BIBLIOGRAPHY

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ABSTRACT

This study was conducted to compare the growth and fresh pod yield of the three snap bean varieties; determine the growth and fresh pod yield of the snap bean varieties as affected by seed priming; determine the interaction of seed priming and variety on the growth and fresh pod yield of snap bean; and determine the profitability of the three snap bean varieties as affected by seed priming.

HAB 63, BBL 274 and Landmark were the varieties used. All varieties emerged 7 days after sowing, with HAB 63 and Landmark being the first to flower and first to set pod. Landmark was the first to harvest. HAB 63 produced the highest yield of 11.78 tons per hectare and had the highest return on cash expenses (ROCE). The three varieties exhibited mild resistance to bean rust and pod borer.

Seeds primed with water, *Moringa* solution and goat urine emerged, flowered and set pod earlier. In addition, priming enhanced taller plants, higher percent survival and higher number and weight of marketable fresh pod. Seeds primed with water had the highest yield and ROCE.

The yield was not affected by variety and seed priming interaction but a combination of HAB 63 and water was found to be more profitable.

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INTRODUCTION

Snap bean (*Phaseolus vulgaris L.*) is a common source of protein for human diet as well as feed supplement for animals. It is rich in vitamins and soluble carbohydrates. Snap bean thrives well in cool and medium to high area altitude in tropical countries (World book Encyclopedia, 1991). It is grown for both the fresh market and processing industry and may not require intensive management (Swiader and Ware, 2002).

Snap bean is a priority under the National Vegetable R&D Program of PCCARD-DOST. The major producers of fresh snap beans are the Cordillera Administrative Region (47%) and Cagayan Valley (29%). Last 2006, snap bean production was at 3,493 tons (BAS, 2006).

Farmers in Benguet have many practices done on snap beans to improve production such as irrigation, application of fertilizer and pesticides, choices of right varieties and time of planting. Seed priming could be another fruitful practice.

Seed Priming is a process of treating plant seeds before sowing or planting that enable them to undergo faster and more uniform germination (Lankford, 1999). It is a form of seed preparation in which the seeds are pre-soaked before planting (Wikimedia Inc., 2008).

Over the past two decades seed enhancement through seed priming has led to great improvements in a grower's ability to routinely achieve this goal in both the field and greenhouse. Numerous vegetable and ornamental crop species have been primed successfully. In order to maintain a superior product, seed companies have to maintain seed quality and longevity in the primed seed. Uniformity and percentage of seedling emergence of direct-seeded crops have a major impact on final yield and quality. Slow emergence results in smaller plants and seedlings, which are more vulnerable to soil-borne diseases (Cantliffe, 2000).

Seed priming with synthetic chemicals maybe effective in enhancing seed germination, establishment, and early growth but they are quite hazardous. Finding suitable substitute such as the use of some animal urine and plant extract could be very fruitful and environmental friendly. Several studies were conducted on snap bean. This experiment aim to help farmers to save money for re-seeding, time and weak plants.

The objectives of the study were to:

1. compare the growth and fresh pod yield of three snap bean varieties;
2. determine the effect of seed priming on the growth and fresh pod yield of the snap bean varieties;
3. determine the interaction of seed priming and variety on the growth and fresh pod yield of snap bean; and
4. determine the profitability of the three snap bean varieties as affected by seed priming.

The study was conducted at Benguet State University Experimental Farm, Balili, La Trinidad, Benguet from December 2009 to March 2010.

REVIEW OF LITERATURE

Seed Priming

Priming could be defined, as controlling the hydration level within seeds so that the metabolic activity necessary for germination can occur but radical emergence is prevented. Lastly, priming has been commercially used to eliminate or greatly reduce the amount of seed borne fungi and bacteria. The mechanisms responsible for eradication maybe linked to the water potentials that seed are exposed to during priming, differential sensitivity to priming salts and or differential sensitivity oxygen concentration (Bradford, 1995).

Priming is a water-based process that is performed in seeds to increase uniformity of germination and emergence from the soil, and thus enhance growth. Priming decreases the time span between the emergence of the first and the last seedlings and also increases the rate of emergence. Primed seed usually emerges from the soil faster, and more uniformly than the non primed seeds of the same seed lot (Harris, 2008).

In general, most kinds of seed experimented shown an overall advantages over seeds that are not primed (Harris, 2002). Bradford (1995) stated that the benefits of seed priming are overcome or alleviate phytochrome, induce dormancy, decrease the time necessary for germination and for subsequent emergence to occur, and improve the stand uniformity.

On-farm seed priming is safe, effective and easily adopted by resource-poor farmers and has the potential to benefit such farmers in many ways. More work is required to clarify the mechanisms by which priming affects development, growth and disease resistance and to refine methods for low-cost alleviation of some micronutrient deficiencies. Seed priming in chickpea significantly reduced the damage caused by collar rot (*Sclerotium rolfsii*) in Bangladesh in two contrasting seasons. Recent work in Pakistan has demonstrated that mungbean (*Vigna radiata*) grown from seed primed in water for 8 hours before sowing showed significantly fewer serious symptoms of infection by Mungbean Yellow Mosaic Virus (MYMV) than a crop established without priming. The large differences in virus-related damage were associated with significant increases in pod weight and grain weight due to priming (Harris, 2004).

Farmers can prime their own seed if they know the safe limits, are calculated for each variety so that germination will not continue once seed are removed from the water. In most cases, seeds can be primed overnight and simply surface dried and sown the same day. Primed seed will only germinate if it takes up additional moisture from the soil after sowing. It is important to note that between priming and pre germination-sowing, pre-germinated seed under dry land conditions can be disastrous. Apart from and swelling slightly and weighing more, primed seed can be treated in the same way as non primed seed (Harris, 2008).

Seed primed or soaked in water has higher percent survival than the seed soaked in castor bean extract. It provides hint that the castor bean and coconut water or any of the extract used is not really effective in enhancing crop seed germination (Rivera, 2001).

Moringa Leaves and Goat Urine

Moringa leaves contain high Vitamin A, calcium, iron, Vitamin C potassium and protein. However, the leaves and stem of *M. oleifera* are known to have large amounts of their calcium bound in calcium oxalate crystals (Wikipedia, 2009).

Goat urine and feces do not contain urea, and for this reason the bedding can be used directly on the garden for fertilizing and mulching and will not burn plants. A healthy goat will produce feces that look like black, shiny marbles (MacKenzie, 1993). Goat urine content 50 percent of the nitrogen and 60 to 70 percent of the potassium. Frequently, manure has a low fertility value due to failure to incorporate the urine, or the nitrogen is lost through leaching. Eighteen to 20 mcal of energy inputs are required to produce one kg of nitrogen fertilizer (McDowell, 1992). Predictions for the future are that animal wastes will again be viewed more favorably as a useful resource.

Planting and Cultural Management Practices

The seed should be planted 1.27 cm deep, but if the soil is very dry, place the seed about 3.81 cm in deep so they will obtain adequate moisture and will germinate within a reasonable number of days after sowing (Maynard, 2001).

