BIBLIOGRAPHY

GABINO, ANDY T., APRIL 2012. Agronomic characters and acceptability of pole snap bean varieties applied with foliar fertilizers under Kapangan, Benguet Condition. Benguet State University, La Trinidad, Benguet.

Adviser: Esther Josephine D. Sagalla

ABSTRACT

The study was conducted at Gaswiling, Kapangan, Benguet to identify the snap bean variety with the highest yield and resistance to pest; identify which among the foliar fertilizers is best in terms of its effect on the growth, yield, and acceptability of the five pole snap bean varieties; determine the interaction effect between the five varieties of pole snap beans and application of foliar fertilizers; determine the profitability of producing snap beans applied with different foliar fertilizers; and determine the acceptability of pole snap bean varieties among farmers in Gaswiling, Kapangan, Benguet.

Based on the results, all the varieties evaluated produced similar weight of marketable pods and had a moderate resistance to bean rust and pod borer except for Alno which had a high resistance to bean rust.

Application of foliar fertilizers slightly increased plant yield but decreased return on cash expenses.

Alno, Burik, and Maroon were the most preferred entries by farmers in Gaswiling, Kapangan, Benguet.

INTRODUCTION

Snap bean is one of the crops that is commonly grown in Benguet and it ranks fifth in hectarage and sixth in total peso value among the 22 principal vegetables in the country. It is also an important leguminous vegetable since it is an excellent source of proteins, vitamins and minerals (Halog, 1980).

Unlike other crops, bush beans do not require intensive management and high cost of farm inputs. It can also improve soil fertility because of its ability to fix nitrogen in its roots (HADP, 1993).However, some farmers do not produce high yield because many flowers fall during the flowering stage of the plant. Falling of flowers results to poor pod setting and poor pod development (Kinoshita, 1997).

Proper application of foliar fertilizer and the choice of fertilizer to apply might offer a better solution to help snap bean farmers decrease flower abortion, increase yield and income.

Furthermore, past studies show that among the different methods of fertilizer application, foliar fertilizer was selected the best and showed off a marked increase in the yield of some agricultural crops particularly minor crops (Subido, 1961). It was also observed that application of foliar fertilizers in soybean, snap bean, wheat, and oats affected seed oil protein with a tendency to alter seed size (Neuman, 1988).

The study was conducted to:

1. identify the snap bean variety(s) with the highest yield and resistance to pests;

2. identify which among the foliar fertilizers is best in terms of its effect on the growth and yield of the five snap bean varieties;

3. determine the interaction effect between the five varieties of pole snap beans and application of foliar fertilizers;

4. determine the profitability of producing snap beans applied with different foliar fertilizers; and

5. determine the acceptability of pole snap bean varieties among farmers in Gaswiling, Kapangan.

The study was conducted at Gaswiling, Kapangan, Benguet from November to February 2012.

REVIEW OF LITERATURE

Description of the Plant

Snap bean is a determinate leguminous crop which is most widely cultivated in semitropical regions. In temperature regions, the green immature pods are marketed fresh, frozen or canned, cooked and eaten as a vegetable (Acyangan, 2010). Snap bean is consumed in many different forms, such as dry beans, fresh and green state seeds, bean leaves and green pods (Yongzhong, 1994)

Furthermore, snap beans grow best when there is a constant moisture supply and it requires light and frequent irrigations during dry weather (Latimore, 2002). The plants yield well and require the least amount of work as source of nutrients and as a source of income for our farmers. (Seb-aten, 1997). Indeed, snap bean is recognized as an important source of protein, vitamins, and minerals such as calcium and phosphorus.

Climatic and Edaphic Requirements of
Snap Beans

Snap beans grow best in areas with temperature between 15 to 25 degrees centigrade. Maturity is earlier in warmer areas that take 45 to 55 days after planting than in cooler areas that take 56 to 60 days. Harvesting is dependent on the variety used, location, and temperature. Harvesting is usually done by hand or selective harvesting at 3 to 4 days interval (HARRDEC, 2000)

Snap beans grow best on soils that hold water well with a pH of 5.8 to 6.6 and have a good air and water filtration. Pole snap beans are warm temperate season vegetable that will not tolerate frost and it requires adequate amounts of moisture. Temperature is important for rapid growth, good pod set and early maturity (Pacher, 2002). The expected yield of pole snap bean under highland condition ranges from 17 to 23 tons per hectare. First harvest is expected from 60 days after planting. In warmer areas, pods mature earlier than in cooler temperature (Kudan, 1991).

Foliar Fertilization

One method of applying fertilizer to the plant is through solutions as spray or foliar fertilizer. Spraying of foliar fertilizers generally are much more quickly absorbed and utilized by the leaves than being applied in the soil. Application of foliar fertilizer for rapid utilization of nutrients permits the correction of observed deficiency in shorter period of time (Seb-aten, 1997).

