12 | 96.56 | 87.00 | 86.36 | 68.18 | 65.01 | 64.7 | 59.22 | 58.00 |
| | | (11.05) | (9.88) | (9.38) | (9.35) | (8.32) | (8.12) | (8.11) | (7.76) | (7.68) |
| $T_5$ | 305 | 89.32 | 81.67 | 61.93 | 60.40 | 58.99 | 46.12 | 45.12 | 45.12 | 39.61 |
| | | (9.50) | (9.09) | (7.93) | (7.84) | (7.75) | (6.68) | (6.79) | (6.79) | (6.37) |
| $T_6$ | 340 | 153.56 | 115.19 | 110.98 | 110.60 | 98.64 | 97.73 | 96.12 | 89.42 | 79.20 |
| | | (12.43) | (10.78) | (10.58) | (10.56) | (9.98) | (9.94) | (9.51) | (9.51) | (9.51) |
| $T_7$ | 335 | 370.18 | 396.98 | 419.42 | 447.56 | 477.71 | 482.40 | 511.88 | 531.31 | 547.73 |
| | | (19.27) | (19.95) | (20.50) | (21.18) | (21.88) | (21.99) | (22.65) | (23.07) | (23.07) |
| **LSD (0.05)** | **NS** | **1.37** | **0.74** | **1.18** | **1.20** | **0.79** | **1.77** | **1.52** | **0.79** | **0.87** |

*Figures in parentheses are square root transformed value.*

**Table 2a: Effect of different treatment schedules of Buprofezin 15% +Acephate 35% WP against BPH (*Nilaparvata lugens)* on Rice after each spray (kharif, 2013).**

| Sl. No. | Mean No. of BPH per ten hills before spray | Mean% reduction/increase in BPH population at different intervals | | | | | | | | | Overall mean % reduction/ increase in BPH population |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after first spray | | | Days after second spray | | | Days after third spray | | | |
| | | 1st | 5th | 10th | 1st | 5th | 10th | 1st | 5th | 10th | |
| $T_1$ | 73.26 | 78.71 | 84.12 | 85.35 | 87.29 | 89.25 | 90.03 | 90.91 | 91.58 | 85.61 |
| $T_2$ | 84.86 | 89.62 | 92.53 | 93.10 | 95.08 | 97.83 | 98.07 | 100.00 | 100.00 | 94.55 |
| $T_3$ | 89.87 | 91.59 | 95.12 | 95.63 | 96.37 | 99.10 | 99.23 | 100.00 | 100.00 | 96.41 |
| $T_4$ | 67.28 | 75.68 | 79.26 | 80.70 | 85.73 | 86.52 | 87.36 | 88.85 | 89.41 | 82.31 |
| $T_5$ | 75.87 | 79.43 | 85.23 | 86.50 | 87.65 | 90.44 | 91.19 | 91.51 | 92.77 | 86.73 |
| $T_6$ | 58.52 | 70.98 | 73.54 | 75.29 | 79.35 | 79.74 | 81.22 | 83.17 | 85.54 | 76.37 |
| $T_7$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | - |

## RESULTS AND DISCUSSION

### *Brown plant hopper*

The pooled efficacy of different treatment schedules of Buprofezin 15% + Acephate 35% WP against Brown plant hopper (BPH) of rice has been presented in table 1, 1a, 2 and 2a. All the treated plots with chemicals were significantly superior in their performance over that of control plots. Buprofezin 15% + Acephate 35% WP @ 1500 and 1250 ml $ha^{-1}$ gave best control among the other treatments against BPH. It was observed that Buprofezin 15% + Acephate 35% WP @ 1500 and 1250 ml $ha^{-1}$ reduces the BPH population below ETL level from days 1 of spraying. Buprofezin 15% + Acephate 35% WP @ 1500 ml $ha^{-1}$ was recorded most effective insecticide

