Original Research Article

PHYSIOLOGICAL QUALITY OF CAUPI BEANS (scientific name)SEEDS IN THE FUNCTION OF CULTIVARS AND PLANTING TIMES

ABSTRACT

Objective: Germination and vigour evaluation of improved cultivars and creole of cowpea bean seeds as a function of different planting seasons.

Experimental design: A completely randomized design in a factorial scheme, with six treatments and two planting periods, with four replications, each repetition with 25 seeds. The treatments consisted of six cowpea bean (Scientific name) cultivars, and two improved (BRS Tumucumaque, BRS Guariba) and four creoles, (Governor, Passagem, Chico Joaquim and Espírito Santo).

Experiment place and timing: Greenhouse on a riparian zone of the Federal Rural Semi-Arid University (UFERSA), located in the municipality of Mossoró-RN,Country name . The first sowing season comprised the period from April 3 to April 18, 2017, and the second one from January 15 to 30, 2018.

Methodology: The sowing was done in plastic trays. Was used/The sand washed and sterilized as a substrate. The trays were kept in a greenhouse at room temperature. Two irrigations were realized daily. In order to avoid the local effect, the trays were changed position each day. The evaluated characteristics were: Germination percentage, emergence speed index, seedling height, leaf number, root length, stem diameter, fresh and dry mass of seedlings.

Results: There was significant interaction between cultivars and seasons at the 1% probability level, showing that these two factors behave interdependently for all characteristics evaluated.

Conclusion: Creole cultivars showed superior quality to those improved in the second season. In the first season, the cultivars BRS Guariba and BRS Tumucumaque were the most outstanding.

Key words: germination, climatic influence, *Vigna unguiculata* L. Walp , vigour.

1. INTRODUCTION

Cowpea beans (*Vigna unguiculata* L.), also known as string bean or 'feijão massacar', is one of the main components of the diet in the North and Northeast, especially in the rural area, and it is also expanding in Brazilian Midwest (Freire Filho et al., 2011). Its importance is based mainly on the basic diet for the low-income population due to factors such as short cycle, low water requirement, and its rusticity to develop in low fertility soils.

However, cowpea still has low productivity indexes (Leite et al., 2009) one obstacle which prevents a good yield in the culture is low technology employed in the production system. In this sense, among the essential technologies for the success of the crop, usage of high-quality seeds is highlighted, since the productivity can never exceed the used seed quality (DAMIÃO FILHO; MÔRO, 2001). Thus, the use of good quality seeds is a prime factor in the establishment of any crop (Varisco & Simonetti, 2012). According to Teixeira et al., (2010), seeds of low quality, that is reduced germination potential and force, crops failed in plant stand, and consequently, with an inadequate population, leading to serious economic losses.

In this sense, the availability of reliable tests to evaluate the physiological quality of seed has great importance (Costa et al., 2014). Among these, the germination test has been traditionally applied for this purpose. Vigor tests are essential to complement the quality of the seed lot, since, according to Ramos et al., (2004), seedlings emergence may vary in the field even for seed lots that have high germination depending on the vigour.

After all, a correct choice of the cultivar for a particular environment and production system is essential for obtaining good productivity. Additionally must be noticed that an appropriate choice of the sowing season is fundamental to extract the maximum performance of the seeds, either Creole or improved, since different genotypes require different environmental conditions of climate-related to the season for proper development. According to Dias (2009) environmental and genetic factors operate together through physiological processes, which control the growth and development of plants. Dutra et al. (2007) evaluated the physiological quality of cowpea seeds in four regions of the state of Ceará, were verified seeds of the cultivars Sempre Verde, Setentão, Pingo de Ouro e Aparecido presents higher physiological performance than the cultivars Epace- 10 and Patativa, which had intermediate and inferior performance, respectively.

In view of the above, this present work aims to evaluate germination and vigor of bean seeds cowpea been as a function of creole and improved cultivars and also planting seasons.