Furthermore, applying fertilizers through the leaves by means of foliar spray might increase the efficiency of fertilizer utilization by plants. The consequence of this fertilizers could be the elimination of fertilizer wastage, the lessening of production cost and an increase in yield. It may even decrease the problem of leaching, fixation; denitrification, root injury and soil pH that are encountered in applying inorganic fertilizer to the soil. Foliar sprays are also advantageous in terms of distribution and transportation especially in remote places where roads are not available (Seb-aten, 1997).Past studies also proved that applying foliar fertilizers prevent the occurrence of problems in soil minimizing waste as well as cost of production, which will lead to increase profit (Caldito, 1999)

Varietal Evaluation

Varietal evaluation gathers data on plant characteristics, yield performance and pod quality. Hence, we can obtain high yielding and improve cultivars (Regmi, 1990).

Moreover, Bautista and Mabesa (1997) stated that the variety has to be high yielding, pest and disease resistant and early maturing so that production would entail less expense and ensure more profit. Choosing the right variety will minimize problems associated with water and fertilizer management.

Selection of the variety of plant is one of the most important that the commercial vegetable grower must take each season. Grower should evaluate some new varieties each year on a trial basis to observe performance on their own forms (Wesley, 2005). Varietal evaluation is important to observe the performance character such as yield, earliness, vigor, maturity, and quality because varieties have a wide range of difference in terms of size and yield performance (Work and Carew, 1995).

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

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

MATERIALS AND METHODS

An area of 225 m^2 was thoroughly prepared and divided into 45 plots (Figure 1). Each plot were measured 1m x 5 m and the treatments were laid-out following the Split plot design with three replications.

The treatments were follows:

Main plot - Foliar fertilizer (F)	Subplot - Pole snap bean varieties (V)
F_1- No foliar fertilizer	V_1- Black Valentine/ Alno
F_2- Abundant harvest	V_2 - Burik
F_3- Care crop international	V_3 -Stone hill black
	V_4 –Stone hill brown
	V_5 -Maroon (Check)

The seeds of each variety were sown in a double row-plot at a distance of 20 x 20 cm between hills and rows at a rate of 2 to 3 seeds per hill. Chicken manure was applied at the rate of one hand per hole. Spraying of foliar fertilizers was done during the vegetative and fruiting stage of the crop. Ten cups of abundant harvest foliar fertilizer was diluted in 16 liters of water and was applied every three days. When the plant started to flower, the foliar fertilizer was applied every five days until the last harvest. Care crop international foliar fertilizer was also diluted in 16 liters of water at the rate of 10 cups and was applied at seven days interval.

Table 1. The NPK content of the foliar fertilizers used are the following:

Element	Abundant harvest (%)	Care crop international (%)
Nitrogen	10.38	18
Phosphorus	8.34	28
Potassium	9.45	28

Plants were irrigated twice a week up to saturation point (field capacity) from planting up to 50 days after planting. Side-dressing and hilling-up was done two to three weeks after planting followed by trellising. During the conduct of the study, all other cultural management practices were followed.

Figure 1. Land preparation in the experimental area.

Data Gathered:

1. Soil analysis. One kg of soil sample from the site of experiment was collected randomly before land preparation and after harvest for the determination of the initial and final soil properties like pH, nitrogen, phosphorus, potassium, and organic matter. The soil samples were analyzed at the Soils laboratory, Department of Agriculture in Pacdal, Baguio City.

2. Meteorological data. Monthly mean maximum and minimum temperature and relative humidity was taken using a digital hygrometer. Rainfall was collected and measured using a graduated cylinder while light intensity was measured using a light meter.

3. Maturity

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

b. Plant survival. This was obtained by counting the plants that survived per plot and was computed using the following formula:

$$\text{Plant survival (\%)} = \frac{\text{Number of Plants survived}}{\text{Number of seeds sown}} \times 100$$

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

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

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

4. Number of flowers per cluster. This was recorded by counting the number of flower per cluster that developed per plant from ten sample plants per plot.

5. Number of flower clusters per plant. This was taken by counting the number of flower cluster per plant using ten sample plants per treatment.

6. Number of pods per cluster. This was recorded by counting the number of pods per cluster from ten sample plants per treatment.

7. Number of pod clusters per plant. This was recorded by counting the number of pod cluster per plant from ten sample plants per treatment.

8. Fresh Pod Characters

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

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

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

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

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

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

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

9. Yield and Yield components

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

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

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

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

Yield per hectare (t ha) = Total yield/plot (kg m^2) x 2

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

a. Bean rust

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

b. Pod borer

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

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

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

12. Sensory evaluation. Ten farmers were invited in the farm during the peak of harvest at 79 days after sowing. They were requested to make their own selection and express their reason for choosing or not choosing the ten varieties of pole snap bean. Selection was based on the following:

a. Acceptability

Scale	Description
1	dislike very much
2	dislike moderately
3	like
4	like moderately
5	like very much

b. Plant morphology. This was evaluated by farmers based on the varieties of pole snap bean using structured questionnaire.

c. Pod characters. This was evaluated by farmers based on pod shape, size, pod texture, pod color and general acceptability of snap bean using the same questionnaire in appendix 19.

Data Analysis

All quantitative data were gathered and analyzed statistically using the analysis of variance (ANOVA) for Split Plot Design. The significant differences among the treatment means were tested using the Duncan's Multiple Range Test (DMRT).

