BIBLIOGRAPHY

EPIE, MARGIE S. APRIL 2013. Growth and Yield of Traditional Glutinous Rice Varieties Sprayed with Mokusaku Under Kapangan, Benguet Condtion. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted to: determine the growth and yield of traditional glutinous rice varieties; determine the effect of *Mokusaku* application on the growth and yield of traditional glutinous rice varieties; determine the interaction effect of *Mokusaku* and traditional glutinous rice varieties; and determine the profitability of growing the different traditional glutinous rice varieties sprayed with *Mokusaku*.

Based on the results of the study, all of the varieties were resistant to stem borer and blast. Balatinaw produced the highest yield among the varieties evaluated. Glutinous rice varieties sprayed with *Mokusaku* showed significant effect on the number of filled grains and computed yield per hectare. Furthermore, Bongkitan sprayed with *Mokusaku* produced taller seedlings and more grains. Bongkitan and Balatinaw variety sprayed with *Mokusaku* realized the highest profit.

INTRODUCTION

Rice, botanically known as *Oryza sativa* L., is a well known plant which is cultivated in both warm and cool climates. It is well adapted to a wide range of diversity from rain-fed dryland to deep water condition. In most rice growing areas, flooding the soil to a certain period or for the entire crop season is mostly practiced. The rice crop grows variably in height usually from 3 to 16 feet and bears a panicle with a floret of more than 300 (Sheaffer, 2009).

Rice being the staple of billions of people including Filipinos contains protein, fats, and carbohydrates with a supply of 250 calories per day (IRRI, 1993). In Benguet and some parts of Cordillera, traditional rice varieties are being preserved and valued because it is embedded in the culture of the people. Kapangan in particular, traditional rice varieties are cultivated for traditional festivals, other occasions and for commercial purposes as well. However, most of the farmers are not applying fertilizer to improve the growth and yieldof traditional rice varieties.

Mokusaku as a foliar spray contains organic compounds that enhances rooting, promotes photosynthesis and protects the plants from pests and diseases (DA-Thailand, 2011). Moreover, the beneficial microbes present in *Mokusaku* promote plant growth (Tancho, 2011). It has also the ability to absorb plant substances, accelerate nitrogen to amino acids and water absorption of the plant is easy (Burnette, 2012).

In the past decades until now, high yielding rice varieties (HYV'S), pesticides and synthetic fertilizers are being introduced leading to the almost disappearance of traditional rice varieties. Traditional rice varieties being cultivated are generally low yielding and late maturing making the plants vulnerable to be replaced by high yielding varieties even if resistant to severe pests and diseases, adapted to the low temperature, have good eating quality and a good price (CECAP, 2000).

Therefore, practices that will increase the yield is one of the important aspects in the conduct of this study. Application of *Mokusaku* (wood vinegar) may improve the growth and increase the yield of traditional rice varieties.

Whatever good result of this study, it will serve as source of information for the farmers to improve and sustain production of traditional varieties.

The objectives of the study were to:

1. determine the growth and yield of traditional glutinous rice varieties sprayed with *Mokusaku*;

2. determine the effect of *Mokusaku* on the growth and yield of traditional glutinous rice varieties;

3. determine the interaction effect between the traditional glutinous rice varieties and *Mokusaku* on the growth and seed yield of traditional glutinous rice; and

4. determine the profitability of growing the traditional glutinous rice varieties sprayed with *Mokusaku*, under Kapangan, Benguet, condition.

The study was conducted at Balakbak, Kapangan, Benguet from August 2012 to January 2013.

REVIEW OF LITERATURE

The Economic Importance of Rice

Rice is the most important crop in Asia and the staple food for about half of the world's population. It is grown in about 143.5M hectares all over the world, more than 90% of which in Asia. Rice is an economically important food crop with nutritional diversification and helps in poverty alleviation. Rice is ranked as the world's number one human food crop. Rice provides more calories per hectare than any other cereal crop. Rice is planted to about 2.8ha with an average yield of 3.8 tons. About 2.5 M Filipino rice farmers depend on rice industry to livelihood and it provides employment to 11.78M agricultural labor forces (BAS, 2008). Rice is produced in 111 countries in the world and the region with high population density and the most rapid population growth produced and consumed the most rice (Nanda, 2000).

Characteristics of Traditional Rice

PhilRice (2000) enumerated some characteristics of traditional rice varieties grown in the cordillera as those with low fertility awned grains, tall stalk, and late maturing.

CECAP and PhilRice (2000) stated also that traditional rice varieties are mostly 16cm-200cm in height with droopy leaves, photoperiodic which means their growth duration depends on the month of planting, low yielding, late maturing and it has a less response to nitrogen fertilizers.

Chemical Composition of *Mokusaku*

Mokusaku is a liquid obtained from oil, juices, sap and other liquid contents of organic materials such as wood, coconut shell, bamboo, grass, and other plants after being heated in a chamber. It has qualities that provide growth inducing effects to plants (De Guzman, 2009).

