BIBLIOGRAPHY

TAY-EO, JOMAR W. APRIL 2011. Evaluation of Ten Glutinous Rice *(Oryza sativa)* Varieties under Kapangan, Benguet Condition. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study will be conducted to determine the growth and yield of the ten glutinous traditional rice varieties in Kapangan, Benguet; determine the best glutinous rice varieties based on its performance and resistance to pests and diseases; and determine the profitability of growing the different glutinous traditional rice varieties.

Bayabas and Kintoman are the best performing landraces and considered to be adapted at Kapangan, Benguet because they produce the highest yield and ROCE and both varieties were also profitable.

INTRODUCTION

The snap bean (*Phaseolus vulgaris* L.) is herbaceous plant that is grown worldwide for its edible bean, popularlyboth as dry and as a green bean. Botanically, it is classified as a dicotyledon. Snap beans are legumes and thus acquire their nitrogen through an association with rhizobia, a genus of nitrogen-fixing bacteria.

The bush varieties form erect bushes 20 – 60 cm tall, while the pole or twinning varieties form vines 2 – 3 m long vines. All varieties bear alternate, green or purple leaves, divided into three oval, smooth-edged leaflets, each 6-15 cm long and 3-11 cm wide. The white, pink, or purple flowers are about 1 cm long, and give way to pods 8-20 cm long, 1-1.5 cm wide, green, yellow, black or purple in color, each containing 4-6 beans. The beans are smooth, plump, kidney-shaped, up to 1.5 cm long, range widely in color, and are often mottled into more colors (Wikipedia, 2010).

Snap bean is an important food worldwide and a significant source of nutrient because of its fiber, proteins and vitamin contents. It is traditionally a basic food crop in many developing countries and it serves as a major plant protein source for rural and urban poor (Dursun, 2007).

Benguet is one of the major agricultural areas in the country where snap beans or "Baguio beans", as it is locally called have long been cultivated. Snap beanis one of the most popular crops being grown commercially. One important factor to consider for successful production is the variety that are adapted to the environmental condition.Some studies revealed that the growth and yield of pole snap beans are best in higher elevation areas which include Benguet province.

The commercial production of beans is distributed worldwide. It is highly adapted and performs well in terms of growth and yield. However, many problems are still encountered even with such knowledge and experiences about proper management in growing beans. Therefore, continued efforts and inclusive research approach are required to improve performance and resolve the yield, disease and quality problems that limit the production.

The seed is the most basic input in agriculture. It is the beginning or source of a plant. Its practical purpose is for planting, propagation and multiplication (Fernandez, 2003). In Benguet, a lot of studies have been conducted regarding snap beans but few focused on the performance of seeds that are stored in different span of years. Most of the farmers use their own produced seeds as planting materials.Proper storage and labeling are sometimes neglected that result to poor growth and low yield.In this regards, it is important to know the nature of the seed before sowing.

The objectives of the study were to:

1. evaluate the growth and yield of fivevarieties of pole snap bean that were produced in three different years under organic production system in La Trinidad, Benguet;

2. determine the best variety of pole snap bean fororganic production in La Trinidad, Benguet;

3. determine the best yearof seed production of pole snap bean as source of planting material; and

4. determine the interaction effect of variety and year of seed production of pole snap bean.

The study was conducted atthe Organic Farm of Benguet State University,in Balili, La Trinidad, Benguet from November 2010 to March2011.

REVIEW OF LITERATURE

The Plant

Snap bean (*Phaseolus vulgaris*) is a member of the Fabaceae or legume family and is of New World origin. The wild ancestors of the modern snap bean come from Central and South America. These ancestral types are found across a range of environments, from moderately hot, arid climates to humid lowland tropics and even into cooler upland areas of South America. The beans of this species grown in North America today are grown in a more limited temperate climatic zone (Navazio*et al*., 2007).

Kampermpool (2005) cited that snap beans is a popular legume that provides a good source of protein and carbohydrates and their origin can be traced to Central America. It is widely cultivated in temperate, subtropical, and tropical regions. Snap beans are cultivated for its edible, tender pods and dry seeds.

Shrestha (1989) added that legumes are the richest and cheapest common source of protein among all foods of plant origin. Its protein content is a cheap substitute for animal protein. Legumes are recognized as important food for human diet and supplementary feed for animals.

Aside from the importance of legumes as food, Rai (1986) states that legumes are important in agriculture as replenisher of soil nitrogen. With the rising world population and the declining supply of fossil fuels required to manufacture nitrogen fertilizer, it may be necessary to rely more on microorganisms associated with legumes to supply plant need for nitrogen. Legumes produce nodules in which the root nodule bacteria in symbiosis with the plants fix atmospheric nitrogen in the form to be utilized by the plant.

Climatic Requirements

Snap bean is a tender, warm season crop that requires warm, well drained soils for germination. Temperature of 70°-80°F (21°-27°C) is preferred for optimum crop growth. Temperatures above 90°F or below 50°F during flowering may adversely affect pod set and seed yields. Most snap bean cultivars germinate best when soil temperature is at or above 65°F (12°C), but germination may be inhibited at temperatures above 95°F (35°C). There are instances when seed growers must plant with soil temperatures below optimum in order to fully mature a seed crop by the end of the season. Cultivars vary considerably in their ability to germinate in cool, moist soils and to resist common root rot organisms that can damage or destroy seedlings (Navazio*et al*., 2007).

Peet (1995) states that beans are day-neutral or short day plants. The optimum temperature for seed emergence is 77^0F. Germination is slow at 60 ^{0}F and seeds rot at lower temperatures. Because of the large volume of the seed relative to its surface area, a moist soil is required for germination. Since bean cotyledons must be pushed through the soil to the surface, a crusted or cloddy soil reduces emergence.

Peet(1995) also added that the optimum temperature for plant growth is 60 to 70 ^{0}F with some growth occurring between 50 to 80 ^{0}F. Snap beans require 1,050 to 1,150 degree days of heat, with a base of 50 ^{0}F. Temperatures above 90 ^{0}F cause fibrous pods and blossom drop. Very rainy conditions during flowering also can cause flowers to drop. Southern peas are usually considered to be more heat and drought tolerant than snap beans.

Varietal Evaluation

Varietal evaluation is a process in crop breeding whichprovidescomparisonofpromisinglines with the local check in order toestablish the superiority of the lines developed by the breeder. It is only through varietal evaluation that a breeder sees the better performance of developed lines in terms of yield and quality, resistance to pests, stress and other parameters.

Different varieties have different potentials of fixing atmospheric nitrogen and yield with response to the inoculation. Varietal evaluation is important to determine high yielding varieties which is most responsive to inoculation (Shrestha, 1989).

According to Bantog and Padua in 1999, to ensure productivity of excellent varieties, varieties either from local or foreign collection have to be introduced. Nevertheless, the yield and quality potentials of varieties vary depending on the condition they are exposed to such as climate, weather, soil factors and the like. The ultimate way to determine the best variety/ies is to test how they fare in specific localities or representative areas per elevation.

In 2008, Tandang*et al*. identified and selected some promising varieties or potential parentals of snap beans not only for the highlands but also for the mid-elevation areas and lowlands. They added that these improved materials need further evaluation to identify new varieties that are high yielding, with good pod qualities and high resistance to major pests.

<u>Soil and Fertilization</u>

Snap beans are adaptable to a wide range of soil types but will have difficulty emerging in crushed soils. Cover crops or other types of mulch or use of a rotary hoe may be necessary on heavy soils to break the crust. Beans will grow satisfactorily on heavy soils after emergence, however, uniform emergence is particularly important for bush type beans which will be onceover mechanically harvested. For maximum uniformity of emergence and subsequent maturity, all areas of the field must be well drained and prepared with no crushed, cold or wet areas. Snap beans prefer a well drainedsoil with a pH of 5.5 to 6.0 but the pH can be as low as 5.0 if Mn or Al are not present in toxic concentrations. Snap beans are sensitive to boron and may experience toxicity problems in fields where boron is naturally high or where it has been added to meet the requirements of cole crops such as cabbage or broccoli. If little or no nitrogen is available in the field, snap beans will nodulate and form symbiotic associations with N-fixing bacteria in the soil even without artificial inoculation. Plants fixing their own N often get off to a slower start in cool spring weather and are less uniform in bloom time and subsequent number of days to harvest, however. Inoculating bean seed with N-fixing bacteria has not been shown to increase yields or even provide nitrogen to snap beans. If not the proper strain, the N-fixing bacterium will be ineffective and possibly parasitic. Fertilization of snap beans is particularly difficult in sandy soils because the risk of salt injury to snap beans is high. High salt levels cause shriveled or desiccated areas on the foliage which often resemble cold injury. Initially, fertilizer applications are sometimes broadcast, rather than banded, to reduce salt injury, but sidedressings of N at vining and/or bloom are recommended in sandy soils, or where there have been leaching rains. In soils where zinc is tied up by high pH and phosphate levels, zinc sulfate may be required. Harvesting one ton of snap beans removes 30 to 74 pounds N, 2 to 6 pounds P2O5 and 5 to 6 pounds K2O from the soil. Manures can be used to supply nutrients for bean production. Experiments in Alabama showed broiler litter with nutrient levels of 2.8 % N, 1.6 % P and 2.2 % K and applied at a rate of 2.1 tons per acre was as effective as commercial fertilizer (Peet, 1995).

Planting and Seed Handling Precautions

Bean seeds sometimes fail to germinate properly because they have dried down too much in storage. Such seed are said to be 'hard'. Depending on the cultivar, seed moisture contents shouldnotfallbelow 7 to 10 %. Thisrepresentsrelative humidity in storage of 30 to 45 % for beans kept at 77 ^{0}F. In some cases, exposing seed to humid conditions for several days before planting will help, but it is better to use properly stored seed. Bean seed is fragile and bags of seed must be handled carefully, not dropping or compressing seed bags. Cracking of the seed coats leads to leaching of carbohydrates and rotting of the seed after planting. Breaking off either the plummule or a cotyledon results in 'snakeheads' or 'baldheads' with slow growth, increased disease and insect susceptibility and decreased uniformity. Operating a plate type planter at less than 3 mph and plateless types at 4 to 5 mph will help protect seed during planting (Peet, 1995).

Icishahayo*et al*. (2007) stated that a crop may be suitable for commercial seed production if farmers are not satisfied with the availability or quality of their own seed or seed sold in markets and shops, experience seed shortages at planting time, are already used to purchasing seed, the crop suffers from diseases found inside the seed or carried in the soil, or good quality seed can be produced by non-specialists.

Mallya (1992) as cited by Icishahayo*et al*. (2007) added that seed quality is the total sum of many seed attributes likegenetic purity, moisture content, mechanical damage,viability and vigor, size and appearance.

According to the International Seed Testing Association (ISTA) (1999) as cited by Icishahayo*et al*. (2007) defined that health of seed refers to the presence or absence ofdisease-causing organisms, such as fungi, bacteria andviruses, and animal pests, such as eelworms and insects.

