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FEEDING RATES AND AGE STRUCTURE OF GOLDEN SNAIL (*Pomacea canaliculata*) AT IRRIGATED RICE FIELD IN MALAKA REGENCY, INDONESIA: IMPLICATION ON INTEGRATED PEST MANAGEMENT

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ABSTRACT

The studies determined the feeding capacity of golden snail (*Pomacea canaliculata* Lamarck**)** and described the age structure of the snail at irrigated rice field in Malaka regency, East Nusa Tenggara Province, Indonesia, to support IPM program in this area. An individual snail was allowed to eat on 60 rice seedlings of Ciherang variety and 1 to 6 weeks old for 24 hours. Results showed that the rice seedlings of 6 weeks old were rejected by all stages of the snail. The young snail (11-20 mm) fed on 1-3 week old of the rice seedlings while the old ones (21-40 mm) fed on 1-5 weeks old of the rice seedlings. The younger the rice seedlings age the more sensitive to be eaten by the snail. The snail was very voracious. In average, snail individual of 11-20 mm, 21-30 mm, and 31-40 mm in length were able to eat transplanted rice seedlings of 3 weeks old as many as 5.4, 14.2 and 20.2 seedlings, respectively. The snails existed in all stages of the rice crop during planting season, from the times of before planting, planting, 1, 2, 3, 4, and 6 weeks after planting, primordial, ripening, and after harvest. The snail population densities were dominated by the smallest one (2-10 mm), followed by 11-20 mm, egg mass, 21-30 mm, 31-40 mm, and 41-50 mm in length i.e. 43.43, 21.31, 13,74, 12.92, 8.51, and 0.08%, respectively. Potency of the snail colonies to destroy paddy at 0 days after transplanting, with assumption that the transplanted rice seedling was 3 weeks old and the water was available enough for snail mobilization, was ca. 1.381seedlings with 148.6 snails/80m^2. It implies that destroy potential of the snail colonies with various stages can be predicted since their feeding capacity and its age structure are known. It also supports decision making for control action in the system of integrated pest management.

Keywords: paddy, golden snail, *Pomacea canaliculata,* voracity, age structure

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INTRODUCTION

The golden snail (*Pomacea canaliculata* Lamarck) is a serious rice pest in Malaka Regency, East Nusa Tenggara Province, Indonesia. Here after the golden snail is called as snail. The snail was not recognized before 2000 but it was very surprising and suddenly getting outbreaks in 2010-2012. The pest infestation had impact on rice yield loss very significantly, from no yield up to 2 ton/ha (Fransisco, 2013; personel communication). The snail is reproducing very fast and it is really threaten rice production in this area (Wagiman, 2014). The problem still not coped well until now.

Previous studies revealed that the snail was distributed at every habitat with puddles. Before rice transplanting the snail colonies were dominated by nymphs, followed by juvenile and adults with proportions of 61.45, 30.32 and 8.23%, respectively (Wagiman, 2014). The snail is belong to fresh-water invasive-species, some of them causing problems of wide environmental and economic impacts (Pimentel *et al*., 2005). Amongst hundreds of the most invasive in the world, the snail is known as one of them (Lowe *et al*., 2000; IRRN, 2005).

Feeding rate and host range of the snail had been reported. The snail is very voracious and feeds on many water vegetations (Fang *et al*, 2010). The host range plants which preferred by the snail are young and soft plants such as rice seedlings, algae, kale, vegetable crops, hyacinth, taro, lotus, and other water weeds (Budiono, 2006., Matsukura, *et al*., 2013). Knowledge on feeding capacity and age structure of the snail are important in relation to determining the tolerable level of its population densities.

MATERIALS AND METHODS

The snail feeding rates

The trial was conducted on arena of 30 buckets sizing 22 cm height, 27 cm top diameter, and 19 cm bottom diameter. The bucket was filled with mud as high as 15 cm and water as high as 6 cm. The snails of 11-20, 21-30 and 31-40 mm in size were used in this trial. Rice seeds of Ciherang variety were planted periodically per week during six consecutive weeks to get various ages of seedlings. As many as 60 rice seedlings were planted circularly at 12 points on each bucket out of 30 buckets.

The snails were collected from rice fields in the afternoon at 16.00-18.00 p.m. Central Indonesia Time (CIT) then starved for 16 hours. A single snail was infested on the test arena at 10.00 a.m. CIT and allowed to feed on the seedlings and its feeding rate was oberved at 24 hours later.