The characterization of liquid products from pyrolysis has been continued a long time. The products contain many organic components and the composition is very complicated. During the last twenty years the interest has mainly been focused on the liquid product from fast pyrolysis. According to reference the main organic components of *Mokusaku* are methanol and acetic acid. Other components are acetone, methyl acetone, acetaldehyde, allyl alcohol, furan and furfural, formic, propionic and butyric 114 aci (Tiilikkala *et al.*, 2010).

Mokusaku as a Foliar Spray

Mokusaku, like hormones, will be absorbed into twigs, trunks, or leaves. Plants will be stronger, and leaves will be greener and resistant to pests and diseases. For plant production specifically, spray the solution over plant shoots. Through foliar application of *Mokusaku*, the leaves become shiny and darker in color. This is due to the increase in chlorophyll through the effect of ester in the *Mokusaku* which promotes photosynthesis. The ester also helps in the formation of sugar and amino acids that result in a better taste of the produce. The healthier leaves naturally have a stronger resistance against pests and diseases. *Mokusaku* has capability to break water into smaller clusters. It means that pesticides diluted in water and added with *Mokusaku* will penetrate faster and better into plant leaves and plants sprayed with *Mokusaku*-mixed liquid dry faster too (Yokomori, 2011).

Effect of *Mokusaku* on Crops

Yokomori (2011) reported his interview with Mr. Capsuyan, applying *Mokusaku* on carrots by spraying once a week at five to seven days interval with a dosage of one small can of sardines (180 ml) plus fungicides (mancozeb and other fungicide) and insecticides (half of the recommended dosage) in a 16 liter capacity knapsack sprayer during the vegetative stage. Result showed that *Mokusaku* reduced the strong odor of pesticide; wide and thicker leaves; big sizes of roots and were almost uniform in size. Four tons of carrot was harvested from a 400 grams seed. The increase in yields attributed to low quantity of rejects. The same observation was noted in celery.

Another interview with Mr. Renato Dingwas (2011), a member of the LATOPMPC who used *Mokusaku* in sweet potato noticed that it can also control insect pest such as beetles that feed on the leaves and also leaf folders that feed on the young shoots and observed to be robust. Application was done either as fertigation or foliar and applied once a month.

MATERIALS AND METHODS

An area of 180m^2 was properly prepared and divided into three blocks consisting of 10 plots each measuring 1m x 6m (Figure 1). The experiment was laid-out using split plot design in randomized complete block design (RCBD). The treatments were as follows:

<u>Main plot: *Mokusaku* application (M)</u>

M_1= without *Mokusaku* application

M_2= with *Mokusaku* application

<u>Sub-plot: Traditional glutinous rice varieties (V)</u>

Code	Variety	Source
V_1	'Molis'	Balakbak , Kapangan, Benguet
V_2	'Balatinaw'	Balakbak , Kapangan, Benguet
V_3	'Bongkitan'	Balakbak , Kapangan, Benguet
V_4	'Langkay'	Balakbak , Kapangan, Benguet
V_5	'Malunaw'	Cuba, Kapangan, Benguet

The rice seedling of each variety was raised in a wet-bed method. The rice seedlings were transplanted at 30 days after sowing (Figure 2). Two seedlings per hill were planted at a distance of 20 cm x 20 cm between hills and row. Replanting was done five days after transplanting (DAT) to ensure that all hills will have a growing plant.

Mokusaku was sprayed for an interval of 14 days with a ratio of 2 liters water: 4 table spoons of *Mokusaku* (Legueb, 2012). The *Mokusaku* was acquired at the Municipality of Kapangan, Benguet.

Weeding was done after 30 days of transplanting (DAP) and other cultural management practices were done equally.

Figure 1. Overview of the production site during land preparation

Figure 2. Transplanting of 30-day old rice seedlings

Data Gathered

1. Meteorological data. The temperature and relative humidity were taken by using a hygrometer. Rainfall was taken by placing plastic containers within the field to collect water when precipitation occurs. The volume of water collected was measured using a graduated cylinder. Rainfall was recorded by getting the average volume of water from the plastic container. Light intensity was taken by using a digital light meter.

2. Soil analysis. Soil samples were taken from the experimental area before and after harvesting.

3. Plant vigor. This was taken before transplanting using the following scale (Phil Rice, 1996):

Scale	Description	Remarks
1	Majority of the seedling have 5 or more leaves with 2-3 tillers	Very vigorous
2	Majority of the seedlings have 1-5 leaves with 1-2 tillers	Vigorous
3	Most of the seedling have 4 leaves without tillers	Normal
4	Most of the seedlings have 3-4 leaves without tillers	Weak
5	Most of the seedlings turned yellow and thin	Very weak

4. Seedling height (cm). This was measured from the base of the shoot to the tip of the tallest leaf blade. Ten seedlings per variety were measured before transplanting (Phil Rice, 1996):

Scale	Remarks
1	Short (30cm)
2	Intermediate (45cm)
3	Tall (> 60 cm)

5. Height at maturity (cm). This was measured from the base of the plant to the tip at harvest. Ten samples per plot were selected randomly.

