

BIBLIOGRAPHY

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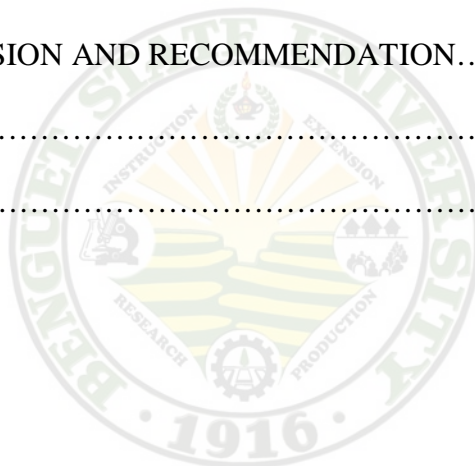
ABSTRACT

The performance of four varieties of lisianthus namely; Echo Pink, Echo White, Echo Blue and Blue Picottee were evaluated based on their growth and flower characteristics and to determine the best-suited variety/ies under La Trinidad Benguet condition. Results show that the number of days from transplanting to flower bud formation, number of days from flower bud formation to harvesting stage, number of laterals, final height, number of leaves, length of stem, flower size, cutflower yield, number of laterals produced per plant and number of petals per flower, were comparable in all the varieties grown and evaluated. However, Blue Picottee cutflower had the longest vase life of 10 days from holding and the highest cutflower yield of 12.49 cut flower per 1×5 m plot.

TABLE OF CONTENTS

	Page
Bibliography.....	i
Abstract.....	i
Table of Contents.....	ii
INTRODUCTION.....	1
REVIEW OF LITERATURE	
The Plant.....	3
Light and Temperature Requirement.....	3
Soil and Fertilizer Requirement.....	4
Harvesting and Postharvest Handling.....	4
MATERIALS AND METHODS	
Materials.....	5
Methods.....	5
RESULTS AND DISCUSSION	
Vegetative Growth	
Final Height at Flowering (cm).....	6
Number Leaves per plant at Flowering.....	6
Number of laterals per plant at flowering.....	7
Number of Days from Transplanting to Flower Bud Formation.....	10
Number of Days from Flower Bud Formation to Harvesting Stage.....	10

Length of Stem at Harvesting Stage (cm).....	12
Flower Size at Full Bloom Stage (cm).....	12
Cutflower Yield per 1x5m per Plot.....	13
Number of Flowers Produced per Plant for the Duration Cropping Period.....	14
Number of petals per flower.....	14
Vaseliflife.....	15
Occurrence of Insect Pest and Diseases.....	16
Documentation of the Study.....	17
SUMMARY, CONCLUSION AND RECOMMENDATION.....	18
LITERATURE CITED.....	19
APPENDICES.....	20



INTRODUCTION

Lisianthus (*Eustoma grandiflorum*) is a North American wild flower. It is a native to the prairies of Nebraska, Colorado and Texas. They are also known as Prairie Gentian or Texas Blue Bell, the latter name a reference to the blue flowers of the wild species. Cultivars in production today offer a wide range of colours, including purple, rose, pink, white and various colors (Fox, 1998).

Lisianthus has the qualities of an “ideal cutflower” (attractive flowers and long vase life) and should continue to increase in popularity throughout the next century (Gill, undated). According to Hermano (2006), the vase life range from two to three weeks from harvesting of the cutflowers.

Plant breeders have done a wonderful job of developing outstanding flower colors and introducing single and double-flowering forms, adding to the beauty of this flower. The flower is elegant in form and easily mistaken for rose.

There had been no studies conducted yet to determine the suitable lisianthus varieties for the locality; hence, this study was conceived since lisianthus is a new cutflower crop in the area. The results of this study may be used as a guide for researchers and growers with the purpose of improving and promoting the cutflower industry in Benguet and giving the consumers a wider array of cutflowers to select from.



This study was conducted at Benguet State University Ornamental Horticulture Research Area from October 2007 to March 2008 to evaluate the growth and flowering characteristics of the different varieties of lisianthus under La Trinidad Benguet condition; and to determine the best suited variety/ies for lisianthus farming in the locality.



