Augmentation Model of *Trichogramma japonicum* for Yellow Rice Stem Borer (*Schirpophaga incertulas* Waker) Control On Organic Rice Cultivation

M Syarief[1] **and I Erdiyansyah**[2]

[1,2] Agricultural Production Department, State Polytechnic of Jember, East Java, Indonesia

E-mail: m_syarief@polije.ac.id

Abstract. This study aims to identify the diversity of yellow rice stem borer (YRSB) in organic and non-organic rice plants, *T. Japonicum* parasitation on *Corcyra cephalonica* eggs, the effect of *T. japonicum* augmentation on the intensity of attacks and yields... Augmentation of 5000 *T. japonicum* per week on organic rice fields starting three weeks after planting (WAP) to 7 WAP, do not use insecticides. Non organic rice cultivation are not augmented use synthetic insecticides. The area of each plot is 1000 m^2. The results showed that parasitoid egg associated with YRSB, includes *Tetrastichus schoenobii* Ferr, *Telenomus rowani* Gahan and *Trichogramma japonicum* Ashm .Yellor Rice Stem Borer attack intensity at 4 WAP, 5 WAP and 8 WAP, non augmentation treatment shows higher than augmentation. The yield of dry weight grain without augmentation was 40.543 grams per clump higher than augmentation was 27.369 grams per clump.

1. Introductions

Parasitoid Augmentation is a biological control technology that needs to be developed for the realization of sustainable agriculture [1]. Parasitoid released in the field comes from one type of parasitoid that has been known to be able to control pests. These successes are still diverse. YRSB control by releasing *Trichogramma spp.* which has been carried out in Indonesia needs to be evaluated further so as to obtain biological control practices with effective and efficient egg parasitoid augmentation techniques. Further evaluation that needs to be done is the selection of the right parasitoid candidate species so that it can effectively provide a real mortality contribution to the target pest. The population dynamics of target pest insects in an ecosystem have been understood so that they can apply effective control techniques by adjusting the release time and the presence of the host in the crop, as well as the number of parasitoid released [2].

The aim of this research to identify the diversity of YRSB egg parasitoid, parasitic *T. japonicum* on *C. cephalonica* eggs, the effect of *T. japonicum* augmentation on the intensity of YRSB attack and yield.

Expectations of the results of this study can motivate farmers to implement control YRSB uses *T. japonicum* egg parasitoid to support the food security program.The benefits of this research in terms of technology are improving the efficiency of pest control in organic rice cultivation by utilizing the potential of natural enemies available in nature, and opening business opportunities through mass production of artificial eggs (*C. Cepalonica*) synchronized with *T. japonicum*.

2. Literatur View

Anonimous [3] explains that the YRSB is the main pest crop of rice in Central Java in the last ten years. The existence of YRSB occurs during the rice growing season with high intensity, especially in the rainy season. The main type of YRSB is *S. incertulas*. *Trichogramma japonicum* application in organic farming is still not widely applied. Information is lacking, including information about species and abundance of the *T.japonicum* population. In this study investigated the species and abundance of YRSB populations in organic and inorganic rice ecosystems. The results showed that the dominant Rice Stem Borer (RSB) was *S. incertulas*. Yellow Rice Stem Borer is found in every rice growing season in both organic and inorganic rice fields.

Baehaki [4] explains that in Indonesia there are five species of RSB which are an obstacle in irrigated and tidal land. The rice stem borer is a yellow rice stem borer *Scirpophaga (Tryporyza) incertulas* (Walker) (Lepidoptera: Pyralidae), white rice stemborer *Scirpophaga (Tryporyza) innotata* (Walker), *Chilo suppressalis* (Walker), *Chilo Polychrysus* (Meyrick), and *Sesamia inferens* (Walker).

Suharto [5] explains that temporary stains are the second important rice pest after rats in Indonesia. Results showed that the dominant species of stem borer was YRSB (*S. incertulas*.). Degree of stem borers infestation depended upon the planting time. Attack intensity at the first planting time was higher (average 37.90%) compared to those found at the second and third planting time, i.e. 0.65% and 0.54%, respectively. Rice yields of Fatmawati, Gilirang, Maro, Intani-3, and Cilosari cultivars correlated with the degree of YSRB temporary infestation.

