Growth and Yield Performance of Pole Snap Beans (Phaseolus vulgaris L.) Under Conner, Apayao Condition

Asia Pacific Journal of Multidisciplinary Research
Vol. 4 No.4, 126-133
November 2016
P-ISSN 2350-7756
E-ISSN 2350-8442
www.apjmr.com

Agustina G. Pattung, Nathaniel T. Llamelo, Stephen P. Bulalin, Satur B. Bangyad
Apayao State College, Philippines
stephen_kb24@yahoo.com

Date Received: July 7, 2016; Date Revised: September 20, 2016

Abstract - *The study was undertaken to evaluate the growth and yield performance of pole snap beans varieties under Conner, Apayao condition. Specifically, it aimed to determine the high yielding variety/ies, the incidence of pests and diseases, and to determine the cost and return analysis of pole snap beans production.*

The study was conducted at Herreras' Farm at Purok 5, Karikitan, Conner, Apayao from November 2014 to February 2015. Seven varieties (Burik, Maroon, Stonehill Black, Taichung, Tublay Black Valentine and Violeta) were used in this study.

The research was laid out in a 160 square meter area which was divided into three blocks representing replication. Each block was further subdivided into 7 plots representing the different varieties. The Randomized Complete Block Design was utilized in the study. The data gathered was analyzed using the Analysis of Variance and the significance between treatments was compared through the Duncans' Multiple Range Test.

Results of the study showed that the varieties Burik, Stonehill Black and Black Valentine were the first to emerge, bear flowers, harvest and mature. Also, Burik registered the highest number of harvested pods, number of marketable pods and number of non-marketable pods. Furthermore, Burik had the highest weight of marketable pods, weight of non-marketable pods, total weight of harvested pods and computed yield of green pods.

However, the variety Violeta had the longest pods and the most number of seeds per pod. Meanwhile, on the weight of 1,000 seeds, total weight of dried beans and computed yield of dried beans, the following varieties were significantly similar: Maroon, Stonehill Black, Taichung, Tublay and Black Valentine.

All the varieties had high bean fly infestationon the early stage and had high pod borer damage during harvesting. However, leafminer damage was minimal on all the varieties tested. Also, all the varieties were resistant to blight infection.

The dried beans production registered higher ROI than the green pods. On per variety basis, Burik had the highest ROI for green pods while Maroon and Black Valentine for the dried beans.

Keywords: *pole snap beans, marketable pods, non-marketable pods, dried beans, green pods*

INTRODUCTION

Legume crops grown for human consumption belong to the Fabaceae (formerly Leguminosae) family. In most tropical and subtropical countries, they are ranked second to cereals as source of food for humans and animals [1]. Further, the common bean (Phaseolus vulgaris L.) is also considered one of the most important sources of protein [2] and is a rich source of vitamins, minerals and dietary fiber [3]. Even the immature pods of these crops are also an important food source in many locations around the world, where they are known as green beans, snap beans, French beans or string beans [4].

Beans are also known as nitrogen fixing crops [5]. Nitrogen fixation by these legumes serves an alternative to inorganic nitrogen fertilizers thus helping minimize the adverse effects of excessive use

of chemicals on the environment [6]. Legumes are also utilized in crop rotation systems to improve soil conditions.

Snap beans (Phaseolus vulgaris L.), which originated in South America, is cultivated throughout the temperate, tropical and sub-tropical areas of the world. It belongs to the family Legumeceae, where podded vegetables like pole sitao, cowpea, winged bean, lima bean, chick pea and edible-podded pea belongs [7].

In countries like Africa, snap beans is an important export vegetable crop wherein more than 90% of the crop is exported to regional and international markets. The crop is produced mainly by small to medium scale farmers and the agricultural venture proves a good source of income for the rural community [8].

Locally, it is known as "bitsuelas", "lubias" and "Baguio beans" owing to the fact that most of the crops' supply came from Baguio City and the nearby areas in the Province of Benguet. It is usually grown by farmers whose average farm size is less than one hectare, such that initial investment is relatively low. The species of snap beans in the Cordilleras are cultivated for either their dried beans or the immature green pods. These pods are harvested at their tender stage to be used as vegetables.

Varieties had been developed for better and higher yield, but these varieties perform differently in a particular environment. The need for a varietal trial for this commodity is necessary to determine adaptability and validate the performance of these varieties in a specific location.

