BIBLIOGRAPHY

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ABSTRACT

The study was conducted to determine the growth and yield of seven bush bean entries in Camangaan, Sison, Pangasinan; determine the best entries adapted in Camangaan, Sison, Pangasinan based on growth, yield and insect pest and disease resistance; and to determine the profitability of growing bush bean in Camangaan, Sison, Pangasinan.

In terms of plant vigor, all the seven entries evaluated were highly vigorous at 30 DAP. Majority of the seven entries of bush bean emerged seven days after sowing. Hab 63, Hab 323, Green crop, Contender and Hab 19 were the earliest to flower at 28 DAS and earliest to set pods. All the seven entries were harvested at 43 DAS.

Most of the bush bean entries produced three to four flowers per cluster and three pods per cluster. Contender had the highest number of flowers per plant and flower per cluster. BBL 274, Landmark, Green crop and Contender produced the highest number of pods per cluster while Green crop had the highest percentage of pod setting. Contender had the longest pod and BBL 274 had the narrowest pod.

BBL 274, Landmark and Green Crop produced the highest yield per $5m^2$ and recorded the highest ROCE. The seven entries exhibited resistance to bean rust and they were not infested by pod borer under natural field condition.

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INTRODUCTION

Bush bean (*Phaseolus vulgaris*) belongs to the *Leguminosae* family locally known as “lubias”. It is one of the vegetable legumes grown in many parts of the Cordillera region. They are excellent sources of proteins, vitamins and other functional nutrients that are important for human health.

Cultivation of leguminous crops like bush bean helps to maintain and improve the soil fertility because of its ability to fix nitrogen from the atmosphere through the action of nitrogen fixing bacteria present in the roots (Agayao, 2002).

Nowadays, because of nutritional importance, increasing population, economic crisis and to prevent malnutrition in the country, production must be increased through the use of early maturing, high yielding varieties that are resistant to pest and diseases.

Using good and new varieties for local farmers may be the solution of the low – yielding problem that had been observed and reported. Thus, evaluating different bean varieties is essential in convincing the farmers to plant the crop.

Several studies conducted on varietal evaluation, with regards to the growth and yield performance of crops, show that different crop varieties have varying performance in different places. Therefore, continuous evaluation of varieties is needed in order to determine the best variety that is adapted in a certain locality (Pastor, 2005).

Moreover, with the effect of climate change in agriculture particularly on crop evaluation, adaptation and proper management are required for successful production. The selection and suitability of varieties that could perform well and accepted by farmers should be considered in introducing a crop in the locality. The growth and yield of a new crop with economic potential is also essential in attaining sustainability, stability and for

increasing food sufficiency. Thus, evaluation of potential crops as an alternative crop is essential.

The study aimed to:

1. determine the growth and yield of seven bush bean entries in Camangaan, Sison, Pangasinan;

2. determine the best entries adapted in Camangaan, Sison, Pangasinan based on growth, yield and insect pest and diseases; and

3. determine the profitability of growing bush bean in Camangaan, Sison, Pangasinan.

The study was conducted at Camangaan, Sison, Pangasinan from December 2009 to February 2010.

REVIEW OF LITERATURE

Adaptation of Bush bean

The climatic requirements for bush bean are about the same as garden pea. It grow best in areas with temperatures between 15 to 20 ^{o}C. However, it can tolerate warm temperature up to 25^{o}C. The planting season is usually during dry season to avoid adverse weather conditions brought by typhoons. Yield performance varies widely with variety, soil condition, climate, incidence of pests and diseases. In general, higher yield is obtained during dry season particularly in irrigated field (HARRDEC, 1989).

Bean performs best in soil that are well structured and heavy rich loam with an optimum pH range of 5.6-6.8. It is a short day crop, sensitive to photoperiod. Its growth and development are favored mildly by cool environments, while high temperatures delay flowering (Bawang, 2006).

Varietal Adaptation

Bantog (1993) reported that growth and yield of bush snap beans are best in high elevation, however, yield are significantly reduced in low elevation and maturity of snap bean is longer in high elevation than in lower elevation .

The adaptability and introduction of new varieties in particular location is important for a successful production. It serves two purposes wherein, if it is proven that it is suitable under local conditions it can be propagated and released for commercial production, also important sources of variability and sources of desirable genes which can be used in hybridization work (Bao-an, 2002).

Variety must be adapted to the area in which it is grown. When grown under the same method of culture there is a great variation in the yielding ability of the different varieties. It is not a guarantee that a variety that yields best in one region will perform well in another region (Reily and Shry, 1991). Good performance and high yield of a crop in an area could convince and encouraged farmers to grow legumes.

Varietal Evaluation

Improving crop performance, productivity, plant breeding and using new developments in agricultural biotechnology will allow increase in crop yields and maintenance of yield stability without increasing land usage (Reddy and Hodges, 2000).

Characteristics of a good variety should be high yielding, pest and diseases resistant, good post harvest characteristic, eating quality and must be 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 (Bautista and Mabesa, 1986).