Baehaki [4] explains that the intensity of YSRB attacks will be high during the rainy season when the rice plant population is also abundant and the humidity is very high. In Central Java as well as other types of YSRB followed by white rice stem borer is the dominant type compared to other types of stem borer. The relationship between parasitic level of egg borers and occurrence of YSRB can provide a real picture of the performance of parasitoid *Tetrasticus schoenobii*, *Telenomus rowani, Telenomus dignus*, and *T. japonicum* in inhibiting hatching of YSRB eggs. The high parasitoid parasitation is expected to inhibit hatching eggs, so that the symptoms of YSRB in the cropping can be reduced.

Hadi [3] explains that until now there has never been a full development of research related to the diversity of YRSB populations in organic and inorganic rice fields. By minimizing the use of chemicals in organic rice fields, both in the form of fertilizers and pesticides, it certainly provides an opportunity for increasing the diversity of YRSB populations, compared to inorganic rice fields that still use synthetic chemicals in the form of fertilizers and pesticides.

3. Methodology

The experiment was conducted in Balung Lor village, Jember, East Java in the dry season of 2018. This study aims to identify the diversity of YSRB egg parasitoid, *T. japonicum* parasitic against *Corcyra cephalonica* eggs, the effect of *T. japonicum* augmentation on intensity attack and yields. The study was conducted by comparing 2 different treatment plots. The first plot of augmentation treatment on organic rice cultivation is 5000 *T. japonicum* every week starting at three WAP to 7 WAP. Inorganic rice cultivation are not augmented. Plot area of each treatment is 1000 m^2, non organic rice cultivation applies synthetic insecticide, organic rice cultivation without insecticide application.

The parameters observed include: a. Diversity of YRSB egg parasitoid b. The percentage of parasitation of eggs of *T. japonicum* on *C. cephalonica* eggs. c. Intensity of YRSB attacks d. Yields. Data is displayed in the form of a Box plot, analyzed using non-parametric analysis with SPSS 23.0.

1) Yellow Rice Stem Borrer egg parasitoid diversity.

Yellow Rice Stem Borrer egg mass obtained from the field, taken on plants aged 2 - 3 weeks by cutting rice leaves three cm containing YRSB eggs, then put in a plastic tube, labeled the location and date of extraction, brought to the laboratory for maintained and identification. Identification of parasitoid insects that appear to be carried out up to the species level using the book The Pest of Crops in Indonesia [6]. Observation begins a day after sampling until no parasitoid appears. Observations included the number of parasites, parasitoid species that appeared, the group of eggs that did not hatch first removed their hair, then soaked with 3% KOH as much as 3 ml for 24 hours then performed dissection under a microscope. Larva YRSB and imago parasitoid still left in the egg is recorded.

2) Percentage of parasitation

The *C. cephalonica* eggs in pyas were 10 mm x 10 mm @ 2500 *C. cephalonica eggs* which *is* parasitized by *T. japonicum*, in a glass tube (Ø15 mm, 80 mm long), stored in a room with a temperature of 27 ± 2 ° C, RH = 70-80% . Percentage of parasitation by *T. japonicum* was observed using the following formula:

$$P = \frac{A}{B} x100\% \quad (1)$$

Description: P = Percentage of parasitation; A = Number of parasites; B = Number of whole eggs.

3) Intensity of YRSB attacks

Observation of the intensity of the YRSB attack was carried out 6 days after augmentation, using the formula:

$$IS = \frac{a}{a+b} x100\% \quad (2)$$

Description: IS Intensity of YRSB attacks (%), a number of plants attacked, b number of plants not attacked.

4) Yields observation is carried out on the weight of dry grains per clump.

4. Result and discussion

1) Yellor Rice Stem Borrer egg parasitoid diversity.

Egg parasitoid associated with YRSB includes *Tetrastichus schoenobii* Ferr (Hymenoptera: Eulophidae), *Telenomus rowani* Gahan (Hymenoptera: Scelionidae) and *Trichogramma japonicum* Ashm (Hymenoptera: Trichogrammatidae). This is consistent with the results of Supartha's study [7] conducted in Badung, Tabanan and Jembrana regencies that the characteristics of the egg parasitoid community associated with YRSB consisted of three species namely *Tetratichus schonobii*, *Telenomus rowani* and *Trichogramma japonicum*, with Similarity index is 1.

Figure 1. *Tetrastichus schoenobii* Ferr

Tetrastichus schoenobii egg parasitoid is blue, metallic green or bright green. Short blunt head with fine hair and oval occeli. The blackish brown antenna has eight segments. The lower mouth is shiny brown. The cheeks are bright and soft, there are front wings and sword-shaped rear wings with curved edges. Abdomen round cylindrical with eight segments. Ovipositor is a yellowish brown color, very short and thick. The legs are yellow with four segmented tarsus [6].

