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Full Length Research Paper

Performance of soybean plants originated from seeds of high and low vigor submitted to water deficit

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This study had the objective of evaluating the effect of water deficit on the growth of soybean plants from seeds with high and low vigor. It was conducted at the Faculdade de Agronomia "Eliseu Maciel" (FAEM-UFPel) using the cultivar M-SOY 8008 RR. The experimental design was a completely randomized in factorial AXB (Factor A: Variables 2, 3, 4 and 5 water deficits; Factor B: two levels of seed vigor, high and low) and a total of ten treatments with four replications. Evaluations of fresh mater, plant height, leaf area and dry weight, at the 10, 20, 30 and 40 DAE. Soybean plants from high vigor seeds have higher fresh weight, plant height, leaf area and dry weight until 40 DAE, and provide higher rates of growth up to 40 DAE. High vigor seeds have better performance than plants of low vigor, when submitted to water deficit until 40 DAE. Water deficit reduces the performance of both plants grown from seeds of high and low vigor.

Key words: *Glycine max* (L.) Merrill, initial growth, physiological quality, growth rate.

INTRODUCTION

The frequent water deficit in southern Brazil causes major crop damage, as rainfall is the main source of water for crops. The higher frequency of water deficit occurs in summer, affecting crops of great importance concerning the acreage and production, such as soybeans and corn. The water deficit is characterized by sweating that exceeds the water absorption rate and thus, acts directly on water relations of plants (Costa et al., 2008) in which damage to the plant depend on the intensity and exposure time. With a period of 20 to 30 years, data from 40 meteorological stations in Southern Brazil were observed and it was detected that water availability is a variable that limits the expression of yield potential of soybeans, regardless of the growing cycle, sowing date and location (Cunha et al., 1998). The reduction in available soil water for the plant, affects negatively the growth and development (Sinclair and Ludlow, 1986).

Levit (1980) stresses the importance of analyzing the responses of plants and their defense mechanisms to soil water deficit.

The success of a crop is influenced, directly, by a high-quality seed to be sown and contributes, significantly, to high yields, while low-quality seeds, undertake to obtain an adequate plant stand, directly influencing the productivity of a crop (Krzyzanowski and France Neto, 2003). Early in the development, more vigorous seeds are more resistant to conditions of less water availability, favoring the establishment of field plant population (Tekrony and Egli, 1991).

Despite the complexity involved in growing of plant species, growth analysis is an efficient way to monitor progress and measure the contribution of different physiological processes on the plant behavior (Benincasa, 2003). It can also use the analysis of growth in the observations of physiological parameters indicative of safe methods to increase productivity (Castro, 1974). Campos et al. (2008), consider the analysis of growth as an important measure to explain the growth of plants, because about 90% of dry matter accumulation by plants throughout their development results of photosynthetic activity, allowing to evaluate the growth of the plant as a

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final whole and the contribution of different organs in overall development.

This study was done to evaluate the effect of water deficit on the growth of soybean plants grown from seeds with high and low vigor.

MATERIALS AND METHODS

This study was conducted in the crop year 2009/2010, at the Laboratório Didático de Análise de Sementes and in the greenhouse of the Faculdade de Agronomia "Eliseu Maciel", Universidade Federal de Pelotas, city of Capão do Leão - RS.

It were filled with soil, pots with capacity of 15 L and the soil was collected from the A1 horizon of a Typic Hapludalf Eutrophic solodic (Embrapa, 2006) belonging to the mapping unit Pelotas. The fertilization was performed according to CFQS RS (Rio Grande do Sul, state)/SC (Santa Catarina, state) (Committee of Fertility and Soil Chemistry - RS / SC, 2004), incorporating the nutrients to the soil, five days before sowing and liming was performed sixty days before sowing.

The cultivar used was M-SOY 8008 RR. Prior to sowing, seeds were treated with inoculant Gelfix 5®, 200 ml/100 kg of seed and fungicide (chemical group Fenilpirrol Acilalaninato + and + fludioxinil active ingredient Metalaxyl-M (25 ± 10 gL^{-1})), Maxim-XL at a dosage of 100 ml/100 kg seed.

