

Short Communication

Effectiveness of Various Botanical Traps against Apple Snail, *Pomacea maculata* (Gastropoda: Ampullariidae) in a Rice Field

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ABSTRACT

The adverse effects of molluscicides applied for the control of the invasive apple snails, *Pomacea* spp., have led to the search for eco-based cultural, mechanical and biological control techniques. Therefore, a field study on the relative effectiveness of locally available and cost effective plant-based traps against *Pomacea* spp. was conducted. Results showed jackfruit skin ($9.03 \pm 0.60 / \text{m}^2$ and $6.03 \pm 0.60 / \text{m}^2$) and damaged pomelo ($9.00 \pm 0.61 / \text{m}^2$ and $5.78 \pm 0.74 / \text{m}^2$) were relatively more effective than tapioca leaves, water spinach leaves and old newspaper. Snails also displayed preference for fresh materials as compared to rotten materials. Thus, incorporating these findings in rice fields during early susceptible growth will ease the collection and destruction of snails.

Keywords: Apple snail, *Pomacea*, rice, botanical trap

INTRODUCTION

Invasive apple snails, *Pomacea maculata* Perry, 1810 and *Pomacea canaliculata* Lamarck, 1822 (Gastropoda; Ampullariidae)

are serious pests of many aquatic macrophytes including rice (Hayes et al., 2008; Horgan et al., 2014). These invasive snails were introduced into Malaysia around 1991 and spread to all rice growing areas of the country, causing heavy losses to rice yields (Yahaya et al., 2006; Arfan et al., 2014). Snails mostly feed on young rice seedlings and their severe damage could result in complete loss of rice crop (Teo, 2003). In Malaysia, growers often spend

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approximately RM 425 per hectare to control snails (Yahaya et al., 2006), whereas global cost of apple snail infestation could reach billion of US\$ (Horgan et al., 2014). In an attempt to control snails, growers mostly apply chemicals which are often not specific molluscicides. These random chemicals are more preferred due to their easy application and fast action (Schnorbach et al., 2006). However, the adverse effect of chemicals on men and their environment always necessitate for alternative cultural, mechanical and biological control measures to manage apple snails (Yusa, 2006). To date, the effectiveness of botanical traps as an alternative control measure in the collection and destruction of snails have been evaluated in different countries with varying success (Joshi et al., 2001; Teo, 2003). However, such studies are still lacking in Peninsular Malaysia, with the only available work done by Amzah and Yahya (2014). Lettuce, jackfruit, papaya fruit and leaves, cassava leaves, sweet potato, tapioca, taro, water melon and aubergines are some of the botanical materials used as baits against apple snails, which are mainly to ease in their collection and killing so as to manage their population below the threshold levels (Glover & Campbell, 1994; Fukushima et al., 2001; Cagauan, 2003; Teo, 2003). Therefore, considering the potential of botanical traps in managing apple snail populations, the relative effectiveness of various locally available and cost effective botanical traps was thoroughly evaluated against *Pomacea* spp. in a rice field. The results of the study could be utilised in

the management of apple snails in rice field by facilitating their easy picking and destruction, thus reducing damages to rice.

MATERIALS AND METHODS

Study site

The study was conducted at a 0.405 hectare farmer managed rice field in Koding, Kedah (6° 21' 55.19" N, 100° 20' 21.31" E) during the months of August-September, 2014. The field is under the management of MUDA Agricultural Development Authority (MADA). Rice variety MR220CL1 was cultivated by direct seeding.

Botanical Traps

The attractants used in this study were jackfruit skin (*Artocarpus heterophyllus* L.), tapioca leaves (*Manihot esculenta* Crantz), water spinach leaves (*Ipomoea aquatic* Forssk.), damaged pomelo (*Citrus maxima* Merr.) and old newspapers (Figure 1). The attractants were selected according to their local availability throughout the rice growing season and cost effectiveness. All the attractant materials were filled into individual containers of 17 cm x 12 cm x 5.5 cm size and covered with wire mesh to prevent attractant materials from floating into the field. All traps set up were fully submerged in the rice field to enhance their attractiveness to snails (Fukushima et al., 2001).

Experimental Design, Data Collection and Analysis

The experiment was conducted in a Randomised Complete Block Design (RCBD). The rice field was divided into four blocks depending on the source of irrigation in the field. In each block, all five attractants were randomly placed at four locations (replicates) with a one meter distance between the individual attractants to avoid their interference in attracting the snails. The observations were started one week after sowing of rice and continued up to week four as snails are more destructive to young rice seedlings than older seedlings (Sanico et al., 2002). The observations were taken twice in a week i.e., day one (fresh attractant) and day four (rotten attractant). Materials were deemed as rotten when it deteriorated in shape after being set as traps. The attractants were replaced with fresh materials every week. On each observation, the total number of apple snails attracted were counted, identified and classified as juveniles and adults according to their life stages. The identification was done according to Cowie et al. (2006), Hayes

et al. (2012) and Marwato and Nur (2012) based on the external morphology of the apple snails.

