BIBLIGRAPHY

MENES, ALIZER A. APRIL 2010. Response of Pole Snapbeans to Animal Manure Application at La Trinidad, Benguet. Benguet State University. La Trinidad, Benguet.

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ABSTRACT

This study was conducted to determine the best performing pole snapbean variety grown organically under La Trinidad condition; to determine the best animal manure to be applied in pole snapbean; to determine the interaction effect between varieties of pole snapbean and animal manures; and to determine the profitability of different pole snapbean varieties applied with different manure.

Significant differences were noted in the application of chicken manure from the horse and pig manure in terms of percent survival, total yield per plot and computed yield per hectare. Mild resistance to Bean rust was observed in crops applied with the different animal manure during 45 DAP and were very susceptible during 60 DAP. All plants were susceptible to pod borer at 60 DAP.

Among the varieties, “Taichung” had the highest percent survival, had the longest pods, highest marketable pods and highest ROCE. Blue Lake was the earliest to flower and had the highest percentage pod setting. However, it had the lowest ROCE. All varieties showed mild resistance to bean rust except Blue Lake which showed moderate resistance at 45 DAP but all were very susceptible during 60 DAP. All plants were

susceptible to pod borer at 60 DAP. Significant interaction effect were observed on pod length, width and number of seeds per pod. Interaction indicates that Chicken manure enhances pod length and number of seeds per pod of the pole snapbean varieties. Significant interaction also indicates that the three animal manure treatments enhance pod width of the four pole snapbean varieties.

The application of chicken manure realized the highest net income but highest ROCE was obtained from the application of pig manure. Among the varieties, “Taichung” is the most profitable since it had the highest ROCE of 203.50 %.

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INTRODUCTION

Legumes including pole snap beans are one of the most important food crops in the world. They are characterized by their high protein and low fat content. Therefore, the need to increase legume production and supply an adequate quantity in order to meet the nutritional requirements of the growing world population is widely appreciated. In developing countries, cultivation of legumes is the best and the quickest way to augment the production of food proteins (Chapman, 1976).

In Benguet, the use of agricultural pesticides is a common practice among pole bean farmers. In fact, pesticide residues are found in samples of vegetables, fruits, rice and other kinds of foods that are present in the market (PCARRD, 1989). The soil that is also utilized for farming many times was found to be heavy with toxic chemicals which can adversely affect production. Due to the effects of pesticide application, some farmers switch to organic farming (VLIR-PIUC and SLU, 2000).

Organic production is a system that not only avoids the use of synthetic farm chemicals but also uses organic manure as fertilizer (PCARRD, 2000). Manures contribute to the fertility of the soil by adding organic matter and nutrients such as nitrogen (Chastain, 2008). Organic matter that is present in animal manures can reduce the toxicity of the soil that has been built up due to the continuous use of insecticides and fungicides. Aside from that, it has a special function in making phosphorus more readily available in acidic soils upon decomposition (FAO, 1978). Thus, evaluation of pole snap bean varieties using animal manure should be done to give correct recommendations with regard to the right varieties and fertilizer in which they can be grown and can most profitably be used (FAO, 1978).

This study had the following objectives:

1 determine the best performing variety of pole snapbean grown organically under La Trinidad condition;

2. determine the best animal manure to be applied in pole snapbean;

3. determine the interaction between varieties of pole snapbean and the organic fertilizers; and

4. determine the profitability of pole snapbean varieties applied with different manure.

The study was conducted at Benguet State University Experimental Area, Balili, La Trinidad, Benguet from October 2008- January 2009.

REVIEW OF LITERATURE

The Plant

Snapbeans grow best in the areas with temperature between 15 to 21 degrees centigrade. Maturity is earlier in warmer areas that take 45 to 55 days after planting than in cooler areas that take 56 to 60 days. Harvesting is dependent on the variety used, location and temperature. It is usually done by hand or selective harvesting at 3 to 4 days interval (HARRDEC, 2000).

Kudan (1991), reported that the expected yield of pole snapbean under highlands condition ranges from 17-23 tons/ha. First harvest is expected from 60 days after planting. In warmer areas, pods mature earlier than in cooler temperature.

Organic Production

Organic production is the conservation and maintenance of environment quality. Foods are safe to consume and contains significantly lower levels of pesticide residues than conventionally produced. Organic production relies heavily upon crop and soil management practices that aid water infiltration, resist soil erosion, improve soil tilt and productivity, recycle organic waste and reduce pollution of the soil and water (USDA, 2000).

According to Hopkins et al. (2001), the advantage of organic farming is the higher prices for organically produced because it reflects the true cost of growing the food. Prices for organic foods include cost of growing, harvesting, transportation and storage.

Organic production is a system that sustains the health of soils, ecosystem and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic production combines tradition, innovation and science to benefit the environment and promote fair relationships and a good quality of life (IFOAM, 2008).

Varietal Evaluation under Organic Production

Varietal evaluation is a process in plant breeding, which provides comparison of promising lines developed by breeders. It is through varietal evaluation that a breeder selects the best performing variety in terms of yield, quality, adaptability, stress tolerance and resistance to pest and disease (Sunil, 1990).

Bacod (2007), reported that potato accessions namely, 13.1.1, 38 0251.17, 573275, 5.19.2.2, 676089 and Ganza can be produced through organic production with or without probiotics application.

In 2007, Wesley characterized bush snapbean varieties under organic production. The result revealed that varieties Green Crop and Torrent produced the tallest plants. However, Lipstican and HAB 19 produced the highest yield among the varieties.

Bautista and Mabesa (1977), suggested that varieties should be high yielding, resistant to pest and diseases, early maturing and these should have traits that could make the growing of the crop productive and less expensive.

Varietal Evaluation in La Trinidad, Benguet

Pog-ok (2001), recommended the pole snapbean varieties Pencil Pod and B-21 because of their better growth and yield performance among other varieties under La Trinidad, Benguet condition. However, Neyney (2005), stated in his study that Violeta and Taichung has a yielding potential with regards to number of flower cluster per plant, flower per cluster, number of pod per plant and weight of marketable and total pods yield.

Furthermore, Dagson (2000), reported that varieties of bush snapbean namely, HAB. 63, Stringless Valentine, Torrent and BBL 274 could be grown at La Trinidad, Benguet due to its better growth and yield performance.

Use of Manure

Briones (1981), revealed that applying animal manure improves the structure of the soil. This may be due to the presence of nutrient elements in the organic matter. He mentioned that C:N ratio may indicate the availability of N in organic matter since the lower C:N ratio is better due to the availability of nitrogen.

In addition, Rasnake (2001), stressed that animal manures are the digestive by-products of the feed ingested by the animals and any associated bedding materials or water used in the animal production. Therefore, the nutrient content of manure is closely related to the chemical content of feeds consumed by the animals. During digestion, the animals retain some of the energy, nutrients, vitamins and minerals in food. However, most of the nutrients pass through the animal in urine or feces.

Several homemade manures such as compost, stable manure, fermented night soil, livestock urine, chicken dropping, and green manure containing mainly nitrogen tend to improve the physical and chemical properties of the soil. Farm manure tends to increase crop yield and organic residues and enhances soil granulation that binds or lightens and expands soil aggregates making the soil porous (Kinoshita, 1972).

Brady (1990), also pointed out that farm manure is valuable to crops because of its nitrogen content and influence in the soil. Farm manure increases crop yield and the value of farm manure is determined not only by the organic matter it furnishes but especially by the quality of nitrogen that it supplies.

Moreover, manure stimulates the work of soil microbes that unlock plant food held in the soil borne mineral compounds. It adds nutrients and humus to the soil, aids composting operations and provides heat for cold frames in the green state as it decomposes. In addition, it also improves the physical conditions of heavy soils (Bohn *et al,* 2001).

MATERIALS AND METHODS

An area of 180 m^2 was thoroughly prepared and divided into three blocks consisting of 12 plots per block measuring 1m x 5m each. Two seeds were sown in a double row with a distance of 25 cm between hills and 30 cm between rows.

Cultural Management

Mushroom compost was incorporated to the soil during plot preparation. Corn plants were planted around the area as barriers against pest and diseases. Zero chemical spraying was strictly implemented. All the recommended cultural management practices like irrigation, leaf thinning and weeding were done to maintain the growth of the crop. Trellis support was administered as soon as the vines reach 20 cm after hilling-up. The organic fertilizers was basally applied before sowing following the recommended rate for snapbean, which is 50-120-50 kg N-$P_2$0-$K_2$0/ ha.

Treatment and Lay-out

The experimental lay-out was split-plot design. The organic fertilizers were assigned as the main plots and the varieties served as sub-plots.

The treatments were as follows:

Main plot (Organic fertilizer)		Rate of Application
F_1	Chicken manure	3 kg/ plot (4-1.98-2.32)
F_2	Horse manure	6 kg/ plot (1.54-1.05-0.65)
F_3	Pig manure	5 kg/ plot (2.81-1.16-0.52)
Sub-plot (Variety)		**Place of Collection**
V_1	Alno	BSU- IPB HCRS

V_2	Blue Lake	La Trinidad, Benguet
V_3	Maroon	Tublay, Benguet
V_4	Taichung	BSU- IPB HCRS

The data gathered were:

1. Soil property. One kg of soil sample from the site of experiment was collected randomly before land preparation and after harvest for the determination of the initial and final soil properties like pH, NPK and organic matter.