6. Maturity

6.1. No. of days from transplanting to tillering. This was taken when 50% of the plants produced tillers.

6.2. No. of days from transplanting to booting. This was taken when 50% of the total plant in a plot booted as shown by the swelling of the upper flag sheath.

6.3. No. of days from transplanting to heading. This was recorded when 50% of the total plant produced panicles.

6.4. No. of days from transplanting to ripening. This was recorded when 50% of the panicles turn yellow.

7. No. of tillers produced. Tillers were counted just before booting using ten hills per treatment.

8. No. of productive tillers per hill. The productive tillers were counted using ten hills per treatment selected randomly. Only the plants which produce panicles were considered productive.

9. Yield and yield component (Phil Rice, 1996)

9.1 No. of filled and unfilled grains per panicle. This was recorded by counting the no. of filled and unfilled grains at heading.

9.2. Yield per plot (kg). Grain yield per plot was taken after threshing and drying at 14% moisture content (MC) then weighed.

9.3. Grain weight (g). Random samples of 1000 well-developed whole grains, dried to 13% MC were weighed on a sensitive balance.

9.4. Computed yield per hectare. This was taken by converting grain yield per treatment into yield per hectare using the following ratio and proportion:

$$\text{Yield/ha} = \frac{\text{Yield per plot (kg)}}{\text{Plot size x 1000}} \times 10{,}000$$

10. ROCE. This was the actual expenses during the conduct of the study and will be computed using the formula:

$$\text{ROCE} = \frac{\text{Net income}}{\text{Total cost production}} \times 100$$

11. Pest and disease incidence

11.1. Stem borer damage evaluation. Field rating was based on the actual no. of panicles affected using the three middle of the plot as sampling area. Ten sample hills were selected at random where white heads were counted ten days before harvest, using the following scale (Phil Rice, 1996).

Scale	Descriptive	Rating
1	1-5 white heads	Resistant
2	6-10 white heads	Moderately resistant
3	11-15 white heads	Intermediate
4	16-25 white heads	Moderately susceptible
5	26 and above white heads	Susceptible

11.2. Blast resistance (neck rot). Evaluation of the severity of rice blast was taken from the plant at the center rows per hill. Ten sample plant hills were taken randomly. Computation of percent infected was done by using the formula (Phil Rice, 1996).

$$\% \text{ infection} = \frac{\text{No. of panicles infected}}{\text{Total no. of panicles}} \times 100$$

Scale	Description	Rating
1	0-5% are affected by blast	Resistant
2	6-25% are affected by blast	Intermediate
3	26% and above are affected by blast	Susceptible

Data Analysis

All quantitative data were analyzed using the Analysis of Variance (ANOVA) for split plot design in Randomized Complete Block Design (RCBD) with three replications. The significance of differences among the treatments was tested using the Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Meteorological Data

The monthly temperature, relative humidity, rainfall amount, and light intensity from August to December 2012 are shown in Table 1. It was observed that the lowest temperature was recorded in the month of October (25^{o}C) and the highest temperature was recorded during the month of September (32^{o}C). The relative humidity of the study ranges from 72% (December) to 80 % (October).

The highest rainfall was recorded in the month of September (2750.01 ml) and zero rainfall was recorded in the month of December. Arraudeau *et al.*, (1998) stated that irregular amount and duration of rainfall are the most important factor in planting rice.

Rice plants at seedling stage require a temperature ranged of 12-13^{o}C, 16-19^{o}C at the tillering stage, 15-20^{o}C at panicle initiation stage and 22-24^{o}C at the anthesis stage (De Datta, 1981). Thus, the temperature recorded was favorable for rice production during the conduct of the study.

Table 1. Meteorological data during the conduct of the study

MONTH	TEMPERATURE MIN (°C)	TEMPERATURE MAX (°C)	RELATIVE HUMIDITY %	RAINFALL AMOUNT (ml)	LIGHT INTENSITY (lux)
August	27.00	30.00	75	146.67	1054.00
September	28.80	32.00	76	2750.01	1043.60
October	25.00	30.75	80	563.33	563.33
November	26.50	31.00	73	366.67	1305.50
December	26.25	28.75	72	0	1250.00
MEAN	26.71	30.50	75	765.34	1043.29

Soil Chemical Properties

Table 2 shows the chemical properties before transplanting and after harvesting during the conduct of the study. It was observed that the soil pH of the soil decreased from 6.50 to 6.10 after harvesting. The organic matter of the soil decreased from 3.5% to 2.5 and 2.8% after harvesting.

Soil nitrogen and phosphorus decreased after harvesting which may have been consumed by the plants for its growth and development. Phosphorus is especially essential for root development, tillering and ripening (IRRI, 2007). Potassium content of the soil increased from 112 to 135 ppm after planting which imply that potassium is more than enough for the rice requirement.

