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Effect of Seed Priming on Germination and Initial Growth of China Aster [*Callistephus chinensis* (L.) Nees.] Varieties

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ABSTRACT

The present investigation was carried out at Floriculture Research Farm, ACHF, NAU, Navsari during August-November, 2019 in CRD with factorial concept with three replications comprising two varieties and twelve different seed priming treatments. The findings revealed that significantly maximum speed of germination (24.45), germination percentage at 7th and 14th day (71.50 and 90.00, respectively), root length (6.63 cm), seedling length (17.70 cm), seedling fresh and dry weight (1618.00 mg and 141.33 mg, respectively), seed vigour index-I and II (1627.62 and 10082.00, respectively) was recorded in seeds of var Arka Archana primed with GA_3 @ 100 ppm for 24 hrs (V_1T_5) followed by GA_3 50 ppm for 24 hrs. Whereas, rest of all the characters were found non-significant but maximum shoot length (11.07 cm), minimum mean germination time (13.67 days) and days required to reach the 5th leaf stage (29.60) were obtained in same treatment (V_1T_5). Moreover, poor performance was recorded in seeds of var Arka Kamini treated with *Nauroji* Novel organic liquid fertilizer @ 2 % for 24 hrs (V_2T_{12}).

Keywords Priming, China aster, Arka Archana, Arka Kamini, Germination.

INTRODUCTION

China aster (*Callistephus chinensis* (L.) Nees) is an important commercial annual flower which belongs to the family Asteracea and native to China and Europe. The genus *Callistephus* derived from two Greek words '*kalistos*' and '*stephos*' meaning 'most beautiful' and 'a crown', respectively. Commercially it is being grown in different parts of the world in open conditions as loose flower, cut flower, bedding plant and potted plant. In India, China aster is widely being grown in states like Karnataka, Maharashtra, Tamil Nadu, West Bengal and Andra Pradesh. It is popular due to its magnificent colors and flowers vary from single to semidouble and double.

With the development of floriculture industry in India, the area under flower crops is increasing year by year. Flower production of China aster is often hampered by the availability of poor quality of seeds,

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which is mostly connected with unfavorable weather conditions during seed development, maturation and storage. Seed germination and growth of seedling is also found poor in this crop. Therefore, there is an urgent need to employ some special technique for improving the germination in seeds of China aster. One potential way of improving the seeds quality is seed priming. Seed priming is a controlled hydration process followed by re-drying that helps to reduce germination time, harmonize germination, improves seed germination rate and quality of seedlings for the better crop establishment in many crops. But the research on improving seed germination and initial growth of seedlings of China aster varieties is meager. Hence, the study was undertaken to find best priming treatments for China aster.

MATERIALS AND METHODS

The present investigation was conducted at Floriculture Research Farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during August-November 2019. The experiment consisted of two factors including factor 1: China aster varieties viz., Arka Archana (V_1) and Arka Kamini (V_2) and factor 2 having 12 priming treatments viz., T_1: Control, T_2: Hydropriming for 12 hrs, T_3: Hydropriming for 24 hrs, T_4: GA_3 @ 50 ppm for 24 hrs, T_5: GA_3 @ 100 ppm for 24 hrs, T_6: GA_3 @ 150 ppm for 24 hrs, T_7: KNO_3 @ 250 ppm for 24 hrs, T_8: KNO_3 @ 500 ppm for 24 hrs, T_9: KNO_3 @ 750 ppm for 24 hrs, T_{10}: *Trichoderma viride* @ $1x10^7$ cfu/ml for 24 hrs, T_{11}: *Nauroji* Novel organic liquid fertilizer @ 1% for 24 hrs and T_{12}: *Nauroji* Novel organic liquid fertilizer @ 2 % for 24 hrs.