OBJECTIVES OF THE STUDY

This study was conducted to determine the growth and yield of pole snap beans under Conner, Apayao condition.

Specifically, it was conducted to determine the high yielding variety/ies; to determine the incidence of pests and diseases; and to determine the cost and return analysis of pole snap beans production.

MATERIALS AND METHODS

Research Environment

The study was conducted at Herreras' Farm located at Purok 5, Karikitan, Conner, Apayao from November 2014 to February 2015. The crop is grown in Alemodian Clay Loam soil [9] with a semi-rolling topography and previously planted with corn. Except for the variety Violeta, which is locally produced, the planting materials were procured from Benguet State University- Horticultural Research Training Institute (BSU-Horti) with harvest date of February 2014.

Methods

The study was laid out in a Randomized Complete Block Design (RCBD) with seven treatments and three replications. The 160 m2 experimental area was cleaned and manually dug using a grab hoe to loosen and pulverize the soil. The seven treatment beds measuring 1.0 m x 5.0 m was spaced 50 cm apart with 50 cm border allowance on both sides and between replications. The seven varieties randomly assigned as treatments were:

V1 - Burik
V2 - Maroon
V3 - Stonehill Black
V4 - Taichung
V5 - Tublay
V6 - Black Valentine
V7 - Violeta – Local Farmers' Variety

Two (2) seeds per hill were planted on two rows spaced 70 cm apart and 20 cm between hills. One row (about 25 hills) was identified as the harvest area for green pods, and the other one was for the matured seeds.

At 14 days after planting (DAP), side dressing was done using equal amount of 46-0-0 and 14-14-14 applied at the rate 50 grams per m2. Hilling up was done after side dressing, and trellis materials was installed right after hilling up. At 35 DAP and 42 DAP, fertigation was done using equal amount 14-14-14 and 0-0-60 at the rate 100 grams per 16 liters water and applied at 1 liter per m2.

Spraying of Cypermethrin (Cymbush 5 EC) was done at 25 DAP to control the bean fly attack, and again at 60 DAP to control the pod borers attacking the developing pods. No fungicide was used since blight damage is minimal.

DATA GATHERED

Growth Parameters

Number of Days to Seedling Emergence. The number of days from planting to seedling emergence was counted and means were taken.

Mortality After One Month. Mortality of plants per treatment was determined by counting the number of plants died (not germinated included) at 30 DAP.

The mortality percentage was computed using the formula:

$$\text{Mortality (\%)} = \frac{\text{Number of dead plants}}{\text{Total number of seeds sown}}\ x\ 100$$

Number of Days to Flowering. The number of days from planting to opening of flowers was counted and means were taken.

Number of Days to Harvesting. The number of days from planting to first priming/ harvesting was counted and properly recorded.

Number of Days to Maturity. The number of days from planting to at least 50% of the pods had matured are counted. Maturity index of the pods is shown by the drying of the pods and full seeds development.

Incidence of Pests and Diseases

Bean Fly Damage. Bean fly damage was assessed by counting the number of plants with pest damage. The damage symptoms were characterized by the presence of perforations in the leaves. Percentage of damage was determined using the formula:

$$\text{Damage (\%)} = \frac{\text{Number of damaged plants}}{\text{Total number of plants}}\ x\ 100$$

Leaf Miner Damage. Leaf miner damage was assessed by counting the number of plants with damage symptoms characterized by mini tunnels in the leaves of the bean plants. Percentage of damage was determined using the formula:

$$\text{Damage (\%)} = \frac{\text{Number of damaged plants}}{\text{Total number of plants}}\ x\ 100$$

Pod Borer Damage. Pod borer damage was assessed by counting the number of pods with holes as result of bean pod borer attack. Percentage of damage was determined using the formula:

$$\text{Damage (\%)} = \frac{\text{Number of damaged pods}}{\text{Total number of pods harvested}}\ x\ 100$$

Late Blight Infection. Plants with leaves infected with late blight was counted and evaluated at peak of vegetative stage (30 DAP), reproductive stage (45 DAP) and during harvesting (60 DAP). The rating scale was as follows:

Rating Scale	Description	Remarks
1	1-10% of plants per plot were infected	Resistant (R)
3	11-20% of plants per plot were infected	Moderately Resistant (MR)
5	21-30% of plants per plot were infected	Intermediate (I)
7	31-60% of plants per plot were infected	Moderately Susceptible (MS)
9	61% and above of the plants per plot were infected	Susceptible (S)

Yield and Yield Components

Number of Marketable Pods. All pods suitable for selling purposes were counted and properly recorded per plot starting from first priming to last harvesting.

