BIBLIOGRAPHY

SARMOYAN, JENIFER QUEEN B. APRIL 2008. Production of Pole Snap Bean Under Organic-Based Soil Amendments at Taloy Norte, Tuba, Benguet Condition. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted to determine the variety best suited in Taloy Norte, Tuba, Benguet condition; determine the effect of three organic-based soil amendments on the growth and yield of pole snap bean; identify the interaction of pole snap bean varieties applied with organic-based soil amendments; and determine the economic benefits of pole snap bean varieties applied with organic-based soil amendments.

Study shows that Maroon (Beta) is the best variety suited in Taloy Norte, Tuba, Benguet condition. Maroon (Beta) bean was the most responsive to Carbonized rice hull as soil amendment in terms of yield, but in growth Maroon (Beta) was more responsive to garden compost. The interaction of Maroon (Beta) and Coco coir dust were significantly on number of marketable pods per plot, and the number of pods per plot observed on Maroon (Beta) in combination with garden compost.

With the good performance of Maroon (Beta), it is highly recommended for fresh pod and seed production under Taloy Norte, Tuba, Benguet condition for higher return on cash expense. Likewise, Coco coir dust as soil amendment is also recommended for higher marketable seed and fresh pod yield. Stonehill with Carbonized rice hull as soil amendment could be an alternative choice.

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INTRODUCTION

Snap bean (*Phaseolus vulgaris*), also known as common bean is grown for its seeds or tender and green pods. It is an annual crop that can be grown profitably in high elevated areas in the tropics. In lower elevation, yield was significantly lower (George, 1985).

Buyers tend to buy legumes as substitutes for meat products when the prices of the meat products are too expensive. Legumes are recognized as important source of protein, vitamins, and minerals such as calcium and phosphorus which maybe consumed as dry seeds or as green fresh pods for human nutrition (Work and Crew, 1995).

Costumers are turning to organic food because they believe it to be tastier, as well as healthier, both for themselves and the environment. Despite the higher cost for organic products, costumers are willing to pay for their preferences.

Organic farming is environmentally friendly. Organic inputs keep dangerous chemicals out of the environment and maintain the natural balance of ecosystems. Furthermore, organic farming employs many positive environmental practices such as recycling and composting and helps maintain soil health through natural methods (Anonymous, 1999).

Organic farms use natural methods of protection from pest such as those derived from plants. Natural pesticides are a last resort, while growing healthier, disease resistant plants, using cover crops and crop rotation, and encouraging beneficial insects and birds are the primary methods of pest control. The most common organic pesticides used by most organic farmers include, *Bt pytethrum* and *retonone*. On the other hand, conventional farming uses large quantities of pesticides through techniques such as crop dusting. People who work with pesticides have an increase risk of developing Parkinson's disease. If the herbicide parquet and fungicide *maneb* mix together may cause brain damage in mice. But some organic pesticides, such as *retonone*, have high toxicity that affects the fishes and aquatic creatures, including mammals and humans (Guthman, 2004).

Legumes are highly recommended for crop rotation and green manuring due to their capability to fix atmosphere nitrogen to plants in usable form with the aid of some species of bacteria. The system of nitrogen fixation can offer economically acceptable and environment friendly way of applying fertilizer by reducing chemical inputs (Brickbauer and Mortenson, 1978).

Snap bean production is one of the main sources of income of the farmers in highlands. The production of snap bean should therefore be given due attention. One of the ways to increase production is through the use of the varieties that are high in yielding and resistant to pest and diseases that are best adapted in the locality. Some farmers do not consider much the importance of the variety and quality of seeds they use for the production. In this case, there is need to evaluate different varieties in the different growing areas to identify the varieties that are high yielding and suited in growing areas.

Although they claim that organic food is expensive than conventional food and thus too highly priced to be affordable to persons on a lower income. Organic products typically cost 10 % to 40 % more than similar conventionally produced products. Processed organic foods vary greatly in price when compared to their conventional counterparts. But despite the highly priced of organic products costumers are willing to pay for their preferences. Organic food is tastier, as well as healthier, both for their health and environment (Kuepper, 2003).

Organic products have higher cost because it reflects many of the cost as conventional foods in terms of growing, harvesting, transporting and storage. It must meet stricter regulations, governing all these steps so that the process is often more labor and management intensive, and farming tends to be a smaller scale. There is mounting evidence that is all the indirect cost of conventional food production were factored into the price of food, organic foods would cost the same, or more likely is cheaper (Anonymous, 1999).

The objectives of the study were to:

1. determine the variety best suited in Taloy Norte, Tuba, Benguet condition;

2. determine the effect of three organic-based soil amendments on the growth and yield of pole snap bean;

3. identify the interaction of pole snap bean varieties applied with organic-based soil amendments; and

4. determine the economic benefits of pole snap bean varieties applied with organic-based soil amendments.

The study was conducted at Taloy Norte, Tuba, and Benguet from December 2007 to March 2008.

REVIEW OF LITERATURE

Environmental Requirements of Snap bean

Snap beans grow best in areas with temperature between 15 to 21°C like in Benguet. Bush varieties can tolerate low temperature better than the climbing varieties and can tolerate warm temperature up to 25°C.

Snap beans grow well in loose textured soil with good drainage. They can tolerate soil pH of 5.5 to 6.5 but perform best between pH ranges of 5.8 to 6.0. Soils that crust or cake easily resulted in poor crop stand. Well-drained bottomland in the mountain has been most satisfactory. Plowing under green manure crops will increase the organic matter of the soil as well as improve the yield and quality of the beans.

Varietal Evaluation

Varietal evaluation is done to find out those varieties of crops that are adapted to the grower's need, is very important. But after testing most attention should be paid to test strains and stocks of varieties selected because great differences exist between strains of many crops and is the only by trial that superior varieties are found (Thompson and Kelly, 1957).

Varietal evaluation is done to gather data on plant character, yield and pod quality (Regmi, 1990) as well as to observe characters such as earliness, vigor, maturity and keeping quality because different varieties have a wide range of difference (Work and Crew, 1995). It is done therefore to ascertain adaptability of varieties in a certain locality.

Evaluation of different snap bean varieties have been continuously conducted in various parts of Benguet. Working on six varieties, Mulchino (2007) concluded that Blue lake and Taichung are the varieties suited for Gusaran, Kabayan, Benguet due to their high return on cash expenses. Cayso (2005) evaluated ten varieties of pole snap bean collected from different places according to plant growth, flowering habit, maturity, and highest number of pods per plot, and resistant to pest and disease. She found out that Blue lake, Maccarao, and B-12 have good performance in terms of yield reaction to pest and diseases and adaptability under Basil, Tublay, Benguet condition.

