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Original Research Article

Impact of storage containers on storability and seed quality parameters of kabuli chickpea (*Cicer kabulium*)

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Cicer kabulium; Seed storage; Containers; Seed quality parameters.

ABSTRACT
The study was conducted on two kabuli ckickpea varieties Virat and Kripa in Department of Seed Science and Technology, CCS HAU, Hisar during 2021-22. The results revealed that variety Virat recorded higher germination and other seed quality parameters values than Kripa. Virat maintained germination above IMSCS (>85%) after 13 months of harvesting in both the containers *i.e.* gunny bags and HDPE bags. Maximum germination (86.25%) was recorded in the seeds stored in HDPE bags in Virat variety while minimum (79.75%) was recorded in cloth bag in Kripa variety after 13 months of storage. HDPE bags showed superiority over Gunny bags in all seed quality parameters because in HDPE bags seed moisture content remained constant throughout the storage period while fluctuation was recorded in gunny bags during storage period. This may be the possible reason that HDPE bag performed better in maintaining the seed quality. Radicle emergence was recorded just after 24 hours in Virat variety but in Kripa no radicle emergence was observed even after 48 hours also. After 13 months of storage, radicle emergence in virat was observed after 96 hours but in Kripa radicle emergence was observed at 72 hours. Maximum radicle emergence (97%) was recorded after 96 hours in virat variety in both the containers after 6 months of storage. It is concluded from the study that germination of kabuli chickpea can be maintained above IMSCS (>85%) up to 13 months in HDPE bags.

1. Introduction

Chickpea (*Cicer kabulium*), belongs to family Fabaceae, is a major rabi crop in India and an important and inexpensive source of protein in human food and animal feed. Two primary cultivar types have arisen through domestication, known as Desi/Brown gram (microsperma) and Kabuli/White chickpea (macrosperma). Desi chickpeas are characterized by their small, angular shape and rough brown to yellow testas, whereas Kabuli types are relatively larger, plumper, and possess smooth, cream-colored testas. Kabuli types chickpea are often viewed as more advanced due to their larger seed size and reduced pigmentation, which have been achieved through deliberate selection processes. *Kabuli* types contain higher amount of dietary fiber, particularly cellulose and hemicellulose. Seeds play a crucial role in agriculture, as their availability in optimal quality during sowing time is paramount for achieving maximum production. Seeds exhibit peak vigour and viability at the stage of physiological maturity; however, their quality gradually diminishes over time. While seed deterioration is inevitable, it can be slowed down by employing appropriate storage containers and maintaining optimal environmental conditions. Factors such as high temperature, relative humidity, and moisture levels in the storage environment are known to significantly contribute to seed quality degradation. The loss of germination capacity marks the culmination of seed deterioration. Poor storage conditions significantly affect seed vigour [1]. Additionally, seed longevity diminishes with increasing storage temperature and moisture content [2]. The rate of deterioration is influenced by various storage conditions, including temperature, relative humidity, seed moisture levels, and storage containers [3]. The present study was planned to assess the effect of storage containers on seed quality parameters of kabuli chickpea seeds during storage.

2. Materials and methods

The experiment was conducted on two kabuli chickpea varieties *viz.,* Kripa and Virat (Figure 2) during 2021-22 in laboratory of Department of Seed Science & Technology, CCS Haryana Agricultural University, Hisar. The seed was received from MPKV, Rahuri in August, 2021 which was stored in two type of containers *i.e.* cloth bag (Ordinary container) and moisture proof containers (Polythene bag>700gauge) under ambient condition (Figure 1). The seed of both the variety was evaluated for various seed quality parameters *viz.,* test weight (g), moisture content (%), first count (%), germination (%), seedling length (cm), seedling dry weight (mg), vigour index-I and vigour Index-II and radicle emergence at monthly interval upto May 2022. The germination test was carried out with 100 seeds, conducted in four replications at 20±1°C temperature and relative humidity of 90±1%. After fourteen days, the seedlings were assessed for normal seedlings, abnormal seedlings, hard seeds, and dead seeds, with counts expressed as a percentage following the guidelines of the International Seed Testing Association [4]. The length of seedlings (cm) was

determined by averaging measurements from ten normal seedlings in each replication. Subsequently, these ten fresh seedlings were dried in a hot air oven for 24 hours at 80±10°C. The dried seedlings from each replication were then weighed, and the average seedling dry weight was expressed in milligrams. Seedling vigour indices were calculated using the following formula [5]:

Vigour index-I= Germination (%) x average seedling length (cm)

Vigour index-II= Germination (%) x average seedling dry weight (mg)

The moisture content of the seed samples was measured by ISTA recommended hot air oven method. Five gram ground seed sample was put at 130°C±1°C in oven for 2 hours. The sample was then removed from oven and put into desiccator for 35-45 min. and moisture was calculated by using following formula:

M_2 - M_3

$$\text{SMC (\%)},\ M = \frac{M_2 - M_3}{M_2 - M_1} \times 100$$

where, M_1 = Weight of empty container with lid

M_2 = Weight of container with lid and seed before drying, and

M_3 = Weight of container with lid and seed after drying and cooling.

