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RESEARCH ARTICLE

DETERMINATION OF THE PHYSIOLOGICAL AND PHYSICAL QUALITY OF SEEDS OF *Phaseolus vulgaris* CREOLE

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ABSTRACT

Creole seeds should be studied and valued, since they can contribute to the improvement of the productive, commercial and feeding aspects of family farmers. The objective of this study was to evaluate the physiological and physical quality of bean seeds from the Regional Seed Bank. Creole seeds came from the Regional Seed Bank (BSR) of the Caiana community in Brazil. The seeds were submitted to germination and vigor analysis, germination speed index, root and shoot length, green and dry mass of normal seedlings, moisture, weight of seed, seed mass, apparent and real density, porosity, seed volume and colorimetric parameters (L*, a*, b*, Chroma C* and darkening index). The varieties Owl and Blue presented higher physiological quality and the Sedinha variety presented greater weight of one thousand seeds, greater apparent and real density, as well as porosity and humidity in relation to the other varieties.

INTRODUCTION

The Green Revolution was responsible for the loss of much of the diversity and variability of the cultivated plants, due to the transformation of agroecosystems into monoculture varieties of narrow genetic base. There are still a considerable number of rural properties that maintains cultivated plants that have only been improved by the hands of family farmers, called traditional varieties, passion seeds or creole (Soares Júnior *et al*., 2015). These varieties, which have the greatest variability among cultivated plants, are largely maintained by farmers in community seed banks.

According to Barbosa and Gonzaga (2012) seed quality is expressed through the interaction of four components: genetic, physical, physiological and sanitary. Creole seeds if stored correctly and taking care during production and harvesting the use of these seeds appears as an alternative to family farming in order to preserve the germplasm bank of a given region.

The evaluation of the physiological quality of the seed for field sowing and marketing purposes is fundamentally based on the germination test, conducted under favorable conditions of humidity, temperature and substrate, which allows expressing the maximum production potential of normal seedlings (Larré *et al*., 2007).

Among the creole varieties of beans there is great variation of colors, morphology and uses. The preference of the use of creole seeds is attributed mainly to characteristics such as adaptability, valorization of customs, taste and quality of traditional varieties, besides the low cost of production (Pelwing *et al*., 2008).

The strategies of conservation, use, multiplication and commercialization of the native seeds translate into actions, such as valuation of community seed banks and tests for the quality control of seeds produced in rural communities, so that farmers have more autonomy (Catão *et al*., 2010). Due to the scarcity of information on the physiological and physical quality of bean seeds, it is necessary to develop more research; therefore the objective was to evaluate the physiological and physical quality of bean seeds from the Regional Seed Bank.

MATERIAL AND METHODS

Creole seeds (Sedinha, Owl and Blue) were used, from the Regional Seed Bank (BSR) of the Caiana community in the city of Soledade, Brazil. The city of Soledade is situated at 523 meters of altitude, Latitude: 7° 3' 27' 'South, Longitude: 36° 21' 47" West. The work was carried out from May to October 2017. In the Laboratory of Storage and Processing of Agricultural

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Products of the Federal University of Campina Grande, the seeds were submitted to the following analyzes:

Germination test: conducted with four replicates of 50 seeds, seeded in trays, in the vermiculite substrate with distilled water, counts at five and nine days, corresponding to the first and last count, according to the Rules for Seed Analysis (Brazil, 2009);

Root and shoot length: 10 seedlings of each replicate were evaluated, measuring the length of the aerial part and the primary root of the normal seedlings in centimeters;

Green and dry mass of normal seedlings: obtained by weighing in analytical balance and dried in an oven at 60 ± 5 ºC until constant mass, respectively and the results were expressed in gram (Nakagawa, 1994);

Vigor test: evaluated by the first count of the germination, was carried out concomitantly with the germination test;

Germination Rate Index (IVG): determined in conjunction with the germination test, daily percentage of normal seedlings being evaluated until nine days after sowing, according to Vieira and Carvalho (1994);

