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Developmental Archetype of Lentil (*Lens culinaris* Medik) Seed Considering A Few Seed Traits

Arindam Mandal[1*], Jayanta Mandal, Sudipta Roy[1] and Prabir Chakraboti

Dept. of Seed Science and Technology, Faculty of Agriculture

Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal

[1]Dept. of Botany, University of Kalyani, Kalyani, Nadia, West Bengal

*Corresponding Author E-mail: arindammandal002@gmail.com

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ABSTRACT

Lentil is most preferred rabi pulse crop of West Bengal due to its better nutritive value and easy mode of cultivation. In current study, the precious developmental pattern of seed considering the morphological and biochemical changes may gather the knowledge on seed growth, physiological maturity, and critical period of seed/grain enlargement that may ensures the cultivation schedule. The seed of lentil (Lens culinaris Medik) cv. Asha were collected from each 3 replications under RBD fashion in University (BCKV) farms considering consecutive two years (2013-14 and 2014-15). A large numbers of appeared pod of tagged flowers were collected on specific day considering 5 days interval with an initiation from 10th day after anthesis (DAA) to 45th day during maturation. The collected seeds were exploited for analyzing the seed maturity programme utilizing seed length, width, fresh and dry seed weight, chlorophyll content, alpha-amylase activity of seed, etc. Seed length was increased upto 35 DAA though the seed width was enlarged upto last stage of maturity. Enhancement nature of seed fresh and dry weight was noted up to 40 DAA. The chlorophyll content and alpha-amylase activity was highest in 20 DAA and 25 DAA respectively though it was declined afterwards. In consideration of physiological maturity, the stage VII (40DAA) may be as the valuable stage of this maturity.

Key words: *Lentil seed, Development, Seed morphology, Physiological maturity.*

INTRODUCTION

Lentil is one of the predominant winter pulse crop, which contributes significantly to food, feed and sustainable farming systems. The initial fruit growth is categorised by an enhanced accumulation of mass, due to happening of quick and added cellular divisions, followed by a phase with the prevalence of cellular expansion, and finally maturation, reaching maximum fruit mass[18]. The seed growth phases are viewed in between fertilization and extreme fresh weight accumulation where seed maturation starts at the end of seed expansion and remains up to harvest[1]. Seed growth is a greatly complex process and generally divided into three stages—embryogenesis, expansion, and maturation—according to alterations in seed weight[4,15].

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The seed potential may be reduced in relation to continuing growth seed on mother plant[23]. Seed maturation refers to morpho-physiological modifications that take place from the stage of fertilization till the matured ovules are equipped to harvest. Commonly, the Physiological maturity is considered the situation of maximum dry weight of seed[17] at which nutrient is not flowing into the seed from the mother plant. A comprehensive understanding on seed enlargement and maturation, particularly physiological maturity (PM), help to plant breeders and producers for harvesting the crops in suitable time, especially in seed production system by avoiding its deterioration in quality. Several studies have shown that harvest is conducted at end of maximum dry matter accumulation, known as the physiological maturity phase, assuring good seed quality[8]. However, distinct studies also have shown that this situation cannot be applied to all plant species[16]At physiological maturity, the vascular connection to the seed is broken by the formation of an abscission layer[12]. Physiological maturity stage for pod and seed harvest may indicate diverge nature with the environmental fluctuations, different varieties even in soil situations. Physiological changes might set in if the seed are retained on the mother plant for longer duration after physiological maturity (PM)[21] which would lead to the formation of hard seed with off-colour seed predominantly in pulse crops[10].Good quality seeds possess genetic, physical, physiological, and sanitary attributes that aim at ensuring good agronomic performance and consequently high yields. Of these, physiological quality is one of the more important attributes. Usually, it is related to ability of the seed to play its vital functions, characterized by longevity, germination percentage and vigour, providing rapid and uniform emergence, yielding seedlings with increased tolerance to environmental adversity and more uniform maturity of the crop[14,18,20].In present scenario, the study on seed enlargement and maturation is more pertinent and vital as the seed may be collected in perfect to escape ageing, to settle top yield that maintained the standard viability, vigour and field performance at last. The facts on dormancy by reason of alterations of bio-molecular action during seed enlargement in addition to time required for attaining the Physiological Maturity and/or the time gap concerning Physiological and harvest maturity are inadequate. The current programme was interrelated to detect accurate phase of Physiological Maturity as well as to have facts in design of variation on morphological, physiological predominantly, alpha-amylase, moisture content during seed development.