**Table 3: Effect of different treatment schedules of Buprofezin 15% +Acephate 35% WP on the population of WBPH (*Sogatella furcifera)* on rice after each spray (*boro*, 2012).**

| Sl. No. | Mean No. of BPH per ten hills before spray | Mean population of BPH at different intervals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after first spray | | | Days after second spray | | | Days after third spray | | |
| | | 1st | 5th | 10th | 1st | 5th | 10th | 1st | 5th | 10th |
| $T_1$ | 138 | 29.70 | 20.42 | 17.72 | 17.29 | 16.97 | 15.60 | 14.11 | 13.00 | 13.71 |
| | | (5.54) | (4.63) | (4.33) | (4.28) | (4.24) | (4.07) | (3.89) | (3.74) | (3.84) |
| $T_2$ | 127 | 14.32 | 12.99 | 8.10 | 7.60 | 5.59 | 2.29 | 2.00 | 1.50 | 0.00 |
| | | (3.91) | (3.74) | (3.02) | (2.93) | (2.57) | (1.81) | (1.73) | (1.58) | (1.00) |
| $T_3$ | 142 | 12.13 | 8.98 | 5.71 | 5.01 | 3.13 | 1.30 | 0.71 | 0.00 | 0.00 |
| | | (3.62) | (3.16) | (2.59) | (2.45) | (2.03) | (1.52) | (1.31) | (1.00) | (1.00) |
| $T_4$ | 155 | 32.10 | 29.03 | 24.49 | 23.40 | 21.08 | 19.83 | 18.31 | 16.98 | 14.61 |
| | | (5.75) | (5.48) | (5.05) | (4.94) | (4.70) | (4.56) | (4.39) | (4.24) | (3.95) |
| $T_5$ | 136 | 19.31 | 18.10 | 17.70 | 16.70 | 15.99 | 13.21 | 12.28 | 7.45 | 4.83 |
| | | (4.51) | (4.37) | (4.32) | (4.21) | (4.12) | (3.77) | (3.64) | (2.91) | (2.41) |
| $T_6$ | 128 | 43.56 | 33.64 | 27.54 | 26.97 | 24.69 | 20.98 | 19.74 | 17.38 | 10.17 |
| | | (6.68) | (5.89) | (5.34) | (5.29) | (5.07) | (4.69) | (4.55) | (4.29) | (3.34) |
| $T_7$ | 144 | 91.28 | 115.60 | 132.36 | 154.24 | 170.00 | 182.88 | 188.64 | 191.52 | 192.96 |
| | | (9.61) | (10.80) | (11.55) | (12.46) | (13.08) | (13.56) | (13.77) | (13.88) | (13.93) |
| **LSD (0.05)** | **NS** | **0.58** | **0.61** | **0.55** | **0.50** | **0.61** | **0.43** | **0.59** | **0.65** | **0.09** |

*Figures in parentheses are square root transformed value.*

**Table 3a: Effect of different treatment schedules of Buprofezin 15% +Acephate 35% WP on per cent reduction/ increase in WBPH (*Sogatella furcifera*) on Rice after each spray (boro, 2012).**

| Sl. No. | Mean No. of BPH per ten hills before spray | Mean% reduction/increase in BPH population at different intervals | | | | | | | | | Overall mean % reduction/ increase in BPH population |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after first spray | | | Days after second spray | | | Days after third spray | | | |
| | | 1st | 5th | 10th | 1st | 5th | 10th | 1st | 5th | 10th | |
| $T_1$ | 138 | 67.46 | 82.34 | 86.61 | 88.79 | 90.02 | 91.47 | 92.52 | 93.21 | 92.89 | 87.26 |
| $T_2$ | 127 | 84.31 | 88.76 | 93.88 | 95.07 | 96.71 | 98.75 | 98.94 | 99.22 | 100.00 | 95.07 |
| $T_3$ | 142 | 86.71 | 92.23 | 95.69 | 96.75 | 98.16 | 99.29 | 99.62 | 100.00 | 100.00 | 96.49 |
| $T_4$ | 155 | 64.83 | 74.89 | 81.50 | 84.83 | 87.60 | 89.16 | 90.29 | 91.13 | 92.43 | 84.07 |
| $T_5$ | 136 | 78.85 | 84.34 | 86.63 | 89.17 | 90.59 | 92.78 | 93.49 | 96.11 | 97.50 | 89.94 |
| $T_6$ | 128 | 52.28 | 70.90 | 79.19 | 82.51 | 85.48 | 88.53 | 89.54 | 90.93 | 94.73 | 81.57 |

