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Molluscicide from Tobacco Waste

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Abstract

Tobacco waste can be molluscicide for Golden Apple snail control in paddy field as trialed in 3 experiments e.g. laboratory, green house and field trial. In laboratory found LD_{50} of tobacco waste on golden apple snail, fish, frog and crab were 5456.25, 687.5, 1562.5 and 5000 Kg/ha respectively. In greenhouse and field trial were found rate of tobacco waste at 1562.5 Kg/ha could kill golden apple snail 100% in two days. Tobacco waste affected to increased electrical conductivity, biological oxygen demand, chemical oxygen demand in water but decreased water pH and dissolved oxygen. Otherwise, tobacco waste can be supplied soil fertility with high organic matter, available phosphorus, exchangeable potassium, calcium and magnesium. Tobacco waste can be increased rice growth and yield without nicotine and acute toxicity inspected.

Keywords: Molluscicide, tobacco waste, Golden apple snail

1. Introduction

Golden apple snail (*Pomacea canaliculata Lamarck*) is native animal of South America. It was imported to Thailand in 1982 for aquarium purposes. It was not prefer for customer then eliminate to river and canal and it wide spread to paddy field. Snail can consumes early growth of rice after planting till 15 day after planting. In Thailand, Golden apple snail outbreak since 1985 within 60 provinces on damaged area 34.375 million ha (Department of Agricultural Extension, 2000). The controlling procedures are man-power and chemical treated with Methaldehyde, tea seed and niclosamide (Bio-Agro Thai, 2007 and Promrangsan, 2007). Tobacco waste from cigarette production process is about 5 ton/day. Normally, tobacco waste is indigenous pesticide for aphid and cutworm control. In this study was studied on quality and rate of tobacco waste on Golden apple snail control. It is possible to reduce chemical import and organic waste garbage pollution.

This project was corroborated between Thailand Tobacco Monopoly, Ministry of Finance and Fertilizer Technology center, Thailand Institute of Scientific and Technological Research in 2007. Tobacco waste from cigarette production process in powder form was tested in laboratory, green house and field to solve out optimum rate of application for Golden apple snail control and affected on rice growth, rice quality and water quality.

2. Materials and methods

2.1 Laboratory trial

- Studied on LD_{50} of tobacco waste on aquatic animals e.g. fish, crab, frog and golden apple snail.
- The effect of tobacco waste on dissolved oxygen, pH and electrical conductivity.
- Studied on dissolved nicotine and decomposition rate of nicotine at various times and rates of tobacco waste.
- Studied on shelf life of nicotine in tobacco waste at room temperature and freezes dry at 4°C.

- Toxicity testing on mammal e.g. acute oral toxicity, acute dermal toxicity testing and acute dermal irritation (Auletta, C.S. and Acute, 1995; Organization for Economic Co-operation and Development, 1987; Organization for Economic Co-operation and Development, 2002 and United State Environment Protection Agency (EPA), 1998).

2.2 Green house trial

There were 2 trials established in green house at Fertilizer technology center, Klong luang, Phathumthani. First trial was tested on various rates of tobacco waste between 0 to 9375 Kg/ha on rice growth. There were 9 treatments (tobacco waste at 0, 312.5, 625, 1562.5, 3125, 4687.5, 6250, 7812.5 and 9375 Kg/ha) in 4 replications. Second trial was tested on tobacco waste mixed with chemical fertilizer in 7 treatments (control, basal with chemical fertilizer grade 16-16-8 @ 156.25 Kg/ha and top dressing with 46-0-0 @ 31.25 Kg/ha, tobacco waste 625 Kg/ha, tobacco waste 1562.5 Kg/ha, tobacco waste 625 Kg/ha mix with chemical fertilizer grade 16-16-8 @ 78.125 Kg/ha, tobacco waste 1562.5 Kg/ha mix with chemical fertilizer grade 16-16-8 @ 78.125 Kg/ha and tea seed 15.625 Kg/ha mix with chemical fertilizer grade 16-16-8 @ 156.25 Kg/ha) in 4 replications. The data was collected on tobacco waste efficiency to control golden apple snail (mortality), rice damage, water qualities e.g. BOD, COD, DO, pH, electrical conductivity, chemical soil properties e.g. pH, electrical conductivity, organic matter, available phosphorus, exchangeable potassium, exchangeable calcium and exchangeable calcium (Scientific for land development division, Land Development Department, 2004) and affect on rice growth e.g. height, tiller, biomass and yield.