REVIEW OF LITERATURE

The Plant

Eustoma grandiflorum is a perennial plant that is treated in most areas as annual. The seed is relatively small (19,000 seeds/gm) or (545,000 seeds/oz) and is hard to handle in field plantings. Because of its small size, seedlings are generally started in plug trays and transplanted into the field. A plug size of 288 or 392 mm has been successful for commercial producers. Plants are moved to the field when they have developed 2 to 3 sets of the true leaves (approximately 3 months from seedling time). Although for some varieties, terminal cuttings are used, plants from seeds are more common (Gill, undated).

Light and Temperature Requirement

According to Hernando (2006) lisianthus grows best in areas where the temperature is from 10 to 25° C. Below 10° C and much lower, the growth declines. Likewise, for temperatures of 30° C and above, the growth is reduced and flower sizes are significantly smaller. Lisianthus is a sun loving plant thus; it can be grown in open field areas provided it is planted during the summer season. However, it can be commercially grown under plastic sheet coverings. Maturity period (transplanting to flower) is from 140 to 160 days.



Soil and Fertilizer Requirement

Lisianthus is sensitive to soil, acidity and alkalinity. The soil pH must be 7.0. However, the pH can be lowered to 6.5. Light soil with higher organic matter is ideal for lisianthus production.

Harvesting and Postharvest Handling

Lisianthus are harvested when one flower are open. Harvesting is done in the morning; when the flowers and plant tissues are cool (*PanAmerican Seed*, undated). Hermano (2006) stated that on non-pinch plants, stems are cut above the third node from the ground. Similarly, the stems are cut above the third node of the lateral shoots on pinched plants. This site of cut allows the plants to produce laterals shoots for the second flush of laterals for flower production. Upon cutting, the cutflowers are soaked in clean water or in warm pulse solution (40° C). Flowers are sorted and graded according to color and stem length.



MATERIALS AND METHODS

Materials

The materials used in this study were two inches seedlings of four varieties of lisianthus namely: Echo Pink, Echo White, Echo Blue and Blue Picottee. The materials used in this study were quick release fertilizers (Triple 14), compost (Alnus leaves), coco peat, pesticides, plant supports, garden tools and labeling materials.

Methods

The Lisianthus seedlings were transplanted inside the greenhouse with a lot of 60 sq.m. A 1×5 m plot represented one treatment with three replications per treatment. The study was arranged in a Randomized Complete Block Design (RCBD).

Cultural management practices such as watering; fertilizer application, weeding and crop protection sprays were applied uniformly to all plants.

The following are the lisianthus varieties which served as treatments:

<u>Treatment Code</u>	<u>Lisianthus Varieties</u>
V ₁	Echo Pink
V ₂	Echo White
V ₃	Echo Blue
V ₄	Blue Picottee



Data Gathered

A. Vegetative Growth

1. Final height at flowering. Final height was measured from the base of the plant to the tip of the flowers at harvesting stage. (50 % anthesis).
2. Number of laterals produce per plant. This was obtained by counting the number of laterals produce per plant at an anthesis.
3. Number leaves per plant at flowering. This was obtained by counting the number of leaves produced per plant at flowering.

B. Reproductive Growth

1. Number of days from plating to flower-bud formation.(0.5 cm bud size).
2. Number of days from flower bud formation to harvesting stage.(1st 3 flowers at loose-bud stage).

C. Flower Characteristics

1. Length of stem at harvesting stage (cm) .This was measured by getting the length of the stem in centimeter from the base of the stem 5cm from the ground to the tip of the flower.
2. Flower size at full bloom (cm). This was measured by getting the diameter of the flower in centimeter by the use of foot rule at 100% anthesis.
3. Cut Flower yield per 1x 5 m plot. This was taken by counting the total number of flowers per plant at full bloom stage.
4. Number of flower produced per plant for the duration of the cropping period.



5. Number of petals per flower. This was taken by counting the number of petals per flower at full bloom stage.
6. Vaselife. This was taken by counting the number of days after harvesting the flowers and holding them in a vase with pure tap water only up to the onset of senescence.
7. Leaf and Stem Color. This was recorded at full bloom stage.

D. Documentation of the study in picture

E. Occurrence of insect pests and diseases.

The prevalence and degree of pests and diseases infestation was recorded during the duration of the cropping year with the following data gathered.

- a. Number of infested plants per plot.
- b. Types of pest and diseases present.
- c. Degree of infection. This was obtained by using the following rating.

<u>Rating</u>	<u>Degree of Infestation/Infection</u>
1	1-20% infested/infected plants
2	25-40% infested/infected plants
3	45-60% infested/infected plants
4	65-80% infested/infected plants



RESULTS AND DISCUSSION

Vegetative Growth

Final Height at Flowering (cm).