2. Percent Survival. This was obtained by using the formula:

$$\% \text{ Survival} = \frac{\text{Total number of plant per plot at maturity}}{\text{Total number of seed sown per plot}} \times 100$$

3. Maturity

a. Days from sowing to emergence. This was obtained by counting the number of days from sowing to emergence.

b. Days from emergence to flowering. This was obtained by counting the days from emergence to the time when 75% of the plants per entry started to produce flowers.

c. Number of days to pod setting. This was recorded by counting the days from flowering up to when 75% of the flowers break up and pod length is measured 2 cm.

d. Days from sowing to first harvest. This was obtained by counting the days from sowing to first harvest.

e. Days from sowing to last harvest. This was done by counting the days from sowing to last harvest.

4. Flower and Pod Characteristics

a. Number of flowers per cluster. This was obtained by counting the number of flowers per cluster of ten plant samples per entry.

b. Number of pods per cluster. This was obtained by counting the number of pods developed per cluster.

c. Percentage pod set per cluster. This was determined by using the formula:

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

d. Length of pods (cm). Ten sample pods per entry were selected and measured from pedicel end to distal end.

e. Width of pods (cm). Ten sample pods per entry were selected and measured at the broadest part.

f. Number of seeds per pod. This was obtained by counting the number of seeds of pods of ten sample plants per treatment.

5. Yield and Yield Components

a. Weight of marketable fresh pod (kg). Pods that were free from pest and disease and were straight were weighed from first to last harvest.

b. Weight of non- marketable pods (kg). Pods that were malformed and damaged by pest and disease were weighed from first to last harvest.

c. Total yield per plot (kg). This was the total weight of marketable and non marketable pods per plot.

d. Computed yield per hectare (t/ha). The data was computed by using the following formula:

$$\text{Yield (t/ha)} = \text{Total yield/ plot} \times 2$$

e. Number of harvesting per treatment. This was recorded by counting the number of harvest per entry.

6. Reaction to bean rust and pod borer

a. Reaction to bean rust. This was obtained by using the following rating scale at 15, 30, 45 and 60 DAP (Cho, 1987):

Scale	Description	Remarks
1	No infection	High resistance
2	1-25% of the total plant	Mild resistance
3	26-50 of the total plant	Moderate resistance
4	51-75 of the total plant	Susceptible
5	76-100 of the total plant/ plot is infected	Very susceptible

b. Reaction to pod borer. This was obtained during the first harvest using the following scale (Cho, 1987):

Scale	Description	Remarks
1	No infection	High resistance
2	1-25% of the total plant	Mild resistance
3	26-50% of the total plant	Moderate resistance
4	51- 75% of the total plant	Susceptible
5	76-100% of the total plant/ plot is affected	Very Susceptible

7. Return on Cash Expense (ROCE). Production cost, gross and net income were determined and computed using the formula:

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

Analysis of Data

All the quantitative data gathered were statistically analyzed. The significance of difference among means was tested using the Duncan's Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Agroclimatic Data

Table 1 shows the temperature, relative humidity, amount of rainfall and sunshine duration during the conduct of the study. Minimum temperature ranges from 13.4 ˚C to 16.2 ˚C and maximum temperature ranges from 24.4 ˚C to 25.2 ˚C. Relative humidity was at mean of 80.7 %. Rainfall amount was at mean of 1.07 mm and the sunshine duration was at a mean of 341.1 Kj.

The temperature during the conduct of the study was favorable to snapbean production which ranges between 15 to 21 ˚C. However, snapbean can tolerate warm temperature up to 25 ˚C (PCARRD, 1989). As stated by Kudan, (1999) snapbean is a short day plant and planting from October to November shows higher percentage pod set of 62.5 %.

Table 1. Temperature, relative humidity, amount of rainfall and sunshine duration during the conduct of the study

MONTHS	TEMPERATURE (˚C)		RELATIVE HUMIDITY (%)	RAINFALL AMOUNT (mm)	SUNSHINE DURATION (Kj)
	MAX	MIN			
November	25.2	16.2	75.2	3.10	304.6
December	24.4	13.6	82.0	0.10	369.8
January	24.6	13.4	85.0	0.03	349.0
Mean	24.7	14.4	80.7	1.07	341.1

Soil Property

As shown in Table 2, the soil pH before and after the experiment was 5.5 which favors the growth of pole snapbean. The percent soil organic matter before and after planting was 2.5 % except for the soil applied with pig manure (1.5 %). On nitrogen content, no change in the amount was observed before and after the application of chicken and horse manure except for soil applied with pig manure. This may imply that the nitrogen in the soil is enough for the nutrient need of the snapbean plant since it can also fix its own nitrogen.

The Phosphorus content of the soil after the experiment increased from 116 to as high as 260. On potassium content, there was an increase from soil applied with chicken manure (190). Soil applied with horse and pig manure had decreased to potassium content (88 and 60, respectively). The decrease in the amount of Potassium to soil applied with horse and chicken manure after the experiment could be due to the high Potassium requirement of the plant which is needed for photosynthesis and respiration.

Table 2. Soil pH, organic matter, nitrogen, phosphorus and potassium before planting and after harvesting

	pH	ORGANIC MATTER (%)	NITROGEN (%)	PHOSPHORUS (%)	POTASSIUM (ppm)
Before planting	5.5	2.5	0.125	116	112
After harvesting					
Chicken manure	5.5	2.5	0.125	260	190
Horse manure	5.5	2.5	0.125	155	88
Pig manure	5.5	1.5	0.075	230	60

Plant Survival

Effect of animal manure. Among the three animal manures used, the application of chicken manure gave the highest plant survival of 91 % followed by plants applied with horse and pig manure (89% and 88%, respectively). No significant differences were noted as shown in Table 3.

Effect of variety. Table 2 shows significant differences on plant survival. "Taichung" obtained the highest percentage of plant survival of 94% which is comparable with Alno and Maroon having plant survival of 93% and 92%, respectively. The lowest percent plant survival was observed in Blue Lake (79%) as shown in Figure 1 and 2.

Interaction effect. There were no significant interaction effect between the application of different animal manure and the different varieties of pole snapbean on plant survival.

Number of Days from Sowing to Emergence

Effect of animal manure. Table 4 shows that the application of animal manure had no significant effect on the number of days from sowing to emergence. All the pole snapbean plants emerged eight days from sowing.

Effect of variety. Significant differences were noted among the varieties. Most of the varieties emerged after eight days while Blue Lake emerged nine days after planting. The early emergence of the varieties maybe attributed to varietal characteristics.

Interaction effect. No significant interaction effect between the animal manures and varieties on number of days from sowing to emergence was observed.

Figure 1. Overview of pole snapbean plants at 25 days after planting.

Figure 2. Overview of pole snapbean plants at 60 days after planting.

Table 3. Plant survival of pole snapbean varieties as affected by the application of different animal manure

TREATMENT	PLANT SURVIVAL (%)
Fertilizer (F)	
Chicken manure	91
Horse manure	89
Pig manure	88
Variety (V)	
Alno	93[a]
Blue Lake	79[b]
Maroon	92[a]
"Taichung"	94[a]
F x V	Ns
CV (a) %	7.66
CV (b) %	7.80

Means followed by common letters are not significantly different at 5% level of DMRT.

Number of Days from Emergence to Flowering

Effect of animal manure. Plants fertilized with pig manure flowered at 47 days after emergence (DAE) followed by the plants applied with chicken and horse manure at 48 DAE. There were no significant differences among the treatments observed.

Effect of variety. Blue Lake was significantly the earliest to flower at 43 DAE followed by Maroon at 47 DAE, Alno at 49 DAE and "Taichung" at 51 DAE. The significant differences observed from Blue Lake may be attributed to the flowering characteristic of the variety.

Interaction effect. No significant interaction was revealed in the application of animal manures and pole snapbean varieties on the number of days from emergence to flowering.

Number of Days from Flowering to Pod Setting

Effect of animal manure. Plants treated with different manure set pod at five days from flowering as shown in Table 5. There were no significant differences among the different animal manure used on days from flowering to pod setting.

Table 4. Number of days from sowing to emergence and emergence to flowering of the pole snapbean varieties as affected by the application of different animal manure

TREATMENT	NUMBER OF DAYS FROM	
	SOWING TO EMERGENCE	EMERGENCE TO FLOWERING
Fertilizer (F)		
Chicken manure	8	48
Horse manure	8	48
Pig manure	8	47
Variety (V)		
Alno	8[a]	49[bc]
Blue Lake	9[b]	43[a]
Maroon	8[a]	47[b]
"Taichung"	8[a]	51[c]
F x V	ns	ns
CV (a) %	4.01	5.41
CV (b) %	5.68	4.24

Means followed by common letters are not significantly different at 5% level of DMRT

Effect of variety. No significant differences were observed on the number of days from flowering to pod setting as affected by the varieties of pole snapbean. All the varieties set pod at five days from flowering.

Interaction effect. No significant interaction was revealed in the application of animal manures and pole snapbean varieties on the number of days from flowering to pod setting.

Number of Days from Sowing to First Harvest

Effect of animal manure. The crops were first harvested at 68 DAE regardless of the manure applied. No significant differences among the three animal manure used were revealed.

