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Storage behavior studies of jambhiri seeds

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Abstract
An investigation on "Effect of storage conditions and containers on storability of jambhiri seeds" was conducted at the Post-Harvest Technology Laboratory, Section of Horticulture, College of Agriculture Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during the year 2018-2019 with the objectives to study the effect of different packaging material on storability of jambhiri seeds under refrigerated condition and to find out suitable packaging material and storage condition for better storability, germination seed and seedling growth of jambhiri. The jambhiri seeds were stored at 4 °C ± 1,7 °C ± 1 and Ambient temperature in polybag 200 gauge, cotton bags, plastic container and plastic container with jambhiri juice. The experiment was laid out in Factorial Completely Randomized Design.
From the findings it was observed that, the jambhiri seeds stored at 7 °C in plastic container showed maximum germination percentage (55.26%), whereas, minimum (20.12%) was observed in seeds stored at 7 °C in polybag 200 gauge after 150 days of storage. Minimum days to 50% germination (13.00) was observed when seeds stored at 7 °C in plastic container whereas, maximum (16.00) days to 50% germination was observed when seeds stored at 7 °C in plastic container with juice after 150 days of storage. Maximum bartlett's rate index observed when seeds stored at 7 ^{0}C in plastic container (0.478). While, minimum bartlett's rate index (0.449) was observed at 7 °C temperature with polybag 200 gauge. Maximum vigour index (394.21) was observed in seed stored at 7 °C plastic container and minimum vigour index (116.16) was observed at 7 °C polybag 200 gauge.

Keywords: Jambhiri seeds, mrig bahar, storage conditions, containers

Introduction
In the recent, the role of rootstock in citrus has assumed greater importance to have profound effect on the vigour, longevity, precocity, productivity, resistant or tolerance to diseases and pests and the quality of citrus fruits. Therefore, the successful and rapid means of raising good and true to type rootstock seedlings of citrus has been a primary concern of nurserymen and research workers.Generally in citrus nursery, the seeds of the rootstock sown in the month of September-October. For this purpose commonly, *Ambia bahar* seeds are preferred. But availability of genuine seeds are megre and the adultrated seeds are procured from the local market to metigate the demand of the seeds. This is the primary source for entry of the Galgal like species as a rootstock.
The *mrig bahar* seeds of jamberi are not use for raising of primary citrus nursery. If the seseeds (*mrig bahar*) can be stored for some days in laboratory, then same can be used for raising the nursery upto certain limit and the demand of seeds may be fulfilled.
By keeping in view, the experiment being conducted to study effect of different storage conditions and containers on storability of jambhiri seeds, in order to obtain true to type rough lemon rootstock seedlings.

Material and Methods
The jambhiri seeds were collected from the uniform sized, matured and true to type fruits of *mrig bahar*, which were harvested in the month of April from 15 years old jambhiri tree planted at Main Garden, Department of Horticulture, Dr. PDKV, Akola. The seeds were extracted carefully, washed with clean water and dried in shade for a day.
The sound and fresh seeds of jambhiri fruits were used for experiment. The seeds were dipped in distilled water and allowed to settle at the bottom of the beaker for a few minutes. The seeds floating on the surface of water were discarded and those which settled at the bottom were used for experiment. Selected seeds were divided in to 36 lots; each of these lots was treated with chemical fungicide copper oxychloride 3g/kg of jambhiri seed.

The seeds were packed in polybag (200 gauge), cotton bag, plastic container and plastic container with jambhiri juice and stored at 4 °C, 7 °C and ambient temperature for five months. After every one month 50 stored seeds from each packaging material were sown in earthen pot and counted the germination percentage and transplanted the seedlings in black polyethylene bags (25×16 cm) for further growth studies. Jambhiri seedlings of about two months aged were transplanted in perforated black polyethylene bags. The black polyethylene bags were filled with soil and farm yard manure (2:1 soil and FYM).

