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Original Article

Trichogrammatid egg parasitoids on Lepidopteran pests in West Sumatera and their parasitization

Hidrayani*, Yunisman
Plant Protection Department, Agriculture Faculty, Universitas Andalas, Padang, Indonesia

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**Corresponding author email:*
hidrayani@yahoo.com

Abstract

Species diversity of Trichogrammatid egg parasitoids parasitized lepidopteran pests was studied in West Sumatera. The lepidopteran eggs were collected from rice plants, corns, cabbages, and tomatoes distributed in five regencies with different altitudes. Three species of Trichogrammatid were recorded. *Trichogramma japonicum* parasitized *Schirphopaga incertulas* and distributed in all regencies planted rice with their parasitization ranged between 3.5-27.8%. *Trichogramma chilotreae* parasitizing *Crocidolomia binotalis* was distributed in all regencies planted cabbages with parasitization ranged between 5.3-5.6%. *Trichogrammatiodea* sp. parasitizing *Helicoverpa armigera* attacking corns was only found in Solok with parasitization 18.4%. Only one species of Trichogrammatid was found to parasitize each of lepidopteran eggs. None of egg parasitoid was found to parasitize *H. armigera* attacking tomatoes. No difference was shown on the parasitization level of *T. japonicum* between high and low land planted rice.

Keywords: Diversity, Trichogrammatidae, Lepidopteran pests

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Introduction

Many farmers in West Sumatera still use chemical insecticides even though the negative impacts have been detected from overuse of those chemicals. The insecticides have killed the natural enemies (Oatman and Kennedy; 1976, Hidrayani et al., 2005), causing insect resistance to insecticides (Parella, 1982; Johnson, 1993), causing resurgence, secondary pests outbreak, problem of residue, health, and environmental pollution (Rauf et al., 2000). To decrease the negative impacts, the government has instructed to implement Integrated Pest Management (IPM) since 1986 (Untung, 1993). However, up to present time the adoption of the technology is still slow, one of the reasons is due to IPM complexity and it is knowledge based technology (Peshin et al., 2009) and also location specific. So, the farmers have to understand the principal of IPM strategies one of which is preserving and enhancing the function of natural enemies. The farmers will not be able to conserve and enhance the natural enemies if they do not know the kind of natural enemies present around them.

There have been a lot of studies done on larval parasitoids in West Sumatera mainly on vegetables (Hidrayani, 2003; Hidrayani et al., 2006 & 2009; Hidrayani, 2010: Nelly et al., 2010). However, there

has not been a study done on egg parasitoids, such as *Trichogramma* and *Trichogrammatoidea* spp. which belong to family Trichogrammatidae even though they have a great potential to control the pest population in early stage and attack various kind of eggs from different orders, and also it can be reared on fictitious hosts (Buchori et al., 2002). So far, around 15 spesies of Trichogrammatidae have been reported in Indonesia (Buchori et al., 200) and 5 species were recorded in Java (Buchori et al., 2010). *Trichogramma agriae*, *T. chilonis* and *T. chilotraeae* were collected and reported from all five Agro-climatic zones in India (Yousuf et al., 2016).

It is very important to explore the species of Trichogrammatidae and its diversity as a basic information in controlling Lepidopteran pests in the field to complete the IPM components. Ecologically, it is also important to study the effect of host plants of pests on the parasitoids because the host plants are known to have an effect on the parasitoid choices to host insects (Hidrayani et al., 2007). The altitude also needs to be considered as the factor influencing the species and its abundance. Therefore, this research was aimed at studying the species diversity of Trichogrammatid egg parasitoids and their parasitization on different host insects and plants, and altitudes in West Sumatera.

Material and Methods

Exploration

The exploration aimed at determining the species, the abundance, and the parasitization level of Trichogramma egg parasitoids parasitizing various eggs of lepidopteran pests attacking different host plants (rice, corn, tomato, and cabbage) distributed in low and high lands in five regencies in West Sumatera. Samples from low land areas were collected from three regencies in West Sumatera, i.e. Padang Pariaman, Lima Puluh Kota, and Tanah Datar, and samples from upland areas were collected from three regencies also, i.e. Solok, Tanah Datar, and Agam. Stratified purposive sampling method was applied.

Each area is the production center for rice, corn, tomato, and cabbage. The samples were taken from two farmer's field per area. The lepidopteran eggs were collected from 40 plants located along diagonals of 400 m² area. The eggs collected were *Schirpophaga incertulas* from rice, *Helicoverpa armigera* from corn and tomato plants, and *Crocidolomia pavonana* from cabbage.

