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Phenotype stability of soybean genotypes for characters related to the physiological quality of seed produced under different environmental conditions

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ABSTRACT

This study aimed to verify the effects of the interaction genotype *x* environment on the physiological parameters of quality of soybean seeds produced under different environmental conditions. Conducted in Federal University of Santa Maria, and Federal University of Pelotas. The experimental design was randomized blocks in a factorial design with 20 soybean genotypes *x* five cultivation environments for the production of seeds, with eight replications. Data were submitted to analysis of variance by F test at 5% probability, when the significant effects of interaction were dismembered into simple effects and absence of significant effects of interaction. The main effects of each factor were separated. The measured characters were subjected to an Annicchiarico analysis. The character seedling emergence is the most affected by the interaction genotype *x* cultivation environment regarding the production of soybean seeds. Germination, first germination counting, shoot length and primary root length have a greater phenotype stability when assessed by the Annicchiarico method. The genotype BRS Tordilha RR is the most phenotype-stable genotype. It is superior regarding first germination counting, shoot length and primary root length. The cultivation environments Tenente Portela-RS, Campos Borges-RS and Arroio Grande-RS are favorable for seedling dry mass, shoot length and primary root length.

INTRODUCTION

Soy (*Glycine max*(L.) Merrill) is a major agricultural commodity. It is a raw material for numerous products used in human and animal feed (Bornhofen *et al*., 2015). In the 2014/2015 harvest, more than 31 million hectares were sown in Brazil, reaching a productivity higher than 3,000 Kg ha^{-1} and a production of 93 million tons of grain (Conab, 2015). The physiological quality of seeds used at sowing is related to genetic, physical, sanitary and physiological factors, interfering in the ability of seeds to provide high vigor seedlings (Peske *et al*., 2012). Soybean seeds with a high physiological potential make possible an adequate stand of plants, making this

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genotype more competitive against weeds. It increases the efficiency and the use of nutrients and water, consequently resulting in a higher grain productivity (Scheeren *et al*., 2010).

The soybean seed production environment is influenced by the production and quality of seeds produced, where relative humidity, photoperiod, air temperature and solar radiation are critical for seed quality, especially regarding vigor (Peske *et al*., 2012). The physiological quality may be determined by germination test, electrical conductivity of seeds, first counting of germination, respiratory activity, length and dry mass of seedlings, andpercentage of seedling emergence in the field or substrate (Peske *et al*., 2012). The interaction environment *x* genotype is due to the phenotype variation of genotypes when subjected to different medium conditions and different soil and climatic conditions. There is a great variability in productive performance among cultivars. This situation hinders the recommendation of stable genotypes and genotypesadapted to growing conditions that varyin each microregion or microclimate (Silva & Duarte, 2006). In this sense, a correct positioning of genotypes is fundamental to ensure the best genetic performance in each environmental condition.

Given the imposed differentiations among cultivation environments, it is necessary to understand the influence of stability of characters related to soybean genotypes in order to maximize the production process and the use of edaphoclimatic resources. Thus, the method developed byAnnicchiarico (1992), based on the sums of squares of analysis of variances, enables revealing the stability of genotypes compared to the average of the tested environments (Cruz *et al*., 2014). The results are based on confidence index estimates for each genotype, allowing inferring the phenotype superiority and which environments are the most favorable to each character (Cruz *et al*., 2014). This study aimed to verify the effects of the interaction genotype *x* environment on the physiological parameters of quality of soybean seeds produced under different environmental conditions.

MATERIAL AND METHODS

Laboratory analyses were conducted at the Federal University of Santa Maria, and Didactic Laboratory of the Department of Plant Seeds Analysis of the Faculty of Agronomy Eliseu Maciel, Federal University of Pelotas. The experimental design was randomized blocks in a factorial design with 20 soybean genotypes *x* five cultivation environments for the production of seeds, with eight replications. The cultivation environments were arranged in Santa Rosa-RS (27°52'16" S and 54°28'55" W), at an altitude of 268 m; Tenente Portela - RS (27°22'15" S and 53°45 28" W), at altitude of 420 m; Campos Borges-RS (28°52'31" S and 53°0'55" W) at an altitude of 513 m; Sarandi-RS (27º56'38" S and 52º55'23" W), at an altitude of 503 m; and Arroio Grande-RS (32°14'19" S and 53°5'27" W), at an altitude of 22 m.

