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Rooting and growth of chrysanthemum cultivars in response to different levels of calcium

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Abstract

An experiment was conducted at Ornamental Horticulture Nursery, Department of Horticulture, University of Agriculture Peshawar, Pakistan in 2012. The cuttings of four cultivars (Candy Floss, Lilian Jackson, Elizabeth Lawson and Herry Revil) were treated with calcium at the rate of 0, 10, 20, 30 and 40%. Increase in plant height (26.40cm) and number of roots plant^{-1} (35.92) was observed when calcium was applied at the rate of 30% while the minimum days (16.75) to sprouting and higher sprouting percentage (63.33%) were noted in cuttings treated with no calcium. Cultivar Elizabeth Lawson showed best result pertaining plant height (24.80cm) and number of roots per plant (34.17). Since calcium and cultivars interaction showed significant result among most of the parameters observed hence for good rooting and resultant growth, cuttings of Cultivar Elizabeth Lawson with the application of 30% calcium is recommended.

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Introduction

The name Chrysanthemum is derived from two Greek words "chrysos" and "anthos" meaning gold and flower respectively (*Subhendu et al.,* 2005). Chrysanthemum botanically called *Dendranthema grandiflorum L.* belongs to family Asteraceae. Its growing was first started in Asia and has more than 500 cultivars with different names. Chrysanthemum is a pot plant (*Subhendu et al.,* 2005) and is popular in white, yellow and different shades of pink (Gokongwei, 2009). Chrysanthemums are a sparkling flower and recently its popularity has increased because of its aesthetic beauty and potential as cut flower in many countries (*Anjum et al.,* 2007). The demand for it is 35% in the market, second to roses (Nawaz *et al.,* 2009). Chrysanthemum flower symbolizes long life, joy, optimism and fidelity. Beside ornamental purposes it is also used as a medicinal plant. Drinking Chrysanthemum flower syrup treats headaches, intestinal gas and sore throat. It cleans the liver and purifies blood. The extract from Chrysanthemum flower has potential to reduce high blood pressure and cholesterol level. It is used to treat the eyes with stress or fluid deficiency and to treat spots in front of eyes. It is also used in cosmetics and skin softness (Navale *et al.,* 2010). Chrysanthemum can be propagated through many ways such as seeds, suckers and cuttings. Low germination percentage and high seed prices are the main problems in propagation through seeds. Similarly the suckers are produced in less number that cannot fulfil market demand. Besides seeds and suckers, cuttings can be obtained in large numbers from Chrysanthemum plants and can easily fulfil the market demand. In propagation through cuttings, IBA is used for the initiation of roots. As farmers cannot afford IBA therefore it should be substituted with some other rooting hormone. Since calcium is cheaper and also induce root initiation therefore it can replace Indole-3-butyric acid. Calcium functions as a secondary messenger in the transmission and transduction of several environmental signals acting as intracellular metabolic agent. Calcium shows far above the ground resemblance with calmodulin and other calcium binding proteins that may directly control several physiological processes (Hepler and Wayne, 1985).

Keeping in the view of Importance of calcium and Chrysanthemum the research was carried for the following Objective.

Objectives

1. To find out the optimum level of calcium for the propagation of chrysanthemum.
2. To investigate the effect of calcium on growth chrysanthemum cuttings.
3. To evaluate the effect of calcium on rooting of chrysanthemum cuttings.
4. To study the role of calcium on cutting of chrysanthemum cultivars.

Materials and methods

An experiment entitled was carried out at ornamental nursery Farm Department of Horticulture, The University of Agriculture Peshawar during the year 2012. The experiment was laid down in Randomized Complete Block Design (RCBD) with two factors factorial arrangement. There were 20 treatments replicated three times.

The details of the experiment are as follow.

Calcium levels:

T_0 = 0%

T_1 = 10%

T_2 = 20%

T_3 = 30%

T_4 = 40%

Cultivars:

C_1: Candy Floss

C_2: Lilian Jackson

C_3: Elizabeth Lawson

C_4: Harry Revil

The cuttings were obtained from healthy plants. The cuttings used were about 7 cm long. The cuttings treated with calcium were planted in plastic bags filled with mixture of sand, clay and farm yard manure with the ratio of 1:1:1. Ten cuttings were planted in each treatment with a total number of 150

cuttings from each cultivar and a total of 600 cuttings for the whole experiment. Cuttings were than kept in white polythene tunnel for retaining their moisture.

Parameters

Data was recorded on the following parameters.