Six varieties studied by Dagson (2000) showed that HAB 63, Stringless, Torrent and BBL 274 is recommended in La Trinidad condition due to better growth and yield performance.

The result of the study of Pog-ok (2001) revealed that the Pencil variety performance is significantly better than the other varieties with regards to the number of days to flowering and first harvesting, pod length, pod diameter and resistance. Varieties B - 21 and Hav 16 gave the highest pod yield of about 12 tons per hectare.

Paredes (2003) evaluated six varieties of bush snap beans namely Kentucky wonder, Bush blue lake, Green crop, Blue lake, Landmark and Contender had the highest

number of flower per cluster. In addition Green crop variety was the highest yielding varieties in terms of marketable and computed yield per hectare.

Lumicquio (2007) evaluated ten varieties of bush snap bean to determine the economic benefits of fresh pods and dry seed production. Based on the results, BBL 274 and Contender showed the higher ROCE for dry seed yield.

Among the five varieties of bush snap bean evaluated by Orlang (2008), HAB 323 was the best performing bush bean variety evaluated because it is early maturing, earliest to produce dry pod and to mature, registered the tallest plant, numerically produced the heaviest marketable and computed seed yield and highly resistant to bean rust and pod borers.

MATERIALS AND METHODS

A total land area of 105m^2 was properly cleaned and prepared. The area was divided into three blocks, consisting of seven plots each with a dimension of 1m x 5m. The experimental area was laid out in Randomized Complete Block Design (RCBD) with three replications. Seven entries of bush beans were used in the study. Two seeds were sown per hill at a distance of 20 cm between rows and 20 cm between hills. The cultural management practices such as weeding, irrigation, hilling –up were done three weeks after planting and spraying of insecticide with an interval of seven days were uniformly employed in all treatments.

The seeds of the following entries, which served as treatments, were obtained from BSU-IPB Highland Crops Research Station at BSU:

CODE	ENTRY
V1	Hab 63
V2	BBL 274
V3	Landmark
V4	Hab 323
V5	Green crop
V6	Contender
V7	Hab 19

Farm Location

Barangay Camangaan, Sison, Pangasinan is geographically located at the northern portion of Pangasinan lying within the provincial boundaries of La Union and Benguet. It is 43 km away from Baguio City.

The average monthly temperature is 27.91 degrees centigrade. Dry season arises from November to April and during the rest of the year. It lies within the latitude of 16^{o} 11^{o} and longitude of 12^{o} and 39^{o} east. The soil is classified as clay loam and the terrain is largely flat with a slope ranging from 0-15 %, moderately undulated and rolling in many directions.

Data gathered

1. Meteorological data. Temperature, relative humidity and rainfall were taken during the conduct of experiment at Dagupan PAGASA Station.

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

$$\text{Percent survival} = \frac{\text{Total number of plants per plot at 30 days}}{\text{Total number of sown seeds per plot}} \text{ X } 100$$

3. Plant vigor. The plants were rated at 30 DAP using the following scale:

Scale	Description	Remarks
1	Plants are weak with few stems and leaves; very pale	Poor vigor
2	Plants are weak with few thin stems and leaves; pale	Less vigorous
3	Better than vigorous	Vigorous
4	Plants are moderately strong with robust stems and leaves; leaves light green in color	Moderately vigorous

5	Plants are strong with robust stems and leaves; leaves are light to dark green color	Highly vigorous

4. Maturity

a. Days from sowing to emergence. This was recorded by counting the number of days from planting to the time when at least 50% of plants have fully emerged.

b. Days from emergence to flowering. This was recorded by counting the days from emergence to the day when at least 50% of the plants have fully opened flowers.

c. Days from flowering to pod setting. This was recorded by counting the number of days starting from flowering to the day when pod sets formed.

d. Days from emergence to first harvest of fresh pods. This was recorded by counting the number of days from emergence to first harvest.

e. Days from emergence to last harvest of fresh pods. This was recorded by counting the number of days from emergence to the last harvest.

5. Plant height

a. Initial plant height (cm). This was measured one week after emergence from the base of the plant at the ground level to the tip of the youngest shoots using meter stick from ten sample plants.

b. Final plant height (cm). This was measured from the base of the plant at the ground level to the youngest shoots before the first harvest, using a meter stick from ten sample plants.

6. Reproductive characters

a. Number of flower per cluster. The number of flower per cluster was counted from ten random sample plants per plot.

b. Number of flowers per plant. The number of flower per plant was counted from ten sample plants per plot.

c. Number of flower cluster per plant. This was obtained by counting the number of flower cluster per plant from ten random sample plants per plot.

d. Number of pod per cluster. This was obtained by counting the number of pod per cluster from ten random sample plants per plot.

e. Number of pod cluster per plant. This was obtained by counting the number of pod cluster per plant from ten random sample plants per plot.

