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Genetic diversity in physiological performances of seed considering Lentil genotypes under diverse seed storage

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Abstract
In qualitative assessment of ten lentil genotypes, the physiological performances of seed under storage condition were undertaken that may achieve appropriate seed production with strategic breeding to advance resourceful strains. The statistical design, CRD was followed for those seed traits maintaining the various durations and containers at ambient storage condition. The genotypesWBL77 and PRECOZ showed prominence with wide range of variable expression among genotypes for the characters though an inconsistency was also observed. In storage techniques, the Plastic container specified most encouraging in significant manner by reducing the deterioration rate and the stage M_1 (0 months) was noticeably superior in progression of storage. The minimum deviation in GCV and PCV recognized the genetic influence of considerable seed traits that was reinforced by higher value ofheritability (H^2%) excepting ECvalue. The genetic advance (GA%) indicated the influence of additive gene for all characters excepting seed germination. In correlation matrix, the positive significant among all parameters and negative relationship only with EC were strictly followed indicating usefulness of these characters for good seed. Therefore, the considerable parameters may be considered in strain selection for quality seed production of Lentil.

Keywords: Genetic diversity, seedling parameters, storage, Lentil

Introduction

Lentil is one of the leading field crops under various pulses in India due to food practice of Indian people as well as societal traditions. In cultivation, the foremost pulse crop, Lentil (*Lens culinaris* Medik) is occupied maximum cultivable land due to its cultivation prospects, adapted nutritious status, generalised demand etc. India placed first in area and second in production contributing 39.79% and 25% of the world respectively [1]. During 12thPlan of India, the production of Lentil is reinforced by influencing area of cultivation in addition to advancement in productivity. The peak yield was recorded in Bihar (1124 kgha^{-1}) followed by West Bengal (961 kgha^{-1}) though it is very poor in comparison to productivity of the world (1140 kgha^{-1}) [1]. Therefore, an incredible scope is there for inspiring the productivity of Lentil through improving the cultivation inputs. Non-availability of good qualitative seed materials is one of the crucial reasons for reducing productivity as retaining of the quality during seed storage is not proper under seed production system. The qualitative approach in agricultural production, predominantly in seed production system depends on several factors that can be attained into two ways viz. Pre-harvest management and Post-harvest handling. The post-harvest handling was reformed through artificial supervision for retaining the seed quality up to next season which was achieved in pre-harvest stage. The study on variability pattern of promising genotypes considering deterioration for seedling parameters i.e. physiological performances of seed under diverse storage situations are valuable to identify the suitable genotype with an adept competence in retaining of seed quality that may be utilized in breeding programme. In seed storage, the abiotic factors like seed moisture content (M.C.), storage temperature, O_2accessibility and relative humidity are the most imperative factors distressing storage life which over again influences the biotic aspects. The biotic factors, storage fungi occasionally do not occurrence in seeds to any noticeable point before harvest, but they can source immense seed discolouration in storage ensuing germination failure [2] discoloured or otherwise spoiled embryos or entire seed and creation of mycotoxins that establish a health hazard [3]. The reduced viability is observed in most seed even under the optimal storage settingsunder genebank [4] (Anon, 2005). The frequency of ageing in stored seeds principally depends on chemical configuration of seeds [5]. In short term storage, the storing of seed up to next sowing is most difficult due to minimum infrastructure of farmers' provided for low-value field crops. Losses due to stored grain pests (including insects, moulds, and toxins produced by fungi) may exceed 45% of potential production per year in developing countries mainly due to improper management [6]. The selection various seed traits were closely linked to seed superiority that was very much accommodating in crop establishment with optimum production. In this perception, the current study was undertaken to evaluate the effect on seed storability under dissimilar micro-environment containing storing devices with duration of in respect to variable aberration considering physiological performances of seed or seedling parameters. Proper selection measures might helpful to achieve the required production potential through establishing the superior genotypes.

