

Research Article INVESTIGATIONS ON STORAGE POTENTIAL OF DIFFERENT VARIETIES IN FENUGREEK

LAKSHMI J.*1, RAME GOWDA2 AND PARASHIVAMURTHY3

¹Technical Assistant, Seed Technology Research Unit, AICRP-NSP (Crops), University of Agricultural Sciences, GKVK, Bengaluru, 560065, Karnataka, India ²Retired Professor and Chairman, Department of Seed Science and Technology, University of Agricultural Sciences, GKVK, Bengaluru, 560065, Karnataka, India ³Professor and Head, Department of Seed Science and Technology, University of Agricultural Sciences, GKVK, Bengaluru, 560065, Karnataka, India ^{*}Corresponding Author: Email - lakshmi_jagannatha@rediffmail.com

Received: December 05, 2019; Revised: December 22, 2019; Accepted: December 24, 2019; Published: December 30, 2019

Abstract: An experiment was conducted to know the storage potential of different fenugreek cultivars. The seeds which were produced during *rabi*, 2005 and summer, 2006 at Agricultural Research Station, Balajigapade, Chikkaballapura district, Karnataka were packed in cloth bag and stored under ambient conditions of Bengaluru. Samples were drawn at three months intervals (0, 3, 6 and 9) initially and subsequently at monthly intervals (up to the end of 12 months of storage) for seed quality analysis. The results revealed the significant increase in seed moisture over storage under ambient conditions irrespective of season of production. Variety Bangalore-local recorded significantly higher germination (96.71 % and 91.21 %), seedling vigour index-I (1501 and 1651) and lower electrical conductivity (243 and 212 dSm⁻¹) which was produced in both *rabi*, 2005and summer, 2006 respectively. The seeds produced during summer 2006 have better storage potential as compared seeds produced during *rabi* 2005 wherein the percentage reduction in germination was significantly higher.

Keywords: Seedling vigour index, Storage Potential, Fenugreek

Citation: Lakshmi J., et al., (2019) Investigations on Storage Potential of Different Varieties in Fenugreek. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 11, Issue 24, pp.- 9336-9340.

Copyright: Copyright©2019 Lakshmi J., et al., This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Academic Editor / Reviewer: Dr Gitam Singh, Dr Eleonora Nistor, Belinda Vallejo-Cordoba, Mathi P. Madhu

Introduction

Fenugreek (Trigonella foenum-graecum L.), commonly known as methi, is cultivated for leafy vegetable, spice, medicinal and fodder purposes. It is basically grown as a cool season crop. It belongs to the family leguminosae. It is an annual herb, 40-90 cm tall, leaves are light green, pinnately trifoliate. Flowers are hermophrodite and are self-pollinated. Seeds are small and brownish yellow in colour and they are thick and hard in texture. Fenugreek seeds are endospermic in nature, bitter in taste with a peculiar odour and flavour. Because of its high economic value, much emphasis is being given for increasing area and production under fenugreek which is possible only through the use of sufficient quantity of high quality seeds. In India, fenugreek is the third largest seed spice grown after coriander and cumin and it is now being cultivated commercially on large scale to meet its ever rising demand as a spice, condiment, medicinal and aromatic product. In order to meet our country's domestic as well as export demands; there is a need to evolve a low cost but scientific technology to produce higher quality seeds in fenugreek. The available information on the pattern of seed deterioration in relation to loss of germination and seedling vigour in fenugreek is rather scanty and hence the present study was envisaged with a view to obtain more information on the nature of storage behavior in terms of viability, vigour and its characteristics associated with loss of quality during storage under ambient conditions.

Material and methods

Fresh seeds of five varieties *viz.*, Bangalore local (V1), Pusa Early Bunching (V2), Lam Selection⁻¹ (V3), CO-1 (V4) and CO-2 (V5) which were produced during *rabi*, 2005 and summer, 2006 at Agricultural Research Station, Balajigapade, Chikkaballapura district, Karnataka were used for the study. The seeds were cleaned and graded to uniform size. Around 500g seeds of each variety with a moisture content of less than 12 percent were packed in cloth bag and stored

under ambient conditions at the Department of Seed Science and Technology, UAS, GKVK, Bangalore. Samples were drawn at three months intervals (0, 3, 6 and 9) initially and subsequently at monthly intervals (up to the end of 12 months of storage). They were evaluated for various quality attributes like moisture content (%), 100 seed weight (g), germination (%), seedling length (cm), seedling dry weight (mg), seedling vigour index (I & II), electrical conductivity (dSm⁻¹) of seed leachate and field emergence (%) by adopting standard methods.

Seed moisture content was determined by low constant temperature oven method [1]. For 100 seed weight, from each treatment combination, sample of 100 seeds were randomly taken and the average weight of eight replicates was recorded and expressed in grams. The standard germination test was carried out in four replicates of hundred seeds by between paper method. The rolled towels were incubated at germinator maintained at 25±1°C and 90±2 percent RH as per ISTA rules [1]. The number of normal seedlings was counted on fourth and tenth day of germination test as first and final count, respectively and the average of four replications was worked out and expressed as percentage based on normal seedlings. For recording seedling length, ten normal seedlings were selected at random from the germination test on tenth day (final count). Summation of mean shoot and root lengths was considered as mean seedling length. Further seedling dry weight the seedlings used for measuring the length, were dried in a hot air oven at 82±1°C for 24h. The dry weight was recorded and expressed in milligrams per seedling. The seedling vigour indices were calculated as per the formula given by [2]. SVI-I= Germination (%) x Mean seedling length (cm) and SVI-II = Germination (%) x Mean seedling dry weight (mg). For assessing the electrical conductivity of seed leachate, twenty-five seeds of four replicates were washed with acetone for few minutes and soaked in 25 ml of double distilled water and kept in an incubator maintained at 25±1°C for 18h. Then, the steeped water (seed leachate) from the soaked seeds was collected and electrical conductivity (EC) of the leachate was measured in the Digital Conductivity meter.

Investigations on Storage Potential of Different Varieties in Fenugreek

Table-1 Seed moisture content (%) and 100 seed weight (g) as influenced by the varieties and storage period during rabi, 2005 and summer, 2006