Beans can be planted the whole year around. It is commonly direct seeded in the rows for easy cultivation. Seeding rates may differ depending on seed size, percent germination, irrigation and row spacing. The planting distance is 20 cm x 20cm both ways with 2-3 seeds per hill is best for snap bean production. Seed planted during dry season should be covered with soil equal to avoid rotting of seeds (HARRDEC, 1989). Beans are moderately deep rooted crops in which a constant supply of moisture in needed to maximize yield and quality and to maintain uniformity. The plant should use as much as .508 cm of water per day season. A shortage of moisture during flowering can cause blossom and pods to drop. Deformed pods can results from water stress due to low soil moisture or excessive transpiration (Swiader and Ware, 2002).

Suitable area for snap bean production

Snap bean grows best with temperature 15-21^{0}C.This crop can tolerate warmer temperature up to 25^{0}C (HARRDEC, 1989). Growth and yield of snap bean are also best in high elevation, yield was significantly low in lower elevation and maturity was longer in higher duration than in lower duration (Bantog and Padua 1999).

It is reported that bean is best on soil that hold water well and have a good air and water filtration. Soil should have a pH of 5.8 to 6.6. Pacher (2002) stated that snap bean is a warm season vegetable that can tolerate frost. It requires adequate amount of moisture for rapid growth, good pod set and early maturity.

MATERIALS AND METHODS

An area of 180 square meters was thoroughly prepared and divided into 36 plots measuring 1m x 5m. The experiment was laid out using a 3 x 4 factor factorial design arranged in Randomized Complete Block Design (RCBD) with 3 replications.

Processed chicken manure at the rate of 5 kg per $5m^2$ as basal fertilizer and 1000 kg/ha of Triple 14 was sidedressed during hilling up at 20 days after planting. Before sowing, the seeds of 3 varieties of snap bean were primed for 8 hours in pure water, *Moringa* leaves solution and goat urine solution; other seeds were unprimed and served as control. Two seeds per hill were sown in double row plot at a distance of 20cm x 20cm between hills and rows. Cultural management practices were employed to ensure the normal growths of the plants such as irrigation were done in 3 days interval and weeding done by hand pulling. Crop protection was also done by spraying the recommended rate of insecticides and fungicide on the label at seven days interval.

The treatments were as follows:

Factor A- Variety

V_1= HAB 63

V_2= BBL 274

V_3= Landmark

Factor B- Priming materials

$P_{0=}$ control (unprimed)

P_1= primed with water for 8 hrs.

P_2= primed with *Moringa* (*Moringa oleifera Lam.*) solution for 8 hrs.

P_3= primed with goat urine solution for 8 hrs

Data gathered

1. Days from sowing to emergence, flowering pod setting and first harvest

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

b. Number of days from sowing to flowering. This was recorded by counting the number of days from sowing to at least 50% of the plants 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 pod sets are developed.

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

2. Plant height

a. Initial plant height. The initial plant height was measured 30 days after planting (DAP) from 10 sample plants using meter stick.

b. Final plant height. This was measured from ground level to the tip of the plant during last harvest from 10 sample plants.

3. Percent survival. The data was computed using the formula:

$$\% \text{ Survival} = \frac{\text{Total no. of seed emergence}}{\text{Total no. of seed sown}} \times 100$$

4. Plant vigor. This was rated using the following scale:

Scale	Remarks
1	very poor growth
2	poor growth
3	moderate vigorous

4	vigorous
5	very vigorous

5. Number of flower per cluster. The number of flower per cluster was obtained from 10 random sample plants.

6. Number of pod per cluster. The number of flower pod per cluster was obtained from 10 random sample plants.

7. Percent pod set per cluster. This was computed using the following formula:

$$\%\text{ pod set} = \frac{\text{Total number of pod per cluster}}{\text{Total number of flower per cluster}} \times 100$$

8. Yield and yield components

a. Number and Weight of marketable fresh pod per plot (kg). This was recorded by counting and weighing the marketable fresh pods per plot per treatment. Marketable pods were free from disease and insect damage and not deformed.

b. Number and Weight of non-marketable fresh pods per plot (kg). This was obtained by counting and weighing the non-marketable pods per plot per treatment. Non marketable was observed as diseased, insect damaged and deformed pods.

c. Computed fresh pod yield per hectare (t/ha). Total yield per hectare in tons was computed by using the following formula:

$$\text{Yield (t/ha)} = \frac{\text{Total yield per plot}}{5\text{m}^2} \times \frac{10{,}000\text{ m}^2}{1{,}000\text{ kg}}$$

9. Return on Cash Expense. This was computed using the following formula:

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

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

a. Bean rust.

Scale	Description	Remarks
0	No infection per plot	High resistant
1	21-30 % infections per plot	Mild resistant
2	31-45% infections per plot	Moderate resistant
3	46-60% infection per plot	Susceptible
4	greater than 60% infection per plot	Very susceptible

b. Pod borer.

Scale	Description	Remarks
0	No infestation per plot	High resistant
1	21-30 % infestations per plot	Mild resistant
2	31-45% infestations per plot	Moderate resistant
3	46-60% infestation per plot	Susceptible
4	greater than 60% infestation per plot	Very susceptible

Analysis of Data

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

RESULTS AND DISCUSSSION

Number of Days from sowing to emergence, to flowering, emergence to pod setting and sowing to first harvest

Effect of variety. Table 1 shows the number of days from sowing to emergence, sowing to flowering, emergence to pod setting, and sowing to first harvest. On the number of days from sowing to harvesting, the varieties emerged 7 days after sowing. On the other hand, HAB 63 and Landmark flowered 41 days after sowing while BBL 274 flowered a day later. The same results were noted on the number of days from emergence to pod setting. HAB 63 and Landmark produced pods 35 days after emergence while BBL 274 produced pods a day later at 36 days. Lastly, Landmark was harvested the earliest at 55 days after sowing followed by HAB 63 which was harvested after 57 days while BBL 274 was harvested after 58 days from sowing. Differences might be due to the different genetic characteristics of the snap bean varieties.

Effect of priming materials. Primed seeds of snap beans emerged a day earlier than the unprimed (control) snap bean seeds. This result supports the finding of Harris (2008) that primed seed usually emerge from the soil faster and more uniformly than non-primed seed.

On the number of days from sowing to flowering, those seeds primed with water, *Moringa* solution and goat urine for 8 hours flowered a day earlier than seeds that were unprimed. Primed seeds produced pods 35 days from emergence while the unprimed seeds produced seeds a day later (36 days). In addition, primed seeds were harvested earlier at 57 days after sowing while unprimed seeds were harvested a day later in 58 days.

Table 1. Number of days from sowing to emergence, sowing to flowering, emergence to pod setting, and sowing to first harvest of bush snap bean varieties as affected by seed priming

TREATMENT	NUMBER OF DAYS FROM:			
	SOWING TO EMERGENCE	SOWING TO FLOWERING	EMERGENCE TO POD SETTING	SOWING TO FIRST HARVEST
Variety (V)				
HAB 63	7	41	35	52
BBL 274	7	42	36	58
Landmark	7	41	35	55
Priming Materials (P)				
Control (unprimed)	8	42	36	58
Water	7	41	35	57
Moringa solution	7	41	35	57
Goat urine solution	7	41	35	57

Initial Plant Height

Effect of variety. No significant differences were noted on the initial height of the different varieties of snap beans (Table 2). It was noted that the average initial height of the snap beans which was taken 30 days after planting was 11 centimeters.

Effect of priming materials. Significant differences were noted on the initial plant height of the snap beans as affected by the different priming materials. Snap beans primed with water and *Moringa* solution were taller as compared to seeds primed with goat solution and seeds which were unprimed.

