BIBLIOGRAPHY

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ABSTRACT

The study was conducted to determine the growth and yield of the different bush snap bean varieties applied with the different volumes of water; determine the best water requirements for bush snap bean production; and to determine the interaction effect of the bush snap bean varieties and the volumes of water on the growth and yield of bush snap beans.

Sablan and Bokod have the tallest plant height at 30 and 60 DAP, produced more flower clusters, more pods per clusters while Contender had the widest leaf area, highest percentage pod set per cluster, widest pod, longest pod, and more crown roots. On the other hand Sablan has the longest roots and Bokod had the highest total yield per plant.

The different volumes of water significantly affected the number of crown roots and length of the roots of the different bush bean varieties.

No significant differences were noted in all the parameters gathered as affected by the bush snap bean varieties and the application of different volumes of water.

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INTRODUCTION

Snap bean (*Phaseolus vulgaris L.*) is a common source of protein for human diet and as well as feed supplement for animals. Snap bean thrives well in cool medium to high altitude just like Benguet (Mariano, 2007). Further, it is one of the main sources of income of the farmers in the highlands, like Benguet. They plant this crop mostly for it is easily grown and does not require intensive management, but, for how many decades, climate change became one of the major constraints to the bean production.

Pendleton and Lawson (1987) quoted that weather and climate changes strongly affect the fluctuation of food supplies. Also, climate is a foremost factor in determining the adaptability of crops. High rainfall and humidity which adversely affect reproduction, ripening, drying, storage, increase pest and disease problems of cereals and grain legumes. Fluctuating rainfall patterns combined with soils of low moisture-holding capacity often lead to periodic drought.

One farmer mentioned that farming is a game of chance ("Sugal id niman nan men garden") (BSU-ISRD and FAO, Undated). This proves that farmers in Benguet are already experiencing the effects of climate change as evident in the observed occurrence of new pests and diseases, also crop destruction due to El Niño, La Niña, hail stone and frost, and disruption of agricultural calendar.

At present, water stress is also one of the factors which limit the production of snap bean. Water stress reduced the expression of most traits with the exception of days to flower and leaf retention capacity. In addition, legume species often result in a loss of seed yield (Singh and Saxena, 1990). Plants react to stress where there is abnormal growth, and it could be either a decline in quality or yield reduction, where both are

important. Water stress can cause direct and indirect damages to the crops. Deficiency in water can cause poor stand when water stress occurs during germination, and yield reduction or decline in quality, such as deformity in the fruits of beans. Indirect damage may consists of calcium deficiency , while water excess can also cause direct damage, such as leaching of fertilizers, reduced root development, and development of adventitious roots. Indirect effect can favor the occurrences of root rot and other diseases.

In this case, there is a need to evaluate potential varieties of beans which are able to withstand different volume of water condition.

Thus, this study was conducted to:

1. evaluate the growth and yield of the different bush snap bean varieties applied with different volumes of water;

2. determine the best water requirements for bush snap bean production; and

3. determine the interaction effect of the bush snap bean varieties and the different volumes of water on the growth and yield of bush snap bean.

In addition, the choice of appropriate variety that can cope up with different volumes of water is an important factor in the successful production of beans because planting of variety that does not tolerate different volumes of water will lead to losses.

The study was conducted at Balili, La Trinidad, Benguet in a greenhouse from November 2010 to March 2011.

REVIEW OF LITERATURE

Effect of Water Stress on the Plant

Water stress affects practically every aspects of plant growth, modifying the anatomy, morphology, physiology and biochemistry (Kramer, 1993).

In 1975, Tisdale and Nelson stated that plants require water for the manufacture of carbohydrates, to maintain hydration of protoplasm, and as a vehicle of the translocation of foods and other mineral elements. It also said that moisture stress causes reduction in the cell elongation, hence retarding the growth of the plant. Recently, Chapman and Carter (1976) postulated that all plants are harmed to some degree by inadequate moisture and added that under condition of drought where total plant growths or dry matter is reduced consequently reducing yield.

However, excessive water also affects crop growth where it causes direct damage to shoots, high incidence of pests and diseases, physical destruction of flowers, and less activity of pollinators (AVRDC, 1990).

Effects of Water Stress on Growth Stages of the Plant

Maiti (1997) stated that the normal process of seedling development is largely controlled by environmental factors and influences the development of the adult plant. Kramer (1976) as cited by Bawang (1990) stated that the vegetative growth is particularly sensitive to water deficit because growth is closely related to turgor and loss of turgidity stops cell division.

In addition, AVRDC (1990) stated that under this condition, guard cells lose their turgidity and stomatal opening decreases. Eventually, the rate of photosynthesis and

consequently growth and yield also decrease where in extreme condition the plant may either wilt or die.

However, under excess water conditions plant growth are being toxified, and finally retards growth of the plant. It also said that crops in the early vegetative stage may be unable to develop a deep root system if light watering is made regularly.

Effects of Water Stress on the Flower,
Pod set and Pod Formation of the Plant

Salehi *et al.,* (2006) reported that seedling and flowering stages were the most sensitive to water availability and water stress. However, occurrence of water stress during any growth stages in legume species often results in a loss of yield especially seed yield. Catipon *et al*. (1988) reported that intensive water stress in dry season and strong wind in humid season reduced mungbean seed yield.

For all crops grown for fruits and seed, Chapman and Carter (1976) stated that moisture stress before, during and immediately after flowering seems to have the greatest effect on reducing yield.

Excessive abortion of flowers, young pods and seeds occurs in dry bean because of water stress during pre- flowering (10 to 12 days before anthesis) and reproductive periods. Moderate to severe water stress reduced biomass and seed yield from 20 percent to 90 percent, harvest index, number of pods and seeds, seed weight, and days to maturity (Salehi *et al.,* 2008).

Effect of Water Stress on Root

Drought stress increase root shrinkage that consequently affects nutrient transport to the root surface due to reduced contact between root and soil (North and Nobel, 1997).

Passioura (2002) stated that dry soil particles hold water and nutrient more strongly on the surface, and dry soil is more compact for root penetration. Root rots caused by *Macrophomina phaseolina* (Tassi) Groid; *Fusarium solani f.sp.phaseoli* (Burk), and other fungi may aggravate drought stress. Similarly, drought stress cultivars are prone to damage by leafhoppers in the tropics and subtropics. While excess water can also reduced root development and development of adventitious roots. Indirect damage due to excess water consists of root rot and other diseases, which are favored by high soil moisture (AVRDC, 1990). As a result, plant roots cannot obtain oxygen for respiration to maintain their activities for nutrient and water uptake.

Water Stress Resistance in Legumes

Some bean cultivars reportedly have a certain degree of resistance to water stress. Resistant varieties are capable of growing and yielding satisfactorily under unfavorable growing conditions. Plants which can survive drought either avoid or tolerate drought are called to be drought avoiders where they avoid drying of their tissues by maintaining their water uptake and/or reducing water loss. The plant should be able to produce more roots than shoots. In addition, it has the ability to move its leaves so that only a very small leaf area is exposed to incoming radiation. It also develops hairs to insulate the leaf surface and it becomes waxier. According to AVRDC (1990) all these characteristics reduce light absorption, hence, reduce water loss. In most of these drought avoiders are, legumes.

On the other hand, tolerators survive drought by functioning normally even with a low amount of water in their tissues (AVRDC, 1990).

Kramer (1969) pointed out that very young seedlings are more resistant to water stress than older plants.

Excessive water also affects crop growth but however, the extent of flooding damages depends upon the susceptibility of species or variety (AVRDC, 1990).

MATERIALS AND METHODS

The experiment was done at BSU- Experimental Station in Balili, La Trinidad, Benguet in a greenhouse. The area was properly cleaned. Plastic pots with a measurement of 15.24cm x 27.94cm were used and filled with soil and bio-fertilizer with a 3:1 ratio. Three bean seeds were planted per pot at a depth not exceeding 2.5 centimeters. After one week germination it was thinned to only one plant per pot. The study was laid out using 3x5 factor factorial in Completely Randomize Design (CRD) with three replications. Weeding was done to avoid water and nutrient competition on the crop. A rate of 120 grams compost fertilizer was applied to every pot at 20 days after planting. Irrigation management as treatment was strictly applied to the plant when the true leaves fully appeared. The different volumes of water served as Factor A and the three bush snap bean varieties served as Factor B.

Factor A: Volume of water (T)

Code	Treatment
T_0	200 ml. of water will be applied to all control plants every other day (Farmers Practice)
T_1	800 ml. of water will be applied every morning of the day to all plants when the true leaf has fully appeared
T_2	500 of water will be applied every morning of the day to all plants when the true leaf has fully appeared
T_3	100 ml. of water will be applied every other day to all plants when the true leaf has fully appeared
T_4	45 ml. of water will be applied every other day to all plants when the true leaf has fully appeared

Factor B: Varieties (V)

Code	Variety	Source
V_1	Contender	BSU- NPRCRTC
V_2	Bokod	BSU- NPRCRTC
V_3	Sablan	BSU- NPRCRTC

The data gathered were the following:

1. Number of days from sowing to emergence. This was recorded by counting the number of days from sowing to emergence and when at least 60% of the seed sown has emerged.

