BIBLIOGRAPHY

JUANITO, TONY B. APRIL 2007. Breaking Dormancy of Benguet Lily Bulbs (*Lilium philippinensis*). Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted at the Horticulture Department Laboratory area, Benguet State University, La Trinidad, Benguet from July to September 2006 to evaluate the effect of cold stratification, ethyl alcohol, calcium carbide (C_aC_2), and Gibberellic Acid (GA_3) on breaking dormancy of Benguet lily bulbs, and to determine the best treatment that will effectively promote earlier shoot and root initiation of Benguet lily bulbs.

Result shows that Benguet lily bulbs dipped in 500 ppm GA_3 significantly promoted earlier formation of roots, had the highest percentage of sprouting and were the earliest to attain 2.5 cm. shoot formation. However, it had the least number of roots two months from treatment. Benguet lily bulbs treated with C_aC_2 for two weeks and cold stratified at 5^oC for two weeks had the highest percentage of root development and had the longest roots two months from treatment. The highest percentage of bulb damage was significantly observed in ethyl alcohol treated bulbs.

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INTRODUCTION

Benguet lily belongs to the family *Liliceae* that are hardy perennials. It is a relative of the equally popular Easter lily (*Lilium longiforum).* The distinguishing characteristics between them are that the leaves and flowers of the Benguet lily are very much narrower than those of the Easter lily (Asuncion *et al*., 1976) and the former can be propagated through bulbs, seeds or by bulblets.

Lily plants are known and familiar in the country. In the Cordillera, these plants are known as Benguet lily (*Lilium philippinensis*) and are considered indigenous (Hermano, 2000). The name given by an American pioneer during the World War II who was the first to cultivate and saw its potential as a cutflower crop (Cimato, 2000). The plant grows predominantly in the province of Benguet and other highland areas in the Cordilleras. It is one of many endemic plants in the region. Its white fragrant flowers symbolizes beauty, purity and peace (Artajo, 2000). The Benguet or Mountain lilies however, have never been or seldom used since their flowers are few and seasonal due to the absence of technology in growing them. Despite the situation about its technology it was once proposed to be the provincial flower of Benguet (Hermano, 2000). The flower measures from 5-7 inches long with either one or two blossoms per stalk. The flowers are used to decorate church altars during weddings and on other special occasions.

Benguet lily plants became an endangered species due to continues collection of the plant from its native habitat and the lack of local domestication efforts. It has become rare, vulnerable and dependent on rainwater in the wild. This has been considered a very delicate flower and is said to die once if it is taken from its natural habitat (Olarte, 2001).

It was further added that at present, Benguet lily has lost even its name and no longer known as such in the International Flower Trade for its name has been changed and has even lost its birthright (Cimatu, 2000). Furthermore, the same source stated that Benguet lily has been used as base for cross breeding lilies abroad since no Baguio Horticulturist accepted the challenge.

Most plants will be lost or will revert to less desirable forms unless they are propagated under controlled conditions that preserve the unique characteristics that makes them useful (Hartmann et al., 1986).

It was reported in1995 that the population of lily plants was declining due to over collection, becoming rare and endangered due to the effort of man to domesticate it which has brought about the rapid depletion of the species in its natural habitat (Ampaguey, *et al*., 2003). The delicate flower delicate dies once it is taken from its natural habitat (Olarte, 2001).

This study is important because there is no study conducted on the breaking dormancy of Benguet lily bulb.

Objective of the Study

The study was conducted to:

1. Evaluate the effect of cold stratification, calcium carbide (CaC_2) ethyl alcohol and Gibberellic acid (GA_3) on the breaking of dormancy of Benguet lily bulbs.

2. To determine the best treatment that will effectively promote earlier shoot and root initiation and break dormancy of Benguet lily bulbs.

The study was conducted at the Department of Horticulture Postharvest laboratory room at AC 105, Benguet State University, La Trinidad, Benguet.

The study was conducted to:

1. To evaluate the effect of cold stratification, calcium carbide (C_aC_2), ethyl alcohol and Gibberellic acid (GA_3) on the breaking dormancy of Benguet lily bulbs.

2. To determine the best treatment that will effectively promote earlier shoot and root initiation and break dormancy of Benguet lily bulbs.

The study was conducted at the Department of Horticulture Laboratory Area, Benguet State University, La Trinidad, Benguet from July to September 2006.

REVIEW OF LITERATURE

The Plant

Lilies are very delicate plants with lovely bell like flowers and grows in a wide range of soil types, varying climate, altitudes and shades. Some lilies grow only in the highlands like Baguio lily or the Benguet lily (Asuncion *et al*., 1976).

Lily is one of the top ten popular flowers in the world. It ranks 5th in the Holland and 6th in Japan in 1988 and 1993, respectively. Japan is importing 25% of their 11 million flower requirements in 1993. Locally, the market demand markedly increasing particularly the newly introduced lilies (Hermano, 2000).

The species of the genus Lilium are classified botanically into seven sections (Comber, 1944 as cited by Collicut and Ronald, 1996), while the various types as cultivated lilies are divided into nine horticultural divisions (Anonymous, 1964) cultivars of the Aurelian and Oriental Horticultural Division constitute a large portion of cultivated lilies. Aurelian hybrids are considered quite a reliable plant for northern gardens, however, most oriental lilies are late flowering and fail to mature in the Northern zones (Collicut and Ronald, 1996).