Schwartz and Gálvez (1980) as cited by Icishhayo*et al*. (2007) stated that fungal seed borne disease pathogens affect bean seedviability and germination. Furthermore, they said that germination tests areessential as they help to determine the maximumgermination potential of a seed lot, which can be used tocompare the quality of different seed lots and alsoestimate the field planting value. Seed quality adverselyaffects crop establishment and the capacity to realize yieldpotential. Healthy and pathogen-free seeds should be ableto germinate and give rise to vigorous plants with highyielding capacity. In general what is considered cleanseed has 0% pathogen infection, however in tropicalconditions marginal levels between 0.5 and 1% infectioncan be accepted.

Seed Germination and Viability

The term germination is applied to the resumption of the growth of the seed embryo after the period of dormancy. Germination does not take place unless the seed has been transported to a favorable environment by one of the agencies of seed dispersal. The primary conditions of a favorable environment are adequate water, oxygen and suitable temperature. Different species of plants germinate best in different temperatures; as a rule, extremely cold or extremely warm temperature does not favor germination. Some seeds also require adequate exposure to light before germination. Each species has its specific period of viability (capable of growing into healthy organism); seeds sown after the period of optimum viability may produce weak plants or may not germinate (Microsoft Encarta, 2007).

Seed History and Performance

Louwaars (1994) as cited by De Guzman and Fernandez (2003) stated that the use of seeds marks the transition from human food collection to the sedentary civilizations. Seed remains to be a basic input in any agricultural production system and thus, its proper storage is of utmost importance.

Harrington (1973) as cited by De Guzman and Fernandez (2003) stated that in ancient times, seeds were stored in clay jars, woven grass or cane baskets, and leather bags. These containers are still used by farmers in many parts of the world. At present, hermetic storage, resealable tins or plastic containers are some of the recommended methods for storage of seeds.

In 1999, Bantog and Padua evaluated promising varieties of pole snap beans in different elevations. The study revealed that maturity was earliest in low elevation compared to mid elevation and high elevation. BSU Sel. No. 1 and Blue Lake were the earliest-maturing variety and latest-maturing variety, respectively. Alno, Burik and Patig are mid-maturing varieties. The study also proved that climatic condition, specifically temperature, have an enzymatic effect on biological and physiological activities in plants that resulted to shorter maturity. Regarding yield performance, Patig significantly outyielded all the varieties evaluated including Alno, the control, and BSU Sel. No. 1 was the poorest yielder. Burik and Alno yielded comparatively with Patig. Thus, they recommended Patig, Alno and Burik should be planted in high elevation areas for best results.

In 2005, Neyney evaluated the pod setting and fresh pod potential of commonly grown pole snapbean varieties in La Trinidad. He recommended Taichung and Violeta for commercial production under La Trinidad because of better performance than the others. These two varieties performed significantly in terms of number of flower cluster per plant, flower per cluster, number of pods per plant and weight of marketable and total pod yields.

In 2007, Tandang and her team evaluated snapbean cultivars for the Philippine highlands. Twelve pole snap bean were included in the study namely: Alno, CPV 69, Hav 71, Patig, CPV 64, Violeta, Burik, B-21, N2643, CPV 60, Taichung, Bluelake and FM 1. The study revealed that Violeta significantly registered the highest computed yield/ha followed by Burik and N26

MATERIALS AND METHODS

An area of 225m² wasthoroughly prepared and divided into three blocks consisting of 15 1mx5m plotsper replication. The experiment was laid out following 3x5 factorialexperimentinrandomized complete block design (RCBD) with three replications.

The seeds of pole snap beans were obtained from Benguet State University – Institute of Plant Breeding Highland Crops Research Station (BSU-IPB HCRS). The production year of planting materialswasconsidered as factor A and the promising varieties of pole snap bean for organic production as factor B, as follows:

Factor A:Production year of planting materials	Factor B: Promising organic varieties
Y_1 - 2008	V_1 – Patig
Y_2 - 2009	V_2 – Mabunga
Y_3 - 2010	V_3 – CPV 60
	V_4 – Tublay
	V_5 – B 21

Three seeds of snap bean were sown per hill in a double row plot at a distance of 30cm x 30cm between hills and between rows. All cultural management practices for organic production of snap beans such as application of BSU Grower's compost, irrigation by the use of water pump from Balili River, hand weeding, trellising (Figure 1), hilling-up (Figure 2), and pest control with the use of yellow trap and leaf pruning or leaf thinning, i.e.removal of infected and infested leaves were practiced.

Figure 1. Trellising of pole snap bean varieties

Figure 2. Hilling-up of pole snap bean

Data Gathered:

1. Agroclimatic data. Monthly mean maximum and minimum temperature, relative humidity, rainfall and sunshine duration prevailing over theexperimental area during the period of study were collected at theBSU/PAGASA, Agronomical –Meteorological Station.

2. Maturity

a. Number of days from sowing to emergence. This was taken by counting the number of days from planting up to the time when at least 50% of plants per plot emerged (Figure 3).

Figure 3. Emergence of pole snap bean varieties with different production year of planting materials

b. Percent germination. This was obtained by counting the seeds that germinatedper plot (8 DAP) and it was computed using the following formula:

$$\text{Germination Percentage (\%)} = \frac{\text{Number of Germinated Seeds}}{\text{Number of Seeds Sown}} \times 100$$

c. Number of days from emergence to flowering. This was determined by counting the number of days from date of emergence to the time at least 50% of the plants in the plot have fully opened flowers (Figure 4).

d. Number of days from emergence to first harvest. This was taken by counting the number of days from emergence to the first harvesting of pod.

e. Number of days from emergence to last harvest. This was taken by counting the number of days from emergence to the last harvesting of pods.

Figure 4. Flowering of different pole snap bean varieties

3.Fresh Pod Character

a. Pod length (cm). This was taken by measuring the length in cm of sample pods from the pedicel end to the blossom end using foot rule.

b. Pod width (cm). This was taken by measuring the width of the middle portion of five sample pods per plot.

c. Pod texture. This was taken by feel method and observed the texture as course or smooth.

d. Pod straightness. This was recorded from visual observation as either straight or curve pod.

e. Pod shape. This was recorded visually as flat or round pod.

f. Pod color. This was recorded visually as green, dark green and others when the pods were fully developed.

g. Pod diameter (cm). The diameter of ten sample pods per plot was measured using vernier caliper.

4. Yield and Yield Component

a. Weight of marketable pods per plot. This was gathered by getting the weight of pods that were straight, tender and free from insect pest damage and diseases (Figure 5).

Figure 5. Marketable fresh pod yield of CPV 60

b. Weight of non-marketable pods per plot. This was gathered by getting the weight of pods that were abnormal in shape and had 20% or more insect pest and disease damage.

c. Total yield per plot. The over-all total weight of marketable and non-marketable pods was obtained by getting the sum of all the weight of marketable and non-marketable yield throughout the harvesting period.

d. Computed yield per hectare (t/ha). This was computed using the formula:

$$\text{Yield per hectare(t/ha)} = \text{Total yield/plot (kg/m}^2\text{)} \times 2$$

where 2 was the factor used to convert yield in kg/5m² plot into yield per hectare in ton/ha.

5. Reaction to bean rust and pod borer. This was determined at peak of harvesting stage using the respective rating scale for bean rust infection (Figure 6) and pod borer infestation used at BSU-IPB by Tandang*et al*., (2008) as follows:

a. Bean rust

Scale	Percent infection	Remarks
1	Less than 20% infection per plot	highly resistant
2	20-40% infection per plot	moderately resistant
3	41-60% infection per plot	mildly resistant
4	61-80% infection per plot	susceptible
5	81-100% infection per plot	very susceptible

Figure 6. Mild resistance of pole snap bean to bean rust infection

b. Pod borer

Scale	Percent infection	Remarks
1	No infestation	highly tolerant
2	1-25% of the plant/plot are infested	moderately tolerant
3	25-50% of the plant/plot are infested	mildly tolerant
4	51-75% of the plant/plot are infested	susceptible
5	76-100% of the plant/plot are infested	very susceptible

G. Return on cash expenses (ROCE). Production cost, gross and net income were recorded and ROCE was determined using the following formula:

$$\text{ROCE (\%)} = \frac{\text{Gross Sales} - \text{Total Expenses}}{\text{Total Expenses}} \times 100$$

Analysis of Data

All quantitative data were analyzed using Analysis of Variance (ANOVA) for 3x5 factorialexperimentinrandomized complete block design (RCBD) with three replications. The significance of differences among treatments means were tested using Duncan’s Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DICUSSION

Agroclimatic Data

During the conduct of the study,the prevailing temperature and relative humidity in La Trinidad were within the range that is favorable for organic production of snap beans.According to Navazio, J. *et al*. in 2007, temperature of 21^0C to 27^0C is preferred for optimum growth of snap bean. Table 1 shows the temperature that prevailed during the conduct of the study. Itranged from 15.15^0C to 23.83 ^{0}C and the relative humidity ranged from 77.50 % to 86.75 %.

The total amount of rainfall recorded was 7.34 mm in November 2010 then it declined in the succeeding months. In December, rainfall was only 2.76 mm and 1.64 mm in January 2011 which was observed insufficient for snap bean production. Thus, irrigation was done using water pump once a week to supplement adequate water requirement for snap bean production. Sunshine duration was also low during the conduct of the study. In November, it was 262.40 min, then it increased to 303.00 min in December. There was 319.94 min daily sunshine duration in January 2011

Table 1.The Agroclimatic condition gathered from November 2010 to January 2011.

MONTH	AIR TEMPERATURE (^{0}C)		RELATIVE HUMIDITY (%)	AMOUNT OF RAINFALL (mm)	SUNSHINE DURATION (min)
	MIN	MAX			
November	15.15	23.83	84.50	7.34	262.40
December	14.10	24.78	86.75	2.76	303.00
January	18.23	24.28	77.50	1.64	318.94

Number of Days from Sowing to Emergence

Effect of production year of planting materials.Highly significant differences on the number of days from sowing to emergence among the different production years of planting materials were noted (Table 2 Figure 3). Planting materials that wereproduced in 2009 and 2010 emerged similarly in seven days after planting (DAP), one day earlier than the emergence of planting materials produced in 2008.

