Study on physiological performances and germination accompanying enzymes of seed considering some Lentil genotypes

ABSTRACT

Considering ten (10) Lentil genotypes, some vibrant physiological activities of seed traits and germination linked enzymes was observed for assessing the status on heritability. The study on two successive years showed significant hierarchy for some seed traits in 1st year related to seedling performances and biomolecular activities though others characters showed non-significant association. Considering two years, the genotypes showed significant demarcation among them where the maximum value was in ASHA for all seed traits with enzyme activity. The interacted values of genotypes x year showed significant variation for most of the seed traits excepting seedling length and seedling dry weight. The study on genetic analysis indicated minimum deviation in between genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) that recognized the genetic influence of all considerable seed traits. High heritability (H^2%) along with genetic advance indicated the impact of additive gene for all characters except soluble protein and percent of germination. In correlation matrix, the non-significant or negative relationship was followed in between germination linked biomolecules and physiological performances of seed though positive significant relation was followed within each group. Therefore, the considerable parameters may be considered in breeding schedule for quality seed production of Lentil.

Keywords: Seed germination, Enzymes, Genetic variability, Lentil seed

INTRODUCTION

Lentil (*Lens culinaris* Medik), a pulse of global economic importance, has been long domesticated. Among the pulses, lentil is of special interest with 23.7% content of grain protein. In addition to protein, its seed is a rich source of minerals and vitamins as human food, while the straw serves as high-value animal feed (Rasheed *et al*., 2010). Lentil is an important dietary crop with a high content of proteins, micronutrients and vitamins that are important in human food. The mature vegetative parts serve as excellent fodder for animals (Sarker and Erskine, 2006). In dry areas with an insufficient rainfall, the crop is generally grown in rotation with cereals to break the cereal disease cycles and to fix atmospheric nitrogen, thus reducing the demand of nitrogenous fertilizers for other cereal crops

(Fikiru*etal*., 2007). Lentil is cultivated as a winter crop compared with the cereals because of shorter growing period, least hazard of drought stress in arid and semi-arid regions. One of the primary objectives of breeders is to increase the quantitative and qualitative upgradation of economic produce especially in seed through selection and utilization of suitable genotypes with consideration of the probable stress.

The process of crop or seed development till maturation is an organized programme of physiological or biochemical component in plant and it involves in an organized sequence of changes at development stages predominantly in seed. Studies on physiological maturity become significant because seeds should be harvested at appropriate time to confirm their quality in terms of germinability and vigour. The accurate harvest time arouses the seed quality in germination, vigour, viability and also to expand the storability. The retaining seed quality possess genetic, physical, physiological, and healthy attributes that expresses the good agronomic performance with consecutive superior yield in next season. Usually, the rapid and uniform emergence of seed, early seedling established with greater vigour have ability to tolerate the environmental stress, better crop growth and uniform maturity in seed with optimum quality.

Genetic variability is the pre-requisite for plant breeding program where we can consider the superior potentiality in qualitative and quantitative manner. Actually, the characterization of crop plant consists of high heritable characters suitable to establish better plant and adaptation to wide environments. Generally, these studies were restricted to yield attributing parameters, though the characterization of physiological performances of seed was also valuable for storability in seed production. The experiment is undertaken to study the magnitude of genetic variability on seed for creating the better scope in selection under crop improvement programme. Genetic parameters such as genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) are useful in detecting the amount of variability present in the germplasm (Idris *et al*., 2012). The present investigation aimed at the performance and genetic variability on seed of ten Lentil genotypes in order to employ the most competent character(s) and suitable genotypes for development of a good strain particularly under West Bengal condition.

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MATERIALS AND METHODS

Ten (10) Lentil genotypes were sown in two successive years November, 2017-18 and 2018-19 under AB-Block Seed Farm, Bidhan Chandra Krishi Viswavidyalaya (BCKV), Nadia, and West Bengal. In trial, the usable genotypes were WBL-81, DPL-62, SUBRATA, PL-639, WBL-77, PL-406, ASHA, KLS-218, K-75, and PRE-COZ which were arranged in Randomise block design (RBD) with three replications allowing for a specific plot size 2m x 3m with 25cm plant spacing. Advised intercultural practices were done as and when required for precise crop growth and seed development of the plants. After collecting the seed at harvest maturity, the eight important seed traits were projected viz., germination percentage, speed of germination, seedling length, seedling dry weight, vigour index -I, in addition to the 3 (three) vital biomolecules at 24 hours stage of imbibition viz. soluble protein, α-amylase activity (colorimetric method with DNS reagent) and Peroxidase activity (Kar and Mishra, 1976) for assessing the physiological performances of seed. The statistical calculation was done through consideration of factorial design (2 factors) in CRD fashion utilizing OPSTAT software. The genotypic and phenotypic coefficient of variation was assessed through the methods of Burton (1953). The other genetic parameters like broad sense heritability (H^2%), genetic advance as percent mean (>20%) were calculated through MS Excel (Johanson *et al*., 1955). In deliberation of the values for each character, the fresh harvested seed was composed from ten competitive plants in each plot on random basis.

