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Influence of storage period and growing media on seed germination and growth of acid lime seedlings (*Citrus aurantifolia* Swingle) Cv. Kagzi

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Abstract

An investigation entitled "Influence of storage period and growing media on seed germination and growth of acid lime seedlings (*Citrus aurantifolia* Swingle) cv. Kagzi" was conducted during the year *Kharif* - 2016 at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand. The treatments comprised four levels of storage period (S) viz., S₁- 0 day after seed extraction, S₂- 15 days after seed extraction, S₃- 30 days after seed extraction and S₄- 45 days after seed extraction and three levels of growing media (M) viz., M₁- Soil + Vermicompost (1:1), M₂- Soil + Cocopeat (1:1) and M₃- Soil + FYM (1:1). The experiment was laid out in a Completely Randomized Design (Factorial) with twelve treatment combinations and repeated thrice. Sowing of seed immediately after extraction (S₁) from fruits recorded minimum number of days (22.33) required for 50 percent germination, maximum germination percentage (70.50) 45 DAS and speed of germination (13.38) as well as growth parameters viz., maximum seedling height (50.99 cm), number of leaves per plant (26.07), root length (30.11 cm), shoot length (20.88 cm), dry weight of shoot (3.01 g), dry weight of root (1.56 g) and root : shoot ratio (0.52) at 120 DAS. Growing media M₂ recorded minimum days (30.33) for 50 percent germination, maximum germination percentage (63.27) at 45 DAS and speed of germination (12.47). At 120 DAS growing media M₁ recorded maximum seedling height (35.85 cm), number of leaves per plant (16.47), root length (22.72 cm), shoot length (13.13 cm), dry weight of shoot (1.66 g), dry weight of root (0.85 g) and root : shoot ratio (0.48). Treatment combination S₁M₂ recorded minimum days (18.00) for 50 percent germination with maximum germination percentage (74.55) at 45 DAS. Whereas, treatment combination S₁M₁ recorded maximum seedling height (53.7 cm), number of leaves per plant (30.87), shoot length (21.59 cm), dry weight of shoot (3.51 g) and dry weight of root (1.93 g) 120 DAS.

Keywords: Storage period, Growing media, Germination parameters, Growth parameters

Introduction

Citrus belongs to Rutaceae family and third most important fruit crop of India after mango and banana. Important species of citrus group is acid lime (*Citrus aurantifolia*) which is also known as kagzi lime or maxican lime or pati lime. India is the largest producer of acid lime in world. Kagzi lime seeds are recalcitrant in nature. The recalcitrant seeds impose serious storage problems due to their desiccation and chilling sensitivity (Chin and Roberts, 1980) [6]. These seeds undergo no maturation and drying during final phase of seed development and are thus shed in moist condition. Storage above critical level of time leads to loss of viability. Growing media play an important role in germination of seed and further growth of seedling. It is a substrate that provides, the required elements and physical support to the growing plants. Media should also have good water holding capacity, so that proper growth of seedling take place.

Nursery mane faces the problem of poor germination of kagzi lime seed which having short storage period and use of improper growing media for nursery raising. For overcoming such types of problems at nursery stage, investigation is important to find out the influence of storage period and growing media on seed germination and growth of acid lime seedlings. Keeping in view the foregoing consideration an investigation was carried.

Materials and Methods

The experiment was conducted in the Net House at the Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand during the *Kharif* - 2016. Seeds of fully ripe kagzi lime fruits were extracted manually and rubbed in ash to remove sticky material on seed.

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Seeds were sown immediately while remained seeds were stored in cloth bag at ambient condition. The seeds were stored in different lots for different sowing dates. Various growing media viz., soil, vermicompost, cocopeat and FYM were used in 1:1 proportion as a mixture for sowing seeds. Black polythene bags of 6" × 8" size were filled with (1:1) proportion for different mixture of growing media according to the treatments. One seed of acid lime was dibbled at about 2 to 3 cm depth in each polythene bag. For each replication 60 polyphone bags were filled and kept in net house having 75%

green shed net. Data on number of days required for 50 percent germination, germination percentage (At 45 DAS) and speed of germination were recorded. Growth parameters viz., seedling height (cm), number of leaves per plant, root length (cm), shoot length (cm), dry weight of shoot (g), dry weight of root (g), root : shoot ratio was recorded from five randomly selected plants at 60, 90 and 120 DAS and statically analysed.

