

## **BIBLIOGRAPHY**

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## **ABSTRACT**

The study was conducted to evaluate the growth and French pod yield of eight bush snap bean accessions grown organically; determine the acceptability and profitability of eight bush snap bean accessions for French pod production in La Trinidad, Benguet; and to determine the best accessions of eight bush snap beans applied with organic fertilizers in terms of growth and French pod yield, acceptability and profitability in La Trinidad, Benguet.

All the eight bush snap bean accessions emerged in seven days after sowing except for Green Crop that emerged in eight DAS. HAB 323, Green Crop, HAB 19 and Contender were the earliest to flower in 41 DAS. Torrent produced the tallest plants while Landmark produced the shortest plants. At 30 DAP, Green Crop recorded the highest canopy cover while BBL 274 had increased canopy cover at 45 and 60 DAP. All accessions produced four to six flowers per cluster and three to five pods per cluster. BBL 274 had the highest total number of French pods per plant. BBL 274 had the longest pods, HAB 323 had the widest pods and the pod diameter of eight bush snap bean accessions ranged from 0.2-0.5 cm. HAB 63 produced the highest French pod yield per plot and total

yield per hectare, highest ROCE and highest acceptability rating by farmers and students together with BBL 274 and HAB 323. All the eight bush snap bean accessions exhibited resistance to bean rust and moderately tolerant to pod borer.



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## INTRODUCTION

Snap bean (*Phaseolus vulgaris.L*) is a food crop, popularly known as “Baguio beans” or “lubias”. It is cultivated throughout the temperate, tropical and subtropical areas of the world. It is the species cultivated for either dried beans or the immature green pods. (Jose, 2004).

Snap bean is recognized as important source of proteins, vitamins, and minerals, such as calcium & phosphorus. It is consumed mainly in the green pod stage or as fresh pods as source of nutrients for human growth and development and as source of income for the farmers (Seb-aten, 1997).

In Benguet where vegetable raising is one of the main sources of livelihood, snap bean is among the popular crops being grown commercially. Farmers grow various crops that are usually adapted to the environmental conditions in their respective locality. Under Benguet condition, snap bean is one of the vegetable crops that perform well in terms of growth and yield.

French beans are bush-type beans that produce very narrow, sometimes pencil-thin pods. They are primarily grown for their immature green pods for export market to European Union and elite local urban markets. The length of French beans is about four inches and six to ten millimeter in diameter. The French beans is deep emerald in color with tiny seeds (Decker, 2009).

In the Philippines, organic farming is being advocated. The use of resistant varieties against diseases and insects would minimize the use of synthetic fungicides and insecticides, is very important. Evaluation of introduced resistant and high yielding snap bean varieties adapted to organic production is therefore necessary.



Traditionally, in the Philippines, specifically in La Trinidad, bush snap beans are grown for their tender and smooth green fresh snap bean pods. Ideally, the snap bean growers prefer varieties with stringless pods i.e without suture, straight and slender with 0.80-1.00 cm diameter (Tandang, *et.al.*, 2005). Presently, consumers are looking for French type varieties with immature green pods since younger pods when consumed are better are for human health.

The evaluation of growth and French pod yield of bush bean accessions in La Trinidad Benguet is important to determine the best bush snap bean accession in terms of French type pod yield and to encourage farmers to grow snap bean for French type pod production as source of nutrients and higher income for they are more expensive than ordinarily bush snap bean..

The objectives of the study were to:

1. evaluate the growth and French pod yield of eight bush snap bean accessions grown organically in La Trinidad, Benguet;
2. determine the acceptability and profitability of eight accessions of bush snap bean in La Trinidad, Benguet; and
3. determine the best accessions of bush snap bean applied with organic fertilizers in terms of growth and French pod yield, acceptability and profitability in La Trinidad Benguet.

The study was conducted at Benguet State University-Institute of Plant Breeding Highland Crop Research Station (BSU-IPB HCRS), La Trinidad, Benguet from December 2009 to March 2010.



## REVIEW OF LITERATURE

### Description of the Bush Snap Bean Plant

Bush snap beans (*Phaseolus vulgaris*) are tender warm season annuals that originated in part of South and Central America. They are grown for their fleshy immature pods that reach maturity from 50-70 days after planting. As a member of the legumes family, snap bean roots contain nodules with rhizobium species that allow the plant to fix atmospheric nitrogen (Delahaut, 2000).

In temperate countries, the green immature pods are cooked and eaten as vegetable. Immature pods are marketed fresh, frozen or canned, wholecut, or French-cut. In some parts of the tropics, leaves are used as potherb and to a lesser extent the green shelled beans are eaten (Duke, 1998)

### Adaptation of Snap bean

It is reported that beans grow best on soils that hold water well and have a good aeration and water filtration. Soil should have a pH of 5.8-6.6. Temperature is important for rapid growth, good pod set, and early maturity (Pacher, 2002)

Snap beans grow best in areas with temperature between 15<sup>0</sup>C to 21<sup>0</sup>C. Planting snap beans should be scheduled during typhoon-free months as these cannot stand adverse condition. In Benguet, typhoons usually occur between the months of June to November. Hence, planting should be done from December to April to avoid the on slough of adverse weather (PCARRD, 1989).



## Varietal Evaluation

Varietal evaluation is a process in crop breeding which provides comparison of promising lines with the local check in order to establish the superiority of the lines developed by the breeder. It is only through varietal evaluation that a breeder sees or shows the better performance of developed lines in terms of yield and quality, resistance to diseases and pests, stress and other parameters ( Kimeu, 1994)

Regmi (1990) stated that varietal evaluation gathers data on plant characteristics, yield performance and pod quality. Hence, we obtain high yielding and improve cultivars that are known to plants important role in boosting production.

The result of the study of Pog-ok (2001) revealed that Pencil pod performed significantly better than the other varieties with regard to the number of days to flowering and first harvesting, pod length, pod diameter and resistance. B-21 and Hav 106 gave the highest pod yield of about 12 tons/ha. Although statistically there were similarities with the yield of Alno and other varieties studied

Lab-oyan (1987) as cited by Cadley (1999) revealed that a space of 30 cm between rows produced the longest pods. The test varieties and spacing on the production had no significant interaction effect. FLO had the highest seed yield among the varieties tested.

Paredes (2003) found that the six varieties of bush snap bean he evaluated had varying adaptability under La Trinidad conditions. Green Crop and Contender were the most suited varieties due to the higher production of flower and high yield.





### Effect of Organic fertilizer

Organic fertilizers are 'naturally' occurring compounds manufactured through natural processes. It contains essential nutrients to improve the health and productivity of soil and encourage plant growth. Organic nutrients increase the abundance of soil organisms by providing organic matter and micronutrients for organisms such as fungal mycorrhiza, which aid plants in absorbing nutrients.

PCARRD (1982) stated that organic fertilizers supply some amount of the nutrient requirements of the crop they promote favorable soil properties, such as granulation and good tilt for efficient aeration, easy root penetration and improve water holding capacity.

