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Stage of maturity and its effect on seed qualities in pigeonpea cultivars

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ABSTRACT Field experiment was carried out at National Seed Project, University of Agricultural Sciences Bangalore during *kharif* 2010 to determine the optimum stage of harvest for getting higher quality seeds in pigeonpea {*Cajanus cajan* (L.) Mill sp.} cultivars BRG-1 and BRG-2. The pods of both cultivars were harvested at 45, 50, 55 and 60 days after anthesis (DAA). Our results showed that, the cultivars BRG-1 and BRG-2 attained physiological maturity at 55 and 50 DAA respectively and at this stage the seeds recorded higher dry matter accumulation (12.26 g/10pods and 6.33 g/10pods) with maximum germination (80.50 % & 83.25 %), vigour index -I (2380 & 2800) and vigour index-II (3100 & 3368), field emergence (78.25 % & 79.25 %), pH of seed leachate (6.35 & 6.31), total dehydrogenase activity (2.50 & 1.76), and lowest electrical conductivity (1.52 mS & 1.22 mS), minimum seed infestation (18.00 % & 11.75 %) respectively. The findings of the study conclude that, pigeonpea cultivars BRG-1 and BRG-2 could be harvest at 55 and 50 DAA for better seed quality.

Keywords Physiological maturity, pigeonpea, germination and vigour index.

Seed maturity and harvesting are two major considerations in production of quality seed. The development process during seed growth and maturation interact with the environment to determine the planting quality of harvested seed lot. Seed development and maturation in pigeonpea is rendered difficult on account of the racemose inflorescence where the flowering is spread over long time, depending upon the crop duration. Indexing of the visible indicators that are closely associated with physiological and harvestable maturity for easy identification in the field will be of more practically viable. Earlier attempts of Paroda *et al.* [1], to determine the physiological maturity in pigeonpea has not resulted in any systemic report. Further, any delay in timely harvest cause considerable field losses. Also, food grains undergo a series of operations such as harvesting, threshing, winnowing, bagging, transportation, storage, and processing before they reach the consumer, and there are appreciable losses in crop output at all these stages. The post-harvest losses in India amount to 12 to 16 million metric tons of food grains each year [2].

The extent of field loss varies with variety and method of harvest [3]. Therefore, it is desirable to harvest pigeonpea when it attains physiological maturity for better seed quality. In order to determine the suitable stage of harvest for better seed qualities the experiment was carried out by using two popular cultivars of pigeonpea.

MATERIALS AND METHODS

Seeds of pigeonpea cultivars BRG-1 and BRG-2 were obtained from pigeonpea scheme and grown during *kharif* 2010 at National Seed Project, University of Agricultural Sciences, GKVK, Bangalore. All recommended agronomic practices were followed and optimum doses of fertilizers were applied. In each plant all the flowers were tagged day before opening and various colour tags were used to indicate different harvesting stages. The pods developed on tagged flowers were

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harvested at 45, 50, 55 and 60 days after anthesis. Hundred pods in four replications were randomly selected from each harvesting stage. The pods were brought to the laboratory in polythene covers to avoid any moisture loss, and the following observations *viz.*, dry weight of seed (g/10 pods), seed moisture content (%), germination (%), vigour index-I and II, electrical conductivity of seed leachate (mS), pH of seed leachate, total dehydrogenase activity (A_{480}), field emergence (%) and seed infection (%) were recorded as per ISTA standards. The data was statistically analyzed by using Factorial RCBD.

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences between cultivars, harvesting stages and their interaction for dry weight of seed (g/10 pods), seed moisture content (%), germination (%), vigour index-I and II, field emergence (%), electrical conductivity of seed leachate (mS), pH of seed leachate, total dehydrogenase activity (A_{480}) and seed infection (%) as presented in tables 1, 2 and 3.

The seed moisture content of seed was highest at initial seed development stage in the two cultivars of pigeonpea, thereafter reduced progressively as the period of seed development advanced from anthesis. The moisture content was significantly higher (42.07 percent) in BRG-1 compared to BRG-2 (28.89 percent) irrespective of maturity stages. The moisture content in BRG-1 and BRG-2 was observed to be 59.49 and 44.46 percent respectively on 45 days after anthesis and gradually declined to 25.46 and 17.53 percent on 60 days after anthesis respectively. The observed decrease in moisture content at 60 DAA may be due to more accumulation of dry matter in seed. Whereas, the moisture content of seed at physiological maturity (*i.e.* at 55 and 50 DAA) was 35.68 and 31.28 percent in BRG-1 and BRG-2 respectively (Table 1). Sanhewe and Ellis [4] observed that in French bean, seed moisture content showed constant decline during dry matter accumulation from 7 to 47 percent. Choudhari and Bapat [5] obtained physiological maturity in sorghum at 29.11 percent moisture content.

