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Seed Priming to Ensure Better Crop Stand of Chrysanthemum (*Chrysanthemum coronarium*)

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ABSTRACT: Germination or seed quality of Chrysanthemum is a crucial feature affecting seedling survival and establishment whilst seeded directly in the field. Annual chrysanthemum is highly remunerative and short duration flower crop, which has problems like poor seed germination, low seed vigour and short storage life. An effort was made to study the effect of priming on seed quality as four different seeds collected from Horticulture farm, Department of Horticulture were subjected to different priming treatments. The priming treatments composed of 0.1 and 1% KNO_3, 2 and 4% $CaCl_2$, 100, 200 and 300ppm GA_3, control and hydration. Of the treatments evaluated for seed quality in fresh seeds, Gen1T4 performed significantly better as compared to other treatments. It was observed that priming with 0.5% KNO_3 in fresh seeds showed significant improvement in seed quality parameters. Priming treatments were more effective in improving the seed quality and viability for storage.

Keywords: Annual chrysanthemum, priming, $CaCl_2$, KNO_3, GA_3, seed quality.

INTRODUCTION

Seed priming ensures increased and uniform germination by reducing the imbibition time, increase the enzyme activation, enhance metabolite production, repairing the damaged DNA, and regulating osmosis. Number of reports on seed priming towards improved seed germination, seedling emergence, stand establishment, crop growth, nodulation, and productivity in various crop species viz., rice , wheat , pulses, okra , Chinese cabbage , sunflower , and melons were observed in literature (Damalas *et al.*, 2019; Mirmazloum *et al.*, 2020). Seed priming induces antioxidant activity and storage protein solubelization and minimizes lipid per oxidation (Dorajeerao and Mokashi, 2020). In recent years many tactics have been engaged to accelerate the speed of germination and to improve seedling uniformity (Vishvanathan *et al.*, 2020). Pre sowing treatment of seed priming has been proven as an effective strategy to ensure uniform emergence at rapid, as well as for recuperating seed vigour, viability, and seedling crop stand even under the hostile situation (Sisodia *et al.*, 2018; Raj and Raj, 2019). Annual chrysanthemum, botanically known as *Chrysanthemum coronarium* L., annual herbaceous plant with aromatic flavor, popularly known as garland chrysanthemum. The plants are hardy, vigorous and relatively of short duration besides provided attractive flowers in various shades of yellow and white having single or double forms (Waqas *et al.*, 2019). Commercially grown in various parts of India for production of loose flowers to be used alone or in combination with marigold and other flowers for making garlands as well as for religious offerings (Mustafa *et al.*, 2017). There are various treatments with chemicals like GA_3, Calcium chloride and KNO3, are found beneficial to increase the storage life of the seeds (Jena and Mohanty 2019). The priming treatments hydrate the seed to a point where germination process begins. Hence it's important to stimulate attention towards the cost-effective strategies that improve crop growth and quality resulting in improved gross returns to the farming community.

MATERIALS AND METHODS

The seed material for the present investigation was collected from Horticulture farm, Department of Horticulture CCS Haryana Agricultural University Hisar. The present study was carried out on annual chrysanthemum seeds of four lines which were harvested during April 2018-19. The harvested seeds of Genotype-1 (White double), Genotype-2(Yellow semi double) , Genotype-3 (White semi double) and Genotype-4(Yellow double) were exposed to priming treatments for 6 hours along with control treatment as hydro priming, Calcium Chloride $CaCl_2$@2%, 4%, Potassium Nitrate KNO_3@ 0.5%, 1.0% and Gibberellic acid GA_3@ 100, 200, 300 ppm followed by dehydration at room temperature. Data were recorded for 15 days on a daily basis for emergence with subsequent seedling assessment protocol as given in the handbook of the Association of Official Seed Analysts (Adinde *et al.,* 2020). Ultimate germination percentage was calculated at the end of 15th day. Sufficient number of seeds from different seed genotypes were placed over filter paper soaked in solution of the desired treatment in a beaker and kept it at room temperature. The seeds were allowed to imbibe solution for 6 h in all the treatments. After the completion of treatment period, the seeds were dehydrated at room temperature. Standard Germination Test (%), Shoot length (cm), Root Length (cm), Seedling Dry Weight Seedling vigour index I and II, Electrical conductivity test (EC) (ds/cm/seed), Dehydrogenase activity (DHA) test, Peroxidase Activity, Catalase Activity, Superoxide dismutase activity, Speed of emergence index, Seedling establishment, Mean emergence time etc. Reputed statistical software SAS version 9.3 along with JMP 9 was exploited for analysis and graphical presentations.

