ECOLOGY OF DIAMONDBACK MOTH, *Plutella xylostella* L. (LEPIDOPTERA: YPONOMEUTIDAE) ON MUSTARD *(Brassica juncea* COSS) IN LOWLAND AREA OF SOUTH SUMATERA

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ABSTRACT

Surveys during February up to November 2003 at Kenten, Sukarami, and Talang Buruk, South Sumatera were conducted to determine population and damage by the DBM on mustard, to identify its parasitoid species, and to evaluate parasitism by the parasitoids. The larval-infested leaves and its population were recorded every 3-4 days. The eggs, and the 3rd and 4th instars or pupae were collected weekly from mustard (*Brassica juncea* Coss.) for recording the level of the parasitism. Among three locations, the highest population was found at Sukarami (0.40 larvae per plant). The larval population was associated with crop age. The population increased with the increasing the crop age. The damage by DBM was higher on mustard at Sukarami (15.55%) and Talang Buruk (15.77%) than at Kenten (11.78%). The mustard leaf damage was up to 38.54% at Talang Buruk. We found two species of hymenopteran parasitoids associated with the eggs, and the 3rd and 4th instars or pupae. The parasitoids found were *Trichogramma* sp., and *Cotesia* sp. Rates of the parasitism by the egg parasitoid reached 8.33%. The most common larval parasitoid found was *Cotesia* sp., and its parasitism reached 80.95.

Keywords: Population, damage, parasitoids, diamondback moth, and South Sumatera

INTRODUCTION

Background

The diamondback moth (DBM), *Plutella xylostella* L. (Lepidoptera: Yponomeutidae) is the most damaging insect pest of brassicaceous vegetables, particularly cabbage, broccoli, and mustard in Indonesia. The larval stages feed on the leaves of host plants, and at high densities this feeding can severely reduce yields to zero, especially under dry condition (Sastrosiswojo 1984; Sastrosiswojo, 1993).

Control of the DBM using sinthetic insecticides has been extensively researched and commonly used by smallholder farmers in Indonesia, especially in South Sumatera. Its resistance to major classes of the insecticides in field populations has evolved worldwide (Shelton et al., 1993; Shelton et al., 2000; Zhao et al., 2002; Listyaningrum et al., 2003; Sastrosiswojo et al., 2003; Willis, 2003). To counter this problem, efforts are being made to develop biological control-based management programmes for this pest (Kartosuwondo & Sunjaya 1990; Idris & Grafius, 1995; Kartosuwondo, 1994; Akol et al., 2002; Herlinda et al., 2003; Herlinda & Winasa, 2003). The biological control is an important keystone of integrated pest management (IPM). For integrated pest management, basic information on the ecology of this pest

is necessary. That information in field vegetable crops in lowland area of South Sumatera is lacking.

Objectives

This research was conducted to determine population and damage by the DBM on mustard, to identify its parasitoid species, and to evaluate parasitism by the parasitoids.

METHODS

Surveys were conducted from February until November 2003 at Kenten, Sukarami, and Talang Buruk, South Sumatera. The temperature and relative humidity during surveys were 30^{o} C and 80%, respectively. Rainfall was 7 mm/day, and the elevation of the location is 5 m above sea level.

DBM Damage and Population

This DBM population was monitored in field mustard leaves at Kenten, Sukarami, and Talang Buruk, South Sumatera. The population was monitored by observing directly leaves infested by this pest. The population monitored from three until 21 days after mustard planting. The host leaves infested by this pest were observed every three or four days.

This DBM damage was also recorded in the same plot of the population monitored. From the plot, we took 10 % of plant population to determine the damage of DBM. Determination of damage by DBM i.e. 0 = no damage; 1 = > 0 damage ≥ 25%; 2 = > 25 damage ≥ 50%; 3 = > 50 damage ≥ 75%; dan 4 = >75 damage ≥ 100%.

DBM Parasitoids

To explore the parasitoid DBM eggs and larvae, and to evaluate the rates of the parasitism by parasitoids, we took surveys at the center of braccicaceous vegetables, such as Kenten, Sukarami, and Talang Buruk, South Sumatera. The eggs, and 3rd and 4th instars or larvae from mustard (*Brassica juncea* Coss) were collected every three days or weekly. Then, the eggs kept in test tubes, but the larvae kept in plastic container (15 cm diameter, 20 cm height) at the Plant Pest Laboratory of Plant Pest and Disease Department, Faculty of Agriculture, Sriwijaya University, and provided with leaves of mustard growing at the Greenhouse of the Plant Pest and Disease Department. The eggs or larvae from different host plants and locations kept in the different containers. The DBM adults and the parasitoids emerged were recorded daily. The parasitoids kept in vials containing 70% alcohol. The parasitoids found were identified at the Plant Pest Laboratory of Faculty of Agriculture, Sriwijaya University.