Data collected for the level of attractiveness of different traps were analysed using two-way analysis of variance. The means, with significant differences, were separated using Least Square Difference (LSD). All the analyses were done using SAS 9.3 statistical package (SAS Institute Inc. 2009).

RESULTS AND DISCUSSION

Species Identification

All the snails collected during the study were identified as *P. maculata* according to their shell morphology Cowie et al. (2006), Hayes et al. (2012) and Marwato and Nur (2012). The presence of at least four apple snail species (*P. canaliculata*, *P. maculata*, *P. scalaris* and *P. diffusa*) has been reported in Southeast Asia, with former two being most abundant and widely distributed (Rawlings et al., 2007; Hayes et al., 2008). Higher abundance and wider distribution of *P. canaliculata* in comparison to *P. maculata*

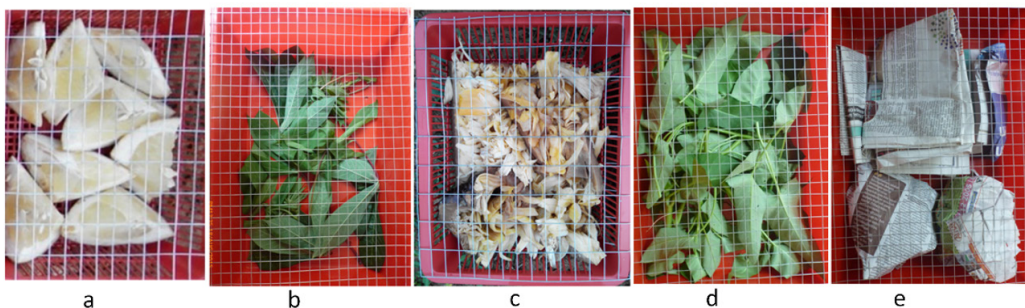


Figure 1. Different attractants used in the study (a) damaged pomelo; (b) tapioca leaves; (c) jackfruit skin; (d) water spinach (e) old newspaper

in invaded areas including Malaysia have also been reported (Yahaya et al., 2006; Rawlings et al., 2007; Hayes et al., 2008). However, recent studies in Peninsular Malaysia confirmed the abundance and wide scale distribution of *P. maculata* as compared to *P. canaliculata* (Arfan et al., 2014).

Level of Attractiveness of Different Botanical Traps Against Juveniles and Adult P. maculata

Results showed that all the materials used have the potential to attract juvenile and adult snails (Figure 2). However, jackfruit skin ($9.03 \pm 0.60 / m^2$ and $6.03 \pm 0.60 / m^2$) and damaged pomelo ($9.00 \pm 0.61 / m^2$ and $5.78 \pm 0.74 / m^2$) showed significantly higher attractiveness for both juvenile and adult snails, respectively ($P < 0.05$), although no difference was recorded between them ($P > 0.05$). Similarly, no significant difference was also recorded in

the relative attractiveness of tapioca leaves, water spinach and old newspapers ($P < 0.05$). Moreover, juveniles showed significantly more preference for fresh jackfruit skin ($10.06 \pm 0.60 / m^2$), damaged pomelo ($9.81 \pm 0.71 / m^2$) and tapioca leaves ($7.69 \pm 0.10 / m^2$) as compared to rotten traps of respective materials ($P < 0.05$; Figure 3). Moreover, no significant difference was recorded between fresh and rotten traps of water spinach and newspapers in attracting juveniles ($P > 0.05$; Figure 3). However, the adult snails only showed significant difference between fresh ($6.50 \pm 0.61 / m^2$) and rotten ($5.06 \pm 0.50 / m^2$) jackfruit skin ($P < 0.05$; Figure 4). Previous studies also highlighted the potential of various botanical materials such as lettuce, cassava, sweet potato, taro, tapioca, giliricidia and papaya to attract apple snails with varying success (Glover & Campbell, 1994; Cowie, 2002; Teo, 2003). Comparatively higher preferences for water melon, lettuce, aubergines and tomato in