Results and Discussion

Effect of storage conditions on moisture content and germination of seed

The data in respect of moisture content of jambhiri seeds as influenced by different storage conditions was recorded up to 150 days of storage are presented in Table 1.The effect of storage conditions was significantly influenced at all the stages of observations except initial. During the storage period, the decreasing trend was observed in moisture content in jambhiri seeds. At 30 days after storage, the seeds stored at 4 °C temperature recorded significantly maximum moisture content (38.32%) followed by seed stored at 7 °C temperature (37.99%). Whereas, minimum moisture content was found in seed stored at ambient temperature (24.33%). Similar trend of results was noticed at 90 and 150 days of storage period.

Low temperature may minimize metabolic rates of the stored seeds which determines the low temperature can be suitable for seed storage (Berjak and Pammenter, 2002, Bonner, 2008) [2, 3]. Similar results were also reported by Khan *et al*. (2003) [10] in *Sacatan citrumelo*, Sandra (2005) [18] in dog wood seed and Lucille *et al*. (2009) [11] in Physic nut (*Jatropa curcas* L.).

The data in respect of germination of jambhiri seeds as influenced by different storage conditions was recorded up to 150 days of storage are presented in Table 1. Decreasing trend was observed in germination percentage of jambhiri seeds during storage. At the 30 days after storage, the seeds stored in 4 °C temperature recorded significantly maximum germination percentage (58.85%) and similar trend was observed in 90 days after storage. Significantly maximum germination percentage was observed (18.84%) at 150 days after storage in treatment 7 °C temperature and minimum germination percentage (16.55%) was recorded in treatment 4 °C temperature at 150 days after storage. The slow loss of viability and germination under refrigerated conditions may possibly due to reduced rate of metabolic activities and inactivation of enzymes at low temperature thus helping to retain viability. The rapid decrease in seed viability under ambient temperature conditions may be due to high metabolic activity at high temperature and due to loss of moisture which is the chief cause of seed deterioration under ambient conditions. Similar results were found by Fonesca *et al*. (1980) [6] the bean seed stored under ambient conditions (16-30 °C and 30% RH) deteriorated at faster rate and gave lower germination per cent. Garica and Perez (1985) [7] recorded higher onion seed germination values *viz*., 80, 77, 83 and 78 percent at 10 °C.

Table 1: Effect storage conditions and containers on moisture content and germination of jambhiri seeds

Treatment	Moisture content of seed (%)				Germination (%)			
	Initial	30 DAS May	90 DAS July	150 DAS Sept	Initial	30 DAS May	90 DAS July	150 DAS Sept
	Storage conditions							
T_1 (4 °C)	44.35(41.74)	38.32(37.84)	34.36(34.92)	31.11(32.11)	92.13(73.81)	58.85(50.33)	34.15(32.96)	16.55(17.56)
T_2 (7 °C)	44.35(41.74)	37.99(37.26)	34.34(34.72)	30.08(31.29)	92.13(73.81)	43.88(37.95)	33.22(31.21)	18.84(18.79)
T_3 (Ambient)	44.35(41.74)	24.33(27.81)	20.33(24.03)	17.78(21.31)	92.13(73.81)	0.01(0.405)	0.01(0.405)	0.01(0.405)
F-Test	NS	Sig	Sig	Sig	NS	Sig	Sig	Sig
SE(m) +	0.08	2.15	1.94	1.60	0.76	1.27	1.81	1.73
CD at 5%	-	6.27	5.67	4.69	-	3.75	5.30	5.07
	Containers							
C_1 (Polybag 200 gauge)	44.35(41.74)	36.11(36.70)	29.92(32.85)	24.25(28.57)	92.13(73.81)	28.44(27.09)	23.75(24.29)	15.07(18.80)
C_2 (Cotton bag)	44.35(41.74)	11.46(19.01)	6.43(13.63)	2.69(8.78)	92.13(73.81)	8.37(10.26)	0.01(0.405)	0.01(0.405)
C_3 (Plastic container)	44.35(41.74)	33.16(34.51)	29.82(31.72)	24.16(29.04)	92.13(73.81)	55.10(43.82)	40.82(36.08)	32.12(29.40)
C_4 (Plastic container with juice)	44.35(41.74)	53.45(46.00)	52.93(46.68)	52.92(46.54)	92.13(73.81)	25.07(37.06)	20.25(25.33)	0.01(0.405)
F-Test	NS	Sig	Sig	Sig	NS	Sig	Sig	Sig
SE(m) ±	0.09	2.48	2.24	1.85	0.88	1.47	2.09	1.99
CD at 5%	-	7.24	6.55	5.41	-	4.33	6.12	5.83

