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Studies on seed germination and seedling evaluation of tuberose (*Polianthes tuberosa* L.) hybrids

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Abstract

The experiment was conducted in the Division of Floriculture and Medicinal crops, Indian Institute of Horticultural Research, Bengaluru, to study seed germination and evaluate the seedling performance. Among the different cross combinations, the seeds obtained from the cross IIHR-6 x Mexican Single recorded highest seed germination (72.00%) and the maximum number of days for germination was observed in the seeds obtained from Arka Nirantara x IIHR-6 (46.50 days) whereas the seeds of IIHR-6 x Arka Nirantara germinate the earliest (32.00 days). Arka Sugandhi x IIHR-6 seeds gave the maximum shoot length (16.40 cm) whereas IIHR-6 x Arka Nirantara seeds gave maximum root length (4.89 cm). Vigour index was the highest in the seeds obtained from the cross IIHR-6 x Mexican single (1242.14).

Keywords: Germination, seedling evaluation, tuberose, *Polianthes tuberosa* L.

Introduction

Tuberose (*Polianthes tuberosa* L.) is an ornamental bulbous flower crop belonging to the family Asperagaceae. It is an important flower crop used for different ornamental purposes. Tuberose is native to Mexico and is grown in several parts of tropical and sub-tropical countries (Bailey, 1919). It is a valuable source of essential oil which is largely exploited in perfumery industry. The average yield of concrete from tuberose flowers is 0.08 to 0.14% of which nearly 18.00 to 23.00% constitute the alcohol-soluble absolute (Sadhu and Bose, 1973) [8].

Tuberose is commercially propagated by bulbs and bulblets and the seeds of tuberose genotypes are known to exhibit low percentage of germination (Hemanta, 2015) [3]. However, hybrid development for crop improvement depends on seed production and is required to create the necessary variation in crops. Seed germination varies with genotype, prevalent temperatures during seed development and the level of maturation at harvest (de Vries and Dubois 1987) [2]. The seed and seedling performance also depends on the parental genotypes as well as the climatic conditions. Thus, detailed information can be generated regarding the seed germination and seedling performance for further evaluation, standardization and enhancement of seed germination.

Material and Methods

Six single tuberose genotypes viz Arka Shringar, Arka Nirantara, Arka Sugandhi, IIHR-6, Mexican Single and Variegated maintained at the Division of Floriculture and Medicinal crops, IIHR, Bengaluru, were taken up for the experiment. Direct and reciprocal crossing was made between the six genotypes with a total cross combination of 30. The matured seeds were collected from the pods and sown *in vivo* in pro- trays filled with soil, sand and coco-peat. Completely Randomized Design (CRD) design was used for the experiment with 4 replications. Observations like germination percentage (%), number of days for seed germination, number of leaves, number of roots, shoot length (cm), root length (cm) and seedling vigour index were taken. The vigour index of the seedling was calculated using the formula mentioned by Baki and Anderson (1973) i.e vigour index= germination percentage x (root length + shoot length).

Results and Discussion

The results obtained for the experiment are presented in Table 1-6. Among the genotypes, highest germination percentage was observed in IIHR-6 when crossed with Mexican Single (72.00%) and lowest in Variegated x Arka Nirantara (18.67%). The highest mean seed germination was observed when Arka Sugandhi was used as seed parent (45.87%). Seed germination of 90% was recorded by Seetharamu (1993) [9], whereas, Krishnamoorthy

(2014) [4] recorded the highest germination percentage of 16.50% in the cross Arka Shringar x Mexican Single. Hemanta (2015) [3] had also recorded a maximum of 26% seed germination and maximum germination of 66% was noticed when fresh seeds of tuberose were sown (Raja *et al.*, 2003) [7]. The germination per cent could be influenced by the parental genotypes, their genetic makeup as well as the prevailing temperature during the growing period.

The growing environmental condition also determines the germination rate of the seeds and the maximum number of days taken for seed germination was observed in the seeds of Arka Nirantara (46.50 days) when crossed with IIHR-6 as the male parent and the seeds of IIHR-6 x Arka Nirantara recorded to germinate the earliest (32.00 days). Ranchana and Kannan (2016) [6] recorded 53.64 days for seeds germination of Single x Variegated but Seetharamu (1993) [9] recorded lesser days for seed germination (17.00 days). The results are in conformity with the findings of Uma (1990) [10] in tuberose. The seed germination as recorded by Raja *et al.* (2003) [7] started at 22 days after sowing and completed at 55 days after sowing.