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

$$\% \text{ Pod set} = \frac{\text{Total no. of pods per cluster}}{\text{Total no. of flower per cluster}} \text{ X } 100$$

7. Pod data

a. Length of marketable pods (cm). Ten samples of pods were picked at random from each plot and their length was measured from the pedicel to the blossom end using veirner caliper.

b. Width of marketable pods (cm). This was measured by selecting ten random sample plants and measured by using veirner caliper.

8. Yield and yield components

a. Weight of marketable fresh pods (kg). The marketable fresh pods were harvested and weighed upon maturity. Marketable fresh pods were free from insect pest, diseases and not deformed.

b. Weight of non-marketable fresh pods (kg). The marketable pods were those that are affected by insect pest, diseases and deformed pods. It was weighed and discarded.

c. Total yield per plot. This was the total weight of harvested fresh pods per plot.

d. Computed fresh pod yield per hectare. This was computed using the formula:

Yield (t/ha) = Yield/plot (kg) $5m^2$ x 2

Where 2 is a factor to be used to convert yield in kg/$5m^2$ to ton/ha assuming one hectare effective areas.

9. Insect pest and diseases occurrence. This was determined by assessing the degree of damage caused by specific insect pest and diseases to the crop using the following scale used at BSU-IPBHCRS (Tandang et.al. 2008):

a. Pod borer, Bean rust

Scale	Description	Remark
1	No infestation per plot	Highly resistant
2	1-25% of infestation per plot	Mildly resistant
3	26-50% of infestation per plot	Moderately resistant
4	51-75% of infestation per plot	Susceptible

5	76-100% of infestation per plot	Very susceptible

10. Return on Cash Expenses. This was analyzed using the formula:

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

Data Analysis

All quantitative data were analyzed using the Analysis of Variance (ANOVA) for Randomized Complete Block Design (RCBD) with three replications. The significance of differences among treatments means was tested using the Duncans Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Temperature, Relative Humidity and Rainfall

Table 1 shows the monthly temperature, relative humidity and amount of rainfall during the conduct of the study from December 2009 to February 2010. Minimum temperature ranged from 20.1 to 20.8^{O}C while the maximum temperature ranged from 30.5 to 32.1^{O}C. The relative humidity ranged from 79.6% to 81.6% or an average of 80.5% while no amount of rainfall was recorded. The temperature ranges are appropriate since legume crops like bush bean performs well at 15^{O}C to 31^{O}C. However, Ferrer (1981) reported that bean plants grown in higher elevation with a temperature of 17.2 ^{O}C and relative humidity of 79.2% produced more and better yield than those planted in lower elevations with temperature of 26-30 ^{O}C and relative humidity of 71.4%.

Plant Survival

Among the seven entries evaluated, Hab 323 had the highest percent survival (92%), followed by Landmark (91%) while Hab 19 had the lowest percent survival of 82 % (Table 2). However, based on statistical analysis there were no significant differences

Table 1. Temperature and relative humidity taken during the conduct of the study

MONTH	TEMPERATURE (^{O}C)		RELATIVE HUMIDITY (%)
	MIN.	MAX.	
DECEMBER	20.1	30.5	80.4
JANUARY	20.5	31.4	81.6
FEBRUARY	20.8	32.1	79.6
MEAN	20.5	31.3	80.5

Table 2. Percent survival of the seven bush bean entries at 30 DAP

ENTRY	SURVIVAL (%)
Hab 63	86
BBL 274	86
Landmark	91
Hab 323	92
Green crop	85
Contender	83
Hab 19	82
CV (%)	4.41

on plant survival. Percent rate of survival could be due to the quality of the seeds.

Plant Vigor

All the entries evaluated were rated highly vigorous at 30 DAP. All the plants have strong and robust stems and leaves (Figure 1). Statistical analysis showed that there were no significant differences among the entries in terms of plant vigor. The results could be due to the varietal characteristics coupled with the favorable environmental condition of the area.

Fig. 1. The bush bean entries at 30 days after planting.

Days from Sowing to Emergence

All of the bush bean entries took seven days to emerge and the result showed no significant differences. The results could be attributed to the adaptation of the entries to the locality.

Days from Emergence to Flowering

In terms of days from emergence to flowering, there were no significant differences among all the entries evaluated. Hab 63, Hab 323, Green crop, Contender and Hab 19 flowered earlier at 28 days from emergence (Table 3). On the other hand, the latest to flower were BBL 274 and Landmark at 30 days from emergence. Early flowering could be due to its adaptation to the locality aside from its varietal characteristics.

Days from Flowering to Pod Setting

Among the seven entries of bush bean evaluated in the study, Hab 63, Hab 323, Green crop, Contender and Hab 19 set pods earlier than BBL 274 and Landmark as shown in Table 3. This confirms the findings of Bantog (1993) that the duration for pod setting at lower elevation was earlier than the pod setting of bush bean under high elevation.

