EFFECT OF IRRIGATION ON THE GERMINATION OF BEAN SEEDS CV NAPOLI AND CV CONTENDER

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ABSTRACT: The effect was studied of the irrigation blades on the physiological quality and uniformity of the seeds of bean, cultivars Napoli and Contender, harvested in may 2016 in an area belonging to the State University of Goiás - UEG. The experiment was installed in the Laboratory of Vegetable Production of UEG-GO. The sowing was done using four replicates of 50 seeds, distributed on three sheets of paper germitest moistened with demineralized water. Them, they were taken to germinator regulated at 25°C. The germination indexes, germination speed, hard seeds, dormant and dead, seedlings with small defect index, seeds with secondary infection, and intact seedlings were evaluated. The experimental design was a completely randomized design in a 2 x 5 factorial scheme (cultivars x irrigation blades), with 4 replicates. The physiological quality of the seeds was evaluated by means of the germination and vigor test, and the results measured in percentage. The means were compared by the Tukey test at 5% probability. The seeds that presented the highest physiological quality and uniformity in germination were from the Contender cultivar, in the 100% and 125% irrigation blades. For cultivar Napoli, the rates were 80.5% to 90% in the irrigation blades of 25% and 125%. Seeds with higher indexes showed better performance in both cultivars studied for both quality and vigor.

KEYWORDS: Germination test, germination index, seed characteristics.

GERMINAÇÃO DE SEMENTES DE FEIJÃO VAGEM CV. NAPOLI E CONTENDER ORIUNDAS DE DIFERENTES LÂMINAS DE ÁGUA

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RESUMO: Estudou-se o efeito das lâminas de irrigação na qualidade fisiológica e na uniformidade das sementes das cultivares de feijão vagem Napoli e Contender colhidas em maio de 2016 na área experimental da Universidade Estadual de Goiás – UEG. O experimento foi instalado no Laboratório de Produção Vegetal da UEG-GO. A semeadura foi realizada utilizando-se quatro repetições de 50 sementes, distribuídas entre três folhas de papel germitest, umedecidas com água desmineralizada. Os rolos foram levados para o germinador regulado a 25ºC. Utilizou-se o delineamento experimental inteiramente casualizado em esquema fatorial 2 x 5 (cultivares x lâminas de irrigação), com 4 repetições. Foram avaliados os índices de germinação; velocidade de germinação; sementes duras; dormentes e mortas; índice de plântulas com pequeno defeito; com infecção secundária e plântulas intactas. A qualidade fisiológica das sementes foi avaliada por meio do teste de germinação e vigor e os resultados em porcentagem. As médias foram comparadas entre si pelo teste de Tukey a 5% de probabilidade. As sementes que apresentaram maior qualidade fisiológica e uniformidade na germinação foram para a cultivar Contender nas lâminas de 100% e 125%. Para a cultivar Napoli foram os índices foram de 80,5% a 90% nas lâminas de 25% e 125%. As sementes oriundas de lâminas de maiores índices, obtiveram melhores desempenho em ambas as cultivares estudadas, tanto para a qualidade, quanto para o vigor.

PALAVRAS-CHAVE: Teste de germinação, índice de germinação, características da semente.

INTRODUCTION

The bean, pod belongs to the same botanical species of the common bean (*Phaseolus vulgaris* L.), being considered of the Fabaceae the main fruit vegetable (FILGUEIRA, 2008).

It is a vegetable of global importance and its commercial exploitation is to take advantage of the pods produced by the plant in its immature state, being used in the feeding of various forms, can be consumed "in nature" or taken to be processed in the industries (MALUF et al. 2002).

It is a crop adapted to hot climates, allowing the rotation of the crop with tomato, in which the residues of the fertilization and the tutoring done in the tomato can be used, reducing the costs of production and the increase of the income of the farmers (ABREU, 2001).

The cultivation of the beans is no longer just for subsistence and becoming more and more technified. Among the main technological changes, genetic research stands out, which

substantially interferes with the productivity and quality of the product (SANTOS & BRAGA, 1998).