Identification

The eggs collected were brought to laboratory and then incubated in 25-28ºC until the adult parasitoids emerged and then placed in micro tube (1,5 ml) filled with 70% alcohol and sent to the Laboratory of Department of Plant Protection Agriculture Faculty, Bogor Agricultural University for identification further. Parameters measured were the number of lepidopteran eggs collected, the species and number of each species of Trichogrammatid, and parasitization level of each species of parasitoid. The parasitization level of each species of parasitoid determined by the following formula:

$$\text{Parasitization (\%)} = \frac{\text{total parasitized eggs}}{\text{total collected eggs}} \text{ x } 100\%$$

All data were then arranged in table form and not statistically processed further.

Results and Discussion

Species of Trichogrammatid parasitoids and their parasitization

There were three species of lepidopteran pest eggs collected, i.e. *Scirpophaga incertulas* on rice, *Helicoverpa armigera* on corn and tomato, and *Crocidolomia pavonana* on cabbage. The eggs of *S. incertulas*, *H. armigera*, and *C. pavonana* were parastized by *Trichogramma japonicum* Ashmead, *Trichogrammatoidea* sp and *Trichogramma chilotraeae* Nagaraja & Nagarkatti respectively. There was only one species of Trichogrammatid parasitoid parasitizing each species of pest which means each species of egg parasitoid is specialized. Species of parasitoids and their parasitization in different pests and regencies in West Sumatera were shown in Table 1.

Species of *T. Japonicum* parasitizing rice stem borers was found in almost all regencies sampled. It indicated that this species has been distributed in West Sumatera even though its parasitization was low (3.5 - 27.8 %). However, it was not impossible that this parasitoid was effective in controlling the Lepidopteran pests on rice in the field. Under field condition, Trichogramma is less resistant especially due to its very tiny size and also the overuse of chemical insecticides. It is a good sign that even under pressure the parasitoids were still available.

Table-1: The number of lepidopteran eggs collected and Trichogrammatid parasitoids, and parasitization level on different altitudes and crops in West Sumatera

Regency	District	Host plants	Pests species	∑ egg or egg cluster/ 400 m²	Trichogrammatids		
					Species	∑ adult	Parasitization (%)
Low land							
Padang Pariaman	Batang Anai (155 m asl)	Rice	*S. incertulas*	44	-	-	-
		corn	*H. armigera*	30	-	-	-
		tomato	-	-	-	-	-
		cabbage	-	-	-	-	-
	Lubuk Alung (110 m asl)	rice	*S. incertulas*	53	*T. japonicum*	10	18.9
		corn	*H. armigera*	22	-	-	-
		tomato	-	-	-	-	-
		cabbage	-	-	-	-	-
Tanah Datar	Rambatan (570 m asl)	rice	*S. incertulas*	86	*T. japonicum*	3	3.5
		corn	*H. armigera*	80	-	-	-
		tomato	-	-	-	-	-
		cabbage	-	-	-	-	-
Lima Puluh Kota	Mungka (510 m asl)	Rice	-	-	-	-	-
		corn	*H. armigera*	67	-	-	-
		tomato	-	-	-	-	-
		cabbage	-	-	-	-	-
	Lareh Sago Halaban (680 m asl)	Rice	*S. incertulas*	466	*T. japonicum*	49	10.5
		corn	-	-	-	-	-
		tomato	-	-	-	-	-
		cabbage	-	-	-	-	-
Upland							
Solok	G. Talang (1.380 m asl)	rice	*S. incertulas*	1708	*T. japonicum*	135	7.9
		corn	*H. armigera*	49	*T'oidea Sp.*	9	18.4
		tomato	-	-	-	-	-
		cabbage	-	-	-	-	-
	Lembah Gumanti (1.450 m asl)	rice	-	-	-	-	-
		corn	-	-	-	-	-
		tomato	*H. armigera*	44	-	-	-
		cabbage	*C. pavonana*	1207	*T. chilotraeae*	64	5.3
Tanah Datar	Salimpaung (840 m asl)	rice	*S. incertulas*	1327	*T. japonicum*	73	5.5
		corn	*H. armigera*	34	-	-	-
		tomato	-	-	-	-	-
		cabbage	-	-	-	-	-
	S. Tarab (945 m asl)	rice	*S. incertulas*	4	-	-	-
		corn	-	-	-	-	-
		tomato	*H. armigera*	10	-	-	-
		cabbage	-	-	-	-	-
Agam	IV Koto (1.254 m asl)	rice	*S. incertulas*	36	*T. japonicum*	10	27.8
		corn	*H. armigera*	67	-	-	-
		tomato	-	-	-	-	-
	Banuhampu (1.135 m asl)	rice	-	-	-	-	-
		corn	-	-	-	-	-
		tomato	*H. armigera*	58	-	-	-
		cabbage	*C. pavonana*	1214	*T. chilotraeae*	68	5.6

By managing the field environment the population and function of this parasitoid is expected to increase and will be one component to complete the implementation of Integrated Pest Management of rice pest. It is also very possible to rear the parasitoids since the fictitious host is always available everywhere

in West Sumatera. Trichogrammatid parasitoid is usually appropriate for use as inundative release method to decrease the population of pests in the field. *T. japonicum* was also recorded to be associated with yellow stem borer across the Java Island (Buchori et al., 2010).