Days from Emergence to First and Last Harvesting of Fresh Pods

Based on statistical analysis, no significant differences were noted from emergence to first and last harvest. All of the bush bean entries were first harvested at 43 days from emergence. Entries Hab 323 and Landmark had the longest duration of harves-

Table 3. Number of days from emergence to flowering, pod setting and harvesting of the seven bush bean entries evaluated

ENTRY	NUMBER OF DAYS FROM EMERGENCE TO			
	FLOWERING	POD SETTING	FIRST HARVEST	LAST HARVEST
Hab 63	28	9	43	56
BBL 274	30	11	43	57
Landmark	30	11	43	58
Hab 323	28	9	43	58
Green crop	28	9	43	56
Contender	28	9	43	56
Hab 19	28	9	43	54

ting at 58 days and Hab 19 had the shortest duration of harvesting fresh pods at 54 days.

Findings could be due to its adaptation to the locality aside from its varietal nature and this could be one way to determine its profitability in the area.

Initial and Final Plant Height

Table 4 shows significant differences on the initial and final height of the seven bush bean entries. Contender and Hab 19 were the tallest at 9.85 cm and 9.83 cm, respectively. However, initial plant height of Hab 323 and Hab 63 was statistically comparable. The shortest plants were observed in BBL 274 (8.03cm). On the other hand, it was noted that the shortest entries became the tallest at 43 DAP. It was recorded that BBL 274 was one of the tallest (30.84cm) among all entries but comparable with Landmark, Green crop, Contender and Hab 323 while Hab 19 was the shortest (25.46 cm). The significant differences could be attributed to the inherent characteristics of the

Table 4. Plant height of the seven bush bean entries evaluated

ENTRY	PLANT HEIGHT (cm) 7 DAP	43 DAP
Hab 63	9.17[abc]	27.42[bc]
BBL 274	8. 03[d]	30.84[ab]
Landmark	8.56[bcd]	33.63[a]
Hab 323	9.36[ab]	28.72[abc]
Green crop	8.32[cd]	32.22[ab]
Contender	9.85[a]	31.55[ab]
Hab 19	9.83[a]	25.46[c]
CV%	5.46	9.11

* Means followed by a common letter are significantly different at 5% level by DMRT

entries and wide adaptability to climatic condition. Findings showed that the taller the plants, the higher the number of pods per plant that could be expected due to possible higher photosynthetic rate brought about by longer sunshine duration (Borricano, 2008).

Number of Flowers per Cluster

Table 5 showed no significant differences on the number of flowers per cluster among the seven entries evaluated. The entries produced three to four flowers per cluster.

Number of Flowers per Plant and
Flower Cluster per Plant

Significant differences were observed in the number of flowers per plant and the number of flower cluster per plant. Contender had the highest number of flowers and

flower cluster with means of 28 flowers and 8 flower clusters per plant. Entry Hab 19 produced the lowest number of 17 flowers and five flower clusters per plant but compara-

Table 5. Flowering and pod setting of the seven bush bean entries evaluated

ENTRY	NUMBER					% POD SET PER CLUSTER
	FLOWER PER CLUSTER	FLOWER PER PLANT	FLOWER CLUSTER PER PLANT	POD PER CLUSTER	POD CLUSTER PER PLANT	
Hab 63	4	19^{bc}	6^{b}	3	4^{ab}	83
BBL 274	4	20^{bc}	6^{b}	4	5^{a}	100
Landmark	4	20^{bc}	6^{b}	3	5^{a}	75
Hab 323	4	22^{b}	6^{b}	3	4^{ab}	75
Green crop	4	20^{bc}	6^{b}	3	5^{a}	92
Contender	4	28^{a}	8^{a}	3	5^{a}	78
Hab 19	3	17^{c}	5^{b}	3	3^{b}	83
CV%	13.64	9.86	14.89	11.34	14.35	16.16

* Means followed by a common letter are significantly different at 5% level by DMRT

ble with most of the entries except for Contender (Table 5). The significant differences could be due to the varietal characteristic inherent in each variety.

Number of Pod per Cluster and Pod Cluster per Plant

Significant differences were noted among the bush bean entries evaluated, majority of the entries produced three pods (Table 5).

On the number of pod cluster per plant, significant statistical differences were obtained as shown in Table 5. BBL 274, Landmark, Green crop and Contender significantly gave the highest number of pod cluster per plant which is comparable with

Hab 63 and Hab 323 with a pod cluster of 4 to 5. Hab 19 produced the least number of three pod clusters. Significant differences could be due to their genetic characteristic.

Percent Pod Set per Cluster

Based on statistical analysis, the differences among entries were not significant. Although, numerically, BBL 274 displayed the highest pod set per cluster of 100% while Landmark and Hab 323 gave the lowest of 75% pod set.

Kudan (1999) reported that higher percentage of pod set at 62.5% is obtained during October to November of planting while March to May produced 30 to 40% pod set.

Length and Width of Marketable Pods

To determine the marketability of legume pod, pod length is one of the criteria to be used. Longer pods are usually preferred by consumers and buyers than the shorter ones (Viernes, 2000).