DAS – Days after storage and (Figure in parenthesis are arc sign value)

Effect of storage containers on moisture content and germination

The moisture content in jambhiri seeds was differ significantly except initial due to containers. During storage period, the decreasing trend was observed in moisture content in jambhiri seeds. After 30 days of storage, the jambhiri seeds stored in plastic container with juice recorded maximum moisture content (53.45%). Seed stored in polybag and plastic container recorded (36.11 and 33.16%, respectively) moisture percentage and these are at par with each other. While, minimum moisture content (11.46%) was observed in seed stored in cotton bag. Similar trend of results was noticed at 90 and 150 days after storage period.

The seeds stored in plastic container in juice can withhold moisture in the seed. Absence of appreciable seed senescence in seed in plastic container in juice may be ascribed to maintenance of moisture content and possibly also to non-formation of free fatty acids. Similar results of decreases in moisture content are accordance with the findings of Muthanna *et al*. (2016) [14] in Karonda (C*arissa carandas* L.) after two months storage period. Higher moisture percentage of seed stored in plastic container in juice was supported by the studies made in neem (Ponnuswamy *et al.*, 1991) [15].

The germination percentage was differ significantly due to container during storage period. At 30 days after storage, the jambhiri seed stored in plastic container recorded significantly maximum germination percentage (55.10%). Whereas, the treatment followed by seed stored in polybag 200 gauge recorded (28.44%) germination percentage. While, minimum germination percentage was observed in seed stored in cotton

bag (8.37%). The minimum germination percentage (15.07%) was found in the container polybag 200 gauge at 150 days of storage. This might be due to maintenance of lower moisture content (2.69%) during the storage period. Containers *viz*., plastic container and polythene bag acted as moisture proof barriers. Similar results were observed in Rajasekaran *et al*. (2005) [17] packed the seeds of Niger (*Guizotia abyssinica* L.f. Cass.) in polylined cloth bag which maintained higher germination (95%) after six months of storage. Mohammad *et al*. (2016b) [13] stored the genotype of Paddy (*Oryza sativa* L.) NDR -359 seeds packed in polythene gave significantly higher germination percentage (66.81%). Hunje *et al*. (2007) [9] observed seeds of chilli stored in cloth bag containers (51.00%) showed the highest reduction in germination per cent.

Interaction effect of storage conditions and containers on moisture content and germination

The data in respect of moisture content and germination percentage was influenced by the interaction of storage conditions and containers was recorded up to 150 days storage are presented in Table 2. At 30 days of storage, the interaction effect of storage conditions and containers was found non-significant regarding the seed moisture content. At 90 days after storage, jambhiri seeds stored at (T_1C_4) 4 °C in plastic container with juice recorded maximum moisture content in jambhiri seeds (53.45%). The treatment T_1C_3, T_1C_4, T_2C_1, T_2C_3 and T_2C_4 are at par with each other. The minimum seed moisture content (3.10%) was found in T_3C_2 when seeds stored at ambient temperature in cotton bag. Similar trend of results was noticed at 150 days of storage period. The low moisture content in cotton bag might be due to pores present in cotton bag allowed free movements of air hence, the moisture lost in cotton bag in the form of water vapour and moisture leading to poor hygienic condition inside the container. Similar results were obtained by Meena *et al*. (2017b) [12] in cotton seeds when kept in vacuum packed seeds stored at cold storage (4±1 °C) and room temperature (25±2 °C). Muthanna *et al*. (2016) [14] observed that in Karonda seeds at initial moisture was 67 per cent, after two months of storage the aluminium foil coated pouch in refrigerator (40.00%).

