BIBLIOGRAPHY

ROSENDO, ARACELI APRIL 2013, Growth and Yield of Bush Bean (*var. Sablan*) as Affected by Natural Seed Conditioning Treatments in La Trinidad, Benguet. Benguet State University, La Trinidad, Benguet.

Adviser: Esther Josephine D. Sagalla, Msc.

ABSTRACT

The study was conducted at La Trinidad, Benguet to determine the growth and fresh pod of bush bean applied with natural seed conditioning treatments; determine the effect of time of soaking on growth and fresh yield pod of bush bean; determine the interaction of the natural seed conditioning treatment and on the growth and yield of bush bean; and determine the profitability of bush bean production using natural seed conditioning in La Trinidad, Benguet.

Results showed that non-application and application natural seed conditioners significantly affected plant height, number of flower clusters and pod clusters per plant, and percentage survival. The time of seed soaking also significantly affected the percent survival and height of bush bean plants.

The interaction effect between natural seed conditioners and time of soaking was significant on the number of pod clusters per plant.

Based on the results, plants grown from untreated seeds gave the highest return on cash expense.

INTRODUCTION

Bush bean (*Phaseolus vulgaris*) is commonly grown in Benguet as mature dry seeds and green mature pods. It is rich in protein (22%), fat (2%), carbohydrates (6%) and includes 5% fiber (Hardman, 1990). However from 2004 to 2009, area planted to bush beans decreased from 1,798.23 ha to 817.94 ha (IBP-HCRS, 2009). The volume of production also decreased from 13,098.70 to 6,589.58 metric tons per hectare of fresh pods with an average recoded yield of 7.59 to 9.09 metric tons per hectare. The decrease in yield is due to lack of improved varieties, susceptibility to bean rust, and poor quality (Tandang*et al*., 2010).

One way to improve yield and protect seeds from pest is by seed conditioning.Seed conditioning is done to disinfect the seeds to protect them against pest that may pose hazard during germination and subsequent stages of plant growth, and stimulate seeds to germinate quickly (ISTF, 2007). It can also increase seedling tolerance to stress and initiate metabolic activities, resulting in improved plant population and thus high productivity (Harris, 2001). In addition, the seeds have rapid germination, uniform establishment of seedling, and mild resistance to bean rust and pod borer (Mode and Abebe, 2009).

Thus, evaluating bush beans subjected to seed conditioning is important to help improve yield of bush bean resulting to high profit for farmers.

The objectives of the study were to:

1. determine the growth and fresh pod yield of bush bean (var. *Sablan*) applied with natural seed conditioners;

2. determine the effect of time of soaking on the growth and fresh pod yield of bush beans;

3. determine the interaction of the natural seed conditioners and time of soaking on the growth and yield of bush bean; and

4. determine the profitability of bush bean production as affected natural seed conditioning treatments in La Trinidad, Benguet.

The study was conducted at Benguet State University Experimental Station, La Trinidad, Benguet from October to January 2013.

REVIEW OF LITERTURE

Bush Bean Production

Bush bean is best grown in medium to high elevation areas with a temperature of 18-29^{o} C. It is grown in low elevation areas during the cool, dry months, but the yields tend to be lower and the pods more fibrous. This crop is usually planted during October to November to achieve higher percentage pod set. It is also reported that beans is best in well-drained, clay loam soil, rich in organic matter with pH ranging from 5.5-7.5. It requires adequate moisture for rapid growth, pod sets and early maturity (PCARRD, 2006).

However, Lumicquio (2007) who evaluated ten varieties of stated BBL 274 and Contender showed higher ROCE for dry seed yield. On the other hand, Orlang (2008) who evaluated five varieties of bush bean stated that, HAB 323 was the best performing bush bean variety because it is early maturing, earliest to produce dry pod registered the tallest plants, numerically produced the heaviest marketable pods and was highly resistant to bean rust and pod borer.

Seed Conditioning

Seed conditioning is the use and application of biological, physical and chemical agents and techniques used with seed that provide seed and plant protection and improve the establishment of healthy crops. Seed treatments help protect the seeds and growing crops from devastating diseases and insects (ISTF, 1999).

