Golden Apple Snail (*Pomacea canaliculata* Lamarck, 1819) in Sabah, Malaysia – Current Situation and Management Strategy

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ABSTRACT

The paper reports the control operation of the golden apple snail in Sabah implemented by the Department of Agriculture following the outbreak of the pest in the 1990s. The snail was sighted in Keningau in 1992. Two years later it mushroomed to most of the rice-growing districts with a total infested area of about 5,000 ha. The control operation employed an integrated approach consisting of cultural, biological and chemical components. A research program was initiated at the same time to develop new control techniques. Often, Extension's agents and Research personnel's organized dialogue and briefing sessions to disseminate information and to motivate farmers to participate in the control operation. A task force was set up to supervise and to monitor the progress of the control operation. The pest was brought under control within two years. There were no significant crop losses so far. The most common control measures adopted by farmers were tea seed powder applications, handpicking, water depth management and the use of older seedlings in transplanting. Biological control consisted of duck herding recommended at a density of 5 - 10 ducks/ha. The duck reduced the pest population to a tolerable level after grazing for a period of one to two months. It was foreseen that the pest is going to spread to all the rice-growing areas in Sabah in the future by man activities. So at present it is essential to educate the farmers on the management of the golden apple snail in rice so that should an outbreak occurs, farmers are able to contain the pest themselves.

Keywords: Golden apple snail, *Pomacea canaliculata,* rice pest, snail control

Introduction

The golden apple snail (*Pomacea canaliculata* Lamarck) is a freshwater prosobranch indigenous to South America. In the 1980s it was brought in from Argentina to Taiwan for commercial production as a food source (Mochida, 1991). From Taiwan the snail was distributed to the third world countries for backyard rearings to generate side-incomes (Anderson, 1993) and to supplement protein in the diets of the rural poor (Matienzo, 1984). However, the snail was introduced without prior studies on

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market information and ecological impact (Acosta and Pullin, 1989). Farmers cultured the snail indoors but when market response was poor many snail projects were abandoned and in many instances the snail escaped and ravaged the rice crop with losses running into millions of dollar (Naylor, 1996). The estimated snail-infested areas were 171,425 ha in Taiwan in 1986, 16,195 ha in Japan in 1989 and 400,000 ha in the Philippines in 1989 (Mochida, 1991). The rapid proliferation of the pest was associated with its high reproductive capacity, fast growth and the ability to aestivate underground for more than 6 months during adverse conditions e.g. drought (Anon., 1998). The golden apple snail is now a major rice pest in Asia (Rejesus *et al*., 1990; Jambari *et al*., 1993; Hirai, 1988; Halwart, 1994). In Sabah the snail was sighted in Keningau in 1992. Two years later it spread to most of the rice-growing districts. As soon as the pest was spotted in the field, the Department of Agriculture immediately launched a control operation, which employed an integrated approach consisting of cultural, biological and chemical components (Teo, 1999a). The control operation slowed down the pace of spreading and stopped the snail from causing significant damages. Sabah has a total of 47,282 ha of rice field, 11,332 ha of which is upland rice and 35,950 ha wetland paddy (Anon., 1999). The paper discusses the impact of the golden apple snail in rice production in Sabah and the control strategy adopted by the Department of Agriculture.

Impact of the Golden Apple Snail to Rice Cultivation

The golden apple snail spread rapidly following its occurrence in Keningau in 1992. To date the districts infested with the pest include Keningau, Tenom, Sook, Nabawan, Tambunan, Papar, Penampang, Kota Kinabalu, Beaufort, Kuala Penyu, Tuaran, Sipitang, Kota Belud and Kota Marudu covering an area of about 5,000 ha. Majority of the infested areas have pest population on the low side at less than 1 snail m^{-2}. Often, damages occurred in small patches in pocket areas where the water level was difficult to reduce by draining. The snail devastated some rice fields in the beginning particularly in areas dominated by direct seeding planting method but the damaged area was small, ranging from 0.5 to 1ha. Paddy farmers are now vigilant on the pest and practise proper crop husbandry to counteract snail attack. Cost of production increased as farmers resorted to chemical control. The most common molluscicide used was tea seed powder, which costs US$0.30 to US$0.50 per kilo, or US$16.00 to US$27.00 per ha. If farmers apply cultural and biological controls, the costs are minimal. It is likely that the snail is going to spread to the entire region of Sabah in the future by man activities. Before it happens, it is essential to educate farmers on the

management of the golden apple snail in rice so that should an outbreak occurs, farmers are able to contain the pest themselves.