Amok (2003) found that snap bean plants applied with organic fertilizer performed better than the plants without fertilizer in terms of 100 seed weight with nodule count, fresh and dry weight of leaves and yield performance.

The application of organic fertilizer is an important practice in increasing the productivity of the soil. The transformation and availability of phosphorus in the soil will be more complex of organic fertilizer are used in strongly acidic soils (Chen, *et al.*, 2001)

According to Colting (1994) application of organic fertilizers affects favorable changes in the soil properties. In general, the pH and organic matter content of the soil increased after harvesting of the plants. This indicates that organic farming allows the production of crops while enhancing soil productivity.

Generally, fertilizers are applied at planting or before planting (basal application). Organic fertilizers are should be applied much earlier so that they will be decomposed further and the nutrients will be already available to the plants. Fertilizers are applied not



only at planting but also side dressed during the vegetative growth stage of bean plants during dry season. The first half of a required fertilizer should be applied at planting, and the second half of N should be side dressed three weeks after seeding (AVRDC, 1990)

Koshino (1990) found that nutrient elements from organic fertilizers are released slowly which is particularly important in avoiding salt injury, ensuring a continuous supply of nutrients during the growing season, and producing products of better quality.

The organic fertilizers supplies some amount of the nutrient requirements of the crop and promotes favorable soil properties such as granulation, efficient aeration, easy root penetration and improved water holding capacity of the soil (Marcelino, 1995)

Abadilla (1982) reported that crops fertilized with organic matter have greater resistant to pest and diseases. He also explained that humic acids and growth substances are absorbed into plant tissue through the roots and they favor the formation of proteins by influencing the synthesis of enzymes, increasing the vigor and insect resistance of the plant.

Parnes (1986) claimed that organic matter is the principal source of nitrogen, phosphorus and sulfur become available as the organic matter continuous to decompose, most of the calcium, magnesium and potassium in the decaying organic residue are discarded by the soil organisms during the first stages of decomposition and these nutrients are quickly available to plants organic matter through its effect on physical condition of the soil increases the amount of water available for plant growth.



## MATERIALS AND METHODS

An area of 120m<sup>2</sup> was thoroughly prepared into three blocks consisting 1x5m per plot corresponding to the eight different accessions of bush snap bean. The experiment was laid out following randomized complete block design (RCBD) with three replication. The seeds were sown in a double row plots at a distance of 25cm x 25cm between hills and between rows.

Basal application of the organic fertilizer, i.e. “BSU growers’ compost” was done at planting. It was thoroughly mixed with the soil at 5 kg per 5m<sup>2</sup> plot. It was also side-dressed during hilling up at three weeks after planting at 2 kg per 5m<sup>2</sup> plot.

The following accessions of bush snap beans to be obtained from BSU-IPB HCRS were used as treatments:

<u>CODE</u>	<u>ACCESSIONS</u>
ACC <sub>1</sub>	HAB 63
ACC <sub>2</sub>	BBL 274
ACC <sub>3</sub>	Torrent
ACC <sub>4</sub>	Landmark
ACC <sub>5</sub>	HAB 323
ACC <sub>6</sub>	Green crop
ACC <sub>7</sub>	HAB 19
ACC <sub>8</sub>	Contender

All cultural management practices necessary for French snap bean production such irrigation, weeding was done to ensure the growth of the plants.



Data gathered:

1. Maturity

a. 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.

b. Days from sowing 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.

c. Days from sowing to first harvesting of fresh pods. This was done by counting the number of days from sowing to first harvesting of fresh pods per plot. Fresh pods are ready for harvesting when they are generally about as thin as a pencil and when the pods are immature green.

d. Days from sowing to the last harvesting of fresh pods. This was done by counting the number of days from sowing to last harvesting of fresh pods per plot.

2. Canopy cover. This was gathered at 30, 45 and 60 DAP using a 120 cm x 60cm wooden frame with the ten equal sized (12cmx6cm) grids in ten sample plants per plot.

3. Plant height

a. Initial height (cm). Ten sample plants was selected at random and measured from the base of the plant to the tip of the youngest shoot at 30 DAP using meter stick.

b. Final height (cm). This was done by measuring the ground level to the tip of plant using meter stick during the last harvesting.

4. Reproductive Characters

a. Number of flowers per cluster. This was taken by counting the number of flowers per cluster per plant using ten samples per plot.



b. Number of pod clusters per plant. This was done by counting the number of pod clusters per plant from ten random sample plants per plot.

c. Percent pod set per cluster. This was taken by using the formula:

$$\text{Percent pod setting (\%)} = \frac{\text{Total no. of pods/cluster}}{\text{Total no. of flowers/cluster}} \times 100$$

d. Number of pods per cluster. This was taken by counting the number of pods per cluster using ten sample clusters per plot.

e. Total number of pods per plant. This was done by counting the number of pods per plant using ten samples per plot.

#### 5. Fresh Pod Characters

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 ruler.

b. Pod width (cm). This was taken using the foot ruler at the middle portion of five sample pods per plot.

c. Pod texture. This was taken by touching the pod and the texture feels coarse or smooth.

d. Pod straightness. This was recorded as either straight or curved.

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

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

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



## 6. Yield and Yield Component

a. Number and weight of marketable fresh pods per plot (kg/5m<sup>2</sup>). This was measured by counting and weighing the marketable pods per plot. Pods are considered marketable when they are straight, tender & free from insect & diseases damages.

b. Number and weight of non-marketable fresh pods (kg/5m<sup>2</sup>). Non-marketable pods that are abnormal in shape and affected by pest and diseases were counted and weighed per plot.

c. Total yield per plot (kg/5m<sup>2</sup>). The total weight of marketable and non-marketable pods per plot was computed at the end of the harvesting duration.

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

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

\*where 2 is a factor to be used to convert yield in kg/5m<sup>2</sup> plot into yield per hectare in ton/ha.

7. Reaction to bean rust and pod borer. This was determined at peak of harvesting stage using the respective rating scales for bean rust infection and pod borer infestation used at BSU-IPB HCRS by Tandang *et al.*, in 2008 as follows:

### a. Bean rust.

<u>Scale</u>	<u>Percent infection</u>	<u>Remarks</u>
1	Less than 20% infection per plot	Highly resistant
2	20-40% infection /plot	Moderately resistant
3	41-60% infection/plot	Mildly resistant
4	61-80% infection/plot	Susceptible
5	80-100% infection/plot	Very susceptible



b. Pod borer.