2. Initial plant height (cm). This was measured from the base of the plant at the ground level to the youngest shoots, using a meter stick or a foot rule from five plant samples in different treatment at 30 days after planting.

3. Final height (cm). This was measured from the base of the plant at the ground level to the youngest shoots, using a meter stick or a foot rule from five plant samples in different treatment at 60 DAP.

4. Plant vigor. This was taken using these scales at 30 DAP and 60 DAP. (NPRCRTC, 1997).

Scale	Description	Remarks
1	Plants are weak with few stems and leaves; very pale.	Poor vigor
2	Plants are weak with few thin stems and leaves; pale	Less vigor

Scale	Description	Remarks
3	Better than less vigorous	Vigorous
4	Plants are moderately strong with robust stem and leaves; leaves are light green in color.	Moderately vigorous
5	Plants are strong with robust stems and leaves; leaves are light to dark green color.	Highly vigorous

5. Days from emergence to flowering. This was recorded starting from emergence to the day when 60% of plants have flowered.

6. Days from emergence to pod setting. This was taken by counting the number of days starting from flowering to the days when pods are formed at the same time recording the date of pod setting.

7. Days from emergence to first harvest. This was recorded by counting the number of days from emergence to first harvest at the same time recording the date of first harvest.

8. Days from emergence to last harvest. This was taken by counting the number of days from emergence to last harvest at the same time recording the date of last harvest.

9. Number of flower cluster per plant. This was taken by counting the flower cluster from the five sample plants.

10. Number of flower per cluster. This was taken by counting the flowers per cluster from the five sample plants.

11. Number of pods per cluster. This was recorded by counting the number of pods per cluster from five sample plants.

12. Percentage pod set per cluster. This was taken by using this formula:

$$\% \text{ Pod Setting} = \frac{\text{Total number of pods per cluster}}{\text{Total number of flower per cluster}} \times 100$$

13. Length of pod (cm). This was recorded by measuring the five randomly selected pods at harvest maturity.

14. Width of pod (cm). This was recorded by measuring the five randomly selected pods at harvest maturity.

15. Leaf length (cm). This was recorded by measuring the first trifoliate leaves of five sample plants from petiole to leaf tip at 30 days after planting.

16. Leaf width (cm). This was recorded by measuring the first trifoliate leaves of five sample plants from tip to tip sides at 30 days after planting.

17. Root length. This was recorded by measuring the tap or primary roots of five sample plants using a meter stick or a foot rule after the last harvest.

18. Number of crown roots. This was recorded by counting the crown roots of five sample plants.

19. Weight of marketable fresh pod per plant (kg). This was the pods that are smooth, well- formed and free from damages. The fresh pod of variety in different treatment was weighed after harvest.

20. Weight of non- marketable fresh pods per plant (kg). This was the pods that are over matured, malformed, and damage by pest and diseases. This was obtained by weighing the non- marketable fresh pods of variety in different treatment.

21. Total yield per plant (kg). This was recorded by getting the total weight of marketable and non- marketable fresh pods per plant in the different treatment throughout the harvest period.

22. Disease and Pest Incidence. This was noted by visual observation and was assessed by rating the degree of disease and insect damage on the crop at 30 DAP and 60 DAP.

a. Bean rust. (as cited by Jose, 2004).

Scale	Description	Remark
1	No infection	High resistant
2	1-25% of the total plants are infected.	Mild resistant
3	25-50% of the total plants are infected.	Moderate resistant
4	50-75% of the total plants are infected.	Susceptible
5	75-100% of the total plants are infected.	Very susceptible

b. Pod borer.

Scale	Description	Remark
1	No infection	High resistant
2	1-25% of the total plants are infected.	Mild resistant
3	25-50% of the total plants are infected.	Moderate resistant
4	50-75% of the total plants are infected.	Susceptible
5	75-100% of the total plants are infected.	Very susceptible

23. Agro- climatic data. The average monthly temperature, relative humidity, sun intensity was taken using the appropriate measuring devices like light meter and hygrometer every Mondays during the entire growing seasons of the crop from December 2010 to March 2011.

Data Analysis

All quantitative data was analyzed using analysis of variances (ANOVA) for Completely Randomize Design (CRD) with three replications. The significance of

difference among treatment means was tested using Duncan's Multiple range test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSIONS

Agro- Climatic Data during the Study Period

Table 1 shows the temperature, relative humidity and sunlight intensity. Temperature ranged from 20.17 to 22.17 ^{0}C, relative humidity is 78.03 %, and light intensity in lux ranged from 535.67 to 705 with a mean of 641.

According to BNCRDC Technoguide, snap bean is best grown under cool climate condition. However, it can tolerate warm temperatures up to 25^{o}C.

Days from Sowing to Emergence and Flowering

Effect of water volume. No significant differences were observed on the number of days to emergence until flowering of the three bush snap bean varieties as affected by the different volumes of water application. Different volume of water was applied after the appearances of true leaves at 13 DAP as shown in Figure 1.

Effect of varieties. Result showed that the three bush snap bean varieties uniformly emerged 8 days after sowing and flowered at 32 days from emergence.

Table 1. Agro climatic data during the study period (December, 2010 – February, 2011)

MONTH	TEMPERATURE (^{O}C)	RELATIVE HUMIDITY	SUNLIGHT INTENSITY
	MEAN		(Lux)
December	22.17	77.30	705
January	20.20	79.80	682.6
February	20.17	77.00	535.67
MEAN	20.84	78.03	641.09

Figure 1. Bush snap bean at 13 DAP (formation of true leaf has fully appeared in the start of applying the different volumes of water)

Interaction effect. There was no significant difference observed in the days from emergence to flowering as affected by three varieties and the different volume of water.

Initial Plant Height at 30 and 60 DAP

Effect of water volume. No significant differences were noted on the plant height of the three bush snap beans at 30 and 60 DAP. However, taller plants were noted in the bush snap beans varieties applied with 200 ml of water (farmer's practice) with a height of 25.170 cm. This could be attributed to enough moisture applied to the plant for growth (Table 2).

Tisdale and Nelson (1975) stated that moisture stress causes reduction in the cell elongation, hence retarding the growth of the plant. In addition, Chapman and Carter (1976) postulated that all plants are harmed to some degree by inadequate moisture and added that under condition of drought where total plant growths or dry matter is reduced consequently reducing yield.

Table 2. Plant height at 30 DAP and 60 DAP of the three bush snap bean varieties as affected by the volume of water application

TREATMENTS	PLANT HEIGHT (cm)		PLANT VIGOR	
	30 DAP	60 DAP	30 DAP	60 DAP
VOLUME OF WATER (A)				
200 ml. of water (Farmer's practice)	25.17	41.21	5.00	4.98
800 ml. of water	24.54	37.53	5.00	4.82
500 ml. of water	24.67	37.65	5.00	4.98
100 ml. of water	23.75	38.24	4.96	4.91
45 ml. of water	22.38	37.03	5.00	4.89
VARIETY (B)				
Contender	20.87[b]	34.12[b]	4.97	4.87
Bokod	26.95[a]	41.19[a]	5.00	4.93
Sablan	24.94[a]	39.68[a]	5.00	4.93
AxB	ns	ns	ns	ns
CV%	8.54	8.00	1.19	2.78

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

Effect of variety. Statistically, the plant height of the three bush snap bean varieties was significantly different. Bokod and Sablan were taller than Contender at 30 and 60 DAP. The differences noted could be genetic in nature.

Interaction effect. Statistically, there was no significant interaction effect between the different volumes of water application on the plant height of the three bush snap bean varieties.

Plant Vigor at 30 and 60 DAP

Effect of water volume. Results showed that there were no significant differences on the plant vigor applied with the different volumes of waters at 30 and 60 DAP as shown in Table 2.

Effect of variety. Results showed that there were no significant differences among varieties. All of the varieties were observed to be highly vigorous with robust stem and the leaves are light to dark green in color.

Interaction effect. The interaction between the different volumes of water and bush snap bean varieties was observed to be not significant at 30 and 60 DAP.

Days from Emergence to Pod Setting, First, and Last Harvest

Effect of water volume. No significant differences on the volume of water application on the number of days from emergence to pod setting, days from emergence to first harvest, and days from emergence to last harvest were observed.

Effect of variety. Results showed that there were no varietal significant differences between the three bush snap bean varieties in the days from emergence to pod setting, days from emergence to first harvest, and days from emergence to last harvest.

Interaction effect. There was no significant interaction effect among the three varieties of bush snap beans and the volumes of water applications on the number of days from emergence to pod setting, and emergence to first and last harvest.