Damage Potential of the Golden Apple Snail to Paddy Seedlings

The golden apple snail is destructive for as long as water is not limiting. When the water level is shallower than its shell height, the pest becomes less mobile. When the field is drying up, the snail will creep into the mud to aestivate. Older seedlings are more tolerant to snail for e.g. 40 days old seedlings. This is true if the depth of water does not exceed the height of the hardened culms, the portion of the plant where the snail could not rasp. If the water level rose and the upper tender leaves are submerged in water, these plants become susceptible to the pest. Water is an important factor in determining damage. It is the medium the golden apple snail uses for its attack on plants. A study conducted at Tuaran's Agriculture Research Centre showed that the damage potential of the golden apple snail in rice depended on water depth > seedling age > pest density in the decreasing order. At a water depth > 5.0 cm, direct seeded rice and transplanted 21, 30 and 40 day-old seedlings incurred a damage of 100, 89.2, 59.7 and 46% respectively. At a water depth of 5.0 cm, the pest caused insignificant damage to the 30 and 40 day-old seedlings. The same result occurred in direct seeded rice and 21 day-old seedlings when the water was drained to saturated soil moisture condition. This treatment reduced damage significantly even when pest density was at 5 snails m^{-2}. Dry direct seeding which employed a minimal amount of water in the early stages of growth received 0% damage.

Research Program and Control Measures Developed for Golden Apple Snail

The Department of Agriculture conducted a research program to study golden apple snail as soon as it was spotted in the rice field. A user sensitive research program was formulated to ensure the findings were easy for farmers to adopt. Initial studies focused on the ecology and biology of the pest including its damage potential to rice seedlings. The objective was to acquire knowledge of the pest under its natural habitat with a view to develop control techniques. The studies also covered a trial on the selection and evaluation of molluscicides from marketed products and biopesticides from plants. Later studies emphasized on environment-friendly control measures such as cultural and biological controls. Research findings were pooled to form an integrated pest management (IPM) package, which consisted of cultural, biological and chemical components.

The most common cultural controls practised by farmers were handpicking, water depth management and the use of older seedlings in transplanting. Forty days old seedlings were used for transplanting with the water depth maintained at 5.0 cm. The water level was raised to more than 10.0 cm at the booting stage for yield maximization. For direct seeding, the water was drained to saturated soil moisture condition before broadcasting the germinating seeds. At day 28, water was introduced to a depth of 5.0 only and to a deeper depth at the booting stage. These methods were widely used by farmers because they were easy to apply. Handpicking was carried out occasionally through a community effort. Handpicking is now easier with the use of herbage attractants. Leaves of Papaya, Sweet Potato, Tapioca and Gliricidia were potent snail attractants (Teo, 1999b). The leaves were tied in small bundle and placed underwater on the side of the field. A significant number of snails were attracted to the leaves after 24 hours. The snails were collected and destroyed the following day. This method significantly reduced time and labour required in the normal handpicking operation. While controlling the snail in the field, wire mesh screens or filters were set up at the water inlet points to prevent re-infestation through the flow of snail-polluted water. However, the smallest snail size is 2mm and only meshes size smaller than 2mm is 100% snail proof. So this measure was not widely used because the filters were clogged by dirt or rubbish too soon. Once the filters were blocked by rubbish, water would not flow and flood would start to build up in the irrigation canal. Unless manpower is available for cleaning the filters at regular intervals, filters should not be installed at the irrigation inlets without frequent inspections.

During off-planting seasons farmers were encouraged to keep the field dry to prevent snail from breeding. Dry ploughing and rotovating were carried out just before the pre-planting season to kill snails aestivating underground by exposing them to heat and dryness. During wet ploughing, farm machineries were required to go through a sanitation procedure. Tractors and combine harvesters after operating in an infested area were instructed to wash thoroughly at the washing pavement prepared by the District's Agriculture Extension before embarking onto their next destination.

Duck was introduced to the farmers for biological control of snail in paddy fields. The recommended density was 5 to 10 ducks ha^{-1}. At these densities the duck reduced the pest population from 5 snails m^{-2} to less than 1 snail m^{-2} after 1 month. The recommended varieties of duck were William Siam > Taiwan > Mallard >Peking > Khaki Campbell in the decreasing order (Teo, 2001). When the pest population density exceeded 5 snails m^{-2} application of tea seed powder was allowed if time was a constraint for other means of control. Tea seed powder was recommended at 51kg/ha under a stagnant water of depth 5.0 cm. Tea seed powder is a by-product of

oil extraction from tea seeds. It contains 5.2 to 7.2% saponin, which causes hemolysis in animals (Minsalan and Chiu, 1988). It is toxic to most aquatic organisms such as fish and frog. The Department of Agriculture restricted its use to areas with pest population density greater than 5 snails per m^2 only. Pellets of metaldehyde 5% was used when tea seed powder was not available.