RESULTS AND DISCUSSION

Standard germination was better for treatment Gen1T4 as compared to all other treatments. Shoot length and root length of fresh annual chrysanthemum seeds observed that treatment Gen1T4 was highly significant as compare to all other treatments. Seedling dry weight was more for treatment Gen1T4 as compare to all other treatments. This may be because the damage to membrane enzyme, proteins and nucleic acids and such degenerative changes are resulted in the complete disorganization of cell membrane and organelle (Mangena, 2019). Vigour index was found more in the treatment Gen1T4 compared to all other treatments. Seed lots were also found to differ significantly for vigour indices. This showed that it was just not the standard germination to determine the planting value of a seed lot but more importantly it was determined that how vigorous the seedling would emerge out of a viable seed. Electrical conductivity was highly significant of treatment Gen1T1 was highly significant as compare to all other genotypes. This might be due to destructive changes in cellular membrane system resulting in more leakage of organic solutes (free sugars, fatty acids and amino acids) reported by Mustafa et al 2017. Enzymes activities i.e. catalase, peroxidase, dehydrogenase and superoxidedimutase were affected by different storage and treatment conditions. Treatment Gen1T4 was highly significant as compare to all other treatments as the better performance might be priming with KNO_3 can lead to further growth of primed seedlings and because of damage to membrane system could be repair and protected against such changes by invigouration treatments (Sidana *et al.,* 2019).

Variability among genotypes for morphological traits. Good amount of variability had been observed for seedling emergence and germination percentage among the considered treatments as depicted by in Fig. 1. Around the circle in Radar chart 36 treatments were depicted and the values for the traits for a particular treatment were depicted by the point's concentric circles (Bagheri *et al.,* 2019). 50 to 65% seedling emergence percentage and 90 to 63 germination percentage observed. Root length values were depicted by inner circle as values varied from 2 to 4 in Fig. Followed by the circle for Shoot length trait and 5.6 to 7.2 values were expressed in Fig. Emergence time and Seedling length circles cross each other and 7 to 14 observed for seedling length whereas 8 to 12 achieved by Emergence time among treatments. Last and outer circle for Vigour index 2 showed 8 to 17 values in chart. Enzyme activities had been illustrated in Fig. 3 for Electrical conductivity, catalase, peroxidase, along with seedling dry weight and speed of emergence. Superoxidase expressed by inner most circles as marginal variation expressed by treatments. Next denoted by seedling dry weight 0.05 to 0.25 followed the circle for dehydrogenase activity as values ranged from 0.25 to 0.45. Range from 0.24 to 0.46 seen for electrical conductivity. The behaviour of catalase activity (0.34 to 0.54) portrayed similar to variability in peroxidase(0.35 to 0.75), speed of emergence (0.45 to 0.96) mentioned by Khan *et al.* (2021).

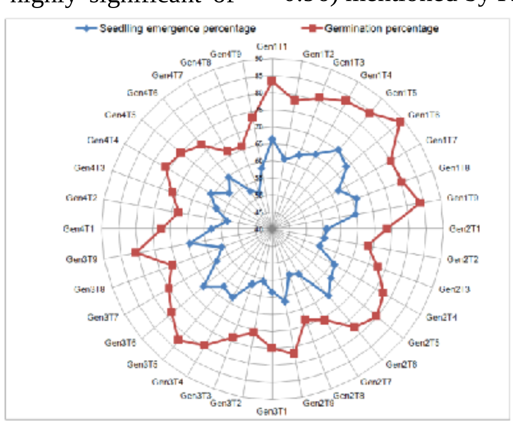

Fig. 1. Variation among treatments for Seedling emergence and germination percentage.