Number of Flower Cluster

Effect of water volume. As shown in Table 3, there were no significant differences on the number of flower cluster as affected by the application of different volumes of water. All of the bush snap beans produced five flower clusters except the plants applied with 200 ml water with six.

Effect of variety. Results showed that there was a significant difference between the varieties on the number of flower cluster produced. Although, Bokod and Sablan have

Table 3. Number of flower cluster and number of flower per cluster of bush snap bean as affected by different volumes of water applied

TREATMENTS	NUMBER	
	FLOWER CLUSTER	FLOWER PER CLUSTER
VOLUME OF WATER (A)		
200 ml. of water (Farmer's practice)	6	6
800 ml. of water	5	5
500 ml. of water	5	5
100 ml. of water	5	5
45 ml. of water	5	5
VARIETY (B)		
Contender	4^b	5^b
Bokod	6^a	6^a
Sablan	6^a	6^a
AxB	ns	ns
CV%	9.31	12.18

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

six flower clusters while Contender has four flower clusters. These differences noted among the three bush snap bean varieties can be associated with their different genetic potentials. The number of flower cluster is an important factor contributing to yield of the plants. Theoretically, the more the flower cluster, the greater the yield (Singha, 1973).

Interaction effect. There was no significant interaction effect between the different volumes of water application on the three bush snap bean varieties on the number of flower cluster.

Number of Flower per Cluster

Effect of water volume. No significant differences were observed on the three varieties of bush snap beans on the number of flower per cluster even applied with different volumes of water. The application of 200 ml of water though produced six flowers per cluster while the rest of the plant produced five.

Salehi *et al.,(* 2008) stated that excessive abortion of flowers, young pods and seeds occurs in dry bean because of water stress during pre- flowering (10 to 12 days before anthesis) and reproductive periods.

Effect of variety. The number of flower produced per cluster is presented in Table 3. Statistically, results showed no significant varietal differences on the number of flowers produced. Means ranged from five to six flowers per cluster.

Interaction effect. There were no significant interactions between the different volumes of water application on the three varieties of bush snap beans evaluated in the production of flowers per cluster.

Number of Pod per Cluster

Effect of water volume. Statistically, there was no significant effect of the different volumes of water application on the production of pod per cluster of the

Table 4. Number of pod per cluster and percentage pod set per cluster as affected different volumes of water applied

TREATMENTS	NUMBER OF POD PER CLUSTER	PERCENTAGE POD SET PER CLUSTER
VOLUME OF WATER (A)		
200 ml. of water (farmer's practice)	4	66.9
800 ml. of water	3	66.3
500 ml. of water	4	67.4
100 ml. of water	3	65.6
45 ml. of water	3	62.6
VARIETY (B)		
Contender	3	67.0
Bokod	4	63.6
Sablan	4	66.7
AxB	ns	ns
CV%	20	18.41

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

different varieties of bush snap beans. The number of pod per cluster produced has a mean of three to four pods (Table 4).

For all crops grown for fruits and seed, Chapman and Carter (1976) stated that moisture stress before, during and immediately after flowering seems to have the greatest effect on reducing yield. In addition, high soil moisture levels during seed formation, pod striping and seed coloring will result in white- mold damage, delayed maturity and quality problems.

Effect of varieties. The different varieties used did not significantly affect the number of pods per cluster produced by the bush snap beans (Table 4). Number of pods ranged from three to four.

Interaction effect. No significant interactions were noted in terms of pod per cluster on the three varieties of bush snap bean as affected by different volumes of water applied.

Percentage Pod Set per Cluster

Effect of water volume. The different volumes of water applied did not significantly influence the percent pod setting of the different varieties. Percentage pod setting ranges from 62.6 to 67.4.

Effect of varieties. The different bush snap bean varieties used did not significantly influence the percent pod setting. Numerically, highest pod setting was recorded in Contender (67 %), followed by Sablan (66.7 %) while 63 % pod setting was observed in Bokod.

Interaction effect. No significant interactions were noted in terms of percentage per cluster on the three varieties of bush snap bean as affected by different volumes of water applied.

Pod Length and Width

Effect of water volume. No significant differences on the effect of the different volume of water application on the pod length and width on the different varieties of bush snap beans were observed as shown in Table 5. Pod length ranges from 14.56 to15.38 cm while pod width ranges from 0.94 to 0.97 cm.

Effect of varieties. No significant differences were also noted on the different varieties of bush snap beans in terms of length. However, in terms of pod width Contender significantly produced the widest pod of 1.12 cm, and the narrowest pod was observed in Bokod and Sablan with 0.80 and 0.85 cm, respectively.

Table 5. Pod length and width of bush snap bean as affected by volumes of water applied

TREATMENTS	POD (cm)	
	LENGTH	WIDTH
VOLUME OF WATER (A)		
200 ml. of water (farmer's practice)	15.38	0.94
800 ml. of water	15.01	0.97
500 ml. of water	15.19	0.94
100 ml. of water	14.79	0.94
45 ml. of water	14.56	0.94
VARIETY (B)		
Contender	15.49	1.12
Bokod	14.80	0.87
Sablan	14.66	0.85
AxB	ns	ns
CV%	6.59	5.67

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

Interaction effect. No significant interaction was recorded in terms of pod length and width as affected by the bush snap bean varieties and by the different volumes of water applied.

Leaf Length and Width

Effect of water volume. No significant differences were observed on the leaf length and width of the three bush snap bean varieties as affected by different volumes of water application.

Effect of varieties. The different bush bean varieties had significantly affected the leaf length and width measured at 30 DAP (Table 6). Contender produced the widest and longest leaf of 21.63 and 14.15 cm, respectively. Comparable leaf width was observed in Bokod (19.23) while Sablan produced the narrowest leaf.

Table 6. Leaf length and width of bush snap bean as applied with different volumes of water

TREATMENTS	LEAF (cm)	
	LENGTH	WIDTH
VOLUME OF WATER (A)		
200 ml. of water (farmer's practice)	13.24	19.72
800 ml. of water	12.62	19.56
500 ml. of water	13.12	20.22
100 ml. of water	12.91	20.11
45 ml. of water	13.54	19.23
VARIETY (B)		
Contender	14.15[a]	21.63[a]
Bokod	12.63[b]	19.23[ab]
Sablan	12.45[b]	18.44[b]
AxB	ns	Ns
CV%	9.98	9.67

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

Figure 2. Leaves of the bush snap beans starting to fold as affected with little volume of water

Crops that have wider leaf area have higher transpiration rate than of leaf that has less area. Since legumes have less leaf area with hairy leaves and have the ability to move their leaves so that only a very small leaf area is exposed to incoming radiation which reduce transpiration (AVRDC, 1990) as shown in Figure 2.

Interaction effect. No significant interaction was noted in terms of leaf length and width on the three bush snap bean varieties as affected by the different volumes of water application.

Number of Crown Roots

Effect of water volume. Statistically, result showed that there was a high significant effect of the different volumes of water applied on the number of crown roots (Table 7). The application of 800 ml of water gave the highest number of crown roots with 12, comparable with the application of 500 and 200 ml of water with 11 and 10 number of crown roots, respectively. The least number of crown roots was observed on plants applied with 45 ml of water. With a high moisture soil plant should produce more

roots for survival and well developed aerenchyma (Buchanan, Gruissem and Jones, 2000).

Effect of variety. As shown in Table 7, Contender significantly displayed the highest number of crown roots, while Bokod and Sablan produced ten crown roots. The differences noted could be genetic in nature. Crops that have more roots are more resistant to drought and can tolerate moist soils (AVRDC, 1990).

Interaction effect. No significant interaction was noted in terms of number of crown roots on the three varieties of bush snap bean as affected by the different volume of water application.

Table 7. Number of crown roots and root length of bush snap bean as applied with different volume of water

TREATMENTS	NUMBER OF CROWN ROOTS	ROOT LENGTH (cm)
VOLUME OF WATER (A)		
200 ml. of water (farmer's practice)	10.30^{ab}	42.20^{ab}
800 ml. of water	11.80^{a}	26.92^{c}
500 ml. of water	11.33^{a}	31.00^{bc}
100 ml. of water	9.49^{bc}	41.95^{ab}
45 ml. of water	9.33^{c}	48.78^{a}
VARIETY (B)		
Contender	11.04^{a}	30.40^{c}
Bokod	10.05^{b}	40.89^{b}
Sablan	10.25^{b}	43.21^{a}
AxB	ns	ns
CV%	10.95	21.83

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

Root Length

Effect of water volume. Result showed that there was a significant effect of the different volumes of water applied on the root length as shown in Table 7. The application of 45ml water produced the longest root of 48.78 cm followed by the significanceapplication of 200 ml and 100 ml of water. The shortest root was recorded on applied with 800 ml of water. Observation showed that high volumes of water produce shorter roots while low volumes of water has longer root. In area where there is a deficit of water the root of the plant should grow longer to absorb water from the lower depths while, excess water can also reduced root development and development of adventitious roots (AVRDC, 1990)

Effect of variety. Significant differences were obtained on the root length as shown in Table 7 and Figure 3. Sablan was noted to produce the longest roots of 43.21 cm while Contender produced the shortest root length of 30.40 cm. Plant that has longer rooting system can absorb water from the lower depths (AVRDC, 1990).