Effect of variety. Alno, Blue Lake and Maroon were first harvested at 67 DAE while "Taichung" was first harvested at 70 DAE. Significant differences obtained were due to the varietal characteristics of the pole snapbeans.

Interaction effect. No significant interaction between the application of different animal manure and pole snapbean varieties was observed on the days from emergence to first harvest.

Number of Days from Sowing to Last Harvest

Effect of animal manure. No significant differences among the three animal manure used was observed on the days from sowing to last harvest. Last harvesting was done at 94 DAE in all the crops.

<u>Effect of variety.</u> Alno and "Taichung" were the last harvested at 96 DAE while Blue Lake and Maroon were last harvested at 92 DAE. This indicates that Alno and "Taichung" had longer life span than Blue Lake and Maroon.

<u>Interaction effect.</u> No significant interaction between the different manures and varieties were noted on the days from sowing to last harvest.

Table 5. Number of days from emergence to pod setting, sowing to first and last harvest of pole snapbean varieties as affected by the application of different animal manure

TREATMENT	NUMBER OF DAYS FROM		
	FLOWERING TO POD SETTING	SOWING TO FIRST HARVEST	SOWING TO LAST HARVEST
Fertilizer (F)			
Chicken manure	5	68	94
Horse manure	5	68	94
Pig manure	5	68	94
Variety (V)			
Alno	5	67[a]	96[b]
Blue Lake	5	67[a]	92[a]
Maroon	5	67[a]	92[a]
"Taichung"	5	70[b]	96[b]
F x V	ns	ns	Ns
CV (a) %	13.80	0.49	0.18
CV (b) %	11.12	0.94	0.18

Means followed by common letters are not significantly different at 5% level of DMRT

Number of Flowers per Cluster

Effect of animal manure. Results revealed no significant differences on the number of flowers per cluster as shown in Table 6. Six to seven flowers were produced by the plants.

Effect of Variety. Seven flowers per cluster were gathered from Maroon and "Taichung" which is significantly higher than Blue Lake and Alno which produced five and six flowers per cluster, respectively.

Interaction effect. The animal manure treatments and the four pole snapbean varieties did not interact in the number of flower per cluster.

Number of Pods per Cluster

Effect of animal manure. The different animal manure applied did not significantly affect the number of pods per cluster. Three pods per cluster were obtained from the plants as shown in Table 6.

Effect of variety. There were no significant variations observed among the four varieties of pole snapbeans on the number of pods per cluster. Three pods per cluster were obtained from the different varieties.

Interaction effect. No significant interaction was noted between the application of different animal manures and the pole snapbean varieties on the number of pods per cluster.

Percentage Pod Set per Cluster

Effect of the animal manure. Among the animal manure used, pig and horse manure application gave the highest percentage pod set of 47.7% and 45.77 %, respectively while the lowest pod set (41.63 %) was obtained in plants applied with chicken manure as shown in Table 6. Low pod set percentage may be attributed to bean rust infection which may have affected flower and pod development.

Effect of variety. Blue Lake significantly obtained the highest percentage pod set of 48.73% which was comparable with “Taichung” and Alno (46.31% and 44.98%, respectively). Maroon had the lowest pod setting of 40.12%. The low percentage of pod setting is due to the susceptibility of the varieties to bean rust.

Table 6. Number of flowers and pods per cluster and percent pod set of pole snapbean varieties as affected by the application of different animal manure

TREATMENT	NUMBER PER CLUSTER		POD SET
	FLOWERS	PODS	(%)
Fertilizer (F)			
Chicken manure	7	3	41.63[b]
Horse manure	6	3	45.77[a]
Pig manure	6	3	47.70[a]
Variety (V)			
Alno	6[ab]	3	44.98[a]
Blue Lake	5[b]	3	48.73[a]
Maroon	7[a]	3	40.12[b]
“Taichung”	7[a]	3	46.31[a]
F x V	ns	ns	Ns
CV(a)%	10.43	13.60	12.61
CV(b)%	13.47	11.15	11.89

Means followed by common letters are not significantly different at 5% level of DMRT

Interaction effect. There was no significant interaction effect between the application of animal manures and the different pole snapbean varieties on the percentage pod set per cluster.

Pod Length

Effect of animal manure. No significant differences were noted on the pod length of the pole snapbean plants treated with the different animal manure. Pod length ranges from 13.35 to 13.88 cm as shown in Table 7.

Effect of variety. The significantly longest pod was gathered from "Taichung" with a mean of 14.68 cm followed by Alno, Blue Lake and Maroon with means of 13.49 cm, 13.12 cm and 12.96 cm, respectively.

Interaction effect. Results revealed significant interaction effect between the animal manure treatments and the four pole snapbean varieties on pod length. As shown in Figure 3, the pods length are longer in varieties treated with chicken manure compared to plants applied with horse and pig manure. This indicates that chicken manure enhances pod length of the pole snapbean varieties. Chicken manure had higher micronutrient contents like Calcium, Magnesium, Iron, Manganese and Zinc that support pod development. Moreover, variety "Taichung" obtained the longest pods among the varieties regardless of the animal manure applied. This implies that pod length is not only enhanced by treatments but is also a varietal characteristic.

Pod Width

Effect of animal manure. Table 6 showed no significant differences on the pod width of plants applied with the different animal manure. All plants obtained 1.01 cm pod width.

Effect of variety. Statistical results showed no significant differences on the pod width. Numerically, "Taichung" produced the widest pod (1.03 cm) followed by Alno and Maroon (1.01 cm). Blue Lake produced the narrowest pod of 0.99 cm.

Interaction effect. As shown in Figure 4, significant interaction effect was noted on the animal manure treatments and the four pole snapbean varieties. Alno and Maroon applied with chicken manure, Blue Lake applied with horse manure, and "Taichung" applied with pig manure produced the widest pods. This implies that the animal manure treatments enhanced the pod width of the pole snapbean varieties.

Number of Seeds per Pod

Effect of animal manure. Among the treatments, application of chicken manure significantly gave the highest number of seeds per pod (8) as shown in Table 7. Plants applied with horse and pig manure gave seven seeds per pod.

Effect of variety. Significant varietal differences on the number of seeds were obtained in "Taichung" with eight seeds per pod while seven seeds per pod were gathered from Alno, Blue Lake and Maroon. The significant difference could be attributed to varietal characteristics (Table 7).

Interaction Effect. There was a significant interaction effect between the different animal manure treatment and the pole snapbean varieties as shown in Figure 5. Plants applied with chicken manure produced more seeds per pod. However, "Taichung" applied with horse and pig manure managed to produce higher number of pods. This implies that number of seeds per pod could not only be enhanced by the application of manure but also by the agronomic characteristics of the varieties.

Table 7. Pod length and width and number of seeds per pod of pole snapbean varieties as affected by the application of different animal manure

TREATMENT	POD LENGTH (cm)	POD WIDTH (cm)	SEED NUMBER PER POD
Fertilizer (F)			
Chicken manure	13.88	1.01	8[a]
Horse manure	13.45	1.01	7[b]
Pig manure	13.35	1.01	7[b]
Variety (V)			
Alno	13.49[b]	1.01	7[b]
Blue Lake	12.96[c]	0.99	7[b]
Maroon	13.12[bc]	1.01	7[b]
"Taichung"	14.68[a]	1.03	8[a]
F x V	**	**	**
CV (a) %	2.86	4.43	2.79
CV (b) %	1.83	4.58	3.21

Means followed by common letters are not significantly different at 5% level of DMRT

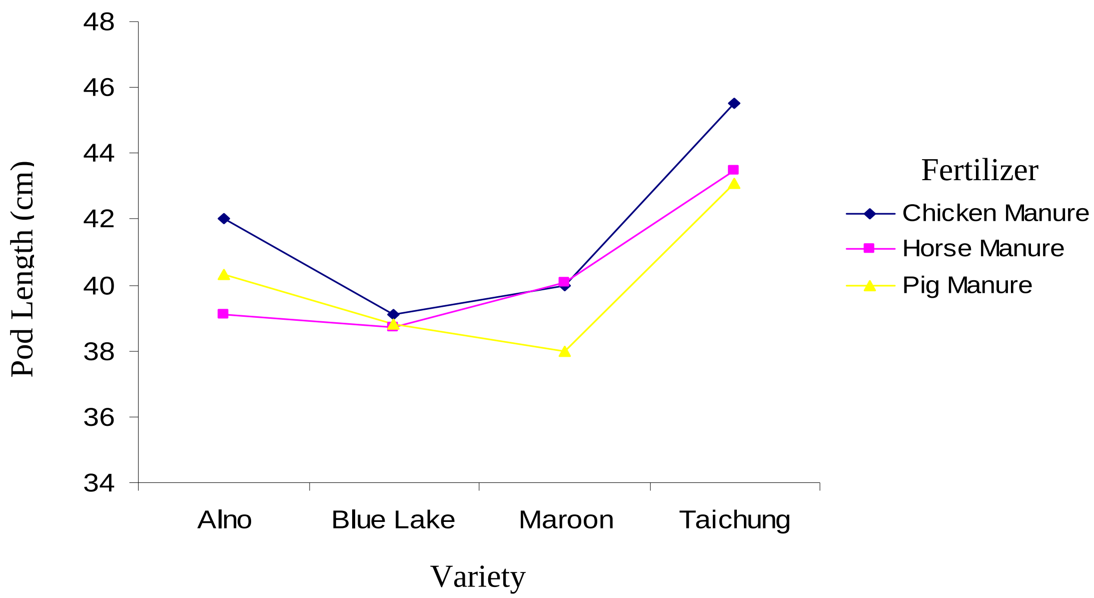

Figure 3. Interaction effect between animal manure treatments and pole snapbean varieties on pod length