Table 2. Soil chemical properties before transplanting and after harvesting

	pH	ORGANIC MATTER (%)	NITROGEN (%)	PHOSPHORUS (ppm)	POTASSIUM (ppm)
Before transplanting	6.50	3.5	0.18	27	112
After harvesting					
Without *Mokusaku*	6.10	2.5	0.13	23	132
With *Mokusaku*	6.10	2.8	0.14	23	135

Analyzed by: Soils Laboratory, City of San Fernando, La Union

Plant Vigor

The plant vigor of the five glutinous rice varieties at seedling stage was normal and all of the seedlings had 4 to 5 leaves as shown in Figure 3.

Seedling Height

Effect of *Mokusaku* application. The height of the seedlings was not significantly affected by the application of *Mokusaku*. Plant height ranges from 29.16 to 29.46 cm (Table 3).

Figure 3. Overview of the rice seedlings of the five varieties before transplanting

Table 3. Seedling height and height at 130 DAT of the glutinous rice varieties sprayed with *Mokusaku*

TREATMENT	SEEDLING HEIGHT (cm)	HEIGHT AT 130 DAT (cm)
Mokusaku Application (M)		
Without *Mokusaku* application	29.46	122.56
With *Mokusaku* application	29.16	124.79
Varieties (V)		
Molis	32.64[a]	140.62[a]
Balatinaw	27.97[b]	140.20[a]
Bongkitan	29.88[b]	122.69[c]
Langkay	28.05[b]	135.32[b]
Malunaw	27.99[b]	79.54[d]
M x V	*	ns
CV_a (%)	5.49	1.57
CV_b (%)	6.88	1.31

Means of the same letter are not significantly different at 5% level of significance by DMRT

<u>Effect of varieties</u>. The seedling height of the glutinous rice varieties differed from each other. Molis significantly had the tallest seedlings among the glutinous rice varieties. The differences in seedling height could be attributed to their varietal characteristics (Ahmed *et al.*, 1995).

<u>Interaction effect</u>. Significant interaction effect was observed between the glutinous rice varieties and *Mokusaku* application on seedling height as shown on Figure 4. Varieties Molis without *Mokusaku* application produced the tallest seedlings.

Height at 130 DAT

Effect of *Mokusaku* application. No significant effect of *Mokusaku* on plant height at maturity was observed (Table 2). Numerically at 130 DAT, rice plants sprayed with *Mokusaku* were taller compared to plants without *Mokusaku*.

Effect of varieties. Significant differences were observed on the height of the rice varieties evaluated. Varieties Molis (140.62 cm) and Balatinaw (140.20 cm) were the tallest while Malunaw was the shortest (79.54 cm). The differences could be attributed to varietal characteristics. In addition, traditional rice varieties were characterized by PhilRice (2000) as tall with an average height of 60 to 200 cm.

Interaction effect. There was no significant interaction observed on the height at maturity of the glutinous rice varieties sprayed with *Mokusaku*.

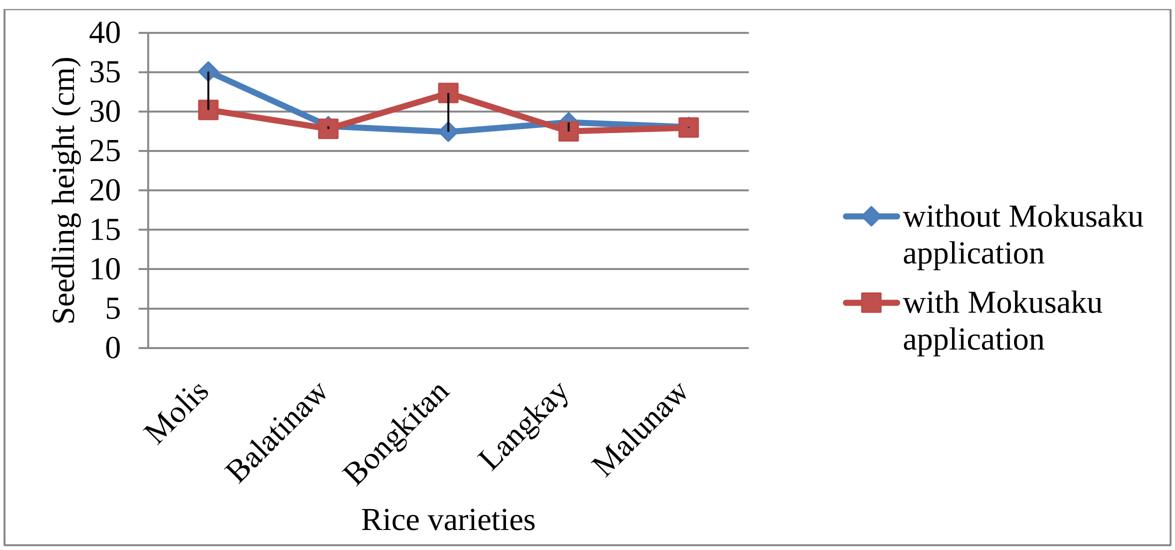

Figure 4. Interaction effect of *Mokusaku* application and glutinous rice varieties on seedling height

Number of Days from Transplanting to Tillering

Effect of *Mokusaku* application. The number of days from transplanting to tillering was not significantly affected by the application of *Mokusaku*. All the plants produced tillers at 31 DAT (Table 4 and Figure 5).