Doorenbos & Kassan, (1979) said that the efficient use of water by agricultural crops depends fundamentally on the physical conditions of the soil, atmospheric conditions, nutritional status of plants, physiological factors, genetic nature, and their stage of development. Plants alone require relatively high amounts of water for the production of dry matter; Bean culture requires about 1750 kg of water for the production of 1 kg of dry matter and grains.

1 gram of pod bean cultivars can be found in the world seed market. A Cultivar Napoli stands out among the shrub cultivars produced and marketed in Brazil. Since the choice of the cultivar and consequently of the seed directly influence the satisfactory result of the crop (PEIXOTO & CARDOSO, 2016).

Characterized by the protrusion of the primary root germination is only complete when the water content of the seed exceeds a critical value that enables the activation of metabolic processes that promote growth of the embryonic axis (TAMBELINI & PEREZ, 1998).

The objective of this study was to verify the physiological quality and uniformity of seed germination and seedling development of the Napoli and Contender pod bean cultivars from different irrigation strips.

MATERIAL AND METHODS

The experiment was carried out in the laboratory of the State University of Goiás, Campus Ipameri (geographical coordinates, latitude 17º 71' 82"S and longitude 48º 14' 35"W).

The bean seeds of Contender and Napoli (Figures 1: A and B) were harvested from the production of different irrigation slides corresponding to 25, 50, 75, 100, and 125%, in the 2016 crop season.

The experimental design was a randomized block design, with treatments distributed in a sub-divided plots scheme 5 x 2, with 4 replications.

The physiological quality of the seeds was evaluated by means of the test and speed index germination of bean seeds.

Seed germination was carried out using four replicates of 100 seeds, put between three sheets of paper towel, moistened with demineralized water, weighing three times the weight of the dry paper. Rolls were elaborated, being taken to germinator regulated at 25ºC (BRASIL, 1992). Counts were made at five and nine days. The percentage of germination was obtained by observing the difference between the last and first count of the germination test.

The germination rate (GR) was evaluated together with the germination test. The GR calculation was performed according to the methodology proposed by Maguire (1962). Thus, the first count and GR were indicative of seed vigor, while the final count, viability.

When emergency stabilization occurred, the calculation of the emergency percentage was elaborated according to (MAGUIRE, 1962; LABOURIAU & VALADARES, 1976). For the evaluation of GR and E%, 4 experimental plots with 25 seeds each were used, totaling 100 seeds per treatment.

$$GR = E1/N1 + E2/N2 + ... + En/Nn \qquad (1)$$

On what,

GR = Emergency speed index;

E1, E2, En = Number of emerged seeds computed in the first count, second count and last count;

N1, N2, Nn = Number of days of sowing at the first, second and last count.

When emergency stabilization occurred, the percentage of emergency (E%) was calculated according to Labouriau & Valadares (1976).

$$E\% = (N/A).100 \qquad (2)$$

On what,

E = Percentage of emergency;

N = Number of emerged seeds;

A = Total number of seeds placed to germinate.

In the seedling length, four subsamples of 25 seeds per treatment were used. The paper towel rolls were taken to the germinator at 25 °C for five days and afterwards the normal seedlings were determined with the aid of a ruler graduated in millimeters. The percentage of hard seeds (HS) was also checked; dormant seeds (DorS); dead seeds (DS); seedling with small defects (SSD); seedling with secondary infection (SSI); intact seedling.

The experimental design used to evaluate seed and seedling quality was in a factorial scheme with 2 cultivars and 5 irrigation slides, with twenty-five replications, respectively. The means were compared by the Tukey test at 5% probability. The results in percentage, for germination and vigor, were transformed into % / 100 sine-arc for statistical analysis and the means presented with the original values. In the legumes, measure the end of the root until the insertion of the cotyledons, or part of the seedling (primary root, hypocotyl, epicotyl). Choosing

the right framework for evaluation is important to have consistent and comparable results (NAKAGAWA, 1994).