Weather data shown in Figure 1 were obtained from automatic weather stations from the National Weather Institute. Data from the station A810 for Santa Rosa-RS, A854 for TenentePortela-RS, A837 for Campos Borges-RS and A856 for Sarandi-RS were used. For the cultivation environment of Arroio Grande-RS, meteorological data from the Pelotas station were used (CapãoLeão-RS).The cultivation environment of Santa Rosa-RS is in the Northwest region of Rio Grande do Sul, and the soil is classified as a typical dystroferric Red Latosol (Embrapa, 2006). TenentePortela-RS is in the Northeast and the soil is classified as a typical ferric Aluminum Red Latosol (Streck *et al*., 2008). Campos Borges-RSis at the PlanaltoMédio in the center-north of the Rio Grande do Sul state, andthe soil is classified as a dark red Latosol (Streck *et al*., 2008). Sarandi-RS is in the Upper Uruguay region, and the soil is characterized as a typical ferric Aluminum Red Latosol (Streck *et al*., 2008). Arroio Grande-RS is located in the South region and the soil is classified as a typical dystrophic Yellow-Red Argisol (Streck *et al*., 2008). The climate on the cultivation environments is Cfa according to the Köppen classification.

The genotypes used were BRS Tordilha RR, FPS Paranapanema RR, Fepagro 37 RR, FPSSolimões RR, Fepagro 36 RR, FPS Netuno RR, FPS Iguaçu RR, FPS Urano RR, FPS Júpiter RR, AMSTibagi RR, BMX Magna RR, A 6411 RG, BMX Apolo RR, BMX Potência RR, BMX Alvo RR, Roos CaminoRR, BMX Ativa RR, NA 5909 RG, BMX Turbo RR and TMG 7161 RR.The sowing of genotypes was performed in the second half of October 2013 and the harvest was held in the first fortnight of April 2014, with plants at the R8 stage, corresponding to full ripening (Fehr &Caviness, 1977). After harvest, the seeds were placed to dry in a greenhouse with forced air ventilation and stored in a cold and dry chamber until the tests, according to recommendation (Peske *et al*., 2012).

The physiological quality tests were based on the use of 400 seeds of each genotypedivided into eight experimental units. The seeds were placed to germinate in three sheets of "*germitest*" germination paper, moistened with distilled water until 2.5 times the mass of the dry paper. The germination paper rolls were made containing the seeds, which were surrounded by a polyethylene wrap to preserve moisture. Then, the rolls were arranged in a B.O.D. camera at 25°C, and measurements of parameters of interest were performed at five and eight days after sowing (Brasil, 2009).

The characters evaluated were germination, performed at eight days after sowing, measured by the number of normal seedlings (Brasil, 2009).The first germination countingwas made five days after sowing with the number of normal seedlings (Brasil, 2009). The seedling dry mass was determined from ten normal seedlings at eight days after the start of tests. For this, the seedlings were dried in an oven with forced air ventilation at 70°C until constant mass, and the results were expressed in grams.

The shoot and primary root length was measured in ten normal seedlings with a digital caliper. The extension from the base to the seedling apical bud or the primary root was measured, and the results were expressed in centimeters. Emergence in field was conducted in a soil characterized as a ferric aluminum Red Latosol (Embrapa, 2006). It was evaluated from the sowing of 400 seeds of each genotype in four replicates, where each experimental unit contained100 seeds. The counting of the number of normal seedlings emerged was made on the twentieth day after sowing, and the results were expressed as percentage of normal seedlings.

Data were submitted to analysis of variance by F test at 5% probability, when the significant effects of interaction were dismembered into simple effects and absence of significant effects of interaction. The main effects of each factor were separated. The measured characters were subjected to anAnnicchiarico analysis (1992) in order to reveal the phenotype stability of genotypes and growing environments used for production (Cruz *et al*., 2014). For that, the analyses were performed using the software Genes (Cruz, 2013).

RESULTS AND DISCUSSION

The analysis of variance showed an interaction between soybean genotypes *x* cultivation environments for seed production at 5% probability regarding charactergermination, first counting, seedling dry weight, shoot and primary root length, and emergence in field. The coefficients of variation obtained for the measured characters presenteda range of 11.56% to 23.84% and are classified as an average level, indicating a moderate experimental accuracy and enabling reliable inferences about the results of the experiments (Pimentel Gomes, 2000).

The character germination for the Santa Rosa-RS cultivation environment was superior in genotypes BMX Potência RR, BRS Tordilha RR, BMX Magna RR, Fepagro 37 RR, A 6411 RG, RoosCamino RR, BMXApolo RR, FPS Netuno RR, Fepagro 36 RR, FPSJúpiter RR and TMG 7161 RR (Table 1). In contrast, compared to the genotype with the highest average, the genotype BMX Ativa RR represented an inferiority of 60% for this character.

