## BIBLIOGRAPHY

JOEL S. CATONES. OCTOBER 2008. Effect of Gibberellic Acid $GA_3$ on the Growth and Flowering of milflores (*Hydrangea Macropylla*). Benguet State University

Adviser; Fernando R. Gonzales, PhD

## ABSTRACT

The study was conducted at Lamtang, Puguis, La Trinidad, Benguet from November 2007 to March 2008 which aimed to compare the effect of $GA_3$ concentration on the vegetative growth and flowering of potted milflores plants; to determine the effect of different gibberellic acid $GA_3$ on the growth and flowering of milflores, and to determine the best concentration of gibberellic acid $GA_3$ that will enhance vegetative growth with better flower quality.

The earliest to develop flower buds observed were on milflores plant treated at three month and the longest flower bud to develop was one month from treatment. Plants sprayed with 50 ppm $GA_3$ were the earliest to develop flower buds while untreated plants required longer days to develop flower buds.

Milflores plants treated with smaller amount of $GA_3$ concentration was the earliest to develop flower followed by the higher amount of $GA_3$ concentration. Untreated plants show delayed flower development and flowering.

The highest number of leaves counted at 75% anthesis was produced by the plant treated at two months. Plant sprayed with 100 ppm $GA_3$ has the highest number of leaves counted followed by 50 ppm.

Milflores plants treated at two month produce the longest stem measured at 75% anthesis followed by one month and three month. Plant sprayed with 250 ppm $GA_3$ the longest stem measured followed by 100 ppm.

The widest flower diameter was produced by 250 ppm followed by 100 ppm $GA_3$ concentration at two month. The smallest flower diameter measured was observed in untreated plants.

The thickest stems were measured on milflores plant treated with 250 ppm and followed by plants sprayed with 50 and 100 ppm $GA_3$. Two month produce the thickest stems followed by three month and one month from treatment.

Plats treated at one month produce the largest number of leaves of lateral stems followed by three month and two month.$GA_3$ have a slight effect on the lateral stems of milflores plants.

TABLE OF CONTENTS

## INTRODUCTION

Nature of the Study

Hydrangea is a genus of shrub of the Saxifrage Family consisting of about 80 species. One of these species is the milflores (*hydrangea macrophylla*). Hydrangea is a strong deciduous shrub having a height and width of 6 feet. Leaves are broadly ovate, 4-6 inches long and 2.75-4 inches wide width coarse4 serrations, yellowish to fresh green in color flowers are in large braches globose cyme of the hortensia or mop-head type with abundant, mostly sterile, individual floret, 4-5petal linked sepal per flower (Anon, 2002).

This group consists of hardy and tender shrubs and woody climbers. They are mostly deciduous plants, through a few of the tender species are evergreen. They are native of the Himalayas, North and South America, and central and eastern Asia. These flowering shrubs have different flower from the large globes of the “mopheads” to the discs of the “lacecaps” to the thick cones of the oakleaf and panicle hydrangea. They come in an array of colors from pure white to brilliant crimson, pale lilac to intensive azure. Some varieties produce blossoms with two-toned colors, while some flowers have contrasting eyes, and some even is speckled or striped with another color. There are two kinds of floret in the flower heads. The fertile or perfect florets are small and inconspicuous. They bear the male and female parts and are usually found in the center of the cluster. The flower heads or mopheads hydrangeas consists almost entirely or sterile floret. Beside from their lovely flower, some hydrangeas are valued for their attractive foliage or bark. The size of the plants range from dwarf (about ft high) to large bushes with stems over 10 ft high. There are also climbing hydrangeas whose aerial can bring stem up to 80 ft high. H. aspera subsp. Sargentia (Sargent Hydrangea) is an attractive medium to large-sized

shrub with hairy shoots and large, plush leaves. The large, flat flower head are produced in mid-o late summer and are bluish with white ray florests. This variety is excellent for a sheltered shrub border or woodland, but need shade and wind protection. H. "Ayesha" is a deciduous shrub that has shiny green leaves and flattened, fragrant flower heads consisting of cup-shape florests, resembling those of the lilac. They are grayish lilac or pink, depending upon the soil, eventually turning a greenish-blue to turquoise color. H. macrophylla 'Alltona' is a mophead hydrangea with flower heads growing up to a foot in diameter. This deciduous plat forms a mall shrub wit large, rose colored florests. This variety grows best in shade. H. quercifolia (Oakleaf Hydrangea) is a medium-sized, deciduous shrub valued for its splendid autumn colors. The large, deeply lobed leaves resemble those of the oak, thus the common name. In late summer, conical heads of large, white, sterile florets are produced. H. serratifoliais a tender, climbing hydrangea that grows best against a wall in sun or shade. It has small, leathery leaves and columnar panicles, up to 5 inches long, of creamy flowers. (Anon. undated)

Importance of the Study

Due to the economic potential and aesthetic value of potted milflores as bedding plants for outdoor landscaping and cut flowers, it is important therefore to find the best way of enhancing growth with quality flower of milflores with the use of giberellic acid.

Objectives of the Study

1. To determine the effect of giberellic acid ($GA_3$) on the growth and flowering of milflores.

2. To determine the best concentration of giberellic acid ($GA_3$) that will enhance vegetative growth with better flower quality.

3. The study was conducted to determine the best stage of gibberellic acid ($GA_3$) application and to;

4. Determine the interaction effect on various stage of gibberellic acid ($GA_3$) application and $GA_3$ concentration.

Place and Time of the Study

The experiment was conducted at the Ornamental Horticulture Research Area, Benguet State University, Benguet August 2007 to January 2008.

## REVIEW OF RELATED LITERATURE

Gibberellic acid $GA_3$ belongs to a group of plant hormones that promote plant growth. It is one of the plant growth regulators that can provide a wide range of plant response such as breaking dormancy, incubation of flowering, parthenocarpic fruit set and sex expression (Devlin 1977).

As Devlin (1977) reported, gibberellins are naturally occurring hormones that have been isolated from higher plant tissues. They act similarly as indole acetic acid (IAA), another kind of hormone to promote cell elongation, induce parthenocarpy, promote cambial activity, and issue new RPA and protein synthesis.

