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GA_3 priming, biopriming and hydropriming effect on quality nursery production of China aster (*Callistephus chinensis*)

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ABSTRACT

The study was carried out at Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, on China aster [*Callistephus chinensis* (L.) Nees] cv 'Poornima' and 'Kamini' in nursery under open field conditions in randomized block design (factorial) comprising eight seed priming treatments, viz. control, hydropriming with water, priming with GA_3 (50, 100 and 150 ppm) and biopriming with *Trichoderma viride* @ 1×10^4 cfu/ml, 1×10^5 cfu/ml and 1×10^6 cfu/ml for 24 hr. There was maximum speed of germination (18.97, 21.58), germination percentage (83.17, 86.33 %), root length (2.87, 2.93 cm), shoot length (6.39, 6.59 cm), seedling length (9.26, 9.52 cm), seedling dry weight (227.67, 248.30 mg), seed vigour index-I (769.89, 822.19), seed vigour index-II (18,934.33, 21,436.62); minimum time taken to seed germination (12.72, 11.33 days) and days required to reach 4-6 leaf stage (23.70, 22.33 days) with priming treatment GA_3 (100 ppm) in Poornima and Kamini, respectively. Hence, it is concluded that seeds of Kamini treated with GA_3 (100 ppm) for 24 hr obtained best results for most of the desirable character for quality nursery production of China aster.

Key words: Germination, Nursery, Priming, Quality, Bioprianing, Hydropriming

China aster [*Callistephus chinensis* (L.) Nees] is an important commercial flower belonging to family Asteraceae. Flower production of China aster is often hampered by the availability of poor quality of seeds, which is mostly connected with unfavourable weather conditions during seed development and maturation (Yu-jie *et al*., 2009). One such method of improvising the seed quality is seed priming, i.e. controlled hydration followed by redrying that helps to reduce germination time, harmonize germination, improves seed germination rate and quality of seedlings for the better crop establishment in many crops (Varier *et al*., 2010). The plant growth regulators like GA_3 has improved the growth and yield parameters in many fruit crops (Patil *et al*., 2017; Priyadarshi and Hota, 2021). Seed priming has presented surprise results for flower crops like pansy, marigold, gladiolus and China aster. Primed seed has effective results on growth, flowering (Pangtu *et al*., 2018) and seed yield (Pangtu *et al*., 2018). Therefore, effect of seed priming on quality nursery production of China aster.

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MATERIALS AND METHODS

The study was carried out at Dr YS Parmar, University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. The primed seeds along with non-primed seeds were sown in raised beds in July under open field conditions. For nursery bed preparation, soil was dug up to a depth of 30 cm and well-rotten farmyard manure at the rate of 5 kg/m^2 was added and mixed well. Raised nursery beds about 6 inch from ground and 2 m × 3 m (length × breadth) were prepared. In nursery beds, treatments were arranged in a randomized blocked design (factorial) having eight treatments with three replications each containing 200 seeds. Seeds were sown in rows 5 cm apart. After placing seeds in rows, these were covered with a fine layer of sieved farmyard manure. Irrigation of nursery bed was done with the help of watering can having fine rose. Nursery bed was then covered with polyethylene sheet. This polyethylene sheet was removed as soon as seeds start germinating. Seedlings of about four to six leaf stage were used for transplanting.

The priming agents required for various seed priming treatments were obtained from the Departmental laboratory and accordingly the desired concentrations were prepared using distilled water as per the details given below:

For hydro-priming 200 seeds were kept in 9 cm Petri-dish on filter paper and moistened with 5ml distilled water. All the petri dishes were kept at 23°C in incubator for 24 hr. Then, seeds were taken out and spread in a thin layer on blotting paper for drying under room conditions.

In order to prepare 50 ppm GA_3 solution, 50 mg of GA_3 powder was weighed with the help of digital electronic balance and dissolved in small amount of distilled water and final volume was made one litre by adding distilled water. Seeds (200 seeds) were kept in 9 cm Petri dish on filter paper and moistened with 5ml of GA_3 (50 ppm) solution. All the Petri dishes were kept at 23°C in incubator for 24 hr. Then, the seeds were taken out and spread in a thin layer on blotting paper for drying under room conditions. Similarly, GA_3 (100 ppm) and GA_3 (150 ppm) solutions were prepared using 100 mg and 150 mg GA_3 powder in one litre of distilled water, respectively. Then the seeds were also treated in the same way as that of priming with GA_3 50 ppm.

