BIBLIOGRAPHY

TONGED, ONOFRE C. OCTOBER 2007. Evaluation of Bush Snapbean Varieties Under Poblacion, Sablan, Benguet Condition. Benguet State University, La Trinidad, Benguet.

Adviser: Guerzon A. Payangdo, MSc.

ABSTRACT

Ten bush snapbean varieties were evaluated to determine their growth and seed yield and identify which of these varieties would perform best under Poblacion, Sablan, Benguet condition.

Bush snapbean varieties significantly varied on the number of days to flowering, plant height at maturity, number of flowers per cluster, pods per cluster, length and width of pods harvest, number of marketable and non-marketable seeds and computed seed yield.

"Lipstican", Maroon and Contender were the earliest to produce flower and China 804 was the tallest at maturity. Maroon and China 804 produced the most number of flowers and pods per cluster. "Lipstican" and Contender significantly produced the heaviest marketable seed and had the highest return on cash expense.

Varieties of Contender, "Lipstican", Maroon and china 804 had the best growth and seed yield performance and most profitable under Poblacion, Sablan, Benguet condition.

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INTRODUCTION

Bush snapbean, scientifically known as *Phaseolus vulgaris* is one of the vegetable legumes grown in many parts of Cordillera region. It is not only grown for its economic value but also for nutrients as it is a good source of proteins, vitamins and others that are important for human health (Celoy, 1999).

The bush snapbean is locally called by Kankana-ey of Benguet as "Tokdo-an" is bushy and determinate; hence it does not require trellising. Bush bean is grown for their tender pods or seeds, and commercially grown in highlands of Cordillera. They are considered as one of the good crop in Benguet and Mountain Province as nourishing vegetable since it is an important source of fiber, riboflavin, niacin, phosphorous, calcium and iron (Loakan, 2003). Moreover, the crops are grown for economic value.

This varietal evaluation was done to identify varieties that are suitable, high yielding, early maturing, resistance to insect pest and diseases. The identified varieties could be an alternate to some of the low yielding farmers' variety.

At present, farmers in the locality are not planting bush snapbean since the main crop produce is rice. Sometimes, when water is available especially during dry season, farmers plant pechay, pole snapbeans, cucumber and others that are early maturing as crop substitute to rice. Because of these practices, it is advisable to introduce and encourage farmers to plant other cash crops like bush snapbean for a better profit.

The use of high yielding varieties is the cheapest means of increasing yield (Rosario, 1974). Furthermore, varietal evaluation is the process in crop breeding program which provides comparison of promising lines developed by breeder. It is only through

varietal evaluation that a breeder observes the performance of developed lines in terms of yield, quality, adaptability and resistance to pest and disease.

The objectives of the study were; to determine the growth and seed yield of different bush snapbean varieties and identify the best performing bush snapbean under Poblacion, Sablan, Benguet condition.

This study was conducted at Poblacion, Sablan, Benguet from March to June 2007.

REVIEW OF LITERATURE

The Plant

Bush snapbean varieties belong to Leguminosae family which are dwarf and determinate plant. Varieties of bush bean are dwarf and that does not require trellis for support due to its determinate growth habit and early maturing. Bush snapbean is a warm temperate season annual crop grown for fresh pods, which are harvested while they are still tender with small seeds. Flat or oval and stringless pods are preferred for the fresh market. On the other hand, round-podded varieties with white seeds are preferred for canning (Purseglove, 1978).

A study by PCARRD (1983) showed that vegetable legumes have trifoliate leaves. The leaflets are ovate, oblong or oblong lancolate and vary in size from small to large. The flowers vary also in size and in color depending on varieties. Calyxes are generally green and purple. The corolla is white, yellow, purple and blue. It was further stated that the characteristics also varies with varieties.

Varietal Evaluation

Varietal evaluation gathers data on plant characteristics, yield performance and pod quality. Hence, we can obtain high yielding and improve varieties that are known to plants important role in boosting production (Regmi, 1990). Moreover, Bautista and Mabesa (1977) stated that the variety to be selected should be high yielding, pest and disease resistant, and early maturing so that production would entail less expense, and ensure more profit. Selecting the right variety will minimize problems associated with water and fertilizer management.

Reily and Shry (1991) reported that variety must be adapted to the area in which it is grown. Different varieties which are grown under the same method of culture have a great variation in the yielding ability. A variety that yields will in one region is not a guarantee that it will perform well in another region.

High yielding and improved cultivars are known to play an important role in boosting production. Large numbers of indigenous and exotic accessories of various plant species are evaluated and the number of cultivars are selected and recommended for mass growing (Bitaga, 2002).

AVRDC (1990) reported that the closest source of varieties for testing are the farmers, who produce their own seeds. They are also excellent sources of information about the characteristics of what they are using. Secondly, there are several local seeds traders. Another source is government institutions, such as universities and the Department of Agriculture, which are involved in variety development. In addition, the most important decisions to commercial grower must use each season for the selection of variety. Observation on plant performance, characteristics and yield can be noted and recorded by using a few number of varieties for evaluation.