RESULT AND DISCUSSION

Soil Analysis

As shown in Table 2, the soil pH before and after the experiment was 5.5 which is within the pH range that favors the growth of pole snap bean. The percent soil organic matter before and after planting was 2.5 % except for soils not applied with foliar fertilizer (1.5 %). In terms of nitrogen content, no change was observed before and after the application of Abundant harvest and Care crop international except for soil with no application of foliar fertilizer. This result may imply that the nitrogen in the soil was replaced by the foliar fertilizers applied, not discounting the fact that pole beans can also fix its own nitrogen.

The phosphorus content of the soil after the experiment increased from 116 % to as high as 230 %. On potassium content, there was an increase from soils applied with Abundant harvest and Care crop international (180 ppm). Soil with no application of foliar fertilizer had decreased potassium content (89 ppm). The decrease in the amount of potassium in soils with no application of foliar fertilizer after harvest could be due to the absorption of potassium by the plant needed for photosynthesis and respiration.

Table 2. Soil physical properties before planting and after harvesting

	PH	ORGANIC	NITRO-	PHOSPHO-	POTA-
MATTER	GEN	RUS	SSIUM		
		(%)	(%)	(%)	(ppm)
Before planting	5.5	2.5	0.125	116	112
After harvesting					
No foliar fertilizer	5.5	1.5	0.075	155	89
Abundant harvest	5.5	2.5	0.125	230	180
Care crop international	5.5	2.5	0.125	210	180

Meteorological Data

Table 3 shows the monthly rainfall, temperature, sunshine duration and relative humidity from November 2011 to February 2012. Temperature that prevailed during the conduct of the study ranged from 14.10^{0}C to 24.78^{0}C. The temperature range is within the appropriate temperature range of pole snap bean production which is 15^{0}C to 25 ^{0}C (HARRDEC, 2000). The relative humidity ranged from 77.50 % to 86.75 %.The total amount of rainfall recorded was 7.34 mm in November 2011 and 14.34mm in December. In January, it declined from 6.20 mm and 1.64 mm in February which was observed as insufficient rainfall for snap bean production. Thus, irrigation was done twice a week to supplement adequate water for snap bean production. The light intensity ranged from 262.40 foot candle to 410.13 foot candle.

Table 3. The temperature, relative humidity, rainfall amount, and light intensity from November 2011 to February 2012

MONTH	AIR TEMPERATURE (^{0}C)		RELATIVE HUMIDITY (%)	AMOUNT OF RAINFALL (mm)	LIGHT INTENSITY (foot candle)
	MIN	MAX			
November	15.15	23.83	84.50	7.34	262.40
December	14.10	24.78	86.75	14.34	303.00
January	16.10	24.28	77.50	6.20	318.94
February	18.23	24.18	80.50	1.64	410.13

Number of Days from Sowing to Emergence

Effect of foliar fertilizer. There is no significant difference on the number of days from sowing to emergence among the varieties applied with different foliar fertilizers (Table 4). The plants emerged at 7 days after sowing.

Effect of variety. Table 3 also shows the significant differences on the number of days from sowing to emergence of the different varieties. Alno, Stone hill black and Stone hill brown emerged within seven DAP, one day earlier than Burik and Maroon. Earlier and late emergence of the plant maybe due to genes and varietal differences of the crop.

Interaction effect. No significant interaction effect on the number of days from sowing to emergence was observed between the varieties and foliar fertilizers applied.

Number of Days from Emergence to Flowering.

Effect of foliar fertilizer. Results revealed highly significant differences on the number of days from emergence to flowering (Table 4). Varieties applied with Abundant harvest and Care crop international flowered in 44 days from emergence to flowering, two days earlier than plants not applied with foliar fertilizer. This result indicates that foliar fertilizer application causes the plant to flower earlier than those plants not applied with foliar fertilizer.

Effect of variety. Alno significantly flowered earlier within 43 days from emergence to flowering, one day earlier than Burik and Maroon (45). Stone hill black and stone hill brown was the latest to flower at 45 days after emergence. Alno flowered earlier which might be due to earlier emergence and varietal differences of the plants.

Table 4. Number of days from sowing to emergence and from emergence to flowering, first and last harvest of five pole snap bean varieties applied with foliar fertilizers

TREATMENT	NUMBER OF DAYS			
	FROM SOWING TO EMERGENCE	FROM EMERGENCE TO		
		FLOWERING	FIRST HARVEST	LAST HARVEST
Foliar Fertilizer (F)				
No foliar fertilizer	7	46[b]	59[b]	91[b]
Abundant harvest	7	44[a]	54[a]	92[b]
Care crop international	7	44[a]	55[a]	93[a]
Variety (V)				
Alno/ Black Valentine	7[a]	43[a]	56[a]	92
Burik	8[b]	44[b]	56[a]	91
Stone hill Black	7[a]	45[c]	57[b]	92
Stone hill Brown	7[a]	45[c]	56[a]	92
Maroon (Check)	8[b]	44[b]	56[a]	92
(AxB)	ns	ns	ns	**
CV_a (%)	2.17	1.50	1.34	0.17
CV_b (%)	5.89	1.11	1.78	1.02

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

Interaction effect. No significant interaction between variety and foliar fertilizers on the number of days from emergence to flowering of snap bean was observed. This indicates that application of any foliar fertilizers to any of the plant varieties will not make any difference on the period of flowering.

Number of Days from Emergence to First Harvest.

