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Influence of ga₃ and storage period of seed on germination parameters of Rangpur lime

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Abstract

An experiment on “Influence of GA₃ and storage period of seed on germination of rangpur lime” was conducted during August-November (2025) at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. The experiment was laid out in a completely randomized design with factorial arrangement (CRD), comprising twelve treatment combinations, each repeated three times. Treatments comprise four levels of GA₃ concentrations, viz., G₁: Water (control), G₂: 50 ppm GA₃, G₃: 100 ppm GA₃ and G₄: 150 ppm GA₃ with three levels of seed storage period, viz., S₁: 0 day after seed extraction, S₂: 15 days after seed extraction, and S₃: 30 days after seed extraction. Rangpur lime seeds treated with 150 ppm GA₃ required minimum number of days (15.89) for germination and the same treatment also exhibited significantly maximum germination (76.67%), survival rate (82.50%), highest Vigour index-I (2011 & 2879 cm) and vigour index-II (77.51 & 159.11 g) at 60 and 90 DAS, respectively. Sowing of freshly extracted seeds (S₁) exhibited significantly maximum germination (94.79%), survival rate (88.84%), yielded maximum vigour index-I (2658 & 3808 cm) vigour index-II (103.33 & 212.67 g) at 60 and 90 DAS, respectively, taking minimum number of days (13.58) for germination.

Keywords: Citrus, Rangpur lime, seed treatment, GA₃, seed storage period, germination parameters

Introduction

Rangpur lime (*Citrus limonia* Osbeck) of the Rutaceae family is originated from the Indian subcontinent, particularly the Rangpur region of *Bangladesh*. According to genomic studies, it is a first generation hybrid of a female citron (*Citrus medica*) and a male mandarin orange (*Citrus reticulata*). This variety is extremely productive, producing well flavored acidic fruits. Rangpur lime is called the “chameleon of citrus” because of its orange like appearance and lime like flavor. Rangpur lime contains tart, acidic profile and it is more sour than other limes. It has sweet mandarin like flavour. Rangpur lime is rich in vitamin C, antioxidants, potassium, calcium and dietary fiber. Regular consumption of Rangpur lime can significantly boost immune function, help combat vitamin C deficiencies and improve iron absorption from plant-based diets.

Rangpur lime is tolerant to Citrus tristeza virus (CTV) but it is susceptible to Citrus exocortis viroid (CEVd) and Citrus sudden death associated virus (SCDaV) (Fadel *et al.* 2018) [7]. Rangpur lime is healthy, productive, semi vigorous, tolerant to salt and greening diseases (Benett and Costa, 1949) [1]. Seedlings of Rangpur lime have a slow growth rate (Kawthalkar and Kunte, 1974) [10]. The growth regulators like NAA and GA₃ have been widely used for pre-sowing seed treatment to increase germination and to accelerate vegetative seedling growth in the genus *Citrus* (Eshuys, 1975) [6]. Gibberellins stimulate the germination process (Domingues *et al.* 2017) [5] and promote seedling growth. Nurseries face challenges because of the short viability period of seeds and low germination rates, when seeds are stored at room temperature. Hence, the integration of both GA₃ and seed storage period has been performed in the current study.

Materials and Methods

The experiment was conducted in the net house at the Horticulture Research Farm and Nursery,

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B. A. College of Agriculture, Anand Agricultural University, Anand, during the August-November (2025) to assess the Influence of GA₃ and storage period of seed on germination of Rangpur lime. The experiment followed a Completely Randomized Design (Factorial) concept with three repetitions, involving four GA₃ concentrations (Water, 50 ppm, 100 ppm & 150 ppm) and three seed storage duration (0, 15 & 30 days after seed extraction) forming 12 treatments combination. A total 1440 seed were sown in 3 × 2 inch polybags filled with soil, sand and FYM (2:1:1) mixture. Seed were stored in cloth bag at ambient temperature. For seed treatment, seed were soaked in GA₃ solution for 12 hrs before sowing.

Results and Discussion

The data presented in Table 1 show that GA₃ treatment and seed storage period had significant influence on germination parameters of Rangpur lime. Observations were recorded from five randomly selected seedling from each treatment. The observed parameter data were analysed according to the statistical procedures outlined by Panse and Sukhatme (1967) [15].

Influence of GA₃ on Germination parameters of Rangpur Lime

Days taken for germination

Treatment G₄ required the shortest period (15.89 days) for the germination while longest time (17.78 days) was taken by treatment G₁ for initiation of germination.

Germination Percentage

Treatment G₄ exhibited the highest germination rate (76.67%), whereas treatment G₁ resulted in lowest germination rate (71.94%). The promotive effect of GA₃ on seed germination might be due to its ability to function as a plant growth regulator by stimulating the embryo to produce hydrolytic enzymes such as amylase and protease, which break down stored food reserves, making nutrients available for the developing embryo, which in turn promotes seed germination and enhances early growth. Similar results were found by Meshram *et al.* (2015) [12] in acid lime and Dilip *et al.* (2017) [14] in kagzi lime.

