The Pharma Innovation Journal 2021; 10(9): 1432-1436

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(9): 1432-1436

www.thepharmajournal.com
Received: 03-07-2021
Accepted: 09-08-2021

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Effect of sampling time and auxins concentration on vegetative growth and survivability of chrysanthemum CV. Chandamama yellow under nursery and field condition

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Abstract
An experiment was conducted in the Floriculture Research Station, (Agricultural Research Institute) Rajendranagar, Hyderabad during August 2018 to October 2018 to investigate "Effect of Sampling time and Auxins concentration on rooting of Chrysanthemum cv. Chandamama Yellow". The study revealed that among different sampling times, the cuttings taken in August recorded minimum days taken to emergence of sprouting, (20.17 days), maximum number of nodes sprouted per cutting (1.22), maximum number of leaves per cutting at 15, 30 and 45 DAP (5.16, 8.21 and 12.59 respectively), survival percentage (87.42%) is observed in nursery condition similarly in field condition also maximum survival percentage (84.64%), plant height (20.56 cm), number of branches per plant (5.65), length of branch (21.34 cm) is observed in the month of August. Among different auxins concentration minimum days to emergence of sprouting (18.68 days), maximum number of nodes sprouted per cutting (1.84), maximum number of leaves per cutting at 15, 30 and 45 DAP (6.44, 8.72 and 14.44 respectively), survival percentage (89.95%) was recorded with rootex-1 powder in nursery condition. In field condition maximum survival percentage (84.34%), plant height (26.41 cm), maximum number of branches per plant (5.78), length of branches (21.75 cm) was recorded with Rootex-1 powder. Among different treatment combinations *i.e.,* sampling time and auxins concentration, minimum days taken to sprouting (14.37 days), maximum number of nodes sprouted per cutting (2.08), maximum number of leaves per cutting at 15, 30 and 45 DAP (6.81, 9.85 and 15.37 respectively), survival percentage (98.26%) is observed with August + Rootex-1 powder in August + IBA 500 ppm at nursery condition and maximum survival percentage (94.54%), plant height (33.33 cm), maximum number of branches per plant (7.20), length of branches (28.20 cm) was recorded with August+Rootex-1 powder at field condition.

Keywords: Sampling time, auxin concentration, survivability, chrysanthemum, chandamama yellow

Introduction
Chrysanthemum is a herbaceous perennial flowering plant extensively grown all over the world for its beautiful charming flowers with an excellent vase life. It ranks second in the international flower trade after rose and was labeled as the 'divas' or 'queen' of autumn gardens. It is believed to be native of northern hemisphere, mainly Europe and Asia. Chrysanthemum is versatile flower with a wide range of types, sizes and colors. Chrysanthemum plants can be propagated both sexually and through vegetative means. Since chrysanthemum is highly cross-pollinated and due to its polyploidal and heterozygous nature, a wide range of variations are observed when grown from seeds. The plants also possess sporophytic self-incompatibility. A commercial method of propagation is through terminal stem cuttings taken from healthy mother plants.

Plant growth regulators play an important role in manipulating growth, flowering and rooting behaviour in flower crops. Exogenous auxin application improves rooting efficiency and quality of stem cuttings. While IBA and NAA stimulate adventitious rooting in cuttings (Copes and Mandel, 2000) [1]. Auxin content and some synergistic components such as diphenyls. These compounds stimulate the related RNAs biosynthesis and hence improve the roots primordia initiation (Henrique *et al*. 2006) [2]. The effectiveness of auxins, however, varies not only with the nature and concentration of the auxin and the plant species, but also with season. (Nanda and Kochhar, 1985) [3].