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Analyses of variance followed by DMRT at $\alpha = 0.05$ were applied to determine the significance effects of the snail stages and seedling ages on their feeding rates.

The snail age structue

In this study the age structure term is defined as proportion of population densities of the snail stages at an observation time and place. The age structure of the snail at various rice growths were observed in the planting season of May 2015 at villages of Kamanasa, Wehali, Umakatahan, Harekakae and Kletek. As wide as 400 m^2 of rice field was taken for observation arena of the snail age-structure. At a village observations were conducted at (1) before rice transplanting, (2) transplanting, (3) 1, 2, 3, 4, 6 weeks after transplanting, (4) primordial , (5) ripening, and (6) after harvest. Sample unit was 80 m^2, it was 1 m width_along the inner circumference of the rice plot of 400 m^2. All snail stages were collected then grouped in to eggs, and 2-10, 11-20, 21-30, 31-40 mm, 41-50 mm in size. Graphical analyses was applied to describe the snail age structure.

RESULTS AND DISCUSSION

The snail feeding rates

Results showed that rice seedling ages significantly determined the feeding rates of all snail stages. The snails of 11-20, 21-30, and 31-40 mm in size, did not eat rice seedlings of 5, 6, and 6 weeks old respectively (Tabel 1), the younger the rice seedling the more sensitive to be attack by the snail. It was reported that a snail eats 1 seedling/3-5 minutes or 1 hill/15 minutes (Basri, 2010). It implies that priority program to manage and control the rice pest is emphasized on the early planting season.

Table 1. The feeding rates of three classes of snails on various ages of rice seedlings

Seedling age (weeks)	Number of rice seedlings eaten by three groups of snail within 24 hours		
	11-20 mm	21-30 mm	31-40 mm
1	19.40 ± 2.561 [a]	50.80 ± 2.332 [a]	55.40 ± 1.568 [a]
2	12.00 ± 1.140 [b]	20.40 ± 1.030 [b]	40.60 ± 1.364 [b]
3	5.40 ± 0.678 [c]	14.20 ± 0.917 [c]	20.20 ± 0.970 [c]
4	1.60 ± 0.400 [d]	7.80 ± 0.663 [d]	12.80 ± 0.860 [d]
5	0 [d]	4.20 ± 0.583 [e]	7.60 ± 0.600 [e]
6	0 [d]	0 [f]	0 [f]

Note: Averages within column followed by the same letters are not significantly different, DMRT $\alpha_{0.05}$

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The snail age structue

All stages of the snail were observed on all stages of rice plants, except of oldest one (41-50 mm in size). The snail age structure is shown with Figure 1. The biggest snail is not reflected in Figure 1 due to its density was very low (Table 2). The existing snail at all its developmental stages on every developmental stage of rice indicate the sustainable snail generation. In Malaka Regency the rice is not planted in the same time, hence, young rice as a vavorable host plants always be available. More over the snail is polyphagous (Matsukura, 2013) so that for survival it does not dependent to the rice availability.