RESULTS AND DISCUSSION

Table 1 shows the mean values of % of initial and final germination and difference between 100% and 100% final germination rates in 100% and 125% seedlings. For germination on 25% irrigation slides, this index was 81%.

Regarding the Napoli cultivar, these rates ranged from 80.5% to 90% of final seed germination, whose yields were perceived in the irrigation slides of 25% and 125%. The increment of slides provided an expressive gain in the final germination indexes with a 19% amplitude between the seeds originated from the production of slides of lower value (25%) to the highest value (125%).

There was a significant difference between Contender and Napoli cultivars due to differences in irrigation depths, and the variables analyzed, excluding germination differences for cv. Contender. In a study about the physiological potential in seeds of cultivars of Creole bean (*Phaseolus vulgaris* L.).

In the interaction between cultivars (Table 1) between different irrigation slides it is possible to verify in the unfolding, that there was difference between the variables, only in the final germination.

The germination percentage averages for bean seeds according to the cultivars were adjusted to the quadratic regression model for irrigation slides (Figures 2). These seed data under the production of irrigation slides, are shown as those responsible for the maximum values estimated for the percentage of germination, 90.5% and 100%, for the cultivars Contender and Napoli, respectively.

The first count and the initial, final, and total GR were affected by the indexes of strips within the cultivars. Seeds showed greater vigor in the initial GR for both cultivars through interaction with irrigation strips (Table 2, Figure 2). In the analysis of the unfolding, it was observed that, when seeds of 100%, 125%, 25%, and 125%, Contender and Napoli, the seeds presented higher vigor, evaluated by the first germination count (Table 1). In the interaction between cultivars in the variables the initial GR, did not present difference between the strips, however, when the total GR were observed, the seeds presented greater vigor when the strips were applied 25%, 100% e 125%.

These results are probably related to the fact that the action of different water offerings during the vegetative stage of the bean pod, together with the genetic factors, allowed the accumulation of reserves, being later translocated to the seeds for the formation of the embryo and the reserve organs (CARVALHO & NAKAGAWA, 2000), contributing to the higher germination index of seeds originated from the production on slides of higher percentage of water.

The mean values in percentage of hard seeds, dormant, dead, seedling with small defect, with secondary infection (Table 2) of different slides, did not present interaction for the variables percentage of hard seeds, seedlings with small defects, and with secondary infection (Table 2) of intact seedlings of bean seeds, Contender and Napoli.

Regarding the unfolding of percentage of intact seedlings, the Contender cultivar was the most responsive (Table 2; Figure 3-A, B) for the seed of the highest indexes. The values of the averages ranged from 70.50 to 96.0% in slides of 25% and 125% for cv. Contender and Napoli from 48.50 to 80.50% intact seedlings on the slides of 75% e 125%.

Seeds generally exhibit a variable germination performance at different temperatures and substrates, which are the basic components of the germination test.

Regarding the production of percentage of hard and dormant seeds, a significant difference was also observed between the cultivars and the irrigation slides. It was verified that the indexes were higher for the Napoli cultivar in the slides of 50% and 75%, for both variables. The ideal conditions for the germination of the seeds of a certain species is of fundamental importance, mainly, by the differentiated responses that the seed can express due to several factors, such as viability, dormancy (FINCH et al., 2006), environment conditions (CHEN et al., 2006), water, light (PROBERT et al., 1986), temperature (SIMPSON et al., 2002), oxygen and absence of pathogens (KOGER et al., 2004). There are even viable seeds that do not germinate, although water, O_2, and temperature conditions are apparently adequate. These seeds are termed dormant and require special treatments to germinate (BEWLEY et al., 1982) cited by Medeiros et al. (2013). Knowing these processes and overcoming methodologies are relevant so that you can produce more and with quality.

CONCLUSION

The seeds that presented the highest physiological quality and uniformity in the germination were for the cultivar Contender in the strips of 100% and 125%

For the cultivar Napoli, the rates were 80.5% to 90% in the strips of 25% and 125%;

The highest indices of intact seedlings were verified for the seeds of the cultivar Contender, in the 100% and 125% strips.

