

## Effect of seed size on germination characteristics of *kabuli* chickpea genotypes

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Seed size is one of the characters associated with seed quality. It is not only an important primary component of grain yield but also a valuable parameter for seedling establishment and crop growth. Scientific seed production recognizes the importance of optimum size of seed to be used for raising crops in order to harvest good quality seeds. Traditionally, seed size within a plant species is considered to be a highly stable characteristic. However, seed size within a species or even in an individual plant can vary greatly [1]. Such variation in seed size may affect germination and seedling characteristics. Therefore, seed size is an integral breeding objective in chickpea improvement programme.

In the present study, 15 *kabuli* chickpea genotypes were grouped into three different classes of seed size on the basis of 100-seed weight, *viz.* small (25-30g), medium (35-40g) and large (greater than 40g). Twenty-five seeds from each genotype were germinated in Pteri-dishes lined with germination paper kept in  $\pm 25^{\circ}\text{C}$  in dark, with four replications. The seeds were considered germinated after the emergence of 2 mm radicle from the seed coat. The date on mean days to germination, per cent germination, root length (cm), shoot length (cm), fresh and dry weight of seedlings (mg), vigour index and electrical conductivity were recorded after 10 days of placement of seeds.

Mean days to germination (MDG) was calculated by the formula given by [4].

$$\text{MDG} = \frac{\sum DN}{\sum N}$$

where, N = number of seeds which germinated on day D, D = number of days counted from the beginning of germination test.

Per cent germination was calculated by using formula:

$$\text{Germination (\%)} = \frac{\text{No. of seeds germinated}}{\text{Total No. of seeds sown}} \times 100$$

Root and shoot length of five seedlings were selected randomly from each replication and were recorded using a centimeter scale and averaged. Fresh weight of seedlings was recorded on tenth day. Dry weight of seedlings was recorded after drying in an oven for 24 hr at  $80^{\circ}\text{C}$  until the constant weight was obtained. Seedling vigour was calculated as Vigour Index (VI) based on the following formulae [1]:

VI -I = per cent germination x seedling dry weight

VI -II = per cent germination x seedling length

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Electrolyte leakage was measured by conductivity meter. Electrolyte leakage (EL) was calculated by formula.

$$EL (\%) = (1 - L_1/L_2) \times 100$$

$L_1$  = leakage before boiling,  $L_2$  = leakage after boiling

In the present investigation, maximum germination was observed in large-seeded category (Mean=96) and minimum in small-seeded category (Mean = 94) (Table 1). It was highest in genotypes, GLK28326 and GLK26164, of large-seeded and medium-seeded categories, respectively. In general, large-seeded category took higher mean days to germination, followed by medium-seeded, least was recorded in small-seeded category. Maximum mean days to germination were found in genotype GLK28326 (3.33) of large-seeded category and minimum in genotype GLK24092 from small-seeded category.

The root length was also significantly higher in large-seeded (Mean=13.22) than medium and small-seeded ones. Highest root length was found in genotype GLK28126, of large-seeded, in their respective categories. On the contrary, shoot length was recorded highest in small-seeded genotypes category, followed by large-seeded, and lowest was recorded in medium-seeded category. Shoot length of seedling was maximum attained by large-seeded genotype (GLK28119) followed by small-seeded genotype (GLK26155). Thus, it was observed that large seeds frequently have greater per cent germination or emergence, and produce larger and more vigorous seedlings than small seeds. Similarly, germination per cent was higher in large-seeded seed and lower in small-seeded ones [5, 6, 14]. It is also reported that small muskmelon seeds had lowest per cent germination and least seedling growth, thereby demonstrating that there is an association between seed physical parameters and seed quality [10].

Similarly, fresh weight of seedling was significantly higher in the large-seeded category, followed by medium-seeded and least in small-seeded category (Table 1). Fresh weight of seedling was found to be highest in large-seeded genotype (GLK28119) followed by GLK28126 and GLK28326,

whereas small-seeded genotype (BG1053) recorded the lowest weight. The dry weight of seedling followed similar trend as of fresh weight of seedling. The results conform to those reported by [7, 15] in gram. Large seeds had a greater percentage of emergence, shoot and root fresh weight than smaller ones [13]. In mungbean small-sized seeds had highest seedling emergence. The larger seeds showed highest epicotyl and hypocotyl length, fresh weight of root, shoot and total seedlings [8]. Large seeds produced highest germination per cent, coleoptiles fresh weight and dry weight, radicle fresh weight and 1,000-seed weight compared to other seed size categories [19]. The superior germination of larger-sized seed is ascribed to a greater amount of endosperm reserves that are available during the germination process [20].

