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# Effects of Pinching, Cycocel and B-nine Treatments on Branching Habit of Pot Poinsettia (*Euphobia pulcherrima* Willd)

D.P. Karunananda and S.E. Peiris[1]

Postgraduate institute of Agriculture
University of Peradeniya
Peradeniya, Sri Lanka

***ABSTRACT.*** *Poinsettia (Euphorbia pulcherrima Willd) is a popular pot plant in many countries and there is a high potential to introduce it to the Sri Lankan floriculture markets. Naturally, poinsettia becomes colourful under short day conditions. However, artificial induction of flowers is necessary for it to produce marketable plants throughout the year. In the natural condition, plants show a vigorous growth and the height is undesirable to accept as a pot plant. Hence, pinching and application of growth retardants were practiced in this study to obtain short bushy plants. Potted rooted cuttings of Euphobia pulcherrima Willd were subjected to single and double pinching and to cycocel and B-nine applications, in 12 combinations. Significantly greater height reduction of shoots (20 cm) and highest number of shoots per plant (36) were obtained when the plants were exposed to double pinching followed by 1500 ppm cycocel application at 14 day intervals. Application of plant growth regulator, B-nine (5000 ppm) did not exert much effect on reducing the shoot height. However, it had some effect on increased shoot production in combination with double pinch. Double pinch gave significantly greater height reduction and increased shoot number when growth regulators were applied.*

## INTRODUCTION

Poinsettia (*Euphorbia pulcherima* Willd) is a popular pot plant in many countries and widely used in Christmas decorations. It ranks first among pot plants in northern Asian countries too, being used in festivals during October to December (Weijie, 2005). Sri Lanka also uses potted plants to decorate indoors and thus a considerable potential has been created to introduce poinsettia to the Sri Lankan floriculture market.

*Euphorbia pulcherrima* belongs to family Euphorbiacea and is highly sensitive to day length and temperature (Larson *et al.*, 1978). Short day condition induces flowering of this plant along with colour change of uppermost leaves (bracts). This could be the only ornamental plant found in the country that responds to a small day length difference (1/2-1hr). Though the flowers are small and not attractive, the colourful bracts (top leaves) that develop around the flowers in the centre make the plant attractive.

Day length requirement of *Euphorbia pulcherrima* flower initiation is less than 12 hours per day which can be obtained from mid October in Sri Lanka. Hence colourful bract formation and flowering occur naturally only after late October (November to February). However, induction of flowering in decorative plants is done by providing artificial short day

[1] Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

conditions. In this early production programmes (probably March-September) of poinsettia, which are grown under relatively warm temperature and long day condition, consequently show a vigorous growth and therefore, excess height becomes a challenge.

The correct canopy architecture is also a main factor of marketable poinsettia production. Hence special attention is required to make short bushy plants to match the market specifications mainly with respect to plant height (mostly less than 45cm). Therefore, control of stem elongation is a critical step in off-season poinsettia production.

Repeated application of plant growth regulators as well as some non-chemical techniques to control plant height is a common practice in the world to face the challenge of environmental stimulation of inter-node elongation. In addition, application of plant growth regulators influence flower production and can advance or delay flowering depending on the species (Meijon *et al.*, 2008).

Chemical plant growth regulators such as triazoles have been developed to inhibit stem elongation of plants. B-nine (Daminocide) and cycocel (Cloromquat chloride) are the common plant growth regulators (PGR), used in poinsettia production and the effectiveness of these chemicals varies with the environments and other conditions (Joiner and Harrison, 1967). However, unavailability of these chemicals in the local market limits the adoption of available protocols locally. Therefore, there should be an alternative non-chemical technique to obtain reduced plant height in poinsettia to make this plant popular. A variety of cultural and environmental techniques have been suggested including mechanical conditioning, genetic manipulation, water and nutritional management and temperature manipulation (Clifford *et al.*, 2004). Of these, mechanical pruning is the economical and convenient method that can be tested under local conditions. However, use of chemical or non-chemical methods alone or in combinations would result in saleable pot plants at marketing stage. Therefore, this study was conducted with the objectives of investigating the effects of B-nine, cycocel and pruning practices in the control of stem elongation of poinsettia, and to identify the best procedure for production of pot poinsettia in accordance with the market standards for plant height.

## METHODOLOGY

### Maintaining of stock plants and obtaining planting material

This experiment was conducted under shade house conditions at Horticulture Research and Development Institute (HORDI), Gannoruwa (Mid country wet zone) during 2008-2009. Established mother plants of poinsettia local line 1101 were pruned on October 24$^{th}$, 2008. As the experiment was started in the later part of the year, mother stock bushes were provided with long day condition by exposing to florescent light from 5.00 pm to 8.00 pm for one month prior to collecting the planting material (Weijie, 2005). These bushes were provided with 10 g of 30:10:18 N:P:K granular mixture one day after pruning followed by spraying with 20:20:20, N:P:K liquid fertilizer at 7 day intervals.

