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Influence of paclobutrazol application on the flower size and yield of China aster (*Callistephus chinensis* (L.) Nees)

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Abstract

The effects of method of application and concentration of paclobutrazol on flower stalk length, flower size, flower longevity and yield of China aster were studied. Thiry five days old seedlings of China aster cv. Poornima were treated with paclobutrazol @ 0, 25, 50, 100 and 200 ppm through root dip, soil drench and foliar spray methods. Length of flower stalk and flower size significantly decreased with increased concentrations of paclobutrazol except in case of flower size when applied as foliar spray. Contrarily, flower longevity not influenced adversely with increased concentration of paclobutrazol, whether applied as root dip or soil drench or foliar spray. In each application method, flower yield was significantly higher at 25 ppm paclobutrazol. However, drench application of paclobutrazol was consistently more effective than foliar or root dip treatments with regard to length of flower stalk. Among the different levels and methods of paclobutrazol application, plants treated with 25 ppm as foliar spray proved to be superior over control and rest of the treatment combinations by increasing flower diameter and yield of cut flower as compared to control.

Key words: Paclobutrazol, China aster, *Callistephus chinensis* (L.) Nees, flower quality, yield

Introduction

Stature of floral plants has a significant effect on the consumer preference. The natural growth habit of many floricultural crops including China aster is large and upright, which reduces the attractiveness of the plant in bed as well as in pots. Though breeding such plants for small stature is possible however, the prospects of advancement through breeding are rather difficult to assess. Chemical growth retardants thus offer quick and viable alternative for manipulating the timing of flowering, number, size, colour, quality and longevity of flowers. The methods of application should also be critically evaluated as it may have a direct influence on the final crop quality especially in the case of flowering pot plants like China aster. In tropical and subtropical countries, it is extensively grown for bedding and cut blooms during the winter months and spring. Cut asters last long and are used in vases and floral decoration. Since, paclobutrazol offer improved growth regulation and greater flexibility of usage over the existing growth regulators, it can be seen as a tool for introducing innovation into ornamental pot plant market. Its commercial introduction in floriculture could pave the way for new market opportunities to be developed in this highly competitive sector. Method and site of application play greater role in effectiveness of paclobutrazol (Barraett and Bartuska, 1982) and it can be more effective and persistent on plant growth when applied as a media or soil drench (Karaguzel, 1999). In the present experiment, therefore, efforts were made to determine the efficacy of paclobutrazol in manipulation of quality and yield of China aster flower through different application methods.

Materials and methods

The experiment was conducted in the Department of Horticulture, Kulbhaskar Ashram Degree College, Allahabad (UP). Healthy and uniform seedlings of China aster cv. Poornima were planted at four-leaf stage in 25.5 cm earthen pots. Thirty five days old seedlings were treated with paclobutrazol @ 0, 25, 50, 100 and 200 ppm through root dip, soil drench and foliar spray methods. These levels of concentration were prepared by diluting a concentrated suspension of paclobutrazol (Cultar 250 g L^{-1} SC; Syngenta). There were 15 treatment combinations replicated three times and laid in factorial Completely Randomized Design. Necessary plant protection measures were followed uniformly during the course of investigation. The observations were recorded on flower yield and quality *viz.*, flower stalk length, flower size, longevity.

Results and discussion

The experimental findings revealed that there was a significant effect of application methods and level of paclobutrazol on flower stalk length. Maximum reduction in flower stalk length was observed with 200 ppm paclobutrazol applied as soil drench over control. Root dip method has least effect on reducing the flower stalk length than foliar spray or soil drench (Fig. 1).

Soil applied paclobutrazol is relatively immobile and is most efficiently taken up by plants when both roots and the chemical are localized in the same area (Lever, 1986). Root applied paclobutrazol is acropetally transported to the leaves primarily via the xylem. Paclobutrazol has been shown to have limited effect on apical growth when applied to leaves, but the chemical applied to stems or soil is readily taken up, presumably via the xylem (Barrett and Bartuska, 1982). This may explain why soil applications of triazoles are generally more effective in retarding growth than foliar application. China aster bears flower at terminal or apical portion. Plant growth retardants, including paclobutrazol is believed to reduce shoot extension by inhibiting the activity of sub-apical meristem. GAs plays a key role in the control of shoot growth (Grochowska and Hodun, 1997) and young leaves