Seeds from larger strips showed better performance in both cultivars studied for both quality and vigor.

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Table 1. Initial (%) and final (%) mean values, and germination difference (GF-GI) of bean seeds, Contender and Napoli, from different irrigation strips (25, 75, 100 e 125 %). Ipameri-GO, 2016.

Cultivar	Irrigation strip (%)	% Initial Germination	% End Germination	% Germination difference (GF-GI)
Contender	25	77.0	81.0	4.0
Contender	50	76.5	81.0	4.5
Contender	75	72.5	80.0	7.5
Contender	100	93.0	100.0	7.0
Contender	125	97.0	100.0	3.0
F		25,0047 **	35,7075 **	4,3494 *
Napoli	25	76.5	80.5	4.0
Napoli	50	61.0	63.0	2.0
Napoli	75	61.5	63.5	2.0
Napoli	100	71.0	75.5	4.5
Napoli	125	86.5	90.5	4.0
F		14,4923 **	15,5250 **	0,9940 ns
Interaction Cv x Irrigation strips		2,1869 ns	3,1387 *	1,5482 ns
CV %		9.74	8.96	67.79

Test F - **, * and ns: significant at 1%, 5%, and not significant, respectively, by the Tukey test.

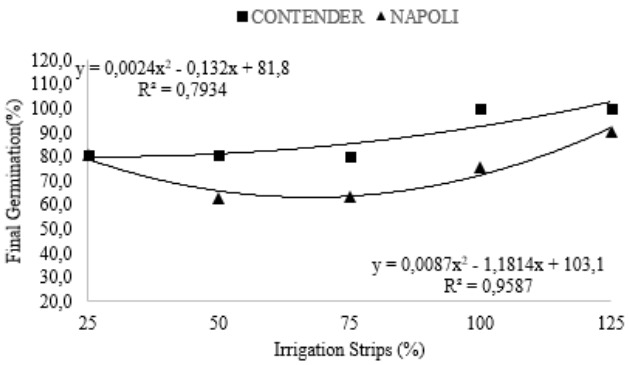

Figure 1. Polynomial function for mean values of final germination (%) of bean seeds, Contender and Napoli cultivars, produced from different irrigation strips (25, 75, 100 e 125 %). Ipameri-GO, 2016.

Table 2. Mean values of initial, final and total germination rate (GR) of bean seeds, cultivar Contender e Napoli, from different irrigation strips (25, 75, 100 e 125 %). Ipameri-GO, 2016.

Cultivar	Irrigation Strips (%)	Initial GR	End GR	Total GR
Contender	25	7.7	4.44	11.84
Contender	50	7.7	4.50	12.15
Contender	75	7.3	4.44	11.69
Contender	100	9.8	5.56	14.86
Contender	125	9.7	5.56	15.26
F		25,0047 **	35,7075 **	29,5467 **
Napoli	25	8.6	5.01	12.12
Napoli	50	6.1	3.50	9.60
Napoli	75	6.2	3.53	9.68
Napoli	100	7.1	4.19	11.29
Napoli	125	8.7	5.03	13.68
F		14,4923 **	15,5250 **	15,3400 **
Interaction Cv x Irrigation strips		2,1869 ns	3,1387 *	2,5482 ns
CV %		9.74	8.96	8.96

Test F - **, * and ns: significant at 1%, 5%, and not significant, respectively, by the Tukey test.

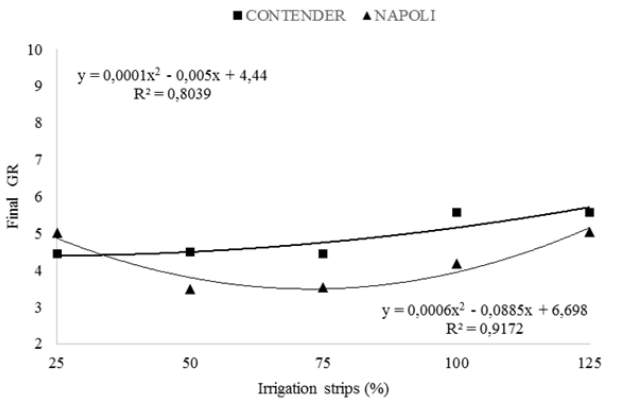

Figure 2. Polynomial Function for mean values of germination rate (GR) of bean seeds at 09 days after putting on germitest paper for the Contender and Napoli cultivars, originating from different irrigation strips (25, 75, 100 e 125 %). Ipameri-GO, 2016.