Interaction effect. No significant interaction effect between variety and priming materials was noted on the initial plant height of snap beans.

Final Plant Height

Effect of variety. Table 2 shows that the final plant height of the different varieties of snap beans ranged from 34.18 cm to 34.30 cm.

Effect of priming materials. Highly significant differences were noted on the final plant height of snap beans as affected by the different priming materials. Snap beans primed with water and *Moringa* solutions for 8 hours significantly produced the tallest

Table 2. Plant height of bush snap bean varieties as affected by seed priming

TREATMENT	PLANT HEIGHT (cm)	
	30 DAP	LAST HARVEST
Variety (V)		
HAB 63	11.41	34.18
BBL 274	10.86	34.28
Landmark	11.13	34.30
Priming Materials (P)		
Control (unprimed)	10.65[b]	33.70[c]
Water	11.49[a]	34.43[a]
Moringa solution	11.45[a]	34.45[a]
Goat solution	10.94[b]	34.36[b]
VxP	ns	ns
CV (%)	5.09	0.69

* Means with common letter are not significantly different at 5% level of significance using DMRT

plants at 34.43 cm and 34.45 cm, respectively. The unprimed snap beans were significantly shorter as compared to the primed snap beans.

Interaction effect. No significant interaction effect was noted on the final plant height of snap beans.

Percentage of Survival

Effect of variety. Highly significant differences were noted on the percentage survival of the different varieties of snap beans (Table 3). HAB 63 had the highest percentage of survival (90.08%) followed by Landmark (83.75%). The different percentage of survival of the snap bean varieties may be attributed to the genetic characteristics of each variety.

Effect of priming materials. Significant differences were noted on the percentage survival of snap beans as affected by the different priming materials. Snap beans primed with water and *Moringa* solution had the highest percentage of survival (87.33% and 88.11%, respectively), followed by seeds primed with goat urine (85%). Unprimed seeds had the lowest percentage of survival of 81%. This result supports the finding of Rivera (2001) that seed primed in water gives higher percent survival. In addition *Moringa* solution which resulted to a higher percent survival maybe due to the vitamins, calcium iron and potassium it contains (Wikipedia, 2009).

Interaction effect. No significant differences were noted on the interaction effect of variety and the priming material on the percent survival of snap beans.

Table 3. Percentage survival of bush snap bean varieties as affected by seed priming

TREATMENT	SURVIVAL (%)
Variety (V)	
HAB 63	90.08[a]
BBL 274	82.25[c]
Landmark	83.75[b]
Priming Materials (P)	
Control (unprimed)	81.00[c]
Water	87.33[a]
Moringa solution	88.11[a]
Goat urine solution	85.00[b]
VxP	ns
CV (%)	6.37

* Means with common letter are not significantly different at 5% level of significance using DMRT

Plant Vigor

Effect of variety. No significant differences were noted on the plant vigor of the different varieties of snap beans (Table 4). All three varieties used showed similar plant vigor of 3.92 which is a reflection of their plant height.

Effect of priming materials. No significant differences were noted on the plant vigor of snap beans as affected by priming materials. Priming does not affect the plant vigor of snap beans.

Interaction effect. No significant interaction was noted between variety and priming material on the plant vigor of snap beans.

Table 4. Plant vigor of bush snap bean varieties as affected by seed priming

TREATMENT	PLANT VIGOR
Variety (V)	
HAB 63	3.92
BBL 274	3.92
Landmark	3.92
Priming Materials (P)	
Control (unprimed)	3.67
Water	4.00
Moringa solution	4.00
Goat urine solution	4.00
VxP	ns
CV (%)	7.37

*1- very poor growth, 2- poor growth, 3- moderate vigorous, 4- vigorous, 5-very vigorous

Number of Flower per Cluster, Pod per Cluster, and Percent Pod Set

Effect of variety. The number of flower per cluster, pod per cluster, and percent pod set of the different varieties of snap beans show no significant differences (Table 5). It was revealed that the average number of flower per cluster of the different varieties of snap beans ranged from 5 to 6 while the number of pods was 5 per cluster. The percentage of pod set ranged from 81.83% to 85.18%.

Effect of priming materials. No significant differences were noted on the number of flowers and pods per cluster and percent pod set of snap beans as affected by the different priming materials. An average of 5 pods per cluster was observed. Unprimed and primed snap beans produced an average number of 5 to 6 flowers per cluster and the percent pod set ranged from 83.42% to 84.56%.

Interaction effect. No significant interaction effect between variety and priming material was noted on the number of pods per cluster, flowers per cluster and percent pod set.

Table 5. Number of pods per cluster, flower per cluster and percentage of pod set of bush snap bean varieties as affected by seed priming

TREATMENT	NUMBER		PERCENT POD SET (%)
	FLOWER PER CLUSTER	POD PER CLUSTER	
Variety (V)			
HAB 63	5.67	4.64	81.83
BBL 274	5.42	4.58	84.50
Landmark	5.42	4.69	86.53
Priming Materials (P)			
Control (unprimed)	5.33	4.54	85.18
Water	5.56	4.67	83.99
Moringa solution	5.67	4.73	83.42
Goat urine solution	5.44	4.60	84.56
VxP	ns	ns	ns
CV (%)	10.50	3.97	4.52

Pest and Disease Incidence Reaction

Effect of variety. All the varieties of snap beans used had mild to moderate resistance to bean rust and pod borer.

Effect of priming materials. Primed snap beans had a mild resistance to bean rust and pod borer as compared to the unprimed snap beans which had moderate resistance.

Interaction effect. No significant interaction between variety and priming materials was noted on resistance to bean rust and pod borer incidence.

Number and Weight of Marketable Fresh Pod

Effect of variety. Table 6 shows highly significant differences on the number and weight of marketable fresh pods of the different varieties of snap beans. HAB 63 had the highest number of marketable fresh pod with (786) followed by BBL 274 (654).

HAB 63 also produced the heaviest marketable fresh pod (5.02 kg) due to its high number of fresh pods while BBL 274 and Landmark had the lowest weight of marketable fresh pod due to its low number of marketable fresh pods produced.

Effect of priming materials. Significant differences were noted on the number of marketable fresh pods of snap beans as affected by the different priming materials. Snap beans primed with water and *Moringa* solution had the highest number of marketable fresh pod of 739 and 702, respectively. On the other hand, seeds primed with goat solution had 696 fresh pods while the unprimed snap bean had the lowest number of marketable fresh pod of 605.

In addition, highly significant differences were noted on the weight of marketable fresh pods of snap beans as affected by the different priming materials. Snap beans primed with water had the highest weight of marketable fresh pod (4.96 kg/5m^2), followed by those primed with *Moringa* solution and goat urine solution (4.45 kg/5m^2) while the unprimed snap beans had the lowest weight of marketable fresh pod (3.97 kg/5m^2). Thus, water is still the best material to use for seed priming of snap bean.

Interaction effect. No significant interaction effect in variety and priming materials were noted on the number and weight of marketable fresh pod of snap beans.

