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Botanical control of golden kuhol (*Pomacea canaliculata* Lamarck) using asyang [*Mikania cordata* (Burm. F.) B.L. Robinson]

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ABSTRACT

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This study was conducted to determine the molluscicidal effect of asyang *(Mikania cordata)* extract against golden kuhol *(Pomacea canaliculata)* under laboratory condition and to evaluate its potential for the control of golden kuhol in the field.

Leachates from 24 and 48 hrs soaking of fresh asyang samples caused 23.4% and 27.2% snail mortality, respectively, one day after treatment. Percent mortality was increased to 33.67% and 56.93% for the 24 and 48-hr treatments, respectively, two days after treatment.

The effect of asyang on the population density of golden kuhol was comparable to that of the molluscicide Bayluscide at the recommended rate. Reduction in the number of damaged rice hills in asyang-treated plots was also noted. Rice plants grown in asyang-treated plots were healthier and heavier than those grown in the control plots.

Keywords: *asyang*. botanicals. golden kuhol.

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INTRODUCTION

Golden kuhol or golden snail (*Pomacea canaliculata* Lamarck) is known to be a native of South America. It was introduced in the Philippines as food with a high protein value. The introduction of golden kuhol was therefore of good intention (see Martin and Sauerborn, 2000, this issue). However, due to its adaptability to Philippine conditions, the golden kuhol was able to reproduce very rapidly. It feeds on azolla, rice, kangkong (water cabbage), sweetpotato, taro and papaya leaves. In time, it became a serious pest infesting the country's major rice producing areas with Region II as the most infested. Tanzo and Barroga (1988) reported that golden kuhol infested about 3.5% of the total ricefields in the Philippines. The Department of Agriculture (1989) reported that the golden snail can cause 1-40% yield losses in rice. About 400,000 hectares of ricefields have been found out to be infested with the pest. Thus, it is considered a serious pest in lowland ricefields.

Golden kuhol can be controlled by mechanical, biological and chemical methods. The use of chemicals is the most effective method because of its knockdown effect on the pest. However, chemical application has hazardous effects on aquatic environments including non-target organisms. Moreover, it also exposes human beings to the toxic effects of these molluscicides.

The biological control of golden kuhol using molluscicidal plants has been the subject of earlier research (Agaceta, 1981; Tanzo and Barroga, 1988; Garcia, 1974 as cited by Buendia, 1988). Moreover, the molluscicidal effect of asyang [*Mikania cordata* (Burm. F.) B. L. Robinson] water extracts under laboratory condition was also reported by Bañoc and Noriel (1992). Likewise, the methanol extract of asyang was found active against *Biomphalaria glabrata* Say, another species of snail (Noriel, unpublished data).

In this study, the potential of asyang (Asteraceae) to control golden kuhol was evaluated. But instead of using an aqueous extract (as done by Bañoc and Noriel, 1992), asyang leachate was prepared and utilized in the laboratory bioassay while in the field experiment, freshly collected asyang tissues were chopped and evenly applied on the plots.

Specifically the objectives of this study were to: determine the toxicity of asyang leachates against golden kuhol under laboratory condition; evaluate the molluscicidal potential of asyang in the field; and determine the effect of asyang application on the growth of rice.

MATERIALS AND METHODS

Laboratory experiment

Five hundred (500) grams of freshly collected chopped asyang vines were washed with tap water and blotted dry. The samples were soaked in 5000 ml water inside covered black plastic pails (4 gallon capacity; 32.5 cm diameter) for 24 and 48 hours. The leachates were collected and strained through several layers of clean nylon tulle and immediately used for bioassay.

Five hundred (500) ml leachates were placed inside plastic bottles (half gallon capacity, 16.5 cm diameter), afterwhich, 10 freshly collected adult golden kuhol (14.65 mm mean operculum diameter) were dipped. The number of dead golden kuhol were counted one and two days after dipping. To be sure that the golden kuhol were dead, they were transferred to clean water for 24 hours and observed for recovery. Final percent mortality was computed using the formula:

$$\text{Percent Mortality} = \frac{\text{no. of dead snails}}{\text{total no. of snails}} \times 100$$

The different treatments consisted of time of soaking (i.e. 24 and 48 hours) and a control was provided using tap water instead of asyang leachates. Five replications were maintained per treatment. The experiment which was laid out in a completely randomized design (CRD) was conducted three times. Treatment means were compared using the Duncan's Multiple Range Test (DMRT).

Field experiment

An experimental area was established at the ViSCA Experimental Station located in Barangay Pangasugan, Baybay, Leyte.