Effect of Organic Amendments to Soil

The best way to improve soil fertility is to increase its organic matter content. Organic matter is a source of nitrogen, phosphorus, and sulfur nutrients which soil organisms require and retain. These nutrients slowly become available as the organic matter continues to decompose. Organic materials can therefore supply the nutritional requirements of the crops. Most of the magnesium, calcium, and potassium in the decaying organic residues are discarded by the soil organisms during the first stage of decomposition and these nutrients are quickly available to plants. Supply of organic matter without excess of nitrogen will decrease the incidence of potato scab by encouraging other soil microorganisms that will compete with the scab producing organisms.

Organic fertilizers improve the soil physical properties, whether they are applied to heavy soil or sandy soil. The loosen up clay soils and improve the water retention of sandy soils. The fibrous portion of organic matter which is high carbon content promotes soil aggregation to improve the permeability and aeration of clay soil, while its ability to absorb moisture helps in the granulation of sandy soils and improve their water holding capacity. It is also mentioned that in the use of organic matter for the biological control of the soil borne diseases of nematodes, some types of organic matter reduces the population of pathogens soil microorganism such as *fusarium* and others could potentially used as a safe and low cost disease control (Sung Ching, 1992)

Some result on fertilizer application shows that the physical and chemical properties of the soil were highly affected by organic fertilizer. The soil bulk density was lowered especially on plots applied with wild sunflower. The values in all the treatments were higher than the ideal bulk density value of 1.33 g/cc. Soil water holding capacity were also increased by organic fertilizers used, hog, manure application had the highest increased in water holding capacity. Wild sunflower application significantly increased the soil pH (Lazo, 2006). Application of organic fertilizer such as compost, wild flower, and chicken dung increases the seed yield and improve the quality of the pole snap bean (Simsim, 2007). Plants Applied with compost produced the highest yield in potato under La Trinidad condition. Entry 676089 was the best performing potato entry in terms of resistance to pest and diseases (Palaroan, 2006).

Effect of Coco Coir Dust

Coco coir dust is a mixture of short and powder fibers. It has a pH of 5.5-5.6 and usually contains higher level of potassium, sodium and chlorine than peat. Coco coir dust can be used as a substitute for peat when reducing container grown *viburnum* and lilac and presumably other woody plants. It is composed of millions of capillary micro-sponges that absorb and hold water up to eight times its own weight. The natural pH is between 5.5 to 6.5 and it has a very high ability to exchange cations. It has a very high water holding capacity and good air porosity and does not compact like sawdust (Bosleng, 2004).

Vavrina (1992) as cited by Daguyan stated that coco coir dust is biodegradable and has superior structural ability, water absorption ability and drainage, and cation exchange capacity compared to either sphagnum peat or sedge peat. Small amount of nitrogen draw down occurred with coco coir dust, but typical production fertilization practices would likely compensate for the amount of nitrogen loss. It has high level of potassium that proves more benefits than a detriment to plant growth. The higher the pH of coco coir, dust may allow less time to add the coco coir dust based medium.

Effect of Carbonized Rice Hull

Gaw (2003) as cited by Cezar claimed that rice hull which is made from the husk of *palay*, carefully carbonized and completely sterilized contains high amounts of carbon essential for proper development of seedlings when added to the mix, it makes the medium loose for better root penetration. It also makes the medium hold fertilizer longer.

Carbonized rice hull can also serve as a moisture retention helper or as a weed growth inhibitor in the soil. When rice hull is burned, the remaining ash serves as mix for fertilizers finely ground rice hull are also used as a components in commercial mixed fertilizers. The rice hull prevents caking of other fertilizers components (Cezar, 2005).

Carbonated rice hull is an excellent soil conditioner. Continuous applications of carbonized rice hull replenish the nutrient lost from the soil as a result of continuous use of inorganic fertilizer. It has high air permeability since it is porous and bulky, and has the ability to replenish air in the soil. It is also favorable habitat for beneficial microorganisms in the soil because it is sterilized from disease organisms (Daguyam, 2006).

MATERIALS AND METHODS

An area of 270 square meters was prepared and divided into 27 plots. Each block was composed of 3 plots measuring 1 m x 10 m. The experiment was laid out in 3 x 3 factorial in randomized complete design (RCBD) with three replications.

Snap beans seeds were planted, 2 to 3 seeds per hill at distances of 20 cm between hills and 50 cm between rows. The organic- based soil amendments were applied at the rate of 20 kg/10 meter square during the land preparation. Cultural management practices such as irrigation, weeding and hilling up were uniformly employed to all the treatments.

Half of the plots was used for fresh pod production and the other half for seed yield.

The treatments were the following:

Factor A – Variety (V)

V1 – Alno

V2 – Maroon (Beta)

V3 – Stonehill

Factor B – Organic-based soil amendments

S1 – Garden compost

S2 – Coco coir dust

S3 – Carbonated rice hull

Data Gathered

A. Vegetative characters

1. Percent germination. This was taken 10 days after planting. It was determined using the formula:

$$\% \text{ Germination} = \frac{\text{Total number of plants germinated}}{\text{Total number of plants planted}} \times 100$$

2. Plant survival (cm). This was taken 2 weeks after germination. It was determined using the formula:

$$\text{Percent survival} = \frac{\text{Total number of plants survived}}{\text{Total number of germinated seeds}} \times 100$$

3. Number of days from planting to flowering. This was taken by counting the number of days from the day of emergence to the time when at least 50 % of the plants had fully-opened flowers.

4. Number of days to maturity. This was taken by counting the number of days from emergence to first harvesting of fresh pods.

5. Final plant height (cm). This was taken by measuring sample plants in each soil plot from the soil surface to the tip of the plant at first harvest of the pods.

6. Total number of pods per plot. This was taken counting the number of pods per cluster developed per plot.

B. Yield components

1. Number and weight of marketable pods per plot (g). Marketable pods are not deformed and free from insect pest and diseases. The marketable pods were counted and weighted from the first to last harvest.

2. Number and weight of non-marketable pods per plot (g). Non-marketable pods are deformed and not free from insect pests and diseases. The non-marketable pods were counted and weighted from the first to last harvest.

3. Total fresh seed yield per plot. This is the sum of all marketable and non-marketable fresh pods.

4. Total seed yield per hectare. This was taken using the formula:

$$\text{Seed yield (tons/ha)} = \frac{\text{Seed yield/plot}}{5\ m^2} \times 10{,}000$$

5. Total fresh pods /hectare. This was taken using the formula:

$$\text{Fresh pods yield (tons/ha)} = \frac{\text{Total fresh pods yield/plot}}{5m^2} \times 10{,}000$$

C. Pest and disease incidence

1. Pod borer. this was taken using the following rating scale:

SCALE	DESCRIPTION	REMARKS
1	No infection	Highly resistance
2	1-25% of the total plant/plot was infected	Mild resistance
3	25-50% of the total plant/plot was infected	Moderate resistance
4	50-75% of the total plant/plot was infected	Susceptible
5	76-100% of the total plant/plot was infected	Very susceptible

2. Bean rust. This was taken using the following rating scale:

SCALE	DESCRIPTION	REMARKS
1	No infection	Highly resistance
2	1-25 % of the total plant/plot was infected	Mild resistance
3	25-50 % of the total plant/plot was infected	Moderate resistance
4	50-75 % of the total plant/plot was infected	Susceptible

5	76-100 % of the total plant/plot was infected	Very susceptible

D. Return on the cash expenses

1. Return on cash expenses. This was computed by the following:

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

RESULTS AND DISCUSSION

Percent Germination

Effect of variety. Table 1 shows the percent germination of the three pole snap bean varieties. The high germination percentage for the three varieties indicate high quality of seeds used in the study. The slight statistical differences observed among the treatments are not of actual marked influence.