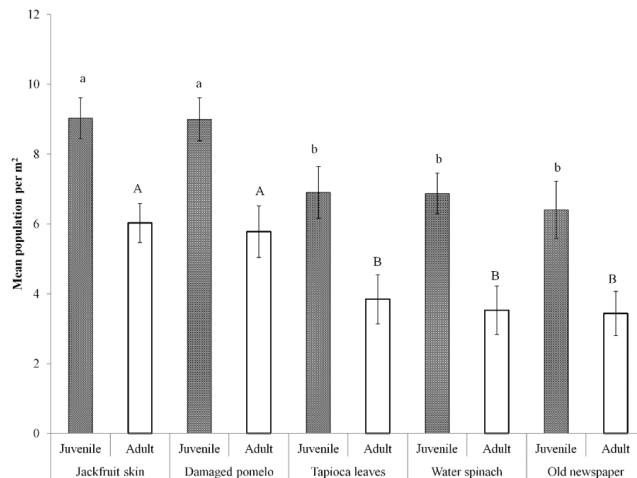


Figure 2. Relative effectiveness of different attractants against juvenile and adult *P. maculata*
 *Means followed by the same letters (small letters = juveniles; capital letters = adult) are not significantly different ($P < 0.05$)

comparison to rice have been reported for apple snails and have been suggested to be exploited for easy hand picking of snails (Fukushima et al., 2001; Cagauan, 2003). Jackfruit, papaya fruit and leaves, cassava leaves, water spinach, banana leaves and old newspapers have also been evaluated as

potential attractants of apple snails, where jackfruit was found to show the highest attractiveness for the apple snails (Amzah & Yahya, 2014). As observed in this study, relatively higher attractiveness of jackfruit skin and damaged pomelo for apple snails could be due to their strong fragrance as

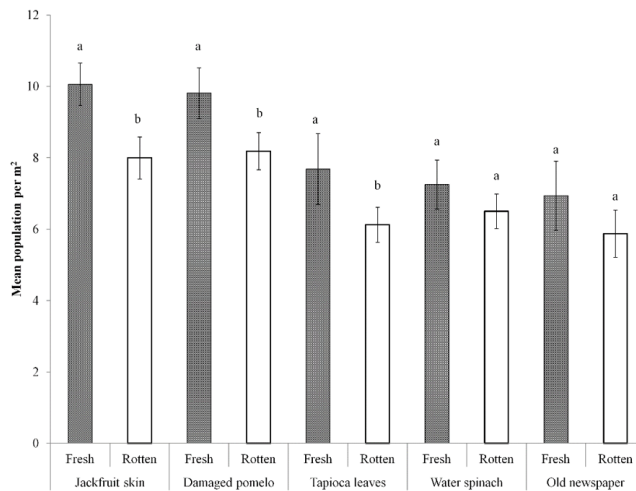


Figure 3. Relative effectiveness of fresh and rotten attractants against juvenile *P. maculata*
*Means followed by different letters against individual traps are not significantly different

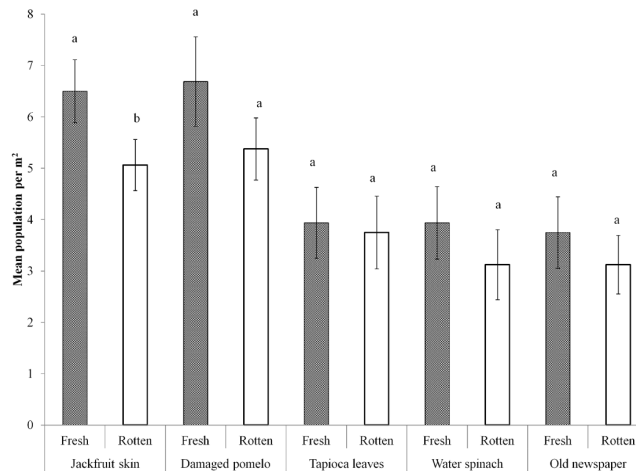


Figure 4. Relative effectiveness of fresh and rotten attractants against adult *P. maculata*
*Means followed by different letters against individual traps are not significantly different

compared to other attractants. Estebenet (1995) has also observed significant role of odour towards damage potential of snails to different macrophytes. The snails are highly dependent on their chemoreceptive ability in detecting macrophytes with strong odour that also supports their faster growth (Cowie, 2002; Van Dyke et al., 2013). In this study, fresh botanical trap materials showed higher attractiveness for adult and juvenile snails. Therefore for better attractiveness of traps, their freshness should be maintained as rotten traps may repel snails away from traps towards rice. It is also important that botanical traps used should be more attractive than rice to divert the snails towards traps (Cowie, 2002).

In conclusion, all the traps studied have the potential to attract juvenile and adult snails. However, jackfruit skin and damaged pomelo were the most attractive botanical traps. In addition, fresh traps of individual materials were more attractive than their rotten traps. This study successfully highlights a variety of potential and effective botanical traps that can be incorporated into the management of *Pomacea* spp. to ease their collection and destruction. All the materials studied are easily available and cost effective for farmers. Fresh traps can be set up on a weekly basis for a better management of snails considering their higher attractiveness. Overall, the findings of this study can serve as an effective option against the commonly applied hazardous chemical control techniques.

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