BIBLIOGRAPHY

SUYAM, BENJAMIN A. APRIL 2006. Response of Six Varieties of Bush Snapbeans to Mulching. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted to evaluate the response of six varieties of bush snapbeans to mulching, identify the most responsive variety of bush snapbeans to mulching, evaluate the effect of mulching materials in bush snapbean production and to determine the best mulching materials for bush snapbean production.

Bush snapbean plants mulched with different materials significantly differed in plant height at first harvest, number of pod clusters per plant, number of pods per plant and per plot, weight of marketable pods per plot and distance of pod cluster to the ground. Unmulched plot and plot with pine needle mulch significantly produced the tallest plants at first harvest. Mulching of bush snapbean with “Taaw” grass and pine needle significantly gave the highest number of pods clusters per plant, and number of pods per plant and per plot. “Taaw” grass as mulch significantly increased the marketable yield per plot of bush snapbean plants. Unmulched plot had the significantly the longest distance pod clusters to the ground.

Highly significant differences were observed among the six varieties of bush snapbeans evaluated in number of pods and pod clusters per plant, pod length and pod width, distance of pod and pod clusters to the ground number and weight of marketable yield per plot, total yield per plot and computed yield per hectare. HAB 63 got the highest number of pods and pod clusters per plant. BBL 274 and Torrent had the longest and widest pods. Torrent had the longest distance of pod and pod clusters to the ground. BBL and Torrent also produced the highest number and heaviest marketable pods per plot, total yield per plot and computed yield per hectare.

Significant interaction effect was observed between mulching material and variety on the distance of pod clusters to the ground, pod width and number of pod clusters per plant.

Economically, even without mulching, snapbean production is already profitable because a grower could realize more than 40 % ROCE. Planting Torrent and Landmark resulted in 29 and 25 % ROCE, respectively. Growing Torrent, BBL 274 and Landmark even without mulching gave 51 to 90 % ROCE. Mulching of pine needles to BBL 274 gave 42 % ROCE and mulching of “Taaw” grass in BBL 274 and Torrent gave 48 and 30 % ROCE, respectively.

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INTRODUCTION

Bush snapbean (*Phaseolus vulgaris* L.) belongs to the leguminous family. This crop is excellent source of protein and vitamins. It is the one most important cash crop.

Legumes like bush snapbean has the ability to fix nitrogen from the atmosphere and convert it into available form with the presence of nitrogen fixing bacteria in their root nodules to help in maintaining soil fertility. Aside from that, to man and animals, legumes serve as source of food and feed respectively (PCARRD, 1983).

Snapbeans are annual crop adapted to wide type of soil with short maturity period and have a trifoliate leaves. This crop is harvested by hand picking. The bushy type are harvested 2 to 5 times but those harvested several times are necessary for the pole type.

Mulching involves the covering of the soil surface with various kind of organic matter and manufactured products such as plastics, foil, paper, etc. Mulching materials can help to protect the soil so that sun heat or rainfall cannot attack directly to the soil. Therefore with the presence of mulch above the soil surface will reduce the washing away of the soil particles and prevents raindrops on splashing on the soil. Aside from this the soil moisture will be saved. More layers of mulch allows the soil to soak up more water so that if there is heat and drying winds, there is less evaporation. It also prevent the attack of pest and diseases; improve the condition of the soil and provide better growing environment for successful production.

In the Cordillera, particularly in Benguet, bush snapbean is planted as intercrop or monocrop in order to have enough food supply. With this, there is still a problem encountered by the farmers in the production of bush snapbeans. Marketable pods are reduced due to its poor quality caused by the soil surface at the base of the plant. When the ground is wet, developing pods reach the soil which usually cause rotting tendering them non marketable. Still the farmers commonly allow them to mature for fresh pod or for seed production. To prevent rotting of pods, one possible remedy is to use best mulching materials to help the farmers increase the marketability of bush snapbean pods, hence increasing productivity and income.

This study was conducted to evaluate the response of six varieties of bush snapbeans to mulching; identify the most responsive variety of bush snapbeans to mulching; evaluate the effect of mulching materials in bush snapbean production; and determine the best mulching materials for bush snapbean production.

The study was conducted at the BSU-IPB Highland Crops Research Station, Benguet State University, La Trinidad, Benguet from November 2005 to February 2006.

REVIEW OF LITERATURE

The Plant

According to PCARRD (1983) vegetable legumes have trifoliate leaves. The leaflets are ovate, oblong, and lanceolate and vary in size from small to large. The color of the pods is light green, yellow or mottled, and the shape is linear, laterally compress beaked and slightly curved.

Tindal (1983) states that dwarf or bush type is day neutral plant, early maturing with 20 to 60cm in height. The roots are rapidly growing toproot, reaching at depth of 90cm. Well modulated roots mainly limited to a depth of 20 cm. Stems are slender, twisted, angled, almost square in cross section, often with purple streaks.

Snap beans are all annuals grown from seeds. The fruits are pods in which the seeds are contained. In green or snapbean, pods are harvested before ripening and both pods and the immature seeds are consumed, in some kinds, the seed when near full grown, but while still immature seeds are threshed from the pods and frozen or canned. In dry or field beans, pods and seeds are allowed to ripen then threshed and only the seeds are consumed (HARRDEC, 1989).

Snapbeans are harvested by hand from 2-5 pickings are sufficient to harvest the dwarf varieties, but several pickings are necessary for the pole varieties. In many cases the pods are picked when they have reached their full size but when the seeds are only about one fourth mature.

Mulching and Mulching Materials

Mulch is any covering material placed over the soil surface to modify soil physical properties, create favorable environments for root development and nutrients uptake and reduce soil erosion and degradation (Wilson and Akapa, 1983) Webster (1960). Defined mulch as leaves, straw, or other loose material spread on the ground around the plants.

Wilken (1987) distinguished between crop residues, which are developed in situ, and mulches, which include fresh and dried plant materials and composts brought to the field. However it should be noted that crop residues are frequently used as mulches. Pathogens are often killed by the heat generated the production of composts.

Unfortunately, mulches provide a good environment for the multiplication or survival of slugs, which sometimes cause serious losses to crops such as beans when mulched. In Costa Rica the same slugs that attacks beans also provide vector a serious human nematode pathogen (Beaver *et al*., 1984). Mulches may also provide nutrition and a suitable environment for certain plant pathogens. The effect of mulches incorporated to the soil on the C/N ratio is important, as a soluble soil nitrogen may be locked up in the microorganisms decomposing the organic materials. This may cause a serious nitrogen deficiency, and make some organic crops more susceptible to soil borne pathogens.

According to Wilken (1987) and Wilson and Akapa (1983) any material used for mulches are traditional. Cereal straw and stalks are perhaps the most commonly used mulches, but other examples are crop debris, sawdust, leaves etc. In modern or commercial agriculture, the list is even longer and include manufactured products such as various plastic material, aluminum foil and paper. Some authors refer to live mulches that is similar to green manures (Akubondo 1984, Karunairajan 1982). Live mulches are intercropped with the crop of interest for their mulch value, where as green manure are also crops grown for their mulch value, but plowed under before planting the crop of interest.

Wilson and Akapa (1983) also reported that mulches also decrease soil moisture evaporation, increase infiltration rate, smother weeds, lower soil temperature, and enrich soil." Mulches are especially valuable for protecting seedlings from the impact of rain, hail, and the wind. Mulches can be especially important in tropical areas with heavy rainfall, as they improve water absorption and are important in water conservation. Mulches reduce rain splashing, an important means of dissemination for numerous bacterial and fungal pathogens. Soil temperatures are lower under mulches in warm tropical areas.

Wrigley (1988) cited a number of benefits from mulching coffee with non-living crop residues. He suggested that mulches reduced soil temperatures, protected against rain, conserved rainfall, increased soil nutrients, increased soil organic matter, produced conditions ideal for root growth, reduced weeds, reduced soil acidity, and increased coffee yields. The main advantage Wrigley cited for the use of mulches was high labor costs.

Bawang and Lapade (1991-1992) stated that mulching of pine needles are suitable for snapbean. They found that pine needle mulch combined with fertilizers tremendously increased yields of the crop studied and effectively controlled weeds, such as broad leaves, grasses and sedges. These also prevent fertilizer from leaching, regulate soil temperature and conserve soil moisture with no residual effect. Similarly with the use of dried straw, they found out that mungo yield increased while the unmulched plot have lower yield despite the application of high rate of fertilizers (Petate, 1978).

Studies showed the effects of rice hull mulch and nitrogen in maize. They concluded that maize yield responded significantly due to mulching the crop and was taller than the unmulched. They also claimed that mulch provides better soil moisture, temperature regimes and reduces weed competition (Nnadi *et al*., 1984).

Varietal Evaluation

The importance of having varietal evaluation is to observe performance such as yield, earliness, vigor, maturity and keeping quality because different varieties have a wide range of difference of plant, in size and in yield performance (Work and Carew, 1995). Varietal evaluation gathers data on plant character, yield, and pod quality. Hence we can obtain high yielding and improved cultivars that are known to play role in boosting production (Regmi, 1990).

Varietal evaluation of bush snapbean conducted by Lab-oyan in 1987 revealed that plants spaced of 30 cm between rows produced the largest pods. The test varieties and spacing on the seed production had no significant interaction effect. Flo had the highest seed yield among the varieties tested.

Dagson (2000) evaluated the six varieties of bush snapbean at La Trinidad and found out that HAB 63, Torrent and String Valentine significantly produce the highest marketable pods per plot. BBL 274 and Torrent significantly had the highest total fresh pod yield of 8 to 9 kg/5m^2 plot. All varieties studied exhibited moderate resistance to pod borer except for HAB 232 which was susceptible to pod borer. On the other hand, Loakan (2003) evaluated Alno selection obtained from different sources in Benguet.

Alno from Tublay and La Trinidad produced significantly longest pod and highest fresh pod yield fallowed by Alno from Mankayan, Kabayan and Bokod.

Likewise, Pog-ok (2001) revealed that Pencil Pod performed significantly better than the other varieties with regards to the number of days to first harvesting, pod length, pod diameter, and resistance unlike Alno, Blue Lake; B-21 and Kentucky Wonder with aromatic pods.

MATERIALS AND METHODS

An area of 390 m^2 was thoroughly prepared for the experiment consisting of 78 plots including the border plot. Each plot measured 1 m x 5 m.

In this study, mulching materials were assigned as factor A while the six varieties of bush snapbean were considered factor B, as follows.

Factor A = Mulching materials (M)

M_1 = Unmulched plot

M_2 = Pine needles

M_3 = "“Taaw”" grass

Factor B = Varieties (V)

V_1 = BBL 274

V_2 = HAB 19

V_3 = HAB 232

V_4 = HAB 63

V_5 = Torrent

V_6 = Landmark

The experiment was laid out following 3 x 6 factor factorial in randomized complete block design (RCBD) with four replications. Mulching materials were placed uniformly on the top of the plot at 30 days after planting (DAP). Other cultural practices were done when needed.