Effect of varieties. No significant differences were observed on the effect of glutinous rice varieties on the number of days from transplanting to tillering. All of the varieties produced tillers at the same time (30 DAT) except Balatinaw which produced tillers at 35 DAT.

Interaction effect. No interaction effect was observed on the number of days from transplanting to tillering and the five glutinous rice varieties sprayed with *Mokusaku*.

Number of Days from Transplanting to Booting

Effect of *Mokusaku* application. No significant differences were observed among the treatments. Plants sprayed and not sprayed with *Mokusaku* booted at 82 DAT (Table 4).

Effect of varieties. Numerically, Malunaw was the earliest to boot at 75 DAT followed by Molis, Bongkitan, and Langkay at 82 DAT.

Booting stage is not always affected by its genetic characteristics. Some factors like temperature, may delay booting when it is low (Arraudeau *et al.*, 1998).

Interaction effect. There was no significant interaction effect between the glutinous rice varieties and *Mokusaku* application on the number of days from transplanting to booting.

Table 4. Number of days from transplanting to tillering, booting, heading, and ripening of the glutinous rice varieties sprayed with *Mokusaku*

TREATMENT	NUMBER OF DAYS FROM TRANSPLANTING TO			
	TILLERING	BOOTING	HEADING	RIPENING
Mokusaku Application (M)				
Without *Mokusaku*	31	82	109	124
With *Mokusaku*	31	82	109	124
Varieties (V)				
Molis	30	82	108	125
Balatinaw	35	89	115	130
Bongkitan	30	82	108	125
Langkay	30	82	108	125
Malunaw	30	75	108	113
M x V	ns	ns	ns	ns
CV (%)	0	0	0	0

Means of the same letter are not significantly different at 5% level of significance by DMRT.

Figure 5. Tillering stage of glutinous rice varieties

Number of Days from Transplanting to Heading

Effect of *Mokusaku* application. No significant differences were observed. All the plants sprayed and not sprayed with *Mokusaku* produced heads at 109 DAT.

Effect of varieties. Molis, Bongkitan, Langkay and Malunaw produced head at the same time (108 DAT) while Balatinaw was the latest to produced heads at 115 DAT (Figure 6).

Interaction effect. No significant interaction effect was observed between the glutinous rice varieties and application of *Mokusaku* on the number of days from transplanting to heading.

Figure 6. Heading stage of glutinous rice varieties

Number of Days from Transplanting to Ripening

Effect of mokusaku application. There were no significant differences observed on the number of days from transplanting to ripening of the glutinous rice varieties sprayed and not sprayed with *Mokusaku.*

Effect of varieties. Malunaw was the earliest to ripen at 113 DAT while Molis, Bongkitan and Langkay ripened at 125 DAT. Balatinaw was the latest to boot and ripen at 130 DAT. Maturity of traditional rice varieties depends on variety and environmental conditions such as nutrient and temperature (Ahmed *et al.*, 1995).

Interaction effect. No significant interaction effect was observed on the number of days from transplanting to ripening between the glutinous rice varieties and *Mokusaku* application.

Number of Tillers

Effect of *Mokusaku* application. The number of tillers of the glutinous rice varieties not sprayed with *Mokusaku* is not significantly different from the tiller number of glutinous rice varieties sprayed with *Mokusaku*. However, it was noted that glutinous rice varieties sprayed with *Mokusaku* produced lesser tillers compared to glutinous rice varieties not sprayed with *Mokusaku* (Table 5).

Effect of varieties. Among the five varieties tested, it was observed that Malunaw significantly had the highest number of tillers (9) and Bongkitan gave the lowest number of tillers (5). Factors such as variety, spacing, nutrient availability and temperature may affect the number of tillers produced (Pandey, 1991).

Table 5. Number of tillers and productive tillers per hill of the glutinous rice varieties sprayed with *Mokusaku*

TREATMENT	NUMBER OF TILLERS	NUMBER OF PRODUCTIVE TILLERS
Mokusaku Application (M)		
Without *Mokusaku* application	7	5
With *Mokusaku* application	6	6
Varieties (V)		
Molis	6^{b}	5^{c}
Balatinaw	6^{b}	5^{c}
Bongkitan	5^{c}	5^{c}
Langkay	6^{b}	6^{b}
Malunaw	9^{a}	8^{a}
M x V	ns	ns
CV_a (%)	8.08	8.25
CV_b (%)	10.27	10.58

Means of the same letter are not significantly different at 5% level of significance by DMRT.

Interaction effect. Significant interaction effect between *Mokusaku* application and glutinous rice varieties was not exhibited on the number of tillers per hill of the glutinous rice varieties.