Effect of soil amendments. It was observed that three soil amendments did not affect the percent germination of pole snap bean (Table 1). For seed germination it appears that Garden compost, Coconut coir dust and Carbonized rice hull had no enhancing or depressive effect on common bean seeds

Table 1. Percent germination, percent survival as affected by variety and soil amendments

TREATMENT	PERCENT	
	GERMINATION	SURVIVAL
Factor (a)		
Alno	91.89 [b]	90.55 [b]
Maroon (Beta)	92.89 [a]	92.11 [a]
Stonehill	92.67 [a]	91.22 [b]
Factor (b)		
Garden compost	92.44	91.11
Coco coir dust	92.56	91.44
Carbonized rice hull	92.44	91.33
a x b	ns	ns
CV (%)	0.43	0.74

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

Interaction effect. Result revealed no significant interaction effect of the variety and soil amendments on germination.

Percent Survival

Effect of variety. The three varieties tested exhibited fairly high percent survival, further proving that the seeds used were of high quality. Statistically, no significant differences were among the three varieties used.

Effect of soil amendments. Table 1 also shows the percent survival of the pole snap bean. Statistically analysis revealed no significant differences on the percent survival of plants applied with different soil amendments.

Interaction effect. The variety and soil amendment interaction did not influence the survival percentage in snap bean (Table 1).

Number of Days to Flowering

Effect of variety. Among the three varieties. Maroon (Beta) and Stone hill were the earliest to flower at 36 DAE. Alno variety was observed to have flowered one day later (Table 2).

In planting in a higher elevation and using six varieties pole snap bean, Neyney found that Alno flowered in 45 days which was 1 to 4 days ahead than the other varieties. Differenced on the days to flowering could be attributed to varietal characteristics of the plant .

Effect of soil amendments. Table 2 shows the number of days to flowering of pole snap bean as affected by the three soil amendments. Statistically analysis, revealed no significant influence of the different soil amendments used on the number of days to flowering of the snap bean plants.

The used of Coconut coir dust and Carbonized rice hull was found to enhance the flowering of bush snap bean by 1 day (Daguyam, 2006). However this finding corroborates the result of Buena (2004) testing Coco coir dust.

Interaction effect. Statistically, there was no interaction effect of variety and soil amendment on the number of days to flowering. This indicated that the three varieties have similar adaptability to the soil amendments tested.

Days of Maturity

Effect of variety. Table 2 shows the number of days to maturity of pole snap bean varieties. It was observed that the Maroon (Beta) and Stonehill were the earliest to mature at 42 DAP. Statistically, however, no significant difference was revealed.

Table 2. Days from planting to flowering, days from maturity and plant height as affected by variety and soil amendments

TREATMENT	DAYS TO:		PLANT HEIGHT (cm)
	FLOWERING	MATURITY	
Factor (a)			
Alno	37 b	43 b	318
Maroon (Beta)	36 a	42 a	349
Stonehill	36 a	42 a	319
Factor (b)			
Garden compost	36	42	331
Coco coir dust	36	42	328
Carbonized rice hull	36	42	328
a x b	ns	ns	ns
CV (%)	0 .53	0 .45	11 .33

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

The trends follows that number of days to maturity where pole snap bean varieties flowered earlier were also noted to have matured earlier.

Effect of soil amendments. The number of days to maturity as affected by the three soil amendments is shown in Table 2. It was observed that the three soil amendments did not influence the number of days to maturity.

Interaction effect. Results, revealed that there was no interaction effect of variety and soil amendment on the number of days to maturity.

Plant Height

Effect of variety. Statistical analysis, revealed no significant difference on the plant height of three pole snap bean varieties tested. This is similar to findings of Paredes (2003).

Effect of soil amendments. Table 2 also shows the plant height of the pole snap bean as affected by the different soil amendments. Statistical analysis, also showed no significant differences on the plant height of the plant although Garden compost seem to enhance the tallest plants.

In potato, Carbonized rice hull enhanced plant height, specially when applied with some amount of inorganic fertilizer. The height of potato was sufficiently affected by the presence or absence of organic fertilizer and the amount of the different organic fertilizer applied (Cezar, 2005).

Interaction effect. The interaction between the varieties and soil amendments did not produce significant results.

Number of Pods Per Plot

Effect of variety. Table 3 shows the number of pods per plot of pole snap bean varieties. Maroon (Beta) and Stonehill had higher number of pods per plot than Alno. Although, Alno had lesser number of pods, its pods were noted to be longer than those of Maroon (Beta) and Stonehill.

Effect of soil amendments. The three soil amendments tested did not influence the number of pods per plot although Garden compost exhibited high number of pods per plot (Table 3).

Interaction effect. It was observed that there were significant interaction effect of variety and soil amendments on the number of pods per plot. Maroon (Beta) seem to perform better under any of the three soil amendments except Stonehill grown with Garden compost. Alno did not respond well to the same treatments. Apparently, Maroon (Beta) could be better suited to low input condition than either Alno or Stonehill (Fig. 1).

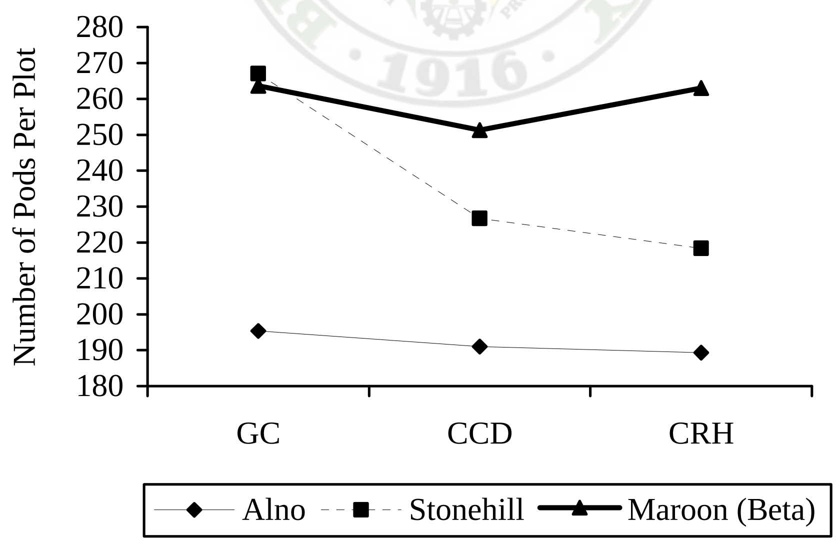

Fig. 1. Number of pods per plot as affected by varieties and soil amendments

Table 3. Numbers of pods, marketable and non-marketable pods per plot as affected by variety and soil amendments

TREATMENT	NUMBER OF:		
	PODS/PLOT	MARKETABLE	NON-MARKETABLE
Factor (a)			
Alno	192 [b]	802 [ab]	17 [b]
Maroon (Beta)	259 [a]	1,357 [a]	21 [a]
Stonehill	237 [a]	1,291 [a]	18 [b]
Factor (b)			
Garden compost	242	1,185 [ab]	19
Coco coir dust	223	1,037 [b]	19
Carbonized rice hull	224	1,227 [a]	17
a x b	*	*	**
CV (%)	10 .49	14 .66	12 .83

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

Number of Marketable Fresh Pods Per Plot

Effect of variety. Maroon and Stonehill exhibited high number of marketable pods per plot. The factors affecting the number of marketable pods per plot were temperature pest and disease incidence and others.