In the TenentePortela-RS cultivation environment, the superiority of the character germination was attributed to Fepagro 36 RR, BRS Tordilha RR, BMX Magna RR, FPS Netuno RR, NA 5909 RG, Fepagro 37RR, A 6411 RG, BMX Alvo RR, BMX Ativa RR, RoosCamino RR, FPS Júpiter RR, FPS Urano RR, BMXPotência RR, FPS Paranapanema RR e BMX Turbo RR. However, the genotype FPS Iguaçu RR proved to be 56% lower than the best genotype for the same conditions and cultivation. Thus, the genotypes Fepagro 36 RR, BRS Tordilha RR, BMX Magna RR,FPS Netuno RR, NA 5909RG, Fepagro 37 RR, A 6411 RG and BMX Alvo RR reached levels of germination higher than that required under the current legislation for marketing seeds, when a percentage of germination above 90% demonstrates superiority (Peske *et al*., 2012).

In Campos Borges-RS, there was a superiority regarding the character germination in FPS Paranapanema RR, Fepagro 37 RR, RoosCaminoRR, BRS Tordilha RR, NA5909 RG, BMX Ativa RR, FPS Urano RR, FPS Júpiter RR, TMG 7161 RR, BMX PotênciaRR, BMX Turbo RR, A 6411 RG, BMX Apolo RR, AMS Tibagi RR, BMX Alvo RR, FPSSolimões RR and FPS Netuno RR. The genotype FPS Iguaçu RR had the lowest magnitude of germination, 41.4% lower than the genotype superior regarding this character (Table 1). Therefore, the genotypes FPS Paranapanema RR, Fepagro 37 RR, RoosCamino RR, BRS Tordilha RR,NA 5909 RG and BMX Ativa RR presented the lowest magnitude of germination percentage required by the Brazilian law (Brasil, 2003).

In Sarandi-RS, there was a superiority of the genotypes RoosCamino RR, BRS Tordilha RR, AMSTibagi RR, FPS Júpiter RR, FPS Netuno RR, FPS Iguaçu RR, BMX Apolo RR, BMX Potência RR, BMX AlvoRR, FPS Urano RR, NA 5909 RG, FPS Paranapanema RR, BMX Turbo RR, Fepagro 37 RR, A 6411 RG and FPS Solimões RR. However, the genotype TMG 7161 RR was found to be 52% lower than the superior genotype in that environment.

For the conditions of Arroio Grande-RS, the highest magnitudes were obtained for the genotypes TMG7161 RR, BMX Alvo RR, FPS Netuno RR, FPS Paranapanema RR, AMS Tibagi RR, Fepagro 36 RR,BRS Tordilha RR, FPS Júpiter RR, FPS Iguaçu RR, RoosCamino RR, Fepagro 37 RR, BMX Potência RR,FPS Solimões RR and BMX Apolo RR. The results show that the genotype A6411 RG, with respect to the superior genotype, was 72% inferior. The seed production in this cultivation environment revealed that the genotypes TMG7161 RR, BMX Alvo RR, FPS Netuno RR, FPS Paranapanema RR and AMS Tibagy RR obtained germination percentages above the minimum required by the legislation (Brasil, 2003). The genotypes BRS Tordilha RR, BMXPotência RR and BMX Turbo RR reached similar results in both environments. However, the genotypes FPS Iguaçu RR and AMS Tibagi RR were superior in Sarandi-RS and Arroio Grande-RS (Table 1).

The Annicchiarico method (1992), applied to the character germination of seeds, revealed that the cultivation environments of TenentePortela-RS, Campos Borges-RS, Sarandi-RS and Arroio Grande-RS were favorable. On the other hand, Santa Rosa-RS was the less favorable to this character. For Schuab*et al*. (2002), the standard germination test cannot be considered as absolute. Its data should be related to the emergence of seedlings in the field, which would enable an estimation of seed vigor.

It is worth noting that the minimum temperature in the five culture environments was similar and reached13.5-24.5°C (Figure 1A), similar to what occurred with the average, with an amplitude of 15.3-25.3°C (Figure 1B). However, the maximum temperature ranged from 15.3°C to 30.5°C. The maximum values occurred in Arroio Grande-RS, Campos Borges-RS and Sarandi-RS (Figure 1C). The solar radiation varied from 9.94 to 94.44 cal cm^{-2} day^{-1}, the highest values observed in Arroio Grande-RS and Campos Borges-RS (Figure 1E). The cumulative rainfall ranged from 760 to 1,130 mm; Santa Rosa-RS had the greatest accumulation (Figure 1F).