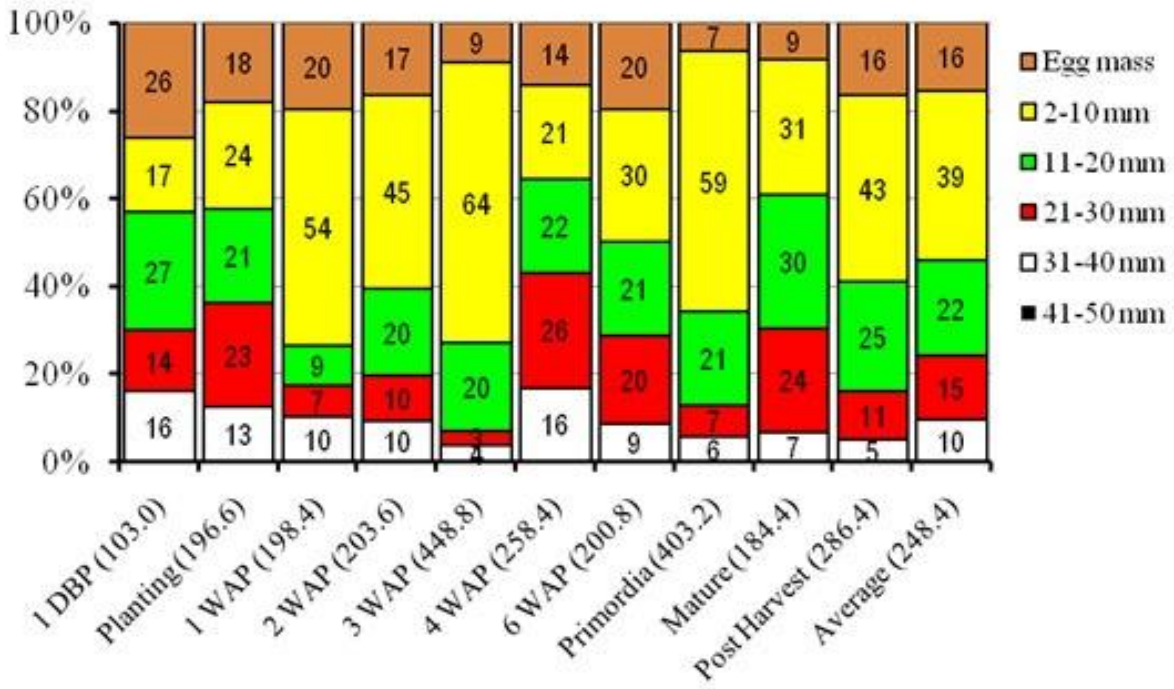

Figure 1. Age structure of the snail at various rice stages in irrigated rice field of Malaka Regency, East Nusa Tenggara Province, Indonesia, at planting season of May 2015

The existing snails prior to and at the time of rice transplanting constitute initial colonies that will be developing in the following rice growth. The bigger snail in size is the more voraceous and the younger rice plant is the more sensitive to be attacked by the snail (Table 1). Figure 1 and Table 2 show the importancy of recognizing the age structure and characteristics of feeding rates of each snail stage. Therefore, when determining the control threshold level at a certain rice

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growth the age stucture and feeding capacity should be taken into account. Severity of the snail infestation on rice is believed to be determined by age structure and densities of the snail.

Table 2. The population densities of snail stages on various stages of rice growth in irrigated rice field of Malaka Regency, East Nusa Tenggara Province, Indonesia, at planting season of May 2015

Stages of rice growth	The snail stages and densities (individuals/400m^2)					
	Egg mass	**2-10 mm**	**11-20 mm**	**21-30 mm**	**31-40 mm**	**41-50 mm**
1 DBP	27.0±48.0	17.4±12.0	27.6±18.9	14.4±24.5	16.6±32.7	0
Planting	35.4±10.8	48.0±35.0	42.2±22.9	46.2±36.1	24.6±10.2	0.20±0.4
1 WAP	39.2±29.9	106.8±130.4	18.0±13.2	13.6±12.9	22.8±16.6	0
2 WAP	33.4±14.9	90.0±54.2	40.0±30.7	20.8±14.9	19.2±13.9	0.20±0.4
3 WAP	41.0±30.8	285.8±370.8	89.8±113.1	14.2±9.0	18.0±7.5	0
4 WAP	36.4±17.2	55.2±25.8	55.8±57.7	67.2±52.0	42.6±27.6	1.20±1.3
6 WAP	39.6±19.8	60.2±37.9	43.0±57.6	40.6±35.7	17.2±10.7	0.20±0.4
Primordial	26.6±15.7	237.8±134.9	86.4±107.8	29.4±21.5	23.0±8.2	0
Mature	15.8±11.7	56.4±58.5	56.0±51.9	43.6±42.1	12.6±11.1	0
Post Harvest	47.0±35.2	122.0±86.0	71.0±48.8	31.2±15.7	15.0±15.2	0.20±0.4

Note: DBP = day before planting. WA = week(s) after planting

In order to manage and control the rice pest, the control threshold level is used as a basis in decision making to do or not to do control the rice pest. In practice, the thing important is to prevent the snail entering rice fields along with the influx of irrigation water. Soon after rice transplanting finish, water has to be drained in such away so that snail is not able to move and feed young rice plants.

CONCLUSION

The snail of 11-20 mm in size preferred young rice seedlings of 1 – 3 weeks old and did not attack 4 – 6 weeks old seedlings, while of 21-30 and 31-40 mm in size preferred 1 - 5 weeks old seedlings and did not attacks 6 weeks old seedlings. The severity damage of the rice plants due to snail attacks was determined by the snail stages and seedling ages. A single snail of 11-20, 21-30, and 31-40 mm in size were able to eat as many as 19.4, 50.8, and 55.4 rice seedlings of 1 week old, respectively. Age structure of the snail at every rice developmental stages showed relatively similar proportion of the snail stages.

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