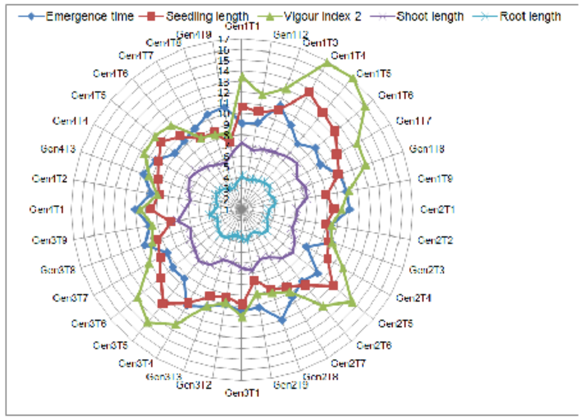

Fig. 2. Variation among treatments for Emergence time, Seedling length, shoot and root length.

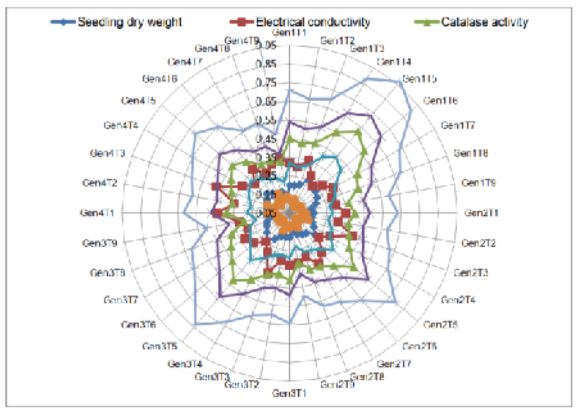

Fig. 3. Variation among treatments for Enzyme activities.

Biplot analysis. Results of the principal component analysis (PC) of traits indicated that the first two components were important in explaining the variation among treatments and cumulatively accounted for 84.1 % of the total variation (Table 1). The first principal component (PC) accounted for 73.5% of the total variation. It illustrated the variations in Vigour index 1, Vigour index 2, Catalase activity Peroxidase Dehydrogenase activity Speed of emergence contributed more. Second Principal component augmented by 10.6% to the remaining variation traits Seedling emergence percentage Root length Shoot length Germination percentage were major contributors. Out of the 15 traits evaluated, 08 were found to contribute most to the first two principal components and were therefore considered most discriminate to summarize variations among the treatments.

Table 1: Loadings of traits for tuberose genotypes.

Traits	Principal Component 1	Principal Component 2	Traits	Principal Component 1	Principal Component 2
Emergence time	-0.090	-0.028	Vigour index 1	0.298	0.065
Seedling length	0.281	0.265	Seedling dry weight	0.277	0.272
Vigour index 2	0.297	0.058	Electrical conductivity	-0.183	0.193
Seedlling emergence percentage	0.245	-0.373	Catalase activity	0.286	0.226
Germination percentage	0.257	-0.337	Peroxidase	0.286	0.236
Shoot length	0.258	-0.369	Dehydrogenase activity	0.285	0.237
Root length	0.257	-0.371	Superoxidedimutase activity	-0.203	0.254
Percent contribution of traits	73.46	10.67	Speed of emergence	0.286	0.238

Clustering pattern. Five clusters of traits were evident in Biplot graphical representation as one cluster in first quadrant, two clusters in adjacent quadrant, one in each opposite quadrants (Fig. 4). Highly significant direct correlation had been maintained by enzyme activities with seedling length, seedling drying weight, speed of emergence traits whereas germination percentage expressed tight association with Root length, shoot length, seedling emergence percentage. Superoxididinutase associated with electrical conductivity while emergence percentage placed separately.

