Efficacy of some biointensive and insecticides based IPM modules against rice plant hopper in coastal Odisha

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ABSTRACT

A field experiment was conducted to determine the comparative efficacy of some biointensive and insecticides-based modules against rice plant hopper during kharif, 2016 and 2017. The biointensive modules included botanicals, parasitoids and entomopathogenic biopesticides. Chlorantraniliprole, buprofezin, and conventional insecticides as adopted by the farmers practice in Puri district of Odisha were the other treatments. The results revealed that nursery treatment with fipronil 0.3G @20kg/ha + chlorantraniliprole 0.4G @10kg/ha at 40 DAT + spray of buprofezin 25%SC @825ml/ha at 65DAT were superior with 83% reduction in plant hoppers population. Also, the maximum grain yield with 31% increase, and incremental benefit cost ratio (5.85: 1.00) were accomplished. The module- nursery treatment with fipronil 0.3G @20kg/ha + Trichogramma japonicum + Beauveria bassiana @2l/ha at 30 and 50 DAT+ neem seed kernel extract (5%) at 65DAT led to 65% reduction in plant hoppers, and was the most effective among the biointensive modules. The predator population was found to be more in these biointensive modules.

Key words: Rice, brown plant hopper, neem seed kernel extract, Trichogramma japonicum, Beauveria bassiana, chlorantraniliprole, buprofezin, fipronil, predators, cost benefits

Rice is grown under diverse ecosystems in India, and rice intensification has led to changes in crop pest scenario which made the plant hoppers as one of the destructive pests. Plant hoppers further exist in two forms namely brown plant hopper (BPH) Nilaparvata lugens, and white backed brown planthopper (WBPH). BPH also acts as a vector in transmitting grassy stunt virus. During 1973, thousands of hectares of rice cultivation were adversely affected by BPH in Odisha. There were also reports which stated that BPH which was a minor pest, but had assumed a serious pest status in two northern districts of West Bengal (Chatterjee, 1969). To control this pest, various insecticides had been evaluated yet, most of these have proved hazardous and cause resurgence problems. Hence, in this study, IPM modules have been evaluated for their efficacy in the coastal district of Odisha. The treatments include some biointensive treatments like neem seed kernel extract, Trichogramma japonicum, Beauveria bassiana, and insecticides like chlorantraniliprole, buprofezin and fipronil. The effect of these on the predators, and cost benefits have also been evaluated.

MATERIALS AND METHODS

Field experiments were conducted during kharif 2016 and 2017 in a Randomized block design with four replications and six treatments at the Regional Research and Technology Transfer Station of OUAT, Bhubaneswar. Two nursery beds (22 x 1 m) were prepared, and the seedlings of one of these was treated with fipronil 0.3G @20kg/ha at 20 days after sowing. Another nursery bed was kept untreated. Pooja, a variety of 150 days duration, was included with spacing of 20x 15 cm, row to row and plant to plant distance, respectively in plots of size 40 m². Ten plants in each plot were randomly selected for observations.

The treatment modules included: M₁: Nursery treatment (NT) with fipronil 0.3G @20kg/ha + pheromone trap (PT) @5/ha for monitoring of yellow stem borer + release of Trichogramma japonicum @50000/ha six times at weekly intervals started after moth catch in pheromone trap + Bt spray @1kg/ha during evening hours at 30 and 50 days after transplanting (DAT) + neem oil (1500 ppm) spray @1.5 l/ha at 65DAT. M₂: Nursery treatment (NT) with fipronil 0.3G@20kg/ha + pheromone trap(PT) @5/ha for monitoring of yellow stem borer + release of Trichogramma japonicum @50000/ha six times at weekly intervals started after moth catch in pheromone trap + Bt spray @1kg/ha during evening hours at 30 and 50 days after transplanting (DAT) + neem oil (1500 ppm) spray @1.5 l/ha at 65DAT. M₃: Nursery treatment (NT) with fipronil 0.3G@20kg/ha + pheromone trap(PT) @5/ha for monitoring of yellow stem borer + release of Trichogramma japonicum @50000/ha six times at weekly intervals started after moth catch in pheromone trap + Bt spray @1kg/ha during evening hours at 30 and 50 days after transplanting (DAT) + neem oil (1500 ppm) spray @1.5 l/ha at 65DAT.