Table 6. Number and weight of marketable fresh pod (5m^2) of bush snap bean varieties as affected by seed priming

TREATMENT	MARKETABLE FRESH POD	
	NUMBER	WEIGHT (kg/5m^2)
Variety (V)		
HAB 63	786^a	5.02^a
BBL 274	654^b	4.26^b
Landmark	617^b	4.10^b
Priming Materials (P)		
Control (unprimed)	605^c	3.97^c
Water	739^a	4.96^a
Moringa solution	702^a	4.45^b
Goat urine solution	696^b	4.45^b
VxP	ns	ns
CV (%)	11.86	9.44

*Means of the same letter are not significantly different from each other at 5% level of significance using DMRT.

Number and Weight of Non – Marketable Fresh Pod

Effect of variety. Significant differences were noted on the number of non – marketable fresh pods of the different varieties of snap beans. HAB 63 significantly had the highest number of non – marketable fresh pods (161) while BBL 274 and Landmark had lower number of non – marketable fresh pods (136 and 161). HAB 63 had smooth pods that may have been easily damaged by pod borer resulting to more non-marketable fresh pods. On the other hand, no significant differences were noted on the weight of non – marketable fresh pods of snap beans varieties (Table 7).

Table 7. Number and weight of non-marketable fresh pod of bush snap bean varieties as affected by seed priming

TREATMENT	NON-MARKETABLE FRESH POD	
	NUMBER	WEIGHT ($kg/5m^2$)
Variety (V)		
HAB 63	161[b]	0.87
BBL 274	136[a]	0.88
Landmark	136[a]	0.81
Priming Materials (P)		
Control (unprimed)	148	0.84
Water	141	0.85
Moringa solution	145	0.87
Goat urine solution	143	0.85
VxP	ns	ns
CV (%)	14.12	9.25

*Means of the same letter are not significantly different from each other at 5% level of significance using DMRT.

Effect of priming materials. No significant differences were noted on the number and weight of non – marketable fresh pods applied with the different priming materials. It was noted that the average number was 141 to 148 non – marketable fresh pods while the average weight was 0.84 kg to 0.87 kg.

Interaction effect. No significant interaction was noted on the number and weight of non – marketable fresh pods of snap beans as affected by the variety and priming materials.

Computed Fresh Pod Yield per Hectare (tons/ha)

Effect of variety. Highly significant differences were noted on the fresh pod yield per hectare of the different varieties of snap beans (Table 8). HAB 63 had the highest fresh pod yield (11.78 tons) per hectare while BBL 274 and Landmark had yields of 1.5 and 2 tons per hectare, respectively. HAB 63 produced higher yield per hectare due to high fresh pod yield produced.

Effect of priming materials. Highly significant differences were noted on the fresh pod yield per hectare of snap beans as affected by the different priming materials.

Snap beans primed with water had the highest fresh pod yield per hectare (11.61 tons) while the unprimed snap beans had the lowest fresh pod yield (9.63 t/ha).

Interaction effect. No significant on the interaction between the variety and priming materials was noted on the fresh pod yield per hectare of snap beans.

Table 8. Computed fresh pod yield per hectare of bush snap bean varieties as affected by seed priming

TREATMENT	FRESH POD YIELD (t/ha)
Variety (V)	
HAB 63	11.78[a]
BBL 274	10.29[b]
Landmark	9.78[b]
Priming Materials (P)	
Control (unprimed)	9.63[c]
Water	11.61[a]
Moringa solution	10.64[b]
Goat urine solution	10.60[b]
VxP	ns
CV (%)	8.14

*Means of the same letter are not significantly different from each other at 5% level of significance using DMRT.

Return on Cash Expenses

Effect of variety. The return on cash expenses of three bush snap bean varieties is shown in Table 9. High ROCE was registered by HAB 63 (96.56 %) followed by BBL 274 (67.06%) and the lowest was obtained from Landmark (60.50%). The high ROCE obtained from HAB 63 was apparently due to its higher production of marketable fresh pods.

Effect of priming materials. Plants treated with water as priming material gave the highest return of 97.67% followed by goat urine (77.35%). Seeds primed with *Moringa* solution gave lower ROCE than seeds primed with goat urine and water due to high variable cost.

Interaction effect. Table 10 presents the three varieties of bush snap beans as affected by the different priming materials. All the treatment combinations were profitable. HAB 63 primed with water registered the highest return on cash expense of 130.35% followed by HAB 63 primed with goat urine solution (104.45%). The least ROCE was recorded from Landmark with unprimed seeds. Among the three varieties of snap bean, HAB 63 is more responsive to priming due to higher yield and ROCE.

Table 9. Return on Cash Expenses of bush snap bean varieties as affected by seed priming

TREATMENT	YIELD ($kg/5m^2$)	VARIABLE COST	GROSS INCOME	NET INCOME	ROCE (%)
Variety (V)					
HAB 63	5.02	66.34	130.52	64.18	96.74
BBL 274	4.26	66.34	110.76	44.42	66.96
Landmark	4.10	66.34	106.60	40.26	60.69
Priming Materials (P)					
Control(unprimed)	3.97	65.24	103.22	37.98	58.22
Water	4.96	65.24	128.96	63.72	97.67
Moringa solution	4.45	69.63	115.70	46.07	66.16
Goat urine solution	4.45	65.24	115.70	50.46	77.35

*Variable cost includes seeds, fertilizers, pesticides and labor
* Sales was based on average of ₽ 26.00per kilo

Table 10. Return on Cash Expenses of bush snap bean varieties with seed priming

TREATMENT	YIELD (kg/5m^2	VARIABLE COST	GROSS INCOME	NET INCOME	ROCE (%)
V_1 P_0	4.23	65.24	109.98	44.74	68.58
P_1	5.78	65.24	150.28	85.04	130.35
P_2	4.92	69.63	127.92	58.29	83.72
P_3	5.13	65.24	133.38	68.14	104.45
V_2 P_0	3.87	65.24	100.62	35.38	54.23
P_1	4.82	65.24	125.32	60.08	92.09
P_2	4.28	69.63	111.28	41.65	59.82
P_3	4.08	65.24	106.08	40.84	62.60
V_3 P_0	3.82	65.24	99.32	34.08	52.24
P_1	4.27	65.24	111.02	45.78	70.17
P_2	4.16	69.63	108.16	38.53	55.34
P_3	4.13	65.24	107.38	42.14	64.59

*Variable cost includes seeds, fertilizers, pesticides and labor
* Sales was based on average of ₱ 26.00per kilo

Legend:
V_1 – HAB 63
V_2 – BBL274
V_3 – Landmark
P_0 – Unprimed (control)
P_1 – Water
P_2 – *Moringa* solution
P_3 – Goat Urine

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

This study was conducted to compare the growth and fresh pod yield of the three snap bean varieties; determine the growth and fresh pod yield of the snap bean varieties as affected by seed priming; determine the interaction of seed priming and variety on the growth and fresh pod yield of snap bean; and determine the profitability of the three snap bean varieties as affected by seed priming.

All varieties emerged 7 days after sowing. HAB 63 and Landmark first flowered within 41 days after sowing and set pod at 35 days after emergence. Landmark was first harvested in 55 days after sowing. HAB 63 had the highest percentage of plant survival, obtained the highest number of marketable fresh pods, highest fresh pod yield per plot and highest return on cash expenses (ROCE). The three varieties of bush snap beans showed mild resistance to bean rust and pod borer.

Priming materials significantly affected the number of days from sowing to emergence, sowing to flowering, emergence to pod setting and sowing to first harvest. Seeds primed with water, *Moringa* solution and goat urine emerged, flowered and set pod a day earlier. The priming materials also enhanced taller plants, higher percentage of plant survival, and high number and weight of marketable fresh pods. Bush snap bean primed with water had the highest fresh pod yield per plot and gave the highest return on cash expenses (ROCE).