Materials and Methods

This experiment was conducted at Floriculture Research Station, (Agricultural Research Institute) Rajendranagar, Hyderabad during August 2018 to October 2018. Experiment was Completely Randomized Design with Factorial concept with three replications and the cuttings were planted on portray and placed at mist chamber. Auxins concentrations were 50,100,250 and 500 mgl-1. Sampling times were July, August and September. One month old cuttings 5-7 cm long with 3-4 buds were selected for root initiation. The cuttings were treated with one per cent Captan to prevent the occurrence of fungal disease later, cuttings basal ends were dipped in PGRs solution for10 minutes. The well sieved soil, sand, cocopeat, FYM (1:1:0.5:0.5) proportion were mixed to prepare growing media. Cells of protrays were filled well with this growing mixture. Sampling was around in one month intervals during July, August and September. 45 days after the treatment, rooted cuttings were assayed for survivability.

Results and Discussion

In Nursery Condition

Days taken to emergence of sprouting

Different sampling times had significant effect on days taken to emergence of sprouting. Among different sampling times, August (S_1) recorded significantly minimum time required for sprouting (20.17 days). There were significant differences with respect to days taken to emergence of sprouting among the different auxins concentration. The minimum time taken for sprouting (18.68 days) was recorded in the treatment Rootex-1 powder (T_9). In the interaction the results showed that minimum time taken for sprouting (14.37 days) was observed in August + Rootex-1 powder (S_1T_9).

This might be due to the congenial weather conditions prevailed during these month triggered cell activity resulted in early sprouting, number of sprouts and shoot length. In August month higher accumulation of Carbohydrates and C: N ratio, which readily served as a reservoir of food for new growth. The present results are in conformity with reports of (Rymbai and Satyanarayana Reddy, 2010) [4] in guava. The result on minimum time taken for sprouting and number of nodes per cutting with Rootex-1 powder, might be due to the fact that Rootex-1 powder containing 20% of organic extracts, 15% of organic plant food, 55% minerals and amino acids. These results are in harmony with those of Arthur *et al*. (2013) [6]. Seaweed extracts effects could chemical profiles contain combination of many components especially minerals and growth regulators that can boost cuttings sprouting, their rooting and growth.

Number of nodes sprouted per cutting

The results revealed that the number of nodes sprouted per cutting was significantly influenced by different sampling times. Among the different sampling times August (S_1) planting recorded significantly maximum number of nodes sprouted per cutting (1.22). The maximum number of sprouts per cutting (1.84) was noticed in Rootex-1 powder (T_9) in different auxins concentration. In Interaction effect August + Rootex-1(S_1T_9) powder recorded the maximum number (2.08) of sprouts per cutting.

Table 1: Effect of Sampling time and Auxins concentration on days taken to emergence of sprouting and number of nodes sprouted per cutting in Chrysanthemum Cv. Chandamama yellow

Auxins concentration (T)		Days taken to emergence of sprouting				Number of nodes sprouted per cutting			
		Sampling time (S)				Sampling time (S)			
		August (S_1)	September (S_2)	October (S_3)	Mean	August (S_1)	September (S_2)	October (S_3)	Mean
T_1	IBA 50 ppm	23.27	26.20	30.27	26.58	0.86	0.81	0.66	0.78
T_2	IBA 100 ppm	20.47	24.40	28.33	24.40	1.24	1.16	0.88	1.10
T_3	IBA 250 ppm	17.47	22.20	26.47	22.04	1.46	1.29	1.08	1.28
T_4	IBA 500 ppm	15.33	20.33	23.40	19.69	1.82	1.67	1.47	1.66
T_5	NAA 50 ppm	25.40	27.20	32.20	28.27	0.62	0.57	0.48	0.55
T_6	NAA 100 ppm	22.50	25.47	29.27	25.74	0.82	0.76	0.64	0.74
T_7	NAA 250 ppm	19.33	23.27	27.40	23.33	1.06	0.93	0.78	0.93
T_8	NAA 500 ppm	18.20	21.47	25.40	21.69	1.55	1.37	0.97	1.29
T_9	Rootex-1 powder	14.37	19.33	22.33	18.68	2.08	1.86	1.57	1.84
T_{10}	Control	25.40	28.47	32.47	28.78	0.65	0.52	0.46	0.54
Mean		20.17	23.83	27.75		1.22	1.10	0.90	
For comparing the means of		S.Em±		CD @ 5%		S.Em±		CD @ 5%	
S (Sampling time)		0.06		0.18		0.004		0.01	
T(Auxins concentration)		0.12		0.33		0.007		0.02	
S X T		0.20		0.57		0.01		0.03	

