# EFFECT OF GROWTH RETARDANTS TO BREAK APICAL DOMINANCE IN *ROSA DAMASCENA*

Malik Mohsin Abbas, Saeed Ahmad* and Raheel Anwar
Institute of Horticultural Sciences, University of Agriculture, Faisalabad 38040, Pakistan
*Email: sandhu100hasan@yahoo.com

The research was carried out to investigate the effect of different growth retardants to break apical dominance in *Rosa damascena*. Cycocel, Alar and Ethephon at different concentrations were applied as a foliar spray. It was observed that Alar and Cycocel showed their superiority on different morphological and floral characteristics at lower concentrations. Maximum number of lateral shoots and flowers were observed by the spray of Alar @ 1000ppm, which attained significant superiority over rest of treatments. From ornamental point of view (compactness), maximum increase in size of shoots was achieved by Alar (6.75cm) and Cycocel (6.25cm) @ 1000ppm.
**Keywords:** Apical dominance, *Rosa damascena*, growth retardants, apical growth.

## INTRODUCTION

Rose, which belongs to the family Rosaceae and genus Rosa, has more than 1400 cultivars and 150 species (Philips and Rix, 1988). Rose is a perennial plant, which produces flowers throughout the year with different colors, shape, fragrance and long period of blooming. Many species of roses have fragrance in their petals and oil can be extracted from them. Several species of genus *Rosa* grow wild in Western Europe to Central Asia. *Rosa damascena* (Damask Rose) Roses are grown for their multiple uses like production of petals, extraction of rose oil, extraction of vitamin C from rose hips for medicine use and for sale as cut flower (Khan, 1978). Due to extensive uses in human life rose has always been found favorite of mankind in all times and in all climates.

In the 20$^{th}$ century, individual growth correlations (i.e. shoot growth or fruit growth) have become special areas of investigation without considering their influence over other correlations. Apical dominance is one such correlation that has been studied extensively and it has become defined area of plant growth research. In apical dominance, the shoot apex can prevent lateral bud growth and the root apex can prevent lateral root formation (Phillips, 1975). The degree of dominance is a function of genetic loci, environmental factors, physiological processes and plant age. Apical dominance means, a complete or nearly complete control of lateral buds by the apex, dominance of one growing shoot over another and the influence on the orientation of branches and leaves. In order to increase the flower production, it is necessary to permit the quiescent buds to develop. This will be possible only if the dominance of the apical bud is broken through some suitable techniques (Gudin, 2001). Apical dominance is thought to be caused by the apical bud producing IAA (auxin) in abundance. This auxin is transported basipetally from the apical bud. The auxin causes the lateral buds to remain dormant. For the application of auxin, commercially available chemicals include Cycocel (ccc, Chloremequat, 2-chloroethyl-ammonium chloride), Alar (Aminozide, B-9, N- dimethylamine succinamic acid) and Ethephon (2-chloroethyl, phoshonic acid). The objective of this research was to determine effect of these three growth retardants on vegetative and reproductive physiology of *Rosa damascena*.

## MATERIAL AND METHODS

The present research was carried out in the *Rose Research Area,* Institute of Horticultural Sciences, University of Agriculture, Faisalabad during 2002-03. Cycocel, Alar and Ethephon were used in this study as growth retardants.

One-year-old *Rosa Damascena* plants were selected in the last week of January, 2003 for the experimental purpose. Four plants were randomly selected in each treatment. These plants were marked and tagged. All the plants were uniformly provided with cultural practices.

The 1.0N stock solutions of Cycocel and Ethephon were prepared in distilled water while Alar in alkali (NaOH) as described by Jackson (1962). Then, 50, 100 and 150ml of stock solution was mixed in 100ml of distilled water to obtained 500, 1000 and 1500ppm solutions, respectively and foliar application of

solutions was done with nap sac sprayer (Hand Spray Gun). Treatments were made as $T_1$) Control, $T_2$) Cycocel @ 500ppm, $T_3$) Cycocel @ 1000ppm, $T_4$) Cycocel @ 1500ppm, $T_5$) Alar @ 500ppm, $T_6$) Alar @ 1000ppm, $T_7$) Alar @ 1500ppm, $T_8$) Ethephon @ 500ppm, $T_9$) Ethephon @ 1000ppm and $T_{10}$) Ethephon @ 1500ppm.

