BIBLIOGRAPHY

DIZON KATHLEEN C. APRIL 2010. EFFECT OF PRIMING ON THE GERMINATION OF SNAP BEAN USING DIFFERENT PLANT EXTRACTS. Benguet State University, La Trinidad Benguet.

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ABSTRACT

The study was conducted in a plastic house at the Benguet State University, La Trinidad Benguet with the following objectives; 1) to determine the best variety of snap bean for seed priming; 2) determine the growth performance of snap bean seeds applied with different plant extracts, and 3) determine the best combination of plant extract and variety of snap bean seeds on priming.

Bush Blue Lake responded better to priming since it had higher germination percentage, longer seedling roots, more vigorous seedlings, high germination percentage as well as greater and heavier root nodules.

Coconut water is a good material for priming snap bean seeds as it enhanced seed, emergence, germination percentage and development of vigorous seedlings. On the other hand, papaya extract increased vigor index and increased dry matter production of growing seedlings. Wild sunflower and golden bush extracts depressed seed germination and seedling growth.

Bush Blue Lake, Alno, and Contender responded positively to papaya, malunggay and angel trumpet extracts in terms of dry matter production, length of roots, number of

root nodules, seedling vigor and percent germination of snap bean. The combination of Bush Blue Lake and pure water or coconut water is best for priming snap bean seeds.

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INTRODUCTION

Snap bean is a priority crop under the national vegetable R&D Program of PCARRD-DOST. The major producers of fresh beans are the Cordillera Administrative Region (47%) and Cagayan Valley (28%). Last 2006, snap bean production was at 13,493 tons (BAS, 2006).

One of the problems of snap bean production is that seeds are easily damaged during transportation, storage, conditioning of seed, handling, and planting. Damage incurred results in low germination percentage and seedling with low. Moreover plant stand and ultimate yield are also affected (Gordon J., 2002).

Seed priming could help in increasing the speed of germination and emergence leading to better crop stand and high yield.

Seed priming involves simply soaking the seed over night, surface drying then sowing it the same day. Priming is an extremely widely used method were seeds maybe soaked in different plant extracts. Using different plant extracts instead of water may have the potential benefits in terms of faster emergence higher germination rate, and better root system.

No cases were reported where priming was worse than not priming. This is significant because, since priming has essentially zero cost, the practice can be considered as reliable "insurance' for farmers (Harris, 2005).

The objectives of the study were:

1. to determine the best variety of snap bean for seed priming;
2. determine the growth performance of snap bean applied with different plant extracts; and

3. determine the best combination of plant extract and varieties of snap bean for seed priming.

The study was conducted in a green house at Benguet State University, La Trinidad, Benguet from June to August, 2009.

REVIEW OF LITERATURE

Origin and History

The best new world species is the common bean or kidney bean, *Phaseolus vulgaris*. It is also known as the navy, snap or French bean. Snap bean which are consumed in immature pods; green shell beans, which are eaten as full size, immature beans that are removed from the pods; and dry shell or kidney beans, which are used in the mature, dry form. Dry bean type includes pinot, navy, Great Northern, red kidney, and pink beans (Bean. 2004).

Seed priming in agriculture is a form of seed planting preparation in which the seeds are pre soaked before planting. Priming is an extremely wide-method. In general, most kinds of the seed experimented so far have shown an over all advantage over seeds that are not primed. Many show faster emergence (time it takes for seeds to rise above the surface of soil), a higher emergence rate (number of seeds that make it to the surface), and better growth, suggesting that the head start helps them get a good root system down early and grow faster. This method can be used by farmers because it saves them the money and time spent for fertilizers, re-seeding, and week plants (Wikipedia Inc., 2008).

Seed Priming

An increasing number of investigators are becoming interested in seed biology with the objective of understanding and controlling the many aspects of seed germination and seedling establishment. The reported opportunity to increase germination rates as well as to improve seedling stands and yields has inspired investigation into the physiological principles controlling these reactions. In addition to the natural regimen

established by nature in native plant seeds, there have been other innovative procedures developed to augment nature's best efforts, such as wetting, drying, chilling, thermal shock, irradiation, aeration, hormone treatments, and others (Bradford, 1995).

Seed priming is a process for treating plant seeds that enables them to undergo faster and more uniform germination on sowing or planting with the option during processing or after sowing and allowing their prolonged storage, in packets displayed at point of sale. The seeds usually germinate more quickly and uniformly than unprimed seeds, where the geographical situation of the point of priming allows. The seeds can be sown directly after priming without drying where upon they germinate even faster than those which have been primed and dried (Lankford B.L., 1999).

For practical purposes, overnight soaking has been shown in rice and corn to be effective, although a superior response is often obtained from soaking rice and maize for 18 hours (Harris 1996). Farmers can prime their own seed if they know the safe limits. These safe limits are calculated for each variety so that germination will not continue once seeds are removed after sowing. Primed seeds will only germinate if it takes up additional moisture form the soil after sowing. It is important to note this distinction between priming and pre-germination-sowing, pre-germinated seed under dry land conditions can be disastrous. In most cases, seed can be primed overnight and is simply surface-dried and sown the same day. Apart from swelling slightly and weighing more, primed seed can be treated in the same way as non-primed seed (Harris, 2005).

Effect of Plant Extracts on Seed Germination
and Seedling Vigor

Moreland *et. al.* (1965) stated that natural inhibitory substance occurs in many plant species. Many of this substances are leached from the leaves or exuded from the roots of the plant extract of many of these plants and were found to contain germination and growing inhibitors.

Lirio (2000) pointed out that it took longer time for the plant extracts-soaked seed to germinate. The slowest being those soaked in MEPb 5000 ppm where only 82.86% germinated. It did not differ significantly with those soaked in hydroxychavicol 1000 from (84.76%) and the chemical standard Aliette 4800ppm (85.718).

Benonga (2000) stressed that more vigorous seedlings were produced using water alone. However, seeds subjected to trumpet plant and sunflower extracts also produced relatively high vigor index although the two plant species obviously have negative influence. Castor bean extracts have a great depressive effect on seedling vigor.

She also revealed that plants of extract hastened seed germination about 5.4 days. The plant extracts appear to have allopathic effect that enhanced longer period of dormancy of weed species, or delayed weed seed germination. This is long enough to prevent adverse weed competition effect on the growth of weeds seedling. In allelopathic study causes long enough to prevent adverse weed competition effect on the growth of wee seedling. It is useful exploited for weed or pest control.

On seedling vigor, Benonga (2000) reported that extract used in her study had a comparable effect on seedling vigor of lettuce and carrots. Seeds soaked in water were much more vigorous compared to the seeds soaked in guava and eucalyptus with moderate vigor.

Further more, plan extracts used in the study had comparable effects on the length of the stem of different weed species. Seed soaked with water produced the longest stem compared to sunflower and trumpet plant while castor bean obtained the shortest stem. It indicates that castor bean extract can prevent the growth of weeds.

Rivera (2001) stated that the seed soaking in water has the higher percent survival than the seed soaked in castor bean. It provides a hint that the castor bean and coconut water or any of the extract used is not really effective in enhancing crop seed germination.

He emphasized in terms of number of days to germination, results showed no significant differences among the treatment, although seeds soaked in mint were the first germinated followed by water and sunflower and castor bean. Together with coconut water, extracts appear ineffective in enhancing seed germination. It shows the different crop seeds have different characteristic some appear to germinate early when soaked in three hours but some crop seed may need more than three hours soaking, to positively adapt to possible effects of the different plant extracts (Rivera, 20001).

Further more, plant extracts did not markedly affect seedling growth but they affected the length of hypocotyls; and epicotyls. Mint extract produced longest hypocotyls and epicotyls which were significantly higher than castor bean and sunflower. Castor bean and sunflower extracts have a depressive effect on seed germination and seedling growth of the crops tested (Rivera, 2001).

A plant growth enhancer from waste coconut water was developed by researchers led by Dr. J.C. Mamaril. The technology developed by Dr. Mamaril's team is the coconut water by filtering and extracting the plant growth hormones. The end-product is a natural,

safe and environment-friendly plant growth enhancer. UPLB-biotech pointed out that the application of the growth enhancer, named commercially as Cocogro, can increase the vitality and germination of seeds, induce root formation, and enable more efficient nutrient uptake, which subsequently result in vigorous, rapid plant growth and increase yield. It also promotes flowering and increase drought resistance owing to increase water retention of the roots. It has been reported that Cocogro is either sprayed on plants or used as soaking medium. The amount and method of applying Cocogro depends on the type of plants grown. Cocogro can also be used in ornamental, cereal crops, fruit trees and other flowering plants. It has been explained that the product is not a fertilizer substitute but an alternative to imported and synthetic plant growth hormones (Fernandez, 2004).

MATERIALS AND METHODS

Preparation of Plant Extracts

Fresh leaves of Sunflower (*Helianthus sp*.), Malunggay (*Moringa oliefera*), Papaya leaves (*Carica papaya*), Golden bush leaves (*Colintus coggygria*) and Trumpet plant (*Datura candida*) were collected and washed with tap water before chopping, macerating and squeezing them to extract the sap. This was screened using fine cotton cloth to collect the extract.

Seed Priming Treatment

Seed of the three varieties of snap bean were soaked for 8 hours in pure water, coconut water, and extracts of malunggay leaves, sunflower leaves, papaya leaves, golden bush leaves and trumpet plant leaves. The experiment was replicated thrice. The treatments were placed in a polyethylene pot measuring 30x30x20. The study was laid out in 3x7 factorial design following randomized complete block design (RCBD). There were four pots per treatments and nine seeds were sown in each pot. After two weeks, thinning was done leaving only 4 seedlings per pot. All necessary cultural management practice such as irrigation and weeding (hand pulling) were done.

The treatments used were:

Factor A

Varieties		Source
V_1	Bush Blue Lake	BPI
V_2	Alno	BPI
V_3	Contender	Pontiac Farm Supply

Factor B

Plant Extracts

E1 – Pure water (control)

E2 – Papaya leaves (*Carica papaya*)

E3 – Wild sunflower leaves (*Helianthus sp.*)

E4 – Malunggay leaves (*Moringa oliefera)*

E5 – Coconut water (Cocos *mucufera*)

E6 – Golden bush leaves (Cotinus coggygria)

E7 – Angel Trumpet plant (*Datura candida*)

All plant extracts were diluted into 90%purity (9 extracts: 1 water).

Data Gathered

1. Days from sowing to emergence. This was recorded by counting the number of days from sowing to emergence.

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

$$\text{Percent survival} = \frac{\text{Total number of seed emergence}}{\text{Total number of sown seed}} \times 100$$

3. No. of normal and abnormal seedlings. This was recorded by counting the number of seedlings through visual observation.

4. No. of dead and fresh ungerminated seeds. This was recorded by counting the number of dead and fresh ungerminated seeds.

5. Vigor index. This was determined using the formula:

$$\text{Vigor index} = \frac{\text{Number of seed germinated, } 1^{st} \text{ count+…Last count}}{\text{Days of germination, } 1^{st} \text{ count+…..Last count}} \times 100$$

6. Plant vigor. The plants were rated using the following scale:

Scale	Remarks
1	Very poor growth
2	Poor growth
3	Moderate vigorous
4	Vigorous
5	Very vigorous

7. Plant height 30 DAP. The height of the plants was measured from the base to the youngest shoot tip 30 days after planting.

8. Dry matter production. This was obtained by weighing five sample plants per treatment. This was oven- dried for 48 hours at 60 C^o.

9. Length and number of roots. This was recorded by measuring the root length (cm) from base to the tip and counting the number of roots. This was done weekly.

10. Number of root nodules. This was recorded by counting the number of nodules produced per plant. This was done weekly.

11. Fresh and Dry weight of root nodules. This was obtained by weighing the fresh root nodules and after oven-drying them for 48 hrs at 60 C^o

12. Seedling growth. This was obtained by measuring five sample plants per treatment from the base to the tip of the plant. This was recorded daily.

RESULTS AND DISCUSSION

Number of Days from Sowing
to Emergence

Effect of variety. Bush Blue Lake was the earliest to emerge while Alno and Contender took one day more to emerge. It was said that successful seedlings must germinate and emerge quickly and uniformly so that water and soil nutrients may be used with maximum efficiency (Harris, 1996).

Effect of plant extract. Seeds primed with papaya, wild sunflower and malunggay extracts appeared to delay germination by one day. The three extracts may contain compounds that may have inhibited or delayed seed emergence.

Table 1. Number of days from sowing to emergence of snap beans as affected by variety and plant extract

TREATMENT	NUMBER OF DAYS
Varieties (A)	
Bush Blue Lake	4
Alno	5
Contender	5
Plant extracts (B)	
Pure water	4
Papaya	5
Wild sunflower	5
Malunggay	5
Coconut water	4
Golden bush	4
Angel trumpet plant	4

Percent Germination

Effect of variety. Bush Blue Lake appeared to have the highest percent germination (78.22%) followed by Alno (68.84%). Contender had a very low germination percentage (46.65%) which could be attributed to the damage during handling and planting that could lower germination percentage and increase number of seedlings with low vigor (Gordon, 2002).

Effect of plant extract. Seeds soaked in pure water and coconut water had the highest germination of about 79% (Table 2). It is said that coconut water contains growth hormones, thus application of coconut water can increase the vitality and germination of seeds (Fernandez, 2004). The other plant extracts used appear to suppress germination.

Interaction effect. Statistical analysis revealed highly significant differences on percent germination as affected by variety and plant extract interaction. Bush Blue Lake treated with coconut water, Alno treated with malunggay and Contender treated with pure water had much higher germination percentage compared to other combinations such as Contender treated with wild sunflower, golden bush and papaya as well as Alno treated with wild sunflower.

Contender soaked in golden bush and wild sunflower had the lowest germination percentage, indicating that the two extracts probably have inhibitory effects on seed germination. Both could be used instead as possible organic weedicide.

Table 2. Percent germination of snap beans as affected by variety and plant extract

TREATMENT	PERCENT GERMINATION
Varieties (A)	
Bush Blue Lake	78.22[a]
Alno	68.84[b]
Contender	43.65[c]
Plant extracts (B)	
Pure water	79.10[a]
Papaya	63.32[b]
Wild sunflower	38.27[d]
Malunggay	69.23[b]
Coconut water	79.06[a]
Golden bush	50.30[c]
Angel trumpet plant	64.81[b]
A x B	**
CV (%)	14.04

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

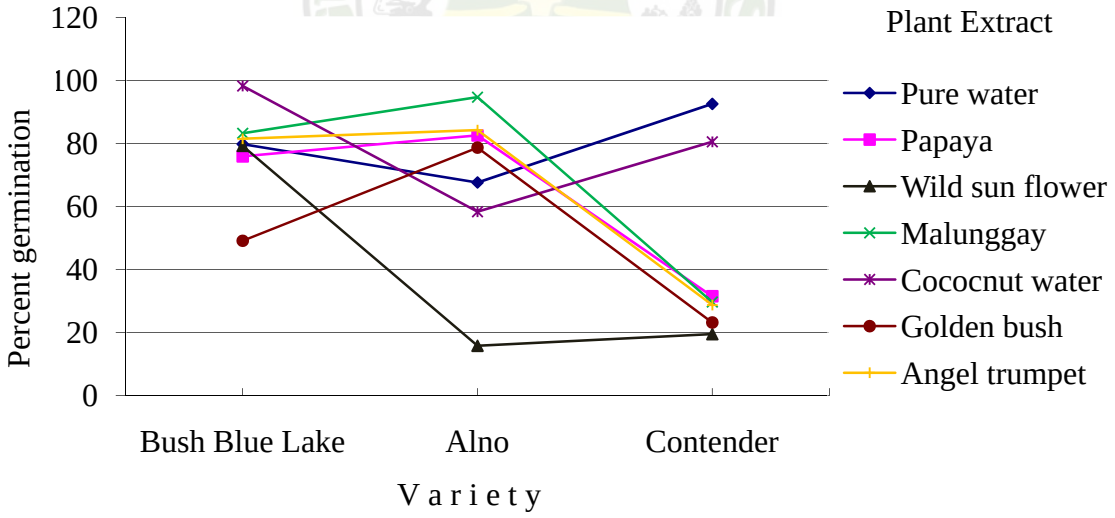

Figure1. Interaction effect of variety and plant extract on the percent germination of snap bean

Number of Normal and
Abnormal Seedlings

Effect of variety. Highly significant differences were observed on the number of normal and abnormal seedlings of the different snap bean varieties (Table 3). Bush Blue Lake had the highest number of normal seedlings while Contender had the least number of normal seedlings. In terms of abnormal seedlings, Alno produced the highest number while Bush Blue Lake produced the least number.

Effect of plant extract. Highly significant differences on number of normal and abnormal seedlings treated with different plant extracts were observed. More normal seedlings was noted in plants treated with malunggay extract and coconut water. In terms of abnormal seedlings, plants treated with coconut water and pure water had the highest number of 8 and 6, respectively. Plants treated with wild sunflower had the least.

This result implies that wild sunflower extract may not have a pronounced effect on the germination and growth of bean seeds in general. This coincides with the findings of Bogatek (2005) that sunflower allelochemicals inhibited seed germination and its influence on seed viability was less pronounced.

Interaction effect. Bush Blue Lake treated with coconut water had higher number of normal seedlings followed by Alno treated with malunggay extract, Bush Blue Lake treated with malunggay, angel trumpet, pure water and wild sunflower extract. Alno treated with coconut water produced the least number of normal seedlings (Fig. 2a).

Alno soaked in coconut water had the highest number of abnormal seedlings while Bush Blue Lake soaked in coconut water had the least number of abnormal seedlings together with Alno soaked in golden bush extract (Fig.2b).

Table 3. Number of normal and abnormal seedlings of snap bean as affected by variety and plant extract

TREATMENT	NUMBER	
	NORMAL	ABNORMAL
Varieties (A)		
Bush Blue Lake	26[a]	3[c]
Alno	18[b]	6[a]
Contender	11[c]	5[b]
Plant extracts (B)		
Pure water	23[a]	6[c]
Papaya	18[b]	4[b]
Wild sunflower	12[c]	2[a]
Malunggay	21[ab]	4[b]
Coconut water	21[ab]	8[c]
Golden bush	14[c]	4[b]
Angel trumpet plant	19[ab]	5[b]
AXB	**	**
CV	15	20

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

Normal seedlings have normal growth of shoots and minor defects in the structure that are ignored if the seedling growth is vigorous. Abnormal seedlings do not have the capacity to evolve into normal plants; it includes defective seedlings and stunted shoots. Its essential structure is so much decayed that it will not develop into normal plants (Singh, 2008).