Yield performance of any variety is affected by environmental factors like soil condition, climate and incidence of pest and diseases (PCARRD, 1989). Diseases are some major problems of snap beans throughout the world. As mentioned by Sunil (1990), varietal evaluation is a process of crop breeding programs which provides comparison of promising lines developed by a breeder. It is only through varietal evaluation that a breeder can see the yield, quality, adaptability, insect pest and disease resistance and stress tolerance.

Suitable areas for Bush Snapbean Production

The flowering of "green matured" pods start 60 days from planting under La Trinidad condition. In warmer area it is earlier to mature while in higher elevations takes longer period with cooler temperature. Harvesting is dependent on the variety used, location and temperature. Seeds are harvested after the pods are mature and when seed moisture content is approximately 16-20 %. Harvesting and handling low-moisture beans (less than 14%) may result in mechanical and seed loss (Kudan, 1991).

It is reported that beans grows best on soils that hold water well and have a good air and water filtration. Soil should have a pH of 5.8 to 6.6. Pacher (2002) stated that bush beans are warm temperature season vegetables that will not tolerate frost. It requires adequate amount of moisture. Temperatures are important for rapid growth. Good pod set, and early maturity.

Bush snapbean grow best in areas with temperature between 15 to 21 degree celcius. However this crop can tolerate warmer temperature up to 25 degree Celsius (HARRDEC, 2000). Growth and yield of snap bean are also best in high elevation. Yield was significantly low in lower elevation, and maturity was longer in higher elevation than in lower elevation (Bantog, 1993).

Ware and Swiader (2002) said that for rapid, uniform emergence, bean seeds should be planted in warm soils. Bush beans grow best on soils that have a temperature range from 60 to 85 degree Fahrenheit (°F) with an optimum of 80^{o}F for seed germination. Below 50^{o}F and above 95^{o}F will slow down the growth and maturation of the crop. If you grow beans in cool, wet soil germination will be delayed, and seed may rot, which can also produce low yield.

Planting Distance, Fertilizer and Irrigation

Beans should be planted the whole year round. It is commonly direct seeded in the rows for easy cultivation. Seeding rates may differ depending on seed size, percentage germination, irrigation and row spacing. The planting distance is 20x20 cm both ways with two to three seed per hill is best for snap bean production. Seeds planted during dry season should be covered with soil equal to the tripled size of seeds planted. During rainy season, less soil is needed to avoid rotting of seeds (HARRDEC, 1989).

In seed production, Ap-apid (1991) found out that the wider the spacing between hills, the heavier were the marketable seeds produced per plant with 10 cm. distance due to high competition for light and nutrients among plant per unit area. Similarly, Ingles (1990) found out that density of two seeds per hill at a distance of 20cm to 30cm between hills yielded the heaviest seeds per plot.

Irrigation is an essential requirement in the farm when rainfall is not secured. Without the selection of seeds, application of adequate fertilizers, insect pest and disease control and the practice of improved cultural management could ensure production of crops with maximum economic returns (Aquision, 1996).

MATERIALS AND METHODS

An area of 300 sq. m. was properly cleaned and prepared into raise beds. The area was divided into three blocks consisting of ten plots per blocks measuring 1m x10 m. The experiment was laid out using randomized complete block design (RCBD) with three replications.

The bush snapbean varieties are as follows;

Variety	Source
V_1- Maroon (check)	Sablan
V_2- HAB 63	BSU
V_3- HAB 323	BSU
V_4- BBL 274	BSU
V_5- Torrent	BSU
V_6- Landmark	BSU
V_7- Greencrop	BSU
V_8- Contender	BSU
V_9- China 804	BSU
V_{10}- “Lipstican”	Kalinga

To ensure growth and yield, cultural management practices such as irrigation, weeding, fertilizer application, side dressing and hilling-up, insect and disease control were properly employed.

Data Gathered

A. Maturity

1. Days to emergence. This was taken by counting the number of days from planting up to the time when at least 50% of the plants per plot emerged.

2. Days to flowering. This was recorded by counting the number of days from planting up to the time when at least 50% of the plants set flowers.

3. Days from planting to first harvest. This was recorded by counting the days from planting to first harvesting.

4. Days from planting to last harvest. This was recorded by counting the days from planting to last harvesting.

5. Days to maturity. This was recorded by counting the number of days from planting up to the time when pods turned yellowish in color.

6. Plant height at maturity (cm). This was taken by measuring ten sample plants per plot from base to shoot tip by random at maturity.

B. Growth Parameters

1. Number of flower per cluster. This was recorded by counting the flower per cluster that develops per plant from ten sample plants per plot.

2. Number of days to pod setting. This was recorded by counting the days when 50% of the flower breaks up and pod measured 1 inch long.

3. Number of pods per cluster. This was recorded by counting the number of pods per cluster per plant.

4. Number of cluster per plant. This was recorded by counting the number of clusters per plant.

5. Percentage pod set (%). This was determined using the data in numbers 1 and 3.

$$\text{Percentage pod (\%)} = \frac{\text{Total number of pods per cluster}}{\text{Total number of flower per cluster}} \text{ x100}$$

6. Number of pods per plant. This was recorded using these formula.

$$\text{Number of pods per plant} = \frac{\text{Total number of pods harvested per plot}}{\text{Total number of plants harvested per plot}} \text{ x100}$$

7. Length of pod at harvest (cm). Ten random sample pods will be obtained per treatment and pod length was measured from pedicel end to distal end using a foot ruler.