Data Gathered

1. Number of days to first flowering. This was recorded when at least 50 % of the plants per plot had at least one fully opened flower per plant.

2. Number of days to first and last harvest of fresh pod. These were obtained by counting the number of days from planting up to the time of first harvesting and last harvesting of fresh pods.

3. Plant height at first harvest. The height of ten sample plants were measured from the base up to the tip of the youngest shoots during the first harvesting of fresh pod.

4. Number of pods per cluster. The number of pods that developed per cluster was counted from ten random sample cluster per plant.

5. Number of pod cluster per plant. This was counted from ten random sample plants per plot.

6. Number of pods per plant. The number pods were counted from ten sample plants per treatment and the average number of pods per plant was per computed.

7. Number of pods per plot. This was obtained by counting the number of harvested marketable and non marketable pods produced per plot.

8. Pod length (cm). This was taken by measuring the length of the ten sample pod per plot from the base up to the tip of the pod.

9. Pod width. The width of the pod was taken by measuring the mid portion of the ten sample pods per plot using a vernier caliper.

10. Distance of the pod to the ground. The distance of ten sample pods produced per plot was measured from the tip of the pod up to the ground using foot ruler.

11. Distance of cluster to the ground. The distance of ten selected sample clusters produced per plant was measured using a foot ruler from the peduncle attachment of the cluster to the soil surface.

12. Straightness of the pod. This was noted from ten random sample pod per plant produced per plot through visual observation and was recorded as straight, slightly curve or curve.

13. Number and weight of marketable pods per plot. Marketable pods were counted and weighed. Marketable pods were smooth, straight, tender and free from insect pest damage and disease infection.

14. Number and Weight of non marketable pods per plot. These were recorded by getting the number and weight of harvested non marketable pods. Non marketable pods were very short, abnormal, over matured and damaged by insect pest and diseases.

15. Total yield per plot (kg/3m^2). This was obtained by getting the total weight of marketable and non marketable pods per plot

16. Computed yield per ha (t/ha). This will be computed using the formula following formula per plot basis.

$$\text{Yield /ha (t/ha)} = \frac{\text{Yield (kg)}}{3\text{m}^2} \text{X } 3.33$$

Where 3.33 is a factor to used to convert yield in kg/5m^2 into yield per hectare in t/ha.

17. Number of seeds per pod. The seeds were counted from ten selected sample pods per plot.

18. Number of days to last flowering. This was obtained by counting the number of days from planting up to the time that the plants stopped to produce flower.

19. Insect pest and disease rating

a. Reaction to leaf miner and pod borer. This was monitored using the following scale used by Dagson in 2000.

SCALE	DESCRIPTION	REMARKS
1	No infestation	High resistance
2	1-25 % infestation	Moderate resistance
3	26-50 % infestation	Resistant
4	51-75 % infestation	Susceptible
5	75 and above	Very susceptible

b. Reaction to rust and rot infection. This was monitored using the fallowing scale used by Loakan in 2003.

RANK	DESCRIPTION	REMARKS
1	No infection	High resistance
2	20-30 % infection	Moderate resistance
3	30-40 % infection	Resistant
4	40-60 % infection	Susceptible
5	60 and above	Very susceptible

20. Return on Cash Expenses (ROCE). This was obtained using the fallowing formula per plot basis:

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

Analysis of Data

All quantitative data were analyzed using analysis of variance for 3 x 6 factor factorial in randomized complete block design (RCBD) with four replications. The significance of differences among treatment means were tested using Duncan's Multiple Range Test (DMRT) at 95 % level of significance.

RESULTS AND DISCUSSION

Number of Days to First Flowering

Effect of mulch. All the bush snapbean plants regardless of mulching materials flowered within 40 days after sowing (DAS).

Effect of variety. No significant differences were observed among the six varieties of bush snapbean used in the study. All varieties took 40 to 41 days to first flowering after planting

Interaction effect. There was no interaction effect on the number of days to first flowering between mulching materials and variety. Results showed that mulching of pine needle and “Taaw” grass had no effect on the number of days to first flowering of bush snapbean plant.

Number of Days to Last Flowering

Effect of mulch. All the plants took 57 days to last flowering regardless of the mulching materials used in the study.

Effect of variety. There were no significant differences in terms of the number of days to last flowering among the six varieties evaluated. All the varieties evaluated took 57 days to last flowering.

Interaction effect. No significant interaction effect of mulching material and varieties was noted on the number of days to last flowering.

Number of Days to First Harvest

Effect of mulch. There were no significant differences among plants with different mulching materials observed in terms of days to first harvest. Both unmulched and mulched plot had a similar number of days to first harvest. They took 59 days to first harvesting of fresh pods.

Effect of variety. No significant differences were also observed on the number of days to first harvest among the varieties evaluated. All the varieties took 59 days to first harvest

Interaction effect. There was no significant interaction effect observed on the number of days to first harvest between mulch and variety.

Number of Days to Last Harvest

Effect of mulch. No significant differences in number of days to last harvest among plants mulched with different materials were observed in this study. All plants with different mulching materials had similar number of days to last harvest of fresh pod, 70 days after planting.

Effect of variety. There were no significant differences on the number of days to last harvest of fresh pod among the six varieties evaluated. All of them were harvested at 70 days after sowing.

Interaction effect. No significant interaction effect of mulching material and variety were observed on number of days to last harvest.

Plant Height at First Harvest

Effect of mulch. Statistical analysis revealed highly significant differences in plant height at harvest among plants mulched with different materials. Table 1 showed that unmulched plot produced the tallest, together with plots mulched with pine needle.

Plants mulched with “Taaw” grass exhibited significantly shorter plants which was comparable to the height of plants mulched with pine needle.

Effect of variety. There were no significant differences observed among the six varieties used in the study in terms of plant height (Table 1). Plant height ranged from 40.8 cm (BBL 274) to 46.7 cm (Torrent).

Interaction effect. It was observed that mulch and variety did not interact significantly with each other, in plant height at first harvest (Table 1).

Table 1. Plant height at first harvest of six varieties of bush snapbeans as affected by different mulching materials

TREATMENT	PLANT HEIGHT (cm)
Mulch (a)	
M_1 – Unmulched	46.8[a]
M_2 – Pine needle	43.4[ab]
M_3 – “Taaw” grass	38.0[b]
Variety (b)	
V_1 – BBL 274	40.8
V_2 – HAB 19	42.3
V_3 – HAB 323	42.2
V_4 – HAB 63	41.6
V_5 – Torrent	46.7
V_6 – Landmark	42.8
axb	ns
CV (%)	10.68

*Means with common letter are not significantly different at 95 % level of significance using DMRT.

Number of Pods Per Cluster

Effect of mulch. No significant differences were observed in number of pods per cluster among the different mulching materials used (Table 2). Mulch and unmulched plants had 3 to 4 pods per cluster.

Effect of variety. There were no significant differences in number of pods per cluster among the six varieties used in the study. Table 2 showed that all the varieties had 3 pods per cluster except Landmark which had 4 pods per cluster.

Interaction effect. It was observed that mulch and variety did not interact with each other in number of pods per cluster (Table 2).

Table 2. Number of pods per cluster per plant and per plot (3 m^2) of six varieties of bush snapbeans as affected by different mulching materials

TREATMENT	NUMBER OF:	
	PODS PER CLUSTER	POD CLUSTERS PER PLANT
Mulch (a)		
M_1 – Unmulched	3	6^b
M_2 – Pine needle	4	7^a
M_3 – "Taaw" grass	3	7^a
Variety (b)		
V_1 – BBL 274	3	6^b
V_2 – HAB 19	3	7^b
V_3 – HAB 323	3	7^b
V_4 – HAB 63	3	8^a
V_5 – Torrent	3	6^b
V_6 – Landmark	4	6^b
Axb	ns	*
CV (%)	13.21	9.68

*Means with common letter are not significantly different at 95 % level of significance using DMRT.

Number of Pod Clusters Per Plant

Effect of mulch. Statistical analysis showed highly significant differences observed on the number of clusters per plant (Appendix Table 6). Mulching pine needle and “Taaw” grass mulch gave significantly higher number of pod clusters per plant than the unmulched plot. It was observed that Pine needle and “Taaw” grass produced statistically similar number of pod clusters per plant (Table 2).

Effect of variety. Highly significant differences on the number of pod clusters per plant were observed among the six varieties of bush snapbean used in the study. HAB 63 significantly produced the highest number pod of clusters per plant. The other varieties BBL evaluated produced significantly lower number of pods clusters per plant (Table 2).

Interaction effect. It was observed that mulch and variety showed significant interaction effect on the number of pod clusters per plant (Figure 1). Results showed that the highest producer was HAB 63 mulched with “Taaw” grass, HAB 19 and HAB 63 were also the highest mulched with pine needle while in the unmulched plot, HAB 63 was the highest. All the varieties without mulched except HAB 63 was the lowest. HAB 63 and Torrent mulched with pine needle and BBL 274 and Landmark mulched with “Taaw” grass had a similar number of pod clusters per plant (6).

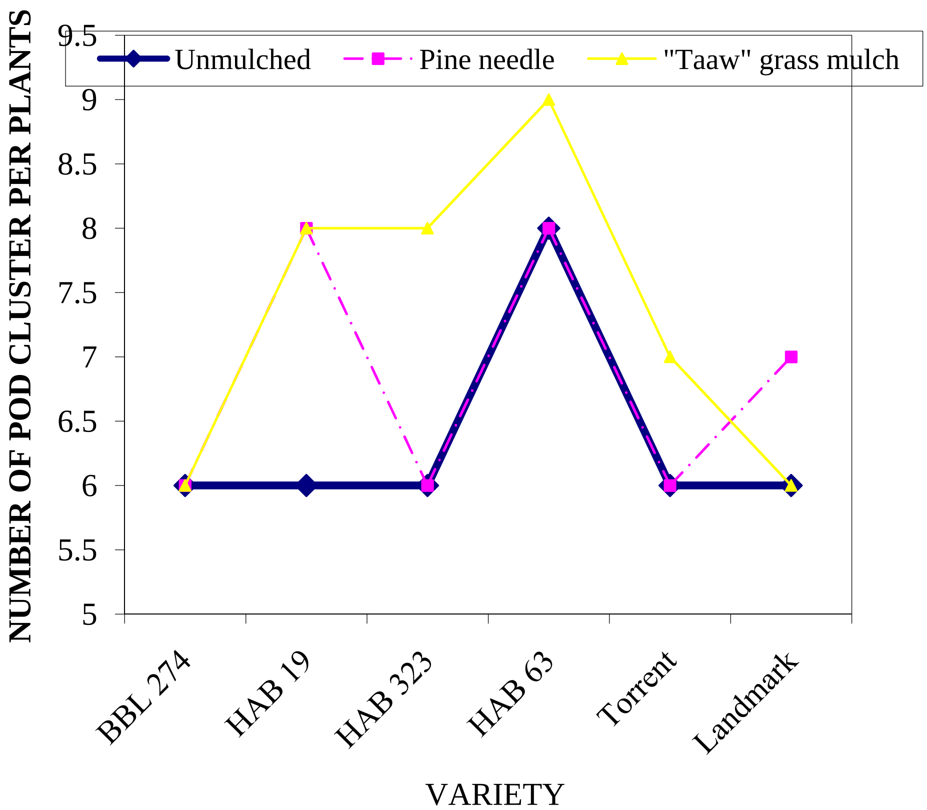

Figure1. Interaction effect between mulch and variety on the number of pod clusters per plant

Number of Pods Per Plant

Effect of mulch. Statistical analysis showed highly significant differences among the plants mulched with different materials in terms of number of pods per plant. Mulching of bush snapbean with pine needles and "Taaw" grass gave significantly higher number of pods per plant than the unmulched plants (Table 3). This indicates that mulching increased the number of pods per plant of bush snapbean.