Number of leaves (15, 30 and 45 DAP):

Among the different sampling times August (S_1) planting recorded significantly maximum number (5.16, 8.21,12.59) of leaves per cutting. Maximum Number of leaves per cutting (6.44, 8.72, 14.44) was noticed in Rootex-1 powder (T_9) in different auxins concentration. The treatment combination august + Rootex-1 powder (S_1T_9) recorded the maximum number (6.81, 9.85, 15.37) of number of leaves per cutting at 15, 30 and 45 DAP. The results revealed that the number of leaves per cutting was significantly influenced by different sampling times.

It may be due to favourable climatic conditions to the higher number of leaves and wood maturity of cutting which probably reserves high starch and sugar. Favourable climatic conditions play an important role to increase the number of leaves. These findings are in close agreement with the findings of Ansari (2013) [5] in pomegranate. Increase in number of leaves may be due to vigorous growth and early initiation of root induced by the growth regulator which absorbs more nutrients and thereby producing more leaves as reported by Stancato *et al*. (2003) [7]. Similar findings were observed by Narayan (2015) [8] in Marigold, Waseem *et al*. (2011) [9] in Chrysanthemum.

Table 2: Effect of Sampling time and Auxins concentration on number of leaves at 15, 30 and 45 DAP in Chrysanthemum Cv. 'Chandamama Yellow'

Auxins concentration (T)		Sampling time (S)											
		15 DAP				30 DAP				45 DAP			
		August (S_1)	September (S_2)	October (S_3)	Mean	August (S_1)	September (S_2)	October (S_3)	Mean	August (S_1)	September (S_2)	October (S_3)	Mean
T_1	IBA 50 ppm	4.67	4.30	4.17	4.38	7.57	6.60	5.75	6.64	11.77	10.95	10.22	10.98
T_2	IBA 100 ppm	5.35	4.85	4.44	4.87	8.26	6.86	6.54	7.22	12.26	11.43	10.77	11.48
T_3	IBA 250 ppm	5.85	5.60	4.85	5.43	8.88	7.72	6.85	7.81	13.60	12.47	11.52	12.53
T_4	IBA 500 ppm	6.75	6.26	5.73	6.25	9.55	8.15	7.88	8.53	14.83	14.22	12.64	13.90
T_5	NAA 50 ppm	4.30	4.11	3.94	4.11	7.02	5.85	5.47	6.11	11.12	10.41	9.74	10.42
T_6	NAA 100 ppm	4.61	4.56	4.38	4.52	7.88	6.28	5.87	6.68	11.84	10.84	10.11	10.94
T_7	NAA 250 ppm	4.82	4.60	4.48	4.63	8.26	6.82	6.26	7.11	12.54	11.74	10.83	11.70
T_8	NAA 500 ppm	5.22	5.19	4.97	5.13	8.94	7.60	6.86	7.80	12.81	13.47	11.63	12.64
T_9	Rootex-1 powder	6.81	6.35	6.16	6.44	9.85	8.25	8.06	8.72	15.37	14.88	13.06	14.44
T_{10}	Control	3.24	3.14	2.62	3.00	5.88	5.13	4.84	5.28	9.74	9.52	8.37	9.21
Mean		5.16	4.90	4.57		8.21	6.93	6.44		12.59	11.99	10.89	
For comparing the means of		S.Em±		CD @ 5%		S.Em±		CD @ 5%		S.Em±		CD @ 5%	
S (Sampling time)		0.03		0.07		0.01		0.02		0.03		0.07	
T (Auxins concentration)		0.05		0.14		0.02		0.04		0.05		0.13	
S X T		0.08		0.25		0.03		0.08		0.08		1.20	

Survival rate at nursery level (%)

Among different sampling times, August (S_1) recorded significantly maximum survival percentage at nursery level (87.42). There were significant differences with respect to survival percentage at nursery level among the different auxins concentration. Maximum survival percentage at nursery level (89.95) was noticed in the treatment Rootex-1 powder (T_9). In interaction the results showed that maximum survival percentage at nursery level (98.26) was observed in August + Rootex-1 powder (S_1T_9).