8. Width of pod at harvest (cm). This was measured from the ten sample pods used in getting the length of pod from its middle portion using foot ruler.

C. Yield components

1. Weight of marketable seed yield per plot (kg). This was the total weight of marketable seeds harvested per plot after threshing, cleaning and removing deformed or insect and disease damaged seeds.

2. Weight of non-marketable seed yield per plot (kg). This was the total weight of non-marketable seeds harvested per plot. Seeds was considered non-marketable when they are malformed/ abnormal and damaged by pest beyond control.

3. Number of seeds per pod. This was taken by counting the number of seeds from ten sample plants per treatment taken at random.

4. Total seeds yield per plot (kg). This was taken by weighing and recording the dry seeds harvested per plot including non-marketable.

5. Computed seed yield per hectare (kg) . This was computed based on the yield per plot using this formula:

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

6. Insect and Disease Incidence. This was taken by assessing the degree of damage caused by specific insect and disease to the crop.

a. Pod Borer (Jose,2004)

Scale	Percent Infestation	Description
1	No infection	Highly resistance
2	1-25% of the plant/plot infested	Mild resistance
3	26-50% of the plant/plot infested	Moderate resistance
4	51-75% of the plant/plot infested	Susceptible
5	76-100% of the plant/plot infested	Very susceptible

b. Bean rust (Jose, 2004)

Scale	Percent Infestation	Description
1	No infection	Highly resistance
2	1-25% of the plant/plot infested	Mild resistance
3	26-50% of the plant/plot infested	Moderate resistance
4	51-75% of the plant/plot infested	Susceptible
5	76-100% of the plant/plot infested	Very susceptible

7. Return on Cash Expense (ROCE). This was analyzed using this formula:

$$\text{ROCE} = \frac{\text{NET income}}{\text{Total production cost}} \times 100$$

Analysis of Data

All quantitative data were analyzed using Analysis of Variance (ANOVA) for RCBD. The significance of difference among treatment means was tested using Duncan's Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Meteorological Data During the Conduct of the Study

Table 1 shows the minimum and maximum temperature of the month during the conduct of the study. This temperature ranges was appropriate since legume crops like bush snapbean perform well at 16 ^{0}C to 31 ^{0}C.

Days to Emergence

Greencrop, Maroon and China 804 were the earliest to emerge in six days followed by the rest which emerge seven days after planting except for Landmark and BBL 274 which was the latest to emerge at eight days from planting, although result indicates no significant differences.

Days to Flowering, Planting to First Harvest to the Last Harvest

Based on the statistical analysis of the data obtained from the different varieties in terms of the number of days to emergence, no significant differences were obtained. As to the number of days to flowering, significant differences were among the varieties,

Table 1. Minimum and maximum temperature of the month during the conduct of the study

Months	Temperature (^{o}C)	
	Minimum	Maximum
March	16.4	29.5
April	18.2	32.4
May	17.8	29.2
June	18.0	31.2
Mean	17.35	30.58

Table 2. Number of days to emergence, days to flowering, days from planting to first harvesting and last harvesting of ten varieties of bush snapbean varieties evaluated

VARIETY	NUMBER OF DAYS TO:			
	EMERGENCE	FLOWERING	FIRST HARVESTING	LAST HARVESTING
Greencrop	6	33[d]	65	79
"Lipstican"	7	30[a]	65	82
Maroon (check)	6	30[a]	64	83
Hab 323	7	32[c]	70	80
China 804	6	31[b]	64	78
Contender	7	30[a]	64	83
Hab 63	7	32 [c]	69	80
Torrent	7	31 [b]	68	82
Landmark	8	34 [e]	70	83
BBL 274	8	31 [b]	71	86
CV (%)	0.00	1.33	0.00	0.00

Means with the same letter are not significantly different at 5% level by DMRT.

Landmark was latest to flower. While on the number of days to the first and last harvest, no significant differences were noted.

Days to maturity, plant height at maturity

Table 3 shows the number of days to maturity with no significant differences noted among the treatments. Although numerically, Contender was the earliest to mature. On plant height at maturity, China 804 was the tallest followed by Torrent and the shortest was Landmark. The significant differences existed among the varieties was attributed to the genetic characteristics. Fig. 1 shows the plants at maturity.

Table 3. Number of days to maturity and plant height at maturity of ten bush snapbean varieties evaluated

VARIETY	DAYS TO MATURITY	HEIGHT AT MATURITY (cm)
Greencrop	61	56.00[ef]
"Lipstican"	60	59.33 [cd]
Maroon (check)	59	55.67 [efg]
Hab 323	62	56.67 [deg]
China 804	60	65.00 [a]
Contender	58	54.00fg
Hab 63	61	60.00[bc]
Torrent	62	62.33 [b]
Landmark	64	53.00 [g]
BBL 274	64	58.00 [cdc]
CV (%)	0.00	2.71

Means with the same letter are not significantly different at 5% level by DMRT.