Effect of variety. Highly significant differences on number of pods per plant were noted among the varieties evaluated. Results showed that HAB 63 gave significantly highest number of pods per plants among the six varieties tested. The other five varieties recorded statistically similar number of pod per plant which ranged from 17 to 19 (Table 3).

Interaction effect. No significant interaction on the number of pods per plant between mulch and variety was observed (Table 3).

Number of Pods Per Plot

Effect of mulch. Statistical analysis showed highly significant differences among the plants mulched with different materials in terms of number of pods per plot. Mulching of Pine needles and "Taaw" grass gave significantly higher number of pods per plot that unmulched plot (Table 3).

Effect of variety. No significant differences in number of pods per plot were recorded among the six varieties evaluated (Table 3). Landmark produced the numerically highest pods per plot (437) and the lowest producer was HAB 63 (361).

Interaction effect. No significant interaction effect on the number of pods per plot between mulch and varieties observed (Table 3).

Table 3. Number of pods per plants and per plot of six varieties of bush snapbeans as affected by different mulching materials

TREATMENT	NUMBER OF PODS PER	
	PLANT	PLOT ($3m^2$)
Mulch (a)		
M_1 – Unmulched	17^b	374^b
M_2 – Pine needle	19^a	410^a
M_3 – "Taaw" grass	19^a	430^a
Variety (b)		
V_1 – BBL 274	17^b	414
V_2 – HAB 19	19^b	386
V_3 – HAB 323	19^b	411
V_4 – HAB 63	21^a	361
V_5 – Torrent	17^b	417
V_6 – Landmark	17^b	437
axb	ns	ns
CV (%)	9.63	18.72

*Means with common letter are not significantly different at 95 % level of significance using DMRT.

Pod Length

Effect of mulch. Statistically, no significant differences in length of pods were observed among the different mulching materials used in the study (Table 4). All had similar pod length of 15 cm.

Effect of variety. Highly significant differences in length of pods were observed among the six varieties evaluated (Table 4). Torrent and BBL 274 significantly gave the longest pod length of 16 cm. HAB 19 and Landmark gave 15 cm while HAB 323 and HAB 63 recorded the significantly shortest pod length (14 cm).

Interaction effect. Result showed no significant interaction effect between mulch and the variety observed in pod length bush snapbean (Table 4).

Pod Width (mm)

Effect of mulch. Results showed no significant differences observed on the width of the pod among the different mulching materials used. All of them gave statistically similar width of pod which ranged from 6 8 to 7.0 mm (Table 4).

Effect of variety. Highly significant differences in pod width were observed among the varieties evaluated. Torrent, BBL 274 and Landmark had statistically similar width of pods of more than 9.0 mm, respectively. These varieties gave significantly the widest pods. HAB 63 and HAB 323 recorded the narrowest pods with 6.5 and 6.3 mm respectively.

Interaction effect. Highly significant interaction effect between mulch and variety was observed on the width of pod (Figure 2). It was shown that the widest pod of 8 mm was measured in BBL 274 without mulch and Torrent mulched with “Taaw” grass. All the varieties mulched with pine needles except HAB 323 had also the widest pod. HAB 63 without mulched and HAB 323 with pine needle mulch had the narrowest pod width. Using “Taaw” grass mulch in HAB 323 and HAB 63 also produced the narrowest pod width.

Table 4. Pod length and width of six varieties of bush snapbeans as affected by different mulching materials

TREATMENT	POD	
	LENGTH (cm)	WIDTH (mm)
Mulch (a)		
M_1 – Unmulched	15	6.9
M_2 – Pine needle	15	7.0
M_3 – “Taaw” grass	15	6.8
Variety (b)		
V_1 – BBL 274	16[a]	7.2[a]
V_2 – HAB 19	15[b]	7.0[a]
V_3 – HAB 323	14[c]	6.3[b]
V_4 – HAB 63	14[c]	6.5[b]
V_5 – Torrent	16[a]	7.4[a]
V_6 – Landmark	15[b]	7.1[a]
axb	ns	**
CV (%)	3.65	4.87

*Means with common letter are not significantly different at 95 % level of significance using DMRT.

Distance of the Pods to the Ground

Effect of mulch. Statistical analysis showed no significant differences observed in distance of the pods to the ground among the different mulching materials used (Table 5).

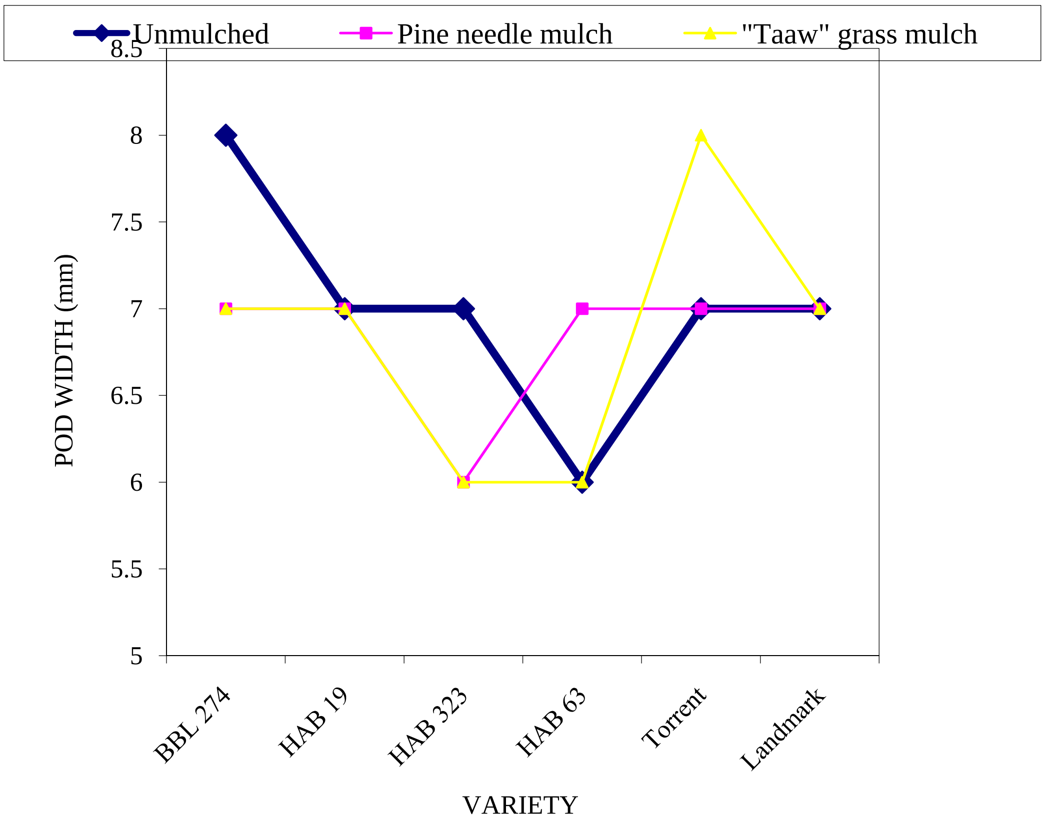

Figure 2. Interaction effect between mulch and varieties in pod width

Effect of variety. Highly significant differences in distance of the pods to the ground were observed among the varieties evaluated. Table 5 showed that Torrent had significantly longest distance of pods from the ground together with HAB 323. The other varieties exhibited statistically similar and lower distance which was also comparable to HAB 323.

Interaction effect. There was no significant interaction effect between mulch and variety observed in distance of pod to the ground (Table 5).

Distance of Cluster to the Ground

Effect of mulch. Statistically significant differences were observed on the distance of cluster to the ground among the different mulching materials used in the study (Table 5). Unmulched plot had the significantly longest distance of pod clusters to the ground than Pine needle mulch and "Taaw" grass.

Effect of variety. Highly significant differences were observed among the varieties evaluated. Torrent significantly obtained the longest distance of cluster to the ground while, HAB 63 obtained the shortest distance of the cluster to the ground which was statistically similar to the distance of other varieties studied.

Interaction effect. Highly significant interaction effect of mulch and variety were observed on the distance of pod clusters to the ground (Figure 3 and Appendix Table 12). Results showed that mulching with different materials in Torrent had the highest distance of pod clusters to the ground. BBL 274 without mulch, HAB 19 mulched with pine needle and Landmark mulched with "Taaw" grass had the lowest distance of pod clusters to the ground.

Table 5. Distance of the pods and cluster to the ground of six varieties of bush snapbeans as affected by different mulching materials

TREATMENT	DISTANCE OF:	
	PODS (cm)	POD CLUSTER (cm)
Mulch (a)		
M_1 – Unmulched	8.1	10.1[a]
M_2 – Pine needle	7.6	9.4[b]
M_3 – "Taaw" grass	8.2	9.2[b]
Variety (b)		
V_1 – BBL 274	7.0[b]	8.8[b]
V_2 – HAB 19	7.2[b]	8.7[b]
V_3 – HAB 323	8.4[ab]	8.9[b]
V_4 – HAB 63	8.1[b]	8.4[b]
V_5 – Torrent	9.8[a]	13.7[a]
V_6 – Landmark	7.2[b]	8.9[b]
axb	ns	**
CV (%)	13.30	11.01

*Means with common letter are not significantly different at 95 % level of significance using DMRT.

Straightness of the Pod

The straightness of the pod was noted through visual observation and recorded as straight, slightly curve and curve. After 1st harvesting of fresh pod, it was recorded that most of the varieties with different mulching materials had a pod with slightly curve except for Torrent and Landmark which had straight pods. Curve pod was observed during the 2nd and or late resulting to non-marketability of pods. However, during second harvest curve pod were lesser than the 3rd harvest or later.