For the selection of seeds that are to be used, it was evaluated that germination (G) was performed with four replicates of 50 seeds for each vigor level, placed on a substrate of germination paper ("germitest"), previously soaked in water, using 2.5 times the mass of dry paper, and kept at 25°C. The evaluations were done according to the RAS -Rules for Testing Seeds (Brazil, 2009) and the evaluation carried out on the eighth day after sowing and results were expressed as percentage of normal seedlings. The first count of germination (FCG) was conducted together with the germination test and evaluated on the fifth day after sowing. The field emergence test (FE) was carried out in plots containing soil, and the manual seeding depth from 0.02 to 0.03 m, using 400 seeds for each level of vigor (four replicates of 100 seeds). The emergence percentage was obtained by counting emerged seedlings in the twenty-first day after sowing.

The physiological quality of seeds was obtained from seed lots produced in the growing season of 2008/2009. The high vigor seed showed 88% germination (G), 82% in the first count of germination (FCG) and 87% field emergence (FE), while the low vigor lot showed 75% G, 61% FCG and 74% FE. It was sown 10 seeds per pot to allow further thinning, removing seedlings earlier in the lot of low vigor and later in the high vigor, with the intention of using the seedlings emerged in the days of major emergency frequency for each level of vigor, leaving at the end, four plants per pot.

The different water restrictions used, which correspond to the treatments, were applied when 51% of the plants were in the stage VE, according to the scale of Fehr and Caviness (1977). Considering the viable seeds used, it was reached, approximately, five to seven days after sowing, for both, high and low vigor seeds.

The treatments consisted of five periods of water deficit and two levels of seed vigor. The periods of water deficits were: control, with irrigation, water deficit from 1 to 10 days after emergence (DAE), water deficit from 11 to 20 DAE, water deficit from 21 to 30 DAE and water deficit from 31 to 40 DAE. Vigor levels studied were high and low, with a total of ten treatments with four replications. Therefore, before and after periods of water deficit, the experimental units were irrigated daily.

Assessments of the effect of physiological quality combined with the water deficit, the initial growth was performed on isolated plants. The following determinations were done: fresh matter (FM), plant height (PH), leaf area (LA) and dry matter (DM). For these determinations, one plant was collected, cut at ground level at 10, 20, 30 and 40 days after emergence (DAE), remaining three plants, two plants and one plant per pot, respectively. For measuring the fresh matter, it used an analytical balance with precision composition. The leaf area of the aerial part of plants was determined using photoelectric determiner (Area Meter, model LI-3100 Li-color Ltda.) giving direct reading in cm². To determine the plant height, the measurement was carried out with the aid of rule and the results were expressed in centimeters. The dry matter of shoots was evaluated by a stove at 60ºC, in which the seedlings were kept for 72 h in the oven and after, weighed on an analytical balance with precision composition.

By the results of leaf area and dry weight, the following were determined: growth rate of culture - GRC (mg pl^{-1} day^{-1}), relative growth rate - RGR (mg g^{-1} day^{-1}) and net assimilation rate - NAR (mg cm^{-2} day^{-1}). These determinations were based on the methodology described in Gardner et al. (1985), in which: GRC = $(DM_2 - DM_1) / (T_2 - T_1)$, RGR = $(\ln DM_2 - \ln DM_1) / (T_2 - T_1)$, NAR = $(DM_2 - DM_1) / (T_2 - T_1) * (LA_2 \ln - \ln LA_1) / (LA_2 - LA_1)$, where: DM: dry mass, T: time, LA: leaf area.

The statistical analysis used the Statistical Analysis System for Windows - WinStat - Version 2.0 (Machado and Conceição, 2003). The experimental design was randomized, and the data subjected to analysis of variance and in the presence of significant interaction, proceeded to the developments needed. Means were compared using the Duncan test at 5% probability, in factorial AXB (variables 2, 3, 4 and 5 periods of water deficit and two levels of vigor), with four replications.