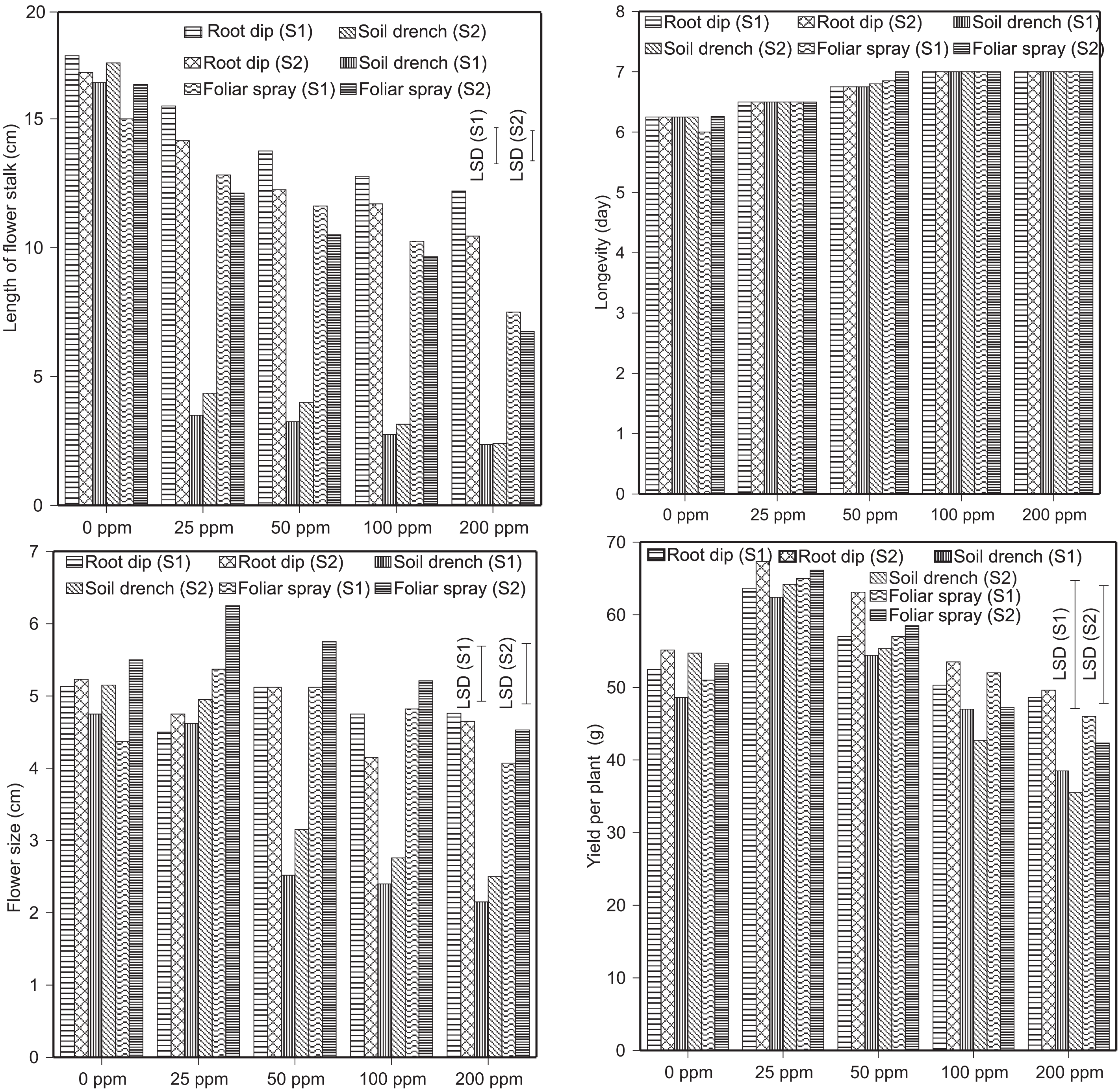

Fig. 1. Effect of paclobutrazol on flower stalk length, flower size, flower longevity and yield of China aster

are the primary site of GA synthesis (Dalziel and Lawerence, 1984). It has, therefore, been assumed that the presence of paclobutrazol in the apical parts of young shoots would thereby be most effective in limiting shoot extension. Reduction in plant height imparted reduced length of flower spike (Chu *et al.*, 2003). Reduced flower stem with application of paclobutrazol coincided with the findings of Yoo-yong *et al.* (1999) and Cai *et al.* (2002) in chrysanthemum.

