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Influence of harvesting stages on seed quality in chickpea varieties

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Abstract

The field studies were conducted to ascertain the influence of harvesting stages on seed quality in five varieties of chickpea seeds harvested at four different stages the selected varieties are Desi type (A-1, Bheema and BGD-103) and two Kabuli (ICCV-2 and KAK-2) chickpea varieties seeds are sown and pods were harvested from each variety at different pod colour stages *viz.* dark green, green to yellow, full yellow pod colour stages and copper brown pod colour stage. In all the chickpea varieties, fresh weight of pod and seed, 100 seed weight, moisture content decreased significantly with advance in maturity while, dry weight of pod, fresh and dry weight of seeds, seed germination, seedling length and vigour index increased. Among varieties, BGD-103 recorded maximum fresh and dry weight of pods, fresh and dry weight of seeds, germination, seedling length, seedling vigour index with lower EC values seeds harvested at yellow pod colour stage (H₃) recorded higher dry seed weight, germination (96.40%), seedling vigour with low electrical conductivity (0.993 dSm⁻¹). In all the chickpea varieties, the seeds harvested at yellow pod stage (H₃), recorded higher pod dry weight, germination, seedling vigour index and lower electrical conductivity. While, seeds harvested at early or later stages than yellow pod stage recorded less germination and seedling vigour index.

Keywords: Influence, seed quality, chickpea varieties

Introduction

Harvesting of seed crop at right stage of physiological maturity is most important to obtain higher seed yield and quality. The seeds harvested at physiological maturity shall have maximum viability and vigour, perform well in field and store for longer period. Physiological maturity refers to morphological, physiological and functional changes from the time of fertilization until the matured ovuls are ready for harvest (Delouche, 1973) [6]. Seed development is the period between fertilization and maximum fresh weight accumulation and maturity begins at the end of seed development and continues up to harvest (Abdul-Baki and Baker, 1973) [1]. Physiological maturity in most of crops is normally understood to occur when seed reaches its maximum dry weight (Harrington, 1972) [7] with low moisture content at which accumulation of nutrients in seeds stops, formation of abscission layer occurs and viability and vigour are at maximum. Stage of physiological maturity varies with crop and also with variety in relation with the environmental factors.

Generally, seed crop is harvested based on certain morphological and physiological changes in plants and seed. However, such maturity studies in chickpea varieties are lacking and there is a need to ascertain the right stage of harvest to obtain high quantity of quality seeds. The experiment is conducted and quality parameters was studied in the laboratory of Department of seed sciences and technology College of Agriculture Dharwad.

Material and Methods

The seeds of Desi and Kabuli varieties *viz.*, A-1, Bheema and BGD-103 (Desi) and kabuli type KAK-2 and ICCV-2 varieties In this experiment, seeds of each variety were sown in 10 lines of 30 metre long with spacing of 30 x 15 cm between rows and plants respectively during rabi seasons of 2007 and 2008. The recommended dose of fertilizer (20:50:00 kg NPK/ha) was applied as basal dose for each plots in the form of urea and diammonium phosphate at the time of sowing. Soon after sowing plots were lightly irrigated. The necessary after care operations such as thinning, hand weeding, inter cultivation and need based plant protection measures were carried out. The plots were irrigated four times during seed crop period. The experiment was laid out in RCBD with factorial concept in three replications the pods were

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harvested from each variety at different pod colour stages viz. dark green, green to yellow, full yellow pod colour stages and copper brown pod colour stage. The observations of seed quality parameters viz., moisture content, 100 seed weight, germination percentage, vigour index (germination (%) x seedling length) and electrical conductivity were recorded by adopting ISTA Rules (Anon., 1996) [2].

Result and Discussion

It has been well documented in most of the field crops that seed maturation proceeds with loss of water at various degrees upon atmospheric conditions and loss of moisture content at maturity stage is an initial phase of seed development. The results of the present study on influence of stages of harvest on seed quality in chickpea varieties are discussed here

Varietal influence

Irrespective of harvesting stages the moisture content of seeds was found to decrease significantly with the advance in maturity in all the five varieties. In ICCV-2 variety the average moisture content of seed was more (37.77%) and was on par with A-1 (37.53%) and it was less (36.37%) in Bheema over harvesting stages. Similar variations in moisture content during maturations of varieties in chickpea, Arulnandhy and Senanayak (1990) [3]. The decrease in moisture content with advancement in maturation stages noticed in the present study could be due to dehydration which could be due to replacement of osmotic material by protein, starch and macromolecules with low hydration capacity.