against BPH after 10 days of second spray and subsequently there was no BPH infestation up to end of third spray. Buprofezin 15% + Acephate 35% WP @ 1250 ml $ha^{-1}$ was considered as next effective insecticidal treatment in reducing the BPH population (recorded 0 population on 10 days after third spray), followed by Buprofezin 25%SC (33.08 number of population ten $hills^{-1}$). On the other hand the conventional insecticide Imidacloprid 17.8%SL recorded 70.02 number of population ten $hills^{-1}$. Whereas 514.56 number BPH population was recorded in control plot at the end of the spray schedule. In respect of percent reduction of BPH population Buprofezin 15% + Acephate 35% WP @ 1500 ml $ha^{-1}$ recorded 100% protection against BPH at 10 days after second spray and onwards. The overall mean per cent reduction of BPH was highest in Buprofezin 15% + Acephate 35% WP @ 1500 ml $ha^{-1}$

**Table 4: Effect of different treatment schedules of Buprofezin 15% +Acephate 35% WP on the population of WBPH (*Sogatella furcifera*) on rice after each spray (*kharif*, 2013)**

| Sl. No. | Mean No. of BPH per ten hills before spray | Mean population of BPH at different intervals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after first spray | | | Days after second spray | | | Days after third spray | | |
| | | 1st | 5th | 10th | 1st | 5th | 10th | 1st | 5th | 10th |
| $T_1$ | 142 | 27.34 | 26.75 | 20.00 | 19.95 | 14.18 | 13.90 | 13.65 | 12.06 | 11.48 |
| | | (5.32) | (5.27) | (4.58) | (4.58) | (3.90) | (3.86) | (3.83) | (3.61) | (3.53) |
| $T_2$ | 131 | 9.82 | 8.65 | 5.04 | 5.00 | 4.06 | 3.75 | 3.12 | 0.33 | 0.00 |
| | | (3.29) | (3.11) | (2.46) | (2.45) | (2.25) | (2.18) | (2.03) | (1.15) | (1.00) |
| $T_3$ | 147 | 7.64 | 7.20 | 4.06 | 3.54 | 2.12 | 1.57 | 0.98 | 0.00 | 0.00 |
| | | (2.94) | (2.86) | (2.25) | (2.13) | (1.77) | (1.60) | (1.41) | (1.00) | (1.00) |
| $T_4$ | 156 | 36.04 | 26.53 | 25.43 | 24.70 | 21.97 | 20.29 | 20.02 | 18.03 | 16.21 |
| | | (6.09) | (5.25) | (5.14) | (5.07) | (4.79) | (4.61) | (4.58) | (4.36) | (4.15) |
| $T_5$ | 140 | 21.89 | 21.00 | 17.60 | 16.00 | 14.10 | 13.08 | 12.08 | 10.98 | 10.42 |
| | | ( 4.78) | (4.69) | (4.31) | (4.12) | (3.89) | (3.75) | (3.62) | (3.46) | (3.38) |
| $T_6$ | 135 | 38.00 | 31.02 | 29.74 | 28.63 | 25.07 | 21.79 | 21.00 | 19.25 | 19.00 |
| | | (6.24) | (5.66) | (5.54) | (5.44) | (5.11) | (4.77) | (4.69) | (4.50) | (4.47) |
| $T_7$ | 146 | 166.73 | 169.8 | 174.47 | 175.2 | 178.27 | 181.92 | 185.71 | 188.19 | 189.36 |
| | | (12.95) | (13.07) | (13.25) | (13.27) | (13.39) | (13.52) | (13.66) | (13.75) | (13.80) |
| **LSD (0.05)** | **NS** | **0.86** | **0.57** | **0.58** | **0.51** | **0.91** | **0.78** | **0.76** | **0.8** | **0.17** |