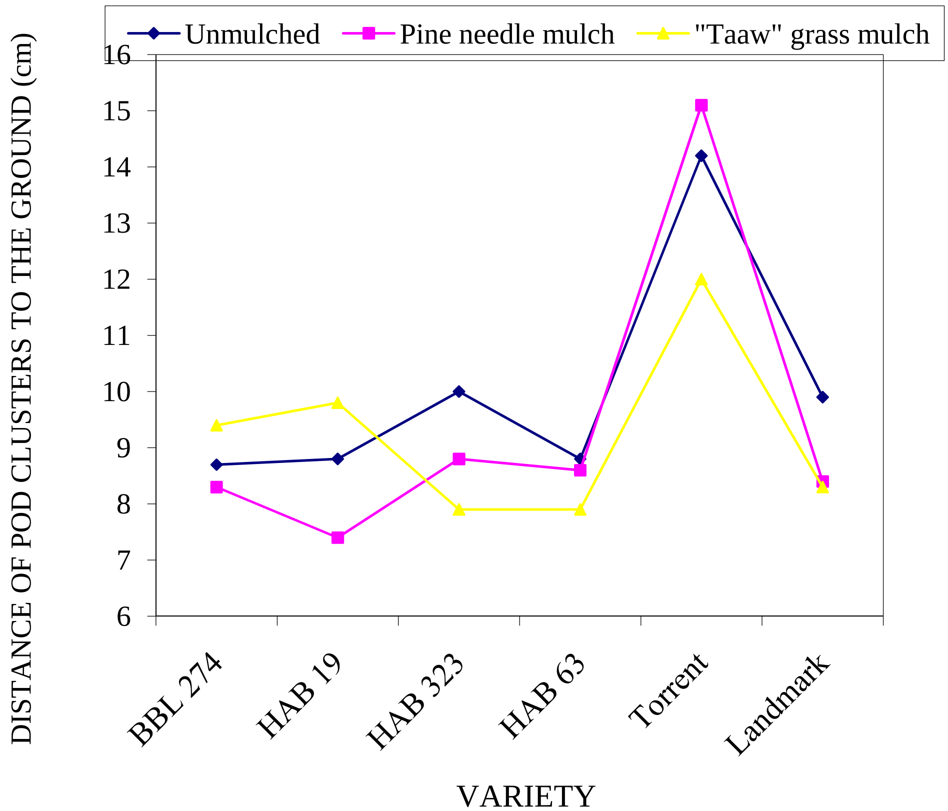

Figure 3. Interaction effect between mulch and varieties on the distance of pod clusters to the ground

Number of Marketable Pod Per Plot

Effect of mulch. There were no significant differences observed among the different mulching materials used in the study in terms of number of marketable pods per plot. Mulching of “Taaw” grass produced the numerically highest number of marketable pods, followed by Pine needle mulched and the lowest was the unmulched (Table 6).

Effect of variety. Highly significant differences in number of marketable pods per plot were observed among the five varieties tested. Results showed that BBL 274 and Torrent had significantly highest number of marketable pods per plot, among the five varieties evaluated (Table 6). The other varieties tested had all statistically lower number of marketable pods per plot.

Table 6. Number of marketable and non-marketable pods per plot

TREATMENT	NUMBER OF PODS PER PLOT (3 m^2)	
	MARKETABLE	NON-MARKETABLE
Mulch (a)		
M_1 – Unmulched	220	156
M_2 – Pine needle	259	155
M_3 – “Taaw” grass	271	153
Variety (b)		
V_1 – BBL 274	285[a]	137
V_2 – HAB 19	243[b]	152
V_3 – HAB 323	223[b]	178
V_4 – HAB 63	208[b]	154
V_5 – Torrent	286[a]	132
V_6 – Landmark	257[b]	173
axb	ns	ns
CV (%)	23.20	26.57

[*]Means with common letter are not significantly different at 95 % level of significance using DMRT.

Interaction effect. No significant interaction effect was noted between mulch and variety of bush snapbeans plant were observed in number of marketable pods per plot. Although varieties applied with mulch obtained numerically higher number of marketable pods per plot than the unmulched (Appendix Table 14).

Number of Non-marketable Pods Per Plot

Effect of mulch. There were no significant differences observed on the number of non-marketable pods per plot among the different mulching materials used. Mulching of “Taaw” grass produced 153 non-marketable pods per plant, while unmulched produced 156 non-marketable pod per plant (Table 6).

Effect of variety. Statistically no significant differences in number of non-marketable pods per plot among the six varieties evaluated were recorded (Table 6).

Interaction effect. No significant interaction between mulching material and variety was observed on the number of non-marketable pods per plot (Table 6).

Weight of Marketable Pods Per Plot

Effect of mulch. Statistical analysis showed highly significant differences in terms of marketable pods per plot among the different mulching materials used in the study (Table 7). Plot mulched with “Taaw” grass significantly recorded the heaviest marketable pods per plot. It was statistically similar with plot mulched with Pine needles. The lowest weight of marketable pods per plot was recorded in the unmulched plot (M_1).

Table 7. Weight of marketable, non-marketable and total yield per plot

TREATMENT	YIELD PER PLOT ($kg/3m^2$)		
	MARKETABLE	NON-MARKETABLE	TOTAL
Mulch (a)			
M_1 – Unmulched	1.53[b]	0.81	230
M_2 – Pine needle	1.81[ab]	0.86	2.67
M_3 – "Taaw" grass	1.89[a]	0.80	2.69
Variety (b)			
V_1 – BBL 274	2.17[a]	0.87	3.03[a]
V_2 – HAB 19	1.70[ab]	0.81	2.51[abc]
V_3 – HAB 323	1.41[b]	0.89	2.24[bc]
V_4 – HAB 63	1.28[b]	0.72	2.00[c]
V_5 – Torrent	2.11[a]	0.80	2.90[ab]
V_6 – Landmark	1.79[ab]	0.84	2.63[abc]
axb	ns	ns	ns
CV (%)	22.45	28.10	19.50

*Means with common letter are not significantly different at 95 % level of significance using DMRT.

Effect of variety. There were highly significant differences observed among the varieties evaluated in terms of weight of marketable pods per plot BBL 274 and Torrent had significantly heaviest marketable pods per plot. They were statistically comparable with marketable yield of Landmark and HAB 19. The lowest was HAB 323 (Table 7).

Interaction effect. Statistical analysis revealed no significant interaction effect of mulching and variety (Table 7) in weight of marketable pods per plot.

Weight of Non-marketable Pods Per Plot (kg)

Effect of mulch. There was no significant difference on the weight of non-marketable pods per plot between the different mulching materials used in the study. Plots with mulch and without mulch got statistical similar weight of non-marketable pods per plot (Table 7).

Effect of variety. No significant differences were observed among the six varieties evaluated in terms of non-marketable pods per plot. They had statistically similar weight of non-marketable pods per plot (Table 7).

Interaction effect. No significant interaction of mulching material and variety was observed in weight of non-marketable pods per plot.

Total Yield Per Plot

Effect of mulch. There were no significant differences in total yield among the plot mulched with different materials (Table 7).

Effect of variety. Statistical analysis showed that there were highly significantly differences in total yield per plot among the six varieties evaluated (Table 7). BBL 274 gave significantly the highest total yield of 3.03 kg per 3 m^2 comparable with the yield HAB 19, Torrent and Landmark. The lowest producer was HAB 63.

Interaction effect. No significant interaction of mulch and variety was noted on the total yield per plot of bush snapbean (Table 7).

Computed Yield Per Hectare

Effect of mulch. The computed yield in tons per hectare was computed based on the total yield per plot. There were no significant differences in terms of computed yield per hectare among the different mulching materials was noted. It was observed that application of mulch gave numerically more yield per hectare than the plots without mulch (Table 8).

Effect of variety. Highly significant differences among the varieties were observed in terms of computed yield per hectare (Table 8). BBL 274 and Torrent significantly obtained the highest yield per hectare which was statistically comparable to computed yield per hectare of Landmark, HAB 19 and HAB 323. HAB 63 significantly obtained the lowest.

Interaction effect. There was no significant interaction effect noted between mulch and variety on the computed yield per hectare (Table 8).

Number of Seeds Per Pod

Effect of mulch. The number of seeds per pod did not differ significantly among the different mulching materials used in this study (Table 8). All of the plants produced similar number of seeds per pod (6).

Effect of variety. No significant differences were observed on the number of seeds per pod among the six varieties evaluated in the study. All of the varieties produced the same number of seeds per pod (Table 8).

Interaction effect. No significant interaction effect between mulched and varieties used was noted in number of seeds per pod (Table 8).

Table 8. Computed yield per hectare and number of seeds per pod of six varieties of bush snapbeans as affected by different mulching materials

TREATMENT	YIELD (t/ha)	NUMBER OF SEED PER POD
Mulch (a)		
M_1 – Unmulched	7.72	6
M_2 – Pine needle	8.81	6
M_3 – "Taaw" grass	8.86	6
Variety (b)		
V_1 – BBL 274	10.01^{a}	6
V_2 – HAB 19	8.29^{ab}	6
V_3 – HAB 323	7.40^{ab}	6
V_4 – HAB 63	6.81^{b}	6
V_5 – Torrent	9.57^{a}	6
V_6 – Landmark	8.69^{ab}	6
axb	ns	ns
CV (%)	20.05	13.21

*Means with common letter are not significantly different at 95 % level of significance using DMRT.

Insect Pest and Disease Incidence

Reaction to Leafminer

Effect of mulch. There were no significant differences on the reaction to leafminer among the different mulching materials used in the study (Table 9). All plants regardless of mulching materials was monitored and rated as resistant to leafminer infestation.

Effect of variety. No significant differences were observed among the varieties evaluated (Table 9). All the bush snapbean plants were resistant to leafminer infestation.

Interaction effect. There was no significant interaction observed on the reaction of bush snapbean to leafminer infestation between mulching materials and variety (Table 9).

Reaction to Pod Borer

Effect of mulch. No significant differences were noted among the different mulching materials used in the study. All plants were rated resistant to of pod borer on infestation.

Effect of variety. There were no significant differences monitored and rated on the reaction to pod borer among the six varieties of bush snapbean studied. HAB 19, HAB 323 and HAB 63 were rated as resistant to pod borer while the other varieties were rated moderately resistance (Table 9).

Interaction effect. No significant interaction of mulching materials and variety was observed in the reaction of pod borer (Table 9).

Reaction to Rust Infection

Effect of mulch. All the bush snapbean plants regardless of mulching materials were monitored and rated as moderately resistant to rust infection (Table 9).

Effect of variety. No significant differences were observed among the six varieties rated in the study. All were moderately resistant to rust infection (Table 9).

Interaction effect. There was no significant interaction effect on the reaction of bush snapbeans to rust infection between mulching material and variety (Table 9).

Table 9. Reaction to leafminer, pod borer, rot infection and rust

TREATMENT	REACTION TO:			
	LEAF MINER	POD BORER	ROT	RUST
Mulch (a)				
M_1 – Unmulched	3	3	1	2
M_2 – Pine needle	3	3	1	2
M_3 – “Taaw” grass	3	3	1	2
Variety (b)				
V_1 – BBL 274	3	2	1	2
V_2 – HAB 19	3	3	1	2
V_3 – HAB 323	3	3	1	2
V_4 – HAB 63	3	3	1	2
V_5 – Torrent	3	2	1	2
V_6 – Landmark	3	2	1	2
axb	ns	ns	ns	
CV (%)	3.95	4.69	11.62	

Remarks: 1 – High resistance, 2 – Moderate resistance, 3 – Resistance, 4- Susceptible, 5 – Very susceptible.