RESULTS AND DISCUSSION

The results presented in Table 1 shows that plants from high vigor seeds presented higher values of MF, PH, LA, DM, than plants from low vigor, in both water regimes. Positive effects of physiological seed quality on the height were also found in other studies; however, they were evaluated in different periods of plant development. In soybean, Vanzolini and Carvalho (2002) observed that seed lots with low physiological quality resulted in plants with lower heights at 18 and 38 days after sowing, compared to lots of medium and high quality. According to the authors, these probably reflect the rate of emergence of seedlings originating from seeds of low physiological quality, significantly lower compared to other lots. Kolchinski et al. (2006), said that soybean plants originated from seeds of higher physiological quality, showed the highest growth rates, as a result of plants with greater dry weight and leaf area at 30 days after emergence and similar results were observed by Machado and Schuch (2004) in oat, in rice (Hofs et al., 2004), and in oats (Schuch et al., 2000). It can also be seen that plants from seeds with high and low vigor when submitted to water deficit, have underperformed plants without water deficit (control) in the variables FM, PH and

Table 1. Fresh mass (MF), plant height (PH), leaf area (LA) and dry mass (DM) of soybean plants originated from seeds with high and low vigor, submitted to drought, 10 DAE. Capão do Leão – RS (2010).

Variable	Deficit/Stage***	Vigor		Means
		High	Low	
$MF(g.pl^{-1})$	Control/VE-V2	3.57	2.63	3.10 a
	1 - 10DAE*/VE-V1	1.45	1.03	1.24 b
	Means	2.51 A**	1.83 B	
	CV (%)	11.62		
PH(cm)	Control/VE-V2	14.0	10.6	12.32 a
	1 - 10DAE*/VE-V1	10.6	7.5	9.06 b
	Means	12.3 A	9.0 B	
	CV (%)	8.03		
$LA(cm^2\ pl^{-1})$	Control/VE-V2	93.65 A a	63.34 B a	78.49
	1 - 10DAE*/VE-V1	49.41 A b	36.74 B b	43.07
	Means	71.53	50.04	
	CV (%)	11.05		
$DM(g.pl^{-1})$	Control/VE-V2	0.22	0.17	0.201 a
	1 to 10DAE*/VE-V1	0.07	0.05	0.069 b
	Means	0.151 A	0.119 B	
	CV (%)	8.22		

*DAE: days after emergence, ** means followed by the same letter in the column and capital on the line do not differ by Duncan test at 5% of probability; *** phenological Stage, according to the scale of Fehr and Caviness (1977).

DM, but no significant effect was observed for LA. The occurrence of severe water deficit in the vegetative stage may compromise the yield due to less development of plants (Mundstock and Thomas, 2005).

The data presented in Table 2 shows that plants grown from seeds with high physiological quality have higher FM, PH, LA and DM in those three periods. Seeds are more vigorous for processing capacity of reserves in storage tissues and there is a greater incorporation on the embryonic axis (Dan et al., 1987). This can result in more rapid and uniform emergence and seedlings with larger initial size (Vanzolini and Carvalho, 2002) thereby, influencing the leaf area and dry matter accumulation. Similar results were found in oats by Schuch et al. (1999) when seedlings from seeds with high vigor, had higher initial size, which, consequently, led to higher rates of crop growth, dry matter production and leaf area, during the initial period of growth. Also in Table 2, it can be realized that plants do not suffer from water deficit (Control), have better performance than that of plants with water deficit from 1 to 10 and 11 to 20 days after emergence in both physiological quality seeds, in the four variables. This result is similar to those reported by Hoogenboom et al. (1987) and Thomas and Costa (1994), that water deficit decreases the height of soybean plants. Observe that plants suffering water deficit in the period from 1 to 10 DAE, despite being watered after that period, they cannot restore normal growth in those variables, when compared to treatments without water deficit. The reduction in relative water content of leaves is caused by deficiency of water in the soil, as occurs during photosynthesis. Loss of water throughout the stomatal mechanism and the rate of assimilation of water is adversely affected during water stress (Versluis et al. 2006).

