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Research Article

EFFECT OF SEED PRIMING ON SHOOT AND ROOT LENGTH IN MARIGOLD SEEDS

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Abstract: Marigold is one of the important annual flowers grown for commercial purpose all over the world. Non availability of high-quality seeds of marigold is one of the major constraints in its cultivation. Priming of Marigold seeds plays crucial role in its germination, shoot length and root length. Hence a laboratory study was carried out to investigate the influence of various priming treatments on shoot and root length of French marigold seeds. This study was carried out on marigold seeds of four lines and nine treatments. Seeds treated with 0.5% KNO_3 exhibited significantly higher shoot length (10.950cm) during 0 month storage. In 2, 4, 6, 8- and 10-months storage duration, significantly maximum shoot length was observed in T4 (9.217cm, 7.225 cm, 6.500 cm, 4.758 cm and 3.458 cm) respectively. Maximum shoot length was recorded in G-4(9.36cm) which was followed by G-1 (8.40 cm) and G-3 (7.85cm) during 0-month storage. In 2, 4, 6, 8- and 10-months storage duration, significantly maximum shoot length was observed in G-4 (8.03cm, 6.763cm, 5.752cm, 4.785cm and 2.956cm) respectively. Seeds treated with 0.5% KNO_3 exhibited significantly higher root length (4.625cm) over the other treatments during 0-month storage. In 2, 4, 6, 8- and 10-months storage duration, significantly maximum root length was observed in T4 (4.175cm, 3.908 cm, 3.275 cm, 2.158 cm and 0.983 cm) respectively. Maximum root length was recorded in G-4(4.877cm) which was followed by G-1 (4.709 cm) and G-3 (4.350 cm) during 0-month storage. In 2, 4, 6, 8- and 10-months storage duration, significantly maximum root length was observed in G-4 (3.933 cm, 3.315 cm, 2.644cm, 1.959 cm and 0.937 cm) respectively.

Keywords: *Marigold, Seed, Priming, Shoot length, Root length*

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Introduction

Marigold (*Tagetes patula* L.), a member of family compositae is an important loose flower crop cultivated in India. It is one of the important annual flowers grown for commercial purpose all over the world. The marigold is also grown as trap crop to control pest activity. Poultry industry is extensively using marigold petals as a natural source of xanthophylls pigment. Tagetes oil, mainly from *T. minuta*, is used in perfume and as savouring constituent. Thus, cultivation of marigold gaining popularity day by day in agriculture business owing to its commercial usage. Marigold seeds exhibit a rapid decline in vigour and viability under ambient conditions of storage from April to October in Northern plains [1]. Non availability of high-quality seeds of marigold is one of the major constraints in its cultivation. Seed possesses maximum vigour at the time of physiological maturity, thereafter in viability and vigour of seed decline gradually Thus, the preparation of seed with high vigour is essential to improve seed storability and seedling establishment which ultimately enhance the productivity under wide range of field conditions. Pre sowing seed treatments with growth regulators, agro-chemicals, fungicides, water etc. have been reported to increase seed quality initially in terms of higher germination and vigour of several crops. Priming treatments have been reported to offer promising means for maintaining the quality of different crop species. Various treatments involving hydration-dehydration or pre sowing treatments with different chemicals – $CaCl_2$ and KNO_3 for increasing the storage of seeds life have been found beneficial. Therefore, a laboratory study was carried out to assess the influence of various priming treatments on shoot and root length of French marigold seeds.

Materials and Methods

A good quality seed is an essential requirement for obtaining higher yields per unit area. To assess the seed quality during storage this research was conducted in laboratory of Seed Science and Technology department, CCS Haryana Agricultural University. The research was planned to determine the ageing, priming and enzyme activity on seed quality parameters of marigold seeds under natural and artificial aged conditions. An effort was made to assess effect of priming treatments on seed quality during storage and the effect of accelerated ageing on primed seed genotypes during storage. The seed material for the present investigation was collected from Horticulture farm, Department of Horticulture CCS Haryana Agricultural University Hisar. The study was carried out on marigold seeds of four lines which were harvested during April. The harvested seeds of different lines (MGH208, MGH205, MGH207 and Hissar Jafri) were designated as Genotype-1; Genotype-2; Genotype-3; and Genotype-4, respectively.

Treatments

The seeds of various genotypes (G-1, G-2, G-3 and G-4) were harvested in 16th April and after processing the seeds were primed and observations were recorded at two months interval upto February (2017).