There are numerous species of the genus Lilium that were mixed through hybridization and become highly hybrids. These hybrids are called Asiatic and Oriental hybrids. The other species that were popular are the *longiforum* and *speciosum* hybrids. The morphology of claimed indigenous lily and lost Easter lily of the Cordillera closely resemble *longiforum* sp. (Hermano, 2000). *Lilium longiforum* has large trumpet-shaped flowers, while the Asiatic hybrids are characterized as open often upward facing with

bright colors and jaunty profiles. The oriental hybrids are described as with much larger blooms and more flamboyant than the Asiatic (Ampaguey *et al.*, 2000).

The distinguishing characteristics of Benguet lily is that it has only two waxy flowers, 12-18 cm (Asuncion *et al*., 1976). Olarte (2001) also identified the plants as branchless, bulbous herbs about 70 cm tall, having big showy flowers with lobes and very narrow leaves.

Benguet lily thrives well in well-drained, loam soil at altitudes of 300 to 1000 m above sea level and grows in isolated, even unreachable areas. This lily is mostly found in the pine regions of Benguet and spotted on the strep ridges of the Halsema highway, a major road linking Benguet to the other Cordillera municipalities (Cimatu, 2000).

Propagation of Lilies

Lilies are propagated through seeds, bulbs, bulbils, bulb scales and tissue culture. Seed propagation is used for the multiplication of species and new cultivars. The seeds of different lily species have different germination requirement (Hartmann *et al*., 1990). Many species are often increased by means of seeds which germinate in two types: the *epigeal* and *hypogeal* germination (Petrova, 1975). For most commercially important species and hybrids like L. *tigrinom,* L. *amabile*, L. *concolor*, L. *longiforom,* Aurelian hybrids, mid-century hybrids and others, the germination, shoots generally emerge three to six weeks after oplanting at moderately high temperature (Hartmann *et al*., 1990).

Bulb Characteristics

Bulbs are generally tunicated, all the coats or layers grow from the base called the basal plate. The outer coat or tunic varies in appearance, in color and thickness depending on the species of the plant. They serve to protect the bulb from damage and drying out (Asuncion *et al.,* 1976). In the center of the bulb is the young bud from which the flower arises. Daughter bulbs form in the axils of the coat on the basal plates and the bud from which the new mother plant develops is located under the inside coat. The rests grow out of the basal plate at the bottom (Petrova, 1975).

Effect of Growth Regulators

Weaver (1972), as cited by (Lab-oyan, 1998) reported that the application of growth regulators to cuttings is usually done for the enhancement of rooting and for uniformity of root formation, and stimulation of rooting period of cuttings. Their effects were explained by Bidwell (1979) and Wilkens (1968) as cited by (Lab-oyan, 1998) is due to cell enlargement and elongation by the hormones which eventually cause the expansion of the growing points affected.

Use of Gibberellic Acid (GA_3) in Plant Growth

The use of GA_3 as a plant hormone can encourage plant growth especially in cold weather, hasten germination, increase in size and yield of some crops and promote flowering in most ornamentals and vegetable crops (Leopold, 1964).

Gibberellic offer to affect almost all plant organs from root development to flower, fruit and seed development.

Stratification

Stratification is an aid for germinating seeds of many species (Copeland and McDonald, 1983). Adriance and Brison (1955) as cited by Paing (1980), reported that stratification as a pre-plant treatment, preserve viability and hasten the germination of seeds by reducing the amount of germination inhibitor within the seeds, thereby enhancing germination.

King (1978) as cited by Antolin (2001) showed that stratification should be done only on freshly extracted seeds. Outdoor stratification in a cellar or other cold storage bin can be accomplished if the temperature remains below 40^{o}F for 6 to 12 weeks.

Copeland and McDonald (1993) added that the stratification requirement of a particular seed lot also depends on the seed age because of the persistence of dormancy increasing with seed age, which is a universal characteristic of indigenous dormancy. But the speed at which dormancy is lost varies among species.

MATERIALS AND METHODS

Materials

The materials that was used in this study were newly harvested Benguet lily bulb, calcium carbide (CaC_2), Gibberillic acid (GA_3), 70% ethyl alcohol, refrigerator, mountain soil and compost.

Methods

Newly harvested Benguet lily bulbs was used in the study. The bulbs was treated according to their treatments specified below. The bulbs was planted in seed boxes after treatment with 1:1 by volume of mountain soil and compost as the rooting media.

Experimental designs and treatments. The experiment was arranged in completely randomized design (CRD). There were 50 bulbs per treatment replicated three times. The treatments were as follows:

Treatment	Duration
T_0 – Control	(No treatment prior to planting)
T_1 – CaC_2	100 g/150 bulbs stored for 2 weeks
T_2 – GA3	Dipped in 500 ppm GA_3 for 1 hour then air dried before planting
T_3 – 70% Ehyl alcohol	Sprayed with 70% ethyl Alcohol then air dried before planting
T_4 – Cold stratification	Refrigerated at 10^{o}C for 2 weeks

Data Gathered

1. Number of days from treatment to breaking dormancy. The number of days from treatment to initial sprouting and root development of bulbs were counted per treatment.

2. Degree of sprouting, root development and bulb damage after treatment. The percentage of sprouting, root development and bulb damage 1 month from treatment were recorded.

3. Number of days from treatment to sprouting (2.5 cm bud size). The number of days from treatment to sprouting (2.5 cm) were counted.

4. Length of roots (cm) and number of roots one month from treatment application were recorded.

RESULTS AND DISCUSSION

Days from Planting/Treatment to Root Formation

Result show that there were highly significant differences observed on the different treatment used with regards to the number of days from planting to root formation. Benguet lily bulbs dipped in 500 ppm Gibberellic Acid (GA_3) for one hour significantly promoted earlier formation of roots with a mean of 9.67 days. Untreated plants had the longest duration to root formation with a mean of 24.33 days. Benguet lily bulbs treated with ethyl alcohol, calcium carbide and cold stratification for 14 days at 5^oC were statistically comparable with regards to days from planting to root formation (Table 1, Figure 1).