At 30 days after storage, the jambhiri seeds stored at 7 °C in plastic container (T_2C_3) recorded significantly maximum germination percentage in jambhiri seeds (85.16%). The treatment followed by 4 °C with plastic container (T_1C_3) and similar trend was observed at 90

Table 2: Interaction effect of storage conditions and containers on moisture content and germination

Treatment	Moisture content of seed (%)				Germination (%)			
	Initial	30 DAS May	90 DAS July	150 DAS Sept	Initial	30 DAS May	90 DAS July	150 DAS Sept
	Storage conditions							
T_1 x C_1	44.35(41.74)	40.06(39.22)	35.33(36.40)	28.71(32.36)	92.13(73.81)	60.12(50.83)	48.13(43.90)	25.11(29.67)
T_1 X C_2	44.35(41.74)	18.03(24.91)	10.01(17.85)	4.01(10.88)	92.13(73.81)	25.12(29.99)	0.01(0.405)	0.01(0.405)
T_1 X C_3	44.35(41.74)	41.01(39.79)	38.67(38.43)	38.34(38.24)	92.13(73.81)	80.15(63.63)	58.27(54.35)	41.10(39.76)
T_1 X C_4	44.35(41.74)	54.45(47.43)	53.45(46.97)	53.44(46.95)	92.13(73.81)	70.04(56.86)	30.22(33.20)	0.01(0.405)
T_2 X C_1	44.35(41.74)	43.16(41.00)	35.37(36.43)	26.34(30.86)	92.13(73.81)	25.21(30.05)	23.14(28.56)	20.12(26.33)
T_2 X C_2	44.35(41.74)	11.26(19.48)	7.14(14.77)	3.02(9.57)	92.13(73.81)	0.01(0.405)	0.01(0.405)	0.01(0.405)
T_2 X C_3	44.35(41.74)	43.46(41.22)	42.69(40.77)	37.96(38.01)	92.13(73.81)	85.16(67.44)	64.20(53.48)	55.26(48.05)
T_2 X C_4	44.35(41.74)	54.44(47.33)	53.43(46.91)	53.42(46.71)	92.13(73.81)	65.18(53.92)	45.55(42.39)	0.01(0.405)
T_3 X C_1	44.35(41.74)	25.11(29.89)	19.05(25.72)	14.70(22.49)	92.13(73.81)	0.01(0.405)	0.01(0.405)	0.01(0.405)
T_3 X C_2	44.35(41.74)	5.11(12.64)	2.16(8.27)	1.06(5.90)	92.13(73.81)	0.01(0.405)	0.01(0.405)	0.01(0.405)
T_3 X C_3	44.35(41.74)	15.03(22.52)	8.10(15.95)	3.68(10.88)	92.13(73.81)	0.01(0.405)	0.01(0.405)	0.01(0.405)
T_3 X C_4	44.35(41.74)	52.09(46.20)	52.04(46.17)	51.69(45.97)	92.13(73.81)	0.01(0.405)	0.01(0.405)	0.01(0.405)
F-Test	NS	NS	Sig	Sig	NS	Sig	Sig	Sig
SE(m) ±	0.16	4.30	3.88	3.21	1.52	2.55	3.63	3.45
CD at 5%	-	-	11.35	9.38	-	7.50	10.60	10.09

DAS – Days after storage and (Figure in parenthesis are arc sign value) and 150 days after storage.

The minimum germination percentage (25.12%) was found in seeds stored at 4 °C in cotton bag (T_1C_2) and minimum germination percentage (23.14 and 20.12%) was recorded at 90 to 150 days after storage in treatment (T_2C_1) 7 °C polybag 200 gauge. The reason for getting highest germination in plastic container stored at 7 °C temperature may be due to the container which acted as moisture impervious and preventing the gain and loss of moisture and retain their viability to germinated the seeds.Similar results were found by Hillary *et al*. (2016) [8], in seed of cowpea stored in cotton bag under ambient temperature and humidity recorded the lowest germination percentage (65%). Muthanna *et al*. (2016) [14] observed maximum germination (56.67%) percentage from seeds stored in aluminium foil coated pouch with refrigerator conditions.