T0 - Untreated (control)
T1 – Hydration (Soaking for 6 h) and dehydration at room temperature
T2 – 2%$CaCl_2$ (Soaking for 6 h) and dehydration at room temperature.
T3 – 4% $CaCl_2$ (Soaking for 6 h) and dehydration at room temperature.
T4 – 0.5% KNO_3 (Soaking for 6 h) and dehydration at room temperature.
T5 – 1% KNO_3 (Soaking for 6 h) and dehydration at room temperature.
T6 – 2% Mannitol (Soaking for 6 h) and dehydration at room temperature.
T7– 4% Mannitol (Soaking for 6 h) and dehydration at room temperature.
T8 – 6% Mannitol (Soaking for 6 h) and dehydration at room temperature.

Table-1 *Effect of priming treatments on shoot length of marigold seeds*

Storage duration In months	Seed genotypes	Shoot length (cm)									Mean (cm)
		Priming treatments									
		T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T8	
0	G-1	8	7.1	8.1	9.1	11.2	10	8.5	7.1	6.5	8.4
	G-2	7.833	6.1	7.6	7.9	9.2	8.7	7.1	7.1	6.1	7.515
	G-3	7.833	6.4	7.6	8.5	10.9	9.4	7.4	6.2	6.47	7.856
	G-4	8.8	7.8	8.8	10.7	12.5	11.2	9	8.5	7	9.367
Mean		8.117	6.85	8.025	9.05	10.95	9.825	8	7.225	6.518	
2	G-1	7	6.1	7.1	8.1	9.267	9	7.5	6.1	5.5	7.296
	G-2	6.9	5.1	6.6	6.9	8.2	7.7	6.1	5.1	5.1	6.411
	G-3	7.1	5.4	6.6	7.5	8.9	8.4	6.4	5.467	5.467	6.804
	G-4	7.8	6.8	7.8	8.7	10.5	9.2	8	7.5	6	8.033
Mean		7.2	5.85	7.025	7.8	9.217	8.575	7	6.042	5.517	
4	G-1	5.7	5	6	6.7	7.2	6	6.7	5.4	5.2	5.989
	G-2	5.3	4.1	5.1	5.8	6.6	6.3	4.9	4.2	3.733	5.115
	G-3	5.3	4.7	5.4	6.2	7	6.3	5.3	6.133	4.1	5.604
	G-4	6.4	5.333	6.7	7	8.1	7.3	7.233	6.9	5.9	6.763
Mean		5.675	4.783	5.8	6.425	7.225	6.475	6.033	5.658	4.733	
6	G-1	5.133	4.133	4.7	5.7	6.7	5.2	5.633	5.067	4.1	5.152
	G-2	4.1	3.133	3.9	4.8	5.8	5.133	4.2	3.8	3.4	4.252
	G-3	4.2	3.3	4.1	5.133	6.3	5.4	4.8	4.2	3.9	4.593
	G-4	6.067	4.933	5.9	6.133	7.2	6.233	6.1	5.7	3.5	5.752
Mean		4.875	3.875	4.65	5.442	6.5	5.492	5.183	4.692	3.725	
8	G-1	3.233	2.8	4.2	4.7	5.5	4.333	4.3	4.3	3.467	4.093
	G-2	2.133	1.567	3.2	3.233	3.2	3.1	1.8	1	1	2.248
	G-3	2.5	1.7	3.2	3.333	4.2	3.5	2.7	2.133	1.5	2.752
	G-4	4.133	3.3	4.7	5.2	6.133	6.167	5.233	4.7	3.5	4.785
Mean		3	2.342	3.825	4.117	4.758	4.275	3.508	3.033	2.367	
10	G-1	1.5	1.833	2.8	3.2	4.3	2.7	2.933	1.5	1	2.419
	G-2	1.5	1.4	1.8	2.033	2.2	1.833	1.5	0.9	0.9	1.563
	G-3	1.8	1.267	2.133	2.3	2.8	2.267	1.8	1.5	1.4	1.919
	G-4	1.333	2.7	3.133	3.7	4.533	3.9	3.3	2.5	1.5	2.956
Mean		1.533	1.8	2.467	2.808	3.458	2.675	2.383	1.6	1.2	
C.D. at 5%											
Genotype = 1.464		Genotype= 0.734				Genotype=0.617					
Treatment = 2.196		Treatments=0.101				Treatments =0.925					
Genotype X Treatments =NS		Genotype X Treatments = 2.203				Genotype X Treatments=1.850					
Genotype =0.662		Genotype=0.879				Genotype=0.866					
Treatment = 0.319		Treatments=1.318				Treatments =1.299					
Genotype X Treatments =0.637		Genotype X Treatments =2.636				Genotype X Treatments =2.598					

Method of application of priming treatments

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.