Table 1. Days from planting/treatment to root formation

TREATMENT	MEAN (Days)
Control	24.33 a
GA3	9.67 c
CaC2	15.00 b
Ethyl alcohol	16.00 b
Cold stratification	14.33 bc

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

Days from Planting/Treatment to Shoot Formation

Table 2 and Figure 2 show the effect of the different treatments used on the number of days from planting to shoot formation of Benguet lily bulbs. Gibberellic Acid (GA_3) treated bulbs significantly enhanced earlier shoot formation with a mean of 14 days while the untreated bulbs were the latest to form shoot after a mean of 40 days from planting. Earlier shoot formation were also noted in bulbs treated with calcium carbide (CaC_2) and applied with cold stratification treatment for 14 days and with means of 17.67 and 16.33 days respectively. Among the treated bulbs, those applied with ethyl alcohol before planting were the latest to form shoots.

This observation is in line with what Mallete and Althouse (1960) found that gibberellins are active in promoting shoot growth, cell elongation and stimulate flower formation.

Table 2. Days from planting/treatment to shoot formation

TREATMENT	MEAN (Days)
Control	40.00 a
GA3	14.00 d
CaC2	17.67 bc
Ethyl alcohol	18.67 b
Cold stratification	16.33 c

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

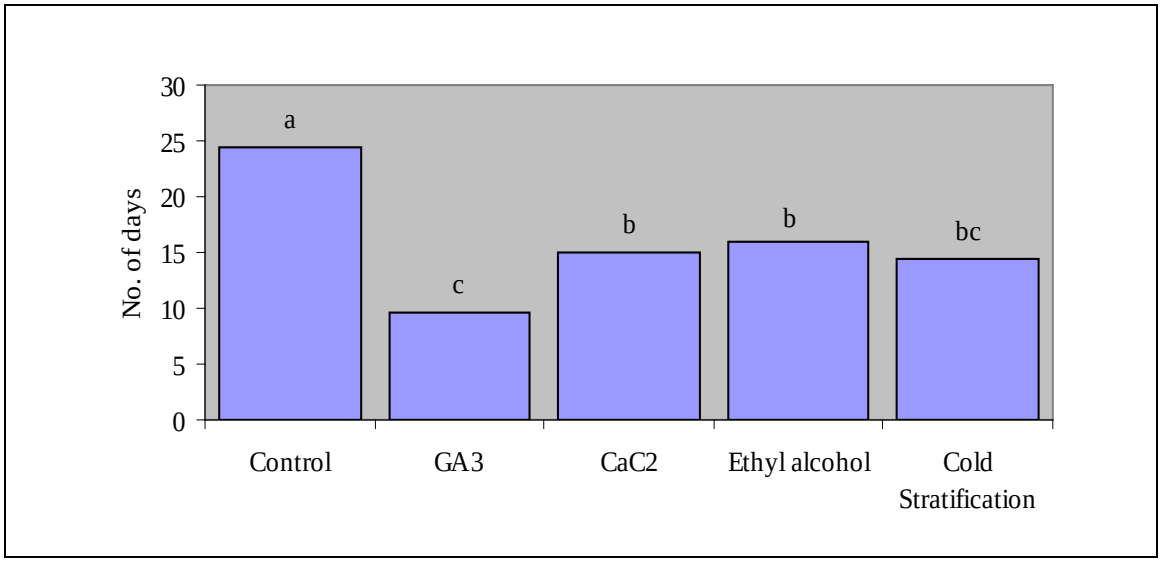

Figure 1. Number of days from planting to root formation as affected by different treatments to break bulb dormancy

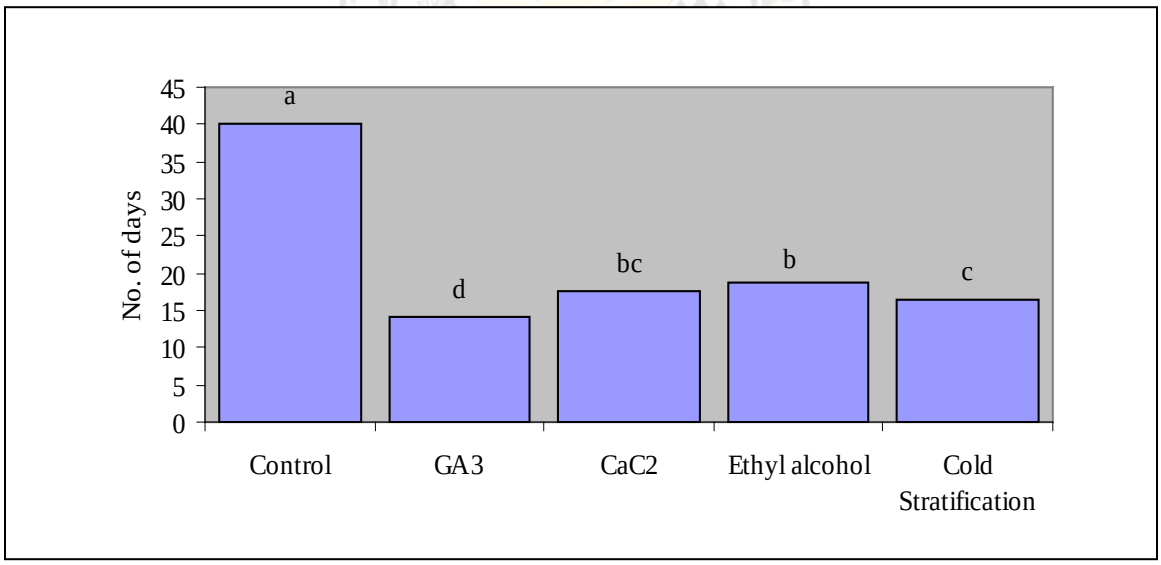

Figure 2. Number of days from planting to shoot formation as affected by different treatment to break bulb dormancy