Figure 1. Plants at maturity

Number of Flowers Per Cluster, Pods Per Cluster and Days to Pod Setting

Table 4 shows significant differences on the number of flowers per cluster which is obtained from Maroon and China 804 varieties, Although, flowers per cluster did not differ statistically for “Lipstican”, HAB 323, Contender and HAB 63. For the pods per cluster, Maroon and China 804 had the most numerous pods per cluster followed by “Lipstican”, HAB 323, Contender and HAB 63. The least pods were obtained from BBL 274. On the number of days to pod setting, Landmark significantly was the latest to set pod followed by HAB 63 and Greencrop and the earliest to set pod were Contender then Maroon, China 804, “Lipstican”, Torrent, HAB 323 and BBL 274. Significant differences were due to the characteristics inherent in each variety.

Table 4. Number of flowers per cluster, pods per cluster, and days to pod setting of ten bush snapbean varieties evaluated

VARIETY	NUMBER OF FLOWER/CLUSTER	NUMBER OF PODS/CLUSTER	DAYS TO POD SETTING
Greencrop	5[b]	4[bc]	39[e]
“Lipstican”	6[ab]	5[b]	37[c]
Maroon (check)	7[a]	6[a]	36[b]
Hab 323	6[ab]	5[b]	38[d]
China 804	7[a]	6[a]	36[b]
Contender	6[ab]	5[b]	35[a]
Hab 63	6a[b]	5[b]	39[e]
Torrent	5[b]	4[bc]	38[d]
Landmark	5[b]	4[bc]	40[f]
BBL 274	5[b]	3[c]	38[d]
CV (%)	10.71	12.25	1.31

Means with the same letter are not significantly different at 5% level by DMRT.

Number of Cluster Per Plant, Pods Per Plant

Table 5 indicates that the number of clusters per plant was not significant. For the number of pod per plant, China 804 had significantly the most numerous pods for plant (12) followed by Maroon and Contender with 11 pods per plant. The lowest registered pods per plant were noted from Torrent, Landmark and BBL 274. The significance differences on percentage pod set could had been influenced by their varietal nature.

Percentage Pod Set (%)

Table 5 indicates no significant differences in terms of days to pod setting although numerically, Maroon variety had the highest pod set percentage and the lowest was Landmark.

Table 5. Number of cluster per plant, number of pods per plant and percentage pod set of ten varieties of bush snapbean evaluated

VARIETY	NUMBER OF CLUSTERS/PLANT	NUMBER OF PODS/PLANT	PERCENTAGE POD SET (%)
Greencrop	3	9	75.56
"Lipstican"	3	10	83.01
Maroon (check)	3	11	84.92
Hab 323	3	9	83.33
China 804	3	12	82.14
Contender	3	11	79.36
Hab 63	3	8	82.22
Torrent	2	7	74.44
Landmark	2	7	68.89
BBL 274	3	7	71.67
CV (%)	15.94	6.00	9.25

Means with the same letter are not significantly different at 5% level by DMRT.

Length and Width of Pods at Harvest

Significant differences were observed among the varieties in terms of pod length at harvest (Table 6). China 804, Greencrop and Contender had the longest pods which were comparable with "Lipstican". The shortest pods were obtained from HAB 323. On pod width at harvest, Greencrop, "Lipstican" and Contender had the widest pods which were not significantly different with that of Maroon, HAB 323, HAB 63, Torrent and BBL 274 and narrowest pods were obtained from China 804. These significant differences were attributed to their varietal characteristics.

Table 6. Length and width of pods at harvest of ten varieties of bush snapbean evaluated

VARIETY	LENGTH (cm)	WIDTH (cm)
Greencrop	16.33[a]	1.40[a]
"Lipstican"	15.67[ab]	1.40[a]
Maroon (check)	14.67[bc]	1.27[ab]
Hab 323	12.33[e]	1.30[c]
China 804	16.67[a]	1.10[a]
Contender	16.00[a]	1.40[a]
Hab 63	13.30[de]	1.27[ab]
Torrent	13.33[de]	1.33[ab]
Landmark	14.00[bc]	1.23[bc]
BBL 274	13.33[de]	1.33[ab]
CV (%)	5.09	6.54

Means with the same letter are not significantly different at 5% level by DMRT.

Weight of Marketable and Non-marketable Seed Yield Per Plot (kg)

Table 7 shows the weight of marketable and non-marketable seed yield per plot. Significant differences were noted on both weight of marketable and non-marketable

seed yield per plot. Such that Contender and "Lipstican" followed by Maroon yielded the heaviest weight of seed yield per plot and the lightest was obtained from BBL 274. On the weight of non-marketable seed yield per plot, "Lipstican" produced the heaviest seeds which were comparable with Contender and China 804 while HAB 323 produced the lightest. The significant differences in terms of marketable seed yield per plot was the effect on the differences in terms of seed sizes. Fig.2 shows the marketable seeds harvested from the different varieties.

Table 7. Weight of marketable and non-marketable seed yield per plot and the number of seeds per pod of ten bush snapbean evaluated.

