Madras Agric. J., 93 (7-12) : 195-200 July-December 2006

https://doi.org/10.29321/MAJ.10.100750

Studies on seed development and maturation in cluster bean *(Cyamopsis tetragonoloba)*

J. RENUGADEVI, N. NATARAJAN AND P.SRIMATHI
Department of Seed Science and Technology, Tamil Nadu Agrl. University, Coimbatore - 641 003.

Abstract: Determination of physiological maturity is essential to harvest the seeds with high quality. The study on these aspects in cluster bean *(Cyamopsis tetragonoloba)* cv. Pusa Navbhagar revealed that, based on physical (fresh and dry weight of pod and seed, length and width of pod and seed), physiological (germination, root length, shoot length, drymatter production and vigour index), biochemical (protein) and visual (pod and seed coat colour) indices, the cluster bean seeds reached their physiological maturity at 50 DAA where the moisture content of seed was 18.2 per cent.

Key words : Cluster bean, physiological maturity, seed vigour

Introduction

Seed development and maturation studies are important because the seeds have to be harvested in time before their ageing. The development processes during seed growth and maturity interact with the production environment to determine the planting quality of a seed. It is well established that physiological maturity determines the time of harvesting. Hence a study on physiological maturity of seed development and maturation in cluster bean was undertaken.

Materials and methods

A bulk crop of cluster bean cv. Pusa Navbhagar was raised at Eastern block farm of Tamil Nadu Agricultural University, Coimbatore, during March 2003, with recommended package of practices. Sufficient number (around 250) of flowers were tagged at the time of anthesis at 5 days interval, upto 55 days (5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55). The pods were collected and recorded for their physical and physiological parameters with 50 x 4 and 100 x 4 replicates of randomly selected pods and seeds respectively. Length, width, fresh weight, dry weight and moisture content of the pod and seed, number of seeds pod^{-1}, 100 seed weight, germination, root length, shoot length, dry matter production for 10 seedling^{-1} and vigour index were recorded in order to determine the optimum time for harvest.

Results and Discussion

Seed maturation refers to the morphological, physiological and functional changes that occur from time of anthesis until the seeds are ready to harvest (Khattra and Singh, 1995). Maturity is the critical and the most important factor that determines the size, quality, planting value and storability of the seed and the seeds harvested at optimum maturity will be possessing maximum germination and vigour (Jerlin *et al.,* 2001).

In the present study, on tracing the development and maturation pattern of cluster bean, the observations on the pod characters revealed that fresh weight of pod steadily increased with advances in maturity upto 45

Table l. Pod characteristics of cluster bean during seed development and maturation

Days after anthesis	Length (cm)	Width (cm)	Fresh weight (g)	Dry weight (g)	Moisture content (%)
5	3.0	0.1	-	-	-
10	4.9	0.3	0.298	-	-
15	6.1	0.4	0.530	0.096	82.0 (64.90)
20	7.0	0.7	1.105	0.278	74.8 (59.87)
25	9.8	0.9	2.488	0.736	70.4 (57.04)
30	10.2	1.0	2.840	1.120	60.6(51.12)
35	11.0	1.1	3.203	1.540	52.0 (36.20)
40	11.2	1.1	3.298	1.714	48.0 (43.85)
45	11.3	1.2	3.336	2.122	36.4(37.11)
50	11.3	1.2	3.381	2.495	26.2 (30.79)
55	11.0	1.0	3.052	2.290	25.0 (30.00)
SEd	0.131	0.157	0.037	0.150	0.269
CD(P=0.05)	0.262	0.312	0.080	0.300	0.556

(Figures in parentheses indicate arc sine transformed values)

days and reached the maximum of 3.381g at 50 days after anthesis (DAA) .The weight of pod was supported by the increase in morphological structure of pod, which was measured through length and width of pod, which attained their maximum at 50 DAA. But at 55 days a slight reduction to a tune of 3 and 20 per cent was observed with length and width of pod while the reduction in fresh weight was 11 per cent from 50 to 55 DAA (Table 1). In general the pod development period was positively correlated with the size and weight of pod while the number of pods was negatively correlated with pod development, and the increase in dry weight of seed was continuous throughout the maturation period, while the dry weight of pod increased upto certain period and then declined in certain legumes. The parallel increase in physical characters of pod with advances in maturation process was due to the development of zygote into mature seed (Mayer and Mayber, 1989).