Gibberellins are known to alter the growth of plants, since their applications has been found to cause rosette plants to elongation in a manner suggestive to bolting. Investigations have been made on effects of $GA_3$ on the floral induction. Their influence on the growth and flowering of some crops has been investigated in greenhouse and in the field for the past years. Studies revealed earlier opening of flowers in those plants treated with $GA_3$ and reduction on the number of days required for the formation of flower buds (Leopold and Kriedman, 1964)

Plants treated with gibberellins generally grow to three times taller than the untreated plants. Promotion of flowering particularly in biennials and long day plants is one of the most striking effects of gibberellins. Biennials commonly do not produce long stem, and flower only if they are exposed to low temperature. However, when treated with gibberellins, they flower without cold temperature (Grealach and Adams, 1962).

Findings revealed that gibberellins variety influence the growth and flowering productivity of Shasta daisy. Lower $GA_3$ concentrations of 600 ppm at repeated application

improve quality and hastened flowering. The treated plants appeared healthy and having standard flower stem length. Similarly, $GA_3$ at flowering concentrations with repeated applications affected the highest number of flowering per plant, but plants treated with the highest concentration had slight decrease in floral production (Dulay, 1980).

Mendoza (1993) stated that gibberellins acid treatment can induce flowering of some periodically sensitive and some cold requiring plants. This means that gibberellins can replace the cold requirements of some plants. Subsequently, it has also been shown that the induction of flowering may bring about a natural size in the endogenous gibberellins content within the plant.

Application of $GA_3$ as foliar spray to stem species at 10- 100 ppm hasten flowering by ton days to four weeks in petunia, stock, larkspur, English daisy, china aster, and gerbera (Weaver 1972).

Weir (1974) stated that gibberellins applied to long day rosette plant produce flowers under short to long day. Likewise gibberellins inhibited flower initiation in many other plants especially woody plants. It has been reported that flowering in Azalea was hastened from 25 to 59 days when sprayed with $GA_{3\ in}$ comparison to plant which received cold treatment for 30 days prior to forcing (Barba and Pokorny, 1961).

As Nickell (1986) stated, $GA_3$ along with kinetin also are known to promote flowering and prevent flower drop in tomato at high temperature. Devlin (1977) also reported that $GA_3$ are used to increase the number of grapes in the cluster. Other commercial uses the stimulation of flower bud formation and fruit set apples and pears and the improvement in size; color and quality of the fruit of many plants.

Caluya and Imlan (1959) reported that $GA_3$ induces the rapid elongation of plants in general. Even s early as one week after first application, the treated plants were already taller that

the untreated plants. Also, it was found that the more concentrated the growth regulator, the higher was the weekly height increasement in the stem length.

Application of 1,250 ppm $GA_3$ at three leaf-stage and four-leaf stage gladiolus bolted earlier, produce bigger sized corns, loner flower spikes at flowering with more and bigger flowers (Albis, 1995).

The earliness in flowering could be attributed to he exogenous application of $GA_3$ that promote flowering by increasing the mitotic cell division in the apex, thus, rendering it more responsible to flower stimulus. Zeevart (1962) farther stated that flowering could be enhanced by increasing the $GA_3$ level of the plant through nitrogenous application. Gibberellins cause or promote flowering by either facilitating the formation of flowering hormones in the leaves or the expressions in the growing bud.

Gibberellins appear to affect almost all plant organs from root to flower, fruit and seed development. Shein and Jackson 1972 reported that gibberellic acid applied to decapitated stems, petioles or to lands promote growth of buds in the axile of primary leaves.

Galimba (1993) reported that three application of 1000 ppm $GA_3$ at weekly intervals significantly promote earlier lower development, improve flower quality, produce bigger sized bloom at harvesting and produce taller plants with longer floral stems of anthuriom cv. Kansako.

It was also reported that gibberellic acid treatment greatly affected the flowering of Mr. Lincoln roses (Mendoza, 1993). Gibberellic acid at 500 ppm with two applications significantly enhanced cutflower production, increase yield, higher number of leaves per plant at anthesis, longer flower buds and blooms higher leaf area and leaf index at flowering and promote longer vase life.

Hermano and Ladilad (1980) found that the rate of growth effected by 400 ppm, four weeks from treatment. However, plant treated with the highest concentration (1000 ppm at $GA_3$ finally showed the fastest rate of growth in the later part of the vegetative stage).

In 1979, Kim started that some change on chemical compounds of plants occurs when treated with gibberellins. These were an increase in water, crude fat and protein content and decrease in glucose, fructose, galactose, and xylose content of winter cultivated Chinese cabbage, the changes in chemical compounds could lead to he accumulation of gibberellins for the synthesis of florigen, a hypothetical flowering hormone which cause early floral evocations.

In general gibberellins are group of plant hormones that promote plant growth. They are used for encouraging plant growth, hastening germination, and encouraging growth in odd weather increasing the size of some fruits, increasing the yield of some cops, and breaking dormancy of various seeds. The response of gibberellins varies with the plant specie (Galingan, 1997).

## MATERIALS AND METHODS

Material

The materials to be used in the experiment will be rooted milflores (Hydrangea Macrophylla) cuttings; gibberellic acid; polyethylene black plastic bags (5x5 inch) filled with the potting mix of garden soil, compost (1:1); watering tools; garden tools; and identifying tags.

Methods

The experiment will be laid out in a complete randomized design (CRD) in factorial arrangement with three replication. Factor A will be the stage of application and factor B will be the gibberellic acid concentrations. There will be five samples per treatment replicated three times. The treatment will be as follows.

Factor A (Stage of Application)

S1 -1 month from planting

S2 -2 month from planting

S3 -3 month from planting

Factor B (Gibberellic Acid Concentration)

C1 – 0 ppm/ control

C2 – 50 ppm

C3 – 100 ppm

C4 – 250 ppm

C5 - 500 ppm

Planting of Milflores

Milflores cutting will be rooted first in a nursery and then transplanted in 5x5 inches polyethylene black plastic bags with 1 part garden soil and 1 part compost and .5 part chicken dung.

Gibberellic Acid Application

The various concentration of gibberellic acid will be applied once on the shoot of milflores plants 15 days and 30 days from planting as specified in the treatment.

Other Cultural Management Practice

All other cultural management practice in milflores production such as watering, and control of pest (insects, disease and weeds) will be strictly employed as the need arise.

Data to be Gathered;

The data to be gathered will be as follows:

1. Days from transplanting to flower bud formation(0.5 cm bud size)

-The number of days from transplanting to (0.5 cm bud size) flower bud formation was counted.

2. Number of days from flower bud formation to 75% anthesis.

-The number of days from flower bud formation to 75% flower anthesis was counted

3. Average number of leaves per plant at 75% anthesis.

-The number of leaves per plant was counted at 75% anthesis at flowering.

