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Standardization of planting time for optimum growth and oil production of geranium (*Pelargonium graveolens* L. Her.) under north Indian plains

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Abstract

The effect of different planting dates on survival, growth, yield and oil characteristics of geranium (*Pelargonium graveolens* L. Her.) was studied at Lucknow (Uttar Pradesh). Fresh terminal stem cuttings were planted on different dates starting from 31 October 2002 to March 2003 at 15 days interval. Cuttings planted in mid December recorded significantly higher survival (93.5%), fresh biomass (539.7 q ha^{-1}) and essential oil yield (54.9 kg ha^{-1}) than earlier or later planted cuttings.

Keywords: geranium, herbage yield, oil yield, *Pelargonium graveolens*, time of planting.

Rose geranium (*Pelargonium graveolens* L. Her.), a perennial herb, is exploited for the production of essential oil, that finds extensive use in flavour and fragrance industries. Geranium is propagated through rooted cuttings by planting fresh cuttings in nursery beds. However, under favourable growing conditions, geranium can also be planted using fresh terminal stem cuttings (Guenther 1965). The present study was conducted with a view to find out the optimum time of planting for geranium through fresh terminal stem cuttings in the north Indian plains.

The field trial was conducted in a plot size of 2.40 m x 2.25 m, in a randomized block design with three replications at the research farm of Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow (25.5° N, 80.5° E 120 m altitude) during 2002–03. The fresh terminal cuttings were planted on nine different dates starting from 31 October 2002 to 1 March 2003 at 15 days' interval. The soil of experimental plot was sandy loam with pH 7.8, low in available N, medium in available P and available K. Fresh terminal stem cuttings 15 cm long, having 3–5 nodes were planted at about 6 cm depth in flat beds at a spacing of 60 cm x 45 cm and irrigated immediately after planting. A basal dose of 20 kg N, 50 kg P_2O_5 and 60 kg K_2O (ha^{-1}) was given before planting. Nitrogen @ 80 kg ha^{-1} was given as top dressing in two equal splits at 60 and 90 days after planting (Ram *et al*. 2003).

Observations on plant survival, plant height, leaf to stem ratio, dry matter content and oil content in fresh herb were recorded at the time of harvest. The oil yield was calculated by multiplying herb yield with per cent oil content of respective treatment and the

approximate specific gravity of geranium oil ie., 0.9. The crop planted on 31 October and 15 November 2002 was harvested on 23 May and 28 May 2003 respectively, whereas 30 November and 15 December 2002 planted crop was harvested on 4 June 2003; the cuttings planted after 15 December 2002 was harvested on 24 June 2003.

The essential oil content (% volume/weight) in freshly harvested biomass was determined by hydro distillation using a Clevenger-type apparatus. Oil samples were subjected to GC analysis on Perkin-Elmer GC, model AUTO XL, fitted with PE-5 capillary column (50 m x 0.32 mm) with nitrogen inlet pressure of 10 psi and temperature program of 100–220°C, respectively. The data were processed on total Chrom Navigator without the use of correction factors. The identification of peaks was based on the GC/MS anlysis on Perkin-Elmer Turbo system under the same conditions with helium at 10 psi as carrier. Wiley and NIST libraries were used for component identification.

The highest survival (93.3%) was recorded in cuttings planted on 15 December 2002. The survival of cuttings planted before and after this date decreased significantly; the lowest (30%) survival was recorded in cuttings planted on 1 March 2003 (Table 1). The cuttings planted on 30 November 2002 produced the tallest plants, while 15 December 2002 planted cuttings produced highest number of primary branches. Leaf to stem ratio in 30 November and 15 December 2002 planted cuttings was lowest (1.7). Leaf to stem ratio had a direct relationship with plant growth parameters namely, height and number of primary branches and herb production.

The cuttings planted on 15 December 2002 produced highest green herb (539.7q ha^{-1}) and oil (54.9 kg ha^{-1}) followed by 30 and 15 November 2002 plantings (Table 2). The essential oil yields declined abruptly in 15 February 2003 (11.5 kg ha^{-1} oil) and 1 March 2003 (10.5 kg ha^{-1} oil) plantings. Since day temperature regimes of 25°C–30° C are the most favourable for the optimum growth of geranium plants (Misra *et al*. 2000), the crop planted on 15 December 2002 exhibited better survival and yield of herb and oil as it was exposed to most optimal growing temperature. Cuttings planted on 15 December 2002 were also exposed to a comparatively low temperature for several weeks during which there could have been more of root development than the shoot (Farrav & William 1991; Sangwan *et al*. 2003). As such, when the plants were exposed to