Again, there were no significant differences observed among the four varieties of lisianthus evaluated with regards to final height (Table 1). However, Echo White was the tallest among the varieties tested with a mean of 56.06 cm and the smallest were measured from the Blue Picottee with a mean of 48.56 cm.

The height range of lisianthus ranges from 30.48 cm to 60.96 cm, which shows all the varieties are adapted to La Trinidad Benguet condition

Number of laterals produced per plant.

Based on the results, there were no significant differences on the number of laterals produced per plant (Table 2). However, Echo Blue has the highest number of laterals produced per plant with a mean of 16.33, while Echo Pink has the lowest number of laterals with a mean of 9.67 laterals per plant.

Table 1. Final height at flowering

VARIETY	MEAN(cm)
Echo Pink	50.39 ^a
Echo White	56.06 ^a
Echo Blue	48.63 ^a
Blue Picottee	48.56 ^a

Means with a common letter are not significantly different at 5% level by DMRT



Number of Leaves per Plant at Flowering

As shown in Table 3, there were no significant differences on the number of leaves per plant at flowering; but the highest number of leaves were counted from Echo Blue with a mean of 38.22 leaves followed by Echo White and Blue Picottee with a mean of 33.89 and 33.56 leaves per plant; respectively.

Table 2. Number of laterals produced per plant

VARIETY	MEAN
Echo Pink	9.67 ^a
Echo White	12.00 ^a
Echo Blue	16.33 ^a
Blue Picottee	13.33 ^a

Means with a common letter are not significantly different at 5% level by DMRT

Table 3. Number of leaves per plant at flowering

VARIETY	MEAN
Echo Pink	29.11 ^a
Echo White	33.89 ^a
Echo Blue	38.22 ^a
Blue Picottee	33.56 ^a

Means with a common letter are not significantly different at 5% level by DMRT



Reproductive Stage

Number of days from Transplanting to Flower bud Formation. Table 4 shows that all; the four varieties of lisianthus planted under La Trinidad condition had no significant differences on the number of days from transplanting to flower bud formation. (0.5 cm bud size)

However, Echo Pink flowered slightly earlier compared to the other varieties with a mean of 111 days. Blue Picottee flowered later with a mean of 117.33 days from transplanting to flower bud formation. It was very evident as shown by the results that the means of all the varieties evaluated did not differ significantly from each other under La Trinidad condition.

Number of days from Flower Bud Formation to Harvesting Stage. Table 5 shows that the four varieties of lisianthus had no significant differences in the number of days from flower bud formation to harvesting stage. However, Echo Pink was the earliest to form flower buds up to harvesting stage with a mean of 27.33 days. While Blue Picottee was the latest to form flower bud formation to harvesting stage with a mean of 31.67 days.



Table 4. Number of days from transplanting to flower bud formation (0.5 cm bud size)

VARIETY	MEAN (days)
Echo Pink	111.00 ^a
Echo White	112.11 ^a
Echo Blue	114.67 ^a
Blue Picottee	117.33 ^a

Means with a common letter are not significantly different at 5% level by DMRT

Table 5. Number of days from flower bud formation to harvesting stage

VARIETY	MEAN
Echo Pink	27.33 ^a
Echo White	28.89 ^a
Echo Blue	28.77 ^a
Blue Picottee	31.67 ^a

Means with a common letter are not significantly different at 5% level by DMRT



Flower Characteristics

Again comparable stem lengths were recorded in all the varieties at flowering and results show that there were no significant differences on the length of stems at harvest (Table 6). However, Echo White had the longest cutflower stem with a mean of 36.77 cm followed by Echo Pink with a mean of 34.50 cm and the shortest was the cutflower Blue Picottee with a mean of 29.58 cm.

Table 6. . Length of stem at harvesting stage

VARIETY	MEAN (cm)
Echo Pink	34.50 ^a
Echo White	36.77 ^a
Echo Blue	31.69 ^a
Blue Picottee	29.58 ^a

Means with a common letter are not significantly different at 5% level by DMRT

Table 7. Flower size at full bloom stage (cm)

VARIETY	MEAN (cm)
Echo Pink	3.37a
Echo White	4.33a
Echo Blue	4.26 a
Blue Picottee	4.61a

Means with a common letter are not significantly different at 5% level by DMRT



Flower size at full bloom (cm). Table 7 presents the flower size at full bloom (cm) at flowering as affected by the four varieties used.