Percentage of Sprouting

Significant differences were obtained on the percentage of sprouting as affected by the different treatments used. Benguet lily bulbs dipped in 500 ppm (GA_3) for one hour had the highest percentage of sprouting with a mean of 30.67%, while bulbs treated with ethyl alcohol had the lowest percentage of sprouting of 4% which was lower than those in control which had 10%. Cold stratified bulbs were comparable with that of the control bulbs. The very low percentage of sprouting in bulbs treated with ethyl alcohol is due to the high percentage of damaged bulbs after treatment (Table 3 and Figure 3).

The results confirm the report of Salda and Bayogan (1985) that GA_3 promoted sprout initiation, resulting in more and longer sprouts.

In 1984, Bayogan and Salda found that when Conchita, Cosima, Fina, Granola and Red Pontiac tubers treated with 2 ppm GA_3 produced longer, uniform and normal sprouts compared to the control lot.

Table 3. Percentage of sprouting (%)

TREATMENT	MEAN
Control	10.00 c
GA3	30.67 a
CaC2	16.67 b
Ethyl alcohol	4.00 d
Cold stratification	12.00 c

Means with a common letter are not significantly difference at 5% level of DMRT

Percentage of Root Development (%)

Table 4 and Figure 4 show that there were significant differences with regards to the development of roots after treatment. Benguet lily bulbs treated with calcium carbide (C_aC_2) for two weeks had the highest percentage of root development with a mean of 94%, while the lowest was obtained from the bulbs dipped in ethyl alcohol prior to planting with a mean of 42.67%. Cold stratification of bulb at 5^oC for 14 days also increased rooting percentage which is comparable with those treated with Gibberellic acid (GA_3). Means were 91.33% and 79.33% respectively.

This result somehow correlates with the work of Zimmerman and Hitchcock (1933), that ethylene, as well as propylene, acetylene and carbon monoxide, was shown to be stimulator of root initiation.

Table 4. Percentage of root development (%)

TREATMENT	MEAN
Control	56.67 b
GA3	79.33 a
CaC2	94.00 a
Ethyl alcohol	46.67 b
Cold stratification	91.33 a

Means with a common letter are not significantly difference at 5% level of DMRT

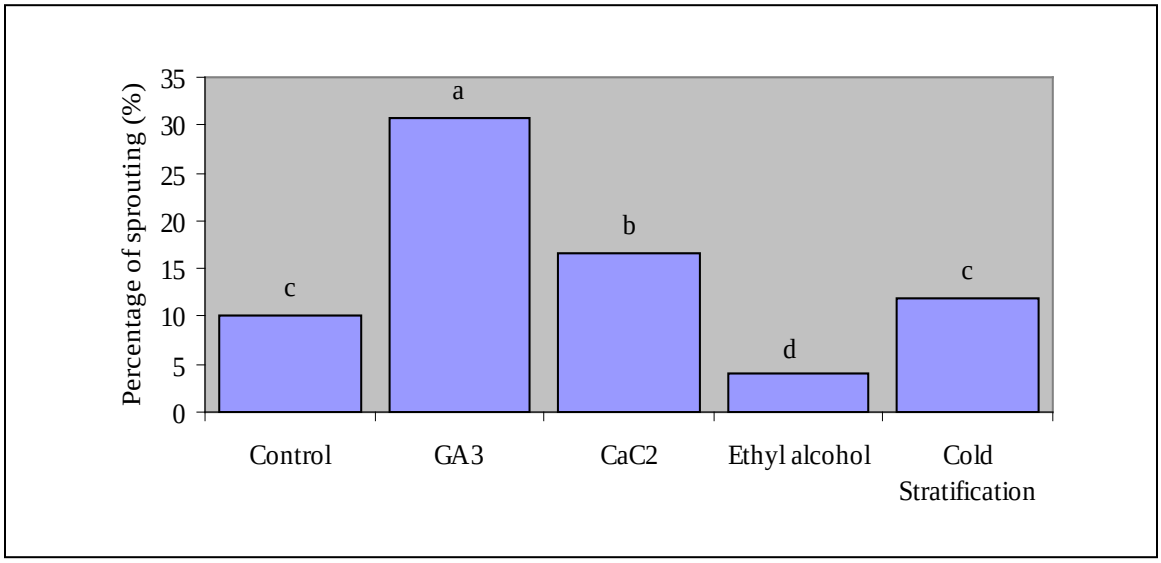

Figure 3. Percentage of sprouting as affected by different treatment to break bulb dormancy