RESULTS AND DISCUSSION

Study on dissimilar physiological performances of seed were obtained seeing 10(ten) genotypes of Lentil under 2(two) successive generations. The observation on seedling and biochemical parameters will be supportive to associate the seed vigour in qualitative manner that can accentuate the assurance on quality seed production (Arun *et al.,* 2017).The percent of germination was the leading sign on seed quality where the plant population of specific seed lot can be assessed with an indication on cultivation arrangement in qualitative and quantitative manner. A significant variation was noted among the observed values of different genotypes under seedling growth practice. The noteworthy variable nature was also detected in different genotypes where most prominent results were detected in genotype SUBRATA followed by ASHA seeing the same trend for both years. The imperative quality indicator for germinating seeds was the speed of germination in which the seed potentiality was measured through active contributionin germination process. The different genotypes followed a noticeable demarcation among them where maximum value was observed in ASHA, DPL-62,WBL-81 followed by SUBRATA. In consideration of the seedling length,

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the germinated seedlings showed a significant variation for both years. The maximum value was observed in ASHA followed by SUBRATA. The accumulation of dry matter at formation of young seedling made the vital information for seed quality akin to seed vigour. The seedling formation of diverse genotypes with variable dry matter accumulation highlighted the seed quality particularly in seedling establishment and uniformity for development of healthy seedling. In diverse genotypes, the most prominent result was observed in SUBRATA with a progression of seedling strength as well as activity for plant development. The most resourceful seed quality indictor was vigour index that showed significant demarcation for all genotypes. The top most value was observed in ASHA followed by SUBRATA with a distinct positive differentiation with the others. The parameter vigour index maintained synchronization for all seedling parameters responsible for physiological performances of seed.

In biochemical action, the germination allied enzymes and soluble protein of seed were measured as a part of qualitative activities of seed at the phase of germination. The content of soluble protein was varied in seed of different genotypes. The highest value on soluble protein was observed in PRE-COZ with significant demarcation among others. The activity of enzyme alpha-amylase systematized to seed activity predominantly at initiation phase of germination. In genotypes, the mean value on α-amylase formation displayed significant variation where maximum value was observed in PRE-COZ. The isozyme peroxidase was valuable to create a defence mechanism in physiological process of plant or seed due to its attuned activity on protection. The advancement of peroxidase activity may be valuable to sustain the germination progress in proper way through controlling the antagonistic activities in changeable metabolic process primarily after beginning of germination. The significant changeability was observed amongst dissimilar genotypes considering the detection of extreme value in PRE-COZ though it was not pursued in seedling actions as its lesser consumption at initial seed actions of definite genotypes. The better physiological performance indicating genotypes, SUBRATA and ASHA were not exposed superior appearance in occurrence of allied enzymes at germination initiation.

In observation of 2 (two) successive years comprising the mean value of genotypes, a significant demarcation was exhibited in both years for all the characters except in germination percentage, vigour index and α-amylase activity. But, the interaction of two factors i.e., genotype x year (Y) showed a significant variation only in seedling length and dry weight of seedling may be due to environmental instability. The significant variation among different genotypes considering selected traits was effective for plant breeders and it was highly active in extreme degree of variation (Debbarma *et al.,* 2018).

The value of genotypic co-efficient of variation (GCV) and phenotypic co-efficient of variation (PCV) showed the genetic pressure on these seed traits demonstrating the prominent genetic influence for all traits which may be supportive in selection of good strain (Seyoum *et al.,* 2012). High heritability (H^2%) in addition to high genetic advance (GA %) as percent mean (>20%) highlighted the action of additive gene for these characters. High heritability (H^2%) with high genetic advance was observed for most of the characters viz.,speed of germination, seedling length, seedling dry weight and vigour index though a few exceptions was observed in α-amylase activity and peroxidase activity only for 2nd year. So, the designated seed traits may be careful for selection criteria in up-gradation of lentil seed production identical to the remark of Abebe *et al.* (2017) and Mandal *et al.* (2019).

In correlation matrix study, the value of R^2 (0.3681) was indicating a positive trend in correlation. The seed germination displayed significant trend for all traits except soluble protein, however the trend was positive concerning to seedling parameters and negative to enzyme action. The positive trend was also true in Vigour Index for seedling. The vital biochemical action of alpha-amylase and peroxidase showed strong negative correlation particularly in germination action though the non-significant effect was observed to the others. The sign may be due to the active utilization of these biomolecules at beginning of germination. The soluble protein of seed followed non-significant relation to all parameters as its utilization was précised at commencement of germination.Therefore, the present study considering several seed performances in unlike years was relevant and the opportunity for enrichment of lentil genotypes exploiting these seed qualities may be considerable in selection practice.