The *Trichoderma viride* culture was procured from Department of Mycology and Plant Pathology, Nauni, Solan. The population density that resulted in formation of 10^4 cfu/ml of fungal isolates were used for preparation of liquid formulation. The 200 seeds were soaked in liquid culture of *Trichoderma* formulation in sterilized petri dishes. All the petri dishes were kept at 23°C in incubator for 24 hr. Then, the seeds were taken out and spread in a thin layer on blotting paper for drying under room conditions. The formulation of *Trichoderma viride* @ 1×10^5 and cfu/ ml (P_7) and *Trichoderma viride* @ 1×10^6 cfu/ ml (P_8) were also prepared in a similar manner and seeds were treated in the same manner as that of biopriming with *Trichoderma viride* @ 1×10^4 cfu/ ml. The effect of seed priming treatments on germination and seedling vigour of China aster under nursery conditions was observed.

RESULTS AND DISCUSSION

The higher speed of germination was noticed in Kamini as compared to Poornima. It may vary from cultivar to cultivar and such differences exist and may be attributed to their genetic make up and environmental conditions. Different seed priming treatments exhibited varied responses to speed of germination. Priming of seeds with P_4 (GA_3 @ 100 ppm) resulted in highest speed of germination. The possible reason for getting enhanced speed of germination with GA_3 (100 ppm) might be ascribed to the fact that GA_3 accelerated various metabolic reactions before germination.

These findings are in conformity with those work of Kumar and Singh (2013). However, minimum speed of germination recorded in non-primed seeds might be ascribed to slow metabolic reactions in non-primed seeds and consequently they took more time to enhance the process of germination. The less time to seed germination was observed in Kamini over Poornima. It is obvious that variation might be attributed to the genetic makeup of these cultivars. Among seed priming treatments, less time taken to seed germination was observed with GA_3 (100 ppm).

The GA_3 might have increased the á- amylase activity for breaking starch stored in seeds to alter the physiology of embryo and activated enzymes which accelerate various developmental processes (Basra *et al.,* 2005). These results are in close proximity with those of Montero *et al.* (1990), Sharma (2012) and Kaya *et al.* (2010) were of the same opinion that GA_3 (100 ppm) primed seeds took lesser time for germination in pea and chickpea, respectively.

Maximum germination percentage was noticed in Kamini over Poornima. As, it may vary from cultivar to cultivar and such differences exist and being attributed due to their genetic makeup and environment conditions. Among different seed priming, treatments maximum germination was noticed in the seeds primed with GA_3 @ 100 ppm. The possible reason for getting maximum germination with GA_3 treatment might be due to the fact that during germination, GA_3 activated the enzymes that digested the endosperm carbohydrates rapidly and efficiently and reduced the mechanical restraints of endosperm thus, providing energy to start and sustain embryo growth. Similar findings were reported by Montero *et al.* (1990). Kumar and Singh (2013) and Sharma (2012) were of same opinion while working on bitter gourd and pea, respectively.

The effect of seed priming on days required to reach 4- 6 leaf stage in both the cultivars. Required less time to reach 4-6 leaf stage as compared to cv. 'Poornima'. The variation might be due to their genetic make up and environmental conditions.

Table 1. Effect of priming treatment on quality nursery production

Priming treatment	Seedling length (cm)			Seedling dry weight (mg)			Seedling vigour index-I			Seedling vigour index-II		
	Poornima	Kamini	Mean	Poornima	Kamini	Mean	Poornima	Kamini	Mean	Poornima	Kamini	Mean
P_1	7.89	8.13	8.01	148.33	160.76	154.55	485.13	571.81	528.47	9,122.33	11,306.79	10,214.56
P_2	8.72	8.97	8.85	210.50	224.63	217.56	649.89	705.64	677.76	15,682.40	17,670.52	16,676.46
P_3	8.96	9.19	9.07	226.47	247.73	237.10	744.62	792.81	768.72	18,827.24	21,378.87	20,103.05
P_4	9.26	9.52	9.39	227.67	248.30	237.98	769.89	822.19	796.04	18,934.33	21,436.62	20,185.47
P_5	8.85	9.06	8.96	200.74	213.62	207.18	685.34	706.93	696.13	15,550.94	16,662.38	16,106.66
P_6	8.89	9.05	8.97	187.45	232.49	209.97	666.95	694.10	680.52	14,058.83	17,823.79	15,941.31
P_7	9.08	9.29	9.19	227.60	247.67	237.63	753.09	801.42	777.25	18,890.80	21,365.47	20,128.13
P_8	8.85	9.07	8.96	198.25	238.57	218.41	622.49	668.16	645.32	13,943.37	17,573.30	15,758.33
Mean	8.81	9.04		203.38	226.72		672.17	720.38		15,626.28	18,152.22	
$CD_{0.05}$												
Cultivars		0.10			0.29			9.45			127.09	
Treatments		0.20			0.59			18.94			254.19	
Cultivars x Treatments		NS			0.83			NS			359.47	

P_1 = Control, P_2 =Hydropriming, P_3 = GA_3 (50ppm), P_4 = GA_3 (100ppm), P_5 = GA_3 (150ppm), P_6 = *Trichoderma viride* (1 x 10^4 cfu/ml), P_7= *Trichoderma viride* (1 x 10^5 cfu/ml) and P_8 = *Trichoderma viride* (1 x 10^6 cfu/ml).