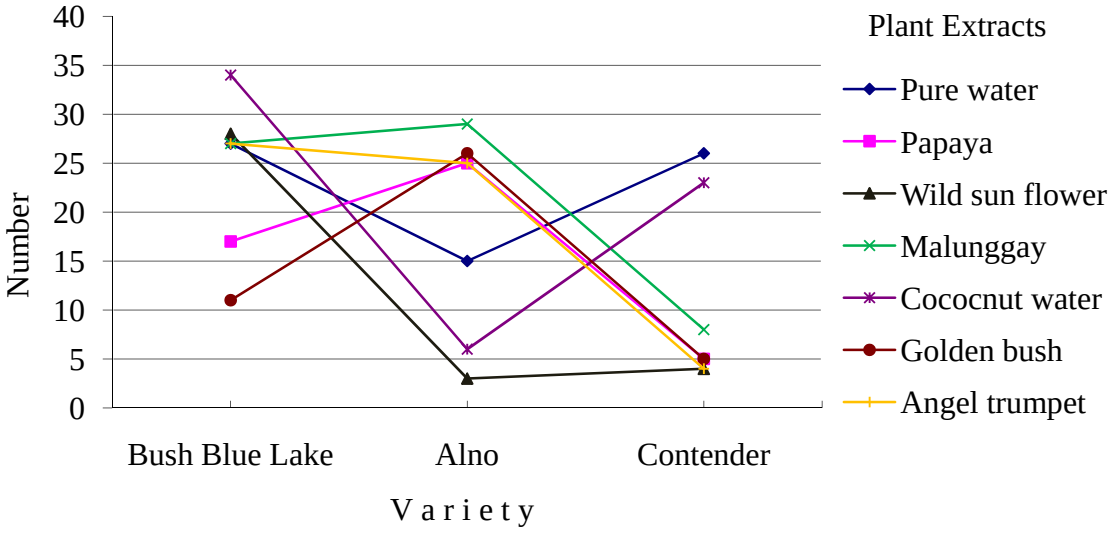

Figure 2a. Interaction effect of variety and plant extract on the number of normal seedlings of snap bean

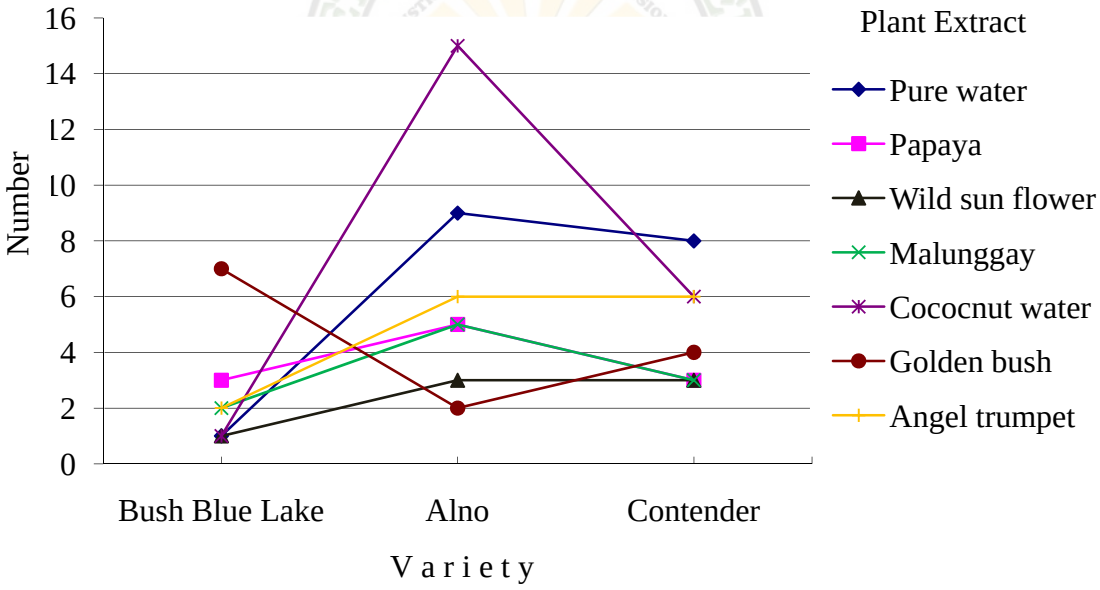

Figure 2b. Interaction effect of variety and plant extract on the number of abnormal seedlings of snap bean

Number of Dead and Fresh
Ungerminated Seed

Effect of variety. High number of dead and fresh ungerminated seeds were noted on Contender while Bush Blue Lake had the least number of dead and fresh ungerminted seeds. Fresh ungerminated seeds were viable seeds, but do not germinate and remain fresh under the growing media (sand). On the other hand, dead seeds were inviable seeds (Singh, 2008).

Effect of plant extracts. Highly significant differences were noted on the number of dead and fresh ungerminated seeds of plants treated with plant extracts (Table 4). The low germination percentage of seeds soaked in wild sunflower noted earlier is due to the high number of dead and fresh ungerminated seeds. Wild sunflower extract may delay or even be detrimental to germination of bean seeds. Seeds treated with wild sunflower produced the highest number of fresh ungerminated seeds while seeds treated with coconut water produced one of the least. Golden bush extract appear to contain some chemicals that delay germination but does not destroy the seeds. Coconut water on the other hand, does not possess seed germination-delaying chemical compound (Fernandez, 2004).

Interaction effect. A highly significant interaction effect between variety and plant extracts was obtained on the number of dead and fresh ungerminated seeds (Table 4).

Alno treated with wild sunflower had more number of dead seeds followed by Contender treated with golden bush, malunggay, angel trumpet extracts (Fig.3).The least affected was Bush Blue Lake treated with coconut water, Contender with pure water, Alno with malunggay and Bush Blue Lake with angel trumpet extract since all had the least number of dead seeds.

Figure 3b. shows the interaction effect of variety and plant extracts on the number of fresh ungerminated seeds. Alno treated with malunggay extract, and Bush Blue Lake treated with coconut water produced the least number of fresh ungerminated seeds while high number of fresh ungerminated seed was found in Alno soaked in wild sunflower extract, Contender soaked in golden bush extract and Contender soaked in angel trumpet or malunggay extract

Table 4. Number of dead and fresh ungerminated seeds of snap bean as affected by variety and plant extract

TREATMENT	DEAD SEED	FRESH UNGERMINATED SEED
Varieties (A)		
Bush Blue Lake	3^{b}	5^{c}
Alno	4^{b}	7^{b}
Contender	8^{a}	12^{a}
Plant extracts (B)		
Pure water	3^{cb}	4^{d}
Papaya	5^{b}	8^{b}
Wild sunflower	11^{a}	11^{a}
Malunggay	4^{cb}	7^{cb}
Coconut water	3^{b}	5^{cd}
Golden bush	5^{b}	12^{a}
Angel trumpet plant	4^{cb}	8^{b}
A x B	**	**
CV (%)	25.40	19.70

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

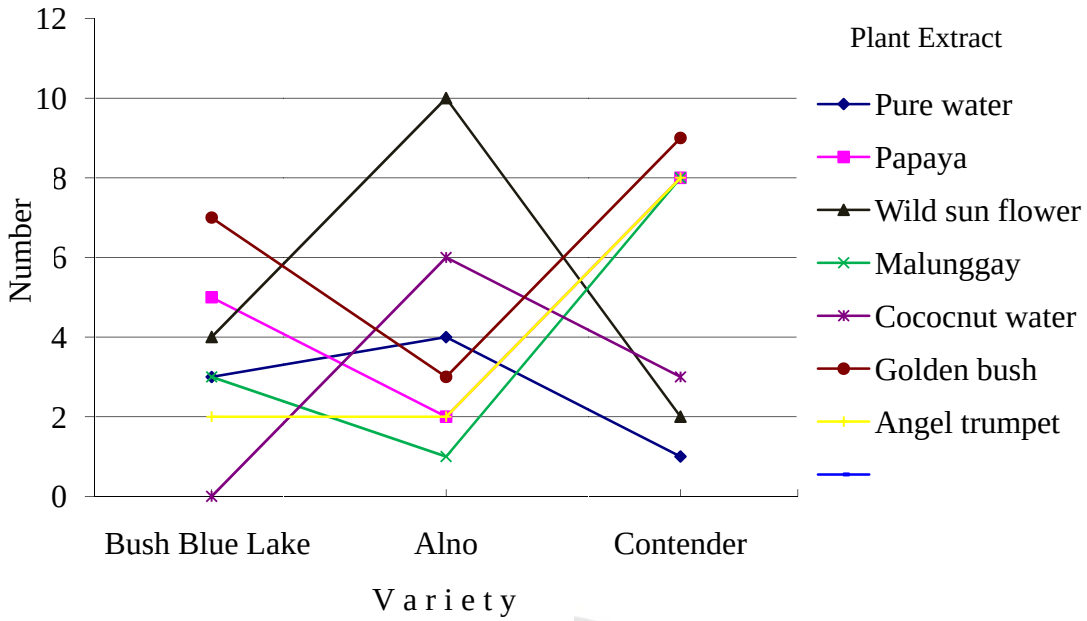

Figure 3a. Interaction effect of variety and plant extract on the number of dead seeds of snap bean

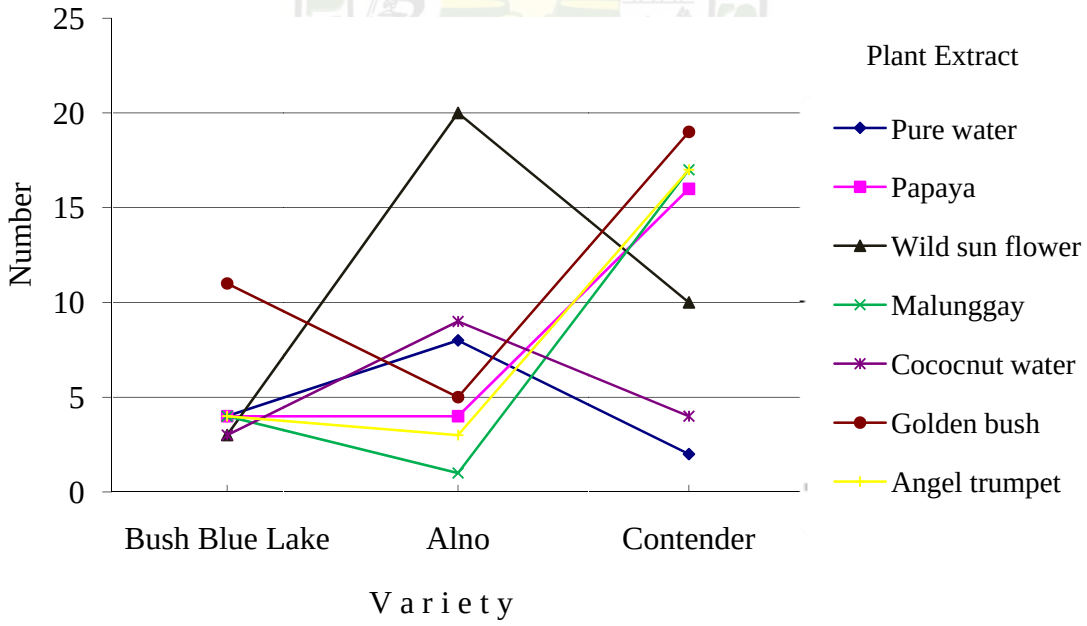

Figure 3b. Interaction effect of variety and plant extract on the number of fresh ungerminated seeds of snap bean

Vigor Index and Seedling Vigor

Effect of variety. Vigor index and seedling vigor were significantly different among the varieties used (Table 5). Bush Blue Lake had markedly higher vigor index at 70.57. In terms of seedling vigor, both Bush Blue Lake and Alno were vigorous. Low seedling vigor was due to the deterioration of seeds, improper planting and handling of seedlings (Gordon, 2002). It seemed that the quality of seeds of Alno was not that desirable.

Effect of plant extract. Among the plant extracts, plants treated with papaya and coconut water had the highest vigor index but they did not outperform the plants treated with pure water (control). This result may indicate the inhibitory effect of many of the extracts used on the seed germination and seedling vigor.

Table 5. Vigor index and seedling vigor of snap bean as affected by variety and plant extract

TREATMENT	VIGOR INDEX (%)	SEEDLING VIGOR
Varieties (A)		
Bush Blue Lake	70.57[a]	4.24[a]
Alno	60.27[b]	4.00[a]
Contender	39.48[c]	2.71[b]
Plant extracts (B)		
Pure water	71.57[a]	4.44[a]
Papaya	66.40[a]	3.56[b]
Wild sunflower	34.50[c]	2.44[d]
Malunggay	57.74[b]	3.89[b]
Coconut water	64.42[a]	4.44[a]
Golden bush	44.96[b]	3.11[c]
Angel trumpet plant	57.81[ab]	3.67[b]
A x B	**	**
CV (%)	11.12	11.93

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

Interaction effect. Significant differences were observed on the interaction effect of variety and plant extracts on the vigor index of snap bean (Fig.4a). Contender soaked in pure water produced high vigor index together with Bush Blue Lake soaked in coconut water and Alno soaked in papaya and malunggay extracts. Alno soaked in wild sun flower extract, Contender soaked in angel trumpet, wild sunflower or golden bush extracts that produced low vigor index.

Figure 4b presents the interaction effect of variety and plant extracts on the seedling vigor of snap bean. Contender soaked in pure water, Alno soaked in malunggay extract and Bush Blue Lake with coconut water registered more vigorous seedlings followed by Bush Blue Lake soaked in angel trumpet extract and Contender soaked in coconut water.

The result of the interaction of variety and plant extract agreed with the findings of Mamaril *et al*. as cited by Fernandez (2004) that coconut water induces root formation and enables more efficient nutrient uptake which subsequently result in vigorous seedlings.

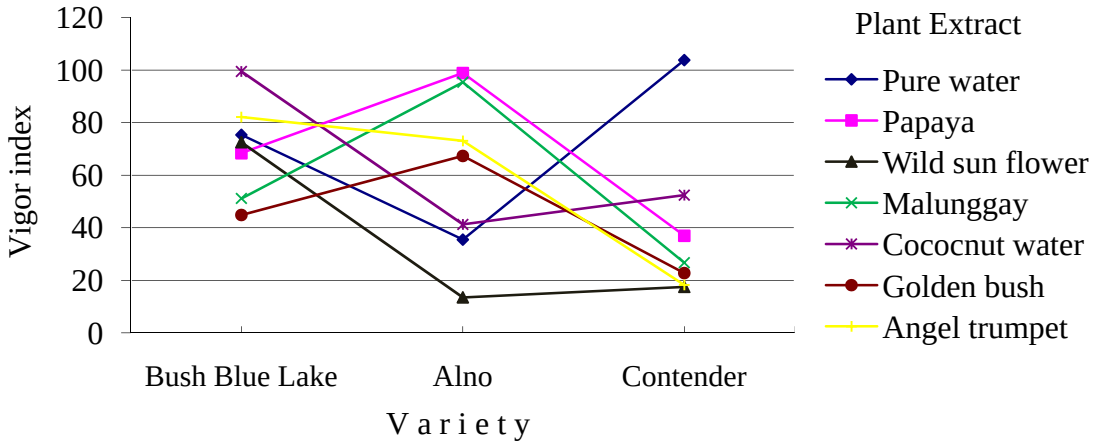

Figure 4a. Interaction effect of variety and plant extract on the vigor index of snap bean

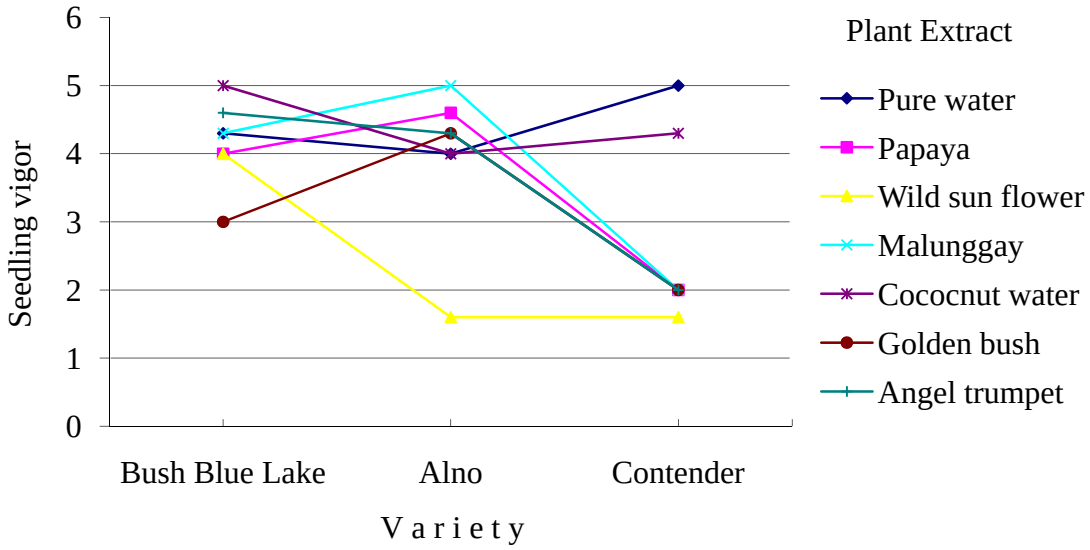

Figure 4b. Interaction effect of variety and plant extract on the seedling vigor of snap bean

Plant Height at 30 DAP

Effect of variety. Highly significant differences were noted on plant height at 30 DAP of the different snap bean varieties (Table 6). Obviously, Bush Blue Lake was the tallest and Contender the shortest.

Effect of plant extract. Significant differences were found on plant height at 30 DAP as affected by plant extracts (Table 6). Seeds soaked in wild sunflower extract produced the shortest seedlings while seeds soaked in pure water and coconut water had the tallest seedlings. It was said that coconut water increases rapid plant growth and increases yield (Fernandez, 2004).

Table 6. Plant height at 30 DAP of snap bean as affected by variety and plant extract

TREATMENT	PLANT HEIGHT (cm)
Varieties (A)	
Bush Blue Lake	117.00[a]
Alno	34.72[b]
Contender	27.31[b]
Plant extracts (B)	
Pure water	98.71[a]
Papaya	54.44[ab]
Wild sunflower	48.29[b]
Malunggay	51.90[ab]
Coconut water	56.43[ab]
Golden bush	53.63[ab]
Angel trumpet plant	54.33[ab]
A x B	*
CV (%)	6.25

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

Interaction effect. Figure 5 presents the interaction of variety and plant extracts on the plant height at 30 DAP. Bush Blue Lake soaked in pure water was noted to be the tallest at 30 DAP. All other interaction resulted to shorter plants indicating that the other plant extracts may depress rather than enhance height of the bean plants.