One month after each spray, morphological parameters were recorded by increase in plant height (cm), number of shoots produced till the completion of flowering after the application of treatment and length of shoots (cm) were recorded along with number of leaves at the stage when the plants shifted over from vegetative to reproductive stage. Reproductive data included average number of flowers plant$^{-1}$, petals flower$^{-1}$ and blooming period (days) from the development of the first flower till the last developed flower started to fade. Flower size (cm$^2$) was measured by $\pi r^2$ (Carlaten and Foote, 1965). To count number of leaves, 25.5cm of shoot length was selected, which is generally considered to be mature enough and have maximum number of leaves. Moreover, vegetative flushes bear flower after attaining the height of 25.5 cm long.

Experiment was laid out according to Randomized Complete Block Design (RCBD) with three replications. Data was analyzed statistically by using the Fishers analysis of variance technique and treatments were compared by using the Duncan's Multiple Range (DMR) test at 5% probability level (Steel & Torrie, 1980). In each experimental unit, there were four plants making the total number of 120 plants.

## RESULTS AND DISCUSSION

As for as plant height is concerned, it was observed that $T_1$ (control) produced maximum plant height of 17.14cm in what time period (Table 1), which was significantly different from rest of the treatments at 5% level of significance. Lower concentrations of growth retardants showed less plant height as compared to control. Cycocel @ 500ppm showed maximum reduction in plant height (17.14cm). Minimum increase in plant height was obtained with Cycocel @ 1000ppm and Alar @ 1000ppm concentration, which measured 6.47cm and 7.63cm, respectively. These results confirmed the earlier findings of Don *et al.,* (2003). The growth retardants were effective in reducing the size. Moreover, the intensity of the action depends upon the concentration of the chemicals used. The reduction of height was due to reduction in cell division frequency of the meristematic tissues in the apical growing regions and reduction in cell elongation.

**Table 1. Effect of growth retardants on the plant morphological characters of *Rosa damascena***

| Treatments | Plant height (cm) | Number of shoots | Length of shoots (cm) | Number of Leaves |
|---|---|---|---|---|
| $T_1$ (Control) | 13.90 d | 27.25 | 13.14 e | 08.00 d |
| $T_2$ (Cycocel @ 500ppm) | 17.14 a | 39.75 | 23.04 a | 07.75 d |
| $T_3$ (Cycocel @ 1000ppm) | 12.70 e | 34.50 | 12.10 f | 11.50 a |
| $T_4$ (Cycocel @ 1500ppm) | 06.47 j | 37.75 | 06.23 i | 10.00 bc |
| $T_5$ (Alar @ 500ppm) | 08.64 h | 32.25 | 16.36 d | 09.00 cd |
| $T_6$ (Alar @ 1000ppm) | 15.75 b | 40.50 | 18.01 c | 08.00 d |
| $T_7$ (Alar @ 1500ppm) | 7.633 i | 33.50 | 06.75 i | 11.00 ab |
| $T_8$ (Ethephon @ 500ppm) | 10.79 f | 30.25 | 11.40 g | 08.50 d |
| $T_9$ (Ethephon @ 1000ppm) | 14.70 c | 35.75 | 21.24 b | 10.25 abc |
| $T_{10}$ (Ethephon @ 1500ppm) | 9.858 g | 31.50 | 09.36 h | 09.00 cd |
| *LSD (p>0.05)* | *0.58* | *NS* | *0.52* | *1.23* |