The shoot length was noticed to be the highest in the seedling obtained from Arka Sugandhi x IIHR-6 (16.40 cm) and lowest

in the seedling from Variegated x Arka Nirantara (8.95 cm). The mean shoot length was observed to be the highest in the seedlings obtained from Arka Nirantara (13.24 cm). The root length also showed variation among the different crosses. It was noticed to be the highest in the seedling obtained from IIHR-6 x Arka Nirantara (4.89 cm) and lowest in the seedling from Arka Sugandhi x Arka Nirantara (2.14 cm). The mean root length was observed to be the highest in the seedlings obtained from Nirantara (3.49 cm). Mean shoot length of 8.32 cm and root length of 9.05 cm was recorded by Ranchana (2013) [5] in tuberose.

The vigour index of the seedlings from various cross combinations was recorded maximum in IIHR-6 x Mexican single (1242.14) and minimum in Variegated x Arka Nirantara (226.34). The maximum mean vigour index was observed in the seedlings obtained from Arka Nirantara (754.22). Ranchana (2013) [5] recorded a mean seedling vigour index of 780.71 among the seedlings of tuberose whereas 379 were reported in case of China aster (Tirakannanavar *et al.*, 2015). The variation in seedling vigour index depends upon the roots and shoots length of the seedlings and the relative length of root and shoot of seedlings would predict their subsequent growth and performance.

Table 1: Studies on seed germination and seedling parameters using Arka Shringar as seed parent

Cross combination	Germination %	Mean No. days for germination	No. of leaves	No. of roots	Shoot length (cm)	Root length (cm)	Seedling vigour index
Arka Shringar x IIHR-6	44.00 (6.60)	34.00	1.75	1.52	9.00	3.25	596.87
Arka Shringar x Mexican Single	30.67(5.54)	38.75	2.15	1.25	12.13	2.39	443.95
Arka Shringar x Variegated	28.00 (5.13)	37.25	2.00	1.42	11.83	2.76	405.87
Arka Shringar x Arka Sugandhi	56.00 (7.48)	40.25	2.42	1.75	12.39	2.83	863.72
Arka Shringar x Arka Nirantara	45.34 (6.72)	32.25	1.88	1.42	13.74	3.38	657.33
Mean	40.80	36.50	2.04	1.47	11.82	2.92	593.55
Range	28.00-56.00	32.25-40.25	1.75-2.42	1.25-1.75	9.00-13.74	2.39-3.38	405.87-863.72
CV %	13.10	8.75	11.56	22.60	16.39	35.50	23.67
SE(d)	0.67	2.26	0.17	0.24	1.37	0.73	114.70
CD (p=0.05)	1.44	4.73	0.35	NS	2.87	NS	246.03

NS: Non-significant; Parentheses: Square root transformed data

Table 2: Studies on seed germination and seedling parameters using Arka Nirantara as seed parent

Cross combination	Germination %	Mean No. days for germination	No. of leaves	No. of roots	Shoot length (cm)	Root length (cm)	Seedling vigour index
Arka Nirantara x Arka Shringar	32.00 (5.50)	35.00	2.00	1.33	14.15	2.65	645.29
Arka Nirantara x IIHR-6	38.67 (6.18)	46.50	2.88	2.13	11.52	4.84	602.11
Arka Nirantara x Mexican Single	44.00 (6.60)	33.00	2.00	1.21	14.83	3.04	814.71
Arka Nirantara x Variegated	66.67 (8.16)	40.25	2.25	1.75	13.98	3.96	1228.51
Arka Nirantara x Arka Sugandhi	32.00 (5.65)	43.25	2.21	1.33	11.72	2.96	480.47
Mean	42.67	39.60	2.27	1.55	13.24	3.49	754.22
Range	32.00-66.67	33.00-46.50	2.00-2.88	1.21-2.13	11.52-14.83	2.65-4.84	480.47-1228.51
CV %	14.36	10.28	11.15	16.77	10.48	46.28	28.55
SE(d)	0.75	2.88	0.18	0.18	0.98	1.14	175.84
CD (p=0.05)	1.61	6.02	0.37	NS	2.05	2.39	377.18

NS: Non-significant; Parentheses: Square root transformed data

Table 3: Studies on seed germination and seedling parameters using Arka Sugandhi as seed parent

Cross combination	Germination %	Mean No. days for germination	No. of leaves	No. of roots	Shoot length (cm)	Root length (cm)	Seedling vigour index
Arka Sugandhi x Arka Shringar	50.67 (7.11)	36.25	2.25	1.50	10.91	3.15	701.83
Arka Sugandhi x IIHR-6	61.34 (7.83)	36.50	2.00	1.25	16.40	2.56	1193.58
Arka Sugandhi x Mexican Single	26.67 (5.10)	43.00	2.25	1.71	12.01	2.49	369.82
Arka Sugandhi x Variegated	45.34 (6.73)	38.75	2.00	1.50	12.09	3.31	704.02
Arka Sugandhi x Arka Nirantara	45.34 (6.71)	36.75	1.85	1.15	10.96	2.14	642.36
Mean	45.87	38.25	2.07	1.42	12.48	2.73	722.32
Range	26.67-61.34	36.25-43.00	1.85-2.25	1.15-1.71	10.91-16.40	2.14-3.31	369.82-1193.58
CV %	22.84	7.49	8.10	21.19	8.96	25.80	16.76
SE(d)	0.99	2.03	0.12	0.21	0.79	0.50	98.86
CD (p=0.05)	2.12	4.24	0.25	NS	1.65	NS	212.05