Effect of storage conditions on days to 50% germination and seedling vigour index

Data in respect of 50% germination of jambhiri seeds as influenced by different storage condition was recorded up to 150 days of storage are presented in Table 3. The effect of storage conditions was significant at all the observations. Days to 50% germination of seed at 30th days of storage, the seeds took minimum days to 50% germination when stored in 7 °C temperature at 30th, 90th and 150th days (7.00, 3.75, and 4.33, respectively). While, maximum days to 50% germination of seed when stored at 4 °C temperature (11.25 and 4.08, respectively).

The seedling vigour index was influenced at all the observations. During the storage period, decreasing trend was observed in vigour index. At 30 days after storage, the seeds stored at 4 °C temperature recorded significantly maximum vigour index (556.85) and at 90 days of storage the vigour index (272.81) was observed significantly maximum in 7 °C temperature and similar trend was observed in 150 days of storage. Whereas, minimum vigour index was found at 30 days of storage in seed stored at 7 °C temperature (447.17) and the minimum vigour index was recorded at 90 days of

storage (105.12) in 4 °C temperature and similar trend was recorded in 150 days of storage. 7 °C storage temperature recorded higher rate of germination compared to 4 °C temperature during the period of 5 months. The seeds preserved in 7 °C storage temperature maintained higher seed quality without loss as it is evidenced by higher germination and rate of germination. It might be due to higher rate of germination is an indication of higher vigour. This implies that seeds stored in the 7 °C storage temperature maintained higher vigour. Similar observations have been recorded by Ellis *et al*. (1991) [5] in onion, Garica and Perez (1985) [7] in onion. Egharveba and Uwadiae (1994) [4] in *Chrysophylium albidum* and Rahman (1987) [16] in tea seeds.

Effect of storage containers on 50% germination and seedling vigour index

Significant influence was observed on days to 50% germination of seed by different storage containers. The days to 50% germination of seed recorded on 30th days stored in polybag took significantly minimum days to 50% germination (5.00) followed by plastic container (9.00). Whereas, maximum days to 50% germination of seed were recorded in plastic container with jambhiri juice at 30th days (10.33).

Vigour index was differ significantly due to container during storage period. At 30 days after storage, jambhiri seed stored in plastic container recorded significantly maximum vigour index (570.50) and similar trend was noticed at 90 and 150 days of storage. While, at 30 days minimum vigour index was observed in seed stored in cotton bag (69.56) and at 90 days of storage the minimum vigour index was recorded in plastic container with jambhiri juice and at 150 days of storage the minimum (86.98) vigour index was found in polybag 200 gauge. The seeds packed in plastic container and polythene bag recorded higher rate of germination, which indicates higher vigour. The containers namely polythene bag and aluminum foil acted as vapour proof barriers. The lower moisture content might have regulated the lower respiration rate, metabolic activity and higher rate of vigour index. Similar results were reported by Rajasekaran *et al*. (2005) [17] in niger (*Guizotia abyssinica*). Hunje *et al*. (2007) [9] in chilli seeds.