Effect of foliar fertilizer. A highly significant difference on the number of days from emergence to first harvest was observed among the plants applied with foliar fertilizers (Table 4). Plants applied with Abundant harvest were first harvested at 54 DAE. Plants applied with Care crop international were harvested at 55 days, 5 days earlier than plants without any application of foliar fertilizer. Results show that application of foliar fertilizes caused early maturity among the pole bean varieties evaluated.

Effect of Variety. Highly significant differences were noted on the number of days from emergence to first harvest among the varieties of snap bean. Alno, Burik, Stone hill brown and Maroon were the first varieties harvested in 56 DAE. Stone hill black was the last variety harvested. The differences noted maybe due to earlier flowering of some varieties which resulted to earlier development of pods.

Interaction effect. No significant interaction effect between variety and foliar fertilizers on the number of days from emergence to first harvest was observed.

Number of Days from Emergence to Last Harvest

Effect of foliar fertilizer. Highly significant differences were noted on the number of days from emergence to last harvest among plants applied with different foliar fertilizers. Plants not applied with any foliar fertilizer took 91 days to harvest, one day earlier than plants applied with Abundant harvest. Plants applied with Care crop international was the last to harvest that took 93 days. This indicates that foliar fertilizer application may lengthen the harvest period of the plants.

Effect of variety. There is no significant difference noted on the number of days from emergence to last harvest of the different varieties evaluated. The varieties were harvested at 91 to 92 DAE.

Interaction effect. Highly significant interaction between variety and foliar fertilizers were observed on the number of days from emergence to last harvest (Figure 2). The Burik variety with no application of foliar fertilizer were first terminated within 90 DAE, one day earlier than Stone hill black and Stone hill brown. Burik and Maroon applied with Abundant harvest and Care crop international took 92 DAE to be harvested. Similarly, Stone hill black and stone hill brown applied with abundant harvest and maroon with no application of foliar fertilizer and applied with Care crop international also were harvested at the same time. Stone hill brown applied with Care crop international took 93 DAE to harvest, one day earlier than Stone hill black (94 DAE). Results revealed that application of Care crop international on Stone hill black, Stone hill brown, Burik, and Maroon may lengthen harvest period and maintain the good performance of the plants resulting to more yield. Similarly, application of abundant harvest on Burik, Stone hill black, and Stone hill brown may lengthen harvest period leading to more yield.

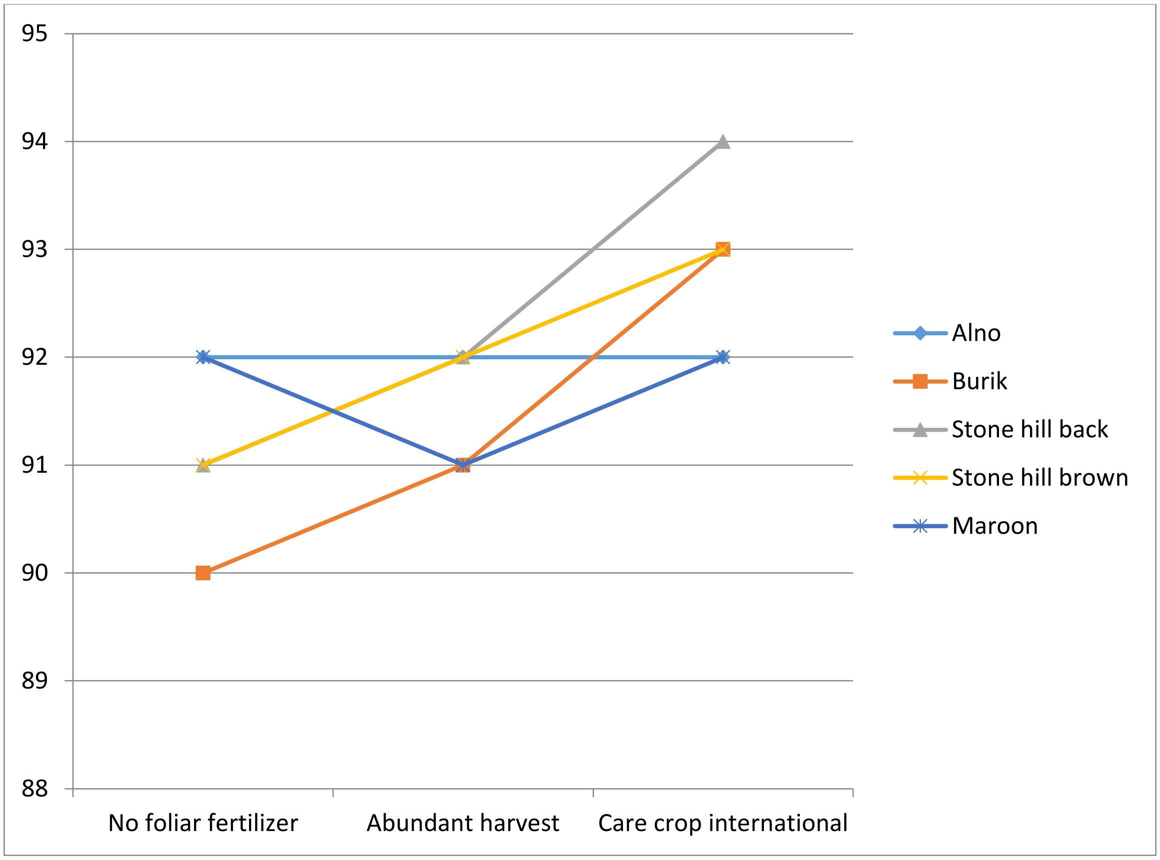

Figure 2. Interaction of variety and foliar fertilizer on the number of days from emergence to last harvest.