Reaction to Rot Infection

Effect of mulch. No significant differences were monitored and rated on the different mulching materials used. All were rated highly resistant rot infection (Table 9).

Effect of variety. There were no significant differences among the varieties evaluated. All the bush snapbean plants were monitored and rated as highly resistant in terms to rot infection (Table 9).

Interaction effect. No significant interaction of mulching materials and variety was observed in the reaction to rot infection (Table 9).

Return on Cash Expense (ROCE)

Effect of mulch. Table 10 presents the return on cash expenses (ROCE) on producing bush snapbean mulched with different materials used in the study. It was observed that unmulched plot gave the highest return on total cash expenses, 40.79 %. It was fallowed by plants mulched with "Taaw" grass and the lowest was the pine needle mulch with a total cash expense of 12.76 % ROCE. This implies that highest ROCE on plants without mulched is due to low cost of production and low cost of labor. Lowest return on cash expenses is due to high cost of production and labor.

Effect of variety. The return on cash expense of six varieties of bush snapbeans is shown in Table 11. It was observed that BBL 274 registered the highest return on cash expense of 50.61 %. It was followed by Torrent with 29.04 % ROCE. Negative ROCE was noted in producing HAB 63. This implies that highest ROCE on the variety is due to high yield and higher income could be expected. Negative ROCE is due to low yield and high cost of production.

Table 10. Return on cash expenses of bush snapbeans as affected by mulching materials per plot ($3m^2$) basis

TREATMENT	YIELD (kg/plot)	GROSS SALE	TOTAL EXPENSES	NET INCOME	ROCE (%)
Unmulched	6.20	99.12	70.40	28.72	40.79
Pine needle	6.75	115.92	102.80	13.12	12.76
"Taaw" grass	7.43	118.8	102.80	16.00	15.56

*Total expenses include cost of labor, seeds and fertilizers.
**The selling price was Php 16/kg.

Table 11. Return on cash expense of bush snapbeans as affected by mulching materials per plot ($3m^2$) basis

TREATMENT	YIELD (kg/plot)	GROSS SALE	TOTAL EXPENSES	NET INCOME	ROCE (%)
BBL 274	8.66	138.56	92.00	31.56	50.61
HAB 19	6.69	106.93	92.00	14.93	16.23
HAB 323	5.93	94.88	92.00	2.88	3.13
HAB 63	4.85	77.60	92.00	-14.4	-15.65
Torrent	7.24	118.72	92.00	26.72	29.04
Landmark	7.19	114.99	92.00	22.99	25.00

*Total expenses include cost of labor, seeds and fertilizers.
**The selling price was Php 16/kg.

Interaction effect. Table 12 presents the of six bush snapbeans varieties as affected by mulching materials. It shows that Torrent without mulching registered the highest total return on cash expense of 90 % followed by BBL 274 with 67 % ROCE. This indicates that plants without mulched was profitable during the month of December to February. Using pine needle mulch, BBL 274 registered the highest with 42 % ROCE and using "Taaw" grass, BBL 274 obtained the highest with 48 % ROCE fallowed by Torrent with 30 % ROCE, HAB 19 with 20 % ROCE and Landmark with 17 % ROCE. This indicates that plants with mulch was also profitable during the months of December to February, however it has a lower ROCE than the unmulched.

Table 12. Return on cash expenses of bush snapbeans as affected by mulching materials per plot (3 m^2) basis

TREATMENT	YIELD (kg/plot)	GROSS SALE	TOTAL EXPENSES	NET INCOME	ROCE (%)
M_1V_1	7.35	117.60	70.40	47.2	67
V_2	5.32	85.12	70.40	14.72	21
V_3	5.10	81.6	70.40	11.20	16
V_4	4.37	69.92	70.40	-0.48	-6
V_5	8.37	133.92	70.40	63.52	90
V_6	6.66	106.56	70.40	36.16	51
M_2V_1	9.14	146.24	102.80	43.44	42
V_2	7.00	112.00	102.80	9.20	9
V_3	6.36	101.76	102.80	-0.04	-3
V_4	5.02	80.32	102.80	-22.48	-21
V_5	5.57	89.12	102.80	-13.68	-13.31
V_6	7.38	118.08	102.80	15.28	15
M_3V_1	9.49	151.84	102.80	49.04	48
V_2	7.73	123.68	102.80	20.88	20
V_3	6.33	101.28	102.80	-1.52	-1
V_4	5.16	82.56	102.80	-20.24	-19
V_5	8.32	133.12	102.80	30.32	30
V_6	7.52	120.32	102.80	17.52	17

Note: Total expenses include cost of labor, seeds and fertilizers the selling price was Php 16/kg.

Legend: M_1 – Unmulched
M_2 – Pine needle mulch
M_3 – "Taaw" grass mulch

V_1 – BBL 274
V_2 – HAB 19
V_3 – HAB 323
V_4 – HAB 63
V_5 – Torrent
V_6 – Landmark

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

This study was conducted to: evaluate the response of six varieties of bush snapbeans to mulching; to identify the most responsive variety of bush snapbeans to mulching; to evaluate the effect of mulching materials in bush snapbean production; and to determine the best mulching materials for bush snapbean production.

Plants mulched with different materials were similar on the number days to first and last flowering, first and last harvesting, number of pods per cluster, number of seeds per pod, pod length and pod width, distance of pods to the ground, non-marketable yield per plot, total yield per plot and computed yield per hectare and reaction to leafminer, pod borer, rust and rot.

Highly significant differences among the kinds of mulching materials were observed on plant height at first harvest, number of pod clusters per plant, number of pods per plant and per plot and weight of marketable pods per plot. Significant differences were also observed on distance of pod clusters to the ground. The longest distance of pod and pod cluster was recorded in the unmulched plot. The highest number of pod clusters per plant was recorded in plants mulched with pine needle. Pine needle mulched resulted the widest pod. Plants mulched with “Taaw” grass had the highest number of pods per plot, the highest number and heaviest marketable pods and non-marketable pods per plot.

Among the six varieties of bush snapbeans evaluated, highly significant differences were observed on number of pod clusters per plant, number of pods per plant, pod length and pod width, distance of pod and pod clusters to the ground, number and

weight of marketable pods per plot, total yield per plot and computed yield per hectare. HAB 63 got the highest number of pod and pod clusters per plant. BBL 274 and Torrent had the longest and widest pod. Torrent had the longest distance of pod and pod clusters to the ground. BBL 274 and Torrent produced the highest number of marketable pods. These varieties also obtained the heaviest marketable pods per plot, total yield per plot and computed yield per hectare. No significant differences on the other parameters gathered were noted among the six varieties studied.

Highly significant interaction effect were observed between mulching material and variety on the distance of pod clusters to the ground and pod width. Significant interaction was also noted in the number of pod clusters per plant. Torrent significantly had the longest distance of pod clusters to the ground and gave the significantly widest pod with pine needle mulch. HAB 63 significantly had the highest number of pod clusters per plant when mulched with pine needle and "Taaw" grass. Economically, even without mulching, snapbean production is already profitable because grower could realized more than 40 % ROCE. Among the six varieties studied growing BBL 274 could result in 51 % ROCE. Planting Torrent and Landmark could also be profitable because 29 and 25 % ROCE could be obtained. Growing Torrent, BBL 274 and Landmark even without mulching could be profitable because 51 to 90 % ROCE could be obtained. When pine needle is available for mulching, BBL 274 could be planted to get 42 % ROCE, and when "Taaw" grass is used as mulching material, planting BBL 274 and Torrent could give 48 and 30 % ROCE, respectively HAB 19 and Landmark could also be grown because 20 and 17 % ROCE could also be obtained.

Conclusion

Significant differences were observed among the kinds of mulching materials used in the study in terms of plant height at first harvest number of pod clusters per plant, number of pods per plant and per plot, distance of pod clusters to the ground and weight of marketable pods per plot.

Mulching of pine needle and “Taaw” grass to bush snapbean could increased number of pod clusters per plant, number of pods per plant and per plot and weight of marketable pods per plot. They could also reduce height of plant at first harvest and distance of pod clusters to the ground.

Highly significant differences were observed among the six varieties of bush snapbeans evaluated in terms of number with pod cluster per plant, number of pod per plant, pod length and pod width, distance of pod and pod clusters to the ground number and weight of marketable yield per plot, total yield per plot and computed yield per hectare. HAB 63 produce the highest number of pods per plant and pod clusters per plant, BBL 274 and Torrent had the longest pod length and widest pod including HAB 19 and Landmark. Torrent has the longest distance of pods and pod clusters to the ground. Torrent and BBL 274 had the highest number and heaviest marketable yield, total yield per plot and computed yield per hectare.

Based on the return on cash expense unmulched plot recorded the highest ROCE among the different mulching materials used. BBL 274 registered the highest ROCE (50.61 %) among the six varieties evaluated. It was fallowed by Torrent and Landmark with 29.04 % and 25 % ROCE, respectively. BBL 274, Torrent and Landmark obtained the highest ROCE even without mulch was profitable which recorded 51 to 90 % ROCE.

BBL 274 could be mulched with pine needle to get 42 % ROCE. BBL 274 and Torrent could also be mulched with “Taaw” grass to get 48 and 30 % ROCE, respectively.

Recommendation

Mulching may not be recommended to bush snapbean growers during November to February planting season because growers could only realize 40 % ROCE. Even without mulch, Torrent, BBL 274 and Landmark could be recommended to growers to get 51 to 90 % ROCE. Whenever pine needle is available as mulching material, BBL 274 is recommended to get 42 % ROCE. “Taaw” grass could also be used as mulching material for profitable in growing of BBL 274, Torrent, HAB 19 and Landmark. The farmer could use BB 274 to get 51 % ROCE or may used Torrent and Landmark to get 51 % ROCE, respectively.