Results showed that there were no significant differences obtained on the flower size of all varieties evaluated. Nevertheless, Blue Picottee produced the biggest flower at full bloom with a mean of 4.61 cm; while variety Echo Pink produced the smallest flower sizes at full bloom with a mean of 3.37 cm.

Cutflower yield per 1×5 m plot. Results show that, Blue Picottee produced significantly higher volume of cutflowers yield per 1×5 m plot compared to the other 3 varieties evaluated; while Echo Pink produced the lowest cut flower yield with a mean of 9.72 cutflower per plot (Table 8).

Table 8. Cutflower yield

VARIETY	MEAN
Echo Pink	9.72 ^b
Echo White	9.72 ^b
Echo Blue	9.44 ^b
Blue Picottee	12.49 ^a

Means with a common letter are not significantly different at 5% level by DMRT



Number of flower produced per plant. A result shows that that there were no significant differences on the number of flower produced per plant (Table 9). How ever, Blue Picottee was the highest number of flower produced per plant with a mean of 3.77; while Echo Pink has the lowest number of flower produced per plant with a mean of 2.66.

Table 9. Number of flowers produced per plant

VARIETY	MEAN
Echo Pink	2.67 ^a
Echo White	3.00 ^a
Echo Blue	3.10 ^a
Blue Picottee	3.78 ^a

Means with a common letter are not significantly different at 5% level by DMRT

Table 10. Number of petals per flower

VARIETY	MEAN
Echo Pink	12.33 ^a
Echo White	14.00 ^a
Echo Blue	12.67 ^a
Blue Picottee	12.66 ^a

Means with a common letter are not significantly different at 5% level by DMRT



Number of Petals per Flower

Results show that, there were no significant differences observed among the varieties evaluated (Table 10). However, flowers of Echo White had slightly higher number of petals counted per flower with a mean of 14 petals followed but Echo Blue and Blue Picottee with a means of 12.67 and 12.66 petals per flower; respectively.

Vaselife

Table 11 shows the vaselife of lisianthus cut flowers as affected by the different varieties evaluated.

Results showed that there were significant differences were observed on the vaselife of the different varieties of lisianthus harvested and held in tap water only under room temperature. However, Blue Picottee had the slightly longer vaselife with a mean of 10 days followed by Echo Blue with a mean of 8.33 days. On the other hand, Echo Pink and Echo White had the shortest vaselife with a mean of 8 days, respectively.

Table 11. Vaselife

VARIETY	MEAN (days)
Echo Pink	8.00 ^b
Echo White	8.00 ^b
Echo Blue	8.33 ^b
Blue Picottee	10.00 ^a

Means with a common letter are not significantly different at 5% level by DMRT



Leaf and Stem Color

It was observed that lisianthus have bluish-green color of leaves and stems. The shape of the leaves is ovate to oblong and is opposite in arrangement or phyllotaxy.

Occurrence of Insect pests and Diseases

It was observed the white flies, cutworms, and leaf miners were the insects infesting the lisianthus plants. The only disease identified was fusarium wilt.

Table 12. Degree of infestation of white flies, cutworms, leaf miner and fusarium wilt

VARIETY	Degree of infestation			
	White flies	Cutworms	Leaf miners	Fusarium wilt.
Echo Pink	1	1	1	1
Echo White	1	1	1	1
Echo Blue	1	1	1	1
Blue Picottee	1	1	1	1

Rating Scale:

1= 1-6

2= 7-12

3= 13-18

4 = 19-24



Documentation of the Study



Figure . 1 “Echo Pink”



Figure 2. “Echo White”



Figure 3. “Echo Blue”



Figure 4. “Blue Picotee “



SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The growth and flower characteristics of four varieties of lisianthus were evaluated at Benguet State University Ornamental Research Area from October 2007 to February 2008, to determine the variety/ies in the locality.

Observations show that there were no significant differences among the varieties of lisianthus in terms of number of days from transplanting to flower bud formation, number of days from flower bud formation to harvesting stage, number of laterals, final height at flowering, number of leaves, length of cutflower stem, flower size at full bloom stage, number of laterals produced per plant and number of petals per flower.

However, Blue Picottee cutflower has the longest vase life of 10 days and the highest volume of cutflower yield with a mean of 12.49 cutflowers per 1×5 m plot compared to the other varieties evaluated.