Table 3: Effect of storage conditions and containers on seedling vigour index

Treatment	Days to 50% germination			Seedling Vigour Index		
	30 DAS (May)	90 DAS (July)	150 DAS (Sept)	30 DAS (May)	90 DAS (July)	150 DAS (Sept)
	Storage conditions					
T_1 (4 °C)	11.25	4.08	0.01	556.85	220.30	105.12
T_2 (7 °C)	7.00	3.75	4.33	447.17	272.81	179.59
T_3 (Ambient)	0.01	0.01	0.01	0.01	0.01	0.01
F-Test	Sig	Sig	Sig	Sig	Sig	Sig
SE(m) ±	0.16	0.20	0.04	20.48	14.36	14.06
CD at 5%	0.48	0.61	0.14	59.79	41.94	41.05
	Containers					
C_1 (Polybag 200 guage)	5.00	0.01	0.01	256.56	187.68	86.98
C_2 (cotton bag)	0.01	0.01	0.01	69.56	0.01	0.01
C_3 (Plastic container)	9.00	10.44	5.77	570.50	384.70	233.30
C_4 (Plastic container with juice)	10.33	0.01	0.01	442.06	181.69	0.01
F-Test	Sig	Sig	Sig	Sig	Sig	Sig
SE(m) ±	0.19	0.24	0.05	23.65	16.59	16.24
CD at 5%	0.56	0.70	0.16	69.04	48.43	47.41
	Interaction effect (TXC)					
T_1 x C_1	15.00	0.01	0.01	533.07	387.42	144.80
T_1 X C_2	0.01	0.01	0.01	208.68	0.01	0.01
T_1 X C_3	14.00	16.33	0.01	802.86	558.61	275.70
T_1 X C_4	16.00	0.01	0.01	682.79	224.97	0.01
T_2 X C_1	0.01	0.01	0.01	236.63	175.62	116.16
T_2 X C_2	0.01	0.01	0.01	0.01	0.01	0.01
T_2 X C_3	13.00	15.00	17.33	908.64	595.50	394.21
T_2 X C_4	15.00	0.01	0.01	643.40	320.11	0.01
T_3 X C_1	0.01	0.01	0.01	0.01	0.01	0.01
T_3 X C_2	0.01	0.01	0.01	0.01	0.01	0.01
T_3 X C_3	0.01	0.01	0.01	0.01	0.01	0.01
T_3 X C_4	0.01	0.01	0.01	0.01	0.01	0.01
F-Test	Sig	Sig	Sig	Sig	Sig	Sig
SE(m) ±	0.33	0.41	0.09	40.97	28.73	28.13
CD at 5%	0.97	1.22	0.28	119.5	83.88	82.11

Interaction effect of storage conditions and containers on 50% germination and seedling vigour index

The interaction effect of storage conditions and containers was found significant for days to 50% germination.The seeds stored at 7 °C temperature with plastic containers (T_2C_3) showed significantly minimum days to 50% germination of seed (13.00, 15.00 and 17.33, respectively) and this treatment combinations is followed by (T_1C_3) 4 °C plastic container (14.00 and 16.33) at 30 and 90 days. While, maximum days to 50% germination of seeds was found in (T_1C_4) 4 °C plastic container with jambhiri juice at 30th (16.00). Seeds stored in plastic container with 7 °C storage conditions showed minimum days to 50% germination of seeds. This might be due to the plastic container acted as moisture impervious which did not allow movement of vapour form of moisture from the outer surrounding and environment. Similar results were found in Muthanna *et al*. (2016) [14] the seeds packed in polyethylene cover and stored in refrigerator took minimum

(29.00) days to reach 50 per cent germination.

At 30 days the jambhiri seeds stored at 7 °C in plastic container (T_2C_3) recorded significantly maximum vigour index of jambhiri seedlings (908.64) and similar trend was observed in 90 and 150 days of storage. This treatment followed by 4 °C with plastic container (T_1C_3) was recorded vigour index (802.86). The minimum seedling vigour index was found at 30 days in (T_1C_2) recorded seedling vigour index (208.68) and at 90 and 150 days of storage the minimum vigour index was recorded in (T_2C_1). Seeds stored in plastic container at 7 °C observed the high vigour index. This might be due to impervious nature of container which was acted as moisture barrier in regulating the moisture content in seeds. The container and low temperature played a significant role in prolonging the viability of seeds and regulating the moisture content in seeds during the storage period and exhibited high vigour. Similar results were reported by Muthanna *et al*. (2016) [14] stored Karonda seeds in aluminium foil coated pouch in refrigerator had highest vigour index- I (731.57 cm) which was on par with the polyethylene cover in refrigerator (628.80 cm) and the lowest vigour (289.30 cm) was noticed in the treatment control in cloth bag. Meena *et al*. (2017) [12] reported the groundnut seeds stored in vacuum packed and recorded significantly higher seedling vigour index (1896) under cold storage (4 ± 1° C).