Percent Emergence

Effect of foliar fertilizer. No significant differences were found on the percent emergence of pole snap bean varieties applied with among the foliar fertilizer. The plants had 79 % and above emergence.

Effect of variety. There are no significant differences on the percent emergence of the pole snap bean varieties tested. The plants had 75 % to 83 % survival.

Interaction effect. No significant interaction effect of variety and foliar fertilizers on the percent emergence of snap bean was observed.

Table 5. Percent emergence of five pole snap bean varieties applied with foliar fertilizers

TREATMENT	PLANT EMERGENCE (%)
Foliar Fertilizer (F)	
No foliar fertilizer	81.47
Abundant harvest	80.32
Care crop international	79.30
Variety (V)	
Alno/ Black Valentine	83.73
Burik	83.54
Stone hill Black	75.80
Stone hill Brown	78.23
Maroon (Check)	80.46
(AxB)	ns
CV_a (%)	14.75
CV_b (%)	13.01

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

Number of Flowers per Cluster

Effect of foliar fertilizer. Significant differences were observed among pole bean plants applied with different foliar fertilizers (Table 6). Plants applied with Care crop international and plants not applied with any foliar fertilizer had the least number of flowers per cluster compared with plants applied with Abundant harvest that produced five flowers per cluster. This indicates that application of Abundant harvest may have reduced flower abortion in pole snap bean under Kapangan, Benguet condition.

Effect of variety. No significant differences were observed among the varieties tested in terms of the number of flowers per cluster (Figure 3). The plants produced four to five flowers per cluster.

Interaction effect. Variety and foliar fertilizers had no significant interaction effect on the number of flowers per cluster.

Number of Flower Clusters per Plant

Effect of foliar fertilizer. The results show that there is a significant difference observed among the plants applied with different foliar fertilizers on the number of flower clusters per plant. Plants applied with Abundant harvest and Care crop international had the highest number of flower clusters. This result corresponds with the findings of Neuman (1988) that application of foliar fertilizers might be the solution to decrease flower abortion, increase yield and income. Plants with no application of foliar fertilizer produced the least number of flower clusters.

Effect of variety. No significant differences were observed among the varieties on the number of flower cluster per plant. All the varieties produced 32 flower clusters per plant.

Interaction effect. No significant interaction effect between variety and foliar fertilizers were observed on the number of flower clusters per plant.

Figure 3. Flowers and pods of the different pole snap bean varieties.

Number of Pods per Cluster

Effect of foliar fertilizer. There is no significant difference among the plants applied with foliar fertilizers on the number of pods per cluster. However, plants with no foliar fertilizer applied produced the lowest number of pods per cluster.

Effect of variety. No significant differences were observed among the varieties on the number of pods per cluster (Figure 3). Maroon had the highest number of pods per cluster while Stone hill black produced the least number of pods.

Table 6.Number of flowers per cluster, flower cluster per plant, pods per cluster and pod clusters per plant of five pole snap bean varieties applied with foliar fertilizers

TREATMENT	FLOWERS PER CLUSTER	FLOWER CLUSTERS PER PLANT	PODS PER CLUSTER	POD CLUSTERS PER PLANT
Foliar Fertilizer (F)				
No foliar fertilizer	4[b]	31[b]	3	24[b]
Abundant harvest	5[a]	32[a]	4	25[a]
Care crop international	4[b]	32[b]	4	25[a]
Variety (V)				
Alno	4	32	4	25[a]
Burik	4	32	4	24[b]
Stone hill Black	4	32	3	24[b]
Stone hill Brown	4	32	4	24[b]
Maroon (Check)	5	32	5	25[a]
(AxB)	ns	ns	ns	ns
CV_a (%)	0.31	5.11	2.91	9.25
CV_b (%)	3.61	3.49	15.83	19.55

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

Interaction effect. No significant interaction effect was observed on variety and foliar fertilizers on the number of pods per cluster.

Number of Pod Clusters per Plant

Effect of foliar fertilizer. Significant differences were observed among the plants applied with foliar fertilizers on the number of pod clusters per plant. Application of Abundant harvest and Care crop international on plants resulted to higher number of pod clusters per plant (25). No application of foliar fertilizer on plants produced the lowest number of pod clusters per plant. This indicates that foliar fertilizer application reduces flower abortion which in turn resulted to high number of pod clusters and pods to harvest.

Effect of variety. There is a significant difference among the varieties on the number of pod clusters per plant. Alno and Maroon significantly produced the most pod clusters per plant. Maroon had the most flowers and pods per cluster and may have lesser flowers aborted.

Interaction effect. No significant interaction effect was observed on variety and foliar fertilizers on the number of pod clusters per plant.

Pod Length

Effect of foliar fertilizer. Highly significant differences were observed on the pod length of plants applied with different foliar fertilizers (Table 7). Plants applied with Abundant harvest had the longest pods (17.35 cm) followed by plants applied with Care crop international (16.97 cm). Plants with no application of foliar fertilizer had the shortest pods (15.29 cm). The longer pods produced may be due to the application of foliar fertilizer that supplied the nitrogen, phosphorus, and potassium needed by the plants.