For test weight, one thousand seeds of each treatment in three replications from each variety were counted, weighed by using electronic balance, and average seed weight was determined.

For estimation of radicle mergence, hundred seeds from each variety in three replications were placed on the top of the moist blotter paper in petri-plates and they are kept in seed germinator for 20°C. The seeds with 2mm radicle emergence were counted on hourly basis. The observations were taken until almost all the seeds get germinated and showed radicle emergence. The experiment was conducted in complete randomized block design (CRD) and the data were analyzed as per methods [6] and using the online statistical tool (OPSTAT) [7].

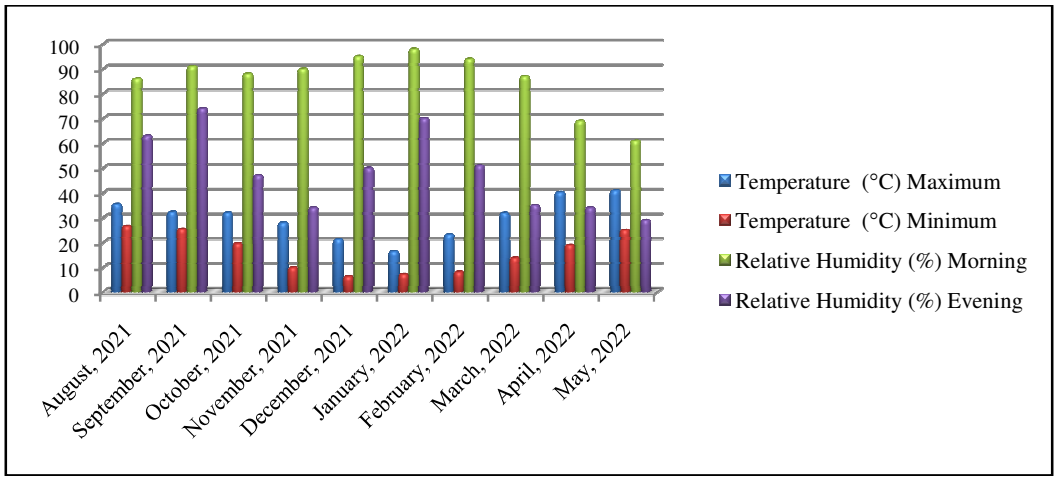

Figure 1: Average weather data of Hisar during storage period.

3. Results and discussion

The results revealed that variety Virat recorded higher germination and other seed quality parameters values than Kripa. Virat maintained germination above IMSCS [8] *i.e.* >85% after 13 months of harvesting in both the containers *i.e.* gunny bags and HDPE bags. Maximum germination (86.25%) was recorded in the seeds stored in HDPE bags in Virat variety while minimum (79.75%) was recorded in cloth bag in Kripa variety after 13 months of storage. HDPE bags showed superiority over Gunny bags in all seed quality parameters because in HDPE bags seed moisture content remained constant throughout the storage period while fluctuation was recorded in gunny bags during storage period (Figure 3). This may be the possible reason that HDPE bag performed better in maintaining the seed quality. Polyethylene bags have demonstrated efficacy in preserving high seed viability at 5°C, making them suitable for okra seed storage. Conversely, aluminum foil pouches have been identified as suitable for long-term seed storage, particularly at sub-zero temperatures [9]. Similarly observed findings in eggplant seeds, noting that cloth bags exhibited a more rapid deterioration in seed quality compared to polyethylene bags with a gauge exceeding 700 [10]. Radicle emergence was recorded just after 24 hours in Virat variety but in Kripa no radicle emergence was observed even after 48 hours also. After 13 months of storage, radicle emergence in virat was observed after 96 hours but in Kripa radicle emergence was observed at 72 hours. Maximum radicle emergence (97%) was recorded after 96 hours in virat variety in both the containers after 6 months of storage. This may be due to difference in vigour content and genetic constituents of these varieties. Radicle emergence test is can be used as a quicker test for prediction of germination test [11]. Kripa is bold seed variety having approximately 640g test weight and Virat is comparatively small seeded variety having 375g test weight. Usually seed size is positively correlated with the seed quality parameters but here the result indicates that seed size doesn't matter as the Virat performed better than Kripa. A study on the germination of chickpea seeds that had been stored for 20 months using four distinct types of seed storage containers: gunny bags, silos, polypropylene sacks, and

hermetic polyethylene bags was conducted and findings revealed that after the 20-month storage period, seeds kept in jute gunny bags, silos, conventional polypropylene sacks, and hermetic polyethylene bags exhibited germination rates of 6%, 36%, 20%, and 48%, respectively [12]. It is concluded from the study that germination of kabuli chickpea can be maintained above IMSCS (>85%) up to 13 months in HDPE bags.