The pruning method used to obtain vegetative shoots was successful and each plant initiated 10-20 new shoots. Healthy vigorous vegetative shoots that grew up to 6-7 nodes in length were rooted in sand beds of a propagator under 30 $^0$C temperature and 75% relative humidity (RH). Well rooted cuttings were selected after one month from the propagator and were transplanted into 20 cm diameter poly bags with compost: sand: coir dust (1:1:0.5) mixture.

Basal rot caused by *Phytophthara* and *Phythium* is a major problem encountered in poinsettia propagation and sometimes it destroys the whole plant stock (Benson *et al*., 2002). The pathogens spread with irrigation water and the medium. The problem is more severe when the potting medium is water logged. Hence, all precautions were taken to avoid water logging. The medium was also sterilized before plants were established. All the plants grew well in the pots after establishing in the medium indicating that the medium used was suitable for plant growth. The water supply was adjusted using the model equation developed by Stanly and Harbaugh (1992) to determine the water requirement of poinsettia Therefore, watering was done at 100 ml $day^{-1}$ in the beginning and gradually increased up to 250 ml $day^{-1}$ at the end.

Gaffney *et al*., (1982), showed that nitrogen (N) in ammonium form reduce the growth and leaf number of poinsettia and N in the superior nitrate form is important to produce optimal vegetative growth. They emphasized that 6-12% N in nitrate form is the best N level for poinsettia production. Micro elements such as Ca, Mo and B play an important role in growth and bract pigmentation of poinsettia (Arreola *et al*., 2008). Therefore, Multiphoska NPK 12-12-17+2 Mgo+TE granular with compost were used as nutrient source throughout the experiment.

**Effects of pinching and growth regulator applications on shoot production and plant height**

Twelve treatment combinations which included pinching and plant growth regulator applications to wet whole canopy were tested (Table 1) to identify the best treatment combination to obtain plants with targeted height and shape. The experimental design was two factor factorial design with three replicates. Three potted plants were included in each replicate.

**Table 1. Treatment combinations of pinching and plant growth regulators**

| Trt. No. | Description |
|---|---|
| 1 | Double pinch + 1500 ppm cycocel + 5000ppm B-nine |
| 2 | Double pinch + 1500ppm cycocel |
| 3 | Double pinch + 5000ppm B-nine |
| 4 | Double pinch only |
| 5 | Single pinch + 1500ppm cycocel + 5000ppm B-nine |
| 6 | Single pinch+ 1500ppm cycocel |
| 7 | Single pinch +5000ppm B-nine |
| 8 | Single pinch only |
| 9 | 1500 cycocel + 5000ppm B-nine only |
| 10 | 5000ppm B-nine only |
| 11 | 1500ppm cycocel only |
| 12 | Untreated control |

**Pinching**

First pinch was applied at the $14^{th}$ day of transplanting, leaving only five to six nodes on growing plants and allowed to produce side shoots. Then the second pinch was performed by removing the apical bud of all the upcoming buds after the first pinch, leaving five nodes at the $14^{th}$ day after $1^{st}$ pinch.

### Plant growth regulator application

Application of cycocel (Cloromquat chloride; Hamidia chemicals, Bangalore, India) at the rate of 1500 ppm was performed 14$^{th}$ day after 2$^{nd}$ pinch, followed by application of B-Nine (Daminocide; Hamidia chemicals, Bangalore, India ) at the rate of 5000 ppm after 7 days of cycocel application. The chemicals were thoroughly dissolved in distilled water and applied onto plants to soak both abaxial and adaxial sides of leaves and stems using 1.5L hand sprayer. Chemicals were applied around 4 pm to facilitate absorption as chemicals remain longer on leaf surface due to lack of evaporation.

Both pinching and PGR application treatments in earlier studies have been practiced with appropriate time intervals to allow the treatments to act on the plant (Weijie, 2005). Therefore, in the present study also the same sequence of treatments was followed.

The experiment was repeated 2 months later using a second set of uniform shoots obtained from the mother stock.

### Data collection and analysis

For each treatment number of shoots and plant height of each plant were recorded from the 2$^{nd}$ week after B-nine application and the latter was continued until flower initiation under imposed short day conditions.

The combined and individual effects of pinching and PGR application on plant height and shoot number were analyzed using PROC GLM procedure of the SAS statistical software (SAS, 2003). The Best treatment combination was identified using ANOVA and Mean comparisons performed using Least significant difference tests at $\alpha$=0.05 significance level.