2. MATERIAL AND METHODS

2.1. Place characterization, climate and season

The experiment was conducted in a greenhouse at the Universidade Federal Rural do Semi-Árido (UFERSA), located in the municipality of Mossoró-RN, Country name whose geographical coordinates are 5º 11' south latitude and 37º 20' west longitude, with an altitude of 18 m; semi-arid climate, according to Thornthwaite , and according to Koppen classification, type BsWh, dry and very hot, having two climatic characteristic seasons well defined: a dry, from June to January and another rainy, from February to May (Alvares et al., 2013). The first sowing period comprised 03 to of 18 April 2017 and the second from 15 to 30 January 2018 (Figure 1).

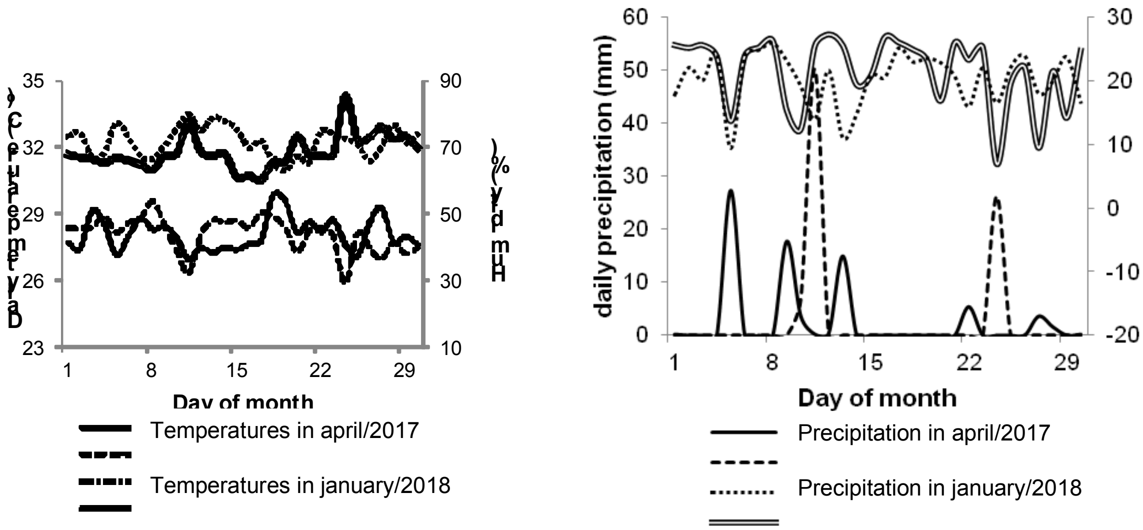

Figure 1. Climatological average of temperature, humidity, precipitation and radiation parameters in the municipality of Mossoró-RN, INMET, 2017/2018

2.2. Experimental design

The experimental design was completely randomized in a factorial scheme, with six treatments and two planting seasons, with four replications, each replicate with 25 seeds. Treatments consisted of six cowpea bean cultivars, being two cultivars of improved (BRS Tumucumaque - T1 and BRS Guariba - T2) and four creoles (Governador - T3, Passagem - T4, Chico Joaquim - T5 and Espírito Santo - T6).

2.3. Assembling and conducting the experiment

Sowing was realized in plastic trays, with dimensions of 50 x 35 x 8 cm (length, width, and depth, respectively), previously washed and disinfected with 10% sodium hypochlorite. The used substrate was washed sand and sterilized by autoclave at 121ºC for 1 hour, and then moistened with 2.5 times the weight of the dry sand, following the methodology described in the rules for seed analysis (Brazil, 2009).

The trays were kept in a greenhouse at room temperature. During the conduction of the experiment, two irrigations were performed daily in the morning and afternoon using a manual irrigator for maintenance of proper moisture for seed germination. The trays were changed position each day to avoid the local effect.