Table 2. Number of days from sowing to emergence and from emergence to flowering, firstharvest and last harvest of five pole snap bean varieties from seeds produced in three different years

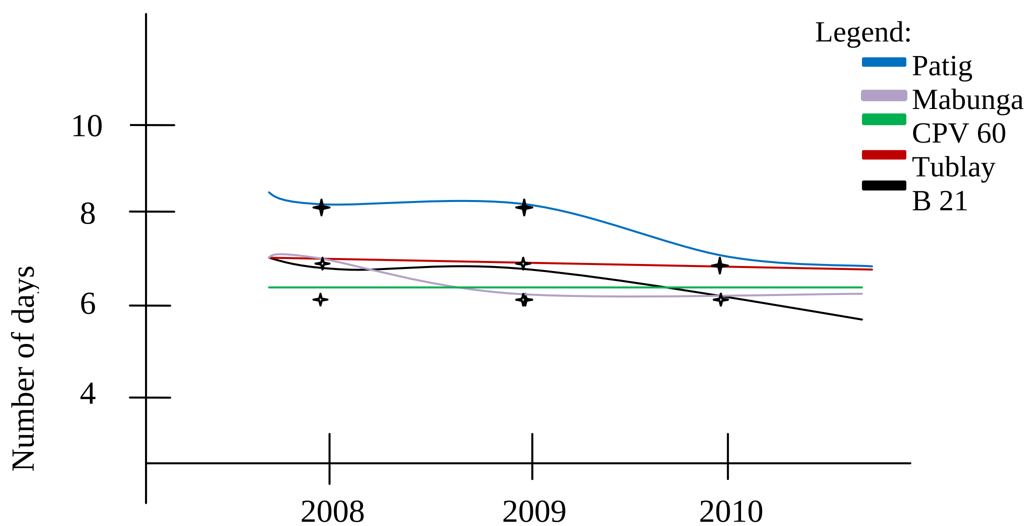
TREATMENT	NUMBER OF DAYS			
	FROM SOWING TO EMERGENCE	FROM EMERGENCE TO		
		FLOWERING	FIRST HARVEST	LAST HARVEST
Production year of planting materials (A)				
2008	7^{b}	44	55^{a}	92^{b}
2009	6^{a}	44	56^{b}	93^{a}
2010	6^{a}	44	55^{a}	93^{a}
Variety (B)				
Patig	8^{c}	47^{d}	59^{c}	95^{a}

Mabunga	6[a]	42[b]	56[b]	95[a]
CPV 60	6[a]	41[a]	50[a]	91[b]
Tublay	7[b]	45[c]	56[b]	91[b]
B 21	7[b]	45[c]	57[b]	91[b]
(A x B)	*	**	**	ns
CV (%)	4.52	1.34	1.46	0.66

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

Effect of variety.Table 2also shows the highly significant differenceson the number of days from sowing to emergence among the varieties evaluated. Mabunga and CPV 60 emerged within six DAP, one day earlier than Tublay and B 21. Patig took eight days to emerge.

Interaction effect. Statistical analysis revealed that variety and production year of planting materials had significant interaction effect on the number of days from sowing to emergence. Figure 7 shows that CPV 60 with planting material produced in year 2008, 2009 and 2010 emerged six days after sowing which was similar to Mabunga with planting materials produced in 2009, 2010 and B21 with planting materials produced in 2010, one day earlier than other treatment combinations except Patig with planting materials produced in 2008 and 2009 which took eight days to emerge.



Production year of planting materials

Figure 7. Significant interaction effect of variety and production year of planting materials on the number of days from sowing to emergence of pole snap beans

Number of Days from Emergence to Flowering

Effect of production year of planting materials. Results revealed no significant differences on the number of days from emergence to flowering among the production years of planting materials (Table 2). Regardless of the production years of planting materials, snap bean took similar number of days from emergence to flowering, within 44 days.

Effect of variety. Among the varieties evaluated, CPV 60 significantly flowered earliest within 41 DAE, one day earlier than Mabunga. Tublay had comparable days from emergence to flowering with B 21, (45 DAE). Patig was the latest to flower in 47 DAE (Table 2).

Interaction effect. Observation showed highly significant interaction effect of variety and production year of planting materials on the number of days from emergence to flowering. CPV 60 with planting materials produced in 2009 and 2010 took the fewest days from emergence to flowering within41 DAE, one day earlier than Mabunga with planting materials produced in 2008, 2009 and CPV 60 with planting materials produced in 2008. Mabunga with planting materials produced in 2010 flowered within 43 DAE which is one day earlier than B 21 with planting materials produced in 2008 and 2010. Tublay with planting materials produced in 2008, 200,2010 and B 21 with planting materials produced in 2009 flowered similarly within 45 DAE, two days earlier than Patig with planting materials produced in 2009 and 2010. Patig with planting materials produced in 2008 took the most days from emergence flowering (Figure 8).

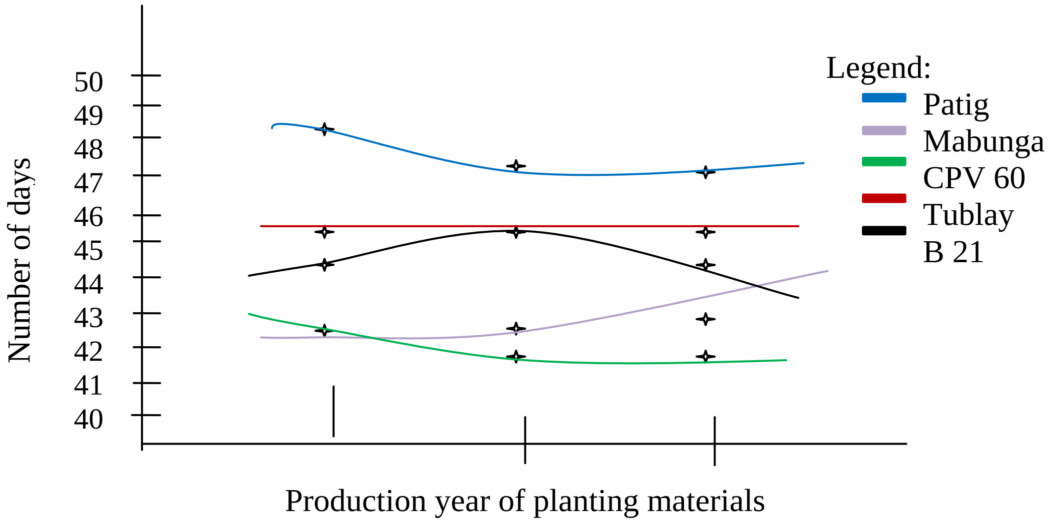


Figure 8. Highly significant interaction effect of variety and production year planting materials on the number of days from emergence to flowering of pole snap beans

Number of Days from Emergence to First Harvest

Effect of production year of planting materials. Statistical analysis revealed highly significant differences on the number of days from emergence (DAE) to first harvesting among the different production years of planting materials (Table 2). Planting materials produced in 2008 were first harvested in 55 DAE similar to those produced in 2010 that was one day earlier than planting materials that were produced in 2009.

Effect of variety.Highly significant differences were noted on number of days from emergence to first harvest among the varieties of snap bean tested.Apparently, it was also observed that number of days from emergence to first harvest was related to number of days from emergence to flowering. Variety which flowered earliestwereconsequently harvested earliest. CPV 60 was first harvested variety within 50 DAE, sixdays earlier than Mabunga and Tublay. B 21 was first harvested within 57 DAE which was two days earlier than Patig (Table 2).

Interaction effect.Highly significant interaction effect of variety and production year of planting materials was observed on the number of days from emergence to first harvest (Figure 9).

The CPV 60 with planting materials produced in year 2009 and 2010 were first harvested within 49 DAE, two days earlier than CPV 60 with planting materials produced in 2008. Mabunga and Tublay with planting materials produced in 2008 was first harvested within 55 DAE, one day earlier than Mabunga with planting materials produced in 2009, 2010 and B 21 with planting materials produced in 2010. Tublay with planting materials produced in 2009 was first harvested within 57 DAE which was comparable to B 21 with planting materials produced in 2008, two days earlier than Patig with planting materials produced in 2009 and 2010. Patig with planting materials produced in 2008 took many days form emergence to first harvest.

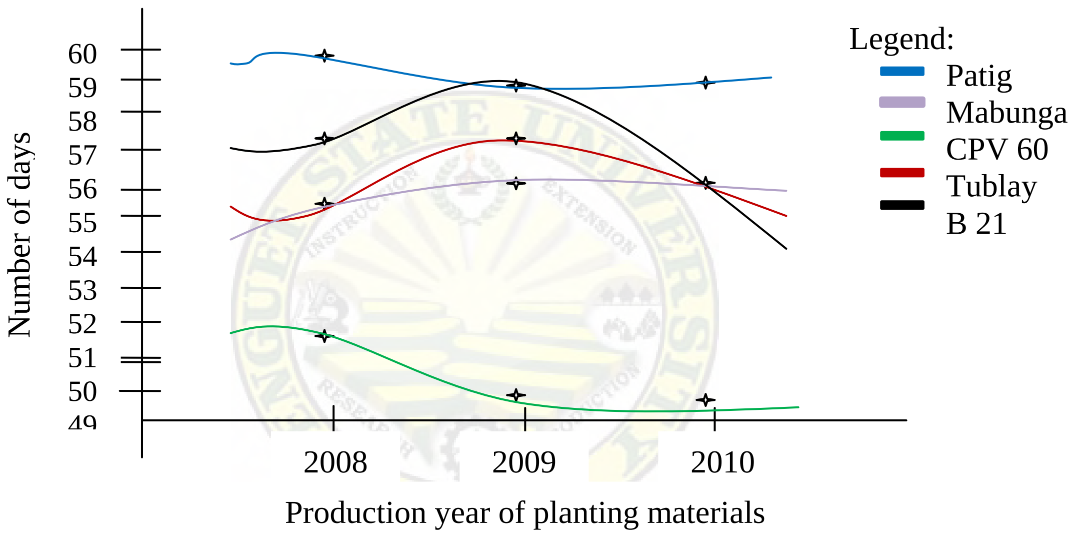


Figure 9. Highly significant interaction effect of variety and production year of planting materials on the number of days from emergence to first harvest

Number of Days from Emergence to Last Harvest

Effect of production year of planting materials. Significant differences were noted onthe number of days from emergence to last harvest amongproduction year of planting materials. Planting materials produced in 2008 took 92 DAE to lastharvest, one day earlier than planting materials produced in 2009 and 2010 (Table 2). This indicated that seeds produced within two years before planting had longer harvesting period than those produced more than two years at planting time.

Effect of variety.Highly significant differences were found on number of days from emergence to last harvest among the five varieties of snap bean evaluated (Table 2).CPV 60, Tublay and B 21 took 91 DAE to last harvest which was earlier than Mabunga and Patig which took 95 DAE to last harvesting. Moreover, CPV 60 had the longest durationof producing fresh pod yield within 41 days which was two days longer than Mabunga. Patigproduced freshpods in 36 days which was one day longer than Tublay while B 21 had the shortest duration of producing pods.

Interaction effect.No significant interaction effect of the variety and production year of planting materials usedwas noted on the number of days from emergence to last harvest (Table 2).

Percent Germination

Effect of production year of planting materials. Statistical analysis revealed highly significant differences in percent germination among the different production years of the planting materials. Seeds produced in 2009 and 2010 had higher percentage germination than the seeds produced in 2008 (Table 3).