2.3 Field trial

There were 2 trials located in Chainat Rice Research Center, Chainat province. First trial was tested in 6 treatments (control, tobacco waste at 625, 1562.5, 3125, tea seed 15.625 Kg/ha, tea seed 31.25 Kg/ha and copper sulphate 6.25 Kg/ha) in 4 replications. Second trial was tested on tobacco waste mixed with chemical fertilizer in 7 treatments (control, basal with chemical fertilizer grade 16-16-8 @ 156.25 Kg/ha and top dressing with 46-0-0 @ 31.25 Kg/ha, tobacco waste 625 Kg/ha, tobacco waste 1562.5 Kg/ha, tobacco waste 625 Kg/ha mix with chemical fertilizer grade 16-16-8 @ 78.125 Kg/ha, tobacco waste 1562.5 Kg/ha mix with chemical fertilizer grade 16-16-8 @ 78.125 Kg/ha and tea seed 15.625 Kg/ha mix with chemical fertilizer grade 16-16-8 @ 156.25 Kg/ha) in 4 replications. The data were determined as collected in green house trials.

3. Results and discussion

3.1 Laboratory trial

Chemical properties of tobacco waste was contained of pH 5.28, electrical conductivity 19.08 dS/m, organic matter 46.65%, C/N ratio 20.19, total nitrogen 1.34%, total phosphorus 0.34%, total potassium 0.24% and nicotine 1.9 ppm.

3.1.1 The effect of tobacco waste on aquatic animal was found at different rates of tobacco waste affected on Golden apple snail mortality significantly. LD_{50} of tobacco waste on golden apple snail was 5456.25 Kg/ha. Tobacco waste was affected on fish significantly. The rate of tobacco waste at 1562.5 Kg/ha can killed fish 85% after applied 3 hours and after applied 2 days at the rate of 1250-1562.5 Kg/ha can killed all of fishes. The LD_{50} on fish is 687.5 Kg/ha. The rate of tobacco waste at 0-937.5 Kg/ha did not found affect on frog living and LD_{50} was 1562.5 Kg/ha. The application on 0-3750 Kg/ha did not affect on crab and LD_{50} is 5000 Kg/ha.

The application with different rates of tobacco waste affected on water pH, electrical conductivity and dissolved oxygen significantly. The increasing rate of tobacco waste affected on water pH, electrical conductivity increment but decreased dissolved oxygen.

3.1.2 Nicotine in tobacco waste is 1.90 ppm. The increasing rate of tobacco waste that can increase dissolved nicotine i.e. tobacco waste at 9375 Kg/ha has dissolved nicotine 1.86 ppm after 1 day and at 625 Kg/ha has dissolved nicotine 0.01 ppm. In the other hand, at the same rate of application was found maximum dissolved nicotine after applied 2 days and decreased at 3 days. There was not detected nicotine after applied 4, 7, 15 and 30 days at the rate of tobacco waste 625, 1562.5, 4687.5 and 9375 Kg/ha respectively. That can simulate nicotine prediction model as dissolved nicotine (ppm) = 0.002 (rate of application in Kg/ha) – 0.1037; $r^2 = 0.98$. Decomposition rate of tobacco waste also can simulated model as 0.0023 (day after applied)^2 – 0.1006 (day after applied) + 0.9644; $r^2 = 0.88$. Nicotine loss (ppm) = -0.0409 (day after applied) + 0.5129; $r^2 = 0.68$.

3.1.3 Temperature did not affect on nicotine in tobacco waste pellet after treated at 4° C and room temperature during 7 months.

3.1.4 Tobacco waste at the rate of 1562.5 Kg/ha has been tested for acute dermal on Wistar mouse LD_{50} was more than 15,000 ml/Kg of body weight. The acute skin tested on white mouse (Sprague Dawley specie) after applied 2,000 ml/Kg of body weight 24 hours then observe abnormal symptom at ½ , 1, 3 hours to 14 days. The weight of each mouse at 8 and 15 days were not different with control, mouse alive and not found abnormal symptom in visceral organ of gross pathology. Skin irritation tested was not found red and swell symptom on rabbit skin.

3.2 Green house trial

Tobacco waste can be reduced rice damaged by golden apple snail about 14%. After applied tobacco waste was increased pH, electrical conductivity, biological oxygen demand, chemical oxygen demand and nicotine in water but reduced dissolved oxygen. However, every parameter will be neutral at 3 days after applied.