Interaction effect. No significant interaction effect was noted in terms of root length on the three varieties of bush snap bean as affected by the different volumes of water applied.

Reaction to Bean Rust and Pod Borer

The three varieties applied with different volumes of water showed mild resistance to bean rust which means 1 to 25 % of the total plants are infected. Resistance to bean rust plays an important role in bush snap bean production because infection could affect the photosynthetic activity of the plant. While the reaction of bush snap beans to

CONTENDER

T_o- 200 ml of water T_1- 800 ml of water T_2- 500 ml of water T_3- 100 ml of water T_4- 45 ml of water

BOKOD

To- 200 ml of water T_1- 800 ml of water T_2- 500 ml of water T_3- 100 ml of water T_4- 45 ml of water

SABLAN

To- 200 ml of water T_1- 800 ml of water T_2- 500 ml of water T_3- 100 ml of water T_4- 45 ml of water

Figure 3. Roots of different bush snap bean varieties as affected with the different volumes of water

pod borer as monitored at 60 DAP showed that the three varieties of bush snap bean were highly resistant to pod borer regardless of the different volumes of water applied.

Weight of Marketable Fresh Pods

Effect of water volume. No significant differences were observed on the weight of marketable fresh pods as affected by the different volume of water applied on the three varieties. Numerically, application of 200 ml of water or the farmers practice yield higher pods (104 gram) per plant while the lowest marketable pods were recorded in plants applied with 45 ml of water. Lack and excess soil moisture content can affect the biomass yield of the crops (Buchanan *et al.*, 2000).

Effect of variety. There were also no significant differences among the three varieties as observed in terms of marketable weight of fresh pods. Bokod and Sablan produced more marketable pods in terms of weight while Contender produced the least.

Interaction effect. No significant interaction was noted in terms of marketable weight of fresh pods on the three varieties as affected by different volumes of water applied.

Non- Marketable Weight of Fresh Pods

Effect of water volume. There were no significant differences in the different volumes of water applied in terms of non- marketable weight of fresh pods.

Effect of variety. The production of non-marketable fresh pods was not significant among the varieties of bush snap beans as shown in Table 8.Non- marketable pod weight ranges from 1.67 to 2.67 g. This is due to protected environment where there is least pest infestation.

Interaction effect. No significant interaction was noted in terms of the production of non- marketable weight of fresh pods on the three varieties of bush snap bean as affected by the different volumes of water applied.

Total Yield Per Plant

Effect of water volume. Table 8 showed that numerically the application of 100 ml of water produce the highest total yield per plant of 110.44 g, followed by the application of 200 ml of water (166.67 g). The lowest total yield per plant was noted on plants applied with 45 ml of water with 83.56 of fresh pods produced. As mentioned earlier, the differences could be attributed to their flower cluster as detected by their genetic make up.

Table 8. Weight of marketable pods, non- marketable and total yield per plant of three bush snap bean as applied with different volumes of water.

TREATMENTS	WEIGHT OF PODS (g)		TOTAL YIELD PER PLANT (g)
	MARKET-ABLE	NON-MARKE TABLE	
VOLUME OF WATER (A)			
200 ml. of water (farmer's practice)	104	2.67	106.67
800 ml. of water	96	0.78	97.22
500 ml. of water	94	1.78	91.00
100 ml. of water	108	1.67	110.44
45 ml. of water	79	4.11	83.56
VARIETY (B)			
Contender	94	3.0	97.13
Bokod	97	1.47	98.87
Sablan	98	2.13	97.33
AxB	ns	ns	ns
CV%	7.56	172.35	56.87

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

CONTENDER

T_O- 200 ml of water T_1- 800 ml of water T_2- 500 ml of water T_3- 100 ml of water T_4- 45 ml of water

BOKOD

T_O- 200 ml of water T_1- 800 ml of water T_2- 500 ml of water T_3- 100 ml of water T_4- 45 ml of water

SABLAN

T_O- 200 ml of water T_1- 800 ml of water T_2- 500 ml of water T_3- 100 ml of water T_4- 45 ml of water

Figure 4. Pods of the three bush snap bean as affected by different volumes of water applied

Effect of variety. The production of total yield per plant was not significant among the varieties of bush snap beans as shown in Table 8. Total yield ranges from 97.13g to 97.87 g. This is due to protected environment where there is least pest infestation as shown in Figure 4.

Interaction effect. No significant interaction was noted in terms of total yield per plant on the three varieties of bush snap bean as affected by the different volumes of water.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Evaluation of bush snap bean varieties applied with different volumes of water was conducted at La Trinidad, Benguet in a greenhouse condition from December 2010 to February 2011. The objectives of the study were to determine the growth and yield of the different bush snap bean variety\ies applied with different volumes of water; determine the best water requirements for bush snap bean production; and determine the interaction effect of variety and the volumes of water on the growth and yield of bush snap bean.

Among the three varieties of bush snap bean, Sablan and Bokod have the tallest plant height at 30 and 60 DAP, produced more flower clusters, more pods per cluster while Contender had the widest leaf area, highest percentage pod set per cluster, widest pod, longest pod, and more crown roots. On the other hand, Sablan had the longest roots and Bokod had the highest total yield per plant.

The different volumes of water significantly affected the number of crown roots and length of the roots of the different bush snap bean varieties.

No significant differences were noted in all the parameters gathered as affected by the bush snap bean varieties and the application of different volume of water.

Conclusions

Sablan variety was the best performing as it produced the tallest plants, longest roots and highest yield. Contender produced the longest and widest leaf but the shortest root.

The application of different volumes of water does not significantly affect the growth and yield of all the bush bean varieties. The volume of water applied by farmers though produced the highest yield. Lowest yield was obtained from bush beans applied with the least amount of water.

The application of different volumes of water did not affect the growth and yield of the different varieties of bush beans

Recommendations

Sablan variety is recommended for production even under different levels of water in a green house. Likewise, application of 200 ml or the farmer's practice of water is still recommended to irrigate the bush snap bean varieties under protected environment.

Further evaluation is recommended to verify the results of the study under open field.

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APPENDICES

Appendix Table 1. Number of days from sowing to emergence

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	8	8	8	24	8
V2	8	8	8	24	8
V3	8	8	8	24	8
Sub- total	24	24	24	72	8
T1V1	8	8	8	24	8
V2	8	8	8	24	8
V3	8	8	8	24	8
Sub- total	24	24	24	72	8
T2V1	8	8	8	24	8
V2	8	8	8	24	8
V3	8	8	8	24	8
Sub-total	24	24	24	72	8
T3V1	8	8	8	24	8
V2	8	8	8	24	8
V3	8	8	8	24	8
Sub- total	24	24	24	72	8
T4V1	8	8	8	24	8
V2	8	8	8	24	8
V3	8	8	8	24	8
Sub- total	24	24	24	72	8

Appendix Table 2. Initial plant height of bush snap beans at 30 DAP

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	20.96	24.68	22.92	68.56	22.85
V2	27.87	27.32	28.86	84.05	28.02
V3	24.56	25.24	24.52	74.32	24.77
Sub- total	73.39	77.24	76.3	226.93	24.21
T1V1	21.82	21.42	20.04	63.28	21.09
V2	30.74	27.26	26.44	84.44	28.15
V3	24.78	23.62	24.74	73.14	24.38
Sub- total	77.34	72.3	71.22	220.86	24.54
T2V1	23.56	20.36	23.62	67.54	22.51
V2	26.00	27.36	27.56	80.92	26.97
V3	25.8	23.6	24.12	73.52	24.51
Sub- total	73.63	71.32	75.3	220.25	24.47
T3V1	22.61	19.66	19.38	61.65	20.55
V2	26.5	25.95	27.1	79.55	26.52
V3	24.84	23.42	24.26	72.52	24.17
Sub- total	73.95	69.03	70.74	213.72	23.75
T4V1	21.78	19.34	20.26	61.38	20.26
V2	27.2	23	25.06	75.26	25.09
V3	25.32	23.5	25	73.82	24.61
Sub- total	74.3	65.84	70.32	210.46	23.38

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	68.56	84.05	74.32	226.93	75.64
800 ml	63.28	84.44	73.14	220.86	73.62
500 ml	67.54	80.92	73.52	220.25	73.42
100ml	61.65	79.55	72.52	213.72	71.24
45 ml	61.38	75.26	73.82	210.46	70.15
TOTAL	322.41	404.22	367.32	1093.95	364.07
MEAN	64.84	80.84	73.46	219.14	72.81