Seed Moisture: determined in an oven at 105 °C, up to constant weight, (Brazil, 2009);

Physical properties: the weight of one thousand seeds was determined in a precision analytical balance in three replicates; seed mass carried out by individual weighing of the seed with three replicates of 100 seeds; for the determination of the actual specific mass three weighings with ten seeds each were carried out: the first weighing consisted of the simple weighing of the seed in precision scale, the second weighing consisted of weighing a becker containing water and the third weighing consists of weighing the becker + water + submerged seed according to Almeida *et al*. (2006); the apparent specific mass was calculated by the simple relationship between the seed mass and the volume occupied by the seeds (container volume); the seed volume was determined by the liquid displacement method using a 50 mL burette, with samples composed of 100 seeds; the porosity was obtained using the following formula:

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Ɛ: porosity of the granular mass (%);
pa: apparent specific mass (kg.m-3);
pr: actual or unit specific mass (kg.m-3).

Colorimetric parameters: determined in digital colorimeter.

The experiment was conducted in a completely randomized design with four replicates. The comparison of means was done by the Tukey test at 5% of significance and the statistical analysis was done by the program Assistat 7.7 (Silva and Azevedo, 2016).

RESULTS AND DISCUSSION

The results showed that, even considering all the varieties produced in the same harvest, climatic and soil conditions, there was variability between the varieties studied for the first count (G1), in which the Sedinha variety had a lower percentage of germination differing statistically from the others (Table 1). According to Vaz-de-Melo *et al*., (2012), water deficit and high temperatures can significantly reduce crop yields and restrict sowing in regions where water resources are constraining.

Table 1 Mean values of the first count (G1), last germination test count (G2), germination speed index (IVG), root length (CR), shoot length (CPA), green mass (GM), dry mass (DM).

Variety	G1 (%)	G2 (%)	IVG	CR (cm)	CPA (cm)	GM (g)	DM (g)
Sedinha	76.00b	87.00b	5.13a	5.87b	13.18a	9.47a	4.81a
Owl	92.00a	97.00a	5.38a	10.90a	13.56a	9.91a	5.34a
Blue	91.00a	98.50a	5.46a	7.78ab	16.62b	10.65a	5.54a
CV (%)	7.84	4.52	3.95	10.87	12.11	7.60	11.65

Note: Means followed by the same letter in the column do not differ significantly from each other by the Tukey test, at 5% probability. CV: Coefficient of Variation.

At the end of the germination test (G2), the Blue variety had a higher germination value than the others. A similar result was observed by Coelho *et al*. (2010), when studying creole bean genotypes. The germination value above 80% is within the minimum value required for the commercialization of bean seeds (Brazil, 2009). The high percentage of germination is fundamental since, the deterioration process begins with the reduction of several attributes of performance and vigor of the seed, resulting, finally, in the loss of the germination capacity of the seeds.Among the methods for the evaluation of seed vigor, the germination speed index stands out. It was observed in the research that there was no statistical difference for the same. It is emphasized that the greater vigor of the seed improves the establishment of the field crop, increases the uniformity of the stand and, consequently, allows an increase in productivity.

The variety Owl presented greater root length, followed by the Blue variety, being this one that presented greater value for the length of the aerial part differing from the others. The studied varieties did not present statistical differences for the green and dry mass of normal seedlings. According to Silva *et al*. (2012), the quality of the bean seeds is affected by the environmental conditions in the period of their development in the field and by the conditions of harvesting, drying, processing and storage.It was observed that the Sedinha variety presented greater weight of one thousand seeds, however the seed mass was higher for the variety Blue and Owl, respectively, (Table 2). According to Bezerra *et al*. (2004), in many species the seed weight is indicative of its physiological quality, and in the same batch, light seeds usually present lower performance than the heavy ones.

Table 2 Mean values and standard deviation of the physical characteristics of bean seeds.