Among different seed priming treatments, less time to reach 4-6 leaf stage was recorded in seeds primed with GA_3 (100 ppm). This might be ascribed to the fact that GA_3 primed seeds exhibited an early and uniform emergence. Pre-sowing hydration might have softened the seed coat that allowed the leakage of germination inhibitors in the seed and this might have contributed to the enhancement of seed germination and early transplanting of the seedlings (Harris, 1996). Similar findings were reported by Montero *et al.* (1990) in Antirrhinum, Kaya *et al*. (2010) in Chickpea also reported that GA_3 (100 ppm) significantly increase the early seed germination and following transplanting.

Seedlings of Kamini produced maximum root length (cm) as compared to Poornima. The variation might be attributed to genetic makeup of these cultivars. Among seed priming treatments, maximum root length was recorded in the seeds primed with GA_3 (100 ppm). The increased root length following priming with GA_3 might be due to higher rate of cell division in root and shoot tips incited by the application and these studies are in confirmation with work of Montero *et al.* (1990), Kaya *et al*. (2010), Sharma (2012) and Kumar and Singh (2013).

Seedlings of Kamini resulted maximum shoot length (cm) as compared to Poornima. The variation might be attributed to genetic make up of these cultivars. Among priming treatments, maximum shoot length was recorded in the seeds primed with GA_3 (100 ppm). The increasing shoot length following priming with GA_3 might be due to the higher rate of cell division in the root and shoot tips incited by the application of GA_3 and these studies are in conformity with those of Montero *et al.* (1990), Kaya *et al*. (2010), Siadat *et al.* (2012), Sharma (2012) and Kumar and Singh (2013).

Seedling length was noticed to be more in Kamini over Poornima. It is quite obvious that such differences between the two cultivars may exist and can be attributed to their genetic makeup and environment conditions as well. Maximum seedling length observed when seeds were treated with GA_3 (100 ppm). This might be ascribed to the fact that this increase in root and shoot length of the seedlings could be positively be correlated with respect to an increase in seedling length. Similar findings were reported by Montero *et al.* (1990), Kaya *et al.* (2010), Sharma (2012) and Kumar and Singh (2013).

Seedling dry weight was more in Kamini over Poornima. Such differences between two cultivars may be attributed to their genetic make up and environmental conditions. Maximum seedling dry weight was observed in GA_3 (100 ppm) primed seeds. This might be ascribed to the fact that GA_3 is known to enhance the water uptake of the seedlings which might have activated the enzymes with an accompanying mobilization of reserve materials in embryo and thus strongest seedlings were obtained as a result of better embryo growth. This increases the fresh weight of the seedlings which is positively correlated further with the increase in the dry weight of the seedlings. These studies got support from the earlier findings of Muhammad and Rha (2007) who observed the maximum dry weight in Sugar beet seeds on priming with GA_3 (100 ppm).

Seed vigour index- I was more in Kamini over Poornima. Such differences between the two cultivars may be attributed to their genetic make up and environment conditions. Among priming treatments, highest vigour index-I was observed with GA_3 (100 ppm). It might be due to production of longer seedlings. Similar findings were reported by Kumar and Singh (2013).

Seed vigour index- II was noticed to be more in Kamini as compared to Poornima. Such differences may exist between the two cultivars being attributed to their genetic makeup and environment conditions. The treatment with GA_3 @ 100 ppm exhibited highest seed vigour index-II. It might be due to increased á-amylase activity for breaking the starch stored in seeds by growth regulators or salt solutions (Basra *et al.,* 2005). Priming caused *de novo* synthesis of á-amylase (Lee and Kim, 2000) increasing metabolic activities in seeds, which resulted in higher seed vigour. Similar findings were in close proximity to those of studies of Muhammad and Rha (2007).

CONCLUSION

The response of different priming treatments on quality nursery production revealed that GA3 @ 100 ppm improved various nursery quality parameters of China aster Poornima and Kamini.

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