This might be attributed favourable external environmental factors, good sun shine, aeration, optimum temperatures and relative humidity during root initiation, quality of roots and influenced subsequent growth and development.

In Field Condition

Survival rate at field level (%): Different sampling times had significant effect on survival percentage at field level. Among different sampling times, August (S_1) recorded significantly maximum survival percentage at field level (84.64). There were significant differences with respect to survival percentage at field level among the different auxins concentration. The highest survival percentage at field level (84.34) was noticed in the treatment Rootex-1 powder (T_9). In interaction the results showed that maximum survival percentage at field level (94.54) was observed in August + Rootex-1 powder (S_1T_9) due to it had better root system and were active to absorb sufficient water and other nutrients from soil and ultimately resulting higher survival percentage. Similar findings were reported by Rymbai and Sathyanarayana Reddy (2010) [4], Kumar and Syamal (2005) [12] in guava.

Table 3: Effect of Sampling time and Auxins concentration on survival rate (%) at nursery level and field level in Chrysanthemum cv. Chandamama yellow

Auxins concentration (T)		Survival percentage				Survival percentage			
		Nursery level				Field level			
		Sampling time (S)				Sampling time (S)			
		August (S_1)	September (S_2)	October (S_3)	Mean	August (S_1)	September (S_2)	October (S_3)	Mean
T_1	IBA 50 ppm	84.77	77.46	68.75	76.99	80.51	73.55	49.73	67.93
T_2	IBA 100 ppm	88.84	80.85	71.85	80.51	84.82	78.84	56.16	73.27
T_3	IBA 250 ppm	92.80	83.17	76.45	84.14	89.53	82.56	67.35	79.81
T_4	IBA 500 ppm	96.57	86.23	80.65	87.82	92.65	84.14	69.36	82.05
T_5	NAA 50 ppm	81.75	75.37	60.14	72.42	80.74	72.55	45.25	66.18
T_6	NAA 100 ppm	83.45	78.05	65.85	75.79	82.52	73.16	54.44	70.04
T_7	NAA 250 ppm	85.19	79.95	68.45	77.86	83.06	75.25	60.74	73.02
T_8	NAA 500 ppm	89.44	82.54	71.36	81.11	86.06	78.54	64.85	76.48
T_9	Rootex-1 powder	98.26	88.65	82.93	89.95	94.54	88.55	69.94	84.34
T_{10}	Control	73.14	70.03	51.36	65.17	71.96	65.72	40.23	59.30
Mean		87.42	80.33	69.78			84.64	77.29	57.81
For comparing the means of		S.Em±		CD @ 5%		S.Em±		CD @ 5%	
S (Sampling time)		0.02		0.01		0.01		0.02	
T(Auxins concentration)		0.04		0.03		0.01		0.04	
S X T		0.06		0.04		0.02		0.06	

Table 4: Effect of Sampling time and Auxins concentration on plant height, no. of branches, length of branch in Chrysanthemum cv. Chandamama yellow