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APPENDICES

APPENDIX TABLE 1. Number of days to first flowering

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	40	40	40	40	160	40
V_2	41	41	41	41	164	41
V_3	41	41	41	41	164	41
V_4	41	41	41	41	164	41
V_5	40	40	40	40	160	40
V_6	40	40	40	40	160	40
M_2V_1	40	40	40	40	160	40
V_2	41	41	41	41	164	41
V_3	41	41	41	41	164	41
V_4	41	41	41	41	164	41
V_5	40	40	40	40	160	40
V_6	40	40	40	40	160	40
M_3V_1	40	40	40	40	160	40
V_2	41	41	41	41	164	41
V_3	41	41	41	41	164	41
V_4	41	41	41	41	164	41
V_5	40	40	40	40	160	40
V_6	40	40	40	40	160	40
BLOCK TOTAL	729	729	729	729	2,916	40.5

APPENDIX TABLE 2. Number of days to first harvest

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	59	59	59	59	236	59
V_2	59	59	59	59	236	59
V_3	59	59	59	59	236	59
V_4	59	59	59	59	236	59
V_5	59	59	59	59	236	59
V_6	59	59	59	59	236	59
M_2V_1	59	59	59	59	236	59
V_2	59	59	59	59	236	59
V_3	59	59	59	59	236	59
V_4	59	59	59	59	236	59
V_5	59	59	59	59	236	59
V_6	59	59	59	59	236	59
M_3V_1	59	59	59	59	236	59
V_2	59	59	59	59	236	59
V_3	59	59	59	59	236	59
V_4	59	59	59	59	236	59
V_5	59	59	59	59	236	59
V_6	59	59	59	59	236	59
BLOCK TOTAL	1,062	1,062	1,062	1,062	4,248	59

APPENDIX TABLE 3. Number of days to last harvest

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	70	70	70	70	280	70
V_2	70	70	70	70	280	70
V_3	70	70	70	70	280	70
V_4	70	70	70	70	280	70
V_5	70	70	70	70	280	70
V_6	70	70	70	70	280	70
M_2V_1	70	70	70	70	280	70
V_2	70	70	70	70	280	70
V_3	70	70	70	70	280	70
V_4	70	70	70	70	280	70
V_5	70	70	70	70	280	70
V_6	70	70	70	70	280	70
M_3V_1	70	70	70	70	280	70
V_2	70	70	70	70	280	70
V_3	70	70	70	70	280	70
V_4	70	70	70	70	280	70
V_5	70	70	70	70	280	70
V_6	70	70	70	70	280	70
BLOCK TOTAL	1,260	1,260	1,260	1,260		

APPENDIX TABLE 4. Plant height at 1st harvest

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	36.4	43.1	44.9	45.5	169.9	42.5
V_2	38.8	46.4	56.0	42.4	183.6	45.9
V_3	39.7	51.9	45.5	43.1	180.2	45.1
V_4	36.6	49.0	53.2	48.2	187.0	46.8
V_5	54.6	50.4	52.9	55.5	213.4	53.4
V_6	51.6	47.8	44.9	45.5	189.8	47.5
M_2V_1	39.2	45.8	47.2	38.0	170.2	42.6
V_2	41.2	45.8	47.9	36.6	171.5	42.9
V_3	42.6	50.0	40.5	35.7	168.8	42.2
V_4	35.3	47.1	40.9	41.1	164.4	41.1
V_5	59.2	55.1	41.9	37.8	194.0	48.3
V_6	45.8	49.6	42.8	34.3	172.5	43.1
M_3V_1	34.7	37.7	38.9	37.7	119.0	29.8
V_2	38.3	40.4	36.2	37.3	152.2	38.1
V_3	39.8	38.0	39.2	40.6	157.6	39.4
V_4	36.6	38.8	36.9	35.4	147.7	36.9
V_5	42.7	35.8	36.5	38.5	153.5	34.4
V_6	36.0	39.8	37.1	39.0	151.9	38.0

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	3	213.794	71.265			
Treatment	17	1,365.840	80.344			
A – Mulch	(2)	951.713	475.856	21.99^{**}	3.18	5.04
B – Variety	(5)	261.141	52.228	2.21^{ns}	2.29	3.39
A x B	(10)	152.986	15.299	0.71^{ns}	2.01	2.61
Error	51	113.442	21.636			
TOTAL	71	2,683.076				

** – highly significant

^{ns} – not significant

Coefficient of Variation = 10.88 %

APPENDIX TABLE 5. Number of pods per cluster

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
M_1V_1	3	6	6	4	13	3
V_2	3	3	4	3	13	3
V_3	4	4	3	3	14	4
V_4	3	4	4	3	14	4
V_5	3	3	4	3	13	3
V_6	3	3	3	4	13	3
M_2V_1	3	3	3	3	12	3
V_2	4	3	4	3	14	4
V_3	3	4	3	4	14	4
V_4	4	4	3	3	14	4
V_5	4	4	4	4	16	4
V_6	3	3	3	3	12	3
M_3V_1	3	3	3	3	12	3
V_2	3	3	4	4	14	4
V_3	3	3	3	3	12	3
V_4	3	4	4	3	14	4
V_5	3	3	3	3	12	3
V_6	3	3	3	3	12	3

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Replication	3	0.278	0.093			
Treatment	17	5.278	0.310			
A – Mulch	(2)	0.778	0.389	2.04^{ns}	3.18	5.04
B – Variety	(5)	1.944	0.389	2.04^{ns}	2.29	3.39
A x B	(10)	2.556	0.256	1.34^{ns}	2.01	2.61
Error	51	9.722	0.191			
TOTAL	71	15.278				

^{ns} – not significant

Coefficient of Variation = 13.21 %

APPENDIX TABLE 6. Number of pod clusters per plant

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
M_1V_1	4	6	6	6	22	6
V_2	7	6	6	6	25	6
V_3	6	6	6	6	24	6
V_4	6	8	8	8	30	8
V_5	5	6	6	6	23	6
V_6	5	8	6	6	25	6
M_2V_1	5	7	6	7	25	6
V_2	9	8	8	8	32	8
V_3	6	6	6	7	25	6
V_4	7	9	8	9	33	8
V_5	6	7	6	6	25	6
V_6	6	8	7	7	28	7
M_3V_1	6	6	5	6	23	6
V_2	7	8	7	8	30	8
V_3	8	7	8	8	31	8
V_4	9	8	9	9	35	9
V_5	6	7	7	7	27	7
V_6	6	6	6	6	24	6

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Replication	3	5.375	1.792			
Treatment	17	63.736	3.749			
A – Mulch	(2)	11.194	5.597	13.05**	3.18	5.04
B – Variety	(5)	41.569	8.314	19.38**	2.29	3.39
A x B	(10)	10.972	1.097	2.56*	2.01	2.61
Error	51	21.875	0.429			
TOTAL	71	90.986				

** – highly significant
* – significant

Coefficient of Variation = 9.68 %

APPENDIX TABLE 7. Number of pods per plant

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	17	16	15	15	63	16
V_2	20	17	17	16	70	18
V_3	20	18	17	17	72	18
V_4	19	25	18	21	83	21
V_5	15	17	17	16	65	16
V_6	14	20	16	17	67	17
M_2V_1	15	19	17	19	70	18
V_2	23	20	21	21	85	21
V_3	19	17	17	22	78	19
V_4	22	24	22	23	91	23
V_5	15	17	17	17	66	17
V_6	17	19	17	18	71	18
M_3V_1	17	15	19	17	68	18
V_2	21	20	19	19	71	20
V_3	23	17	21	20	81	20
V_4	25	19	22	22	88	22
V_5	15	17	18	18	68	17
V_6	16	17	17	17	67	17

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	3	2.153	0.718			
Treatment	17	310.625	18.272			
A – Mulch	(2)	34.083	17.042	5.40^{**}	3.18	5.04
B – Variety	(5)	253.125	50.625	16.03^{**}	2.29	3.39
A x B	(10)	23.417	2.343	0.74^{ns}	2.01	2.61
Error	51	161.097	3.159			
TOTAL	71	473.875				

** – highly significant
^{ns} – not significant

Coefficient of Variation = 9.63 %

APPENDIX TABLE 8. Number of pods per plot (3 m^2)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
M_1V_1	259	380	540	206	1,385	346
V_2	211	432	476	353	1,472	368
V_3	293	348	404	285	1,330	333
V_4	287	379	468	474	1,696	424
V_5	375	379	468	474	1,696	424
V_6	407	463	471	434	1,775	444
M_2V_1	348	399	471	630	1,848	462
V_2	357	275	468	435	1,535	384
V_3	446	449	370	408	1,673	418
V_4	432	250	385	303	1,370	343
V_5	439	307	453	421	1,620	405
V_6	322	478	411	575	1,786	447
M_3V_1	315	448	423	554	1,740	435
V_2	280	512	335	504	1,631	408
V_3	435	452	474	568	1,929	482
V_4	453	399	432	359	1,643	411
V_5	360	414	453	464	1,691	423
V_6	360	399	471	459	1,689	422

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Replication	3	77,330.500	25,776.833			
Treatment	17	138,477.944	8,145.761			
A – Mulch	(2)	38,470.887	19,235.389	3.36^{*}	3.18	5.04
B – Variety	(5)	43,059.944	10,611.989	1.51^{ns}	2.29	3.39
A x B	(10)	56,947.222	5,694.722	0.99^{ns}	2.01	2.61
Error	51	192,411.375	5,733.556			
TOTAL	71					

* – significant

^{ns} – not significant

Coefficient of Variation = 18.72 %

APPENDIX TABLE 9. Pod length (cm)

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	16.8	16.3	15.8	16.0	64.9	16.2
V_2	14.1	14.7	14.9	14.4	58.1	14.5
V_3	14.2	14.4	14.0	14.8	57.4	14.4
V_4	13.8	14.9	14.6	13.9	57.2	14.3
V_5	16.3	15.1	16.7	16.2	64.3	16.1
V_6	15.2	15.2	15.1	14.3	59.8	15.0
M_2V_1	15.8	15.5	15.5	16.8	63.6	16.0
V_2	13.2	14.9	14.9	14.5	57.5	14.4
V_3	13.7	15.4	14.8	13.7	57.6	14.4
V_4	15.3	14.4	14.1	14.8	58.6	14.7
V_5	16.6	16.3	16.4	14.8	64.1	16.0
V_6	15.1	14.9	14.8	14.4	59.2	14.8
M_3V_1	16.4	16.2	15.8	15.5	63.9	16.0
V_2	15.1	15.1	14.8	14.9	60.0	15.0
V_3	14.6	15.0	14.9	14.6	59.1	14.8
V_4	14.7	14.5	14.3	14.6	58.1	14.5
V_5	14.5	15.4	16.1	16.2	62.1	15.6
V_6	15.5	15.2	14.3	14.6	59.6	14.9

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	3	0.562	0.187			
Treatment	17	32.081	1.887			
A – Mulch	(2)	0.101	0.050	0.18^{ns}	3.18	5.04
B – Variety	(5)	29.668	5.934	19.55^{**}	2.29	3.39
A x B	(10)	2.313	0.231	0.78^{ns}	2.01	2.61
Error	51	15.426	0.302			
TOTAL	71	48.069				

** – highly significant

^{ns} – not significant

Coefficient of Variation = 3.65 %

APPENDIX TABLE 10. Pod width (mm)

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	8	7	7	8	30	8
V_2	7	7	7	7	28	7
V_3	6	6	7	7	26	7
V_4	6	6	6	6	24	6
V_5	7	7	8	7	29	7
V_6	7	7	7	7	28	7
M_2V_1	7	7	7	7	28	7
V_2	7	7	7	7	28	7
V_3	6	6	6	7	25	6
V_4	7	7	7	7	28	7
V_5	8	7	7	8	30	7
V_6	7	7	7	8	29	7
M_3V_1	7	7	7	7	28	7
V_2	7	7	7	7	28	7
V_3	6	6	6	6	24	6
V_4	6	6	7	7	26	6
V_5	7	7	8	8	30	8
V_6	7	7	7	7	28	7