Number of Non-marketable Pods. Pods which are malformed, broken, overgrown, short, small, with symptoms of pest and diseases damage were counted starting from first priming to last harvesting.

Total Harvested Pods. All harvested pods, including non-marketable, were counted and properly recorded per plot starting from first priming to the last harvesting.

Average length (cm) of Pods. The average length of 10 sample pods per treatment taken randomly out of the marketable pods at every harvesting schedule was measured and recorded starting from first priming to the last harvesting.

Weight (kg) of marketable Pods. The marketable pods pertreatment was weighed and totaled starting from first priming tolast harvesting.

Weight (kg) of non-marketable Pods. All non-marketable pods per treatmentwas weighed and totaled starting from first priming to last harvesting.

Total Weight (kg) of Pods per Plot. The weight of total harvested pods per treatment starting from first priming to last harvesting.

Computed yield (t/ha), Green Pods. The total weight of harvested pods per treatment computed into tons per hectare basis using the formula:

$$\text{Computed Yield} = \frac{\text{Actual Yield}}{\text{Harvest Area}}\ x\ \frac{1{,}000\ \text{kg}}{10{,}000\ \text{m}^2}$$

Number of Seeds per Pod. The average number of seeds of the 10 sample pods per treatment taken randomly.

Weight of 1000 seeds. The weight of 1000 seeds per treatment was taken randomly after the seeds had been sundried for 3 days.

Total Weight (kg) per Plot (Dried Beans). The total weight of dried beans per treatment with 14% MC.

Computed Yield (t/ha), Dried Beans. The total weight of dried beans per treatment computed into tons per hectare basis.

$$\text{Computed Yield} = \frac{\text{Actual Yield}}{\text{Harvest Area}} \; x \; \frac{1{,}000 \text{ kg}}{10{,}000 \text{ m}^2}$$

COST AND RETURN ANALYSIS

Data Analysis

The Analysis of Variance (ANOVA) was utilized to test the significance of variation among treatments using the F-test at 0.05 level. Treatment means were compared using Duncan's Multiple Range Test (DMRT) through the SPSS statistical package.

RESULTS AND DISCUSSION

A. Climatological Observations

Due to the absence of meteorological station in the locality, climatological observations were limited to actual weather condition during the conduct of the study. The following was noted:

- **November 2014**–generally sunny to cloudy weather during planting to seedling emergence (7 DAP); intermittent rain showers was observed starting 21 November to 30 November (8-17 DAP).
- **December 2014** – cloudy to moderately rainy weather for the whole month (18-49 DAP).
- **January 2015** – sunny to cloudy weather with intermittent rain showers for the whole month (50-80 DAP).
- **February 2015** – sunny to cloudy weather with rain showers was observed during harvesting of the dried pods.

B. Growth Parameters

Number of Days to Seedling Emergence.

As presented at Table 1, varieties Stonehill Black and Black Valentine were the first to emerge after 5 days and Burik. Maroon, Taichung and Tublay followed after 6.33 days and finally Violeta which emerged after 7 days.

Table 1. Growth parameters of the Pole Snap Beans.

Variety	Days to Seedling Emergence	Mortality (%) after One Month	Days to Flowering	Days to Harvesting	Days to Maturity
Burik	5.67^{b}	2.33^{ab}	39.33^{a}	50.67^{a}	87.33^{bc}
Maroon	6.33^{c}	3.67^{abc}	45.33^{c}	56.33^{bc}	89.33^{cde}
Stonehill Black	5.00^{a}	2.67^{abc}	45.67^{cd}	54.33^{b}	84.67^{a}
Taichung	6.33^{c}	5.67^{cd}	47.67^{e}	58.00^{cd}	90.67^{ef}
Tublay	6.33^{c}	2.33^{ab}	47.67^{e}	56.33^{bc}	88.67^{cd}
Black Valentine	5.00^{a}	0.67^{a}	39.67^{ab}	50.67^{a}	85.67^{ab}
Violeta	7.00^{d}	17.00^{e}	48.67^{e}	58.00^{cd}	92.67^{g}
c.v.	6.93%	32.89%	2.21%	3.12%	1.15%