2.4. Evaluated characteristics

The evaluated characteristics were: Percentage of germination (% G), determined by daily counts of emerged plants in each treatment over the period of 15 days calculated by the formula proposed by Labouriau and Valadares (1976); Emergence rate index (IVE), determined by daily count of emerged seedlings in each treatment during the 15 days, being calculated by the formula proposed by Maguire (1962) ; Height of seedlings and root length , which were determined by using a graduated ruler , taking as reference the distance from the collar to the apex of the seedlings and starting from the collar to the end of the main root , respectively; Stem diameter was determined with the aid of a digital caliper used at the height of the collar of the seedling; leave number was obtained by counting leaves larger than three cm present in the emerged seedlings; Fresh mass of seedlings, was obtained through weighing seedlings of the useful area in analytical balance ; Dry mass of seedlings was obtained by drying the previous seedlings, which were placed in a forced air circulation oven at 70 ° C until they have constant weight .

2.5. Used statistics

The data were submitted to univariate analysis of variance by the applicative SISVAR 5.3 software. A joint analysis of the characteristics involving the two eras was also carried out. The treatment averages were compared by the Tukey test at 5% level of probability.

3. RESULTS AND DISCUSSION

There was significant interaction for all evaluated characteristics, demonstrating that both the factors studied, "cultivar" and "season", are interdependent (Table 1).

Table 1. "F" values of germination percentage (GERM), germination speed index (IVG), seedling height (AP), number of leaves per seedlings (NF), diameter collar (DC), root length (CR), fresh mass (FM) and dried (MS) aerial part of cowpea bean seeds as a function of different cultivars and seasons

FV	GERM	IVG	AP (cm)	NF	DC	CR (cm)	MF	MS
ÉPOCA	15,18**	108,75**	41,70**	64,60**	10,46**	3,46ns	0,02ns	9,51**
CULTIVAR	2,14ns	1,74ns	2,36ns	2,00ns	3,37*	2,18ns	0,94ns	2,38ns
E x C	15,77**	10,64**	14,54**	7,09**	3,55*	4,82**	4,31**	4,98**
CV (%)	16,67	17,96	17,22	17,75	12,28	24,55	20,72	18,70

Ns = not significant; * = significant at 5% probability; ** = Significant at 1% probability

Unfolding times within cultivars, it was found that, in relation to the height of the seedling, at the first time the cultivars improved Tumucumaque BRS and Guariba BRS were superior, statistically differing of creoles Governador and Chico Joachim. In the second time, these two cultivars were statistically superior to all others, reaching a mean height of 24.17 and 26.89 cm, respectively. Moreover, unfolding cultivars within times, it is verified that there is a significant difference between seasons only to the governor and Chico Joachim cultivars, where the second season was superior (Table 2).

Table 2. Mean values of seedling height (AP) leaves number per seedling (NF) and collar diameter (DC) of cowpea bean seedlings for different cultivars and seasons

Cultivars	Periods					
	AP		NF		DC	
	Period 1	Period 2	Period 1	Period 2	Period 1	Period 2
BRS Tumucumaque	17,58Aa	17,53Ab	5,00Aab	2,58Bb	2,84Aa	3,23Aa
BRS Guariba	18,29Aa	14,40Ab	5,80Aa	2,47Bb	3,03Aa	2,74Aa
Governador	11,23Bb	24,17Aa	4,94Aab	4,39Aa	2,52Aab	2,85Aa
Passagem	12,29Aab	16,42Ab	4,69Aab	2,61Bb	2,66Aa	3,02Aa
Chico Joaquim	10,52Bb	26,89Aa	4,05Ab	4,46Aa	1,85Ab	2,93Aa
Espírito Santo	14,41Aab	17,13Ab	5,11Aa	3,03Bab	2,70Aa	2,73Aa

* Averages followed by the same lowercase letter in the column, and upper case in the row do not differ by Tukey 's test at the 5% probability level

According to Santos and Lima (2015), even commercial cultivars, when subjected to unfavorable cultivation conditions, may present performance close to or even inferior to creole, which possibly explains the superiority of the improved cultivars only in one season, presumably favoring them.