Materials and methods

The freshly harvested seeds of ten lentil genotypes were collected from separated field plots in 2017-2018 to maintain the authentication of genetic purity which were analysed under storage conditions with dissimilar micro-environment containing storing devices and durations. The considerable genotypes were WBL81(V_1), DPL62(V_2), Subrata(V_3), PL639 (V_4), WBL77(V_5), PL406(V_6), Asha (V_7), KLS218(V_8), K75(V_9), PRECOZ (V_{10}) which were assessed at RKVY laboratory, Department of Seed Science and Technology, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal. The three types of packaging like brown paper packet as control (C_1), Polythene packet (40 micron, sealed) symbolized as C_2, Plastic container (hard plastic, air-tight) symbolized as C_3 were provoked for storing of collected fresh seeds using ambient condition which were estimated at an interim of three months considering 0, 3, 6 months (symbolized as M_1, M_2, M_3) from initial storage. The seven seedling parameters were projected through Glass-Plate method [7] in addition to electrical conductivity [8] usable for analysis of seed-vigour or physiological performances of seed. The statistical analysis was done through complete randomised design since 3 replications for each character. The consequence was achieved at 1% level of significance through application of OPSTAT software. The assessing of genotypic and phenotypic coefficient of variation was followed the method of Burton [9] and heritability in broad sense (H^2 %) was designed as per method of Allard [10] and Robinson *et al.* [11]. The projected Genetic Advance as per cent of mean (GA %) was designed through recommendation of Johnson *et al.* [12].

Result and discussion

The superiority in physiological performances of seed facilitated the crop production that directly associated to genotypic nature of the particular cultivar. The genotype specificity on seed can be judged through the seedling characters that was initiated at the stage of seed germination during crop cultivation. Potential seed exposed good performance by expressing their superiority in seedling parameters measurable under laboratory condition. The strategic approach on different research especially in cultivation practices and breeding programme were evidently dependent on seed or seedling specification, where variable nature of the crop genotype should be informative. In post-harvest stage, the sequential processing and proper storage of seeds were fundamental for qualitative upgradation and preservation. Modified storage situation may elude a share of deleterious effect developed at pre harvest and post-harvest stages that can be favourable for getting better result in terms of seed vigour. The adeptness of qualitative and quantitative characters of seed sustained the crop production directly related to genotypic nature of the particular cultivar. The post-harvest handling of seed was the consequent measure of seed production programme where the seed quality was commonly affected during storage through deterioration of seed storability.

In quality evaluation of stored seeds of lentil genotypes, the various physiological performances of seed(table1) specified the uppermost or nearer to peak activated values in V_5 (WBL77) or V_{10} (PRECOZ) genotypes. V_7 (Asha) genotype also showed greater performance in several parameters though it was not sustained its continuity in seedling dry weight. Similarly, V_{10} genotype was not retained the continuation of highest performance in electrical conductivity (E.C.) where lesser value was maintained to display the seed vigour. Considering the situation of storage, the superior value was observed in C_3 (plastic container) with significant demarcation to the others. The progress of deterioration was continued with storage durations where the apparent conditions, M_2 (3 months) and M_3 (6 months) followed a significant distinct deterioration for each considerable parameter. The deterioration pattern responding in electrical conductivity (E.C.) showed noticeable value in significant manner with the advancement of storage where lowest value was observed in M_1 (0 months) indicating highest seed vigour. The variable nature of E.C. showed non-significant variation in-between M_1 and M_2. The significant observation was followed for interacted values of three factors like genotypes, containers and storage durations predominantly in shoot length, root length, percent of germination, vigour index-Iand E.C. The non-significant nature was

Table 1: Variability in physiological performances of seed considering diverse genotypes, storage durations, storage containers and their interactions.

