Influence of seed size in chickpea on moisture content during seed drying

DVSSR Sastry, HD Upadhyaya* and **CLL Gowda**
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru 502 324, Andhra Pradesh, India
*Corresponding author: h.upadhyaya@cgiar.org

Seed drying by removal of excess moisture in seeds reduces respiration and thereby deterioration. Seed drying involves reduction of seed moisture using techniques, which will not be detrimental to its viability. Chickpea (*Cicer arietinum*) belongs to orthodox nature of seed based on the behavior before and during storage (Roberts 1973). These seeds can be safely dried to very low moisture contents, 2–6%, equivalent to a water potential of –350 Mpa (Roberts and Ellis 1989). The chickpea germplasm collection maintained at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) genebank represents wide diversity for many important characteristics inclusive of the seed size (100-seed weight ranges from 3.8 to 65.4 g). For long-term conservation of germplasm seeds, it is recommended to dry the seeds at a low temperature (15°C) and low relative humidity (RH) (15%) to avoid any adverse effects of drying on the initial quality and subsequent longevity (Cromatry et al. 1982) and different requirements of drying periods for cereals and legumes [eg, groundnut (*Arachis hypogaea*)] were reported under this environment (Sastry et al. 2003). Knowledge on the dynamics of seed drying across seed size is needed for pre-storage processing of seed samples for different storage needs. The objective of this study was to test the influence of seed size in chickpea on moisture content during drying and the impact of drying on seed viability.

A total of 30 chickpea accessions, representing 10 each of small, medium and large size, were used for the study. Freshly harvested seed samples from 2005 postrainy season regeneration at ICRISAT, Patancheru, India were hand-threshed and cleaned samples were held under short-term storage conditions (25°C and 40% RH). Test weight (100-seed weight) was recorded on a random seed sample using a precision balance. The seed moisture content (wet weight basis) was estimated following oven-dry method using two replications each of 5 g (ISTA 1993). After estimating the initial moisture content (*emc*) of seeds, about 200 g seed sample in each accession was kept in muslin cloth bags, to permit free flow of air, and placed in a seed drying room maintaining a constant temperature of 15°C and 15% RH. Seed samples were drawn at an interval of seven days to estimate the moisture content. Seed drying continued until the moisture levels stabilized and no further drying occurred. Seed viability was recorded on samples prior to drying and after final drying. At the final sampling, to avoid imbibition injury, seeds were humidified for 24 h over water in a desiccator before testing viability. Seed viability was tested using a random sample of 100 seeds (two replications of 50 each) following BP (between paper) method (ISTA 1993). Data were analyzed using Genstat 9.1. Observations on mean 100-seed weight, moisture content and viability are presented in Table 1.

The 100-seed weight of the test accessions ranged from 9.6 to 41.0 g with a mean of 23.1 g indicating the seed size diversity included in this study. The *emc* before drying was 9.06% in small seeds, 9.12% in medium seeds and 9.08% in large seeds. Initial seed viability of the tested accessions ranged from 97.4 to 99.2% with a mean of 98.2% and final seed viability ranged from 96.3 to 98.5% with a mean of 97.2%. Seed viability before drying was generally high in all seeds and there is no change in viability when dried to low moisture levels indicating no adverse effect on quality.