NS: Non-significant; Parentheses: Square root transformed data

Table 4: Studies on seed germination and seedling parameters using IIHR-6 as seed parent

Cross combination	Germination %	Mean No. days for germination	No. of leaves	No. of roots	Shoot length (cm)	Root length (cm)	Seedling vigour index
IIHR-6 x Arka Shringar	26.67 (5.03)	35.00	2.42	1.54	11.14	3.84	386.96
IIHR-6 x Mexican Single	72.00 (8.48)	35.00	2.17	1.67	13.40	3.10	1242.14
IIHR-6 x Variegated	33.34 (5.55)	33.50	2.13	1.65	13.42	2.50	559.20
IIHR-6 x Arka Sugandhi	25.34 (4.81)	38.25	2.13	1.38	12.47	2.62	463.67
IIHR-6 x Arka Nirantara	45.34 (6.71)	32.00	2.83	2.58	14.38	4.89	860.64
Mean	40.53	34.75	2.33	1.76	12.96	3.39	702.52
Range	25.34-72.00	32.00-38.25	2.13-2.83	1.54-2.58	11.14-14.38	2.50-4.89	386.96-1242.14
CV %	23.25	6.21	14.29	25.22	9.37	29.77	37.63
SE(d)	1.17	1.52	0.24	0.31	0.86	0.71	215.86
CD (p=0.05)	NS	3.19	0.49	0.66	1.80	1.49	463.01

NS: Non-significant; Parentheses: Square root transformed data

Table 5: Studies on seed germination and seedling parameters using Mexican Single as seed parent

Cross combination	Germination %	Mean No. days for germination	No. of leaves	No. of roots	Shoot length (cm)	Root length (cm)	Seedling vigour index
Mexican Single x Arka Shringar	52.00 (7.19)	39.25	2.58	1.67	13.86	2.20	812.10
Mexican Single x IIHR-6	57.34 (7.56)	44.25	2.08	1.50	14.55	2.92	1032.69
Mexican Single x Variegated	34.67 (5.80)	44.00	1.96	1.50	11.47	2.58	483.33
Mexican Single x Arka Sugandhi	26.67 (5.14)	38.75	2.29	1.46	12.15	2.49	396.00
Mexican Single x Arka Nirantara	24.00 (4.89)	40.00	2.38	1.33	11.60	4.05	375.67
Mean	38.93	41.25	2.26	1.49	12.73	2.85	619.96
Range	24.00-57.34	38.75-44.25	1.96-2.58	1.33-1.67	11.47-14.55	2.20-4.05	375.67-1032.69
CV %	12.45	6.45	16.20	29.24	9.42	24.89	23.63
SE(d)	0.62	1.88	0.26	0.31	0.85	0.50	119.61
CD (p=0.05)	1.33	3.94	0.54	0.65	NS	NS	256.57

NS: Non-significant; Parentheses: Square root transformed data

Table 6: Studies on seed germination and seedling parameters using Variegated as seed parent

Cross combination	Germination %	Mean No. days for germination	No. of leaves	No. of roots	Shoot length (cm)	Root length (cm)	Seedling vigour index
Variegated x Arka Shringar	33.34 (5.73)	36.75	1.92	1.08	12.03	3.51	516.79
Variegated x IIHR-6	34.67 (5.84)	35.50	2.25	1.83	11.22	3.07	484.69
Variegated x Mexican Single	49.34 (7.02)	38.75	2.00	1.40	12.92	2.36	782.57
Variegated x Arka Sugandhi	65.34 (8.08)	40.75	2.25	1.25	12.49	2.43	1000.88
Variegated x Arka Nirantara	18.67 (4.20)	43.50	1.75	1.08	8.95	2.89	226.34
Mean	40.27	39.05	2.03	1.33	11.52	2.85	602.25
Range	18.67-65.34	35.50-43.50	1.75-2.25	1.08-1.83	8.95-12.92	2.36-3.51	226.34-1000.88
CV %	13.09	6.42	16.39	35.93	10.77	28.10	19.31
SE(d)	0.66	1.77	0.24	0.34	0.88	0.57	94.98
CD (p=0.05)	1.42	3.71	0.49	NS	NS	NS	203.73

NS: Non-significant; Parentheses: Square root transformed data

Conclusion

The experiment conducted showed that the seed germination and seedling performance differs among the various cross combinations and may depend on the temperature and other climatic conditions. This result could be used to assess the seedling quality of tuberose genotypes and further improve the seed germination of tuberose hybrids.

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