Figure 2. *Telenomus rowani* Gahan

Telenomus rowani is brownish black with a body length of approximately 2 (two) mm. The 0.28 mm flat wing is located on the thorax. The antenna is elbow-shaped, at the tip of the female antenna it is enlarged while in the male the tip is symmetrical [6].

Figure 3. *T. japonicum* Ashm.

Parasitoid *T. japonicum* is about one mm long. 0.8 mm wing length with hair on its side. Male image at the end of the antenna has comb-like hair, while the female imago does not [6].

2) Percentage of parasitation

The percentage of parasitation *T. japonicum* on *C. cephalonica* was 40.00±4.00%. This shows that the parasitic level is classified as moderate. This can be caused by *C. cephalonica* eggs is not the original host of *T. japonicum*. According to research Rauf [8] states that the parasitization of *Trichogamma sp*. with a parasitic rate of 40% including moderate parasitation.

3) Intensity of YRSB attacks

Table 1. Intensity of YRSB attacks (%)

Treatment	4 WAP	5 WAP	6 WAP	7 WAP	8 WAP
Without augmentation	1.05±3.43[a]	1.45±4.10[a]	2.60±5.96[a]	4.85±8.17[a]	7.85±10.80[a]
Augmentation	0.00±0.00[b]	0.00±0.00[b]	0.20±1.21[a]	1.10±3.45[a]	1.50± 4.52[b]

Remarks: the average number followed by a different letter shows significantly different according to Mann-Whitney Test ($p<0.05$).

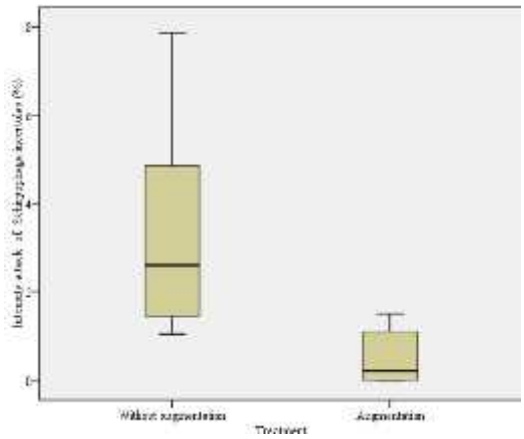

Figure 4. Intensity of YRSB attacks

The intensity of the YRSB attack shows that the augmentation treatment is lower than without augmentation at 4 WAP, 5 WAP and 8 WAP. At 6 WAP and 7 WAP shows different is not real. This can be due to a compatible collaboration between *T. japonicum* and *T. Schonobii* since the beginning of the vegetative phase, whereas since 6 WAP its existence has been replaced by *T. rowani* which has a low capacity. Towards the generative phase, the intensity of YRSB attacks on augmentation treatment was significantly different, this was due to the accumulation of abundance of *T. japonicum* for 2 times augmentation. This condition is in accordance with the results of Supartha's study [7] which states that the three types of egg parasitoids namely *T. Schonobii*, *T. rowani* and *T. japonicum* have been in the ecosystem of rice plants since the plants were 2 WAP, whose population was nominated by *T. Schonobii* in the vegetative phase and since the 6 WAP plant (before the generative phase) is replaced by *T. rowani* population. Another factor causing the high intensity of YRSB attacks is inorganic rice cultivation that applies synthetic insecticide applications every week, indicating the intensity of YRSB attacks is higher than organic rice cultivation. This is due to the intensive application of synthetic insecticides which can kill YRSB egg parasitoid which is not an insecticide target. According to Arifin [10]

and Amalin [11], the populations of arthropods can be affected by pesticides. Pesticides directly affect insect and indirectly impact insecticidal applications through the food chain [12]. Parasitoid activities can affect the level of susceptibility to insecticides. Parasitoids and that are active, are more susceptible to insecticides because they are more often in contact with insecticidal residues attached to the plant surface. Insecticides can also have an indirect effect on parasitoids because they prey on pests contaminated with insecticides. Pests have enzymes that are able to detoxify the toxic compounds they eat, while parasitoids do not have these enzymes. Availability of food in the field is pollen, insecticide-contaminated nectar has a negative influence on the population of parasitoids, especially from the order of Hymenoptera Croft [13].

