# VALIDATION OF ELECTRICAL CONDUCTIVITY TEST FOR BUTTER BEAN SEEDS

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The butter bean (*Phaseolus lunatus* L.) is the second most important legume of this genus due to the protein content and distinctive taste. This bean is used worldwide in the most diverse cuisines, receiving various names, depending on the cultivated area and forms used for human consumption (Martínez-Castillo et al., 2008). In the United States, it is popularly known as lima bean, butter bean, Sieva bean and sugar bean (Oliveira et al., 2004). The butter bean is considered more tolerant to drought, excess moisture and heat when compared to common bean (*Phaseolus vulgaris* L.) and adapting to the most varied environmental conditions (Vieira, 1992). This is important because the predictions of climate change indicate significant changes in rainfall patterns over the coming decades (Borém & Ramalho, 2011). Despite its adaptive potential, related to butter bean crop is still incipient. Therefore, the aim of the present study was to evaluate the adequacy of methodology of the electrical conductivity test for butter bean seed varieties.

Six varieties of butter bean grown in the North of Minas Gerais State, Brazil, were used in this study. The electrical conductivity of the water of hydration was determined from 25 selected beans, discarding malformed and voids. In plastic cups of 200 ml, the beans were immersed in 75 ml of deionized water. Then, the cups were transferred to a germinating chamber under constant temperature of 25°C for 24 hours. The electrical conductivity readings were taken after 4, 8, 12, 16, 20 and 24 hours of soaking. The solutions were gently shaken and the electrical conductivity was determined by conductivity (Model CG1800), and the results were expressed in mS (Dias & Marcos Filho, 1996). The experimental design was completely randomized with six treatments and four replicates per treatment. The data were subjected to analysis of variance and mean to clustering Scott-Knott's test at 5% probability. For validation tests were estimated at different times of soak, linear correlation coefficients (Pearson) between the results of electrical conductivity and other tests related to the physiological quality: Germination (G), First Count Seedling (FCS), Germination Speed Index (GSI), Fresh Mass (FM) and Dry Mass (DM) (Brasil, 2009). All statistical analyzes were done with the program GENES (Cruz, 2001).

In Table 1 we show the results of the electrical conductivity test at different times of soak. In periods of 4, 8 and 12 hours, the varieties 2 and 5 not statistically different from each other and are pointed in the same group. The physiological potential of a seed is inversely proportional to the electrical conductivity values. Therefore, in this period of time, varieties 2 and 5 had lower performance compared to other varieties. Overall, it was inferred that the electrolytes leached by seeds increased linearly in all periods of soaking (Oliveira et al., 2012). During periods of 16, 20 and 24 hours, 6 variety was the most stable, which leads to a good physiological quality, profile maintained since the first hours of evaluation. The simple linear correlation coefficients allowed to set the best time for the electrical conductivity test of butter bean seeds (Table 2). Except for the FM and DM, the results showed a positive correlation in all the tests used to evaluate the physiological quality of seeds in 12 hour of soaking period. Nevertheless, it was possible to organize the varieties into vigor level. In conclusion, in this study, the electrical conductivity test has been validated for the assessment of butter bean seeds. Therefore, it is possible to use such a test for quality control programs in seed laboratories, considering the species *Phaseolus lunatus*.

**Table 1.** Electrical conductivity test of six varieties of butter bean seeds by soaking period of 25 grains for 4, 8, 12, 16, 20 and 24 hours.

| Varieties | Electrical conductivity | | | | | |
|---|---|---|---|---|---|---|
| | 4 h | 8 h | 12 h | 16 h | 20 h | 24 h |
| 1 | 0.77 b | 0.78 b | 1.83 b | 3.32 b | 4.46 b | 5.79 a |
| 2 | 1.25 a | 2.16 a | 2.09 a | 4.95 a | 5.33 a | 5.74 a |
| 3 | 0.53 b | 0.62 b | 1.08 c | 1.75 c | 2.58 c | 5.49 a |
| 4 | 0.61b | 0.90 b | 1.55 b | 2.25 c | 2.70 a | 5.71 a |
| 5 | 1.43 a | 2.44 a | 2.73 a | 3.95 b | 4.49 b | 5.36 a |
| 6 | 0.48 b | 0.76 b | 1.23 b | 2.20 c | 2.24 c | 2.48 b |
| Means | 0.84 | 1.44 | 1.76 | 3.08 | 3.78 | 5.10 |
| CV (%) | 45.13 | 41.81 | 31.65 | 18.84 | 19.89 | 15.035 |

Note: Means followed by the same letter in the column do not differ statistically by Scott and Knott' test at 5% probability; CV: Coefficient of Variation.

**Table 2**. Coefficients of simple linear correlation between the results of electrical conductivity and physiological quality tests on seeds under different soaking time.

| Variables | Time | | | | | |
|---|---|---|---|---|---|---|
| | 4 h | 8 h | 12 h | 16 h | 20 h | 24 h |
| G (%) | 0.2992 | 0.4295 | 0.4692 | 0.3871 | 0.1743 | -0.4163 |
| FCS (%) | 0.4691 | 0.4923 | 0.4920 | 0.5550 | 0.4256 | -0.3846 |
| SGI | 0.3903 | 0.4452 | 0.4962 | 0.3994 | 0.1997 | -0.4559 |
| FM (g) | -0.1280 | -0.0600 | 0.0779 | -0.0301 | -0.2443 | -0.7919 |
| DM (g) | -0.3328 | -0.2671 | 0.0114 | -0.2176 | -0.3750 | -0.8489 |
| G (%)- 4 h | -0.0957 | 0.2195 | 0.2030 | -0.2737 | -0.4328 | -0.5856 |
| G (%)- 8 h | -0.3275 | -0.2742 | 0.0921 | -0.3329 | -0.4864 | -0.6348 |
| G (%)- 12 h | -0.2437 | -0.2646 | 0.0307 | -0.3624 | -0.4412 | -0.6543 |
| FCS (%)- 4 h | -0.1110 | -0.0289 | 0.1556 | -0.2473 | -0.4005 | -0.7640 |
| FCS (%)- 8 h | -0.1552 | 0.1228 | 0.1228 | -0.2475 | -0.4462 | 0.7322 |
| FCS (%)- 12 h | -0.0252 | -0.1061 | 0.1393 | -0.3816 | -0.4566 | -0.3939 |
| FM (g)- 4 h | -0.2958 | -0.2359 | 0.0177 | -0.4198 | -0.5108 | -0.7644 |
| FM (g)- 8 h | -0.3801 | -0.3526 | 0.0354 | -0.3944 | -0.5556 | -0.7605 |
| FM (g)- 12 h | -0.2410 | -0.3265 | -0.1309 | -0.4130 | -0.5295 | -0.7566 |
| DM (g)- 4 h | -0.3046 | -0.2536 | 0.0469 | -0.3788 | -0.5237 | -0.8453 |
| DM (g)- 8 h | -0.3123 | -0.3016 | 0.1007 | -0.3119 | -0.4720 | -0.7792 |
| DM (g)- 12 h | -0.2901 | -0.3282 | -0.1245 | -0.3884 | -0.5120 | -0.8126 |

G: Germination; FCS: First Count Seedling, SGI: Speed Germination Idex; FM: Fresh Mass; DM: Dry Mass.

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