Effect of variety. Highly significant differences were observed on the percent germination among different varieties of pole snap bean evaluated (Table 3). CPV 60 had the highest germination percentage followed by B 21 and Mabunga which was higher than Tublay. Patig had the lowest percent germination. The differences in the rate of germination may be attributed to the varietal characteristics of different snap beans that were evaluated.

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Table 3. Percent germination of five pole snap bean varieties from seeds produced in three different years

TREATMENT	GERMINATION (%)
Production year of planting materials (A)	
2008	48.66[b]
2009	70.67[a]
2010	79.62[a]
Variety (B)	
Patig	53.93[e]
Mabunga	67.66[c]
CPV 60	76.07[a]
Tublay	64.43[d]
B 21	69.50[b]
(A x B)	ns
C.V. (%)	11.22

ns - not significant

Interaction effect. It was observed that there was no significant interaction effect of production year of planting materials and variety on the percent germination of snap beans (Table 3).

Pod Length

Effect of production year of planting materials.Significant differences were observed in pod length among different production years of planting materials (Table 4). Planting materials produced in the year 2009 and 2010 had comparable pod length of more than 14.40 cm. Planting materials produced in 2008 had the shortest pods (14.12 cm)..This indicates that longer pods could be produced using those seeds produced within two years before planting than using more than two year old seeds in growing pole snap bean.

Table 4. Pod length, width and diameter of five pole snap bean varieties from seeds produced in three different years

TREATMENT	POD LENGTH (cm)	POD WIDTH (cm)	POD DIAMETER (cm)
Production year of planting materials(A)			
2008	14.12[b]	1.02[a]	1.04
2009	14.49[a]	1.00[b]	1.04
2010	14.45[a]	1.03[a]	1.04
Variety (B)			
Patig	13.78[b]	1.03[a]	1.03[b]
Mabunga	18.24[a]	1.04[a]	1.05[a]
CPV 60	13.72[b]	1.02[a]	1.05[a]
Tublay	12.98[c]	1.00[ab]	1.04[ab]
B 21	13.06[bc]	0.98[b]	1.03[b]
(A x B)	*	*	ns
CV (%)	2.92	2.16	0.85

* - significant

ns - not significant

Effect of variety. The different varieties showed highly significant differences on pod length (Table 4 and Figure 10).Mabunga produced the longest pods, longer than the other varieties evaluated. Tublay produced the shortest pods.

Variety 1 – Patig

Variety 2 – Mabunga

Variety 3 – CPV 60

Variety 4 - Tublay

Variety 5 – B 21

Figure 10. Fresh pods of five pole snap bean varieties

Interaction effect.Statistical analysis revealed significant interaction effect of variety and production year of planting materials on pod length of snap bean.Figure 11 shows that Mabunga with different production years of planting materials produced significantly longer pods than the other treatment combinationsfollowed by

CPV 60withplanting materials produced in 2010. Patig with planting materials produced in 2008 had 13.93 cm pod length, 0.53 cm longer than B 21 with planting materials produced in 2009. Patig with planting materials produced in 2009 had 13.57 cm length of pods, 0.5 cm longer than Tublay with planting materials produced in 2009. Patig with planting materials produced in 2010 had 13.83 cm length of pod, 0.66 longer than CPV 60 with planting materials produced in 2008. B 21 with planting materials produced in 2008 had the shortest pod length.

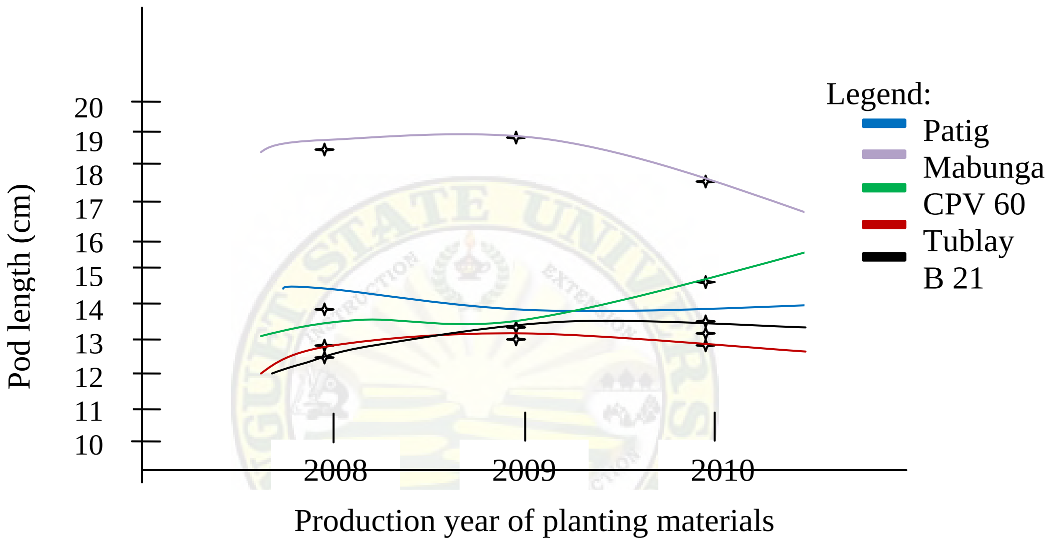

Figure 11.Significant interaction effect of variety and production year of planting materials on the pod length of snap beans.

Pod Width

Effect of production year of planting materials. Highly significant differences were observed on the pod width among different production years of planting materials (Table 4). Planting materials produced in 2010 had the widest pod of 1.03 cm which was comparable to planting materials produced in 2008.Planting materials produced in 2009 had the narrowest pod with a mean width of 1.00 cm.

Effect of variety. Highly significant differences were observed on the pod width among different varieties (Table 4 and Figure 10). Mabunga had the widestpod which were comparable to pod width of other tested varieties except for B 21 which had the narrowest pods.

Interaction effect.Significant interaction effect of variety and production year of planting materials was observedon fresh pod width of pole snap bean. Figure 12 shows that CPV 60 with planting materials produced in 2010 had the broadestpod of 1.05 cm, comparable toMabunga with planting materialsproduced in 2009 and 2010 and Patig with planting materials produced in 2008.Patig with planting materials produced in 2010 had similar pod width with CPV 60 with planting materials produced in 2008 with a mean pod width of 1.03 cm, 0.04 cm wider than Tublaywith planting materials produced in 2010 and B 21 with planting materials produced in 2008. Patig with planting materials produced in 2009 had comparable pod width withTublayand Mabungawith planting materials produced in 2008, 0.02 cm wider than Tublay with planting materials produced in 2009. B 21 with planting materials produced in 2009 had the narrowest pod width.

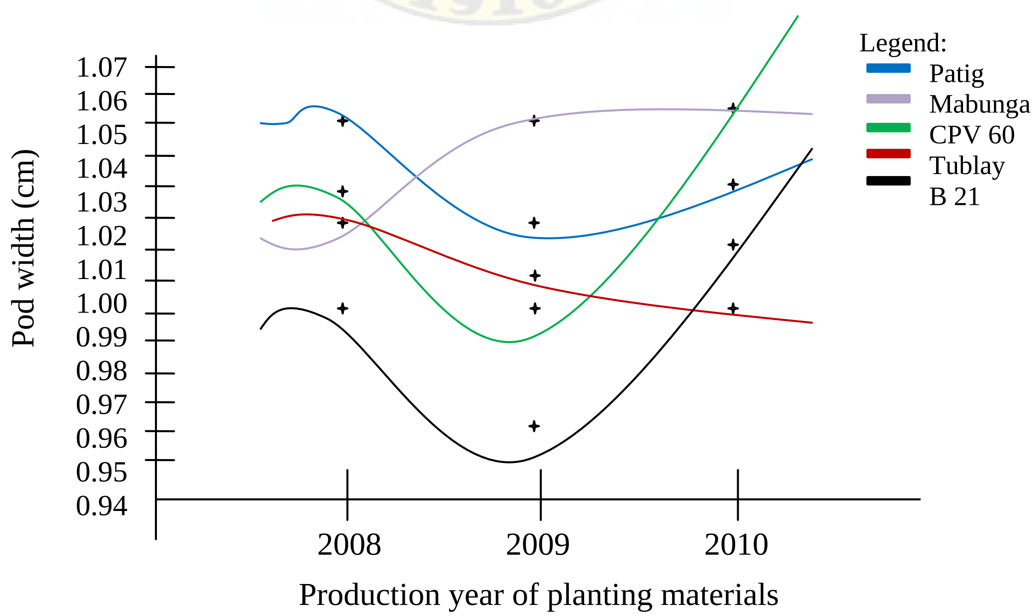

Figure 12.Significant interaction effect of variety and production year of planting materials on pod width of snap bean

Pod Diameter

Effect of production year of planting materials. Table 4further shows no significant differences on pod diameter of snap bean among the production years of planting materials. All the planting materials produced in different years had comparable pod diameter of 1.04 cm.

Effect of variety.Highly significant differences in pod diameter were observed among the varieties of pole snap beanstudied (Table 4). The pod diameter of Mabunga and CPV 60 were comparable, together with the pod diameterof Tublaywhich was statistically similar withpod diameter of B 21 and Patig.

Interaction effect.No significant interaction effect of variety and production year of planting materials was observed on pod diameter of pole snap bean (Table 4).

Pod Texture

The varieties observed in the study had similar smooth textured pods. The study showed that different production year of planting materials did not affect the pod texture exhibited by the different pole snap bean varieties.

Pod Straightness

The study showed that all of the varieties had straight pods. However,Mabunga and Patig produced more curve pods compared to other varieties. This could be due to varietal differences.

Pod Shape

Mabunga had round pods while the other varieties produced flat pods. The study showed that different production year of planting materials did not affect the pod shapeof different pole snap bean varieties. Again, this could be due to varietal differences.

Pod Color

Mabunga produced purple pods while the other varieties produced green pods. The pod color of snap bean was not affected by the different production years of planting materials (Figure 10). The purple color of Mabunga pods is influenced by its unique varietal characteristic.

Weight of Marketable Pods per Plot

Effect of production year of planting materials. There were highly significant differencesin weight of marketable pods per plot among the different production years of planting materials evaluated. Planting materials produced in 2009 and 2010produced significantly higher than planting materials produced in 2008 (Table 5).

Table 5. Fresh pod yield per plot and computed yield per hectare of five pole snap bean varieties from seeds produced in three different years

TREATMENT	FRESH POD YIELD PER PLOT (kg/5m^2)			COMPUTED YIELD PER HECTARE (t/ha)
	MARKETABLE	NON-MARKETABLE	TOTAL	
Production year of planting material (A)				
2008	3.89^{b}	0.94^{b}	4.84^{b}	9.67^{b}
2009	5.31^{a}	1.31^{a}	6.61^{a}	13.22^{a}
2010	5.48^{a}	1.36^{a}	6.84^{a}	13.68^{a}
Variety (B)				
Patig	3.67^{d}	0.83^{c}	4.49^{d}	8.99^{d}
Mabunga	6.27^{a}	2.04^{a}	8.31^{a}	16.62^{a}
CPV 60	5.08^{b}	1.13^{b}	6.21^{b}	12.42^{b}
Tublay	4.26^{c}	1.01^{bc}	5.27^{c}	10.54^{c}
B 21	5.20^{b}	0.99^{bc}	6.19^{b}	12.38^{b}
(A x B)	ns	**	**	**
CV (%)	5.19	9.64	5.16	5.16

** - highly significant ns - not significant

Effect of variety. The five varieties of pole snap bean tested also showed highly significant differences on the weight of marketable pods per plot. Mabunga yielded the highest marketable pods per plot. It was higher than marketable fresh pods of B 21 and CPV 60. Tublay yielded 4.26 kg/5 m^2 while Patig recorded the least marketable yield per plot (Table 5).