Figure 2: Seeds of Virat and Kripa variety.

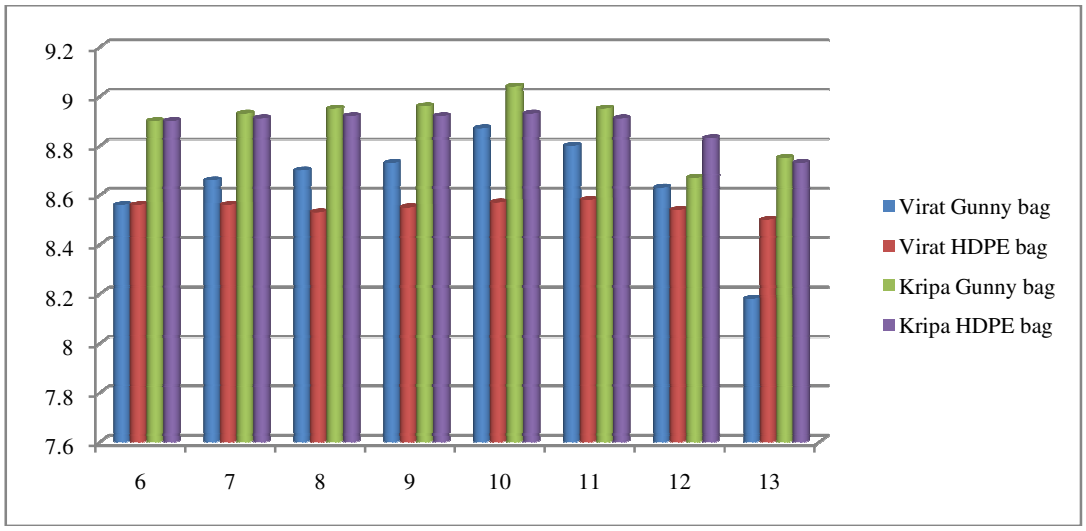

Figure 3: Moisture content (%) in seeds during storage.

Table 1: Effect of storage period and containers on first count (%) and germination (%) of kabuli chickpea.

Storage Period (SP) in months	Virat			Kripa			Virat			Kripa		
	Gunny bag	HDPE bag	Mean	Gunny bag	HDPE bag	Mean	Gunny bag	HDPE bag	Mean	Gunny bag	HDPE bag	Mean
6	88.00	88.00	88.00	62.00	62.00	62.00	96.25	96.25	96.25	87.25	87.25	87.25
7	84.67	87.00	85.83	59.33	61.33	60.33	95.00	96.75	95.88	86.50	86.00	86.25
8	82.67	84.67	83.67	54.67	58.00	56.33	90.50	93.50	92.00	85.25	85.50	85.38
9	78.33	84.67	81.50	51.00	56.00	53.50	86.75	90.00	88.38	83.75	84.75	84.25
10	69.33	81.67	75.50	44.00	54.33	49.17	85.25	86.75	86.00	80.00	84.25	82.13
11	69.00	80.00	74.50	44.00	54.00	49.00	85.75	86.50	86.13	80.00	84.50	82.25
12	66.67	79.00	72.83	43.33	53.00	48.17	85.25	86.00	85.63	80.00	84.75	82.38
13	65.67	77.00	71.33	41.67	52.00	46.83	85.00	86.25	85.63	79.75	84.50	82.13
Mean	75.54	82.75		50.00	56.33		88.72	90.25		82.81	85.19	
SEm (±)	C=0.31, P=0.61, CxP= 0.87			C=0.28, P=0.55, CxP= 0.78			C=0.20, P=0.40, CxP= 0.57			C=0.31, P=0.61, CxP= 0.87		
CD (p=0.05)	C=0.89, P=1.77, CxP= 2.51			C=0.80, P=1.59, CxP= 2.25			C=0.57, P=1.14, CxP= NS			C=0.87, P=1.75, CxP= 2.47		

Table 2: Effect of storage period and containers on vigour indices of kabuli chickpea