Significant differences on the length and width of marketable pods were recorded as shown in Table 6. Green crop produced the longest pods at 16.14 cm and widest pods at 1.2 cm while Contender produced the shortest pods at 12.49 cm. Most of the bush bean entries had a comparable pod width with means ranging from 0.77 to 0.85cm. On the contrary, the snap bean with narrow pods are considered to be desirable in the market and generally preferred by consumers (Calya-en, 2009).

Table 6. Pod length and width of the seven bush bean entries evaluated

ENTRY	POD (cm) LENGTH	WIDTH
Hab 63	13.91[b]	0.85[b]
BBL 274	12.98[cd]	0.77[b]
Landmark	12.84[cd]	0.85[b]
Hab 323	12.49[d]	0.80[b]
Green crop	16.14[a]	1.20[a]
Contender	13.65[bc]	0.84[b]
Hab 19	14.01[b]	0.80[b]
CV%	3.37	5.14

* Means followed by a common letter are significantly different at 5% level by DMRT

Reaction to Bean Rust

The reaction of bush bean entries to insect pest and diseases in natural field environment were rated during the vegetative stage at 30 days. Hab 63, BBL 274, Landmark, Hab 323, Green crop and Contender showed high resistance to bean rust and Hab 19 showed mild resistance to bean rust.

Reaction to Pod Borer

There were no pod borer observed during the conduct of the study.

Weight of Marketable Fresh Pods

The pods are considered marketable when free from insect pest and not deformed. Table 7 shows significant differences on the weight of marketable fresh pods among entries. BBL 274 produced the highest marketable pod yield of 1.73 kg.

Landmark produced comparable weight of marketable fresh pods (1.21 kg). The lowest yield was obtained from Hab 19 and Hab 63 at 0.49 and 0.58 kg, respectively. Significant differences in marketable fresh pods could be attributed to the number of flowers per plant, number of pod cluster per plant and percent pod set produced.

Weight of Non-marketable Fresh Pods

Non-marketable pods are those that are affected by insect pest, diseases and deformed pods. The bush bean entries significantly differed in the weights of non-marketable pods. The lowest weight of non- marketable fresh pods were observed in Hab 63 (0.49 kg), Landmark (0.53 kg), Hab 323 (0.39kg) and Ha19 (0.49 kg). Green crop produced the highest weight of non- marketable fresh pods at 0.74 kg as shown in Table 7.

Total Yield

Total yield per plot of the seven bush bean entries evaluated ranged from 0.98 to 2.27 kg (Table 7 and Figure 2). BBL 274 significantly registered the highest total yield (2.27 kg) which is comparable to Landmark and Green crop (1.74 and 1.7 kg per $5m^2$, respectively). Hab 19 produced the lowest total yield of 0.98 kg per 5 m^2 and computed yield of 1.97 tons per hectare. High total yield of some entries could be attributed to the high marketable and non-marketable yield. It may be also be due to temperature and maturity that may significantly be reduced at lower elevation and higher temperature and the maturity of snap beans is shorter in lower elevation (Bantog, 1993 and Ferrer, 1981).

Computed Fresh Pod Yield per Hectare

Table 7 shows the computed fresh pod yield on a per hectare basis of the seven bush bean entries evaluated with a yield ranging from 1.97 to 4.53 tons per hectare. BBL 274 obtained the highest computed fresh pod yield while Hab 19 produced the lowest fresh pod yield per hectare (Fig.2).

Table 7. Weight of marketable, non-marketable, total yield and computed yield of fresh pods of the seven bush bean entries

ENTRY	FRESH POD YIELD			
	MARKETABLE ($kg/5m^2$)	NON-MARKETABLE ($kg/5m^2$)	TOTAL ($kg/5m^2$)	COMPUTED (t/ha)
Hab 63	0.58	0.46^{a}	1.04^{bc}	2.07
BBL 274	1.73^{a}	0.55^{ab}	2.27^{a}	4.53
Landmark	1.21^{ab}	0.53^{a}	1.74^{ab}	3.48
Hab 323	0.64^{bc}	0.39^{a}	1.03^{bc}	2.07
Green crop	0.96^{bc}	0.74^{b}	1.70^{abc}	3.40
Contender	0.62^{bc}	0.59^{ab}	1.21^{bc}	2.43
Hab 19	0.49^{c}	0.49^{a}	0.98^{c}	1.97
CV%	10.76	20.31	27.71	

* Means followed by a common letter are significantly different at 5% level by DMRT

Fig. 2. Fresh pod yield of the seven bush bean entries.

ROCE of Fresh Pods

The return on cash expense of bush bean entries is shown in Table 8. BBL 274 had the highest ROCE of 212.09% followed by Landmark, Green crop, Contender, Hab 63, Hab 323 and Hab 19. The results indicate that the entries with the highest yield also gained the highest profit. It shows that the entries are best adapted to the area and have high yield potential performance.