Interaction effect. No significant interaction effect of variety and production year of planting materials was observed on the weight of marketable pods per plot of pole snap bean (Table 5).

Weight of Non-marketable Pods per Plot

Effect of production year of planting materials. Highly significant differences were observed on the weight of non-marketable pods per plot among the different production years of planting materials (Table 5). Planting materials produced in 2010 and 2009 had higher non-marketable pods than planting materials produced in 2008 which had lessthan one kilogram of non-marketable pod yield per 5 m^2 plot.The non-marketability of pods was caused not only by pest and diseases but also due to different stages of maturity.Planting materials that were produced in less than two years produced more matured and lumpy pods that were considered as non-marketable.

Effect of variety. Statistical analysis revealed highly significant differences on the weight of non-marketable pods among the different varieties (Table 5). Mabunga had the highest non-marketable fresh pods per plot, It was followed by CPV 60 which had higher non-marketable pods per plot than Tublay and B 21. Patigalso recorded the least weight of non-marketable pods per plot. The higher weight of non-marketable pods of Mabunga was due to the longer pods that tended to bend during pod development that resulted to non-marketable pods.

Interaction effect. Highly significant interaction effect of variety and production year of planting materials was observed on the weight of non-marketable pods per plot. Figure 13 shows that Mabungawith planting materials produced in 2009 and 2010 had the heaviest non-marketable pods, 1.0 kg heavier than CPV 60 with planting materials produced in 2010. Tublay had 1.24 kg of non-marketable pods, less than 0.50 kg heavier than Patig with planting materials produced in

2009 and 2010, CPV 60 with planting materials produced in 2008 and 2009,Tublay with planting materials produced in 2009 and B 21 with planting materials produced in three different years. Patig and Tublay with planting materials produced in 2008 had the least weight of non-marketable pods per plot.

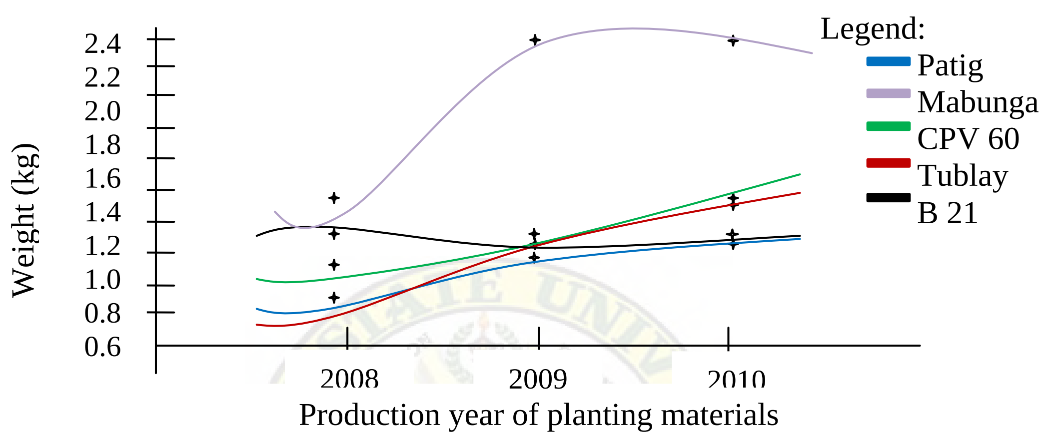

Figure 13.Highly significant interaction effect of variety and production year of planting materials on the weight of non-marketable pods per plot of snap beans

Total Yield per Plot

Effect of production year of planting materials. The total yield per plot of snap beans with planting materials produced in different years were found to be highly significant different (Table 5). Planting materials produced in 2010 produced the highest total yield per plot which was comparable to the total yield of planting materials produced in 2009. They significantly outyielded the planting materials produced in 2008.

Effect of variety.Mabunga gave the highest total yield per plot which was significantly higher than CPV 60 and B 21. Patig gained the lowest total yield per plot.

Interaction effect. The variety and production year of planting materials of pole snap beans had high significant interaction effect on total yield per plot (Figure 14). Among the entries, Mabunga with planting materials produced in 2010 and 2009 yielded most significantly higher than CPV 60 with planting materials produced in 2010. CPV 60 with planting materials produced in 2009 had 6.65 kg of total fresh pod yield per plot which was comparable to the yield of B 21 with planting materials produced in 2009 and 2010, Mabunga with planting materials produced in 2008 and Tublay with planting materials produced in 2010. Tublay with planting materials produced in 2009 had 5.81 kg total yield per plot which was comparable to B 21 with planting materials produced in 2008, almost 0.50 kg heavier than Patig with planting materials produced in 2009, 2010 and CPV 60 with planting materials produced in 2008. Patig and Tublay with planting materials produced in 2008 recorded the least total yield per plot.

Computed Yield per Hectare

Effect of production year of planting materials. Statistical analysis revealed highly significant differences in the computed yield per hectare among the different production years of planting materials (Table 5). Planting materials that were produced in 2010 and 2009 has the highest computed yield per hectare than those of planting materials produced in 2008 (Table 5).

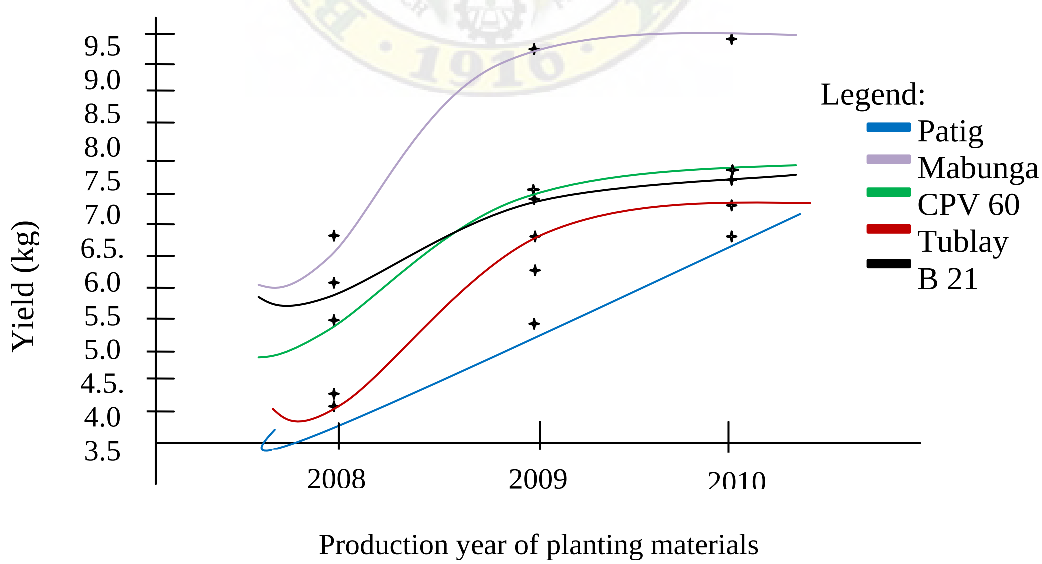

Figure 14.Highly significant interaction effect of variety and production year of planting materials on the total yield per plot of snap beans

Effect of variety. In terms of computed yield per hectare, Mabunga also registered the highest yield per hectare. It was followed by CPV 60 and B 21. Also Patig recorded lowest computed yield per hectare(8.99 t/ha).

Interaction effect. Highly significant interaction effect of variety and production year of planting materials was observed on the computed yield per hectare (Figure 15). Mabunga with planting materials produced in 2010 and 2009 yielded most followed by CPV 60 with planting materials produced in 2010 and 2009. B21 with planting materials produced in 2009 and 2010 were comparable which were higher than Mabunga with planting materials produced in 2008 and Tublay with planting materials produced in 2010. Tublay with planting materials had 11.61 t/ha computed yield, 0.56 t/ha heavier than B 21 with planting materials produced in 2008. Patig with planting materials produced in 2008 yielded least consequently had the least computed yield per hectare. This result shows that seeds of snap beans purposely for planting material are affected by duration of storage. Snap bean seeds stored in more than two years are less productive.

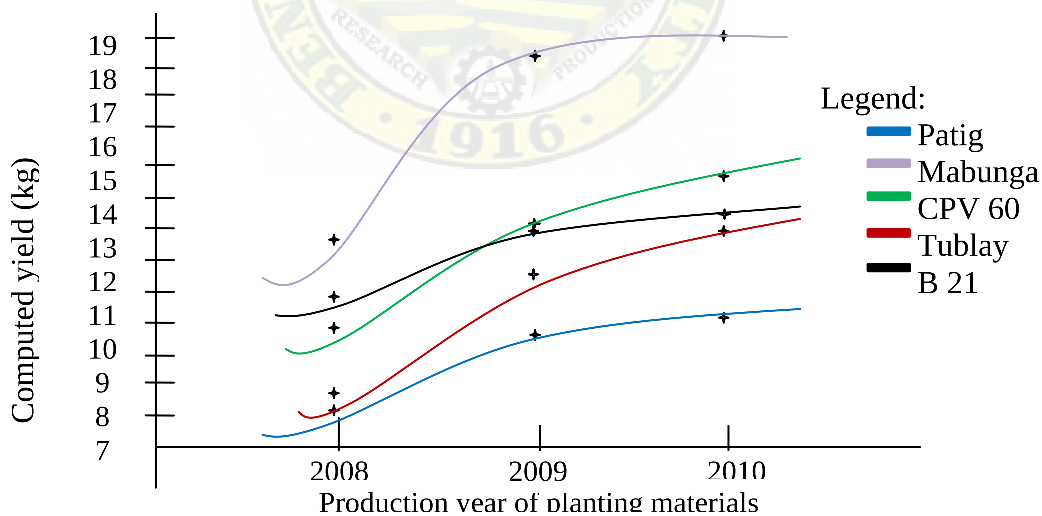

Figure 15. Interaction effect of variety and production year of planting materials on the computed yield per hectare of snap beans

Reaction to Bean Rust

Effect of production year of planting materials. No significant differences were observed on the reaction to bean rust infection among the different production years of planting materials of snap beans. The study revealed that planting materials produced in 2008, 2009 and 2010 had comparable rating of mildly resistant to bean rust.