Data analysis

The population, damage, and parasitoid species of DBM eggs and larvae, and the rates of parasitism by the parasitoids on the larvae were tabulated.

RESULTS AND DISCUSSION

DBM Damage and Population

The adult DBM is about 8-9 mm long. Its body colour is greyish with a characteristic cream row of diamond-shaped marking along the mid-line of the folded wings. This pest is called the diamondback moth due to the marking on the wings. The tips of moth hindwing are fringed with long grey hairs.

DBM immature stages or larval stages are foliage damage. The larval damage on mustard caused slight perforations, created windows on the lower surfaces of leaves (Figure 1). Table 1 shows level of damage by DBM on two different strata of mustard leaves at Kenten, Sukarami, and Talang Buruk, South Sumatera for one period of growing season. At Sukarami and Talang Buruk, mustard damage from upper stratum tended to be lower than lower stratum. Athough DBM larvae fed on all mustard parts, they preferred older leaves. Larvae fed on the lower surfaces of the

Table 1. Vertical distribution of damage by *Plutella xylostella* larvae on mustard leaves according to two different strata of canopy at Kenten, Sukarami, and Talang Buruk, South Sumatera

Age Crop (days)	Damage by *P. xylostella* larvae (%)					
	Kenten		Sukarami		Talang Buruk	
	Upper Stratum	Lower Stratum	Upper Stratum	Lower Stratum	Upper Stratum	Lower Stratum
4	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00
11	6.44	5.64	9.81	6.63	2.76	2.43
14	19.02	19.05	19.57	20.48	14.91	15.24
18	23.02	22.46	29.00	36.58	38.42	38.46
21	23.12	22.64	28.50	36.00	38.42	38.67
Total	71.61	69,79	86.88	99.69	94.51	94.80
Average	11.93	11.64	14.48	16.62	15.75	15.80

Figure 1. Damage caused by *Plutella xylostella* larvae on leaves of mustard

Table 2. Population and damage by *Plutella xylostella* L. larvae on mustard at Kenten, Sukarami, and Talang Buruk, South Sumatera

Age Crop (days)	Larval Population (larvae/plant)			Damage by *P. xylostella* Larvae (%)		
	Kenten	Sukarami	Talang Buruk	Kenten	Sukarami	Talang Buruk

4	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.05	0.00	6.04	8.22	2.60
14	0.73	0.28	0.51	19.03	20.02	15.02
18	0.81	1.21	1.08	22.73	32.78	38.44
21	0.00	0.84	0.68	22.87	32.24	38.54
Total	1.54	2.38	2.27	70.70	93.29	94.66
Average	0.26	0.40	0.38	11.78	15.55	15.77

leaves where they typically created windows. Larvae often moved to the heart of the mustard where they fed on the developing leaves and soiled them with their faeces.

The larvae population of DBM was associated with crop age. The DBM larvae found were low on the young mustard, but more larvae were found at the older one. When the mustard was 4-7 day old, the larvae were not found. Among three locations, the highest population was found at Sukarami (0.40 larvae per plant) (Table 2). Farmers from the locations have been extensively used sinthetic insecticides to control this pest, but this pest still occured. More studies of the effects of the insecticide application showed most types of the sinthetic chemicals suppressed parasitoid populations but not DBM larvae (Listyaningrum et al., 2003; Sastrosiswojo et al., 2003; Willis, 2003).

The larval population affected its damage on mustard leaves. The heaviest infestation occurred when the population was highest. The higher level of DBM damage found at 18 and 21 day mustards. The damage by this pest was higher on mustard at Sukarami (15.55%) and Talang Buruk (15.77%) than at Kenten (11.78%) (Table 2). The mustard leaf damage was up to 38.54% at Talang Buruk. Such leaf damage could make mustard product low priced

DBM Parasitoids

We found a species of hymenopteran parasitoids associated with egg of DBM, and a species of larval parasitoid. The egg parasitoid found was *Trichogramma* sp. and the larval parasitoid found was *Cotesia* sp. (Table 3).

Rates of parasitism by the egg parasitoid varied (1.45-8.33%). The highest rates of the parasitism reached 8.33%. The level of parasitism by this parasitoid on the mustard in low land area tended to be lower. It may indicate that parasitoid is not well established on the crop.

The parasitism by larval parasitoid also varied (0-80.95%). The larval parasitoid found was *Cotesia* sp. and its parasitism reached 80.95% (Table 3). Winasa & Herlinda (2003) reported *Cotesia* sp. was the most common parasitoid found in lowland area. Parasitism by this parasitoid varied among locations. The low parasitism was affected by insecticide usage. At the location applicated with intensive insecticide, the parasitism by *Cotesia* sp tended to be lower.