4. Final height at flowering (cm)

- The height was taken by measuring the plant from base to the top at flowering (75% anthesis)

5. Flower diameter at full bloom stage (cm)

   - The size of the flower was measured at flowering stage (75% anthesis).

6. Stem diameter (cm)

   -This was obtained by measuring the diameter of the center of the plant at flowering (75% anthesis) with the use of vernier caliper.

7. Number of lateral stems at flowering

   -This was counted by counting the lateral stems at flowering stage (75%)

8. Documentation of the study in pictures

   - Documentation of the study was done through pictures

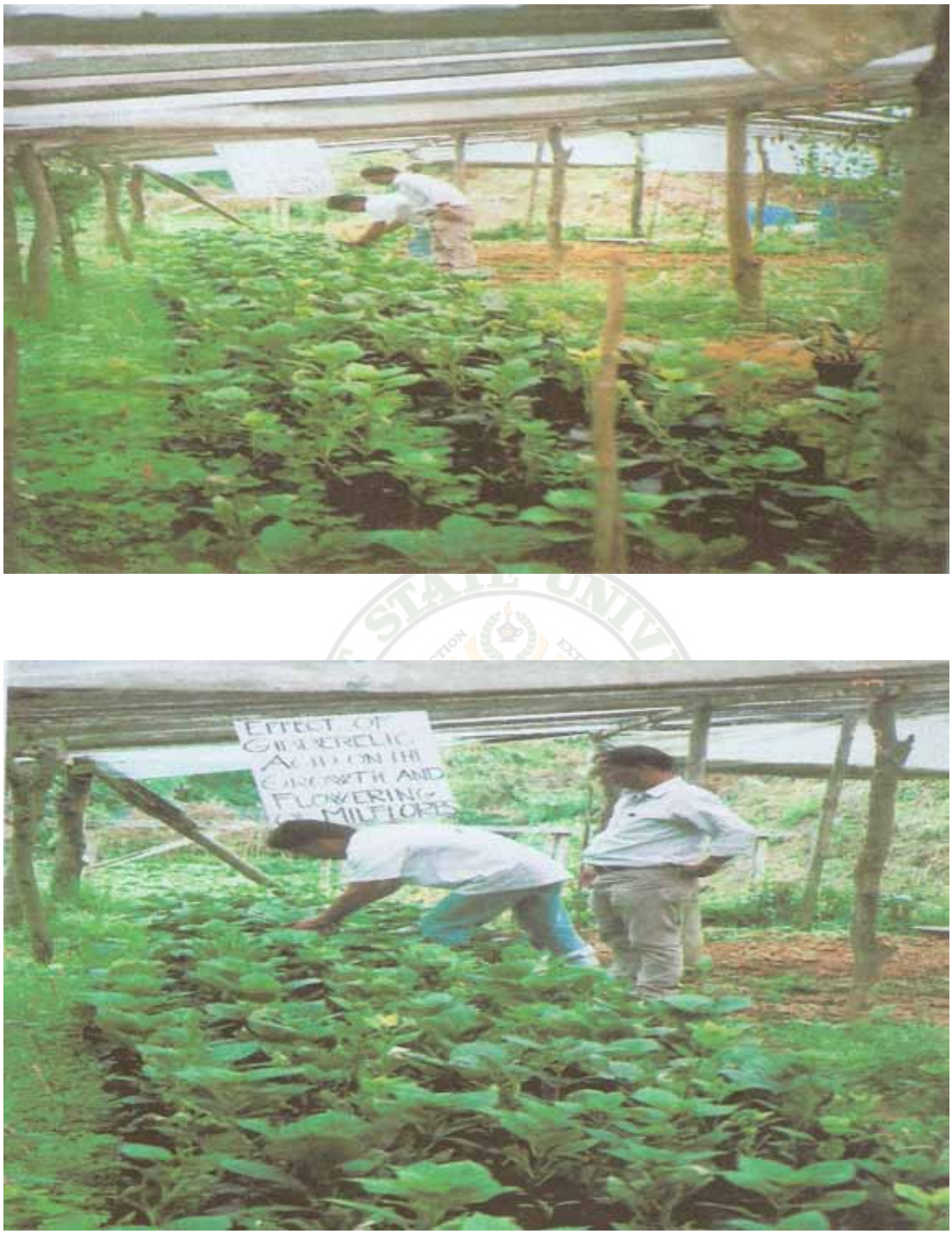


Plate 1. Gibberellic acid application



Plate 2. Gibberellic acid application

Plate 3. Days from flower bud formation to 75% anthesis.

Plate 4. Over view of potted milflores plants treated with gibberellic acid ($GA_3$) at fllowering.

## RESULTS AND DISCUSSION

1. Days from transplanting to flower bud formation (0.5 cm bud size)

Effect on the Stage of Application. Table 1 show that the effect of the stage of application had significant differences. Plant sprayed after three months from planting has the earliest bud to develop, followed by two months to form flower buds. One month was the last to develop flower buds from the time of application.

Weir (1974) stated that gibberellins applied to long day roseate plants produce flowers under short to long day. Like wise gibberellins inhibited flower initiation in many other plants especially woody plants.

Effect of $GA_3$ concentration. Result show that a significant difference was obtained on the number of days from transplanting to flower bud formation as affected by the different concentration of $GA_3$ applied on milflores. The untreated or control required the longest number of days to initiate flower buds from the time of transplanting. Plant sprayed with 50 ppm, was the earliest to develop flower buds, and followed by 100 ppm. Plant sprayed with the highest concentration of 500ppm has developed flower buds late among the treated plants.

Interaction Effect. A significant difference was obtained between the different $GA_3$concentration on the stage of application from transplanting to flower bud formation. Untreated plants showed significantly delayed of flower bud formation with 160.586 days; while the earliest to initiate flower buds were the plant sprayed with 50 ppm with144.400 days. It was observe further, that as the amount of $GA_3$ concentration increases the number of days also increases.

Table 1. Days from transplanting to flower bud formation (0.5 cm)

| ENTRY | MEAN |
|---|---|
| Stage of Application | |
| 1 month | 160.586a |
| 2 month | 157.040b |
| 3 month | 126.577c |
| Gibberellic Acid Concentration | |
| C1 – 0 ppm/ control | 154.556a |
| C2 – 50 ppm | 144.400c |
| C3 – 100 ppm | 145.206c |
| C4 – 250 ppm | 148.308b |
| C5 - 500 ppm | 147.896 |

2. Number of Days from Flower Bud Formation to 75% Anthesis

Effect on the Stage of Application. Result shows no significant effect on the stage of application from flower bud formation to 75% anthesis stage as shown in table 2. However, two month from flower bud formation has reaches its 75% anthesis earlier followed by one month. Three month required longer number of days to reach 75% anthesis. Application of $GA_3$as foliar spray to stem species at10-100 ppm hasten flowering by ten days to four weeks (Weaver, 1972).