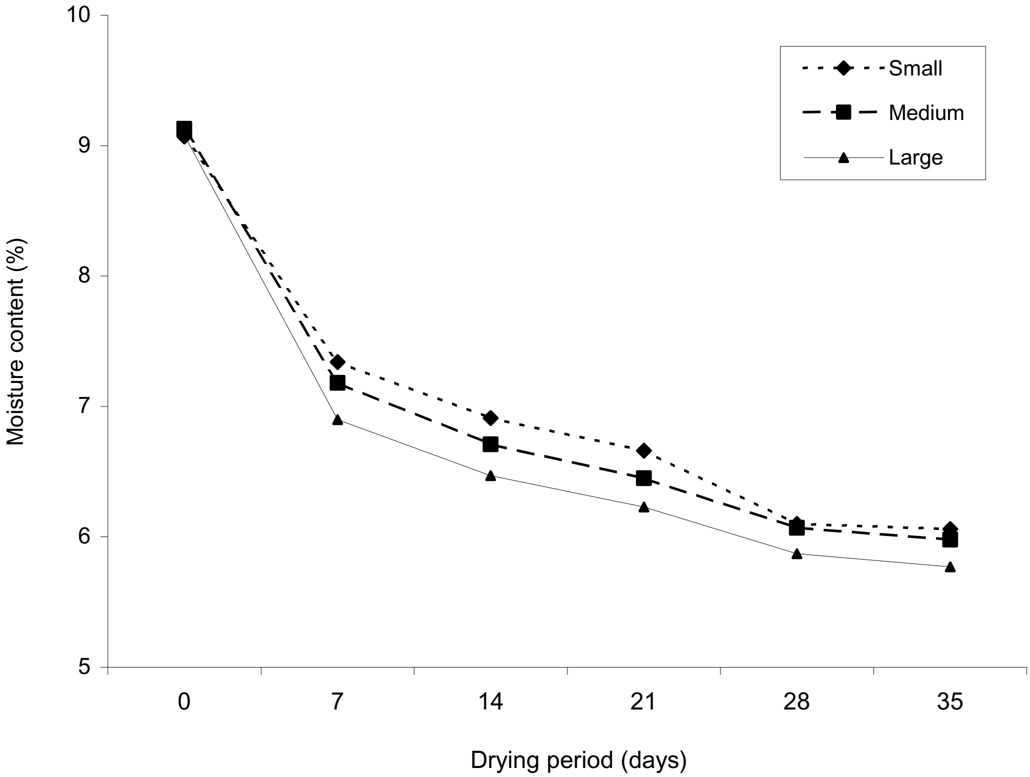

Figure 1. Changes in seed moisture content in chickpea seeds under a constant drying environment.

Table 1. Mean 100-seed weight, changes in moisture content and viability of small-, medium- and large-seeded chickpea under constant seed drying environment.

Seed size	100-seed weight (g)	Seed moisture content (%) 0 days	7 days	14 days	21 days	28 days	35 days	Initial viability (%)	Final viability (%)
Small									
Mean	9.6	9.06	7.33	6.90	6.65	6.10	6.06	99.2	98.5
SE±	0.17	0.027	0.047	0.046	0.034	0.023	0.025	0.61	0.43
Medium									
Mean	18.5	9.12	7.18	6.71	6.45	6.07	5.98	97.4	96.9
SE±	1.03	0.114	0.109	0.062	0.070	0.021	0.032	1.15	0.67
Large									
Mean	41.0	9.08	6.90	6.46	6.23	5.87	5.77	98.2	96.3
SE±	2.74	0.033	0.115	0.078	0.067	0.022	0.032	0.62	0.68
Overall									
Mean	23.1	9.09	7.14	6.69	6.44	6.01	5.93	98.2	97.2
SE±	2.61	0.039	0.63	0.049	0.046	0.022	0.028	0.48	0.38

Differences in seed moisture contents under constant drying environment were significant among the three seed sizes. During the first seven days, small seeds dried from an initial moisture content of 9.06 to 7.33%, medium seeds from 9.12 to 7.18% and large seeds from 9.08 to 6.90%. Greater losses in moisture content were observed during this period. Loss in seed moisture continued within and among seed sizes up to 28 days and the loss in moisture in small seeds was 7.33 to 6.10%, in medium seeds 7.18 to 6.07% and in large seeds 6.9 to 5.87%. Further drying (up to 35 days) did not lead to any significant moisture loss in any of three seed sizes. This was considered as the final seed moisture for the test accessions under the existing drying environment. The final *emc* was 6.06% for small seeds, 5.98% for medium seeds and 5.77% for large seeds indicating significant differences among seed sizes.

Changes in seed moisture content among different groups are presented in Figure 1. The drying curves show a three phase drying under constant environment. In the first phase, considered as rapid drying stage, the loss of moisture is significantly higher compared to the later phases. The second is a normal drying phase and the third a slow drying and stable moisture phase. In chickpea, irrespective of seed size, the initial seed moisture remained same and larger seeds lost moisture relatively rapidly and the seeds attained constant weights at 28 days after the start of drying cycle with no appreciable loss at 35 days after the start of drying. Large seeds showed lowest *emc* compared to medium- and small-sized seeds throughout the drying period.

In this study, seeds were force-ventilated to ensure that transfer of moisture from seed surface to the air was not a limiting factor. The temperature and airflow affecting the rate of drying remained the same for all the samples. Thus, the lower final *emc* of larger seeds was seemingly affected by the nature and the thickness of seed coat. This helps in efficient and cost-effective planning for seed drying. The nature and the behavior of seed coat among seed sizes of different chickpea genotypes and other crops need to be investigated further.

References

Cromatry AS, **Ellis RH** and **Roberts EH.** 1982. The design of seed storage facilities for genetic conservation. Rome, Italy: International Board for Plant Genetic Resources. 96 pp.

ISTA. 1993. International rules for seed testing. Seed Science and Technology 21 (Supplement):1–288.

Roberts EH. 1973. Predicting the storage life of seeds. Seed Science and Technology 1:499–514.

Roberts EH and **Ellis RH.** 1989. Water and seed survival. Annals of Botany 63:39–52.

Sastry DVSSR, **Kameswara Rao N** and **Bramel PJ.** 2003. Seed drying under controlled environment for long-term conservation of germplasm. Seed Research 31(2):148–153.