Results and Discussion

Table 1: Influence of storage period and growing media on seed germination

Treatment	No. of days required for 50% germination	Germination % (At 45 DAS)	Speed of germination
Storage period (S)			
S ₁ 0 days after seed extraction	22.33	70.50	13.38
S ₂ 15 days after seed extraction	30.22	62.52	11.99
S ₃ 30 days after seed extraction	41.67	53.94	10.19
S ₄ 45 days after seed extraction	48.89	41.96	7.23
S.Em. ±	0.60	0.88	0.32
C.D. at 5%	1.75	2.56	0.93
Growing media (M)			
M1 Soil+ Vermicompost (1 : 1)	37.83	54.97	9.95
M2 Soil + Cocopeat (1 : 1)	30.33	63.27	12.47
M3 Soil + FYM (1 : 1)	39.17	53.46	9.67
S.Em. ±	0.52	0.76	0.28
C.D. at 5%	1.51	2.21	0.81
C.V%	5.02	4.59	8.95
S x M	Sig.	Sig.	NS

Table 1: Interaction effect of storage period and growing media on seed germination

S	M	Days required for 50 percent germination			Germination percentage (At 45 DAS)		
		M ₁	M ₂	M ₃	M ₁	M ₂	M ₃
S ₁		23.67	18.00	25.33	71.44	74.55	65.51
S ₂		31.67	26.67	32.33	57.11	68.77	61.67
S ₃		43.33	36.33	45.33	52.33	59.00	50.50
S ₄		52.67	40.33	53.67	39.00	50.74	36.15
S.Em ±		1.04			1.66		
C.D. at 5%		3.03			4.84		

Influence of Storage Period

Storage period showed the significant effect on germination parameters. Sowing of seed immediately after extraction (0 day after seed extraction) observed minimum number of days (22.33) for 50 percent germination, maximum germination percentage at 45 DAS (70.50) and speed of germination (13.38). This might be due to high moisture content of seed and high carbohydrates and protein reserves in the seeds which responsible for fast germination. Similar results were also recorded by Abbas *et al.* (2003) [1] in jamun, Khopkar *et al.* (2014) [9] in pummelo, Merlin and Palanisamy (2000) in jackfruit. Storage period also observed significant influence on growth parameters. Storage period S₁ recorded maximum seedling height (21.42, 35.23 and 50.99 cm, respectively), number of leaves per plant (7.63, 12.02 and 26.07, respectively), root length (13.69, 21.33 and 30.11 cm, respectively), shoot length (7.73, 13.90 and 20.88 cm, respectively), dry weight of shoot (0.39, 1.05 and 3.01 g, respectively), dry weight of root (0.18, 0.51 and 1.56 g, respectively) and root : shoot ratio (0.46, 0.49 and 0.52, respectively) at 60, 90 and 120 DAS. This might be due to freshly extracted seeds have more vigour, high moisture and more nutrient reserve resulted healthy and vigorous seedling. These results are in accordance with Deepika *et al.* (2014) in karonda, Khopkar *et al.* (2014) [9] in pummel and Srimathi *et al.* (2003) in jamun.

Influence of Growing Media

Growing media showed significant effect on germination attributes. Growing media M₂ recorded minimum days (30.33) for 50 percent germination, maximum germination percentage at 45 DAS (63.27) and speed of germination (12.47). It might be due to media M₂ having good water holding capacity and moisture supply as well as sufficient porosity which permit adequate moisture and gaseous exchange between media and seeds. Similar results were also obtained by Nagar *et al.* (2016) [11] and Arvind *et al.* (2015) [3] in papaya. Growing media exhibited significant effect on growth parameters. At 60 DAS growing media M₂ recorded maximum height of seedling (19.84 cm), root length (13.64 cm), dry weight of root (0.15 g) and root: shoot ratio (0.43). Whereas, at 60, 90 and 120 DAS growing media M₁ recorded maximum number of leaves per plant (6.43, 10.11 and 16.47, respectively) and shoot length (6.44, 10.70 and 13.13 cm, respectively). While, at 90 and 120 DAS growing media M₁ recorded maximum seedling height (29.45 and 35.85 cm), dry weight of shoot (0.72 and 1.66 g) and dry weight of root (0.34 and 0.85 g). It might be due to at initial stage soil and cocopeat improved soil texture, porosity, water holding capacity, activity of useful soil micro fauna and flora which maintained soil temperature which improved soil health and nutrient status of medium (Hartmann and Kester, 1997). While, at latter stage vermicompost which contain plant growth regulating

materials, such as humic acid and plant growth regulators like auxin, gibberellins and cytokinins, which are responsible for seedling growth (Atiyeh *et al.*, 2002) ^[4]. Similar results were also obtained by Bhardwaj (2014) ^[15] and Ramteke *et al.* (2015) in papaya.