Effect of soil amendments. Table 3 also shows the number of marketable pods per plot of the three varieties of pole snap bean as affected by soil amendments. It was observed that the Carbonized rice hull as soil additive gave higher number of marketable pods per plot.

Interaction effect. Differences on number of marketable pods per plot of the three varieties in response to soil amendments were found to be statistically significant. Maroon (Beta) and Stonehill grown in soil with Carbonized rice hull as soil additive enhance the higher number of marketable pods per plot (Fig. 2).

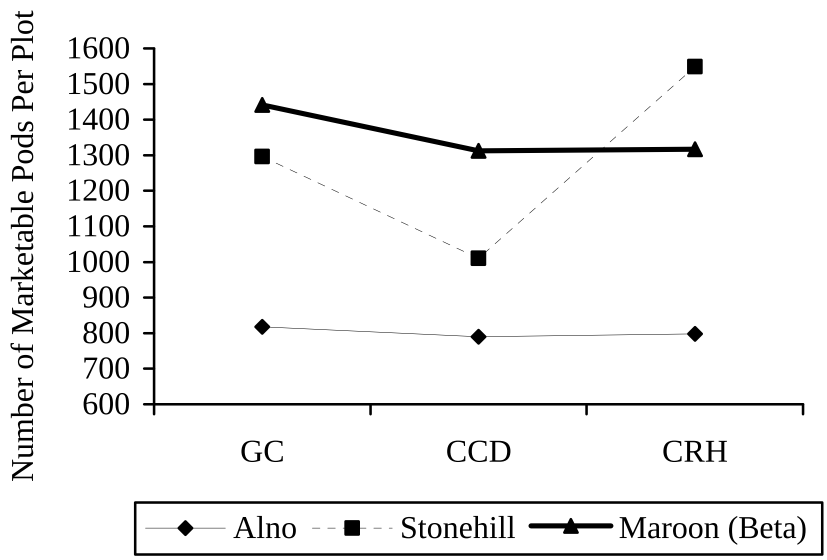

Fig. 2. Number of marketable pods per plot as affected by varieties and soil amendments

Number of Non-marketable Pods Per Plot

Effect of variety. It was observed that Maroon (Beta) had higher number of non-marketable pods per plot. For the number of non-marketable pods per plot shows that more of the pods are shorter and deformed.

Effect of soil amendments. The use of soil amendments did not influence the number of non-marketable pods per plot although plants subjected to Coco coir dust appear to have higher number of non-marketable pods.

Interaction effect. There was no interaction effect between the three varieties and the soil amendment on the number of non-marketable pods per plot.

Weight of Marketable Fresh
Pods Per Plot (kg)

Effect of variety. Table 4 shows the weight of marketable pods per plot. Marketable pods are not deformed and free from the pests and diseases. Results show that Maroon (Beta) and Stonehill exhibited heavier marketable pods per plot compared to Alno. This could be an indication that Maroon (Beta) or Stonehill have higher yield potential than Alno.

Effect of soil amendments. It was observed that Garden compost exhibited high weighted of marketable pods per plot.

Interaction effect. Interaction between variety and soil amendment did not enhance heavier marketable pods per plot.

Table 4. Weight of marketable and non-marketable pods per plot as affected by variety and soil amendments

TREATMENT	WEIGHT OF:	
	MARKETABLE (kg)	NON-MARKETABLE (kg)
Factor (a)		
Alno	6 .03	2 .69
Maroon (Beta)	8 .24	3 .80
Stonehill	7 .78	3 .52
Factor (b)		
Garden compost	7 .49	3 .43
Coco coir dust	7 .20	3 .26
Carbonized rice hull	7 .36	3 .32
a x b	**	ns
CV (%)	8 .60	20 .69

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

Weight of Non-Marketable
Pods Per Plot (kg)

Effect of variety. Table 4 also shows the weight of non-marketable pods per plot. The three varieties produced non-marketable pods which were almost half of the marketable pod yield. This results is not really desirable. Some conditions in the experimental area may have been not so favorable for snap bean production.

Effect of soil amendments. It was observed that the three soil amendments did not affect the weight of non-marketable pods per plot of the three pole snap bean.

Interaction effect. Statistical analysis revealed no significant interaction of the three varieties applied with the different soil amendments. Non-marketable pods were deformed, short and damage by the pest and diseases.

Total Fresh Pod Yield
Per Hectare (t/ha)

Effect of variety. Maroon (Beta) produced the heaviest fresh pods weight with a mean of 2,408.33 t/ha followed by Stonehill with a mean of 2,231.56 t/ha and the least weight was the Alno with a 1,764.89 t/ha. Such significant differences among the treatments could be attributed to their varietal characteristics.

Effect of soil amendments. The result indicates that using any of the three soil amendments did not influence the production of pods though it was observed that the soil with Garden compost gave the highest pod yield per hectare.

Interaction effect. Maroon (Beta) with Garden compost as soil amendment produced the heaviest fresh pod yield per hectare. Statistical analysis revealed significant interaction effect of variety and soil amendments (Fig. 3).

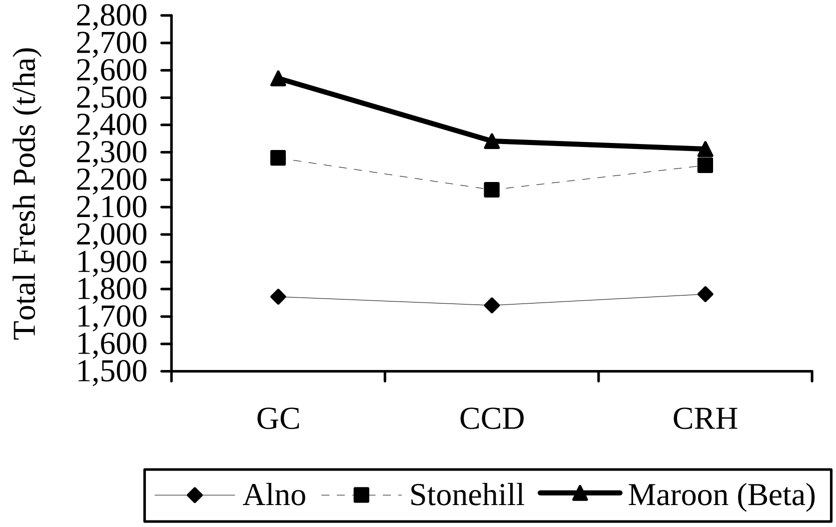

Fig. 3. Total fresh pod yield per hectare as affected by varieties and soil amendments

Total Yield Per Plot (g)

Effect of variety. It was observed that the Maroon (Beta) produce the higher yield per plot than the Stonehill and Alno. The statistical differences observed among the treatments are influence by the genetic potential of the variety to produce higher yield.