Varieties	Seed moisture content (%)															
	Rabi, 2005 produced seeds (Storage months)								Sum	mer, 2006	produced	seeds (S	torage mo	nths)		
	0	3	6	9	10	11	12	Mean	0	3	6	9	10	11	12	Mean
V1	9.21	9.28	9.44	9.83	9.72	9.74	9.93	9.59	9.07	9.22	9.42	9.67	9.80	9.73	10.07	9.59
V2	9.35	9.35	9.52	9.83	9.77	9.94	10.10	9.69	9.56	9.77	10.08	10.02	10.52	10.36	10.78	10.16
V ₃	9.25	9.34	9.58	9.92	9.91	10.09	10.24	9.76	9.35	9.49	9.52	9.75	9.75	9.90	10.20	9.71
V4	9.17	9.25	9.40	9.71	9.71	9.81	9.97	9.57	9.35	9.41	9.54	9.80	10.04	10.26	10.61	9.86
V5	9.26	9.29	9.55	9.78	9.81	9.93	10.33	9.71	9.34	9.31	9.48	9.81	10.13	10.32	10.41	9.83
Mean	9.25	9.30	9.50	9.81	9.78	9.90	10.11	9.66	9.33	9.44	9.61	9.81	10.05	10.11	10.41	9.82
Varieties(V)	S.Em±		CD	(0.05P)					S.Em±		CD	(0.05P)				
Storage period(S)	0.006		0.0	23			CV (%) = 8.23	0.013		0.0	49			CV (%	5) = 7.96
Interaction(Vx S)	0.007		0.0	24					0.015		0.0	52				
	0.016		0.0	46					0.033		0.0	97				
Varieties								100 seed	weight (g)							
Varieties		Ra	<i>bi</i> , 2005 p	roduced s	eeds (Stor	age mont	hs)	100 seed	weight (g)	Sum	mer, 2006	produced	seeds (S	torage mo	nths)	
Varieties	0	Ra 3	<i>bi</i> , 2005 p 6	roduced s 9	eeds (Stoi 10	rage mont 11	hs) 12	100 seed Mean	weight (g) 0	Sum 3	mer, 2006 6	produced 9	seeds (S 10	torage mo 11	nths) 12	Mean
Varieties V1	0 1.580	Ra 3 1.532	<i>bi</i> , 2005 p 6 1.536	roduced s 9 1.523	eeds (Stor 10 1.564	rage mont 11 1.581	hs) 12 1.621	100 seed Mean 1.562	weight (g) 0 1.561	Sum 3 1.572	mer, 2006 6 1.576	produced 9 1.574	seeds (S 10 1.586	torage mo 11 1.589	nths) 12 1.601	Mean 1.580
Varieties V ₁ V ₂	0 1.580 1.297	Ra 3 1.532 1.361	<i>bi</i> , 2005 p 6 1.536 1.347	roduced s 9 1.523 1.228	eeds (Stor 10 1.564 1.389	rage mont 11 1.581 1.402	hs) 12 1.621 1.401	100 seed Mean 1.562 1.346	weight (g) 0 1.561 1.258	Sum 3 1.572 1.263	mer, 2006 6 1.576 1.268	9 9 1.574 1.264	seeds (S 10 1.586 1.425	torage mo 11 1.589 1.284	nths) 12 1.601 1.292	Mean 1.580 1.293
Varieties V1 V2 V3	0 1.580 1.297 1.443	<i>Ra</i> 3 1.532 1.361 1.464	<i>bi</i> , 2005 p 6 1.536 1.347 1.396	roduced s 9 1.523 1.228 1.279	eeds (Stor 10 1.564 1.389 1.282	rage mont 11 1.581 1.402 1.291	hs) 12 1.621 1.401 1.283	100 seed Mean 1.562 1.346 1.348	weight (g) 0 1.561 1.258 1.311	Sum 3 1.572 1.263 1.299	mer, 2006 6 1.576 1.268 1.278	produced 9 1.574 1.264 1.268	seeds (S 10 1.586 1.425 1.275	torage mo 11 1.589 1.284 1.283	nths) 12 1.601 1.292 1.283	Mean 1.580 1.293 1.285
Varieties V1 V2 V3 V4	0 1.580 1.297 1.443 1.147	Ra 3 1.532 1.361 1.464 1.138	<i>bi</i> , 2005 p 6 1.536 1.347 1.396 1.237	roduced s 9 1.523 1.228 1.279 1.239	eeds (Stor 10 1.564 1.389 1.282 1.254	rage mont 11 1.581 1.402 1.291 1.290	hs) 12 1.621 1.401 1.283 1.291	100 seed Mean 1.562 1.346 1.348 1.228	weight (g) 0 1.561 1.258 1.311 1.166	Sum 3 1.572 1.263 1.299 1.143	mer, 2006 6 1.576 1.268 1.278 1.202	produced 9 1.574 1.264 1.268 1.199	seeds (S 10 1.586 1.425 1.275 1.199	torage mo 11 1.589 1.284 1.283 1.198	nths) 12 1.601 1.292 1.283 1.200	Mean 1.580 1.293 1.285 1.187
Varieties	0 1.580 1.297 1.443 1.147 1.151	Ra 3 1.532 1.361 1.464 1.138 1.152	<i>bi</i> , 2005 p 6 1.536 1.347 1.396 1.237 1.178	roduced s 9 1.523 1.228 1.279 1.239 1.201	eeds (Stor 10 1.564 1.389 1.282 1.254 1.208	rage mont 11 1.581 1.402 1.291 1.290 1.206 1.206	hs) 12 1.621 1.401 1.283 1.291 1.213	100 seed Mean 1.562 1.346 1.348 1.228 1.187	weight (g) 0 1.561 1.258 1.311 1.166 1.183	Sum 3 1.572 1.263 1.299 1.143 1.197	mer, 2006 6 1.576 1.268 1.278 1.202 1.198	produced 9 1.574 1.264 1.268 1.199 1.197	seeds (S 10 1.586 1.425 1.275 1.199 1.199	torage mo 11 1.589 1.284 1.283 1.198 1.200	nths) 12 1.601 1.292 1.283 1.200 1.206	Mean 1.580 1.293 1.285 1.187 1.197
Varieties V1 V2 V3 V4 V5 Mean	0 1.580 1.297 1.443 1.147 1.151 1.323	Ra 3 1.532 1.361 1.464 1.138 1.152 1.329	<i>bi,</i> 2005 p 6 1.536 1.347 1.396 1.237 1.178 1.338	roduced s 9 1.523 1.228 1.279 1.239 1.201 1.294	eeds (Stor 10 1.564 1.389 1.282 1.254 1.208 1.340	rage mont 11 1.581 1.402 1.291 1.290 1.206 1.354	hs) 1.621 1.401 1.283 1.291 1.213 1.361	Mean 1.562 1.346 1.348 1.228 1.187 1.334	weight (g) 0 1.561 1.258 1.311 1.166 1.183 1.296	Sum 3 1.572 1.263 1.299 1.143 1.197 1.295	mer, 2006 6 1.576 1.268 1.278 1.202 1.198 1.305	produced 9 1.574 1.264 1.268 1.199 1.197 1.300	seeds (S 10 1.586 1.425 1.275 1.199 1.199 1.337	torage mo 11 1.589 1.284 1.283 1.198 1.200 1.311	nths) 12 1.601 1.292 1.283 1.200 1.206 1.316	Mean 1.580 1.293 1.285 1.187 1.197 1.308
Varieties V1 V2 V3 V4 V5 Mean Varieties(V)	0 1.580 1.297 1.443 1.147 1.151 1.323 S.Em±	Ra 3 1.532 1.361 1.464 1.138 1.152 1.329	<i>bi</i> , 2005 p 6 1.536 1.347 1.396 1.237 1.178 1.338 CD	roduced s 9 1.523 1.228 1.279 1.239 1.201 1.294 (0.05P)	eeds (Stor 10 1.564 1.389 1.282 1.254 1.208 1.340	rage mont 11 1.581 1.402 1.291 1.290 1.206 1.354	hs) 12 1.621 1.401 1.283 1.291 1.213 1.361	100 seed Mean 1.562 1.346 1.348 1.228 1.187 1.334	weight (g) 0 1.561 1.258 1.311 1.166 1.183 1.296 S.Em±	Sum 3 1.572 1.263 1.299 1.143 1.197 1.295	mer, 2006 6 1.576 1.268 1.278 1.202 1.198 1.305 CD	produced 9 1.574 1.264 1.268 1.199 1.197 1.300 (0.05P)	seeds (S 10 1.586 1.425 1.275 1.199 1.199 1.337	torage mo 11 1.589 1.284 1.283 1.198 1.200 1.311	nths) 12 1.601 1.292 1.283 1.200 1.206 1.316	Mean 1.580 1.293 1.285 1.187 1.197 1.308
Varieties V1 V2 V3 V4 V5 Mean Varieties(V) Storage period(S)	0 1.580 1.297 1.443 1.147 1.151 1.323 S.Em± 0.003	Ra 3 1.532 1.361 1.464 1.138 1.152 1.329	<i>bi</i> , 2005 p 6 1.536 1.347 1.396 1.237 1.178 1.338 CD 0.0	roduced s 9 1.523 1.228 1.279 1.239 1.201 1.294 (0.05P) 13	eeds (Stor 10 1.564 1.389 1.282 1.254 1.208 1.340	rage mont 11 1.581 1.402 1.291 1.290 1.206 1.354	hs) 1.621 1.401 1.283 1.291 1.213 1.361 CV (%	100 seed Mean 1.562 1.346 1.348 1.228 1.187 1.334) = 5.21	weight (g) 0 1.561 1.258 1.311 1.166 1.183 1.296 S.Em± 0.007	Sum 3 1.572 1.263 1.299 1.143 1.197 1.295	mer, 2006 6 1.576 1.268 1.278 1.202 1.198 1.305 CD 0.0	produced 9 1.574 1.264 1.268 1.199 1.197 1.300 (0.05P) 26	seeds (S 10 1.586 1.425 1.275 1.199 1.199 1.337	torage mo 11 1.589 1.284 1.283 1.198 1.200 1.311	nths) 12 1.601 1.292 1.283 1.200 1.206 1.316 CV (%	Mean 1.580 1.293 1.285 1.187 1.197 1.308 b) = 6.93
Varieties V1 V2 V3 V4 V5 Mean Varieties(V) Storage period(S) Interaction(VxS)	0 1.580 1.297 1.443 1.147 1.151 1.323 S.Em± 0.003 0.003	Ra 3 1.532 1.361 1.464 1.138 1.152 1.329	<i>bi</i> , 2005 p 6 1.536 1.347 1.396 1.237 1.178 1.338 CD 0.0 0.0	roduced s 9 1.523 1.228 1.279 1.239 1.201 1.294 (0.05P) 13 12	eeds (Stor 10 1.564 1.389 1.282 1.254 1.208 1.340	age mont 11 1.581 1.402 1.291 1.290 1.206 1.354	hs) 12 1.621 1.401 1.283 1.291 1.213 1.361 CV (%	Mean 1.562 1.346 1.348 1.228 1.187 1.334) = 5.21	weight (g) 0 1.561 1.258 1.311 1.166 1.183 1.296 S.Em± 0.007 0.008 0.008	Sum 3 1.572 1.263 1.299 1.143 1.197 1.295	mer, 2006 6 1.576 1.268 1.278 1.202 1.198 1.305 CD 0.00 0.00	produced 9 1.574 1.264 1.268 1.199 1.197 1.300 (0.05P) 26 27	seeds (S 10 1.586 1.425 1.275 1.199 1.199 1.337	torage mo 11 1.589 1.284 1.283 1.198 1.200 1.311	nths) 12 1.601 1.292 1.283 1.200 1.206 1.316 CV (%	Mean 1.580 1.293 1.285 1.187 1.197 1.308 5) = 6.93