The rate of application more than 625 Kg/ha can be improved rice yield and yield component due to tobacco waste contained of high nitrogen with 1.34% and high organic matter with 46.65%. There was not detected nicotine in rice grain. Before study, chemical soil properties were high available phosphorus, high exchangeable potassium but low organic matter. After application of tobacco waste can be improved organic matter, available phosphorus, exchangeable potassium, exchangeable calcium, exchangeable magnesium in soil.

In second pot trial, tobacco waste was mixed with chemical fertilizer that could be controlled golden apple snail as shown in Figure 1. The application of tobacco waste @ 1562.5 Kg/ha and mixed with chemical fertilizer grade 16-16-8 at 156.25 Kg/ha can be killed golden apple 69% after applied one day and 100% in 2 days. Similarly with tobacco waste @ 1562.5 Kg/ha can be killed golden apple snail 42% after one day and 100% in 15 days. Control treatment rice was damaged more than 50%. Tobacco waste application also increased electrical conductivity, pH, biological oxygen demand and chemical oxygen demand of water immediately after applied but will be neutral in 4 days. There was not detected dissolved nicotine in all treatments at various times. Tobacco waste mixed with chemical fertilizer was induced rice tiller more than chemical fertilizer and control. Tobacco waste can be increased organic matter, available phosphorus, exchangeable potassium, exchangeable calcium and exchangeable magnesium in soil.

3.3 Field trial

The best material which can control golden apple snail in field experiment was tea seed powder at the rate of 31.25 Kg/ha (Figure 2). Tea seed powder could kill golden apple snail 81% at first date after applied and 100% in 3 days. Simultaneously, tobacco waste can be killed golden apple snail 20%, 36% and 56% after used 625, 1562.5 and 3125 Kg/ha at first date and 100% in 2 days. Rice damage after tobacco waste treated was 15.19%, 15.41% and 18.62% in 3125, 1562.5 and 625 Kg/ha respectively and stop damage in two days (Figure 3). The application of tobacco waste @ 3125 Kg/ha can be detected nicotine in water after applied 1 hour with 0.09 ppm and dramatically increase in 2 days with 0.26 ppm. Tobacco waste application was increased electrical conductivity, biological oxygen demand and chemical oxygen demand in water. In the other hand, pH and dissolved oxygen in water were decreased. Tobacco waste can be improved soil fertility i.e. organic matter, available phosphorus, exchangeable potassium, exchangeable calcium and exchangeable magnesium.

In second field trial, different methods on golden apple snail controlling affected on mortality of snail significantly (Figure 4). Tea seed powder @ 15.625 Kg/ha was controlled at 8% on first date and 100% in 45 days. The application of tobacco waste @ 1562.5 Kg/ha or mixed with chemical fertilizer grade 16-16-8 @ 78.125 Kg/ha found rate of control at first date 5% and 6% respectively and 100% in 2 days. In control treatment, rice damaged by golden apple snail was 30.98%, 46.52% and 39.79% at 1, 2 and 3 weeks respectively. Tobacco waste @ 1562.5 Kg/ha mixed with chemical fertilizer grade 16-16-8 @ 78.125 Kg/ha was not found rice damage at 7 days (Figure 5). Tobacco waste application can be increased electrical conductivity, biological oxygen demand and chemical oxygen demand in water. In the other hand, pH and dissolved oxygen in water were decreased. Especially in tobacco waste @ 1562.5 Kg/ha or mixed with chemical fertilizer grade 16-16-8 @ 78.125 Kg/ha were dramatically changed. The application of tobacco waste @ 1562.5 Kg/ha or mixed with chemical fertilizer grade 16-16-8 @ 78.125 Kg/ha or mixed with chemical fertilizer grade 16-16-8 @ 156.25 Kg/ha could increase rice yield and yield component without nicotine detected. From this experiment we were found tobacco waste @ 1562.5 Kg/ha can killed all golden apple snail in 2 days. Simultaneously, tobacco waste can be increased organic matter, available phosphorus, exchangeable potassium, exchangeable calcium and exchangeable magnesium in soil.

4. Conclusion

The application of tobacco waste to control golden apple snail in paddy field was increased water pH and electrical conductivity and decreased dissolved oxygen. That caused by organic material in tobacco waste after applied into water was decomposed by aerobic microorganism and ionic bombard will be occurring (Raenwattana and Jenwanit, 2008).

