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Effect of growing media and paclobutrazol on growth, flowering and pot presentability of geranium, *Pelargonium* x *hortorum* LH Bailey

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ABSTRACT

The present investigations were carried out at the experimental farm of the Department of Floriculture and Landscape Architecture, Dr YS Parmar university of Horticulture and Forestry, Nauni, Solan with the objective to work out the effect of growing media and paclobutrazol on growth, flowering and pot presentability of geranium. The experiment was laid out in a completely randomized design (factorial) having 21 treatment combinations of growing media (7) and paclobutrazol doses (3) replicated thrice. Seven growing media viz T_1 (rhododendron forest soil + FYM + vermicompost (1:1:1, v/v), T_2 (rhododendron forest soil + FYM + vermicompost (2:1:1, v/v), T_3 (rai forest soil + FYM + vermicompost (1:1:1, v/v), T_4 (rai forest soil + FYM + vermicompost (2:1:1, v/v), T_5 (Mohru oak forest soil + FYM + vermicompost (1:1:1, v/v), T_6 (Mohru oak forest soil + FYM : vermicompost (2:1:1, v/v), T_7 (soil + FYM + sand (1:1:1, v/v) and three doses of paclobutrazol viz 0, 10 and 20 ppm were used. The observations were recorded on various growth, flowering and pot presentability attributes. The maximum values wrt most desirable parameters viz number of shoots per plant (6.71), plant spread (24.27 cm), number of flowers per inflorescence (17.33), duration of flowering (123.60 days) and pot presentability score (77.00) were recorded in T_4 whereas maximum inflorescence diameter (8.74 cm), number of inflorescences per plant (14.10) and maximum number of inflorescences opened at a time (9.67) were recorded in T_3. Among the paclobutrazol doses used. Untreated control exhibited maximum plant height (30.43 cm), plant spread (26.96 cm), inflorescence diameter (10.11 cm) and duration of flowering (125.30 days). However maximum number of shoots per plant (7.02), days to flower bud formation (124.80), days to first flower opening (135.30), number of inflorescences per plant (12.56) and number of inflorescences opened at a time (8.33) was obtained with 20 ppm paclobutrazol. Drenching of the geranium plants with 10 ppm paclobutrazol dose recorded maximum pot presentability (79.00).

Keywords: Geranium; growing media; paclobutrazol; growth; flowering; pot presentability

INTRODUCTION

The modern florist's geranium, *Pelargonium* x *hortorum* LH Bailey is a native of South Africa and belongs to the family Geraniaceae. It has been the backbone of bedding plant business for decades. Sales of geraniums represent 15 to 20 per cent of total wholesale value of the bedding plant industry (Berninger 1993). Among the top ten outdoor plants sold by FloraHolland during 2008, geranium occupied top position with total sales of 21 million Euros (Desh Raj 2010). Geranium is the most fascinating and important flowering pot plant especially for the temperate regions and is universally admired for its vivid, vivacious and vibrant colour of flowers, varied forms and textures, etc. The beauty and balance of this plant in the pot are marred by excessive long shoots besides short lived and haphazard flowering leading to reduction in pot presentability round the year. Hence it is important to select a suitable growing medium and growth retardant chemical for producing quality geranium pot plants. It is well documented that growing media and growth retarding chemicals play an important role in manipulating shape, size, form, growth, flowering and pot presentability of geranium. Growth retarding chemicals such as chlormequat, ethephon, paclobutrazol, daminozide etc are used to produce more compact, attractive and most presentable potted plants of ornamentals in general and geraniums in particular. Paclobutrazol belonging to the triazol growth retarding chemicals is known to inhibit the gibberellin biosynthesis leading to suppression of internode and long term growth, developing a good plant frame work besides improving the flowering of potted geraniums (Hagiladi and Watad 1992).