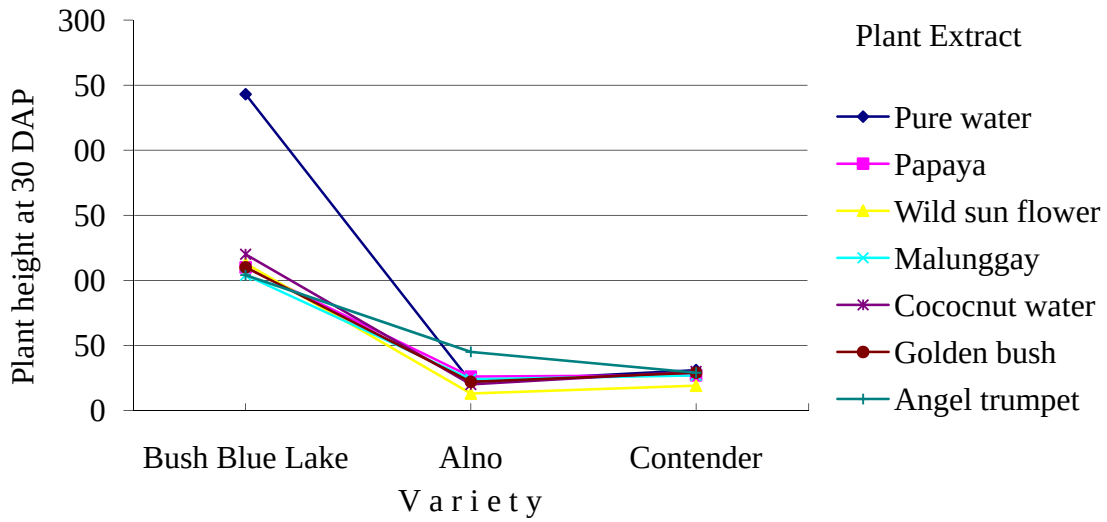

Figure 5. Interaction effect of variety and plant extract on the plant height at 30 DAP of snap bean

Weekly Dry Matter Production of Seedlings

Effect of variety. Significant differences among the varieties on the dry matter production of seedlings were noted on the second, fourth, and fifth week after seed emergence (Table 7). Bush Blue Lake and Alno were observed to be vigorous allowing them to produce higher dry matter production on the second and fourth weeks. Surprisingly, Bush Blue Lake gave the lowest dry matter on the fifth week. Contender had the lowest dry matter production on the second to fourth week but it had the highest dry matter production on the fifth week.

Effect of plant extract. Differences on the dry matter production as affected by plant extracts started to show on the third week of growth (Table 7). Plants treated with papaya and angel trumpet extracts produced higher dry matter production than plants treated with pure water and coconut water.

On the fourth week, plants treated with pure water (75g) were the highest producer of dry matter followed by plants treated with coconut water (64g). The highest dry matter producers were plants treated wild sunflower, golden bush and angel trumpet extracts.

Plants treated with wild sunflower extract gave the lowest dry matter production on the fourth week due to poor seedling vigor.

The decease of dry matter production of the seedlings on the fourth week may due to the uprooting of seedlings for dry matter evaluation.

Interaction effect. Significant interaction effect between variety and plant extract on dry matter production was observed. Bush Blue Lake treated with golden bush extract produced the highest dry matter production on the second week of the study (Fig.6a)

Table 7.Weekly dry matter production of snap bean seedlings as affected by variety and plant extract

TREATMENT	DRY MATTER PRODUCTION (g)			
	2ND WEEK	3RD WEEK	4TH WEEK	5TH WEEK
Varieties (A)				
Bush Blue Lake	0.23^{a}	0.52	0.59^{a}	1.17^{b}
Alno	0.16^{b}	0.51	0.60^{a}	1.59^{a}
Contender	0.14^{b}	0.44	0.34^{b}	1.70^{a}
Plant extracts (B)				
Pure water	0.25	0.58^{a}	0.75^{a}	1.52^{ab}
Papaya	0.18	0.63^{a}	0.55^{ab}	1.39^{ab}
Wild sunflower	0.12	0.31^{b}	0.22^{d}	1.17^{b}
Malunngay	0.15	0.46^{ab}	0.56^{ab}	1.27^{c}
Coconut water	0.23	0.48^{ab}	0.64^{ab}	1.66^{ab}
Golden bush	0.23	0.38^{b}	0.32^{cd}	1.57^{ab}
Angel trumpet plant	0.23	0.16^{a}	0.50^{bc}	1.84^{a}
A x B	*	*	**	*
CV (%)	0.16	0.75	0.88	14.52

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

but on the third week, it was Alno treated with pure water that had highest dry matter production (Fig.6b). Contender treated with pure water was noted to have the highest dry matter production, on the fourth week (Fig.6c) while on the fifth week, Contender treated with Coconut water was the highest producer of dry matter (Fig.6d).

It seemed that the variety and plant extract interaction perform consistently on a week-to-week basis. Probably, there were specific stages of growth in which the influence of certain plant extracts are more evident.

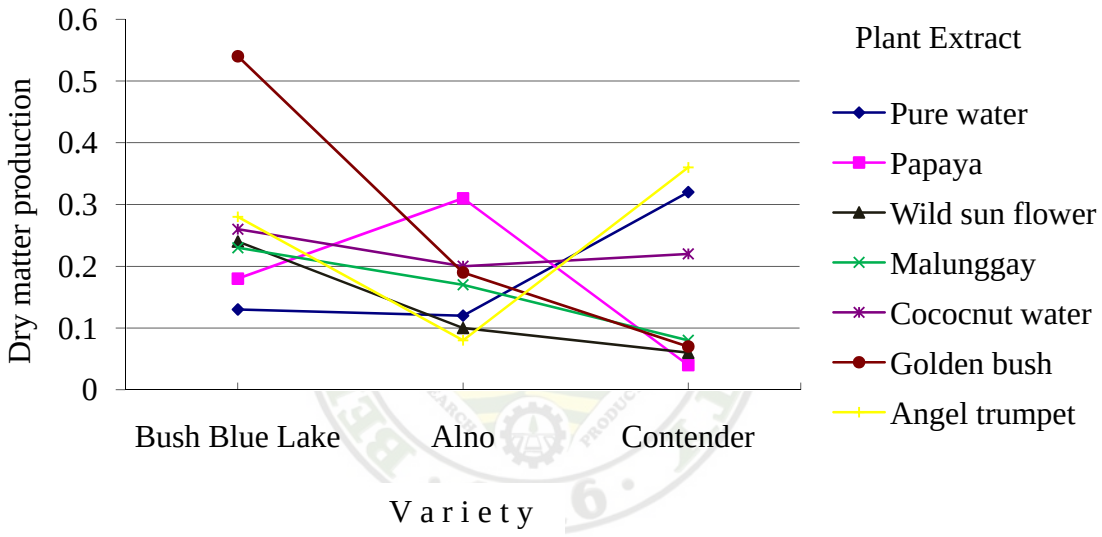

Figure 6a. Interaction effect of variety and plant extract on dry matter production on the 2nd week after seed germination of snap bean

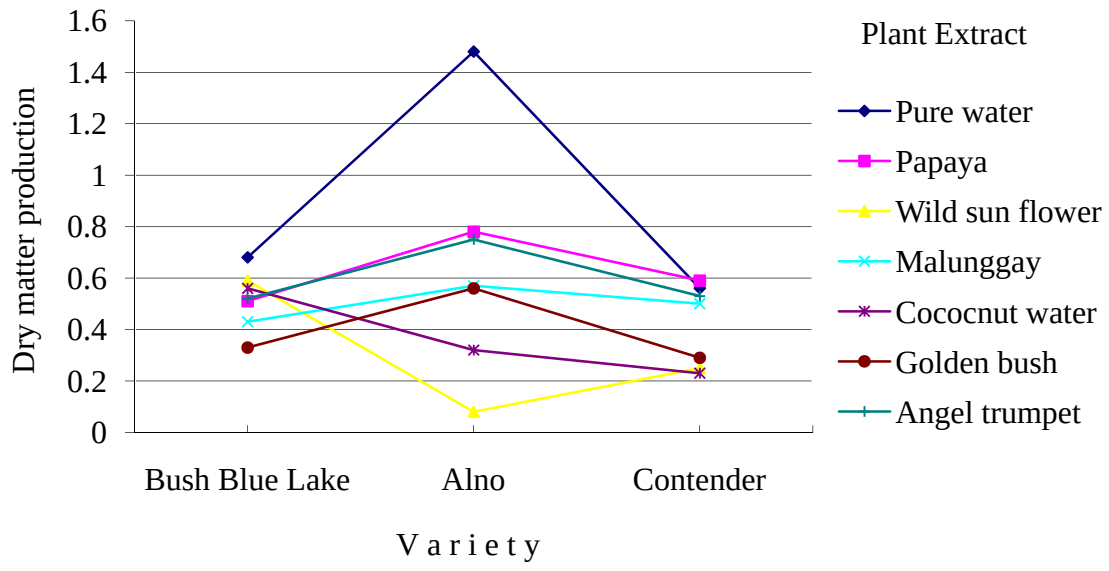

Figure 6b. Interaction effect of variety and plant extract on dry matter production on the 3nd week after seed germination of snap bean

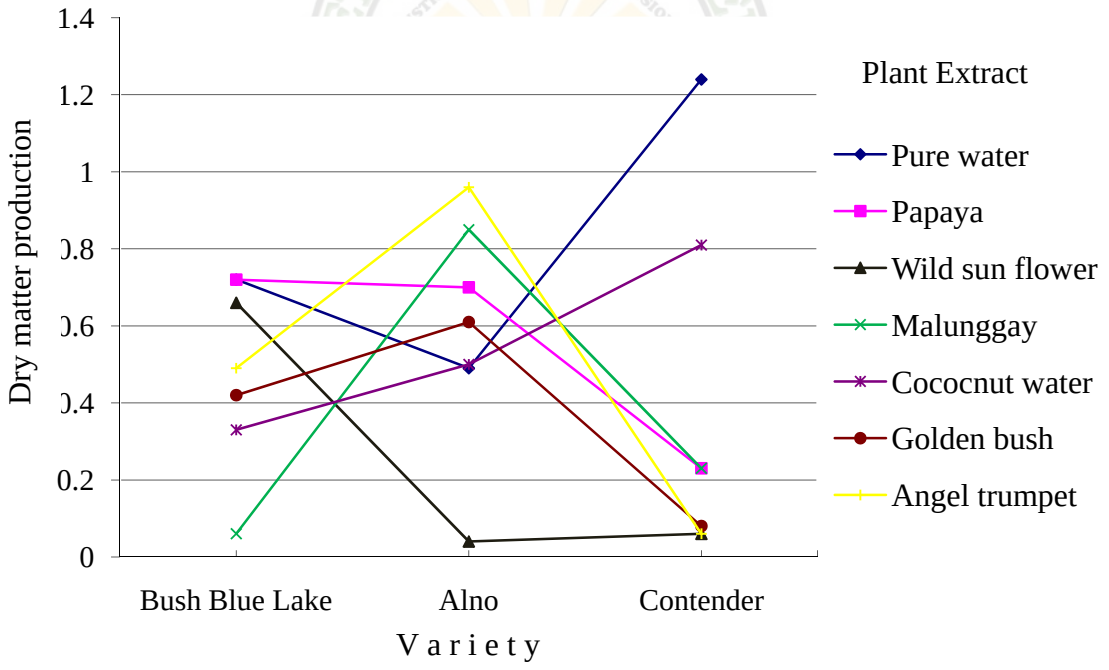

Figure 6c. Interaction effect of variety and plant extract on dry matter production on the 4th week after seed germination of snap bean

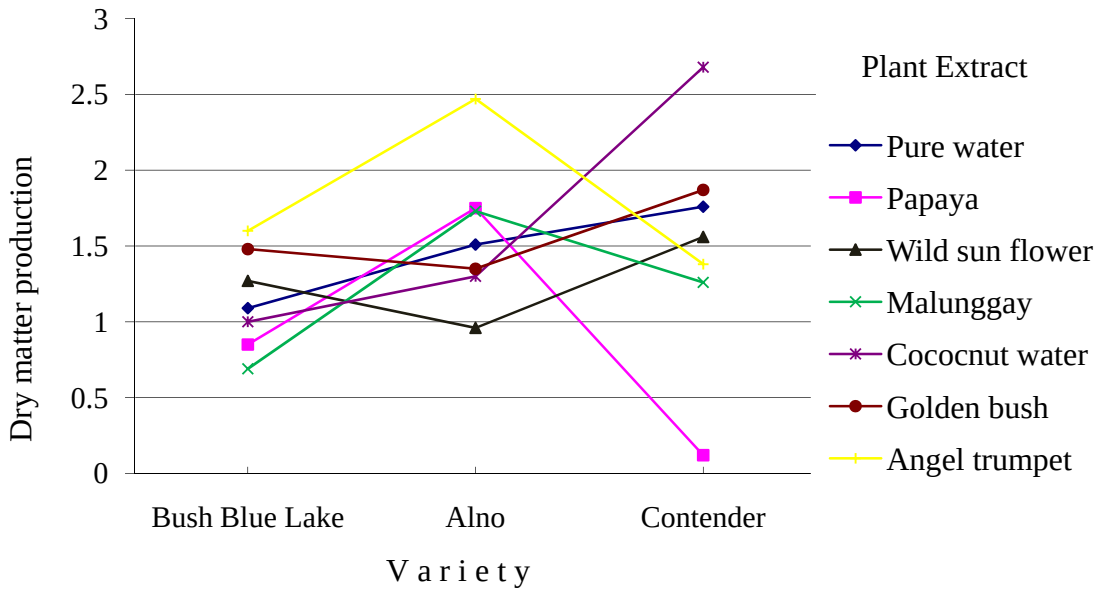

Figure 6d. Interaction effect of variety and plant extract on dry matter production on the 5th week after seed germination of snap bean

Weekly Length of Roots

Effect of variety. Bush Blue Lake produced the longest roots from the second to fourth week after emergence. This was obviously the result of its early emergence as well as high germination percentage. Fast or early germination result in rapid development of the seedling root system (Harris, 2005). The three varieties of bush bean had similar length of roots on the fifth week after seed emergence.

It implies that the length of root system have an effect on the vigor of seedlings, leading to better crop stand and higher dry matter production.

Effect of plant extract. Significant differences among plant extracts were found on the length of roots (Table 8). Coconut water promoted longer roots compared to the other extracts but did not surpass the performance of pure water.

Table 8.Weekly length of roots of snap bean as affected by variety and plant extract

TREATMENT	LENGTH OF ROOTS (cm)			
	2ND WEEK	3RD WEEK	4TH WEEK	5TH WEEK
Varieties (A)				
Bush Blue Lake	14.66_a	19.79_a	15.53_a	21.18
Alno	9.89_b	17.39_{ab}	11.12_b	20.46
Contender	4.11_c	15.10_b	7.65_c	22.23
Plant extracts (B)				
Pure water	11.41	25.59_a	20.65_a	28.56_a
Papaya	11.92	17.66_{ab}	10.63_{bc}	20.97_{ab}
Wild sunflower	6.56	10.81_c	5.01_d	17.72_b
Malunggay	9.32	19.40_{ab}	11.58_{bc}	20.90_{ab}
Coconut water	9.78	19.94_{ab}	14.19_{ab}	19.15_{ab}
Golden bush	9.68	12.54_{bc}	6.94_d	21.55_{ab}
Angel trumpet plant	8.18	16.03_{abc}	11.05_c	20.18_{ab}
A x B	ns	ns	**	ns
CV (%)	0.74	10.59	7.03	7.61

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

Coconut water contain a variety of fine biochemicals including plant growth hormones such as gibberellins, auxins and cytokinins that is essential in promoting seed germination resulting in rapid development of the seedlings root system (Fernandez, 2005).

Interaction effect. Significant interaction between variety and plant extract was observed only on the fourth week of plant emergence. Contender soaked in pure water produced the longest roots followed by Bush Blue Lake soaked in angel trumpet extract. Contender soaked in golden bush, malunggay, papaya and angel trumpet extract as well as Alno soaked in wild sunflower extract, Bush Blue Lake soaked in golden bush extract had poor root development (Fig.7).

Soaking in pure water alone before sowing produced longest root length that could increase the speed of germination and emergence leading to better crop stand (Harris D, 2005).

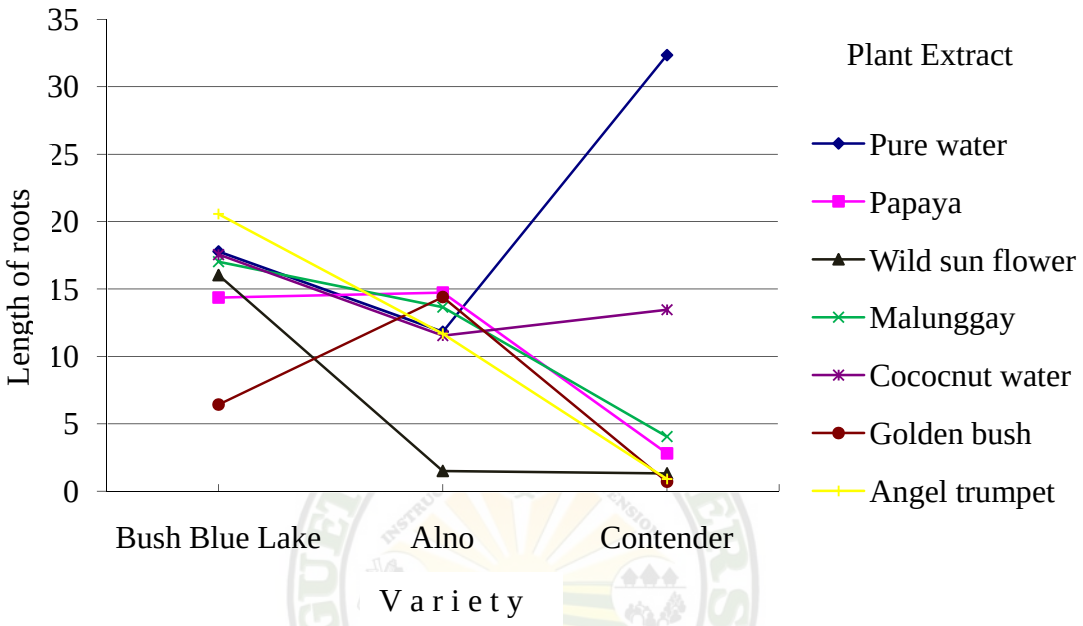

Figure 7. Interaction effect of variety and plant extract on the length of roots on the 4th week after seed germination of snap bean

Weekly Number of Secondary Roots

Effect of variety. Marked differences were observed on the number of developed secondary roots from the second to the fifth week of emergence (Table 9). Bush Blue Lake produced more number of secondary roots from the second to the fifth week after seed emergence. The faster and earlier germination of bush blue lake obviously led to the production of higher number of secondary roots leading to vigorous seedlings.