Table 8. Return on Cash Expenses (ROCE) of growing the seven bush bean entries

ENTRY	YIELD PER PLOT ($5m^2$)	GROSS SALES	TOTAL EXPENSES	NET INCOME	ROCE%
Hab 63	1.04	15.53	10.91	4.62	42.30
BBL 274	2.27	34.05	10.91	23.14	212.09
Landmark	1.74	26.10	10.91	15.19	139.23
Hab 323	1.03	15.45	10.91	4.54	41.61
Green crop	1.70	25.50	10.91	14.59	133.73
Contender	1.21	18.15	10.91	7.24	66.36
Hab 19	0.98	14.70	10.91	3.79	34.74

Fresh pods were sold at PHP 15.00 per kilogram.

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Camangaan, Sison, Pangasinan to determine the growth and yield of seven bush bean entries in Camangaan, Sison, Pangasinan; determine the bean entries adapted in Camangaan, Sison, Pangasinan based on growth, yield and resistance to insect pest and diseases and to determine the profitability of growing bush bean in Camangaan, Sison, Pangasinan.

Among the entries evaluated, Hab 323 had the highest percent survival. Majority of the seven bush bean entries were highly vigorous at 30 DAP, emerged at 7 DAS, flowered at 28 days and set pods at 9 days after flowering. BBL 274 and Landmark were the latest to mature and had the longest harvesting duration. Hab 19 had the shortest duration of harvesting.

In terms of the reproductive characters, Contender had the highest number of flowers per plant, flower cluster per plant and number of pod cluster per plant but comparable with BBL 274, Landmark and Green crop.

High resistance to bean rust were observed from Hab 63, BBL 274, Landmark, Hab 323, Green crop and Contender. No pod borer occurrence was observed.

Based on yield performance, BBL 274 had the highest weight of marketable fresh pods, total yield, computed yield per hectare and gained the highest return on cash expenses but comparable with Landmark and Green crop.

Conclusion

Based on growth, resistance and yield, BBL 274, Landmark and Green crop were highly resistant to bean rust and high yielding.

BBL 274 had the highest return on cash expenses.

Recommendation

Based on the results of the study, BBL 274, Landmark and Green crop are recommended for planting in Camangaan, Sison, Pangasinan.

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APPENDICES

Appendixs Table 1. Percent survival

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	89	78	90	257	86
BBL 274	82	78	97	257	86
Landmark	86	90	97	273	91
Hab 323	90	90	96	276	92
Green crop	84	83	87	254	85
Contender	87	75	88	250	83
Hab 19	81	77	88	246	82
TOTAL	599	571	643	1813	86

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	376.381	188.190			
Treatment	6	256.000	42.667	2.94^{ns}	3.00	4.82
Error	12	174.286	14.525			
Total	20	806.667				

^{ns}= Not significant CV% = 4.41

Appendix Table 2. Plant vigor

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	5	5	5	15	5
BBL 274	5	4	5	14	5
Landmark	5	5	5	15	5
Hab 323	5	5	5	15	5
Green crop	5	5	5	15	5
Contender	5	5	5	15	5
Hab 19	5	4	5	14	5
TOTAL	35	33	25	103	5

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	0.381	0.190			
Treatment	6	0.476	0.079	1.0^{ns}	3.00	4.82
Error	12	0.952	0.079			
Total	20	1.810				

^{ns}= Not significant CV%= 5.74

Appendix Table 3. Days from sowing to emergence

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
Hab 63	7	7	7	21	7
BBL 274	7	7	7	21	7
Landmark	7	7	7	21	7
Hab 323	7	7	7	21	7
Green crop	7	7	7	21	7
Contender	7	7	7	21	7
Hab 19	7	7	7	21	7
TOTAL	49	49	49	147	7

Appendix Table 4. Days from emergence to flowering

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
Hab 63	28	28	28	84	28
BBL 274	30	30	30	90	30
Landmark	30	30	30	90	30
Hab 323	28	28	28	84	28
Green crop	28	28	28	84	28
Contender	28	28	28	84	28
Hab 19	28	28	28	84	28
TOTAL	200	200	200	600	29

Appendix Table 5. Days from flowering to pod setting

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
Hab 63	9	9	9	27	9
BBL 274	11	11	11	33	11
Landmark	11	11	11	33	11
Hab 323	9	9	9	27	9
Green crop	9	9	9	27	9
Contender	9	9	9	27	9
Hab 19	9	9	9	27	9
TOTAL	67	67	67	201	10

Appendix Table 6. Days from emergence to first harvest of fresh pods

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
Hab 63	43	43	43	129	43
BBL 274	43	43	43	129	43
Landmark	43	43	43	129	43
Hab 323	43	43	43	129	43
Green crop	43	43	43	129	43
Contender	43	43	43	129	43
Hab 19	43	43	43	129	43
TOTAL	301	301	301	903	43

Appendix Table 7. Days from emergence to last harvest of fresh pods

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
Hab 63	58	55	55	168	56
BBL 274	58	55	58	171	57
Landmark	58	58	58	174	58
Hab 323	58	58	58	174	58
Green crop	55	55	58	168	56
Contender	55	58	55	168	56
Hab 19	55	51	55	161	54
TOTAL	397	390	397	1184	56