Mode and Abebe (2009) defined seed conditioning as a process of hydrating and dehydrating the seeds of various protocols which result in improvement of seed vigour, increased germination rate and more uniform emergence under a wider range of field environments.

Seed conditioning prior to planting enhances germination and seedling growth by controlling the imbibition and reducing vagaries of adverse weather and soil condition (McDonald, 2000).

Hydro-priming is the simplest approach to increase the percent and rate of germination and increase the uniformity of germination stand establishment under stress conditioned especially in dry areas (Berchie*et al.*, 2010). In addition, Harris (2001) stated that seed priming can improve seedling growth uniform germination, and vigorous stand under a wider range of agro-climatic conditions.

Furthermore, on farm seed conditioning, smallholder farmers reported that emergence of seed is faster, less re-planting was required and plants were more vigorous on a range of crops including maize, sorghum, chickpea (Rhaman, 2011).

Effect of Duration of Soaking

Tavili (2010) stated that hydro-priming for 12 hours resulted higher vigour index, produced more germinated seeds and vigours seedlings. Harris (1992) demonstrated that sorghum seedlings that germinated and emerged fastest, grew most vigorously and that rate of emergence could increase dramatically by soaking the seeds overnight in water before sowing. Note that rapidly germinating seedling could emerge and produce deep root system. Thus, on-farm seed priming is a low-cost, low-risk technique that is easily adopted by resource-poor farmers in developing countries and increases the yield of tropical crops.

Effect of Natural Seed Conditioners

Plant extracts as primer in bush blue lake result to higher germination percentage, longer seedling roots, more vigorous seedlings, higher germination percentage as well as greater and heavier root nodules. Also a is good material for priming snap bean as it enhanced seed emergence, germination percentage and development of vigorous seedlings. In addition, papaya extract increased vigour index and increased dry matter production of growing seedling (Dizon, 2010).

MATERIALS AND METHODS

An area of 180 m^2 was cleared properly and prepared. The area was divided into three blocks consisting of 12 plots each measuring 1 m x 5 m. The treatments were laid-out in a 4 x 3 factor factorial in Randomized Complete Block Design (RCBD) with three replications.

The treatments were as follows:

Factor A. Natural seed conditioners (SC)

SC_1=Untreated (control)

SC_2=fermented plant juice of banana

SC_3= fermented plant juice of camote

SC_4=fermented plant juice of seaweeds

Factor B. Time of soaking (T)

T_1= 12 hours (control)

T_2 =24 hours

T_3 =48 hours

Seed Conditioning Procedure

Before planting, the seeds were soaked in the different natural seed conditionersfor 12, 24, and 48 hours. The natural seed conditioners, which were formulated by Mr. Erick Tinoyan, are fermented plant juice of banana, camote and seaweeds. One liter of water with two table spoons of fermented plant juice of banana, camote and seaweeds were mixed properly and then seeds were soaked.

Planting andCultural Management Practices

The treated seeds were sown in double rows at a distance of 25 cm x 25cm at 2-3 seeds per hill.To ensure the growth and development of plants, proper care was done and cultural practices like hand weeding and irrigation were done uniformly.

Data Gathered

1. Percent survival. Percent survival was computed using the formula:

$$\% \text{ Survival} = \frac{\text{Total plants survival}}{\text{Total number of seeds sown}} \times 100$$

2. Plant vigor. This was recorded using thefollowing scale:

Scale	Description	Remarks
1	Plants are weak with few stems; very pale	Very poor growth
2	Plants are weak with less thin stems; pale	Poor growth
3	Better than vigorous	Moderately vigorous
4	Plants are moderately strong with robust stems and leaves; leaves light green in color	Vigorous
5	Plants are strong with robust stems and leaves; leaves are light color to dark green color	Highly vigorous

3. Maturity

a. Number of days from sowing to emergence. This was recorded when 50% of the plants per plot had emerged.

b. Number of days from sowing to flowering. This was recorded by counting the number of days of sowing to at least 50% of the plant per plot had fully opened flowers.

c. Number of days from emergence to pod setting. This was recorded by counting the number of days from emergence to at least 50% of pods set.

d. Number of days from sowing to first harvest. This was recorded by counting the number of days from sowing to first harvest.

e. Number of days from emergence to last harvest. This was recorded by counting the days from emergence to last harvest.