V1- Bangalore local, V2-PEB, V3-LS-1, V4-CO-1 and V5-CO-2

Table-2 Seed germination (%) and field emergence (%) as influenced by the varieties and storage period during rabi, 2005 and summer, 2006

varieties								Seed gem	nination (%) (
	Rabi, 2005 produced seeds (Storage months)								Sum	mer, 2006	produced	seeds (St	orage mor	nths)		
	0	3	6	9	10	11	12	Mean	0	3	6	9	10	11	12	Mean
V1	98.00	94.50	90.50	89.00	86.00	81.50	79.00	96.71	99.00	97.00	96.50	90.50	88.00	85.00	82.50	91.21
V2	98.00	94.50	92.00	91.00	91.00	84.00	77.00	91.57	98.00	98.00	99.00	91.00	89.50	85.00	82.50	91.86
V ₃	97.50	95.00	88.50	90.50	90.00	81.00	78.50	88.50	97.50	99.00	95.00	88.00	87.50	84.00	80.50	90.21
V4	96.50	92.50	90.50	88.50	84.00	81.00	78.00	85.14	97.00	96.50	96.00	85.00	85.50	84.50	79.00	89.07
V5	98.00	92.00	89.50	85.00	84.50	82.50	79.00	79.29	97.00	95.00	95.00	85.50	85.50	84.00	81.50	89.07
Mean	90.90	90.40	88.70	87.80	87.70	86.00	86.20	88.24	97.70	97.10	96.30	88.00	87.20	84.50	81.20	90.29
Varieties(V)	S.Em±		CD	(0.05P)					S.Em±		CD	(0.05P)				
Storage period(S)	0.283		1.1	11			CV (%	5) = 6.93	0.249		0.97	6			CV (%)	= 8.51
Interaction(Vx S)	0.335		1.1	58					0.294		1.01	8				
	0.749		2.1	85					0.658		1.92	21				
Varieties								Field eme	rgence (%)						
Varieties		Ra	<i>bi</i> , 2005 p	roduced s	eeds (Stor	age mont	hs)	Field eme	rgence (%) Sum	mer, 2006	produced	seeds (St	orage mor	nths)	
Varieties	0	Ra 3	<i>bi</i> , 2005 p 6	roduced s 9	eeds (Stoi 10	age mont 11	hs) 12	Field eme Mean	rgence (% 0) Sum 3	mer, 2006 6	produced 9	seeds (St 10	orage mor 11	nths) 12	Mean
Varieties V ₁	0 93.00	Ra 3 90.50	<i>bi</i> , 2005 p 6 84.00	roduced s 9 81.00	eeds (Stor 10 78.00	age mont 11 75.50	hs) 12 69.00	Field eme Mean 81.57	rgence (% 0 94.50) Sum 3 92.00	mer, 2006 6 89.00	produced 9 84.00	seeds (St 10 79.00	orage mor 11 76.50	nths) 12 74.00	Mean 84.14
Varieties V ₁ V ₂	0 93.00 92.50	Ra 3 90.50 91.00	<i>bi</i> , 2005 p 6 84.00 86.00	roduced s 9 81.00 81.00	eeds (Stor 10 78.00 75.50	age mont 11 75.50 75.50	hs) 12 69.00 69.00	Field eme Mean 81.57 81.50	rgence (% 0 94.50 93.00) Sum 92.00 90.50	mer, 2006 6 89.00 87.00	produced 9 84.00 84.00	seeds (Si 10 79.00 78.50	orage mor 11 76.50 77.00	nths) 12 74.00 74,50	Mean 84.14 83.50
Varieties V1 V2 V3	0 93.00 92.50 94.50	Ra 3 90.50 91.00 89.00	<i>bi</i> , 2005 p 6 84.00 86.00 86.00	roduced s 9 81.00 81.00 80.00	eeds (Stor 10 78.00 75.50 76.50	rage mont 11 75.50 75.50 75.00	hs) 12 69.00 69.00 70.50	Field eme Mean 81.57 81.50 81.64	rgence (% 0 94.50 93.00 95.50) Sum 92.00 90.50 91.00	mer, 2006 6 89.00 87.00 87.00	produced 9 84.00 84.00 79.00	seeds (St 10 79.00 78.50 77.00	orage mor 11 76.50 77.00 77.00	nths) 12 74.00 74,50 75.00	Mean 84.14 83.50 83.07
Varieties V1 V2 V3 V4	0 93.00 92.50 94.50 95.00	Ra 3 90.50 91.00 89.00 90.00	<i>bi</i> , 2005 p 6 84.00 86.00 86.00 86.50	roduced s 9 81.00 81.00 80.00 80.00	eeds (Stor 10 78.00 75.50 76.50 76.00	age mont 11 75.50 75.50 75.00 75.00 75.00	hs) 12 69.00 69.00 70.50 64.50	Field eme Mean 81.57 81.50 81.64 81.00	rgence (% 0 94.50 93.00 95.50 95.50) <u>Sum</u> 92.00 90.50 91.00 92.00	mer, 2006 6 89.00 87.00 87.00 89.00	produced 9 84.00 84.00 79.00 76.50	seeds (St 10 79.00 78.50 77.00 76.50	orage mor 11 76.50 77.00 77.00 76.00	nths) 12 74.00 74,50 75.00 75.00	Mean 84.14 83.50 83.07 82.93
Varieties V1 V2 V3 V4 V5	0 93.00 92.50 94.50 95.00 94.00	Ra 90.50 91.00 89.00 90.00 89.50	bi, 2005 p 6 84.00 86.00 86.00 86.50 84.50	roduced s 9 81.00 81.00 80.00 80.00 80.50	eeds (Stor 10 78.00 75.50 76.50 76.00 75.50	age mont 11 75.50 75.50 75.00 75.00 73.00	hs) 12 69.00 69.00 70.50 64.50 68.00	Field eme Mean 81.57 81.50 81.64 81.00 80.71	rgence (% 0 94.50 93.00 95.50 95.50 95.00) 3 92.00 90.50 91.00 92.00 93.00	mer, 2006 6 89.00 87.00 87.00 89.00 89.00	produced 9 84.00 84.00 79.00 76.50 81.50	seeds (St 10 79.00 78.50 77.00 76.50 77.50	orage mor 11 76.50 77.00 77.00 76.00 76.00	nths) 12 74.00 74,50 75.00 75.00 75.50	Mean 84.14 83.50 83.07 82.93 83.93
Varieties V1 V2 V3 V4 V5 Mean	0 93.00 92.50 94.50 95.00 94.00 93.80	Ra 3 90.50 91.00 89.00 90.00 89.50 90.00	bi, 2005 p 6 84.00 86.00 86.00 86.50 84.50 85.40	roduced s 9 81.00 81.00 80.00 80.00 80.50 80.50	eeds (Stor 10 78.00 75.50 76.50 76.00 75.50 76.30	age mont 11 75.50 75.50 75.00 75.00 73.00 74.80	hs) 12 69.00 69.00 70.50 64.50 68.00 68.20	Field eme Mean 81.57 81.50 81.64 81.00 80.71 81.29	rgence (% 0 94.50 93.00 95.50 95.50 95.00 94.70) 3 92.00 90.50 91.00 92.00 93.00 91.70	mer, 2006 6 89.00 87.00 87.00 89.00 89.00 88.20	produced 9 84.00 84.00 79.00 76.50 81.50 81.00	seeds (St 10 79.00 78.50 77.00 76.50 77.50 77.70	orage mor 11 76.50 77.00 77.00 76.00 76.00 76.50	nths) 12 74.00 74,50 75.00 75.00 75.50 74.80	Mean 84.14 83.50 83.07 82.93 83.93 83.51
Varieties V1 V2 V3 V4 V5 Mean Varieties(V)	0 93.00 92.50 94.50 95.00 94.00 93.80 S.Em±	Ra 3 90.50 91.00 89.00 90.00 89.50 90.00	bi, 2005 p 6 84.00 86.00 86.00 86.50 84.50 85.40 CD	roduced s 9 81.00 81.00 80.00 80.00 80.50 80.50 (0.05P)	eeds (Stor 10 78.00 75.50 76.50 76.00 75.50 76.30	rage mont 11 75.50 75.50 75.00 75.00 75.00 73.00 74.80	hs) 12 69.00 69.00 70.50 64.50 68.00 68.20	Field eme Mean 81.57 81.50 81.64 81.00 80.71 81.29	rgence (% 94.50 93.00 95.50 95.50 95.00 94.70 S.Em±) 3 92.00 90.50 91.00 92.00 93.00 91.70	mer, 2006 6 89.00 87.00 87.00 89.00 89.00 88.20 CD	produced 9 84.00 84.00 79.00 76.50 81.50 81.00 (0.05P)	seeds (Sf 10 79.00 78.50 77.00 76.50 77.50 77.70	orage mor 11 76.50 77.00 77.00 76.00 76.00 76.50	nths) 12 74.00 74,50 75.00 75.00 75.50 74.80	Mean 84.14 83.50 83.07 82.93 83.93 83.51
Varieties V_1 V_2 V_3 V_4 V_5 Mean Varieties(V) Storage period(S)	0 93.00 92.50 94.50 95.00 94.00 93.80 S.Em± 0.24	Ra 3 90.50 91.00 89.00 90.00 89.50 90.00	bi, 2005 p 6 84.00 86.00 86.00 86.50 84.50 85.40 CD NS	roduced s 9 81.00 81.00 80.00 80.00 80.50 80.50 (0.05P)	eeds (Stor 10 78.00 75.50 76.50 76.00 75.50 76.30	rage mont 11 75.50 75.50 75.00 75.00 75.00 73.00 74.80	hs) 12 69.00 69.00 70.50 64.50 68.00 68.20 CV (%	Field eme Mean 81.57 81.50 81.64 81.00 80.71 81.29 b) = 9.55	rgence (% 94.50 93.00 95.50 95.50 95.00 94.70 S.Em± 0.21) 3 92.00 90.50 91.00 92.00 93.00 91.70	mer, 2006 6 89.00 87.00 87.00 89.00 89.00 88.20 CD NS	produced 9 84.00 84.00 79.00 76.50 81.50 81.00 (0.05P)	seeds (Sf 10 79.00 78.50 77.00 76.50 77.50 77.70	orage mor 11 76.50 77.00 77.00 76.00 76.00 76.50	nths) 12 74.00 74,50 75.00 75.00 75.50 74.80 CV (%)	Mean 84.14 83.50 83.07 82.93 83.93 83.51 = 13.54
Varieties V1 V2 V3 V4 V5 Mean Varieties(V) Storage period(S) Interaction(VxS)	0 93.00 92.50 94.50 95.00 94.00 93.80 S.Em± 0.24 0.29	Ra 3 90.50 91.00 89.00 90.00 89.50 90.00	bi, 2005 p 6 84.00 86.00 86.50 84.50 85.40 CD NS 1.00	roduced s 9 81.00 80.00 80.00 80.50 80.50 (0.05P)	eeds (Stor 10 78.00 75.50 76.50 76.00 75.50 76.30	age mont 11 75.50 75.50 75.00 75.00 75.00 73.00 74.80	hs) 12 69.00 69.00 70.50 64.50 68.00 68.20 CV (%	Field eme Mean 81.57 81.50 81.64 81.00 80.71 81.29 5) = 9.55	rgence (% 0 94.50 93.00 95.50 95.50 95.00 94.70 S.Em± 0.21 0.25) 3 92.00 90.50 91.00 92.00 93.00 91.70	mer, 2006 6 89.00 87.00 87.00 89.00 89.00 88.20 CD NS 0.87	produced 9 84.00 84.00 79.00 76.50 81.50 81.00 (0.05P)	seeds (St 10 79.00 78.50 77.00 76.50 77.50 77.70	orage mor 11 76.50 77.00 77.00 76.00 76.00 76.50	nths) 12 74.00 74,50 75.00 75.00 75.50 74.80 CV (%)	Mean 84.14 83.50 83.07 82.93 83.93 83.51 = 13.54