No significant interaction effect was observed between the three bush snap bean varieties and the different priming methods on the weight of marketable pods. Among the treatment combinations, HAB 63 primed with water was the most profitable.

Conclusion

HAB 63 had the highest percent survival, high number of flowers per cluster, highest number of fresh pods thus, producing the highest yield per plot and highest ROCE.

Bush snap beans primed with water had higher number and weight of marketable fresh pods and ROCE. Seeds primed with *Moringa* solution gave the highest percent survival and enhanced taller plants. Primed seeds resulted in mild resistance of bean plants to bean rust.

HAB 63 primed with water was the most profitable among the treatments.

Recommendation

HAB 63 is recommended due to its higher yield and return on cash expenses (ROCE).

Seed primed with water is recommended in producing high yield and return on cash expenses (ROCE). The combination of HAB 63 and the use of water as priming material is recommended.

The use of *Moringa* solution as priming material is also recommended for better plant survival.

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APPENDICES

Appendix Table 1. Number of days from sowing to emergence

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	8	8	8	24	8.00
V_1P_1	7	7	7	21	7.00
V_1P_2	7	7	7	21	7.00
V_1P_3	7	7	7	21	7.00
SUBTOTAL	29	29	29	87	29.00
V_2P_O	8	8	8	24	8.00
V_2P_1	7	7	7	21	7.00
V_2P_2	7	7	7	21	7.00
V_2P_3	7	7	7	21	7.00
SUBTOTAL	29	29	29	87	29.00
V_3P_O	7	8	8	23	7.67
V_3P_1	7	7	7	21	7.00
V_3P_2	7	7	7	21	7.00
V_3P_3	7	7	7	21	7.00
SUBTOTAL	28	29	29	86	28.67
BLOCK TOTAL	86	87	87	260	86.67

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	24	21	21	21	87	21.75
V_2	25	21	21	21	88	22
V_3	23	21	21	21	86	21.5
TOTAL	72	63	63	63	261	
MEAN	24	21	21	21		

Appendix Table 2. Number of days from sowing to flowering

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	42	43	42	127	42
V_1P_1	41	41	41	123	41
V_1P_2	41	41	41	123	41
V_1P_3	41	41	41	123	41
SUBTOTAL	165	166	165	496	165
V_2P_O	42	42	42	126	43
V_2P_1	42	42	42	126	42
V_2P_2	42	42	42	126	42
V_2P_3	42	42	42	126	42
SUBTOTAL	168	169	169	506	169
V_3P_O	41	42	42	125	42
V_3P_1	41	41	41	123	41
V_3P_2	41	41	41	123	41
V_3P_3	41	41	41	123	41
SUBTOTAL	164	165	165	494	165
BLOCK TOTAL	497	500	499	1,496	499

TWO-WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	127	123	123	123	496	124
V_2	128	126	126	126	506	126.5
V_3	125	123	123	123	494	123.5
TOTAL	380	372	372	372	1,496	
MEAN	126.67	124	124	124		

Appendix Table 3. Number of days from emergence to pod setting

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	36	36	35	107	36.33
V_1P_1	35	35	35	105	35
V_1P_2	35	35	35	105	35
V_1P_3	35	35	35	105	35
SUBTOTAL	141	141	140	422	141
V_2P_O	37	37	36	110	37
V_2P_1	36	36	36	108	36
V_2P_2	36	36	36	108	36
V_2P_3	36	36	36	108	36
SUBTOTAL	145	145	144	434	145
V_3P_O	35	36	36	107	36
V_3P_1	35	35	35	105	35
V_3P_2	35	35	35	105	35
V_3P_3	35	35	35	105	35
SUBTOTAL	140	141	141	422	141
BLOCK TOTAL	426	427	425	1,278	427

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	107	105	105	105	422	105.5
V_2	110	108	108	108	432	108.5
V_3	107	105	105	105	422	105.5
TOTAL	324	318	318	318	1,278	
MEAN	108	106	106	106		

Appendix Table 4. Number of days from sowing to first harvest.

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	57	59	58	174	58
V_1P_1	57	57	57	171	57
V_1P_2	57	57	57	171	57
V_1P_3	57	57	57	171	57
SUBTOTAL	228	230	229	687	229
V_2P_O	59	59	58	176	59
V_2P_1	58	58	58	174	58
V_2P_2	58	58	58	174	58
V_2P_3	58	58	58	174	58
SUBTOTAL	233	233	232	698	233
V_3P_O	56	56	55	167	56
V_3P_1	55	55	55	165	55
V_3P_2	55	55	55	165	55
V_3P_3	55	55	55	165	55
SUBTOTAL	221	221	220	660	221
BLOCK TOTAL	682	684	681	2,045	683

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	174	171	171	171	687	171.75
V_2	176	174	174	174	698	174.5
V_3	168	165	165	165	663	165.75
TOTAL	518	510	510	510	2,048	
MEAN	172.67	170	170	170		

Appendix Table 5. Initial plant height (cm)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	10.42	11.32	11.32	33.06	11.02
V_1P_1	11.72	11.92	11.70	35.34	11.78
V_1P_2	11.84	11.90	11.96	35.70	11.9
V_1P_3	11.12	11.62	10.08	32.84	10.95
SUBTOTAL	45.1	46.7	45.06	136.94	45.65
V_2P_O	11.36	9.64	9.54	33.06	10.18
V_2P_1	11.65	11.06	11.24	35.34	11.32
V_2P_2	11.56	10.16	11.32	33.04	11.01
V_2P_3	10.30	11.60	11.86	33.76	11.25
SUBTOTAL	44.87	42.46	43.96	131.29	43.76
V_3P_O	11.84	11.06	10.32	33.22	11.07
V_3P_1	11.12	11.52	11.50	34.14	11.38
V_3P_2	11.24	11.34	11.76	34.34	11.45
V_3P_3	10.12	11.34	11.36	31.82	11.61
SUBTOTAL	44.32	45.26	43.94	133.52	44.51
BLOCK TOTAL	134.29	134.5	132.96	401.75	133.96

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	33.06	35.34	35.7	33.84	136.94	34.24
V_2	29.54	33.95	33.04	33.76	130.29	32.57
V_3	33.26	34.19	34.34	31.82	133.56	33.39
TOTAL	95.86	103.43	103.08	98.42	400.79	
MEAN	31.95	34.48	34.36	34.48		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	0.116	0.058	0.18^{ns}		
Variety	2	1.843	0.921	2.87^{ns}	3.44	5.72
Priming Materials	3	4.526	1.509	4.70^{*}	3.05	4.82
V x PM	6	3.262	0.544	1.69^{ns}	2.55	3.76
Error	22	7.069	0.321			
TOTAL	35	16.815				

ns – not significant
* - significant

CV=5.09%

Appendix Table 6. Final plant height (cm)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	33.28	33.51	33.84	100.53	33.54
V_1P_1	34.04	34.78	34.15	107.97	34.32
V_1P_2	34.13	34.53	34.56	103.22	34.41
V_1P_3	34.16	34.50	34.65	103.31	34.49
SUBTOTAL	135.61	137.32	137.20	410.30	136.71
V_2P_O	33.48	33.77	33.95	101.20	33.73
V_2P_1	34.69	34.49	34.14	103.32	34.44
V_2P_2	34.26	34.58	34.64	103.48	34.49
V_2P_3	34.07	34.11	34.57	102.72	34.25
SUBTOTAL	136.50	136.95	137.30	410.75	136.91
V_3P_O	33.90	33.44	34.09	102.43	33.81
V_3P_1	34.48	34.29	34.79	103.56	34.52
V_3P_2	34.19	34.28	34.80	103.37	34.46
V_3P_3	34.22	34.41	34.58	103.21	34.40
SUBTOTAL	136.79	136.52	138.26	411.57	137.19
BLOCK TOTAL	408.9	410.79	412.76	1,232.45	410.82