4. Plant height

a. Initial plant height. The initial plant height was measured 30 days after planting (DAP) from ten sample plants.

b. Final plant height. This was measured from ground level to the tip of the plant during last harvest from ten sample plants.

5. Reproductive characters

a. Number of flower cluster per plant. This was recorded by counting the flower clusters from ten sample plants.

b. Number of flowers per cluster. This was recorded by counting the number of flowers per cluster from ten sample plants.

c. Number of pods per cluster. The number of pods per cluster was counted from ten sample plants.

d. Number of pod clusters per plant. This was obtained by counting the number of pod clusters per plant from ten sample plants.

6. Yield and Yield components

a. Number and weight of marketable fresh pods per plot (kg\5 m^2). This was recorded by counting and weighing the marketable fresh pods per plot per treatment. Marketable pods were free from diseases and insect damage and not deformed.

b. Number and weight of non-marketable fresh pods per plot (kg\5 m^2). This was obtained by counting and weighing the non-marketable pods per plot per treatment. Non- marketable pods wereobserved as diseased, insect damaged and deformed.

c. Total yield per plot (kg\5 m^2). This was obtained by getting the total weight of marketable and non-marketable pods per plot.

d. Computed fresh pod yield per hectare (t/ha). Computed yield per hectare in tonswas computed using this formula:

$$\text{Yield (t\ha)} = \frac{\text{Total yield per plot}}{\text{Plot size}} \times 10{,}000\ m^2$$

7. Return on cash expense (ROCE). ROCE was computed using the formula:

$$\text{ROCE} = \frac{\text{Gross sale} - \text{total expenses}}{\text{Total expenses}} \times 100$$

8. Reaction to bean rust and pod borer. This was determined using the following scales:

a. Pod borer

Scale	Percent Infested	Remarks

1	No infection	High resistance
2	1-25% of total plant/plot was infested	Mild resistance
3	25-50% of the total plant/plot was infested	Moderate resistance
4	51-75% of the total plant/plot was infested	Susceptible
5	76% of the total plant/plot was infested	Very susceptible

b. Bean rust

Scale	Percent Infected	Remarks
1	No infection	High resistance
2	1-25% of the total plant/plot was infested	Mild resistance
3	25-50% of the total plant/plot was infested	Moderate resistance
4	51-75% of the total plant/plot was infested	Susceptible
5	76-100% of the total plant was infested	Very susceptible

Data Analysis

All quantitative data was analyzed using the Analysis of Variance (ANOVA) for three by four factor factorial in Randomized Complete Block Design (RCBD) with three replications. The significance among the treatment means was tested using Duncan's Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Meteorological Data

The monthly temperature, relative humidity, rainfall amount and sunshine duration from October to December 2012 are shown in Table 1. It was observed that the highest temperature of 23^{o}C was recorded during the month of October while minimum temperature was recorded in November (13.1^{o}C). Relative humidity was high during the month of December recorded at 86.5%.

Generally, rainfall amount was low during the conduct of the study but highest amount of rainfall was recorded in October. The sunshine duration ranged from 12.18 to 11.19 minutes.

Bush beans grow best in areas with a temperature range of 15^{o}C to 21^{o}C (HARRDEC, 2000). The temperature in the site is within the temperature requirement for bush beans.

Table 1. Meteorological data during the conduct of the study

MONTH	TEMPERATURE		RELATIVE HUMIDITY (%)	RAINFALL AMOUNT (mm)	SUNSHINE DURATION (min.)
	MAX.	MIN.			
October	23	15.1	85	2.19	11.09
November	22.6	13.1	84.75	1.33	10.67
December	22.6	13.2	86.5	0.15	12.18

Source: PAG-ASA office, BSU, La Trinidad, Benguet

Percentage Survival

Effect of natural seed conditioner. Highly significant differences were observed on the plant survival of bush beans applied with different natural seed conditioners (Table 2). Plants grown from untreated seeds had the highest percentage survival (88%) but comparable with plants grown from seeds treated with fermented plant juice of banana (80%). This result implies that plants grown from untreated seeds may be preferable for high plant survival.