Effect of soil amendments. Statistical analysis, soil amendments did not appreciably affect the total common bean (Table 5).

Interaction effect. It was observed that the total yield per plot was not influenced by the different soil amendments.

Total Seed Yield
Per Hectare (t/ha)

Effect of variety. Statistical analysis revealed no significant influence of the varieties on the total seed yield per hectare although Maroon (Beta) exhibited numerically higher total seed yield.

Table 5. Total fresh pods yield per hectare as affected by variety and soil amendments

TREATMENT	TOTAL FRESH PODS/HECTARE (t/ha)	TOTAL YIELD PER PLOT (g)	TOTAL SEED YIELD/HECTARE (t/ha)
Factor (a)			
Alno	1,764.89[c]	8,824.4[c]	1,966.7
Maroon (Beta)	2,408.33[a]	11,984.4[a]	2,233.3
Stonehill	2,231.56[b]	11,300.2[b]	2,011.1
Factor (b)			
Garden compost	2,207.56	11,038.0	2,044.4
Coco coir dust	2,082.11	10,443.3	2,144.4
Carbonized rice hull	2,115.11	10,627.8	2,022.2
a x b	*	**	**
CV (%)	5.89	5.75	16.92

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

Effect of soil amendments. Table 5 also shows the total seed yield per plot as affected by soil amendments. Result shows no significant influence of soil amendments on the seed yield per hectare. In potato, the use of Carbonized rice hull and Coco coir dust did not influence soil chemical properties but they enhanced the productivity of the potato (Cezar, 2005).

Interaction effect. Statistically, there was no significant interaction between the variety and soil amendments.

Reaction to Pod Borer and Bean Rust

It was observed that all the varieties grown with different soil amendments were mildly resistant against bean rust (Table 6). For pod borer, mild resistance was showed by Alno while Maroon (Beta) and Stonehill were moderately resistant. This reaction may have been affected by the low temperature that occurred during the experiment.

Table 6. Pest (pod borer) and disease (bean rust) incidence as affected by variety and soil amendments

VARIETY	POD BORER*	BEAN RUST*
Alno	2	2
Maroon (Beta)	3	2
Stonehill	3	2

*Rating scale: 1 – Highly resistant; 2 – Mild resistant; 3 – Moderate resistant; 4 – Susceptible; 5 – Very susceptible

Return on Cash Expenses

Effect of variety. All the pole snap bean varieties evaluated for seed and fresh pod production were found to be profitable under Taloy Norte, Tuba, Benguet condition as evidenced by the computed return on cash expenses (ROCE). It was observed that Maroon (Beta) gave the highest ROCE of 101.04 % followed with the Stonehill that gave ROCE of 84.50 %. The least ROCE was obtained on Alno with 69.62 % (Table 7).

Effect of soil amendments. The ROCE of pole snap bean as affected by the soil amendment is shown in Table 8. It was observed that the plants applied with Coco coir dust registered the highest ROCE of 91.10 % while plant applied with Carbonized rice hull had an ROCE of 84.39 %. The plant applied with compost had the lowest ROCE with 80.03 %. Pole snap bean for fresh and seed production with any of the soil amendments applied had been proven to be profitable (Table 8).

Interaction effect. The highest ROCE was obtained from Maroon (Beta) planted on soil added with Coco coir dust while the lowest ROCE was obtained from Alno using Garden compost as soil amendments. It was observed that the soil amendments influence the three varieties (Table 9).

Table 7. Return on cash expenses of producing three pole snap bean varieties under Taloy Norte, Benguet condition

VARIETY	SEED YIELD (kg)	FRESH POD YIELD (kg)	GROSS SALE (PhP)	TOTAL EXPENSES (PhP)	NET INCOME	ROCE (%)
Alno	5.33	6.03	1,453.1	856.7	596.4	69.62
Maroon (Beta)	6.23	8.24	1,722.3	856.7	865.6	101.04
Stonehill	5.7	7.78	1,580.6	856.7	723.9	84.50

- Total expenses include land preparation, seed cost, cost of soil amendments, care and management includes weeding and watering
- Selling price: Seeds = PhP 250.00 /kg
  Fresh pod = PhP 20.00 /kg

Table 8. Return on cash expenses of producing pole snap bean varieties with soil amendments under Taloy Norte, Tuba, Benguet condition

SOIL AMENDMENTS	SEED YIELD (kg)	FRESH POD YIELD (kg)	GROSS SALE (PhP)	TOTAL EXPENSES (PhP)	NET INCOME	ROCE (%)
Garden compost	5.57	7.49	1,542.3	856.7	685.6	80.03
Coco coir dust	5.97	7.20	1,636.5	856.7	779.9	91.10
Carbonized rice hull	5.73	7.36	1,579.7	856.7	723	84.39

- Total expenses include land preparation, seed cost, cost of soil amendments, care and management includes weeding and watering
- Selling price: Seeds = PhP 250.00 /kg
  Fresh pod = PhP 20.00 /kg

Table 9. Return on cash expenses of producing pole snap bean varieties applied with different soil amendments under Taloy Norte, Tuba, Benguet condition

VARIETY	SEED YIELD (kg)	FRESH POD YIELD (kg)	GROSS SALE (PhP)	TOTAL EXPENSES (PhP)	NET INCOME	ROCE (%)
Soil amendments						
Alno						
Compost	5.1	6.06	1,396.2	856.7	593.5	62.97
CCD	5.2	6.04	1,420.8	856.7	564.1	65.85
CRH	5.7	5.98	1,544.6	856.7	687.9	80.30
Maroon (Beta)						
Compost	5.3	8.45	1,494.0	856.7	637.3	74.39
CCD	6.8	8.31	1,866.2	856.7	1,009.5	117.84
CRH	6.6	7.96	1,809.2	856.7	952.5	111.18
Stonehill						
Compost	6.3	7.96	1,734.2	856.7	877.5	102.43
CCD	5.9	7.25	1,620.0	856.7	763.3	89.10
CRH	4.9	8.15	1,388	856.7	531.3	62.02

- Total expenses include land preparation, seed cost, cost of soil amendments, care and management includes weeding and watering
- Selling price: Seeds = PhP 250.00 /kg
  Fresh pod = PhP 20.00 /kg

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Taloy Norte, Tuba, Benguet to determine the variety best suited in Taloy Norte, Tuba, Benguet condition; determine the effect of three organic-based soil amendments on the growth and yield of pole snap bean; identify the interaction of pole snap bean varieties applied with organic-based soil amendments; and determine the economic benefits of pole snap bean varieties applied with organic-based soil amendments.