After sowing of seeds, counts on germination were made by counting the seeds germinating on alternate day at fixed time and calculated by the following formula and drawn the average of speed of germination at alternate day:

$$\text{Speed of germination} = \Sigma(ni/di)$$

Where,

n_i - Number of germinated seeds in every counting

d_i - Day of counting

Moreover, other observations were recorded on germination percentage at 7th and 14th day, mean germination time (days), days required to reach 5th leaf stage, root length, shoot length, seedling length, seedling fresh weight seedling dry weight at 45 days after seed sowing.

Seed vigour index-I and II was calculated as per the given formula suggested by Abdul-Baki and Anderson (1973) as.

Seed vigour index-I = Germination percentage at 30 DAS x Seedling length (cm)

Seed vigour index-II = Germination percentage at 30 DAS x Seedling dry weight (mg)

The data on various observations recorded during the course of investigation were statistically analyzed by the standard procedure given by Panse and Sukhatme (1985) using Completely Randomized Design with Factorial Concept.

RESULTS AND DISCUSSION

Effect of varieties

The results pertaining from data (Table 1 - 2) revealed that China aster var Arka Archana (V_1) recorded significantly maximum speed of germination (14.90), germination percentage at 7th day (53.95) and 14th day (75.41), root length (4.45 cm), shoot length (8.66 cm), seedling length (13.11 cm), fresh weight (942.28 mg) and dry weight (72.28 mg) of seedling, seed vigour index-I (1041.97) and II (4401.29) with minimum mean germination time (18.42 days) and days required to reach 5th leaf stage (37.29) over var Arka Kamini (V_2) (Table 1 - 2). It might be due to differences exist from cultivar to cultivar which attributed to their genetic makeup and prevailing environmental conditions. These results are in agreement with findings of Bhargava *et al*. (2015) in snapdragon and Pangtu (2017) in China aster.

Effect of priming

Priming of seeds with GA_3 @ 100 ppm for 24 hrs (T_5) resulted in the highest speed of germination (23.38),

Table 1. Individual effect of varieties and priming on different attributes of China aster seeds.

Treatments	Speed of germination	G % at 7th day	G % at 14th day	MGT (days)	Days required to reach 5th leaf stage	Root length (cm)
Varieties (V)						
V_1	14.90	53.95	75.41	18.42	37.29	4.45
V_2	11.99	37.46	70.47	19.42	40.26	4.24
SEm±	0.15	0.24	0.40	0.21	0.14	0.02
CD at 5 %	0.43	0.70	1.13	0.60	0.39	0.06
Priming (T)						
T_1	14.13	41.00	72.92	18.33	40.07	3.65
T_2	16.83	54.00	83.17	16.83	36.33	5.08
T_3	17.05	55.83	85.25	16.33	35.20	5.15
T_4	19.11	59.75	86.58	15.17	34.93	5.55
T_5	23.38	63.50	89.17	14.50	31.17	6.09
T_6	14.75	51.83	81.58	17.67	38.03	4.52
T_7	15.72	52.50	78.92	17.33	38.73	4.74
T_8	14.28	48.67	78.25	18.00	39.07	3.75
T_9	10.80	39.25	69.75	19.83	40.40	3.50
T_{10}	9.93	37.33	66.42	20.83	40.87	3.47
T_{11}	3.07	24.46	42.58	25.83	44.47	3.38
T_{12}	2.28	20.38	40.71	26.33	46.03	3.28
SEm±	0.37	0.60	0.98	0.52	0.33	0.05
CD at 5 %	1.05	1.71	2.78	1.48	0.95	0.13

Table 2. Effect of varieties and priming on different attributes of China aster seeds.