The area was thoroughly plowed, harrowed, and divided into four blocks as replications. Each block was further divided into 6 subplots measuring 3m x 5m. At the adjacent ricefield, seedbeds were prepared afterwhich rice seeds (var. PSB Rc-2) were sown and allowed to grow for two weeks. The experimental area was fenced to keep animals away.

Right after land preparation, the following weights (as treatments) of freshly chopped asyang (vines including leaves) were evenly applied (T_1=0 kg; T_2=1.5 kg; T_3=3.0 kg; T_4=6.0 kg; T_5=9.0 kg; and T_6=Bayluscide at recommended rate).

Two-week old rice seedlings were transplanted 48 hours or 2 days after asyang application (DAA). Application of asyang was again done at 7, 14, and 21 days after transplanting (DATr).

Monitoring and sampling of golden kuhol population were done weekly for 3 weeks. Golden kuhol collected per plot using 1 x 1m quadrat were immediately brought to the laboratory, and placed inside glass jars containing clean water. The kuhol collected were counted and percent mortality was computed based on the number of dead snails noted. Likewise, the number of golden kuhol-damaged rice hills per plot was recorded.

Other parameters gathered include: height of 5 rice plants per plot (i.e. 20 plants per treatment); rice seedlings' gross morphological characteristics (e.g. yellowing of leaves, luxuriant growth, etc.) after asyang application; dry weight (20 plants per treatment); and weight of filled grains (2 x 3m harvest area) dried to 14% moisture. These parameters were noted to determine the effect of asyang on the growth of rice.

Three trials were conducted, the first and third being done during the dry season (March-June 1996 and March-June 1997) and the second during the wet season (August-November 1996).

RESULTS AND DISCUSSION

Molluscicidal activity of asyang leachate

Table 1 shows the percent mortality of golden kuhol as affected by leachates from fresh asyang samples one and two days after treatment. Significant differences in snail mortality were noted between the control and the treated golden kuhol in the trials conducted. Leachates collected from 24 and 48 hours soaking caused an average of 23.4 and 27.4% mortality, respectively, one day after treatment (DAT). Percent mortality was increased to 33.7 and 56.9% for the 24 and 48 hours treatments, respectively, at 2 DAT. This shows that regardless of the time of soaking, leachates from fresh

Table 1. Percent mortality of golden kuhol as affected by leachates from fresh asyang samples

Time of soaking (hr)	Percent mortality of kuhol[1]			
	,Trial 1	Trial 2	Trial 1	Mean
One day				
Control	0.00 b	0.00 b	0.00 b	0.00
24 hrs	10.21 a	20.00 a	40.00 a	23.40
48 hrs	10.40 a	30.80 a	40.40 a	27.40
Two days				
Control	0.00 c	0.20 b	0.00 b	0.06
24 hrs	10.40 b	40.60 a	50.00 a	33.67
48 hrs	70.80 a	50.00 a	50.00 a	56.93

1 Based on 5 replications with 10 golden kuhol per replicate. Means within column followed by the same letter are not significantly different at 5% level DMRT.

asyang exerted molluscicidal activity against golden kuhol. However, toxicity of the leachates increased as time of exposure was prolonged.

The dead snails were found floating on the surface of the leachates (Fig. 1). In severe cases, the meat dehisced from the shell, leaving shells empty (Fig. 2). On the other hand, almost all the snails in the control treatment were found alive and attached to the side of the container (Fig. 3).

Field evaluation of asyang for molluscicidal activity against golden kuhol

Table 2 shows the population density and percent mortality of golden kuhol as influenced by asyang application. The effect was more pronounced during the wet season trial wherein reduction of golden kuhol population and percent mortality were proportional to the rate of asyang application. The reduction in population density of golden kuhol at 9 kg asyang application was comparable to that caused by the molluscicide Bayluscide at the recommended rate. The number of rice hills damaged by golden kuhol applied with asyang are presented in Table 3. Significant differences in the number of damaged rice hills were noted between plots treated with asyang and the control specifically during the last two trials (wet season and dry season). However, no significant differences were recorded between the bayluscide-treated plots and those applied with asyang indicating comparabl effects. The reduction in