<u>Scale</u>	<u>Percent infestation</u>	<u>Remarks</u>
1	No infestation	Highly tolerant
2	1-25% of the plant/plot was infested	Moderately tolerant
3	25-50% of the plant/plot was infested	Mildly tolerant
4	51-75% of the plant/plot was infested	Susceptible
5	76-100% of the plant/plot was infested	Very susceptible

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

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

9. Visual evaluation. Ten farmers and students were invited in the field to serve as panelist to evaluate the eight varieties of bush snap bean at peak of harvest stage. They were also requested to make their own selection based on the following:

a. Plant appearance. This was evaluated by the farmers/students based on the growth of eight French bush snap bean accessions using the questionnaire in Appendix Table 1.

b. Pod characters. This was evaluated by the farmers/students based on pod shape, pod texture, pod color, pod straightness and general acceptability of the ten French bush snap bean accessions using the same questionnaire in Appendix Table 1.



## Analysis of Data

All quantitative data were analyzed using analysis of variance (ANOVA) for randomized complete block design (RCBD) with three replications. Significance of difference among treatment means was tested using Duncan's Multiple Range Test (DMRT) at 5% level of significance.





## RESULTS AND DISCUSSION

### Number of Days from Sowing to Emergence

The number of days from sowing to emergence was not significant among the eight French bush snap bean accessions. Seven of the accessions evaluated emerged in seven days, earlier than Green crop by one day (Table 1).

Table 1. Number of days from sowing to emergence, flowering, first harvesting and last harvesting.

ACCESSIONS	NUMBER OF DAYS FROM SOWING TO			
	EMERGENCE	FLOWERING	FIRST HARVESTING	LAST HARVESTING
HAB 63	7	42 <sup>b</sup>	58 <sup>ab</sup>	79 <sup>ab</sup>
BBL 274	7	44 <sup>a</sup>	59 <sup>a</sup>	80 <sup>a</sup>
Torrent	7	42 <sup>b</sup>	58 <sup>ab</sup>	77 <sup>b</sup>
Landmark	7	42 <sup>b</sup>	59 <sup>a</sup>	77 <sup>b</sup>
HAB 323	7	41 <sup>b</sup>	56 <sup>b</sup>	78 <sup>ab</sup>
Green Crop	8	41 <sup>b</sup>	56 <sup>b</sup>	77 <sup>b</sup>
HAB 19	7	41 <sup>b</sup>	57 <sup>ab</sup>	78 <sup>ab</sup>
Contender	7	41 <sup>b</sup>	56 <sup>b</sup>	77 <sup>b</sup>
CV (%)	7.77	1.62	1.93	1.42

\* Means followed by a common letter are not significantly different at 5% level by DMRT.



### Number of Days from Sowing to Flowering

Highly significant differences in terms of days from sowing to flowering were observed among the eight bush snap bean accessions (Table. 1). HAB 323, Green Crop, HAB 19 and Contender were the earliest to flower at 41 days. The other accessions flowered within 42- 44 days after sowing. The flowering difference could be attributed to their different genetic make-up.

### Number of Days from Sowing to First and Last Harvesting

There were significant differences among treatments in terms of the number of days from sowing to first harvesting and last harvesting. HAB 323, Green Crop, and Contender were the earliest to harvest at 56 days after sowing (DAS). The other accessions were harvested at 57 to 59 days.

Again, HAB 323, Green Crop, and Contender were the earliest accessions that reached last harvesting. BBL 274 and Landmark were the latest to reach last harvesting. Differences on the days to flowering may be attributed to varietal characteristics of the plant.

### Plant Height

The plant height at 30 and 77 DAP did not significantly differ among the eight French bush snap bean accessions evaluated. Plant height ranged from 10 cm to 14 cm at 30 DAP and 13 to 17 cm at 77 DAP.



Table 2. Initial and final plant height of eight bush snap bean accessions

ACCESSIONS	HEIGHT (cm)	
	30 DAP	77 DAP
HAB 63	12	14
BBL 274	12	16
Torrent	14	17
Landmark	10	15
HAB 323	12	16
Green Crop	13	16
HAB 19	12	13
Contender	12	15
CV (%)	8.86	10.61

### Canopy cover

Table 5 shows the canopy cover of the eight bush snap bean accessions which were not significantly different at 30, 45 and 60 DAP. Numerically, at 30 DAP, Green Crop had the widest canopy. HAB 63 and HAB 19 produced the narrowest canopy. All accessions increased in canopy cover at 45 DAP BBL 274 produced the highest canopy cover while HAB 63, Green Crop, HAB 19 and Contender had the lowest canopy cover. At 60 DAP, BBL 274 had the highest canopy cover while Landmark produced the lowest canopy cover.



Table 3. Canopy cover at 30, 45 and 60 DAP of eight bush snap bean accessions

ACCESSIONS	CANOPY COVER (cm <sup>2</sup> )		
	30 DAP	45 DAP	60 DAP
HAB 63	648	1080	1656
BBL 274	720	1224	1500
Torrent	720	1152	1656
Landmark	720	1152	1368
HAB 323	720	1152	1656
Green Crop	292	1080	1584
HAB 19	648	1080	1656
Contender	720	1080	1656
CV (%)	7.62	8.27	11.01

Number of Flowers Per Cluster,  
Pods Per Cluster and  
Percent Pod Set Per Cluster

No significant differences were observed on the number of flowers per cluster.

The accessions evaluated produced four to six flowers per cluster (Table 4).

Significant differences were noted on the number of pods per cluster among eight bush snap bean accessions evaluated (Table 4). Green Crop and Contender had three pods per cluster while all other accessions produced four except for Torrent that had five pods per cluster.

Pod setting of eight bush beans ranged from 59- 84 %.



Table 4. Number of flowers per cluster, pods per cluster and percent pod setting per cluster of eight bush snap bean accessions

ACCESSIONS	NO. OF FLOWERS PER CLUSTER	NO. OF PODS PER CLUSTER	% POD SETTING PER CLUSTER
HAB 63	6	4 <sup>b</sup>	70
BBL 274	4	4 <sup>b</sup>	84
Torrent	5	5 <sup>a</sup>	76
Landmark	5	4 <sup>b</sup>	68
HAB 323	5	4 <sup>b</sup>	74
Green Crop	5	3 <sup>c</sup>	59
HAB 19	6	4 <sup>b</sup>	64
Contender	5	3 <sup>c</sup>	67
CV (%)	18.31	12.38	16.80

\* Means followed by a common letter are not significantly different at 5% level by DMRT.

#### Number of Pod Clusters Per Plant

HAB 323, Green Crop and Contender gave higher number of pod clusters per plant while all other accessions produced the same number of pod clusters per plant (13) (Table 5).

#### Total number of Pods per plant

There were no significant differences observed on the total number of pods per plant among the eight bush beans studied (Table 5). Numerically, Contender had the highest total number of pods per plant (57). BBL 274, Torrent, HAB 323 and Green Crop had the lowest pods per plant (52).