Effect of plant extract. The different plant extracts significantly affected the number of secondary roots only on the third and fourth week after seed emergence but did not affect the number of secondary roots on the second and fifth week after seed emergence. Plants treated with papaya and malunggay extracts together with pure water and coconut water and angel trumpet extract produced higher count of secondary roots than wild sunflower on the third week after seed emergence. On the fourth week, plants treated with pure water and coconut water obtained the higher number of secondary roots while plants treated wild sunflower had the least number of secondary roots. The soaking of snap bean seeds seem to be beneficial in the development of secondary roots that could lead to better mineral absorption and ultimately higher yield.

Wild sunflower extracts influence growth of surrounding plants and can be depressive to some crops because of its high allelopathic potential that inhibit seed germination and negatively influence seed viability. Consequently low seed viability may lead to lower secondary roots production and poor seedling vigor (Bogatek, 2005).

Table 9.Weekly number of secondary roots of snap bean as affected by variety and plant extract

TREATMENT	NUMBER OF SECONDARY ROOTS			
	2ND WEEK	3RD WEEK	4TH WEEK	5TH WEEK
Varieties (A)				
Bush Blue Lake	16[a]	15[a]	10[a]	10[b]
Alno	13[a]	12[b]	9[a]	14[a]
Contender	6[b]	10[b]	4[b]	13[ab]
Plant extracts (B)				
Pure water	16	13[a]	10[a]	13
Papaya	10	14[a]	8a[b]	13
Wild sunflower	9	9[b]	4[c]	12
Malunggay	8	14[a]	8[ab]	11
Coconut water	20	13[a]	10[a]	11
Golden bush	10	10[ab]	6[b]	13
Angel trumpet plant	9	13[a]	8[ab]	13
A x B	ns	*	**	ns
CV (%)	23.38	21.18	21.34	21.23

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

Interaction effect. The interaction effect of variety and plant extracts on the number of roots on the third week after seed emergence is presented in Fig. 8a. Alno soaked in wild sunflower and Contender soaked in golden bush extract had the least number of roots observed. Alno soaked in papaya extract was the best combination followed by Bush Blue Lake soaked in malunggay extract and Bush Blue Lake soaked in wild sunflower extract.

There were highly significant interaction effect of variety and plant extracts on the number of secondary roots on the fourth week. It could be observed that Alno soaked in wild sunflower and angel trumpet extracts, Contender soaked in wild sunflower and angel trumpet extracts produced the lowest number of secondary roots indicating lower potential for dry matter production. Contender soaked in pure water produced more

number of secondary roots that perhaps contributed to the longer roots. This result supports the findings of Harris (1996) that soaking seed in water before sowing could increase germination and emergence leading to better crop stand (Fig.8b).

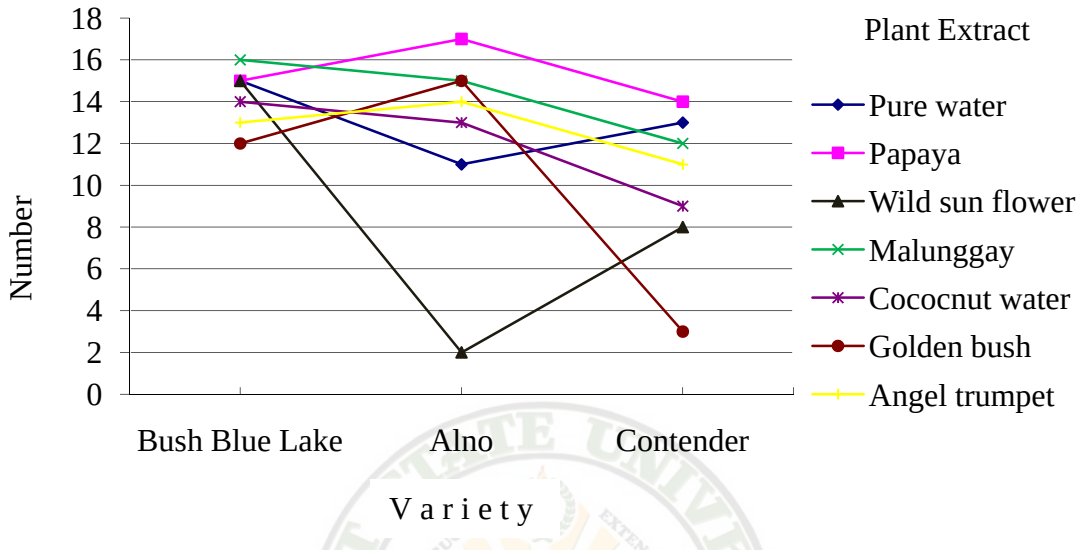

Figure 8a. Interaction effect of variety and plant extract on the number of secondary root on the 3rd week after seed germination of snap bean

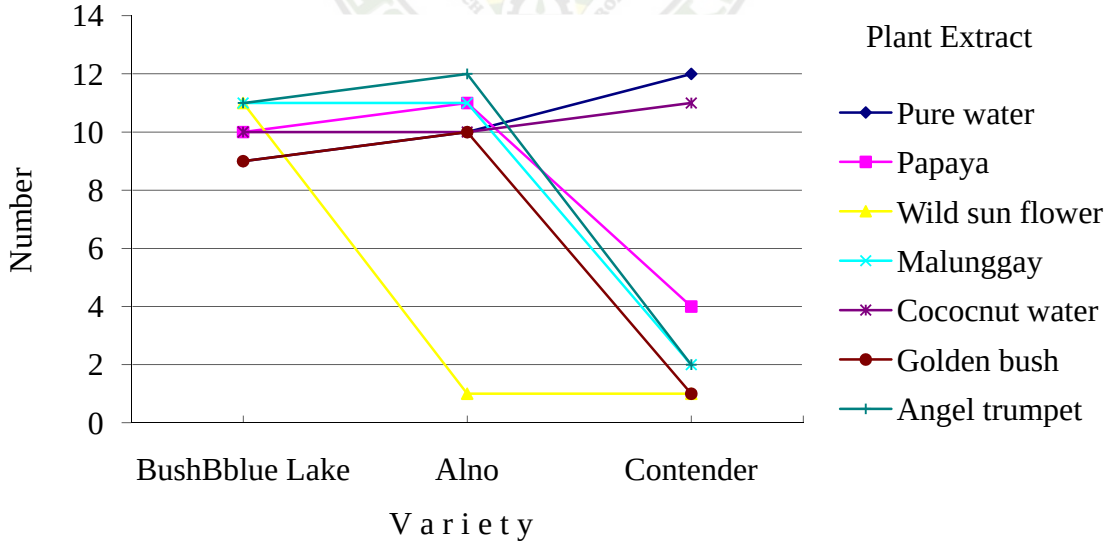

Figure 8b. Interaction effect of variety and plant extract on the number of secondary on the roots 4th week after seed germination of snap bean

Weekly Number of Root Nodules

Effect of variety. Alno had slightly higher number of root nodules on the fourth and fifth week after seed emergence. The presence of root nodule could be a good indication of growth of beans. The more nodules, the better could be the plant growth.

It appeared that the number of root nodules produced was not affected by shorter root length or number of secondary roots.

Effect of plant extract. Marked differences were observed on the number of root nodules on the second to fifth week after seed emergence (Table 10). Plants treated with pure water produced high number of root nodules on the second and fourth week and moderately high number of root nodules on the third and fifth week after seed emergence. Plants treated with papaya extract was observed to have more number of root nodules on the third week and plants treated with coconut water on the fifth week after seed emergence. Plants treated with wild sunflower, golden bush, angel trumpet and malunggay extracts (second week) had the least number of root nodules.

Pure water and coconut water produced high number of root nodules that led to more vigorous crops that could eventually lead to increased yield.

Interaction effect. The interaction effect between snap bean variety and plant extracts on the number of root nodules on weekly growth is presented in Fig, 9a, b and c. Contender soaked in pure water produced the highest number of root nodules followed by Alno soaked in angel trumpet extract and Contender soaked in coconut water. Alno soaked in pure water together with Contender soaked in malunggay extract produced the least number of root nodules (Fig 9a). Surprisingly, Alno soaked in angel trumpet extract was observed to have the least number of root nodules but on the second week, it

produced high number of root nodules. Remarkably, Contender soaked in pure water and coconut water produced the highest number of root nodules while Alno and Contender soaked in wild sunflower extract obtained the least number of root nodules (Fig.9c).

This indicates that pure water and coconut water are still the best in influencing the production of root nodules resulting to much more vigorous seedlings.

Table 10.Weekly number of root nodules of snap bean as affected by variety and plant extract

TREATMENT	NUMBER OF ROOT NODULES			
	2ND WEEK	3RD WEEK	4TH WEEK	5TH WEEK
Varieties (A)				
Bush Blue Lake	4[a]	19	15[a]	22[b]
Alno	1[b]	18	16[a]	30[a]
Contender	4[a]	19	12[b]	29[ab]
Plant extracts (B)				
Pure water	9[a]	21[ab]	23[a]	31[a]
Papaya	1[cd]	25[a]	14[ab]	25[ab]
Wild sunflower	0[d]	12[b]	7[c]	19[b]
Malunggay	1[cd]	20[ab]	14[ab]	34[a]
Coconut water	6[ab]	19[ab]	21[a]	31[ab]
Golden bush	3[bc]	13[ab]	7[c]	25[ab]
Angel trumpet plant	3[bc]	19[ab]	13[bc]	23[ab]
A x B	**	*	**	ns
CV (%)	27.12	25.59	23.35	22.94

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

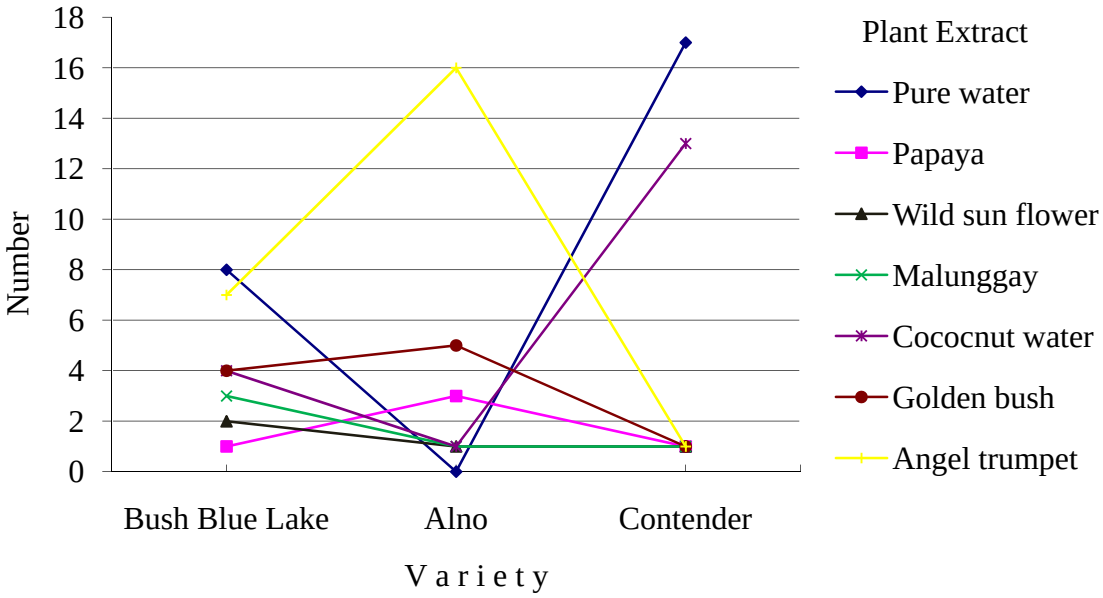

Figure 9a. Interaction effect of variety and plant extract on the number of root nodules on the 2nd week after seed germination of snap bean

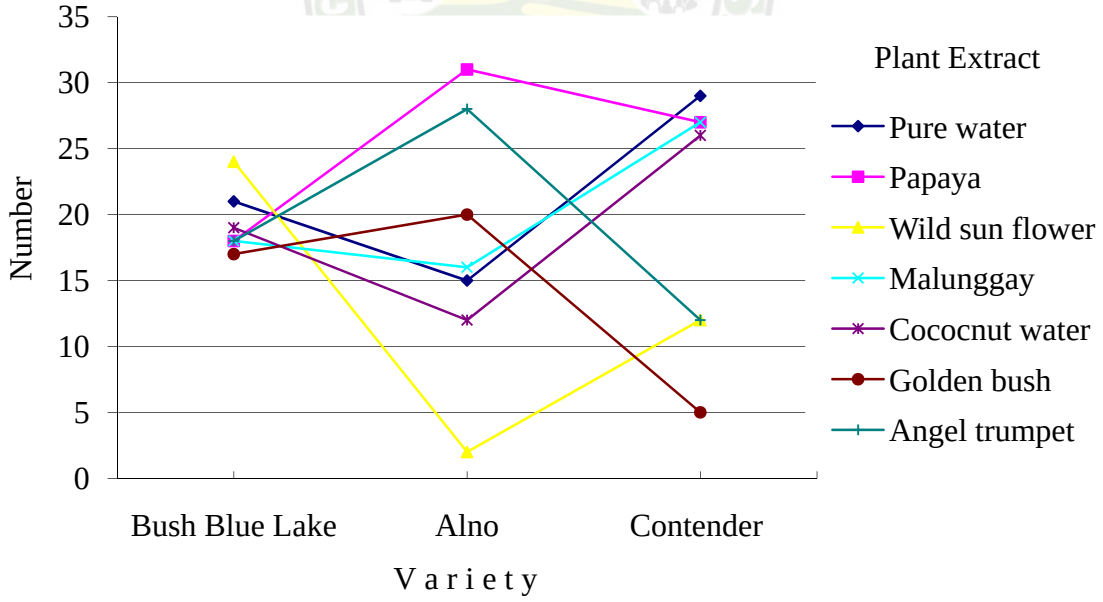

Figure 9b. Interaction effect of variety and plant extract on the weekly number of root nodules on the 3rd week after seed germination of snap bean

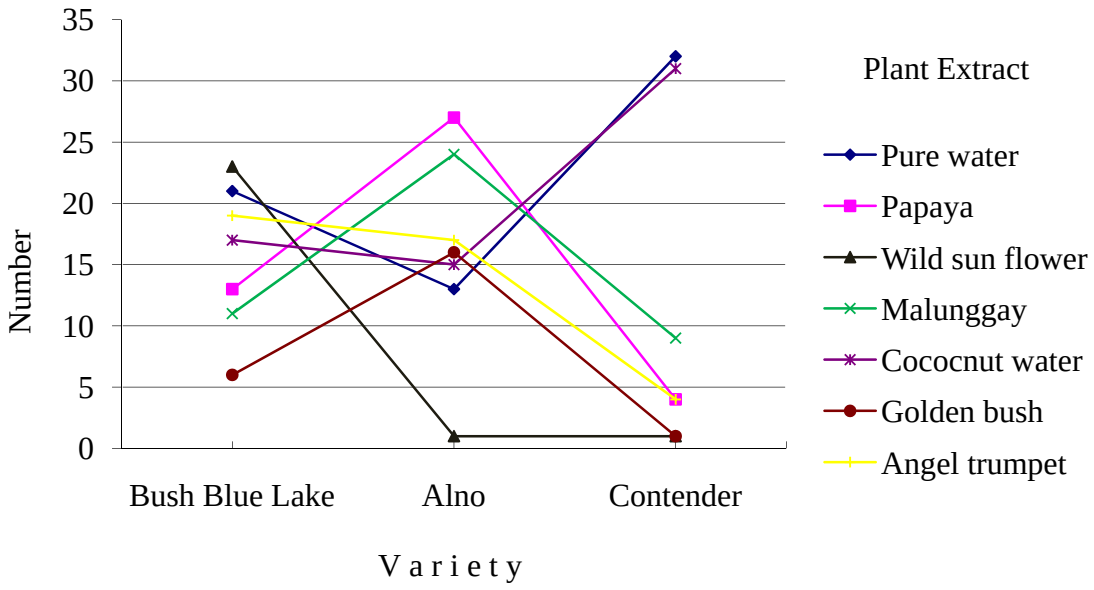

Figure 9c. Interaction effect of variety and plant extract on the weekly number of root nodules on the 4th week after seed germination of snap bean

Weekly Weight of Root Nodules

Effect of variety. There were significant differences on the fresh and dry weight of root nodules only on the fourth week. Contender had significantly lighter fresh and dry weight of root nodules (0.11g) than Bush Blue Lake.

Effect of plant extract. The result revealed significant differences on the effect of plant extracts on the weekly weight of root nodules. Plants treated with wild sunflower seem to have the heaviest fresh on the fourth week and fifth week of growth. Since the performance of pure water was not overshadowed, any of the extracts used did not enhance nodule development.

Table 11.Weekly weight of root nodules of snap bean as affected by variety and plant extract

TREATMENT	WEIGHT OF ROOT NODULES (g)			
	4TH WEEK		5TH WEEK	
	FRESH	DRY	FRESH	DRY
Varieties (A)				
Bush Blue Lake	0.29[a]	0.13[a]	0.52	0.21
Alno	0.14[b]	0.05[b]	0.46	0.19
Contender	0.11[b]	0.05[b]	0.57	0.21
Plant extracts (B)				
Pure water	0.28[a]	0.11[ab]	0.66[a]	0.21
Papaya	0.16[ab]	0.07[abc]	0.53[a]	0.19
Wild sunflower	0.50[a]	0.29[a]	0.02[b]	0.29
Malunggay	0.16[ab]	0.08[abc]	0.53[a]	0.19
Coconut water	0.19[ab]	0.13[a]	0.45[a]	0.25
Golden bush	0.19[ab]	0.05[bc]	0.46[a]	0.17
Angel trumpet plant	0.16[ab]	0.08[bc]	0.40[a]	0.13
A x B	*	ns	ns	ns
CV (%)	0.69	1.03	0.33	0.74

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

Interaction effect. Marked differences among the various interactions were also observed on the fresh weight of root nodules only on the fourth week. Bush Blue Lake soaked in papaya extract and pure water; Contender soaked in pure water and coconut water; Alno soaked in golden bush produced heavier fresh weight of root nodules. The highest root nodules were obtained from Alno soaked in pure water and Contender soaked in papaya.