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trap + *Beauveria bassiana* @ 2l/ha spray at 30 and 50 days after transplanting (DAT) + Spray of Neem Seed Kernel Extract (NSKE) @5% at 65DAT. M₁; Nursery treatment (NT) with fipronil 0.3G @20kg/ha + chlorantraniliprole 0.4 G @10kg/ha at 40 DAT + spray of buprofezin 25% SC @825ml/ha at 65 DAT. M₂; Farmers practice which includes the spraying of Triazophos 35EC + Deltamethrin 1% spray @1 l/ha at 30 and 50 DAT + thiamethoxam spray @150g/ha at 65 DAT. M₃; Untreated control. The mixed hopper population was recorded one day before first spray and then at 7 and 14 days after each spray. At the time of harvest, grain yield was recorded in each plot. Accordingly benefit cost ratios of different treatments were also calculated.

**RESULTS AND DISCUSSION**

**Plant hoppers**

Table 1 reveals that among all the IPM modules, M₁; Nursery treatment (NT) with fipronil 0.3G @20kg/ha + chlorantraniliprole 0.4 G @10kg/ha at 40 DAT + buprofezin 25% SC @825ml/ha at 65 DAT, was significantly superior against BPH and WBPH in both the experiments. The pooled data reveal that in Module 2 (NT + *T. japonicum* + *B. bassiana* @2 lt/ha at 30 and 50DAT + NSKE (5%) at 65DAT) was 6.20 hoppers/hill and in Module 1 (NT + *T. japonicum* + Bt spray @1kg/ha at 30 and 50 DAT + neem oil (1500ppm) @1.5l/ha at 65 DAT) it was 7.40 hoppers/hill. The performance of *B. bassiana* in the present findings is in agreement with the findings of Chi et al. (2005). The effectiveness of neem seed kernel extract (NSKE) which is an important component of Module 2 (M₁) had been reported by Saxena and Barrion (1987). The population of hoppers was increased in Module 5 (M₅) (spray of triazophos 35EC + deltamethrin 1% @1 l/ha at 30 and 50 DAT + thiamethoxam 25WG spray @150gm/ha at 65DAT). Maximum population was in Module 3 (M₃) (NT + *T. japonicum* + neem oil (1500ppm)@1.5 l/ha at 30 and 50 DAT + neem leaf powder @12kg/ha at 65DAT) with 12.70 hoppers/hill. Reduction of plant hoppers over control is maximum in M₁ with 83% control and second best being in M₂ with 65% reduction.

**Spiders and mirids**

The results as given in Table 1 reveal that spider population showed increasing trend in the biointensive modules - M₄ (NT + *T. japonicum* + neem oil (1500ppm)@1.5 l/ha at 30 and 50 DAT + neem leaf powder @12kg/ha at 65DAT) was observed with maximum spiders (2.04 spiders/hill) next to the untreated control (2.21 spiders/hill), Crude formulations of neem had been reported to be safer to natural enemies (Dash et al., 2001). Singh et al. (2008) observed safety of Bt (*Bacillus thuriengensis*) and *Beauveria bassiana* to spiders. Reddy et al. (2013) observed more predators in plots treated with entomopathogens.

As regards the mirid bugs (*Cyrtorhinus lividipennis*), in kharif 2016, the module M₁ was observed with maximum of 3.8 mirids/hill (Table 1); it is followed by the other two biointensive modules M₁ and M₄. During kharif, 2017, the same trend followed. Chelliah et al. (1984) reported that 5% neem oil is the least toxic to mirids. The pooled means clearly show that Module 3 (NT + *T. japonicum* + neem oil 1500ppm@1.5l/ha at 30 and 50 DAT + neem leaf powder @12kg/ha at 65DAT) were the best and safe to mirids. These observations corroborate with those of Ogah et al. (2011) who observed best results with neem seed extracts. The insecticide-based modules viz., M₄; nursery treatment with fipronil 0.3G@20kg/ha + chlorantraniliprole 0.4G@10kg/ha at 40 DAT + buprofezin 25% SC @825ml/ha at 65DAT were not safe.

