IMPACT OF ORGANIC AND CONVENTIONAL PRACTICES ON RICE YELLOW STEM BORER SCIRPOPAGA INCERTULAS (WALKER) AND ITS EGG PARASITOIDS

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ABSTRACT

Organic farming, cultivation without pesticides and fertilizers promotes plant and animal diversity including insects. The present study conducted at the research farm of the ICAR-Indian Agricultural Research Institute, New Delhi evaluates the impact of organic and conventional IPM practices against rice yellow stem borer (YSB), Scirpophaga incertulas (Walker) (Crambidae: Lepidoptera). Infestation at different stages of the crop and the efficiency of its egg parasitoids were assessed. Results indicated that infestation was more in conventional (0.59%) than the organic practice (0.47%). Three egg parasitoids observed include: Telenomus dignus Gahan, Tetrastichus schoenobii Ferriere, and Trichogramma japonicum Ashmead in both the practices, and all these are new records for the Delhi/NCR region. Maximum parasitization was observed with T. dignus (6.59%) followed by T. japonicum (0.58 %) and T. schoenobii (0.42%), and it was during October. Egg parasitization was more in the organic practice (3.27±3.08) compared to the conventional one (1.18±0.99). The results reveal that T. dignus is the most dominant among the parasitoids observed.

Key words: Rice, organic practices, yellow stem borer, egg parasitoids, Delhi, new records, parasitization, Telenomus dignus, dominant

Rice (Oryza sativa L.) is one of the world’s most important food crops (Prasad et al., 2017) and India is one of the world’s largest producers of rice, accounting for 20% world’s production, with 104.32 mt annually (Anon., 2014). Low productivity of rice in India is due to the losses due to insect pests, diseases and weeds, and pests alone cause 10-15% yield loss (Krishnaiah et al., 2013). More than 100 insects are known as rice pests; out of which about 15 are of major economic significance (Teng et al., 1993). Among these the yellow stem borer (YSB) Scirpophaga incertulas (Walker) is the most widespread and serious. Other stem borer species like Scirpophaga fuscula Schulte and S. virginia Hampson are also known (Saini et al., 2017a, b). In Delhi, YSB is the main stem borer causing dead hearts and white ears. Host plant resistance, cultural, mechanical and chemical control methods have been employed against this pest but these are often not successful as the larvae remain concealed. Hence, biological control is the most logical and sound IPM strategy. Organic agriculture practices promote a natural environment and sustain the biodiversity of biological control agents. There is need to study the infestation of YSB and to explore the potential egg parasitoids, to enable biological control and use it in IPM. This study evaluates the impact of conventional and organic cultivation practices on the YSB and its egg parasitoids.

MATERIALS AND METHODS

A field experiment was conducted during kharif 2019 at the ICAR- Indian Agricultural Research Institute; New Delhi (28°38’N,77°10’E, 228.6 masl, with subtropical and semi-arid type with hot and dry summer and cold ‘Trans-Gangetic plains’ zone. The soil was sandy clay loam in texture having pH 7.6, organic carbon (0.54%) and available N, P, K and DTPA-extractable Zn of 200.3 kg/ha, 23.3 kg/ha, 284.6 kg/ha and 0.87 mg/kg, respectively (Prasad et al., 2006). The rice variety ‘Pusa Basmati 1’ was grown in 4.8 m2 plots under long term field experiment of organic basmati production system. Management of organic and conventional practice was in the difference of use of fertilizers, pesticides and plant refuge. The quantity of inorganic fertilizers applied in the conventional field was 120 kg N, 60 kg P₂O₅ and 50 kg K₂O/ha, respectively. All quantity of P₂O₅, K₂O was applied as basal application at the time of puddling, whereas N was applied was applied in three split doses at 10 days after transplanting (DAT), 30 DAT, 50 DAT, respectively. The nutrient inputs for the organic practice included well decomposed farm yard manure (FYM) @ 10 t/ha. Other standard agronomic packages of practices were
followed under both the production systems. Paddy transplanting was carried out during first week of July.

The infestation of YSB at different growth stages like tillering, boot leaf, flag leaf and panicle initiation was observed and % infestation worked out based on number of infested tillers and total number of tillers/panicle bearing tillers. The egg masses of YSB were collected randomly on monthly basis, with a sample size of 20 egg masses along with the leaf bits. These were observed in individual small vials in the laboratory for the emergence of egg parasitoids. The emerged parasitoids and the YSB larvae were counted under a compound microscope. The parasitoids obtained were preserved and processed for taxonomic studies. Then the egg masses were dissected to count the un-emerged parasitoid adults, pupae and unhatched eggs and included in the totals while analyzing the data. The data were pooled and the % parasitization was calculated using the formula (Reuolin et al., 2018). Statistical analysis of the data for standard deviation/error was done with the MS Excel.