Effect of GA3 Concentration. Result showed significant differences on the number of days from flower bud formation to 75% anthesis as affected by the different $GA_3$ concentration. A delayed in flower development were observed in plants which were not sprayed with $GA_3$ concentration or the control. Plant treated with 100 ppm $GA_3$ concentration has the earliest to

reach its 75% anthesis stage, while plant sprayed with 500 ppm $GA_3$ concentration has reaches its 75% anthesis late.

Interaction Effect. Significant interactions were observed between the stage of application from flower bud formation to 75% anthesis and the plant sprayed with different $GA_3$ concentration. Plant sprayed with 100 ppm $GA_3$ concentration that is treated three month after flower bud formation has the earliest to reaches its 75% anthesis while control at three month required longer number of days to bloom at 75% anthesis.

Studies revealed earlier opening of flower in that plant treated with $GA_3$ and reduction on the number of days required for the formation of flower buds (Leopold and Kriedman, 1964).

Table 2. Number of days from flower bud formation t0 75% anthesis

| ENTRY | MEAN |
|---|---|
| Stage of Application | |
| 1 month | 61.487a |
| 2 month | 59.391a |
| 3 month | 62.215a |
| Gibberellic Acid Concentration | |
| C1 – 0 ppm/ control | 68.300a |
| C2 – 50 ppm | 57.467b |
| C3 – 100 ppm | 56.056b |
| C4 – 250 ppm | 61.000b |
| C5 - 500 ppm | 62.333ab |

3. Average Number of Leaves per Plant

Effect on the Stage of Application. Table 3 shows that the number of leaves per plant had significant differences. Plant sprayed after two month has the highest number of leaves with 15.556 leaves per plant, followed by one month after sprayingwith14.327 leaves per plant. Three month from spaying had the least number of leaves with 13.313 per plant at 75% anthesis.

Effect of $GA_3$ Concentration. There is significant effect of the different $GA_3$ concentration on the number of leaves produce per plant at 75% anthesis. Plant sprayed with 100 ppm $GA_3$ concentration obtained the highest number of leaves per plant at 75% anthesis with15.90, followed by 250 ppm and50 ppm $GA_3$ concentration having14.176 and 14.704, respectively. The lowest number of leaves counted was obtained from plants of untreated or control and 500 ppm $GA_3$concentration which had 13.761 and13.444 leaves per plant at 75% anthesis.

Interaction Effect. A significant difference was obtained between the stage of application and the different $GA_3$ concentration in terms on the number of leaves per plant at 75% anthesis. Plant sprayed with 100 ppm $GA_3$ concentration after two month produces the highest number of leaves with18.223 per plant at 75% anthesis. The months that produce the least number of leaves were from three month treated with 500ppm $GA_3$ concentration with 10.223 leaves per plant at 75% anthesis.

Mendoza 19993, stated that gibberellic acid at 500 ppm with two applications significantly enhance cutflower production, increase yield, higher number of leaves per plant at anthesis, longer flower buds and blooms higher leaf area index at flowering and promote longer vase life.

Table 3. Average number of leaves per plant

| ENTRY | MEAN |
|---|---|
| Stage of Application | |
| 1 month | 14.327ab |
| 2 month | 15.556a |
| 3 month | 13.313b |
| Gibberellic Acid Concentration | |
| C1 – 0 ppm/ control | 13.761b |
| C2 – 50 ppm | 14.704ab |
| C3 – 100 ppm | 15.908a |
| C4 – 250 ppm | 14.176b |
| C5 - 500 ppm | 13.444b |

4. Final Height at Flowering (cm)

Effect on the Stage of Application. Result show a significant differences were obtained on the height of plant at 75% anthesis. Two months from spraying had the longest stems with 58.281 cm, followed by one month from spraying with 49.942 cm per plant. Three month from spraying had the shortest stem measured with 44.998 cm at 75% anthesis.

Effect of $GA_3$ Concentration. The different $GA_3$ concentration shows a significant effect on the height of milflores plants at 75% anthesis. Plants sprayed with 250 and 100 ppm $GA_3$ concentration produce longer stem length at 75% anthesis which had 57.394 and 55.924 cm per

plant. The shortest stem measured was obtained from untreated plants with39.482 per plant at 75% anthesis.

Interaction Effect. A significant difference was obtained from the stage of application with the different $GA_3$ concentration on the height of milflores plants at 75% anthesis. Result show that 250 ppm $GA_3$ concentration which was sprayed two month after treatment has the longest stem length with an average of 71.500 cm. on the other hand, untreated plants at two month had the shortest stem length measured with 37.890 cm. it was observed further, that all plants treated with $GA_3$concentration except for the stage of application had a longer stems compared to those which were not treated.

Table 4. Final height at flowering

| ENTRY | MEAN |
|---|---|
| Stage of Application | |
| 1 month | 49.942b |
| 2 month | 58.281a |
| 3 month | 44.998c |
| Gibberellic Acid Concentration | |
| C1 – 0 ppm/ control | 39.482d |
| C2 – 50 ppm | 52.983b |
| C3 – 100 ppm | 55.924a |
| C4 – 250 ppm | 57.394a |
| C5 - 500 ppm | 49.583c |

Caluya and Imlan (1959) reported that $GA_3$ induce the rapid elongation of plants in general. Even as early as one week after first application, the treated plants were already taller than the untreated

5. Flower Diameter

Effect on the Stage of Application. Result shows significant differences were observe on the flower diameter of milflores plants at 75% anthesis. Two months from spraying had the widest and biggest flower diameter measured with 21.897 cm. then followed by three months from spraying with 18.106 cm flower diameter measured. One month from spraying have the smallest flower that bloom measured with 16.300 cm at 75% anthesis.

Effect of $GA_3$ Concentration. The different $GA_3$ concentration shows a significant effect on the flower diameter of milflores plants at 75% anthesis. Plants sprayed with 250 and 100 ppm $GA_3$ concentration obtained the biggest flower diameter measured with 19.699 cm at 75 % anthesis. Plant treated with 500 and 50 ppm $GA_3$ concentration has light significant differences on flower diameter with 18.849 and 18.726 am at 75% anthesis. Untreated plant obtained the smallest flower diameter measured with 17. 053 cm per plant at 75% anthesis.