Conclusion

Based on the results of the study, all the four varieties of lisianthus are adoptable to the existing climatic conditions of La Trinidad Benguet and can be grown for lisianthus cutflower production.



Recommendation

It is recommended that additional varieties of lisianthus should be evaluated in La Trinidad Benguet or nearby areas with similar climatic conditions and planting trials of the four varieties evaluated should be done in other locations in Benguet for proper comparison of results.



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APPENDICES

APPENDIX TABLE 1. Final height at flowering (cm)

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
V1	33.87	37.33	31.70	102.90	34.30
V2	30.50	35.50	44.30	110.30	36.77
V3	25.90	30.83	38.33	95.06	31.69
V4	32.40	25.67	30.67	88.74	29.58

Analysis of Variance

Source of Variance	Degrees of freedom	Sum of squares	Mean square	Computed F	Tabular F	
					0.05	0.01
Replication	2	65.711	32.856			
Treatment	3	87.814	29.271	1.16ns	4.76	9.78
Error	6	150.823	25.137			
Total	11	304.35				

ns= not significant

Coefficient of variation= 15.15%



APPENDIX TABLE 2. Number leaves per plant at flowering

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
V1	24.00	35.33	28.00	87.33	29.11
V2	25.33	41.00	35.33	101.66	33.87
V3	29.33	46.00	39.33	114.66	38.22
V4	32.00	26.00	42.67	100.67	35.56

Analysis of Variance

Source of Variance	Degrees of freedom	Sum of squares	Mean square	Computed F	Tabular F	
					0.05	0.01
Replication	2	219.170	109.585			
Treatment	3	124.661	41.554	0.96 ns	4.76	9.78
Error	6	256.134	42.686			
Total	11	304.35				

ns= not significant

Coefficient of variation= 15.15%



APPENDIX TABLE 3. Number of laterals per plant at flowering

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
V1	7.00	10.00	12.00	29.00	9.67
V2	9.00	12.00	15.00	36.00	12.00
V3	10.00	24.00	15.00	49.00	16.33
V4	9.00	8.00	23.00	40.00	13.33

Analysis of Variance

Source of Variance	Degrees of freedom	Sum of squares	Mean square	Computed F	Tabular F	
					0.05	0.01
Replication	2	115.167	57.583			
Treatment	3	69.667	23.222	0.89 ns	4.76	9.78
Error	6	156.833	23.139			
Total	11	341.667				

ns= not significant

Coefficient of variation= 39.84%



APPENDIX TABLE 4. Number of days from transplanting to flower bud formation

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
V1	114.00	116.00	103.00	333.00	11.00
V2	112.33	115.33	108.67	336.33	112.11
V3	121.00	111.00	112.00	344.00	114.67
V4	119.67	120.00	112.33	352.00	117.33

Analysis of Variance

Source of Variance	Degrees of freedom	Sum of squares	Mean square	Computed F	Tabular F	
					0.05	0.01
Replication	2	139.673	69.837			
Treatment	3	71.789	23.930	1.82ns	4.76	9.78
Error	6	78.848	13.141			
Total	11	290.310				

ns= not significant

Coefficient of variation= 19.39%



APPENDIX TABLE 5. Number of days from flower bud formation to harvesting stage

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
V1	28.00	29.00	25.00	82.00	27.33
V2	30.00	29.00	27.67	86.67	28.89
V3	30.00	29.33	27.00	86.33	28.78
V4	30.33	36.00	28.67	95.00	31.67

Analysis of Variance

Source of Variance	Degrees of freedom	Sum of squares	Mean square	Computed F	Tabular F	
					0.05	0.01
Replication	2	29.125	14.56			
Treatment	3	29.519	9.840	3.52ns	4.76	9.78
Error	6	16.778				
Total	11	75.422				

ns= not significant

Coefficient of variation= 14.87%



APPENDIX TABLE 6. Length of stem at harvesting stage (cm)

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
V1	40.00	52.17	59.00	151.17	50.39
V2	39.50	57.67	71.00	168.17	56.05
V3	47.83	52.17	45.9	145.90	48.63
V4	44.17	48.17	53.33	145.67	48.56