Effect of time of soaking. There were significant differences observed on percentage survival of bush bean as affected by time of soaking. The highest percentage survival was observed from plants grown from seeds soaked for 12 hours. Plants grown from seeds soaked for 24 and 48 hours gave low plant survival and poor stand which could be due to partial fermentation resulting from longer time of soaking.

Table 2. Plant survival of bush beans as affected by natural seed conditioning treatments and time of soaking

TREATMENT	PLANT SURVIVAL (%)
Natural seed conditioners (SC)	
Untreated(No soaking)	88[a]
Fermented plant juice of banana	80[ab]
Fermented plant juice of camote	69[c]
Fermented plant juice of seaweeds	76[bc]
Time of soaking (T)	
12 hours	84[a]
24 hours	77[ab]
48 hours	73[b]
SC x T	ns
CV (%)	15.67

Means with the different letter are significantly differently at 5% level DMRT

Interaction effect. No significant interaction was observed between natural seed conditioners and time of soaking of bush bean seeds on plant survival.

Plant Vigor

Plants grown from seeds soaked in different natural seed conditioners at different number of hours were all vigorous at 30 DAP and moderately vigorous at 45 DAP.

Days from Sowing to Emergence, Flowering,
Pod Setting, and Harvesting

Effect of natural seed conditioner. All of the bush bean plants grown from seeds applied with seed conditioners took seven days to emerge, 40 days to flower, 46 days to set pod, 58 days to first harvest, and 67 days to last harvest.

Effect of time of soaking. All the bush bean plants grown from seeds soaked at different times uniformly emerged in seven days after sowing; flowered at 40 days from sowing and set pod at 46 days from sowing. Harvesting was done at 58 to 67 days from sowing.

Plant Height

Effect of natural seed conditioner. Plant height at 30 and 67 DAP is shown in Table 3. There were no significant differences observed on the height of bush beans treated with natural seed conditioners. Plant height at 67 DAP had highly significant differences. Plant height ranged from 43.00 to 48.31 cm at 67 DAP. The results imply that using natural seed conditioners may enhance height of bush bean plants.

Effect of time of soaking. In terms of time of soaking, plants grown from seeds soaked for 12 hours significantly were the tallest at 30 DAP. For some legumes, 12 hours

of seed conditioning leads to increase in enzyme activity and plant growth (Kaur *et al*., 2002).

Interaction effect. There was no significant interaction between natural seed conditioners and time of soaking on plant height at 30 and 67 DAP.

Number of Flower per Cluster

Effect of natural seed conditioner. No significant differences were noted on the number of flowers per cluster of bush bean plants treated with different natural seed conditioners. All plants had four flowers per cluster (Table 4).

Effect of time of soaking. The results showed that there were no significant differences on the number of flowers per cluster of plants grown from seeds soaked in natural seed conditioners for 12 to 48 hours. All plants had four flowers per cluster.

Table 3. Plant height of bush bean as affected by natural seed conditioning treatments

TREATMENT	PLANT HEIGHT (cm)	
	30 DAP	67 DAP
Natural seed conditioners (SC)		
Untreated (No soaking)	36.40	46.08[ab]
Fermented plant juice of banana	37.30	48.31[a]
Fermented plant juice of camote	36.69	44.56[bc]
Fermented plant juice of seaweeds	36.10	43.00[c]
Time of soaking (T)		
12 hours	39.06[a]	46.42
24 hours	36.58[b]	45.95
48 hours	34.22[c]	44.09
SC x T	ns	ns
CV (%)	8.02	5.67

Means with the different letter are significantly differently at 5% level DMRT

Interaction effect. There was no significant interaction between the natural seed conditioners and time of soaking of bush beans seeds on the number of flowers per cluster produced.

