RATE AND SITES OF WATER UPTAKE BY BEAN SEED AS AFFECTED BY HIGH TEMPERATURE STRESS

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Among seed-quality factors cooking quality and appearance are the most important factors for consumers to make buying decision. The cooking quality of bean depends on cultivar, cultural practices, stress or no stress environment, handling and storage of bean during harvest and postharvest, and cooking method. The bean seed consists largely of dicotyledone, which contributes to 90-92% of the dry weight and it is responsible for the quality characteristics such as appearance, texture, flavor and nutrient bio-availability of the cooked bean. Seed anatomy influences the water uptake, hence determines the hydration properties of bean, a factor of seed quality. Seed coat accounts for 7-10% of a mature dry bean seed, and it is the entrance of water (Beninger et al., 1988). Important structures on the dorsal of the seed are the hilum, micropyle and raphe. The structures function as the primary sites of water entry into seeds (Korban et al., 1981). Water uptake may occur through the seed coat pores. This mechanism of water entry appears mainly a feature of white navy bean (Adams and Bedford, 1973; Wyatt, 1977).

The entry site and rate of water uptake were verified in two meso-american bean cultivars Pérola (carioca type) and BRS-Valente (black) produced with and without high temperature stress (HTS). To study the principal water entry site during soaking the seed structures were sealed with acrylic glue: 1. micropyle, 2. raphe, 3. hilum, 4. micropyle+raphe+hilum and 5. check (without glue). Prior to the treatment the seed was sieved to standardize the seed size and it was selected for seed without physical damage. Each sample of 20 seeds was weighted before and after applying the glue, maintaining the weight deviation as minimum as possible. After soaking of 4, 7 and 24 hours, the sample was dried and weighted. After weighing the sample it was verified whether the glue was still there and then discarded. Two series of experiments with three replications were conducted. The two experiments gave similar results, hence the two were combined for statistic analysis and the results are shown in Table 1 and Figure 1.

Table 1. Seed characteristics of Pérola and BRS-Valente from high temperature stress and non stress site.

Cultivar	**HTS**	**100 seed weight (g)**	**Seed hum. (%)**	**Seed density (g/liter)**	**Germination rate (%)**	**Seed vigor (%)**
Pérola	With	27.5	10.68	815	93	61
	Without	29.1	10.65	823	90	61
BRS-Valente	With	22.3	11.31	888	99	83
	Without	25.4	10.59	844	91	62

The seed production of Pérola and BRS-Valente under HTS produced lower hundred seed weight but higher germination rate than without HTS (Table 1). Seed vigor of Pérola was low in both environment conditions (61%) and BRS-Valente showed higher seed vigor when produced under HTS than without stress (83 and 61%, respectively). Seed humidity was similar for both environments and cultivars. No differences was found in seed density for Pérola but BRS-Valente seed density was higher under HTS. There was significant higher water absorption rate between Pérola seed derived from HTS than seed from traditional bean growing region, during 4 and 7 hours of soaking and the rate was higher than BRS-Valente from HTS. Pérola with no HTS absorbed water only 46% of its weight after 4 hours of soaking, whereas seed with high temperature imbibed more than 95% of its weight in the same period of soaking. BRS-Valente showed the same pattern of water uptake but in lower rate. After 7 hours of soaking BRS-Valente absorbed about 80% of its original seed weight and there was small difference in water uptake between seeds from HTS and no HTS. There was no difference in water absorption rate between cultivars and seed origin after 24 hours of soaking. During this period Pérola and BRS-Valente seeds have absorbed water at least the same amount as their original seed weight.

There was no significant difference among sites of water absorption in the two cultivars. The lowest water absorption occurred when all three sites (micropyle, raphe and hilum) were sealed covering the largest area by the sealant, hence impeding water entrance. This indicates that both cultivars absorbed water through the whole seed coat and the role of micropyle, raphe and hilum in water uptake is less important than reported by Korban et al., 1981, but similar as reported by Wyatt (1971) cited in Korban (1981). The two cultivars tested in this experiment were meso-american and absorbed water faster than those temperate zone cultivars reported by Korban et al. (1980). Understanding the difference in water uptake rate and site of bean races, seed storage condition and duration is important for seed quality selection criteria.

References

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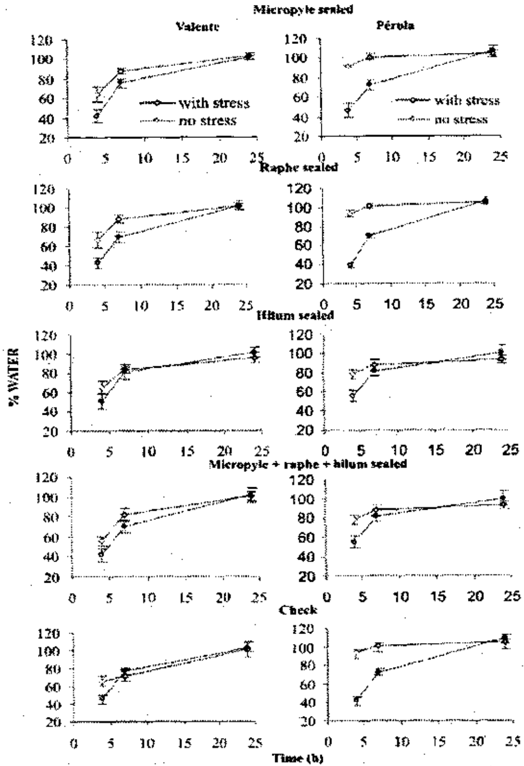

Figure 1. Rate and site of water absorption of Pérola and BRS-Valente seed, produced in region with and without high temperature stress.