Temperature was not affected on nicotine in tobacco waste pellet due to vacuum packaging. Nicotine is compound of nitrogen that can react with acid and produce nicotine salt in solid stage which soluble and volatilize at room temperature (Okamoto *et*. al., 2007).

Chemical properties of tobacco waste is pH 5.28, electrical conductivity 19.08 dS/m, organic matter 46.65%, C/N ratio 20.19, total nitrogen 1.34%, total phosphorus 0.34%, total potassium 0.24% and nicotine 1.8 ppm. The optimum rate of tobacco waste to control golden apple snail was 1562.5 Kg/ha. Iida *et* al. (1998) used tobacco waste which has nicotine 2.8% at the rate of 712.5 Kg/ha to killed snail.

Tobacco waste @ 1562.5 Kg/ha has LD_{50} on acute dermal more than 15,000 ml/Kg of body weight. LD_{50} on acute skin was more than 2,000 ml/Kg of body weight and irritate on skin was not found red symptom and swell on rabbit skin. Toxicity report LD_{50} of nicotine was 50 mg/Kg of rat and 3 mg/Kg of mouse and in human was 40-60 mg/Kg (Kenneth, 2007).

That we recommended tobacco waste at the rate of 1562.5 Kg/ha can be killed all Golden Apple snails in 2 days without toxicity, water pollution and nicotine in rice grain. Tobacco waste can be increased soil fertility e.g. organic matter, available phosphorus, exchangeable potassium, exchangeable calcium and exchangeable magnesium.

Acknowledgement

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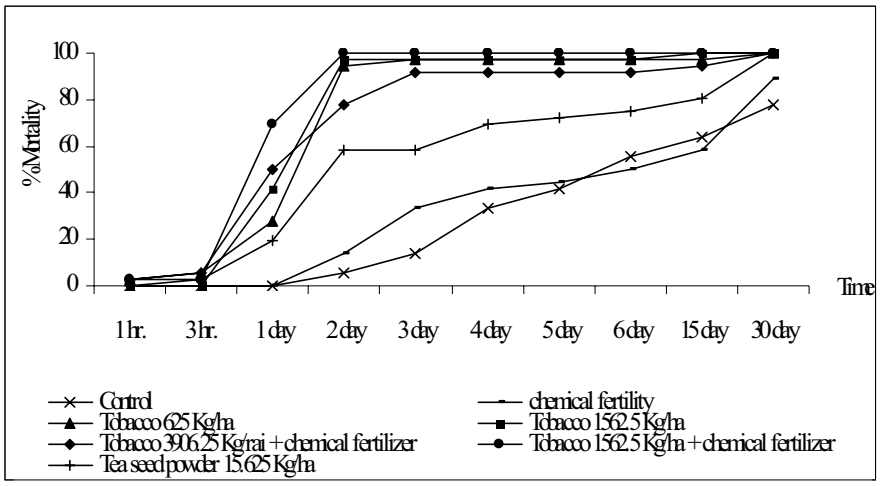

Figure 1. Golden apple snail mortality of each treatment in green house experiment