A trial on the screening of plants with molluscicidal properties identified a plant species known as Yellow Furcraea or Wild Sisal (*Furcraea selloa var. marginata*), which was highly effective against golden apple snail. Dry leaf powder of Yellow Furcraea was recommended for golden apple snail control at 45kg/ha (Teo, 2002), much lower than tea seed powder at 51kg/ha. This plant would be introduced to the farmers for planting in the backyard and hedge land for snail management in rice. Future research program would emphasize on environment-friendly approach for example biological control using fish as snail predator.

Management Strategy

The management strategy consisted of a simple IPM control package with the emphasis on the farmers. Farmers were the implementer and the source of manpower. Without farmers' involvement, the control operation would not be successful. So in the beginning Extension's staff and Research personnel's organized briefing/dialogue sessions repeatedly to disseminate information on the new rice pest and to motivate farmers to participate in the control operation. A leader from the farmers would be picked and one Extension's staff would be assigned to supervise the control program. The Extension staff would report the progress of control to the District's Agriculture Officer who would in turn report to the chairperson of a Pest Surveillance Committee, which held a meeting every month to discuss and to monitor the progress of the control operation. A control program would be formulated for that area where the meet-the-farmer session was held and usually consisted of the schedule for handpicking by the community, tea seed powder applications and setting up of snail filters. Through research and development, the control packages were improved to include duck herding, herbage attractants in handpicking, water depth management and transplanting of older seedlings. For a start, resource-poor farmers were provided with the materials they were lacking, for example, tea seed powder, this was given free to the farmers whose rice fields were heavily infested by the pest. The technology package was kept as simple as possible to ensure farmers could afford to adopt them. Something difficult to apply or too expensive to use would not be introduced to the farmers.

A census was conducted during the next pre-planting season to assess the effectiveness of the control operation by estimating snail population density. Snail density was estimated by throwing at random a 1m-quadrat at 15 throws/ha. Most of the pest population densities in the infested areas now are below 1 snail per m^2. As a backup support, mass media, flyers, posters and signboards were set up at strategic locations to caution the public not to spread the snail. Within two years the pest was brought under control. Nowadays the Pest Surveillance Committee holds its meeting quarterly because the pest has been contained. However, the committee continues to monitor the pest in the direct seeding areas, which are the high-risk zones.

Problems and Constraint

The control operation encountered several social problems. In the beginning many farmers mistook the golden apple snail as the local snail *Pila* spp. and refused to believe that it was an exotic pest until they experienced damages in their crop. In fact, man was the principle agent of dispersal of the pest. The snail spread to most of the districts by man. Farmers brought home the snail for culinary purposes, which at the same time scattered some into their paddy field or backyard to allow it to multiply for future food resources. The control operation could control the pest in the field but it couldn't stop man from spreading it to another place. Response from farmers was poor in some districts. Not many turned up in a briefing/dialogue session or in a handpicking operation. Many chose to use tea seed powder in preference to other control measures. Farmers were also slow in adopting innovations for example duck herding for snail control. As an incentive, ducks were given free to some farmers in the beginning. However, when something was given free, the neighbours and the rest of the farmers hoped to receive the same treatment. Also, not all farmers implemented control measures in their own field. Nearby fields with no control measures carried out became a source of re-infestation to adjacent fields with the pest already under control.

Conclusion

The sudden outbreak of the golden apple snail in Sabah in the 1990s posed a great challenge to the Department of Agriculture. It was a new rice pest with little published information. The Department of Agriculture took immediate actions to contain the pest as soon as it was spotted in the field and at the same time initiated a

research program to develop control techniques. In the beginning handpicking and application of a biopesticide i.e. tea seed powder were widely used to bring the pest population down to a tolerable level. Subsequent control measures incorporated cultural and biological components including handpicking with herbage attractants. Farmers' cooperation was poor in the beginning so dialogue or briefing sessions were frequently held to disseminate information and to motivate them to participate in the control operation. Farmers were important because they were the implementer and source of manpower. Without their involvement the control operation would not be successful. For this reason the control packages were made simple and practical so that farmers could adopt them easily. The pest is now under control. However, it was foreseen that it would spread to the entire region of Sabah in the future because of man activities. Before that happens, it is essential to equip all farmers with the knowledge of snail management in rice in the present.

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