Table 1. Effect of planting dates on the survival percentage and plant characteristics of geranium

Planting dates	Survival (%)	Height (cm)	Primary branches $plant^{-1}$	Leaf to stem ratio *
31 Oct 2002	45.0	76.7	6.0	2.1
15 Nov 2002	62.5	68.0	10.5	2.3
30 Nov 2002	67.5	89.0	7.8	1.7
15 Dec 2002	93.3	78.0	11.0	1.7
30 Dec 2002	55.0	47.0	6.0	2.7
15 Jan 2003	65.0	38.7	7.0	2.5
30 Jan 2003	57.5	59.0	8.5	2.5
15 Feb 2003	45.0	44.0	6.0	2.8
1 Mar 2003	30.0	55.3	5.8	2.6
CD (P= 0.05)	2.4	13.8	3.1	0.4

*Fresh weight basis

Table 2. Effect of planting dates on fresh herb yield and oil content of geranium

Planting dates	Fresh herb yield (q ha^{-1})	Oil content (% v/w)*	Oil yield (kg ha^{-1})
31 Oct 2002	205.8	0.20	37.0
15 Nov 2002	259.2	0.19	44.3
30 Nov 2002	284.2	0.18	45.0
15 Dec 2002	539.7	0.11	54.9
30 Dec 2002	252.7	0.16	36.8
15 Jan 2003	196.9	0.20	36.0
30 Jan 2003	254.6	0.21	48.1
15 Feb 2003	59.2	0.22	11.5
1 Mar 2003	63.8	0.18	10.5
CD (P=0.05)	43.6	0.03	7.5

*Fresh weight basis

optimum growing conditions, a well developed root system could provide the desired quantity of nutrients and water required for a fast vegetative growth. The cuttings planted on later dates though exposed to favourable growing conditions, in the absence of a well developed root system, failed to fully utilize the most conducive environmental conditions available for growth.

The oil content in fresh herb was the lowest (0.11% v/w) in 5 December 2002 planted crop, whereas, it was in the range of 0.20% to 0.22% in the crop planted on 21 October 2002, 15 and 30 January 2003 and 15 February 2003. With better plant growth and herb production, the leaf : stem ratio of the 15 December 2002 planted crop was significantly lower than that of the remaining dates which resulted in a lower oil content because maximum oil in geranium plants is present in the leaves (Rao *et al*. 1997). With increase in plant growth and herb production, decrease in leaf to stem ratio and oil contents have also been reported in *Mentha arvensis* (Singh *et al*. 1998).

The major chemical constituents and their contents in oil (Table 3) were similar to those reported from geranium grown in north Indian plains (Jain *et al*. 2001). Date of planting had no major influence on chemical constituents and their content in the oil. These results confirm the earlier report (Ram *et al*. 1997) where no major variation in quality of geranium oil could be noted due to variation in time of planting.

The study indicated that planting of fresh terminal stem cuttings of geranium in the middle of December is optimum for higher survival and maximum essential oil production under the agro-climatic condition of north Indian plains.

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Table 3. Effect of planting dates on the qualitative characteristics (%) of geranium oil

Chemical constituent	Date of planting								
	31 Oct 2002	15 Nov 2002	30 Nov 2002	15 Dec 2002	30 Dec 2002	15 Jan 2003	30 Jan 2003	15 Feb 2003	1 Mar 2003
Isomenthone	7.6	8.0	8.6	8.0	6.3	7.9	7.7	7.2	7.3
Linalool	3.8	3.6	3.4	3.3	3.3	3.5	6.4	4.6	3.9
Citronellyl formate	6.2	5.8	7.4	6.3	5.1	6.1	5.8	5.3	5.9
Citral b	3.9	0.5	0.2	0.4	0.5	0.5	0.6	0.6	0.6
Citronellyl acetate	0.3	0.9	2.1	1.1	0.4	1.4	0.1	1.2	1.2
Geranyl acetate	0.6	0.2	0.2	0.3	0.2	0.2	0.1	0.2	0.2
Geranyl formate	2.0	2.4	1.4	2.0	2.1	2.5	1.8	2.3	2.5
Citronellol	39.2	42.2	43.8	40.8	30.5	35.1	27.3	37.7	38.3
Nerol	1.1	0.5	0.5	0.6	0.6	0.6	0.5	0.5	0.6
Geraniol	16.3	14.6	14.8	17.0	16.2	18.7	19.4	21.3	19.9
10–epi–γ–Eudesmol	3.8	4.7	4.8	3.9	6.0	4.9	5.2	5.2	5.5
Phenylethyl tiglate	0.7	1.2	1.1	0.8	1.1	0.7	0.4	0.7	0.8

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