MATERIALS AND METHODS

The study on lentil (*Lens culinaris* Medik.) cv. Asha seeds having distinct characters like seed length, width, fresh and dry seed weight, chlorophyll contain of seed, alpha-amylase activity etc. was continued during seed growth and these were collected from AB block Seed Farm, BCKV (Agril. University), West Bengal in consecutive two years (2013-14 and 2014-15) considering 3 replications under RBD fashion. Sufficient number of flowers was tagged on a particular day of anthesis to observe the phenology during seed growth. Developing seeds were collected at eight various phases beginning from 10th day after anthesis (DAA) to 45th DAA allowing for 5 days interval. Observations were recorded on 100 seeds of each replication and the estimation of biochemical action was followed accordingly e.g. acetone method for chlorophyll and alpha-amylase activity[6]. Statistical analysis was done considering factorial analysis of 2 factors under RBD (field related parameters) and CRD (laboratory based parameters) fashion.

RESULTS AND DISCUSSION

In table 1, the length of the seed may be considered as seed superiority showing significant variation during seed growth. The rising value of seed length was continued up to D_6 (35 DAA) followed by a small declining trend upto the end of maturity. Similarly, the seed width was followed equivalent pattern considering the value of subsequent years where significant observation was sustained up to D_6 followed by non-significant expansion of seed growth. The valuable indication regarding seed maturity was fresh and dry weight of the seed in lentil. The increasing trend was observed up to D_7 (40 DAA) for both parameters. The dry weight of seed showed a distinct significant fashion among various phases of growth. Among different treatment stages, D_7 showed superior significant effect in seed development. The accumulation of dry mater clearly indicated its deposition particularly at the stage of D_6 and D_7 though minor reduction was observed at the end (D_8) predominantly in 2nd year.Variation in dry matter accumulation was noted over the years of experimentations indicating its varying response towards differential climatic conditions over the years during seed development and maturation. Progressing trend in development was noted upto stage D_7 (40 DAA) for both the years.A reducing affinity was followed in moisture content of the seed encouraging for seed maturation. A reduction was persistent in every steps upto D_8 (45 DAA) though the rate was higher in later stages with a topmost effect in final conversion i.e. D_7 (40 DAA) to D_8 (45 DAA).The dry mater accumulation in seed was gradually increased with the progression of seed maturation as elimination of moisture was helpful to endure the proper maturation. Moreover, the environmental moisture content in terms of relative humidity may have an influence over seed maturity.The seed chlorophyll content was measured prudently as its quantity was very less exclusively at the end of maturity. In sequence treatment stages of seed, the significant demarcation was noted among different stages where a trend of deterioration was observed from the stage of initiation to end. The declining rate was maximum at the stage of end i.e. from D_7 to D_8.The most common and valuable enzyme of seed related to progression of germination was alpha-amylase**.** In developmental stages, the seed showed variable action of alpha-amylase at the time of its germination where significant variation was observed in between different growth stages of seed maturity. The activity of alpha-amylase was increased with the progression of seed development though after D_5 (30 DAA), it was declined in a rapid way.The significant strict variation was found in mean values of treatments by way of upholding the superiority in D_7 though it was not truly followed in variable growth stages for all characters particularly in observation of biochemical characters under 1st year. In altered growth stages, these were indicated a sharp variation up to D_4 and it may be continued up to D_5 comparatively at slower rate. A sharp decrease was found in D_8 stage for both the years. But, there was a non-significant variation in between Y_1 (1st year) and Y_2 (2nd year) for all characters except in dry weight that was truly followed in interacted values of treatments and years for the above concerned characters (Table 2). The association among various morphological and biochemical parameters of lentil seed was presented in table 3. The different morphological traits with dry matter of seed indicated a strong positive correlation within them though non-significant relation was observed in case of alpha-amylase. The negative correlation was followed in moisture content and chlorophyll content of seed with the other characters. In representation of seed nature, the observation of seed development is crucial related to numerous parameters on different aspects viz. structural, textural, biochemical etc. for studying the physiological seed maturation. This can be evaluated through numeric modifications that expressed in some physical and physiological characteristics, precisely in seed size, moisture content, and accrued dry mass content[18]. Water plays a key role in seed structure, since it primarily acts in the route of cell division and expansion[7,24]. Cell division and expansion regulate the number and size of cells of seed[22] for creating length, width and dry mass. For this reason, seeds present a greater proportion of fresh mass at the commencement of growth, due to the higher quantity of water inside their cells that will later be substituted by produced reserves such as carbohydrates, lipids and minerals[9]. In addition, water acts as a vehicle for the photosynthates that will be part of theseed tissues or will be stored as reserve[2]. The results obtained in the present study indicated that seeds were matured as physiological maturity at D_7 before harvest maturity D_8 due to its highest content mass as dry and fresh basis. The enzyme showed upward, and then downward movement till in the maturing point, as its role may be linked to cell activity during cell division and expansion of seed. Alpha-amylase has an active role in the hydrolysis of the starch during seed germination. It may also be responsible for the maintenance of requisite water potential, by providing solute sugars during the seed growth. The enzyme most frequently credited with the initial attack on starch granules is alpha-amylase[5,25]. The present study revealed the maximum activity of alpha-amylase before initiation of seed ripening growth stage (table 1) may be considerable in utilization of photosynthates for seed growth, there after declined towards phenological stages of ripening[19]. The study on versatile characters of seed may be the indicator of diverse specific study on specific group of characters.