Besides growth retardants growing medium also plays a vital role in manipulating the growth, flowering and presentability of potted geraniums. So selection of a proper growing medium is the most critical for success of all production stages of geranium because geraniums require a medium which is pasteurized, well drained, rich in humus and nutrients besides possessing better other physico-chemical and biological properties particularly in the rhizosphere (Trellinger 1997).

Keeping in view the above facts the present investigations were carried out to select the most suitable growing medium and paclobutrazol dose for producing best quality and most presentable potted geraniums.

MATERIAL and METHODS

The present investigations were carried out at the experimental farm of Department of Floriculture and Landscape Architecture, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP during 2009-2010. The experiment was

laid out in a completely randomized design (factorial) having 21 treatment combinations of growing media (7) and paclobutrazol doses (3) replicated thrice. Seven growing media viz T_1 (rhododendron forest soil + FYM + vermicompost (1:1:1, v/v), T_2 (rhododendron forest soil + FYM + vermicompost (2:1:1, v/v), T_3 (rai forest soil + FYM + vermicompost (1:1:1, v/v), T_4 (rai forest soil + FYM + vermicompost (2:1:1, v/v), T_5 (Mohru oak forest soil + FYM + vermicompost (1:1:1, v/v), T_6 (Mohru oak forest soil + FYM : vermicompost (2:1:1, v/v), T_7 (soil + FYM + sand (1:1:1, v/v) and three doses of paclobutrazol viz 0 (P_1), 10(P_2) and 20 (P_3) ppm were used.

The observations were recorded on various growth, flowering and pot presentability parameters. The healthy, disease free and uniform well rooted plants of geranium cultivar Ped Selection were selected and planted in the earthen pots of size 20 cm diameter containing a sterilized mixture of different growing media as per treatments on volume by volume basis and the pots were kept in the shade net house. After 30 days of planting, plants were pinched to encourage the growth of laterals. After 25 days of pinching the single application of different doses of paclobutrazol (PP 333) @ 0, 10 and 20 ppm was applied. About 150 ml solution of each dose of PP 333 was drenched in each pot as per treatment. To maintain the health and presentability of potted geraniums, the standard plant protection measures were adopted which included fortnightly drenching and spraying with mancozeb M-45 @ 2 g/l and carbebdazim @ 1 g/l alternatively. Besides a fortnightly spray of streptocycline @ 100 ppm was also practiced to check the incidence of bacterial wilt. For controlling the catterpillars and white fly, polytrin and deltamethrin @ 0.1 per cent were sprayed at fortnightly intervals alternatively.

RESULTS and DISCUSSION

The effects of various treatments are given in Table 1.

Plant height

Different growing media exhibited varied responses to plant height of geranium and T_5 (Mohru oak forest soil + FYM + vermicompost (1:1:1, v/v) recorded maximum plant height (25.58 cm). These findings get support from the earlier reports of Noguera et al (2000) in calendula. However minimum plant height (19.78 cm) was recorded in T_7 (soil + FYM + sand (1:1:1, v/v).

Similarly the response of paclobutrazol doses on plant height varied with the doses applied and maximum plant height (30.43 cm) was recorded without the application of paclobutrazol and minimum (18.43 cm) was achieved when plants were drenched with 20 ppm paclobutrazol. The drastic reduction in plant

height (39.44%) with the application of 20 ppm paclobutrazol over control may be attributed to the growth retarding properties of paclobutrazol.

The paclobutrozol being a triazol group of growth retarding chemical is known to retard the internodal length by inhibiting the gibberllic acid biosynthesis besides reducing the activities of cell enlargement and cell division. These results are in close conformity with the findings of Andrasek (1989). Similarly Tayama and Carver (1990) reported 33.13 per cent decrease in plant height with the application of PP 333 @ 15 ppm in comparison to control.