Regarding number of shoots, it was observed that $T_6$ (Alar @ 1000ppm) attained significant superiority over rest of treatments by producing maximum number of lateral shoots plant$^{-1}$ (40.50) (Table 1). This was followed by $T_2$ (Cycocel @ 500ppm) with 39.75 shoots. The other means followed a sequence of $T_4$ (Cycocel @ 1500ppm), $T_9$ (Ethephon @ 1000ppm) and $T_3$ (Cycocel @ 1000ppm) resulting in creating number of shoots plant$^{-1}$ i.e. 37.75, 35.75 and 34.50, respectively. Minimum shoots length and maximum numbers of lateral shoots observed by Alar @ 1000ppm concentration, which attained significant superiority over rest of treatments having average 40.50 shoots plant$^{-1}$. Cycocel @ 500ppm concentration produced 39.75 shoots and attained the second best position. Minimum number of shoots was observed in control giving 6.47 shoots. Similar results were also reported by Bredmose *et al.*, (2001). The effectiveness of the chemicals on shoot production might be due to the retarding effects of the chemicals which, had encouraged lateral shoot development (Moe, 1988)

Control ($T_1$) produced significantly taller length of shoots (23.04cm) than all of rest treatments (Table 1). It was followed by $T_8$ (Ethephon @ 500ppm) by increasing length of lateral branches with 21.24cm. $T_5$ (Alar @ 500ppm) and $T_4$ (Cycocel @ 500ppm) showed 18.01cm and 16.36cm increase in length, respectively. Maximum reduction in average branch size was noted by $T_3$ (Cycocel @ 1000ppm) and $T_6$ (Alar @ 1000ppm) showed the increase in length up to, 6.23 and 6.75cm, respectively. The tallest shoots in control indicated the effectiveness of growth retardants in the reduction of the shoot development (Shin *et al.,* 2001).

$T_2$ (Cycocel @ 500ppm) produced maximum number of leaves (11.50 leaves). It was followed by $T_6$ (Alar @ 1000ppm) producing 11.0 leaves. $T_8$ (Ethephon @ 500ppm) produced 10.25 leaves and $T_3$ (Cycocel @ 1000ppm) produced 10.00 leaves. From the above data, the Cycocel @ 500ppm produced maximum leaves (11.50 leaves), while $T_1$ produced the least number of leaves i.e. 7.75 leaves. The other means followed a sequence of $T_4$ (Cycocel @ 1500ppm), $T_7$ (Alar @ 1500ppm), $T_{10}$ (Ethephon @ 1500ppm), $T_5$ (Alar @ 500ppm), and $T_1$ (Control), respectively in a descending order producing 9.00, 9.00, 8.50, 8.00, 8.00, and 7.75 leaves. Control produced the least number of leaves i.e. 7.75 leaves. The chemicals sprayed enhanced the development of leaf initials. It was observed that growth retardants increased the number of flowers plant$^{-1}$ against control. As the number of leaves increased the treatments become effective in increasing the number of flowers.

To study the effect of growth retardants on flower characteristics, number of flowers, flower size and number of petals flower$^{-1}$ were counted plant$^{-1}$ and treatment means were compared (Table 2). It was observed that growth retardants increased the number of flowers plant$^{-1}$ against control. $T_6$ (Alar @ 1000ppm) produced the highest number of flowers 75.25. $T_5$ (Alar @ 500ppm) and $T_2$ (Cycocel @ 500ppm) gave the second and third best results i.e. 68.50 and 67.75 flowers plant$^{-1}$. The means $T_9$ (Ethephon @ 1000ppm), $T_8$ (Ethephon @ 500ppm), $T_4$ (Cycocel @ 1500ppm), $T_7$ (Alar @ 1500ppm) and