It appears that nodule fresh weight could be enhanced only by the specific combination of Bush Blue Lake with papaya extract.

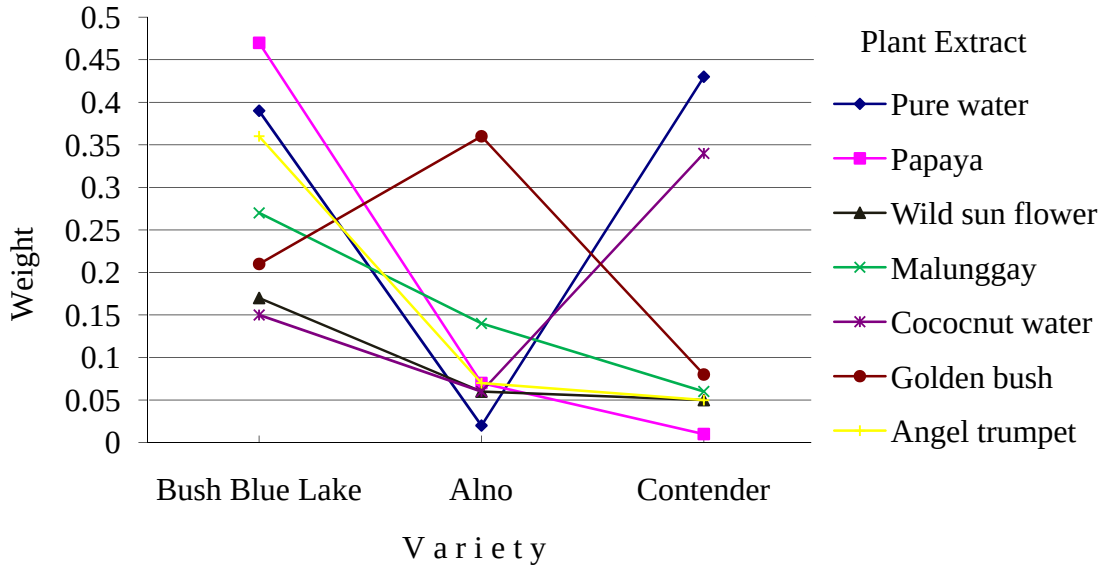

Figure 10. Interaction effect of variety and plant extract on the weekly fresh weight of root nodules on the 4th week after seed germination of snap bean

Seedling Growth

Effect of variety. Bush Blue Lake obviously had the tallest seedlings followed by Alno (Table 12). Bush blue lake produced longer roots leading to better crop stand. These results could have a bearing on the actual yield later.

Effect of plant extract. The seedling growth as affected by plant extract was presented in Table 12. No significant differences on the different plant extracts were noted although plants treated with coconut water and papaya extract had numerically the tallest seedlings while plants treated wild sunflower extract had the shortest seedlings.

Interaction effect. The interaction effect of variety and plant extracts on the seedling growth of snap bean is presented in Fig.11. Alno and Contender soaked in wild sunflower extract was observed to have the shortest seedling while Alno soaked in golden

bush and Bush Blue Lake soaked in coconut water, papaya extract and pure water had the tallest seedlings.

This result further showed that wild sunflower extract was a depressant to seedling growth in contrast to the effect of coconut water, papaya extract, angel trumpet extract and pure water.

Table 12. Seedling growth of snap bean as affected by variety and plant extract

TREATMENT	SEEDLING GROWTH (cm)
Varieties (A)	
Bush Blue Lake	65.10[a]
Alno	26.60[b]
Contender	19.54[c]
Plant extracts (B)	
Pure water	35.25
Papaya	38.92
Wild sunflower	33.81
Malunggay	35.32
Coconut water	39.23
Golden bush	37.52
Angel trumpet plant	37.10
A x B	**
CV (%)	14.76

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

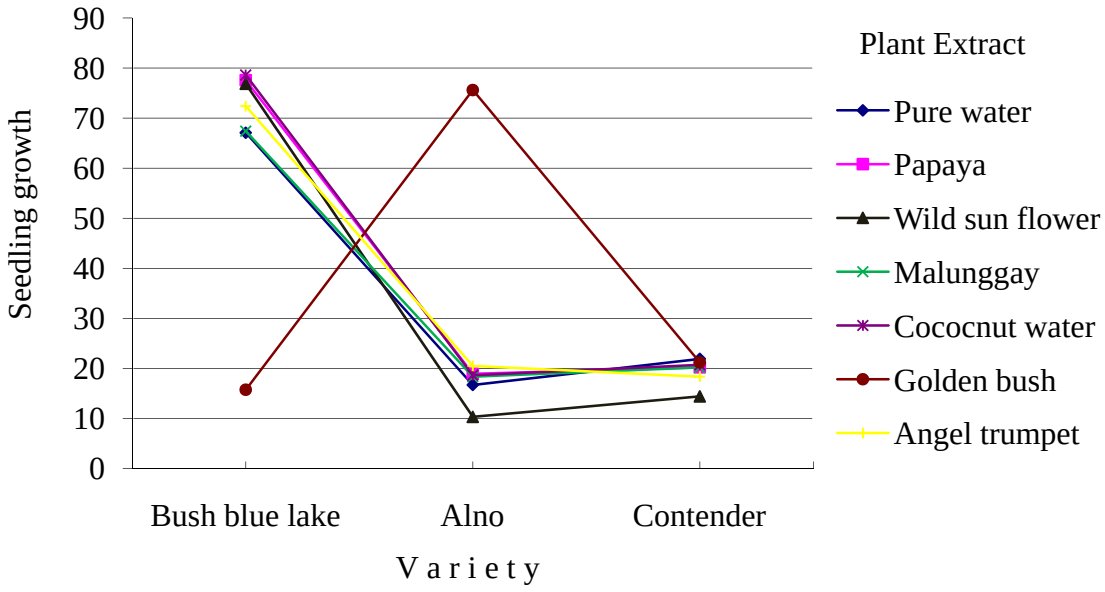

Figure 11. Interaction effect of variety and plant extract on the seedling growth of snap bean

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Three snap bean varieties and five plant extracts together with pure water and coconut water were studied for seed priming under plastic house condition at Benguet State University. The varieties were Bush Blue Lake, Alno and Contender. The plant extracts were papaya, wild sunflower, malunggay, golden bush and angel trumpet plant.

Bush Blue Lake generally performed better than the other two varieties tested. It was the earliest to emerge, had the highest percent germination (78.22%), and highest number of normal seedlings. It also produced vigorous seedlings, high vigor index and the tallest at 30 DAP. Bush Blue Lake also had the longest roots, more number of secondary roots and the heaviest weight of root nodules. On the dry matter production, Bush Blue Lake produced relatively higher dry matter production on the second and third week.

On the weekly number of root nodules, Bush Blue Lake and Contender had significantly higher nodule count on the second and third week but Alno was significantly higher on the fourth and fifth week.

Plants treated with papaya extract increased dry matter production but only on the third week after seed germination. However, it delayed seed germination by one day. Plants treated wild sunflower extract, on the other hand, not only affected the seed vigor but also appeared to enhance seed deterioration and limited dry matter production as well as seedling growth. Malunggay extract increased the number of secondary roots on the fourth week but it also reduced seedling growth.

Coconut water increased percent germination and enhanced the seedling growth of snap bean. In contrast, golden bush extract rpeduced germination and vigor index and decreased the number of secondary roots on the third week consequently affecting the root length and the height of snap bean as well as reduced dry matter production on the fourth week. Angel trumpet increased the number of secondary roots four weeks after seed germination apnd increased dry matter production on the fourth week.

In relation to variety and plant extract interaction, Bush Blue Lake treated with coconut water increased the percent germination and vigor index and produced high number of normal seedling but increased number of dead and ungerminated seeds. Alno with papaya extract increased germination percentage and vigor index. Alno with angel trumpet extract increased dry matter production on the fifth week after seed germination and increased number of root nodules on the second week after seed germination. Alno treated with sunflower extract reduced seed germination, seedling vigor, decreased dry matter production and number of root nodules. Contender treated with papaya extract reduced percent germination due to the delayed seed emergence and negatively affected root length and weight of root nodules on the fourth week. Contender treated with golden bush extract reduced number of normal seedlings, seedling vigor, dry matter production, root length and number of secondary root on the fourth week after seed germination. Contender soaked in angel trumpet extract decreased vigor index and reduced dry matter production and length of root on the fourth week after seed germination.

Conclusions

Bush Blue Lake was the fastest to emerge, enhanced higher percent germination and also produced vigorous seedlings with high dry matter production. It also obtained

the longest roots, higher number of secondary roots and greater number and weight of root nodules.

For seed priming of snap bean, pure water is still the best. However, coconut water is as good as pure water in this regard. For one, coconut water and angel trumpet extract enhanced seed emergence. In addition coconut water also increased percent germination, vigor index and seedling vigor. On the other hand, papaya extract also increased vigor index and has the potential to increase dry matter production of growing seedlings.

In terms of interaction, three snap bean varieties performed differently when applied with extracts. Bush Blue Lake tend to respond better to coconut water application while Alno with either papaya or malunggay extracts appeared to be good combinations. Contender with coconut water is also a good combination for dry matter and root nodule production.

Recommendations

For better seedling development, Bush Blue Lake is recommended. Coconut water is recommended for priming snap bean seeds due to its known nutrient contents which are important for plant growth development. Angel trumpet, Malunggay and papaya extracts could be used for further studies on seed germination. Wild sunflower could be explored as weed control agent.

For priming purposes, Bush Blue Lake could be applied with coconut water.

LITERATURE CITED

BEAN, ALLAN L. 2004. Grolier Encyclopedia of Knowledge. USA. P. 20

BUREAU OF AGRICULTURE STATISTIC. 2006 PCARRRD Information Bulletin No.274/2008.Snap Bean Guide. Accessed at http:pcarrd.dost.gov.ph/joomla/index.php

BENONGA, R.T. 2000. Allelophatic effect of Botanical Extracts of Seed Germination of some Noxious Weed Species and Small Seeded Crops.BS Thesis. Benguet Sate University, La Trinidad, Benguet. Pp.14-17

BOGATEK, R. 2005. Sunflower Allechemicals Mode of action in germination od Mustard seeds. Retrieve February 9 2010 from http://www.regional.org.au/au/allelopathy/2005/2/2/2408_bogatekr.htm

BRADFORD, KENT J. 1995. Water Relations in Seed Germination. Accessed at http:/www.decagon.com/lliterature/app-note/seedpriming.pdf

FERNANDEZ. R.A. 2004. Plant Growth Enhancer from Waste Coco Water Development. Philippines Star. Retrieve July 13 2009 from http:www.up.edu.ph./conline-news-062804.html

GORDON, J. 2008. Legume Vegetable Seed Issues. Extension Ag Agent, Kent Co. Retrieve August 17 2009 from http://www.gcjohn@udel.edu

HARRIS, D. 1996. Plant Science Research Program: Highlights and Impact. Seed Priming. On-Farm Seed Priming. Retrieve March 28 2009 from http://www.fao.org/docs/eims/uypload/agrothec/1894/SeedPriming.pdf

HARRIS, D. 2005. Seed Priming. Retrieve March 28 2009 from http://www.gaiamovement.org/files/booklet29priming.pdf

LANKFORD, B.L. 1999 Seed Priming. Accessed at http://www.patentstorm.us/patents/5873197/description.html

LIRIO, L. 1999-2000. Eradication of Block Rot in Crucifer Seeds by Plant Extracts fro *Psidium Guavaja* and *Piper Betle* LINN. Faculteit Bouekundige En. Toegepaste Biologische Westenschappen. University Gent. PH. Pp. 71,73

MORELAND, D.E., G.H. EGLEX, A.D. WORSHAM and J.J. MANALO. 1965. Regulation of Plant Growth by Constituent from Higher Plant, Natural Agent Control. Advance in Chemistry Series. 23. Pp. 112-141

SINGH, S.K. 2008. Biotechnology Plant Propagation and Plant Breeding. Campus Book International New Dehi. Pp. 322-323.

RIVERA, A.S. 2001. Enhancing the Germination of Selected Crop Seed Using Plant Extract. BS Thesis. Benguet Sate University, La Trinidad, Benguet. Pp.12,31

WIKIPEDIA FOUNDATION INC. 2008. Priming (agriculture). Accessed at http://en.wikipedia.org.wiki.Priming_ (agriculture)

APPENDICES

Appendix Table 1. Number of days from sowing to emergence of snap bean seed as affected by variety and plant extract.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	4	4	4	12	4
V_1E_2	4	4	4	12	4
V_1E_3	4	4	4	12	4
V_1E_4	4	4	4	12	4
V_1E_5	4	4	4	12	4
V_1E_6	5	4	4	13	4
V_1E_7	5	4	4	13	4
V_2E_1	4	4	4	12	4
V_2E_2	4	4	4	12	4
V_2E_3	5	6	6	17	6
V_2E_4	4	5	5	14	5
V_2E_5	5	4	4	17	6
V_2E_6	4	4	4	12	4
V_2E_7	4	4	4	12	4
V_3E_1	4	4	4	12	4
V_3E_2	5	4	4	17	6
V_3E_3	5	7	7	17	6
V_3E_4	4	5	5	14	5
V_3E_5	4	4	4	12	4
V_3E_6	5	5	5	14	5
V_3E_7	6	5	5	15	5

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	4	4	4	12	4
E_2	4	4	6	14	5
E_3	4	6	6	16	5
E_4	4	5	5	14	5
E_5	4	6	4	14	5
E_6	4	4	5	13	4
E_7	4	4	5	13	4
TOTAL	28	33	35		
MEAN	4	5	5		

Appendix Table 2. Percent germination of snap bean seed as affected by variety and plant extract.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	80.55	83.88	75.00	239.43	79.81
V_1E_2	80.55	77.77	69.44	227.76	75.92
V_1E_3	80.55	77.77	80.55	238.87	79.26
V_1E_4	91.66	69.44	88.88	249.98	83.26
V_1E_5	97.22	97.66	100	249.88	98.29
V_1E_6	36.11	47.22	63.88	147.21	49.07
V_1E_7	69.44	100	75.00	244.44	81.48
V_2E_1	55.55	75.00	72.22	202.77	67.59
V_2E_2	83.88	86.11	77.77	247.76	82.58
V_2E_3	16.66	13.88	16.66	42.2	15.73
V_2E_4	97.66	88.88	97.66	284.2	94.73
V_2E_5	55.55	58.33	61.11	174.99	58.33
V_2E_6	88.88	66.66	80.55	236.09	78.69
V_2E_7	100	75.00	77.77	252.77	84.25
V_3E_1	86.11	100	91.66	277.77	92.59
V_3E_2	33.33	30.55	30.55	94.43	31.47
V_3E_3	25.00	27.77	5.55	58.32	19.44
V_3E_4	38.88	30.55	19.44	88.87	29.62
V_3E_5	88.88	75.00	77.77	241.65	80.55
V_3E_6	19.44	22.22	27.77	69.43	23.14
V_3E_7	19.44	38.88	27.77	86.09	28.69

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	78.81	67.59	92.59	239.99	79.99
E_2	75.92	82.58	31.47	189.97	63.32
E_3	79.26	15.73	19.44	114.43	38.14
E_4	83.26	94.73	29.62	207.61	69.20
E_5	98.29	58.33	80.55	237.17	79.06
E_6	49.07	78.69	23.14	150.9	50.3
E_7	81.48	84.25	28.69	194.42	64.81
TOTAL	547.09	481.9	305.5		
MEAN	78.16	68.84	43.64		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	479.24	2078.14	26.10	0.001
Replication	2	23.17	11.58	0.15	0.8650
Variety (A)	2	13425.78	6712.89	84.30**	0.0001
Extract (B)	6	12236.76	2039.46	5.61**	0.0001
AXB	12	20033.52	1669.46	20.96**	0.0001
Error	40	3185.38	79.634		
Total	62	2613.94			

**- highly significant CV=14.04%

Appendix Table 3. Number of normal seedling of snap bean as affected by variety and plant extract.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	27	28	27	84	27
V_1E_2	25	26	22	53	17
V_1E_3	29	26	29	84	28
V_1E_4	29	21	30	80	27
V_1E_5	33	34	36	103	34
V_1E_6	6	7	20	33	11
V_1E_7	23	33	26	82	27
V_2E_1	11	18	17	46	15
V_2E_2	24	25	26	74	25
V_2E_3	0	3	6	9	3
V_2E_4	29	26	33	88	29
V_2E_5	1	6	10	17	6
V_2E_6	29	21	28	78	26
V_2E_7	29	21	24	74	25
V_3E_1	17	33	28	78	26
V_3E_2	1	8	7	16	5
V_3E_3	2	9	1	12	4
V_3E_4	9	9	6	24	8
V_3E_5	25	18	25	68	23
V_3E_6	0	7	7	14	5
V_3E_7	1	8	4	13	4

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	27.3	15.3	26	69	23
E_2	17.3	24.6	5.3	47	16
E_3	28	3	4	39	13
E_4	26.6	29.3	8	64	21
E_5	3.3	5.6	22.6	63	21
E_6	11	26	4.6	83	28
E_7	27.3	24.6	4.3	56	13
TOTAL	172	128	116		
MEAN	25	18	17		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	131.15	5.96	16.06	0.001
Replication	2	6.67	1.83	4.95	0.0120
Variety (A)	2	42.11	21.05	56.73**	0.0001
Extract (B)	6	20.31	3.38	9.12**	0.0001
AXB	12	65.05	5.42	14.60**	0.0001
Error	40	14.84	0.42		
Total	62	146.00			

**- highly significant CV=15.04%

Appendix Table 4. Number of abnormal seedling of snap bean as affected by variety and plant extract.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	2	2	0	4	1
V_1E_2	4	2	3	9	3
V_1E_3	0	2	0	2	1
V_1E_4	4	4	2	5	2
V_1E_5	2	1	0	3	1
V_1E_6	7	10	3	20	7
V_1E_7	2	3	1	6	2
V_2E_1	9	9	9	27	9
V_2E_2	6	6	3	15	5
V_2E_3	6	2	0	8	3
V_2E_4	6	6	2	14	5
V_2E_5	19	15	12	46	15
V_2E_6	3	3	1	7	3
V_2E_7	7	6	4	17	6
V_3E_1	14	4	5	23	8
V_3E_2	1	3	4	8	3
V_3E_3	7	1	1	9	3
V_3E_4	5	2	1	8	3
V_3E_5	7	9	3	19	6
V_3E_6	7	1	3	11	4
V_3E_7	6	6	6	18	6

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	1.3	9	7.6	18	6
E_2	3	5	2.6	11	4
E_3	0.6	2.6	3	6	3
E_4	1.6	4.6	2.6	9	3
E_5	1	15.3	6.6	23	8
E_6	6.6	2.3	3.6	13	4
E_7	2	5.6	6	14	5
TOTAL	16	5	29		
MEAN	2	8	4		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	34.19	1.55	8.14	0.001
Replication	2	4.99	2.49	13.07	0.0001
Variety (A)	2	7.56	3.78	20.02**	0.0001
Extract (B)	6	6.86	1.44	5.99**	0.0002
AXB	12	14.76	1.23	6.44**	0.0001
Error	40	7.64	0.19		
Total	62	41.83			

**- highly significant CV=20.97%

Appendix Table 5. Number of dead seeds of snap bean as affected by variety and plant extract.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	3	2	5	10	3
V_1E_2	2	5	8	15	5
V_1E_3	3	5	4	12	4
V_1E_4	0	5	2	7	3
V_1E_5	0	0	0	0	0
V_1E_6	4	7	0	14	7
V_1E_7	7	0	3	7	2
V_2E_1	6	4	3	13	4
V_2E_2	2	1	3	6	2
V_2E_3	12	10	9	31	10
V_2E_4	1	1	1	3	1
V_2E_5	7	5	5	17	6
V_2E_6	1	4	3	8	3
V_2E_7	0	4	3	7	2
V_3E_1	2	0	0	2	1
V_3E_2	5	9	11	25	8
V_3E_3	18	19	20	57	19
V_3E_4	6	7	12	25	8
V_3E_5	1	4	4	9	3
V_3E_6	10	11	5	26	9
V_3E_7	12	6	7	25	8

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	3.3	4.3	0.6	8	3
E_2	5	2	8.3	5	5
E_3	4	10.3	19	33	11
E_4	2.3	1	8.3	12	4
E_5	0	5.6	3	9	3
E_6	5.6	2.6	8.6	17	6
E_7	2.3	2.3	8.3	13	4
TOTAL	23	28	56		
MEAN	3	9	8		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	45.50	2.06	6.89	0.001
Replication	2	0.13	0.06	0.22	0.0001
Variety (A)	2	10.76	5.38	17.93**	0.8002
Extract (B)	6	16.10	2.68	8.94**	0.0001
AXB	12	18.49	1.54	6.80**	0.0001
Error	40	12.01	0.30		
Total	62	57.51			

**- highly significant CV=25.40%

Appendix Table 6. Number of fresh ungerminated seeds of snap bean as affected by variety and plant extract.

