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Influence of Brassinosteroids on Rooting and Growth of Geranium (*Pelargonium* sp.) Stem Cuttings

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Abstract: Effect of 24-epibrassinolide and 28-homobrassinolide on rooting, root growth and shoot growth of geranium (*Pelargonium* sp.) bourbon type were studied. Both the brassinosteroids increased root formation on stem cuttings. Brassinosteroid application also resulted in substantial improvement in root growth. The brassinosteroid treated cuttings growth was increased over untreated cuttings.

Key words: Brassinosteroids, geranium, growth, rooting, stem cutting

INTRODUCTION

Rose scented geranium (*Pelargonium graveolens* L.), an important aromatic plant, is the source for the highly valued geraniol and citronellol. Geranium is a native of South Africa, successfully introduced and acclimatized in India. As there is no seed setting in geranium, vegetative propagation is the only method for its cultivation. The ability of auxins to induce the rhizogenesis is well known, a positive correlation has been reported between endogenous levels of auxin in the cuttings and the number of root primordia formed per cutting (Alvarez *et al*., 1989; Weiget *et al*., 1984). The ability of polyamines in the induction of adventitious root formation was elucidated recently (Couee *et al*., 2004).

Brassinosteroids are now considered as the sixth group of phytohormones in plant kingdom (Clouse and Sasse, 1998; Rao *et al*., 2002). Sasse (1997) considered brassinosteroids as plant growth regulators with pleiotropic effects as they influence diverse developmental events such as growth, germination, flowering, abscission and senescence. Brassinosteroids also confer resistance to plants against biotic and abiotic stresses (Khripach *et al*., 1999; Costle *et al*., 2003). In the present study, the effect of brassinosteroids on rooting of stem cuttings and root growth in geranium has been investigated. In addition, growth of geranium plants obtained from stem cuttings treated with brassinosteroids has also been studied.

MATERIALS AND METHODS

Chemicals: Two bioactive brassinosteroids, viz., 24-epibrassinolide and 28-homobrassinolide were purchased from M/s CID tech Research Inc, Mississauga, Ontario, Canada.

Plant material: Geranium (*Pelargonium* sp.) Bourbon type plant cuttings were obtained from Central Institute of Medicinal and Aromatic Plants (CIMAP), Resource Centre, Boduppal, Hyderabad. The plants were maintained in the Botanical Garden of the Department of Botany at Osmania University, Hyderabad, India. The experiments were conducted twice between August 2004 to February 2005.

Treatments: Healthy plant cuttings measuring a length of 12 cm and having three small leaves were selected. Two centimeter of basal part was dipped for 5 min in brassinosteroid solution of 50 or 100 µM concentration. Plant cuttings dipped in distilled water were used as controls. The treated plant cuttings were transplanted to nursery covers filled with the garden soil. Sufficient number of replicates were maintained so as to terminate the experiments periodically for recording different parameters. The nursery covers were placed in glass-house and watered regularly.

Rooting: For recording the rooting, nursery covers were flooded with water and then the covers were cut with scissors and the plants were gently separated from the soil without causing any damage to the root system. The number of roots formed per cutting was recorded on 15th and 25th day of treatment. Further counts could not be possible due to web like growth of root system.

Root growth: Fresh weight of the root per plant was recorded on 25th and 45th day. The roots were dried

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separately in an oven at 70°C for 48 h and then the dry weight was recorded.

Shoot growth: The shoot growth of the plant was recorded on 45th day in terms of fresh weight, dry weight of the shoots, number of leaves and total fresh weight of leaves per plant.

Statistical analysis: The data obtained was subjected to student t-test for significance.

RESULTS AND DISCUSSION

Treatment of geranium stem cuttings with brassinosteroids significantly increased the number of roots on 15th and 25th day after application (Table 1). Among the two brassinosteroids employed in the study, the impact of 28-homobrassinolide was found marginally more than 24-epibrassinolide. There are contrasting reports about the impact of applied brassinosteroids in the rhizogenesis. While Guan and Roddick (1988a, b) reported inhibition of adventitious root formation in mung bean hypocotyls by brassinosteroids, stimulation of adventitious root formation in soybean hypocotyls by epibrassinolide was observed by Sathiyamoorthy and Nakamura (1990). Ronsch *et al.* (1993) obtained enhanced root formation on the stem cuttings of Norway spruce (*Picea abies*) by the application of homobrassinolide. The result of the present study clearly indicates the ability of brassinosteroids to trigger the intrinsic rhizogenetic capability in geranium cuttings. The ability of brassinosteroids to initiate roots on stem cuttings can be profitably employed for vegetative propagation of geranium, one of the most valued aromatic plant.