Regarding the assessment at 30 DAE, in Table 3, it can be considered that plants originated from seeds with high vigor continued with higher FM, PH, LA and DM, in the four water deficit periods studied. Seed with low vigor can be led to reductions in field emergence, speed of emergence and initial plant size (Schuch, 2006). Assessing the behavior of individual plants in communities of soybean, Kolchinski et al. (2005) found that the effect of seed physiological quality on seedling development, determined higher seed yields. According to the authors, the use of seeds with high physiological quality provided greater leaf area and dry matter production and, consequently, initial competitive advantage in the use of environmental resources, which resulted in the later stages of development until the maturation phase, resulting in higher seed yield.

Water deficits modify plant metabolism in different ways.

Table 2. Fresh mass (MF), plant height (PH), leaf area (LA) and dry mass (DM) of soybean plants originated from seeds with high and low vigor, submitted to drought, 20 DAE. Capão do Leão – RS (2010).

Variable	Deficit/Stage ***	Vigor		Means
		High	Low	
	Control/VE-V5	14.33 A a**	9.36 B a	11.84
	1 a 10DAE*/VE-V1	8.15 A b	5.65 B b	6.90
MF ($g.pl^{-1}$)	11 a 20DAE/V1 e V3 e V4	5.54 A c	3.75 B c	4.64
	Means	9.34	6.25	
	CV (%)	8.33		
	Control/VE-V5	35.8	25.5	30.63 a
	1 a 10DAE*/VE-V1	28.7	20.8	24.73 b
PH (cm)	11 a 20DAE/V1 e V3 e V4	24.9	17.9	21.38 c
	Means	29.7 A	21.4 B	
	CV (%)	6.74		
	Control/VE-V5	498.00 A a	323.77 B a	410.88
	1 a 10DAE*/VE-V1	268.63 A b	178.94 B b	223.78
LA (cm^2 pl^{-1})	11 a 20DAE/V1 e V3 e V4	234.57 A b	155.77 B b	195.17
	Means	333.73	219.49	
	CV (%)	11.47		
	Control/VE-V5	2.76 A a	1.53 B a	2.15
	1 a 10DAE*/VE-V1	1.31 A b	0.82 B b	1.07
DM ($g.pl^{-1}$)	11 a 20DAE/V1 e V3 e V4	1.40 A b	0.85 B b	1.13
	Means	1.829	1.07	
	CV (%)	11.96		

*DAE: days after emergence, ** means followed by the same letter in the column and capital on the line, do not differ by Duncan test at 5% of probability; *** phenological stage, according to the scale of Fehr and Caviness (1977).

It is observed in water deficit condition that there is increased synthesis of abscisic acid (ABA) in roots, which is subsequently transported to the shoot via the xylem, after rainfall or irrigation (Hartung et al., 2002). For Thomas and Costa (1994), the photosynthetically active leaf area of plants is the most sensitive to water deficit and one of the factors that affect crop yields. It is inferred that, because of stomatal closure caused by water deficit, the treatments without water deficit, along with treatment with water deficit from 1 to 10 DAE, in both levels of vigor, got the best performance for the variables analyzed (Table 3). The superior performance of the control treatment suggests an occurrence in this treatment that remained with irrigation, during the whole period of conducting the experiment, causing the plants an expression of the full potential of growth, showing the negative effects of water deficits on those parameters evaluated. The level of proline, according to Kishor et al. (1995), increased significantly only after 4 days the plants suffered from water deficit and this accumulation is a characteristic response of plants under abiotic stress, which acts as osmotic regulator, in order to reduce the negative effects in plants under adverse conditions, in addition, it promotes increased resistance of cells in these conditions (Xiong and Zhu, 2002). Similar results on the proline accumulation in plants under water deficit was observed by Sarker et al. (1999) working with cultivars of *Triticum aestivum* and Costa (1999) studying *Vigna unguiculata*.