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	26.589	13.295	7.04**	2.04	2.74
Factor A	4	42.594	10.648	2.51^{ns}	2.69	4.02
Factor B	2	280.723	140.362	33.13**	3.32	5.39
A x B	8	30.430	3.804	0.90^{ns}	2.27	3.17
Error	30	127.080	4.236			
TOTAL	44	480.827				

** - Highly significant
ns - not significant

Coefficient of variation=8.54%

Appendix Table 3. Final plant height of bush snap beans at 60 DAP

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	35.38	36.76	35.2	107.34	35.78
V2	41.68	42.04	50.42	134.14	44.71
V3	40.88	46.32	42.26	129.46	43.15
Sub- total	117.94	125.12	127.88	370.94	41.22
T1V1	36.3	35.16	34.6	106.06	35.35
V2	44.3	43.32	33.2	120.82	40.27
V3	36.88	34.6	39.44	110.95	36.97
Sub- total	117.48	113.08	107.24	337.8	37.53
T2V1	36.9	32.08	32.66	101.64	33.88
V2	37.82	40.84	40.2	118.86	39.62
V3	42.9	37.82	37.6	118.32	39.44
Sub- total	117.62	110.74	110.46	338.82	37.65
T3V1	32.34	36.58	32.5	101.42	33.81
V2	41.5	44	42.76	128.26	42.75
V3	38.56	35.44	40.46	114.46	38.15
Sub- total	112.4	116.02	115.72	344.14	38.24
T4V1	30.1	32.54	32.74	95.38	31.79
V2	38.34	37.72	39.74	115.8	38.6
V3	46.3	35.8	40	122.1	40.7
Sub- total	114.74	106.06	112.48	333.28	37.03

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	107.34	134.14	129.46	370.94	123.65
800 ml	106.06	120.82	110.95	337.8	112.6
500 ml	101.64	118.86	118.32	338.82	112.94
100ml	101.42	128.26	114.46	344.14	114.71
45 ml	95.38	115.8	122.1	333.28	111.09
TOTAL	511.84	617.88	595.29	1724.98	574.99
MEAN	102.37	123.58	118.01	343.96	114.10

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	588.497	42.035	5.0**	2.04	2.74
Factor A	4	100.113	25.028	2.66^{ns}	2.69	4.02
Factor B	2	415.890	207.945	2.13**	3.32	5.39
A x B	8	72.494	9.062	0.96^{ns}	2.27	3.17
Error	30	281.861	9.395			
TOTAL	44	870.358				

** - Highly significant
ns - not significant

Coefficient of variation=8.00%

Appendix Table 4. Plant vigor of bush snap beans at 30 DAP

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	5	5	5	15	5
V2	5	5	5	15	5
V3	5	5	5	15	5
Sub- total	15	15	15	45	5
T1V1	5	5	5	15	5
V2	5	5	5	15	5
V3	5	5	5	15	5
Sub- total	5	5	5	45	5
T2V1	5	5	5	15	5
V2	5	5	5	15	5
V3	5	5	5	15	5
Sub- total	15	15	15	45	5
T3V1	5	5	5	15	5
V2	5	5	5	15	5
V3	5	5	5	15	5
Sub- total	15	15	15	45	5
T4V1	5	5	5	15	5
V2	5	5	5	15	5
V3	5	5	5	15	5
Sub- total	15	15	15	45	5

Appendix Table 5. Plant vigor of bush snap beans at 60 DAP

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	5	5	5	15	5
V2	4.8	5	5	14.8	4.93
V3	5	5	5	15	5
Sub- total	14.8	15	15	44.8	4.98
T1V1	4.8	5	4.6	14.4	4.8
V2	5	4.6	5	14.6	4.86
V3	4.8	4.6	5	14.4	4.8
Sub- total	14.6	14.2	14.6	43.4	4.82
T2V1	5	5	4.8	14.8	4.93
V2	5	5	5	15	5
V3	5	5	5	15	5
Sub- total	15	15	14.8	44.8	4.98
T3V1	4.8	4.6	5	14.4	4.8
V2	4.8	5	5	14.8	4.93
V3	5	5	5	5	5
Sub- total	14.6	14.6	15	44.2	4.91
T4V1	5	4.6	4.8	14.4	4.8
V2	4.8	5	5	14.8	4.93
V3	5	5	4.8	14.8	4.93
Sub- total	14.8	14.6	14.6	44	4.89

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	15	14.8	15	44.8	14.93
800 ml	14.4	14.6	14.4	43.4	14.47
500 ml	14.8	15	15	44.8	14.93
100ml	14.4	14.8	15	44.2	14.73
45 ml	14.4	14.8	14.8	44	14.67
TOTAL	73	74	74.2	221.2	73.73
MEAN	24.33	24.67	24.73	73.73	14.75

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	0.50	0.004	1.0^{ns}	2.04	2.74
Factor A	4	0.014	0.004	1.0^{ns}	2.69	4.02
Factor B	2	0.007	0.004	1.0^{ns}	3.32	5.39
A x B	8	0.028	0.004	1.0^{ns}	2.27	3.17
Error	30	0.107	0.004			
TOTAL	44	0.156				

^{ns}- not significant Coefficient of variation=8.00%

Appendix Table 6. Days from emergence to flowering

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
TOV1	32	32	32	96	32
V2	32	32	32	96	32
V3	32	32	32	96	32
Sub- total	96	96	96	288	32
T1V1	32	32	32	96	32
V2	32	32	32	96	32
V3	32	32	32	96	32
Sub- total	96	96	96	288	32
T2V1	32	32	32	96	32
V2	32	32	32	96	32
V3	32	32	32	96	32
Sub- total	96	96	96	288	32
T3V1	32	32	32	96	32
V2	32	32	32	96	32
V3	32	32	32	96	32
Sub- total	96	96	96	288	32
T4V1	32	32	32	96	32
V2	32	32	32	96	32
V3	32	32	32	96	32
Sub- total	96	96	96	288	32

Appendix Table 7. Days from flowering to pod setting

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	7	7	7	21	7
V2	7	7	7	21	7
V3	7	7	7	21	7
Sub- total	21	21	21	63	7
T1V1	7	7	7	21	7
V2	7	7	7	21	7
V3	7	7	7	21	7
Sub- total	21	21	21	63	7
T2V1	7	7	7	21	7
V2	7	7	7	21	7
V3	7	7	7	21	7
Sub- total	21	21	21	63	7
T3V1	7	7	7	21	7
V2	7	7	7	21	7
V3	7	7	7	21	7
Sub- total	21	21	21	63	7
T4V1	7	7	7	21	7
V2	7	7	7	21	7
V3	7	7	7	21	7
Sub- total	21	21	21	63	7

Appendix Table 8. Days from emergence to first harvest

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
TOV1	56	56	56	168	56
V2	56	56	56	168	56
V3	56	56	56	168	56
Sub- total	168	168	168	504	56
T1V1	56	56	56	168	56
V2	56	56	56	168	56
V3	56	56	56	168	56
Sub- total	168	168	168	504	56
T2V1	56	56	56	168	56
V2	56	56	56	168	56
V3	56	56	56	168	56
Sub- total	168	168	168	504	56
T3V1	56	56	56	168	56
V2	56	56	56	168	56
V3	56	56	56	168	56
Sub- total	168	168	168	504	56
T4V1	56	56	56	168	56
V2	56	56	56	168	56
V3	56	56	56	168	56
Sub- total	168	168	168	504	56

Appendix Table 9. Days from emergence to last harvest

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
TOV1	66	66	66	198	66
V2	66	66	66	198	66
V3	66	66	66	198	66
Sub- total	198	198	198	594	66
T1V1	66	66	66	198	66
V2	66	66	66	198	66
V3	66	66	66	198	66
Sub- total	198	198	198	594	66
T2V1	66	66	66	198	66
V2	66	66	66	198	66
V3	66	66	66	198	66
Sub- total	198	198	198	594	66
T3V1	66	66	66	198	66
V2	66	66	66	198	66
V3	66	66	66	198	66
Sub- total	198	198	198	594	66
T4V1	66	66	66	198	66
V2	66	66	66	198	66
V3	66	66	66	198	66
Sub- total	198	198	198	594	66

Appendix Table 10. Number of flower cluster per plant

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	5	4	5	14	4.67
V2	6	6	6	18	6.00
V3	6	6	6	18	6.00
Sub- total	17	16	17	50	5.56
T1V1	4	5	5	14	4.67
V2	5	6	5	16	5.33
V3	5	5	6	16	5.33
Sub- total	14	16	16	46	5.11
T2V1	5	5	5	15	5.00
V2	6	5	6	17	5.67
V3	5	6	5	16	5.33
Sub- total	16	16	16	48	5.33
T3V1	5	4	5	14	4.67
V2	6	5	6	17	5.67
V3	5	6	5	16	5.33
Sub- total	16	15	16	47	5.22
T4V1	5	5	5	15	5.00
V2	6	6	5	17	5.67
V3	5	5	6	16	5.33
Sub- total	16	16	16	48	5.33