*Figures in parentheses are square root transformed value.*

**Table 4a: Effect of different treatment schedules of Buprofezin 15% +Acephate 35% WP against WBPH (*Sogatella furcifera*) on Rice after each spray (kharif, 2013)**

| Sl. No. | Mean No. of BPH per ten hills before spray | Mean% reduction/increase in BPH population at different intervals | | | | | | | | | Overall mean % reduction/ increase in BPH population |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after first spray | | | Days after second spray | | | Days after third spray | | | |
| | | 1st | 5th | 10th | 1st | 5th | 10th | 1st | 5th | 10th | |
| $T_1$ | 83.60 | 84.25 | 88.54 | | 88.61 | 92.05 | 92.36 | 92.65 | 93.59 | 93.94 | 89.95 |
| $T_2$ | 94.11 | 94.91 | 97.11 | | 97.15 | 97.72 | 97.94 | 98.32 | 99.82 | 100.00 | 97.45 |
| $T_3$ | 95.42 | 95.76 | 97.67 | | 97.98 | 98.81 | 99.14 | 99.47 | 100.00 | 100.00 | 98.25 |
| $T_4$ | 78.38 | 84.38 | 85.42 | | 85.90 | 87.68 | 88.85 | 89.22 | 90.42 | 91.44 | 86.85 |
| $T_5$ | 86.87 | 87.63 | 89.91 | | 90.87 | 92.09 | 92.81 | 93.50 | 94.17 | 94.50 | 91.37 |
| $T_6$ | 77.21 | 81.73 | 82.95 | | 83.66 | 85.94 | 88.02 | 88.69 | 89.77 | 89.97 | 85.33 |
| $T_7$ | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

(95.85%), which was at par with Buprofezin 15% + Acephate 35% WP @ 1250 ml $ha^{-1}$ (93.87%), while the conventional insecticide Buprofezin 25%SC @ 800 ml $ha^{-1}$ and Imidacloprid 17.8 SL @ 125 ml $ha^{-1}$ provided 85.5% and 76.32% protection respectively against BPH at the end of the spray schedule.

Similar result was observed in the kharif season also, the ready mixed insecticide Buprofezin 15% + Acephate 35% WP @ 1500 ml $ha^{-1}$ was proved as best insecticide against BPH population. It was observed that Buprofezin 15% + Acephate 35% WP @ 1500 and 1250 ml $ha^{-1}$ provided 89.87 and 84.86per cent protection at 1 days after first spray and subsequently provided an increased level of protection against BPH and therefore provided 100 per cent protection at 5 days after second spray. Buprofezin 25% SC and Acephate 75% WP sole provided 86.73 and 82.31per cent overall mean reduction of BPH population at the end of spray schedule.