The dry matter accumulation in the seed gradually increased from milk stage and attained maximum at physiological maturity. Maximum dry matter accumulation of 12.26 g/10 pods and 6.33 g/10 pods was observed at 55 and 50 days after anthesis in BRG-1 and BRG-2 respectively. Similar results were also obtained by Choudhari *et al.* [6] in sorghum for dry matter accumulation. After physiological maturity a slight reduction in the dry matter content (dry weight) was observed. This may be due to prolonged exposure of seeds to sun in the field, delay in harvest after physiological maturity and also may be due to high respiration and exhaustion of the seed reserves.

The findings are in agreement with Choudhari and Bapat [5] on sorghum seed. It was found that seed germination improved with increase in dry matter content and decrease in seed moisture content in both the varieties. The germination, irrespective of maturity stages was significantly highest in BRG-2 (78 percent) compared to BRG-1 (69.75 percent). The germination percent in BRG-1 and BRG-2 were observed to be 53.50 and 66.25 percent respectively on 45 days after anthesis. The seeds harvested before the attainment of physiological maturity recorded lesser viability and vigour potentials, due to more number of immature seeds with relatively low degree of embryo development and high moisture content as reported by Mahesha *et al.* [7] in sunflower and in mung bean [8]. Highest germination percentage of 80.50% and 83.25% were recorded at 55 and 50 DAA for BRG-1 and BRG-2 respectively. Similar varietal differences in germination percentage and time after pollination were observed in sorghum by Choudhari and Bhapat [5].

Table 1. Influence of stage of maturity on seed moisture content, seed dry weight, germination percent and vigour index-I of pigeonpea.

Maturity stages	Moisture content of seeds (%)			Dry seed weight (g/10 Pods)			Germination (%)			Vigour index -I		
	Varieties			Varieties			Varieties			Varieties		
	BRG-1	BRG-2	Mean	BRG-1	BRG-2	Mean	BRG-1	BRG-2	Mean	BRG-1	BRG-2	Mean
D_1:45DAA	59.49	44.46	51.97	10.28	6.09	8.19	53.50	66.25	59.87	1043	1842	1442
D_2:50DAA	47.17	31.28	39.22	11.72	6.33	9.02	65.25	83.25	74.25	1501	2800	2150
D_3:55DAA	35.68	22.29	28.98	12.26	5.83	9.04	80.50	82.25	81.37	2380	2690	2535
D_4:60DAA	25.96	17.53	21.74	11.71	5.57	8.64	79.75	80.25	80.00	2330	2598	2464
Mean	42.075	28.89	-	15.24	8.06	-	69.75	78.00	-	1813	2482	-
	V	D	V X D	V	D	V X D	V	D	V X D	V	D	V X D
SEM±	0.066	0.094	0.133	0.110	0.156	0.221	0.40	0.56	0.80	12.53	17.72	25.06
C.D(p=0.05)	0.192	0.272	0.385	0.319	0.452	0.639	1.15	1.63	2.31	36.14	51.11	72.29

V: varieties
D: Days after Anthesis
V X D: Interaction of Variety and days after anthesis

The seedling vigour index-I and II differed significantly with respect to variety as well as days after anthesis. BRG-2 showed significantly higher mean vigour index-I (2482) and vigour index-II (3209) compared to BRG-I (1913 and 2395, respectively). Vigour index –I and II (1442 and 1927) was least at 45 days after anthesis and significantly inferior to all other maturity stages. The highest vigour index-I (2380 and 2800) was at 55 and 50days after anthesis in BRG-1 and BRG-2 respectively and similar trend was observed with respect to vigour index II (3100 and 3368). The results are in conformation with the findings of Rajanna and Andrews [9], who reported that seed maturation may be regarded as a positive process during seed development encompassing additive changes in seed characterstics *i.e.* increase in seed dry weight, test weight and vigour, following attainment of its maximum potential by the seed.

These results are in conformity with Zade *et al.* [10] who reported that seed development continued up to 19 DAA and reached physiological maturity at 22 DAA, when dry seed weight, germination percent and seedling vigour were maximum in rice bean.

The lowest (1.17 mS) electrical conductivity of seed leachate was recorded in BRG-2 variety, which differed significantly with BRG-1(1.76 mS). Considering the various stages of maturity, the least electrical

Table 2. Influence of stage of maturity on vigour index-II, electrical conductivity of seed leachate, pH of seed leachate and total dehydrogenase activity of pigeonpea.