Trichogrammatoidea sp was only found parasitized *H. Armigera* sampled from Solok regency. None of *Trichogrammatoidea* sp was found in other 4 regencies in West Sumatera. It indicated that this species was still not distributed in West Sumatera. Agriculture officer stated that in Solok there was once a release of Trichogrammatid around the year 2000 brought from East Jawa by agricultural staff. It might be the species that still existed in Solok but had not yet distributed to other locations. There should be an action to distribute the parasitoid since the parasitisation of that species is good enough compared to other species. By doing so, the IPM corn pest management can be supported. *H. armigera* eggs were also collected from tomato in three locations but none of parasitoid emerged from the eggs. This condition could be the result of excessively use of chemical pesticides on tomato for pests and diseases management that caused the parasitoid never establish there. Tomato farmers usually spray the tomato plants based on calendar schedule that really affects the parasitoids.

Trichogramma chilotraeae parasitized *C. pavonana* was found in two cabbage production areas - Agam and Solok regencies with more or less the same level of parasitization which was very low (5.3-5.6 %). However, it was a good sign that the species existed already in the cabbage fields in West Sumatera. By managing the environment we could expect the population to be enhanced and would support the IPM of cabbage pests.

Over all parasitization level of Trichogrammatid egg parasitoids found in West Sumatera were very low. This should be related to the very intensive use of synthetic pesticides which kill natural enemies (Hidrayani, 2003; Oatman and Kennedy, 1976). Thus, reduction in synthetic pesticide use will support the function of natural enemies.

Diversity of Trichogrammatid egg parasitoids on different host insects and plants and altitudes

There was only one species of Trichogrammatid egg parasitoid found parasitizing each of lepidopteran pest species attacking different species of plants (Table 1). It indicated that in West Sumatera this species was very specific to its host insect and plant. Different host insect was parasitized by different species of egg parasitoid. Two species of egg parasitoid, *T. japonicum* and *T. chilotraeae* were distributed in almost all location in West Sumatera, except egg parasitoid *Trichogrammatoidea* sp. which showed the effect of host plant. No parasitoid was found parasitizing *H. armigera* attacking tomato. However, this condition weather the effect of host plant or intensiveness of pesticide use, or the effect of altitude, could not be explained here and it needed more detailed study.

The effect of altitude on diversity of egg parasitoid could be studied on the abundance of *T. japonicum* since rice is distributed in low and high land (Table 2). Data on Table 2 showed that the parasitization of *T. japonicum* on yellow rice stem borer attacking low land planted rice ranged from 0 - 13.14 %, which was not different from the one in the high land, 0 - 2.63 %.

Table-2: Abundance and parasitization of egg parasitoid, *Trichogramma japonicum* attacking yellow rice stem borer on low land and high land that planted by rice

Altitude	Regency	Number of egg clusters/400 m²	Number of eggs	Number of *T. japonicum*	Parasitization (%)
Low land	Padang Pariaman	25	916	0	0
	Tanah Datar	16	1,698	3	0.18
	Lima Puluh Kota	2	137	18	13.14
High land	Agam	8	380	10	2.63
	Tanah Datar	4	256	0	0
	Solok	23	2,228	51	2.29

Conclusion

Three species of Trichogrammatidae parasitized lepidopteran pests attacking several crops were recorded in West Sumatera. They were *Trichogramma japonicum*, *Trichogrammatoidea* sp., and *Trichogramma chilotreae* which parasitized *Scirphopaga incertulas* on rice, *Helicoverpa armigera* on corn, and *Crocidolomia pavonana* on cabbage respectively. Parasitization of each parasitoid was low of 0 – 27.7%. Only one species found parasitized each of egg pest species. Altitudes of rice planting areas did not show effect on diversity of *Trichogrammatidae*. Further studies were needed to investigate the real potential of these egg parasitoid as biological control agents for Lepidopteran pests.

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Contribution of Authors

Hidrayani: Conceived idea, conducted experiment, compilation of results and write up of article
Yunisman: Helped in experiment and article write up

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