Table 1: Study on different qualitative parameters of seed during seed growth stages

Characters	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	SEm (±)	LSD 0.01
Seed Length (mm)	1.44	1.90	2.39	2.63	2.96	3.41	3.22	3.04	0.035	0.101
Seed Width (mm)	0.97	1.31	1.72	1.96	2.31	2.71	2.75	2.82	0.027	0.079
Fresh weight of seed (mg)	1.95	6.75	15.00	22.40	27.60	29.90	36.85	22.00	0.102	0.295
Dry weight of seed (mg)	0.27	1.24	3.18	5.69	9.29	12.94	20.43	19.08	0.105	0.303
Moisture content	68.79	65.04	62.94	60.07	54.85	49.15	42.17	21.71	0.504	1.462
Chlorophyll content (mg g^{-1})	0.21	0.18	0.15	0.13	0.12	0.09	0.05	0.01	0.004	0.011
α- amylase (μg g^{-1} m^{-1})	83.69	95.77	128.59	148.07	170.97	136.71	90.36	79.18	2.282	6.623

Table 2: Study on different qualitative parameters of seed considering two years and its interaction effects with various growth stages

Year	Seed Length (mm)	Seed Width (mm)	Fresh weight of seed (g)	Dry weight of seed (g)	Moisture content	Chlorophyll contain (mg g^{-1})	α - amylase (μg g^{-1} m^{-1})
Y_1	2.628	2.073	20.263	8.841	53.209	0.118	117.547
Y_2	2.619	2.063	20.350	9.185	52.970	0.120	115.789
SEm(±)	0.017	0.014	0.048	0.052	0.252	0.002	1.141
LSD 0.01	NS	NS	NS	0.151	NS	NS	NS
Y×D							
SEm(±)	0.049	0.039	0.135	0.147	0.712	0.005	3.227
LSD 0.01	NS	NS	NS	0.428	NS	NS	NS

Table 3: Study on correlation of various seed parameters during seed development

	Seed length	Width of the seed (mm)	Fresh weight of seed (mg)	Moisture content of seed	Chlorophyll content in seed (mg g^{-1})	α-amylase activity (µg g^{-1} m^{-1})
Width of the seed (mm)	0.973**					
Fresh weight of seed (mg)	0.943**	0.908**				
Moisture contain of seed	-0.698**	-0.840**	-0.586**			
Chlorophyll content in seed (mg g^{-1})	-0.688**	-0.833**	-0.579**	0.999**		
α-amylase activity (µg g^{-1} m^{-1})	0.324*	0.142^{NS}	0.344*	0.283^{NS}	0.306*	
Dry weight of seed (mg)	0.837**	0.931**	0.827**	-0.908**	-0.911**	-0.163^{NS}

CONCLUSION

Seed development and maturation through sign of morphological and biochemical nature indicated that the possible physiological maturation of lentil seed is 40 DAA predominantly based on proper reliable character seed dry weight with a dissimilar pattern variable parameters essential to grow quality seed. Therefore, the maximum dry matter depositing D_7 stage can be optimum to ensure physiological maturity in contrast to maximum rate moisture reduction with an indication of deteriorating trend of total chlorophyll.

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