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	14	18	18	50	16.67
800 ml	14	16	16	46	15.33
500 ml	15	17	16	48	16.00
100ml	14	17	16	47	15.67
45 ml	15	17	16	48	16.00
TOTAL	72	85	82	239	79.67
MEAN	24	28.33	27.33	79.66	15.93

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	8.311	0.594	2.32^{*}	2.04	2.74
Factor A	4	0.978	0.244	1.0^{ns}	2.69	4.02
Factor B	2	6.178	3.089	12.64^{**}	3.32	5.39
A x B	8	1.156	0.144	0.59^{ns}	2.27	3.17
Error	30	7.333	0.244			
TOTAL	44	15.644				

*- significant
^{ns}- not significant
**-Highly significant

Coefficient of variation=9.31%

Appendix Table 11. Number of flower per clusters

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	5	5	5	15	5
V2	5	7	6	18	6
V3	5	6	7	18	6
Sub- total	15	18	18	51	5.67
T1V1	6	5	4	15	3
V2	5	6	5	16	5.33
V3	5	5	6	16	5.33
Sub- total	16	16	15	47	5.22
T2V1	5	5	5	15	5
V2	6	5	6	17	5.67
V3	5	6	5	16	5.33
Sub- total	16	16	16	48	5.33
T3V1	4	5	5	14	4.67
V2	6	5	6	17	5.67
V3	5	6	5	16	5.33
Sub- total	15	16	16	47	5.22
T4V1	5	5	4	14	4.67
V2	5	6	5	16	5.33
V3	6	5	6	17	5.67
Sub- total	16	16	15	47	5.22

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	15	18	18	51	17.00
800 ml	15	16	16	47	15.67
500 ml	15	17	16	48	16.00
100ml	14	17	16	47	15.67
45 ml	14	16	17	47	15.67
TOTAL	73	84	83	240	80.01
MEAN	24.33	28	26.67	79	16.12

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	7.333	0.540	1.21^{ns}	2.04	2.74
Factor A	4	1.333	0.333	0.79^{ns}	2.04	2.74
Factor B	2	4.933	2.467	5.84^{**}	2.69	4.02
A x B	8	1.067	0.133	0.32^{ns}	3.32	3.17
Error	30	12.667	0.422			
TOTAL	44	20.000				

** Highly significant
ns- not significant

Coefficient of variation=12.18%

Appendix Table 12. Number of pod per cluster

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
TOV1	4	3	4	11	3.67
V2	4	4	3	11	3.67
V3	4	3	4	11	3.67
Sub- total	12	10	11	33	3.67
T1V1	4	4	2	10	3.33
V2	3	4	4	11	3.67
V3	3	4	3	10	3.33
Sub- total	10	12	10	32	3.56
T2V1	3	4	3	10	3.33
V2	4	3	4	11	3.67
V3	3	4	4	11	3.67
Sub- total	10	11	11	32	3.56
T3V1	3	2	4	9	3.00
V2	4	3	4	11	3.67
V3	4	4	3	11	3.67
Sub- total	11	9	11	31	3.44
T4V1	4	3	2	9	3.00
V2	4	3	3	10	3.33
V3	4	3	4	11	3.67
Sub- total	12	9	9	30	3.33

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	11	11	11	33	11.00
800 ml	10	11	10	32	10.67
500 ml	10	11	11	32	10.67
100ml	9	11	11	31	10.33
45 ml	9	10	11	30	10.00
TOTAL	49	54	54	158	52.67
MEAN	16.33	18	18	52.33	10.53

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	2.578	0.184	0.37^{ns}	2.04	2.74
Factor A	4	0.578	0.144	0.30^{ns}	2.69	4.02
Factor B	2	1.111	0.556	1.13^{ns}	3.32	5.39
A x B	8	0.889	0.111	0.22^{ns}	2.27	3.17
Error	30	14.667	0.489			
TOTAL	44	17.244				

^{ns}- not significant Coefficient of variation=9.31%

Appendix Table 13. Percentage pod set per clusters

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	80	75	80	235	78.33
V2	66.67	66.67	50	183.34	61.11
V3	66.67	50	66.67	183.34	61.11
Sub- total	213.34	191.67	196.67	601.68	66.85
T1V1	80	80	40	200	66.67
V2	60	66.67	80	206.67	68.89
V3	60	80	50	190	63.33
Sub- total	200	226.67	170	596.67	66.30
T2V1	60	80	60	200	66.67
V2	66.67	60	66067	193.34	64.45
V3	66.67	66.67	80	213.34	71.11
Sub- total	193.34	206.67	206.67	606.68	67.41
T3V1	60	50	80	190	63.33
V2	66.67	60	66.67	193.34	64.45
V3	80	66.67	60	206.67	68.89
Sub- total	206.67	176.67	206.67	590.01	65.56
T4V1	80	60	40	180	60
V2	66.67	50	60	176.67	58.89
V3	80	60	66.67	206.67	68.89
Sub- total	226.67	170	166.67	563.34	62.59

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	235	183.34	183.34	601.68	200.56
800 ml	200	206.67	190	596.67	198.89
500 ml	200	193.34	213.34	606.68	202.23
100ml	190	193.34	206.67	590.01	196.67
45 ml	180	176.67	206.67	563.34	187.78
TOTAL	1005	953.36	1000.02	2958.38	986.13
MEAN	201	190.6	200	590.6	197.226

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	1069.684	76.406	0.52^{ns}	2.04	2.74
Factor A	4	128.427	32.107	0.22^{ns}	2.69	4.02
Factor B	2	108.192	54.096	0.37^{ns}	3.32	5.39
A x B	8	833.065	104.133	0.71^{ns}	2.27	3.17
Error	30	4394.600	146.487			
TOTAL	44	5464.284				

^{ns}- not significant Coefficient of variation=18.41%

Appendix Table 14. Pod length

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
TOV1	16.8	15.42	15.56	47.78	15.93
V2	16.36	14.1	15.4	45.86	15.23
V3	14.88	14.58	15.34	44.8	14.93
Sub- total	48.04	44.1	46.3	138.44	15.38
T1V1	15.72	14.7	16.18	46.6	15.53
V2	14.02	16.98	13.82	44.82	14.94
V3	15.82	13.7	14.14	43.66	14.55
Sub- total	45.56	45.38	44.14	135.08	15.01
T2V1	16.42	15.68	15.04	47.14	15.71
V2	14.82	14.08	15.82	44.72	14.91
V3	14.98	15.96	13.94	44.88	14.96
Sub- total	46.22	45.72	44.6	136.54	15.17
T3V1	15.06	15.12	15.7	45.88	15.29
V2	15.64	13.72	14.02	43.38	14.46
V3	16.34	13.28	14.22	43.84	14.61
Sub- total	47.04	42.12	43.94	133.1	14.79
T4V1	14.96	14.76	15.3	45.02	15.01
V2	14.96	13.4	14.86	43.22	14.41
V3	13.98	15.32	13.46	42.76	14.25
Sub- total	43.9	43.48	43.62	131	14.56

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	47.78	45.86	44.8	138.44	46.15
800 ml	46.6	44.82	43.66	135.08	45.03
500 ml	47.14	44.72	44.88	136.54	45.51
100ml	45.88	43.38	43.84	133.1	44.37
45 ml	45.02	43.22	42.76	131	43.67
TOTAL	232.42	222	219.94	674.36	224.73
MEAN	46.484	44.4	43.99	134.87	44.95

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	10.157	0.726	0.79^{ns}	2.04	2.74
Factor A	4	3.822	0.955	0.98^{ns}	2.69	4.02
Factor B	2	5.968	2.984	3.06^{ns}	3.32	5.39
A x B	8	0.367	0.046	0.05^{ns}	2.27	3.17
Error	30	29.266	0.976			
TOTAL	44	39.424				

^{ns}- not significant Coefficient of variation=6.59%

Appendix Table 15. Pods width

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	1.12	1.09	1.12	3.33	1.11
V2	0.9	0.82	0.85	2.57	0.86
V3	0.82	0.84	0.91	2.57	0.86
Sub- total	2.84	2.75	2.88	8.47	0.94
T1V1	1.34	1.10	1.06	3.5	1.17
V2	0.85	0.93	0.91	2.69	0.89
V3	0.84	0.83	0.88	2.55	0.85
Sub- total	3.03	2.86	2.85	8.74	0.97
T2V1	1.09	1.06	1.11	3.26	1.09
V2	0.84	0.84	0.94	2.62	0.87
V3	0.85	0.85	0.84	2.54	0.85
Sub- total	2.78	2.75	2.89	8.42	0.94
T3V1	1.09	1.12	1.17	3.38	1.13
V2	0.86	0.86	0.85	2.57	0.86
V3	0.85	0.86	0.84	2.55	0.85
Sub- total	2.8	2.84	2.86	8.5	0.94
T4V1	1.04	1.18	1.05	3.27	1.09
V2	0.86	0.85	0.88	2.59	0.86
V3	0.84	0.85	0.87	2.56	0.85
Sub- total	2.74	2.88	2.8	8.42	0.94

