Effect of Substrates on Germination, Growth and Flowering of Different Winter Annuals

ABSTRACT

This study was conducted at Centre for Quality Plant Material, Chaudhary Charan Singh Haryana Agricultural University, Hisar during 2015-16 to 2017-18 to determine the effect of different substrates and their combinations on vegetative growth and flowering of winter annuals (Larkspur, Antirrhinum, California Poppy and Dahlia). Six types of substrates (cocopeat, perlite, vermiculite, vermicompost, Farm Yard Manure and send) were mixed by volume to create seven different treatments. The seeds were sown in the month of October in different treatments to record vegetative and floral parameters. The results showed that using substrate, that mixture of cocopeat with vermiculite and perlite following rate 3:1:1, gave higher and early germination and longer seedling length, seedling root length duration of flowering and earliest flowering and is found suitable for winter annuals nursery raising, vegetative growth and flowering.

Keywords: Substrates, Antirrhinum, California poppy, Flowering, Winter Annuals

1. INTRODUCTION

Floriculture is a fast emerging industry, as progress both scientifically and commercially. Today commercial floriculture is the most profitable business and expanding rapidly all over the world [1]. As demand for flowers has gradually increased, floriculture has become an important trade in agriculture in the commercial sector [2]. The term "annuals" when applied to herbaceous ornamentals, refers to plants that are grow from seeds, produce flowers, set seeds and complete their life cycle for only one season [3] and serve as essential components in any landscape plan [4]. They are frequently used as bedding plants, garden plants, rockery plants, window basket, cut flowers, loose flowers and herbaceous border in gardens [5].

Growing media not only plays important role for seed germination and root development but also act as a source of nutrient for quality seedling [6-7]. Cultivation of flower crops in soil is inexpensive, but it brings some risks like-soil borne disease, insect-pest and poor drainage, which suppressed the development of root system [8]. Generally, media for seedling are composed of soil, organic matter, pond soil and sand. Supplementing of the sand is aimed to make media more porous, while the organic matter (vermicompost) is added so as to enrich adequate nutrients for the seedling. Cocopeat is an agricultural by-product obtained after the extraction of fiber from the coconut husk with acceptable pH, EC (electrical conductivity) and other chemical attributes [7], which is mixable with high cation exchange and water holding capacities [9]. Vermicompost has high porosity, aeration, drainage, and water holding capacity [10] and also contains most nutrients in plant- available forms such as nitrates, phosphates, and exchangeable calcium and soluble potassium [11]. Keeping in view the effect of different substrate combinations was studied on growth and flowering in different winter annuals.

2. MATERIALS AND METHODS

The experiment was carried at Centre for Quality Plant Material, Chaudhary Charan Singh Haryana Agricultural University, Hisar (Haryana). In the study, Larkspur, Antirrhinum, California poppy and Dahlia were used during the year 2015-16 to 2017-18. Six substrates cocopeat, perlite, vermiculite, vermicompost, FYM and send were used to create the seven different treatments in different proportion (by volume) for cultivation. The seven-substrate mixtures with five replications /treatments (with 5 plants/ replications) were arranged in single rows on a greenhouse trough. The treatments were:

S_1 – cocopeat + vermicompost + perlite (1:1:1)

S_2 – cocopeat + vermiculite + perlite (3:1:1)

S_3 – cocopeat + vermiculite + perlite (1:1:1)

S_4 – sand + vermicompost (9:1)

S_5 – sand + FYM (9:1)

S_6 – sand + vermiculite (9:1)

S_7 – sand (control)

The seeds of different winter annuals were cultivated with above media combination during October after treating with fungicide. The greenhouse with facility of controlling temperature, humidity and light with automation system for irrigation and fertigation was used. After recording of data of seedling plants, the plants were transplanted were kept under uniform condition during the study period where all the management practices were carried out as per the package of practices. The data were analyzed according to the procedure for analysis of factorial randomized block design (Factorial RBD) as given by Panse and Sukatme [12]. The overall significance of difference among the treatments was tested, using critical differences (C.D.) at 5% level of significance. The results were statistically analyzed with the help of a windows based computer package OPSTAT (Operational Statistics) [13].