V1- Bangalore local, V2-PEB, V3-LS-1, V4-CO-1 and V5-CO-2

The EC values due to electrolytes were expressed in dSm⁻¹ [3]. The field emergence was conducted on a well-prepared raised seed bed in the field with two hundred seeds from each treatment obtained randomly. They were sown in four replications of 50 seeds each and optimum soil moisture was maintained by watering regularly. The number of seedlings emerged on 15th day of sowing were counted and expressed in percentage considering the normal seedlings.

Results and discussion

Moisture content (%) of the seeds produced during both the seasons and stored in cloth bag under ambient conditions for a period of twelve months differed significantly between the varieties and storage months. Irrespective of varieties it increased with the advance in storage period in both *rabi*, 2005 and summer, 2006 produced seeds. At the end of storage period, lower moisture content was recorded in V4 and V1 (9.57 and 9.59 %) and higher in V3 and V2 (9.76 and 10.16 %) in *rabi*, 2005 and summer, 2006, respectively. Initially, the seed moisture

content was 9.25 and 9.33 percent and it increased thereafter, till the end of storage period. However, at the end of twelve months of storage, the moisture content increased to 10.11 and 10.41 percent in the seeds of *rabi*, 2005 and summer, 2006, respectively. These results agree with the findings of [4], [5] in soybean and [6] in summer groundnut. 100 seed weight was significantly higher in V1 in both the seasons (1.562 and 1.580 g, respectively) and it was lower in V5 (1.187 g) in *rabi*, 2005 and in V4 (1.187 g) in summer, 2006. There was slight increase in 100 seed weight towards the end of storage during *rabi*, 2005.

The germination (%) of seeds stored in cloth bag under ambient conditions for 12 months differed significantly between the varieties, storage months and their interactions. At the end of storage period, higher germination was recorded in V1 (96.71 %) and lower in V5 (79.29 %) in *rabi*, 2005. During summer, 2006, V2 recorded higher germination (91.86 %) but it was lower in V4 and V5 (89.07 %). Significant differences were observed on germination percentage of seeds among the storage months.

