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SHORT COMMUNICATION

Field evaluation of plants molluscicide against *Pomacea canaliculata*

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ABSTRACT

Two plants reported as molluscicides have been tested against the snail *Pomacea canaliculata* under field conditions. The molluscicide activity of the formulation *Sapindus saponaria* L. (100%) was compared with the mixture of *Sapindus saponaria* L. and *Solanum mammosum* L. (50:50, w/w) using different concentrations (10, 50, 100, 200, 400 mg.L^{-1}). LC_{50} and LC_{90} values were calculated using Probit Model. *Sapindus saponaria* L. (100%) showed higher molluscicide activity and reported a LC_{50} value of 66.6 mg.L^{-1}. These results have not been informed in the literature.

Keywords: *Sapindus saponaria* L; *Solanum mammosum* L.; Rice, LC_{50}

INTRODUCTION

Pomacea canaliculata (Lamarck) is a large freshwater snail. It is listed in the "100 World's Worst Invasive Alien Species" of the Global Invasive Species Group Database[1]. Its feeding habit is, mostly, towards the young stems and leaves of paddy rice (Nylor, 1996), and it could consume 7-24 rice seedlings per day (Oya, 1986), thus, resulting in extreme damage to growing rice. Consequently, the integrity of the rice bowl and food security could be threatened in those countries that depend on rice as their principal staple food and income (Noor et al., 2012). In an attempt to control *Pomacea canaliculata*, pesticide misuse and abuse by farmers have caused serious economic, social, and environmental impacts, biodiversity loss, and health hazards to rice farming communities (Rejesus et al., 1988).

Solanum mammosum L. and *Sapindus saponaria* L. are natural molluscicide and their combined effect against *Pomacea canaliculata* has been evaluated under laboratory conditions by Quijano et al. (2014); those authors demonstrated that there was not a synergism effect in the combination *Sapindus saponaria* L. and *Solanum mammosum* L. (50:50, w/w). However, the mixture showed a similar lethal effect to that of *Sapindus saponaria* L. (100%).

World Health Organization (WHO) recommends that molluscicides should be evaluated in conditions that mimic the closest to natural zone in which the molluscicide will be employed. In this context, the aim of this this study is to evaluate the molluscicidal activity of the mixture of aqueous extracts of *Sapindus saponaria* L. and *Solanum mammosum* L. (50:50, w/w) and *Sapindus saponaria* L. (100%) against the snail *Pomacea canaliculata* under field conditions.

MATERIALS AND METHODS

Extraction

Ripe fruits of *Solanum mammosum* L. (CIBE012) and *Sapindus saponaria* L. (CIBE018) were cut into small pieces, dried at 60º C for 24 hours and grinded to get fine particles. Aqueous extracts of each fruit were processed separately by decoction of the vegetal material in proportion of 10% in distilled water during 20 min. The aqueous extracts were lyophilized at 120 x 10^{-3} mbar and 47º C below zero.

Field trials

Molluscicide field trials were conducted in Daule, Ecuador located at 1º, 51'36" S, -79º, 59', 24" W. The place has a

1 (ISSG, www.issg.org/database).

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warm temperature almost all year, for its location on the equator. Forty-eight square-shaped plots were constructed in a paddy field. Plots were constructed with the following dimensions: 0.5 m width × 0.5 m length × 0.4 m height (Figs. 1 and 2). Molluscicides were applied only once to each plot, afterwards ten snails were introduced to it.

Design of experiment

The formulations *Sapindus saponaria* L. (100%) and *Sapindus saponaria* L./*Solanum mammosum* L. (50:50, w/w) were prepared at five concentrations (10, 50, 100, 200, 400 mg · L^{-1}), which were applied in four repeated measurements and three replicates. The arrangement included a negative and positive control which consisted in distilled water and 10 ml · L^{-1} of endosulfan respectively. The time of exposure of the snails in the bioactive formulated was 24 hours. The individuals that showed no vital signs after tipping with a needle were counted as dead, while snails showing movements or reduced viability were counted as survivors (WHO, 1965a). Fig. 2

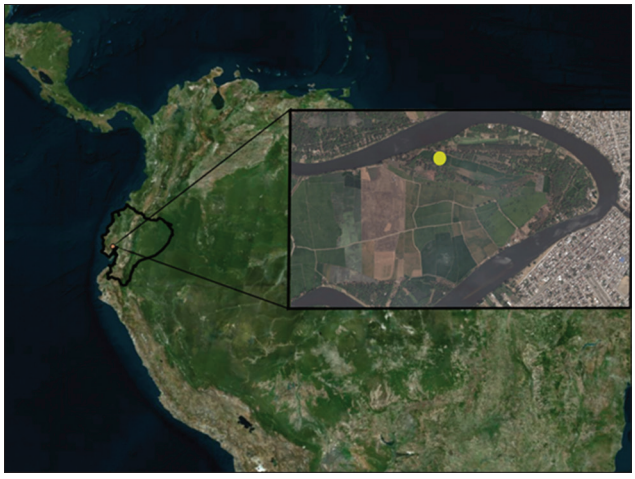

Fig 1. Location of the study, Daule, Ecuador.