Interaction Effect of Storage Period And Growing Media

Interaction effect of storage period and growing media showed the significant effect on germination parameters. Treatment combination S₁M₂ recorded minimum days (18.00) for 50 percent germination with maximum germination percentage at 45 DAS (74.55). This might be due to fresh seed having good vigour and moisture in early stage and media provided good moisture, aeration and water holding capacity which might shorten germination duration. Similar results were also found by Bhardwaj (2014) ^[15], Ramteke *et al.* (2015) and Arvind *et al.* (2015) ^[3] in papaya. Interaction effect of storage period and growing media showed the significant effect on growth parameters. Seedling height was remain non-significant at 60 DAS while it was found maximum (38.87 and 53.07 cm) at 90 and 120 DAS.

Treatment combination S₁M₂ found maximum at 60, 90 and 120 DAS for number of leaves per plant (8.63, 14.40 and 30.87, respectively) shoot length (8.68, 16.71 and 21.71 cm, respectively) and dry weight of shoot (0.41, 1.12 and 3.51 g, respectively). However, root length (15.60 cm) and dry weight (0.20 g) was recorded maximum in S₁M₁ combination at 60 DAS. Whereas, it was found maximum in S₁M₁ treatment combination (22.15 and 41.57 cm) and (0.55 and 1.93 g), respectively at 90 and 120 DAS. This might be due to high moisture content and vigour of seed and vermicompost which having growth regulating substances such as humic acid, auxin, gibberellin as well as due to supply more of nutrients to seedling. Similar results were also obtained by Bhardwaj (2014) ^[15], Ramteke *et al.* (2015) in papaya and Abirami *et al.* (2010) ^[2] in nutmeg.

Table 3: Influence of storage period and growing media on growth of acid lime seedling

Treatment	Seedling height (cm)			No. of leaves per plant			Root length (cm)			Shoot length (cm)			Dry weight of shoot (g)			Dry weight of root (g)			Root : shoot ratio		
	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS
Storage period (S)																					
S ₁ 0 days after seed extraction	21.42	35.23	50.99	7.63	12.0	26.0	13.69	21.33	30.11	7.73	13.90	20.88	0.39	1.05	3.01	0.18	0.51	1.56	0.46	0.49	0.52
S ₂ 15 days after seed extraction	18.84	28.84	33.29	6.43	8.74	12.8	12.60	19.75	22.49	6.23	9.09	10.80	0.34	0.66	1.36	0.13	0.30	0.65	0.39	0.46	0.48
S ₃ 30 days after seed extraction	17.38	24.27	26.10	5.02	8.66	10.4	11.84	16.25	16.88	5.54	8.02	9.21	0.30	0.53	0.93	0.12	0.23	0.42	0.38	0.44	0.45
S ₄ 45 days after seed extraction	16.21	21.49	23.74	4.62	6.38	7.87	11.25	14.56	15.78	4.96	6.93	7.96	0.27	0.34	0.48	0.10	0.14	0.20	0.37	0.40	0.43
S.Em. ±	0.27	0.68	0.69	0.13	0.16	0.24	0.19	0.57	0.43	0.15	0.30	0.24	0.004	0.012	0.022	0.002	0.004	0.021	0.009	0.008	0.012
C.D. at 5%	0.79	1.99	2.01	0.38	0.48	0.71	0.55	1.65	1.27	0.45	0.87	0.70	0.011	0.034	0.064	0.007	0.012	0.060	0.027	0.025	0.036
Growing media (M)																					
M ₁ Soil+ Vermicompost (1 : 1)	18.16	29.45	35.85	6.43	10.1	16.4	11.73	18.75	22.72	6.44	10.70	13.13	0.33	0.72	1.66	0.13	0.34	0.85	0.39	0.45	0.48
M ₂ Soil + Cocopeat (1 : 1)	19.84	26.63	31.36	5.50	8.58	13.0	13.64	17.41	19.58	6.20	9.22	11.78	0.34	0.60	1.23	0.15	0.27	0.59	0.43	0.45	0.46
M ₃ Soil + FYM (1 : 1)	17.38	26.30	33.37	5.85	8.16	13.4	11.67	17.77	21.64	5.71	8.53	11.73	0.30	0.61	1.44	0.12	0.28	0.68	0.38	0.44	0.46
S.Em. ±	0.24	0.59	0.60	0.11	0.14	0.21	0.16	0.49	0.38	0.13	0.26	0.21	0.003	0.010	0.019	0.002	0.003	0.018	0.008	0.008	0.010
C.D. at 5%	0.69	1.73	1.74	0.33	0.41	0.61	0.48	NS	1.10	0.39	0.75	0.61	0.010	0.030	0.064	0.006	0.010	0.052	0.023	NS	NS
C.V%	4.42	7.46	6.15	6.50	5.46	5.08	4.60	9.45	6.10	7.50	9.40	5.89	3.57	5.43	4.58	5.20	4.04	8.73	7.01	5.86	7.98
S X M	NS	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	NS	Sig.	Sig.	Sig.	NS	Sig.	Sig.	Sig.	Sig.	Sig.	NS	NS	NS