## RESULTS

### Effects of pinching and growth regulator applications on shoot production and plant height

### Controlling of stem elongation

The best height control was obtained from the Treatment 2 (double pinch plus cycocel)) and Treatment 1 (double pinch plus cycocel with B-nine). It also showed that there was no significant contribution from B-nine for control of stem elongation when used in combination with pinching and cycocel treatments. This is also evident from the results of the treatment 3 (double pinch plus B-nine) and Treatment 4 (double pinch only). Treatment 5 (B-nine with cycocel plus single pinch), Treatment 6 (Cycocel with single pinch) and Treatment7 (B-nine with single pinch) produced shoots with the same height ( Table 2).

Height control of Treatments 5, 6 and 7 was not significantly different from the height control obtained from the single pinch (Treatment 8) showing the lack of effect of B-nine on height control of poinsettia shoots. Cycocel showed the best height reduction when combined with pinching. Cycocel with double pinching gave better results than cycocel with single pinching. As indicated in Treatment 10, cycocel alone did not control height of poinsettia shoots over the control significantly. However, response of cycocel in keeping plant at

preferable height is better than the response of B-nine. The three applications, pinching, cycocel and B-nine when applied singly did not contribute to reduce plant height.

**Increase of number of shoots**

The highest number of poinsettia shoots (36) was produced by the combination of double pinch plus cycocel treatment (Table 3) and the shoot number was not significantly different from the Treatment 1, indicating that there was no contribution to increase of shoot production by B-nine application in combination with the others.

**Table 2. Effects of pinching and PGR treatment combinations on height reduction**

| Tre. No | Treatment | Height (cm) |
|---|---|---|
| 1 | Double pinch +cycocel + B-nine | 20.4$^{e}$ |
| 2 | Double pinch+ cycocel | 20.3$^{e}$ |
| 3 | Double pinch + B-nine | 23.82$^{d}$ |
| 4 | Double pinch only | 26.32$^{d}$ |
| 5 | Single pinch+ cycocel + B-nine | 32.15$^{c}$ |
| 6 | Single pinch+ cycocel | 32.15$^{c}$ |
| 7 | Single pinch+ B-nine | 31.50$^{c}$ |
| 8 | Single pinch only | 34.90$^{bc}$ |
| 9 | Cycocel + B-nine | 38.00$^{ab}$ |
| 10 | Cycocel | 42.00$^{a}$ |
| 11 | B-nine | 39.57$^{ab}$ |
| 12 | Control | 41.25$^{a}$ |
| | LSD | 4.75 |
| | CV (%) | 9.20 |

Values followed by the same letter are not significantly different at p= 0.05 in LSD test (n = 9)

**Table 3. Effects of pinching and PGR treatment combinations on shoot production**

| Tre. No | Treatment | Shoot no/plant |
|---|---|---|
| 1 | Double pinch +cycocel + B-nine | 34.0$^{a}$ |
| 2 | Double pinch+ cycocel | 36.0$^{a}$ |
| 3 | Double pinch + B-nine | 30.3$^{ab}$ |
| 4 | Double pinch only | 30.60$^{ab}$ |
| 5 | Single pinch+ cycocel + B-nine | 23.00$^{c}$ |
| 6 | Single pinch+ cycocel | 26.00$^{cb}$ |
| 7 | Single pinch+ B-nine | 22.00$^{c}$ |
| 8 | Single pinch only | 20.66$^{c}$ |
| 9 | cycocel + B-nine | 9.00$^{d}$ |
| 10 | cycocel | 11.33$^{d}$ |
| 11 | B-nine | 11.56$^{d}$ |
| 12 | Control | 12.0$^{d}$ |
| | LSD | 6.58 |
| | CV (%) | 17.34 |

Values followed by the same letter are not significantly different at p= 0.05 in LSD test n = 9

However, when applied on double pinched plants, the shoot production appeared to be significantly higher than double pinch alone. This indicated that either cycocel or B-nine can contribute to higher shoot production after the double pinch was applied. Comparative results

in treatments 1-3 vs. 5-8, combining PGR with double pinch is better than single pinch. Also comparative results in treatments 5-8 vs. 9-12 shows combining single pinch with cycocel is better than the Control and individual treatments.

## DISCUSSION

With regard to overall effect of the treatments, treatment combination 2, which was double pinch plus cycocel application, showed the shortest and the highest number of lateral shoots. Meanwhile the effect of B-nine in combination with pinching and cycocel was not clearly evident.