Number of shoots per plant

Maximum shoots per plant (6.71) were found in the plants grown in T_4 and minimum (4.20) in the T_7. This medium (T_4) might have supplied more nutrients in available form especially nitrogen which contributed to better plant growth and production of more biomass. Nitrogen is known to stimulate the manufacture of carbohydrates and proteins which in turn enhance cell division and hence improve the vegetative growth of plant and production of more shoots per plant (Meyer and Anderson 1970).

The number of shoots per plant increased with the increasing dose of paclobutrozol and was found to be maximum (7.02) in the plants drenched with 20 ppm dose of paclobutrazol. Similar findings have been reported in azalea by Wilkinson and Richards (1991). However Latimer and Baden (1994) reported increase in number of branches with the application of 7 ppm paclobutrazol in geranium cultivars Ringo White and Ringo Rose. Similar results have also been reported by Nasr and Shalabi (1996) in *Zantedeschia* and Wang and Gregg (1994) in golden pathos.

Plant spread

Maximum plant spread (24.27 cm) was achieved in plants being grown in T_4 whereas it was minimum (18.96 cm) in T_7.

Maximum plant spread (26.96 cm) was recorded without the application of paclobutrazol and it was minimum (17.54 cm) in plants receiving 20 ppm dose of paclobutrazol. Similar findings have been reported by Andrasek (1989).

Days to flower bud formation and first flowering

Minimum number of days to flower bud formation (114.30) and first flowering (124.40) were recorded in T_3. In case of paclobutrazol treatments earliest bud formation and flowering were recorded when no PP333 was applied whereas bud formation and flowering were delayed with increasing concentration of PP333. Paclobutrazol has also been reported to delay flowering by earlier workers like

Schekel and Blau (1987), Clements and Ellis (1986) and Farthing and Ellis (1990) in geranium. The interaction effect of growing media and paclobutrazol showed that minimum number of days to flowering were taken by plants grown in T_2 medium and drenched with 10 PP333.

Inflorescence diameter

The plants grown in T_3 produced the inflorescences of maximum size (8.74 cm) in comparison to other growing media. Maximum inflorescence diameter (10.11 cm) was recorded without paclobutrazol application. These findings get support from the work of Andrasek (1989) and Nasr (1995) in geranium. However the interaction effects were found to be non-significant.

Number of inflorescences per plant

The plants grown in T_3 recorded maximum number of inflorescences per plant (14.01). The highest inflorescences per plant (12.56) were recorded with 20 ppm paclobutrazol. Latimer and Baden (1994) reported similar results in geranium cvs Ringo White and Ringo Rose.

The interaction of different growing media and paclobutrazol doses indicated that the growing media enriched with rai forest soil and drenched with 10 ppm paclobutrazol dose (T_3P_2) have shown great promise to produce more number of inflorescences per plant (17.52).

Maximum number of inflorescences per plant opened at a time

Maximum number of inflorescences per plant opened at a time (9.67) was recorded in the plants grown in T_3 and was found to be at par with T_4.

The application of 20 ppm paclobutrazol recorded the highest number of inflorescences opened at a time (8.33). However these results are not in conformity with the findings of Tayama and Carver (1990) who reported reduction in number of inflorescences opened at a time at higher doses of paclobutrazol.

The interaction effects indicated that growing medium comprising T_3 and drenching with 10 ppm dose of paclobutrazol recorded maximum number of inflorescences opened at a time per plant (13.00).

Duration of flowering

Maximum duration of flowering (123.60 days) was recorded in T_4. The drenching of paclobutrazol reduced flowering duration considerably and maximum reduction in duration of flowering was recorded with 20 ppm paclobutrazol. These findings are in agreement with those of Andrasek (1989) and Sullhan (2000). However Andrade et al (1991) have reported increase in the duration of flowering with the application of paclobutrazol.