Physical characteristics	Varieties		
	Sedinha	Owl	Blue
Weight of 1000 seeds (g)	131.65±1.18	126.82±0.96	128.08±1.19
Seed mass (g)	0.2355±0.002	0.2979±0.01	0.2980±0.007
Apparently density (g/cm^3)	0.7335±0.04	0.7315±0.04	0.6901±0.01
Real density (g/cm^3)	1.26±0.02	1.14±0.02	1.17±0.02
Porosity (%)	41.55±3.85	35.98±4.31	40.88±1.98
Seed volume (cm^3)	0.3672±0.03	0.5049±0.03	0.4734±0.05
Moisture (%)	12.24±1.76	10.88±0.22	10.96±0.27
L*	53.18±0.23	29.49±0.03	26.98±0.03
a*	5.98±0.08	15.64±0.05	17.77±0.04
b*	22.69±0.36	21.58±1.78	14.68±0.06
Chroma C*	23.47	26.65	24.67
Dimming index	11	89.19	52.71

The Sedinha variety presented higher real density, since the actual specific mass was higher than the apparent in the three varieties studied. Since the apparent specific mass takes into account the intergranular voids existing in the seed mass, this determination is important for the commercialization, sizing of silos, dryers, tanks and transport systems, and can also be used to determine damage caused by insects , as well as fungal deterioration in stored products (Mir *et al*., 2013).

The porosity of the seeds Sedinha variety was higher, indicating this to the amount of voids in the seed mass, it is associated to the resistance that the layer of products offers to the movement of the air. This information is widely used in the projects of equipment for drying and storage of grains and seeds. It was observed that the volume of the grain was higher for the variety Owl, the volumetric variations may be one of the main causes of changes in the physical properties of agricultural products.

Resende *et al*., (2005) observed that the porosity of the grain mass has greater influence with the reduction of the water content. The creole sedley variety presented higher moisture content; however, the humidity of the three varieties is within the limits allowed by the legislation, which is 13%. Higher water content in the seed can cause problems during storage. Seed drying is the most used process to ensure its quality and stability, since the biological and physico-chemical activities that occur during storage decrease with the reduction of the water content, also inhibiting the growth of microorganisms and the possibility of insect and pest proliferation (Resende *et al*., 2008).

The determination of the physical properties is necessary in engineering projects for the development and improvement of machines and equipment present in the agricultural productive chain, especially the geometric properties (Goneli *et al*., 2011). In addition, due to the variability in the physical properties of seeds and grains of bean cultivars, associated with the need to provide data for sizing and improvement of sowing, harvesting and post-harvesting machines, including the drying, processing and packaging phases, makes necessary the search of these types of information.

Color is a quality parameter capable of influencing the acceptance of food products. According to Pathare *et al*. (2013) the parameter a* assumes positive values for reddish colors (close to 100) and negative values for greenish (close to 0), while b* takes positive values for yellowish colors and negative values for bluish ones. It was observed that the Sedinha variety presented light color with low red intensity. The variety Owl presented a reddish color, and the Blue variety showed blue tones. The L* indicates the luminosity with values between black (0) and white (100), indicating in this work an intense luminosity for the Sedinha variety and low luminosity (white) for the other varieties.

The Owl variety presented the highest value of Chroma, this parameter reveals the color intensity, the higher its value, the greater the perceived color intensity. The variety Owl presented a high darkening index, followed by the Blue variety, the index indicates possible enzymatic or non-enzymatic darkening reactions. It was observed that the value of Chroma verified for the Sedinha variety was low, indicating a lower probability of occurrence of enzymatic or non-enzymatic darkening reactions.

CONCLUSION

The studied varieties presented germination percentage superior to 80%. The varieties Owl and Blue presented higher physiological quality, being superior to the Sedinha variety, where it presented the lowest values for germination, IVG, CR, CPA, GM and DM.

In the physical analyzes, it was observed that the Sedinha variety presented greater weight of one thousand seeds, greater apparent and real density, as well as porosity and humidity in relation to the other varieties.

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