Appendix Table 8. Initial plant height (cm)

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	8.95	10.2	8.37	27.52	9.17^{abc}
BBL 274	8.45	8.08	7.55	24.08	8. 03^{d}
Landmark	8.95	8.75	7.99	25.69	8.56^{bcd}
Hab 323	10	9.32	8.75	28.07	9.36^{ab}
Green crop	8.7	8.2	8.07	24.97	8.32^{cd}
Contender	10.82	9.05	9.68	29.55	9.85^{a}
Hab 19	10.55	9.86	9.08	29.49	9.83^{a}
TOTAL	66.42	63.46	59.49	189.37	9

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	3.455	1.727			
Treatment	6	9.487	1.581	6.51**	3.00	4.82
Error	12	2.913	0.243			
Total	20	15.855				

** = Highly significant CV% = 5.46

Appendix Table 9. Final plant height

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	29.34	25.65	27.28	82.27	27.42[bc]
BBL 274	33	27.53	31.98	92.51	30.84[ab]
Landmark	36.14	30.26	34.5	100.9	33.63[a]
Hab 323	30.2	26.37	29.58	86.15	28.72[abc]
Green crop	38.56	30.58	27.32	96.67	32.22[ab]
Contender	28.95	31.91	33.8	94.66	31.55[ab]
Hab 19	25.02	24.87	26.49	76.38	25.46[c]
TOTAL	221.21	197.17	210.95	629.54	30

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	41.575	20.788			
Treatment	6	149.524	24.921	3.34*	3.00	4.82
Error	12	89.488	7.457			
Total	20	280.587				

* = significant CV% = 9.11

Appendix Table 10. Number of flower per cluster

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	3	4	4	11	4
BBL 274	4	3	4	11	4
Landmark	4	4	4	12	4
Hab 323	4	4	4	12	4
Green crop	4	4	3	11	4
Contender	4	4	5	13	4
Hab 19	3	4	3	10	3
TOTAL	26	27	27	80	4

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	0.095	0.048			
Treatment	6	1.905	0.317	1.18^{ns}	3.00	4.82
Error	12	3.238	0.270			
Total	20	5.238				

^{ns}=Not significant CV% =13.64

Appendix Table 11. Number of flower per plant

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	18	18	20	56	19^{bc}
BBL 274	22	18	20	60	20^{bc}
Landmark	19	18	22	59	20^{bc}
Hab 323	26	20	21	67	22^{b}
Green crop	23	18	18	59	20^{bc}
Contender	29	24	31	84	28^{a}
Hab 19	16	16	19	51	17^{c}
TOTAL	153	132	151	436	21

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	38.381	19.190			
Treatment	6	229.143	38.190	9.11**	3.00	4.82
Error	12	50.286	4.190			
Total	20	317.810				

**= Highly significant CV% = 9.86

Appendix Table 12. Number of flower cluster per plant

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	6	5	7	18	6[b]
BBL 274	8	4	6	18	6[b]
Landmark	6	4	7	17	6[b]
Hab 323	9	5	6	20	6[b]
Green crop	9	5	6	19	6[b]
Contender	11	6	8	25	8[a]
Hab 19	7	4	5	16	5[b]
TOTAL	56	33	45	133	6

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	34.667	17.333			
Treatment	6	17.333	2.889	3.25*	3.00	4.82
Error	12	10.667	0.889			
Total	20	62.667				

*= significant CV% = 14.89

Appendix Table 13. Number of pod per cluster

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	3	3	3	9	3
BBL 274	4	3	4	11	4
Landmark	3	3	3	9	3
Hab 323	3	3	3	9	3
Green crop	4	3	3	10	3
Contender	4	3	3	10	3
Hab 19	3	2	3	8	3
TOTAL	23	20	23	66	3

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	1.143	0.571			
Treatment	6	1.905	0.317	2.50^{ns}	3.00	4.82
Error	12	1.524	0.127			
Total	20	4.571				

^{ns}= Not significant CV% = 11.34

Appendix Table 14. Number of pod cluster per plant

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	4	3	4	11	4[ab]
BBL 274	5	4	5	14	5[a]
Landmark	5	4	6	15	5[a]
Hab 323	5	4	4	13	4[ab]
Green crop	6	5	4	15	5[a]
Contender	5	5	6	16	5[a]
Hab 19	3	3	4	10	3[b]
TOTAL	33	23	33	94	4

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	2.381	1.190			
Treatment	6	9.905	1.651	4.0*	3.00	4.82
Error	12	4.952	0.413			
Total	20	17.238				

* = significant CV% = 14.35

Appendix Table 15. Percent pod set per cluster

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	100	75	75	250	83
BBL 274	100	100	100	300	100
Landmark	75	75	75	225	75
Hab 323	75	75	75	225	75
Green crop	100	75	100	275	92
Contender	100	75	60	235	78
Hab 19	100	50	100	250	83
TOTAL	650	525	585	1760	84