The assessment at 40 DAE in Table 4, showed that plants from high vigor seeds were superior to the plants originated from seeds of low vigor and the control treatment in four periods with water deficit studied in the four variables. This behavior suggests a direct effect of seed vigor on the ability of the tissues of soybean plants to convert solar radiation into dry matter during this period of growth. However, for Tekrony and Egli (1991), the direct effects of seed vigor on the further development of the plants are unlikely to occur.

According to those authors, the structures present in the seeds are important for growth, only during a short period, immediately after emergence. It states that most of the plant tissues involved in the production of dry matter and yield are formed after the emergency.

Table 3. Fresh mass (MF), plant height (PH), leaf area (LA) and dry mass (DM) of soybean plants originated from seeds with high and low vigor, submitted to drought, 30 DAE. Capão do Leão – RS (2010).

Variable	Deficit/Stage ***	Vigor		Means
		High	Low	
MF ($g.pl^{-1}$)	Control/VE-V7 e V8	24.61	17.92	21.27 a
	1 a 10DAE*/VE e V1	21.14	15.68	18.41 b
	11 a 20DAE/V1 e V3 e V4	13.45	9.81	11.63 d
	21 a 30DAE/V3 e V4-V6 e V7	16.78	11.79	14.28 c
	Means	18.99 A**	13.80 B	
	CV (%)	13.41		
PH (cm)	Control/VE-V7 e V8	45.2	35.1	40.10 a
	1 a 10DAE*/VE e V1	47.7	38.4	43.05 a
	11 a 20DAE/V1 e V3 e V4	34.4	26.9	30.65 c
	21 a 30DAE/V3 e V4-V6 e V7	41.5	30.9	36.18 b
	Means	42.1 A	32.8 B	
	CV (%)	8.75		
LA (cm^2 pl^{-1})	Control/VE-V7 e V8	917.57 A a	606.06 B a	761.81
	1 a 10DAE*/VE e V1	925.96 A a	657.29 B a	791.62
	11 a 20DAE/V1 e V3 e V4	486.37 A c	346.75 B b	416.56
	21 a 30DAE/V3 e V4-V6 e V7	594.73 A b	392.05 B b	493.39
	Means	731.15	500.53	
	CV (%)			
DM ($g.pl^{-1}$)	Control/VE-V7 e V8	5.60	3.95	4.78 a
	1 a 10DAE*/VE e V1	5.17	3.70	4.44 a
	11 a 20DAE/V1 e V3 e V4	2.69	1.92	2.30 c
	21 a 30DAE/V3 e V4-V6 e V7	4.28	2.98	3.63 b
	Means	4.44 A	3.14 B	
	CV (%)	12.42		

*DAE: days after emergence, ** means followed by the same letter in the column and capital on the line, do not differ by Duncan's test at 5% of probability; *** phenological Stage, according to the scale of Fehr and Caviness (1977).

Severe water deficit in the vegetative phase, according to Bonato (2000), can reduce plant growth and reduce leaf area and yield. Also, it was emphasized that the water deficit plants of smaller stature, stunted with small leaves and short nodes, were determined. Results obtained by Petry (2000) confirm that water deficit reduces applied at vegetative growth of soybean due to the decrease in the number of nodes and the length between NODES. It also can be seen in Table 4 that the treatments performed significantly better than the other treatments were the water deficit periods 1 to 10, 11 to 20, and 31 to 40 DAE, the variables FM, PH and DM, respectively. In variable LA, it is observed that treatments with water deficit from 1 to 10 and 11 to 20 DAE, together with the control treatment differed significantly from other treatments. As a result, it appears that the growth of roots, is a strategy used by plants to capture the substrate water in water deficit conditions (Lobato et al., 2008), in which growth and development of plants are dependent on cell turgor, as the water fills the cell and promotes a positive pressure through this mechanism of tissue extension (Kerbauy, 2004).