Auxins concentration (T)		Sampling time (S)											
		Plant height (cm)				No. of branches				Length of branch			
		August (S_1)	September (S_2)	October (S_3)	Mean	August (S_1)	September (S_2)	October (S_3)	Mean	August (S_1)	September (S_2)	October (S_3)	Mean
T_1	IBA 50 ppm	24.27	20.47	13.30	19.34	5.17	4.22	3.31	4.23	17.43	15.53	12.20	15.06
T_2	IBA 100 ppm	25.80	21.80	15.43	21.01	5.62	4.66	3.52	4.60	19.67	16.94	13.50	16.70
T_3	IBA 250 ppm	27.43	23.53	17.73	22.90	5.83	4.87	3.84	4.85	23.67	18.47	14.73	18.96
T_4	IBA 500 ppm	30.40	25.40	18.87	24.89	6.56	5.72	4.13	5.47	27.80	19.83	16.00	21.21
T_5	NAA 50 ppm	23.70	19.37	12.77	18.61	5.03	4.02	3.13	4.06	16.23	14.70	11.60	14.18
T_6	NAA 100 ppm	24.73	19.80	14.40	19.64	5.27	4.33	3.38	4.33	18.27	15.80	12.73	15.60
T_7	NAA 250 ppm	26.60	22.33	15.20	21.38	5.60	4.52	3.65	4.59	21.33	16.64	14.27	17.41
T_8	NAA 500 ppm	28.27	23.57	16.63	22.82	5.76	4.93	3.73	4.81	25.43	17.80	15.67	19.63
T_9	Rootex-1 powder	33.33	26.80	19.10	26.41	7.20	6.22	3.93	5.78	28.20	20.57	16.47	21.75
T_{10}	Control	21.10	17.00	11.43	16.51	4.47	4.02	3.05	3.84	15.33	14.50	11.30	13.71
Mean		26.56	22.01	15.49		5.65	4.75	3.57		21.34	17.08	13.85	
For comparing the means of		S.Em±		CD @ 5%		S.Em±	CD @ 5%			S.Em±		CD @ 5%	
S (Sampling time)		0.03		0.07		0.01	0.04			0.04		0.09	
T(Auxins concentration)		0.05		0.13		0.02	0.07			0.06		0.18	
S X T		0.08		0.22		0.04	0.11			0.11		0.31	

Plant height (cm)

The highest plant height (26.56 cm) was recorded during August (S_1). The maximum height (26.41cm) was noticed in Rootex-1 powder (T_9) at 45 days after transplanting. In interaction the highest plant height (33.33 cm) was observed in combination of August and Rootex-1 powder (S_1T_9).

The increase in plant height and length of branches with August sampling time might be due to prevailing of congenial environmental conditions such as photoperiod and temperature for root growth at nursery stage resulted in vigorous growth at field level. Similar results were reported by Yadram *et al*. (2015) in African marigold and Prasad and Reddy (2003) [10] in China aster.

Number of branches per plant

The highest number of branches per plant (5.65) was recorded during August (S_1) and the results revealed that there was a significant effect of auxins concentrations, Rootex-1 Powder on number of branches per plant. has shown significant effect on number of branches per plant. The maximum number of branches (5.78) were noticed Rootex-1 Powder (T_9) at 60 DAT. In interaction more number of branches (7.20) was observed in August + Rootex-1 Powder (S_1T_9). August sampled cutting resulted in more number of branches per plant, due to better root and shoot growth at nursery stage the better adaptability with the prevailing environmental conditions. The results are conformity with the findings of Lakshmi *et al*. (2014) and Yadram *et al*. (2015) in African marigold.

Length of branch (cm)

Among the different sampling times August (S_1) sampled cuttings recorded significantly maximum shoot length (21.34 cm) and the maximum length of shoot (21.75 cm) was noticed in Rootex-1 powder (T_9). Interaction effect of sampling time and auxins concentration had significant effect on length of branch. The treatment combination August + Rootex-1 powder (S_1T_{10}) recorded the maximum length of branch (28.20 cm).

Conclusions

On the basis of results obtained from the present investigation it can be concluded that the cuttings taken during August month and treated with Rootex-1 powder was found better than all other treatment recording the maximum value of various attributes related to the maximum number of nodes sprouted, number of leaves, survival percentage, early sprouting in nursery and maximum survival percentage, plant height, number of branches, length of branch in field condition of chrysanthemum cuttings.

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