The Brazilian tropical conditions are characterized by the predominance of high temperatures and high rainfall during the ripening period ofsoybeans. Thus, according to França Neto & Krzyzanowski (2007), a viable alternative for the production of seeds is to choose regions with an altitude of 700 m and adjust the sowing time.

The character first germination counting evaluated in Santa Rosa-RS presented a superiority for the genotypes BMX Potência RR, BMX Magna RR, BMX Apolo RR, RoosCamino RR, BRS Tordilha RR,Fepagro 37 RR,FPS Netuno RR,Fepagro 36 RR and A 6411 RG.The genotype FPS Iguaçu RR, in relation to the genotype BMX Potência RR, revealed an inferiority of 61.3% (Table 2). For the TenentePortela-RS cultivation environment, it was observed a superiority for BRSTordilha RR, Fepagro 37 RR, FPS Júpiter RR,BMX Magna RR, FPS NetunoRR, Fepagro 36 RR, BMX Ativa RR, NA 5909 RG, FPS Urano RR, FPSSolimões RR, A 6411 RG, RoosCamino RR, BMX Alvo RR, FPSParanapanema RR, BMX Turbo RR, BMX Apolo RR,TMG 7161 RR and BMX Potência RR. However, a lower magnitude was attributed to the genotype AMS Tibagi RR, which showed an inferiority of 45.4% compared to the genotype with the highest average.

In Campos Borges-RS, a superiority was obtained for the character first germination counting in genotypes BMX Ativa RR, FPS Paranapanema RR,NA 5909 RG, RoosCamino RR, Fepagro 37 RR, BRS Tordilha RR, FPS Urano RR, TMG 7161 RR, FPS Netuno RR, BMX Turbo RR, BMX Apolo RR, AMS Tibagi RR, BMX Alvo RR, FPS Júpiter RR, BMX Potência RR, A 6411 RG, FPS Solimões RR and Fepagro 36 RR, although higher magnitudes have been attributed to FPS Iguaçu RR, which was 30.6% inferior when compared to the best genotype under these conditions.

For the Sarandi-RS cultivation environment, the best results were obtainedin the genotypes BMX Alvo RR, BMX Apolo RR, FPS Netuno RR, RoosCamino RR, BRS Tordilha RR, FPS Júpiter RR, AMS Tibagi RR, FPS Iguaçu RR, Fepagro 37 RR, BMX Potência RR,A 6411 RG, FPS Urano RR, BMX Turbo RR, NA 5909 RR, BMX Magna RR, FPS Paranapanema RR and BMX Ativa RR. These are 33.4% higher than the genotype TMG 7161 RR, with a lower first counting value.

In Arroio Grande-RS, the best results for the character first germinationcounting were attributed to genotypes BMX AlvoRR, TMG 7161 RR, RoosCamino RR, FPS Paranapanema RR, FPS Solimões RR, FPS Júpiter RR, AMS Tibagi RR, FPS Netuno RR, BRS Tordilha RR, BMX Apolo RR, BMX Potência RR, Fepagro 36 RR, Fepagro 37 RR, FPS Iguaçu RR and BMX Ativa RR.The genotype NA 5909 RG was 56.4% inferior when comparedto the highest average obtained for this environment and for the characterphysiological seed quality. It is worth mentioning that the genotypesBRS Tordilha RR, Fepagro 37 RR, FPS Netuno RR, BMX Apolo RR and RoosCamino RR showed similar results for all cultivation environments when considering the first germination counting (Table 2).

The Annicchiarico method (1992) characterized the cultivation environments of TenentePortela-RS and Sarandi-RS as favorable to the increment of the first germination counting (Table 2). The first germination counting test evaluates the vigor attributed to seeds and may be associated with the speed of root and shoot emission. The vigor is related to the efficiency of embryo growth recovery, i.e., a greater reorganization capacity of membrane systems, hydrolysis, translocation, assimilation and use of reserves (Bewley, 2014).

The genotype BRS Tordilha RR, based on the Annicchiarico method, had an increase of 4.1% for the character first germination counting (Table 2). There is an influence of environmental conditions on the deterioration of seeds and the characteristics intrinsic to the genotype in certain environments. The genotype AMS Tibagy RR was 45.9% inferior in the first germination counting in relation to the superior genotype. For TenentePortela-RS, there were responses similar to genotypes BRS Tordilha RR and FPS Júpiter RR, expressing higher magnitudes. Vigor is the form of evaluation most related to the physiological performance of seeds and plants in the field, being dependent on soil and climatic growing conditions, proper positioning of cultivars in microregions, fertilization and appropriate cultural practices (Peske *et al*., 2012).