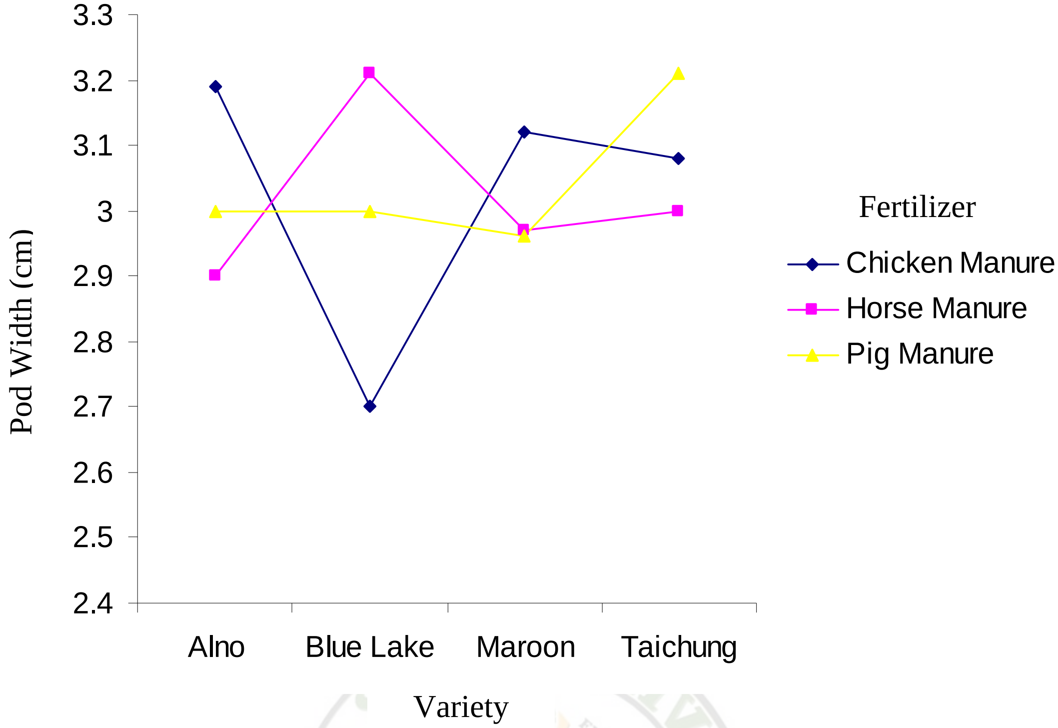

Figure 4. Interaction effect between animal manure treatments and pole snapbean varieties on pod width

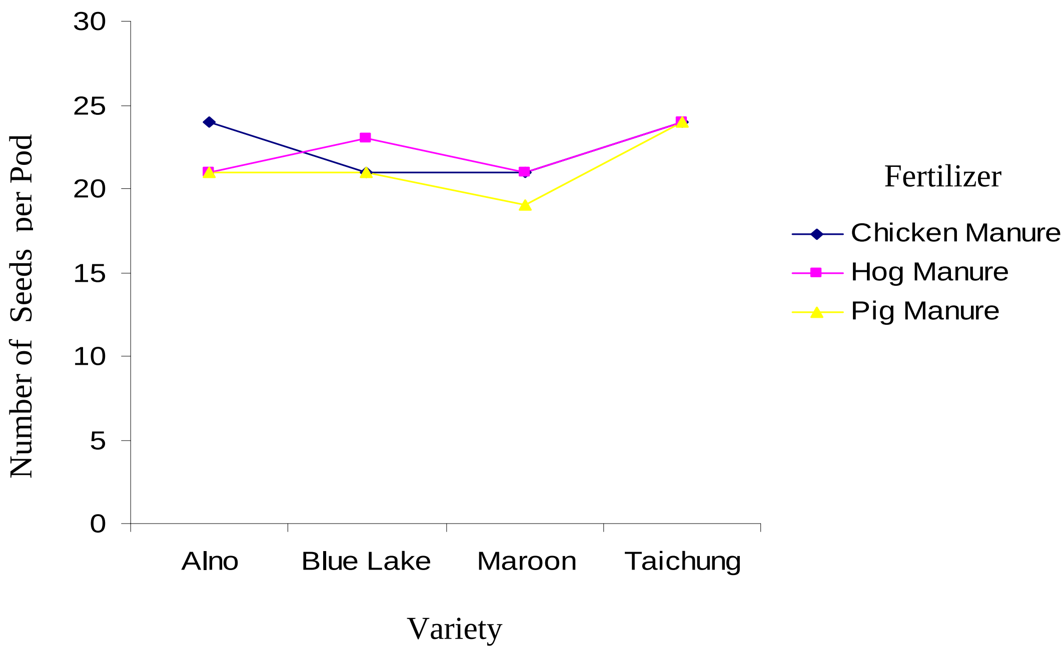

Figure 5. Interaction effect between animal manure treatments and pole snapbean varieties on number of seeds per pod

Reaction to Bean Rust

Effect of animal manure. All the plants treated with animal manure were not infected by bean rust until 30 DAP but showed mild resistance during 45 DAP and were very susceptible at 60 DAP.

Effect of variety. All the varieties showed no infection until 30 DAP but at 45 days after planting, Blue Lake showed moderate resistance while the other varieties showed mild resistance. However, all the varieties were very susceptible during 60 DAP.

Reaction to Pod Borer

Effect of animal manure. All plants applied with animal manure were found to be susceptible to pod borer at 60 DAP as shown in Table 8.

Effect of variety. Among the varieties, Blue Lake was moderately resistant to pod borer as shown by the small number of plants that survived and produced less pods. Meanwhile, Alno, Maroon and “Taichung” were susceptible to pod borer (Table 8).

Number of Harvesting

Effect of animal manure. The crops were harvested five times (Table 9). No significant differences were observed among the three animal manures used on the number of harvesting.

Effect of variety. Alno had significantly greater number of harvesting (6) than Blue Lake, Maroon and “Taichung” which were harvested five times. The significant difference obtained from Alno is attributed to higher number of pods produced.

Table 8. Reaction to bean rust and pod borer at 45 and 60 DAP of pole snapbean varieties as affected by the application of animal manure

TREATMENT	BEAN RUST RATING		POD BORER RATING
	45 DAP	60 DAP	60 DAP
Fertilizer (F)			
Chicken manure	Mild resistant	Very susceptible	Susceptible
Horse manure	Mild resistant	Very susceptible	Susceptible
Pig manure	Mild resistant	Very susceptible	Susceptible
Variety (V)			
Alno	Mild resistant	Very susceptible	Susceptible
Blue Lake	Moderately resistant	Very susceptible	Moderately resistant
Maroon	Mild resistant	Very susceptible	Susceptible
"Taichung"	Mild resistant	Very susceptible	Susceptible

Interaction effect. No significant interaction effect was observed between the application of the animal manure and the four varieties of pole snapbean on number of harvesting.

Weight of Marketable Fresh Pod

Effect of animal manure. Plants applied with chicken manure produced 2.83 kg of marketable fresh pod followed by plants applied with horse and pig manure (2.59 kg and 2.58 kg, respectively). There was no significant difference revealed on the effect of manure application as shown in Table 10 (Figures 6, 7 and 8).

Marketable

Alno Blue Lake Maroon

Non-marketable

Alno Blue Lake

Maroon “Taichung”

Figure 6. Marketable and non- marketable pods obtained from plants applied with chicken manure

Marketable

Alno Blue Lake

Maroon "Taichung"

Non-marketable

Blue Lake Maroon "Taichung"

Figure 7. Marketable and non-marketable pods obtained from plants applied with horse manure

Marketable

Alno Blue Lake

Maroon "Taichung"

Non-marketable

Alno Blue Lake Maroon "Taichung"

Figure 8. Marketable and non-marketable pods obtained from plants applied with pig manure

Table 9. Number of harvesting of pole snapbean varieties as affected by the application of different animal manure

TREATMENT	NUMBER OF HARVEST
Fertilizer (F)	
Chicken manure	5
Horse manure	5
Pig manure	5
Variety (V)	
Alno	6[a]
Blue Lake	5[b]
Maroon	5[b]
"Taichung"	5[b]
F x V	ns
CV (a) %	10.88
CV (b) %	7.01

Means followed by common letters are not significantly different at 5% level of DMRT

Effect of variety. Among the varieties, Taichung produced significantly higher marketable fresh pods (3.66 kg). Alno produced 2.76 kg, Maroon produced 2.52 kg and the lowest marketable pod was recorded from Blue Lake (1.74 kg). The significant differences were due to the longer pod length and greater seed number per pod produced by "Taichung".

Interaction effect. The interaction effect between animal manure application and the pole snapbean varieties on the weight of marketable fresh pod was not significant.

Weight of Non-marketable Pods

Effect of animal manure. There were no significant differences noted on the effect of animal manure application as shown in Table 10. Numerically, heaviest non-marketable pods was observed from plants applied with chicken manure (2.20 kg) followed by plants applied with pig manure (1.97 kg) and horse manure (1.90 kg).