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	100.63	102.97	103.22	103.31	410.13	102.53
V_2	101.20	103.32	103.48	102.75	410.75	102.69
V_3	101.43	103.36	103.37	103.21	411.57	102.89
TOTAL	303.26	309.85	310.07	309.27	1,232.45	
MEAN	101.09	103.28	103.36	103.09		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	0.618	0.309	5.61^{*}		
Variety	2	0.086	0.043	0.78^{ns}	3.44	5.72
Priming Materials	3	3.531	1.177	21.37^{**}	3.05	4.82
V x PM	6	0.156	0.026	0.47^{ns}	2.55	3.76
Error	22	1.211	0.055			
TOTAL	35	5.602				

ns – not significant CV = 0.69%
** - highly significant

Appendix Table 7. Percent Survival

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	94	88	86	268	89.33
V_1P_1	91	87	92	270	90.00
V_1P_2	91	94	88	273	91.00
V_1P_3	88	93	89	270	90.00
SUBTOTAL	364	362	255	1,081	360.33
V_2P_O	61	78	86	225	75.00
V_2P_1	84	90	84	258	86.00
V_2P_2	84	89	88	261	87.00
V_2P_3	85	78	89	243	81.00
SUBTOTAL	314	335	338	987	329.00
V_3P_O	82	80	74	236	76.67
V_3P_1	86	84	88	258	86.00
V_3P_2	86	84	89	259	86.33
V_3P_3	74	86	92	252	84.00
SUBTOTAL	328	334	343	1,005	335.00
BLOCK TOTAL	1,006	1,031	1,036	3,073	1,024.33

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	268	270	273	270	1,081	270.25
V_2	225	258	261	243	987	246.75
V_3	236	258	259	252	1,005	251.25
TOTAL	729	786	793	765	3,073	
MEAN	243	262	264.33	255		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	43.056	21.528	0.73^{ns}		
Variety	2	414.889	207.444	7.01^{**}	3.44	5.72
Priming Materials	3	275.417	91.806	3.10^{*}	3.05	4.82
V x PM	6	114.000	19.000	0.64^{ns}	2.55	3.76
Error	22	650.944	29.588			
TOTAL	35	1498.306				

ns – not significant

** - highly significant

* - significant

CV = 6.37%

Appendix Table 8. Plant Vigor

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	4	4	3	11	3.67
V_1P_1	4	4	4	12	4.00
V_1P_2	4	4	4	12	4.00
V_1P_3	4	4	4	12	4.00
SUBTOTAL	16	16	15	47	16.00
V_2P_O	3	4	3	10	3.33
V_2P_1	4	4	4	12	4.00
V_2P_2	4	4	4	12	4.00
V_2P_3	4	3	4	11	4.00
SUBTOTAL	15	15	15	45	15.00
V_3P_O	4	4	3	11	3.67
V_3P_1	4	4	4	12	4.00
V_3P_2	4	4	4	12	4.00
V_3P_3	4	4	4	12	4.00
SUBTOTAL	16	16	15	47	16.00
BLOCK TOTAL	16	16	15	47	16.00

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	11	12	12	12	47	11.75
V_2	10	12	12	12	46	11.5
V_3	11	12	12	12	47	11.75
TOTAL	32	36	36	36	140	
MEAN	10.67	12	12	12		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F .05	TABULATED F .01
Replication	2	0.167	0.083	1.00^{ns}		
Variety	2	0.000	0.000	0.00^{ns}	3.44	5.72
Priming Materials	3	0.750	0.250	3.00^{ns}	3.05	4.82
V x PM	6	0.000	0.000	0.00^{ns}	2.55	3.76
Error	22	1.833	0.083			
TOTAL	35	2.750				

ns – not significant CV = 7.37%

** - highly significant

Appendix Table 9. Number of flower per cluster

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	5.6	5.9	5.2	16.7	5.56
V_1P_1	5.2	5.6	6	16.8	5.60
V_1P_2	5.6	6	5.2	17.2	5.60
V_1P_3	5.9	5.8	5	16.7	5.57
SUBTOTAL	22.3	23.3	21.4	67.4	22.47
V_2P_O	5.2	5.2	5.1	15.5	5.17
V_2P_1	5	5.5	5.6	16.1	5.37
V_2P_2	5.57	5.3	5.5	16.5	5.50
V_2P_3	5.6	5	5	15.6	5.20
SUBTOTAL	21.5	21.0	21.2	63.7	21.23
V_3P_O	5	5.1	5.2	15.3	5.10
V_3P_1	5.3	6	5.4	16.7	5.57
V_3P_2	6	5	6	17	5.67
V_3P_3	5.3	5.1	5.5	15.9	5.30
SUBTOTAL	21.6	21.2	22.1	64.9	21.63
BLOCK TOTAL	65.4	65.5	64.7	196.0	65.33

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	17	17	17	17	68	17.00
V_2	15	17	17	16	65	16.25
V_3	16	16	17	16	65	16.25
TOTAL	48	50	51	49	198	
MEAN	16.00	16.67	17.00	16.33		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	0.000	0.000	0.00^{ns}		
Variety	2	0.500	0.250	0.75^{ns}	3.44	5.72
Priming Materials	3	0.556	0.190	0.56^{ns}	3.05	4.82
V x PM	6	0.611	0.100	0.31^{ns}	2.55	3.76
Error	22	7.330	0.330			
TOTAL	35	9.000				

ns – not significant CV = 10.50%

** - highly significant

Appendix Table 10. Number of pod per cluster

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	4.7	4.7	4.4	13.8	4.6
V_1P_1	4.6	4.7	4.6	13.9	4.69
V_1P_2	4.5	4.9	4.7	14.1	4.70
V_1P_3	4.7	4.7	4.5	13.9	4.63
SUBTOTAL	18.5	19.0	18.2	55.7	18.57
V_2P_O	4.4	4.5	4.6	13.5	4.50
V_2P_1	4.4	4.6	4.8	13.8	4.60
V_2P_2	4.8	4.5	4.7	14	4.67
V_2P_3	4.7	4.4	4.5	13.6	4.53
SUBTOTAL	18.3	18.0	18.6	54.9	18.3
V_3P_O	4.6	4.5	4.5	13.6	4.53
V_3P_1	4.5	5.2	4.6	14.3	4.77
V_3P_2	4.9	4.6	5	14.5	4.83
V_3P_3	4.7	4.6	4.6	13.9	4.63
SUBTOTAL	18.7	18.9	18.7	56.3	18.76
BLOCK TOTAL	55.5	55.9	55.5	166.9	55.63