International Journal of Agriculture Sciences ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 11, Issue 24, 2019

Lakshmi J., Rame Gowda and Parashivamurthy

Table-3 Seedling length (cm) and seedling dry weight (mg) as influenced by the varieties and storage period during rabi, 2005 and summer, 2006

Varieties	Seedling length (cm)															
	Rabi, 2005 produced seeds (Storage months)							Summer, 2006 produced seeds (Storage months)								
	0	3	6	9	10	11	12	Mean	0	3	6	9	10	11	12	Mean
V1	25.40	24.37	22.83	21.23	20.19	19.56	19.00	21.80	25.61	24.63	22.94	21.72	20.95	20.80	20.01	22.38
V2	22.03	21.61	18.86	21.06	21.00	20.35	20.18	20.73	23.29	23.08	21.48	21.07	20.88	19.79	19.28	21.26
V ₃	21.88	21.88	19.95	19.59	18.23	18.14	18.26	19.70	22.86	22.18	21.14	21.19	20.90	20.16	19.19	21.09
V4	21.58	20.62	18.06	19.23	17.42	17.35	17.09	18.76	22.70	22.59	22.46	21.40	21.10	21.00	19.28	21.50
V5	22.52	22.38	18.63	20.34	19.74	19.77	19.12	20.36	23.02	22.01	21.53	21.56	21.04	20.09	18.95	21.17
Mean	22.68	22.17	19.67	20.29	19.32	19.03	18.73	20.27	23.50	22.90	21.91	21.39	20.97	20.37	19.34	21.48
Varieties(V)	S.Em±		CD	(0.05P)					S.Em±		CD	(0.05P)				
Storage period(S)	0.080		0.3	14			CV (%	o) = 8.26	0.074		0.2	91			CV (%	5) = 8.69
Interaction(Vx S)	0.095		0.3	27					0.088		0.3	03				
	0.211		0.6	17					0.196		0.5	72				
Varieties							Se	edling dry	weight (m	ng)						
Varieties		Ra	<i>bi</i> , 2005 p	roduced s	eeds (Stor	age mont	Se hs)	edling dry	weight (m	ng) Sum	mer, 2006	producec	seeds (S	torage mo	nths)	
Varieties	0	<i>Ra</i> 3	<i>bi</i> , 2005 p 6	roduced s 9	eeds (Stor 10	rage mont 11	Se hs) 12	edling dry Mean	vweight (m 0	ng) Sum 3	mer, 2006 6	producec 9	seeds (S 10	torage mo 11	nths) 12	Mean
Varieties V1	0 20.28	<i>Ra</i> 3 19.53	<i>bi</i> , 2005 p 6 11.68	roduced s 9 11.55	eeds (Stor 10 10.25	rage mont 11 9.30	Se hs) 12 8.83	edling dry Mean 13.06	weight (m 0 19.23	ng) Sum 3 18.80	mer, 2006 6 17.80	produced 9 16.75	seeds (S 10 14.03	torage mo 11 12.03	nths) 12 9.60	Mean 15.46
Varieties V1 V2	0 20.28 15.80	Ra 3 19.53 15.43	<i>bi</i> , 2005 p 6 11.68 13.88	roduced s 9 11.55 9.08	eeds (Stor 10 10.25 7.90	rage mont 11 9.30 7.65	Se hs) 12 8.83 7.13	Mean 13.06 10.98	weight (m 0 19.23 15.73	ng) Sum 3 18.80 16.00	mer, 2006 6 17.80 15.75	produced 9 16.75 14.83	seeds (S 10 14.03 12.88	torage mo 11 12.03 9.88	nths) 12 9.60 7.65	Mean 15.46 13.24
Varieties V1 V2 V3	0 20.28 15.80 15.28	Ra 3 19.53 15.43 15.40	<i>bi</i> , 2005 p 6 11.68 13.88 12.53	roduced s 9 11.55 9.08 8.45	eeds (Stor 10 10.25 7.90 7.80	rage mont 11 9.30 7.65 6.83	Se hs) 8.83 7.13 7.23	Mean 13.06 10.98 10.50	weight (m 0 19.23 15.73 16.75	ng) Sum 3 18.80 16.00 16.55	mer, 2006 6 17.80 15.75 16.18	9 16.75 14.83 14.98	seeds (S 10 14.03 12.88 13.18	torage mo 11 12.03 9.88 10.98	nths) 12 9.60 7.65 8.28	Mean 15.46 13.24 13.84
Varieties V1 V2 V3 V4	0 20.28 15.80 15.28 16.63	Ra 3 19.53 15.43 15.40 14.30	<i>bi</i> , 2005 p 6 11.68 13.88 12.53 13.68	roduced s 9 11.55 9.08 8.45 9.50	eeds (Stor 10 10.25 7.90 7.80 7.60	rage mont 11 9.30 7.65 6.83 7.23	Se hs) 12 8.83 7.13 7.23 7.20	Mean 13.06 10.98 10.50 10.88	weight (m 0 19.23 15.73 16.75 17.05	ng) Sum 18.80 16.00 16.55 16.75	mer, 2006 6 17.80 15.75 16.18 16.28	9 16.75 14.83 14.98 16.65	seeds (S 10 14.03 12.88 13.18 13.40	torage mo 11 12.03 9.88 10.98 10.30	nths) 12 9.60 7.65 8.28 7.90	Mean 15.46 13.24 13.84 13.90
Varieties V1 V2 V3 V4 V5	0 20.28 15.80 15.28 16.63 16.13	Ra 3 19.53 15.43 15.40 14.30 14.50	<i>bi</i> , 2005 p 6 11.68 13.88 12.53 13.68 12.35	roduced s 9 11.55 9.08 8.45 9.50 8.63	eeds (Stor 10 10.25 7.90 7.80 7.60 6.58	age mont 11 9.30 7.65 6.83 7.23 6.80	Se hs) 12 8.83 7.13 7.23 7.20 6.78	Mean 13.06 10.98 10.50 10.88 10.25	weight (m 0 19.23 15.73 16.75 17.05 16.95	ng) Sum 3 18.80 16.00 16.55 16.75 16.65	mer, 2006 6 17.80 15.75 16.18 16.28 16.40	produced 9 16.75 14.83 14.98 16.65 15.55	seeds (S 10 14.03 12.88 13.18 13.40 12.93	torage mo 11 12.03 9.88 10.98 10.30 9.98	nths) 12 9.60 7.65 8.28 7.90 7.58	Mean 15.46 13.24 13.84 13.90 13.72
Varieties V1 V2 V3 V4 V5 Mean	0 20.28 15.80 15.28 16.63 16.13 16.82	Ra 3 19.53 15.43 15.40 14.30 14.50 15.83	<i>bi</i> , 2005 p 6 11.68 13.88 12.53 13.68 12.35 12.82	roduced s 9 11.55 9.08 8.45 9.50 8.63 9.44	eeds (Stor 10 10.25 7.90 7.80 7.60 6.58 8.03	age mont 11 9.30 7.65 6.83 7.23 6.80 7.56	Se hs) 12 8.83 7.13 7.23 7.20 6.78 7.43	Mean 13.06 10.98 10.50 10.88 10.25 11.14	weight (m 0 19.23 15.73 16.75 17.05 16.95 17.14	ng) Sum 18.80 16.00 16.55 16.75 16.65 16.95	mer, 2006 6 17.80 15.75 16.18 16.28 16.40 16.48	produced 9 16.75 14.83 14.98 16.65 15.55 15.55	seeds (S 10 14.03 12.88 13.18 13.40 12.93 13.28	torage mo 11 12.03 9.88 10.98 10.30 9.98 10.63	nths) 12 9.60 7.65 8.28 7.90 7.58 8.20	Mean 15.46 13.24 13.84 13.90 13.72 14.03
Varieties V1 V2 V3 V4 V5 Mean Varieties(V)	0 20.28 15.80 15.28 16.63 16.13 16.82 S.Em±	Ra 3 19.53 15.43 15.40 14.30 14.50 15.83	<i>bi</i> , 2005 p 6 11.68 13.88 12.53 13.68 12.35 12.82 CD	roduced s 9 11.55 9.08 8.45 9.50 8.63 9.44 (0.05P)	eeds (Stor 10 10.25 7.90 7.80 7.60 6.58 8.03	rage mont 11 9.30 7.65 6.83 7.23 6.80 7.56	Se hs) 12 8.83 7.13 7.23 7.20 6.78 7.43	Mean 13.06 10.98 10.50 10.88 10.25 11.14	weight (m 0 19.23 15.73 16.75 17.05 16.95 17.14 S.Em±	ng) Sum 18.80 16.00 16.55 16.75 16.65 16.95	mer, 2006 6 17.80 15.75 16.18 16.28 16.40 16.48 CD	produced 9 16.75 14.83 14.98 16.65 15.55 15.55 (0.05P)	seeds (S 10 14.03 12.88 13.18 13.40 12.93 13.28	torage mo 11 12.03 9.88 10.98 10.30 9.98 10.63	nths) 12 9.60 7.65 8.28 7.90 7.58 8.20	Mean 15.46 13.24 13.84 13.90 13.72 14.03
Varieties V1 V2 V3 V4 V5 Mean Varieties(V) Storage period(S)	0 20.28 15.80 15.28 16.63 16.13 16.82 S.Em± 0.062	Ra 3 19.53 15.43 15.40 14.30 14.50 15.83	<i>bi</i> , 2005 p 6 11.68 13.88 12.53 13.68 12.35 12.82 CD 0.2	roduced s 9 11.55 9.08 8.45 9.50 8.63 9.44 (0.05P) 43	eeds (Stor 10 10.25 7.90 7.80 7.60 6.58 8.03	rage mont 11 9.30 7.65 6.83 7.23 6.80 7.56	Se hs) 12 8.83 7.13 7.23 7.20 6.78 7.43 CV (%	Mean 13.06 10.98 10.50 10.88 10.25 11.14 b) = 9.32	weight (m 0 19.23 15.73 16.75 17.05 16.95 17.14 S.Em± 0.059	ng) Sum 3 18.80 16.00 16.55 16.55 16.65 16.95	mer, 2006 6 17.80 15.75 16.18 16.28 16.40 16.48 CD 0.2	produced 9 16.75 14.83 14.98 16.65 15.55 15.55 (0.05P) 76	seeds (S 10 14.03 12.88 13.18 13.40 12.93 13.28	torage mo 11 12.03 9.88 10.98 10.30 9.98 10.63	nths) 12 9.60 7.65 8.28 7.90 7.58 8.20 CV (%	Mean 15.46 13.24 13.84 13.90 13.72 14.03
Varieties V1 V2 V3 V4 V5 Mean Varieties(V) Storage period(S) Interaction(VxS)	0 20.28 15.80 15.28 16.63 16.13 16.82 S.Em± 0.062 0.073	Ra 3 19.53 15.43 15.40 14.30 14.50 15.83	<i>bi</i> , 2005 p 6 11.68 13.88 12.53 13.68 12.35 12.82 CD 0.2 0.2 0.2	roduced s 9 11.55 9.08 8.45 9.50 8.63 9.44 (0.05P) 43 53	eeds (Stor 10 10.25 7.90 7.80 7.60 6.58 8.03	rage mont 11 9.30 7.65 6.83 7.23 6.80 7.56	Se hs) 12 8.83 7.13 7.23 7.20 6.78 7.43 CV (%	Mean 13.06 10.98 10.50 10.88 10.25 11.14 •) = 9.32	weight (m 0 19.23 15.73 16.75 17.05 16.95 17.14 S.Em± 0.059 0.070	ng) Sum 18.80 16.00 16.55 16.55 16.65 16.95	mer, 2006 6 17.80 15.75 16.18 16.28 16.40 16.48 CD 0.2 0.2	produced 9 16.75 14.83 14.98 16.65 15.55 15.55 (0.05P) 76 43	seeds (S 10 14.03 12.88 13.18 13.40 12.93 13.28	torage mo 11 12.03 9.88 10.98 10.30 9.98 10.63	nths) 12 9.60 7.65 8.28 7.90 7.58 8.20 CV (%	Mean 15.46 13.24 13.84 13.90 13.72 14.03 b) = 6.22