Figure 1. Dead golden kuhol floating on asyang leachate

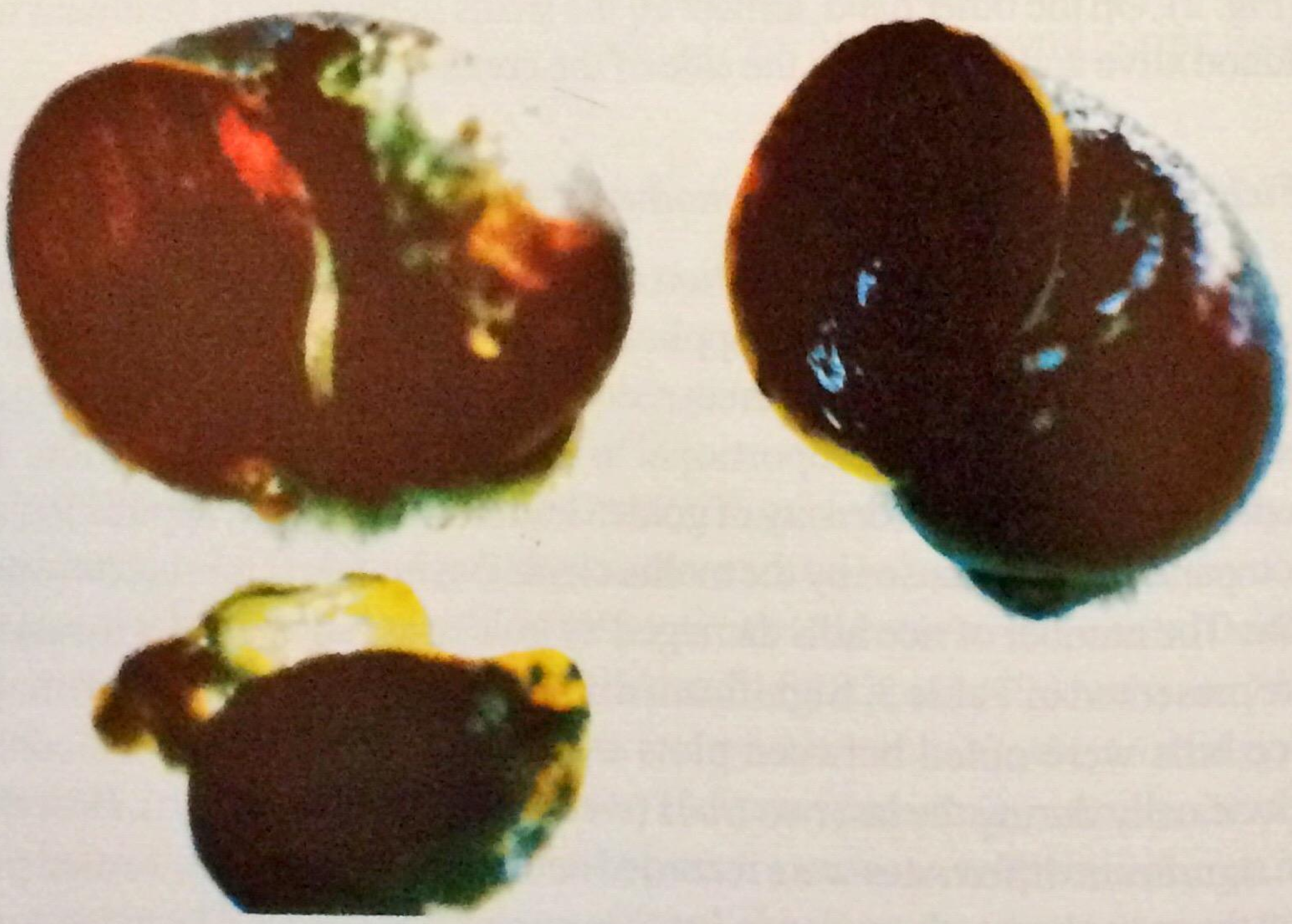

Figure 2. The meat dehisced from the shell in the treated kuhol (A) while those in the control (B) remained inside the shell

Figure 3. Live golden kuhol in the control treatment attached to the side of the container

the number of damaged rice hills in asyang-treated and in Bayluscide-treated plots can be ascribed to the lower population density and higher percent mortality of golden kuhol in said plots (Table 2).

Effect of asyang application on the growth of rice

Differences in the weight of filled grains among treatments in both wet and dry seasons were not significant (Table 4). However, a slightly higher yield was consistently obtained in plots treated with asyang. This slight increase in yield can be due to the significant reduction in the number of damaged rice hills as a consequence of the lower population density of golden kuhol brought about by asyang application.

Tables 5 and 6 show the height and dry biomass weight of PSB Rc-2, respectively, as influenced by different rates of asyang application. No significant differences in plant height were observed during the wet and dry seasons, although a slight increase in height of rice was noted in plots treated with

Table 2. Population density and percent mortality of golden kuhol as affected by varying rates of asyang application

Treatment	Kuhol density			Percent mortality		
	DS	WS	DS	DS	WS	DS
T1 (control, 0 kg)	6.22 a	7.00 a	16.87 a	0.00 c	0.00 c	0.00 c
T2 (1.5 kg asyang)	1.89 ab	3.45 ab	15.50 a	0.41 b	4.85 b	1.21 b
T3 (3.0 kg asyang)	2.67 ab	2.67 b	16.33 a	10.40 ab	24.29 ab	4.64 b
T4 (6.0 kg asyang)	4.39 ab	1.56 a	13.25 a	4.27 b	23.61 ab	3.24 b
T5 (9.0 kg asyang)	1.00 b	1.00 b	9.67 a	58.38 ab	35.18 a	11.49 b
T6 (Bayluscide)	0.33 b	0.78 b	5.50 a	100.00 a	100.00 a	100.00 a