***White backed plant hopper***

The pooled efficacy of different treatment schedules of Buprofezin 15% + Acephate 35% WP against white backed plant hopper (WBPH) of rice has been presented in table 3, 3a, 4 and 4a. All the treated plots with chemicals were significantly superior in their performance over that of control plots during both the experimental seasons. During the boro season of 2012, Buprofezin 15% + Acephate 35% WP @ 1500 and 1250 ml $ha^{-1}$ conferred best control among the other treatments against *Sogatella furcifera* (WBPH), Buprofezin 15% + Acephate 35% WP @ 1500 ml $ha^{-1}$ was recorded most effective insecticide against WBPH from day 1 after first spray recorded minimum WBPH population (12.13 insects ten $hill^{-1}$), it was recorded that there were no WBPH population was observed from 5 days after third spray. Buprofezin 15% + Acephate 35% WP @ 1250 ml $ha^{-1}$ was considered as second most effective treatment against WBPH population which also recorded no WBPH population during 10 days after third spray followed by sole insecticide Buprofezin 25%SC (4.83 number of population ten $hills^{-1}$), Imidacloprid 17.8%SL (10.17 insects ten $hills^{-1}$) Buprofezin 15% + Acephate 35% WP @ 1000 ml $ha^{-1}$ (13.71 insects ten $hills^{-1}$) and Acephate 75% WP (14.61 insects ten $hills^{-1}$). All the insecticidal treatment was proved as effective in keeping the population level below ETL at the end of spraying. Here also a steady increase of WBPH population was observed in control plot during the experiment. In respect of percent reduction of WBPH population Buprofezin 15% + Acephate 35% WP @ 1500 ml $ha^{-1}$ was considered as best effective treatments against WBPH (96.49% overall mean protection against WBPH) which was at par with Buprofezin 15% + Acephate 35% WP @ 1250 ml $ha^{-1}$ (95.07%), while the conventional insecticide Buprofezin 25%SC @ 800 ml $ha^{-1}$ and Imidacloprid 17.8 SL @ 125 ml $ha^{-1}$ provided 89.94 and 81.57 per cent protection respectively against BPH at the end of the spray schedule.

Analogous result was observed during *kharif* season also the ready mixed insecticide Buprofezin 15% + Acephate 35% WP @ 1500 ml $ha^{-1}$ was provided superlative result in reducing the hopper population and considered to be as best insecticide against WBPH population. It was observed that Buprofezin 15% + Acephate 35% WP @ 1500 and 1250 ml $ha^{-1}$ provided 95.42 and 94.11per cent protection at 1 days after first spray and subsequently provided an increased level of protection against BPH and therefore provided 100per cent protection. Buprofezin 25 SC, Acephate 75 WP and Imidacloprid 17.8 SL provided 91.37 and 86.85 per cent and 85.33per cent overall mean reduction of WBPH population at the end of spraying.

Wang *et al.* (2008) supported that buprofezin was effective against homopteran insect pests, such as planthopper with very low risks to environment and human beings. Chau (2007) reported that imidacloprid at recommended rates of 28 and 20 g a.i. $ha^{-1}$ showed very good control of BPH in wet season. Though in India, planthopper resistance by 35.13, 10.78 and 4.98 fold to imidacloprid, thiamethoxam and clothianidin respectively has been detected during 2006 by Krishnaiah *et al.* (2006). A conventional insecticide like acephate belongs to organophosphate class is still being used to suppress the population of *N. lugens*. However, this insecticide is only recommended for limited use in rotation with neonicotinoids and buprofezin to control BPH and WBPH which is comparable with the present finding that Buprofezin + Acephate can effectively control the plant hopper in rice ecosystem. Buprofezin exhibited good efficacy against *N. lugens*. Buprofezin 25 SC @ 175 g a. i. $ha^{-1}$ were found to be effective against brown planthopper alone at 35 locations in India during 2009 (Anonymous, 2010). It can be assumed that Acephate, an organophosphate foliar insecticide of moderate persistence with residual systemic activity of about 10-15 days at the recommended use rate when used with chitin synthesis and prostaglandin inhibitor insecticide Buprofezin having hormonal disturbing effect, leading to suppression of ecdysis can effectively exerts a good control against plant hopper with two different mode of action, which was proved in our present experiment.

It is evident from the present investigation that there was a significant variation between the ready mixed insecticide Buprofezin 15% + Acephate 35% WP and the conventional insecticides Buprofezin, Acephate and Imidacloprid. Therefore it can be concluded that Buprofezin 15% + Acephate 35% WP was very effective against BPH and WBPH in transplanted paddy than the conventional insecticides.

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