Table 4: Interaction effect of storage period and growing media on growth of acid lime seedling

S	M	Seedling height (cm)						Number of leaves per plant						Root length (cm)								
		90 DAS			120 DAS			60 DAS			90 DAS			120 DAS			60 DAS			90 DAS		
		M ₁	M ₂	M ₃	M ₁	M ₂	M ₃	M ₁	M ₂	M ₃	M ₁	M ₂	M ₃	M ₁	M ₂	M ₃	M ₁	M ₂	M ₃	M ₁	M ₂	M ₃
S ₁		38.87	33.62	33.21	53.07	47.49	52.40	8.63	6.93	7.33	14.40	10.07	11.60	30.87	23.33	24.00	12.83	15.60	12.64	22.15	20.84	21.00
S ₂		31.11	30.66	24.77	37.94	31.27	30.66	7.17	6.00	6.13	10.50	7.97	7.77	15.22	11.33	12.07	11.39	14.16	12.26	21.09	20.92	17.24
S ₃		27.06	21.59	24.15	28.34	24.38	25.57	5.07	4.40	5.60	9.27	8.63	8.07	11.59	10.07	9.70	11.64	12.88	10.99	17.94	14.29	16.51
S ₄		20.77	20.65	23.05	24.05	22.31	24.86	4.87	4.67	4.33	6.27	7.67	5.20	8.20	7.53	7.87	11.07	11.91	10.77	13.80	13.57	16.32
S.Em.±		1.18			1.19			0.22			0.28			0.42			0.33			0.98		
C.D. 5%		3.45			3.48			0.65			0.82			1.22			0.96			2.86		

S	M	Shoot length (cm)						Dry weight of shoot (g)						Dry weight of root (g)											
		60 DAS			90 DAS			120 DAS			90 DAS			120 DAS			60 DAS			90 DAS			120 DAS		
		M ₁	M ₂	M ₃	M ₁	M ₂	M ₃	M ₁	M ₂	M ₃	M ₁	M ₂	M ₃	M ₁	M ₂	M ₃	M ₁	M ₂	M ₃	M ₁	M ₂	M ₃	M ₁	M ₂	M ₃
S ₁		8.68	7.32	7.19	16.71	12.77	12.21	21.59	20.39	20.65	1.12	0.97	1.05	3.51	2.50	3.01	0.18	0.20	0.15	0.55	0.48	0.49	1.93	1.28	1.47
S ₂		6.57	6.17	5.96	10.01	9.74	7.53	13.02	10.16	9.23	0.91	0.53	0.55	1.61	1.20	1.27	0.13	0.15	0.12	0.42	0.24	0.25	0.78	0.56	0.61
S ₃		5.33	6.29	5.01	9.12	7.30	7.64	9.96	8.99	8.68	0.51	0.55	0.51	0.98	0.82	0.98	0.12	0.12	0.11	0.22	0.23	0.23	0.45	0.36	0.45
S ₄		5.17	5.03	4.67	6.97	7.08	6.73	7.95	7.58	8.36	0.36	0.34	0.34	0.55	0.38	0.51	0.10	0.11	0.08	0.15	0.14	0.12	0.24	0.16	0.21
S.Em.±		0.26			0.51			0.42			0.020			0.038			0.004			0.007			0.036		
C.D. 5%		0.77			1.50			1.21			0.059			0.111			0.012			0.020			0.104		

Conclusion

Better germination of acid lime seed can be obtained by sowing the seed immediately after extraction in growing media soil + cocopeat (1:1). Where, as Growth parameters of seedling viz. seedling height, number of leaves, root length, shoot length, dry weight of root, dry weight of shoot found higher when seed sown immediately after extraction in soil + vermicompost (1:1) growing media.

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