Variety	G% (TR value)	Sp G	SL (cm)	RL (cm)	FW (mg)	DW (mg)	VI-I	E.C. ($\mu Scm^{-1}g^{-1}$)
V_1	87.46 (69.74)	24.57	9.64	10.08	345.33	29.75	1726.84	3.69
V_2	84.95 (67.60)	20.72	8.73	12.93	383.83	31.02	1842.18	3.22
V_3	86.31 (68.73)	20.83	8.79	10.29	373.72	31.97	1648.62	3.49
V_4	82.51 (65.67)	21.56	7.92	9.77	351.89	33.62	1459.93	3.25
V_5	89.48 (71.57)	25.09	9.77	13.67	449.45	49.62	2098.87	2.05
V_6	82.87 (65.94)	22.77	8.60	10.55	363.45	36.94	1586.99	2.92
V_7	88.94 (71.09)	26.74	9.52	13.40	440.56	43.42	2039.88	2.49
V_8	83.16 (66.17)	21.50	7.29	10.60	354.56	32.85	1488.23	2.84
V_9	81.90 (65.21)	21.01	7.94	12.43	339.45	29.99	1668.80	2.98
V_{10}	83.72 (66.89)	30.22	9.73	13.55	493.22	57.17	1956.76	2.98

SEm (±)	0.10	0.35	0.07	0.07	4.62	0.40	8.65	0.02
LSD (0.01)	0.28	0.99	0.19	0.19	12.88	1.12	24.13	0.06
M_1	85.74	24.06	9.16	12.19	416.65	38.21	1834.08	2.93
M_2	85.41	23.96	8.85	11.86	380.63	36.93	1770.93	2.88
M_3	84.73	22.46	8.37	11.14	371.35	37.76	1650.13	3.17
SEm (±)	0.06	0.19	0.04	0.04	2.53	0.22	4.74	0.01
LSD (0.01)	0.16	0.54	0.10	0.11	7.06	0.61	13.21	0.03
C_1	76.12	22.52	8.66	11.41	386.73	37.75	1697.68	3.23
C_2	84.91	23.90	8.84	11.77	392.95	37.29	1754.69	3.01
C_3	86.13	24.09	8.89	12.00	388.95	37.87	1802.76	2.73
SEm (±)	0.06	0.19	0.04	0.04	2.53	0.22	4.74	0.01
LSD (0.01)	0.16	0.54	0.10	0.11	NS	NS	13.21	0.03

Interaction effects (V x M x C)

	SEm (±)	LSD (0.01)	SEm (±)	LSD (0.01)	SEm (±)	LSD (0.01)	SEm (±)	LSD (0.01)	SEm (±)	LSD (0.01)	SEm (±)	LSD (0.01)	SEm (±)	LSD (0.01)	SEm (±)	LSD (0.01)
(V×C)	0.18	0.49	0.61	NS	0.12	0.33	0.12	0.33	7.99	NS	0.69	NS	14.98	41.79	0.04	0.11
(V×M)	0.18	0.49	0.61	1.71	0.12	0.33	0.12	0.33	7.99	22.31	0.69	1.94	14.98	41.79	0.04	0.11
(C×M)	0.10	0.27	0.34	0.93	0.07	0.18	0.07	0.18	4.38	NS	0.38	NS	8.20	22.89	0.02	0.06
(V×C×M)	0.31	0.85	1.06	NS	0.20	0.57	0.21	0.58	13.85	NS	1.20	NS	25.94	72.39	0.07	0.19

G%- Percent of germination (TR-Transformation/Arcsine value); SpG- Speed of germination; SL- Shoot length; RL- Root length, FW- Fresh weight of seedling; DW- Dry weight of seedling; VI-I - Vigour Index-I; EC- Electrical conductivity.

Observed in some interacted values considering the seedling fresh weight and dry weight. In view of total observation, the variability was followed for all considerable factors. To prevent the rate of deterioration or retaining of seed quality irrespective of genotypes, the present study specified the influence of storage technique in noticeable mode, similar to the information of earlier researcher [13].