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	3.33	2.57	2.57	8.47	2.82
800 ml	3.5	2.69	2.55	8.74	2.91
500 ml	3.26	2.62	2.54	8.42	2.81
100ml	3.38	2.57	2.55	8.50	2.83
45 ml	3.27	2.59	2.56	8.42	2.81
TOTAL	16.74	13.04	12.77	42.55	14.18
MEAN					

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	0.676	0.048	15.97**	2.04	2.74
Factor A	4	0.008	0.002	0.68ns	2.69	4.02
Factor B	2	0.660	0.330	115.23**	3.32	5.39
A x B	8	0.008	0.001	0.34ns	2.27	3.17
Error	30	0.086	0.003			
TOTAL	44	0.762				

** - highly significant
ns - not significant

Coefficient of variation=5.67%

Appendix Table 16. Leaf length (cm)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
TOV1	20.14	21.6	20.84	62.58	20.86
V2	18.94	21.3	19.8	60.04	20.01
V3	19.38	17.54	17.92	54.84	18.28
Sub- total	58.46	60.44	58.56	177.46	19.72
T1V1	21.4	22.24	20.14	63.78	21.26
V2	21.52	20.52	15.88	57.92	19.31
V3	17.36	17.6	19.4	54.36	18.12
Sub- total	60.28	60.36	55.42	176.06	19.56
T2V1	24.56	21.5	21.16	67.22	22.41
V2	18.34	21.56	19.06	58.96	19.65
V3	20.38	16.38	19.06	55.82	18.61
Sub- total	63.28	59.44	59.28	182	20.22
T3V1	23.1	25.74	20.96	69.8	23.27
V2	19.78	16.9	19.4	56.08	18.69
V3	17.56	18.04	19.52	55.12	18.37
Sub- total	60.44	60.68	59.88	181	20.11
T4V1	21.04	21.4	18.68	61.12	20.37
V2	18.58	18.16	18.72	55.46	18.49
V3	23.6	15.26	17.66	56.52	18.84
Sub- total	63.22	54.82	55.06	173.1	19.23

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	62.58	60.04	54.84	177.46	59.15
800 ml	63.78	57.92	54.36	176.06	58.69
500 ml	67.22	58.96	55.82	182	60.67
100ml	69.8	56.08	55.12	181	60.33
45 ml	61.12	55.46	56.52	173.1	57.70
TOTAL	324.5	288.46	276.66	889.62	296.54
MEAN	64.9	57.69	55.33	177.92	59.31

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	38.002	2.710	1.64^{ns}	2.04	2.74
Factor A	4	4.323	1.081	0.63^{ns}	2.69	4.02
Factor B	2	27.373	13.686	8.02^{**}	3.32	5.39
A x B	8	6.306	0.788	0.46^{ns}	2.27	3.17
Error	30	51.196	1.707			
TOTAL	44	89.197				

**-Highly significant
^{ns}- not significant

Coefficient of variation=9.98%

Appendix Table 17. Leaf width (cm)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
TOV1	15.42	14.92	13.5	43.84	14.61
V2	13.12	13.5	12.52	39.14	13.05
V3	12.9	11.68	11.56	36.14	12.05
Sub- total	41.44	40.1	37.58	119.12	13.24
T1V1	13.5	13.84	12.94	40.28	13.43
V2	13.82	12.52	10.18	36.52	12.17
V3	11.56	12.24	12.98	36.78	12.26
Sub- total	38.88	38.6	36.1	113.58	12.62
T2V1	15.6	12.46	16.44	44.5	14.83
V2	12.08	13.26	12.38	37.72	12.57
V3	12.84	10.8	12.24	35.88	11.96
Sub- total	40.52	36.52	41.06	118.1	13.12
T3V1	13.98	15.3	13.56	42.84	14.28
V2	12.6	10.78	12.76	36.14	12.05
V3	13.58	11.88	12.74	38.2	12.73
Sub- total	40.16	37.96	39.06	117.18	13.02
T4V1	15.38	15.48	11.44	42.3	14.1
V2	12.18	12.48	15.2	39.86	13.29
V3	14.6	11.82	13.3	39.72	13.24
Sub- total	42.16	39.78	39.94	121.88	13.54

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	43.84	39.14	36.14	119.12	39.71
800 ml	40.28	36.52	36.78	113.58	37.86
500 ml	44.5	37.72	35.88	118.1	39.37
100ml	42.84	36.14	38.2	117.18	39.06
45 ml	42.3	39.86	39.72	121.88	40.62
TOTAL	213.68	189.38	186.72	589.86	196.62
MEAN	42.74	37.88	37.34	117.96	39.32

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	105.468	7.533	2.12^{*}	2.04	2.74
Factor A	4	5.893	1.473	0.40^{ns}	2.69	4.02
Factor B	2	82.817	41.409	11.34**	3.32	5.39
A x B	8	16.758	2.095	0.57^{ns}	2.27	3.17
Error	30	109.526	3.651			
TOTAL	44	214.994				

** -Highly significant
ns- not significant
* - significant

Coefficient of variation=9.67%

Appendix Table 18. Weight of marketable pods (gram)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
TOV1	158	135	31	324	108.00
V2	64	145	93	302	100.67
V3	42	157	111	310	103.33
Sub- total	264	437	235	936	62.4
T1V1	134	137	28	299	99.67
V2	55	161	89	305	101.67
V3	33	130	101	264	88.00
Sub- total	222	428	218	868	57.87
T2V1	83	103	101	287	95.67
V2	47	180	30	257	85.67
V3	69	187	53	309	103.00
Sub- total	199	470	184	853	56.87
T3V1	122	80	63	265	88.33
V2	52	151	161	364	121.33
V3	54	198	98	350	116.67
Sub- total	228	429	322	979	65.27
T4V1	119	78	42	239	79.67
V2	50	152	31	233	77.67
V3	52	125	68	245	81.67
Sub- total	221	355	141	717	47.8

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	324	302	310	936	312.00
800 ml	299	305	264	868	289.33
500 ml	287	257	309	853	284.33
100ml	265	364	350	979	326.33
45 ml	239	233	245	717	239.00
TOTAL	1414	1461	1478	4353	1450.99
MEAN	282.8	292.2	295.6	870.6	290.20

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	7238	517	0.16^{ns}	2.04	2.74
Factor A	4	4437.47	1109.37	0.35^{ns}	2.69	4.02
Factor B	2	146.53	73.27	0.02^{ns}	3.32	5.39
A x B	8	2654.80	331.85	0.10^{ns}	2.27	3.17
Error	30	96578	3219.27			
TOTAL	44	555.20				

^{ns}- not significant Coefficient of variation=7.56%

Appendix Table 19. Weight of non- marketable pods (gram)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	0	5	4	9	3
V2	0	0	0	0	0
V3	0	15	0	15	5
Sub- total	0	20	4	24	2.67
T1V1	0	4	1	5	1.67
V2	0	0	0	0	0
V3	0	2	0	2	0.67
Sub- total	0	6	1	7	0.78
T2V1	0	2	9	11	3.67
V2	0	5	0	5	1.67
V3	0	0	0	0	0
Sub- total	0	7	9	16	1.78
T3V1	0	2	3	5	1.67
V2	0	0	6	6	2
V3	0	4	0	4	1.33
Sub- total	0	6	9	15	5
T4V1	0	10	5	15	5
V2	0	0	11	11	3.67
V3	0	4	7	11	3.67
Sub- total	0	14	23	37	4.11

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	9	0	15	24	8.00
800 ml	5	0	2	7	2.33
500 ml	11	5	0	16	5.33
100ml	5	6	4	15	5.00
45 ml	15	11	11	37	12.33
TOTAL	45	22	32	99	32.99
MEAN	9	4.4	6.4	19.8	6.60

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	123.87	8.85	0.62^{ns}	2.04	2.74
Factor A	4	57.20	14.300	0.99^{ns}	2.69	4.02
Factor B	2	17.73	8.867	0.62^{ns}	3.32	5.39
A x B	8	48.93	6.117	0.43^{ns}	2.27	3.17
Error	30	431.33	14.378			
TOTAL	44	555.20				

^{ns}- not significant Coefficient of variation=172.35%

Appendix Table 20. Total yield per plant (g)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
TOV1	158	140	35	333	111
V2	64	145	93	302	100.67
V3	42	172	111	325	108.33
Sub- total	264	457	239	960	64
T1V1	134	141	29	304	101.33
V2	55	161	89	305	101.67
V3	33	132	101	266	88.67
Sub- total	222	434	219	875	58.33
T2V1	83	105	110	298	99.33
V2	47	185	30	262	87.33
V3	69	137	53	259	86.33
Sub- total	199	427	193	819	56.4
T3V1	122	82	66	270	90
V2	52	151	167	370	123.33
V3	54	202	98	354	118
Sub- total	228	435	331	994	66.27
T4V1	119	88	45	252	84
V2	50	152	42	244	81.33
V3	52	129	75	256	85.33
Sub- total	221	369	162	752	50.13