Number of Productive Tillers

Effect of *Mokusaku* application. Statistically, there was no significant effect of spraying *Mokusaku* on the number of productive tillers of glutinous rice varieties (Table 5). However, it was noted that glutinous rice varieties not sprayed with *Mokusaku* produced seven tillers but only five tillers were productive. On the other hand, glutinous rice varieties sprayed with *Mokusaku* produced six tillers but all were productive.

Effect of varieties. As shown in Table 5, significant differences among the five glutinous rice varieties were observed. Malunaw produced eight productive tillers followed by Langkay with six productive tillers. Tiller production in rice may be attributed to varietal characteristics and a well-balanced nutrient (Vergara, 1983).

Interaction effect. There was no significant interaction effect observed between the glutinous rice varieties and application of *Mokusaku* on the number of productive tillers.

Number of Filled and Unfilled Grains

Effect of *Mokusaku* application. Plants sprayed with *Mokusaku* significantly had the highest number of filled grains per panicle of 149 as shown in Table 6. Plants not sprayed with *Mokusaku* had the least number of filled grains per panicle. Application of *Mokusaku* helps in the prevention and attack of insect pests promoting to better growth and productivity of the plants (Yokomori, 2011).

Glutinous rice varieties sprayed with *Mokusaku* had the least number of unfilled grains while glutinous rice varieties without *Mokusaku* application had the highest number of unfilled grains.

Table 6. Number of filled and unfilled grains per panicle of the glutinous rice varieties sprayed with *Mokusaku*

TREATMENT	NUMBER OF GRAINS PER PANICLE	
	FILLED	UNFILLED
Mokusaku Application (M)		
Without *Mokusaku* application	125^{b}	16
With *Mokusaku* application	149^{a}	13
Varieties (V)		
Molis	135^{c}	14^{a}
Balatinaw	157^{b}	14^{a}
Bongkitan	169^{a}	19^{b}
Langkay	136^{c}	13^{a}
Malunaw	89^{d}	15^{a}
M x V	**	*
CV_a (%)	1.70	16.81
CV_b (%)	3.92	11.83

Means of the same letter are not significantly different at 5% level of significance by DMRT.

Effect of varieties. Significant differences were observed among the five varieties as shown in Table 6. Bongkitan had the highest number of filled grains per panicle (169) while Malunaw had the lowest number of filled grains per panicle (89).

Bongkitan had the highest number of unfilled grains per panicle while the other varieties had lesser unfilled grains produced. Arraudeau *et al*. (1998) stated that such varieties usually permit the production of sufficient tillers and leaf area resulting to well- filled grains.

Interaction effect. There was a significant interaction between glutinous rice varieties and *Mokusaku* application on the number of filled and unfilled grains per panicle. In Figure 7, it shows that application of *Mokusaku* increases the number of filled grains of Bongkitan variety with the highest increase. In terms of the number of unfilled grains, plants sprayed with *Mokusaku* had lesser number of unfilled grains in varieties Langkay and Malunaw (Figure 8).

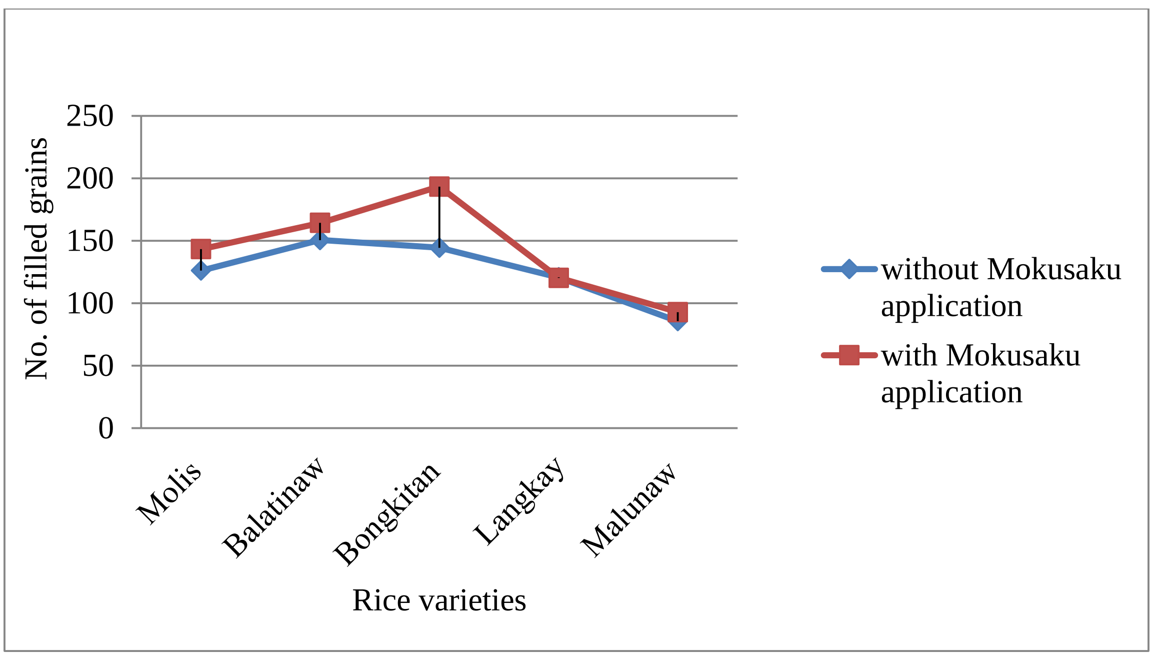

Figure 7. Interaction effect of *Mokusaku* application and glutinous rice varieties on number of filled grains per panicle