For seedling leaves number, within the first season, the Guariba BRS (5.80) and Espírito Santo (5.11) overcomes the others, only statistically differencing Chico Joachim, which reached leaves the average number of 4.05. At the second season, the cultivars Governador and Chico Joaquim differed statistically from all others, obtaining 4.39 and 4.49 leaves per seedling, respectively. There was a significant difference among the seasons for all cultivars, especially for the season 1, except for Governador and Chico Joaquim. These characteristic variations occurred possibly due to the environmental peculiarities of each period. According to Neto (2000), the different luminous intensities cause physiological changes in plants, where adaptation degree is dictated by the interactions between the genetic characteristics of the different cultivars and the characteristics of the environment. In addition, studies have demonstrated the ability of plant species adaptation to different light conditions, evidencing that different levels of radiation influence the growth and development of plants, changing characteristics such as stem and petiole length, leaf area, dry matter, biomass partition, number of tillering and branches (Martuscello et al . 2009).

Regarding the stem diameter, in period 1, the cultivars Tumucumaque BRS, Guariba BRS, Passagem and Espírito Santo had better performance, distinguishing themselves, but significantly only cultivar Chico Joaquim. The best responses resulted from improved cultivars. In period 2 no significant difference between the cultivars was observed. There was also no significant difference between the periods.

Seeds of the cultivar Tumucumaque BRS and Espírito Santo in the first period presented a higher germination percentage (corresponding to 87% and 78%), differing statistically from the cultivars Governador, Passagem and Chico Joaquim (Table 3).

Table 3. Average values of germination percentage (GERM) and germination speed index (IVG) of cowpea bean seedlings as function of different cultivars and seasons

Cultivars	Periods			
	GERM		IVG	
	Period 1	Period 2	Period 1	Period 2
BRS Tumucumaque	87Aa	72Abc	1,50Aa	1,92Abc
BRS Guariba	72Aab	57Ac	1,29Aab	1,62Ac
Governador	45Bc	92Aab	1,07Bab	2,29Aab
Passagem	49Bbc	76Aabc	1,18Bab	1,32Aab
Chico Joaquim	46Bc	97Aa	0,84Bb	2,88Aa
Espírito Santo	78Aa	61Bc	1,45Aab	1,72Abc

* Averages followed by the same lowercase letter in the column, and upper case in the row do not differ by Tukey test at the 5% probability level

In the second period, with the exception of the cultivar Espírito Santo, the creole stood out because of their high percentage of germination (Governador - 92%, Passagem - 76%, Chico Joaquim - 97%), not differing statistically from each other. This value for the cultivar Governador is a quite expressive whether compared with studies by Teixeira et. al. (2010), which evaluated agronomic performance and seed quality of cowpea bean cultivars in the cerrado region, obtained a germinative percentage of the same value of the improved cultivar BRS Rouxinol. It was observed a significant difference between the periods in all creole cultivars, in which, except for the cultivar Espírito Santo, where the first period was superior, period 2 assured higher germination percentage.

The germinate differences observed in this study should be explained by the variation of the temperature effect of climate peculiarities of each studied period. According to Bewley and Black (199 4), this climatic factor exerts great influence both in percent germination as in determining seedling vigour, influencing water absorption by seed and biochemical reactions that regulate the entire metabolic process. Moreover, the phenotypic cowpea beans diversity caused by the interaction between the inherent genotype every cultivar and the environment in the different periods is one of the preponderant factors for the variation observed in the characteristics as a function of each period.