Survival Percentage

Treatment G₄ exhibited the highest mean survival rate (82.50%) among all other treatments. Treatment G₁ recorded the lowest mean survival rate (76.53%). A higher survival percentage of seedlings might be due to the power of GA₃ to initiate the enzymatic energy mobilization for faster germination, which reduces the amount of time in the vulnerable state of the plant. These results are in agreement with Panda *et al.* (2018) [14] in kagzi lime and Parmar *et al.* (2019) [16] in lime.

Vigour index-I

Treatment G₄ yielded significantly highest vigour index-I (2011 & 2879 cm) while treatment G₁ resulted in lowest vigour index-I (1635 & 2455 cm) at 60 and 90 DAS, respectively. Higher vigour index-I might be due to the increased growth of seedling resulting from the stimulatory effect of GA₃ hormone. These results are in conformity with the finding of Patil *et al.* (2012)

[17] in Rangpur lime.

Vigour index-II

Treatment G₄ resulted in the highest vigour index-II (77.51 & 159.11 g), while the lowest value of vigour index-II (64.81 & 134.94 g) was found with treatment G₁ at 60 and 90 DAS, respectively. The increase in vigour index-II might be attributed to the higher germination percentage and greater seedling dry weight observed in seeds treated with 150 ppm GA₃. Results are in agreement with Mistry (2019) [13] in karonda and Suthar *et al.* (2021) [18] in acid lime.

Influence of storage period of seed on germination parameters of Rangpur lime

Days Taken for Germination

The treatment S₁ took minimum number of days (13.58), while treatment S₃ required maximum number of days (21.25) for the initiation of germination which can be due to the higher vigour and absence of the dormancy in fresh seeds. The results are consistent with those reported by Kadam (1982) [8] in Rangpur lime.

Germination Percentage

Treatment S₁ showed an optimum germination (94.79%). While the treatment S₃ resulted in minimum germination (38.75%). Loss in seed viability might be associated with increased electrolyte leakage resulting from decreased moisture levels during seed storage. Similar result was observed by Khopkar *et al.* (2014) [11] in pummelo.

Survival percentage

Treatment S₁ demonstrated the maximum average survival rate (88.84%), in contrast, treatment S₃ result in the lowest mean survival rate (71.49%). Higher survival percentage of freshly extracted seeds might be due to their increasing vigour, moisture content and nutrient reserve than stored seeds. Similar trends were reported by Chaudhari (2020) [3] in jackfruit.

Vigour index-I

Treatment S₁ resulted in the highest vigour index-I (2658 & 3808 cm), while the least vigour index-I (737 & 1140 cm) was found with treatment S₃ at 60 and 90 DAS, respectively. An increase in the vigour index-I might be due to a significantly higher germination rate and increased height of seedlings that are grown from the freshly extracted seeds. Similar observation was reported by Kaur & Kaur (2019) [9] in karonda.

Vigour index-II

Treatment S₁ recorded the significantly highest vigour index-II (103.33 & 212.67 g), while the lowest value of vigour index-II (29.32 & 60.26 g) was found in treatment S₃ at 60 and 90 DAS, respectively. Higher vigour index-II of fresh seeds might be attributed to their undepleted food reserves, leading to higher germination and greater seedling dry weight accumulation compared to stored seeds that suffer from metabolic aging and nutrient exhaustion. Similar finding was reported by Chandana *et al.* (2023) [2] in karonda.

Table 1: Influence of GA₃ and storage period of seed on germination parameters of Rangpur lime

Treatment	Days taken for germination	Germination percentage (%)	Survival Percentage (%)	Vigour index-I (cm)		Vigour index-II (g)	
				60 DAS	90 DAS	60 DAS	90 DAS
GA ₃ treatment (G)							
G ₁ : Water (Control)	17.78	71.94	76.53	1635	2455	64.81	134.94
G ₂ : 50 ppm GA ₃	17.56	73.33	78.67	1808	2577	69.29	139.28
G ₃ : 100 ppm GA ₃	16.67	74.44	79.94	1864	2643	72.70	147.88
G ₄ : 150 ppm GA ₃	15.89	76.67	82.50	2011	2879	77.51	159.11
S.Em ±	0.33	1.14	1.41	35.72	53.69	2.15	3.77
CD at (p=0.05)	0.96	3.34	4.13	104.25	156.70	6.27	10.73
Seed storage period (S)							
S ₁ : 0 day after extraction	13.58	94.79	88.84	2658	3808	103.33	212.67
S ₂ : 15 days after extraction	16.08	88.75	77.90	2094	2968	80.58	162.97
S ₃ : 30 days after extraction	21.25	38.75	71.49	737	1140	29.32	60.26
S.Em ±	0.28	0.99	1.23	30.93	46.49	1.86	3.27
CD at (p=0.05)	0.83	2.89	3.58	90.29	135.71	5.43	9.30
Interaction (G × S)							
S.Em ±	0.57	1.98	2.45	61.86	92.99	3.72	6.53
CD at (p=0.05)	NS	NS	NS	NS	NS	NS	NS
C.V%	5.81	4.64	5.35	5.86	6.10	9.07	7.79

Conclusion

Based on the findings of the present investigation, it can be concluded that the freshly extracted seeds soaked in 150 ppm GA₃ for 12 hrs took minimum number of days/ for germination and also resulted in the highest germination percentage, survival percentage, maximum vigour index-I and vigour index-II.

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