V1- Bangalore local, V2-PEB, V3-LS-1, V4-CO-1 and V5-CO-2

|--|

Varieties								seedling vi	gour index							
	Rabi, 2005 produced seeds (Storage months)							Summer, 2006 produced seeds (Storage months)								
	0	3	6	9	10	11	12	Mean	0	3	6	9	10	11	12	Mean
V1	2490	2303	2066	1889	1736	1594	1501	1940	2536	2389	2214	1966	1844	1768	1651	2053
V ₂	2159	2042	1735	1916	1911	1709	1554	1861	2282	2262	2126	1917	1869	1682	1590	1961
V ₃	2134	2079	1766	1773	1641	1469	1434	1756	2229	2195	2008	1865	1829	1693	1545	1909
V4	2082	1907	1635	1702	1463	1405	1333	1647	2202	2180	2156	1819	1804	1774	1523	1923
V5	2206	2060	1667	1729	1668	1631	1510	1781	2233	2091	2045	1843	1799	1687	1545	1892
Mean	2214	2078	1774	1802	1684	1562	1466	1797	2296	2223	2110	1882	1829	1721	1571	1947
Varieties(V)	S.Em±		CD	(0.05P)					S.Em±		CD	(0.05P)				
Storage period(S)	9.89		38.8	31			CV (%) = 11.92	9.25		36.3	33			CV (%) = 12.55
Interaction(Vx S)	11.70		40.4	48					10.95		37.8	39				
	26.15		76.3	34					24.49		71.4	47				
Varieties								Seedling vig	gour index	<u> </u>						
Varieties		Ra	<i>abi</i> , 2005 p	oroduced s	eeds (Sto	rage mont	hs)	Seedling viç	our index	ll Sum	mer, 2006	produced	l seeds (S	torage mo	nths)	
Varieties	0	Ra 3	<i>abi</i> , 2005 p 6	produced s 9	eeds (Sto 10	rage mont 11	hs) 12	Seedling vig Mean	gour index 0	II Sum 3	imer, 2006 6	produced 9	l seeds (S 10	torage mo 11	nths) 12	Mean
Varieties V1	0 1986	Ra 3 1845	abi, 2005 p 6 1057	produced s 9 1028	eeds (Sto 10 881	rage mont 11 758	hs) 12 697	Seedling vig Mean 1179	our index 0 1904	II Sum 3 1824	imer, 2006 6 1718	produced 9 1516	l seeds (S 10 1234	torage mo 11 1022	nths) 12 792	Mean 1430
Varieties	0 1986 1549	Ra 3 1845 1458	abi, 2005 p 6 1057 1276	9 9 1028 826	eeds (Sto 10 881 719	rage mont 11 758 643	hs) 12 697 549	Mean 1179 1003	our index 0 1904 1541	II Sum 3 1824 1568	mer, 2006 6 1718 1559	produced 9 1516 1349	l seeds (S 10 1234 1152	torage mo 11 1022 840	nths) 12 792 631	Mean 1430 1234
Varieties V1 V2 V3	0 1986 1549 1509	Ra 3 1845 1458 1462	abi, 2005 p 6 1057 1276 1109	roduced s 9 1028 826 765	eeds (Sto 10 881 719 702	rage mont 11 758 643 553	hs) 12 697 549 567	Seedling vig Mean 1179 1003 952	0 1904 1541 1633	II Sum 1824 1568 1638	mer, 2006 6 1718 1559 1537	produced 9 1516 1349 1318	1 seeds (S 10 1234 1152 1153	torage mo 11 1022 840 922	nths) 12 792 631 666	Mean 1430 1234 1267
Varieties V1 V2 V3 V4	0 1986 1549 1509 1604	Ra 3 1845 1458 1462 1323	abi, 2005 p 6 1057 1276 1109 1238	9 1028 826 765 841	eeds (Sto 10 881 719 702 638	rage mont 11 758 643 553 585	hs) 12 697 549 567 562	Seedling vig Mean 1179 1003 952 970	0 1904 1541 1633 1654	II Sum 1824 1568 1638 1616	mer, 2006 6 1718 1559 1537 1563	produced 9 1516 1349 1318 1330	l seeds (S 10 1234 1152 1153 1146	torage mo 11 1022 840 922 871	nths) 12 792 631 666 624	Mean 1430 1234 1267 1258
Varieties V1 V2 V3 V4 V5	0 1986 1549 1509 1604 1580	Ra 3 1845 1458 1462 1323 1334	abi, 2005 p 6 1057 1276 1109 1238 1105	roduced s 9 1028 826 765 841 733	eeds (Sto 10 881 719 702 638 556	rage mont 11 758 643 553 585 561	hs) 12 697 549 567 562 535	Mean 1179 1003 952 970 915	0 1904 1541 1633 1654 1644	II Sum 1824 1568 1638 1616 1582	mer, 2006 6 1718 1559 1537 1563 1558	produced 9 1516 1349 1318 1330 1330	l seeds (S 10 1234 1152 1153 1146 1105	torage mo 11 1022 840 922 871 838	nths) 12 792 631 666 624 618	Mean 1430 1234 1267 1258 1239
Varieties V1 V2 V3 V4 V5 Mean	0 1986 1549 1509 1604 1580 1646	Ra 3 1845 1458 1462 1323 1334 1484	abi, 2005 p 6 1057 1276 1109 1238 1105 1157	roduced s 9 1028 826 765 841 733 838	eeds (Sto 10 881 719 702 638 556 699	rage mont 11 758 643 553 553 585 561 620	hs) 12 697 549 567 562 535 582	Mean 1179 1003 952 970 915 1004	0 1904 1541 1633 1654 1644 1675	II Sum 1824 1568 1638 1616 1582 1646	mer, 2006 6 1718 1559 1537 1563 1558 1587	produced 9 1516 1349 1318 1330 1330 1369	l seeds (S 10 1234 1152 1153 1146 1105 1158	torage mo 11 1022 840 922 871 838 898	nths) 12 792 631 666 624 618 666	Mean 1430 1234 1267 1258 1239 1286
Varieties	0 1986 1549 1509 1604 1580 1646 S.Em±	Ra 3 1845 1458 1462 1323 1334 1484	abi, 2005 p 6 1057 1276 1109 1238 1105 1157 CD	roduced s 9 1028 826 765 841 733 838 (0.05P)	eeds (Sto 10 881 719 702 638 556 699	rage mont 11 758 643 553 585 561 620	ths) 12 697 549 567 562 535 582	Mean 1179 1003 952 970 915 1004	0 1904 1541 1633 1654 1644 1675 S.Em±	II Sum 1824 1568 1638 1616 1582 1646	mer, 2006 6 1718 1559 1537 1563 1558 1558 1587 CD	5 produced 9 1516 1349 1318 1330 1330 1369 (0.05P)	1 seeds (S 10 1234 1152 1153 1146 1105 1158	torage mo 11 1022 840 922 871 838 898	nths) 12 792 631 666 624 618 666	Mean 1430 1234 1267 1258 1239 1286
Varieties V1 V2 V3 V4 V5 Mean Varieties(V) Storage period(S)	0 1986 1549 1509 1604 1580 1646 S.Em± 5.96	Ra 3 1845 1458 1462 1323 1334 1484	abi, 2005 p 6 1057 1276 1109 1238 1105 1157 CD 23.4	roduced s 9 1028 826 765 841 733 838 (0.05P) 40	eeds (Sto 10 881 719 702 638 556 699	rage mont 11 758 643 553 563 561 620	ts) 12 697 549 567 562 535 582 CV (%	Mean 1179 1003 952 970 915 1004	0 1904 1541 1633 1654 1644 1675 S.Em± 6.90	II Sum 3 1824 1568 1638 1616 1582 1646	mer, 2006 6 1718 1559 1537 1563 1558 1587 CD 27.0	5 produced 9 1516 1349 1318 1330 1330 1369 (0.05P) 08	1 seeds (S 10 1234 1152 1153 1146 1105 1158	torage mo 11 1022 840 922 871 838 898	nths) 12 792 631 666 624 618 666 CV (%	Mean 1430 1234 1267 1258 1239 1286) = 9.83
Varieties V1 V2 V3 V4 V5 Mean Varieties(V) Storage period(S) Interaction(VxS)	0 1986 1549 1509 1604 1580 1646 S.Em± 5.96 7.05	Ra 3 1845 1458 1462 1323 1334 1484	abi, 2005 p 6 1057 1276 1109 1238 1105 1157 CD 23.4 24.4	9 1028 826 765 841 733 838 (0.05P) 40	seeds (Sto 10 881 719 702 638 556 699	rage mont 11 758 643 553 553 561 620	ts) 12 697 549 567 562 535 582 CV (%	Mean 1179 1003 952 970 915 1004	0 1904 1541 1633 1654 1644 1675 S.Em± 6.90 8.16	II Sum 3 1824 1568 1638 1616 1582 1646	mer, 2006 6 1718 1559 1537 1563 1558 1587 CD 27.0 28.2	5 produced 9 1516 1349 1318 1330 1330 1369 (0.05P) 08 24	1 seeds (S 10 1234 1152 1153 1146 1105 1158	torage mo 11 1022 840 922 871 838 898	nths) 12 792 631 666 624 618 666 CV (%	Mean 1430 1234 1267 1258 1239 1286) = 9.83