The maturation process proceeds with water loss at various degrees depending upon the atmospheric condition. Khattra and Singh (1995) also expressed that accumulation of dry matter with loss of moisture is as the characteristic feature that could be observed during seed development and maturation in any crop. In the present study, the pod moisture content decreased from 82 to 25 per cent with maturation (15 to 55 DAA). With advancement in maturation, the decrease in moisture content of pod was at a faster rate and which could be due to the replacement of osmotic materials such as starch and other large molecules with low hydration capacity. Ellis *et al.* (1987) reported that when harvest was delayed beyond the optimal moisture content of seeds there was a substantial decline

Table 2. Seed quality characteristics of cluster bean during seed development and maturation

Days after anthesis (DAA)	Length (cm)	Width (cm)	Fresh weight (g)	Dry weight (g)	Moisture content (%)	Number of seed pod^{-1}	100 seed weight (g)
5	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-
15	0.1	-	0.36	0.10	72.2 (58.18)	-	0.101
20	0.2	0.1	0.98	0.38	61.2 (51.47)	10.0	0.292
25	0.3	0.2	1.56	0.70	55.1 (47.93)	10.0	0.748
30	0.4	0.3	2.52	1.30	48.4 (44.08)	10.0	1.320
35	0.4	0.3	3.28	2.08	36.6 (37.23)	10.0	2.418
40	0.5	0.4	3.94	3.04	22.8 (28.52)	10.0	3.312
45	0.5	0.4	4.28	3.38	21.0 (27.27)	10.0	3.722
50	0.5	0.4	4.40	3.60	18.2 (23.25)	10.0	3.842
55	0.5	0.4	4.00	3.40	15.0 (22.79)	10.0	3.521
SEd	0.065	0.057	0.029	0.026	0.387	0.050	0.005
CD	0.125	0.114	0.060	0.050	0.800	NS	0.011

(P=0.05) (Figures in parentheses indicate arc sine transformed values)

in viability and an increase in seedling abnormalities.

Physiological maturation occurs commonly in seeds to recapture the reproducing capacity of the younger generation and this normally coincide with the attainment of maximum dry weight where the flow of nutrients to the seed from the mother plant is ceased (Harrington, 1973). The observed seed characters expressed similar trend as that of pod in maximization of fresh weight (4.40g), seed length (0.5 cm) and width (0.4 cm) at 50 DAA and a reduction of moisture content from 72.2 per cent at 15 DAA to 15.0 per cent at 55 DAA (Table 2). The dry weight of the seed which is the characteristic feature of seed maturation (Agrawal, 1996 and Copeland, 1988) was also maximized at 50 DAA (3.60g). The duration for physiological maturation is the period between fertilization and accumulation of maximum dry weight that reflected in the maximization of seed and seedling quality characteristics.

Table 3. Seed and seedling quality characteristics of cluster bean during seed development and maturation

Days after anthesis (DAA)	Germi-nation (%)	Root length (cm)	Shoot length (cm)	Drymatter production 10 seedling^{-1} (mg)	Vigour index	Protein content (%)
5	-	-	-	-	-	-
10	-	-	-	-	-	-
15	-	-	-	-	-	-
20	20.0 (26.57)	3.5	2.2	52	115	6.3
25	24.0 (29.33)	6.7	6.8	120	326	10.5
30	36.0 (36.87)	10.5	10.3	148	749	15.4
35	52.0 (36.20)	14.8	11.2	172	1354	18.5
40	76.0 (60.67)	16.2	13.0	188	2219	20.4
45	92.0 (73.57)	16.5	14.1	192	2815	22.5
50	96.0 (78.46)	17.0	14.8	214	3055	23.8
55	96.0 (78.46)	16.8	14.5	200	3005	23.0
SEd	3.464	0.140	0.089	0.010	65	0.106
CD (P=0.05)	6.930	0.280	0.190	0.020	133	0.212

(Figures in parentheses indicate arc sine transformed values)

Harrington (1973) expressed that the fluid and gaseous forms of nutrients and volatile substances present in the pod would escape during maturation causing reduction in dry weight of pod and seed by oxidation and volatalisation. The reduction in dry weight of pod and seed during the last phase of the present study (50 DAA) also could be due to the elimination of certain amount of nutrients along with the higher rate of moisture elimination. Rajasekaran (1997) expressed similar results with rice bean.

The germination capacity is the prime indicator of seed quality where the final produce is seed, which is characterized for their regeneration capacity. The seeds of the present study recorded the germination of 20 per cent at 20 DAA and it increased with advances in maturity and reached a maximum of 96 per cent at 50 DAA which coincide well with the accumulation of maximum fresh and dry weight of seed (Table 3). Arul Prabu (1998) in pole bean also expressed that the maximum germination of seed correlated well with the maximization of dry weight with a reduction trend in seed moisture content.