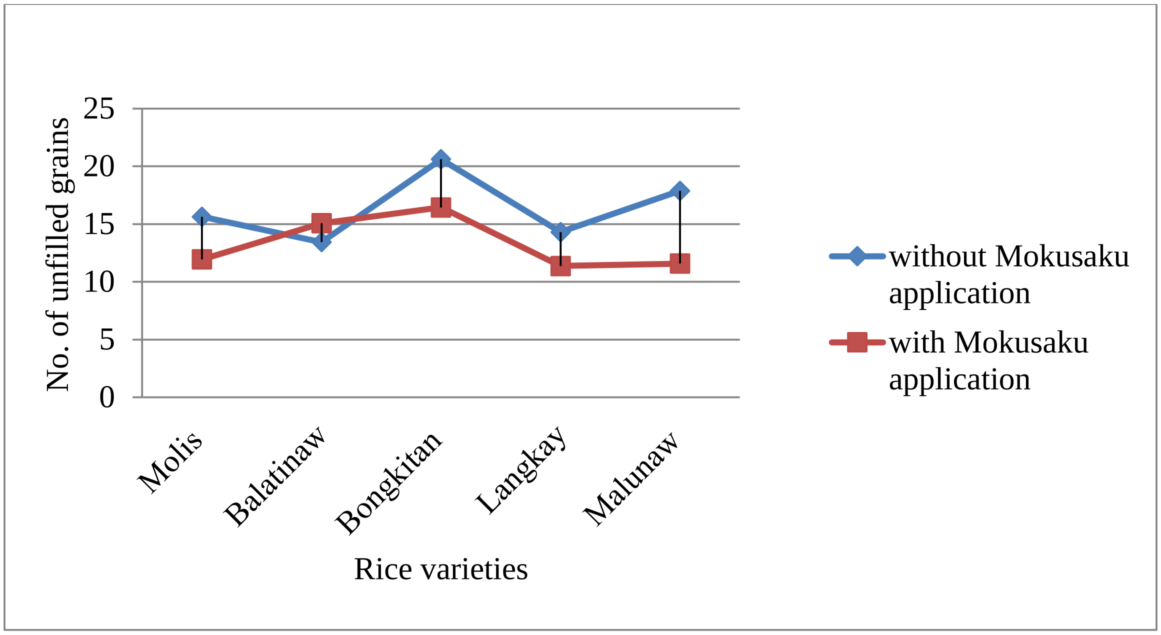

Figure 7. Interaction effect of *Mokusaku* application and glutinous rice varieties on number of unfilled grains per panicle

1000-Grain Weight (g)

Effect of *Mokusaku* application. No significant differences were observed in the 1000-grain weight of glutinous rice varieties sprayed and not sprayed with *Mokusaku*. Numerically, grains of glutinous rice varieties sprayed with *Mokusaku* had the heavier grain weight at 31.20 grams (Table 7).

Effect of varieties. No significant differences were observed among the glutinous rice varieties sprayed with *Mokusaku* mean of 1000 filled grains range from 29.67 to 31.33 grams.

Interaction effect. No significant interaction effect was observed among the glutinous rice varieties and *Mokusaku* application on 1000-grain weight.

Table 7. 1000-grain weight, total yield per plot and computed yield per hectare of the glutinous rice sprayed with *Mokusaku*

TREATMENT	WEIGHT OF 1000 FILLED GRAINS (g)	YIELD	
		TOTAL ($kg/6m^2$)	COMPUTED (t/ha)
Mokusaku Application (M)			
Without *Mokusaku* application	29.80	1.67^b	2.67^b
With *Mokusaku* application	31.20	1.87^a	3.06^a
Varieties (V)			
Molis	29.83	1.63	2.71
Balatinaw	29.67	1.83	2.99
Bongkitan	31.00	1.71	2.85
Langkay	30.67	1.79	2.85
Malunaw	31.33	1.75	2.92
M x V	ns	ns	ns
CV_a (%)	4.75	7.91	5.41
CV_b (%)	4.80	12.43	12.26

Means of the same letter are not significantly different at 5% level of significance by DMRT.