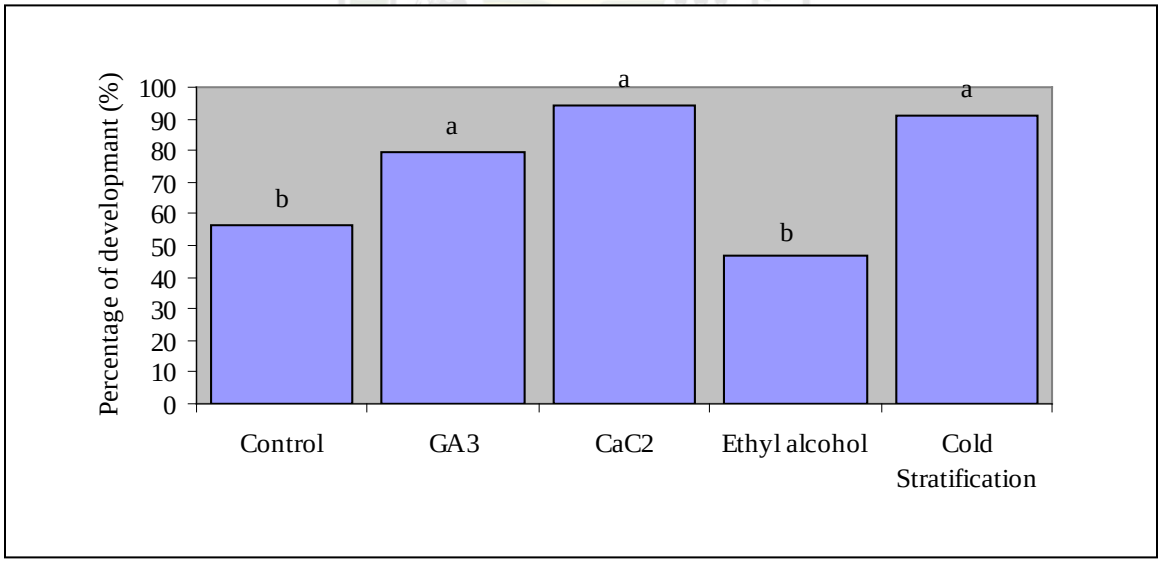

Figure 4. Percentage of root development as affected by different treatment to break bulb dormancy

No. of Roots Two Months from Treatment

Table 5 and Figure 5 present the number of roots two months from treatment. Results show that there were significant differences obtained among the treatments used. Significantly more roots were observed on bulbs treated with calcium carbide (CAC_2) for two weeks with a mean of 5.10 roots, followed by the untreatred bulbs and the one treated with cold stratification which had an identical mean of 3.33 roots. Bulbs treated with Gibberellic acid (GA_3) and ethyl alcohol had significantly lesser roots with an average of 1.80 and 1.93 roots per bulb, respectively.

These results correlate with the findings of Jones in 1968, that acetylene generated from C_aC_2 can produce ethylene – like effects which might stimulate the release of Gibberellic – induced alpha-amylase from the aleuron cells into the endosperm a storage tissue which stimulates germination, root initiation and sprouting.

Table 5. Number of roots two months from treatment

TREATMENT	MEAN
Control	3.33 b
GA3	1.80 c
CaC2	5.10 a
Ethyl alcohol	1.93 c
Cold stratification	3.33 b

Means with a common letter are not significantly difference at 5% level of DMRT

Average Number of Days from Treatment to Sprouting

Results showed highly significant differences on the number of days from treatment to sprouting (2.5 cm bud size) as affected by treatments used. Benguet lily bulbs treated with 500 ppm Gibberellic Acid (GA_3) for one hour were the earliest to break dormancy which sprouted after 19.33 days, followed by those applied with calcium carbide (C_aC_2) which had the visible sprouts of 2.5 cm, after 27.33 days from planting. On the other hand, bulbs that were not treated (control) had delayed shoot development and were the latest to break their dormancy and sprouted after 52 days from planting. (Table 6 and Figure 6).

These results correlates with the report of Bayogan *et al.*, (1985) that tubers dipped in 20 to 40 ppm GA_3 concentration resulted in rapid sprout initiation and longer sprouts in Cosima.

Table 6. No. of days from treatment to sprouting (2.5 cm bud size)

TREATMENT	MEAN (Days)
Control	52.00 a
GA3	19.33 e
CaC2	27.33 d
Ethyl alcohol	43.33 b
Cold stratification	37.67 c

Means with a common letter are not significantly difference at 5% level of DMRT

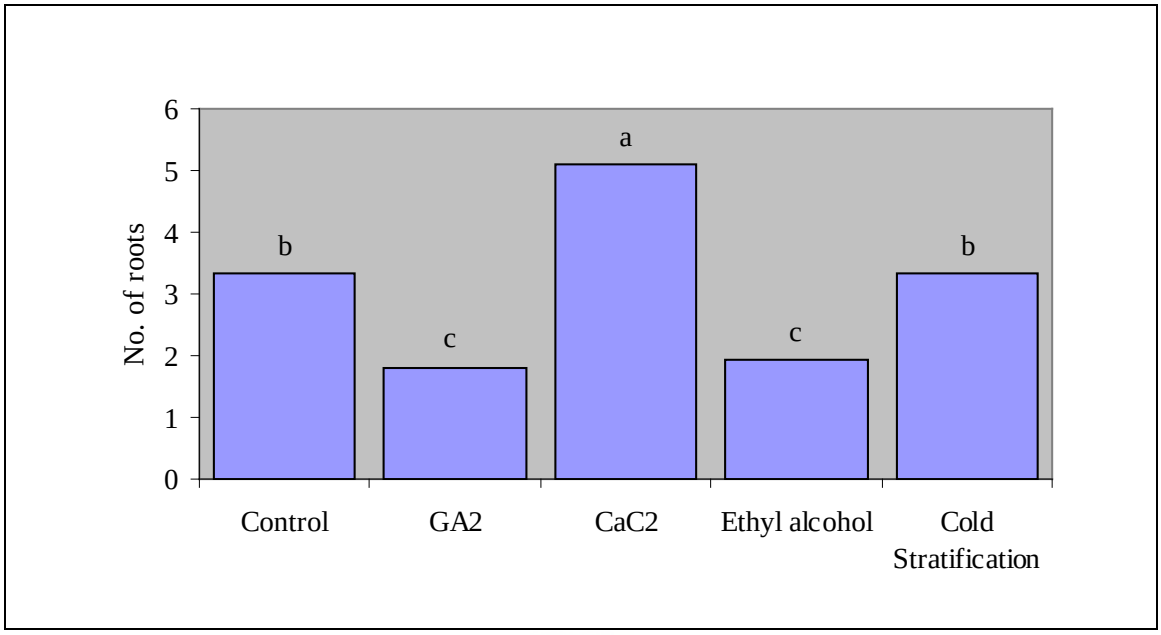

Figure 5. Number of roots two months from planting as affected by different treatment to break bulb dormancy