Germination percentage was found to increase gradually with the increase in maturity stages in all the varieties and attained maximum at yellow pod stage (H₄) and then found to decline. Similarly, the seedling length and vigour index followed same trend as that of germination parameter. Among varieties, BGD-103 (V₃) recorded higher values for all these seed quality parameters compared to other varieties and was least in KAK-2 (V₃). The differences in seed quality parameters noticed among varieties may be ascribed to differences in accumulation of reserve food material in seed and its efficient utilization during germination and seedling growth.

The seed quality is negatively related to EC of seed leachate. Higher the EC lower is the seed quality. In the present study, BGD-103 (V₅) recorded lower EC (1.514 dSm⁻¹) while was higher (1.826 dSm⁻¹) with KAK-2. The similar varietal difference with respect to seed quality parameters and EC was recorded by Bharud and Patil (1990) [4] in chickpea.

Influence of harvesting stages

The seed quality parameters depend on the stage at which the seed crop is harvested. Harvesting at early stage may result in more number of underdeveloped and immature seeds with high seed moisture content and delayed harvesting results in yield and quality losses due to field weathering. Hence, harvesting at appropriate stage of physiological maturity is most important for obtaining increased seed yield and quality. The moisture content of seeds was found to decrease with

increase in harvest period irrespective of varieties. The moisture content of seed was highest (60.05%) at H₁ stage (full green pod colour) compared to other stages of harvest and was minimum (12.42%) at H₄ stage (copper brown pod colour). Similar decrease in moisture content with advance in maturity stages have been reported by Macha (2004) [9] in cluster

Irrespective of varieties, the percentage of germination, seedling length and vigour index found to increase gradually from H₁ to H₃ stage and declined then after at H₄ stage. The seeds collected from H₃ stage recorded significantly higher seed quality parameters viz., germination (96.40%), seedling length (31.90 cm) and vigour index (3075) with low electrical conductivity (0.993 dSm⁻¹) compared to other stages of harvest. While in seed collected at (H₄) stage the germination, seedling length, vigour index decreased concomitantly with drastic reduction in fresh and dry weight. Reduction in pod and seed weight may be related to inbuilt mechanism, cessation and disorganization of cell organelles within few days from H₃ stage of harvest (Mathews, 1973) [10].

The lower seed quality parameters observed in the early stage of harvest (H₁) might be due to presence of more number of undeveloped physiologically immature seeds. Similarly poor seed quality with early harvests were reported by Bharud and Patil (1990) [4] in chickpea, Arulandy and Senanayake (1990) [3]. The seed quality parameters were also relatively lesser in seeds harvested at complete copper brown pod stage (H₄) compared to H₃ stage of pod harvest.

Influence of interaction of variety and stage of harvest

In all the five chickpea varieties, the moisture content of seeds decreased gradually with advancement in maturity. The decrease in moisture content of seeds with increase harvest stages may be due to rapid loss of moisture from the seed during seed development. Similar loss of moisture content of seed with advancement in maturity was also observed by Bharud and Patil (1990) [4] in chickpea. The physiological seed quality parameters such as germination (more than 95%), seedling length and vigour index were found to increase gradually and attained maximum at yellow pod stage (H₃) stage of maturity in all the chickpea varieties.

In all the five chickpea varieties, maximum physical and physiological seed quality coincided with duration taken for attainment of maximum dry weight of seed, low moisture content with decrease in fresh weight of seed at H₃ stage. Heydecker *et al.* (1972) [8] also opined that physical and physiological seed quality parameters which represent totality of seed quality attains maximum values with duration taken for maximization of dry weight, germination, vigour index *etc.* which were claimed to the physical and physiological indices of seed maturation. In the present study, maximum germination, seedling length and seedling vigour index increased with advance in maturation stages which coincided with maximum dry weight of seed and minimum fresh weight of seed. Copland and Mc. Donald (1995) [5] claimed that maximum germination, seedling length and vigour index to be physical and physiological indices of seed maturation.

Table 1: Influence of stages of harvest on moisture content in chickpea varieties

Treatments	Fresh weight of seed (g)			
	H ₁	H ₂	H ₃	H ₄
V ₁	41.00	42.87	33.83	27.5
V ₂	44.77	46.53	37.17	28.40
V ₃	49.10	47.50	46.17	39.83

V ₄	52.13	52.10	48.87	41.50
V ₅	53.07	54.73	51.83	42.40
Mean	48.01	48.75	43.57	35.93
Comparison for means of		S.Em±	CD (5%)	
V		0.34	0.97	
H		0.30	0.87	
V X H		0.68	1.94	

Varieties: V₁: A-1 V₂: ICCV-2 V₃: KAK-2 V₄: Bheema V₅: BGD 103

Flowering stage: H₁: Full green pod harvest stage H₂: Green to yellow pod stage H₃: Full yellow pod stage H₄: Copper brown pod stage

Table 2: Influence of stages of harvest on fresh weight and dry weight of seed in chickpea varieties