Table 3. Mean values as a percentage of hard seeds (DS), dormant seeds (Dors), dead seeds (DS), seedlings with small defects (SSD), seedlings with secondary infection. (SSI), and intact seedling of bean, Contender and Napoli, from different irrigation strips (25, 75, 100 e 125 %). Ipameri-GO, 2016.

C.v.	Strips	% HS	% DorS	% DS	% SSD	% SSI	% Intact seedling
Cont.	25	5.77	3.94	3.12	6.00	2.00	70.50
Cont.	50	3.63	3.63	8.41	4.50	3.00	73.50
Cont.	75	4.53	4.03	5.07	5.50	2.50	74.00
Cont.	100	1.00	1.00	1.00	6.00	2.50	91.50
Cont.	125	1.00	1.00	1.00	4.50	2.00	96.00
F (%)		22.4360 **	26.3631 **	1.7827 ns	2.1107 ns	2.1107 ns	151.6995 **
Nap.	25	7.00	7.50	4.07	7.00	3.50	65.50
Nap.	50	13.00	18.50	4.19	3.00	3.00	51.50
Nap.	75	10.50	9.50	6.20	4.50	5.00	48.50
Nap	100	6.00	3.50	6.33	3.50	8.00	52.00
Nap	125	3.00	3.50	3.00	4.00	3.00	80.50
	F	5.85 **	8.46 **	3.95 **	0.73 ns	0.83 ns	31.0012 **
	Inter. Cv x Irrig. strips	2,16 ns	4,3034 **	3,8899 **	0,512 ns	0,7110 ns	10,6411 **
CV %		80.32	89.79	82.06	53.78	57.12	11.1

Test F - **, * and ns: significant at 1%, 5%, and not significant, respectively, by the Tukey test.

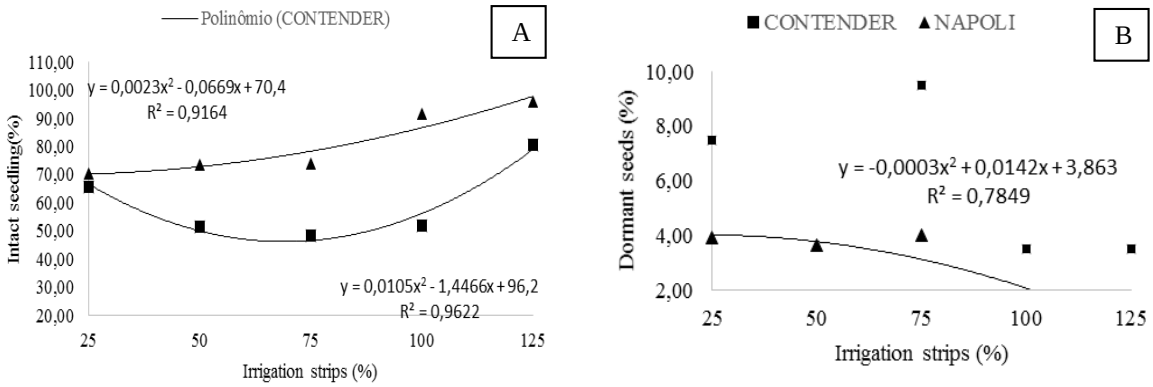

Figure 3. A) Polynomial function for mean values of dormant bean seeds at 09 days after and **B)** Polynomial function for mean values of intact seedling after putting on germitest paper for Contender and Napoli cultivars, produced from different irrigation strips (25, 75, 100 e 125 %). Ipameri-GO, 2016.