Effect of variety. Blue Lake significantly produced the least weight of non-marketable pods with a mean of 1.33 kg followed by Alno, Maroon and "Taichung" with means of 2.10 kg, 2.22, and 2.44, respectively. The significant difference observed in Blue Lake might be due to its moderate resistance to pod borer.

Interaction effect. No significant interaction effect was observed on the weight of non-marketable pod produced as affected by animal manure application and the different pole snapbean varieties.

Total Yield and Computed Yield

Effect of animal manure. Table 10 showed that chicken manure application produced the heaviest total and computed yield per hectare followed by pig manure and horse manure application. No significant difference was revealed as an effect of the application of animal manure.

Effect of variety. Significant differences were observed from the pole snapbean varieties on total and computed yield. "Taichung" significantly recorded the highest total and computed yield of 6.00 kg per $5m^2$ and 12 tons per hectare, respectively. The lowest total and computed yield was obtained from Blue Lake (3.07 kg per $5m^2$ and 6.14 tons per hectare, respectively).

Interaction effect. No significant interaction effect was noted on the total and computed yield as affected by the application of different animal manure and the pole snapbean varieties.

Return on Cash Expense (ROCE)

Effect of animal manure. Table 11 shows that the application of chicken manure gave the highest net income of PhP 80.75 while the lowest was realized from the application of horse manure (PhP 71.00). However, the highest ROCE was recorded from the application of pig manure (185 %) followed by chicken manure application (179 %) while horse manure application had the lowest ROCE of 177.50 %. The high ROCE obtained from pig manure application was due to the cheaper cost of the fertilizer material.

Effect of variety. Among the varieties, “Taichung” is the most profitable due to the higher net income and ROCE of PhP 101.75 and 203.50 %, respectively. “Taichung” having the highest yield also had the highest ROCE.

Table 10. Weight of marketable and non-marketable fresh pods, total and computed yield of pole snapbean varieties as affected by the application of different animal manure

TREATMENT	MARKETABLE (kg)	NON-MARKETABLE (kg)	TOTAL YIELD PER PLOT ($kg/5m^2$)	COMPUTED YIELD PER HECTARE (t/ha)
Fertilizer (F)				
Chicken manure	2.83	2.20	5.03	10.06
Horse manure	2.59	1.90	4.54	9.08
Pig manure	2.58	1.97	4.55	9.10
Variety (V)				
Alno	2.76^b	2.10^a	4.86^b	9.72^b
Blue Lake	1.74^c	1.33^b	3.07^c	6.14^c
Maroon	2.52^b	2.22^a	4.74^b	9.48^b
"Taichung"	3.66^a	2.44^a	6.00^a	12.00^a
F x V	ns	ns	ns	ns
CV (a) %	18.07	18.37	15.20	15.20
CV (b) %	10.19	10.11	9.07	9.07

Means followed by common letters are not significantly different at 5% level of DMRT

Table 11. Cost and return analysis of pole snapbean varieties as affected by the application of animal manure

TREATMENT	YIELD (kg)(5m^2)	VARIABLE COST PhP	GROSS INCOME PhP	NET INCOME PhP	ROCE (%)
Fertilizer (F)					
Chicken manure	5.03	45	125.75	80.75	179.44
Horse manure	4.44	40	111.00	71.00	177.50
Pig manure	4.56	40	114.00	74.00	185.00
Variety (V)					
Alno	4.86^b	50	121.50	71.00	142.00
Blue Lake	3.07^c	50	76.75	26.75	53.50
Maroon	4.70^b	50	117.50	67.50	135.00
Taichung	6.07^a	50	151.75	101.75	203.50

*Variable cost includes cost of seeds, fertilizers and fuel for irrigation
* Sales was based on the average of 25 PhP per kilo

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This study was conducted to determine the best performing pole snapbean variety grown organically under La Trinidad condition; determine the best animal manure to be applied in pole snapbean; determine the interaction effect between varieties of pole snapbean and organic fertilizers; and determine the profitability of different pole snapbean varieties with different manure application.

Significant differences were noted in animal manure application in terms of percent survival, total yield per plot and computed yield per hectare. Mild resistance to bean rust was observed in crops applied with different manure during 45 DAP and were very susceptible during 60 DAP. All plants were susceptible to pod borer at 60 DAP.

Among the varieties, "Taichung" had the highest percentage in terms of survival, had the longest pods, highest marketable pods produced and highest ROCE. Blue Lake was the earliest to flower and had the highest percentage pod set. However, it had the lowest ROCE. All varieties showed mild resistance to bean rust except Blue Lake which showed moderate resistance at 45 DAP and were very susceptible at 60 DAP. All plants were susceptible to pod borer at 60 DAP.

Significant interaction effect was observed on pod length, width and number of seeds per pod. Significant interaction indicates that chicken manure enhances pod length and number seeds per pod of pole snapbean varieties. Alno and Maroon applied with chicken manure had the widest pods. Moreover, variety "Taichung" obtained the longest pods and had the most number of seeds per pod in all the animal manure treatments.

Chicken manure application had the highest net income but highest ROCE was

obtained from pig manure application (185 %) due to. Among the varieties, "Taichung" is the most profitable with ROCE of 203.50 %.

Conclusion

Taichung is the best variety for organic production based on its high percentage of survival, long pods, heaviest marketable pods and highest ROCE.

Chicken manure is the best manure to be applied on pole snapbeans due to its significant effect on percent survival, total yield per plot and computed yield per hectare. However, application of Pig manure to Pole snapbean varieties is the most profitable due to the high ROCE.

"Taichung" applied with chicken or pig manure is the best combination to produce high yield and ROCE.

Recommendation

Taichung variety is recommended for organic production at La Trinidad, Benguet due to its significant performance in terms of percent survival, pod length, production of marketable pods and ROCE.

Application of chicken manure to pole snapbean is recommended due to its outstanding effect in terms of percent survival, total yield per plot and computed yield per hectare. However, application of pig manure is the best for increased profitability.

Further study on pole snapbean varieties under organic production in different areas is recommended.

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APPENDICES

Appendix Table 1. Percent plant survival

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	87	94	94	275	92
V2	76	85	86	247	82
V3	89	96	97	282	94
V4	89	99	96	284	95
Subtotal	341	374	373	1088	363
F2 V1	91	96	93	280	93
V2	90	74	69	233	78
V3	88	100	83	271	90
V4	85	100	100	285	95
Subtotal	354	370	345	1069	356
F3 V1	94	87	100	281	94
V2	80	85	65	230	77
V3	97	87	89	273	91
V4	89	100	89	278	93
Subtotal	360	359	343	1062	92
TOTAL	1055	1103	1061	3219	82

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	275	280	281	836	279
V2	247	233	230	710	237
V3	282	271	273	826	275
V4	284	285	278	847	282
TOTAL	1088	1069	1082	3219	
Mean	272	267	266		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	114.000	57.000			
Main-plot factor (A)	2	30.167	15.083	0.32^{ns}	6.94	18.00
Error (a)	4	187.833	46.958			
Subplot factor (B)	3	1354.528	451.509	9.28**	3.16	5.09
A x B	6	64.056	10.676	0.22^{ns}	3.66	4.01
Error (b)	18	876.167	48.676			
TOTAL	35	2626.750				

**Highly significant
ns = not significant

Coefficient of Variance (a): 7.66
Coefficient of Variance (b): 7.80

Appendix Table 2. Number of days from sowing to emergence

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	8	8	8	24	8
V2	9	9	9	27	9
V3	8	8	8	24	8
V4	8	8	8	24	8
Subtotal	33	33	33	99	33
F2 V1	8	8	8	24	8
V2	8	10	10	28	9
V3	8	8	8	24	8
V4	8	8	8	24	8
Subtotal	32	34	34	100	33
F3 V1	8	8	8	24	8
V2	8	10	10	28	9
V3	8	8	8	24	8
V4	8	8	8	24	8
Subtotal	32	34	34	100	33
TOTAL	97	101	101	299	99

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	24	24	24	72	24
V2	27	28	28	83	28
V3	24	24	24	72	24
V4	24	24	24	72	24
TOTAL	99	100	100	299	
Mean	33	33	33		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	0.889	0.444			
Main-plot factor (A)	2	0.056	0.028	0.25^{ns}	6.94	18.00
Error (a)	4	0.444	0.111			
Subplot factor (B)	3	10.083	3.361	15.12**	3.16	5.09
A x B	6	0.167	0.028	0.12^{ns}	3.66	4.01
Error (b)	18	4.000	0.222			
TOTAL	35	15.639				

**Highly significant
ns = not significant

Coefficient of Variance (a): 4.01
Coefficient of Variance (b): 5.68

Appendix table 3. Number of days from emergence to flowering

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	50	49	45	144	48
V2	40	45	44	129	43
V3	49	48	48	145	49
V4	51	50	55	156	52
Subtotal	190	192	192	574	192
F2 V1	45	53	53	151	50
V2	41	42	41	124	41
V3	45	46	46	137	46
V4	51	53	54	158	53
Subtotal	182	192	192	574	192
F3 V1	48	48	49	145	48
V2	47	43	44	134	45
V3	47	46	47	140	47
V4	51	49	49	149	50
Subtotal	193	186	189	568	190
TOTAL	565	570	573	1716	574