V1- Bangalore local, V2-PEB, V3-LS-1, V4-CO-1 and V5-CO-2, Seedling vigour index I - Germination x Mean seedling length

Seedling vigour index II - Germination x Mean seedling dry weight

Irrespective of the varieties, germination percentage declined with the advance in storage months in both the seasons. Initially the germination was 90.90 and 97.70 percent which declined to 86.20 and 81.20 percent, during *rabi*, 2005 and summer, 2006, respectively. Varietal differences for germination in storage is also reported by [5-11] in soybean and [12] in mungbean. The decrease in germination percentage was more (16.50%) in seeds produced in summer, 2005 Similar results of decrease in germination were also reported by [13, 14, 11] in soybean, [15] in rice bean and [16] in fenugreek. Although, germinability of seeds of fenugreek decreased, it was well above seed certification standard (>70%) at the end of twelve months of storage. At the end of one year of storage, V1 recorded higher seedling length (21.80 and 22.38 cm) during *rabi*, 2005 and summer, 2006, respectively. Lower seedling length was recorded in V4 (18.76 cm) during *rabi*, 2005 and V3 (21.09 cm) during summer, 2006. There was a drastic reduction in seedling length over storage. Initially higher seedling length was recorded (22.68)

cm and 23.50 cm) which declined to 18.73 cm and 19.34 cm after 12 months of storage from the seeds of *rabi*, 2005 and summer, 2006, respectively. Varietal differences during storage have been reported by [13] in soybean and [17] in black gram. The decline in seedling length during storage was from 22.68cm to 18.73cm and 23.50cm to 20.97cm in seeds produced during *rabi*, 2005 and summer, 2006, respectively. Similar trend was also noticed for seedling dry weight. The reduction in seedling dry weight was from 16.82mg to 7.43mg and 17.14mg to 8.20mg in seeds produced during *rabi*, 2005 and summer, 2006, respectively. Similar findings were also reported by [13] in soybean, [17] in black gram and [16] in fenugreek.

Seeding vigour index is one of the important seed quality attributes. Generally, it decreased in the seeds produced during both the seasons in all varieties tested with increase in storage period. But the extent of reduction varied with the varieties.

Table-5 Electrical conductivity (dSm⁻¹) of seed leachate as influenced by the varieties and storage period during rabi, 2005 and summer, 2006.