Table 1:Variability in seed traits considering diverse Lentil genotypes

Genotypes	Germination percentage	Speed of Germination	Seedling Length	Seedling dry weight	Vigour Index	Soluble Protein	α-amylase activity	Peroxidase activity
WBL-81	88.33	26.54	20.31	0.098	1,794	21.22	55.54	1.136
DPL-62	85.00	26.62	19.98	0.096	1,699	20.09	57.99	1.233
SUBRATA	91.67	26.06	22.56	0.130	2,068	20.90	60.87	1.285
PL-639	78.34	25.12	20.02	0.091	1,568	20.66	65.83	1.285
WBL-77	84.92	26.25	20.59	0.114	1,749	20.42	66.83	1.299
PL-406	85.00	19.53	18.47	0.103	1,570	19.92	67.29	1.207
ASHA	90.00	26.64	24.98	0.096	2,249	21.81	67.93	1.245
KLS-218	83.33	22.02	20.86	0.103	1,739	19.68	67.89	1.261
K-75	81.67	20.14	22.25	0.102	1,817	21.32	65.91	1.419
PRE-COZ	75.00	19.36	18.55	0.097	1,391	22.76	74.72	1.476
SEm (±)	**0.696**	**0.198**	**0.183**	**0.002**	**20.899**	**0.16**	**0.476**	**0.008**
LSD 0.01	**1.997**	**0.569**	**0.524**	**0.005**	**59.954**	**0.458**	**1.366**	**0.023**

Table 2:Variability within years considering seed traits and interaction effect of the same

	Germination percentage	Speed of Germination	Seedling Length	Seedling dry weight	Vigour Index	Soluble Protein	α-amylase activity	Peroxidase activity
Y1	84.33	23.45	20.98	0.105	1,775	21.14	65.294	1.243
Y2	84.32	24.20	20.73	0.101	1,753	20.62	64.866	1.326
SEm (±)	**0.311**	**0.089**	**0.082**	**0.001**	**9.346**	**0.071**	**0.213**	**0.004**
LSD 0.01	**NS**	**0.254**	**0.234**	**0.002**	**NS**	**0.205**	**NS**	**0.01**

Interaction (VxY) between genotypes x years

SEm (±)	**0.984**	**0.28**	**0.258**	**0.002**	**29.56**	**0.23**	**0.673**	**0.011**
LSD 0.01	**2.824**	**0.804**	**NS**	**NS**	**84.79**	**0.65**	**1.932**	**0.032**

NS- Non-Significant**,** Y1- 1st year, Y2**-**2nd year

Table 3: **Genetic variability in different seed traits considering two years observations**

	GCV		PCV		H^2%		GA%	
Parameters	**Y1**	**Y2**	**Y1**	**Y2**	**Y1**	**Y2**	**Y1**	**Y2**
Germination percentage	10.283	10.296	10.284	10.297	99.986	99.987	15.676	15.697
Speed of Germination	10.944	13.019	10.944	13.020	99.987	99.986	31.638	37.046
Seedling Length	7.453	7.459	7.548	7.473	97.508	99.611	22.494	22.889
Seedling dry weight	0.672	0.544	0.691	0.547	94.705	99.015	28.248	23.884
Vigour Index	106.572	101.524	107.144	101.643	98.935	99.767	35.224	33.903
Soluble Protein	3.185	5.513	3.288	5.590	93.832	97.272	9.395	16.765
α-amylase activity	16.109	9.476	16.208	9.532	98.782	98.831	27.740	16.375
Peroxidase activity	1.659	1.451	1.664	1.454	99.384	99.555	20.772	17.599

GCV-Genotypic coefficient of variation;**PCV**-Phenotypic coefficient of variation; **H2**-Heritability;**GA**-Genetic advance;**Y1**- 1st year, **Y2**-2nd year

Table 4: **Correlation Matrix of the dissimilar seed traits**

	Germination Percentage	Speed of Germination	Seedling Length	Seedling dry weight	Vigour Index	Soluble Protein	α-amylase activity
Speed of Germination	0.588**						
Seedling Length	0.543**	0.399**					
Seedling dry weight	0.449**	0.086^{NS}	0.231^{NS}				
Vigour Index	0.820**	0.535**	0.924**	0.358**			
Soluble Protein	-0.167^{NS}	-0.175^{NS}	0.148^{NS}	-0.088^{NS}	0.052^{NS}		
α-amylase activity	-0.405**	-0.486**	-0.090^{NS}	-0.115^{NS}	-0.227^{NS}	0.253^{NS}	
Peroxidase	-0.571**	-0.461**	-0.069^{NS}	-0.034^{NS}	-0.298*	0.281*	0.498**

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

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Conclusion

The complete outcome specified a core set of germplasm with high genetic variability where ASHA and SUBRATA may be appropriate for quality seed production in New Alluvial Zone of West Bengal. The broad sense heritability and genetic advance as percentage of mean showed that entire parameters excepting germination percentage and soluble protein content presented distinctive association on seed activity and selection based on these qualities for Lentil genotypes principally in upgradation of seed production programme.

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