**Yield and economics**

Grain yield of 58.5 q/ha was obtained in M₄ (nursery treatment with fipronil 0.3G@20kg/ha + chlorantraniliprole 0.4G@10kg/ha at 40 DAT + buprofezin 25% SC @825ml/ha at 65DAT). Bhutto and Soomro (2009) revealed that granular insecticide of 4G formulation increased the yield. Yield advantage over untreated control is found to be high in M₄ having 31% higher yield whereas only 9% increase in M₃. The incremental benefit cost ratio (IBCR) was the maximum IBCR (5.85: 1.00) with module 4 followed by module 5 (4.85 :1.00); and among the biointensive modules, M₂ was the best (2.95:1.00) (Table 2). This corroborates with the findings of Sahu (2016) on chlorantraniliprole.

Thus, it is concluded that the treatment module M₄ (Nursery treatment (NT) with fipronil 0.3G@20kg/ha + chlorantraniliprole 0.4G@10kg/ha at 40 DAT + buprofezin 25% SC @825ml/ha at 65DAT) is the superior, while among the biointensive ones, M₁ (NT + *T. japonicum* + *B. bassiana* @2lt/ha at 30 and 50 DAT+
<table>
<thead>
<tr>
<th>No.</th>
<th>Treatment details</th>
<th>Before spray</th>
<th>Hoppers/ hill at 7 days after spray</th>
<th>Hoppers/ hill at 14 days after spray</th>
<th>Hoppers/ hill (Pooled mean)</th>
<th>Spiders/ hill</th>
<th>Mirid bugs/ hill</th>
<th>Grain yield (q/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M₁</td>
<td>NT + T. japonicum +Bt spray @1kg/ha at 30 and 50 DAT + neem oil (1500ppm)@1.5lt/ha at 65 DAT.</td>
<td>21.8 (4.72)</td>
<td>26.4 (5.18)</td>
<td>7.60 (2.85)</td>
<td>11.40 (3.45)</td>
<td>9.62 (2.63)</td>
<td>7.40 (2.81)</td>
<td>0.96 (1.21)</td>
</tr>
<tr>
<td>M₂</td>
<td>NT + T. japonicum + B. bassiana @2lt/ha at 30&amp;50 DAT + NSKE (5%) at 65DAT</td>
<td>23.6 (4.91)</td>
<td>29.2 (5.45)</td>
<td>5.30 (2.41)</td>
<td>8.30 (2.97)</td>
<td>4.90 (2.24)</td>
<td>7.50 (2.83)</td>
<td>0.62 (1.06)</td>
</tr>
<tr>
<td>M₃</td>
<td>NT + T. japonicum + neem oil (1500ppm)@1.5lt/ha at 30&amp;50 DAT + neem leaf powder @12kg/ha at 65DAT</td>
<td>23.4 (4.89)</td>
<td>28.6 (5.39)</td>
<td>16.45 (4.12)</td>
<td>14.83 (3.40)</td>
<td>12.16 (3.56)</td>
<td>13.24 (3.71)</td>
<td>1.48 (1.41)</td>
</tr>
<tr>
<td>M₄</td>
<td>NT + chlorantraniliprole 0.4G@10kg/ha at 40 DAT + buprofezin 25% SC @825ml/ha at 65DAT</td>
<td>25.9 (5.14)</td>
<td>25.8 (5.14)</td>
<td>3.33 (1.96)</td>
<td>3.20 (1.92)</td>
<td>2.03 (1.59)</td>
<td>3.44 (1.98)</td>
<td>0.89 (1.18)</td>
</tr>
<tr>
<td>M₅</td>
<td>FP (Triazophos 35 EC + Deltamethrin 1%)@1 lt/ha at 30 and 50 DAT + thiamethoxam 25WG spray @150gm/ha at 65DAT</td>
<td>24.5 (4.98)</td>
<td>28.3 (5.36)</td>
<td>8.5 (3.00)</td>
<td>17.80 (4.28)</td>
<td>4.28 (2.19)</td>
<td>7.42 (2.81)</td>
<td>0.17 (0.82)</td>
</tr>
<tr>
<td>M₆</td>
<td>Untreated control</td>
<td>25.5 (5.10)</td>
<td>26.6 (5.21)</td>
<td>18.34 (4.34)</td>
<td>21.42 (4.68)</td>
<td>12.62 (3.62)</td>
<td>18.82 (4.40)</td>
<td>15.48 (4.00)</td>
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<tr>
<td></td>
<td>SE(m) ±</td>
<td>0.015</td>
<td>0.017</td>
<td>0.108</td>
<td>0.081</td>
<td>0.013</td>
<td>0.087</td>
<td>0.081</td>
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<tr>
<td>C.D. (0.05)</td>
<td>0.04</td>
<td>0.05</td>
<td>0.32</td>
<td>0.24</td>
<td>0.31</td>
<td>0.26</td>
<td>0.24</td>
<td>0.24</td>
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</tbody>
</table>