VARIETY	MARKETABLE SEED	NON-MARKETABLE SEEDS	NUMBER OF SEEDS PER POD
Greencrop	0.73^{c}	0.40^{bc}	5^{b}
"Lipstican"	1.03^{a}	0.52^{a}	5^{b}
Maroon (check)	0.88^{b}	0.30^{cd}	6^{a}
Hab 323	0.72^{c}	0.22^{d}	6^{a}
China 804	0.57^{d}	0.50^{ab}	6^{a}
Contender	1.13^{a}	0.50^{ab}	6^{a}
Hab 63	0.68^{cd}	0.32^{cd}	6^{a}
Torrent	0.57^{d}	0.40^{bc}	5^{b}
Landmark	0.38^{e}	0.27^{d}	5^{b}
BBL 274	0.32^{e}	0.33^{cd}	5^{b}
CV (%)	10.05	16.01	7.97

Means with the same letter are not significantly different at 5% level by DMRT.

Figure 2. Marketable seeds harvested from the ten bush snapbean varieties

Number of Seeds Per Pod

The varieties which produced highest yield per pod were Maroon, HAB 323, China 804, Contender and HAB 63. The significant differences could be attributed to their varietal characteristics since each variety differ in the number of seeds per pod and length.

Total Seed Yield Per Plot

The total seed yield per plot of ten bush snapbeans studied revealed that "Lipstican" and Contender varieties yielded the heaviest per plot followed by Maroon and China 804. The lowest was noted from Landmark and BBL 274 varieties.

Table 8. Total seed yield per plot and computed seed yield per hectare of ten bush snapbean varieties evaluated

VARIETY	SEED YIELD/PLOT ($kg/10m^2$)	COMPUTED SEED YIELD (tons/ha)
Greencrop	1.13^{bc}	1130.00
"Lipstican"	1.55^{a}	1550.00
Maroon (check)	1.18^{b}	1180.00
Hab 323	0.93^{d}	930.00
China 804	1.07^{bcd}	1070.00
Contender	1.63^{a}	1630.00
Hab 63	1.00^{cd}	1000.00
Torrent	0.97^{d}	970.00
Landmark	0.65^{e}	650.00
BBL 274	0.65^{e}	650.00
CV (%)	7.22	16.42

Means with the same letter are not significantly different at 5% level by DMRT.

Computed Seed Yield Per Hectare (kg)

Table 8 presents the computed seed yield per hectare of ten bush snapbean varieties evaluated. Based on statistical analysis, significant differences exist among varieties. Contender and Lipstican varieties had the heaviest seed yield per plot and per hectare followed by Maroon in the seed yield per plot and Greencrop, China 804, HAB 63, Torrent for the computed seed yield per hectare and the lowest were Landmark and BBL 274. This seed yield weight differences were accounted to their seed size differences.

Insect and Disease Incidence

Visual rating for the occurrence of bean rust and pod borer among ten varieties was done during the growth and reproductive stage. Due to the weekly application of insecticides and fungicide, it was observed that mostly all the varieties had no damage by pod borer and bean rust.

Return on Cash Expense

Table 9 presents the computed return on cash expense (ROCE) of the ten varieties of bush snapbeans evaluated which Contender had 240% as the highest followed by the Lipstican with 209.97%. The lowest was obtained from BBL 274 with a negative ROCE of -05.00%. This high ROCE indicated by Contender was the result of its high seed yield per hectare and the higher selling price per kg.

Table 9. Return on cash expense (ROCE) of ten bush snapbean varieties evaluated

VARIETY	TOTAL COST OF PROD'N	SEED YIELD TON/HA	GROSS INCOME	NET INCOME	ROCE (%)
Greencrop	1760	2.20	3872.00	2112.00	120.00
Lipstican	1725	3.10	5347.05	3622.05	209.97
Maroon (check)	1725	2.65	4571.25	2846.25	165.00
Hab 323	1760	2.15	3784.00	2024.00	115.00
China 804	1725	1.70	2932.05	1207.05	69.97
Contender	1760	3.40	5984.00	4225.00	240.00
Hab 63	1760	2.05	3608.00	1848.00	105.00
Torrent	1760	1.70	2992.00	1232.00	70.00
Landmark	1760	1.15	2024.00	264.00	15.00
BBL (%)	1760	0.95	1672.00	-88.00	-05.00

-total expenses include land preparation, seeds, fertilizer and maintenance like weeding, irrigation, spraying and hilling-up.
-selling price; China 804, Maroon (check) and Lipstican = Php250.00/kg
-HAB 323, HAB63, Torrent, Landmark, Contender, Greencrop, BBL 274=Php320.00/kg

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

A total of ten bush snapbean varieties were evaluated for the growth and seed yield performance under Poblacion, Sablan, Benguet from March to June 2007.

No significant differences among treatments were noted on the number of days to emergence, number of days from planting to first harvesting to the last harvesting. While on the days to flowering, significant differences existed among the cultivars. Landmark variety had the latest while Maroon and Contender varieties were the earliest to flower. Significant differences were noted on the number of flower per cluster, pods per cluster and days to pod setting. Maroon and China 804 varieties had the highest number of flowers and pods per cluster and BBL 274 had the lowest number of pods per cluster.

China 804 variety had the longest pods and the tallest plants. Significant differences were noted both on weight of marketable and non-marketable seed yield per plot. “Lipstican” and Contender varieties produced the highest weight followed by maroon while BBL variety had the lowest on marketable seed yield per plot. On the other hand, “Lipstican” variety produced the highest weight which is comparable with Contender and HAB 63 while HAB 323 had the lowest weight on non-marketable seed yield per plot.

