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Effect of seed storage period and growth regulators on seed germination, growth and survival of jackfruit seedling

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Abstract
An experiment entitled "Effect of seed storage period and growth regulators on seed germination, growth and survival of jackfruit seedling" was conducted in green shade net house at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand during the year *kharif*- 2019. The treatment comprised three levels of seed storage period (S) *viz*., S_1- 0 day after extraction of seed, S_2- 5 days after extraction of seed and S_3- 10 days after extraction of seed and five seed soaking treatments of growth regulators GA_3 24 hrs (G) *viz*., G_1- GA_3 @ 100 mg l^{-1}, G_2- GA_3 @ 150 mg l^{-1}, G_3- NAA @ 25 mg l^{-1}, G_4- NAA @ 50 mg l^{-1} and G_5- Control. The experiment was carried out in Completely Randomized Design (Factorial) with fifteen treatment combinations and repeated thrice. Sowing of fresh extracted seeds of jackfruit recorded minimum number of days (14.89) taken for germination with maximum germination percentage (81.60) and at 90 DAS maximum height of seedling (37.78 cm), girth of seedling (4.32 mm), number of leaves per plant (6.88), length of seedling (50.99 cm), root length (13.21 cm), fresh weight of shoot (8.04 g), fresh weight of root (2.33 g), dry weight of shoot (3.19 g), dry weight of root (0.69 g), and survival percentage of seedling (69.60).
Jackfruit seed soaked in GA_3 @ 100 mg l^{-1} for 24 hrs recorded significantly, minimum number of days (15.58) taken for germination with maximum germination percentage (76.67) and at 90 DAS maximum height of seedling (37.57 cm), girth of seedling (4.07 mm), number of leaves per plant (6.97) length of seedling (49.67 cm), length of root (12.10 cm), fresh weight of shoot (8.13 g), fresh weight of root (2.25g), dry weight of shoot (3.35 g), dry weight of root (0.73 g) and survival percentage of seedling (68.18).
Fresh extracted jackfruit seed soaked in GA_3 @ 100 mg l^{-1} for 24 hrs recorded minimum number of days (12.34) taken for germination with maximum germination percentage (96.67) and at 90 DAS maximum height of seedling (43.30 cm), fresh weight of shoot (10.33 g), dry weight of shoot (4.59 g), dry weight of root (0.97 g) and survival percentage of seedling (84.24).

Keywords: Seed storage period, growth regulators, germination parameters, growth parameters, survival of seedling

Introduction
Jackfruit (*Artocarpus heterophyllus* Lam.) belongs to the family Moraceae. It is the largest edible fruit in the world. It is considered to be a native species of the rain forests of the Western Ghats of India and the Malaysia. The main jackfruit producer countries are Bangladesh, India, Myanmar, Indonesia, Sri Lanka and Malaysia. The viability of jackfruit seeds lost very quickly even one or two weeks delay in sowing will lead to poor germination. Jackfruit seeds are recalcitrant in nature. Recalcitrant seeds are relatively high in moisture content and possess a characteristic feature of losing their viability during desiccation. The recalcitrant seeds impose serious storage problems due to their desiccation and chilling sensitivity. Storage above critical level of time leads to loss of viability. Recalcitrant seeds are intolerant to drying and long period storage.
Hence, prolonging viability of seeds would facilitate the availability of seeds for various plantation programmes and also for use by nursery men and local farmers throughout the year. Realizing the importance of raising jackfruit seedling, for quick germination of seeds and subsequent growth of seedling pre-soaking treatment of seeds with growth regulators have been taken under the present experiment.

Materials and Methods
The experiment was conducted in the green shade net house (75 % shade) at the Horticulture Research Farm and Nursery, B. A. College of Agriculture, Anand Agricultural University,

Anand during the month July- October, 2019. The experiment was laid out in Completely Randomized Design with factorial concept having fifteen treatment combinations, comprising three level of seed storage period *viz.*, S_1- 0 day after extraction of seed, S_2- 5 days after extraction of seed and S_3- 10 days after extraction of seed with five levels of growth regulators (G) *viz.*, G_1- GA_3 @ 100 mg l^{-1}, G_2- GA_3 @ 150 mg l^{-1}, G_3- NAA @ 25 mg l^{-1}, G_4- NAA @ 50 mg l^{-1} and G_5- Control. The treatment was repeated thrice. Fresh Jackfruits were collected from the local farmer field. From them uniform size and healthy fruit were selected for the experiment. Seeds were extracted from fully ripened and healthy fruits of jackfruit. Healthy seeds were selected and soaked in solution of different concentration of growth regulators for 24 hours as per the treatments. Healthy seeds were stored in cloth bag at ambient condition. The seeds were stored in different lots for different sowing dates. After treatment seeds were sown in polythene bag size of 7"× 5", previously filled with potting mixture which was prepared by mixing two part of soil, one part of rotted FYM and one part of vermicompost (2:1:1). The polythene bags were placed in flat beds and proper space in green shade net. The bags were watered regularly every day. The observation of germination parameters *viz*. number of days taken for germination, germination percentage was recorded. The observation of growth parameters *viz*., height of seedling, girth of seedling, number of leaves per seedling, length of seedling, length of root, fresh weight of shoot, fresh weight of root, dry weight of shoot, dry weight of root and survival percentage of seedling at 90 DAS was recorded from 5 randomly selected plants and statically analysed.