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	144	151	145	440	146.7
V2	129	124	134	387	129
V3	145	137	140	422	140.7
V4	156	158	149	463	154.3
TOTAL	574	574	568	1712	
Mean	143.5	142.5	142		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	4.389	2.194			
Main-plot factor (A)	2	1.556	0.778	0.12^{ns}	6.94	18.00
Error (a)	4	26.444	6.611			
Subplot factor (B)	3	342.889	114.296	28.12**	3.16	5.09
A x B	6	50.444	8.407	2.06^{ns}	3.66	4.01
Error (b)	18	73.167	4.065			
TOTAL	35	498.889				

**Highly significant
ns = not significant

Coefficient of Variance (a): 5.41
Coefficient of Variance (b): 4.24

Appendix Table 4. Number of days to pod setting

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	6	6	5	17	5.66
V2	5	6	5	16	5.33
V3	6	5	5	16	5.33
V4	5	5	5	15	5.00
Subtotal	22	22	20	64	21.32
F2 V1	5	5	6	15	5.00
V2	6	5	5	17	5.66
V3	5	5	5	15	5.00
V4	5	5	6	15	5.00
Subtotal	21	20	22	63	20.66
F3 V1	5	5	6	16	5.33
V2	5	5	6	16	5.33
V3	5	5	6	16	5.33
V4	5	7	5	17	5.66
Subtotal	20	22	23	65	21.65
TOTAL	63	64	65	192	63.63

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	17	15	16	48.0	16.0
V2	16	17	16	49	16
V3	16	15	16	47.0	15.7
V4	15	15	17	47.0	15.7
TOTAL	64	63	65	191.0	
Mean	16	15.5	16.25		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	0.167	0.083			
Main-plot factor (A)	2	0.167	0.083	0.15^{ns}	6.94	18.00
Error (a)	4	2.167	0.542			
Subplot factor (B)	3	0.222	0.074	0.21^{ns}	3.16	5.09
A x B	6	0.944	0.157	0.45^{ns}	3.66	4.01
Error (b)	18	6.333	0.352			
TOTAL	35	10.000				

**Highly significant
ns = not significant

Coefficient of Variance (a): 13.80
Coefficient of Variance (b): 11.12

Appendix Table 5. Number of days from sowing to first harvest

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	69	67	69	205	68.33
V2	67	67	67	201	67.00
V3	67	69	67	203	67.66
V4	70	70	70	210	70.00
Subtotal	273	273	273	819	272.99
F2 V1	67	67	67	201	67.00
V2	67	67	67	201	67.00
V3	67	67	67	201	67.00
V4	70	70	70	210	70.00
Subtotal	271	271	271	813	271.00
F3 V1	67	67	67	201	67.00
V2	67	67	67	201	67.00
V3	69	67	67	203	67.66
V4	70	70	70	210	70.00
Subtotal	273	271	271	815	271.66
TOTAL	817	815	815	2447.0	815.65

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	201	201	201	603	201
V2	201	201	201	603	201
V3	203	203	203	609	203
V4	210	210	210	630	210
TOTAL	819	813	815	2445	
Mean	203.75	203.75	203.75		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	0.222	0.111			
Main-plot factor (A)	2	1.556	0.778	7.0^{ns}	6.94	18.00
Error (a)	4	0.444	0.111			
Subplot factor (B)	3	50.528	16.843	16.84**	3.16	5.09
A x B	6	2.889	0.481	1.18^{ns}	3.66	4.01
Error (b)	18	7.333	0.407			
TOTAL	35	62.972				

**Highly significant
ns = not significant

Coefficient of Variance (a): 0.94
Coefficient of Variance (b): 0.49

Appendix Table 6. Number of days from sowing to last harvest

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	96	96	96	288	96
V2	92	93	92	277	92
V3	92	92	92	276	92
V4	96	96	96	288	96
Subtotal	376	377	376	1129	376
F2 V1	96	96	96	288	96
V2	92	92	92	276	92
V3	92	92	92	276	92
V4	96	96	96	288	96
Subtotal	376	376	376	1128	376
F3 V1	96	96	96	288	96
V2	92	92	92	276	92
V3	92	92	92	276	92
V4	96	96	96	288	96
Subtotal	376	376	376	1128	376
TOTAL	1128	1129	1128	3384	1128

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	288	288	288	864	288
V2	277	276	276	829	276.3
V3	276	276	276	828	276
V4	288	288	288	864	288
TOTAL	1129	1128	1128	3385	
Mean	282.3	282	282		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	0.056	0.028			
Main-plot factor (A)	2	0.056	0.028	1.0^{ns}	6.94	18.00
Error (a)	4	0.111	0.028			
Subplot factor (B)	3	140.083	46.694	1681**	3.16	5.09
A x B	6	0.167	0.028	1.0^{ns}	3.66	4.01
Error (b)	18	0.500	0.028			
TOTAL	35	140.972				

**Highly significant
ns = not significant

Coefficient of Variance (a): 0.18
Coefficient of Variance (b): 0.18

Appendix Table 7. Number of harvesting per treatment

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	6	6	6	18	6.0
V2	5	5	5	15	5.0
V3	5	4	5	14	4.6
V4	5	5	5	15	5.0
Subtotal	21	20	21	62	20.6
F2 V1	6	6	6	18	6.0
V2	5	5	5	15	5.0
V3	5	5	5	15	5.0
V4	5	5	5	15	5.0
Subtotal	21	21	21	63	21.0
F3 V1	6	6	6	18	6.0
V2	5	5	4	14	4.6
V3	5	5	3	13	4.3
V4	5	5	5	15	5.0
Subtotal	21	21	18	60	19.3
TOTAL	63	61	60	185	60.9

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	18	18	18	54	18
V2	15	15	14	44	15
V3	14	15	13	42	14
V4	15	15	15	45	15
TOTAL	62	63	60	185	
Mean	15.5	15.75	15		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	0.389	0.194			
Main-plot factor (A)	2	0.389	0.194	0.61^{ns}	6.94	18.00
Error (a)	4	1.278	0.319			
Subplot factor (B)	3	9.417	3.139	24.21**	3.16	5.09
A x B	6	0.500	0.083	0.64^{ns}	3.66	4.01
Error (b)	18	2.333	0.130			
TOTAL	35	14.306				

**Highly significant
ns = not significant

Coefficient of Variance (a): 10.88
Coefficient of Variance (b): 7.01

Appendix Table 8. Number of flowers per cluster

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	6	7	7	21	7
V2	5	6	6	17	6
V3	8	9	7	24	8
V4	7	7	8	22	7
Subtotal	26	29	28	83	28
F2 V1	6	7	6	19	6
V2	5	6	5	16	5
V3	7	7	7	21	7
V4	6	7	6	19	6
Subtotal	23	27	24	74	25
F3 V1	6	7	6	19	6
V2	4	5	6	15	5
V3	6	9	4	19	6
V4	6	7	6	19	6
Subtotal	23	28	22	73	24
TOTAL	71	85	75	231	77

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	21	19	19	59	20
V2	17	16	15	48	16
V3	24	21	19	64	21
V4	22	19	19	60	20
TOTAL	83	74	73	231	
Mean	21	19	18		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	6.889	3444			
Main-plot factor (A)	2	5.389	2.694	6.06^{ns}	6.94	18.00
Error (a)	4	1.778	0.444			
Subplot factor (B)	3	15.444	5.148	6.95**.	3.16	5.09
A x B	6	1.722	0.287	0.39^{ns}	3.66	4.01
Error (b)	18	13.333	0.741			
TOTAL	35	44.556				

**Highly significant
ns = not significant

Coefficient of Variance (a): 10.43
Coefficient of Variance (b): 13.47

Appendix Table 9. Number of pods per cluster

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	3	2	3	8	3
V2	3	3	3	9	3
V3	3	3	3	9	3
V4	3	3	3	9	3
Subtotal	12	11	12	35	12
F2 V1	3	3	3	9	3
V2	2	3	2	7	2
V3	2	3	3	8	3
V4	3	3	3	9	3
Subtotal	10	12	11	33	11
F3 V1	3	3	3	9	3
V2	2	3	3	8	3
V3	3	3	3	9	3
V4	3	3	3	9	3
Subtotal	11	12	12	35	12
TOTAL	34	35	34	103	34

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	8	9	9		
V2	9	7	8	26	9
V3	9	8	9	24	8
V4	9	9	9	26	9
TOTAL	35	33	35	27	9
Mean	9	8	9		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	0.222	0.111			
Main-plot factor (A)	2	0.222	0.111	0.73^{ns}	6.94	18.00
Error (a)	4	0.611	0.153			
Subplot factor (B)	3	0.528	0.176	1.73^{ns}	3.16	5.09
A x B	6	0.889	0.148	1.45^{ns}	3.66	4.01
Error (b)	18	1.833	0.102			
TOTAL	35	4.306				