Maturity stages	Vigour index -II			EC (mS)			pH			TDH (A_{480})		
	Varieties			Varieties			Varieties			Varieties		
	BRG-1	BRG-2	Mean	BRG-1	BRG-2	Mean	BRG-1	BRG-2	Mean	BRG-1	BRG-2	Mean
D_1:45DAA	1505	2349	1927	2.10	1.42	1.76	6.13	5.85	5.99	1.22	1.34	1.28
D_2:50DAA	2005	3368	2687	2.09	1.22	1.65	6.17	6.31	6.24	2.38	1.76	2.07
D_3:55DAA	3100	3242	3171	1.52	1.09	1.30	6.35	6.30	6.32	2.50	1.66	2.08
D_4:60DAA	2971	3154	3063	1.45	0.98	1.21	6.32	6.28	6.30	2.36	1.65	2.005
Mean	2395	3029		1.79	1.17		6.242	6.185		2.115	1.6025	
	V	D	V X D	V	D	V X D	V	D	V X D	V	D	V X D
SEM±	19.04	26.93	38.09	0.012	0.018	0.025	0.003	0.004	0.006	0.010	0.014	0.020
CD	54.94	77.70	109.88	0.037	0.052	0.074	0.008	0.012	0.017	0.030	0.042	0.060

V: varieties
D: Days after Anthesis
V X D: Interaction of Variety and days after anthesis

conductivity of seed leachate (1.21 mS) was at 60 DAA and it differed significantly with remaining stages, highest (1.76 mS) being at 45 DAA. At the time of physiological maturity electrical conductivity was noted to be 1.22 mS and 1.52 mS in BRG-2 and BRG-1 respectively.

Electrical conductivity is an indirect measure of seed quality, with lower values denoting higher seed quality. Significant differences were observed between varieties, days after anthesis and their interaction for the pH of seed leachate, highest pH (6.242) was recorded in BRG-1 compared to BRG-2 (6.185). The pH of seed leachate increases with increase in days after anthesis from 5.99 to 6.32 at 45 DAA to 55 DAA and slight reduction was observed at 60 DAA (6.30). With respect to days after anthesis, the highest (6.32) pH of seed leachate was noticed at 55 days after anthesis, while lowest (5.98) was observed at 45 days after anthesis. Significant differences were observed between the varieties and days after anthesis. The pH of seed leachate was maximum (6.35) at 55 DAA in BRG-1, while minimum of 5.85 pH was recorded at 45 days after anthesis in BRG-2Similar results were observed with respect to total dehydrogenase activity (A_{480}) with a maximum of 2.50 in BRG-1 at 55 DAA and 1.76 in BRG-2 at 50 DAA.

Table 3. Influence of stage of maturity on field emergence and infection of pigeon pea.

Maturity stages	Field Emergence (%)			Infection (%)		
	Varieties			Varieties		
	BRG-1	BRG-2	Mean	BRG-1	BRG-2	Mean
D_1:45DAA	50.75	62.25	56.50	30.00	24.5	27.25
D_2:50DAA	61.50	79.25	70.37	21.75	11.75	16.75
D_3:55DAA	78.25	77.75	78.00	18.00	14.00	16.00
D_4:60DAA	78.00	73.25	75.62	14.5	12.5	13.50
Mean	67.50	73.12		21.06	15.68	
	V	D	V X D	V	D	V X D
SEM±	0.436	0.61	0.87	0.26	0.37	1.09
CD (p=0.05)	1.258	1.78	2.51	0.77	0.53	1.54

V: Varieties
D: Days after Anthesis
V X D: Interaction of Variety and days after anthesis

Field emergence recorded significance difference at different stage of maturity. The highest field emergence of 78.00% was found at 55 DAA while lowest of 56.50% was recorded at 45 DAA irrespective of cultivars. The difference was also significant between cultivar, BRG-2 recorded higher (73.12 %) field emergence as compared to BRG-1 (67.50 %). Similar findings were also noticed by Jayaraj and Karivaratharaju [11] in the bunch type of groundnut cultivars where, higher seed vigour and viability were recorded when seeds are harvested at 60 DAA.

Seed infection was more (27.5%), when seeds harvested at 45 days after anthesis and the infection decreased (13.5%) at 60 days after anthesis. This decline in infection with maturity may be due to the observed decline in the moisture content from 45 DAA to 60 DAA. The study concludes that the cultivars, BRG-1 and BRG-2, could be harvest at 55 days after anthesis and 50 days after anthesis, respectively for higher seed quality.

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