Figures in parentheses √(x+0.5) transformed values
NSKE (5%) at 65DAT was the best Bio intensive modules resulted in conserving the predators as well.

ACKNOWLEDGEMENTS

The authors acknowledge the Regional Research and Technology Transfer Station (Coastal Zone), OUAT for providing facilities.

REFERENCES


Table 2. Incremental Benefit Cost ratio in different treatment modules

<table>
<thead>
<tr>
<th>Treatment details</th>
<th>Pooled mean yield (q/ha)</th>
<th>Additional yield (q/ha)</th>
<th>Additional income (@Rs1550/q) (Rs /ha)</th>
<th>Cost of IPM modules (Rs/ha)</th>
<th>Net profit (Rs/ha)</th>
<th>Incremental benefit cost ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>51.90</td>
<td>7.20</td>
<td>11160</td>
<td>6500</td>
<td>4660</td>
<td>0.71: 1.00</td>
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<td>NT + T. japonicum + Bt spray@1kg/ha at 30 and 50 DAT + neem oil (1500ppm)@1.5 l/ ha at 65 DAT.</td>
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<tr>
<td>M2</td>
<td>54.80</td>
<td>10.10</td>
<td>15655</td>
<td>3965</td>
<td>11690</td>
<td>2.95: 1.00</td>
</tr>
<tr>
<td>NT + T. japonicum + B. bassiana @2l/ ha at 30 &amp; 50 DAT + NSKE (5%) at 65DAT.</td>
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<tr>
<td>M3</td>
<td>48.50</td>
<td>3.80</td>
<td>5890</td>
<td>2600</td>
<td>3290</td>
<td>1.27: 1.00</td>
</tr>
<tr>
<td>NT + T. japonicum + neem oil (1500ppm)@1.5l/ ha at 30 &amp; 50 DAT + neem leaf powder @12kg/ha at 65DAT.</td>
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<tr>
<td>M4</td>
<td>58.50</td>
<td>13.80</td>
<td>21390</td>
<td>3123</td>
<td>18267</td>
<td>5.85: 1.00</td>
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<tr>
<td>NT + chlorantraniliprole 0.4G@10kg /ha at 40 DAT + buprofezin 25% SC @825ml/ ha at 65DAT.</td>
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<tr>
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<td>51.80</td>
<td>7.10</td>
<td>11005</td>
<td>1880</td>
<td>9125</td>
<td>4.85: 1.00</td>
</tr>
<tr>
<td>FP(Triazophos 35 EC + Deltamethrin 1%) @ 1 lt/ ha at 30 and 50 DAT + thiamethoxam 25WG spray @150g /ha at 65DAT.</td>
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<tr>
<td>M6</td>
<td>44.70</td>
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<td>Untreated control</td>
<td>44.70</td>
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