Table 1: Effect of growing media and paclobutrazol on growth, flowering and pot presentability of geranium (*Pelargonium* x *hortorum* LH Bailey)

Growing medium	Plant height (cm)	# shoots/ plant	Plant spread (cm)	Days to flower bud formation	# days to first flower opening	Inflorescence diameter (cm)	# inflorescence /plant	# inflorescence/ plant opened at a time	Duration of flowering	Pot presentability
T_1	21.29	6.20	19.24	115.30	125.40	8.72	8.80	5.67	119.30	71.33
T_2	22.72	6.40	21.98	114.40	125.20	8.52	8.42	5.22	122.20	74.33
T_3	25.03	5.82	22.50	114.30	124.40	8.74	14.01	9.67	121.90	76.33
T_4	24.33	6.71	24.27	117.00	125.30	8.35	13.22	8.78	123.60	77.00
T_5	25.58	6.20	21.89	115.30	125.90	8.66	12.63	6.33	120.30	66.67
T_6	23.34	5.89	22.14	115.60	129.10	7.48	6.13	2.89	122.00	72.00
T_7	19.78	4.20	18.96	115.10	126.60	8.08	9.11	5.11	117.40	66.33
$CD_{0.05}$	2.73	0.78	1.78	NS	NS	0.75	1.44	0.82	2.43	0.57
Paclobutrazol dose										
P_1	30.43	5.26	26.96	104.00	116.20	10.11	6.53	3.24	125.30	66.71
P_2	20.61	5.46	20.20	117.10	126.50	8.10	11.90	7.14	120.30	79.00
P_3	18.43	7.02	17.54	124.80	135.30	6.89	12.56	8.33	117.20	70.29
$CD_{0.05}$	1.78	0.51	1.17	1.27	1.97	0.49	0.94	0.54	1.59	0.38
Growing medium x Paclobutrazol dose										
T_1 x P_1	26.03	5.06	23.13	103.70	113.30	10.03	5.83	3.00	122.70	62.00
T_2 x P_2	31.10	5.86	27.67	103.70	111.70	9.90	4.75	2.67	127.70	73.00
T_3 x P_3	30.37	5.26	28.47	105.00	114.30	10.50	7.60	4.33	126.70	68.00
T_4 x P_1	32.67	5.60	28.87	105.70	119.00	10.00	6.72	3.67	130.70	68.00
T_5 x P_2	33.67	6.20	27.47	104.00	114.70	10.59	8.40	4.67	125.00	61.00

T_6 x P_3	32.80	5.00	29.75	103.30	123.30	9.50	5.93	2.33	125.70	68.00
T_7 x P_1	26.35	3.86	23.40	102.30	117.30	10.25	6.50	2.00	119.00	67.00
T_1 x P_2	18.80	5.20	18.37	117.30	127.30	8.83	8.67	5.67	118.70	62.00
T_2 x P_3	18.82	5.93	21.00	116.70	129.00	8.35	8.87	5.33	120.70	73.00
T_3 x P_1	23.40	6.00	20.83	115.00	125.70	8.16	16.92	11.67	122.70	68.00
T_4 x P_2	21.33	6.67	23.95	117.70	120.00	8.05	16.27	11.00	121.70	68.00
T_5 x P_3	23.80	5.66	20.87	117.00	127.30	8.50	15.92	7.00	119.70	61.00
T_6 x P_1	19.58	4.86	18.87	118.00	128.00	6.92	6.36	3.00	121.30	68.00
T_7 x P_2	18.53	3.93	17.53	118.30	128.00	7.89	10.30	6.33	117.70	67.00
T_1 x P_3	19.03	8.33	16.23	125.00	135.70	7.30	11.89	8.33	116.70	71.00
T_2 x P_1	18.23	7.40	17.27	123.00	135.00	7.32	11.63	7.67	118.30	72.00
T_3 x P_2	21.33	6.20	18.20	123.00	133.30	7.57	17.52	13.00	116.30	76.00
T_4 x P_3	19.00	7.87	20.00	127.70	137.00	6.99	16.68	11.67	118.30	74.00
T_5 x P_1	19.27	6.73	17.33	125.00	135.70	6.88	13.58	7.33	116.30	68.00
T_6 x P_2	17.65	7.80	17.80	125.30	136.00	6.03	6.10	3.33	119.00	70.00
T_7 x P_3	14.47	4.80	15.93	124.70	134.30	6.10	10.53	7.00	115.70	61.00
$CD_{0.05}$	NS	NS	NS	NS	5.21	NS	2.94	1.41	NS	1.03