**Table 2. Effect of growth retardants on the flower characters of *Rosa damascena***

| Treatments | Number of flowers | Flower size (cm$^2$) | Number of petals flower$^{-1}$ |
|---|---|---|---|
| $T_1$ (Control) | 45.00 h | 29.79 j | 33.50 ef |
| $T_2$ (Cycocel @ 500ppm) | 41.25 i | 38.52 a | 35.25 de |
| $T_3$ (Cycocel @ 1000ppm) | 67.75 b | 37.41 b | 42.50 a |
| $T_4$ (Cycocel @ 1500ppm) | 48.00 g | 35.99 d | 40.00 ab |
| $T_5$ (Alar @ 500ppm) | 55.50 e | 33.71 g | 31.75 f |
| $T_6$ (Alar @ 1000ppm) | 68.50 b | 36.54 c | 42.80 a |
| $T_7$ (Alar @ 1500ppm) | 75.25 a | 34.50 f | 38.75 bc |
| $T_8$ (Ethephon @ 500ppm) | 52.50 f | 31.45 i | 28.50 g |
| $T_9$ (Ethephon @ 1000ppm) | 60.00 d | 35.45 e | 36.75 cd |
| $T_{10}$ (Ethephon @ 1500ppm) | 64.75 c | 32.05 e | 35.25 de |
| *LSD (p>0.05)* | *2.81* | *0.52* | *2.61* |

$T_3$ (Cycocel @ 1000ppm) produced 64.75, 60.00, 55.50, 52.50, 48.00 and 45.00 flowers. Alar @ 1000ppm produced the highest number of flowers i.e. 75.25 flowers plant$^{-1}$, while $T_1$ control produced the least number of flowers i.e. 41.25 flowers plant$^{-1}$. The same trend in flower production frequency, due to growth retardant effect, has also been depicted by Zieslin (1985).

Results significant sponsored the superiority of $T_1$ (Control) over rest of treatments giving 38.52cm$^2$ of flower size (Table 2). T2 (Cycocel @ 500ppm) and $T_5$ (Alar @ 500ppm) attained the second and third positions producing the sizes of 37.41cm$^2$ and 36.54cm$^2$, respectively. While, $T_3$ (Cycocel @ 1000ppm), $T_8$ (Ethephon @ 500ppm), $T_6$ (Alar @ 1000ppm) and $T_4$ (Cycocel @ 1500ppm) showed the reduction in size of flower as 35.99cm$^2$, 35.11cm$^2$, 34.50cm$^2$ and 33.71cm$^2$ in descending order. Reduction of size of flower was greater in the means $T_9$ (Ethephon @ 1000ppm) and $T_7$ (Alar @ 1500ppm) resulted into 32.05cm$^2$ and 31.45cm$^2$ size of flowers. Smallest sized flowers were resulted by $T_{10}$ (Ethephon @ 1500ppm), which resulted into 29.79cm$^2$-sized flowers, which were statistically different with other treatments. In case of size of flower, it was observed that control produced the largest size of flower (38.52cm$^2$). It was followed by Cycocel @ 500ppm producing 37.41cm$^2$of flower size (Larsen, 1984; Bredmose *et al,* 1999). Growth retardants reduce the size of flowers as their concentrations were increased. It was observed that the chemicals managed to produce the greater number of flowers. Size of flowers, therefore was smaller. Greater the number of flowers lesser will be the size of flowers.

