

ABSTRACT

Golden Apple Snail (GAS), the most pervasive and destructively invasive rice pest is a global cause of concern, resulting in a huge economic loss worldwide. In Peninsular Malaysia, the distribution of *Pomacea maculata* Perry is predominant in the major rice producing regions. This snail is also known as Giant Apple Snail and Black Apple Snail. As a part of Integrated Pest Management, the application of niclosamide, a synthetic molluscicide became the mainstay of GAS control programs. The cost of synthetic molluscicides, its toxicity to non-target organisms and long term persistence in the environment propelled the research and development on target specific, ecologically and toxicologically safe and effective plant-derived molluscicides. Despite concerted efforts on the application of plant molluscicides against fresh water vector-snails of genera, *Biomphalaria*, *Bulinus* and *Oncomelania* which transmit severe diseases in humans, less commercial success has been achieved for the control of GAS. In the recent past, most research efforts were focused on single plant extract for its molluscicidal potency against GAS and were not proved entirely effective in rice field. Selective consortium of synergistically active molluscicidal compounds from various plant extracts might be an effective alternative. In this direction, the molluscicidal activity of the six different plants viz; *Azadirachta indica* A. Juss (neem), *Nicotiana tabacum* L (tobacco), *Nerium indicum* Mill (nerium), *Pongamia pinnata* L (pongamia), *Zingiber officinale* L (zinger) and *Piper nigrum* L (piper) were evaluated individually as well as in selective combinations at different concentrations (50 mg/l to 500 mg/l) on the mortality of *Pomacea maculata* after 48 hours exposure and 24 hours recovery period under laboratory conditions. The LC₅₀ and LC₉₀ values with their associated 95% confidence intervals (95% CI) were estimated by probit analysis using SPSS (Version 22). The mortality rates of snails exposed to different concentrations of plant extracts were analysed using a one-way analysis of variance (ANOVA) and two-way analysis of variance (ANOVA) and mean comparisons were computed by Duncan's multiple comparison tests using SPSS (Version 22) at the 5% significant level. Of the various consortia studied, a binary extract formulation (1:1 w/w) of nerium and tobacco and two tri-herbal extracts formulations (1:1:1 w/w) of nerium, neem, tobacco and nerium, tobacco, piper were found to be most effective with LC₉₀ value of 177 to 191 mg/l at 48 h of exposure. The synergistic effect of the combined extracts resulted in around 45 % reduction in LC₉₀ value of the individual extracts. The molluscicide bait, a strategic combination of feed and toxicant is target specific and cost effective. Bait attractiveness determines the efficacy of a bait formulation. So far no

specific feed formulation was exclusively developed as the base for bait development against GAS. In addition, there are certain limitations in accurately evaluating the attractiveness of a feed material / bait with the existing experimental devices. Therefore, this study meticulously developed an attractive and appetent base feed formulation and also designed and developed a Snail Attractant Tracking Device (SATD) for evaluating the feed / bait formulation precisely. The feed formulation developed consists of rice flour with 5% sugar, 15% wheat flour and 0.5% fish-meal, has shown maximum attraction and consumed effectively by snails. The evaluation of three different consortia of herbal bait formulations indicated 73 to 97% mortality of *P.maculata* at 0.6 to 0.9 g of bait consumption at 48 h. The phytotoxic effect was not observed at lower concentrations (50 and 100 mg/l) of the binary and tri-herbal extracts on the germination and various morphological traits in rice M 219 seedlings. In comparison with niclosamide (100%), the binary extract (nerium and tobacco) exhibited 43.30 % mortality on guppy fish. Overall, the study has demonstrated that the selective combination of herbal extracts as bait formulations are effective for sustainable management of GAS, *P.maculata*.