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	3	1.486	0.495			
Treatment	17	18.069	0.886			
A – Mulch	(2)	0.361	0.181	1.59^{ns}	3.18	5.04
B – Variety	(5)	11.569	2.314	20.47^{**}	2.29	3.39
A x B	(10)	3.139	0.302	2.78^{**}	2.01	2.61
Error	51	5.764	0.113			
TOTAL	71	22.319				

** – highly significant
^{ns} – not significant

Coefficient of Variation = 4.87 %

APPENDIX TABLE 11. Distance of the pod to the ground (cm)

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	7.7	6.5	7.3	6.7	28.2	7.1
V_2	5.9	5.9	6.9	6.4	27.7	6.9
V_3	10.2	10.2	9.1	8.7	34.7	8.7
V_4	7.9	7.9	7.8	7.8	31.6	7.9
V_5	12.3	12.3	10.2	8.3	40.6	10.2
V_6	6.1	6.1	7.1	9.0	30.8	7.7
M_2V_1	6.8	6.8	6.2	7.0	25.7	6.4
V_2	6.0	6.0	6.3	6.8	26.3	6.6
V_3	6.6	6.6	7.5	7.3	29.8	7.6
V_4	7.9	7.9	8.3	7.5	31.7	7.9
V_5	10.1	10.1	9.9	8.4	40.3	10.1
V_6	7.4	7.4	7.3	7.9	28.6	7.2
M_3V_1	7.5	7.5	7.7	8.7	30.6	7.7
V_2	8.3	8.3	7.6	7.6	32.1	8.0
V_3	7.6	7.6	8.2	10.9	35.8	9.0
V_4	6.9	6.9	9.1	8.6	34.0	8.5
V_5	9.1	9.1	7.8	8.4	36.8	9.2
V_6	6.2	6.2	8.4	6.9	28.5	7.1

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	3	2.626	0.875			
Treatment	17	82.144	4.832			
A – Mulch	(2)	5.287	2.644	2.36^{ns}	3.18	5.04
B – Variety	(5)	65.496	13.099	11.66^{**}	2.29	3.39
A x B	(10)	11.360	1.136	1.03^{ns}	2.01	2.61
Error	51	57.320	1.124			
TOTAL	71	142.079				

** – highly significant

^{ns} – not significant

Coefficient of Variation = 13.30 %

APPENDIX TABLE 12. Distance of pod clusters to the ground (cm)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
M_1V_1	8.3	8.6	9.2	8.7	34.8	8.7
V_2	10.4	7.9	7.6	9.2	35.1	8.8
V_3	11.6	9.8	8.4	10.2	40.0	10.0
V_4	8.4	9.5	8.5	8.6	35.0	8.8
V_5	11.6	14.8	16.6	13.8	56.8	14.2
V_6	8.8	10.7	11.0	9.1	39.6	9.9
M_2V_1	8.7	6.7	9.8	7.8	33.0	8.3
V_2	7.7	7.4	7.3	7.3	29.7	7.4
V_3	8.9	9.9	8.4	7.9	35.1	8.8
V_4	8.5	8.5	9.0	8.5	34.5	8.6
V_5	12.4	16.8	17.0	14.0	60.2	15.1
V_6	7.6	8.7	9.5	8.0	33.8	8.4
M_3V_1	8.8	10.1	10.1	8.4	37.4	9.4
V_2	9.4	11.2	9.3	9.2	39.1	9.8
V_3	8.0	8.5	7.1	8.0	31.6	7.9
V_4	8.1	8.2	7.8	7.5	31.6	7.9
V_5	12.6	11.3	13.2	10.9	48.0	12.0
V_6	8.7	8.3	8.0	8.1	33.1	8.3

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Replication	3	6.450	2.150			
Treatment	17	304.776	17.928			
A – Mulch	(2)	9.382	4.691	4.23*	3.18	5.04
B – Variety	(5)	254.431	50.886	45.86**	2.29	3.39
A x B	(10)	40.963	4.096	3.69**	2.01	2.61
Error	51	56.585	1.110			
TOTAL	71	367.811				

* – significant
** – highly significant

Coefficient of Variation = 11.02 %

APPENDIX TABLE 13. Straightness of the pod

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	Sc	Sc	Sc	Sc	Sc	Sc
V_2	Sc	Sc	Sc	Sc	Sc	Sc
V_3	Sc	Sc	Sc	Sc	Sc	Sc
V_4	Sc	Sc	Sc	Sc	Sc	Sc
V_5	S	S	S	S	S	S
V_6	S	S	S	S	S	S
M_2V_1	Sc	Sc	Sc	Sc	Sc	Sc
V_2	Sc	Sc	Sc	Sc	Sc	Sc
V_3	Sc	Sc	Sc	Sc	Sc	Sc
V_4	Sc	Sc	Sc	Sc	Sc	Sc
V_5	S	S	S	S	S	S
V_6	S	S	S	S	S	S
M_3V_1	Sc	Sc	Sc	Sc	Sc	Sc
V_2	Sc	Sc	Sc	Sc	Sc	Sc
V_3	Sc	Sc	Sc	Sc	Sc	Sc
V_4	Sc	Sc	Sc	Sc	Sc	Sc
V_5	S	S	S	S	S	S
V_6	S	S	S	S	S	S

Legend:
S = Straight
Sc = Slightly Curve
C = Curve

APPENDIX TABLE 14. Number of marketable pods per plot (3 m^2)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
M_1V_1	191	245	322	180	938	235
V_2	132	228	259	174	793	198
V_3	156	195	173	172	696	174
V_4	159	162	223	193	737	184
V_5	261	253	326	294	1,134	283
V_6	243	250	230	259	982	245
M_2V_1	270	277	291	419	1,257	314
V_2	348	161	232	264	1,005	257
V_3	285	271	219	182	957	239
V_4	297	153	206	136	792	198
V_5	319	224	351	248	1,142	285
V_6	221	294	260	294	1,069	267
M_3V_1	249	311	277	393	1,130	282
V_2	200	345	188	383	1,116	279
V_3	237	218	254	309	1,018	254
V_4	317	254	231	161	963	241
V_5	206	252	330	363	1,151	288
V_6	297	226	283	228	1,034	258

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Replication	3	5,132.500	1,710.833			
Treatment	17	109,556.000	6,444.471			
A – Mulch	(2)	61,987.278	17,286.722	3.12^{ns}	3.18	5.04
B – Variety	(5)	17,105.556	12,397.456	3.67**	2.29	3.39
A x B	(10)	171,876.500	1,710.556	0.51^{ns}	2.01	2.61
Error	51	290,675.278	3,370.127			
TOTAL	71					

** – highly significant
^{ns} – not significant

Coefficient of Variation = 23.20 %

APPENDIX TABLE 15. Number of non-marketable pods per plot

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	68	135	218	124	545	136
V_2	79	204	217	179	679	170
V_3	147	153	231	113	644	161
V_4	128	186	109	158	581	145
V_5	114	126	142	180	562	141
V_6	164	213	181	175	733	183
M_2V_1	74	126	180	211	591	148
V_2	109	114	236	171	630	158
V_3	161	178	151	200	690	173
V_4	155	97	177	167	596	149
V_5	119	83	102	173	477	119
V_6	101	194	151	281	727	182
M_3V_1	66	137	147	161	511	128
V_2	80	167	147	121	515	129
V_3	198	134	210	259	801	200
V_4	136	145	211	190	682	171
V_5	154	162	123	101	540	135
V_6	63	173	148	231	615	154

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	3	39,251.708	13,083.903			
Treatment	17	32,873.403	1,933.730			
A – Mulch	(2)	134.194	67.347	0.04^{ns}	3.18	5.04
B – Variety	(5)	20,599.736	4,119.947	2.45^{ns}	2.29	3.39
A x B	(10)	12,138.972	1,213.897	0.72^{ns}	2.01	2.61
Error	51	85,814.452	0.153			
TOTAL	71	157,939.653				

^{ns} – not significant

Coefficient of Variation = 26.57 %

APPENDIX TABLE 16. Weight of marketable pods per plot (kg)

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	1.55	2.05	2.37	1.38	7.35	1.84
V_2	0.94	1.74	1.93	1.21	5.82	1.46
V_3	0.98	1.15	1.01	1.10	4.24	1.06
V_4	0.90	1.00	1.28	1.19	4.37	1.09
V_5	1.93	1.92	2.51	2.01	8.37	2.09
V_6	1.52	1.73	1.61	1.60	6.46	1.62
M_2V_1	1.85	2.25	2.00	3.04	9.14	2.29
V_2	2.31	1.38	1.48	1.85	7.02	1.76
V_3	1.69	2.07	1.44	1.16	6.36	1.59
V_4	1.48	0.97	1.68	0.89	5.02	1.26
V_5	2.41	1.75	2.53	1.88	8.57	2.14
V_6	1.48	1.98	1.70	2.22	7.38	1.85
M_3V_1	2.03	2.46	2.05	2.95	9.49	2.37
V_2	1.40	2.22	1.23	2.64	7.58	1.90
V_3	1.58	1.32	1.61	1.82	6.33	1.58
V_4	1.91	1.59	1.42	1.10	6.02	1.51
V_5	1.43	1.81	2.48	2.60	8.32	2.08
V_6	2.24	1.76	2.04	1.60	7.94	1.91

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	3	0.279	0.093			
Treatment	17	9.955	0.586			
A – Mulch	(2)	1.775	0.888	5.80^{**}	3.18	5.04
B – Variety	(5)	7.608	1.521	9.94^{**}	2.29	3.39
A x B	(10)	0.573	0.057	0.37^{ns}	2.01	2.61
Error	51	7.806	0.153			
TOTAL	71	18.040				

** – highly significant
^{ns} – not significant

Coefficient of Variation = 22.45 %

APPENDIX TABLE 17. Weight of non-marketable pods/plot (kg)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
M_1V_1	0.50	0.92	1.35	0.78	3.55	0.89
V_2	0.66	0.93	1.16	0.95	3.70	0.93
V_3	0.66	0.80	1.05	0.61	3.12	0.78
V_4	0.55	0.81	0.51	0.85	2.72	0.68
V_5	0.75	0.75	0.80	0.89	3.19	0.80
V_6	0.71	0.67	1.07	0.79	3.24	0.81
M_2V_1	0.80	0.83	0.93	1.18	3.74	0.94
V_2	0.65	0.57	1.28	0.90	3.40	0.85
V_3	0.60	0.82	0.76	1.05	3.23	0.81
V_4	0.80	0.47	0.77	0.90	2.94	0.74
V_5	1.55	0.32	0.72	0.86	3.45	0.86
V_6	0.50	1.08	0.77	1.50	3.85	0.96
M_3V_1	0.44	0.78	1.06	0.89	3.17	0.79
V_2	0.32	0.83	0.77	0.72	2.64	0.66
V_3	0.98	1.11	1.13	1.15	4.37	1.09
V_4	0.61	0.68	0.88	0.75	2.92	0.73
V_5	0.70	0.79	0.74	0.70	3.93	0.73
V_6	0.30	0.96	0.86	0.92	3.04	0.76