As to computed seed yield per hectare, significant differences exist among the varieties. Contender and “Lipstican” varieties had the heaviest seed yield while Landmark and BBL 274 varieties had the lowest seed yield. Results on the return on cash expense (ROCE) shows that Contender and “Lipstican” varieties obtained the highest

percentage of 240% and 209.97% followed by maroon with165%. The lowest was obtained from BBL 274 with –05%.

On the occurrence of insects and disease incidence, varieties of bush snapbean are rated mild resistance to pod borer and bean rust. This could be due to the alternate application of insecticides and fungicides every week.

Conclusion

Not all varieties of bush snapbean had good response in terms of growth parameters and seed yield. “Lipstican” and Contender varieties produced the heaviest weight on marketable seed yield per plot. This indicates that these varieties are adapted under Poblacion, Sablan, Benguet condition.

Recommendation

Based on the results, varieties of “Lipstican” and Contender are recommended for seed yield production at Poblacion, Sablan, Benguet.

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APPENDICES

Appendix Table 1. Days to emergence

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	6	6	6	18	6
Lipstican	7	7	7	21	7
Maroon	6	6	6	18	6
Hab 323	7	7	7	21	7
China 804	6	6	6	18	6
Contender	7	7	7	21	7
Hab 63	7	7	7	21	7
Torrent	7	7	7	21	7
Landmark	8	8	8	24	8
BBL 274	8	8	8	24	8
TOTAL	69	69	69	207	69

Appendix Table 2. Number of days to flowering

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	33	33	33	99	33[b]
Lipstican	30	31	30	91	30[e]
Maroon	30	30	30	90	30[e]
Hab 323	32	31	32	95	32[c]
China 804	30	31	31	92	31[d]
Contender	30	30	30	90	30[e]
Hab 63	32	32	31	95	32[c]
Torrent	31	31	30	92	31[d]
Landmark	34	34	34	102	34[a]
BBL 274	31	31	31	93	31[d]
TOTAL	313	314	312	939	314

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
Block	2	0.200	0.100			
Variety	9	46.967	5.219	29.98**	2.46	3.60
Error	18	3.133.	0.174			
TOTAL	29	50.300				

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

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	65	65	65	195	65
Lipstican	65	65	65	195	65
Maroon	64	64	64	192	64
Hab 323	70	70	70	210	70
China 804	64	64	64	192	64
Contender	64	64	64	192	64
Hab 63	69	69	69	207	69
Torrent	68	68	68	204	68
Landmark	70	70	70	210	70
BBL 274	71	71	71	213	71
TOTAL	670	670	670	2010	670

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

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	79	79	79	237	79
Lipstican	82	82	82	246	82
Maroon	83	83	83	249	83
Hab 323	80	80	80	240	80
China 804	78	78	78	234	78
Contender	83	83	83	249	83
Hab 63	80	80	80	240	80
Torrent	82	82	82	246	82
Landmark	83	83	83	249	83
BBL 274	86	86	86	258	86
TOTAL	816	816	816	2448	816

Appendix Table 5. Number of days to maturity

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	61	61	61	183	61
Lipstican	60	60	60	180	60
Maroon	59	59	59	177	59
Hab 323	62	62	62	186	62
China 804	60	60	60	180	60
Contender	58	58	58	174	58
Hab 63	61	61	61	183	61
Torrent	62	62	62	186	62
Landmark	64	64	64	192	64
BBL 274	64	64	64	192	64
TOTAL	611	611	611	1833	611

Appendix Table 6. Plant height at maturity (cm)

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	54	58	56	168	56.00^{ef}
Lipstican	56	62	60	178	59.33^{cd}
Maroon	57	55	55	167	55.67^{efg}
Hab 323	58	55	57	170	56.67^{def}
China 804	63	65	67	195	65.00^{a}
Contender	54	54	54	162	54.00^{fg}
Hab 63	60	60	60	180	60.00^{bc}
Torrent	62	64	61	187	62.33^{b}
Landmark	53	54	52	159	53.00^{g}
BBL 274	57	58	59	174	58.00^{cde}
TOTAL	574	585	581	1740	580.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Block	2	6.200	3.100			
Variety	9	377.333	41.926	16.97**	2.46	3.60
Error	18	44.467	2.470			
Total	29	428.000				

**- highly significant Coefficient of Variance = 2.71%

Appendix Table 7. Number of flowers per cluster

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	5	6	5	16	5[b]
Lipstican	7	5	6	18	6[ab]
Maroon	7	7	8	22	7[a]
Hab 323	6	6	6	18	6[ab]
China 804	7	8	7	22	7[a]
Contender	7	6	6	19	6[ab]
Hab 63	6	6	5	17	6[ab]
Torrent	5	6	5	16	5[b]
Landmark	5	5	6	16	5[b]
BBL 274	4	5	5	14	5[b]
TOTAL	59	60	59	178	59

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.067	0.033			
Variety	9	20.533	2.281	5.65**	2.46	3.60
Error	18	7.267	0.404			
TOTAL	29	27.867				