It is considered that the analysis of growth is still the most accessible and accurate, for evaluating growth and to infer the contribution of different physiological processes on the plant behavior (Trindade and Oliveira, 1999). By observation of Table 5, it appears that GRC plants originated from seeds of high vigor had improved performance over existing plants from low in the four periods. However in the period from 11 to 20 DAE, there was no statistical difference between high and low seed vigor in the control treatment and treatment with a water deficit of 11 to 20 DAE. Oat seeds of high vigor, (Schuch, 1999) produced plants with greater dry matter production, leaf area and growth rates in the early period of culture. The control treatment differed significantly from other

Table 4. Fresh mass (MF), plant height (PH), leaf area (LA) and dry mass (DM) of soybean plants originated from seeds with high and low vigor, submitted to drought, 40 DAE. Capão do Leão – RS (2010).

Variable	Deficit/Stage***	Vigor		Means
		High	Low	
MF ($g.pl^{-1}$)	Control/VE-V9	39.57	30.03	34.80 b
	1 a 10DAE*/VE-V1	37.15	28.91	33.03 b
	11 a 20DAE/V1 e V3 e V4	47.00	38.00	42.05 a
	21 a 30DAE/V3 e V4 –V6 e V7	31.16	23.67	27.41 c
	31 a 40DAE/V6 e V7 e V8	22.83	17.02	19.92 d
	Means	35.54 A**	27.53 B	
	CV (%)	9.03		
PH (cm)	Control/VE-V9	48.5	40.2	44.32 b
	1 a 10DAE*/VE-V1	54.0	45.1	49.55 a
	11 a 20DAE/V1 e V3 e V4	49.2	42.1	45.61 b
	21 a 30DAE/V3 e V4 –V6 e V7	46.5	38.0	42.26 b
	31 a 40DAE/V6 e V7 e V8	47.5	37.8	42.63 b
	Means	49.12 A	40.63 B	
	CV (%)	7.51		
LA (cm^2 pl^{-1})	Control/VE-V9	957.81	719.3	838.56 a
	1 a 10DAE*/VE-V1	926.95	696.32	811.63 a
	11 a 20DAE/V1 e V3 e V4	914.34	715.87	815.11 a
	21 a 30DAE/V3 e V4 –V6 e V7	796.61	596.8	696.70 b
	31 a 40DAE/V6 e V7 e V8	794.72	565.55	680.13 b
	Means	878.08 A	658.77 B	
	CV (%)	5.57		
DM ($g.pl^{-1}$)	Control/VE-V9	7.79	6.11	6.94 b
	1 a 10DAE*/VE-V1	6.65	5.19	5.91 c
	11 a 20DAE/V1 e V3 e V4	6.88	5.50	6.18 c
	21 a 30DAE/V3 e V4 –V6 e V7	6.39	4.97	5.67 c
	31 a 40DAE/V6 e V7 e V8	8.69	6.42	7.55 a
	Means	7.27 A	5.63 B	
	CV (%)	7.81		

*DAE: days after emergence, ** means followed by the same letter in the column and capital on the line, do not differ by Duncan's test at 5% of probability; *** phenological Stage, according to the scale of Fehr and Caviness (1977).

treatments during periods of GRC 1 to 10 and 11 to 20 DAE. CRG in the period from 21 to 30 DAE result in higher water deficit treatment with 10 to 10 DAE, as the period from 31 to 40 DAE GRC superior performances in dealing with water deficit from 11 to 20 DAE.

It is found RGR that plants from seeds of high vigor have improved performance over existing plants from low in the period from 11 to 20 DAE, but the periods 21 to 30 and 31 to 40 DAE observed that plants grown from seeds of low vigor differed significantly from plants grown from seeds of low vigor. It can also be observed that the water deficit treatment with 1 to 10 DAE was higher than control and also to the other treatments during periods of RGR 11 to 20 and 21 to 30 DAE. However, RGR in the period from 31 to 40 DAE had superior performance in dealing with water deficit from 21 to 30 DAE.

