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Standardization of Growing Medium for Growth and Flowering of Alstroemeria cv. 'Capri' under Solan-Nauni Conditions

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ABSTRACT

The present investigation was carried out for two consecutive years viz., 2014-2015 and 2015-2016 at Experimental farm, Department of Floriculture and Landscape Architecture, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India to standardize growing medium for growth and flowering of Alstroemeria cv. 'Capri'. The experiment was laid under protected condition in a completely randomized design, comprising of nine treatments with three replications each. The treatments consisted of growing media in nine different combinations i.e.; Sand+Soil+FYM (1:1:1; v/v), Sand+Soil+FYM (2:1:1; v/v), Sand+Soil+FYM (1:1:2; v/v), Sand+Soil+FYM (2:1:2; v/v), Cocopeat+FYM (1:1; v/v), Cocopeat+Soil+FYM (1:1:1; v/v), Sand+Soil+FYM (1:1:1; v/v)+Cocopeat (1:1; v/v), Sand+Soil+FYM (1:1:1; v/v)+Vermicompost (2:1; v/v) and Sand+Soil+FYM (1:1:1; v/v)+Vermicompost+Cocopeat (2:1:1; v/v). According to pooled data of these two consecutive years, growing medium consisting of Sand+Soil+FYM (1:1:1; v/v)+Vermicompost+Cocopeat (2:1:1; v/v) i.e., T_9 was observed to be the best substrate for maximum plant height (123.54 cm), length of cut stem (103.83 cm), weight of cut stem (61.80 g), advanced flowering (161.83 days) and greater number of flowering stems plant^{-1} (34.80). Treatment T_9 (vase life of 12.50 days) was also one of the most effective treatment with extended vase life as it also encouraged the growth and development of flowers. Thus, it can be concluded from the findings that treatment T_9 was most effective in improving growth and flowering attributes of Alstroemeria cv. 'Capri'.

KEYWORDS: Alstroemeria, capri, cocopeat, flowering, growing media, vermicompost

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1. INTRODUCTION

Alstroemeria (*Alstroemeria hybrida* L.), commonly known as Peruvian or Inca lily, is an exotic, rhizomatous (Puntieri et al., 2014) and perennial cut flower crop mostly cultivated under protection in India (Singh, 2006). It has chromosome number of 2n=2x=16 (Baeza et al., 2016, Baeza et al., 2020, Jara-Seguel et al., 2021). Alstroemeria species are native to South America (Chile and eastern Brazil; being two distinct centres of diversity) and belongs to family Alstroemeriaceae (Aagesen and Sanso, 2003, Aker and Healy, 1990, Bayer, 1987, Chacon et al., 2012, Meerow et al., 1999, Sanso et al., 2005). It was named by Linnaeus (Sanso and Xifreda, 2001) after Klas van Alstromer who collected seeds of this flower from Spain in 1753 which, in fact, came from Chile and Brazil in South America (Talukdar, 2006). Later he introduced this plant in Europe. It belongs to one of the quickest growing flowers and is available in various colours (Aros et al., 2015). Alstroemeria species and hybrids have gained world-wide importance as cut flower crop due to its attractive flowers and the excellent keeping quality (Aros and Rogers, 2013, Sanso et al., 2005). It is an important cut flower in Europe and is popularly used in bouquets and flower arrangements. The extended vase life up to 10-13 days (Chanasut et al., 2003; Kabari and Solimandarabi, 2019; Naghiloo et al., 2020) at room temperature makes this flower a prominent item in the international floral trade. According to the economic value and trends of the world's flower market, the research value of Alstroemeria is considerable (Dhiman and Kashyap, 2021). It is commonly grown in the Netherlands, Colombia, Japan, USA, England, Kenya, Denmark and other countries. Based on the performance of Alstroemeria cultivars under polyhouse conditions, emphasis needs to be paid towards the introduction of several cultivars for cut flower production in hilly regions (Saha et al., 2014, Singh, 2006). In Himachal Pradesh, it showed encouraging results (Kashyap et al., 2018) at floriculture farms of Mahog Bagh (Chail) and Solan. For successful cultivation of Alstroemeria; growing medium should be loose, deep, rich in organic matter, lightly textured with an ability to retain sufficient moisture uniformly throughout, besides serving as a reservoir of essential plant nutrients as well as ensuring appropriate gaseous exchange (Bridgen, 2018).