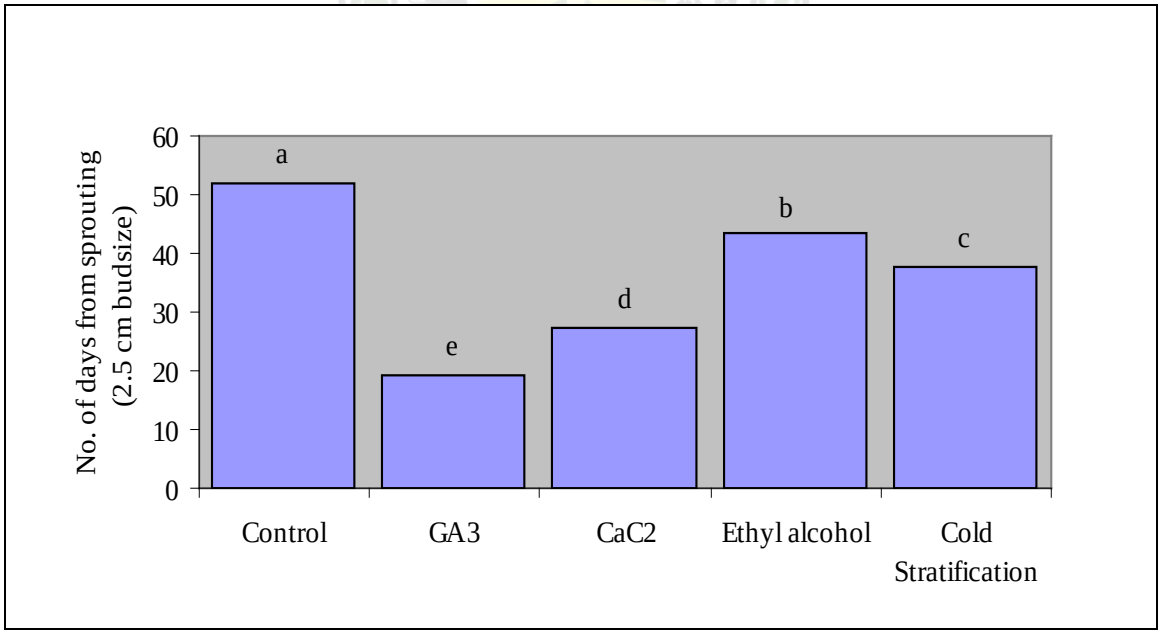

Figure 6. Number of days from planting to sprouting (2.5 cm budsize) as affected by different treatment to break bulb dormancy

Average Length of Roots Two Months from Treatment

Statistical analysis showed significant effects on the length of roots two months from treatment as affected by the different treatments applied. Bulbs treated with cold stratification for 14 days at 5^{o}C had the longest roots with a mean of12.42 cm while bulbs that were untreated (control) had the shortest roots with a mean of 5.81cm. Shortest roots were likewise, noted from bulbs treated with 500 ppm GA_3 and C_aC_2 means were 6.10 and 10.56 cm respectively. (Table 7 and Figure 7).

Antolin (2001) as cited by Deponio (2002) mentioned that in Gipas seeds, alternate cold and warm stratification reduced the number of days from sowing to complete germination by nine days. Seeds of many species appear to require several cycles of stratification treatment to be completed. Copeland and McDonald (1985) added that the stratification requirement of a particular seed lot also depends on the seed age because of the persistence of dormancy increasing with seed age, which is a universal characteristic of indigenous dormancy. But the speed at which dormancy is lost varies among species.

Percentage of Bulb Damage Two Months After Treatment

Results revealed highly significant differences on the percentage of bulb damage two months after treatment. Benguet lily bulb dipped in ethyl alcohol had the highest percentage of bulb damage with a mean of 57.33%. This was followed by bulbs that were not treated (control) with a mean of 40%. Benguet lily bulbs that were treated C_aC_2

Table 7. Length of roots two months from treatment (cm)

TREATMENT	MEAN
Control	52.00 a
GA3	19.33 e
CaC2	27.33 d
Ethyl alcohol	43.33 b
Cold stratification	37.67 c

Means with a common letter are not significantly difference at 5% level of DMRT

had the lowest percentage of bulb damage with a mean of 6%. This means that C_aC_2 as a pre-planting treatment ensures lower percentage of bulb damage in breaking dormancy in Benguet lily. Likewise, a low bulb damage of 12.67% was obtained in bulbs treated with cold stratification at 5^oC for 14 days which was significantly lower compared to those treated with GA_3 with a mean of 20.67% (Table 8 and Figure 8).

This result conforms with the findings of Gonzales, F.R. (1983) that lower CaC_2 concentration (30 g) and short duration of exposure (10-40 days) did not damage the corms exposed during treatment. This may be attributed to the amount of acetylene generated from CaC_2 present in the box where corms of gladiolus were stored.