Analysis of Variance

Source of Variance	Degrees of freedom	Sum of squares	Mean square	Computed F	Tabular F	
					0.05	0.01
Replication	2	432.650	216.325			
Treatment	3	112.440	37.480	0.71ns	4.76	9.78
Error	6	315.434	52.572			
Total	11	860.523				

ns= not significant

Coefficient of variation= 14.24%



APPENDIX TABLE 7. Flower size at full bloom stage

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
V1	3.08	3.92	3.10	10.10	3.37
V2	4.41	4.17	4.42	13.00	4.33
V3	4.25	3.45	5.08	12.78	4.26
V4	4.75	5.00	4.08	13.03	4.61

Analysis of Variance

Source of Variance	Degrees of freedom	Sum of squares	Mean square	Computed F	Tabular F	
					0.05	0.01
Replication	2	0.005	0.002			
Treatment	3	2.612	0.871	2.30ns	4.76	9.78
Error	6	2.276	0.379			
Total	11	4.893				

ns= not significant

Coefficient of variation= 14.87%



APPENDIX TABLE 8. Cutflower yield per 1x5m per plot

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
V1	8.33	10.00	10.82	29.16	9.72
V2	9.16	10.00	10.00	29.16	9.72
V3	10.00	9.16	9.16	28.32	9.44
V4	11.66	13.32	12.50	37.48	12.49

Analysis of Variance

Source of Variance	Degrees of freedom	Sum of squares	Mean square	Computed F	Tabular F	
					0.05	0.01
Replication	2	1.505	0.753			
Treatment	3	19.854	6.618	14.86**	4.76	9.78
Error	6	2.673	0.445			
Total	11	24.673				

** - highly significant

Coefficient of variation= 6.50%



APPENDIX TABLE 9. Number of flowers produced per plant for the duration cropping period

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
V1	2.33	2.33	3.33	8.67	2.89
V2	3.00	3.33	2.67	9.00	3.00
V3	3.33	2.30	3.67	3.67	3.11
V4	3.00	3.33	5.00	11.33	3.77

Analysis of Variance

Source of Variance	Degrees of freedom	Sum of squares	Mean square	Computed F	Tabular F	
					0.05	0.01
Replication	2	1.718	0.859			
Treatment	3	1.961	0.654	1.58ns	4.76	9.78
Error	6	2.483	0.414			
Total	11	6.163				

ns= not significant

Coefficient of variation= 20.52%



APPENDIX TABLE 10. Number of petals per flower

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
V1	12.33	11.67	13.00	37.00	12.33
V2	14.00	13.67	14.33	42.00	14.00
V3	12.00	13.67	12.33	38.00	12.67
V4	12.33	13.33	12.33	37.99	12.66

Analysis of Variance

Source of Variance	Degrees of freedom	Sum of squares	Mean square	Computed F	Tabular F	
					0.05	0.01
Replication	2	0.393	0.196			
Treatment	3	4.922	1.641	3.35ns	4.76	9.78
Error	6	2.941	0.490			
Total	11	8.255				

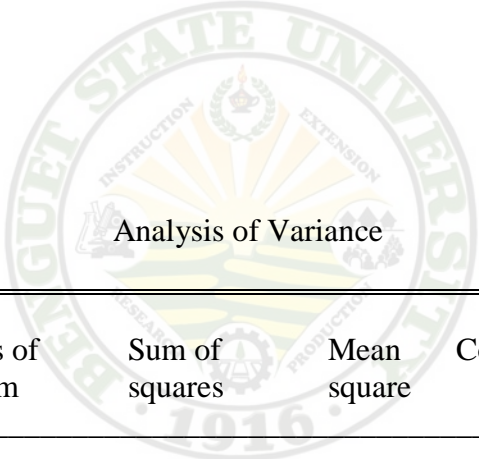
ns= not significant

Coefficient of variation= 15.15%



APPENDIX TABLE 11. Vaselife

VARIETY	REPLICATION			TOTAL	MEAN
	I	II	III		
V1	8.00	8.00	8.00	24.00	8.00
V2	8.00	8.00	8.00	24.00	8.00
V3	8.00	8.00	9.00	25.00	8.33
V4	10.00	10.00	10.00	30.00	10.00



Analysis of Variance

Source of Variance	Degrees of freedom	Sum of squares	Mean square	Computed F	Tabular F	
					0.05	0.01
Replication	2	0.167	0.083			
Treatment	3	8.250	2.750	33.00**	4.76	9.78
Error	6	0.500	0.083			
Total	11	8.917				

** - highly significant

Coefficient of variation = 3.36%