Total Yield per Plot

Effect of *Mokusaku* application. There were significant differences observed on the total yield per plot of the glutinous rice varieties sprayed and not sprayed with *Mokusaku*. Glutinous rice varieties sprayed with *Mokusaku* had the highest yield of 3.06 kg (Table 7). Results are due to high number of filled grains and heavier weight of glutinous rice varieties sprayed with *Mokusaku*.

Effect of varieties. No significant differences were observed on the total yield per plot among the glutinous rice varieties (Table 7). Numerically, Balatinaw variety had the highest yield of 1.83 kg followed by Langkay (1.79 kg), Malunaw (1.75 kg), Bongkitan (1.71 kg) and Molis which had the lowest yield of 1.63 kg.

Interaction effect. No significant interaction effect was observed between the total yield per plot of the glutinous rice varieties and *Mokusaku* application.

Computed Yield per Hectare (tons/ha)

Effect of *Mokusaku* application. Glutinous rice varieties sprayed with *Mokusaku* significantly had a higher computed yield per hectare compared to glutinous rice varieties not sprayed with *Mokusaku*. Nutrient uptake from *Mokusaku* application in each phase of the plant growth may resulted in high yield.

Effect of varieties. Numerically, Balatinaw had the highest yield of 2.99 t/ha followed by Malunaw (2.92 t/ha).

Interaction effect. No significant interaction effect was observed between the glutinous rice varieties and *Mokusaku* application on the computed yield per hectare.

Reaction to Stem Borer and Blast

All the glutinous rice varieties were resistant to stem borer and blast.

Return on Cash Expense

Glutinous rice varieties sprayed and not sprayed with *Mokusaku* obtained a positive ROCE. Balatinaw and Bongkitan sprayed with *Mokusaku* had the highest ROCE due to high yield and resistance to pest.

Table 8. ROCE of the glutinous rice varieties sprayed with *Mokusaku*

TREATMENT	YIELD (kg/18 m^2)	GROSS INCOME (Php)	COST OF PRODUCTION (Php)	NET INCOME (Php)	ROCE (%)
Without *Mokusaku*					
Molis	4.75	380.00	110.00	270.00	245.45
Balatinaw	5.00	400.00	110.00	290.00	263.64
Bongkitan	4.25	340.00	110.00	230.00	209.09
Langkay	5.25	420.00	110.00	310.00	281.82
Malunaw	5.00	400.00	110.00	290.00	263.64
Mean					252.73
With *Mokusaku*					
Molis	5.00	250.00	125.00	125.00	220.00
Balatinaw	6.00	300.00	125.00	175.00	284.00
Bongkitan	6.00	300.00	125.00	175.00	284.00
Langkay	5.50	275.00	125.00	150.00	252.00
Malunaw	5.50	275.00	125.00	150.00	252.00
Mean					258.40

Note: Milled grains were sold at P 80.00 per kilo
Total cost of production includes seeds, labor and *Mokusaku*

SUMMARY, CONCLUSIONS AND RECOMMENDATION

Summary

The study was conducted at Balakbak, Kapangan, Benguet to: determine the growth and yield of glutinous rice varieties; determine the effect of *Mokusaku* application on the growth in yield of rice varieties; determine the interaction effect glutinous rice varieties and of *Mokusaku* application; and determine the profitability of growing the different glutinous rice varieties sprayed with *Mokusaku*.

Mokusaku application significantly affected the number of filled grains per panicle, yield per plot, and computed yield per plot. *Mokusaku* application to glutinous rice varieties provided the highest number of filled grains and yield.

Significant differences among the glutinous rice varieties were observed on the seedling height, height at maturity, number of produced tillers, number of productive tillers and number of filled and unfilled grains per panicle. Molis variety had the tallest seedling height and plant height at 130 DAT followed by Balatinaw. Malunaw variety had the highest number of productive tillers. For the unfilled grains, Langkay, Molis and Balatinaw had the least number while Bongkitan had the highest number of filled grains followed by Balatinaw. In terms of yield, Balatinaw had the highest yield, followed by Langkay, Malunaw and Bongkitan.

Interaction effect of glutinous rice varieties and *Mokusaku* application were significant on the seedling height, number of filled grains per panicle and number of unfilled grains per panicle. Bongkitan had the tallest seedling height and highest number of filled grains per panicle.

Glutinous rice either sprayed or not with *Mokusaku* realized a positive ROCE.

Conclusions

Based on the results of the study, all the varieties were resistant to stem borer and blast. Malunaw produced the highest number of productive tillers while Bongkitan had the highest number of filled grains. All the rice varieties had a comparable total and computed yield.

Application of *Mokusaku* increased the total and computed yield of the rice varieties. Furthermore, application of *Mokusaku* on Bongkitan variety produced the taller seedlings and more filled grains.

Regardless of treatment, positive ROCE was obtained.

Bongkitan and Balatinaw variety sprayed with *Mokusaku* showed the highest profitability.

Recommendation

All the five traditional glutinous rice varieties evaluated in this study are recommended for traditional glutinous rice production under Kapangan, Benguet condition while spraying of *Mokusaku* may not be done on traditional glutinous rice.

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