Positive correlation has been observed between vigour index 1 with vigor index2 and both uncorrelated with Emergence as observed at opposite end of rays in biplot (Fig. 5). Superoxididemutase strongly associated with electrical conductivity whereas no correlation with measures Germination percentage, Seedling emergence percentage, root length, shoot length grouped together. Group of Seedling length, seedling dry weight, dehydrogenase activity, Speed of emergence, Peroxidase, Catalase activity exhibited strong correlation among themselves and moderate relation with Vigor indexes. This group of traits also showed right angles with Germination percentage, Seedling emergence percentage, root length, shoot length measures. Treatment having long length of the vector *viz*. Gen2T9, Gen4T9, Gen4T7, Gen2T3, Gen1T4, Gen1T5, Gen1T6, Gen7T8 have higher or extreme values for one or more traits.

Hierarchical Multivariate analysis. Hierarchical clustering techniques have long been the most popular clustering method with Ward's method and average linkage probably being the best available. Only four clusters of studied treatments had been observed as marked by different colors in clustering pattern as well as by clustering handle (Fig. 6). Small groups of treatments (Gen1T9, Gen2T9, Gen3T9, Gen4T9) placed with Gen1T4, Gen1T5, Gen1T6, Gen2T5, Gen3T5 in between of two large size clustered in first and separated by fourth cluster of remaining treatments. Two dimensional clustering had been also carried out to group the traits as per variations observed in treatments combinations during field evaluation (Fig. 7). Catalase activity devided traits in two groups consisting of Emergence time, eclectrical conductvity, Superoxidedimutase activity, seedling length, seedling dry weight and second group of Peroxidase, Speed of emergence, Dehydrogenase activity, vigour index 1, vigour index 2, seedling emergence percentage, Germination percentage, shoot length, Root length.

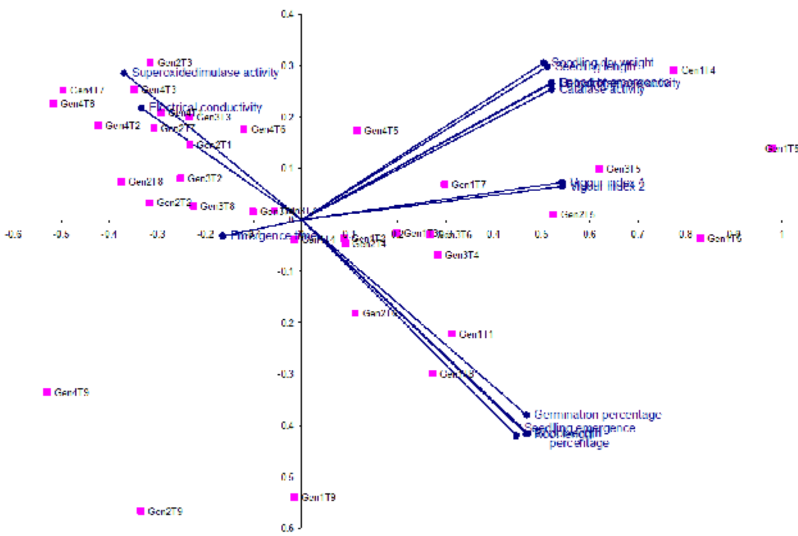

Fig. 4. Biplot graphical analysis of treatments and traits.