It is observed in Table 3 that, in the Santa Rosa-RS cultivation environment, produced seeds had a superiority regarding the character seedling dry mass in the genotypes Fepagro 37 RR, Fepagro 36 RR, A 6411 RG, BRS Tordilha RR, FPS Urano RR, FPS Netuno RR, BMX Turbo RR, RoosCamino RR, FPS Júpiter RR, BMX Potência RR, BMX Magna RR, TMG 7161 RR, BMX Apolo RR, FPS Iguaçu RR and BMX Alvo RR. However, the genotype AMS Tibagi RR was 45.9% inferior regarding this character in relation to the superior genotype. For TenentePortela-RS, there were responses similar to the genotypes BRS Tordilha RR and FPS Júpiter RR, expressing higher magnitudes. The genotype BMX Potência RR obtained a seedling dry mass 66%

inferior than the best genotypes for this character. In cultivation environments of Campos Borges-RS and Tenente Portela-RS, genotypes responded similarly regarding seedling dry mass because the highest magnitude was obtained by the genotype FPS Iguaçu RR and the lowest magnitude was obtained by BMX Vigor RR, which was 68.9% inferior (Table 3).

In Sarandi-RS, the best results were expressed by the genotypes BMX Ativa RR, FPS Iguaçu RR, FPS Netuno RR, BRS Tordilha RR, RoosCamino RR, FPS Urano RR, NA 5909 RG, BMX Turbo RR, TMG 7161 RR, BMX Alvo RR and BMX Apolo RR. The genotype FPS Solimões RR, considering seedling dry mass, was 62.6% inferior to the best genotype. InArroio Grande-RS, higher magnitudes of seedling dry mass were observed for the genotypes Fepagro 36 RR, BMX Turbo RR, BMX Potência RR, NA 5909 RG, FPS Urano RR, BMX Apolo RR and AMS Tibagi RR(Table 3). The genotype A 6411 R presented an inferiority of 47.5% compared to the best genotype regarding this character. The genotypes FPS Paranapanema RR and FPS Solimões RR were similar regarding seedling dry mass in both environments.

The Annicchiarico method (1992) evidenced that TenentePortela-RS, Campos Borges-RS and Arroio Grande-RS were favorable for seedling dry mass (Table 3). Therefore, the choice of the cultivation environment for the production of seedsand the most appropriate genotype for each sub-area may contribute to obtain seeds with a superior physiological performance, producing stronger seedlings with a higher mass, allowing an increase in grain yield.

The cultivation environments Arroio Grande-RS and Campos Borges-RS had the highest levels of solar radiation in the experiment (Figure 1E). For soybeans, radiation is a determining factor for productivity because it is related to photosynthesis, elongation of main stem and branches, leaf expansion and fixation of legumes and seeds (Casaroli *et al*., 2007). In contrast, a high radiation intensity may lead to light saturation, reducing the radiation conversion efficiency (Jiang *et al*., 2004). Temperature (Figure 1B) had averages of 20.7°C in Arroio Grande-RS, 22.1°C in Campos Borges-RS, and 21.7°C in TenentePortela-RS. According to Farias *et al*. (2009), soybeans show a better adaptation to regions where temperatures vary from 20°C to 30°C. However, regions with temperatures lower than 10°C are considered unfit for cultivation, affecting the growth and the development of the culture.

Table 4 shows that in the Santa Rosa-RS cultivation environment, the genotypes Roos Camino RR, A 6411 RG, BMX Potência RR, BMX Apolo RR, BRS Tordilha RR, NA 5909 RG, BMX Magna RR, AMS Tibagi RR, Fepagro 37 RR, Fepagro 36 RR, FPS Netuno RR, FPS Júpiter RR, TMG 7161 RR, BMX Alvo RR, BMX Turbo RR, FPS Paranapanema RR and FPS Urano RR were superior to the others. Therefore, the genotype BMX Active RR revealed, for the character shoot length, an inferiority of 54% in relation to the genotype with the highest magnitude.

In Tenente Portela-RS, the superiority ofshoot length was obtained for the genotypes FPS Netuno RR, Fepagro 37 RR, BMX Alvo RR, BMX Magna RR, A 6411 RG, BMX Potência RR, FPS Júpiter RR, FPS Urano RR, NA 5909 RG, BMX Ativa RR and TMG 7161 RR (Table 4). The genotype BMX Apollo RR was 52.4% inferiorto the superior genotype for this character. In Campos Borges-RS, the results were similar to those of Tenente Portela-RS, except for the genotype FPS Solimões RR, which had an inferiority of 64.5% compared to the best genotype. In the Sarandi-RS cultivation environment, the superiority was attributed to the genotypes Fepagro37 RR, BMX Potência RR, BRS Tordilha RR, NA 5909 RG, BMX Magna RR, BMX Alvo RR, BMX Apolo RR, FPS Júpiter RR, AMS Tibagi RR, FPS Netuno RR and FPS Urano RR. On the other hand, the genotype TMG 7161 RR was 44.5% inferior regarding shoot length.