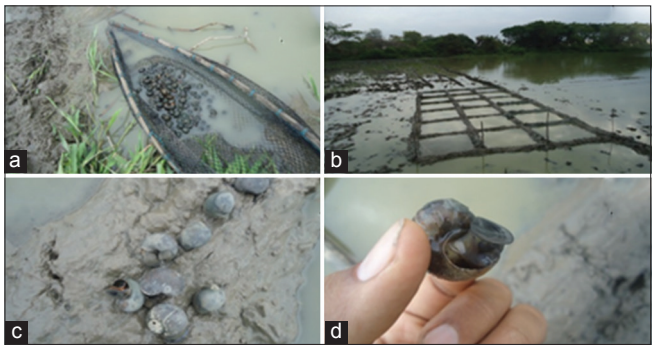

Fig 2. Field Trial Scheme. (a) Collection of snails; (b) Design of square-shaped plots; (c,d) Dead snails.

Statistical analysis

LC_{50} (median lethal concentration), LC_{90} (lethal concentration for 90 % of the population) values and their confidence limits, probit/log concentration regression equations and slope were calculated by the method described by Finney (1971).

RESULTS AND DISCUSSION

According with the Table 1, both formulations (*Sapindus saponaria* L. 100% and *Sapindus saponaria* L/*Solanum mammosum* L. (50:50, w/w)) showed molluscicidal activity against *Pomacea canaliculata*. *Sapindus saponaria* L. molluscicidal activity is attributed to the presence of saponins (Pinto et al., 1944), substances that interact with sterols present in cell walls of gills mollusks, causing cell rupture (Karabaliev et al., 2003; San Matins et al., 2009); and, by the presence of steroidal glycoalkaloids in *Solanum mammosum* L.: solasonine 1 and solamargine 2 (Liam, 2012).

LC_{50} values presented in the Table 1 probed that *Sapindus saponaria* L. 100% was more toxic than the mixture *Sapindus saponaria* L. and *Solanum mammosum* L. (50:50, w/w). and LC_{90} values indicated that both formulations could not be considered as good molluscicide candidates due to the fact that WHO prerequisites indicate that crude organic extracts should present LC_{90} values bellow 20 ppm for direct application in infested water (WHO, 1983b).

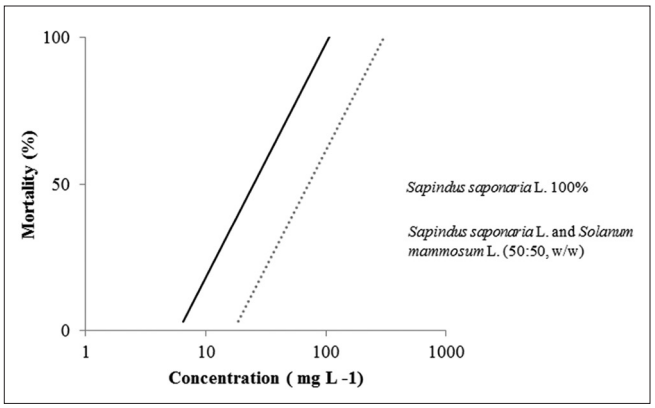

Fig 3. Molluscicidal activity of *S. saponaria* and *S. saponaria/S. mammosum* crude extracts of species against *P. canaliculata*.

Table 1: Results of 48-h toxicity utilizing *Sapindus saponaria* L. 100% and *Sapindus saponaria* L/*Solanum mammosum* L. 50%/50%

Formulation	Probit equation Y=a+bx	Activity [mg.L^{-1}]		R^2
		LC_{50} (95% CI)	LC_{90} (95% CI)	
SAP (100)	Y=0,6419X - 1.12	66.6 (54.0-80.2)	129.1 (106.5-163.7)	0.96
SAP:SOL (50:50)	Y=0,2223X - 1.12	192.3 (159.0-228.9)	372.8 (308.8-474.9)	0.96

SAP (100): *Sapindus saponaria* L. (100%), SAP: SOL (50:50): *Sapindus saponaria* L. - *Solanum mammosum* L. (50:50, w/w)

Fig. 3 illustrates the concentration/mortality regression lines of the formulations *Sapindus saponaria* L. 100% and *Sapindus saponaria* L. and *Solanum mammosum* L. (50:50, w/w) tested against *Pomacea canaliculata*. Both formulations exhibited significant difference ($p<0.05$) in the molluscicidal effect on field evaluation. In contrast, under laboratory conditions the formulations *Sapindus saponaria* L. 100% and *Sapindus saponaria* L. and *Solanum mammosum* L. (50:50, w/w) showed no statistically significant difference on the molluscicidal activity against *Pomacea canaliculata* and reported LC_{50} values of 24.04 $mg.L^{-1}$ and 17.78 $mg.L^{-1}$, respectively(Quijano et al., 2014). Discrepancy between laboratory and field assays may arise because the presence of weed, mud and lower content of dissolved oxygen in the water, factors that reduced the molluscicidal activity of both formulations (Adewunmi and Marquis, 1987; San Martín et al., 2009). These findings suggest that it is not practical to make a partial substitution of *Sapindus saponaria* L. by *Solanum mammosum* L., because molluscicidal activity is reduced.

CONCLUSIONS

Results revealed that under field conditions *Sapindus saponaria* L. 100% have a higher molluscicidal potency than *Sapindus saponaria* L. and *Solanum mammosum* L. (50:50, w/w) against *Pomacea canaliculata*. However, as large amounts of plant extract are needed to kill the 90% of the snails, one of the prerequisite set by the WHO to consider a plant to be a molluscicide is not satisfied. Another species of plant should be considered to test against *Pomacea canaliculata*.

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Author Contributions

P. M. and M.M. were responsible of the conception and design of the experiment. G. L. and A.B. were in charge of the acquisition of data. M.Q. analyzed and interpreted the data. M.Q. and C. R. prepared the manuscript. P. M. and M.M. did the critical revision.

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