Means of the same letter are not significantly different at 0.5 level DMRT

Mortality After One Month

The variety Black Valentine had the least percentage of mortality with 0.67% which is significantly similar with Burik (2.33%), Tublay (2.33%), Stonehill Black (2.67%) and Maroon (3.67%). On the contrary, Violeta had the most mortality with 17.00% may be due to the fact that the seeds used came from a local farmer, that is the quality of the planting material is not assured.

Number of Days to Flowering

The variety Burik and Black Valentine flowered early with mean of 39.33 and 39.67 days respectively. It was followed by Maroon and Stonehill Black. On the other hand, Taichung and Tublay and Violeta flowered only after 47.67 and 48.67 days respectively.

Number of Days to Harvesting

Similarly, the varieties Burik and Black Valentine started priming after 50.67 days. It was followed by Stonehill Black (54.33), Maroon (56.33) and Tublay (56.33). Taichung and Violeta started priming only after 58 days.

It can be observed that those varieties which flowered early were also the ones which started priming early.

Number of Days to Maturity

Stonehill Black and Black Valentine matured early with means of 84.67 and 85.67 days. Significant difference was observed on the other varieties like Burik (87.33), Tublay (88.67), Maroon (89.33), Taichung (90.67) and Violeta (92.67).

C. Incidence of Pests and Diseases

Bean Fly Damage

High bean fly damage was observed on the varieties Taichung, Burik, Black Valentine and Tublay while Violeta was the least affected with mean of 45 plants being attacked by the pest. However, it can be observed that almost all the varieties have high percentage of pest damage at the early stage of the crop (10-14 DAP) which means high susceptibility especially those mentioned above.

The presence of broadleaves and other leguminous crops being simultaneously planted nearby the pole snap beans served as alternate host of the pests which attacked the plants.

Table 2. Pests damage on pole snap beans

Variety	Bean Fly Damage	Leaf Miner Damage	Pod Borer Damage
Burik	64.33^{ab}	3.67^{ns}	155.00^{ab}
Maroon	47.67^{e}	4.00	138.33^{abc}
Stonehill Black	52.33^{cd}	4.33	115.00^{bcd}
Taichung	66.33^{a}	5.33	162.33^{a}
Tublay	61.67^{abcd}	4.67	80.00^{e}
Black Valentine	62.33^{abc}	4.00	99.33^{de}
Violeta	45.00^{e}	5.00	88.00^{e}
c.v.	4.22%	39.03%	11.77%

Means of the same letter are not significant at 5 % level DMRT
NS – not significant

Leaf Miner Damage

Interestingly, there was a very minimal leaf miner damage observed in the plants. Analysis of Variance reveals no significant difference on the percentage of plants being attacked by the pest.

Pod Borer Damage

The variety Taichung registered the most number of pod borer damage with 162.33 which is significantly the same with Burik (155.00) and Maroon (138.33). On the other hand, the variety Tublay (80.00) and Violeta (88.00) had the least number of damage which is significantly similar.

Late Blight Infection

As presented in Table 3, all the varieties were resistant to late blight during the vegetative stage (30 DAP) and reproductive stage (45 DAP). During harvesting (60 DAP), only the variety Burik, Maroon and Taichung showed minimal blight infection.

This could be attributed to the mixed cropping system instituted in the research area in which spring onions, pepper, okra, pechay, mungbeans and bush beans were planted almost simultaneously to create crop diversity.

Table 3. Late Blight Infection at 30, 45 and 60 DAP

Variety	Late blight Infection		
	Vegetative Stage (30 DAP)	Reproductive Stage (45 DAP)	Harvesting (60 DAP)
Burik	R	R	MR
Maroon	R	R	MR
Stonehill Black	R	R	R
Taichung	R	R	MR
Tublay	R	R	R
Black Valentine	R	R	R
Violeta	R	R	R

As presented in Table 3, it can be noted that all the varieties tested were Resistant to blight infection up to 45 DAP. The varieties Burik, Maroon and Taichung showed Moderately Resistant at 60 DAP while all the other varieties remained Resistant.