Effect of variety. Table 6 also shows a highly significant difference on the pod length of the varieties. Alno produced longer pods than Burik, Stone hill brown, and Maroon. Stone hill black produced the shortest pods (15.29 cm). This may be due to genes and varietal differences of the plants.

Interaction effect. It was observed that there was no significant interaction of variety and foliar fertilizers on the pod length of snap bean.

Table 7. Pod length, width and diameter of five pole snap bean varieties applied with foliar fertilizers

TREATMENT	POD LENGTH (cm)	POD WIDTH (cm)	POD DIAMETER (cm)
Foliar Fertilizer (F)			
No foliar fertilizer	15.29[b]	1.17	1.53
Abundant harvest	17.35[a]	1.26	1.56
Care crop international	16.98[a]	1.23	1.53
Variety (V)			
Alno/ Black Valentine	17.67[a]	1.36[a]	1.65[a]
Burik	16.50[b]	1.18[bc]	1.52[bc]
Stone hill Black	15.78[c]	1.11[c]	1.46[c]
Stone hill Brown	16.26[b]	1.18[bc]	1.47[c]
Maroon (Check)	17.49[b]	1.25[b]	1.60[ab]
(AxB)	ns	ns	ns
CV_a (%)	67	0.83	0
CV_b(%)	4.22	7.91	6.94

Pod Width

Effect of foliar fertilizer. No significant differences were observed on the pod width of plants applied with foliar fertilizers.

Effect of variety. Highly significant differences were observed on the pod width of the different varieties (Table 7). Alno had the widest pod (1.36cm) followed by Maroon (1.25cm). Burik had a comparable pod width with Stone hill brown (1.18 cm). The wide pods produced may contribute to high weight of pods and thus more profit.

Interaction effect. There is no significant interaction effect of variety and foliar fertilizers observed on the pod width of snap bean.

Pod Diameter

Effect of foliar fertilizer. No significant differences were observed among plants applied with foliar fertilizers on pod diameter.

Effect of variety. Highly significant differences were observed among the varieties on pod diameter. Alno had the highest pod diameter which may be related to its wide pods.

Interaction effect. No significant interaction effect of variety and foliar fertilizers was observed on the pod diameter of snap bean.

Weight of Marketable Pods per Plot

Effect of foliar fertilizer. No significant differences were observed on the plants applied with foliar fertilizers on the weight of marketable pods per plot. Results imply that application and non-application of foliar fertilizer to the plants will have the same effect on the marketable pods produced.

Effect of variety. There is no significant difference among the varieties of pole snap bean on the weight of marketable pods per plot. All the varieties produced less than 5 kg of marketable pods per plot (Figure 4).

Interaction effect. No significant interaction effect of variety and foliar fertilizers was observed on the weight of marketable pods per plot.

Alno

Burik

Stone hill black

Stone hill brown

Maroon

Figure 4. Marketable fresh pod yield of the pole snap bean varieties.

Weight of Non-Marketable Pods per Plot

Effect of foliar fertilizer. No significant differences were found on the weight of non-marketable pods per plot among the plants applied with foliar fertilizers (Table 8).

Effect of variety. Highly significant differences were observed among the different varieties of pole snap bean on the weight of non-marketable pods per plot (Table 8). Stone hill brown produced the highest number of non-marketable pods per plot which may be due to bean rust infection.

Table 8.Fresh pod yield per plot and computed yield per hectare of five pole snap bean varieties applied with foliar fertilizer

TREATMENT	FRESH POD YIELD PER PLOT ($kg/5m^2$) MARKETABLE	NON MARKETABLE	TOTAL	COMPUTED YIELD PER HECTARE (t/ha)
Foliar Fertilizer (F)				
No foliar fertilizer	4.26	1.05	5.26	10.52
Abundant harvest	4.40	0.91	5.30	10.59
Care crop international	4.39	1.11	5.45	10.88
Variety (V)				
Alno	4.62	0.80[a]	5.31	10.62
Burik	3.94	0.98[a]	4.89	9.78
Stone hill Black	4.54	1.12[b]	5.64	11.29
Stone hill Brown	4.66	1.28[c]	5.93	11.84
Maroon (Check)	3.98	0.93[a]	4.90	9.78
(AxB)	ns	*	ns	ns
CV_a (%)	69.66	5.88	48.69	97.75
CV_b (%)	24.60	14.47	20.50	20.53

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

Interaction effect. It was observed that there is a significant interaction effect of variety and foliar fertilizers on the weight of non-marketable pods per plot. Figure 4 shows that Stone hill brown applied with Care crop international had the heaviest non-marketable pods (1.47 kg).Thus, for low non-marketable yield, Abundant harvest applied on Alno, Burik, Stone hill black, and Maroon should be done.