Storage Period (SP) in months	Kripa			Virat			Kripa			Virat		
	Vigour Index-I						Vigour Index-II					
	Gunny bag	HDPE bag	Mean	Gunny bag	HDPE bag	Mean	Gunny bag	HDPE bag	Mean	Gunny bag	HDPE bag	Mean
6	2356	2356	2356	1754	1754	1754	111	111	111	87	87	87
7	2311	2368	2339	1730	1726	1728	109	111	110	84	86	85
8	2181	2282	2231	1698	1721	1710	102	107	105	81	84	82
9	2080	2176	2128	1646	1695	1671	97	103	100	74	81	77
10	1959	2049	2004	1496	1658	1577	84	98	91	62	76	69
11	1936	1975	1955	1450	1643	1547	53	56	55	58	74	66
12	1788	1898	1843	1412	1598	1505	52	54	53	50	57	54
13	1683	1857	1770	1354	1532	1443	51	50	50	47	52	50
Mean	2037	2120		1567	1666		82	86		66	75	
SEm (±)	C=9.30, P=18.61, CxP= 26.32			C=6.61, P=13.21, CxP= 18.68			C=0.52, P=1.03, CxP= 1.46			C=0.33, P=0.66, CxP= 0.93		
CD (p=0.05)	C=26.54, P=53.07, CxP= NS			C=18.84, P=37.68, CxP= 53.29			C=1.47, P=2.94, CxP= 4.16			C=0.94, P=1.87, CxP= 2.65		

Table 3: Effect of storage period and containers on radicle emergence (%) of kabuli chickpea

Storage Period (SP) in months	Virat						Kripa					
	24h			48h			24h			48h		
	Gunny bag	HDPE bag	Mean	Gunny bag	HDPE bag	Mean	Gunny bag	HDPE bag	Mean	Gunny bag	HDPE bag	Mean
6	27.0	27.0	27.0	43.7	43.7	43.7	0	0	0	0	0	0
7	26.3	26.7	26.5	41.3	43.0	42.2	0	0	0	0	0	0
8	23.3	24.0	23.7	39.3	42.7	41.0	0	0	0	0	0	0
9	21.7	23.0	22.3	35.7	40.7	38.2	0	0	0	0	0	0
10	19.3	22.0	20.7	34.0	40.3	37.2	0	0	0	0	0	0
11	9.3	16.3	12.8	21.3	24.3	22.8	0	0	0	0	0	0
12	0.0	7.3	3.7	0.0	11.0	5.5	0	0	0	0	0	0
13	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0
Mean	15.9	18.3		26.9	30.7		0	0		0	0	
SEm (±)	C=0.31, P=0.63, CxP= 0.89			C=0.35, P=0.70, CxP= 0.98								
CD (p=0.05)	C=0.91, P=1.81, CxP= 2.56			C=1.01, P=2.01, CxP= 2.84								

Table 4: Effect of storage period and containers on radicle emergence (%) of kabuli chickpea

Storage Period (SP) in months	Virat						Kripa					
	72h			96h			72h			96h		
	Gunny bag	HDPE bag	Mean	Gunny bag	HDPE bag	Mean	Gunny bag	HDPE bag	Mean	Gunny bag	HDPE bag	Mean
6	69.7	69.7	69.7	97.0	97.0	97.0	14.3	14.3	14.3	42.0	42.0	42.0
7	68.0	69.0	68.5	95.7	96.7	96.2	13.3	13.7	13.5	40.0	41.7	40.8
8	66.7	67.7	67.2	94.0	96.0	95.0	10.7	14.3	12.5	38.3	41.0	39.7
9	62.7	66.3	64.5	91.0	95.0	93.0	8.0	14.3	11.2	31.0	39.3	35.2
10	58.3	65.3	61.8	88.0	93.3	90.7	6.3	13.0	9.7	27.3	38.7	33.0
11	37.7	46.3	42.0	85.3	78.3	81.8	5.7	10.7	8.2	24.0	29.3	26.7
12	6.0	26.3	16.2	67.7	78.0	72.8	3.3	10.0	6.7	18.3	23.7	21.0
13	0.0	0.0	0.0	55.3	65.0	60.2	3.0	4.0	3.5	17.3	19.3	18.3
Mean	46.1	51.3		84.3	87.4		8.1	11.8		29.8	34.4	
SEm (±)	C=0.35, P=0.71, CxP= 1.00			C=0.40, P=0.79, CxP= 1.12			C=0.47, P=0.75, CxP= 1.06			C=0.46, P=0.72, CxP= 1.02		
CD (p=0.05)	C=0.91, P=1.81, CxP= 2.56			C=1.01, P=2.01, CxP= 2.84			C=1.41, P=2.23, CxP= 3.15			C=1.35, P=2.14, CxP= NS		

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