RESULTS AND DISCUSSION

For all substrates and their combinations, the germination rates were below 85% in the all winter annuals (Table 1). Results showed that seed sown in cocopeat + vermiculite + perlite, 3:1:1 (S_2), had the highest germination rate (81.5%) followed by S_3 (77.2%), while lowest germination percentage was recorded in sand (63.4%), which was statistically at par with S_6 (65.4%). Larkspur, Antirrhinum and California poppy resulted into significantly higher germination percentage (82.2%, 80.5%, 84.3%) than Dahalia (79.0%) with cocopeat + vermiculite + perlite (3:1:1). California poppy seeds resulted in maximum germination percentage (72.6%), which was statistically at par with antirrhinum (71.7%). It can be observed that the seeds of California poppy seeds grown with T_2 showed highest germination percentage (84.3%), which was statistically at par with S_2T_1 (82.2%), S_2T_2 (80.5%), S_3T_3 (80.4%) and S_2T_4 (79.0%).

Significant difference in days taken to 50% germination due to interactive effect of substrates and different winter annuals were observed and present in Table 2. Lowest days for 50% germination (7.5 days) was recorded with S_2 (cocopeat + vermiculite + perlite, 3:1:1) followed by S_3 (9.5 days). With the same media (Cocopeat + vermiculite + perlite, 3:1:1) antirrhinum and California poppy resulted into significantly lesser number of days taken to 50% germination (6.2 and 6.8 days) than larkspur and dahalia (7.6 and 9.2 days).

The results indicate that the effect of different substrate combinations on germination was significant. It is hardy possible to obtained a good crop without successful seedling establishment and the period of germination and seedling emergence is most vulnerable stage in a crop life [14]. The results also agreed with the earlier findings of Anderson [15], who observed that cocopeat is an important component and has a profound impact on physical, chemical and biological properties of substrates and is known to enhance seedbed conditions for desired seed emergence. Poor seedling emergence in send based substrate might be due to poor moisture holding capacity [16] physical properties [17] and diurnal temperature fluctuation in root zone [16].

The length of seedling differed significantly due to combinations of substrates and type of winter annuals (Table 3). The maximum seedling length (9.6 cm) was reported from S_2 (cocopeat + vermiculite + perlite, 3:1:1), followed by S_3 (8.2 cm). California poppy resulted into significantly higher seedling length (12.2 cm) followed by dahalia (8.1 cm) and antirrhinum (7.4 cm), while lowest seedling length (4.6 cm) was found in larkspur. Conclusively, California poppy grown in S_2 (cocopeat + vermiculite + perlite, 3:1:1) produced largest seedlings (12.2 cm), followed by S_1T_3 (11.2 cm), whereas, shortest seedlings (2.9 cm) was observed from S_7T_1 (2.9 cm), which was statistically at par with S_6T_1 (3.3 cm) and S_5T_1 (3.5 cm). It could be due to the reason that combination of 3 cocopeat: 1 vermiculite: 1 perlite improved the water and nutrient consumption and maintained porosity. This result is also in agreement with the work of Godara *et al* [18] who suggested that soilless substrate caused better exchange of elements especially cations inside the substrate and they distributed humidity properly around the root zone and it was finally effective in shoot length.

The difference in seedling root length of different winter annuals with respect to the substrates was found significant (Table 4). The highest seedling root length (6.1 cm) was reported from S_2 (cocopeat + vermiculite + perlite, 3:1:1) followed by S_3 (5.1 cm) and S_1 (3.9 cm), while lowest seedling root length (3.2 cm) was found in S_4 (sand + vermicompost, 9:1) followed by sand alone (3.6 cm). California poppy resulted into significantly higher seedling root length (6.4 cm) followed by antirrhinum (3.7 cm), whereas, lowest seedling root length (3.3 cm) was reported in both larkspur and dahalia. The data given in Table 4 also showed that the combined use of California poppy with S_2, produced maximum seedling root length (8.2 cm) followed by S_3T_3 (7.6 cm), whereas, minimum seedling root length was measured from S_4T_4 (2.0 cm), which was statistically at par with S_4T_1 (2.1 cm), S_6T_4 (2.1 cm), S_5T_1 (2.4 cm), S_5T_2 (2.4 cm) and S_7T_4 (2.4 cm).