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	1116.667	558.333			
Treatment	6	1528.571	254.762	1.39 ^{ns}	3.00	4.82
Error	12	2200.000	183.333			
Total	20	4845.238				

^{ns}= Not significant CV% = 16.16

Appendix Table 16. Length of marketable pods (cm)

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	14.14	13.59	14	41.73	13.91[b]
BBL 274	12.39	13.61	12.94	38.94	12.98[cd]
Landmark	13.63	12.37	12.51	38.51	12.84[cd]
Hab 323	12.3	13.02	12.15	37.47	12.49[d]
Green crop	16.06	16.28	16.08	48.42	16.14[a]
Contender	13.35	13.98	13.63	40.96	13.65[bc]
Hab 19	13.59	14.2	14.25	42.04	14.01[b]
TOTAL	95.46	97.05	95.56	288.07	13.72

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	0.227	0.113			
Treatment	6	26.471	4.412	20.61**	3.00	4.82
Error	12	2.569	0.214			
Total	20	29.267				

** = Highly significant CV% = 3.37

Appendix Table 17. Width of marketable pods (cm)

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	0.85	0.82	0.89	2.56	0.85[b]
BBL 274	0.84	0.73	0.75	2.32	0.77[b]
Landmark	0.94	0.8	0.8	2.54	0.85[b]
Hab 323	0.8	0.8	0.81	2.41	0.80[b]
Green crop	1.19	1.21	1.2	3.6	1.2[a]
Contender	0.8	0.89	0.83	2.52	0.84[b]
Hab 19	0.81	0.8	0.8	2.41	0.80[b]
TOTAL	6.23	6.05	6.08	18.09	0.86

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	0.003	0.001			
Treatment	6	0.386	0.064	31.82**	3.00	4.82
Error	12	0.024	0.002			
Total	20	0.413				

** = Highly significant CV% =5.14

Appendix Table 18. Weight of marketable fresh pods (kg)

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	0.55	0.625	0.55	1.725	0.575[c]
BBL 274	2	0.9	2.3	5.2	1.73[a]
Landmark	0.9	1.325	1.4	3.625	1.21[ab]
Hab 323	0.575	0.55	0.8	1.925	0.64[bc]
Green crop	1.35	0.6	0.925	2.875	0.96[bc]
Contender	0.725	0.55	0.58	1.855	0.62[bc]
Hab 19	0.45	0.475	0.55	1.475	0.49[c]
TOTAL	6.55	5.23	7.0	18.68	0.89

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	0.331	0.166			
Treatment	6	3.632	0.605	5.82**	3.00	4.82
Error	12	1.248	0.104			
Total	20	5.211				

** = Highly significant CV% =10.76

Appendix Table 19. Weight of non-marketable fresh pods (kg)

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	0.455	0.55	0.375	1.38	0.46[b]
BBL 274	0.55	0.5	0.6	1.65	0.55[ab]
Landmark	0.4	0.65	0.55	1.6	0.53[b]
Hab 323	0.425	0.475	0.275	1.175	0.39[b]
Green crop	0.925	0.725	0.575	2.225	0.74[a]
Contender	0.575	0.625	0.58	1.78	0.59[ab]
Hab 19	0.4	0.475	0.6	1.475	0.49[b]
TOTAL	3.73	4	3.56	11.29	0.54

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	0.014	0.007			
Treatment	6	0.223	0.037	3.12*	3.00	4.82
Error	12	0.143	0.012			
Total	20	0.380				

*= Significant CV%= 20.31

Appendix Table 20. Total yield per plot

VARIETIES	REPLICATION I	II	III	TOTAL	MEAN
Hab 63	1.005	1.175	0.925	3.105	1.035^{bc}
BBL 274	2.55	1.4	2.85	6.8	2.27^{a}
Landmark	1.3	1.975	1.95	5.225	1.74^{ab}
Hab 323	1	1.025	1.075	3.1	1.03^{bc}
Green crop	2.275	1.325	1.5	5.1	1.7^{abc}
Contender	1.3	1.175	1.16	3.635	1.21^{bc}
Hab 19	0.85	0.95	1.15	2.95	0.98^{c}
TOTAL	10.28	9.03	10.61	29.92	1.42

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	0.200	0.100			
Treatment	6	4.291	0.715	4.59*	3.00	4.82
Error	12	1.870	0.156			
Total	20	6.361				

*= Significant CV% =27.71

SAppendix Table 21. Computed fresh pod yield per hectare

VARIETIES	REPLICATION			TOTAL	MEAN
	I	II	III		
Hab 63	2.01	2.35	1.85	6.21	2.07
BBL 274	5.1	2.8	5.7	13.6	4.53
Landmark	2.6	3.95	3.9	10.45	3.48
Hab 323	2	2.05	2.15	6.2	2.07
Green crop	4.55	2.65	3	10.2	3.4
Contender	2.6	2.35	2.32	7.27	2.43
Hab 19	1.7	1.9	2.3	5.9	1.97
TOTAL	20.56	18.05	21.22	59.83	2.85