Table 8. Percentage of bulb damage two months after treatment (%)

TREATMENT	MEAN
Control	40.00 b
GA3	20.67 c
CaC2	6.00 d
Ethyl alcohol	57.33 a
Cold stratification	12.67 cd

Means with a common letter are not significantly difference at 5% level of DMRT

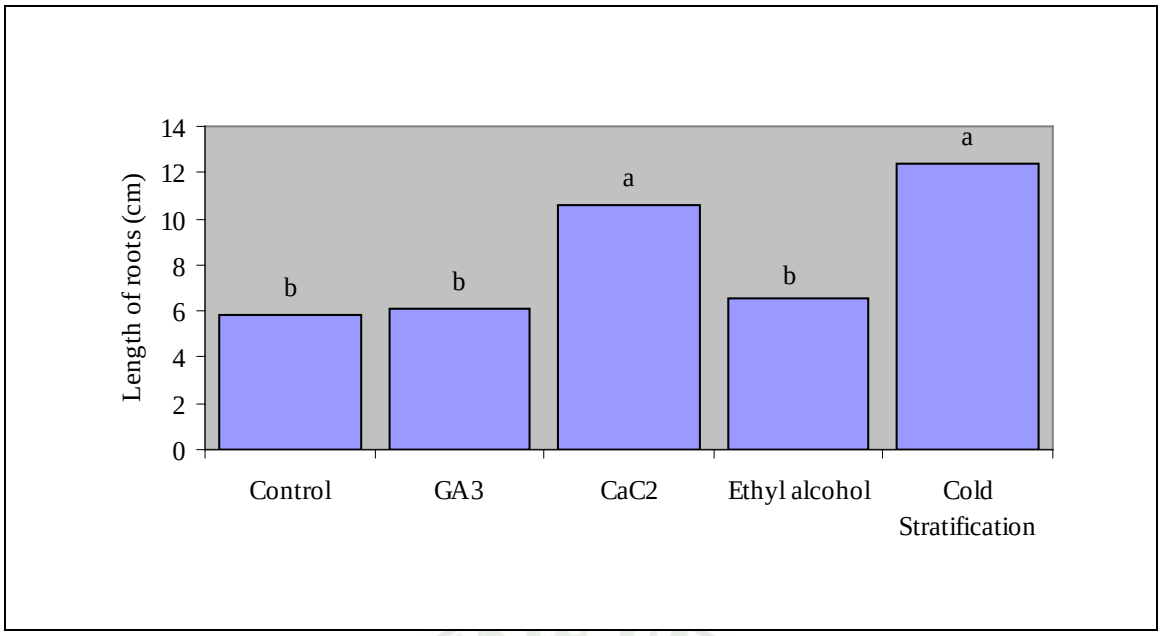

Figure 7. Length of roots (cm) two months from planting as affected by different treatment to break bulb dormancy

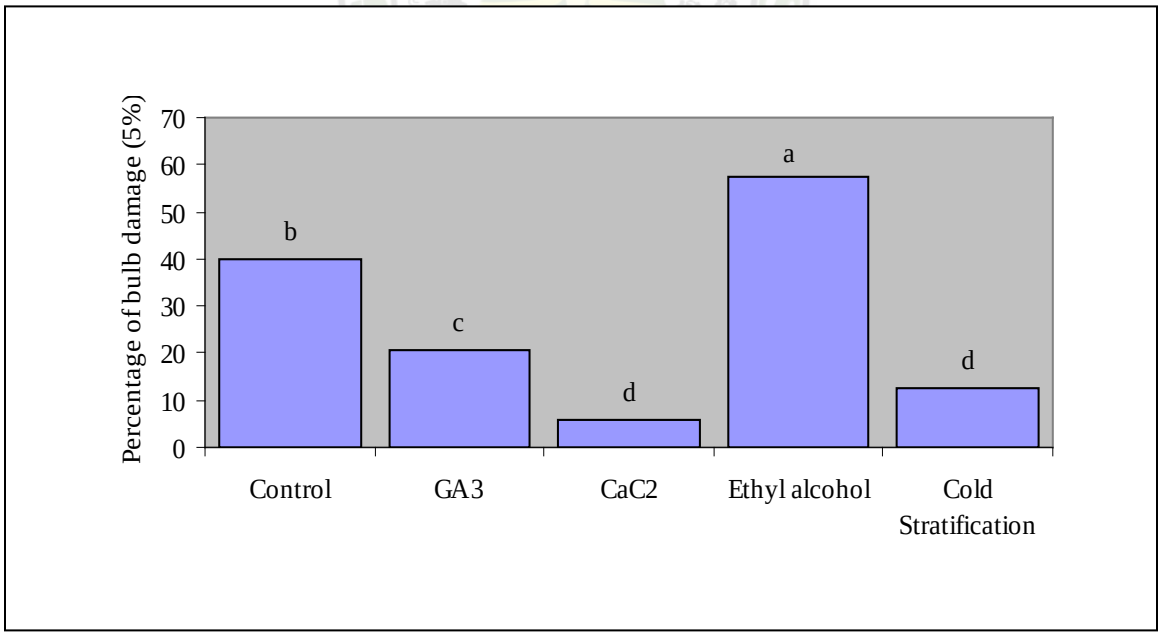

Figure 8. Percentage of bulb damage two months after planting as affected by different treatment to break bulb dormancy

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at the Horticulture Department Laboratory area, Benguet State University, La Trinidad, Benguet from July to September 2006 to evaluate the effect of cold stratification, ethyl alcohol, calcium carbide (C_aC_2) and Giberellic Acid (GA_3) on the breaking dormancy of Benguet lily bulbs, and to determine the best treatment that will effectively promote earlier shoot and root initiation of Benguet lily bulbs.