The mean value of VI-1 was significantly higher in large-seeded category compared to medium-and small-seeded category (Table 1). Highest VI-1 was found in GLK28119 of large-seeded and least in GLK24092 of small-seeded category. In VI-2, mean value was highest in large-seeded than in small-seeded category, followed by lowest in medium-seeded category. Maximum VI-2 in large seeded category was found in GLK26171 and minimum in GLK26173 of medium-seeded category. The mean electrolyte leakage is found to be maximum in small-seeded category and minimum in large-seeded category. Minimum electrolyte conductance was found in large-seeded genotypes (GLK28119 and GLK28126) and maximum in small-seeded genotype BG1053 from among all the seed size categories. High levels of electrolyte leakage in coleoptiles of small-seeded genotypes may be associated with mechanical damage, cryptic damage, poor organellar and cellular membrane integrity and low seed vigour. This leakage may result in the unavailability of metabolites for its growth.

The correlation analysis showed that different germination characters, *viz.* root length, fresh and dry weight of seedlings, vigour index, germination percentage are significantly correlated with each other except shoot length which was negatively correlated with dry weight of seedlings and germination percentage. All these characters

Table 1. Germination and vigour characteristics of *kabuli* chickpea genotypes varying in seed size

Seed size category/ genotype	Germination (%)	Mean days to germination	Root length (cm)	Shoot length (cm)	Seedling fresh weight (g)	Seedling dry weight (g)	Vigour index-I	Vigour index-II	Electrolyte leakage (%)
<i>Small-seeded</i>									
GLK27202	96	2.50	8.09	6.58	1.01	0.27	126.33	1405.24	55
GLK24096	92	2.39	7.19	7.21	1.16	0.30	134.18	1331.32	45
GLK24092	94	2.36	8.84	7.47	0.97	0.23	119.42	1528.37	55
GLK26155	98	2.42	11.73	7.71	1.15	0.30	140.02	1909.41	58
BG1053	91	2.51	7.64	5.78	0.95	0.27	122.51	1212.25	59
Mean	94	2.44	8.70	6.95	1.05	0.27	128.49	1477.32	54
<i>Medium-seeded</i>									
GLK28378	100	2.57	10.51	7.05	1.41	0.36	177.75	1755.00	54
GLK26173	90	2.66	7.61	5.22	1.02	0.32	131.77	1158.40	54
GLK23001	98	2.85	12.86	6.05	1.18	0.33	158.12	1853.20	45
GLK25121	96	2.68	8.82	5.29	1.09	0.31	164.00	1350.74	46
GLK25136	90	2.65	7.74	6.10	1.13	0.28	131.19	1243.42	47
Mean	95	2.68	9.51	5.94	1.17	0.32	152.57	1472.15	49
<i>Large seeded</i>									
GLK26171	96	3.05	11.34	5.19	1.34	0.34	172.1	1955.98	53
GLK28326	100	3.33	11.91	6.57	1.54	0.41	193.16	1847.5	43
GLK28378	93	3.24	13.08	5.33	1.31	0.36	164.73	1711.34	46
GLK28119	94	3.24	14.44	7.77	1.56	0.41	206.49	2104.79	34
GLK28126	99	3.30	15.34	6.82	1.55	0.41	205.5	2220.12	34
Mean	96	3.23	13.22	6.34	1.46	0.38	188.4	1967.95	42
CD (5%)	5.48	0.16	1.63	1.33	0.12	0.38	19.14	246.11	3.70

Table 2. Correlation analysis on mean basis of different germination characteristics of *kabuli* chickpea genotypes varying in seed size

	Root length	Shoot length	Seedling fresh weight	Seedling dry weight	Vigor index	Germination
Shoot length	0.165					
Seedling fresh weight	0.750*	0.156				
Seedling dry weight	0.696*	-0.004	0.918*			
Vigour index	0.735*	0.050	0.930*	0.986*		
Germination	0.667*	-0.557	0.782*	0.825*	0.799*	
Seed size	0.460	-0.150	0.717*	0.747*	0.751*	0.757*

were also positively correlated with seed size variation except shoot length (Table 2). Similarly, in both blackgram and greengram seed weight was positively correlated with root length [3].

Thus, it can be concluded that large-seeded category had higher seed vigour characters compared to medium- and small-seeded category. The seed quality parameters may help in seedling establishment in the field. Previous workers have also observed that larger-sized seeds are superior to small ones which might be attributed to the advantage of large seeds having more stored energy. However, better performance of large seed in respect of emergence, shoot and root production was reported to be associated with a greater initial meristematic tissue coupled with greater amount of reserved materials.

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