Number of Flower Cluster per Plant

Effect of natural seed conditioners. Bush beans plants grown from seeds soaked in fermented plant juice of banana and plants grown from untreated seeds significantly had the highest number of flower clusters per plant. This result implies that bush bean seeds

Table4. Number of flower per cluster, flower clusters, pod per cluster, and pod cluster per plant of bush bean as affected by natural seed conditioning treatments

TREATMENTS	NUMBER PER PLANT			
	FLOWER PER CLUSTER	FLOWER CLUSTER	POD PER CLUSTER	POD CLUSTER
Natural seed conditioners (SC)				
Untreated (No soaking)	4	10[a]	4	10[a]
Fermented plant juice of banana	4	10[a]	4	10[a]
Fermented plant juice of camote	4	8[b]	4	8[b]
Fermented plant juice of seaweeds	4	8[b]	4	8[b]
Time of soaking (T)	4	9	4	9
12 hours	4	9	4	9
24 hours	4	9	4	9
48 hours				
SC x T	ns	ns	ns	*
CV (%)	4.18	10.84	4.72	10.24

Means with the different letter are significantly differently at 5% level DMRT

may or may not be applied with fermented plant juice of banana for higher production of flower clusters per plant.

Effect of time of soaking. There were no significant differences observed on the number of flower clusters per plant of bush bean plants produced from seeds soaked at different times.

Interaction effect. No significant interaction between the natural seed conditioners and time of soaking was observed on the number of flower clusters per plant.

Number of Pods per Cluster

Effect of natural seed conditioner. No significant differences were noted on the number of pods per cluster of bush beans grown from seeds soaked in different natural seed conditioners. All plants had four pods per cluster (Table 4).

Effect of time of soaking. There were no significant differences observed on the number of pods per cluster of bush beans produced from seeds soaked at different times.

Interaction effect. There was no significant interaction between the natural seed conditioners and time of soaking of bush beans seeds on the number of pods per cluster.

Number of Pod Cluster per Plant

Effect of natural seed conditioner. The number of pod clusters per plant of bush beans produced from untreated seeds and seeds soaked in fermented plant juice of banana significantly had the most pod clusters per plant due to more flower clusters per plant. It was observed that pod clusters per plant ranged from 8 to 10 (Table 4).

Effect of time of soaking. Statistically, no significant differences on the number of pod clusters per plant was observed.