WS/DS wet season/dry season

Table 3. Effect of varying rates of asyang application on the number of rice hills damaged by golden kuhol infestation

Treatment	Number of damaged hills/plot*		
	Dry season	Wet season	Dry season
T1 (control, 0 kg)	2.33 a	28.85 a	31.67 a
T2 (1.5 kg asyang)	2.50 a	1.00 b	0.83 b
T3 (3.0 kg asyang)	1.58 ab	1.25 b	1.25 b
T4 (6.0 kg asyang)	0.83 bc	7.41 b	7.17 b
T5 (9.0 kg asyang)	1.08 bc	6.16 b	6.33 b
T6 (Bayluscide)	0.25 c	0.16 b	0.17 b

* Means of 4 replications with 5 quadrats/replicates. Noted on the day of collection. In a column, means followed by a common letter are not significantly different at 5% level, DMRT

Table 4. Grain yield of PSB-Rc2 rice cultivar as influenced by asyang application

Treatment	Weight of filled grains (kg/m^2)*		
	Dry season	Wet season	Dry season
T1 (control, 0 kg)	0.837a	1.492 a	2.030 b
T2 (1.5 kg asyang)	0.899a	1.607 a	2.270 ab
T3 (3.0 kg asyang)	0.926a	1.915 a	2.564 a
T4 (6.0 kg asyang)	0.920a	1.855 a	2.370 ab
T5 (9.0 kg asyang)	0.902a	1.763 a	2.778 a
T6 (Bayluscide)	1.006a	1.725 a	2.337 ab

* Means of 4 replications with 5 quadrats/replicates. Noted on the day of collection. In a column, means followed by a common letter are not significantly different at 5% level, DMRT

Table 5. Height of rice plants at harvest as affected by different rates of asyang application

Treatment	Height of rice plant (cm)*		
	Dry season	Wet season	Dry season
T1 (control, 0 kg)	102.27 a	104.30 b	76.19 b
T2 (1.5 kg asyang)	102.26 a	105.05 b	78.29 ab
T3 (3.0 kg asyang)	104.55 a	105.48 ab	78.38 ab
T4 (6.0 kg asyang)	105.89 a	108.26 ab	83.41 a
T5 (9.0 kg asyang)	107.55 a	109.38 a	83.75 a
T6 (Bayluscide)	103.53 a	108.09 ab	75.58 b

* Means of 20 plants per treatment. In a column, means followed by a common letter are not significantly different at 5% level, DMRT

Table 6. Biomass of rice variety PSB-Rc2 as influenced by varying rates of asyang application

Treatment	Biomass of rice plant (g)*		
	Dry season	Wet season	Dry season
T1 (control, 0 kg)	15.69 a	35.97 a	79.51 ab
T2 (1.5 kg asyang)	16.94 bc	35.42 a	76.04 ab
T3 (3.0 kg asyang)	23.93 a	39.66 a	85.89 ab
T4 (6.0 kg asyang)	21.95 ab	42.65 a	108.56 a
T5 (9.0 kg asyang)	19.54 abc	41.56 a	97.12 ab
T6 (Bayluscide)	22.17 a	39.91 a	69.55 b

* Means of 20 plants per treatment. In a column, means followed by a common letter are not significantly different at 5% level, DMRT

asyang especially at higher rates (6 and 9 kg/plot). Likewise, rice plants grown in asyang-treated plots were slightly heavier than those grown in the control plots. These results imply that asyang application does not adversely affect the growth of rice (PSB Rc-2). In fact, the growth of rice might have been enhanced by the application of asyang as shown by the increase in height (Fig. 4) and by greater dry weights at harvest (Table 6). It can be speculated that asyang might also contain natural compounds that can favor the growth of rice.

Figure 4. Rice plants grown in different treatments. Field experiments showed that asyang application did not adversely affect rice.

RECOMMENDATIONS

The factors affecting the efficacy of asyang leachates from fresh samples should be determined (e.g. time of storage, temperature, etc.). The use of dried asyang samples for the control of golden kuhol should also be tried.

Field experiments need to be conducted in other rice producing areas of the country to verify the results of this study. The effect of continuous asyang application on soil properties and other non-target organisms should be investigated.

Identification and isolation of the active component of asyang should be done to develop a biodegradable compound for the control of golden kuhol.

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