Based on the result, it was find out that Maroon (Beta) and Stonehill exhibited fairly high percent germination percent survival, number of days to flowering, number of days to maturity and number of pods per plot. Maroon (Beta) enhance of higher percent survival, number of non-marketable pods per plot, total yield per plot and total fresh pod per hectare. For the plant height, weight of non-marketable pods per plot and total seed yield per hectare revealed no significant influence.

It was observe that the three soil amendments had no enhancing or depressive effect on common bean seeds in percent germination, percent survival, number of day to flowering, number of days to maturity, plant height, number of pods per plot, number of non-marketable pods, weight of non-marketable and marketable pods, total fresh pods per hectare, total yield per plot and total seed yield per hectare. For the number of marketable pods per plot, it appears that Carbonized rice hull as soil additive gave the higher number of marketable pods.

The variety and soil amendments interaction did not influence the percent germination, percent survival, number of days to flowering and maturity, plant height,

weight of non-marketable pods. It was observed that there were significant interaction effect of variety and soil amendments on the number of pods per plot. Maroon (Beta) seems to perform better under any of the three soil amendments except Stonehill grown with Garden compost. Maroon (Beta) and Stonehill grown in soil with Carbonized rice hull as soil additive enhance the higher number of marketable pods per plot. Maroon (Beta) with Garden compost as soil amendment produced the heaviest fresh pod yield per hectare.

Maroon (Beta) with Coco coir dust obtained the highest ROCE.

Conclusion

The best combination for the variety and soil amendments for growth and yield were Maroon (Beta) and Stonehill with any of the three soil amendments. Maroon (Beta) with Coco coir dust obtained the higher ROCE.

Recommendation

Based on the condition of the study, it is recommended that the best variety suited in Taloy Norte, Tuba, Benguet condition is Maroon (Beta). For the growth and yield, Maroon (Beta) and Stonehill with any of the three soil amendments are recommended.

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APPENDICES

APPENDIX TABLE 1. Percent germination (%)

TREATMENT	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
V_1S_1	92	92	92	276	92.00
S_2	92	91	92	275	91.67
S_3	92	92	92	276	92.00
V_2S_1	93	93	92	278	92.67
S_2	93	93	93	279	93.00
S_3	93	93	93	279	93.00
V_3S_1	92	93	93	279	92.67
S_2	93	93	93	279	93.00
S_3	92	93	92	277	92.33
TOTAL	832	833	832	2,497	

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS: GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL	TOTAL	MEAN
Alno	276	275	276	827	275.67
Maroon (Beta)	278	279	279	836	278.67
Stonehill	279	279	279	837	279.00
TOTAL	835	833	834	2,500	833.34
MEAN	277.67	277.67	278	833.33	277.78

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Block	2	0.07	0.04	0.23	3.63	6.23
Variety (v)	2	4.96	2.48	15.31	3.63	6.23
Soil amendments (s)	2	0.07	0.04	0.23	3.63	6.23
v x s	4	1.04	0.26	1.60^{ns}	3.01	4.77
Error	16	2.59	0.16			
Total	26	8.74	0.16			

^{ns} – Not significant CV (%) =0.43

APPENDIX TABLE 2. Percent survival (%)

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1S_1	90	90	92	272	90.67
S_2	90	90	91	271	90.33
S_3	90	90	92	272	90.67
V_2S_1	92	92	92	276	92.00
S_2	92	92	92	276	92.00
S_3	92	93	92	276	92.33
V_3S_1	91	90	91	276	90.67
S_2	92	92	92	276	92.00
S_3	90	92	91	273	91.00
TOTAL	819	821	825	2,465	

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS			TOTAL	MEAN
	GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL		
Alno	272	271	272	815	271.67
Maroon (Beta)	276	276	276	828	276.00
Stonehill	276	276	273	825	275.00
TOTAL	824	823	821	2,468	822.67
MEAN	274.67	274.33	273.67	822.67	274.22

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	2.07	1.04	2.29	3.63	6.23
Variety (v)	2	10.96	5.48	12.08	3.63	6.23
Soil amendments (s)	2	0.52	0.26	0.57	3.63	6.23
v x s	4	2.81	0.70	1.55^{ns}	3.01	4.77
Error	16	7.26	0.45			
Total	26	23.63				

^{ns} – Not significant CV (%) =0.74

APPENDIX TABLE 3. Number of days to flowering

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1S_1	37	37	37	111	37.00
S_2	37	37	37	111	37.00
S_3	36	37	37	110	36.67
V_2S_1	36	36	36	108	36.00
S_2	36	36	36	108	36.00
S_3	36	36	36	108	36.00
V_3S_1	36	36	36	108	36.00
S_2	36	36	36	108	36.00
S_3	36	36	36	108	36.00
TOTAL	326	294	294	914	

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS			TOTAL	MEAN
	GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL		
Alno	111	111	110	332	110.67
Maroon (Beta)	108	108	108	324	108.00
Stonehill	108	108	108	324	108.00
TOTAL	327	327	326	980	326.67
MEAN	109	109	108.67	326.67	108.89

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	0.07	0.04	1.00	3.63	6.23
Variety (v)	2	4.74	2.38	64.00	3.63	6.23
Soil amendments (s)	2	0.07	0.04	1.00	3.63	6.23
v x s	4	0.15	0.04	1.00^{ns}	3.01	4.77
Error	16	0.59	0.37			
Total	26	5.63				

^{ns} – Not significant CV (%) =0.45

APPENDIX TABLE 4. Number of days to maturity

TREATMENT	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
V_1S_1	43	43	43	129	43.00
S_2	43	43	43	129	43.00
S_3	42	43	43	128	42.67
V_2S_1	42	42	42	126	42.00
S_2	42	42	42	126	42.00
S_3	42	42	42	126	42.00
V_3S_1	42	42	42	126	42.00
S_2	42	42	42	126	42.00
S_3	42	42	42	126	42.00
TOTAL	380	381	381	1,142	

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS: GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL	TOTAL	MEAN
Alno	129	129	128	386	128.67
Maroon (Beta)	126	126	126	378	126.00
Stonehill	126	126	126	378	126.00
TOTAL	381	381	380	1,142	380.67
MEAN	127	384	126.67	381.67	126.89

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Block	2	0.07	0.04	1.00	3.63	6.23
Variety (v)	2	4.74	2.37	64.00	3.63	6.23
Soil amendments (s)	2	0.074	0.04	1.00	3.63	6.23
v x s	4	0.15	0.04	1.00^{ns}	3.01	4.77
Error	16	0.59	0.04			
Total	26	5.63				