The seedling root and shoot length are also a measure of seedling vigour that favoured

the performance of seed under given environmental condition. In the present study, these characters increased with advances in maturation and were maximum at 50 DAA. The seedling drymatter which is another parameter of seed vigour, was also in the increasing order with days of maturation due to accumulation of higher quantum of fresh and dry weight in pods and seeds that reached the maximum at 50 DAA. But thereafter at 55 DAA, the dry weight of seedling exerted a slight reduction due to the development of an in built mechanism that involved in the disorganisation of cell organelles within a few days after physiological maturity. The seed vigour is the inherent ability of the seed to survive well under wide range of conditions. The computed vigour index values of the present study, which was the totality of seed quality, recorded maximum value at 50 DAA. Not only the physical and physiological but also the biochemical symptoms are expressed by seed on maturation. Sale and Campbell (1980) also expressed that the accumulation of protein found to improve with maturation along with dry weight accumulation. In the present study also a similar trend was observed and the protein content was maximum at 50 DAA (23.8 per cent) which was maintained thereafter upto 55 DAA. Dasgupta and Bewley (1982) reported that immature seeds of *Phaseolus vulgaris* failed to germinate without desiccation, which was associated with protein synthesis and desiccation played a role in permanently suppressing developmental protein synthesis and in inducing germination protein synthesis and the desiccation of developing seeds was characterised by the accumulation of a set of mRNA and related proteins called late embryogenic abundant proteins in the desiccation stage of seeds.

Parameswari (1999) and Jeeva (2003) considered the change of pod and seed colour as a promising visual index of seed maturation. In the present study, such observations on visual indices of pod colour found to change from green to greenish yellow upto 30 days and light yellowish brown to dark yellowish brown upto 45 days. Among the colour gradation, the dark brown coincided well with 50 DAA. The seed also exerted the changes in colour, which was observed to be from light brown to dark brown at physiological maturation and thereafter it turned to black colour. Carlson (1973) expressed that the photosynthates moved into the developing ovule through extensive network of vascular tissue located throughout the open integument and the vascular system of the integumentry was destroyed as the seed matures and resulted in changing of seed coat colour with advances in maturation. Irrespective of harvesting time, the colour of pod could be considered as an index of seed maturity for harvesting good quality seeds.

Thus, the study revealed that, based on physical, physiological, biochemical and visual indices, the cluster bean seeds reached their physiological maturity at 50 DAA where the moisture content of seed was 18.2 per cent.

References

Agrawal, R.L. (1996). Seed Technology. Oxford and IBH publishing company, New Delhi.

Arul Prabu, C. (1998).Studies on certain aspects of seed production and storage in polebean *(Phaseolous vulgaris* L.) M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Carlson, J.B. (1973). Morphology. In: Soybean improvement, production and uses (ed. B.E. Caldwell), American Society of Agronomy, Wis.

Copeland, L.O. (1988).Seed deterioration *In :* Principles of Seed Science and Technology,

Subject Publishers, New Delhi, pp. 107-115.

Dasgupta, J. and Bewley, J.D. (1982). Desiccation of axes of *Phaseolua vulgaris* during development a switch from development pattern of protein synthesis to a germination pattern. *Plant* Physiol. **70:** 1224-1227

Ellis, R.H., Hong, T.D. and Roberts, E.H. (1987). The development of desiccation tolerance and maximum seed quality during seed maturation in six grain legumes. *Annals of Botany.* **59:** 23-29.

Harrington, J.F. (1972). Seed storage and longevity, Seed biology (ED) T.T. Kozlowski Academic Press. New York and London, pp. 145-245,

Harrington, J.K. (1973). Biochemical basis of seed longevity. *Seed Sci. and Technol.* **1:** 453-461.

Jeeva, B. (2003). Seed development and maturation, picking and storage studies in *Mucuna pruriens* (L.) M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Jerlin, R., Srimathi, P. and Vanangamudi, K. (2001). Seed physiological and maturity indices. *In:* Recent techniques and participatory approaches on quality seed production. (Eds. K. Vanangamudi, A.Bharathi, P. Natesan, R. Jerlin, T.M. Thiyagarajan and S. Kannaiyan) Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore.

Khattra, S. and Singh,G.(1995). Indices of physiological maturity of seeds. *A Review. Seed Res.,* **23(1):** 13-21.

Mayer, A.M. and Mayber, A.P. (1989). The germination of seed. Pergamon press.

Parameswari, K. (1999). Seed technological studies in Tamarind *(Tamarindus indicus* Linn.). M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Rajasekaran, S. (1997). Seed technological studies in ricebean M.Sc.(Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Sale, P.W.G. and Campbell, L.C. (1980). Changes in physical characteristics and composition of soybean seed during crop development. *Fld. Crop Res.,* **32:** 142-155.