RESULTS AND DISCUSSION

The YSB infestation at different developmental stages indicated that dead hearts were more in conventional rice at initial developmental stages (0.30% to 0.43%). Before harvesting white ear incidence was more in organic practice (1.34%) compared to conventional one (1.34%) (Fig. 1). It was observed that peak infestation of YSB occurred twice, first during second week of August coinciding with tillering stage and second during second week of September with flag leaf stage. In contrast, Varma et al. (2000) observed three peaks in kharif (July, August, September) and two during rabi (January and March/April) at Andhra Pradesh and concluded that late planted crop was more affected than the early planted crop.

The parasitization by egg parasitoids given in Table I reveal the occurrence of parasitoids belonging to three families of Hymenoptera viz., Scelionidae, Eulophidae and Trichogrammatidae. Maintaining high parasitoid diversity is very important in preserving and sustaining the natural agro ecosystems (Buchori et al., 2008). In our study the minimum egg parasitization (1.01%) by *Telenomus dignus* was observed during August and it increased from August to October (6.59%) under organic practice. Similar observations were made by Kumar et al. (2008) who observed that parasitisation by *Telenomus* sp. was up to 78.4% during October, and the least during the 1st fortnight of August (6.4%). The parasitization by *T. japonicum* (0.58%) and *T. schoenobii* (0.42%) was maximum during October. Overall organic practice supported maximum combination of all the three parasitoids (0.62 to 7.47%); total parasitisation during August, September, October and November was 1.39, 0.62, 7.47 and 3.62%, respectively. Activity of *Telenomus dignus* was observed from late August to middle of November with peak during October in organic practice.

Similarly Varma et al. (2009) reported that the *Trichogramma* was the predominant egg parasitoid during September while, *T. schoenobii* and *T. dignus* became dominant during October at Andhra Pradesh. Baghel (2011) observed *Telenomus* sp. to be most active during the fourth week of October parasitizing 0.00 to 71.02% eggs at Raipur. Egg mass was mostly parasitized either by single or by two parasitoid species. Nirala (2014) observed maximum parasitization by *Telenomus* sp. in the second week of October (53.95%) and by *Trichogramma* sp. It was maximum (17.31%) during 39 SMW at Raipur. Vidyawati (2012) observed maximum parasitization by *Telenomus* sp. during the first fortnight of November (38%). In the present study *T. dignus* was observed as the dominant egg parasitoid, and being most active during second week of October.

All three parasitoids were more in the organic practice (0.62 to 7.47%) compared to the conventional one (0.31 to 2.47%). During the present study it was observed that egg parasitoid abundance fluctuated depending upon the developmental stage of crop. The most abundant *T. dignus* was observed in both organic and conventional practice, and in October under organic practice was up to 6.59% against 0.02% under conventional one. All the parasitoids observed now are new records for Delhi region as per the compiled checklist of the biodiversity of hymenopterous parasitoids associated with rice ecosystem by Dey et al.
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Enhanced natural enemy abundance had been reported in several organic systems (Fuller et al., 2005), and increased population of natural enemies, such as carabid beetles were noted (Pfinner et al., 1996). Rice cultivation system using conventional methods supports low biodiversity (Loreau et al., 2002), however, organic farming can reduce leaching of nutrients and store more carbon (Drinkwater et al., 1995). The present results indicate that release of biocontrol agents if done at the early crop stage would yield better control of YSB, and mass production and release of *Telenomus* sp. can be recommended due to its maximum efficiency.

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Table 1. Parasitization of *S. incertulas* by egg parasitoids in organic and conventional practices in rice (kharif, 2019)

<table>
<thead>
<tr>
<th>Month of egg mass collection</th>
<th><em>Telenomus dignus</em> (Mean ± S.Ed)</th>
<th><em>Tetrastichus schoenobii</em></th>
<th><em>Trichogramma japonicum</em></th>
<th><em>Telenomus dignus + Tetrastichus schoenobii + Trichogramma japonicum</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>August</td>
<td>1.01 ± 2.83</td>
<td>0.01</td>
<td>0.16 ± 0.16</td>
<td>0.24 ± 0.01 0.01</td>
</tr>
<tr>
<td>September</td>
<td>0.31 ± 0.02</td>
<td>0.16</td>
<td>0.07 ± 0.01</td>
<td>0.16 ± 0.07 0.07</td>
</tr>
<tr>
<td>October</td>
<td>6.59 ± 2.56</td>
<td>0.02</td>
<td>0.16 ± 0.01</td>
<td>0.58 ± 0.15 0.01</td>
</tr>
<tr>
<td>November</td>
<td>3.09 ± 2.34</td>
<td>1.16</td>
<td>0.24 ± 0.05</td>
<td>0.32 ± 0.15 0.15</td>
</tr>
<tr>
<td>(Mean ± S.E.d)</td>
<td>2.76 ± 2.83</td>
<td>0.34 ± 0.56</td>
<td>0.25 ± 0.13</td>
<td>0.06 ± 0.08 0.07 ± 0.01</td>
</tr>
</tbody>
</table>

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