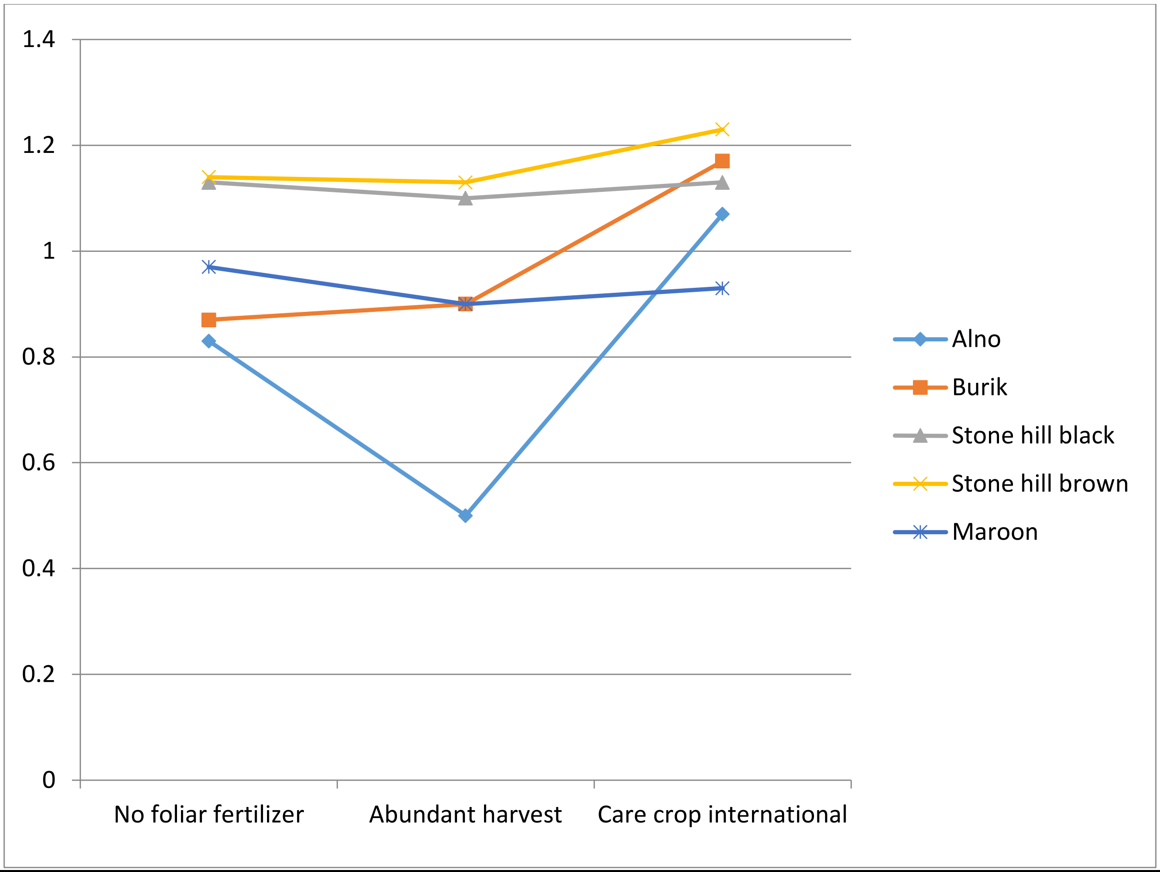

Figure 5. Interaction effect of variety and foliar fertilizers on the weight of non-marketable pods per plot.

Total Yield per Plot

Effect of foliar fertilizer. No significant differences were observed among the plants applied with foliar fertilizers on the total yield per plot. Results show that application or non-application of foliar fertilizer will have little effect on the total yield of the plants.

Effect of variety. It was found that there is no significant difference among the varieties on the total yield per plot. The varieties had a total yield of five to six kilograms.

Interaction effect. Observation shows that there is no significant interaction effect of variety and foliar fertilizers on the total yield per plot of the snap bean plants.

Computed Yield per Hectare

Effect of foliar fertilizer. No significant differences were observed among the plants applied with foliar fertilizers on the computed yield per hectare.

Effect of variety. It was found that there is no significant difference observed among the varieties on the computed yield per hectare. The plants produced 10 to 12 tons/ha of fresh pods.

Interaction effect. No interaction effect of the variety and foliar fertilizers was observed on the computed yield per hectare.

Reaction to Bean Rust

Effect of foliar fertilizer. In terms of reaction to bean rust, it was observed that all the plants applied with foliar fertilizers were moderately resistant to bean rust. Plants not applied with foliar fertilizer were also moderately resistant. This result indicates with or without application of foliar fertilizer made no difference on the resistance of the plants.

Effect of variety. A significant difference was observed among the varieties on reaction to bean rust (figure 6). Alno had higher resistance than Burik, Stone hill black, Stone hill brown and Maroon, which were moderately resistant to bean rust. Resistance of plants to pest is due to its genetic make-up.

Reaction to Pod Borer

Effect of foliar fertilizer. No significant differences were observed on the reaction to pod borer infestation of the plants applied with different foliar fertilizers. All of the plants showed moderate resistance to pod borer.

Effect of variety. Among the varieties tested, it was observed that all were moderately resistant to pod borer.

Figure 6. Response of pole snap bean to bean rust and pod borer.