It could be due to the alteration of physico-chemical properties (such as porosity, moisture content and air capacity) of raw material and hence the air and water balance in the root environment. These results were agreed with Sharma *et al* [19], who reported that soilless substrate showed better water retention, air filled porosity, gas diffusion and nutrient availability to the root development.

The days taken to initiate first flower exhibited significant difference due to different combinations of substrates, however the interactions between substrate and different winter annuals were non-significant (Table 5). Among all the substrate combinations, cocopeat + vermiculite + perlite (1:1:1) resulted into lesser number of days taken to first flower (57.8 days), followed by S_2 (63.2 days), whereas, highest number of days taken to first flower (74.8 days) was reported from control. Dahalia took minimum days (68.1 days) to first flower, which was statistically at par with antirrhinum (68.9 days) and California poppy (69.4 days), while maximum days to first flower were observed from larkspur (72.5 days).

The data given in Table 6 showed that among the different substrate combinations tried, S_2 (cocopeat + vermiculite + perlite, 3:1:1) resulted into longer duration of flowering (40.7 days) followed by S_3 (37.9 days), whereas, shorter duration of flowering (29.7 days) was reported from sand only. In case of different winter annuals, dahalia showed highest duration of flowering (37.2 days), which was statistically at par with California poppy (36.5 days) and minimum duration for flowering was observed from larkspur (30.2 days). The interactive effect of substrate and plant type was found non-significant.

Conclusion

In the present studies all substrates exhibited significant effect on precocity and duration of flowering in different winter annuals. Among the different combinations, the S_3 has perhaps created the most appropriate condition for days to first flower in all winter annuals. This is might be due to the physiochemical properties of the growing media pose their effect on the plant growth and flowering (20-21) and the composition of growth media is very important factor to be taken under consideration [22]. Nourizadeh [23] has also reported the increase flowering in plants due to suitable conditions in soilless substrate by ventilation and water maintenance. According to Riaz *et al.* [24], coconut coir based growing media can significantly improve days to first flower and flower duration in zinnia.

Table 1: Effect of substrates on per cent germination of different winter annuals under polyhouse conditions

Treatment	Germination (%)				
	Larkspur (T_1)	**Antirrhinum (T_2)**	**California Poppy (T_3)**	**Dahalia (T_4)**	**Mean**
S_1	70.2	78.4	72.3	66.9	**72.0**
S_2	82.2	80.5	84.3	79.0	**81.5**
S_3	78.5	73.3	80.4	76.5	**77.2**
S_4	68.9	71.8	76.3	71.5	**72.1**
S_5	60.5	63.5	65.8	74.8	**66.2**
S_6	63.4	66.3	67.9	64.1	**65.4**

S_7	65.2	68.4	61.3	58.5	**63.4**
Mean	**69.8**	**71.7**	**72.6**	**70.2**	
CD (p = 0.05)	**A = 2.87**		**B = 2.17**		**A×B = 5.74**

Table 2: Effect of substrates on days taken to 50% germination of different winter annuals under polyhouse conditions

Treatment	Days taken to 50% germination				
	Larkspur (T_1)	**Antirrhinum (T_2)**	**California Poppy (T_3)**	**Dahalia (T_4)**	**Mean**
S_1	12.4	10.8	7.5	11.7	**10.6**
S_2	7.6	6.2	6.8	9.2	**7.5**
S_3	9.6	7.5	9.9	10.9	**9.5**
S_4	14.3	8.4	11.8	9.8	**11.1**
S_5	15.2	12.2	8.6	10.2	**11.6**
S_6	13.5	9.8	8.2	12.1	**10.9**
S_7	10.7	13.6	10.8	13.3	**12.1**
Mean	**11.9**	**9.8**	**9.1**	**11.0**	
CD (p = 0.05)	**A = 0.42**		**B = 0.32**	**A×B = 0.85**	