D. Yield and Yield Components

Table 4. Number of Marketable and Non-Marketable Pods, Total Harvested Pods per Plot, and Average Length (cm) of Pods of Pole Snap Beans.

Variety	Number of Marketable pods	Number of Non-Marketable Pods	Total Harvested Pods per Plot	Length of Pods (cm)
Burik	737.33^{a}	341.33^{a}	1078.67^{a}	15.76^{e}
Maroon	617.00^{b}	301.33^{a}	918.33^{b}	15.52^{e}
Stonehill Black	521.00^{bc}	205.33^{b}	729.33^{bc}	17.40^{c}
Taichung	496.67^{c}	195.67^{b}	692.33^{c}	16.78^{d}
Tublay	551.67^{bc}	167.67^{b}	719.33^{bc}	15.06^{g}
Black Valentine	550.33^{bc}	201.33^{b}	751.67^{bc}	17.94^{ab}
Violeta	482.33^{c}	176.33^{b}	658.67^{c}	17.96^{a}
c.v.	10.01%	15.00%	8.66%	1.59%

Means of the same letter are not significant at 5% level DMRT

Number of Marketable Pods

The variety Burik had the most number of marketable pods with mean of 737.33 followed by Maroon (617.00), Tublay (551.67), Black Valentine

(550.33) and Stonehill Black (521.00) which are significantly the same. Taichung (496.67) and Violeta (482.33) had the least number of marketable pods which are significantly similar.

Number of Non-Marketable Pods

The number of non-marketable pods were very high on the varieties Burik (341.33) and Maroon (301.33) because of so many short pods which cannot pass the standard market size. The other 5 varieties had significantly similar number of non-marketable pods.

Total Harvested Pods per Plot

Burik registered the highest number of harvested pods per plot with 1078.67 which significantly higher than the other varieties tested, while on the other hand, Violeta (658.67) had the least harvested pods.

Average Length of Pods (cm)

The variety Violeta and Black Valentine had the longest pods with an average of 17.96 cm and 17.94 cm respectively, which are significantly longer than the other varieties. On the other hand, Maroon (15.52) and Burik (15.76) had the shortest pods among the varieties tested.

Table 5. Weight (kg) of Marketable and Non-Marketable Pods, Total Weight (kg) of Harvested Pods per Plot, and Computed Yield (t/ha), Green Pods of Pole Snap Beans

Variety	Weight (kg) of Marketable Pods	Weight (kg) of Non-Marketable Pods	Total Weight (kg) of Harvested Pods per Plot	Computed Yield (t/ha), Green Pods
Burik	5.13^{a}	1.63^{a}	6.76^{a}	27.04^{a}
Maroon	4.50^{bc}	1.42^{b}	5.92^{b}	23.68^{ab}
Stonehill Black	4.51^{bc}	1.26^{c}	5.77^{bcd}	23.08^{ab}
Taichung	4.23^{c}	1.17^{de}	5.25^{d}	21.00^{ab}
Tublay	4.34^{bc}	0.98^{f}	5.32^{d}	23.28^{ab}
Black Valentine	4.69^{bc}	1.21^{cd}	5.90^{bc}	23.60^{ab}
Violeta	4.16^{c}	1.03^{f}	5.19^{d}	20.76^{b}
c.v.	6.45%	13.97%	6.45%	7.76%

Means of the same letter are not significantly different at 5% level DMRT

Weight (kg) of Marketable Pods

Burik yielded the highest weight with mean of 5.13 kgs. It is followed by Black Valentine (4.69), Stonehill Black (4.51), Maroon (4.50) and Tublay (4.34) which are significantly similar to one another. Taichung and Violeta had the lowest mean yield with mean of 4.23 and 4.16kgs respectively.

Weight (kg) of Non-Marketable Pods

Burik and Maroon had the highest weight of non-marketable pods with mean of 1.63 and 1.42 kgs respectively. The varieties bear more pods but cannot pass the standard size, thus considered rejects. Stonehill Black (1.26), Black Valentine (1.21) and Taichung (1.17) followed, in which the high pod borer damage contributed much on the harvest losses. Violeta and Tublay had the least weight of non-marketable pods with means of 1.03 and 0.98 kgs respectively.