Results and Discussion

Effect of Seed Storage Period

Seed storage period showed the significant effect on germination parameters. Sowing of fresh extracted seeds (S_1-0 day after extraction of seed) observed minimum number of days (14.89) taken for germination with maximum germination percentage (81.60). This might be due to the presence of more moisture, vigour of seeds and absence of dormancy resulted early germination. Similar, results were also obtained by Prajapati *et al.* (2017) [7] in Kagzilime, Mahasin and Mustafa (2015) [3] in mango, and Merlin and Palanisamy (2000) [4] in jackfruit. Seed storage period also observed significant effect on growth parameters. Sowing of fresh extracted seeds recorded maximum height of seedling (37.78 cm), girth of seedling (4.32 mm), number of leaves per seedling (6.88). length of seedling (50.99 cm), length of root (13.21 cm), fresh weight of shoot (8.04 g), fresh weight of root (2.33 g), dry weight of shoot (3.19 g), dry weight of root (0.69 g) and maximum survival percentage of seedling (69.60) at 90 DAS. It might be due to the overall performance in relation to germination and better growth parameters which ultimately increased the survival percentage of seedling. Similar, result was also recorded by Chaudhary *et al.* (2019)[1] in kagzi lime.

Table 1: Effect of seed storage period and growth regulators on seed germination

Treatments	Number of days taken for germination	Germination percentage
Seed storage period (S)		
S_1 0 day after extraction of seed	14.89	81.60
S_2 5 days after extraction of seed	17.27	67.86
S_3 10 days after extraction of seed	19.93	53.00
S.Em. ±	0.21	0.90
C.D. at 5 %	0.61	2.60
Growth regulators (G)		
G_1 GA_3 @ 100 mg l^{-1}	15.58	76.67
G_2 GA_3 @ 150 mg l^{-1}	17.09	64.11
G_3 NAA @ 25 mg l^{-1}	18.39	68.89
G_4 NAA @ 50 mg l^{-1}	15.85	73.32
G_5 Control	19.90	54.44
S.Em. ±	0.27	1.16
C.D. at 5 %	0.78	3.35
S × G	Sig.	Sig.
C.V %	4.64	5.16

Table 2: Interaction effect of seed storage period and growth regulators on seed germination

S/G	Number of days taken for germination			Germination percentage		
	S_1	S_2	S_3	S_1	S_2	S_3
G_1	12.34	15.68	18.71	96.67	73.33	60.00
G_2	14.68	16.14	20.46	74.00	68.33	50.00
G_3	16.76	18.42	20.00	81.67	71.67	53.33
G_4	12.45	15.43	19.67	94.00	70.97	55.00
G_5	18.19	20.67	20.83	61.67	55.00	46.67
S.Em.±	0.47			2.01		
C.D. at 5%	1.34			5.80		

Effect of Growth Regulators

Soaking of seeds in growth regulators showed the significant effect on germination parameters. Soaking of seeds in GA_3 @ 100 mg l^{-1} for 24 hrs (G_1) recorded minimum number of days (15.58) taken for germination with maximum germination percentage (76.67). GA_3 was effective treatment might be due to GA_3 increased the activities of hydrolyzing enzyme and α-amylase at initial stage of germination which convert starch into simple carbohydrate and chemical energy which is used in the activation of embryo and facilitated to germination

process. Similar, results were also obtained by Panda *et al.* (2018) [5] in kagzi lime, Prajapati *et al.* (2014) [6], Singh *et al.* (2002) [9] and Prakash (1998) [8] in jackfruit. Growth regulators also observed significant effect on growth parameters. Soaking of seeds in GA_3 @ 100 mg l^{-1} for 24 hrs (G_1) recorded maximum height of seedling (37.57 cm), girth of seedling (4.07 mm) number of leaves per seedling (6.97), length of seedling (46.67 cm), length of root (12.10 cm), fresh weight of shoot (8.13 g), fresh weight of root (2.25g), dry weight of shoot (3.35 g), dry weight of root (0.73 g) and maximum survival percentage of seedling (68.18) at 90 DAS. This might be due to the overall performance in relation to germination and better growth parameters which ultimately increased the survival percentage of seedling. Similar, result was also recorded by Chaudhary *et al.* (2019) [1] in kagzi lime and Deepika *et al.* (2014) [2] in karonda.