Effect of variety. Bean rust infection among five varieties of pole snap bean was found highly significant. Mabunga and Tublay had moderate resistance rating. CPV 60 and B 21 had both mildly resistant rating while Patig was found susceptible to bean rust.

Interaction effect. No significant interaction effect of variety and production year of planting materials was observed on the bean rust infection in pole snap bean.

Reaction to Pod Borer

Effect of production year of planting materials. No significant differences were observed on the pod borer infestation among the different production year of planting material of snap beans.

Effect of variety. Highly significant differences were observed on the pod borer infestation among the different varieties tested. CPV 60, B 21, Tublay and Mabunga wererated moderately resistant to pod borer whilePatigwas most affected exhibiting mild resistance to pod borer.

Interaction effect. No significant interaction effect of the variety and production year of planting materials was observed on the pod borer infestation in pole snap bean. All the varietiestested with different production year of planting materials exhibitedmoderate resistance to pod borer exceptPatig with planting materials produced in 2008, 2009 and 2010were found to have comparable mild resistance rating.

Return on Cash Expenses (ROCE)

Effect of production year of planting materials.The ROCE on growing pole snap beans grown for seeds of different production years of pole snap beans is shown in Table 6. It was seen that planting materials produced in 2010 recorded the highest ROCE followed by planting materials that were produced in 2009. Planting materials produced in 2008 registered the least

ROCE. Planting materials produced in the last two years before planting gave higher ROCE than those planting materials produced in 2008. Although positive ROCE was realized even when the seeds used in planting snap bean had been stored for three years under ambient room condition.

Effect of variety. All the varieties studied were found profitable. Mabungathat gave the highest pod yield consequently had the highest ROCE followed by B 21 which had comparableROCE with CPV 60. Patig registered the least ROCE (Table 6).

Interaction effect.Mabunga with planting materials produced in 2010 and 2009 recorded the highest ROCE followed by CPV 60 and B 21 with planting materials produced in 2010. CPV 60 and B21 with planting materials produced in 2009 were comparable, 30% higher than Tublay with planting materials produced in 2010. Mabunga with planting materials produced in 2008 had 143.41% ROCE, 15% higher than Tublay with planting materials produced in 2009. Tublay with planting materials produced in 2008 had 13% advantage than Patig with planting materials produced in 2010. CPV 60 with planting materials produced in 2008 and Patig with planting materials produced in 2009 had comparable ROCE, 40% higher than Tublay with planting materials produced in 2008. Patig with planting materials produced in 2008 had the least ROCE.

Table 6. Return on Cash Expenses (ROCE) on growing five pole snap bean varieties from seeds produced in three different years

ENTRIES	MARKETABLE PODS (kg)	GROSS SALE (PhP)	TOTAL EXPENSES (PhP)	NET INCOME (PhP)	ROCE (%)
Planting materials produced in 2008					
Patig	8.5	340	246.5	93.5	37.93
Mabunga	15	600	246.5	353.5	143.41
CPV 60	12	480	246.5	233.5	94.73
Tublay	9.5	380	246.5	133.5	54.16
B 21	13.4	536	246.5	289.5	117.44

Planting materials produced in 2009					
Patig	11.9	476	246.5	229.5	93.10
Mabunga	20.5	820	246.5	573.5	232.66
CPV 60	16.5	660	246.5	413.5	167.75
Tublay	14.1	564	246.5	317.5	128.80
B 21	16.6	664	246.5	417.5	169.37
Planting materials produced in 2010					
Patig	12.6	504	246.5	257.5	104.46
Mabunga	20.9	836	246.5	589.5	239.15
CPV 60	17.2	688	246.5	441.5	179.11
Tublay	14.7	588	246.5	341.5	138.54
B 21	16.8	672	246.5	425.5	172.62

- Total expenses includes land preparation, cost of compost fertilizer, trellis, care and management include weeding, hilling-up and watering.

  Selling price: Php 40/kg

SUMMARRY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The study was conducted at Benguet State University Experimental Station, Balili, La Trinidad to evaluate different pole snap bean varieties with different production years of planting materials under organic production system; determine the best variety and best storage duration of seeds for planting material; and to determine the interaction effect of variety and different storage duration of planting materials.

There were significant differences in almost all the parameters observed in this study among the different production years of planting materials except for days from emergence to flowering, pod diameter and resistance to bean rust and pod borer. Planting materials produced in 2010 had better or comparable performance with planting materials produced in 2009 which significantly outperformed snap beans grown from planting materials produced in 2008.

In all the parameters measured, there were highly significant differences among the five varieties evaluated. Mabunga was the first to germinate which was comparable to CPV 60, one day earlier than Tublay and B 21. Patig took eight days to emerge. CPV 60 had the highest percent germination which was comparable to B 21, Mabunga and Tublay. Patig had the least percent emergence. CPV 60 flowered and matured first among the varieties evaluated. Patig was the latest to flower and to mature. Mabungaoutyielded other varieties and it was observed moderately resistant to bean rust and pod borer. Patig was the poorest yielder and it was observed mildly resistant to bean rust and pod borer.

No significant interaction effect of variety and production year of planting materials was observed on the percent germination, number of days from emergence to last harvest, pod diameter, weight of marketable pods per plot, reaction to bean rust infection and reaction to pod borer infestation. However, significant interactions effect was observed on the number of days from sowing to emergence, pod length and pod width. Furthermore, highly significant interaction effect was observed on the number of days from emergence to flowering, number of days from emergence to first harvest, weight of non-marketable pods per plot, total yield per plot and computed yield per hectare.

In planting pole snap bean under organic production system, positive ROCE was obtained regardless of production year of planting materials used. However, higher ROCE was obtained from snap bean grown from planting materials produced in 2009 and 2010 or from one to two year stored seeds. Mabunga registered the highest ROCE, followed by B 21 and CPV 60. The other varieties also recorded very high ROCE. All the varieties grown in this study was found profitable under organic production system in La Trinidad, Benguet.

Conclusions

The storage duration of planting materials of snap bean under ordinary room condition affect the performance of the crop. The long duration of storage of planting materials caused the seed to deteriorate. The results of this study proved that snap bean grown from seeds stored within two years resulted in higher percent germination, longer pods and higher yield than those snap bean grown from seeds stored longer than two years. Planting materials produced in 2009 and 2010 performed well in terms of growth and yield with high ROCE. Among the varieties evaluated, CPV 60 had the highest percent germination and was early maturing variety. B 21, Tublay and Mabunga are mid-maturing varieties while Patig was late maturing. All the varieties studied were high yielding though Mabunga registered the highest yield and ROCE under organic production system. Furthermore, all the varieties had moderate resistance to bean rust and pod borer except for Patig which had mild resistance to the said pest and disease.

The variety and production year of planting materials had significant interaction effect on number of days from sowing to emergence, number of days from emergence to first and last harvest, pod length and width, weight of non-marketable pods, total yield per plot and computed yield per hectare.

Recommendations

Based on the results of this study, one to two year old pole snap bean seeds could be used to grow any of the five evaluated varieties of pole snap bean under organic production system in La Trinidad, Benguet.

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APPENDICES

Appendix Table 1. Number of days from sowing to emergence

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
2008					
Patig	8	8	8	24	8.00
Mabunga	7	7	7	21	7.00
CPV 60	7	6	6	19	6.33
Tublay	7	7	7	21	7.00
B 21	7	7	7	21	7.00
2009					
Patig	7	8	8	23	7.67
Mabunga	6	6	6	18	6.00
CPV 60	6	6	6	18	6.00
Tublay	7	7	7	21	7.00
B 21	7	7	7	21	7.00
2010					
Patig	7	7	8	22	7.33
Mabunga	7	6	6	19	6.33
CPV 60	6	6	6	18	6.00
Tublay	7	7	7	21	7.00
B 21	6	6	6	18	6.00
TOTAL	102	101	102		
GRAND TOTAL				305	
GRAND MEAN					6.78

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	8	8	7	23	8[c]
Mabunga	7	6	6	19	6[a]
CPV 60	6	6	6	18	6[a]
Tublay	7	7	7	21	7[b]
B 21	7	7	6	20	7[b]
Production year of planting materials total	35	34	33	102	
MEAN	7[b]	6[a]	6[a]		7

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	0.044	0.022			
FACTOR A	2	2.178	1.089	11.62**	3.34	5.45
FACTOR B	4	12.667	3.167	33.81**	2.71	4.07
A x B	8	2.267	0.283	3.02*	2.29	3.23
ERROR	28	2.622	0.094			
TOTAL	44	19.778				

** - highly significant
 * - significant

C.V. = 4.52%

Appendix Table 2. Number of days from emergence to flowering

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
2008					
Patig	48	47	48	143	48
Mabunga	41	42	42	125	42
CPV 60	42	42	43	127	42
Tublay	44	45	46	135	45
B 21	45	44	44	133	44
2009					
Patig	47	47	47	141	47
Mabunga	42	43	42	127	42
CPV 60	41	41	40	122	41
Tublay	45	45	46	136	45
B 21	46	44	45	135	45
2010					
Patig	47	47	47	141	47
Mabunga	43	43	43	129	43
CPV 60	41	41	40	122	41
Tublay	45	45	45	135	45
B 21	45	44	44	133	44
TOTAL	662	660	662		
GRAND TOTAL				1984	
GRAND MEAN					44

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	48	47	47	142	47^{d}
Mabunga	42	42	43	127	42^{b}
CPV 60	42	41	41	124	41^{a}
Tublay	45	45	45	135	45^{c}
B 21	44	45	44	134	45^{c}
Production year of planting materials total	221	220	220	661	
MEAN	44	44	44		44

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	0.178	0.089			
FACTOR A	2	0.311	0.156	0.44^{ns}	3.34	5.45
FACTOR B	4	201.422	50.356	143.54**	2.71	4.07
A x B	8	9.911	1.239	3.53**	2.29	3.23
ERROR	28	9.822	0.351			
TOTAL	44	221.644				

** - highly significant C.V. = 1.34%
ns - notsignific

Appendix Table 3. Number of days from emergence to first harvest

ENTRIES	REPLICATION I	II	III	TOTAL	MEAN
2008					
Patig	59	60	60	179	60
Mabunga	54	55	55	164	55
CPV 60	50	51	51	152	51
Tublay	54	56	55	165	55
B 21	56	57	57	170	57
2009					
Patig	59	59	60	178	59
Mabunga	55	57	56	168	56
CPV 60	49	49	50	148	49
Tublay	58	57	56	171	57
B 21	58	60	59	177	59
2010					
Patig	59	59	60	178	59
Mabunga	57	56	55	168	56
CPV 60	49	49	50	148	49
Tublay	55	57	55	167	56
B 21	57	55	55	167	56
TOTAL	829	837	834		
GRAND TOTAL				2500	
GRAND MEAN					56

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	60	59	59	178	59[c]
Mabunga	55	56	56	167	56[b]
CPV 60	51	49	49	149	50[a]
Tublay	55	57	56	168	56[b]
B 21	57	59	56	171	57[b]
Production year of planting materials total	277	281	276	833	
MEAN	55[a]	56[b]	55[a]		56