Effect of storage conditions on Bartlett's rate index

The data in respect of Bartlett's rate index of jambhiri seeds as influenced by different storage condition was recorded upto 150 days of storage are presented in Table 4. At 30 days after storage, the seeds stored at 4 °C temperature recorded significantly maximum bartlett's rate index (0.516) and at 90 days after storage the bartlett's rate index (0.377) was observed significantly maximum at 7 °C temperature and similar trend was observed in 150 days after storage. Whereas, minimum bartlett's rate index was found at 30 days after storage in seed stored at 7 °C temperature (0.417) and the minimum bartlett's rate index was recorded at 90 days after storage (0.353) in 4 °C temperature and similar trend was recorded in 150 days after storage.

Effect of storage containers on Bartlett's rate index

At 30 days after storage the jambhiri seed stored in plastic container recorded significantly maximum bartlett's rate index (0.390) and similar trend was noticed at 90 and 150 days after storage. Whereas, this treatment is followed by polybag 200 gauge (0.352). While, at 30 days, minimum bartlett's rate index was observed in seed stored in cotton bag (0.157) and 90 days of storage the minimum bartlett's rate index was recorded in plastic container with jambhiri juice and at 150 days of storage the minimum (0.303) bartlett's rate index was found in polybag 200 gauge.

Table 4: Effect of storage conditions and containers on Bartlett's rate index

Treatment	Bartlett's rate index		
	30 DAS (May)	90 DAS (July)	150 DAS (Sept)
	Storage conditions		
T_1 (4 °C)	0.516	0.353	0.231
T_2 (7 °C)	0.417	0.377	0.235
T_3 (Ambient)	0.01	0.010	0.01
F-Test	Sig	Sig	Sig
SE(m) +	0.01	0.007	0.001
CD at 5%	0.02	0.019	0.003
	Containers		
C_1 (Polybag 200 guage)	0.352	0.323	0.303
C_2 (cotton bag)	0.157	0.010	0.010
C_3 (Plastic container)	0.390	0.359	0.316
C_4 (Plastic container with juice)	0.342	0.306	0.005
F-Test	Sig	Sig	Sig
SE(m) +	0.01	0.007	0.003
CD at 5%	0.03	0.022	0.011
	Interaction effect (TXC)		
T_1 x C_1	0.543	0.489	0.461
T_1 X C_2	0.471	0.010	0.010
T_1 X C_3	0.538	0.510	0.470
T_1 X C_4	0.510	0.480	0.010
T_2 X C_1	0.514	0.456	0.449
T_2 X C_2	0.010	0.010	0.010
T_2 X C_3	0.634	0.568	0.478
T_2 X C_4	0.518	0.506	0.010
T_3 X C_1	0.010	0.010	0.010
T_3 X C_2	0.010	0.010	0.010
T_3 X C_3	0.010	0.010	0.010
T_3 X C_4	0.010	0.010	0.010
F-Test	Sig	Sig	Sig
SE(m) +	0.02	0.01	0.002
CD at 5%	0.05	0.03	0.006

Interaction effect of storage conditions and containers on Bartlett's rate index

At 30 days, the jambhiri seeds stored at 7 °C in plastic container (T_2C_3) recorded significantly maximum bartlett's rate index of jambhiri seedlings (0.634) and similar trend was observed in 90 and 150 days after storage. This treatment

combination is followed by T_1C_3 (0.538). The minimum bartlett's rate index was found at 30 days in (T_1C_2) 4 °C in cotton bag (0.471) and at 90 and 150 days after storage the minimum bartlett's rate index was recorded in (T_2C_1) polybag 200 gauge stored at 7 °C.

Conclusion

Jambhiri seeds stored at 7 °C in plastic container showed maximum germination percentage (55.26%) after 150 days of storage. Minimum days to 50% germination (13.00) was observed when seeds stored at 7 °C in plastic container whereas, maximum (16.00) days to 50% germination was observed when seeds stored at 7 °C in plastic container with juice after 150 days of storage. Maximum bartlett's rate index (0.478). While, minimum bartlett's rate index (0.449) was observed at 7 °C temperature with polybag 200 gauge. Maximum vigour index (394.21) was observed in seed stored at 7 °C plastic container and minimum vigour index (116.16) was observed at 7 °C polybag 200 gauge.

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