** -highly significant Coefficient of Variance = 10.71%

Appendix Table 8. Number of days to pod setting

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	39	39	39	117	39[b]
Lipstican	37	37	37	111	37[d]
Maroon	36	36	36	108	36[e]
Hab 323	38	38	37	113	38[c]
China 804	35	37	37	109	36[e]
Contender	35	35	35	105	35[f]
Hab 63	39	40	39	118	39[b]
Torrent	39	38	38	115	38[c]
Landmark	40	40	40	120	40[a]
BBL 274	38	38	38	114	38[c]
TOTAL	376	378	376	1130	377

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.267	0.133			
Variety	9	68.000	7.556	30.91**	2.46	3.60
Error	18	4.400	0.244			
TOTAL	29	72.667				

** -highly significant Coefficient of Variance = 1.31%

Appendix Table 9. Number of pods per cluster

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	4	4	4	12	4[bc]
Lipstican	6	4	5	15	5[b]
Maroon	6	6	5	17	6[a]
Hab 323	5	5	5	15	5[b]
China 804	6	6	6	18	6[a]
Contender	5	5	5	15	5[b]
Hab 63	5	5	4	14	5[b]
Torrent	4	5	3	12	4[bc]
Landmark	3	4	4	11	4[bc]
BBL 274	3	4	3	10	3[c]
TOTAL	47	48	44	139	46

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.867	0.433			
Variety	9	20.300	2.256	7.00**	2.46	3.60
Error	18	5.800	0.322			
TOTAL	29	26.967				

** -highly significant Coefficient of Variance = 12.25%

Appendix Table 10. Number of cluster per plant

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	3	3	2	8	3
Lipstican	3	3	3	9	3
Maroon	3	3	4	10	3
Hab 323	3	3	3	9	3
China 804	4	3	3	10	3
Contender	3	4	3	10	3
Hab 63	3	3	3	9	3
Torrent	2	3	2	7	2
Landmark	2	2	3	7	2
BBL 274	3	3	3	9	3
TOTAL	29	30	29	88	29

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.067	0.033			
Variety	9	3.867	0.430	1.97^{ns}	2.46	3.60
Error	18	3.933	0.219			
TOTAL	29	7.867				

ns –not significant Coefficient of Variance = 15.94%

Appendix Table 11. Percentage pod set (%).

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	80.00	66.67	80.00	226.67	75.56
Lipstican	85.71	80.00	83.33	249.04	83.01
Maroon	85.71	85.71	83.33	254.75	84.92
Hab 323	83.33	83.33	83.33	249.99	83.33
China 804	75.00	85.71	85.71	246.42	82.14
Contender	71.43	83.33	83.33	238.09	79.36
Hab 63	83.33	83.33	80.00	246.66	82.22
Torrent	80.00	83.33	60.00	223.33	74.44
Landmark	60.00	80.00	66.67	206.67	68.89
BBL 274	75.00	80.00	60.00	215.00	71.67
TOTAL	779.51	811.41	765.70	2356.62	785.54

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	109.924	54.962			
Variety	9	830.530	92.281	1.75^{ns}	2.46	3.60
Error	18	949.551	52.753			
TOTAL	29	1890.005				

ns –not significant Coefficient of Variance = 9.25%

Appendix Table 12. Number of pods per plant

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	9	9	10	28	9[d]
Lipstican	10	10	10	30	10[c]
Maroon	11	10	11	32	11[b]
Hab 323	8	10	9	27	9[d]
China 804	12	12	12	36	12[a]
Contender	11	11	11	33	11[b]
Hab 63	7	9	9	25	8[e]
Torrent	7	8	7	22	7[f]
Landmark	7	7	7	21	7[f]
BBL 274	7	7	7	21	7[f]
TOTAL	89	93	93	275	92

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	1.067	0.533			
Variety	9	83.500	9.728	29.82**	2.46	3.60
Error	18	5.600	0.311			
TOTAL	29	90.167				

** -highly significant Coefficient of Variance = 6.00%

Appendix Table 13. Length of pods at harvest (cm).

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	16	17	16	49	16.33[a]
Lipstican	15	15	17	47	15.67[ab]
Maroon	14	15	15	44	14.67[bc]
Hab 323	13	12	12	37	12.33[e]
China 804	17	16	17	50	16.67[a]
Contender	16	16	16	48	16.00[a]
Hab 63	14	12	13	39	13.00[de]
Torrent	13	13	14	40	13.33[de]
Landmark	14	14	14	42	14.00[bc]
BBL 274	13	15	12	40	13.33[de]
TOTAL	145	145	146	436	145.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.200	0.100			
Variety	9	67.500	7.500	13.78**	2.46	3.60
Error	18	9.800	0.544			
TOTAL	29	77.800				

** -highly significant Coefficient of Variance = 5.09%

Appendix Table 14. Width of pods at harvest (cm).

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	1.4	1.4	1.4	4.2	1.40[a]
Lipstican	1.5	1.4	1.3	4.2	1.40[a]
Maroon	1.2	1.3	1.3	3.8	1.27[ab]
Hab 323	1.3	1.3	1.3	3.9	1.30[ab]
China 804	1.0	1.2	1.1	3.3	1.10[c]
Contender	1.4	1.3	1.5	4.2	1.40[a]
Hab 63	1.2	1.4	1.2	3.8	1.27[ab]
Torrent	1.3	1.5	1.2	4.0	1.33[ab]
Landmark	1.2	1.2	1.3	3.7	1.23[bc]
BBL 274	1.3	1.3	1.4	4.0	1.33[ab]
TOTAL	12.8	13.3	13.0	39.1	13.03

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.009	0.004			
Variety	9	0.199	0.022	3.03*	2.46	3.60
Error	18	0.131	0.007			
TOTAL	29	0.339				

* -significant

Coefficient of Variance = 6.54%

Appendix Table 15. Weight of marketable seed yield per plot (kg).