Treatments	Shoot length (cm)	Seedling length (cm)	Seedling fresh weight (mg)	Seedling dry weight (mg)	Seed vigour index-I	Seed vigour index-II
Varieties (V)						
V_1	8.66	13.11	942.28	72.28	1041.97	4401.29
V_2	8.41	12.65	890.50	58.56	946.50	2650.53
SEm±	0.05	0.06	8.98	0.26	7.165	26.52
CD at 5 %	0.17	0.18	25.54	0.75	20.37	75.42
Priming (T)						
T_1	8.06	11.71	683.00	47.00	878.18	2251.67
T_2	9.17	14.25	1079.33	74.00	1214.24	4399.92
T_3	9.77	14.92	1286.67	89.67	1301.45	5587.58
T_4	10.05	15.61	1532.00	109.33	1383.06	7037.00
T_5	10.73	16.82	1571.67	127.00	1533.69	8328.00
T_6	8.51	13.02	774.00	51.33	1088.45	2865.00
T_7	8.81	13.55	967.33	64.00	1096.46	3647.42
T_8	8.44	12.19	726.33	48.67	978.05	2617.67
T_9	7.86	11.36	629.67	46.00	815.58	2128.75
T_{10}	7.78	11.25	609.00	46.00	770.58	1965.50
T_{11}	7.59	10.97	571.67	40.67	489.80	822.54
T_{12}	5.65	8.92	566.00	41.33	381.32	659.83
SEm±	0.14	0.15	22.00	0.64	17.55	64.97
CD at 5 %	0.41	0.43	62.57	1.83	49.91	184.74

maximum germination percentage on 7th day (63.50) and 14th day (89.17) which was followed by lower concentration of GA_3 as compared to other priming treatments (Table 1). This improvement might be due to GA_3 i.e. 50 ppm for 24 hrs which breaks dormancy. This might be because of softening of the seed coat by pre-sowing hydration that allowed the leakage of germination inhibitors in the seed which enhance the seed germination and early transplanting of the seedlings. Similar significant results for germination speed and germination percentage were reported by Kumar and Singh (2013) in bitter gourd.

Significantly minimum mean germination time (14.50 days) and time to reach 5th leaf stage (31.17 days) were observed in seeds primed with T_5 i.e. GA_3 @ 100 ppm for 24 hrs (Table 1). These might be due to GA_3 that accelerate α - amylase activity for breaking starch stored in seeds and it also promotes hypocotyl length during seed germination that resulted into early seedling development (Mirlotfi *et al*. 2015).

Maximum root length (6.09 cm), shoot length (10.73 cm) and seedling length (16.82 cm) was produced by the seeds primed with GA_3 @ 100 ppm for 24 hrs (T_5) (Table 1 - 2). It might be due to the higher rate of cell division in the root and shoot tips by GA_3 treatment (Pangtu 2017) and these findings are in conformity with the work of Karimi and Varyani (2016) in calendula. Similarly, the results revealed that seeds treated with GA_3 @ 100 ppm for 24 hrs recorded significantly increased seedling fresh weight (1571.67

mg) and seedling dry weight (127.00 mg) (Table 2). This was because of increased seedling length that increases the fresh weight of the seedlings which is positively correlated further with the increase in the dry weight of the seedlings. The results of present study are in accordance with Ramzan *et al*. (2014) in Ad-Rem tulip and Pangtu (2017) in China aster.

Furthermore, the results discovered that seeds primed with GA_3 @ 100 ppm for 24 hrs gave significantly highest vigour index-I (1533.69) and II (8328.00) among all treatments (Table 2). Calculation of these parameters depending of germination percentage, seedling length and seedling dry weight which was found maximum in the same treatment. Similar findings were reported by Pangtu (2017) in China aster and Kumar and Singh (2013) in bitter gourd.

Interaction effect

Results of interaction of varieties and priming treatments are depicted in Tables 3 and 4. Significantly maximum speed of germination (24.45), germination on 7th day (71.50 %) and 14th day (90.00 %), root length (6.63 cm), seedling length (17.70 cm), seedling fresh weight (1618.00 mg) and dry weight (141.33 mg), seed vigour index-I (1627.62) and II (10082.00) were recorded in seeds of var Arka Archana which were treated with GA_3 @ 100 ppm for 24 hrs (Tables 1 and 2) while, rest of all the characters were non-significant but maximum shoot length (11.07 cm), minimum mean germination time (13.67 days) and days required to reach the 5th leaf stage (29.60). These might be because of cumulative effect of differences in their genetic makeup of varieties and environmental conditions along with continuous availability of reserve food material to the developing embryo due to digestion of endosperm carbohydrate by activating enzyme α-amylase through GA_3 treatment (Pangtu 2017). Moreover, GA_3 @ 100 ppm for 24 hrs performed better in case of Arka Kamini with respect to all parameters as compared to other priming treatments.