Root and Shoot length (cm)

The root and shoot length of five randomly selected seedlings were measured in centimetres in all three replications at the termination of standard germination test period.

Results

Shoot length

The perusal of [Table-1] revealed that fresh seeds treated with 0.5% KNO_3 exhibited significantly higher shoot length (10.950cm) during 0 month storage. In 2, 4, 6, 8 and 10 months storage duration, significantly maximum shoot length was observed in T4 (9.217cm, 7.225 cm, 6.500 cm, 4.758 cm and 3.458 cm) respectively. Maximum shoot length was observed in G-4(9.36cm) which was followed by G-1 (8.40 cm) and G-3 (7.85cm) during 0 month storage. In 2, 4, 6, 8 and 10 months storage duration, significantly maximum shoot length was observed in G-4 (8.03cm, 6.763cm, 5.752cm, 4.785cm and 2.956cm) respectively. The highest shoot length was observed in T4and G-4 interaction (12.500cm) during 0 month storage. In 2, 4, 6, 8 and 10 months storage duration, significantly maximum shoot length was observed in T4 and G-4 interaction (10.500 cm, 8.100 cm,7.200 cm, 6.133 cm and 4.533 cm) respectively.

Root length

The fresh seeds treated with 0.5% KNO_3 exhibited significantly higher root length (4.625cm) over the other treatments during 0 month storage [Table-2]. In 2, 4, 6, 8 and 10 months storage duration, significantly maximum root length was observed in T4 (4.175cm, 3.908 cm, 3.275 cm, 2.158 cm and 0.983 cm) respectively. Maximum root length was recorded in G-4(4.877cm) which was followed by G-1 (4.709 cm) and G-3 (4.350 cm) during 0 month storage. In 2, 4, 6, 8 and 10 months storage duration, significantly maximum root length was observed in G-4 (3.933 cm, 3.315 cm, 2.644cm, 1.959 cm and 0.937 cm) respectively. The root length observed in T4and G-4 interaction was non significant in 4 and 6 month storage. In 2, 8 and 10 months storage duration, significantly maximum root length was observed in T4 and G-4 interaction (5.133 cm, 2.900 cm and 1.500 cm) respectively.

Discussion

Shoot length

Effects of priming treatments on shoot length of marigold seeds have been depicted in [Table-1]. It was observed that treatment T4 (0.5% KNO_3) and G-4 was highly significant compared to all other treatments and genotypes respectively. Similar results were observed over the storage duration. The results are in concurrent with the finding of [2] (2011) in tomato seeds. The better performance of KNO_3 might be due to lower electrical conductivity of seed leachates, higher total and reducing sugars along with increase in alpha-amylase activity. Similar results were obtained by [3] in lentil seeds.