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	2.178	1.089			
FACTOR A	2	7.644	3.822	5.79**	3.34	5.45
FACTOR B	4	459.333	114.833	173.90**	2.71	4.07
A x B	8	23.467	2.933	4.44**	2.29	3.23
ERROR	28	18.489	0.660			
TOTAL	44	511.111				

** - highly significant C.V. = 1.

Appendix Table 4. Number of days from emergence to last harvest

ENTRIES	REPLICATION I	II	III	TOTAL	MEAN
2008					
Patig	96	95	95	286	95
Mabunga	94	94	94	282	94
CPV 60	90	90	91	271	90
Tublay	90	91	91	272	91
B 21	90	92	91	273	91
2009					
Patig	95	95	95	285	95
Mabunga	95	95	95	285	95
CPV 60	90	91	91	272	91

Tublay	92	92	91	275	92
B 21	92	92	90	274	91
2010					
Patig	96	95	96	287	96
Mabunga	95	95	95	285	95
CPV 60	90	92	91	273	91
Tublay	91	92	92	275	92
B 21	91	91	91	273	91
TOTAL	1387	1392	1389		
GRAND TOTAL				4168	
GRAND MEAN					93

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	95	95	96	286	95^{a}
Mabunga	94	95	95	284	95^{a}
CPV 60	90	91	91	272	91^{b}
Tublay	91	92	92	274	91^{b}
B 21	91	91	91	273	91^{b}
Production year of planting materials total	461	464	464	1389	
MEAN	92^{b}	93^{a}	93^{a}		93

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	0.844	0.422			
FACTOR A	2	2.978	1.489	3.97*	3.34	5.45
FACTOR B	4	173.689	43.422	115.91**	2.71	4.07
A x B	8	2.578	0.322	0.86^{ns}	2.29	3.23
ERROR	28	10.489	0.375			
TOTAL	44	190.578				

** - highly significant
C.V. = 0.66%
* - significant
ns - not significant

Appendix Table 5. Percent emergence

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
2008					
Patig	40.00	31.10	37.80	108.90	36.30
Mabunga	57.70	55.60	50.00	163.30	54.43
CPV 60	47.80	58.90	58.90	165.60	55.20
Tublay	36.60	53.30	41.10	131.00	43.67
B 21	44.40	65.60	51.10	161.10	53.70
2009					
Patig	72.20	51.10	55.60	178.90	59.63
Mabunga	83.30	66.70	77.80	227.80	75.93
CPV 60	87.80	75.60	87.80	251.20	83.73
Tublay	61.10	71.10	70.00	202.20	67.40
B 21	64.40	70.00	65.60	200.00	66.67
2010					
Patig	81.10	55.40	61.10	197.60	65.87
Mabunga	73.30	76.70	67.80	217.80	72.60
CPV 60	90.00	90.00	87.80	267.80	89.27
Tublay	86.70	82.20	77.80	246.70	82.23
B 21	84.40	88.90	91.10	264.40	88.13
TOTAL	1010.80	992.20	981.30		
GRAND TOTAL				2984.30	
GRAND MEAN					66.32

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	36.30	59.63	65.87	161.80	53.93^{e}
Mabunga	54.43	75.93	72.60	202.97	67.66^{c}
CPV 60	55.20	83.73	89.27	228.20	76.07^{a}
Tublay	43.67	67.40	82.23	193.30	64.43^{d}
B 21	53.70	66.67	88.13	208.50	69.50^{b}
Production year of planting materials total	243.30	353.37	398.10	994.77	
MEAN	48.66^{b}	70.67^{a}	79.62^{a}		66.32

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	29.667	14.834			
FACTOR A	2	7615.757	3807.878	68.83**	3.34	5.45
FACTOR B	4	2374.944	593.736	10.73**	2.71	4.07
A x B	8	735.719	91.965	1.66^{ns}	2.29	3.23
ERROR	28	1548.920	55.319			
TOTAL	44	12305.006				

** - highly significant C.V. = 11.22%
ns - not significant

Appendix Table 6. Pod length (cm)

ENTRIES	REPLICATION I	II	III	TOTAL	MEAN
2008					
Patig	13.20	14.20	14.40	41.80	13.93
Mabunga	18.30	18.30	18.40	55.00	18.33
CPV 60	13.60	13.20	12.70	39.50	13.17
Tublay	12.40	13.00	12.90	38.30	12.77
B 21	12.60	12.20	12.40	37.20	12.40
2009					
Patig	14.20	13.60	12.90	40.70	13.57
Mabunga	18.60	18.50	19.00	56.10	18.70
CPV 60	13.50	13.50	14.20	41.20	13.73
Tublay	13.10	13.00	13.10	39.20	13.07
B 21	12.80	13.60	13.80	40.20	13.40
2010					
Patig	13.30	14.20	14.00	41.50	13.83
Mabunga	18.20	17.20	17.70	53.10	17.70
CPV 60	14.50	14.00	14.30	42.80	14.27
Tublay	12.70	13.20	13.40	39.30	13.10
B 21	13.70	13.40	13.00	40.10	13.37
TOTAL	214.70	215.10	216.20		
GRAND TOTAL				646.00	
GRAND MEAN					14.36

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	13.93	13.57	13.83	41.33	13.78[b]
Mabunga	18.33	18.70	17.70	54.73	18.24[a]
CPV 60	13.17	13.73	14.27	41.17	13.72[b]
Tublay	12.77	13.07	13.10	38.93	12.98[c]
B 21	12.40	13.40	13.37	39.17	13.06[bc]
Production year of planting materials total	70.60	72.47	72.27	215.33	
MEAN	14.12[b]	14.49[a]	14.45[a]		14.36

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	0.080	0.040			
FACTOR A	2	1.260	0.630	3.60*	3.34	5.45
FACTOR B	4	175.020	43.755	249.71**	2.71	4.07
A x B	8	4.444	0.555	3.17*	2.29	3.23
ERROR	28	4.906	0.175			
TOTAL	44	185.711				

** - highly significant
 * - significant

C.V. = 2.92%

Appendix Table 7. Pod width (cm)

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
2008					
Patig	1.00	1.06	1.08	3.14	1.05
Mabunga	1.00	1.04	1.02	3.06	1.02
CPV 60	1.04	1.04	1.00	3.08	1.03
Tublay	1.00	1.04	1.02	3.06	1.02
B 21	0.98	1.02	0.98	2.98	0.99
2009					
Patig	1.00	1.02	1.04	3.06	1.02
Mabunga	1.02	1.06	1.06	3.14	1.05

CPV 60	0.94	1.02	1.00	2.96	0.99
Tublay	1.00	1.02	0.98	3.00	1.00
B 21	0.90	0.96	0.98	2.84	0.95
2010					
Patig	1.02	1.02	1.04	3.08	1.03
Mabunga	1.04	1.08	1.02	3.14	1.05
CPV 60	1.04	1.06	1.06	3.16	1.05
Tublay	0.98	1.00	1.00	2.98	0.99
B 21	1.04	1.00	1.00	3.04	1.01
TOTAL	15.00	15.44	15.28		
GRAND TOTAL				45.72	
GRAND MEAN					1.02

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	1.05	1.02	1.03	3.09	1.03[b]
Mabunga	1.02	1.05	1.05	3.11	1.04[a]
CPV 60	1.03	0.99	1.05	3.07	1.02[c]
Tublay	1.02	1.00	0.99	3.01	1.00[d]
B 21	0.99	0.95	1.01	2.95	0.98[e]
Production year of planting materials total	5.11	5.00	5.13	15.24	
MEAN	1.02[a]	1.00[b]	1.03[a]		1.02

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	0.163	0.082			
FACTOR A	2	0.166	0.083	6.89**	3.34	5.45
FACTOR B	4	0.407	0.102	8.45**	2.71	4.07
A x B	8	0.285	0.036	2.96*	2.29	3.23
ERROR	28	0.337	0.012			
TOTAL	44	1.358				

** - highly significant C.V. = 2.16%

 * - significant

Appendix Table 8. Pod diameter (cm)

ENTRIES	REPLICATION I	II	III	TOTAL	MEAN
2008					
Patig	1.03	1.03	1.03	3.09	1.03
Mabunga	1.04	1.05	1.06	3.15	1.05
CPV 60	1.05	1.07	1.05	3.17	1.06
Tublay	1.04	1.03	1.06	3.13	1.04
B 21	1.03	1.03	1.02	3.08	1.03
2009					
Patig	1.03	1.03	1.02	3.08	1.03
Mabunga	1.05	1.06	1.05	3.16	1.05
CPV 60	1.05	1.05	1.04	3.14	1.05
Tublay	1.03	1.05	1.03	3.11	1.04
B 21	1.02	1.05	1.03	3.10	1.03
2010					
Patig	1.02	1.03	1.03	3.08	1.03
Mabunga	1.05	1.05	1.04	3.14	1.05
CPV 60	1.05	1.05	1.05	3.15	1.05
Tublay	1.03	1.05	1.05	3.13	1.04
B 21	1.03	1.05	1.02	3.10	1.03
TOTAL	15.55	15.68	15.58		
GRAND TOTAL				46.81	
GRAND MEAN					1.04

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	1.03	1.03	1.03	3.09	1.03^{b}
Mabunga	1.05	1.05	1.05	3.15	1.05^{a}
CPV 60	1.06	1.05	1.05	3.16	1.05^{a}
Tublay	1.04	1.04	1.04	3.12	1.04^{ab}
B 21	1.03	1.03	1.03	3.09	1.03^{b}
Production year of planting materials total	5.21	5.2	5.2	15.61	
MEAN	1.04	1.04	1.04		1.04

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	0.062	0.031			
FACTOR A	2	0.003	0.002	0.20^{ns}	3.34	5.45
FACTOR B	4	0.404	0.102	13.07**	2.71	4.07
A x B	8	0.039	0.005	0.63^{ns}	2.29	3.23
ERROR	28	0.218	0.008			
TOTAL	44	0.730				

** - highly significant C.V. = 0.85%
ns - not significant

Appendix Table 9. Weight of marketable pods per plot (kg/5m^2)

ENTRIES	REPLICATION I	II	III	TOTAL	MEAN
2008					
Patig	2.80	3.20	2.50	8.50	2.83
Mabunga	4.80	5.50	4.70	15.00	5.00
CPV 60	4.10	4.10	3.80	12.00	4.00
Tublay	3.00	3.30	3.20	9.50	3.17
B 21	4.60	4.50	4.30	13.40	4.47
2009					
Patig	4.30	3.70	3.90	11.90	3.97
Mabunga	6.90	6.80	6.80	20.50	6.83
CPV 60	5.10	5.60	5.80	16.50	5.50
Tublay	4.50	4.80	4.80	14.10	4.70
B 21	5.50	5.80	5.30	16.60	5.53
2010					
Patig	4.50	3.90	4.20	12.60	4.20
Mabunga	7.10	6.80	7.00	20.90	6.97
CPV 60	5.60	5.60	6.00	17.20	5.73
Tublay	4.80	5.00	4.90	14.70	4.90
B 21	5.80	5.70	5.30	16.80	5.60
TOTAL	73.40	74.30	72.50		
GRAND TOTAL				220.20	
GRAND MEAN					4.89