However, seeds of China aster varieties (Arka Archana and Arka Kamini) treated with *Trichoderma viride* in this investigation showed poor characteristics. This might be due to the fact that *Trichoderma* isolates produce *Trichoderma* species/strain-specific auxin like and/or auxin inducer compounds that have inhibitory effect at the higher concentration than optimal doses. These findings are in conformity with the work of Bhargava *et al*. (2015) in snapdragon. Similarly, performance of seeds primed with 1 % and 2 % *Nauroji* Novel organic liquid fertilizers for 24 hrs was found worst in both varieties of China

Table 3. Interaction effect of varieties and priming on different attributes of China aster seeds.

Treatments	Speed of germination	G % at 7th day	G % at 14th day	MGT (days)	Days required to reach 5th leaf stage	Root length (cm)
V_1T_1	15.23	56.00	79.17	17.67	38.33	3.74
V_1T_2	18.25	61.33	84.17	16.33	34.80	5.12
V_1T_3	18.37	64.67	86.00	15.67	33.47	5.16
V_1T_4	21.3	65.83	87.33	14.33	33.20	5.62
V_1T_5	24.45	71.50	90.00	13.67	29.60	6.63
V_1T_6	15.61	60.17	81.50	17.00	36.80	4.60
V_1T_7	16.32	61.00	79.83	16.67	38.00	4.76
V_1T_8	15.31	57.17	79.67	17.00	38.27	3.93
V_1T_9	14.68	53.00	75.67	20.00	39.00	3.58
V_1T_{10}	13.63	49.67	73.17	21.67	39.13	3.51
V_1T_{11}	3.35	26.50	45.17	25.00	42.80	3.49
V_1T_{12}	2.32	20.58	43.25	25.67	44.13	3.31
V_2P_1	13.04	26.00	66.67	19.00	41.80	3.56
V_2P_2	15.41	46.67	82.17	17.33	37.87	5.04
V_2P_3	15.73	47.00	84.5	17.00	36.93	5.14
V_2P_4	16.93	53.67	85.83	16.00	36.67	5.49
V_2P_5	22.31	55.50	88.33	15.33	32.73	5.55
V_2T_6	13.90	43.50	81.67	18.33	39.27	4.44
V_2T_7	15.13	44.00	78.00	18.00	39.47	4.71
V_2T_8	13.24	40.17	76.83	18.67	39.87	3.57
V_2T_9	6.93	25.50	63.83	19.67	41.80	3.43
V_2T_{10}	6.23	25.00	59.67	20.00	42.60	3.42
V_2T_{11}	2.79	22.42	40.00	26.67	46.13	3.26
V_2T_{12}	2.25	20.17	38.17	27.00	47.93	3.24
SEm±	0.52	0.85	1.38	0.74	0.47	0.07
CD at 5 %	1.48	2.41	3.93	NS	NS	0.19

Table 4. Interaction effect of varieties and priming on different attributes of China aster seeds.