Results showed that Benguet lily bulbs dipped in 500 ppm GA_3 for one hour significantly promoted earlier formation of roots with a mean of 9.67 days from treatment, were the earliest to form shoots after 14 days and were the earliest to attain 2.5 cm. sprout after 19.33 days. However, GA_3 treated bulbs had the lowest number of roots two months from treatment. Benguet lily bulbs treated with C_aC_2 for two weeks and cold stratified for 2 weeks at 5^oC had the highest percentage of root development two months from treatment with 94% and 91.33% respectively. The highest percentage of damaged bulbs after treatment was significantly observed on ethyl alcohol treated bulbs with 57.33% while bulbs treated with C_aC_2 for 2 weeks had the least damaged bulbs after treatment with only 6 percent.

Conclusion

It is therefore concluded that dipping Benguet lily bulbs in 500 ppm Gibberellic Acid (GA_3) for one hour could enhance earlier formation of roots, earlier shoot

formation, highest percentage of sprouting and were the earliest to break dormancy. On the other hand, application of calcium carbide (C_aC_2) promoted highest percentage of root development, highest number of roots two months from treatment, and had the lowest percentage of bulb damage. Likewise, bulbs treated with cold stratification for 14 days at 5^oC had the longest roots two months from treatment.

Recommendation

Based on the findings of the study, dipping Benguet lily bulbs in 500 ppm Gibberellic Acid (GA_3) for one hour is recommended for earlier formation of roots, earlier shoot formation, highest percentage of sprouting and were the earliest to break dormancy of Benguet lily bulbs.

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APPENDICES

Appendix Table 1. Days from planting/treatment to root formation

TREATMENT	R E P L I C A T I O N I	II	III	TOTAL	MEAN
Control	20	28	25	73	24.22
Ga3	10	12	7	29	9.67
CaC2	12	17	16	45	15.00
Ethyl alcohol	16	15	17	48	16.00
Cold stratification	12	15	16	43	14.33

Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	TABULAR F 0.05	0.01
Treatment	4	339.733	84.933	12.13**	3.48	5.99
Error	10	70.000	7.000			
Total	14	409.733				

** = Highly significant Coefficient of variation = 16.67%

Appendix Table 2. Days from planting/treatment to shoot formation

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	40	40	40	120	40.00
Ga3	14	13	15	42	14.67
CaC2	17	19	17	53	18.67
Ethyl alcohol	18	19	19	56	18.67
Cold stratification	18	15	16	49	16.33

Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	TABULAR F 0.05	0.01
Treatment	4	1343.333	84.933	12.13**	3.48	5.99
Error	10	10.000	7.000			
Total	14	1353.333				

** = Highly significant Coefficient of variation = 4.69%

Appendix Table 3. Percentage of sprouting (%)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	10	10	10	30	10.00
Ga3	35	28	29	92	30.67
CaC2	18	16	16	50	16.67
Ethyl alcohol	4	4	4	12	4.00
Cold stratification	8	12	16	36	12.00

Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	TABULAR F 0.05	0.01
Treatment	4	1208.00	302.00	47.68**	3.48	5.99
Error	10	63.33	6.33			
Total	14	1271.33				

** = Highly significant

Coefficient of variation = 17.16%

Appendix Table 4. Percentage of root development (%)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	50	50	70	170	56.67
Ga3	74	94	70	238	79.33
CaC2	94	94	94	282	94.00
Ethyl alcohol	42	24	62	128	42.67
Cold stratification	98	80	96	274	91.33

Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	TABULAR F 0.05	0.01
Treatment	4	6011.73	1502.93	9.92**	3.48	5.99
Error	10	1514.67	151.47			
Total	14	7526.40				

** = Highly significant Coefficient of variation = 16.90%

Appendix Table 5. Number of root two months from treatment

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	2.6	4.44	3.0	10	3.33
Ga3	1.4	1.4	1.4	5.4	1.80
CaC2	4.6	5.4	5.2	15.2	5.10
Ethyl alcohol	1.8	2.2	1.8	5.8	1.93
Cold stratification	2.8	3.6	3.6	10	3.33

Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	TABULAR F 0.05	0.01
Treatment	4	21.083	5.271	14.53**	3.48	5.99
Error	10	3.627	0.363			
Total	14	24.709				

** = Highly significant Coefficient of variation = 19.47%

Appendix Table 6. Number of days from treatment to sprouting (2.5 cm bud size)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	52	52	52	156	52.00
Ga3	19	19	20	58	19.33
CaC2	26	29	27	82	27.33
Ethyl alcohol	43	44	43	130	43.33
Cold stratification	39	36	38	113	37.67

Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	TABULAR F 0.05	0.01
Treatment	4	1996.267	499.067	467.88**	3.48	5.99
Error	10	10.67	1.067			
Total	14	2006.933				

** = Highly significant Coefficient of variation = 2.87%

Appendix Table 7. Length of roots (cm) two months from treatment

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	2.37	7.52	7.56	17.45	5.81
Ga3	7.38	5.53	5.38	18.29	6.10
CaC2	12.22	7.96	11.5	31.68	10.56
Ethyl alcohol	4.94	8.52	5.21	19.67	6.56
Cold stratification	11.03	12.03	14.2	37.26	12.42

Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	TABULAR F 0.05	0.01
Treatment	4	107.927	26.982	5.82*	3.48	5.99
Error	10	46.342	4.634			
Total	14	154.269				

* - significant

Coefficient of variation = 26.22%

Appendix Table 8. Percentage of bulb damage two months after treatment (%)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	50	40	30	120	50.00
Ga3	26	26	30	62	20.67
CaC2	6	6	6	18	6.00
Ethyl alcohol	58	76	38	172	37.33
Cold stratification	12	12	14	38	12.67

Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	TABULAR F 0.05	0.01
Treatment	4	5165.333	1291.333	13.80**	3.48	5.99
Error	10	936.000	93.600			
Total	14	6101.333				

** = Highly significant Coefficient of variation = 33.75%