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Replication	3	0.759	0.253			
Treatment	17	0.808	0.027			
A – Mulch	(2)	0.052	0.026	0.49^{ns}	3.18	5.04
B – Variety	(5)	0.242	0.048	0.91^{ns}	2.29	3.39
A x B	(10)	0.509	0.051	0.75^{ns}	2.01	2.61
Error	51	2.722	0.053			
TOTAL	71	4.284				

^{ns} – not significant

Coefficient of Variation = 28.10 %

APPENDIX TABLE 18. Total yield per plot

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	2.02	2.93	3.72	2.16	10.86	2.72
V_2	1.60	2.67	3.09	2.16	9.52	2.38
V_3	1.64	1.23	2.06	1.71	6.64	1.66
V_4	1.45	1.81	1.79	2.01	7.06	1.77
V_5	2.64	2.67	3.31	2.90	11.52	2.88
V_6	2.23	2.40	2.68	2.39	9.70	2.43
M_2V_1	2.65	3.08	2.93	4.22	12.88	3.22
V_2	2.95	1.95	2.76	2.75	10.41	2.60
V_3	2.29	2.89	2.20	2.21	9.59	2.40
V_4	2.28	1.44	2.45	1.79	7.96	1.99
V_5	3.96	2.07	3.25	2.74	12.02	3.01
V_6	1.98	3.06	2.47	3.72	11.23	2.81
M_3V_1	2.47	3.24	3.11	3.84	12.66	3.17
V_2	1.72	3.05	2.09	3.36	10.19	2.55
V_3	2.56	2.43	2.74	2.97	10.70	2.68
V_4	2.52	2.27	2.30	1.85	8.94	2.24
V_5	2.13	2.60	3.22	3.30	11.25	2.81
V_6	2.54	2.72	2.90	2.52	10.68	2.67

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	3	2.058	0.690			
Treatment	17	12.908	0.759			
A – Mulch	(2)	2.238	1.119	3.11^{ns}	3.18	5.04
B – Variety	(5)	9.164	1.833	7.39^{**}	2.29	3.39
A x B	(10)	1.506	0.151	0.61^{ns}	2.01	2.61
Error	51	12.647	0.248			
TOTAL	71	27.624				

** – highly significant

^{ns} – not significant

Coefficient of Variation = 19.50%

APPENDIX TABLE 19. Computed yield (t/ha)

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	6.77	9.67	12.28	7.13	35.85	8.96
V_2	5.28	8.81	10.20	7.13	31.42	7.86
V_3	5.41	4.06	6.80	5.64	21.91	5.48
V_4	4.78	5.97	5.91	6.33	11.99	5.75
V_5	8.71	8.81	10.92	9.57	38.01	9.50
V_6	7.36	7.92	8.84	7.89	38.01	8.00
M_2V_1	8.75	10.16	9.67	13.93	42.51	10.63
V_2	9.74	6.44	9.11	9.08	34.37	8.59
V_3	7.56	9.54	7.26	7.29	31.65	7.91
V_4	7.52	4.75	8.09	5.91	26.27	6.57
V_5	13.07	6.83	10.73	9.04	39.67	9.92
V_6	6.53	10.1	8.15	12.28	37.06	9.27
M_3V_1	8.15	10.69	10.26	12.67	41.77	10.44
V_2	5.68	10.07	6.90	11.09	33.74	8.44
V_3	8.45	8.02	9.04	9.80	35.31	8.83
V_4	8.32	7.49	7.59	6.11	29.51	7.37
V_5	7.03	8.58	10.63	10.89	37.13	9.28
V_6	8.38	8.98	9.57	8.32	35.25	8.81

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	3	22.258	7.419			
Treatment	17	142.201	8.365			
A – Mulch	(2)	24.912	12.456	3.08^{ns}	3.18	5.04
B – Variety	(5)	100.928	20.186	7.48^{**}	2.29	3.39
A x B	(10)	16.361	1.636	0.61^{ns}	2.01	2.61
Error	51	137.675	2.700			
TOTAL	71	302.134				

** – highly significant
^{ns} – not significant

Coefficient of Variation = 19.51 %

APPENDIX TABLE 20. Number of seed per pod

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
M_1V_1	5	5	5	5	20	5
V_2	5	5	5	6	21	5
V_3	6	6	6	6	24	6
V_4	6	6	6	6	24	6
V_5	5	6	6	6	23	6
V_6	6	5	6	6	23	6
M_2V_1	6	6	6	6	24	6
V_2	6	5	5	6	22	6
V_3	7	6	6	6	25	6
V_4	6	6	6	6	24	6
V_5	6	5	5	6	22	6
V_6	6	6	6	6	24	6
M_3V_1	6	6	6	6	24	6
V_2	6	6	6	6	24	6
V_3	6	6	6	6	24	6
V_4	5	6	6	6	23	6
V_5	6	6	6	6	24	6
V_6	6	6	6	6	24	6

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Replication	3	0.486	0.162			
Treatment	17	6.903	0.406			
A – Mulch	(2)	1.444	0.722	3.01^{ns}	3.18	5.04
B – Variety	(5)	2.069	0.414	2.21^{ns}	2.29	3.39
A x B	(10)	3.389	0.339	0.43^{ns}	2.01	2.61
Error	51	5.264	0.103			
TOTAL	71	12.653				

^{ns} – not significant Coefficient of Variation = 5.52 %

APPENDIX TABLE 21. Number of days to last flowering

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	57	57	57	57	228	57
V_2	57	57	57	57	228	57
V_3	57	57	57	57	228	57
V_4	57	57	57	57	228	57
V_5	57	57	57	57	228	57
V_6	57	57	57	57	228	57
M_2V_1	57	57	57	57	228	57
V_2	57	57	57	57	228	57
V_3	57	57	57	57	228	57
V_4	57	57	57	57	228	57
V_5	57	57	57	57	228	57
V_6	57	57	57	57	228	57
M_3V_1	57	57	57	57	228	57
V_2	57	57	57	57	228	57
V_3	57	57	57	57	228	57
V_4	57	57	57	57	228	57
V_5	57	57	57	57	228	57
V_6	57	57	57	57	228	57
BLOCK TOTAL	1,026	1,026	1,026	1,026	4,104	1,026

APPENDIX TABLE 22. Reaction to leafminer

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	3	3	3	3	12	3
V_2	3	3	3	3	12	3
V_3	3	3	3	3	12	3
V_4	3	3	3	3	12	3
V_5	3	3	3	3	12	3
V_6	3	3	3	3	12	3
M_2V_1	3	3	3	3	12	3
V_2	3	3	3	3	12	3
V_3	3	3	3	3	12	3
V_4	3	3	3	3	12	3
V_5	3	3	3	3	12	3
V_6	3	3	3	3	12	3
M_3V_1	3	3	3	3	12	3
V_2	3	3	3	3	12	3
V_3	3	3	3	3	12	3
V_4	3	3	3	3	12	3
V_5	3	3	3	3	12	3
V_6	3	3	3	3	12	3

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F	
					0.05	0.01
Replication	3	0.000	0.000			
Treatment	17	0.042	0.014			
A – Mulch	(2)	0.028	0.014	1.0^{ns}	3.18	5.04
B – Variety	(5)	0.000	0.000			
A x B	(10)	0.000	0.000			
Error	51	0.000	0.000			
TOTAL	71	0.042				

^{ns} – not significant   Coefficient of Variation = 3.95 %

APPENDIX TABLE 23. Reaction to pod borer

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
M_1V_1	2	2	2	2	8	2
V_2	3	3	3	3	12	3
V_3	3	3	3	3	12	3
V_4	3	3	3	3	12	3
V_5	2	2	2	2	8	2
V_6	2	2	2	2	8	2
M_2V_1	2	2	2	2	8	2
V_2	3	3	3	3	12	3
V_3	3	3	3	3	12	3
V_4	3	3	3	3	12	3
V_5	2	2	2	2	8	2
V_6	2	2	2	2	8	2
M_3V_1	2	2	2	2	8	2
V_2	3	3	3	3	12	3
V_3	3	3	3	3	12	3
V_4	3	3	3	3	12	3
V_5	2	2	2	2	8	2
V_6	2	2	2	2	8	2

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	TABULATED F 0.01
Replication	3	0.000	0.000			
Treatment	17	17.236	1.014			
A – Mulch	(2)	0.028	0.014	1.0^{ns}	3.18	5.04
B – Variety	(5)	0.000	0.000			
A x B	(10)	0.000	0.000			
Error	51	0.000	0.000			
TOTAL	71	17.236				

^{ns} – not significant   Coefficient of Variation = 4.69 %

APPENDIX TABLE 24. Reaction to rust

TREATMENT	BLOCK				TOTAL	MEAN
	I	II	III	IV		
M_1V_1	2	2	2	2	8	2
V_2	2	2	2	2	8	2
V_3	2	2	2	2	8	2
V_4	2	2	2	2	8	2
V_5	2	2	2	2	8	2
V_6	2	2	2	2	8	2
M_2V_1	2	2	2	2	8	2
V_2	2	2	2	2	8	2
V_3	2	2	2	2	8	2
V_4	2	2	2	2	8	2
V_5	2	2	2	2	8	2
V_6	2	2	2	2	8	2
M_3V_1	2	2	2	2	8	2
V_2	2	2	2	2	8	2
V_3	2	2	2	2	8	2
V_4	2	2	2	2	8	2
V_5	2	2	2	2	8	2
V_6	2	2	2	2	8	2
BLOCK TOTAL	36	36	36	36		

APPENDIX TABLE 25. Reaction to rot infection

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
M_1V_1	1	1	1	1	4	1
V_2	1	1	1	1	4	1
V_3	1	1	1	1	4	1
V_4	1	1	1	1	4	1
V_5	1	1	1	1	4	1
V_6	1	1	1	1	4	1
M_2V_1	1	1	1	1	4	1
V_2	1	1	1	1	4	1
V_3	1	1	1	1	4	1
V_4	1	1	1	1	4	1
V_5	1	1	1	1	4	1
V_6	1	1	1	1	4	1
M_3V_1	1	1	1	1	4	1
V_2	1	1	1	1	4	1
V_3	1	1	1	1	4	1
V_4	1	1	1	1	4	1
V_5	1	1	1	1	4	1
V_6	1	1	1	1	4	1

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULATED F 0.05	0.01
Replication	3	0.000	0.000			
Treatment	17	0.231	0.014			
A – Mulch	(2)	0.028	0.014	1.0^{ns}	3.18	5.04
B – Variety	(5)	0.000	0.000			
A x B	(10)	0.000	0.000			
Error	51	0.000	0.000			
TOTAL	71	0.231				

^{ns} – not significant

Coefficient of Variation = 11.62 %