For the cultivation environment Arroio Grande-RS, the superiority of shoot length was observed for the genotypes FPS Júpiter RR, Fepagro 37 RR, FPS Netuno RR, BRS Tordilha RR, TMG 7161 RR, FPS Paranapanema RR, BMX Apolo RR, FPS Solimões RR, AMS Tibagi RR and FPS Iguaçu RR, with the genotype BMX Turbo RR 42.7% inferior than the best genotype. The genotypes BRS Tordilha RR, BMX Magna RR and BMX Potência RR were similar regarding shoot length. However, genotypes FPS Solimões RR and RR FPS Jupiter had a behavior more adequate to the Arroio Grande-RS cultivation environment.

TheAnnicchiarico method (1992) revealed that Tenente Portela-RS, Campos Borges-RS and Arroio Grande-RS were favorable to the character shoot length and Santa Rosa-RS and Sarandi-RS were less favorable (Table 4). The genotype Fepagro 37 RR had an increase of 2.5% regarding this characteristic.

The primary root length measured in the Santa Rosa-RS cultivation environment showed that the genotypes BMX Magna RR, BMX Potência RR, Fepagro 37 RR, BMX Apolo RR, BRS Tordilha RR, Fepagro 36 RR, A 6411 RG and FPS Júpiter RR were superior, and that the genotype BMX Ativa RR had an inferiority of 17% in the character physiological quality (Table 5). In Tenente Portela-RS, the superiority was attributed to the genotypes FPS Netuno RR, BMX Magna RR, A 6411 RG, Fepagro 37 RR, BRS Tordilha RR, Fepagro 36 RR, FPS Urano RR, NA 5909 RG, BMX Potência RR, BMX Alvo RR, FPS Júpiter RR and FPS Paranapanema RR. The genotype AMS Tibagi RR had an inferiority of 38.7%.

For the Campos Borges-RS cultivation environment, it was found that the genotypes Fepagro 37 RR, NA 5909 RG, BMX Turbo RR, BMX Ativa RR, BMX Potência RR, FPS UranoRR and Roos Camino RR were superior regarding primary root length. The genotype FPS Solimões RR was 39.4% inferior when compared to the genotype with the best response to the character. For the Sarandi-RS cultivation environment, the genotypes BRS Tordilha RR, BMX Alvo RR, Fepagro 37 RR, FPS Netuno RR, FPS Júpiter RR, AMS Tibagi RR, BMX Apolo RR, BMX Potência RR, Roos Camino RR, FPS Iguaçu RR, BMX Magna RR, FPS Urano RR, Fepagro 36 RR, FPS Paranapanema RR and A 6411 RG were superior than the others for this character and the lowest magnitude was attributed to the genotype BMX Ativa RR, i.e., it was 32.4% inferior to the best genotype (Table 5).

ForArroio Grande-RS, the highest magnitudes were obtained for the genotypes Roos Camino RR, Fepagro 37 RR, TMG 7161 RR, FPS Júpiter RR, BRS Tordilha RR, AMS Tibagi RR, BMX Alvo RR, BMX Ativa RR, FPS Paranapanema RR, FPS Solimões RR, BMX Apolo RR, FPS Netuno RR, BMX Magna RR, BMX Potência RR and FPS Iguaçu RR. An inferior performance was attributed to the genotype BMX Turbo RR, i.e., it was 43.4% inferior to the superior genotype regarding primary root length. The genotype BRS Tordilha RR showed similar results among cultivation environments regarding production of seeds (Table 5). However, the genotypes FPS Solimões RR and TMG 7161 RR were superior in Arroio Grande-RS. The seedling shoot length is an indicative of the initial vigor of seeds used, and it is related to their ability of generating seedlings with a greater initial start during the establishment of plants in the field (Peske *et al*., 2012). The size or volume of roots allows a better occupation of land, favoring the absorption of water and minerals for the growth and plant development (Barber, 1988). The Annicchiarico method (1992), applied in function of primary root length, evidenced that Tenente Portela-RS, Campos Borges-RS and Arroio Grande-RS are favorable to the character in question. However, Santa Rosa-RS and Sarandi-RS were classified as less favorable. The genotype Fepagro 37 RR showed an increase of 10.2%, based on the Annicchiarico method, in primary root length in relation to average performance in all environments tested.