Return on Cash Expenses (ROCE)

Table 8 shows the return on cash expenses of growing pole snap bean as affected by different foliar fertilizers. It was observed that plants not applied with any foliar fertilizer produced the highest return on cash expenses due to lesser expenditures. Plants applied with Care crop international produced the least return on cash expenses. In terms of varieties, Alno and Stone hill brown not applied with foliar fertilizers had the highest return on cash expenses due to low weight of non-marketable pods and resistance to bean rust. The negative ROCE from Burik, Stone hill black, and Stone hill brown may be due to the low selling price and high cost of foliar fertilizers applied.

Table 8. Return on Cash Expenses (ROCE) on growing five pole snap bean varieties applied with foliar fertilizers

TREATMENT	MARKETABLE PODS (Kg/15m^2)	GROSS SALE (PhP)	TOTAL EXPENSES (PhP)	NET INCOME (PhP)	ROCE* (%)
No foliar fertilizer					
Alno	15.3	306	145.62	160.38	110.14
Burik	11.2	224	145.62	78.38	53.83
Stone hill black	11.2	224	145.62	78.38	53.83
Stone hill brown	15.6	312	145.62	166.38	114.26
Maroon (Check)	10.6	212	145.62	66.38	45.58
Mean					75.53
Abundant harvest					
Alno	13.6	272	235.62	36.38	15.44
Burik	12.7	254	235.62	18.38	7.80
Stone hill black	11.10	222	235.62	-13.62	-5.78
Stone hill brown	15.20	304	235.62	68.38	29.02
Maroon (Check)	13.4	268	235.62	32.38	13.74
Mean					12.04
Care crop international					
Alno	12.7	254	235.62	18.38	7.80
Burik	11.16	232	235.62	-3.62	-1.54
Stone hill black	18.6	372	235.62	136.38	57.88
Stone hill brown	11.1	222	235.62	-13.62	-5.78
Maroon (Check)	11.8	236	235.62	0.38	0.16
Mean					11.70

*variable cost includes cost of seeds, foliar fertilizers, trellises, and others.
*sales were based on the average of 20 PhP per kilo

Farmer Acceptability

Ten farmers of Gaswiling, Kapangan, Benguet were invited to evaluate the plant stand and fresh pods of the five varieties of pole snap bean. The evaluation of farmers was based on plant morphology, pod characteristics, and general acceptability (Table 9).

Alno, Burik, and Maroon were liked very much by the farmers which might be due to the vigorous plants and long, straight, and smooth pods produced by the varieties. Finally, Stone hill black and brown were moderately liked by farmers which might be due to the stunted growth and short pods produced.

Table 9.Farmer acceptability of pole snap bean varieties

VARIETY	DISLIKE VERY MUCH	DISLIKE MODERA-TELY	LIKE	LIKE MODERA-TELY	LIKE VERY MUCH
Alno	-	-	-	1	9
Burik	-	-	1	2	7
Stone hill Black	-	1	2	7	-
Stone hill Brown	-	-	3	5	2
Maroon (Check)	-	-	-	2	8

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Gaswiling, Kapangan, Benguet to identify the snap bean variety(s) with the highest yield and resistance to pest; identify which among the foliar fertilizers is best in terms of its effect on the growth, yield, and acceptability of the five pole snap bean varieties; determine the interaction effect between the five varieties of pole snap beans and application of foliar fertilizers; determine the profitability of producing snap beans applied with different foliar fertilizers; and determine the acceptability of pole snap bean varieties among farmers in Gaswiling, Kapangan, Benguet.

There were significant differences in most of the parameters observed among plants applied with foliar fertilizers except for the number of days from sowing to emergence, percent emergence, number of flower cluster per plant, pod width, pod diameter, weight of marketable pods per plot, weight of non-marketable pods per plot, total yield per plot, computed yield per plot, and reaction to bean rust and pod borer.

There were significant differences observed among the varieties of snap bean. Alno, Stone hill black and Stone hill brown emerged within seven DAE, one day earlier than Burik and Maroon. Alno, Burik, Maroon, and Stone hill brown were the first varieties to be harvested in 56 DAE compared to Stone hill black which was the last variety to be harvested. Maroon had the highest number of pods per cluster while Stone hill black produced the least number of pods. Alno had higher resistance to bean rust than Burik, Stone hill black, Stone hill brown and Maroon.

No significant interaction of variety and foliar fertilizers was observed on most parameters except for the number of days from emergence to last harvest and weight of non-marketable pods per plot.

In terms of acceptability by the farmers, Alno, Burik, and Maroon were the most preferred because of its good plant stand and pod characters.

Conclusion

All the varieties evaluated produced similar weight of marketable pods and had a moderate resistance to bean rust and pod borer except for Alno which had a high resistance to bean rust. Stone hill brown and Alno had the highest yield.

Application of foliar fertilizers slightly increased plant yield but became an added cost resulting to decreased returns. Plants applied with Care crop international had the highest total yield.

Combination of Alno and Abundant harvest may decrease non-marketable pods per plot.

Pole bean plants not applied with foliar fertilizers were the most profitable.

Alno, Burik, and Maroon were the most preferred entries by farmers in Gaswiling, Kapangan, Benguet.

Recommendation

Based on the conditions of this study, foliar fertilizers may not be applied to pole beans since it had little effect on yield and was added cost which lead to decreased returns. In terms of profitability and farmer acceptability, Alno and Stone hill brown are recommended under Gaswiling, Kapangan, Benguet condition.

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