Table-2 *Effect of priming treatments on root length of marigold seeds*

Storage duration	Seed genotypes	Root length (cm)									Mean (cm)
		Priming treatments									
In months		T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T8	
0	G-1	5.1	4.223	4.5	4.8	6.5	5	4.2	4.03	4.03	4.709
	G-2	4.3	4.1	3.9	4.3	4.16	4.1	3.9	3.2	3.5	3.94
	G-3	4.7	4.43	4.2	4.3	5.9	4.1	4.22	3.5	3.8	4.35
	G-4	4.5	4.8	4.9	5.367	6.13	5.3	5.1	4.13	3.667	4.877
Mean		4.65	4.388	4.375	4.692	5.673	4.625	4.355	3.715	3.749	
2	G-1	4.1	3.233	3.5	3.8	4.5	4	3.2	3.033	3.033	3.6
	G-2	3.3	3.1	2.9	3.3	3.167	3.1	2.9	2.3	2.5	2.952
	G-3	3.7	3.433	3.2	3.3	3.9	3.1	2.9	2.5	2.8	3.204
	G-4	4.5	3.8	3.9	4.233	5.133	4.3	3.4	3.133	3	3.933
Mean		3.9	3.392	3.375	3.658	4.175	3.625	3.1	2.742	2.833	
4	G-1	3.4	2.9	2.867	3.1	4.2	3.6	2.9	2.8	2.3	3.119
	G-2	3	2.5	2.3	2.8	3.5	2.967	2.4	2.033	2.2	2.633
	G-3	3.2	2.5	2.5	2.8	3.533	3.333	2.4	2.133	2.5	2.767
	G-4	3.9	3.067	3.067	3.3	4.4	3.7	3	2.8	2.6	3.315
Mean		3.375	2.742	2.683	3	3.908	3.4	2.675	2.442	2.4	
6	G-1	2.4	1.9	2.3	2.7	3.4	3.2	2.6	1.7	1.5	2.411
	G-2	2	1.733	1.8	2.2	2.8	2.5	1.5	1.1	1.233	1.874
	G-3	2.1	1.7	2.2	2.4	3.2	3.1	1.8	1.4	1.167	2.119
	G-4	2.567	2.233	2.5	2.9	3.7	3.4	2.5	2.1	1.9	2.644
Mean		2.267	1.892	2.2	2.55	3.275	3.05	2.1	1.575	1.45	
8	G-1	1.5	1.033	1.7	1.7	2.5	2	1.033	1.5	0.8	1.53
	G-2	0.533	0.333	0.7	1	1.533	0.8	0.533	0.9	0.6	0.77
	G-3	0.7	0.333	1.2	1	1.7	0.667	0.8	0.7	0.7	0.867
	G-4	1.567	1.533	2	2.3	2.9	2.7	1.3	1.833	1.5	1.959
Mean		1.075	0.808	1.4	1.5	2.158	1.542	0.917	1.233	0.9	
10	G-1	0.533	0.233	0.5	1	1.1	1.1	0.333	0.8	0.7	0.7
	G-2	0.3	0.233	0.433	0.5	0.533	0.5	0.333	0.333	0.233	0.378
	G-3	0.333	0.333	0.533	0.733	0.8	0.7	0.533	0.433	0.433	0.537
	G-4	0.5	0.333	1.333	1.3	1.5	1.1	1.033	0.8	0.533	0.937
Mean		0.417	0.283	0.7	0.883	0.983	0.85	0.558	0.592	0.475	
C.D. at 5%											
Genotype = 0.085		Genotype= 0.141				Genotype=0.144					
Treatment = 0.128		Treatments=0.212				Treatments =0.216					
Genotype X Treatments =0.256		Genotype X Treatments = NS				Genotype X Treatments=NS					
Genotype =0.135		Genotype=0.130				Genotype=0.103					
Treatment = 0.203		Treatments=0.195				Treatments =0.154					
Genotype X Treatments =NS		Genotype X Treatments =0.390				Genotype X Treatments =0.308					

Root length

Effect of priming treatments on root length of marigold seeds can be observed in [Table-2]. It was observed that treatment T4 (0.5%KNO_3) was highly significant compared to all other treatments whereas genotype G-4 was highly significant compare to all other genotypes. During the storage months same trend was noticed. Results are in agreement with the finding of [3] in lentil seeds. The better performance of KNO_3 might be due to its accumulation in the embryo and during priming the embryo expands and compresses the endosperm. The compression force of embryo and hydrolytic activities on the endosperm cell walls may deform the tissues that have lost their flexibility upon dehydration, producing free space and facilitating root protrusion after rehydration and due to the presence of essential nutrients such as nitrate and potassium, priming with KNO_3 can lead to further growth of primed seedlings. Similar results were reported by [4] in calendula seeds.

Summary

Seeds were primed with various priming treatments viz 0.5 and 2% KNO_3, 2 and 4% $CaCl_2$, 2, 4 and 6% Mannitol, control and dehydration. Treatment T4 (0.5% KNO_3) exhibited higher shoot length and root length as compared to other treatments and Seed genotype-4 was found to be performing significantly better shoot and root length than rest of genotypes.

Conclusion

Fresh seeds were tested for various vigour and viability parameters in a completely randomized design with three replications. The statistical analysis of data for various parameters was carried out according to the standard procedure.

Application of research: The research has practical utility in the field of floriculture. The results of this study implicate that seed priming improve the germination rate and improve the root and shoot length.

Research Category: Floriculture

Abbreviations: KNO_3: Potassium nitrate, $CaCl_2$: Calcium chloride

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Study area / Sample Collection: CCS Haryana Agricultural University, Hisar

Cultivar / Variety / Breed name: MGH208, MGH205, MGH207 and Hissar Jafri

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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