-	Fresh weight of seed (g)				Mean	Dry weight of seed (g)				Mean
	H ₁	H ₂	H ₃	H ₄		H ₁	H ₂	H ₃	H ₄	
V ₁	41.00	42.87	33.83	27.5	36.30	16.60	19.77	25.73	24.03	21.53
V ₂	44.77	46.53	37.17	28.40	39.22	17.67	21.53	28.37	24.67	23.06
V ₃	49.10	47.50	46.17	39.83	45.65	20.33	26.23	36.00	35.00	29.39
V ₄	52.13	52.10	48.87	41.50	48.65	21.04	26.32	40.03	37.13	30.18
V ₅	53.07	54.73	51.83	42.40	50.51	20.25	25.77	38.13	36.57	31.13
Mean	48.01	48.75	43.57	35.93	44.07	19.18	23.92	33.65	31.48	27.06
Comparison for means of		S.Em±	CD (5%)				S.Em±	CD (5%)		
V		0.34	0.97				0.23	0.65		
H		0.30	0.87				0.20	0.58		
V X H		0.68	1.94				0.46	1.31		

Varieties: V₁: A-1 V₂: ICCV-2 V₃: KAK-2 V₄: Bheema V₅: BGD 103

Flowering stage: H₁: Full green pod harvest stage H₂: Green to yellow pod stage H₃: Full yellow pod stage H₄: Copper brown pod stage

Table 3: Influence of stages of harvest on germination and seedling length in chickpea varieties

Treatments	Germination (%)				Mean	Seedling length (cm)				Mean
	H ₁	H ₂	H ₃	H ₄		H ₁	H ₂	H ₃	H ₄	
V ₁	0 (0.00)	58.33 (49.78)	97.67 (81.19)	95.00 (77.05)	62.70 (52.34)	0	19.33	29.50	28.33	19.29
V ₂	0 (0.00)	58.00 (49.58)	94.67 (76.62)	92.67 (74.26)	61.34 (51.53)	0	20.83	31.17	30.30	20.58
V ₃	0 (0.00)	55.33 (48.04)	95.33 (77.49)	94.33 (76.19)	61.25 (51.48)	0	20.83	33.00	32.00	21.46
V ₄	0 (0.00)	56.66 (48.81)	97.00 (79.99)	95.33 (77.49)	62.25 (52.07)	0	21.83	32.83	31.33	21.50
V ₅	0 (0.00)	57.00 (49.00)	97.33 (80.56)	96.67 (79.45)	62.75 (52.37)	0	23.00	33.00	32.17	22.04
Mean	0.00 (0.00)	57.06 (49.04)	96.40 (79.03)	94.80 (76.79)	62.07 (51.96)	0.00	21.23	31.90	30.83	20.97
Comparison for means of		S.Em±	CD (5%)				S.Em±	CD (5%)		
V		0.35	0.99				0.23	0.66		
H		0.31	0.89				0.21	0.59		
V X H		0.69	1.98				0.46	1.33		

Arcsine transformed values in parenthesis

Varieties: V₁: A-1, V₂: ICCV-2, V₃: KAK-2, V₄: Bheema, V₅: BGD 103

Flowering stage: H₁: Full green pod harvest stage H₂: Green to yellow pod stage H₃: Full yellow pod stage H₄: Copper brown pod stage

Table 4: Influence of stages of harvest on seedling vigour index and electrical conductivity in chickpea varieties

Treatments	Seedling Vigour Index				Mean	Electrical conductivity (dSm1)				Mean
	H ₁	H ₂	H ₃	H ₄		H ₁	H ₂	H ₃	H ₄	
V ₁	0	962	2395	2183	1010	2.647	1.977	0.923	0.997	1.628
V ₂	0	1033	2388	2250	1061	2.843	2.077	1.007	1.037	1.741
V ₃	0	1001	2557	2438	1105	2.943	2.183	1.077	1.100	1.826
V ₄	0	1065	2626	2428	1119	2.800	1.977	0.980	1.040	1.699
V ₅	0	1127	2659	2556	1154	2.093	1.953	0.977	1.033	1.514
Mean	0	1041	2521	2367	1090	2.665	2.033	0.993	1.035	1.682
Comparison for means of		S.Em±	CD (5%)				S.Em±	CD (5%)		
V		20.32	58.18				0.080	0.230	0.080	
H		18.18	52.04				0.072	0.205	0.072	
V X H		40.64	116.36				0.160	0.459	0.160	

Varieties: V₁: A-1 V₂: ICCV-2 V₃: KAK-2 V₄: Bheema V₅: BGD 103

Flowering stage: H₁: Full green pod harvest stage H₂: Green to yellow pod stage H₃: Full yellow pod stage H₄: Copper brown pod stage

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