^{ns} – Not significant CV (%) =0.53

APPENDIX TABLE 5. Final plant height (cm)

TREATMENT	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
V_1S_1	318.17	325.83	344.43	988.43	329.48
S_2	323.50	287.17	356.76	967.43	322.48
S_3	269.33	301.62	332.05	903.00	301.00
V_2S_1	397.67	346.33	281.79	1,025.79	341.93
S_2	312.88	370.50	388.73	1,072.11	357.37
S_3	365.00	287.80	392.21	1,045.01	348.34
V_3S_1	325.60	293.82	343.23	962.65	320.88
S_2	344.33	288.30	271.75	904.38	301.46
S_3	325.82	337.34	339.46	1,002.62	334.21
TOTAL	2,982.30	2,838.71	3,050.41	8,871.43	

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL	TOTAL	MEAN
Alno	988.43	967.43	903.00	2,858.86	952.95
Maroon (Beta)	1,025.79	1,072.11	1,045.01	3,142.91	1,047.64
Stonehill	962.65	904.38	1,002.62	2,869.65	956.55
TOTAL	2,976.87	2,943.92	2,950.63	8,871.42	2,957.14
MEAN	992.29	981.31	983.54	2,957.14	985.71

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Block	2	2,595.33	1,297.66	0.90	3.63	6.23
Variety (v)	2	5,758.22	2,879.11	2.08	3.63	6.23
Soil amendments (s)	2	67.38	33.69	0.02	3.63	6.23
v x s	4	3,241.95	810.48	0.59^{ns}	3.01	4.77
Error	16	22,160.90	1,385.06			
Total	26	33,823.78				

^{ns} – Not significant

CV (%) = 11.33

APPENDIX TABLE 6. Numbers of pods per plot

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1S_1	197	191	198	586	195.33
S_2	192	192	189	573	191.00
S_3	189	185	194	568	189.33
V_2S_1	269	258	264	791	263.67
S_2	258	247	249	754	251.33
S_3	259	242	288	789	263.00
V_3S_1	237	338	226	801	267.00
S_2	235	227	218	680	226.67
S_3	229	205	221	655	218.33
TOTAL	2,065	2,085	2,047	6,197	

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS			TOTAL	MEAN
	GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL		
Alno	586	573	568	1,727	575.67
Maroon (Beta)	791	754	789	2,334	778.00
Stonehill	801	680	655	656.18	218.73
TOTAL	2,178	2,007	2,012	6,197	1,572.40
MEAN	726	669	670.67	2,065.67	524.13

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	80.30	40.15	0.07	3.63	6.23
Variety (v)	2	21,293.85	10,646.92	18.37	3.63	6.23
Soil amendments (s)	2	2,104.52	1,052.26	1.82	3.63	6.23
v x s	4	2,306.37	576.59	1.00*	3.01	4.77
Error	16	9,271.70	579.48			
Total	26	35,056.74				

* – Significant CV (%) = 10.49

APPENDIX TABLE 7. Number of marketable pods per plot

TREATMENT	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
V_1S_1	710	900	844	2,484	818.00
S_2	744	912	714	2,370	790.00
S_3	906	810	680	2,396	798.67
V_2S_1	1,430	1,506	1,389	4,325	1,441.67
S_2	1,370	1,058	1,509	3,937	1,312.33
S_3	1,182	1,667	1,102	3,951	1,317.00
V_3S_1	1,281	1,287	1,322	3,890	1,296.67
S_2	9,948	1,026	1,056	3,030	1,010.00
S_3	1,821	1,443	1,382	4,464	1,548.67
TOTAL	10,392	10,609	9,998	30,999	

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS: GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL	TOTAL	MEAN
Alno	2,454	2,370	2,396	7,220	2,406.67
Maroon (Beta)	4,325	3,937	3,951	12,213	4,071
Stonehill	3,890	3,030	4,646	11,566	3,855.33
TOTAL	10,669	9,337	10,993	30,999	10,333.00
MEAN	3,556.33	3,112.33	3,664.33	10,333	3,44.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Block	2	24,572.07	12,286.04	0.43	3.63	6.23
Variety (v)	2	1,652,269.40	826,134.70	29.05	3.63	6.23
Soil amendments (s)	2	178,686.59	79,397.92	3.14	3.63	6.23
v x s	4	317,591.70	79,397.92	2.79	3.01	4.77
Error	16	455,091.26	288,443.20			
Total	26	2,628,210.96				

* – Significant

CV (%) = 14.66

APPENDIX TABLE 8. Number of non-marketable pods per plot

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1S_1	202	302	280	784	261.33
S_2	358	272	260	890	292.67
S_3	305	281	276	862	287.33
V_2S_1	545	610	600	1,755	585.00
S_2	292	608	340	1,240	413.33
S_3	340	338	282	960	320.00
V_3S_1	268	286	339	893	297.67
S_2	608	260	393	1,161	387.00
S_3	261	282	262	805	268.33
TOTAL	3,179	3,239	2,932	9,350	

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS			TOTAL	MEAN
	GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL		
Alno	784	890	862	2,536	845.33
Maroon (Beta)	1,755	1,240	960	3,955	1,318.33
Stonehill	893	1,161	805	2,859	953.00
TOTAL	3,432	3,291	2,627	9,350	3,116.66
MEAN	1,144	1,097	875.67	3,116.67	1,038.89

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	3.27	1.64	0.30	3.63	6.23
Variety (v)	2	77.66	38.83	7.00	3.63	6.23
Soil amendments (s)	2	23.16	11.58	2.09	3.63	6.23
v x s	4	53.82	13.45	2.42**	3.01	4.77
Error	16	88.81	5.55			
Total	26	246.72				

** – Highly significant

CV (%) = 12.83

APPENDIX TABLE 9. Weight of marketable pods per plot (g)

TREATMENT	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
V_1S_1	5,030	6,700	6,460	18,190	6,063.33
S_2	5,900	7,060	5,150	18,110	6,036.67
S_3	6,820	6,030	5,090	17,940	5,980.00
V_2S_1	8,290	8690	8,380	25,360	8,453.33
S_2	8,200	8,020	8,700	24,920	8,306.67
S_3	7,380	8,420	8,080	23,880	7,960.00
V_3S_1	7,450	8,280	8,160	23,890	7,963.33
S_2	6,390	7,350	8,020	21,760	7,253.33
S_3	8,360	8,230	7,860	24,450	8,150
TOTAL	63,820	68,780	65,900	98,500	

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS: GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL	TOTAL	MEAN
Alno	18,190	18,110	17,940	54,240	18,080.00
Maroon (Beta)	25,360	24,920	23,880	52,668	17,556.00
Stonehill	23,890	21,760	24,450	70,100	23,366.67
TOTAL	67,440	64,790	66,270	177,008	59,002.61
MEAN	22,480	2,156.67	22,090	59,002.7	19,667.56