The NAR was not different in plants that originated from seeds with high and low vigor, during the periods from 11 to 20 and 21 to 30 DAE, but the period from 31 to 40 DAE plants originated from seeds of low vigor obtained better results than plants that originated from seeds of high vigor. The NAR, in the period from 11 to 20 DAE showed no significant difference between control and water deficits treatments, from 1 to 10 DAE, as the period from 21 to 30 DAE RAN was superior in performance, when dealing with water deficit from 10 to 10 DAE.

Considering the NAR, in the period from 31 to 40 DAE, it was observed that the water deficit period from 11 to 20

Table 5. Growth rate of culture (CRG), relative growth rate (RGR) and net assimilation rate (RAN) of soybean plants from seeds of high and low vigor, submitted to drought. Capão do Leão – RS (2010).

Variable	Deficit	Vigor		Means
		High	Low	
CRG (1 - 10 DAE)	Control	22.32	17.90	22.11 a
	1 - 10DAE*	7.94	5.89	6.91 b
	Means	15.13 A**	11.90 B	
	CV (%)	8.23		
CRG (11 - 20 DAE)	Control	254.6 A a	135.6 B a	195.1
	1 a 10DAE	123.4 A b	77.0 B b	100.2
	Means	189.0	106.3	
	CV (%)	12.41		
CRG (21 - 30 DAE)	Control	283.47	242.12	262.8 b
	1 a 10DAE	386.50	287.50	337.0 a
	11 a 20DAE	128.92	106.52	117.7 c
	Means	266.4 A	212.0 B	
	CV (%)	23.28		
CRG (31 - 40 DAE)	Control	2189.75	2149.00	2169.3 b
	1 a 10DAE	1473.75	1481.50	1477.6 c
	11 a 20DAE	4181.75	3582.25	3882.0 a
	21 a 30DAE	2103.50	1978.00	2040.7 bc
	Means	2487.1 A	2297.6 A	
	CV (%)	23.56		
RGR (11 - 20 DAE)	Control/V5	0.025	0.021	0.023 b
	1 a 10DAE/V5	0.028	0.026	0.027 a
	Means	0.026 A	0.023 B	
	CV (%)	4.75		
RGR (21 - 30 DAE)	Control	0.069	0.094	0.082 b
	1 a 10DAE	0.137	0.150	0.144 a
	11 a 20DAE	0.064	0.081	0.073 b
	Means	0.090 B	0.108 A	
	CV (%)	19.66		
RGR (31 - 40 DAE)	Control	0.034	0.043	0.039 bc
	1 a 10DAE	0.025	0.033	0.029 c
	11 a 20DAE	0.095	0.105	0.099 a
	21 a 30DAE	0.039	0.051	0.045 b
	Means	0.048 B	0.058 A	
	CV (%)	23.40		
RAN (11 - 20 DAE)	Control	1.052	0.853	0.952 a
	1 a 10DAE	0.963	0.866	0.914 a
	Means	1.008 A	0.859 A	
	CV (%)	14.4		
RAN (21 - 30 DAE)	Control	0.416	0.537	0.476 b
	1 a 10DAE	0.735	0.784	0.760 a
	11 a 20DAE	0.373	0.448	0.411 b
	Means	0.590 A	0.508 A	
	CV (%)	22.91		

Table 5. Contd.

	Control	0.233	0.325	0.279 b
	1 a 10DAE	0.158	0.219	0.189 c
RAN (31 - 40 DAE)	11 a 20DAE	0.614	0.703	0.659 a
	21 a 30DAE	0.308	0.411	0.360 b
	Means	0.328 B	0.415 A	
	CV (%)	22.56		

*DAE: days after emergence, ** means followed by the same letter in the column and capital on the line, do not differ by Duncan's test at 5% probability.

DAE was bigger than other treatments.

CONCLUSIONS

Soybean seeds of high vigor generate plants with higher growth rate of the culture until 30 DAE.

Soybean plants from seeds of higher physiological quality submitted to water deficit, up to 40 DAE, have higher performance than the plants from seeds with low vigor.

Water deficits reduce performance at different stages of growth of soybean plants derived from high and low vigor seeds.

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