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	0.70	0.85	0.65	2.20	0.73[c]
Lipstican	1.15	1.05	0.90	3.10	1.03[a]
Maroon	0.80	0.95	0.90	2.65	0.88[b]
Hab 323	0.75	0.65	0.75	2.15	0.72[c]
China 804	0.55	0.60	0.55	1.70	0.57[d]
Contender	1.10	1.25	1.05	3.40	1.13[a]
Hab 63	0.70	0.75	0.60	2.05	0.68[cd]
Torrent	0.60	0.55	0.55	1.70	0.57[d]
Landmark	0.40	0.35	0.40	1.15	0.38[e]
BBL 274	0.35	0.30	0.30	0.95	0.32[e]
TOTAL	7.10	7.30	6.65	21.05	7.02

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.022	0.011			
Variety	9	1.851	0.206	45.36**	2.46	3.60
Error	18	0.090	0.005			
TOTAL	29	1.963				

** -highly significant Coefficient of Variance = 10.05%

Appendix Table 16. Weight of non-marketable seed yield per plot (kg).

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	0.35	0.35	0.50	1.20	0.40^{bc}
Lipstican	0.50	0.50	0.55	1.55	0.52^{a}
Maroon	0.25	0.35	0.30	0.90	0.30^{cd}
Hab 323	0.20	0.25	0.20	0.65	0.22^{d}
China 804	0.50	0.45	0.55	1.50	0.50^{ab}
Contender	0.45	0.45	0.60	1.50	0.50^{ab}
Hab 63	0.40	0.20	0.35	0.95	0.32^{cd}
Torrent	0.40	0.35	0.45	1.20	0.40^{bc}
Landmark	0.25	0.25	0.30	0.80	0.27^{d}
BBL 274	0.30	0.40	0.30	1.00	0.33^{cd}
TOTAL	3.60	3.55	4.10	11.25	3.75

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.021	0.010			
Variety	9	0.289	0.032	8.97**	2.46	3.60
Error	18	0.064	0.004			
TOTAL	29	0.374				

** -highly significant Coefficient of Variance = 16.01%

Appendix Table 17. Number of seeds per pod

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	5	5	5	15	5[b]
Lipstican	5	5	5	15	5[b]
Maroon	6	5	6	17	6[a]
Hab 323	5	6	6	17	6[a]
China 804	6	7	6	19	6[a]
Contender	6	6	6	18	6[a]
Hab 63	6	6	6	18	6[a]
Torrent	5	5	5	15	5[b]
Landmark	5	5	4	14	5[b]
BBL 274	5	4	5	14	5[b]
TOTAL	54	54	54	162	54

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.000	0.000			
Variety	9	9.867	1.096	5.92**	2.46	3.60
Error	18	3.333	0.185			
TOTAL	29	13.200				

** -highly significant Coefficient of Variance = 7.97%

Appendix Table 18. Total seed yield per plot (kg)

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	1.05	1.20	1.15	3.40	1.13[bc]
Lipstican	1.65	1.55	1.45	4.65	1.55[a]
Maroon	1.05	1.30	1.20	3.55	1.18[b]
Hab 323	0.95	0.90	0.95	2.80	0.93[d]
China 804	1.05	1.05	1.10	3.20	1.07[bcd]
Contender	1.55	1.70	1.65	4.90	1.63[a]
Hab 63	1.10	0.95	0.95	3.00	1.00[cd]
Torrent	1.00	0.90	1.00	2.90	0.97[d]
Landmark	0.65	0.60	0.70	1.95	0.65[e]
BBL 274	0.65	0.70	0.60	1.95	0.65[e]
TOTAL	10.70	10.85	10.75	32.30	10.77

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.001	0.001			
Variety	9	2.854	0.317	52.44**	2.46	3.60
Error	18	0.109	0.006			
TOTAL	29	2.964				

** -highly significant Coefficient of Variance = 7.22%

Appendix Table 19. Computed yield per hectare (kg).

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
Greencrop	1050	1200	1150	3400	1133.33
Lipstican	1650	1550	1450	4650	1550.00
Maroon	1050	1300	1200	3550	1183.33
Hab 323	950	900	950	2800	933.33b
China 804	1050	1050	1100	3200	1066.67
Contender	1550	1700	1650	4900	1633.33
Hab 63	1100	950	950	3000	1000.00
Torrent	1000	900	1000	2900	966.67
Landmark	650	600	700	1950	650.00
BBL 274	650	700	600	1950	650.00
TOTAL	10700	10850	10750	32300	1066.67

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	2	58166.667	29083.033			
Variety	9	3294666.667	366073.074	12.39**	2.46	3.60
Error	18	531833.333	29546.296			
TOTAL	29	3884666.667				

** -highly significant Coefficient of Variance = 16.42%