Days to sprouting

Days to sprouting were counted in plants from the date of planting till appearance of first sprout, and average was calculated.

Sprouting percentage

Sprouting percentage was recorded by selecting sprouted plants with in each treatment and average were calculated by following formula.

$$Sprouting\% = \frac{Total\ no\ of\ sprouting\ cuttings}{Total\ no\ of\ cuttings} \times 100$$

Plant height

From each treatment, five plants were taken and their height was measured through measuring tape from soil surface to the tip of plant and then average was calculated.

Number of roots plant^{-1}

The numbers of roots plant^{-1} were counted from three randomly selected plants and average was calculated.

Statistical procedure

The data collected on different parameters was subjected to analysis of variance (ANOVA) technology to observe the difference, between different treatments as well as their interactions. In case where the difference was significant the mean was further assist for differences through least significant difference (LSD) test. Statistical computer software, MSTATC (Michigan state university, USA), was applied for computing both ANOVA and LSD. (Steel and Torrie, 1997).

Results and discussion

Days to sprouting (cm)

Mean values pertaining days to sprouting is presented in Table 1. Analysis of variance shows that days to sprouting were not significantly affected by different levels of calcium, cultivars and their interaction. Calcium levels shows that minimum days to sprouting (16.67) were observed in cuttings treated with no calcium followed by (16.75) with the application of 20% calcium while the maximum days to sprouting (16.83) were observed in the cuttings treated with 10% calcium. Likewise data regarding cultivars revealed that the minimum number of days (16.27) to sprouting were observed in the cuttings of cultivar "Harry Revil" followed by (16.60) observed in cultivar "Lilian Jackson" while the maximum number of days to sprouting (16.73) were observed in cultivar "Candy Floss".

Table 1. Days to Sprouting as affected by Cultivars and Calcium levels.

Cultivars	Calcium					Mean
	0%	10%	20%	30%	40%	
Candy Floss	16.33	16.33	17.00	16.33	17.66	16.73
Lilian Jackson	15.33	17.33	17.33	17.33	15.67	16.60
Elizabeth Lawson	17.67	17.00	16.67	17.33	19.00	17.53
Harry Revil	17.33	16.67	16.00	16.33	15.00	16.27
Mean	16.67	16.83	16.75	16.83	16.83	

The interaction between calcium levels and cultivars showed that minimum number of days (16.33) to sprouting was observed in cultivar "Candy Floss" treated with calcium at the level of 30% while the maximum days to sprouting (19.00) were observed in cultivar "Elizabeth Lawson" treated with 40% calcium. It might be due to the antagonistic effect of calcium on iron and it is confirmed by Malvi, (2011) who elaborated that excessive calcium reduces uptake of iron and Skandari, (2011) evaluated that

iron plays a vital role in growth of young plants.

Sprouting percentage

Mean data for sprouting percentage is presented in Table 2. Analysis of variance revealed that calcium levels, cultivars and their interaction showed no significant effect on days to sprouting. However mean table for different levels of calcium showed that cuttings treated with no calcium resulted in the highest sprouting percentage (63.33%), followed by (53.33%) in the cuttings treated with 40% calcium while the lowest sprouting percentage (48.33%) was observed in the cuttings with the application of 20 and 30% calcium.

Table 2. Sprouting percentage as affected by Cultivars and Calcium levels.

Cultivars	Calcium					Mean
	0%	10%	20%	30%	40%	
Candy Floss	66.67	66.67	60.00	46.67	53.33	58.67
Lilian Jackson	46.67	53.33	46.67	33.33	46.67	45.33
Elizabeth Lawson	66.67	46.67	53.33	60.00	46.67	54.67
Harry Revil	73.33	40.00	33.33	53.33	66.67	53.33
Mean	63.33	51.67	48.33	48.33	53.33	

Similarly data regarding cultivars revealed that maximum sprouting percentage (58.67%) was recorded in cuttings of cultivar "Candy Floss" followed by (54.67%) in cultivar "Elizabeth Lawson", while the minimum sprouting percentage (45.33%) was noticed in cultivar "Lilian Jackson". The interaction between calcium levels and cultivars showed that the highest sprouting percentage (73.33%) was observed in cultivar "Harry Revil" untreated with calcium while the lowest sprouting percentage (40%) was observed in the cuttings of cultivar "Harry Revil" treated with calcium level at the rate of 10%. It might be due to the antagonistic effect of calcium on iron and this statement is supported by the Malvi,(2011) who reported that increase in calcium cocentration reduces uptake of iron in plant and Skandari, (2011) evaluated that iron plays a vital role in growth of young plants.