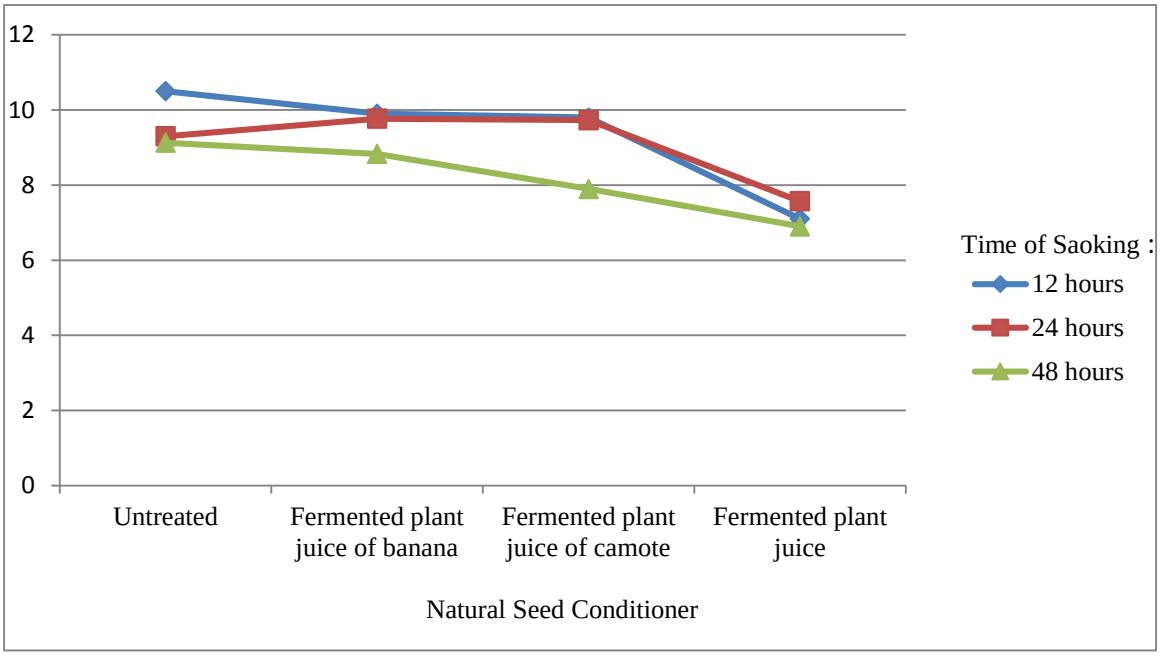

Figure 1. Interaction of natural seed conditioners and time of soaking on the number of pod per plants.

Interaction effect. It was observed that there was a significant interaction between natural seed conditioners and time of soaking on the number of pod clusters per plant (Figure 1). Plants grown from untreated seeds had more pod clusters per plant. Thus, for higher production of pod per clusters, both factors used in the study should be considered.

Reaction to bean rust and pod borer

All bush bean plants produced from seeds soaked in different natural seed conditioners at different times were mildly resistant to pod borer and bean rust.

Number and Weight of Marketable Fresh Pod

Effect of natural seed conditioner. It was observed that there were no significant differences on the number and weight of marketable fresh pods of bush bean plants grown from seed soaked in different natural seed conditioners (Table 5). Numerically, plants grown from untreated seeds had the highest marketable pod weight.

Table 5. Number and weight of marketable fresh pods and non-marketable of bush beans affected by natural seed conditioning treatments

TREATMENT	MARKETABLE FRESH POD		NON-MARKETABLE FRESH POD	
	NUMBER (per 5 m^2)	WEIGHT ($kg/5m^2$)	NUMBER (per 5 m^2)	WEIGHT ($kg/5m^2$)
Natural seed conditioners (SC)				
Untreated(No soaking)	370	2.10	38	0.33
Fermented plant juice of banana	291	1.74	51	0.24
Fermented plant juice of camote	267	1.58	42	0.24
Fermented plant juice of seaweed	277	1.54	60	0.31
Time of soaking (T)				
12 hours	338	2.30	59	0.32
24 hours	300	1.72	46	0.28
48 hours	266	1.49	38	0.24
SC x T	ns	ns	ns	Ns
CV (%)	10.06	12.96	15.11	13.19

Means with the different letter are significantly differently at 5% level DMRT

Effect of time of soaking. There were no significant differences in terms of number and weight of marketable pods of plants grown from seeds soaked at different times. The weight of marketable pods ranged from 1.49 to 2.30 kg\ 5 m^2.

Interaction effect. No significant interaction was observed between natural seed conditioners and time of soaking on the number and weight of marketable pods.

Number and Weight of Non-Marketable Fresh Pod

Effect of natural seed conditioner. It was observed that there were no significant differences on the number and weight of non- marketable pods of bush bean plants grown

from seeds soaked in different natural seed conditioners (Table 5). Numerically, plants grown from seeds soaked in fermented banana and camote had the least non- marketable pods.

Effect of time of soaking. There were no significant differences in terms of number and weight of non-marketable pods of bush bean plants grown from seeds soaked at different times.

Interaction effect. No significant interaction was observed between natural seed conditioners and time of soaking on the number and weight of non-marketable pods.

Total and Computed Yield

Effect of natural seed conditioner. The different natural seed conditioners did not significantly increase the weight of total and computed yield of bush beans. Total pod yield ranged from 3.41 to 3.71 kg/5 m^2 while computed yield ranged from 7.22 to 7.88 tons/ha.

Effect of time of soaking. There were no significant differences on total and computed yield of bush beans grown from seeds soaked at different times. Numerically, plants grown from seeds soaked for 12 hours produced the highest total and computed yield.