Treatments	Shoot length (cm)	Seedling length (cm)	Seedling fresh weight (mg)	Seedling dry weight (mg)	Seed vigour index-I	Seed vigour index-II
V_1T_1	8.13	11.87	690.00	52.67	963.15	3160.33
V_1T_2	9.28	14.41	1126.67	81.33	1241.31	5435.83
V_1T_3	9.99	15.15	1358	102.00	1332.99	7089.17
V_1T_4	10.39	16.01	1584.67	124.67	1430.26	8872.50
V_1T_5	11.07	17.70	1618.00	141.33	1627.62	10082
V_1T_6	8.58	13.18	844.00	54.00	1101.00	3474.67
V_1T_7	8.87	13.63	928.00	63.33	1115.31	4127.17
V_1T_8	8.45	12.38	763.33	52.67	1011.15	3203.67
V_1T_9	7.89	11.46	632.00	50.67	890.51	2928.67
V_1T_{10}	7.86	11.37	605.33	51.33	854.88	2789.33
V_1T_{11}	7.68	11.17	588.00	46.00	527.65	918.25
V_1T_{12}	5.70	9.01	569.33	47.33	407.83	733.83
V_2P_1	8.00	11.55	676.00	41.33	793.22	1343.00
V_2P_2	9.06	14.10	1032.00	66.67	1187.16	3364.00
V_2P_3	9.55	14.69	1215.33	77.33	1269.91	4086.00
V_2P_4	9.72	15.21	1479.33	94.00	1335.86	5201.50
V_2P_5	10.39	15.94	1525.33	112.67	1439.77	6574.00
V_2T_6	8.43	12.87	704.00	48.67	1075.91	2255.33
V_2T_7	8.76	13.47	1006.67	64.67	1077.62	3167.67
V_2T_8	8.42	11.99	689.33	44.67	944.96	2031.67
V_2T_9	7.83	11.26	627.33	41.33	740.65	1328.83
V_2T_{10}	7.71	11.13	612.67	40.67	686.27	1141.67
V_2T_{11}	7.50	10.76	555.33	35.33	451.94	726.83
V_2T_{12}	5.60	8.83	562.67	35.33	354.81	585.83
SEm±	0.21	0.21	31.12	0.91	24.82	91.88
CD at 5 %	NS	0.61	88.48	2.59	70.58	261.27

aster which might be due to adverse effect of composition of NNLF on metabolism of seeds and hence, causing death of seeds, hindering the germination of seeds which further leads to deterioration in seedling growth. There were no supportive documents available on this aspect to clarify exact cause.

CONCLUSION

It can be concluded from the present study that priming is very helpful for improving germination and vigour in both the varieties of China aster viz., Arka Archana and Arka Kamini. Seed priming treatment with GA_3 @ 100 ppm was found best for getting higher germination along with better seedling establishment in China aster var Arka Archana under Navsari condition.

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REFERENCES

Abdul-Baki AA, Anderson JD (1973) Vigour determination in soybean by multiple criteria. *Crop Sci* 13: 630-633.

Bhargava B, Gupta YC, Dhiman SR, Sharma P (2015) Effect of seed priming on germination, growth and flowering of Snapdragon (*Antirrhinum majus* L.). *Natl Acad Sci Lett* 38: 81-85.

Karimi M, Varyani M (2016) Role of priming techniques in germination parameters of calendula seeds. *J Agri Sci* 61 (3): 215-226.

Kumar R, Singh R (2013) Effect of seed priming on emergence and vigour of bitter gourd (*Momordica charantia* L.). *J Res* 50: 114-118.

Mirlotfi, Bakhtiari S, Bazrgar AB (2015) Effect of seed priming on germination and seedling traits of pot marigold (*Calendula officinalis*) at saline condition. *Int J Agri Sci* 7 (1): 1626-1630.

Pangtu Shabnam (2017) Effect of seed priming on growth, flowering and seed yield of China aster (*Callistephus chinensis* (L.) Nees). MSc thesis. submitted to Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan.

Panse VG, Sukhatme PV (1985) Statistical Methods of Agriculture. Indian Council of Agril Res. New Delhi, India.

Ramzan F, Younis A, Riaz A (2014) Pre-planting exogenous application of gibberellic acid influences sprouting, vegetative growth, flowering and subsequent bulb characteristics of 'Ad-Rem' tulip. *Hortic Env Biotech* 55: 479-488.