** Highly significant
ns = not significant

Coefficient of Variance (a): 13.67
Coefficient of Variance (b): 11.15

Appendix Table 10. Percentage pod set per cluster

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	42.85	28.76	42.05	113.66	37.89
V2	51.85	44.82	48.38	145.05	48.35
V3	38.66	35.10	36.61	110.37	36.79
V4	45.58	42.85	42.10	130.53	43.51
Subtotal	178.94	151.53	169.14	499.61	166.54
F2 V1	56.14	44.28	55.00	155.42	51.81
V2	42.30	45.07	51.06	138.43	46.14
V3	34.78	40.84	38.35	113.97	37.99
V4	55.35	39.18	46.87	141.40	47.13
Subtotal	188.57	169.37	191.28	549.22	183.07
F3 V1	53.44	39.72	42.62	135.78	45.26
V2	55.81	50.98	48.27	155.06	51.69
V3	44.26	35.63	56.81	136.70	45.57
V4	52.38	46.47	46.03	144.88	48.29
Subtotal	205.89	172.80	193.73	572.42	190.81
TOTAL	573.40	493.70	554.15	1621.25	540.42

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	113.66	155.42	135.78	404.86	134.95
V2	145.05	138.43	155.06	438.54	146.18
V3	110.37	113.97	136.70	361.04	120.35
V4	130.53	141.40	144.88	416.81	138.94
TOTAL	499.61	549.22	572.42	1621.25	
Mean	124.90	137.31	143.11		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	288.246	144.123			
Main-plot factor (A)	2	230.575	115.287	23.51**	6.94	18.00
Error (a)	4	19.618	4.905			
Subplot factor (B)	3	355.169	118.390	4.12*	3.16	5.09
A x B	6	280.378	46.730	1.62^{ns}	3.66	4.01
Error (b)	18	516.077	28.671			
TOTAL	35	1690.063				

**Highly significant
*significant
ns = not significant

Coefficient of Variance (a): 4.61
Coefficient of Variance (b): 11.89

Appendix Table 11. Length of pods

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	13.50	14.00	14.50	42.00	14.00
V2	13.00	13.00	13.10	39.10	13.03
V3	13.20	13.50	13.30	40.00	13.33
V4	15.00	15.50	15.00	45.50	15.17
Subtotal	54.70	56.00	55.90	166.60	55.53
F2 V1	13.00	12.70	13.40	39.10	13.03
V2	13.00	12.30	13.40	38.70	12.90
V3	13.30	13.50	13.30	40.10	13.37
V4	14.50	14.50	14.50	43.50	14.50
Subtotal	53.80	53.00	54.60	161.40	53.80
F3 V1	13.40	13.50	13.40	40.30	13.43
V2	12.90	13.00	12.90	38.80	12.93
V3	12.50	13.00	12.50	38.00	12.67
V4	14.30	14.60	14.20	43.10	14.37
Subtotal	53.10	54.10	53.00	160.20	53.40
TOTAL	13.50	14.00	14.50	42.00	14.00

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	42.00	39.10	40.30	121.40	40.47[b]
V2	39.10	38.70	38.80	116.60	38.87[d]
V3	40.00	40.10	38.00	118.10	39.37[c]
V4	45.50	43.50	43.10	132.10	44.03a
TOTAL	166.60	161.40	160.20	488.20	
Mean	41.65	40.35	40.05		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	0.167	0.084			
Main-plot factor (A)	2	1.929	0.964	6.44[ns]	6.94	18.00
Error (a)	4	0.599	0.150			
Subplot factor (B)	3	16.303	5.434	87.86**	3.16	5.09
A x B	6	1.553	0.259	4.19**	3.66	4.01
Error (b)	18	1.113	0.062			
TOTAL	35	21.666				

**Highly significant
ns = not significant

Coefficient of Variance (a): 2.86
Coefficient of Variance (b): 1.83

Appendix Table 12. Width of pods

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	1.06	1.05	1.08	3.19	1.06
V2	1.00	0.90	0.80	2.70	0.90
V3	1.00	1.05	1.07	3.12	1.04
V4	1.00	1.03	1.05	3.08	1.03
Subtotal	4.06	4.03	4.00	12.09	4.03
F2 V1	1.00	0.90	1.00	2.90	0.97
V2	1.10	0.99	1.12	3.21	1.07
V3	0.99	0.99	0.99	2.97	0.99
V4	0.99	1.00	1.01	3.00	1.00
Subtotal	4.08	3.88	4.12	12.08	4.03
F3 V1	1.01	0.99	1.00	3.00	1.00
V2	0.99	1.00	1.01	3.00	1.00
V3	0.99	0.98	0.99	2.96	0.99
V4	1.00	1.09	1.12	3.21	1.07
Subtotal	3.99	4.06	4.12	12.17	4.06
TOTAL	12.13	11.97	12.24	36.34	12.11

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	3.19	2.90	3.00	9.09	3.03[ab]
V2	2.70	3.21	3.00	8.91	2.97[b]
V3	3.12	2.97	2.96	9.05	3.02[b]
V4	3.08	3.00	3.21	9.29	3.10[a]
TOTAL	12.09	12.08	12.17	36.34	
Mean	3.02	3.02	3.04		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	0.003	0.002			
Main-plot factor (A)	2	0.000	0.000	0.10[ns]	6.94	18.00
Error (a)	4	0.008	0.002			
Subplot factor (B)	3	0.008	0.003	1.28[ns]	3.16	5.09
A x B	6	0.071	0.012	5.51**	3.66	4.01
Error (b)	18	0.038	0.002			
TOTAL	35	0.129	0.002			

**Highly significant
ns = not significant

Coefficient of Variance (a): 4.43
Coefficient of Variance (b): 4.58

Appendix Table 13. Bean rust reaction at 30 DAP

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	1	1	1	3	1
V2	1	1	1	3	1
V3	1	1	1	3	1
V4	1	1	1	3	1
Subtotal	4	4	4	12	4
F2 V1	1	1	1	3	1
V2	1	1	1	3	1
V3	1	1	1	3	1
V4	1	1	1	3	1
Subtotal	4	4	4	12	4
F3 V1	1	1	1	3	1
V2	1	1	1	3	1
V3	1	1	1	3	1
V4	1	1	1	3	1
Subtotal	4	4	4	12	4
TOTAL	12	12	12	36	12

Appendix Table 14. Bean rust reaction at 45 DAP

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	2	3	2	7	2
V2	3	3	2	8	3
V3	2	2	3	7	2
V4	3	2	2	7	2
Subtotal	10	10	9	29	10
F2 V1	3	2	2	7	2
V2	2	3	3	8	3
V3	2	3	2	7	2
V4	2	2	3	7	2
Subtotal	9	10	10	29	10
F3 V1	2	3	2	7	2
V2	3	2	3	8	3
V3	2	2	3	7	2
V4	3	2	2	7	2
Subtotal	10	9	10	29	10
TOTAL	29	29	29	78	30

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	7	7	7	21	7
V2	8	8	8	24	8
V3	7	7	7	21	7
V4	7	7	7	21	7
TOTAL	29	29	29	87	
Mean	7	7	7		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	0.000	0.000			
Main-plot factor (A)	2	0.000	0.000	0.0^{ns}	6.94	18.00
Error (a)	4	0.500	0.125			
Subplot factor (B)	3	0.750	0.250	0.60^{ns}	3.16	5.09
A x B	6	0.000	0.000	0.0^{ns}	3.66	4.01
Error (b)	18	7.500	0.417			
TOTAL	35	8.750				

ns= not significant

Coefficient of Variance (a): 14.62
Coefficient of Variance (b): 26.71

Appendix Table 15. Bean rust reaction at 60 DAP

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	5	4	5	14	4.7
V2	5	5	5	15	5.0
V3	5	5	4	14	4.7
V4	5	4	5	14	4.7
Subtotal	20	18	19	57	19.0
F2 V1	4	5	5	14	4.7
V2	5	5	5	15	5.0
V3	5	5	4	14	4.7
V4	4	5	5	14	4.7
Subtotal	18	20	19	57	19.0
F3 V1	5	4	5	14	4.7
V2	5	5	5	15	5.0
V3	4	5	5	14	4.7
V4	5	5	4	14	4.7
Subtotal	19	19	19	57	19.0
TOTAL	5	4	5	14	4.7

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	14	14	14	42	14
V2	15	15	15	45	15
V3	14	14	14	42	14
V4	14	14	14	42	14
TOTAL	57	57	57	171	
Mean	14	14	14		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	0.000	0.000			
Main-plot factor (A)	2	0.000	0.000	0.0^{ns}	6.94	18.00
Error (a)	4	1.000	0.250			
Subplot factor (B)	3	0.750	0.250	0.90^{ns}	3.16	5.09
A x B	6	0.000	0.000	0.0^{ns}	3.66	4.01
Error (b)	18	5.000	0.278			
TOTAL	35	6.750				

ns= not significant

Coefficient of Variance (a): 10.53
Coefficient of Variance (b): 11.10

Appendix Table 16. Pod borer reaction at 60 DAP

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	4	3	4	11	4
V2	3	4	3	10	3
V3	4	4	3	11	4
V4	3	4	4	11	4
Subtotal	14	15	14	43	14
F2 V1	3	4	3	10	3
V2	4	3	3	10	3
V3	4	4	3	11	4
V4	4	4	3	11	4
Subtotal	15	15	12	42	14
F3 V1	4	3	4	11	4
V2	3	3	4	10	3
V3	3	4	4	11	4
V4	4	4	3	11	4
Subtotal	14	14	15	43	14
TOTAL	43	44	42	128	42