Among the different levels and methods of paclobutrazol application, plants treated with 25 ppm as foliar spray showed 18.62 per cent increase in flower diameter over control (Fig. 1). Whereas, higher concentration *i.e.* 200 ppm paclobutrazol applied as soil drench reduced the flower diameter. This may be due to its inhibiting influence on cell enlargement and shoot expansion. Whereas, at lower concentration it seems to be optimum (25 ppm paclobutrazol as foliar) for enlargement of the flower size which may be due to the effect of paclobutrazol on reduction of vegetative growth as the energy required for vegetative growth is converted into reproductive growth and development. Increases in size of flower in chrysanthemum with paclobutrazol application have been reported by Gilbertz (1992), Yewale *et al.* (1998) and Syam'un *et al.* (2011). While, Muhammad *et al.* (2002) reported reduction in chrysanthemum flower size due to paclobutrazol. The discrepancies in the results may be due to the differences in doses, time and method of application, plant species and environments.

The effect of paclobutrazol due to different levels and methods of application was non significant with regards to longevity of flower in China aster cv. Poornima (Fig. 1). However, in each application method, longevity of flower increased linearly and quadraticaly with increased concentration of paclobutrazol.

Cut flower yield per plant significantly differed by the different levels and methods of paclobutrazol application. Foliar spray at 25 ppm paclobutrazol improved the yield of cut flower. Whereas, the plants treated with 200 ppm paclobutrazol as soil drench reduced yield of cut flower. In the present investigation, improved flower size was recorded with 25 ppm as foliar spray and thus the treatment proved better with regards to yield of cut flower per plant.

Flower yield per plant is directly or indirectly influenced by vegetative growth of a plant. Mishra *et al.* (2005) reported that paclobutrazol application had marked effect on plant height, number of branches, number of leaves, leaf area, root number and root length of China aster plant. Plant height was reduced increasingly with increased level of paclobutrazol. At higher concentration plants growth was found stunted, whereas optimum level *i.e.* 25 ppm as foliar spray inhibited the growth of plant and induced bushiness.

China aster bear flower at apical portion of each shoot and each shoot bear single flower. Application of paclobutrazol at optimum level increased the number of shoots which consequently improved the production of flowers. Total number of leaves and leaf area per plants directly influence the yield of flower branches (Mishra *et al.,* 2005). Treatment with paclobutrazol at above the optimum level significantly reduced the leaf number and area per plant, whereas at optimum level *i.e.* 25 ppm, leaf area and number reduces at threshold levels, which encouraged the production of flower. Leaves are centre of photosynthetic process and the final product of photosynthesis is carbohydrate, which converted to plant growth and development or indirectly to yield. Because the paclobutrazol reduces the leaf number and leaf area, they may reduce the amount of photosynthetic surface per plant and thereby reduce whole plant photosynthesis and final product. Yield of flower may also directly or indirectly be influenced by root number and length. Triazole treated plants have often exhibited numerous thickened, fleshy roots, due to increased root diameter and decreased root length. Because triazoles influence root growth, root number and morphology, they potentially could alter mineral uptake and inhence plant nutrition.

Contrary to this, Wahyuni *et al.* (2011) reported that paclobutrazol at 0.25 mg *a.i.* per plant applied alone or in combination with GA_3 had extended flower development in *Brunonia*, and resulted in a reduced number of inflorescences per plant compared to the control plants. Paclobutrazol treated *Calandrinia* looked compact and attractive, and paclobutrazol application did not affect time to flower and flower number.

Reduction of growth at threshold level (optimum level) by paclobutrazol converted the vegetative growth towards floral development. However, at higher concentration plants growth remain stunted and the production affected adversely. Similar findings were reported in chrysanthemum (Singh *et al.*, 1999; Muhammad *et al.*, 2002), Celosia, Snapdragon and Salvia (Barrett and Nell, 1986) and in marigold (Keever and Cox, 1989)

The study revealed that higher concentration (200 ppm) of paclobutrazol exhibited supraoptimal responses whereas, 25 ppm as foliar spray was optimal. Better dwarfing, flower size and yield were obtained with foliar spray (25 ppm).

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