Interaction Effect. A significant difference were observed between the difference GA3 concentration and the stage of application in terms on stem diameter measured on milflores plants at 75% anthesis. Plants treated with 250 ppm $GA_3$ concentration at two month produce the widest flower diameter measured with 23.250 cm at 75% anthesis. And smallest flower diameter measured was from untreated plants at one month with 14.500 cm per plant at 75% anthesis.

Application of 1,250 ppm $GA_3$, at three leaf-stage and four-leaf stage gladiolus bolted earlier, produce bigger size corms, longer flower spikes at flowering with more and bigger flowers (Albis, 1995)

Table 5. Stem diameter (cm)

| ENTRY | MEAN |
|---|---|
| Stage of Application | |
| 1 month | 16.331c |
| 2 month | 21.897a |
| 3 month | 18.106b |
| Gibberellic Acid Concentration | |
| C1 – 0 ppm/ control | 17.053c |
| C2 – 50 ppm | 18.726b |
| C3 – 100 ppm | 19.530ab |
| C4 – 250 ppm | 19.699a |
| C5 - 500 ppm | 18.849ab |

6. Stem Diameter (cm)

Effect on the Stage of Application. Significant differences were observed on the stem diameter of milflores plants at 75% anthesis. Milflores plants sprayed with $GA_3$ at two month have the biggest stem diameter measured with 1.186cm, followed by three month from spraying with 1.131 cm per plant at 75% anthesis. One month from spraying $GA_3$ have the smallest stem diameter measured with 0.724 cm per plant at 75% anthesis. Further more, because of the smallness of the stems of milflores plants treated at one month, it needs a supporting material (stick) so that the flower will not touch the ground.

Effect of $GA_3$ Concentration. A significant effect ware obtained from the different $GA_3$ concentration with the stem diameter of milflores plants. Plans treated with 250 ppm $GA_3$

concentration have the biggest stem diameter measured with 1.128 cm at 75% anthesis. A significant difference was measured on 500 and 100 ppm $GA_3$concentration with a1.084 and1.030 cm per plant at the time of flowering. Untreated plants obtained the smallest stem diameter that has been measured with 0.550 cm at 75% anthesis.

Table 6. Flower diameter (cm)

| ENTRY | MEAN |
|---|---|
| Stage of Application | |
| 1 month | 0.724b |
| 2 month | 1.186a |
| 3 month | 1.131a |
| Gibberellic Acid Concentration | |
| C1 – 0 ppm/ control | 0.844a |
| C2 – 50 ppm | 1.084ab |
| C3 – 100 ppm | 1.030ab |
| C4 – 250 ppm | 1.128a |
| C5 - 500 ppm | 0.981b |

Interaction Effect. A significant effect was observed between the different $GA_3$ concentration and the stage of application in terms of stem diameter at 75% anthesis. Milflores plants treated with 100 ppm $GA_3$ concentration at two month have the largest stem diameter ,

while untreated plants at one month have the smallest stem diameter measured with 0.550 cm at 75% anthesis.

7. Number of Lateral Stems

Effect on the Stage of Application. A significant difference was obtained on the number of lateral stems with the effect of the st6age of application at 75% anthesis. Plants treated at one month have the largest number of lateral stems counted with 3.0 lateral stems per plant, while the smallest number of lateral stems counted was two month from treatment with 2.200lateral stems per plant at 75% anthesis.

Effect of $GA_3$ Concentration. Spraying $GA_3$ concentration on potted milflores plants did not significantly affect the number of lateral stems produced per plant at 75% anthesis.

Interaction Effect. Table 7 shows a comparable significant effect between the different $GA_3$ concentration and the stage of application on the potted milflores plants. Milflores plants treated with 50 ppm at one month and 500 ppm $GA_3$concentration obtained the highest number of lateral stems with 3.333 per plant at 75% anthesis. While untreated plants at two month produce the least number of lateral stems at 75% anthesis with 1.667 per plant.

Hermano and Ladilad (1980) found that the rate of growth effected by 400 ppm, four weeks from treatment. However, plant treated with the highest concentration (1000 ppm) at $GA_3$ finally showed the fastest rate of growth in the later part of the vegetative stage.

Table 7. Number of lateral stems

| ENTRY | MEAN |
|---|---|
| Stage of Application | |
| 1 month | 3.000a |
| 2 month | 2.200b |
| 3 month | 2.533ab |
| Gibberellic Acid Concentration | |
| C1 – 0 ppm/ control | 2.222a |
| C2 – 50 ppm | 2.556a |
| C3 – 100 ppm | 2.667a |
| C4 – 250 ppm | 3.000a |
| C5 - 500 ppm | 2.444a |

## SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Lamtang, Puguis, La Trinidad, Benguet from November 2007 to March 2008 which aimed to compare the effect of $GA_3$ concentration on the vegetative growth and flowering of potted milflores plants; to determine the effect of different gibberellic acid $GA_3$ on the growth and flowering of milflores, and to determine the best concentration of gibberellic acid $GA_3$ that will enhance vegetative growth with better flower quality.

The earliest to develop flower buds observed were on milflores plant treated at three month and the longest flower bud to develop was one month from treatment. Plants sprayed with 50 ppm $GA_3$ were the earliest to develop flower buds while untreated plants required longer days to develop flower buds.

Milflores plants treated with smaller amount of $GA_3$ concentration was the earliest to develop flower followed by the higher amount of $GA_3$ concentration. Untreated plants show delayed flower development and flowering.

The highest number of leaves counted at 75% anthesis was produced by the plant treated at two months. Plant sprayed with 100 ppm $GA_3$ has the highest number of leaves counted followed by 50 ppm.

Milflores plants treated at two month produce the longest stem measured at 75% anthesis followed by one month and three month. Plant sprayed with 250 ppm $GA_3$ the longest stem measured followed by 100 ppm.

The widest flower diameter was produced by 250 ppm followed by 100 ppm $GA_3$ concentration at two month. The smallest flower diameter measured was observed in untreated plants.

The thickest stems were measured on milflores plant treated with 250 ppm and followed by plants sprayed with 50 and 100 ppm $GA_3$. Two month produce the thickest stems followed by three month and one month from treatment.

Plats treated at one month produce the largest number of leaves of lateral stems followed by three month and two month.$GA_3$ have a slight effect on the lateral stems of milflores plants.

## Conclusion

Based on the study conducted, and on the data gathered, potted milflores plants treated at two month shows to have responded better on the different $GA_3$ concentration based on the observed effect on its vegetative growth, and flower quality produced per plant.