Interaction Effect of Seed Storage Period and Growth Regulators

Interaction effect of seed storage period and growth regulators showed the significant effect on germination parameters. Treatment combination sowing of fresh extracted seeds with soaking in GA_3 @ 100 mg l^{-1} for 24 hrs (S_1G_1) recorded minimum number of days (12.34) taken for germination with maximum germination percentage (96.67). It might be due to in fresh seeds presence of more moisture and vigour which recorded high germination percentage and growth regulators GA_3 enhance seed germination due to diffusion of endogenous auxin and gibberellins like substances.

Interaction effect of seed storage period and growth regulators showed the significant effect on growth parameters. Treatment combination sowing of fresh extracted seeds with soaking in GA_3 @ 100 mg l^{-1} for 24 hrs (S_1G_1) found significantly, maximum height of seedling (43.30 cm), fresh weight of shoot (10.33 g), dry weight of shoot (4.59 g), dry weight of root (0.97 g) and survival percentage of seedling (84.24). This might be due to the combined effect of fresh seeds and GA_3 which increased the vigour in seedling and survival percentage.

Table 3: Effect of seed storage period and growth regulators on growth parameters and survival of jackfruit seedling at 90 DAS

Treatments	Height of seedling (cm)	Girth of seedling (mm)	Number of leaves per seedling	Length of seedling (cm)	Length of root (cm)	Fresh weight of shoot (g)	Fresh weight of root (g)	Dry weight of shoot (g)	Dry weight of root (g)	Survival Percentage
Seed storage period (S)										
S_1 0 day after extraction of seed	37.78	4.32	6.88	50.99	13.21	8.04	2.33	3.19	0.69	69.60
S_2 5 days after extraction of seed	33.65	4.10	6.30	43.75	10.10	6.80	1.70	2.67	0.53	57.75
S_3 10 days after extraction of seed	32.52	2.18	5.84	41.79	9.27	4.78	1.35	1.97	0.38	48.29
S.Em. ±	0.38	0.04	0.10	0.53	0.20	0.12	0.05	0.04	0.008	0.73
C.D. at 5 %	1.11	0.13	0.28	1.53	0.58	0.35	0.13	0.12	0.02	2.10
Growth regulators (G)										
G_1 GA_3 @ 100 mg l^{-1}	37.57	4.07	6.97	49.67	12.10	8.13	2.25	3.35	0.73	68.18
G_2 GA_3 @ 150 mg l^{-1}	33.04	3.54	6.15	43.28	10.23	6.57	1.94	2.50	0.49	59.91
G_3 NAA @ 25 mg l^{-1}	33.94	3.51	6.22	44.70	10.75	5.25	1.55	1.97	0.40	54.76
G_4 NAA @ 50 mg l^{-1}	36.16	3.31	6.63	47.59	11.43	7.73	2.10	3.28	0.70	62.43
G_5 Control	32.52	3.22	5.72	42.31	9.79	5.03	1.14	1.95	0.37	47.48
S.Em. ±	0.50	0.06	0.13	0.68	0.26	0.16	0.06	0.05	0.01	0.94
C.D. at 5%	1.43	0.16	0.36	1.97	0.75	0.45	0.17	0.15	0.03	2.71
S × G	**Sig**	**NS**	**NS**	**NS**	**NS**	**Sig.**	**NS**	**Sig.**	**Sig.**	**Sig.**
C.V %	4.29	4.77	5.93	4.50	7.18	7.09	9.63	5.92	5.84	4.81

Table 4: Interaction effect of seed storage period and growth regulators on growth parameters and survival of jackfruit seedling at 90 DAS

S/G	Height of seedling (cm)			Fresh weight of shoot (g)			Dry weight of shoot (g)			Dry weight of root (g)			Survival percentage		
	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
G_1	43.30	35.07	34.33	10.33	8.88	5.18	4.59	3.29	2.17	0.97	0.80	0.41	84.24	63.23	57.07
G_2	34.40	31.70	33.03	8.20	7.40	4.11	3.01	2.45	2.05	0.55	0.52	0.39	65.33	61.27	53.13
G_3	36.07	33.07	32.70	5.42	6.08	4.23	2.51	2.02	1.39	0.65	0.28	0.26	66.70	49.10	48.47
G_4	39.92	36.03	32.53	9.49	7.04	6.66	3.49	3.47	2.87	0.80	0.69	0.60	80.03	62.78	44.47
G_5	35.20	32.37	30.00	6.75	4.60	3.74	2.35	2.13	1.37	0.49	0.35	0.25	51.70	52.40	38.33
S.Em±	0.86			0.27			0.09			0.02			1.63		
C.D. at 5 %	2.48			0.77			0.26			0.05			4.70		

Conclusion

Based on the results of the experiment it can be concluded that for getting early and better germination as well as healthy and vigours seedling fresh extracted seed of jackfruit should be treated with GA_3 @ 100 mg l^{-1} for 24 hours before sowing.

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