Table 5. Number of pod clusters per plant and total number of pods per plant of eight bush snap bean accessions

ACCESSIONS	NUMBER OF POD CLUSTERS PER PLANT	TOTAL NUMBER OF PODS PER PLANT
HAB 63	13	53
BBL 274	13	52
Torrent	13	52
Landmark	13	54
HAB 323	14	52
Green Crop	14	52
HAB 19	13	54
Contender	14	54
CV (%)	7.92	8.68

French Pod length, Width and diameter of eight French Bush Snap Bean Accessions

There were no significant differences in French pod length of the accessions studied. BBL 274 gave the longest pods while HAB 63, Torrent and Landmark recorded the shortest pods (Table 6).

Results showed no significant differences observed on the width of the pods among the eight accessions used. All of them gave statistically similar width which ranged from 0.3 to 0.5 cm (Table 6). HAB 323 gave the widest pods and Torrent recorded the narrowest pods.



The diameter of the eight bush snap bean accessions were also statistically similar. Majority of the snap bean accessions evaluated had around 0.4 mm pod diameter. Torrent had 2 mm while HAB 63 registered 5 mm (Table 6 and Figure 1).

Table 6. Fresh pod length, width and diameter of eight French bush snap bean accessions

ACCESSIONS	POD LENGTH (cm)	POD WIDTH (cm)	POD DIAMETER (mm)
HAB 63	9	0.4	0.4
BBL 274	11	0.4	0.4
Torrent	9	0.4	0.2
Landmark	9	0.4	0.4
HAB 323	10	0.5	0.5
Green Crop	10	0.4	0.4
HAB 19	10	0.4	0.4
Contender	10	0.4	0.4
CV (%)	12.00	9.97	18.84



### Reaction to bean rust and pod borer

It was observed that the eight evaluated accessions were highly resistant to bean rust and moderately tolerant to pod borer under organic production in La Trinidad, Benguet.



Figure 1. French pods of eight bush snap bean accessions

### Number of Marketable French pods per 5m<sup>2</sup>

All the accessions tested had comparable number of marketable pods per plot. HAB 63 produced the highest number of marketable pods while HAB 19 gave the lowest number of marketable pods per plot (Table 7).





### Number of non-marketable pods per 5m<sup>2</sup>

Table 7 shows the number of non-marketable pods per plot. HAB 63 obtained the highest number of non-marketable French pods per plot followed by BBL 274. No significant differences were obtained among the accessions grown.

Table 7. Number of marketable and non-marketable pods of eight bush snap bean accessions

ACCESSIONS	NUMBER OF PODS PER (5m <sup>2</sup> )	
	MARKETABLE	NON-MARKETABLE
HAB 63	185	59
BBL 274	176	38
Torrent	135	32
Landmark	153	31
HAB 323	175	33
Green Crop	134	31
HAB 19	129	37
Contender	162	33
CV (%)	18.97	28.48

### Weight of Marketable French pods

The marketable French pod yield per plot of eight bush snap bean accessions were statistically similar. It ranged from 1.7 to 2.9 kg/5m<sup>2</sup> (Table 8).



### Weight of non-marketable French pods

Highly significant differences in non-marketable French pod yield were observed among the treatments. HAB 63 produced heavier non-marketable French pod yield/plot than all other accessions (Table 8).

Table 8. Weight of marketable and non-marketable French pods per plot of eight French bush snap bean accessions

ACCESSIONS	WEIGHT PER 5m <sup>2</sup> (kg)	
	MARKETABLE	NON-MARKETABLE
HAB 63	2.9	1.5 <sup>a</sup>
BBL 274	2.73	0.64 <sup>b</sup>
Torrent	2.86	0.60 <sup>b</sup>
Landmark	2.33	0.73 <sup>b</sup>
HAB 323	2.54	0.73 <sup>b</sup>
Green Crop	1.87	0.73 <sup>b</sup>
HAB 19	1.78	0.72 <sup>b</sup>
Contender	2.5	1.06 <sup>b</sup>
CV (%)	20.23	29.33

\* Means followed by a common letter are not significantly different at 5% level by DMRT.

### Total Yield per 5m<sup>2</sup> and per hectare

HAB 63 gave higher total French pod yield than the comparable French pod yield of all other bush snap beans tested (Table 9). The total yield per plot and per hectare of the eight French bush snap bean accessions could be attributed to high marketable and non-marketable yield.



Table 9. Total yield per 5m<sup>2</sup> and per hectare of eight French bush snap bean accessions

ACCESSIONS	TOTAL YIELD	
	PER 5m <sup>2</sup> (kg)	PER HECTARE (tons)
HAB 63	4.5 <sup>a</sup>	9.12 <sup>a</sup>
BBL 274	3.4 <sup>b</sup>	6.74 <sup>b</sup>
Torrent	3.5 <sup>b</sup>	6.90 <sup>b</sup>
Landmark	3.0 <sup>b</sup>	6.11 <sup>b</sup>
HAB 323	3.2 <sup>b</sup>	6.57 <sup>b</sup>
Green Crop	2.6 <sup>b</sup>	5.20 <sup>b</sup>
HAB 19	2.5 <sup>b</sup>	5.00 <sup>b</sup>
Contender	3.5 <sup>b</sup>	7.12 <sup>b</sup>
CV (%)	17.39	17.39

\* Means followed by a common letter are not significantly different at 5% level by DMRT.

#### Return on Cash Expense (ROCE)

HAB 63 had the highest return on cash expense (ROCE) followed by Contender, Torrent and BBL 274 while HAB 19 had the lowest return on cash expense because of their lower pod yield.

This indicates that high ROCE could be realized from growing bush snap bean organically for French pod production.



Table 10. Return on cash expense of growing eight French bush snap bean accessions

ACCESSIONS	YIELD	GROSS	TOTAL	NET	ROCE
	(kg)	SALES	EXPENSES	INCOME	(%)
HAB 63	4.56	136.8	32.61	104.19	319.50
BBL 274	3.37	101.1	32.61	68.49	210.03
Torrent	3.45	103.5	32.61	70.89	217.39
Landmark	3.06	91.80	32.61	59.19	107.57
HAB 323	3.28	98.40	32.61	65.79	201.75
Green Crop	2.60	78.00	32.61	45.39	138.85
HAB 19	2.50	75.00	32.61	42.39	129.99
Contender	3.56	106.8	32.61	74.19	227.51

Fresh pods were sold at PhP 30 per kg.

#### Acceptability

Ten farmers and students were invited to evaluate the harvested pods of the eight French bush snap bean accessions. The farmers consisted of five females and one male with ages ranging from 35-50 years old while four of the students had ages ranging from 19- 21 years old. The result of the visual evaluation based on plant appearance, pod characters, and general acceptability of the eight French bush snap bean accessions are shown in Table 11.

Based on appearance, HAB 63 Landmark and HAB 323 were liked moderately. BBL 274, Torrent and Contender were liked slightly. HAB 19 was disliked slightly and Green Crop was disliked moderately.



In terms of French pod characters, BBL 274 and HAB 323 were liked very much and the other accessions were liked moderately except for HAB 19 which was liked slightly. Only Green Crop was disliked very much because of its flat, big and coarse pods.