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	2.83	3.97	4.20	11.00	3.67[d]
Mabunga	5.00	6.83	6.97	18.80	6.27[a]
CPV 60	4.00	5.50	5.73	15.23	5.08[b]
Tublay	3.17	4.70	4.90	12.77	4.26[c]
B 21	4.47	5.53	5.60	15.60	5.20[b]
Production year of planting materials total	19.47	26.53	27.40	73.40	
MEAN	3.89[b]	5.31[a]	5.48[a]		4.89

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	0.108	0.054			
FACTOR A	2	22.725	11.363	176.23**	3.34	5.45
FACTOR B	4	35.330	8.833	136.99**	2.71	4.07
A x B	8	0.859	0.107	1.67[ns]	2.29	3.23
ERROR	28	1.805	0.064			
TOTAL	44	60.828				

** - highly significant
ns - not significant

C.V. = 5.19%

Appendix Table 10. Weight of non-marketable pods per plot (kg/5m^2)

ENTRIES	REPLICATION I	II	III	TOTAL	MEAN
2008					
Patig	0.64	0.74	0.66	2.04	0.68
Mabunga	1.10	1.67	1.32	4.09	1.36
CPV 60	0.80	0.97	0.96	2.73	0.91
Tublay	0.62	0.73	0.75	2.10	0.70
B 21	0.83	1.24	1.10	3.17	1.06
2009					
Patig	0.85	0.96	0.86	2.67	0.89
Mabunga	2.34	2.40	2.46	7.20	2.40
CPV 60	1.08	1.10	1.26	3.44	1.15

Tublay	0.96	1.00	1.36	3.32	1.11
B 21	0.78	1.10	1.09	2.97	0.99
2010					
Patig	0.97	0.90	0.87	2.74	0.91
Mabunga	2.15	2.60	2.36	7.11	2.37
CPV 60	1.30	1.28	1.45	4.03	1.34
Tublay	1.16	1.25	1.30	3.71	1.24
B 21	0.91	0.97	0.93	2.81	0.94
TOTAL	16.49	18.91	18.73		
GRAND TOTAL				54.13	
GRAND MEAN					1.20

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	0.68	0.89	0.91	2.48	0.83[c]
Mabunga	1.36	2.40	2.37	6.13	2.04[a]
CPV 60	0.91	1.15	1.34	3.40	1.13[b]
Tublay	0.70	1.11	1.24	3.04	1.01[bc]
B 21	1.06	0.99	0.94	2.98	0.99[bc]
Production year of planting materials total	4.71	6.53	6.80	18.04	
MEAN	0.94[b]	1.31[a]	1.36[a]		1.20

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	0.242	0.121			
FACTOR A	2	1.553	0.776	57.72**	3.34	5.45
FACTOR B	4	8.395	2.099	156.04**	2.71	4.07
A x B	8	1.410	0.176	13.10**	2.29	3.23
ERROR	28	0.377	0.013			
TOTAL	44	11.976				

** - highly significant C.V. = 9.64%

Appendix Table 11. Total yield per plot (kg/5m^2)

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
2008					
Patig	3.44	3.94	3.16	10.54	3.51
Mabunga	5.90	7.17	6.02	19.09	6.36
CPV 60	4.90	5.07	4.76	14.73	4.91
Tublay	3.62	4.03	3.95	11.60	3.87
B 21	5.43	5.74	5.40	16.57	5.52
2009					
Patig	5.15	4.66	4.76	14.57	4.86
Mabunga	9.24	9.20	9.26	27.70	9.23
CPV 60	6.18	6.70	7.06	19.94	6.65
Tublay	5.46	5.80	6.16	17.42	5.81
B 21	6.28	6.90	6.39	19.57	6.52
2010					
Patig	5.47	4.80	5.07	15.34	5.11
Mabunga	9.25	9.40	9.36	28.01	9.34
CPV 60	6.90	6.88	7.45	21.23	7.08
Tublay	5.96	6.25	6.20	18.41	6.14
B 21	6.71	6.67	6.23	19.61	6.54
TOTAL	89.89	93.21	91.23		
GRAND TOTAL				274.33	
GRAND MEAN					6.10

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	3.51	4.86	5.11	13.48	4.49[d]
Mabunga	6.36	9.23	9.34	24.93	8.31[a]
CPV 60	4.91	6.65	7.08	18.63	6.21[b]
Tublay	3.87	5.81	6.14	15.81	5.27[c]
B 21	5.52	6.52	6.54	18.58	6.19[b]
Production year of planting materials total	24.18	33.07	34.20	91.44	
MEAN	4.84[b]	6.61[a]	6.84[a]		6.10

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	0.372	0.186			
FACTOR A	2	36.157	18.078	182.94**	3.34	5.45
FACTOR B	4	73.592	18.398	186.18**	2.71	4.07
A x B	8	4.310	0.539	5.45**	2.29	3.23
ERROR	28	2.767	0.099			
TOTAL	44	117.198				

** - highly significant C.V. = 5.16%

Appendix Table 12. Computed yield per hectare (t/ha)

ENTRIES	REPLICATION I	II	III	TOTAL	MEAN
2008					
Patig	6.88	7.88	6.32	21.08	7.03
Mabunga	11.80	14.34	12.04	38.18	12.73
CPV 60	9.80	10.14	9.52	29.46	9.82
Tublay	7.24	8.06	7.90	23.20	7.73
B 21	10.86	11.48	10.80	33.14	11.05
2009					
Patig	10.30	9.32	9.52	29.14	9.71
Mabunga	18.48	18.40	18.52	55.40	18.47
CPV 60	12.36	13.40	14.12	39.88	13.29
Tublay	10.92	11.60	12.32	34.84	11.61
B 21	12.56	13.80	12.78	39.14	13.05
2010					
Patig	10.94	9.60	10.14	30.68	10.23
Mabunga	18.50	18.80	18.72	56.02	18.67
CPV 60	13.80	13.76	14.90	42.46	14.15
Tublay	11.92	12.50	12.40	36.82	12.27
B 21	13.42	13.34	12.46	39.22	13.07
TOTAL	179.78	186.42	182.46		
GRAND TOTAL				548.66	
GRAND MEAN					12.19

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	7.03	9.71	10.23	26.97	8.99[d]
Mabunga	12.73	18.47	18.67	49.87	16.62[a]
CPV 60	9.82	13.29	14.15	37.27	12.42[b]
Tublay	7.73	11.61	12.27	31.62	10.54[c]
B 21	11.05	13.05	13.07	37.17	12.39[b]
Production year of planting materials total	48.35	66.13	68.40	182.89	
MEAN	9.67[b]	13.23[a]	13.68[a]		12.19

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	1.488	0.744			
FACTOR A	2	144.627	72.313	182.94**	3.34	5.45
FACTOR B	4	294.369	73.592	186.18**	2.71	4.07
A x B	8	17.239	2.155	5.45**	2.29	3.23
ERROR	28	11.068	0.395			
TOTAL	44	468.791				

** - highly significant C.V. = 5.16%

Appendix Table 13. Bean rust infection

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
2008					
Patig	4	4	4	12	4.00
Mabunga	3	2	2	7	2.33
CPV 60	1	1	2	4	1.33
Tublay	2	3	2	7	2.33
B 21	2	2	3	7	2.33
2009					
Patig	4	3	4	11	3.67
Mabunga	2	2	2	6	2.00
CPV 60	2	2	2	6	2.00

Tublay	3	3	2	8	2.67
B 21	3	2	3	8	2.67
2010					
Patig	3	4	3	10	3.33
Mabunga	2	3	2	7	2.33
CPV 60	2	2	2	6	2.00
Tublay	2	2	3	7	2.33
B 21	2	3	3	8	2.67
TOTAL	37	38	39		
GRAND TOTAL				114	
GRAND MEAN					2.53

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}	VARIETY TOTAL	MEAN
Patig	4.00	3.67	3.33	11.00	3.67[a]
Mabunga	2.33	2.00	2.33	6.67	2.22[b]
CPV 60	1.33	2.00	2.00	5.33	1.78[b]
Tublay	2.33	2.67	2.33	7.33	2.44[b]
B 21	2.33	2.67	2.67	7.67	2.56[b]
Production year of planting materials total	12.33	13.00	12.67	38.00	
MEAN	2.47	2.60	2.53		2.53

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	O.133	0.067			
FACTOR A	2	0.133	0.067	0.26[ns]	3.34	5.45
FACTOR B	4	17.644	4.411	17.15**	2.71	4.07
A x B	8	2.089	0.261	1.01[ns]	2.29	3.23
ERROR	28	7.200	0.257			
TOTAL	44	27.200				

** - highly significant C.V. = 20.02%
ns - not significant

Appendix Table 14. Pod borer infestation

ENTRIES	REPLICATION			TOTAL	MEAN
	I	II	III		
2008					
Patig	3	3	2	8	2.67
Mabunga	2	2	3	7	2.33
CPV 60	2	2	2	6	2.00
Tublay	2	3	2	7	2.33
B 21	2	2	2	6	2.00
2009					
Patig	3	3	2	8	2.67
Mabunga	2	2	3	7	2.33
CPV 60	2	2	2	6	2.00
Tublay	2	2	2	6	2.00
B 21	2	2	2	6	2.00
2010					
Patig	3	3	3	9	3.00
Mabunga	2	2	2	6	2.00
CPV 60	2	2	2	6	2.00
Tublay	2	2	2	6	2.00
B 21	2	2	2	6	2.00
TOTAL	33	34	33		
GRAND TOTAL				100	
GRAND MEAN					2.22

TWO-WAY TABLE

VARIETY	Y_{S8}	Y_{S9}	Y_{S10}		VARIETY TOTAL	MEAN
Patig	2.67	2.67	3.00		8.33	2.78
Mabunga	2.33	2.33	2.00		6.67	2.22
CPV 60	2.00	2.00	2.00		6.00	2.00
Tublay	2.33	2.00	2.00		6.33	2.11
B 21	2.00	2.00	2.00		6.00	2.00
Production year of planting materials total		11.33	11.00	11.00		33.33
MEAN	2.27	2.20	2.20			2.22

ANOVA TABLE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
REPLICATION	2	O.044	0.022			
FACTOR A	2	0.044	0.022	0.19^{ns}	3.34	5.45
FACTOR B	4	3.778	0.944	8.04**	2.71	4.07
A x B	8	0.622	0.078	0.66^{ns}	2.29	3.23
ERROR	28	3.289	0.117			
TOTAL	44	7.778				

** - highly significant

ns - not significant

C.V. = 15.42%