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Standardization of growing substrates and NPK doses for growth and flowering of alstroemeria (*Alstroemeria hybrida* L.)

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ABSTRACT : Investigations were carried out during 2010 to standardize growing substrates and NPK doses for growth and flowering of alstroemeria. In this experiment different growing substrates and NPK doses combinations were tested. A field experiment was laid under poly house conditions in split plot design, consisted of four growing substrates *viz.*, sand: soil: FYM (1:1:1, v/v), rhododendron forest soil (*Rhododendron arboreum* L.), rai forest soil (*Picea smithiana* L.) and five NPK doses *viz.*, basal dose of 30: 15: 30 g/m^2, once a week fertigation with 100: 50: 100 ppm, twice a week fertigation with 100: 50: 100ppm, once a week fertigation with 150: 100: 150 ppm, twice a week fertigation with 150: 100: 150 ppm. Growing substrate consisting of rhododendron forest soil was found to be best growing substrate for vegetative and flowering parameters like stem length, stem thickness, early flowering, number of flowers per cyme, vase life and cut stems per plant. Whereas twice a week fertigation with 150: 100: 150 ppm NPK found best dose for stem length, stem thickness, early flowering, number of flowers per stem, vase life and cut stems per plant.

KEY WORDS : Alstroemeria, Growing substrate, NPK doses, Growing media, NPK doses

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Alstroemeria (*Alstroemeria hybrida* L.) is a recent introduction into the world's floriculture scene and has become a major cut flower. The genus is a rhizomatous monocot and belongs to family Alstroemeriaceae. The popularity of this flower is still growing in the global perspective. With the development of new hybrids, Alstroemeria has attained the status of one of the ten most important cut flowers in the world. Alstroemeria rhizomes should be planted in loose, well drained medium for cut and pot plant production, some substrates such as peat, perlite and vermiculite have successfully been used by various researchers and growers to raise alstroemeria crop. But they are not available to common grower, if available, are very expensive. Commonly used growing medium containing sand, soil and FYM is too heavy for this crop, having fleshy and sensitive fibrous root. Therefore, need was felt to find out standardize locally available, cheep, good quality growing substrate for succesful production of alstroemeria. Applications of NPK increase the production and quality of alstroemeria. The standradization of NPK dose and application technique will give impetus to the production of quality cut alstroemeria for domestic as well as foreign markets. The present investigations were, therefore, undertaken to standardize the growing substrate and NPK doses under mid hill condition of Himachal Pradesh.

RESEARCH METHODS

Rhizomes of 3-4 cm with 4-5 storage roots having numerous fibrous roots attached to each fleshy storage root and 2-3 shoots with average height of 15 cm. The experiment

was conducted in Split Plot Design with 3 replications and 20 treatment combinations. There were four growing substrates *viz.*, sand: soil: FYM (1: 1: 1, v/v), rhododendron forest soil (*Rhododendron arboreum* L.), rai forest soil (*Picea smithiana* L.), cocopeat and five NPK doses *viz.*, basal dose of 30: 15: 30 g/m^2, once a week fertigation with 100: 50: 100ppm, twice a week fertigation with 100: 50: 100, once a week fertigation with 150: 100:150 ppm and twice a week fertigation with 150: 100: 100. Planting in 1x1m raised bed (prepared with stone tiles so that we can reduce the mixing of other substrates and for reducing error) with 4 plants in one bed was planted in 2nd week of November 2010. Application of NPK was done with SSP, MOP and urea as basal dose and 19: 19: 19, urea and MOP for fertigation. One bed was fertigated with 20 litre of solution in water. Thin, week and extra shoots (vegetative shoots) were removed continuously by pulling. Staking with staking net were done and other cultural practices like weeding and hoeing was done during period of production.

RESEARCH FINDINGS AND DISCUSSION

The perusal of data presented in Table 1 indicates that there was significant effect of growing substrate and NPK doses on stem length. Among various substrates used T_3 consisting of rhododendron forest soil, resulted in maximum stem length (99.73cm). As regards the effect of NPK doses, the maximum stem length (105.70cm) was obtained with the application of NPK @150:100:150 ppm twice a week through fertigation and found to be significantly higher than all other doses. The interaction between growing substrate and NPK doses was found to be significant. Among the various interactions T_3F_5 *i.e.* when plants were grown in rhododendron forest soil and fertigated with 150:100:150 ppm NPK, obtained maximum stem length (112.30 cm).The effect of growing substrate on stem thickness was non significant (Table 1), but it was recorded maximum in cocopeat. Maximum stem thickness (7.52 mm) was recorded in F_5 NPK dose *i.e.* fertigation of 150: 100: 150 ppm NPK twice a week. Interaction T_3F_5 *i.e.* when plants were grown in rhododendron forest soil and fertigated twice a week with 150: 100: 150 ppm NPK registered maximum stem thickness (7.81mm). Among various substrates used, T_3, consisting of rhododendron forest soil, resulted in early flowering (149.90 days).As regards the effect of NPK doses, early flowering (145.60 days) was recorded in F_5 *i.e.* twice a week fertigation of 150: 100: 150 ppm NPK . Interaction, T_3F_5 *i.e.* when plans were grown in rhododendron forest soil and fertigated twice a week with 150: 100: 150 ppm NPK registered early flowering (139.40 days).