The continuous demand for new and special products in the floricultural market encouraged the discovery and introduction of new genetic sources in areas that are less exploited (Bridgen et al., 2002). Commonly used growing medium containing Sand, Soil and FYM is too heavy for this crop having fleshy storage and sensitive fibrous roots. Some substrates viz. Peat, Perlite and Vermiculite have successfully been used by commercial growers and researchers such as Heins and Wilkins (1979) to raise this crop. Wazir et al. (2009) reported that under wet temperate conditions, growing media consisting of Soil+Cocopeat+Vermicompost+FYM+Sand in equal proportions by volume was the best substrate for various vegetative, flowering and pot presentability attributes of Alstroemeria cultivars viz., 'Pluto', 'Selection No-14' and 'Riana'. However, Singh et al. (2013) found that Rhododendron-forest soil proved its superiority over other substrates concerning most of the cut flower parameters in Alstroemeria cv. 'Capri'. But these media are not easily available to the common growers of Alstroemeria or if available, are very expensive. Therefore, the need was felt to find out and standardize locally available, economical and a good quality growing medium for successful production of Alstroemeria.

2. MATERIALS AND METHODS

The present investigation was carried out for two consecutive years viz., 2014–2015 and 2015–2016 at Experimental farm, Department of Floriculture and Landscape Architecture, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan which comes under Mid Hills (Sub Temperate) Horticulture Zone of Himachal Pradesh in the heart of the Western Himalayas. The university is located at an elevation of 1300 m above mean sea level having 30°86' N Latitude and 77°16' E Longitude. The experiment was conducted under naturally ventilated polyhouse condition in a completely randomized design, with nine different growing media treatments and each was replicated three times. The treatments consisted of growing media having nine different combinations viz., T_1 = Sand+Soil+FYM (1:1:1; v/v), T_2 = Sand+Soil+FYM (2:1:1; v/v), T_3 = Sand+Soil+FYM (1:1:2; v/v), T_4 = Sand+Soil+FYM (2:1:2; v/v), T_5 = Cocopeat+FYM (1:1; v/v), T_6 = Cocopeat+Soil+FYM (1:1:1; v/v), T_7 = Sand+Soil+FYM (1:1:1; v/v)+Cocopeat (1:1; v/v), T_8 = Sand+Soil+FYM (1:1:1; v/v)+Vermicompost (2:1; v/v) and T_9 = Sand+Soil+FYM (1:1:1; v/v)+Vermicompost+Cocopeat (2:1:1; v/v). Under polyhouse condition, 27 pits of 1m x 1m x 0.45 m size were dug. Before planting, pits were filled with the respective growing medium as per technical programme.

Alstroemeria is propagated vegetatively by rhizome division (Chiari and Bridgen, 2000). Rhizome divisions for planting of Alstroemeria cv. 'Capri' were procured from Department of Floriculture and Landscape Architecture, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan. The uniform size rhizome clusters having fleshy storage roots, numerous fibrous roots and 3-5 shoots (average height 15 cm) of Alstroemeria (*Alstroemeria hybrida*) cv. 'Capri' were used as planting material. They were planted on 4th October 2014 at a spacing of 50×50 cm^2 accommodating 4 plants $plot^{-1}$ having a size of 1 m x 1

m. After planting of rhizomes, beds were drenched with a fungicide to maintain good plant health. All the standard cultural practices were kept uniform for all the treatments to raise a successful crop which included irrigation, weeding, hoeing, wiring for support of plants, etc. Weak and blind shoots were thinned or removed by pulling the stems from rhizomes when the growth was judged excessive (Bakken, 2000; Puntieri et al., 2014). A sticky trap was placed at plant height near the centre of each plot to monitor the infestation of whiteflies and thrips (Johansen et al., 2018). In the end of August 2015, when flowering was over and stems became yellow, the plants were cut from the base to spur the crop for the successive year i.e., 2016. The pooled data on vegetative and flowering parameters was recorded and analyzed by simple statistical methods for data interpretation using the procedures suggested by Gomez and Gomez (1984).