4) Yields

Table 2. Yields of dry grain per clump (grams)

Treatment	Average (±SD)
Without augmentation	40.543±13,62[b]
Augmentation	27.369±11,89[a]

Remarks: the average number followed by different letters shows significantly different according to the Mann-Whitney Test ($p < 0.05$).

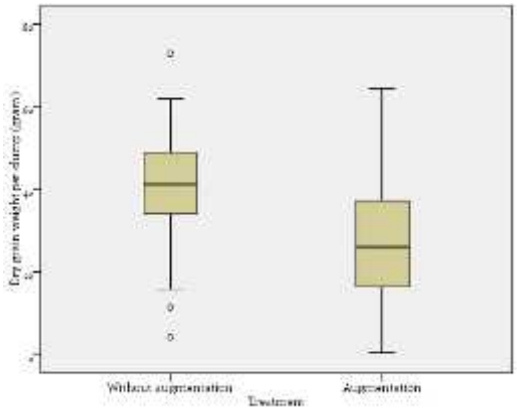

Figure 5. Dry grain weight per clump

The dry weight of grain per clump on the augmentation is lower, while the intensity of the YRSB attack is lower. This is more influenced by fertilization factors. Inorganic rice cultivation uses inorganic fertilizer, while organic cultivation uses organic fertilizer as a whole without combination with organic fertilizer, this will have an impact on high yields in inorganic rice cultivation rather than inorganic. The main function of inorganic fertilizers is plant nutrient enhancer, has several advantages. The benefits of inorganic fertilizers are able to provide nutrients in a relatively faster time, produce available nutrients that are ready to be absorbed by plants, more nutrients than organic fertilizers. Weakness of organic fertilizer compared to mineral fertilizer, is low nutrient content, availability of nutrients is slow. Organic fertilization without NPK does not support plant growth. This is in accordance with Manik's research [9] which states that organic fertilizer "PhOSta" given without the addition of mineral fertilizers does not have a positive impact on plants.

5. Conclusion

Parasitoid Egg associated with YRSB, includes *Tetrastichus schoenobii* Ferr (Hymenoptera: Eulophidae), *Telenomus rowani* Gahan (Hymenoptera: Scelionidae) and *Trichogramma japonicum* Ashm (Hymenoptera: Trichogrammatidae). Yellor Rice Stem Borer attack intensity at 4 WAP, 5 WAP and 8 WAP, non augmentation treatment shows higher than augmentation. The yield of dry weight grain treatment without augmentation was higher 40,543±13,62 grams per clump compared to the treatment of augmentation 27,369 ± 11.89 grams per clump.

6. Acknowledgement

On this occasion the author expressed his appreciation and utmost gratitude to the State Polytechnic of Jember, for funding this research activity. We also thank the Head of the Research Center and Community Service, Mr. Sulkan who have supported this research activity.

.

References

[1] Buchori D, Nurindah A, Sari D Adisunarto and B Sahari 2009. *Proc. Nat. on Entomol.*(Bogor) PP 52-63
[2] Nurindah, D.A. Sunarto and Sujak 2016. *Indonesian J. Entomol.* Vol. **13** Issue 2 PP 107-116.
[3] Hadi RC, H Soesilohadi, FX Wagiman, YR Suhardjono 2014 *Bul. Anat & Phys*. Vol. **22** Issue 1 PP 72-77
[4] Baehaki SE 2013 *J. Agric.Sci*.Vol. **6** Issue 2 PP 39-45
[6] Kalshoven LGE 1981. *The Pest of Crops in Indonesia* (Jakarta: Ichtiar Baru-van Hoeve)
[7] Supartha IW, IW Susila, MS and IK Sumiartha 2015 (Denpasar: Udayana University) p.54
[8] Rauf A 2000 *Bul. Plant Pests and Diseases* ISSN 0854-3836 Vol.**12** Issue 1 PP 1-10.
[9] Manik DP 2011 (Bogor: Bogor Agricultural University) 39 p
[10] Arifin M, IBG Suryawan, BH Priyanto and A Alwi 2011 *Food Crops Res.* Vol. **15** Issue 2 PP 5-12.
[11] Amalin DMJ, E Pera, R Duncan, J Leavengood and S Koptur 2009 *Proc. Fla. State Hort. Soc*. Vol. **122** PP 429-437.
[12] Brown AWA. 1987. *Ecology of pesticides*. (New York: Wiley)
[13] Croft BA, 1990. *Arthrpod Biological Agents and Pesticides*. (New York: Wiley)