In Table 2, as regards the effect of NPK doses maximum number of flowers per stem (16.58) was recorded in rododendron forest soil. Maximum number of flowers per stem (17.73) was obtained with twice a week fertigation with 150:100: 150 ppm NPK. Interaction, T_3F_5, was recorded maximum number of flowers per stem (18.92) in rai forest soil, when fertigated twice a week with 150: 100: 150 ppm NPK.

The vase life of Alstroemeria was recorded maximum (19.20 days) in rhododendron forest soil (Table 2). Among the all doses of NPK, F_5 dose *i.e.* twice a week fertigation with 150: 100: 150 ppm NPK registered maximum vase life (15.08 days). Interaction, T_3F_5 *i.e.* when plants were grown in rodendron forest soil and fertigated twice a week with 150: 100: 150 ppm NPK recorded maximum vase life (16.33 days). Yield per plant was registered maximum (30.53 cut stems) in rhododendron forest soil. F_5 *i.e.* when plants were

Table 1 : Effect of growing substrate and NPK doses on stem length, stem thickness and days taken to flowering of Alstroemeria

Growing substrates / NPK doses	Stem length (cm)					Stem thickness (mm)					Days to 1st flowring (days)				
	T_1	T_2	T_3	T_4	Mean	T_1	T_2	T_3	T_4	Mean	T_1	T_2	T_3	T_4	Mean
F_1	79.99	87.52	91.43	86.47	86.35	5.12	6.43	6.00	6.37	5.98	166.20	161.50	158.70	160.30	161.70
F_2	82.79	90.41	89.93	90.54	88.42	6.08	5.63	6.57	7.35	6.41	163.90	157.00	156.80	157.70	158.90
F_3	84.50	97.66	96.37	93.50	93.01	5.44	7.88	6.33	6.47	6.53	160.30	155.30	150.30	153.40	154.90
F_4	91.54	104.90	108.60	100.00	101.30	6.39	6.98	6.89	6.91	6.79	157.90	150.20	144.00	150.20	150.60
F_5	99.24	108.40	112.30	102.70	105.70	7.06	7.63	7.81	7.57	7.52	150.60	145.80	139.40	146.70	145.60
Mean	87.61	97.78	99.73	94.64		6.02	6.91	6.72	6.93		159.80	154.00	149.90	153.70	

Growing substrate	=	5.05	NS	2.86
NPK doses	=	2.70	0.62	1.63
Growing substrate x NPK doses	=	5.39	1.24	3.25

Growing substrates
T_1 = Sand : Soil : FYM (1:1:1, v/v)
T_2 = Rai Forest soil
T_3 = Rhododendron Forest soil
T_4 = Cocopeat

NPK doses
F_1 = N : P : K :- 30 : 15 :30 g/m^2 (as control)
F_2 = N : P : K :-100 : 50 : 100 ppm once a week
F_3 = N : P : K :-100 : 50 : 100 ppm twice a week
F_4 = N : P : K :-150 : 100 : 150 ppm once a week
F_5 = N : P : K :-150 : 100 : 150 ppm twice a wee

fertigated twice a week with 150: 100: 150 ppm NPK, produce significantly higher yield per plant (31.12 cut stems) than all other doses of NPK. Among the various interactions, T_3F_5 *i.e.* when plants were grown in rhododendron forest soil and fertigated twice a week with 150:100:150 NPK produce maximum yield per plant (37.17 cut stems) and found to be significantly higher than all interactions.

The findings obtained have indicated that substrates and NPK doses had a definitive role to play in the overall growth, flowering, vase life and yield of alstroemeria. For majority of growth and flowering parameters, a substrate consisting of rhododendron forest soil and in NPK doses, twice a week fertigation with 150: 100: 150 ppm NPK and interaction, when plants grown in rhododendron forest soil and fertigated twice a week with 150:100:150 ppm NPK were the best for alstroemeria production.

The findings obtained have indicated that substrates have a definitive role to play in the overall growth and development of alstroemeria plants. For majority of growth and flowering parameters, a substrate consisting of rhododendron forest soil was the best growing substrate for alstroemeria production. This could be atteributed to some of the substrate physico- chemical properties like optimum pH, high nutrent content, EC, high organic matter of this substrate as compared to other growing substrate (Table 3), the findings to increased stem length, stem thickness in nutritive substrate were in tune with Bond and Alderson (1993); Lisiecka and Szuozepaniak (1992), who obtained similar results in nutritive peat based substrate. Where as in case of NPK doses, the maximum dose with short duration *i.e.* twice a week fertigation of 150: 100: 150 ppm NPK increased the stem length and stem thickness increased with the increase in dose of nitrogen. This might be due to fact that nitrogen increased the vegetative growth and nitrogen is highly mobile in plant. Due to this the higher doses with short interval increased the nitrogen use efficiency. As compared to basal dose firtigation improved nitrogen use efficiency and it decreased the leaching loss. Similar findings have been reported by Singh *et al.* (2003) who observed similar results in geranium.