Regarding IVG, in the first period, there was a significant difference only between Tumucumaque BRS and Chico Joaquim cultivars, where the improved cultivar had a higher germination rate index, equivalent to 1.50. In the second period, the creole cultivars were the ones that stood out the most. The cultivar Chico Joaquim presented IVG corresponding to 2.88, being statistically superior to the two improved ones and the creole Espírito Santo. These results are explained water absorption capacity of the seed coat whose speed differs depending on the cultivar. This can be proved by Horling et al (199 1), according to whom, citing a similar case, soybean strains with hard integument tend to imbibe water more slowly than others, which may directly influence the speed rate of germination. Comparing the two periods, it was verified that in all cultivars the second season was superior, there was a significant difference in the cultivars Governador, Passagem and Chico Joaquim, which presented germination speed indexes of 2.29, 1.32 and 2.88, respectively. Environmental factors such as temperature mainly influence directly the speed and the final germination percentage (Carvalho & Nakagawa, 2012), decreasing with temperatures below the optimum, ranging up to higher temperatures, so the second was the period which provided optimum conditions for higher GSI.

There was no significant difference in root length for the cultivars in the first period (Table 4).

Table 4. Mean values of fresh (MF) and dry mass (DM) and root length (CR) of cowpea bean seedlings as a function of different cultivars and periods

Cultivars	Periods					
	CR		MF		MS	
	Period 1	Period 2	Period 1	Period 2	Period 1	Period 2
BRS Tumucumaque	11,44Aa	9,86Ab	21,50Aab	24,25Aa	3,00Aa	2,85Aa
BRS Guariba	12,49Aa	10,74Ab	30,25Aa	21,13Ba	3,00Aa	2,47Aa
Governador	8,33Ba	13,93Aab	19,00Ab	25,82Aa	1,75Bab	2,85Aa
Passagem	8,97Aa	9,69Ab	24,75Aab	21,72Aa	1,50Bb	2,46Aa
Chico Joaquim	9,71Ba	17,79Aa	20,50Bab	30,22Aa	1,25Bb	3,31Aa
Espírito Santo	12,73Aa	10,64Ab	29,50Aab	23,67Aa	2,50Bab	2,39Aa

* Means followed by the same lowercase letter in the column, and upper case in the row do not differ by Tukey test at the 5% level of significance

There was, however, a difference in the second period where the cultivar Chico Joaquim was superior to the others, except for the cultivar Governador, which did not differ statistically. It is also observed that there is a significant difference between the periods only in cultivars and Governador and Chico Joachim, where the second period was more favorable providing an average length of 13.93 and 17.79 cm, respectively. Coelho et. al. (2010) studying the physiological potential in seeds of bean creole cultivars (Phaseolus vulgaris L.) observed the same below values obtained in the present work for this feature, ranging from 2.13 cm (Red) and 11.35 cm (Rosinha) between the different genotypes.

About fresh mass, in the first period, there was a significant difference only when compared to the cultivars Guariba BRS and Governador, which reached mean values of 30.25 and 19.00 g. In period 2 there was no significant difference between cultivars. Comparing the two seasons, it was verified that in the Guariba BRS cultivar that period 1 provided the highest fresh mass (30.25g), while in the cultivar Chico Joaquim the second period it did (30.22g). In the other cultivars, there was no significant difference between periods.

In the dry mass, improved cultivars of the first period differed statistically from the others reaching an average weight of 3.00 g. Cultivars from the second period did not differ statistically among themselves. It was observed a significant difference between the two seasons only on creole cultivars, where the second period was more favorable, reflecting positively on plant investment in phytomass production. These results seem promising. Dutra et. al. (2012), working with the nitrogen fertilization in the function of Canapuzinho cultivar obtained a dry mass lower value that is 1.69 g in the control treatment that did not differ from the others, only the overcoming the cultivars passagem and Joachim Chico in the first time.

The results also presented that the improved cultivars remain its biomass production capacity more than creoles cultivars, thus presenting higher stability on dry biomass production over the period changes.

CONCLUSION

Cowpea beans seeds physiological quality is directly influenced by the cultivar, as well as by the sowing period. Creole cultivars presented superior quality to those improved in the second period. At the first period were the cultivars Guariba BRS and Tumucumaque BRS that stood out (explain production/productivity).

COMPETITIVE INTERESTS

The authors have stated that there are no competing interests.

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