Total Weight (kg) of Harvested Pods per Plot

The variety Burik had the highest total yield with 6.76 kgs followed by Maroon (5.92) Black Valentine (5.90) and Stonehill Black (5.77) which are not significantly different from one another. Tublay, Taichung and Violeta registered the lowest yield with means of 5.32, 5.25 and 5.19 kgs respectively.

Computed Yield (t/ha), Green Pods

Burik had the highest computed yield with 27.04 t/ha. There was no significant difference between Maroon (23.68), Black Valentine (23.60), Tublay (23.28), Stonehill Black (23.08) and Taichung (21.00). Violeta had the lowest yield with 20.76 t/ha.

The yield registered by the seven varieties tested were higher than the average yield at Baguio-Benguet area which is 20 t/ha [10].

Table 6. Number of seeds per Pod, Weight (g) of 1,000 Seeds, Weight (kg) per Plot, and Computed Yield (t/ha), Dried Beans of Pole Snap Beans.

Variety	Number of Seeds per Pod	Weight (grams) of 1,000 seeds	Weight (kg) per Plot, Dried Beans	Computed Yield (t/ha), Dried Beans
Burik	7.53^{g}	278.33^{b}	1.07^{b}	4.28^{b}
Maroon	7.70^{e}	298.33^{a}	1.14^{a}	4.53^{a}
Stonehill Black	8.53^{d}	295.00^{a}	1.09^{ab}	4.34^{ab}
Taichung	8.73^{c}	301.67^{a}	1.03^{b}	4.11^{b}
Tublay	7.63^{ef}	301.67^{a}	1.10^{a}	4.38^{a}
Black Valentine	8.87^{b}	281.67^{ab}	1.14^{a}	4.57^{a}
Violeta	9.10^{a}	270.00^{b}	1.06^{b}	4.25^{b}
c.v.	2.69%	2.15%	3.90%	3.84%

Table 7. Cost and Return Analysis: Green Pods and Dried Beans Production

Item		Green Pods	Dried Beans
LABOR COST	MD @ 150		
Site Clearing	1	75.00	75.00
Hoeing and Bed Formation	2	150.00	150.00
Planting	1	75.00	75.00
Weeding	2	150.00	150.00
Trellis Installation	2	150.00	150.00
Spraying	2	150.00	150.00
Fertilization	2	150.00	150.00
Harvesting	10	1,050.00	450.00
Sub- Total		**1,950.00**	**1,350.00**
MATERIALS/ INPUTS			
Seeds (7 vars @ 60)		210.00	210.00
Trellis Materials (1,000 @ 1.00)		550.00	550.00
Fertilizers			
10 kg 46-0-0 @ 24 /kg		120.00	120.00
10 kg 14-14-14 @ 32 /kg		160.00	160.00
5 kg 0-0-60 @ 36 /kg		90.00	90.00
Chemicals			
500 ml Cymbush @ 380		190.00	190.00
Sub- Total		**1,320.00**	**1,320.00**
TOTAL PRODUCTION COST		**3,270.00**	**2,670.00**
GROSS INCOME			
Harvested Marketable Pods 120.28 kg @ 35 / kg		**4,209.80**	
Harvested Dried Beans 32.855 kg @ 300 / kg			**6,856.50**
NET INCOME		**939.80**	**4,186.50**
ROI		**28.72%**	**156.80%**

As presented in Table 7, higher Return on Investment was realized in the dried beans compared to the green pods production. This can be attributed to the fact that most farmers engage into pole snap beans production mainly for the green pods, which has a very high market demand.

On the other hand, the high price of quality dried beans which can be utilized as planting materials for the next planting season resulted to higher income and higher ROI. Dried beans production is a lucrative undertaking for a farmer if he can assure and maintain the quality of the seeds produced.

On the per variety basis, Burik registered the highest ROI with 51.80% for the green pods production while Black Valentine and Maroon for the dried beans.