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	11	10	11	32	11
V2	10	10	10	30	10
V3	11	11	11	33	11
V4	11	11	11	33	11
TOTAL	43	42	43	128	
Mean	11	11	11		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	0.389	0.194			
Main-plot factor (A)	2	0.056	0.028	0.08^{ns}	6.94	18.00
Error (a)	4	1.444	0.361			
Subplot factor (B)	3	0.667	0.222	0.65^{ns}	3.16	5.09
A x B	6	0.167	0.028	0.08^{ns}	3.66	4.01
Error (b)	18	6.167	0.343			
TOTAL	35	8.889				

ns= not significant

Coefficient of Variance (a): 16.90

Coefficient of Variance (b): 11.10

Appendix Table 17. Number of seeds per pod

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	8	8	8	24	8
V2	7	7	7	21	7
V3	7	7	7	21	7
V4	8	8	8	24	8
Subtotal	30	30	30	90	30
F2 V1	7	7	7	21	7
V2	8	7	8	23	8
V3	7	7	7	21	7
V4	8	8	8	24	8
Subtotal	30	29	30	89	30
F3 V1	7	7	7	21	7
V2	7	7	7	21	7
V3	7	6	6	19	6
V4	8	8	8	24	8
Subtotal	29	28	28	85	28
TOTAL	89	87	88	264	88

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	24	21	21	66	22[b]
V2	21	23	21	65	22[b]
V3	21	21	19	61	20[c]
V4	24	24	24	72	24[a]
TOTAL	90	89	85	264	
Mean	23	22	21		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	0.167	0.083			
Main-plot factor (A)	2	1.167	0.583	14.00*	6.94	18.00
Error (a)	4	0.167	0.042			
Subplot factor (B)	3	6.889	2.296	41.33**	3.16	5.09
A x B	6	2.611	0.435	7.83**	3.66	4.01
Error (b)	18	1.000	0.056			
TOTAL	35	12.000				

**Highly significant
*significant

Coefficient of Variance (a): 2.79
Coefficient of Variance (b): 3.21

Appendix Table 18. Weight of marketable fresh pods

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	2.970	2.600	2.920	8.490	2.830
V2	1.720	1.630	2.200	5.550	1.850
V3	2.610	2.020	3.160	7.790	2.597
V4	4.110	4.110	3.950	12.170	4.057
Subtotal	11.410	10.360	12.230	34.000	11.333
F2 V1	2.320	2.620	2.610	7.550	2.517
V2	1.660	1.770	1.900	5.330	1.777
V3	2.520	3.000	2.400	7.920	2.640
V4	3.210	3.740	3.400	10.350	3.450
Subtotal	9.7100	11.130	10.310	31.1500	10.383
F3 V1	2.860	3.250	2.680	8.790	2.930
V2	1.465	1.860	1.500	4.825	1.608
V3	2.420	2.730	1.850	7.000	2.333
V4	2.960	3.570	3.870	10.400	3.467
Subtotal	9.705	11.410	9.900	31.015	10.338
TOTAL	30.825	32.900	32.440	96.165	32.055

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	8.490	7.550	8.790	24.83	8.277
V2	5.550	5.330	4.825	15.705	5.235
V3	7.790	7.920	7.000	22.71	7.570
V4	12.170	10.350	10.400	32.92	10.973
TOTAL	34.000	31.1500	31.015	96.165	
Mean	8.500	7.788	7.754		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	0.198	0.099			
Main-plot factor (A)	2	0.474	0.237	1.02^{ns}	6.94	18.00
Error (a)	4	0.931	0.233			
Subplot factor (B)	3	16.747	5.582	75.36**	3.16	5.09
A x B	6	0.779	0.130	1.75^{ns}	3.66	4.01
Error (b)	18	1.333	0.074			
TOTAL	35	20.462				

**Highly significant
ns = not significant

Coefficient of Variance (a): 18.07
Coefficient of Variance (b): 10.19

Appendix Table 19. Weight of non-marketable pods

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	2.170	2.300	2.510	6.980	2.327
V2	1.300	1.270	1.450	4.020	1.340
V3	2.310	1.875	2.690	6.875	2.292
V4	2.550	3.200	2.750	8.500	2.833
Subtotal	8.330	8.645	9.400	26.375	8.792
F2 V1	1.880	1.600	1.990	5.470	1.823
V2	1.210	1.230	1.440	3.880	1.293
V3	2.310	2.130	2.110	6.550	2.183
V4	2.550	2.100	2.250	6.900	2.300
Subtotal	7.950	7.060	7.790	22.800	7.600
F3 V1	2.160	2.430	1.880	6.470	2.157
V2	1.300	1.420	1.310	4.030	1.343
V3	2.350	2.450	1.79	6.590	2.197
V4	2.255	2.250	2.070	6.575	2.192
Subtotal	8.065	8.550	7.050	23.665	11.833
TOTAL	24.345	24.255	24.240	72.840	52.504

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	6.980	5.470	6.470	18.920	6.307
V2	4.020	3.880	4.030	11.930	3.977
V3	6.875	6.550	6.590	20.015	6.672
V4	8.500	6.900	6.575	21.975	7.325
TOTAL	26.375	22.800	23.665	72.840	
Mean	6.594	5.700	5.916		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	0.001	0.000			
Main-plot factor (A)	2	0.580	0.290	2.08^{ns}	6.94	18.00
Error (a)	4	0.556	0.139			
Subplot factor (B)	3	6.375	2.125	50.79**	3.16	5.09
A x B	6	0.547	0.091	2.18^{ns}	3.66	4.01
Error (b)	18	0.753	0.042			
TOTAL	35	8.812				

**Highly significant
ns = not significant

Coefficient of Variance (a): 18.37
Coefficient of Variance (b): 10.11

Appendix Table 20. Total yield per plot ($5m^2$)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	5.140	4.900	5.430	15.470	5.157
V2	3.020	2.900	3.650	9.570	3.190
V3	4.920	3.895	5.850	14.665	4.888
V4	6.660	7.310	6.700	20.670	6.890
Subtotal	19.740	19.005	21.630	60.375	20.125
F2 V1	4.200	4.220	4.600	13.020	4.340
V2	2.870	3.000	3.340	9.210	3.070
V3	4.430	5.130	4.510	14.070	4.690
V4	5.460	5.840	5.650	16.950	5.650
Subtotal	16.960	18.190	18.100	53.250	17.750
F3 V1	5.020	5.680	4.560	15.260	5.087
V2	2.765	3.280	2.810	8.855	2.952
V3	4.770	5.180	3.640	13.590	4.530
V4	5.215	5.820	5.940	16.975	5.658
Subtotal	17.770	19.960	16.950	54.680	18.227
TOTAL	54.470	57.155	56.680	168.305	56.102

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	15.470	13.020	15.260	43.750	14.583
V2	9.570	9.210	8.855	27.635	9.212
V3	14.665	14.070	13.590	42.325	14.108
V4	20.670	16.950	16.975	54.595	18.198
TOTAL	60.375	53.250	54.680	168.305	
Mean	15.094	13.313	13.670		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	0.342	0.171			
Main-plot factor (A)	2	2.368	1.184	2.34^{ns}	6.94	18.00
Error (a)	4	2.020	0.505			
Subplot factor (B)	3	40.904	13.635	75.82**	3.16	5.09
A x B	6	2.195	0.366	2.03^{ns}	3.66	4.01
Error (b)	18	3.237	0.180			
TOTAL	35	51.066				

**Highly significant
ns = not significant

Coefficient of Variance (a): 15.20
Coefficient of Variance (b): 9.07

Appendix Table 21. Computed yield per hectare (t/ha)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
F1 V1	10.28	9.80	10.86	30.94	10.313
V2	6.04	5.80	7.30	19.14	6.380
V3	9.84	7.79	11.70	29.33	9.777
V4	13.32	14.62	13.40	41.34	13.780
Subtotal	39.48	38.01	43.26	120.75	40.250
F2 V1	8.40	8.44	9.20	26.04	8.680
V2	5.74	6.00	6.68	18.42	6.140
V3	8.86	10.26	9.02	28.14	9.380
V4	10.92	11.68	11.30	33.90	11.300
Subtotal	33.92	36.38	36.20	106.50	35.500
F3 V1	10.04	11.36	9.12	30.52	10.173
V2	5.53	6.56	5.62	17.71	5.903
V3	9.54	10.36	7.28	27.18	9.060
V4	10.43	11.64	11.88	33.95	11.317
Subtotal	35.54	39.92	33.9	109.36	10.313
TOTAL	108.94	114.31	113.36	336.61	112.203

TWO WAY TABLE

TREATMENT	FERTILIZER			TOTAL	MEAN
	F1	F2	F3		
V1	30.94	26.04	30.52		
V2	19.14	18.42	17.71	87.5	29.17
V3	29.33	28.14	27.18	55.27	18.42
V4	41.34	33.90	33.95	84.65	28.22
TOTAL	120.75	106.50	109.36	109.19	36.40
Mean	30.19	26.63	27.34		

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	1.369	0.684			
Main-plot factor (A)	2	9.472	4.736	2.34^{ns}	6.94	18.00
Error (a)	4	8.082	2.020			
Subplot factor (B)	3	163.614	54.538	75.82**	3.16	5.09
A x B	6	8.779	1.463	2.03^{ns}	3.66	4.01
Error (b)	18	12.947	0.719			
TOTAL	35					

**Highly significant
ns = not significant

Coefficient of Variance (a): 15.20
Coefficient of Variance (b): 9.07