## Recommendation

It is therefore recommended the use of gibberellic acid ($GA_3$) as a growth regulator for milflores plants. And a further study regarding non milflores plants with a higher concentration as a consideration on its growth development should be conducted.

**LITERATURE CITED**


ANONYMOUS.2002. Undated. Hydrangea macrophylla 'Nigra' http://www. Jgeocities.com/enchantedforest/palace/1170/abatias.htm

ANONYMOUS. Undated. Hydrangea macrophylla 'mophead' http://www.botany. com/hydrangea.htm.

ALBIS, M. C. 1995. Growth and flowering of gladiolus cv. Friendship pink as affected by $GA_3$ Treatments. Unpublished BS Thesis. Benguet State University, La Trinidad, Benguet, p.3

BARBA, R.C. and F. A. Pokorny.1961. Influence of several concentration of $GA_3$. Proc. Assoc. of Southern Agriculture Workers. Pp 60-61

CALUYA, M. and J. S. IMLAN.1959. Effect of gibberellic acid on the fiber of kenaf. The Philippine Agriculturist.43 (5) 369-372.

DEVLIN, B. M. 1977. Plant Physiology. New York. Von Nostrand Rienholdn Co. Pp.387-484.

DULAY. T. A. 1980. The effect of $GA_3$ on the growth and flowering productivity of Chrysanthemum maximum. Unpublished BS Thesis. Mountain State Agricultural College, La Trinidad, Benguet. Pp.37-39.

GALIMBA, S. B. 1913. Effect of foliar gibberellic acid on the flowering of anthurium cv. Kansako under La Trinidad, Benguet condition. BS Thesis. BSU La Trinidad Benguet. Pp. 37-39.

GALINGAN, A. C. 1977. Growth and flowering of five Lilium cut flowers as affected by $GA_3$ Application BS Thesis (Unpub). Benguet State University, La Trinidad, Benguet.Pp.3-5.

GREULACH , V. A. and L. E. ADANIS. 1926. Plants. An Introduction of Modern Botany, Men Larch: John Wiley and Sons, Inc. Pp 367-370.

HERMANO, F. G. and B. D. LADILAD. 1980. Flower induction of chrysanthemum morifolium Ex. Ruby Brethaupt. Mountain State Agricultural College.

KIM, H. K. 1979. Studies in the composition of varieties cultivated Chinese cabbage treated with Gibberellins. Korean Hort. Scr. 7(6): 7-72.

LEOPOLD, A.C. and P.E. KRIEDMAN.1964. Plant Growth and Development. 2nd ed. New York: McGrawHill Book Co. pp. 230-233.

MENDOZA, L. C. 1993. Effect of Gibberellic Acid on the flowering and yield of rose cv. Mr. Lincoln BS Thesis BSU La Trinidad, Benguet. Pp.39-41.

NICKELL, L. G. 1993. Effect of $GA_3$ on the flowering and yield of rose cv. Mr. Lincoln. Unpublished BS Thesis. Benguet State University, La Trinidad, Benguet. P.3

SHEIN, T. G. and D.I. JACKSON.1972. Interaction between hormones, light, nutrition, and Extension of lateral and in Phjaseolus Vulgaris, I.M.J. Bot. Pp.791-800.

WEIER, T. E. 1974 Botany: An Introduction to plant biology, Canada: John Willy and Sons inc. Pp. 397-398.

WEAVER, R. J. 1972. Plant Growth Substance in Agriculture. San Francesco: WH Freeman and Co.Pp. 379-381.

ZEEVART, J. A. 1962. The relationship between gibberellins and floral stimulus in Byophyllum daigremontranum. Planta. SD: 531-42.

**APPENDICES**

Appendix Table 1. Days from transplanting to flower bud formation (0.5 cm bud size)

| TREATMENT | REPLICATION I | II | III | TOTAL | MEAN |
|---|---|---|---|---|---|
| S1 C1 | 167 | 167 | 170 | 504.30 | 168.100 |
| C2 | 152.25 | 155 | 159.75 | 467.00 | 155.667 |
| C3 | 155.25 | 159 | 155 | 469.25 | 156.417 |
| C4 | 160.5 | 163.67 | 162 | 486.17 | 162.057 |
| C5 | 162 | 158.4 | 161.67 | 482.07 | 160.690 |
| S2 C1 | 157.8 | 159.2 | 166.7 | 483.70 | 161.233 |
| C2 | 151.8 | 151.8 | 158.2 | 461.80 | 153.933 |
| C3 | 150.5 | 156.5 | 156 | 463.00 | 154.333 |
| C4 | 159.8 | 156.8 | 156 | 472.60 | 157.533 |
| C5 | 158 | 159.5 | 157 | 474.50 | 158.167 |
| S3 C1 | 137 | 134 | 132 | 403.00 | 134.333 |
| C2 | 122.4 | 123 | 125.4 | 370.80 | 123.600 |
| C3 | 125.6 | 126.6 | 122.4 | 374.60 | 124.867 |
| C4 | 126 | 124.4 | 125.6 | 376.00 | 125.333 |
| C5 | 123 | 126.75 | 124.5 | 374.25 | 124.750 |
| Total | | | | | |

Analysis of Variance

| Source of Variation | Degrees of Freedom | Sum of Squares | mean of Squares | Computed F | TABULAR F 0.05 | TABULAR F 0.01 |
|---|---|---|---|---|---|---|
| Factor A | 2 | 10486.118 | 5243.059 | 788.19** | 3.32 | 5.59 |
| Factor B | 4 | 574.500 | 143.625 | 21.59** | 4.69 | 4.02 |
| AB | 8 | 64.873 | 8.109 | 1.22ns | 2.27 | 5.17 |
| Error | 30 | 199.561 | 6.652 | | | |
| Total | 44 | 11325.052 | | | | |