3. RESULTS AND DISCUSSION

The growing media having nine different combinations exhibited wide variation for growth and flowering attributes of Alstroemeria cv. 'Capri'. A close look at the data revealed that growing media has a significant effect on plant height, length of cut stem and weight of cut stem during both the years. Pooled data pertaining to the effect of growing media on these growth parameters in Alstroemeria cv. 'Capri' has been presented in Table 1.

Table 1: Effect of growing media on plant height, length of cut stems, weight of cut stems, number of days taken to flowering, number of flowering stems plant^{-1} and vase life of Alstroemeria cv. 'Capri'

Growing media	Plant height (cm)	Length of cut stem (cm)	Weight of cut stem (cm)	No. of days taken to flowering	No. of flowering stems plant^{-1}	Vase life in distilled water (days)
T_1: Sand+soil+FYM (1:1:1; v/v)	118.10	94.43	52.15	169.67	30.11	12.00
T_2: Sand+soil+FYM (2:1:1; v/v)	117.08	93.38	50.07	176.67	21.41	13.50
T_3: Sand+soil+FYM (1:1:2; v/v)	117.95	98.14	52.33	174.50	24.32	13.77
T_4: Sand+soil+FYM (2:1:2; v/v)	113.53	90.18	46.57	179.67	19.82	12.87
T_5: Cocopeat+FYM (1:1; v/v)	123.45	100.21	48.58	172.83	24.82	10.83
T_6: Cocopeat+soil+FYM (1:1:1; v/v)	109.31	91.50	54.70	164.67	27.99	11.57
T_7: T_1+Cocopeat (1:1; v/v)	122.99	97.71	53.90	170.00	27.00	12.03
T_8: T_1+Vermicompost (2:1; v/v)	118.41	97.69	57.23	171.00	23.57	13.13
T_9: T_1+Vermicompost+Cocopeat (2:1:1; v/v)	123.54	103.83	61.80	161.83	34.80	12.50
CD (p=0.05)						
Growing media	5.46	3.37	2.87	1.68	4.09	0.90
Years	3.15	1.95	1.66	0.97	2.36	0.52
Year×Growing media	NS	NS	NS	2.37	NS	NS

It is evident from the pooled data that the maximum plant height (123.54 cm), length of cut stem (103.83 cm) and weight of cut stem (61.80 g) were recorded in growing medium consisting of T_1+Vermicompost+Cocopeat (2:1:1; v/v) i.e., T_9. Interaction, year x growing media were found to be non-significant for all these vegetative growth characters discussed above.

It is revealed from table 1 that plants grown in growing medium consisting of T_1+Vermicompost+Cocopeat (2:1:1; v/v) i.e., T_9 produced significantly advanced flowering (161.83 days) in pooled data. Interaction year x growing media was found to be significant. Among interaction, growing medium consisting of T_1+Vermicompost+Cocopeat (2:1:1; v/v) i.e., T_9 resulted in earliest flowering (155.00 days) during 2015–16 which was appeared to be at par with T_6 during the same year.

The same treatment i.e. T_9 resulted in the maximum number of flowering stems plant^{-1} (34.80) in pooled data. Also, the study revealed that the number of flowering stems plant^{-1} was more during the year 2015–16 than 2014–15. For the number of flowering stems plant^{-1}, interaction year x growing media was found to be non-significant.

The findings obtained have indicated that growing media have a definitive role to play in the production of desirable vegetative and flowering characters of Alstroemeria. The pooled analysis shows that maximum plant height, length of cut stem, weight of cut stem, advanced flowering and number of flowering stems plant^{-1} (Table

1) were obtained in the growing medium T_9 containing T_1+Vermicompost+Cocopeat (2:1:1; v/v). This can be attributed to the fact that this growing medium has better physico-chemical properties (Table 2), besides maintaining a requisite biological balance that could contribute to the better growth and development of plants in comparison to other growing media used. The better water holding capacity, aeration, low bulk density, nearly neutral pH and normal EC value, high organic carbon content, medium N and high P and K status of the media might have improved the ability to supply ample quantities of nutrients to plants in order to sustain the growth and development of a plant. Which further leads to more plant height, length of cut stem, weight of cut stem and early flowering of Alstroemeria. This contributed for production of more multi-stemmed rhizomes leading to the production of more flowering stems plant^{-1} in this media. Our results are in accordance with that of Wazir et al. (2009) who obtained similar results in Alstroemeria and in almost similar growing media containing sand, soil, farmyard manure, vermicompost and cocopeat under Mashobra conditions of H.P.