TREATMENt	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	4	4	4	12	4
V_1E_2	5	3	3	11	4
V_1E_3	4	3	3	10	3
V_1E_4	3	6	2	11	4
V_1E_5	1	7	0	8	11
V_1E_6	16	12	4	32	4
V_1E_7	7	0	6	13	4
V_2E_1	10	5	7	22	8
V_2E_2	4	4	5	13	4
V_2E_3	18	21	21	60	20
V_2E_4	0	3	0	3	1
V_2E_5	9	10	9	28	9
V_2E_6	3	8	4	15	5
V_2E_7	0	5	5	10	3
V_3E_1	3	3	3	6	2
V_3E_2	19	14	14	50	16
V_3E_3	9	14	14	30	10
V_3E_4	16	17	17	51	17
V_3E_5	3	4	4	12	4
V_3E_6	19	21	21	57	19
V_3E_7	17	19	19	52	17

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	4	7.8	2	14	5
E_2	3.6	4.3	16.2	24	8
E_3	3.3	20	10	33	11
E_4	3.6	1	17	21	7
E_5	2.6	9.3	4	16	5
E_6	10.6	5	1	35	12
E_7	4.3	3.3	17.3	25	8
TOTAL	32	51	84		
MEAN	5	7	12		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DF	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	2352.92	106.95	16.39	0.001
Replication	2	0.92	0.49	0.08	0.9275
Variety (A)	2	639.46	319.73	49.00**	0.8002
Extract (B)	6	385.49	64.24	9.85**	0.0001
AXB	12	1326.98	110.58	16.95**	0.0001
Error	40	261.01	6.52		
Total	62	2613.93			

**- highly significant CV=31.80%

Appendix Table 7. Vigor index of snap bean as affected by variety and plant extract.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	59.18	76.92	90.00	226.1	75.36
V_1E_2	74.36	66.66	64.10	205.11	68.37
V_1E_3	74.36	46.66	96.66	217.44	72.55
V_1E_4	67.34	41.66	44.44	153.44	51.14
V_1E_5	89.74	116.66	92.30	298.4	99.46
V_1E_6	58.97	28.57	46.93	134.47	44.82
V_1E_7	64.10	92.30	90.00	246.4	82.13
V_2E_1	15.28	55.10	36.11	106.49	35.49
V_2E_2	136.36	79.48	71.79	289.63	98.87
V_2E_3	15.38	12.82	12.24	40.44	13.48
V_2E_4	89.74	106.66	89.74	286.14	95.38
V_2E_5	33.33	53.84	36.66	123.83	41.27
V_2E_6	65.30	40.00	96.66	201.96	67.32
V_2E_7	92.30	55.10	71.79	219.19	73.06
V_3E_1	63.26	163.63	84.61	311.5	103.82
V_3E_2	40.00	28.20	36.66	104.86	34.95
V_3E_3	16.32	33.33	2.77	52.45	17.47
V_3E_4	28.57	28.20	23.33	80.1	26.7
V_3E_5	63.26	55.10	38.88	157.25	52.41
V_3E_6	17.94	36.36	13.88	68.18	22.72
V_3E_7	12.24	28.57	13.88	54.69	18.23

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	75.36	35.49	103.82	214.67	71.56
E_2	68.37	98.87	34.95	202.19	67.40
E_3	72.55	13.48	17.47	103.5	34.5
E_4	51.14	95.38	26.7	173.22	57.74
E_5	99.46	41.27	52.41	193.14	64.38
E_6	44.82	67.32	22.72	130.37	43.46
E_7	82.3	73.06	18.23	173.42	57.81
TOTAL	493.83	424.87	276.3		
MEAN	70.55	60.70	92.1		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	2.89	0.13	8.20	0.0001
Replication	2	0.02	0.01	0.69	0.5082
Variety (A)	2	0.76	0.38	0.23**	0.0001
Extract (B)	6	0.65	0.10	6.79**	0.0001
AXB	12	01.45	0.12	7.55**	0.0001
Error	40	0.64	0.01		
Total	62	3.53			

**- highly significant CV=7.16%

Appendix Table 8. Plant vigor of snap bean as affected by variety and plant extract.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	4	5	4	13	4.3
V_1E_2	4	4	4	12	4
V_1E_3	4	4	4	12	4
V_1E_4	5	4	5	13	4.3
V_1E_5	5	5	5	15	5
V_1E_6	2	3	4	9	3
V_1E_7	5	5	4	14	4.6
V_2E_1	4	4	4	12	4
V_2E_2	5	5	4	14	4.6
V_2E_3	5	1	2	5	1.6
V_2E_4	5	5	5	15	5
V_2E_5	4	4	4	12	4
V_2E_6	5	4	4	13	4.3
V_2E_7	5	4	4	13	4.6
V_3E_1	5	5	5	15	5
V_3E_2	2	2	2	6	2
V_3E_3	2	2	1	5	1.6
V_3E_4	2	2	2	6	2
V_3E_5	5	4	4	13	4.3
V_3E_6	2	2	2	6	2
V_3E_7	2	2	2	6	2

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	4.3	4	5	13.5	4.5
E_2	4	4.6	2	10.6	3.5
E_3	4	1.6	1.6	7.2	2.4
E_4	4.3	5	2	11.3	3.8
E_5	5	4	4.3	13.3	4.4
E_6	3	4.3	2	9.3	3.1
E_7	4.6	4.3	2	10.9	3.6
TOTAL	29.2	27.8	18.9		
MEAN	4.2	3.9	2.7		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	90.73	4.2	2.74	0.0001
Replication	2	0.41	0.20	1.09	0.5082
Variety (A)	2	28.22	14.11	74.39**	0.0001
Extract (B)	6	27.65	4.60	24.30**	0.0001
AXB	12	34.44	2.87	15.13**	0.0001
Error	40	7.58	0.18		
Total	62	98.31			

**- highly significant CV=11.93%

Appendix Table 9. Plant height of snap bean at 30 DAP (cm).

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	93.08	112.26	521.70	727.76	242.58
V_1E_2	110.98	107.74	112.44	331.16	110.39
V_1E_3	115.86	103.01	119.12	338.00	112.66
V_1E_4	107.8	93.42	111.74	312.96	104.32
V_1E_5	135.44	108.22	115.48	359.14	119.71
V_1E_6	106.26	111.02	111.74	329.2	109.73
V_1E_7	104.92	109.82	106.02	320.94	106.98
V_2E_1	22.42	22.98	21.62	67.02	22.34
V_2E_2	21.86	26.98	29.40	78.24	26.08
V_2E_3	12.00	13.24	15.20	40.44	13.46
V_2E_4	25.50	24.50	22.40	72.4	24.13
V_2E_5	20.38	20.16	19.08	59.56	19.85
V_2E_6	25.14	19.82	22.26	67.14	22.40
V_2E_7	28.66	29.06	23.88	136.14	45.38
V_3E_1	28.72	32.72	32.20	93.64	31.21
V_3E_2	25.34	28.62	26.62	80.58	26.86
V_3E_3	22.09	28.78	4.48	56.16	18.72
V_3E_4	29.56	25.88	26.28	81.72	18.24
V_3E_5	29.22	32.84	27.06	89.12	29.70
V_3E_6	31.64	26.90	27.72	86.26	28.75
V_3E_7	17.84	39.28	28.96	86.08	28.69

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	242.58	22.34	31.21	293.13	98.71
E_2	110.39	26.08	26.86	163.33	54.44
E_3	112.66	13.46	18..72	144.84	48.28
E_4	104.32	24.13	27.24	155.69	51.90
E_5	119.71	19.85	29.70	169.26	56.42
E_6	22.40	109.85	28.75	160.88	53.62
E_7	103.98	45.38	28.69	181.05	60.35
TOTAL	816.04	260.97	191.17		
MEAN	116.57	37.2	27.31		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	0.98	0.22	19.27	0.0005
Replication	2	0.00	0.00	0.19	0.8292
Variety (A)	2	2.88	1.44	124.02**	0.0001
Extract (B)	6	0.14	0.02	0.96*	0.0867
AXB	12	1.90	0.15	13.63*	0.0001
Error	40	0.46	0.01		
Total	62	5.40			

**- highly significant
*- significant

CV=6.25%

Appendix Table 10. Dry matter production of snap bean as affected by variety and plant extract (g). Second week after seed germination of snap bean.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	0.28	0.33	0.32	0.93	0.31
V_1E_2	0.27	0.00	0.29	0.56	0.18
V_1E_3	0.27	0.19	0.28	0.74	0.24
V_1E_4	0.30	0.20	0.19	0.69	0.23
V_1E_5	0.27	0.30	0.23	0.8	0.26
V_1E_6	0.24	0.26	0.25	1.62	0.54
V_1E_7	0.27	0.31	0.26	0.84	0.28
V_2E_1	0.16	0.04	0.16	0.36	0.12
V_2E_2	0.33	0.27	0.33	0.93	0.31
V_2E_3	0.31	0.00	0.00	0.31	0.10
V_2E_4	0.19	0.10	0.23	0.52	0.17
V_2E_5	0.10	0.29	0.23	0.62	0.20
V_2E_6	0.08	0.34	0.17	0.59	0.19
V_2E_7	0.00	0.00	0.00	0.00	0.00
V_3E_1	0.26	0.33	0.37	0.96	0.32
V_3E_2	0.08	0.00	0.05	0.13	0.04
V_3E_3	0.00	0.00	0.00	0.00	0.00
V_3E_4	0.11	0.00	0.00	0.00	0.00
V_3E_5	0.38	0.28	0.00	0.66	0.22
V_3E_6	0.00	0.00	0.00	0.00	0.00
V_3E_7	0.00	0.10	1.00	1.10	0.36

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	0.31	0.12	0.32	0.75	0.25
E_2	0.18	0.31	0.04	0.53	0.18
E_3	0.24	0.10	0	0.34	0.11
E_4	0.23	0.17	0	0.4	0.13
E_5	0.26	0.20	0.22	0.68	0.23
E_6	0.54	0.19	0	0.73	0.24
E_7	0.28	0	36	0.64	0.21
TOTAL	2.04	1.09	0.94		
MEAN	0.29	0.16	0.13		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	0.82	0.03	1.74	0.0627
Replication	2	0.02	0.01	0.55	0.5785
Variety (A)	2	0.15	0.07	3.68*	0.0341
Extract (B)	6	0.13	0.02	1.03^{ns}	0.4212
AXB	12	0.51	0.04	0.97*	0.0540
Error	40	0.88			
Total	62	0.61			

ns- not significant
*- significant

CV=0.61%

Appendix Table 11. Dry matter production of snap bean as affected by variety and plant extract (g). Third week after seed germination of snap bean.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	0.59	1.04	0.43	2.06	0.68
V_1E_2	0.47	0.71	0.36	1.54	0.51
V_1E_3	0.53	0.66	0.59	1.78	0.59
V_1E_4	0.63	0.06	0.62	1.31	0.43
V_1E_5	0.45	0.65	0.60	1.7	0.56
V_1E_6	0.21	0.28	0.52	0.01	0.33
V_1E_7	0.50	0.59	0.49	1.58	0.52
V_2E_1	0.51	0.51	0.42	1.44	0.48
V_2E_2	0.87	0.80	0.68	2.35	0.78
V_2E_3	0.06	0.20	0.00	0.26	0.08
V_2E_4	0.50	0.61	0.61	1.72	0.57
V_2E_5	0.30	0.35	0.31	0.96	0.32
V_2E_6	0.56	0.56	0.58	1.7	0.56
V_2E_7	0.67	0.91	0.70	2.28	0.76
V_3E_1	0.55	0.53	0.60	1.68	0.56
V_3E_2	0.53	0.97	0.27	1.77	0.59
V_3E_3	0.28	0.47	0.00	0.75	0.25
V_3E_4	0.61	0.42	0.10	0.51	0.50
V_3E_5	0.73	0.62	0.28	0.71	0.23
V_3E_6	0.16	0.55	0.00	0.89	0.29
V_3E_7	0.15	0.91	0.55	1.61	0.53

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	0.68	1.48	0.56	1.75	0.57
E_2	0.51	0.78	0.59	1.88	0.63
E_3	0.59	0.08	0.25	0.92	0.31
E_4	0.43	0.57	0.50	1.5	0.5
E_5	0.56	0.32	0.23	1.11	0.37
E_6	0.33	0.56	0.29	1.18	0.39
E_7	0.52	0.75	0.53	1.8	0.6
TOTAL	3.62	3.54	2.95		
MEAN	0.52	0.51	0.42		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	2.14	0.09	2.85	0.0020
Replication	2	0.33	0.16	4.88	0.0127
Variety (A)	2	0.07	0.03	1.19^{ns}	0.3136
Extract (B)	6	0.77	0.12	3.76*	0.0046
AXB	12	0.95	0.07	2.32*	0.0226
Error	40	1.37	0.03		
Total	62	3.51			

ns- not significant
*- significant

CV=0.75%

Appendix Table 12. Dry matter production of snap bean as affected by variety and plant extract (g). Fourth week after seed germination of snap bean.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	0.64	0.82	0.71	2.17	0.72
V_1E_2	0.67	0.72	0.77	0.16	0.72
V_1E_3	0.71	0.47	0.81	1.99	0.66
V_1E_4	0.66	0.30	0.84	1.8	0.6
V_1E_5	0.56	0.72	0.50	1.00	0.33
V_1E_6	0.03	0.29	0.68	1.27	0.42
V_1E_7	0.58	0.23	0.67	0.48	0.49
V_2E_1	0.48	0.61	0.38	1.42	0.49
V_2E_2	0.07	0.87	0.16	2.1	0.7
V_2E_3	0.38	0.28	0.54	1.2	0.4
V_2E_4	0.67	0.81	1.08	2.56	0.85
V_2E_5	0.20	0.52	0.80	0.52	0.50
V_2E_6	0.65	0.31	0.88	0.84	0.61
V_2E_7	0.79	1.31	0.78	2.88	0.96
V_3E_1	0.62	1.14	1.33	3.09	3.09
V_3E_2	0.00	0.48	0.22	0.7	0.7
V_3E_3	0.00	0.00	0.00	0.00	0.00
V_3E_4	0.30	0.00	0.39	0.69	0.23
V_3E_5	0.82	0.63	1.00	2.45	0.81
V_3E_6	0.00	0.00	0.00	0.00	0.00
V_3E_7	0.00	0.18	0.00	0.18	0.06

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	0.72	0.49	1.24	2.24	0.75
E_2	0.72	0.7	0.23	1.65	0.55
E_3	0.66	0.00	0.00	0.66	0.22
E_4	0.06	0.85	0.23	1.68	0.56
E_5	0.33	0.50	0.81	1.64	0.55
E_6	0.42	0.61	0.00	1.03	0.34
E_7	0.49	0.96	0.06	1.51	0.50
TOTAL	3.94	4.11	2.36		
MEAN	0.56	0.59	0.34		

ANALYSIS OF VARIANCE

SV	DF	SS	MS	F	PR>F
Treatment	22	0.01	0.01	6.34	0.001
Replication	2	0.01	0.01	5.11	0.0106
Variety (A)	2	0.01	0.01	9.67**	0.0004
Extract (B)	6	0.01	0.01	6.38**	0.0001
AXB	12	0.01	0.01	5.97**	0.0001
Error	40	0.01	0.01		
Total	62	0.01			