Table 6shows that the percentage of seedlingemergence in the field, in the Santa Rosa-RScultivation environment, was superior to the genotypes BMX Magna RR, A 6411 RG and Fepagro 37 RR.The lowest magnitudes were observed for the genotypes FPS Paranapanema RR, FPS Solimões RR, BMX Ativa RR and NA 5909 RG, which showed an inferiority of 52% in relation to the genotype with the best performance. In Tenente Portela-RS, the highest magnitude of the seedlingemergence percentage was obtained for the genotype BMX Magna RR. The genotype BMX Ativa RR showed an inferiority of 64% regarding this character.

In Campos Borges-RS, the superior genotypes,regarding percentage of emergence, were Fepagro 37 RR, FPS Júpiter RR, NA 5909 RG, BMX Alvo RR,FPS Urano RR and FPS Paranapanema RR. The lowest magnitudes were obtained for the genotype TMG 7161 RR, which was 36% inferior to the superior genotype. For the Sarandi-RS cultivation environment, the superiority was attributed to the genotypes FPS Netuno RR, A 6411 RG, FPS Iguaçu RR, BMX Apolo RR, FPS Urano RR, NA 5909 RG, TMG 7161 RR, BMX Turbo RR and BMX Ativa RR. The lowest magnitudes were obtained by the genotypes Roos Camino RR and FPS Paranapanema RR, which were 31.3% inferior in relation to the best genotype regarding this character. In Arroio Grande-RS, the superiority was obtained for the genotypes AMS Tibagi RR, TMG 7161 RR and BMX Magna RR. The genotype FPS Iguaçu RR was 40% inferior to the highest values obtained for seedling emergence percentagein the field. For this character, no genotype showed similar results among seed production environments, demonstrating a high effect of the environment'sintrinsic characteristics on the character in question.

The Annicchiarico method (1992), applied in function of seedling emergencein the field, shows that only the Tenente Portela-RS cultivation environment was favorable to the character (Table 6). Research by *Matsuoet al. (2008) evaluated the* stability and the predictability of the physiological quality of seeds of thirteen soybeangenotypes grown in three environments. They obtained a low predictability of physiological characters. In the physiological ripening, seeds reached the highest allocation of dry mass, germination and vigor.

Vigor is the result of the interaction genotype *x* environment. It has a close relation with the capacity and with the efficiency of use of water and energy resources and pre-crop seed conditions (Peske *et al*., 2012). Seedling emergence enables evaluating seed vigor and allows an approximate reproduction of the physiological performance of seeds in the field, while the evaluation of germination does not allow obtaining reliable answers because, when seeds are exposed to field conditions, they become subjected to adverse conditions (Guedes *et al*., 2015).

The twenty genotypes evaluated were somehow influenced by the interaction genotype *x* environment. There was a differential performance regarding the various attributes of physiological seed quality. The knowledge of the differential performance is relevant to obtain more productive results regarding the factor environment, which is difficult to control. The proper study of regional conditions, the knowledge of responses by different cultivars to edaphoclimatic conditions and the knowledge on topics for positioning are important tools to obtain soybean seeds with a high physiological quality.

Table 1: Genotype x environment cultivation for the production of soybean seeds, for seed germination character and phenotypic stability by the method of Annicchiarico (1992).