HAB 63, BBL 274 and HAB 323 were liked very much by farmers and students in La Trinidad. HAB 63 was robust and produced many pods. BBL 274 produced straight, smooth, green French pods while Torrent, Landmark and Contender were liked moderately because of their desirable characters. Green Crop and HAB 19 were liked slightly



Table 11. Visual evaluation by farmers and students of eight French bush snap bean accessions

ACCESSIONS	APPEARANCE	POD CHARACTERS				GENERAL ACCEPTABILITY	REASONS FOR ACCEPTABILITY
		SHAPE	SIZE	TEXTURE	COLOR		
HAB 63	Like moderately	Like moderately	Like moderately	Like moderately	Like moderately	Like very much	Very robust, produced more pods
BBL 274	Like slightly	Like very much	Like very much	Like very much	Like moderately	Like very much	Produced straight, smooth and green pods
Torrent	Like moderately	Like moderately	Like moderately	Like moderately	Like very much	Like moderately	Exhibited good plant height
Landmark	Like moderately	Like moderately	Like moderately	Like moderately	Like moderately	Like moderately	It had long narrow, straight pods
HAB 323	Like moderately	Like very much	Like moderately	Like moderately	Like moderately	Like very much	Early maturing, had good pod set
Green Crop	Dislike very much	Dislike very much	Dislike very much	Dislike very much	Like moderately	Like slightly	Flat, big, coarse pods
HAB 19	Dislike slightly	Like slightly	Like slightly	Like slightly	Like moderately	Like slightly	Had long pods
Contender	Like slightly	Like moderately	Like moderately	Like moderately	Like very much	Like moderately	Produced good growth



## **SUMMARY, CONCLUSION AND RECOMMENDATION**

The study aimed to evaluate the growth and French pod yield of eight bush snap bean accessions grown organically in La Trinidad, Benguet; to determine their acceptability and profitability; and to determine the best accessions in terms of growth and French pod yield, acceptability and profitability in La Trinidad, Benguet.

All the accessions emerged in seven days except for Green Crop which emerged one day later. HAB 323, Green Crop, HAB 19 and Contender were the earliest to flower at 41 DAS. The earliest accessions to harvest for French pod production accessions were harvested two to three days later.

All the accessions had comparable initial and final plant height, and canopy cover at 30, 45 and 60 DAP. The eight bush snap bean accessions produced four to six flowers per cluster and three to five pods per cluster.

BBL 274 had the highest percentage pod setting while HAB 323, Green Crop and Contender had the highest number of pod clusters per plant. Contender produced the highest total number of French pods per plot. All the accessions had comparable pod length, width and diameter.

The eight accessions had statistically similar number and weight of marketable French pods per plot. The accessions produced higher total French pod yield per plot and per hectare. All the accessions evaluated had high resistance to bean rust and were moderately tolerant to pod borer under organic production.

The highest ROCE was obtained from producing HAB 63, BBL 274 and HAB 323. The accessions were liked very much based on plant morphology, pod characters and general acceptability.



### Conclusion

The eight bush snap bean accessions were comparable in days from sowing to emergence, to plant height, canopy cover, flowers per cluster, percentage pod setting, pod clusters per plant, number and weight of marketable French pods, total number of pods per plot, pod length, width and diameter.

The accessions differed in number of days from sowing to flowering, to first and last harvesting, pods per cluster, number and weight of marketable French pods per plot and total French pod yield.

HAB 63 was the highest French pod yielder and the most profitable to grow organically although all other accessions had comparable French pod yield and ROCE.

HAB 63, BBL 274 and HAB 323 were acceptable to farmers and students because of their good growth and pod characteristics.

### Recommendation

Based on the results of this study, HAB 63, BBL 274 and HAB 323 could be planted in La Trinidad Benguet for French pod production because of their good growth, high yielding ability, profitability and acceptability during the dry season.





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## APPENDICES

### Appendix Table 1. Visual evaluation.

Structured questionnaire used in evaluating ten bush snap bean accessions for French type pod under La Trinidad Benguet.

Name:

Sex:

Age:

Status:

Accessions	Appearance	Pod characters				General acceptability	Reasons for acceptability
		Shape	texture	Color	straightness		
HAB 63							
BBL 274							
Torrent							
Landmark							
HAB 323							
Green Crop							
HAB 19							
Contender							

#### Legend Reaction Scale

- 1-Like extremely
- 2-Like very much
- 3-Like moderately
- 4-Like slightly
- 5-Neither like nor not dislike
- 6-Dislike slightly
- 7-Dislike moderately
- 8-Dislike very much
- 9-Dislike extremely



Appendix Table 2. Number of days from sowing to emergence of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	7	7	8	22	7
BBL 274	7	7	7	21	7
Torrent	8	7	7	22	7
Landmark	7	7	7	21	7
HAB 323	7	8	8	23	7
Green Crop	8	8	8	24	8
HAB 19	7	7	7	21	7
Contender	7	7	9	23	7
<b>TOTAL</b>	<b>58</b>	<b>58</b>	<b>61</b>	<b>177</b>	<b>7</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.750	0.375			
Treatment	7	2.958	0.423	1.51 <sup>ns</sup>	2.77	4.28
Error	14	3.917	0.280			
<b>TOTAL</b>	<b>23</b>	<b>7.625</b>				

<sup>ns</sup>= Not significant

Coefficient of Variation (%)= 7.17



Appendix Table 3. Number of days to flowering of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	44	41	41	126	42
BBL 274	44	44	44	132	44
Torrent	42	42	41	125	41
Landmark	44	42	42	128	42
HAB 323	41	41	41	123	41
Green Crop	41	41	41	123	41
HAB 19	41	41	41	123	41
Contender	42	41	41	124	41
TOTAL	339	333	332	1004	840

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED f	TABULATED f	
					0.05	0.01
Replication	2	3.583	1.792			
Treatment	7	23.333	3.333	7.27**	2.77	4.28
Error	14	6.417	0.458			
TOTAL	23	33.333				

\*\*= Highly significant

Coefficient of Variation (%) =1.62



Appendix Table 4. Number of days to first harvest of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	59	56	59	174	58
BBL 274	59	59	59	177	59
Torrent	59	59	56	174	58
Landmark	59	59	59	177	59
HAB 323	56	56	56	168	56
Green Crop	56	56	56	168	56
HAB 19	56	59	56	171	57
Contender	56	56	56	168	56
<b>TOTAL</b>	<b>460</b>	<b>460</b>	<b>457</b>	<b>1377</b>	<b>459</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.750	0.375			
Treatment	7	35.625	5.089	4.13*	2.77	4.28
Error	14	17.250	1.232			
<b>TOTAL</b>	<b>23</b>	<b>53.625</b>				