Table 1: Effect of brassinosteroids on the rooting of stem cutting of geranium

	No. of roots per cutting	
Treatments	15th day	25th day
Control	2.0±0.35	11.0±1.17
24-epibrassinolide 50 μM	3.8±0.65	15.8±1.29
24-epibrassinolide 100 μM	5.6±0.44	23.8±1.34
28-homobrassinolide 50 μM	4.0±0.61	16.4±0.57
28-homobrassinolide 100 μM	5.8±0.41	24.2±0.96

The data presented are the mean±SE (n = 5), p<0.05

The two brassinosteroids employed in the study were not only stimulated root formation but also improved root growth (Table 2). Significant increase in fresh weight and dry weight of roots were observed in plants obtained from brassinosteroid treated stem cuttings. Among all the treatments 28-homobrassinolide at 100 μM was found most effective in promoting root growth. Sasse (1994) observed enhanced root mass in case of transplanted seedlings of *Pinus radiata* due to root soak in 24-epibrassinolide.

Increase in adventitious root formation in geranium stem cuttings by the treatment with 24-epibrassinolide and 28-homobrassinolide was further translated into improved growth of the plants as reflected in enhancement in fresh weight and dry weight of the shoot system (Table 3). The economic yield of the plant as measured in terms of leaf biomass was also found increased in case of plants obtained from brassinosteroid treated stem cuttings (Table 4). In case of foliage growth also 28-homobrassinolide was found more effective to 24-epibrassinolide. Brassinolide induced exaggerated growth in hydrophonically grown *Arabidopsis thaliana* was reported by Arteca and Arteca (2001).

Table 2: Effect of brassinosteroids on the root growth of geranium

	25-day-old plant		45-day-old plant	
Treatments	Fresh weight of roots (mg)	Dry weight of roots (mg)	Fresh weight of roots (mg)	Dry weight of roots (mg)
Control	123.6±3.6	36.6±2.1	846±36	116.6±7.7
24-epibrassinolide 50 μM	178.0±6.3	57.6±3.7	1012±43	141.8±40
24-epibrassinolide 100 μM	200.6±4.0	71.0±3.0	1228±61	163.8±4.2
28-homobrassinolide 50 μM	189.0±4.5	62.8±2.9	1032±35	143.6±9.2
28-homobrassinolide 100 μM	225.8±4.0	73.8±2.0	1280±86	178.2±4.4

The data presented are the mean±SE (n = 5), p<0.05

Table 3 : Effect of brassinosteroids on the shoot growth of geranium

	25-day-old plant		45-day-old plant	
Treatments	Fresh weight of shoot (g)	Dry weight of shoot (g)	Fresh weight of shoot (g)	Dry weight of shoot (g)
Control	3.4±0.3	632±15	8.72±0.55	1.4±0.02
24-epibrassinolide 50 μM	4.6±0.2	718±17	11.72±0.25	1.9±0.02
24-epibrassinolide 100 μM	5.2±0.3	760±14	13.71±0.20	2.4±0.04
28-homobrassinolide 50 μM	4.7±0.3	734±16	11.97±0.34	2.0±0.03
28-homobrassinolide 100 μM	5.7±0.2	794±11	14.62±0.23	2.5±0.16

The data presented are the mean±SE (n = 5), p<0.05

Table 4: Effect of brassinosteroids on the leaf growth of geranium

	45-day-old plant			
Treatments	No. of leaves/plant	Area of the leaves/plant	Fresh weight of leaves/plant (g)	Dry weight of leaves/plant (g)
Control	10±0.8	56.41±0.2	4.32±0.17	0.706±0.1
24-epibrassinolide 50 μM	13±0.6	68.81±0.7	7.04±0.22	0.917±0.2
24-epibrassinolide 100 μM	15±0.8	79.34±0.1	8.70±0.30	1.300±0.1
28-homobrassinolide 50 μM	14±0.8	71.51±0.8	7.16±0.26	1.100±0.2
28-homobrassinolide 100 μM	16±0.4	85.93±0.5	9.47±0.11	1.600±0.1

The data presented are the mean ±SE (n = 5), $p<0.05$

The ability of brassinosteroids to improve the yield of cereals, vegetable crops, oil seed crops and fruit crops is well established (Antonio *et al*., 2002; Sasse *et al*., 1999). A great role of brassinosteroids in 21st century agriculture is envisaged (Hayat *et al*., 2003; Khripach *et al*., 2000). The present study clearly demonstrated the usefulness of brassinosteroids in the vegetative propagation of the geranium plants. Earlier Youssef and Talaat (1998) also reported increase in the growth and essential oil production in lavender by brassinosteroids. The present study demonstrated the usefulness of brassinosteroids in improving the growth of geranium a highly valued aromatic plant.

The results of the study with geranium and the earlier observation of Youssef and Talaat (1998) with lavender clearly indicates the usefulness of brassinosteroids in improving performance of aromatic plants by the exogenous application of brassinosteroids. Further research is in progress to unravel the impact of this new growth of plant growth regulators in the essential oil production of geranium

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