Interaction effect. No significant interaction was noted between the natural seed conditioners and time of soaking in terms of total and computed yield of bush beans.

Table 6. Total and computed pod yield of bush beans as affected by natural seed conditioning treatments

TREATMENT	TOTAL YIELD COMPUTED ($kg/5m^2$)	YIELD (tons/ha)
Natural seed conditioners (SC)		
Untreated(No soaking)	3.75	7.45
Fermented plant juice of banana	3.61	7.21
Fermented plant juice of camote	3.94	7.88
Fermented plant juice of seaweeds	3.41	6.82
Time of soaking (T)		
12 hours	3.37	7.54
24 hours	3.61	7.22
48 hours	3.63	7.26
SC x T	ns	ns
CV (%)	10.75	17.74

Means with the different letter are significantly differently at 5% level DMRT

Return on Cash Expense

It was observed that plants grown from untreated seeds had the highest return on cash expense of 35.04% due to high marketable pod yield. Negative ROCE was observed from plants treated with fermented plant juice of banana, camote and seaweeds.

Table7. Return on cash expense (ROCE) of bush bean as affected by natural seed conditioning treatment

TREATMENT	MARKET-ABLE PODS (kg/5 m^2)	GROSS INCOME (Php)	COST OF PRODUCTION (Php)	NET INCOME (Php)	ROCE (%)
Untreated	2.09	73.15	54.17	18.98	35.04
Mean					35.04
Fermented plant juice of banana					
12 hours	2.08	72.8	174.17	-101.37	-58.20
24 hours	1.53	62.3	174.17	-111.87	-64.23
48 hours	1.78	51.1	174.17	123.07	-70.66
Mean					-64.36
Fermented plant juice of camote					
12 hours	1.93	72.8	129.17	-61.62	-47.70
24 hours	1.53	53.55	12917	-75.67	-58.54
48 hours	1.78	62.3	129.17	-66.87	-51.77
Mean					-52.67
Fermented plant juice of seaweeds					
12 hours	1.93	67.55	174.17	-106.62	-61.22
24 hours	1.53	53.55	174.17	-120.62	-69.28
48 hours	1.78	62.3	174.17	-111.82	-64.23
Mean					-64.91

*Land preparation, management, seed and cost of natural seed conditioners
*Sold at PhP35 per kilo

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at La Trinidad, Benguet to determine the growth and fresh pod of bush bean (*var. Sablan*) applied with natural seed conditioning treatments; determine the effect of time of soaking on growth and fresh yield pod of bush bean; determine the interaction of the natural seed conditioners and time of soaking on the growth and yield of bush bean; and determine the profitability of bush bean production as affected by natural seed conditioning treatments in La Trinidad, Benguet

Based on the results of the study, application of natural seed conditioners significantly affected plant height, number of flower clusters and pod clusters per plant, and percentage survival. Plants grown from no natural seed conditioners produced the highest yield per 5 m^2 resulting in relatively high return on cash expense.

The time of soaking significantly affected the percent survival and height of bush bean plants. All the bush bean plants treated with natural seed conditioners at different times showed mild resistance to pod borer and bean rust.

The interaction effect of natural seed conditioners and time of soaking was significant on the number of pod cluster per plant.

Conclusion

Based on the results, bush bean plants grownfromuntreated seeds had the highest plant survival, number of flower cluster and pod per cluster, weight of marketable fresh pods, and ROCE.

Seeds applied with fermented plant juice of banana also resulted in higher plant survival, taller plants, and high number of flower per cluster and pod cluster per plant. However, using this fermented plant juice added to production cost and resulted to negative ROCE.

Soaking seeds in natural seed conditioners for 12 hours significantly affected the plant survival and height of bush bean plants.

Recommendation

Soakingbush bean seeds with fermented plant juice of banana, camote, and seaweeds for 12, 24, and 48 hours is not recommended for bush bean production in La Trinidad, Benguet. Further studies on the application of natural seed conditioners on other crops may be done.

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