** = Highly Significant Coefficient of variation= 40.49%

Ns = Not Significant

Appendix Table 2. Number of days from flower bud formation to 75% anthesis

| TREATMENT | REPLICATION I | II | III | TOTAL | MEAN |
|---|---|---|---|---|---|
| $S_1 C_1$ | 65 | 66 | 67 | 198.00 | 66.000 |
| $C_2$ | 55.8 | 50.33 | 56.5 | 162.63 | 54.467 |
| $C_3$ | 60 | 61.67 | 63.5 | 185.17 | 61.723 |
| $C_4$ | 61 | 60.5 | 63 | 184.50 | 61.500 |
| $C_5$ | 65 | 66.5 | 60.5 | 192.00 | 64.000 |
| $S_2 C_1$ | 65 | 66.2 | 67.5 | 198.70 | 66.233 |
| $C_2$ | 55 | 57.75 | 57 | 162.75 | 56.583 |
| $C_3$ | 56.75 | 56.67 | 57.5 | 170.92 | 56.973 |
| $C_4$ | 57 | 59.5 | 58 | 174.50 | 58.167 |
| $C_5$ | 60 | 57.5 | 59.5 | 177.00 | 59.000 |
| $S_3 C_1$ | 75.5 | 71 5 | 71 | 218.00 | 72.667 |
| $C_2$ | 60.66 | 62.66 | 61.5 | 184.82 | 61.607 |
| $C_3$ | 62 | 61.66 | 64.75 | 148.41 | 49.470 |
| $C_4$ | 62 | 64.4 | 63.6 | 190.00 | 63.333 |
| $C_5$ | 64 | 62 | 66 | 192.00 | 64.000 |
| Total | | | | | |

Analysis of Variance

| Source of Variation | Degrees of Freedom | Sum of Squares | mean of Squares | Computed F | TABULAR F 0.05 | TABULAR F 0.01 |
|---|---|---|---|---|---|---|
| Factor A | 2 | 64.482 | 32.241 | 0.77ns | 3.32 | 5.59 |
| Factor B | 4 | 827.954 | 206.989 | 1.94** | 2.69 | 4.02 |
| AB | 8 | 427.155 | 53.394 | 1.27ns | 2.27 | 5.17 |
| Error | 30 | 1257.256 | 41.909 | | | |
| Total | 44 | 2576.847 | | | | |

** = Highly Significant

Coefficient of variation= 10.61%

Ns = Not Significant

Appendix Table 3. Average number of leaves per plant

| TREATMENT | REPLICATION I | II | III | TOTAL | MEAN |
|---|---|---|---|---|---|
| $S_1 C_1$ | 14 | 12 | 13 | 13.000 | 39.00 |
| $C_2$ | 11 | 17 | 13.25 | 13.750 | 41.25 |
| $C_3$ | 19 | 12 | 15 | 15.333 | 46.00 |
| $C_4$ | 14.33 | 13 | 14.5 | 13.943 | 41.83 |
| $C_5$ | 16 | 16.5 | 14.33 | 15.610 | 46.83 |
| $S_2 C_1$ | 15.25 | 13 | 14.25 | 14.167 | 42.50 |
| $C_2$ | 15 | 16.67 | 15 | 15.557 | 46.67 |
| $C_3$ | 18 | 16.67 | 20 | 18.223 | 54.67 |
| $C_4$ | 16 | 16 | 14 | 15.333 | 46.00 |
| $C_5$ | 13 | 14.5 | 16 | 14.500 | 43.50 |
| $S_3 C_1$ | 15.75 | 14 | 12.6 | 14.117 | 42.35 |
| $C_2$ | 16 | 14.67 | 13.75 | 14.807 | 44.42 |
| $C_3$ | 15.75 | 12.5 | 14.25 | 14.067 | 42.50 |
| $C_4$ | 14.25 | 13.6 | 11.9 | 03.250 | 39.75 |
| $C_5$ | 11 | 8.67 | 11 | 10.223 | 30.67 |
| Total | | | | | |

Analysis of Variance

| Source of Variation | Degrees of Freedom | Sum of Squares | mean of Squares | Computed F | TABULAR F 0.05 | TABULAR F 0.01 |
|---|---|---|---|---|---|---|
| Factor A | 2 | 37.859 | 18.929 | 6.64** | 3.32 | 5.59 |
| Factor B | 4 | 33.639 | 8.410 | 2.95* | 2.69 | 4.02 |
| AB | 8 | 51.156 | 6.395 | 2.24ns | 2.27 | 5.17 |
| Error | 30 | 85.557 | 2.852 | | | |
| Total | 44 | 208.211 | | | | |

** = Highly Significant

Coefficient of variation= 11.73%

*= Significant

Ns = Not Significant

Appendix Table 4. Final height at flowering (cm)

| TREATMENT | REPLICATION I | II | III | TOTAL | MEAN |
|---|---|---|---|---|---|
| $S_1 C_1$ | 48 | 33.5 | 37.5 | 119.00 | 39.667 |
| $C_2$ | 49.3 | 55 | 53.75 | 158.05 | 52.683 |
| $C_3$ | 51.33 | 53 | 53.33 | 157.66 | 52.553 |
| $C_4$ | 52.33 | 53.75 | 52.67 | 158.75 | 52.917 |
| $C_5$ | 50.67 | 51 | 54 | 155.67 | 51.890 |
| $S_2 C_1$ | 37.5 | 39 | 37.12 | 113.62 | 37.873 |
| $C_2$ | 63 | 64.67 | 59 | 186.67 | 62.223 |
| $C_3$ | 72 | 62.67 | 71.5 | 206.17 | 68.723 |
| $C_4$ | 74.5 | 71.5 | 68.5 | 214.50 | 71.500 |
| $C_5$ | 51.25 | 51.5 | 50.5 | 153.25 | 51.083 |
| $S_3 C_1$ | 40.62 | 39.87 | 42.6 | 122.72 | 40.907 |
| $C_2$ | 48.1 | 42.66 | 41.37 | 132.13 | 44.043 |
| $C_3$ | 45.12 | 47.25 | 47.12 | 139.49 | 46.497 |
| $C_4$ | 47.5 | 47.7 | 48.1 | 143.30 | 47.767 |
| $C_5$ | 44.5 | 48.33 | 44.5 | 137.33 | 45.777 |
| Total | | | | | |

Analysis of Variance

| Source of Variation | Degrees of Freedom | Sum of Squares | mean of Squares | Computed F | TABULAR F 0.05 | TABULAR F 0.01 |
|---|---|---|---|---|---|---|
| Factor A | 2 | 1352.029 | 676.014 | 73.60** | 3.32 | 5.59 |
| Factor B | 4 | 1833.406 | 458.352 | 49.90** | 2.69 | 4.02 |
| AB | 8 | 951.595 | 111.949 | 12.95** | 2.27 | 5.17 |
| Error | 30 | 275.543 | 9.185 | | | |
| Total | 44 | 4412.573 | | | | |