\* = significant

Coefficient of Variation (%) = 1.93



Appendix Table 5. Days from sowing to last harvesting of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	80	77	80	237	79
BBL 274	80	80	80	240	80
Torrent	80	80	77	237	79
Landmark	80	80	80	240	80
HAB 323	77	77	77	231	77
Green Crop	77	77	77	231	77
HAB 19	77	80	77	234	78
Contender	77	77	77	231	77
<b>TOTAL</b>	<b>628</b>	<b>628</b>	<b>625</b>	<b>1881</b>	<b>627</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.750	0.375			
Treatment	7	35.625	5.089	4.13*	2.77	4.28
Error	14	17.250	1.232			
<b>TOTAL</b>	<b>23</b>	<b>53.625</b>				

\* = significant

Coefficient of Variation (%) = 1.42



Appendix Table 6. Initial plant height at 30 DAP of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	12.82	12.62	13.21	38.65	12.88
BBL 274	13.74	12.46	11.11	37.31	12.43
Torrent	14.00	14.31	15.84	44.15	14.71
Landmark	11.85	10.63	10.51	32.99	10.99
HAB 323	13.96	12.04	12.53	38.99	12.96
Green Crop	11.59	15.03	13.00	39.89	13.29
HAB 19	13.23	12.13	12.04	37.57	12.52
Contender	11.92	12.18	13.82	37.92	12.64
<b>TOTAL</b>	<b>103.11</b>	<b>102.2</b>	<b>102.06</b>	<b>307.37</b>	<b>102.42</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.081	0.041			
Treatment	7	22.319	3.188	2.48 <sup>ns</sup>	2.77	4.28
Error	14	18.016	1.287			
<b>TOTAL</b>	<b>23</b>	<b>40.416</b>				

<sup>ns</sup> = not significant

Coefficient of Variation(%)=1.42





Appendix Table 7. Final plant height of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	15.62	13.89	15.38	44.89	14.96
BBL 274	15.72	16.73	16.49	48.94	16.31
Torrent	19.03	17.49	15.17	51.69	17.23
Landmark	16.88	12.17	16.13	45.18	15.06
HAB 323	17.42	15.42	15.36	48.02	16.07
Green Crop	14.3	18.62	16.26	49.18	16.39
HAB 19	16.33	11.84	13.06	41.77	13.92
Contender	16.05	15.69	15.53	47.27	15.76
<b>TOTAL</b>	<b>131.35</b>	<b>121.85</b>	<b>123.92</b>	<b>377.12</b>	<b>125.7</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	6.239	3.120			
Treatment	7	22.329	3.190	1.14 <sup>ns</sup>	2.77	4.28
Error	14	38.921	2.780			
<b>TOTAL</b>	<b>23</b>	<b>67.489</b>				

<sup>ns</sup> = not significant

Coefficient of Variation(%)=10.61



Appendix Table 8. Canopy cover at 30 DAP of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	11.1	8.9	9.6	29.6	9.87
BBL 274	10.0	9.2	12.5	31.7	10.56
Torrent	10.9	9.8	9.4	30.1	10.03
Landmark	10.7	9.4	11.5	31.6	10.53
HAB 323	11.1	9.9	10.3	31.3	10.43
Green Crop	11.4	10.7	11.2	33.3	11.10
HAB 19	10.8	9.7	9.4	29.9	9.97
Contender	11.0	10.1	11.5	32.6	10.87
TOTAL	87.0	77.7	85.4	25.1	83.37

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	6.181	0.630			
Treatment	7	4.073	0.582	0.92 <sup>ns</sup>	2.77	4.28
Error	14	8.826	0.630			
TOTAL	23	19.080				

<sup>ns</sup> = not significant

Coefficient of Variation (%)=7.62



Appendix Table 8. Canopy cover at 45 DAP of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	16.0	15.5	15.6	47.1	15.7
BBL 274	19.6	16.0	16.9	52.5	17.05
Torrent	17.3	16.3	17.1	50.7	16.09
Landmark	17.0	14.3	17.5	48.8	16.27
HAB 323	19.8	15.4	14.8	50.0	16.67
Green Crop	16.4	14.5	15.6	46.5	15.05
HAB 19	17.9	15.2	13.2	46.3	15.43
Contender	15.1	16.0	16.4	47.5	15.83
TOTAL	139.1	123.2	127.1	344.4	129.8

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	17.167	8.584			
Treatment	7	11.578	1.654	0.92 <sup>ns</sup>	2.77	4.28
Error	14	25.219	1.801			
TOTAL	23	53.965				

<sup>ns</sup> = not significant

Coefficient of Variation (%)=8.27



Appendix Table 9. Canopy cover at 60 DAP of eight bush bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	23.6	23.3	22.3	69.2	23.07
BBL 274	27.8	24.4	24.8	77.0	25.65
Torrent	24.2	25.3	22.3	71.8	23.93
Landmark	24.1	23.6	11.6	59.3	19.77
HAB 323	26.0	23.4	21.0	70.4	23.47
Green Crop	22.2	22.1	23.4	67.7	22.57
HAB 19	24.1	22.6	20.6	67.3	22.43
Contender	23.2	24.5	22.2	69.9	23.3
<b>TOTAL</b>	<b>195.2</b>	<b>165.8</b>	<b>168.2</b>	<b>552.6</b>	<b>184.19</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	39.000	19.500			
Treatment	7	56.833	8.119	1.25 <sup>ns</sup>	2.77	4.28
Error	14	90.987	6.499			
<b>TOTAL</b>	<b>23</b>	<b>186.820</b>				

<sup>ns</sup> = not significant

Coefficient of Variation (%) = 11.01



Appendix Table 10. Number of flowers per cluster of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	Mean
	I	II	III		
HAB 63	8	5	5	18	6.00
BBL 274	4	5	5	14	4.67
Torrent	5	7	5	17	5.67
Landmark	6	5	6	17	5.67
HAB 323	5	5	6	16	5.33
Green Crop	6	5	6	17	5.67
HAB 19	7	7	5	19	6.33
Contender	6	5	4	15	5.00
<b>TOTAL</b>	<b>45</b>	<b>44</b>	<b>42</b>	<b>133</b>	<b>44.34</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	1.583	0.792			
Treatment	7	5.958	0.851	0.83 <sup>ns</sup>	2.77	4.28
Error	14	14.417	1.030			
<b>TOTAL</b>	<b>23</b>	<b>21.958</b>				

<sup>ns</sup> = not significant

Coefficient of Variation (%) = 18.31



Appendix Table 11. Number of pods per cluster of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	Mean
	I	II	III		
HAB 63	4	4	4	12	4 <sup>b</sup>
BBL 274	4	4	4	12	4 <sup>b</sup>
Torrent	4	6	4	14	5 <sup>a</sup>
Landmark	3	4	4	11	4 <sup>b</sup>
HAB 323	3	4	4	11	4 <sup>b</sup>
Green Crop	3	4	3	10	3 <sup>c</sup>
HAB 19	4	4	4	12	4 <sup>b</sup>
Contender	3	3	3	9	3 <sup>c</sup>
<b>TOTAL</b>	<b>28</b>	<b>33</b>	<b>30</b>	<b>91</b>	<b>31</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	1.583	0.792			
Treatment	7	5.292	0.756	3.43*	2.77	4.28
Error	14	3.083	0.220			
<b>TOTAL</b>	<b>23</b>	<b>9.958</b>				