Table 3. The egg and larval parasitoids of *Plutella xylostella* from mustard at Kenten, Sukarami, and Talang Buruk, South Sumatera

Locations of surveys	Period of Survey	Egg or Larval Samples	Parasitoid Species Emerged	The Level of Parasitism (%)
- Kenten	February 5	84 larvae	*Cotesia* sp.	5.95
- Kenten	February 12	86 larvae	*Cotesia* sp.	4.65
- Kenten	February 19	74 larvae	*Cotesia* sp.	4.05
- Kenten	February 26	86 larvae	*Cotesia* sp.	3.49
- Kenten	May 16	32 larvae	*Cotesia* sp.	12.50
- Kenten	May 16	3 pupae	-	0.00
- Kenten	May 17	19 larvae	*Cotesia* sp.	21.05
- Kenten	May 17	22 pupae	-	0.00
- Kenten	May 27	154 larvae	*Cotesia* sp.	1.95
- Kenten	May 27	18 pupae	-	0.00
- Kenten	October 18	91 eggs	*Trichogramma* sp.	5.49
- Kenten	October 21	180 eggs	*Trichogramma* sp.	5.00
- Kenten	October 24	276 eggs	*Trichogramma* sp.	1.45
- Kenten	October 27	193 eggs	*Trichogramma* sp.	2.07
- Kenten	October 30	252 eggs	*Trichogramma* sp.	8.33
- Sukarami	February 05	55 larvae	*Cotesia* sp.	9.09
- Sukarami	February 12	90 larvae	*Cotesia* sp.	2.22
- Sukarami	February 19	89 larvae	*Cotesia* sp.	3.37
- Sukarami	February 26	90 larvae	*Cotesia* sp.	4.44
- Sukarami	May 11	41 larvae	-	0.00
- Sukarami	May 11	6 pupae	-	0.00
- Sukarami	May 13	31 larvae	*Cotesia* sp.	3.23
- Sukarami	May 13	12 pupae	*Cotesia* sp.	8.33
- Sukarami	May 14	34 larvae	*Cotesia* sp.	14.71

Table 3. Continued

Locations of surveys	Period of Survey	Egg or Larval Samples	Parasitoid Species Emerged	The Level of Parasitism (%)
- Sukarami	May 14	5 pupae	*Cotesia* sp.	20.00
- Sukarami	November 4	24 larvae	*Cotesia* sp.	16.67
- Sukarami	November 7	36 larvae	*Cotesia* sp.	22.22
- Sukarami	November 10	21 larvae	*Cotesia* sp.	80.95
- Talang Buruk	February 05	68 larvae	*Cotesia* sp.	0.00
- Talang Buruk	February 12	87 larvae	*Cotesia* sp.	5.75
- Talang Buruk	February 19	83 larvae	*Cotesia* sp.	3.61
- Talang Buruk	February 26	70 larvae	*Cotesia* sp.	2.87
- Talang Buruk	May 20	3 larvae	*Cotesia* sp.	33.33
- Talang Buruk	May 26	20 larvae	*Cotesia* sp.	20.00
- Talang Buruk	May 26	3 pupae	-	0.00
- Talang Buruk	May 26	9 larvae	*Cotesia* sp.	11.11

- Parasitoids not found

CONCLUSION AND RECOMMENDATION

We found two species of hymenopteran parasitoids associated with the eggs and larvae of *P. xylostella*. The egg parasitoid found was *Trichogramma* sp., and the larval parasitoid was *Cotesia* sp. Rates of parasitism by the egg parasitoid reached 8.33%. The most common larval parasitoid found was *Cotesia* sp., and its parasitism reached 80.95%. Among three locations, the highest population of *P. xylostella* was found at Sukarami (0.40 larvae per plant). The larval population was associated with crop age. The population increased with increasing the crop age. The damage by *P. xylostella* was higher on mustard at Sukarami (15.55%) and Talang Buruk (15.77%) than at Kenten (11.78%). The mustard leaf damage was up to 38.54% at Talang Buruk.

The rates of parasitism was greatly affected by insecticide application. The field treated by scheduled application of insecticide had generally low parasitism. *P. xylostella* parasitoids are well established and in most cases providing effective suppression of this pest, if we do not treat the field with insecticides.

ACKNOWLEDGEMENTS

We thank Rini Andayani, Mul Watawally, Devi Magrina, Anita Simatupang, and Darini Chodijah for technical assistance. Financial support of this research was provided by the 10th Integrated Competitive Research Funds, Research and Technology Council (Budget Year 2003, Contract Number: 14.76/SK/RUT/2003, 28th January 2003).

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