** = Highly Significant

Coefficient of variation= 5.93%

Appendix Table 5. Flower diameter (cm)

| TREATMENT | REPLICATION I | II | III | TOTAL | MEAN |
|---|---|---|---|---|---|
| $S_1 C_1$ | 14 | 13.5 | 16 | 43.50 | 14.500 |
| $C_2$ | 15.1 | 16.83 | 14.25 | 46.18 | 15.393 |
| $C_3$ | 17.66 | 16 | 18 | 51.66 | 17.220 |
| $C_4$ | 18.33 | 16 | 18.5 | 52.83 | 17.610 |
| $C_5$ | 17.67 | 17.5 | 15.33 | 50.50 | 16.833 |
| $S_2 C_1$ | 20.13 | 20 | 19.38 | 59.51 | 19.837 |
| $C_2$ | 21.5 | 22.67 | 22.17 | 66.34 | 22.113 |
| $C_3$ | 22.65 | 22.83 | 22.5 | 67.98 | 22.660 |
| $C_4$ | 23.75 | 22.5 | 23.5 | 69.75 | 23.250 |
| $C_5$ | 21.25 | 21.62 | 22 | 64.87 | 21.623 |
| $S_3 C_1$ | 17.75 | 16.12 | 132 | 50.47 | 16.823 |
| $C_2$ | 18.7 | 19 | 125.4 | 56.01 | 18.670 |
| $C_3$ | 18.88 | 19.25 | 122.4 | 56.13 | 18.710 |
| $C_4$ | 18.31 | 17 | 125.6 | 54.71 | 18.237 |
| $C_5$ | 18.63 | 17.17 | 124.5 | 54.27 | 18.090 |
| Total | | | | | |

Analysis of Variance

| Source of Variation | Degrees of Freedom | Sum of Squares | mean of Squares | Computed F | TABULAR F 0.05 | TABULAR F 0.01 |
|---|---|---|---|---|---|---|
| Factor A | 2 | 243.930 | 121.965 | 143.52** | 3.32 | 5.59 |
| Factor B | 4 | 39.560 | 9.890 | 11.64** | 4.69 | 4.02 |
| AB | 8 | 8.540 | 1.067 | 1.26ns | 2.27 | 5.17 |
| Error | 30 | 25.494 | 0.850 | | | |
| Total | 44 | 317.523 | | | | |

** = Highly Significant

Coefficient of variation= 4.91%

Ns = Not Significant

Appendix Table 6. Stem diameter (cm)

| TREATMENT | REPLICATION I | II | III | TOTAL | MEAN |
|---|---|---|---|---|---|
| $S_1 C_1$ | .60 | .45 | .60 | 1.65 | 0.550 |
| $C_2$ | .66 | .70 | .94 | 2.30 | 0.767 |
| $C_3$ | .73 | .50 | .70 | 1.93 | 0.643 |
| $C_4$ | .90 | .70 | .85 | 2.45 | 0.817 |
| $C_5$ | .83 | 1.0 | .70 | 2.53 | 0.843 |
| $S_2 C_1$ | .64 | 1.20 | 1.05 | 2.89 | 0.963 |
| $C_2$ | 1.50 | 1.47 | 1.40 | 4.37 | 1.457 |
| $C_3$ | 1.40 | 1.33 | 1.30 | 4.03 | 1.343 |
| $C_4$ | 1.35 | 1.30 | 1.15 | 3.80 | 1.267 |
| $C_5$ | .70 | .90 | 1.1 | 2.70 | 0.900 |
| $S_3 C_1$ | .875 | 1.10 | 1.08 | 3.06 | 1.020 |
| $C_2$ | 1.20 | .97 | .92 | 3.09 | 1.030 |
| $C_3$ | 1.01 | 1.15 | 1.15 | 3.31 | 1.103 |
| $C_4$ | 1.20 | 1.28 | 1.42 | 3.90 | 1.300 |
| $C_5$ | 1.20 | 1.10 | 1.30 | 3.60 | 1.200 |
| Total | | | | | |

Analysis of Variance

| Source of Variation | Degrees of Freedom | Sum of Squares | mean of Squares | Computed F | TABULAR F 0.05 | TABULAR F 0.01 |
|---|---|---|---|---|---|---|
| Factor A | 2 | 1.909 | 0.955 | 50.12** | 3.32 | 5.59 |
| Factor B | 4 | 0.432 | 0.108 | 5.67** | 4.69 | 4.02 |
| AB | 8 | 0.630 | 0.079 | 4.13* | 2.27 | 5.17 |
| Error | 30 | 0.571 | 0.019 | | | |
| Total | 44 | 3.543 | | | | |

** = Highly Significant

Coefficient of variation= 13.62%

* = Significant

Appendix Table 7. Number of lateral stems

| TREATMENT | REPLICATION I | II | III | TOTAL | MEAN |
|---|---|---|---|---|---|
| $S_1 C_1$ | 3 | 2 | 3 | 8 | 2.667 |
| $C_2$ | 4 | 3 | 3 | 10 | 3.333 |
| $C_3$ | 3 | 2 | 4 | 9 | 3.000 |
| $C_4$ | 2 | 4 | 3 | 9 | 3.000 |
| $C_5$ | 3 | 3 | 3 | 9 | 3.000 |
| $S_2 C_1$ | 1 | 2 | 2 | 5 | 1.667 |
| $C_2$ | 2 | 2 | 2 | 6 | 2.000 |
| $C_3$ | 3 | 2 | 3 | 8 | 2.667 |
| $C_4$ | 2 | 3 | 3 | 8 | 2.667 |
| $C_5$ | 1 | 3 | 2 | 6 | 2.000 |
| $S_3 C_1$ | 1 | 3 | 3 | 7 | 2.333 |
| $C_2$ | 2 | 2 | 3 | 7 | 2.333 |
| $C_3$ | 3 | 2 | 2 | 7 | 2.333 |
| $C_4$ | 3 | 3 | 4 | 10 | 3.333 |
| $C_5$ | 2 | 2 | 3 | 7 | 2.333 |
| Total | | | | | |

Analysis of Variance

| Source of Variation | Degrees of Freedom | Sum of Squares | mean of Squares | Computed F | TABULAR F 0.05 | TABULAR F 0.01 |
|---|---|---|---|---|---|---|
| Factor A | 2 | 4.844 | 2.422 | 4.95* | 3.32 | 5.59 |
| Factor B | 4 | 2.978 | 0.744 | 1.52ns | 4.69 | 4.02 |
| AB | 8 | 2.489 | 0.311 | 0.64ns | 2.27 | 5.17 |
| Error | 30 | 14.667 | 0.489 | | | |
| Total | 44 | 24.978 | | | | |

* = Significant

Coefficient of variation= 27.12%

Ns = Not Significant