Table 8. Cost and Return Analysis : Green Pods and Dried Beans, per Variety

	VARIETIES						
Green Pods	**Burik**	**Maroon**	**Stonehill Black**	**Taichung**	**Tublay**	**Black Valentine**	**Violeta**
Production Cost	467.14	467.14	467.14	467.14	467.14	467.14	467.14
Gross Income *actual yield @ 35/ kg	709.10	610.00	605.50	551.53	558.43	618.98	545.13
Net Income	241.96	142.86	138.36	84.39	91.29	151.84	77.99
ROI	**51.80%**	**30.58%**	**29.62%**	**18.07%**	**19.54%**	**32.50%**	**16.70%**
Dried Beans							
Production Cost	381.43	381.43	381.43	381.43	381.43	381.43	381.43
Gross Income #actual yield @ 300/kg	963.90	1,021.80	977.40	924.00	985.80	1,027.50	956.10
Net Income	582.47	640.37	595.97	542.57	604.37	646.07	574.67
ROI	**152.7%**	**167.8%**	**156.2%**	**142.25%**	**158.4%**	**169.38%**	**150.6%**

CONCLUSION

Based on the data gathered, all the varieties being tested were adaptable for planting in the locality. The variety Burik, Maroon, Black Valentine and Stonehill Black were fast growing varieties as observed for their early emergence, shorter days to flowering, harvesting and maturity.

The variety Burik produced the most number of total harvested pods, marketable pods and non-marketable pods. Also, it has the highest weight of marketable pods, weight of non-marketable pods, total harvested pods and computed yield of green pods while Maroon, Stonehill Black, Taichung, Tublay and Black Valentinewere significantly similar in terms of weight of 1,000 seeds, total weight and computed yield of dried beans. Meanwhile, Violeta produced the longest pods and had the most number of seeds per pod.

On the pests and disease incidence, all the varieties had high bean fly infestation at the early stage of the plants and had high pod borer damage during harvesting. However, leafminer damage was minimal on all the varieties tested. Also, all the varieties were resistant to blight infection.

The dried beans production registered higher ROI than the green pods. On per variety basis, Burik had the highest ROI for green pods while Maroon and Black Valentine for the dried beans.

RECOMMENDATIONS

1. All the varieties tested were adaptable and were recommended for planting in the locality;
2. The varieties be planted earlier, perhaps month of September or October;
3. For higher ROI, engage into dried beans production. However, ensure quality.
4. For the follow-up study, the varieties be sprayed with the different organically prepared foliar bio-fertilizers (FPJ, FFJ, EMAS and Vermi Tea).

REFERENCES

[1] Graham, P.H. and Vance, C.P. 2003. Legumes: Importance and constraints to greater use. Plant Physiology, Vol. 131, pp. 872–877.

[2] Boudoin, J. and Maquet, A. 1999. Improvement of protein and amino acid contents in seeds of food legumes. A case study in Phaseolus. Biotechnology Agronomy Society of Environment, 3(4): 220-224.

[3] Kelly, J.F. and Scott, M.K. 1992. The nutritional value of snap beans versus other vegetables, p. 23-46. In: Henry, G. and W. Janssen (Tech. Eds.). CIAT Proceedings of an International Conference on Snap beans in the Developing World held from 16th to 20th October 1989 in Cali, Colombia.

[4] Richardson, K. 2012. Evaluation of four green bean varieties (Phaseolus vulgaris L.) for pest and disease tolerance. In: Gladstone Road Agricultural Centre Crop Research Report No. 7, Department of Agriculture Nassau, Bahamas.

[5] Piha, M.I. and Munns, D.N. 1987. Nitrogen fixation potential of beans (Phaseolus vulgaris L.) compared with other grain legumes under controlled conditions. Plant and Soil, 98: 169182.

[6] Nason, G.E., and Myrold, D.D. 1992. Nitrogen fertilizers: Fates and environmental effects in forests. p. 67-81. In Forest Fertilization: Sustaining and Improving Nutrition and Growth of Western Forests (H.N. Chappell, G.F. Weetman, and R.E. Miller, eds.). Institute of Forest Resources Contrib. 73. College of Forest Resources, Univ. of Washington, Seattle, WA.

[7] Encyclopedia of gardening. 1992. The Royal Horticultural Society. Dorling Kindersley Publishers Limited. London.

[8] Monda, E.O., Munene, S. and Ndegua, A. 2003. French bean production constraints

[9] in Kenya. Africa Crop Science Conference Proceedings, Vol.6. 683-687.

[10] Land utilization survey. 2000. Municipal Planning and Development Office. Municipality of Conner, Apayao Province.Technoguide: Snap beans production. 2002. Department of Agriculture-Cordillera Administrative Region.

COPYRIGHTS