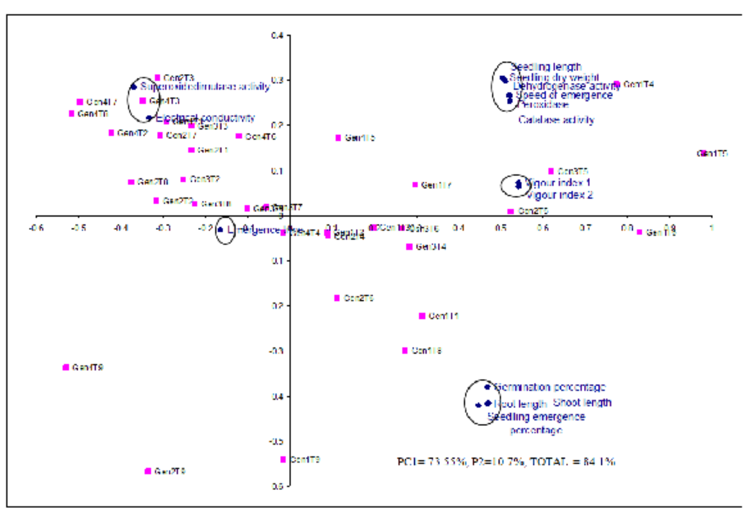

Fig. 5. Biplot clustering of traits vis-à-vis treatments.

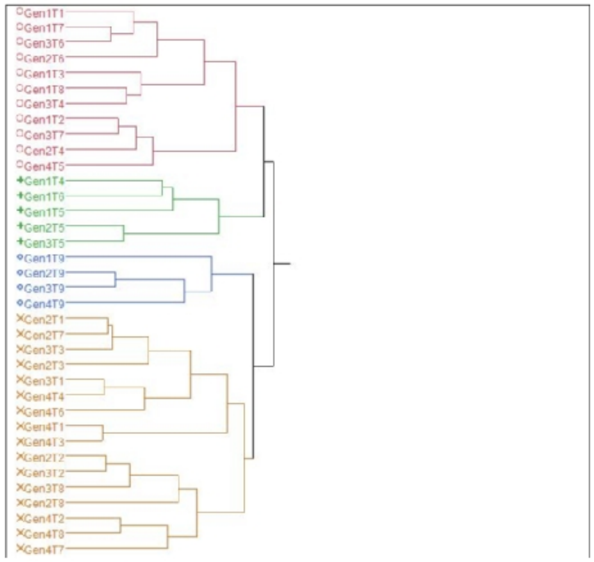

Fig. 6. Hierarchical Multivariate analysis of treatments by Ward's method.

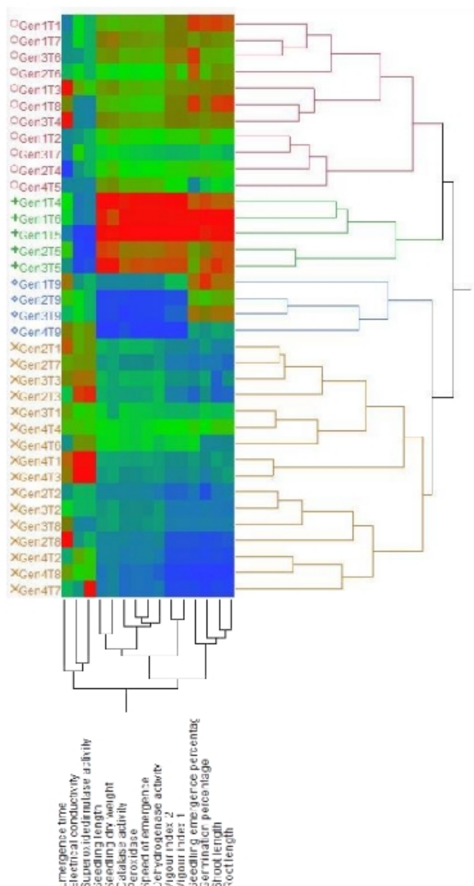

Fig. 7. Multivariate two clustering of treatments vis-à-vis traits.

CONCLUSIONS

Results revealed that in primed seeds enhanced the standard germination, viability percentage, shoot and root length, dry weight, vigour index, and enzyme activity (dehydrogenase, catalase, peroxidase and superoixidedimutase) declined significantly. All the seed genotypes were found significantly different for vigour and viability tests.

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Conflict of Interest. None.

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