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Block	2	1,378,607.40	689,303.7	1.70	3.63	6.23
Variety (v)	2	24,623,318.52	12,311,659.3	30.86	3.63	6.23
Soil amendments (s)	2	391,918.52	195,959.3	0.49	3.63	6.23
v x s	4	1,346,970.37	336742.6	0.84**	3.01	4.77
Error	16	6,382,392.59	398,899.5			
Total	26	34,123,207.40				

** – Highly significant

CV (%) = 8.59

APPENDIX TABLE 10. Weight of non-marketable pods per plot (g)

TREATMENT	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
V_1S_1	1,500	3,400	2,500	7,400	2,466.67
S_2	2,500	2,2500	3,300	8,000	2,666.67
S_3	1,900	3,700	3,200	8,800	2,933.33
V_2S_1	4,100	4,400	4,700	13,200	4,400.00
S_2	3,500	4,300	2,400	10,200	3,400.00
S_3	4,000	3,900	2,900	10,800	3,600.00
V_3S_1	3,400	3,000	3,900	10,300	3,433.33
S_2	4,400	3,200	3,500	11,000	3,666.67
S_3	3,300	3,700	3,300	10,300	3,433.33
TOTAL	28,500	31,800	29,700	90,000	

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS			TOTAL	MEAN
	GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL		
Alno	7,400	8,000	8,800	24,200	8,066.67
Maroon (Beta)	13,200	10,200	10,800	24,200	11,400.00
Stonehill	10,300	11,000	10,300	31,600	10,533.33
TOTAL	30,900	29,200	29,900	90,000	30,000.00
MEAN	10,300	9,733.33	9,966.67	30,000	10,000.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	579,409.40	293,703.7	0.62	3.63	6.23
Variety (v)	2	6,018,518.518	3,009,259.2	6.31	3.63	6.23
Soil amendments (s)	2	145,185.18	72,592.6	0.15	3.63	6.23
v x s	4	2,002,925.92	501,481.5	1.05^{ns}	3.01	4.77
Error	16	7,625,925.92	476,620.4			
Total	26	16,382,962.96				

^{ns} – Not significant

CV (%) = 20.69

APPENDIX TABLE 11. Total fresh pods yield per hectare (t/ha)

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1S_1	1,506	2,020	1,792	5,318	1,772.67
S_2	1,680	1,852	1,690	5,222	1,740.67
S_3	1,740	1,946	1,658	5,344	1,781.33
V_2S_1	2,478	2,618	2,616	7,712	2,570.67
S_2	2,340	2,464	2,220	7,024	2,341.33
S_3	2,276	2,464	2,196	6,936	2,312.00
V_3S_1	2,170	2,256	2,412	6,838	2,279.33
S_2	2,076	2,110	2,304	6,490	2,163.33
S_3	2,138	2,386	2,232	6,756	2,252.00
TOTAL					

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS			TOTAL	MEAN
	GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL		
Alno	5,318	5,222	5,344	15,884	5,294.67
Maroon (Beta)	7,712	7,024	6,936	21,672	7,224.00
Stonehill	6,838	6,490	6,756	20,084	6,694.67
TOTAL	19,868	18,736	19,036	57,640	19,213.34
MEAN	6,622.67	6,245.33	6,345.33	19,213.33	6,404.45

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	163,743.18	81,871.59	6.43	3.63	6.23
Variety (v)	2	1,989,146.74	994,573.37	78.08	3.63	6.23
Soil amendments (s)	2	76,113.85	38,056.93	2.99	3.63	6.23
v x s	4	68,668.59	17,167.15	1.35	3.01	4.77
Error	16	203,809.48	12,738.09			
Total	26					

* – Significant CV (%) = 5.29

APPENDIX TABLE 12. Total yield per plot (g)

TREATMENT	BLOCK			TOTAL	MEAN
	I	II	III		
V_1S_1	7,530	10,100	8,960	26,590	8,863.33
S_2	8,400	9,260	8,450	26,110	8,703.33
S_3	8,700	9,730	8,290	26,720	8,906.67
V_2S_1	12,390	13,090	13,080	38,560	12,853.33
S_2	11,700	12,320	11,100	35,120	11,706.67
S_3	11,380	12,320	10,980	34,680	11,560.00
V_3S_1	10,850	11,282	12,060	3,410	11,396.67
S_2	10,690	10,550	11,520	32,760	10,920.00
S_3	11,660	11,930	11,260	34,750	11,583.33
TOTAL	93,300	100,580	95,600	289,480	

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS			TOTAL	MEAN
	GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL		
Alno	26,590	26,110	26,720	79,420	26,473.33
Maroon (Beta)	38,360	35,120	34,680	108,360	36,120.00
Stonehill	34,190	32,760	34,750	101,700	33,900.00
TOTAL	99,340	93,990	96,150	289.480	96,493.00
MEAN	99,343	31,330	32,050	96,493.33	32,164.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Block	2	3,197,031.41	1,598,515.7	4.23	3.63	6.23
Variety (v)	2	49,749,706.96	24,874,853.5	65.75	3.63	6.23
Soil amendments (s)	2	1,667,791.41	833,895.7	2.20	3.63	6.23
v x s	4	2,648,107.26	662,026.8	1.75**	3.01	4.77
Error	16	6,052,837.93	378,302.4			
Total	26	63,315,474.96				

** – Highly significant

CV (%) = 5.75

APPENDIX TABLE 13. Total seed yield per hectare (t/ha)

TREATMENT	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
V_1S_1	2,500	1,600	1,800	5,900	1,966.67
S_2	1,900	1,400	2,500	5,800	1,933.33
S_3	2,000	1,700	2,300	6,000	2,000.00
V_2S_1	1,800	2,00	1,900	5,700	1,900.00
S_2	1,900	2,800	2,600	7,300	2,433.33
S_3	2,100	2,800	2,200	7,100	2,366.67
V_3S_1	2,000	2,300	3,500	6,800	2,266.67
S_2	1,900	2,100	2,200	6,200	2,066.67
S_3	1,700	1,500	2,900	5,100	1,700.00
TOTAL	17,800	18,200	19,900	55,900	

TWO-WAY TABLE

VARIETY	SOIL AMENDMENTS GARDEN COMPOST	COCO COIR DUST	CARBONIZED RICE HULL	TOTAL	MEAN
Alno	5,900	5,800	6,000	17,700	5,900.00
Maroon (Beta)	5,700	7,300	7,100	20,100	6,700.00
Stonehill	6,800	6,200	5,100	18,100	6,033.33
TOTAL	18,400	19,300	18,200	55,900	18,633.33
MEAN	6,133.33	6,433.33	6,066.67	18,633.33	6,211.11

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Block	2	276,296.30	1,381,448.15	1.13	3.63	6.23
Variety (v)	2	367,407.40	183,703.70	1.50	3.63	6.23
Soil amendments (s)	2	76,296.29	38,148.15	0.31	3.63	6.23
v x s	4	93,259.59	233,148.15	1.90**	3.01	4.77
Error	16	1,963,703.70	122,731.48			
Total	26	3,616,296.30				

* – Highly significant CV (%) = 16.92