Pinching is commonly practiced to promote bushy growth of the canopy by counteracting the apical dominance. Apical dominance plays a significant role in potted plant production. It has direct relationship with plant form and subsequent potential for yield increment too (Martin, 1987). However, removal of apical dominance enhances the growth of lateral branches and preliminary experiments of this study revealed that hand pruning (thumb nail pruning) is the most practicable and convenient pruning method in poinsettia production. In this experiment first pinching was done leaving 5 nodes in the stem where there was a possibility to produce 5-6 side shoots. From the second pinching, that was practiced to leave 5 nodes in each lateral shoot; it was expected to multiply shoot number again by 5-6 folds. However, the plants sometimes produced shoots even more than the expected level (2 or more shoots from the same node). The results revealed that pinching at the right time produced more lateral shoots and make the pot plant well shaped, bushy and attractive. It was observed in the experiment that untreated plants also produced few lateral shoots during this period but did not give proper shape to the plant. According to Martin (1987), not only physical removal of bud but a number of other factors effect apical dominance and lateral branch production. Among these factors, light levels of the surrounding, inorganic nutrients and carbon dioxide are prominent. Since this experiment was conducted under long day conditions, the light factor may have some effect on additional shoot production and taller shoot production which were obtained in the control treatment.

Both the plant growth regulators (PGRs) used in this experiment were not effective in increasing shoot number in individual applications. In 1991, Bailey and Miller reported that application of PGRs did not effect the number of shoots in poinsettia. Thus, the results of this experiment also revealed that the main use of PGR in poinsettia production is on inhibition of plant height but not the promotion of shoot production. In 1937, Thimann reported that auxin is the major plant hormone responsible for apical dominance. When the apical bud is removed the lateral buds have relatively high indole acetic acid (IAA) concentrations which induce their elongation. Further, in 1959 Brian *et al.,* showed that GA was not involved in lateral bud development or in apical dominance in sweet pea. It could accentuate apical dominance by increasing the apex growth rate. Therefore, increasing of shoot number could not be expected through inhibiting GA production using PGR as proven in this study.

Cycocel and B-nine are commonly used in height control of poinsettia, which inhibits the synthesis of *ent* kaurene; an early step in gibberellic acid biosynthesis pathway which is catalized by the enzyme *ent* kaurene synthesis Meijon *et al.*, (2009). Latimer (2001) has given 1500-3000 ppm and 5000 ppm as the best levels of cycocel and B-nine respectively for poinsettia production. In 1967 Joiner and Harison have reported that chlorotic edges could be observed 3-4 days after applying 2500 ppm of cycocel and severe leaf necrosis could be

observed 2 days after applying 10000 ppm of B-nine. Hence in this experiment the lowest suggested levels for PGRs were used. Chlorotic spots on poinsettia leaves have been observed by Lewis *et al*., (2004) when cycocel was applied at 1500 ppm. In contrast to that report no phytotoxicity was observed in this experiment. Several workers have shown that mixing of cycocel and B nine was more effective and it reduced labour cost (Lewis *et al*., 2004, Lopez and Runkel, 2007, Joiner and Harrison, 1967). But Weijie (2005) has stated that sequential application of PGR had given best poinsettia production. He has indicated that closer applications or mixed applications lead to reduction of bract size of plants. According to Joiner and Harrison (1967), height control due to chemical treatments was accompanied in every instance by reduction of bract size. Reduction in height probably was caused by restriction in cell elongation rather than cell division. Apparently the decrease in cell elongation affects bract size. Therefore, the period of application of B-nine in this experiment (2 weeks after cycocel treatment) could be well justified.

In agreement with Joiner and Harrison (1967), in terms of height, cycocel was the most effective growth retardant used in the experiment and could obtain plants of acceptable size without application of B-nine. According to the results obtained, application of B- Nine was ineffective. The possible reasons may be delayed application (therefore not enough time available to be productive), the sub optimal concentration or some unknown environmental and physiological causes. However, most of the plants in this study were saleable and reached acceptable shape and height (Fig. 1), except untreated control. Well shaped plants were obtained from the treatment combination of cycocel and B-nine, both with pinching once or twice and cycocel alone with pinching once or twice (Tables 1 & 2 and Fig. 2).

This experiment will be continued with induction of flowering by providing artificial short day condition. This technology, would be a new introduction to local floriculture industry which will fulfill the demand of colourful potted plants for festivals. The protocol developed through this study would facilitate pot plant production and used as a reference for further improvement.

**Fig. 1. Potted plants produced from the experiment**


**Fig. 2. a. Plant from treatment combination 2 b. Control**

## CONCLUSIONS

Cycocel when applied on poinsettia shoots in combination with double pinching could significantly improve height control (20.3 cm) while increasing the number of shoots (36). B-nine was not as effective as cycocel in controlling shoot height. Poinsettia plants can be developed into acceptable characteristic shape of pot plants by applying double pinch plus 1500 ppm of cycocel at 14 day intervals.

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