\* = significant

Coefficient of Variation (%) = 12.38



Appendix Table 12. Percent pod set per cluster of eight bush bean accessions

ACCESSIONS	REPLICATION			TOTAL	Mean
	I	II	III		
HAB 63	48.19	80.77	81.48	210.44	70.15
BBL 274	92.31	81.48	79.63	253.42	84.47
Torrent	77.55	55.38	95.65	228.58	76.19
Landmark	55.74	74.07	76.36	206.17	68.72
HAB 323	65.38	88.89	69.09	223.36	74.45
Green crop	53.33	67.31	58.62	179.26	59.75
HAB 19	53.62	61.19	78.00	192.81	64.27
Contender	59.65	69.39	74.42	203.46	67.82
<b>TOTAL</b>	<b>505.77</b>	<b>578.48</b>	<b>613.25</b>	<b>1697.5</b>	<b>565.82</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	752.697	376.348			
Treatment	7	1224.584	174.941	1.24 <sup>ns</sup>	2.77	4.28
Error	14	1976.371	141.169			
<b>TOTAL</b>	<b>23</b>	<b>3953.651</b>				

<sup>ns</sup> = not significant

Coefficient of Variation (%) = 16.80



Appendix Table 13. Number of pod clusters per plot of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	12	14	14	40	13
BBL 274	13	13	13	39	13
Torrent	11	14	15	40	13
Landmark	13	15	13	41	13
HAB 323	15	14	14	43	14
Green Crop	14	15	13	42	14
HAB 19	14	13	13	40	13
Contender	15	14	14	43	14
<b>TOTAL</b>	<b>107</b>	<b>112</b>	<b>109</b>	<b>328</b>	<b>107</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	1.583	0.792			
Treatment	7	5.333	0.762	0.65 <sup>ns</sup>	2.77	4.28
Error	14	16.417	1.173			
<b>TOTAL</b>	<b>23</b>	<b>23.333</b>				

<sup>ns</sup> = not significant

Coefficient of Variation (%) = 7.92





Appendix Table 14. Total number. of pods per plant of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	Mean
	I	II	III		
HAB 63	47	57	56	160	53
BBL 274	50	54	53	157	52
Torrent	44	54	60	158	52
Landmark	51	59	52	162	54
HAB 323	46	56	56	158	52
Green Crop	43	61	52	156	52
HAB 19	58	52	52	162	54
Contender	58	57	56	171	54
<b>TOTAL</b>	<b>397</b>	<b>450</b>	<b>437</b>	<b>1284</b>	<b>423</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	190.750	95.375			
Treatment	7	53.333	7.619	0.35 <sup>ns</sup>	2.77	4.28
Error	14	301.917	21.565			
<b>TOTAL</b>	<b>23</b>	<b>546.000</b>				

<sup>ns</sup> = not significant

Coefficient of Variation (%) = 8.68



Appendix Table 15. Pod length of eight bush snap bean accessions (cm)

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	9.27	10.01	10.01	27.92	9.09
BBL 274	9.59	14.89	9.81	34.29	11.43
Torrent	9.54	9.87	8.81	28.22	9.4
Landmark	9.24	9.63	10.38	29.25	9.75
HAB 323	10.71	10.7	10.87	32.38	10.76
Green Crop	10.02	11.09	9.65	30.76	10.25
HAB 19	9.87	9.99	10.44	30.3	10.1
Contender	10.6	9.8	9.68	30.08	10.02
<b>TOTAL</b>	<b>78.84</b>	<b>428.5</b>	<b>79.65</b>	<b>243.2</b>	<b>80.8</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	5.479	2.740			
Treatment	7	11.530	1.647	1.12 <sup>ns</sup>	2.77	4.28
Error	14	20.585	1.470			
<b>TOTAL</b>	<b>23</b>	<b>37.594</b>				

<sup>ns</sup> = not significant

Coefficient of Variation (%) = 12.00



Appendix Table 16.Pod width of eight bush snap bean accessions (cm)

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	0.39	0.51	0.41	1.31	0.44
BBL 274	0.45	0.04	0.49	1.34	0.45
Torrent	0.04	0.04	0.39	1.19	0.04
Landmark	0.49	0.39	0.55	1.43	0.48
HAB 323	0.49	0.52	0.55	1.56	0.52
Green Crop	0.44	0.48	0.43	1.35	0.45
HAB 19	0.43	0.49	0.52	1.44	0.48
Contender	0.41	0.41	0.46	1.28	0.43
TOTAL	3.5	3.6	3.8	10.9	3.65

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.006	0.003			
Treatment	7	0.030	0.004	2.08 <sup>ns</sup>	2.77	4.28
Error	14	0.029	0.002			
TOTAL	23	0.064				

<sup>ns</sup> = not significant

Coefficient of Variation (%) =12.00



Appendix Table 17. Pod diameter of eight bush snap bean accessions (mm)

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	0.48	0.48	0.03	1.26	0.42
BBL 274	0.42	0.41	0.41	1.24	0.41
Torrent	0.26	0.03	0.28	0.84	0.28
Landmark	0.45	0.28	0.47	1.20	0.40
HAB 323	0.47	0.54	0.54	1.55	0.52
Green Crop	0.29	0.49	0.47	1.25	0.42
HAB 19	0.48	0.42	0.51	1.41	0.47
Contender	0.37	0.34	0.05	1.21	0.40
<b>TOTAL</b>	<b>3.22</b>	<b>3.26</b>	<b>3.8</b>	<b>8.88</b>	<b>3.32</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.005	0.002			
Treatment	7	0.096	0.014	2.24 <sup>ns</sup>	2.77	4.28
Error	14	0.086	0.006			
<b>TOTAL</b>	<b>23</b>	<b>0.186</b>				

<sup>ns</sup>= not significant

Coefficient of Variation (%) =18.84



Appendix Table 18. Number of marketable pods per plot of eight bush snap bean accessions (5m<sup>2</sup>)

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	169	207	180	556	185
BBL 274	190	182	157	529	176
Torrent	156	110	141	407	135
Landmark	142	184	134	460	153
HAB 323	226	162	140	526	175
Green Crop	172	117	114	403	134
HAB 19	105	150	132	387	129
Contender	151	137	198	486	162
<b>TOTAL</b>	<b>1311</b>	<b>1249</b>	<b>1196</b>	<b>3756</b>	<b>1249</b>

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	830.083	415.042			
Treatment	7	9903.833	1414.833	1.61 <sup>ns</sup>	2.77	4.28
Error	14	12321.917	880.137			
<b>TOTAL</b>	<b>23</b>	<b>23055.833</b>				