**- highly significant CV=0.88%

Appendix Table 13. Weekly dry matter production of snap bean as affected by variety and plant extract (g). Fifth week after seed germination.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	1.82	1.17	0.84	3.29	1.09
V_1E_2	0.98	0.29	1.30	2.57	0.85
V_1E_3	1.14	1.13	1.56	3.83	1.27
V_1E_4	0.01	0.92	1.15	2.08	0.69
V_1E_5	0.30	1.17	1.55	0.02	1.0
V_1E_6	1.80	1.56	1.10	4.46	1.48
V_1E_7	0.94	2.48	1.48	4.9	1.6
V_2E_1	1.34	1.54	1.66	4.54	1.51
V_2E_2	1.11	1.49	2.68	5.28	1.76
V_2E_3	0.74	0.84	1.30	2.88	0.96
V_2E_4	1.46	1.52	2.22	5.2	1.73
V_2E_5	1.12	1.16	1.63	3.91	1.30
V_2E_6	1.17	1.30	1.59	4.06	1.35
V_2E_7	2.65	2.38	2.48	7.42	2.47
V_3E_1	1.08	1.27	2.95	5.3	1.76
V_3E_2	1.48	1.45	1.77	4.7	0.12
V_3E_3	1.39	1.99	0.40	3.78	1.56
V_3E_4	1.59	1.42	1.17	4.18	1.26
V_3E_5	1.89	4.14	2.03	8.06	2.68
V_3E_6	1.73	2.38	1.52	5.63	1.87
V_3E_7	0.65	1.31	2.18	4.14	1.38

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	1.09	1.51	1.76	4.36	1.45
E_2	0.85	1.76	0.12	2.73	0.91
E_3	1.27	0.96	1.56	3.76	1.26
E_4	0.69	1.73	1.26	3.68	1.23
E_5	1.0	1.30	2.68	4.98	1.66
E_6	1.48	1.35	1.87	4.7	1.56
E_7	1.6	2.47	1.38	5.45	1.82
TOTAL	7.98	11.08	10.63		
MEAN	1.14	1.58	1.52		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	15.61	0.70	2.20	0.0151
Replication	2	1.77	0.88	2.75	0.0761
Variety (A)	2	3.24	1.62	5.02**	0.0113
Extract (B)	6	2.89	0.48	1.49^{ns}	0.0205
AXB	12	7.69	0.64	1.98*	0.0524
Error	40	12.93	0.32		
Total	62	28.55			

**- highly significant
*- significant
ns- not significant

CV=38.17%

Appendix Table 14. Weekly length of snap bean root as affected by variety and plant extract (cm). Second week after seed germination.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	17.46	13.46	11.16	42.08	14.02
V_1E_2	22.3	0.00	14.48	36.78	12.26
V_1E_3	18.92	9.28	16.98	45.18	15.06
V_1E_4	17.84	10.96	13.78	42.58	14.19
V_1E_5	21.74	6.68	16.2	44.26	14.87
V_1E_6	13.14	10.38	29.4	52.96	10.58
V_1E_7	19.96	8.88	14.76	43.6	14.53
V_2E_1	11.00	8.52	9.4	29.92	9.97
V_2E_2	19.92	48.2	0.00	67.12	23.37
V_2E_3	12.26	0.00	0.00	12.26	4.08
V_2E_4	14.66	0.00	9.36	24.02	8.00
V_2E_5	1.92	0.00	10.92	12.84	4.28
V_2E_6	14.64	10.02	9.52	34.18	11.39
V_2E_7	0.00	14.34	12.98	27.32	9.10
V_3E_1	11.04	7.8	32.08	32.08	10.69
V_3E_2	2.4	0.00	2.4	2.4	0.8
V_3E_3	0.00	0.00	1.6	1.6	0.5
V_3E_4	17.3	0.00	17.3	17.3	5.76
V_3E_5	12.92	8.76	30.6	30.6	10.2
V_3E_6	0.00	0.00	0.00	0.00	0.00
V_3E_7	0.00	2.68	2.68	2.68	0.89

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	14.12	9.97	10.69	34.68	11.56
E_2	12.26	23.37	0.8	35.71	11.90
E_3	15.06	4.08	0.5	19.64	6.55
E_4	14.19	8.00	5.76	27.95	9.32
E_5	14.87	4.28	10.2	29.35	9.78
E_6	10.58	11.39	0.00	21.97	7.32
E_7	14.53	9.10	0.89	24.52	8.17
TOTAL	95.51	80.09			
MEAN	13.64	11.44			

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	1.36	0.06	2.68	0.0033
Replication	2	0.12	0.06	2.68	0.0809
Variety (A)	2	0.68	0.34	17.78**	0.0001
Extract (B)	6	0.11	0.01	0.57^{ns}	0.5636
AXB	12	0.44	0.03	1.59^{ns}	0.1338
Error	40	0.92	0.02		
Total	62	2.29			

**- highly significant
ns- not significant

CV=12.19%

Appendix Table 15. Weekly length of snap bean root as affected by variety and plant extract. Third week after seed germination.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	24.00	20.16	16.62	60.2	20.26
V_1E_2	29.53	24.58	9.4	63.51	21.17
V_1E_3	33.73	20.82	15.16	69.71	23.23
V_1E_4	18.8	27.36	21.02	67.18	22.39
V_1E_5	20.44	26.02	18.16	64.62	21.54
V_1E_6	9.58	16.00	12.28	37.86	12.62
V_1E_7	18.08	20.56	13.32	51.96	17.32
V_2E_1	12.58	17.78	11.16	41.52	13.84
V_2E_2	14.00	17.18	16.92	48.1	16.03
V_2E_3	3.94	1.5	0.00	5.44	1.81
V_2E_4	36.94	15.2	12.12	64.25	21.42
V_2E_5	11.76	14.88	10.46	37.28	12.42
V_2E_6	23.28	19.5	18.26	61.04	20.34
V_2E_7	25.74	20.8	12.94	59.48	19.82
V_3E_1	95.5	17.8	14.7	12.8	42.66
V_3E_2	14.12	16.6	16.64	47.36	15.78
V_3E_3	11.16	11.00	0.00	22.16	7.38
V_3E_4	16.52	20.32	6.4	43.24	14.41
V_3E_5	16.44	0.00	61.1	77.54	25.84
V_3E_6	6.16	7.82	0.00	8.98	2.99
V_3E_7	6.5	12.6	13.75	32.82	10.94

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	20.26	13.84	42.66	76.76	25.59
E_2	2.17	16.03	15.78	52.98	17.66
E_3	23.23	1.81	7.38	32.98	10.81
E_4	22.39	21.42	14.41	58.22	19.41
E_5	21.54	12.42	25.84	59.8	19.93
E_6	12.62	20.34	2.99	35.95	11.98
E_7	17.32	19.82	10.94	48.08	16.02
TOTAL	138.53	105.68	120		
MEAN	19.79	15.10	17.14		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	1.10	0.05	2.28	0.0117
Replication	2	0.11	0.05	2.55	0.0911
Variety (A)	2	0.13	0.06	3.08^{ns}	0.0568
Extract (B)	6	0.32	0.05	1.45^{ns}	0.0409
AXB	12	0.53	0.04	2.01^{ns}	0.0496
Error	40	0.88	0.02		
Total	62	1.98			

ns- not significant CV=10.59%

Appendix Table 16. Weekly length of snap bean roots as affected by variety and plant extract. Forth week after seed germination.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	20.34	17.98	15.02	53.34	17.78
V_1E_2	18.26	10.7	14.12	43.08	14.36
V_1E_3	21.92	8.8	14.38	45.1	15.03
V_1E_4	20.04	13.22	17.82	51.08	17.02
V_1E_5	17.54	19.42	15.7	52.66	17.55
V_1E_6	1.00	8.42	9.86	19.28	6.42
V_1E_7	23.88	16.86	20.96	61.7	20.56
V_2E_1	13.28	12.9	9.3	35.48	17.78
V_2E_2	15.7	15.46	13.04	44.2	14.36
V_2E_3	0.00	0.00	0.00	0.00	15.03
V_2E_4	16.36	10.54	14.04	40.96	17.02
V_2E_5	9.58	15.44	9.62	34.64	17.55
V_2E_6	21.36	4.16	17.68	43.2	6.42
V_2E_7	13.34	11.88	9.82	35.04	20.56
V_3E_1	13.28	12.9	9.3	35.48	11.82
V_3E_2	15.7	15.46	13.04	44.2	14.73
V_3E_3	0.00	0.00	0.00	0.00	0.00
V_3E_4	16.36	10.54	14.04	40.96	13.56
V_3E_5	9.58	15.44	9.62	34.64	11.54
V_3E_6	21.36	4.16	17.68	43.2	14.4
V_3E_7	13.34	11.88	9.82	35.04	11.68

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	17.78	11.82	32.35	6.95	2065
E_2	14.36	14.73	2.8	31.89	10.63
E_3	15.03	0.00	0.00	15.03	5.01
E_4	17.02	13.65	4.05	34.72	11.57
E_5	17.55	11.54	13.46	42.55	14.18
E_6	6.42	14.4	0.00	20.82	6.94
E_7	20.56	11.68	0.9	31.14	11.04
TOTAL	108.72	77.82	53.56		
MEAN	15.53	11.11	7.65		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	1.19	0.08	10.55	0.0001
Replication	2	0.03	0.01	2.11	0.340
Variety (A)	2	0.51	0.25	31.24**	0.0001
Extract (B)	6	0.64	0.10	13.03**	0.0001
AXB	12	0.72	0.06	7.26**	0.0001
Error	40	0.33	0.00		
Total	62	2.24			

**- highly significant CV=7.03%

Appendix Table 17. Weekly length of snap bean roots as affected by variety and plant extract. Fifth week after seed germination

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	24.44	19.48	20.68	64.60	21.53
V_1E_2	21.16	23.94	24.82	69.92	23.30
V_1E_3	25.62	29.34	21.38	76.34	25.44
V_1E_4	20.86	13.73	18.74	53.36	17.78
V_1E_5	21.86	25.54	19.26	66.66	22.22
V_1E_6	16.84	14.78	19.86	51.48	17.16
V_1E_7	17.64	21.26	23.58	62.48	20.82
V_2E_1	21.9	17.56	24.4	63.86	21.28
V_2E_2	20.7	21.54	23.12	65.36	21.78
V_2E_3	11.72	15.64	19.26	45.62	12.20
V_2E_4	18.94	33.68	13.40	66.02	22.00
V_2E_5	2.31	17.58	28.76	69.44	23.14
V_2E_6	22.04	18.82	31.34	72.16	24.05
V_2E_7	21.86	18.78	26.2	66.84	22.28
V_3E_1	86.2	18.74	23.62	128.26	42.85
V_3E_2	17.82	17.08	18.52	58.52	19.50
V_3E_3	18.52	14.94	2.98	54.12	18.04
V_3E_4	29.36	20.92	18.44	68.72	22.90
V_3E_5	20.08	17.54	19.38	59.5	19.82
V_3E_6	27.92	20.96	21.38	70.26	23.42
V_3E_7	8.78	19.74	23.76	52.28	17.42

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	21.53	21.28	42.85	85.66	28.55
E_2	3.30	21.78	19.50	64.58	2.53
E_3	24.44	12.20	18.04	55.68	20.89
E_4	17.78	22.00	22.90	62.68	18.56
E_5	22.22	23.4	19.82	65.45	21.82
E_6	17.16	24.05	23.43	64.64	21.54
E_7	20.82	22.28	17.42	60.52	20.17
TOTAL	148.25	146.99	163.97		
MEAN	2.18	20.10	23.42		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	0.28	0.10	1.03	0.4525
Replication	2	0.00	0.00	0.05	0.9492
Variety (A)	2	0.00	0.00	0.17^{ns}	0.8465
Extract (B)	6	0.08	0.01	1.09^{ns}	0.0389
AXB	12	0.09	0.01	1.31^{ns}	0.2520
Error	40	0.50	0.01		
Total	62	0.79			

ns- not significant CV=7.61%

Appendix Table 18. Weekly number of secondary roots of snap bean as affected by variety and plant extract. Second week after seed germination.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	10	16	10	36	12
V_1E_2	12	0	9	21	7
V_1E_3	32	9	10	51	17
V_1E_4	11	14	12	37	12
V_1E_5	96	16	11	37	12
V_1E_6	11	9	12	32	11
V_1E_7	10	8	10	37	12
V_2E_1	10	11	35	33	12
V_2E_2	12	11	32	32	11
V_2E_3	11	0	11	11	4
V_2E_4	10	0	20	20	7
V_2E_5	7	0	15	15	5
V_2E_6	9	12	34	34	11
V_2E_7	0	9	31	31	10
V_3E_1	13	25	15	53	18
V_3E_2	12	0	0	12	4
V_3E_3	0	0	13	3	1
V_3E_4	4	0	0	4	1
V_3E_5	12	11	14	37	12
V_3E_6	2	1	0	1	1
V_3E_7	0	9	0	2	1

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	12	12	18	42	14
E_2	7	11	4	22	7
E_3	17	4	1	22	7
E_4	12	7	1	20	7
E_5	12	5	12	29	10
E_6	11	11	1	22	7
E_7	12	10	1	23	8
TOTAL	83	60	38		
MEAN	12	9	5		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	103.24	4.69	2.26	0.0123
Replication	2	1.27	5.36	2.72	0.0783
Variety (A)	2	30.25	15.12	7.29*	0.0020
Extract (B)	6	21.62	3.60	1.74ns	0.1377
AXB	12	40.08	3.34	1.61ns	0.1282
Error	40	83.05			
Total	62	186.29			

*- significant
ns- not significant

CV=47.44%

Appendix Table 19. Weekly number of secondary roots of snap bean as affected by variety and plant extract. Third week after seed germination.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	14	15	17	46	15
V_1E_2	17	15	12	44	15
V_1E_3	14	17	15	46	15
V_1E_4	20	15	13	48	16
V_1E_5	17	14	16	42	14
V_1E_6	13	12	10	35	12
V_1E_7	10	20	10	40	13
V_2E_1	10	13	9	32	11
V_2E_2	11	22	8	50	17
V_2E_3	4	2	0	6	2
V_2E_4	13	14	16	44	15
V_2E_5	10	16	13	40	13
V_2E_6	16	14	18	48	15
V_2E_7	12	17	13	43	14
V_3E_1	11	18	11	40	13
V_3E_2	15	18	11	43	14
V_3E_3	9	16	0	24	8
V_3E_4	16	18	2	37	12
V_3E_5	14	0	13	27	9
V_3E_6	3	6	0	10	3
V_3E_7	10	12	10	32	11

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	15	11	13	39	13
E_2	15	17	14	46	15
E_3	15	2	8	25	8
E_4	16	15	12	43	14
E_5	14	13	9	6	12
E_6	12	15	3	30	10
E_7	13	14	11	38	13
TOTAL	100	87	70		
MEAN	14	12	10		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	35.96	1.63	3.08	0.0010
Replication	2	3.97	1.98	3.75	0.0321
Variety (A)	2	7.17	1.50	6.76*	0.0030
Extract (B)	6	9.00	1.50	2.82*	0.0216
AXB	12	15.80	01.31	2.48*	0.0155
Error	40	21.21	0.53		
Total	62	57.18			

*- significant CV=21.18%

Appendix Table 20. Weekly number of secondary roots of snap bean as affected by variety and plant extract. Forth week after seed germination

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	11	9	7	27	9
V_1E_2	11	9	11	31	10
V_1E_3	9	15	8	32	11
V_1E_4	10	12	10	32	11
V_1E_5	8	10	13	31	10
V_1E_6	1	17	9	27	9
V_1E_7	13	10	11	34	11
V_2E_1	16	9	6	31	10
V_2E_2	13	10	11	34	11
V_2E_3	0	2	1	3	1
V_2E_4	13	10	11	34	11
V_2E_5	9	10	12	31	10
V_2E_6	15	3	11	29	10
V_2E_7	12	15	8	35	12
V_3E_1	13	13	9	35	12
V_3E_2	0	7	4	11	4
V_3E_3	0	1	2	3	1
V_3E_4	3	0	4	7	2
V_3E_5	13	15	4	32	11
V_3E_6	0	2	2	4	1
V_3E_7	0	5	0	5	2

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	9	10	12	31	10
E_2	10	11	4	25	8
E_3	11	0	0	11	4
E_4	11	11	2	24	4
E_5	10	10	11	31	10
E_6	9	10	0	19	6
E_7	11	2	2	15	5
TOTAL	71	54	31		
MEAN	10	8	4		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	64.88	2.94	7.00	0.0001
Replication	2	0.50	0.25	0.60	0.5557
Variety (A)	2	22.80	11.40	27.07**	0.0001
Extract (B)	6	19.57	3.26	7.75**	0.0014
AXB	12	21.99	1.83	4.35**	0.0002
Error	40	6.84	0.42		
Total	62	81.72			

**- highly significant CV=32.55%

Appendix Table 21. Weekly number of secondary roots of snap bean as affected by variety and plant extract. Fifth week after seed germination.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	15	7	11	33	11
V_1E_2	9	7	7	23	8
V_1E_3	8	18	19	45	15
V_1E_4	7	9	9	25	8
V_1E_5	8	9	9	26	9
V_1E_6	7	10	15	32	11
V_1E_7	9	10	9	28	9
V_2E_1	19	9	12	40	13
V_2E_2	21	14	22	57	19
V_2E_3	6	13	6	25	8
V_2E_4	9	12	13	34	11
V_2E_5	17	12	19	48	16
V_2E_6	17	12	9	38	13
V_2E_7	24	19	13	56	19
V_3E_1	7	28	10	45	15
V_3E_2	9	21	10	40	13
V_3E_3	14	18	2	34	11
V_3E_4	26	10	8	44	9
V_3E_5	9	10	9	28	6
V_3E_6	10	19	20	49	10
V_3E_7	5	12	19	36	12

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	11	13	15	39	13
E_2	8	19	13	40	13
E_3	15	8	11	34	11
E_4	8	11	9	28	9
E_5	9	16	6	31	10
E_6	11	13	10	34	11
E_7	9	9	12	40	13
TOTAL	71	89	76		
MEAN	10	14	11		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	13.95	0.58	1.05	0.4329
Replication	2	0.53	0.26	0.48	0.6235
Variety (A)	2	3.35	1.67	3.00*	0.0613
Extract (B)	6	1.02	0.17	0.31^{ns}	0.9304
AXB	12	8.03	0.66	1.20^{ns}	0.3194
Error	40	22.39	0.55		
Total	62	35.34			

*- significant
ns- not significant

CV=21.23%

Appendix Table 22. Weekly number of roots nodules of snap bean as affected by variety and plant extract. Second week after seed germination.