The analysis on genotypic co-efficient of variation (GCV) and phenotypic co-efficient of variation (PCV) (table 2) provided a measure to compare the variability in considerable seed traits by displaying the genetic pressure on these seed traits or demonstrating the prominent genetic influence which may be supportive in selection of good strain [14] (Seyoum *et al.*, 2012). The degree of variances between PCV and GCV was detected to be somewhat low for all traits matching to the observation of Parvathi *et al.* [15] (2011) with minor exception in electrical conductivity. In seedling parameters, the GCV was high only for dry weight than other parameters considering all factors of storage. In germination percentage and shoot length, the GCV as well as PCV both were very low, though the heritability was high in consideration of diverse factors of seed storage. But, the genetic advance (GA%) was lower for the above two seed traits. High heritability (H^2%) in addition to high genetic advance (GA %) as percent mean was recorded in speed of germination, fresh weight and dry weight under considerable physiological performances of seedas their more impact on variability through the consequence of additive gene. So, the designated seed traits may be careful in consideration of selection criteria for advancement of good strain similar to the study ofsome recent workers [16, 17].

Table 2: Genetic evaluation in physiological performances of seed as influenced by storage conditions on various genotypes.

Characters	GCV	PCV	H^2 (%)	GA (%)
G%	3.38	3.43	96.63	4.65
SpG	13.33	13.44	98.41	18.51
SL	9.82	10.17	93.26	13.27
RL	13.59	13.79	97.05	18.75
FW	13.48	13.63	97.76	18.66
DW	24.94	25.03	99.34	34.80
VI-I	12.75	12.96	96.79	17.56
E.C.	15.20	17.29	77.26	18.71

GCV- Genotypic coefficient of variation; PCV- Phenotypic coefficient of variation;
H^2- Heritability; GA- Genetic advance.

A group of researchers [18, 19, 20] estimated the genetic variability on different crops though the observation on physiological performances of seed which was very meagre especially at seed storage. The specific sign of present work may be suitable for scheduling the selection procedure to fulfil the breeders target in development of seed quality comparable to recent opinion of seed traits on rice [17].

A strong positive correlation was observed for considerable physiological performances of seed (table3) indicating their close association within them that was also perceived in study on Rice [21]. The value, 0.7046 for R^2 indicated the strong significant relationship for the considerable characters. All parameters showed positive significant mode though an exception was revealed in electrical conductivity under non-significant mode. The negative significant relationship of electrical conductivity indicated its definite close relationship with diverse seedling parameters on the basis of seed vigour of the crop genotype.

Table 3: Correlation Matrix of different physiological performances of seed.

Characters	G%	SpG	RL	SL	FW	DW	VI-I
SpG	0.418*						
RL	0.406*	0.549**					
SL	0.739**	0.720**	0.510**				
FW	0.438*	0.816**	0.756**	0.669**			
DW	0.314NS	0.839**	0.654**	0.591**	0.943**		
VI-I	0.754**	0.675**	0.878**	0.827**	0.792**	0.673**	
EC	-0.371*	-0.356NS	-0.592**	-0.198NS	-0.472**	-0.523**	-0.526**

NS- Non-Significant;* Significant; **Highly significant

Considering the above outcome, it is anticipated that the dissimilar parameters sustained a relation within them where V_5 (WBL77) and V_{10} (PRECOZ) were promising in comparison to others. The seed storage in C_3 (Plastic container) specified the most capable result and the significant deterioration was progressed with duration of seed storage representing the variability of various storage containers. The observed results specified the core set of germplasm contain high genetic variability. The broad sense heritability (H^2) and genetic advance (GA) as percentage of mean designated the parameters speed of germination, fresh weight and dry weight under considerable physiological performances of seed were the most significant characteristics in seed. The selection based on these traits would be extremely valuable for lentil genotypes. Inclusion of these findings may be suitable for upgradation of cultivation principally seed production of Lentil.

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