varieties			Rabi, 200	b produced	seeds (Stor	age months	S)	
	0	3	6	9	10	11	12	Mean
V1	138	138	151	177	195	212	243	179
V2	185	189	192	212	241	245	267	219
V ₃	168	177	187	222	230	231	267	212
V4	149	151	160	185	210	237	258	192
V5	176	179	194	206	223	244	269	213
Mean	163	167	177	200	220	234	260	203
	S.Er	n±	CE) (0.05P)				
Varieties (V)	0.39		1.5	53		(CV (%) = 7.1	10
Storage period (S	6) 0.46		1.6	60				
Interaction (V x S) 1.03		3.0)1				
Varieties			Summer 20	006 produce	d seeds (St	torage mont	hs)	
Vanotioo			Carrinor, EC		a 000 a 0 (0)	ierage men		
	0	3	6	9	10	11	12	Mean
V ₁	0 150	3 154	6 167	9 185	10 199	11 208	12 212	Mean 182
V ₁ V ₂	0 150 169	3 154 173	6 167 188	9 185 193	10 199 208	11 208 215	12 212 223	Mean 182 195
V ₁ V ₂ V ₃	0 150 169 154	3 154 173 152	6 167 188 171	9 185 193 193	10 199 208 204	11 208 215 218	12 212 223 219	Mean 182 195 187
V ₁ V ₂ V ₃ V ₄	0 150 169 154 165	3 154 173 152 165	6 167 188 171 178	9 185 193 193 193	10 199 208 204 205	11 208 215 218 213	12 212 223 219 215	Mean 182 195 187 190
V1 V2 V3 V4 V5	0 150 169 154 165 161	3 154 173 152 165 162	6 167 188 171 178 177	9 185 193 193 193 193 192	10 199 208 204 205 208	11 208 215 218 213 214	12 212 223 219 215 221	Mean 182 195 187 190 190
V1 V2 V3 V4 V5 Mean	0 150 169 154 165 161 160	3 154 173 152 165 162 161	6 167 188 171 178 177 176	9 185 193 193 193 193 192 191	10 199 208 204 205 208 205	11 208 215 218 213 214 213	12 212 223 219 215 221 218	Mean 182 195 187 190 190 189
V1 V2 V3 V4 V5 Mean	0 150 169 154 165 161 160 S.Er	3 154 173 152 165 162 161 n±	6 167 188 171 178 177 176 CE	9 185 193 193 193 193 192 191 0 (0.05P)	10 199 208 204 205 208	11 208 215 218 213 214 213	12 212 223 219 215 221 218	Mean 182 195 187 190 190 189
V1 V2 V3 V4 V5 Mean	0 150 169 154 165 161 160 S.Er 0.26	3 154 173 152 165 162 161 n±	6 167 188 171 178 177 176 CE 1.0	9 185 193 193 193 192 191 0 (0.05P) 13	10 199 208 204 205 208 205 208	11 208 215 218 213 214 213	12 212 223 219 215 221 218 CV (%) = 7.5	Mean 182 195 187 190 190 189 83
$V_1 \\ V_2 \\ V_3 \\ V_4 \\ V_5 \\ \hline Mean \\ Varieties (V) \\ Storage period (S$	0 150 169 154 165 161 160 S.Er 0.26 0.31	3 154 173 152 165 162 161 n±	6 167 188 171 178 177 176 CE 1.0 1.0	9 185 193 193 193 192 191 0 (0.05P) 13 18	10 199 208 204 205 208 205	11 208 215 218 213 214 213	12 212 223 219 215 221 218 CV (%) = 7.5	Mean 182 195 187 190 190 189 83

V1- Bangalore local, V2-PEB, V3-LS-1, V4-CO-1 and V5-CO-2

Superiority of Bangalore local was observed over other varieties in both the seasons for seedling vigour index-I (1940 and 2053) and respectively for seedling vigour index-II (1179 and 1430). It was lower in CO-1 (1647 for seedling vigour index-I) and CO-2 (915 for seedling vigour index-II) in seeds produced in *rabi*, 2005 and in summer, 2006. Further, CO-2 (1892 for seedling vigour index-I) and Pusa Early Bunching (1234 for seedling vigour index-II) also recorded considerable seedling vigour. Similar findings were reported by [18] in French bean, [15] in rice bean and [16] in fenugreek.

Another aspect which is related to vigour and viability of seed is the electrical conductivity of seed leachates. This is attributed to the loss of membrane integrity and the extent of leakage, which is directly proportional to the conductivity of solution [19]. Many research workers reported significant but negative correlation between germination and electrical conductivity of leachates. In the present investigation also, a progressive but tremendous increase in the electrical conductivity of seed leachates over storage, irrespective of varieties. Among varieties, Bangalore local recorded lower electrical conductivity (179dSm⁻¹ and 182dSm⁻¹) and it was higher in Pusa Early Bunching (219dSm⁻¹ and 195dSm⁻¹) in both the seasons, respectively at the end of storage period. The increase in electrical conductivity was significant (163dSm⁻¹ to 260dSm⁻¹ and 160dSm⁻¹ to 218dSm⁻¹) in both rabi, 2005 and summer, 2006, respectively. Similar trend in increased electrical conductivity was also observed by [20] in crimson clover, [13] in soybean and [16] in fenugreek. Varieties did not differ significantly for field emergence but the storage months and interactions of V x S, differed considerably in both the seasons. With the advance in storage period, there was a decline in field emergence of seeds produced in rabi, 2005 and summer, 2006 and it was well corroborated with the laboratory germination. The decline in field emergence was lower (93.80 to 68.20%) in rabi, 2005 compared to higher (94.70 to 74.80%) recorded in the seeds of summer, 2006. These results are in conformity with the findings of [21] and [22] in soybean who had also observed similar decline in field emergence over storage.

Conclusion

Moisture content increased with storage period under ambient conditions in the seeds of both *rabi*, 2005 and summer, 2006. Variety Bangalore-local recorded significantly higher germination (96.71% and 91.21%) in both the seasons. Germination declined gradually over storage (90.90 to 86.20%) in the seeds of both *rabi*, 2005 and summer, 2006 (97.70 to 81.20%), but it was well above the minimum certification standard (>70%) at the end of 12 months of storage. Correspondingly, seedling vigour indices also declined significantly with increase in storage period in the seeds of both the seasons and varieties.

Application of research: Fenugreek seeds with moisture content of around 9 percent and packed in cloth bag could be stored under ambient conditions for a period of at least 12 months to maintain minimum seed certification standard (>70%) of germination.

Research Category: Seed Science and Technology

Acknowledgement / Funding: Authors are thankful to University of Agricultural Sciences, GKVK, Bengaluru, 560065, Karnataka, India

*Research Guide or Chairperson of research: Dr Rame Gowda University: University of Agricultural Sciences, Bengaluru, 560065, India Research project name or number: PhD Thesis

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Agricultural Research Station, Balajigapade, Chikkaballapura district, Karnataka

Cultivar / Variety / Breed name: Fenugreek (Trigonella foenum-graecum L.)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors. Ethical Committee Approval Number: Nil

References

- [1] Anonymous (2007) Seed Sci& Technol., (Supplement), 35, 25-30.
- [2] Abdul-Baki A.A. and Anderson J.D. (1973) Crop Sci., 13, 630-637.
- [3] Presley H. T. (1958) Pl. Dis. Rep., 42, 52.
- [4] Jawale L.N., Deosarkar D.B., Nayeem K.A. and Patinge S.P. (2002) Seed Tech News, 191.
- [5] Sharma S.N., Goyal K.C., Gupta J.J., Gupta H.C., Kakralya, B.H., Sharma S.K., Mehta S.M. and Rathore A.K.S. (1998) Seed Res., 26(1), 89-91.

- [6] Patra A.K., Tripathy S.K. and Samui R.C. (2000) Seed Res., 28(1), 32-35.
- [7] Mohan Rao A. (1993) M.Sc. (Agri.) Thesis, submitted to University of Agricultural Sciences, Bangalore.
- [8] Vamadevappa H. (1998) M.Sc. (Agri.) Thesis, submitted to University of Agricultural Sciences, Bangalore.
- [9] Shamsul H., Ahmad A., Yahiya M. And Khan T. (1996) *Legume Res.*, 19, 70-74.
- [10] Singh G. and Gill S.S. (1996) Seed Res., 22, 137-140.
- [11] Kharb R.P.S., Deswal D.P. and Dahiya B.S. (1998) Seed Tech News, 28, 85.
- [12] Udai R., Bishnoi and Santosh M.M. (1997) Seed Res., 25, 31-36.
- [13] Verma R.S. and Gupta P.C. (1975) Seed Res., 3, 39-44.
- [14] Kumar S., Singal N.C. and Prakash S. (1997) Indian J. Genetics and Plant Breeding, 57, 204-209.
- [15] Singh S.N., Singh B.B. and Chowdhary N.K. (1998) Seed Tech News, 28, 32.
- [16] Indira K., Gunasekaran M. and Prasath D. (2000) Orissa J.Hort., 28(1), 34-37.
- [17] Dharmalingam C., Ramakrishnan V. and Ramaswamy K.R. (1976) Seed Res., 4, 40-50.
- [18] Simon E.W. (1974) New Photol.,73, 377-420.
- [19] Ching J.M. (1972) Crop Sci., 12, 415-418.
- [20] Vasundhara S. and Bomme Gowda A. (1999) Seed Res., 27(2), 223-224
- [21] Dombarmattur S. I. (2001) Karnataka J. Agric. Sci., 14(1), 248-249.