Table 3: Effect of substrates on seedling length (cm) of different winter annuals under polyhouse conditions

Treatment	Seedling length (cm)				
	Larkspur (T_1)	**Antirrhinum 4(T_2)**	**California Poppy (T_3)**	**Dahalia (T_4)**	**Mean**
S_1	4.9	7.1	11.2	9.2	**8.1**
S_2	7.0	9.2	12.2	10.2	**9.6**
S_3	6.2	7.3	10.8	8.4	**8.2**
S_4	4.5	8.5	9.7	8.1	**7.7**
S_5	3.5	7.6	10.3	7.8	**7.3**
S_6	3.3	6.2	6.7	7.3	**5.9**
S_7	2.9	5.7	8.5	5.6	**5.7**
Mean	**4.6**	**7.4**	**9.9**	**8.1**	
CD (p = 0.05)	**A = 0.33**		**B = 0.25**		**A×B = 0.65**

Table 4: Effect of substrates on seedling root length (cm) of different winter annuals under polyhouse conditions

Treatment	Seedling root length (cm)				
	Larkspur (T_1)	**Antirrhinum (T_2)**	**California Poppy (T_3)**	**Dahalia (T_4)**	**Mean**
S_1	2.5	3.8	5.4	3.8	**3.9**
S_2	5.1	5.8	8.2	5.2	**6.1**
S_3	3.4	4.7	7.6	4.7	**5.1**
S_4	2.1	4.2	4.7	2.0	**3.2**
S_5	2.4	2.4	6.8	3.2	**3.7**
S_6	4.8	8.9	5.8	2.1	**3.7**

S_7	3.1	2.8	6.2	2.4	**3.6**
Mean	**3.3**	**3.7**	**6.4**	**3.3**	
CD (p = 0.05)	**A = 0.18**		**B = 0.14**	**A×B = 0.37**	

Table 5: Effect of substrates on days to first flower of different winter annuals under polyhouse conditions

Treatment	**Days to first flower**				
	Larkspur (T_1)	**Antirrhinum (T_2)**	**California Poppy (T_3)**	**Dahalia (T_4)**	**Mean**
S_1	65.8	65.9	64.7	66.9	**65.8**
S_2	62.9	63.8	63.2	63.1	**63.2**
S_3	69.4	68.2	68.9	64.9	**57.8**
S_4	76.9	69.1	72.6	67.5	**71.5**
S_5	75.3	69.0	72.8	71.3	**72.1**
S_6	78.3	72.3	69.8	70.6	**72.8**
S_7	78.9	74.2	73.9	72.1	**74.8**
Mean	**72.5**	**68.9**	**69.4**	**68.1**	
CD (p = 0.05)	**A = 0.75**		**B = 2.08**	**A×B = N.S.**	

Table 6: Effect of substrates on duration of flowering (days) of different winter annuals under polyhouse conditions

Treatment	**Duration of flowering (days)**				
	Larkspur (T_1)	**Antirrhinum (T_2)**	**California Poppy (T_3)**	**Dahalia (T_4)**	**Mean**
S_1	33.5	38.1	38.2	37.4	**36.8**
S_2	34.9	41.7	42.8	43.2	**40.7**
S_3	71.7	39.6	41.3	39.1	**37.9**
S_4	28.1	33.4	35.3	36.2	**33.2**
S_5	29.8	34.3	34.6	35.5	**33.5**
S_6	27.1	32.9	33.7	36.8	**32.6**
S_7	26.2	30.6	29.8	32.1	**29.7**
Mean	**30.2**	**35.8**	**36.5**	**37.2**	
CD (p = 0.05)	**A = 1.31**		**B = 0.99**	**A×B = N.S.**	

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