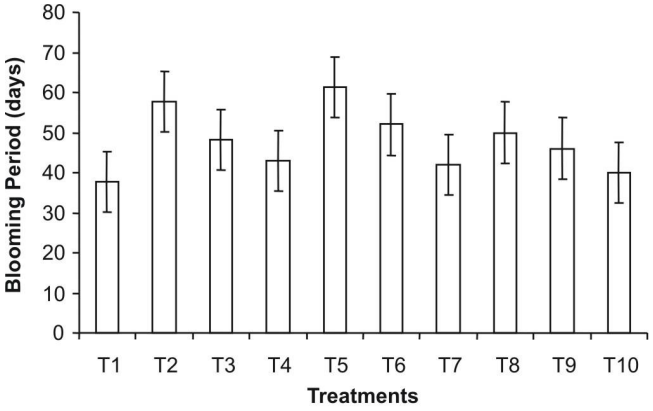


**Figure 2. Effect of growth retardants on blooming period (days). Vertical bars represent standard deviation at 7.63**

Data regarding effect of growth retardants on number of petals flower$^{-1}$, it was observed that $T_2$ (Cycocel @ 500ppm) produced the greatest number of petals, which are 42.50 petals flower$^{-1}$ plant$^{-1}$. $T_5$ (Alar @ 500ppm), $T_3$ (Cycocel @ 1000ppm), $T_6$ (Alar @ 1000ppm) and $T_8$ (Ethephon @ 500ppm) resulted in production of 42.25, 40.00, 38.75 and 36.75 number of petals flower$^{-1}$ plant$^{-1}$. The smallest number of petals were produced by $T_7$ (Alar @ 1500ppm), which was 28.50 petals flower$^{-1}$ plant$^{-1}$ and highest number of petals were produced by $T_2$ (Cycocel @ 500ppm) which was 42.50 petals flower$^{-1}$ plant$^{-1}$. Cycocel @ 500ppm produced the highest number of petals which was 42.50 petals flower$^{-1}$ plant$^{-1}$.

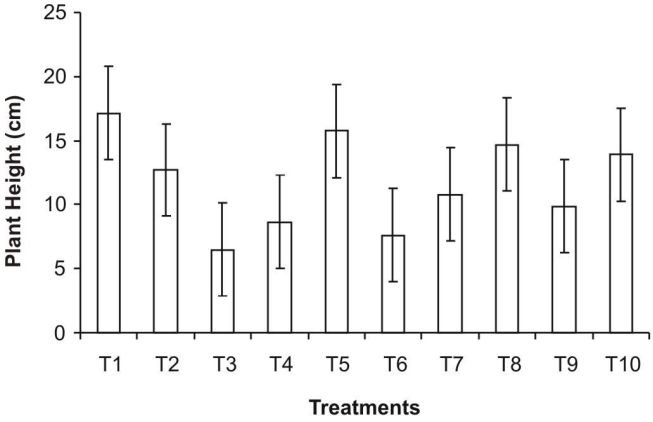


**Figure 1. Effect of growth retardants on plant height (cm). Vertical bars represent standard deviation at 3.63**

Growth retardants were found be significantly effecting blooming period (Fig. 2). $T_2$ (Cycocel @ 500ppm) and $T_6$ (Alar @ 1000ppm) increased number of days as 57.75 and 52.00 days, respectively. There was also increase in blooming period by $T_8$ (Ethephon @ 500ppm), $T_3$ (Cycocel @ 1000ppm), $T_9$ (Ethephon @ 1000ppm) and $T_4$ (Cycocel @ 1500ppm), which increased the blooming period up to 50.0, 48.25, 46.0 and 43.00 days, respectively. Control showed the least period of flowering, which was 37.75 days. Alar @ 500ppm and Cycocel @ 500ppm increased the blooming period 61.25 and 57.75 days as compared to control i.e. 37.75 days (Bhattacharjee, 1985; Rajaimani & Sundaram, 1997). Alar @ 1000ppm and Cycocel @ 1000ppm increased the blooming period up to 52.0 and 48.25 days, respectively. This position can be explained by considering two factors in view. Firstly, when the growth ceases there is a possibility of emergence of new shoots from the lower sides. The lateral shoots arise under these conditions. These

branches would then differ in accordance with age and development. Consequently, the flowering of the shoots would follow on different times, hence prolonged blooming period. Secondly, when the plant continues growth, it gets depleted in plant materials because growth is the almost exhaustive process hence resource depletion will be minimized.

## CONCLUSION

*Rosa damascena* (Damask Rose) flower once a year and its blooming time is very short. If the crop is on vast area it is very much difficult to prune the crop, for that purpose the maximum number of lateral shoots and flowers can be produce by the foliar application of Alar @ 1000ppm.

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