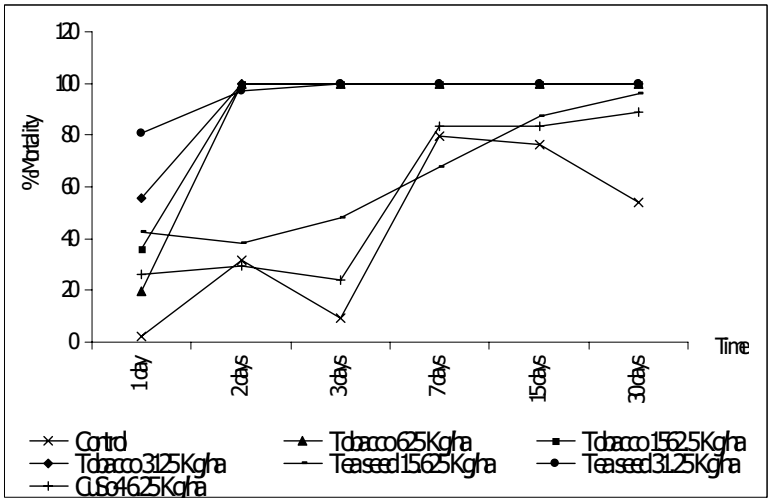

Figure 2. Mortality rate of golden apple snail in first field trial

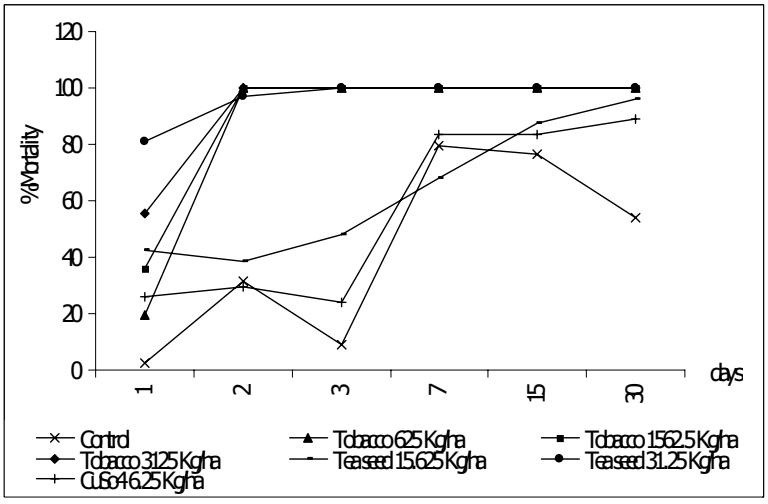

Figure 3. Rice damage rate in first field trial

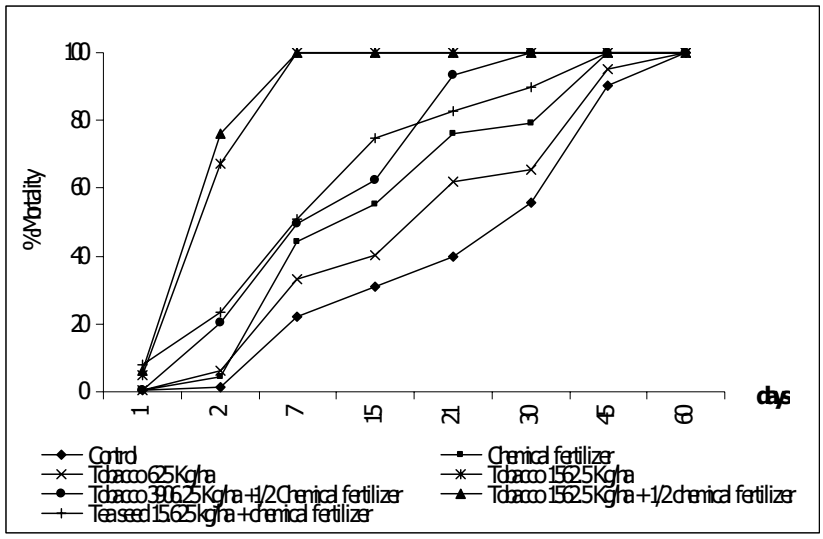

Figure 4. Mortality rate of golden apple snail in second field trial

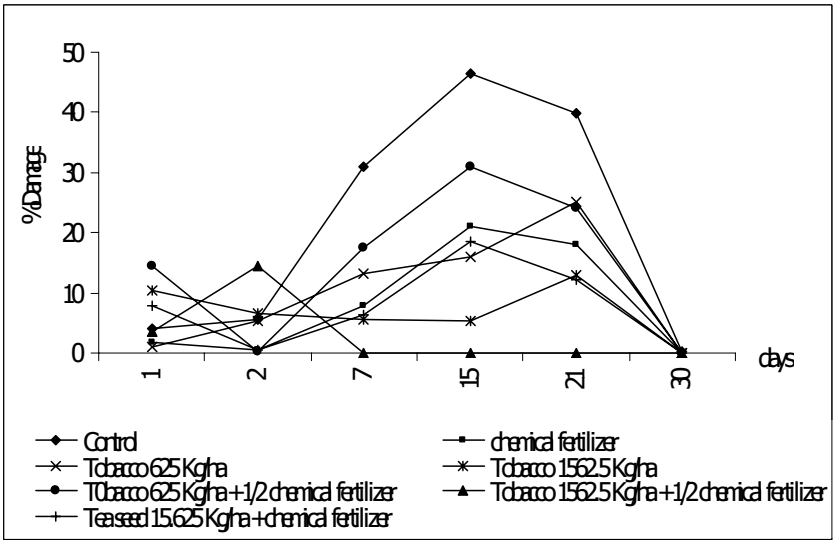

Figure 5. Rice damage rate in second field trial