<sup>ns</sup>= not significant

Coefficient of Variation (%) =18.97



Appendix Table 19. Number of non-marketable pods per plot of eight bush snap bean accessions (5m<sup>2</sup>)

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	59	49	71	179	59
BBL 274	30	35	49	114	38
Torrent	46	22	28	96	32
Landmark	32	32	31	95	31
HAB 323	54	23	23	100	33
Green Crop	37	33	24	94	31
HAB 19	40	23	49	112	37
Contender	25	33	42	100	33
<b>TOTAL</b>	<b>323</b>	<b>250</b>	<b>317</b>	<b>890</b>	<b>294</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	410.583	205.292			
Treatment	7	1881.833	268.833	2.41 <sup>ns</sup>	2.77	4.28
Error	14	1561.417	111.530			
<b>TOTAL</b>	<b>23</b>	<b>3583.833</b>				

<sup>ns</sup>= not significant

Coefficient of Variation(%)=18.97



Appendix Table 20. Weight of marketable pods per plot of eight French bush snap bean accessions (kg /5m<sup>2</sup>)

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	2.67	3.26	2.77	8.07	2.9
BBL 274	2.71	2.08	2.68	8.19	2.73
Torrent	2.59	2.56	3.42	8.57	2.86
Landmark	2.71	2.67	1.61	6.99	2.33
HAB 323	3.03	2.64	1.96	7.63	2.54
Green Crop	1.93	1.95	1.73	5.61	1.87
HAB 19	1.28	1.96	2.11	5.35	1.78
Contender	2.42	1.85	3.22	7.49	2.5
Total	19.34	19.69	19.5	58.53	19.51

#### ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED f	TABULATED f	
					0.05	0.01
Replication	2	0.008	0.004			
Treatment	7	3.754	0.536	2.20 <sup>ns</sup>	2.77	4.28
Error	14	3.409	0.243			
TOTAL	23	7.171				

<sup>ns</sup> = not significant

Coefficient of Variation(%)=20.23



Appendix Table 21. Weight of non-marketable pods per plot of eight French bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	1.49	1.68	1.33	4.5	1.5 <sup>a</sup>
BBL 274	0.58	0.61	0.73	1.92	0.64 <sup>b</sup>
Torrent	0.78	0.5	0.51	1.79	0.60 <sup>b</sup>
Landmark	0.75	0.74	0.69	2.18	0.73 <sup>b</sup>
HAB 323	0.94	0.07	0.56	2.2	0.73 <sup>b</sup>
Green Crop	0.09	0.07	0.59	2.19	0.73 <sup>b</sup>
HAB 19	1.00	0.48	0.68	2.16	0.72 <sup>b</sup>
Contender	0.51	1.26	1.42	3.19	1.06 <sup>b</sup>
Total	6.95	6.67	6.51	20.13	6.71

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.012	0.006			
Treatment	7	1.906	0.272	4.50**	2.77	4.28
Error	14	0.847	0.061			
TOTAL	23	2.766				

\*\* = Highly significant

Coefficient of Variation (%) =29.33





Appendix Table 22. Total yield per plot of eight French bush snap bean (kg/5m<sup>2</sup>)

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	4.16	4.94	4.59	13.69	4.5 <sup>a</sup>
BBL 274	3.29	3.41	3.41	10.11	3.4 <sup>b</sup>
Torrent	3.37	3.06	3.93	10.36	3.5 <sup>b</sup>
Landmark	3.46	3.41	2.03	9.17	3.0 <sup>b</sup>
HAB 323	3.97	3.34	2.55	9.86	3.2 <sup>b</sup>
Green Crop	2.83	2.65	2.32	7.08	2.6 <sup>b</sup>
HAB 19	2.28	2.44	2.79	7.51	2.5 <sup>b</sup>
Contender	2.93	3.11	4.64	10.68	3.5 <sup>b</sup>
Total	26.29	26.36	26.53	79.18	26.2

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.004	0.002			
Treatment	7	8.268	1.233	3.74*	2.77	4.28
Error	14	4.608	0.329			
TOTAL	23	13.240				

\* = significant

Coefficient of Variation (%) = 17.39



Appendix Table 23. Computed yield per hectare of eight French bush snap bean accessions (t /ha)

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	8.32	9.88	9.18	27.38	9.12 <sup>b</sup>
BBL 274	6.58	6.82	6.82	20.22	6.74 <sup>b</sup>
Torrent	6.74	6.12	7.86	20.72	6.90 <sup>b</sup>
Landmark	6.92	6.82	4.06	18.34	6.11 <sup>b</sup>
HAB 323	7.94	6.68	5.01	19.72	6.57 <sup>b</sup>
Green Crop	5.66	5.03	4.64	15.06	5.20 <sup>b</sup>
HAB 19	4.56	4.88	5.58	15.02	5.00 <sup>b</sup>
Contender	5.86	6.22	9.28	21.36	7.12 <sup>b</sup>
<b>Total</b>	<b>52.58</b>	<b>52.72</b>	<b>53.06</b>	<b>158.36</b>	<b>52.76</b>

#### ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.015	0.015			
Treatment	7	34.513	4.930	3.74*	2.77	4.28
Error	14	18.433	1.317			
<b>TOTAL</b>	<b>23</b>	<b>52.961</b>				

\* = significant

Coefficient of Variation (%) =17.39



Appendix Table 24. Reaction to bean rust of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	1	1	1	3	1
BBL 274	1	1	1	3	1
Torrent	1	1	1	3	1
Landmark	1	1	1	3	1
HAB 323	1	1	1	3	1
Green Crop	2	1	1	4	1.33
HAB 19	1	2	1	4	1.33
Contender	1	1	2	4	1.33
Total	9	9	9	27	8.99

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.000	0.000			
Treatment	7	0.625	0.089	0.62 <sup>ns</sup>	2.77	4.28
Error	14	2.000	0.143			
TOTAL	23	2.625				

<sup>ns</sup>= non-significant

Coefficient of Variation(%)=10.76



Appendix Table 25. Reaction to pod borer of eight bush snap bean accessions

ACCESSIONS	REPLICATION			TOTAL	MEAN
	I	II	III		
HAB 63	2	2	3	9	3
BBL 274	2	2	2	6	2
Torrent	2	2	3	7	2.33
Landmark	3	2	2	7	2.33
HAB 323	2	2	3	7	2.33
Green Crop	2	2	2	6	2.00
HAB 19	2	2	2	6	2.00
Contender	2	2	2	7	2.33
<b>Total</b>	<b>18</b>	<b>18</b>	<b>19</b>	<b>55</b>	<b>18.32</b>

## ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	2	0.750	0.375			
Treatment	7	6.292	0.899	1.47 <sup>ns</sup>	2.77	4.28
Error	14	8.583	0.613			
<b>TOTAL</b>	<b>23</b>	<b>15.625</b>				

<sup>ns</sup>= non-significant

Coefficient of Variation (%) = 10.93