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	13.8	13.9	14.1	13.9	55.7	13.93
V_2	13.5	13.8	14.0	13.6	54.9	13.73
V_3	13.6	14.3	14.5	13.9	56.3	14.08
TOTAL	40.09	42.00	42.60	41.40	166.9	
MEAN	13.63	14.00	14.00	14.00		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	0.009	0.004	0.13^{ns}		
Variety	2	0.082	0.410	1.21^{ns}	3.44	5.72
Priming Materials	3	0.181	0.060	1.78^{ns}	3.05	4.82
V x PM	6	0.047	0.008	0.23^{ns}	2.55	3.76
Error	22	0.744	0.034			
TOTAL	35	1.063				

ns – not significant
** - highly significant

CV = 3.97%

Appendix Table 11. Percent pod set per cluster

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	83.93	79.67	84.62	248.22	82.74
V_1P_1	88.46	83.93	76.67	249.06	83.02
V_1P_2	80.36	81.67	90.38	252.41	84.14
V_1P_3	79.66	82.76	90.00	252.42	84.14
SUBTOTAL	332.41	328.03	341.67	1,002.11	334.04
V_2P_O	84.62	86.54	90.20	261.36	87.12
V_2P_1	88	86.79	87.30	262.09	87.36
V_2P_2	84.21	84.90	85.45	254.56	85.85
V_2P_3	83.92	88.00	90.00	261.92	87.31
SUBTOTAL	340.75	346.23	352.95	1,039.93	346.64
V_3P_O	92	88.24	86.54	266.78	88.93
V_3P_1	84.91	86.67	85.19	275.78	91.86
V_3P_2	81.67	92	83.33	257.00	85.67
V_3P_3	88.68	90.20	83.64	262.52	87.51
SUBTOTAL	347.26	357.11	338.7	1,043.07	347.69
BLOCK TOTAL	1,020.42	1,031.37	1,033.32	3,085.11	1,028.37

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	248.20	249.06	252.41	252.42	1,002.09	250.52
V_2	261.36	262.10	254.56	261.92	1,039.94	299.99
V_3	266.78	275.58	257.03	262.9	1,062.29	265.57
TOTAL	776.34	786.74	764.00	777.24	3,104.32	
MEAN	258.78	258.78	254.67	259.08		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	9.575	4.788	0.32^{ns}		
Variety	2	85.505	42.752	2.86^{ns}	3.44	5.72
Priming Materials	3	14.689	4.896	0.33^{ns}	3.05	4.82
V x PM	6	29.618	4.936	0.33^{ns}	2.55	3.76
Error	22	329.423	14.974			
TOTAL	35	468.810				

ns – not significant
** - highly significant

CV = 4.52%

Appendix Table 12. Number of marketable fresh pod per plot

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	673	712	501	1,886	628.67
V_1P_1	822	1,052	729	2,600	866.67
V_1P_2	886	852	679	2,417	805.67
V_1P_3	818	803	905	2,526	842.00
SUBTOTAL	3,199	3,419	2,811	9,429	3,143
V_2P_O	558	617	568	1,743	581
V_2P_1	695	693	824	2,212	737.33
V_2P_2	607	759	606	1,972	657.33
V_2P_3	616	620	679	1,915	638.33
SUBTOTAL	2,476	2,689	2,677	7,842	2,614
V_3P_O	544	639	634	1,817	605.67
V_3P_1	564	640	632	1,836	612.00
V_3P_2	572	639	717	1,928	642.67
V_3P_3	625	582	614	1,821	607.00
SUBTOTAL	2,305	2,500	2,597	7,402	2,467.34
BLOCK TOTAL	7,980	8,608	8,085	24,673	8,224.34

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	1,886	2,600	2,417	2,526	9,429	2,357.25
V_2	1,743	2,212	1,972	1,915	7,842	1,960.5
V_3	1,817	1,836	1,928	1,821	7,402	1,850.5
TOTAL	5,446	6,642	6,317	6,6262	24,673	
MEAN	1,818.33	2,216	2,105.67	2,087.33		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	18795.670	9397.750	1.42^{ns}		
Variety	2	189268.667	94634.333	14.33^{**}	3.44	5.72
Priming Materials	3	86948.222	28982.741	4.39^{*}	3.05	4.82
V x PM	6	57613.111	9602.185	1.45^{ns}	2.55	3.76
Error	22	145324.500	6605.659			
TOTAL	35	497950.000				

ns – not significant
** - highly significant
* - significant

CV = 11.86%

Appendix Table 13. Weight of marketable fresh pod per plot (kg)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	4.45	4.85	3.4	12.7	4.23
V_1P_1	5.80	6.40	5.15	17.35	5.78
V_1P_2	5.05	4.9	4.5	14.75	4.92
V_1P_3	5.4	4.7	5.3	15.4	5.13
SUBTOTAL	20.7	20.85	18.65	60.2	20.06
V_2P_O	3.5	4.45	3.65	11.6	3.87
V_2P_1	4.45	4.8	5.2	14.45	4.82
V_2P_2	4.05	4.55	4.25	12.85	4.28
V_2P_3	4.20	3.85	4.20	12.25	4.08
SUBTOTAL	16.2	17.65	17.3	51.15	17.05
V_3P_O	3.55	4.05	3.85	11.45	3.82
V_3P_1	3.95	4.45	4.40	12.8	4.27
V_3P_2	3.75	4.18	4.55	12.48	4.16
V_3P_3	4.55	3.75	4.1	12.4	4.13
SUBTOTAL	15.8	16.49	16.9	49.13	16.38
BLOCK TOTAL	52.7	54.93	52.85	160.42	53.49

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	12.70	17.35	14.75	15.40	60.2	15.05
V_2	11.60	14.45	12.85	12.25	51.15	12.79
V_3	11.45	12.80	12.48	12.40	49.13	12.28
TOTAL	35.75	44.6	40.08	40.05	100.48	
MEAN	11.92	14.87	14.87	13.35		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	0.259	0.129	0.73^{ns}		
Variety	2	5.792	2.896	16.36^{**}	3.44	5.72
Priming Materials	3	4.353	1.451	8.20^{**}	3.05	4.82
V x PM	6	1.149	0.192	1.08^{ns}	2.55	3.76
Error	22	3.895	0.177			
TOTAL	35	15.448				

ns – not significant

** - highly significant

CV = 9.44%

Appendix Table 14. Number of non-marketable per plot

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	181	158	139	478	159.33
V_1P_1	169	185	113	467	155.67
V_1P_2	157	178	150	485	161.67
V_1P_3	156	167	173	496	164.33
SUBTOTAL	663	688	575	1,926	642
V_2P_O	112	150	141	403	134.33
V_2P_1	152	139	131	422	140.67
V_2P_2	142	137	110	389	129.67
V_2P_3	148	124	144	416	138.67
SUBTOTAL	554	550	526	1,630	543.33
V_3P_O	191	139	117	447	149.00
V_3P_1	115	131	134	380	126.67
V_3P_2	133	171	141	428	142.67
V_3P_3	116	123	137	376	125.33
SUBTOTAL	555	564	512	1,631	543.67
BLOCK TOTAL	1,772	1,802	1,613	5,187	1,729