Greater plant height, length of cut stem and weight of cut stem were obtained in the year 2014-15 as compared to 2015-16. This might be due to the reason that in the first year the growing media have better nutrient content to support the plant, which resulted in more plant height, length and weight of cut stem. It was observed that earlier flowering and a greater number of flowering stems plant^{-1} were obtained in the year 2015-16 as compared to 2014-15. This is due to the reason that in the second year the plants had enough reserved food material in the rhizomes and storage roots, which might have resulted in earlier flowering and a greater number of flowering stems plant^{-1}. Our results were in consonance with that of Singh et al., (2013) who obtained earlier flowering in successive years as compared to the first-year crop of Alstroemeria cv. 'Capri'.

Pooled data pertaining to the effect of growing media on vase life in distilled water of Alstroemeria cv. 'Capri' in the year 2014–15 and 2015–16 has also been presented in Table 1. Growing medium consisting of Sand+Soil+FYM (1:1:2; v/v) i.e., T_3 was the most effective treatment for extending vase life in distilled water (13.77 days) in pooled

Table 2: Analysis report on soil samples of different growing media used under studies

Growing media	pH	EC	O.C.	Available macro nutrient (ppm)			Bulk Density
	(1:2)	(dS m^{-1})	(%)	N	P	K	
T_1: Sand+soil+FYM (1:1:1; v/v)	7.11	1.96	1.20	184.77	150	737.50	0.93
T_2: Sand+soil+FYM (2:1:1; v/v)	7.22	0.467	1.35	187.58	185	447.50	0.94
T_3: Sand+soil+FYM (1:1:2; v/v)	7.40	0.940	2.40	215.58	320	1555.00	0.91
T_4: Sand+soil+FYM (2:1:2; v/v)	7.44	0.812	0.78	190.40	245	1164.73	0.86
T_5: Cocopeat+FYM (1:1; v/v)	7.11	1.028	9.09	252.00	530	750.00	0.38
T_6: Cocopeat+soil+FYM (1:1:1; v/v)	7.10	0.682	1.38	249.24	495	2255.00	0.71
T_7: T_1+Cocopeat (1:1; v/v)	7.06	0.562	4.50	190.40	170	1542.50	0.62
T_8: T_1+Vermicompost (2:1; v/v)	7.23	1.709	2.25	246.38	385	2247.50	0.80
T_9: T_1+Vermicompost+Cocopeat (2:1:1; v/v)	7.11	0.642	3.30	207.18	295	1405.00	0.61

analysis, yet found to be at par with Sand+Soil+FYM (1:1:1; v/v)+Vermicompost (2:1; v/v) (T_8), Sand+Soil+FYM (2:1:2; v/v) (T_4), and Sand+Soil+FYM (2:1:1; v/v) (T_2). Vase life differed slightly for treatment T_9 but it also persisted for longer duration (12.50 days) after flower opening. Similarly, vase life in distilled water significantly extended during the year 2014-15 as compared to 2015-16. Interaction year x growing media was found to be non-significant for vase life of Alstroemeria. Alstroemeria bears typically a cymose type of inflorescence and all the florets do not open at the same time. Therefore, the treatments having a greater number of florets had prolonged vase life. Increase in size and number of florets in these particular growing media might be attributed to more availability of macronutrient elements particularly P and K. Our findings are in accordance with the studies carried out by Anonymous (2016) in Lilium in different growing media under Solan-Nauni conditions, where more vase life was achieved in the media treatments which had more number of flowers. Most flowering shoots (cymes) produced a succession of flowers as they do when growing on the plant, thus increasing the vase life of the inflorescence as a whole (Chanasut et al., 2003).

4. CONCLUSION

The growing medium consisting of Sand+Soil+FYM (1:1:1; v/v)+Vermicompost+Cocopeat (2:1:1; v/v) i.e.,

T_9 proved best for improving plant height, length of cut stem, weight of cut stem, number of days taken to flowering, number of flowering stems plant^{-1} and vase life of flowers in distilled water.

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