	1	2	3		
V_1E_1	1	12	12	25	8
V_1E_2	0	0	3	3	1
V_1E_3	1	0	5	6	2
V_1E_4	2	1	5	8	3
V_1E_5	6	2	3	11	4
V_1E_6	2	5	6	13	4
V_1E_7	10	7	5	22	7
V_2E_1	0	2	1	3	1
V_2E_2	3	3	0	6	3
V_2E_3	1	1	1	3	1
V_2E_4	0	1	2	3	1
V_2E_5	0	0	4	4	1
V_2E_6	4	4	6	14	5
V_2E_7	12	15	21	48	16
V_3E_1	32	6	13	51	17
V_3E_2	1	2	3	6	2
V_3E_3	0	1	2	3	1
V_3E_4	0	2	1	3	1
V_3E_5	26	10	4	40	13
V_3E_6	0	0	0	0	0
V_3E_7	0	1	0	1	0

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	8	0	17	25	8
E_2	1	3	0	4	1
E_3	2	0	0	2	1
E_4	3	0	0	3	1
E_5	4	1	13	18	6
E_6	4	5	0	9	3
E_7	7	16	0	23	8
TOTAL	29	25	30		
MEAN	4	4	4		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	57.68	2.62	5.09	0.0001
Replication	2	0.72	0.36	0.70	0.5011
Variety (A)	2	20.02	2.85	5.54*	0.0072
Extract (B)	6	31.23	3.33	6.47**	0.0001
AXB	12	20.62	2.60	5.05**	0.0001
Error	40	78.31	0.51		
Total	62	206.58			

*- significant CV=44.59%
**- highly significant

Appendix Table 23. Weekly number of root nodules of snap bean as affected by variety and plant extract. Third week after seed emergence.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	20	25	17	62	21
V_1E_2	18	25	10	53	18
V_1E_3	25	30	18	73	24
V_1E_4	18	17	19	54	18
V_1E_5	16	18	22	56	19
V_1E_6	6	14	31	51	17
V_1E_7	18	23	14	55	18
V_2E_1	12	24	8	44	15
V_2E_2	36	30	26	92	31
V_2E_3	0	1	6	7	2
V_2E_4	12	15	21	48	16
V_2E_5	4	22	11	37	12
V_2E_6	23	17	20	60	20
V_2E_7	30	35	20	85	28
V_3E_1	32	33	22	87	29
V_3E_2	32	50	0	82	27
V_3E_3	12	23	0	35	12
V_3E_4	38	40	4	82	27
V_3E_5	40	0	38	78	26
V_3E_6	9	5	0	14	5
V_3E_7	3	21	12	36	12

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	21	15	29	65	22
E_2	18	31	27	76	25
E_3	24	2	12	38	13
E_4	18	16	27	61	20
E_5	19	12	26	57	19
E_6	17	20	5	42	14
E_7	18	28	12	58	19
TOTAL	135	124	138		
MEAN	19	18	20		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	70.89	3.22	1.58	0.1011
Replication	2	8.13	4.06	2.00	0.1485
Variety (A)	2	2.29	1.14	0.02^{ns}	0.5726
Extract (B)	6	18.46	3.07	1.51^{ns}	0.1986
AXB	12	41.99	3.49	1.72*	0.0985
Error	40	81.33	2.03		
Total	62	152.23			

*- significant
ns- not significant

CV=34.59%

Appendix Table 24. Weekly number of roots nodules of snap bean as affected by variety and plant extract. Fourth week after seed germination.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	21	24	18	63	21
V_1E_2	14	9	15	38	13
V_1E_3	29	14	25	68	23
V_1E_4	12	0	20	32	11
V_1E_5	14	12	26	52	17
V_1E_6	0	1	16	17	6
V_1E_7	24	14	20	58	19
V_2E_1	20	17	2	39	13
V_2E_2	29	18	33	80	27
V_2E_3	0	1	2	3	1
V_2E_4	14	34	25	73	24
V_2E_5	5	7	33	45	15
V_2E_6	13	9	27	49	16
V_2E_7	0	34	16	50	17
V_3E_1	35	25	47	97	32
V_3E_2	0	8	4	12	4
V_3E_3	1	1	1	3	1
V_3E_4	10	0	17	27	9
V_3E_5	27	31	36	94	31
V_3E_6	0	0	3	3	1
V_3E_7	0	12	0	12	4

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	21	13	32	66	22
E_2	13	27	4	44	15
E_3	20	1	1	23	8
E_4	11	24	9	44	15
E_5	17	15	31	64	21
E_6	6	16	1	22	7
E_7	19	17	4	40	13
TOTAL	107	113	82		
MEAN	16	16	11		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	163.36	7.3	4.98	0.0001
Replication	2	7.12	3.56	2.39	0.1049
Variety (A)	2	12.96	3.56	4.34^{ns}	0.0196
Extract (B)	6	54.09	9.10	6.04**	0.0001
AXB	12	89.46	7.45	24.99**	0.0001
Error	40	59.70	1.49		
Total	62	223.39			

**- highly significant
ns- not significant

CV=36.03%

Appendix Table 25. Weekly number of roots nodules of snap bean as affected by variety and plant extract. Fifth week after seed germination

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	29	15	41	85	28
V_1E_2	13	15	19	47	16
V_1E_3	17	31	5	53	18
V_1E_4	13	16	36	65	22
V_1E_5	12	11	57	80	27
V_1E_6	5	20	37	62	21
V_1E_7	11	17	46	74	25
V_2E_1	29	25	47	101	34
V_2E_2	58	28	32	118	39
V_2E_3	5	9	12	26	9
V_2E_4	30	48	45	123	41
V_2E_5	26	21	47	94	3
V_2E_6	23	28	29	80	27
V_2E_7	24	35	44	103	34
V_3E_1	19	57	25	101	34
V_3E_2	16	27	17	60	20
V_3E_3	24	43	28	95	32
V_3E_4	52	37	33	122	41
V_3E_5	15	52	38	105	35
V_3E_6	20	24	47	91	30
V_3E_7	3	38	25	66	22

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	28	34	34	96	32
E_2	16	39	20	75	25
E_3	18	9	32	59	20
E_4	22	41	41	104	35
E_5	27	31	35	93	31
E_6	21	27	30	78	26
E_7	25	34	22	81	27
TOTAL	157	215	214		
MEAN	22	31	31		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	73.23	3.32	2.45	0.0067
Replication	2	17.36	8.68	6.40	0.0039
Variety (A)	2	9.10	4.50	3.32*	0.0464
Extract (B)	6	16.44	2.74	2.02^{ns}	0.0856
AXB	12	30.41	2.53	1.87^{ns}	0.0695
Error	40	54.30	1.35		
Total	62	127.53			

*- significant
ns- not significant

CV=22.94%

Appendix Table 26. Weekly fresh weight of roots nodules of snap bean as affected by variety and plant extract. Fourth week after seed germination.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	0.33	0.72	0.13	1.18	0.39
V_1E_2	0.70	0.27	0.45	1.42	0.47
V_1E_3	0.19	0.11	0.23	0.53	0.17
V_1E_4	0.05	0.00	0.76	0.81	0.27
V_1E_5	0.08	0.18	0.21	0.47	0.15
V_1E_6	0.00	0.4	0.20	0.6	0.2
V_1E_7	0.41	0.24	0.44	1.09	0.36
V_2E_1	0.04	0.02	0.00	0.06	0.02
V_2E_2	0.14	0.00	0.09	0.23	0.07
V_2E_3	0.00	0.19	0.00	0.19	0.06
V_2E_4	0.12	0.10	0.20	0.42	0.14
V_2E_5	0.00	0.08	0.10	0.18	0.06
V_2E_6	0.32	0.13	0.63	0.08	0.36
V_2E_7	0.00	0.00	0.23	0.23	0.07
V_3E_1	0.31	0.49	0.49	1.29	0.43
V_3E_2	0.00	0.28	0.02	0.3	0.01
V_3E_3	0.08	0.04	0.03	0.15	0.05
V_3E_4	0.15	0.00	0.05	0.2	0.06
V_3E_5	0.29	0.59	0.15	1.03	0.34
V_3E_6	0.00	0.00	0.00	0.00	0.00
V_3E_7	0.00	0.15	0.00	0.15	0.05

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	0.39	0.02	0.43	0.84	0.28
E_2	0.47	0.07	0.01	0.55	0.18
E_3	0.17	0.06	0.05	0.23	0.08
E_4	0.27	0.14	0.06	0.47	0.16
E_5	0.15	0.06	0.34	0.55	0.18
E_6	0.2	0.36	0.00	0.56	0.19
E_7	0.36	0.07	0.05	0.48	0.16
TOTAL	2.01	0.78	0.94		
MEAN	0.29	0.11	0.13		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	1.45	0.06	2.40	0.0080
Replication	2	0.03	0.01	0.69	0.5105
Variety (A)	2	0.37	0.18	6.86*	0.0028
Extract (B)	6	0.20	0.03	1.21^{ns}	0.3229
AXB	12	0.83	0.69	2.53*	0.0137
Error	40	0.12	0.02		
Total	62	2.58			

*- significant
ns- not significant

CV=0.69%

Appendix Table 27. Weekly dry weight of roots nodules of snap bean as affected by variety and plant extract. Fourth week after seed germination).

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	0.04	0.10	0.37	0.51	0.17
V_1E_2	0.10	0.10	0.15	0.35	0.12
V_1E_3	0.01	0.05	0.08	0.14	0.05
V_1E_4	0.20	0.00	0.24	0.44	0.15
V_1E_5	0.10	0.07	0.54	0.62	0.21
V_1E_6	0.00	0.02	0.07	0.09	0.03
V_1E_7	0.16	0.11	0.19	0.46	0.15
V_2E_1	0.03	0.01	0.00	0.04	0.04
V_2E_2	0.08	0.00	0.05	0.13	0.13
V_2E_3	0.00	0.00	0.00	0.00	0.00
V_2E_4	0.06	0.03	0.08	0.17	0.17
V_2E_5	0.01	0.01	0.10	0.13	0.13
V_2E_6	0.10	0.02	0.21	0.12	0.24
V_2E_7	0.00	0.06	0.10	0.16	0.16
V_3E_1	0.12	0.20	0.15	0.74	0.16
V_3E_2	0.00	0.12	0.01	0.13	0.04
V_3E_3	0.00	0.00	0.00	0.00	0.00
V_3E_4	0.04	0.00	0.03	0.07	0.02
V_3E_5	0.07	0.23	0.07	0.37	0.12
V_3E_6	0.00	0.00	0.00	0.00	0.00
V_3E_7	0.00	0.06	0.00	0.02	0.00

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	0.7	0.04	0.16	0.37	0.12
E_2	0.2	0.13	0.04	0.29	0.19
E_3	0.05	0.00	0.00	0.05	0.02
E_4	0.15	0.17	0.02	0.34	0.11
E_5	0.21	0.13	0.12	0.46	0.15
E_6	0.03	0.24	0.00	0.27	0.09
E_7	0.15	0.16	0.00	0.31	0.10
TOTAL	0.88	0.87	0.34		
MEAN	0.13	0.12	0.05		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	0.32	0.01	2.34	0.0094
Replication	2	0.05	0.02	4.11	0.0239
Variety (A)	2	0.08	0.04	7.05*	0.0024
Extract (B)	6	0.08	0.01	2.19^{ns}	0.0645
AXB	12	0.10	0.00	1.34^{ns}	0.2335
Error	40	0.25	0.00		
Total	62	0.58			

*- significant
ns- not significant

CV=0.33%

Appendix Table 28. Weekly fresh weight of roots nodules of snap bean as affected by variety and plant extract. Fifth week after seed germination.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	0.41	0.83	0.60	1.84	0.61
V_1E_2	0.61	0.24	0.54	0.39	0.46
V_1E_3	0.61	0.38	0.46	1.45	0.48
V_1E_4	0.53	0.51	0.30	1.34	0.44
V_1E_5	0.33	0.32	1.01	1.66	0.55
V_1E_6	0.19	0.35	1.04	1.58	0.52
V_1E_7	0.71	0.34	0.53	1.58	0.52
V_2E_1	0.65	0.31	0.63	1.59	0.53
V_2E_2	0.50	0.52	0.37	1.39	0.46
V_2E_3	0.17	0.23	0.31	0.71	0.23
V_2E_4	0.40	0.82	0.77	1.99	0.66
V_2E_5	0.41	0.02	0.78	1.21	0.40
V_2E_6	0.52	0.46	0.61	1.59	0.53
V_2E_7	0.45	0.23	0.47	1.15	0.38
V_3E_1	0.74	1.38	0.41	2.53	0.84
V_3E_2	0.84	0.60	0.55	1.99	0.66
V_3E_3	0.31	0.81	1.19	2.31	0.77
V_3E_4	0.07	0.65	0.74	1.46	0.48
V_3E_5	0.39	0.08	0.74	1.21	0.40
V_3E_6	0.26	0.30	0.43	0.99	0.33
V_3E_7	0.22	0.48	0.71	1.41	0.47

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	0.16	0.53	0.84	1.98	0.66
E_2	0.46	0.46	0.66	1.58	0.53
E_3	0.48	0.23	0.77	1.48	0.49
E_4	0.44	0.66	0.48	1.58	0.53
E_5	0.55	0.40	0.40	1.35	0.45
E_6	0.52	0.53	0.33	1.38	0.46
E_7	0.52	0.38	0.47	1.37	0.46
TOTAL	3.58	3.19	3.95		
MEAN	0.51	0.46	0.56		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	1.60	0.07	1.09	0.3918
Replication	2	0.41	0.20	3.8	0.0523
Variety (A)	2	0.12	0.06	0.89^{ns}	0.4200
Extract (B)	6	0.28	0.04	0.72^{ns}	0.6330
AXB	12	0.77	0.06	0.97^{ns}	0.4958
Error	40	2.67	0.06		
Total	62	4.28			

ns- not significant CV=1.03%

Appendix Table 29. Weekly dry weight of roots nodules of snap bean as affected by different plant extract. Fifth week after seed germination.

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	0.16	0.32	0.30	0.78	0.26
V_1E_2	0.21	0.13	0.2	0.54	0.18
V_1E_3	0.22	0.12	0.20	0.564	0.18
V_1E_4	0.16	0.15	0.30	0.61	0.20
V_1E_5	0.11	0.07	0.69	0.87	0.29
V_1E_6	0.07	0.11	0.27	0.45	0.15
V_1E_7	0.23	0.09	0.16	0.48	0.16
V_2E_1	0.18	0.11	0.16	0.45	0.15
V_2E_2	0.17	0.17	0.08	0.42	0.14
V_2E_3	0.03	0.88	0.09	1.00	0.33
V_2E_4	0.13	0.09	0.18	0.4	0.13
V_2E_5	0.19	0.17	0.25	0.53	0.17
V_2E_6	0.18	0.13	0.21	0.55	0.18
V_2E_7	0.12	0.18	0.15	0.45	0.15
V_3E_1	0.21	0.33	0.13	0.67	0.22
V_3E_2	0.24	0.16	0.16	0.56	0.18
V_3E_3	0.09	0.92	0.06	0.07	0.35
V_3E_4	0.22	0.24	0.21	0.57	0.19
V_3E_5	0.15	0.26	0.26	0.67	0.22
V_3E_6	0.29	0.10	0.13	0.52	0.17
V_3E_7	0.07	0.05	0.19	0.31	0.10

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	0.26	0.15	0.22	0.63	0.21
E_2	0.18	0.14	0.18	0.5	0.17
E_3	0.18	0.33	0.35	0.86	0.29
E_4	0.20	0.13	0.19	0.56	0.17
E_5	0.29	0.13	0.22	0.58	0.23
E_6	0.15	0.18	0.17	0.5	0.17
E_7	0.16	0.15	0.10	0.41	0.14
TOTAL	1.42	1.25	1.43		
MEAN	0.20	0.18	0.20		

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN OF SQUARE	F VALUE	PR>F
Treatment	22	0.13	0.01	0.44	0.9783
Replication	2	0.49	0.02	0.74	0.4838
Variety (A)	2	0.00	0.00	0.13^{ns}	0.880
Extract (B)	6	0.14	0.02	0.75^{ns}	0.6152
AXB	12	0.11	0.00	0.29^{ns}	0.9880
Error	40	1.23	0.03		
Total	62	1.55			

ns- not significant CV=0.74%

Appendix Table 30. Seedling growth of snap bean as affected by variety and plant extract (cm).

TREATMENT	REPLICATION			TOTAL	MEAN
	1	2	3		
V_1E_1	46.81	79.89	74.59	201.29	67.09
V_1E_2	78.50	75.25	78.99	232.74	77.58
V_1E_3	83.50	70.70	76.74	230.53	76.84
V_1E_4	63.84	68.85	69.49	202.18	67.39
V_1E_5	79.92	77.49	78.43	235.84	78.61
V_1E_6	17.13	14.90	15.22	47.25	15.75
V_1E_7	66.84	78.20	72.13	217.17	72.39
V_2E_1	17.07	16.52	16.56	50.15	16.71
V_2E_2	17.35	22.67	16.84	58.86	18.95
V_2E_3	09.24	10.40	11.38	31.02	10.34
V_2E_4	19.53	18.54	17.00	55.07	18.35
V_2E_5	22.72	15.84	17.45	56.00	18.66
V_2E_6	74.33	70.71	81.76	226.80	75.60
V_2E_7	21.28	21.74	18.54	61.60	20.52
V_3E_1	24.24	18.94	22.59	65.77	21.92
V_3E_2	19.61	20.62	20.46	60.69	20.23
V_3E_3	17.89	21.13	4.30	43.32	14.44
V_3E_4	20.48	20.62	19.52	60.62	20.20
V_3E_5	20.13	26.14	14.97	62.24	20.74
V_3E_6	22.85	19.76	21.00	63.61	21.20
V_3E_7	13.74	21.54	19.86	55.14	18.38

TWO WAY TABLE

TREATMENT	VARIETY 1	2	3	TOTAL	MEAN
E_1	67.09	16.17	21.92	105.72	35.24
E_2	77.58	18.95	20.23	116.76	38.92
E_3	76.84	10.34	14.44	101.62	33.87
E_4	67.39	18.35	20.20	105.94	35.31
E_5	78.61	19.66	20.74	118.01	39.34
E_6	15.75	75.60	21.20	112.55	37.52
E_7	72.39	20.52	18.38	111.29	37.19
TOTAL	455.65	171.13	137.11		
MEAN	65.09	24.45	19.59		

ANALYSIS OF VARIANCE

SV	DF	SS	MS	F	PR>F
Treatment	22	43714.45	1987.02	67.57	0.0001
Replication	2	28.31	14.15	0.48	0.6215
Variety (A)	2	25704.54	12852.27	437.04**	0.0001
Extract (B)	6	217.43	36.23	1.23^{ns}	0.3105
AXB	12	17764.6	1480.34	50.34**	0.0001
Error	40	1176.31	29.40		
Total	62	44890.76			

**- highly significant
ns- not significant

CV=0.14.76%