NS = Non-signficant

Pot presentability

The maximum pot presentability score (77.00) was observed in growing medium comprising T_4. The application of paclobutrazol 10 ppm resulted in the maximum pot presentability score (79.00). In case of interaction maximum pot presentability (76.00) was recorded in plants grown in T_3 and drenched with 10 ppm PP333. These results are in close agreement with the findings of Sullhan (2000) in geranium and Pathak (1996) in *Begonia* x *tuberhybrida* and *Primula obconica*.

REFERENCES

Andrade RM, Colinas LMT and Lozoya SH 1991. Chemical treatment for growth control in impatiens (*Impatiens walliriana* S). Revista Chapingo **15:** 73-74.

Andrasek K 1989. Increasing the ornamental value of *Hibiscus rosa-sinensis* and *Pelargonium hortorum* cv Springtime by gibberellins inhibitor growth regulator. Acta Horticulturae **251:** 329-331.

Berninger LM 1993. Status of the industry. In: Geraniums IV (JW White ed). Ball Publishing, Geneva, IL.

Clements F and Ellis SR 1986. Geranium update. Grower **105(10):** 21, 23-24.

Desh Raj 2010. Vista horticulture. Kalyani Publishers, New Delhi, India 330p.

Farthing JG and Ellis SR 1990. Growth regulants for modules bedding plants. Acta Horticulturae **272:** 293-297.

Hagiladi A and Watad AA 1992. *Cordyline terminalis* plants respond to foliar sprays and medium drenches of paclobutrazol. HortScience **27(2):** 128-130.

Latimer JG and Baden SA 1994. Persistent effects of plant growth regulators on landscape performance of seed geraniums. Journal of Environmental Horticulture **12(3):** 150-154.

Meyer BS and Anderson DB 1970. Plant physiology. East West Press Pvt Ltd, New Delhi, India.

Nasr MN 1995. Effect of methods of application and concentration of paclobutrazol on *Pelargonium zonale* (L) L'Her ex Ait as a pot plant. Alexandria Journal of Agricultural Research **40(3):** 261-279.

Nasr MN and Shalabi HG 1996. Production of zantedeschia as flowering plant by using growth regulator. Alexandria Journal of Agricultural Research **41(2):** 147-156.

Noguera P, Ahad M and Noguera V 2000. Coconut coir waste: a new and viable ecologically friendly peat substitute. Acta Horticulturae **517:** 279-283.

Pathak N 1996. Effect of plant bioregulators and potting mixtures on growth, flowering and seed setting in *Begonia* x *tuberhybrida* Voss and *Primula obconica* Hanle. MSc thesis, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India.

Schekel KA and Blau S 1987. Influence of paclobutrazol and gibberellic acid on flowering of geranium. (Abstr). HortScience **22:** 1155.

Sullhan B 2000. Effect of paclobutrazol and *Azotobacter* on presentability of potted geraniums (*Pelargonium* x *hortorum* LH Bailey). MSc thesis, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India.

Tayama HK and Carver SA 1990. Zonal geranium growth and flowering responses to six growth regulators. HortScience **25(1):** 82-83.

Trellinger K 1997. Top ten tips for perfect ivy geraniums. Grower Talks **61(8):** 73-75.

Wang YT and Gregg LL 1994. Chemical regulators affect growth, post production performance and propagation of golden pothos. HortScience **29(3):** 183-185.

Wilkinson RI and Richards D 1991. Influence of paclobutrazol on growth and flowering of rhododendron Sir Robert Peel. HortScience **26(3):** 282-284.

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