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	478	467	485	496	1,926	481.5
V_2	403	422	389	416	1,630	407.5
V_3	447	380	428	376	1,631	407.75
TOTAL	1,328	1,269	1,302	1,288	5,178	
MEAN	442.67	423.00	434.00	429.33		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	1719.500	859.750	2.08^{ns}		
Variety	2	4851.167	2425.583	5.86^{*}	3.44	5.72
Priming Materials	3	205.639	68.546	0.17^{ns}	3.05	4.82
V x PM	6	1400.611	233.435	0.56^{ns}	2.55	3.76
Error	22	9103.833	413.811			
TOTAL	35	17280.750				

ns – not significant

* - significant

CV = 14.12%

Appendix Table 15. Weight of non-marketable fresh pod per plot (kg)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	1.03	0.85	0.84	2.73	0.91
V_1P_1	0.88	0.95	0.83	2.66	0.87
V_1P_2	0.78	0.88	0.80	2.46	0.82
V_1P_3	0.84	0.90	0.83	2.57	0.86
SUBTOTAL	3.53	3.58	3.30	10.41	3.48
V_2P_O	0.88	0.90	0.89	2.67	0.89
V_2P_1	0.98	0.85	0.83	2.66	0.87
V_2P_2	0.83	0.98	0.79	2.60	0.87
V_2P_3	0.97	0.75	0.96	2.68	0.89
SUBTOTAL	3.66	3.48	3.47	10.61	3.54
V_3P_O	0.85	0.61	0.75	2.21	0.74
V_3P_1	0.78	0.76	0.79	2.33	0.78
V_3P_2	0.95	0.97	0.85	2.77	0.92
V_3P_3	0.77	0.75	0.87	2.39	0.80
SUBTOTAL	3.35	3.09	3.26	9.7	3.24
BLOCK TOTAL	10.54	10.15	10.03	30.72	10.26

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	2.73	2.66	2.46	2.57	10.42	2.61
V_2	2.67	2.66	2.60	2.68	10.61	2.65
V_3	2.21	2.33	2.77	2.39	9.7	2.43
TOTAL	7.61	7.65	7.83	7.64	30.73	
MEAN	2.54	2.55	2.61	2.55		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	0.012	0.006	0.95^{ns}		
Variety	2	0.038	0.019	3.06^{ns}	3.44	5.72
Priming Materials	3	0.003	0.001	0.19^{ns}	3.05	4.82
V x PM	6	0.069	0.012	1.85^{ns}	2.55	3.76
Error	22	0.137	0.006			
TOTAL	35	0.260				

ns – not significant

CV = 9.25%

Appendix Table 16. Computed fresh pod per hectare (tons/ha)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	5.48	5.7	4.24	15.92	5.14
V_1P_1	6.68	7.35	5.98	20.01	6.67
V_1P_2	5.83	5.78	5.6	17.21	5.74
V_1P_3	6.24	5.6	6.13	17.97	5.99
SUBTOTAL	24.23	24.43	21.95	71.11	23.54
V_2P_O	4.38	5.35	4.54	14.27	4.76
V_2P_1	5.43	5.65	6.03	17.11	5.70
V_2P_2	4.88	5.53	5.04	15.45	5.15
V_2P_3	5.17	4.60	5.16	14.93	4.98
SUBTOTAL	19.86	21.13	20.77	61.76	20.59
V_3P_O	4.40	4.66	4.60	13,66	4.55
V_3P_1	4.73	5.21	5.19	15.13	5.04
V_3P_2	4.70	5.15	5.35	15.2	5.07
V_3P_3	5.32	4.5	4.97	14.79	4.93
SUBTOTAL	19.5	19.52	20.11	45.12	19.59
BLOCK TOTAL	101.96	101.88	106.05	255.25	103.29

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	30.84	40.02	34.42	35.94	141.22	35.31
V_2	28.54	34.22	30.9	29.86	123.52	30.88
V_3	27.32	30.26	30.4	29.58	117.56	29.39
TOTAL	86.7	104.5	95.72	195.38	328.3	
MEAN	28.9	34.83	31.91	31.79		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	0.957	0.479	0.64^{ns}		
Variety	2	25.239	12.620	16.87^{**}	3.44	5.72
Priming Materials	3	17.609	5.870	7.85^{**}	3.05	4.82
V x PM	6	4.766	0.794	1.06^{ns}	2.55	3.76
Error	22	16.457	0.748			
TOTAL	35	65.028				

ns – not significant
** - highly significant

CV = 8.14%

Appendix Table 17. Reaction to Bean rust

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
V_1P_O	2	2	1	5	1.67
V_1P_1	1	1	1	3	1.00
V_1P_2	1	1	1	3	1.00
V_1P_3	1	2	1	4	1.33
SUBTOTAL	5	6	4	15	5.00
V_2P_O	1	2	2	5	1.67
V_2P_1	1	1	1	3	1.00
V_2P_2	2	1	1	4	1.33
V_2P_3	2	1	1	4	1.33
SUBTOTAL	6	5	5	16	4.00
V_3P_O	1	2	2	5	1.67
V_3P_1	1	1	1	3	1.00
V_3P_2	1	1	1	3	1.00
V_3P_3	2	1	1	4	1.33
SUBTOTAL	5	5	5	15	5.00
BLOCK TOTAL	16	16	14	46	15.33

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	5	3	3	4	15	3.75
V_2	5	3	4	4	16	4.00
V_3	5	3	3	4	15	3.75
TOTAL	15	9	10	12	46	
MEAN	5.0	3.0	3.33	4.0		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	0.222	0.111	0.55^{ns}		
Variety	2	0.056	0.028	0.14^{ns}	3.44	5.72
Priming Materials	3	2.333	0.778	3.85^{*}	3.05	4.82
V x PM	6	0.167	0.028	0.14^{ns}	2.55	3.76
Error	22	4.444	0.202			
TOTAL	35	7.222				

ns – not significant

* - significant

CV = 35.18%

Appendix Table 18. Reaction to pod borer

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
V_1P_O	1	2	1	4	1.33
V_1P_1	1	1	2	4	1.33
V_1P_2	1	1	1	3	1.00
V_1P_3	1	1	1	3	1.00
SUBTOTAL	4	5	5	14	4.67
V_2P_O	2	1	1	4	1.33
V_2P_1	1	1	1	3	1.00
V_2P_2	2	1	1	4	1.33
V_2P_3	2	1	1	4	1.33
SUBTOTAL	7	4	4	15	5
V_3P_O	1	2	1	4	1.33
V_3P_1	1	1	1	3	1.00
V_3P_2	1	1	1	3	1.00
V_3P_3	2	1	1	4	1.33
SUBTOTAL	5	5	4	14	4.67
BLOCK TOTAL	16	14	13	44	14.34

TWO - WAY TABLE

VARIETIES	PRIMIMG MATERIALS (P)				TOTAL	MEAN
	P_0	P_1	P_2	P_3		
V_1	4	4	3	3	14	3.5
V_2	4	3	4	4	15	3.75
V_3	4	3	3	4	14	3.5
TOTAL	12	10	10	11	43	
MEAN	4.00	3.33	3.33	3.67		

ANALLYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULATED F	
					.05	.01
Replication	2	0.167	0.083	0.48^{ns}		
Variety	2	0.167	0.083	0.48^{ns}	3.44	5.72
Priming Materials	3	0.333	0.111	0.64^{ns}	3.05	4.82
V x PM	6	0.500	0.083	0.48^{ns}	2.55	3.76
Error	22	3.833	0.174			
TOTAL	35	5.000				

ns – not significant

CV = 35.78%