Table 3. Number of roots plant^{-1} as affected by cultivars and calcium levels.

Cultivars	Calcium					Mean
	0%	10%	20%	30%	40%	
Candy Floss	23.50	26.50	31.83	35.83	27.16	28.97c
Lilian Jackson	30.5	30.17	31.83	37.17	30.50	32.03bc
Elizabeth Lawson	27.83	26.17	38.17	39.50	39.17	34.17a
Harry Revil	27.83	29.83	32.83	31.17	31.83	30.70bc
Mean	27.42c	28.17c	33.67ab	35.92a	32.17b	

LSD value for Cultivars at 5 % level of probability = 2.6227

LSD value for Calcium levels at 5% level of probability = 2.9323

LSD valve for interaction at 5% level of probability = 5.8646.

Number of roots plant^{-1}

The recorded data regarding number of roots plant^{-1} is presented in Table 3. Analysis of variance revealed that calcium levels, cultivars and its interaction significantly affected number of roots plant^{-1}. Mean table for calcium levels showed that more number of roots (35.92) plant^{-1} were noticed in the cuttings treated with calcium at the rate of 30% followed by (33.67) with the application of 20% calcium while the least number of roots (27.42) plant^{-1} were observed in

cuttings treated with no calcium. Maximum number of roots (34.17) plant^{-1} were recorded in cuttings of cultivar "Elizabeth Lawson" followed by (32.03) observed in cultivar "Lilian Jackson" while the minimum number of roots (28.97) plant^{-1} were noticed in cultivar "Candy Floss". The interaction between calcium levels and cultivars showed that more number of roots (39.50) plant^{-1} was recorded in cultivar "Elizabeth Lawson" treated with calcium at the level of 30% while the least number of roots plant^{-1} (23.00) were observed in cultivar "Candy Floss" treated with no calcium. Calcium regulates the uptake of nutrients into the roots throughout the cell within the plants. More number of roots in cuttings treated with 30% calcium may be due to involvement calcium in cell division and auxin transport. These results are supported by the work of Schwambach *et al.*, (2005) who reported that root number was increased significantly with the increase level of calcium and Lanteri *et al.,* (2005) who reported that the absence of calcium in medium reduced rooting percentage.

Table 4. Plant height as affected by Cultivars and Calcium levels.

Cultivars	Calcium					Mean
	0%	10%	20%	30%	40%	
Candy Floss	14.47	15.15	16.41	24.59	21.91	18.51c
Lilian Jackson	17.86	18.42	22.40	24.57	23.32	21.31bc
Elizabeth Lawson	21.14	22.61	25.06	28.82	26.35	24.80a
Harry Revil	18.59	17.43	22.35	27.62	21.91	21.58b
Mean	18.02c	18.40c	21.56c	26.40a	23.37b	

LSD value for Cultivars at 5 % level of probability = 2.3972

LSD value for Calcium levels at 5% level of probability = 2.6802

LSD valve for interaction at 5% level of probability = 5.3603.

Plant height (cm)

The recorded data for plant height is presented in Table 4. Analysis of variance revealed that calcium levels, cultivars and their interaction significantly affected plant height. Mean table for calcium levels showed that the tallest plants of height (26.40) was recorded in the cuttings treated with calcium at the rate of 30% followed by (23.37) in cuttings with the application of 40% calcium while the smallest plants of height (18.02) was noticed in cuttings treated with no calcium. Similarly mean table regarding cultivars showed that maximum plant height (24.80) was recorded in cultivar "Elizabeth Lawson" followed by (21.58) in cultivar "Harry Ravil" while the minimum plant height (18.51) was observed in cultivar "Candy Floss". The interaction between calcium levels and cultivars showed that the tallest plants of height (28.82) was observed in cultivar "Elizabeth Lawson" treated with calcium at the level of 30% while the lowest plant height (14.47) was observed in cultivar "Candy Floss" treated with no calcium. The increase in plant height may be due to the increased number of roots produced by the cuttings treated with calcium at the rate of 30% which increased nutrients uptake and enhanced plant growth.

These results are in conformity with Harper *et al.,* (2004) who reported that calcium enhances plant growth and development in all aspects.

Conclusion

Based on the current research work, it is concluded that best results were observed in Cultivar Elizabeth Lawson with calcium at the level of 30% among growth parameter and is therefore recommended for rooting and growth of chrysanthemum under the agro climatic conditions of Peshawar.

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