In case of flowering parameters, maximum number flowers per plant, early flowering and maximum yield per plant was recorded in rhododendron forest soil. Which may be ascribed the fact that plants grown in above mentioned growing substrate was provided congenial phesico- chemical and biological properties as a result of what plant took, maximum number of flowers per plant took, minimum time to flowering and maximum number of yield per plant. Similar findings have been reported in alstroemeria by Wajir *et al.* (2009) and Anuje (2004) in gerbera. However, in case of NPK doses higher dose *i.e.* twice a week fertigation with 150: 100: 150 ppm NPK resulted best effect on maximum

Table 2 : Effect of growing substrate and NPK doses on number of flowers per stem, vase life and yield per plant of Alstroemeria

Growing substrates / NPK doses	Number of flowers per stem					Vase life (days)					Yield per plant (cut stem)				
	T_1	T_2	T_3	T_4	Mean	T_1	T_2	T_3	T_4	Mean	T_1	T_2	T_3	T_4	Mean
F_1	9.67	12.92	14.92	13.33	12.71	10.33	12.33	12.33	13.00	12.00	18.83	21.92	25.08	23.58	22.35
F_2	11.17	14.25	16.25	14.75	14.10	11.00	13.00	12.67	13.00	12.42	20.33	23.58	28.75	24.42	24.27
F_3	11.92	16.50	16.75	14.58	14.94	12.67	12.67	13.00	14.00	13.08	22.75	26.00	29.50	25.42	25.92
F_4	14.33	16.83	16.83	16.17	16.04	13.67	14.67	13.33	13.33	13.75	25.67	31.00	32.17	28.83	29.42
F_5	16.42	18.92	18.17	17.42	17.73	13.33	16.00	16.33	14.67	15.08	24.00	33.75	37.17	29.58	31.12
Mean	12.70	15.88	16.58	15.88		12.20	13.53	13.60	13.73		22.32	27.25	30.53	26.37	

Growing substrate	=	2.84	0.66	1.50
NPK doses	=	1.37	0.91	1.54
Growing substrate x NPK doses	=	2.74	1.81	3.07

Growing substrates
T_1 = Sand : Soil : FYM (1:1:1, v/v)
T_2 = Rai Forest soil
T_3 = Rhododendron Forest soil
T_4 = Cocopeat

NPK doses
F_1 = N : P : K :- 30 : 15 :30 g/m^2 (as control)
F_2 = N : P : K :-100 : 50 : 100 ppm once a week
F_3 = N : P : K :-100 : 50 : 100 ppm twice a week
F_4 = N : P : K :-150 : 100 : 150 ppm once a week

Table 3 : Physico-chemical properties of various growing substrates

Growing Media	Major elements (Available nutrient)			pH	EC	OC
	N (%)	P (%)	K (%)	1:2.5	(ds/m)	(%)
T_1= Soil : FYM : Sand (1:1:1, v/v)	0.02	0.03	0.12	7.2	0.24	1.20
T_2= Rai (*Picea smithiana* L.) forest soil	0.03	0.07	0.62	6.0	1.24	4.10
T_3= = Rhododendron (*Rhododendron arboreum* L.) forest soil	0.05	0.08	0.40	6.3	1.74	5.17
T_4= Cocopeat	0.02	0.15	0.61	6.3	1.96	4.25

number of flower per stem, early flowering and maximum yield per plant. Which might be due to the application of higher potassium with sort duration, potassium in higher in plant improves the transportation of water and nutrients throughout the plant in xylem. It also increase the root growth. Due to this plants were healthy and produce higher number of flowers per stem, early flowering and maximum yield per plant. A similar result was reported in alstroemeria by wazir *et al*. (2009).

Vase life of alstroemeria also registered maximum in rhododendron forest soil. As it is well documented that K generally acts as protected element and known to reduce the rate of flower senescence. The potassium is believed to increase resistance of plant and flowers to the adverse condition and provide mechanical strength to the flower patels and tissue stems, so it helps in increase vase life. So in case of rhododendron forest soil, stems taken from that substrate recorded maximum vase life because that substrate have maximum amount of K contents (Dubby, 2010). In case of NPK doses higher dose with short interval with higher dose of P, provide maximum P to plant. The phosphorus is believed to participated in skeleton of plasma membrane nucleic acid as well as co-enzymes and subsequently lower down the respiratory activities and degree of dehydration. Thus increase the vase life.

Based upon the present findings, it can be concluded that optimum growth, flowering, yield and flowering of alstroemeria, a combination with rai forest soil and twice a week fertigation with 150:100:150 ppm NPK is best for all the parameters.

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