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	333	302	325	960	320.00
800 ml	304	305	266	875	291.67
500 ml	298	262	259	819	273.00
100ml	270	370	354	994	331.33
45 ml	252	244	256	752	250.67
TOTAL	291.4	296.6	292	880	293.34
MEAN	58.28	59.32	58.4		58.68

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	7156.45	511.18	0.61^{ns}	2.04	2.74
Factor A	4	4391.78	1097.94	0.35^{ns}	2.69	4.02
Factor B	2	26.98	13.49	0.00^{ns}	3.32	5.39
A x B	8	2737.69	342.211	0.11^{ns}	2.27	3.17
Error	30	92745.33	3091.51			
TOTAL	44	99901.78				

^{ns}- not significant Coefficient of variation=56.87%

Appendix Table 21. Pest incidence (60 DAP)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	2	3	2	7	2.3
V2	2	2	2	6	2
V3	2	2	2	6	2
Sub- total	6	7	6	19	2.1
T1V1	2	2	2	6	2
V2	2	2	2	6	2
V3	2	3	2	7	2.3
Sub- total	6	7	6	19	2.1
T2V1	2	2	2	6	2
V2	3	2	2	6	2.3
V3	2	2	2	7	2
Sub- total	7	6	6	19	2.1
T3V1	2	2	2	6	2
V2	2	2	2	6	2
V3	2	2	2	6	2
Sub- total	6	6	6	18	2
T4V1	2	2	2	6	2
V2	2	2	2	6	2
V3	2	2	2	6	2
Sub- total	6	6	6	18	2

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	7	6	6	19	6.33
800 ml	6	6	7	19	6.33
500 ml	6	6	7	19	6.33
100ml	6	6	6	18	6.00
45 ml	6	6	6	18	6.00
TOTAL	31	30	32	93	30.99
MEAN	6.2	6	6.4	18.6	6.20

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	0.800	0.057	0.86^{ns}	2.04	2.74
Factor A	4	0.133	0.033	0.50^{ns}	2.69	4.02
Factor B	2	0.000	0.000	0.00^{ns}	3.32	5.39
A x B	8	0.667	0.667	1.25^{ns}	2.27	3.17
Error	30	2.000	2.000			
TOTAL	44	2.800	2.800			

^{ns}- not significant Coefficient of variation=12.49%

Appendix Table 22. Diseases incidence (60 DAP)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	3	2	2	7	2.3
V2	2	2	3	7	2.3
V3	2	2	2	6	2
Sub- total	7	6	7	20	2.22
T1V1	2	2	2	6	2
V2	3	2	2	6	2
V3	2	3	2	7	2
Sub- total	7	7	6	20	2.3
T2V1	2	2	2	6	2.22
V2	2	2	2	6	2
V3	2	2	2	6	2
Sub- total	6	6	6	18	2
T3V1	2	2	2	6	2
V2	2	2	2	6	2
V3	2	2	2	6	2
Sub- total	6	6	6	18	2
T4V1	3	2	2	7	2.3
V2	2	2	3	7	2.3
V3	2	3	2	7	2.3
Sub- total	7	7	7	21	2.3

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	7	7	6	20	4.00
800 ml	6	6	7	19	3.80
500 ml	6	6	6	18	3.60
100ml	6	6	6	18	3.60
45 ml	7	7	7	21	4.20
TOTAL	32	32	32	96	19.2
MEAN	6.4	6.4	6.4	19.2	3.84

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	1.244	0.089	0.82^{ns}	2.04	2.74
Factor A	4	0.800	0.200	1.29^{ns}	2.69	4.02
Factor B	2	0.044	0.022	0.14^{ns}	3.32	5.39
A x B	8	0.400	0.050	0.32^{ns}	2.27	3.17
Error	30	4.667	0.156			
TOTAL	44	5.911				

^{ns}- not significant

Coefficient of variation=11.95%

Appendix Table 23. Number of crown roots

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
TOV1	11.2	11.6	11.2	34	
V2	8.4	9.4	10.6	28.4	
V3	11	9.8	9.4	30.2	
Sub- total	30.6	30.8	31.2	92.6	
T1V1	12.2	12.6	12.2	37	
V2	12.8	9.8	12	34.6	
V3	11.2	10	13.4	34.6	
Sub- total	36.2	32.4	37.6	106.2	
T2V1	10.2	11.8	12.4	34.4	
V2	10	10.4	11.2	31.6	
V3	11	11	14	36	
Sub- total	31.2	33.2	37.6	102	
T3V1	9.8	12.8	9	31.6	
V2	10	10	8.8	28.8	
V3	8.6	8	8.4	25	
Sub- total	28.4	30.8	26.2	85.4	
T4V1	8.8	10	9.8	28.6	
V2	7.4	9.6	10.4	27.4	
V3	9	9.2	9.8	28	
Sub- total	25.2	28.8	30	84	

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	34	28.4	30.2	92.6	30.87
800 ml	37	34.6	34.6	106.2	35.40
500 ml	34.4	31.6	36	102	34.00
100ml	31.6	28.8	25	85.4	28.47
45 ml	9	9.2	9.8	28	9.33
TOTAL	146	132.6	135.6	414.2	138.07
MEAN	29.2	26.52	27.12	82.84	27.61

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	60.786	4.342	3.31^{**}	2.04	2.74
Factor A	4	43.195	10.799	8.24^{**}	2.69	4.02
Factor B	2	8.162	4.081	3.11^{ns}	3.32	5.39
A x B	8	9.429	1.179	0.90^{ns}	2.27	3.17
Error	30	39.307	1.310			
TOTAL	44	100.092				

^{ns}- not significant
**-Highly significant

Coefficient of variation=10.95%

Appendix Table 24. Root length (cm)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
TOV1	32.3	36.76	41.4	110.46	36.82
V2	45.2	41.1	52.6	138.9	46.3
V3	43.06	52.2	54.22	149.48	49.83
Sub- total	120.56	130.06	148.22	398.84	44.32
T1V1	22.6	22.2	19.26	64.06	21.35
V2	49.62	16.28	23.06	88.96	29.65
V3	41.44	18.38	29.4	89.22	29.74
Sub- total	113.66	56.86	71.72	242.24	26.92
T2V1	24.72	24.54	18.92	68.18	7.58
V2	31.24	25.48	42.9	99.62	33.21
V3	42.2	32.9	36.1	111.2	37.07
Sub- total	98.16	82.92	97.92	279	31
T3V1	37.4	32.4	38.4	108.2	36.07
V2	47.6	48	38.42	134.02	44.67
V3	41.2	41	53.1	135.3	45.1
Sub- total	126.2	121.4	129.92	377.52	41.94
T4V1	45.14	36.5	42.52	124.16	42.39
V2	51.4	41.8	58.6	151.8	50.6
V3	57	54.56	51.38	162.94	54.31
Sub- total	153.54	132.86	152.5	438.9	48.77

TWO WAY TABLE

DIFFERENT VOLUMES OF WATER	VARIETY			TOTAL	MEAN
	CONTENDER	BOKOD	SABLAN		
200 ml	110.46	138.9	149.48	398.84	132.95
800 ml	64.06	88.96	89.22	242.24	80.75
500 ml	68.18	99.62	111.2	279	93.00
100ml	108.2	134.02	135.3	377.52	125.84
45 ml	124.16	151.8	162.94	438.9	146.30
TOTAL	475.06	613.3	648.14	1736.5	578.84
MEAN	95.01	122.66	129.63	347.3	115.77

ANALYSIS OF VARIANCE

SOURCE VARIANCE	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	14	4415.871	315.459	4.78**	2.04	2.74
Factor A	4	2888.106	722.027	10.40**	2.69	4.02
Factor B	2	1396.288	698.144	10.05**	3.32	5.39
A x B	8	131.477	16.435	0.24ns	2.27	3.17
Error	30	2082.760	69.425			
TOTAL	44	6498.630				

**-Highly significant
ns- not significant

Coefficient of variation=21.83%

Appendix Table 25. Agro climatic data during the study (December 2010 to February 2011)

MONTH	TEMPERATURE		RELATIVE HUMIDTY	LIGHT INTENSITY
	MIN	MAX	(%)	LUX
December				
1st week	15	28	80	715
2nd week	16	29	77	650
3rd week	16	29	75	750
MEAN	15.67	28.67	77.33	705
January				
1stweek	15	28	80	827
2nd week	14	24	79	347
3rdweek	13	25	79	672
4thweek	14	26	82	712
5thweek	14	29	79	855
MEAN	14	26.4	79.8	682.6
February				
1stweek	13	26	75	662
2nd week	14	27	77	122
3rdweek	14	27	79	820
MEAN	13.67	26.67	77	535.67