Soybean Genotypes	Environment cultivation for the production of soybean seeds					
	Santa Rosa	Tenente Portela	Campos Borges	Sarandi	Arroio Grande	Annicchiarico
	U	F	F	F	F	Wi
BRS Tordilha RR	72.0 ab A	90.6 ab A	82.6 aA	88.0 ab A	77.3 abcde A	109.0 (F)
FPS Paranapanema RR	37.3 efg B	66.6 abcdef A	88.0 aA	73.3 abcd A	82.6 abc A	64.9 (U)
Fepagro 37 RR	69.3 abc AB	88.0 abc A	88.0 aA	65.3 abcde B	72.0 abcdef AB	87.2 (U)
FPS Solimões RR	36.0 efg B	64.0 bcdef A	61.3 abc A	62.6 abcde A	68.0 abcdef A	67.0 (U)
Fepagro 36 RR	60.0 abcdef BC	94.6 aA	48.0 c C	49.3 de C	77.3 abcde AB	51.4 (U)
FPS Netuno RR	60.0 abcdef B	86.6 abc A	60.0 abc B	88.0 ab A	86.6 ab A	86.6 (U)
FPS Iguaçu RR	36.0 efg B	38.6 f B	46.6 c B	85.3 abc A	74.6 abcde A	36.0 (U)
FPS Urano RR	33.3 fg B	72.0 abcd A	74.6 abc A	77.3 abcd A	49.3 ef B	56.2 (U)
FPS Júpiter RR	60.0 abcdef B	72.0 abcd AB	73.3 abc AB	88.0 ab A	77.3 abcde AB	96.5 (U)
AMS Tibagi RR	40.0 defg C	41.3 ef C	64.0 abc B	88.0 ab A	80.0 abcd AB	47.5 (U)
BMX Magna RR	70.6 abc AB	90.6 ab A	52.0 bc B	60.0 bcde B	58.6 bcdef B	56.0 (U)
A 6411 RG	68.0 abcd A	82.6 abcd A	69.3 abc A	65.3 abcde A	17.3 g B	26.1 (U)
BMX Apolo RR	64.0 abcde AB	56.0 def B	68.0 abc AB	80.0 abc A	61.3 abcdef AB	71.2 (U)
BMX Potência RR	80.0 aA	68.0 abcde A	70.6 abc A	78.6 abc A	70.6 abcdef A	74.2 (U)
BMX Alvo RR	42.6 cdefg C	80.0 abcd AB	62.6 abc BC	77.3 abcd AB	88.0 aA	71.8 (U)
Roos Camino RR	64.0 abcde B	72.0 abcd AB	84.0 a AB	89.3 aA	72.0 abcdef AB	96.6 (U)
BMX Ativa RR	20.0 g C	74.6 abcd AB	80.0 ab A	58.6 cde AB	54.6 cdef B	35.0 (U)
NA 5909 RG	42.6 cdefg B	85.3 abc A	82.6 aA	74.6 abcd A	44.0 fg B	58.2 (U)
BMX Turbo RR	49.3 bcdef A	66.6 abcdef A	69.3 abc A	69.3 abcd A	53.3 def A	78.9 (U)
TMG 7161 RR	52.0 abcdef BC	60.0 cdef B	73.3 abc AB	37.3 e C	89.3 aA	44.9 (U)
CV (%)	14.12					α=0.95

* Means followed by the same letter in the column for genotypes, and capitalized on the line for production environments the seeds did not differ statistically Tukey at 5% probability. * F to favorable environments. * U unfavorable environments . * Wi Annicchiarico method (1992).

Table 2: Genotype x environment cultivation for the production of soybean seeds, for seed for the character first count and phenotypic stability by the method of Annicchiarico (1992).

Soybean Genotypes	Environment cultivation for the production of soybean seeds					
	Santa Rosa	Tenente Portela	Campos Borges	Sarandi	Arroio Grande	Annicchiarico
	U	F	U	F	U	*Wi*
BRS Tordilha RR	84.0 ab A	100.0 a A	85.3 abc A	90.6 abc A	86.6 ab A	104.1 (F)
FPS Paranapanema RR	41.3 f B	84.0 ab A	90.6 a A	76.0 abcd A	89.3 a A	59.4 (U)
Fepagro 37 RR	84.0 ab A	97.3 a A	88.0 ab A	86.6 abcd A	77.3 abcd A	96.2 (U)
FPS Solimões RR	50.6 ef B	92.0 a A	66.6 abc B	64.0 cd B	88.0 a A	62.8 (U)
Fepagro 36 RR	78.6 abcd AB	94.6 a A	65.3 abc B	68.0 bcdB	82.6 abc AB	74.0 (U)
FPS Netuno RR	82.6 abc A	96.0 a A	80.0 abc A	92.0 abA	86.6 ab A	99.9 (U)
FPS Iguaçu RR	37.3 f C	64.0 bc B	60.0 c B	88.0 abcd A	76.0 abcd AB	48.2 (U)
FPS Urano RR	56.0 cdef B	93.3 a A	82.6 abc A	82.6 abcd A	57.3 cde B	70.7 (U)
FPS Júpiter RR	62.6 bcdef C	97.3 a A	76.0 abc BC	89.3 abcd AB	88.0 a AB	89.6 (U)
AMS Tibagi RR	46.6 f B	54.6 c B	77.3 abc A	89.3 abcd A	88.0 a A	52.1 (U)
BMX Magna RR	89.3 ab A	97.3 a A	62.6 bc B	78.6 abcd AB	60.0 bcde B	62.1 (U)
A 6411 RG	76.0 abcde A	92.0 a A	72.0 abc A	82.6 abcd A	40.0 e B	53.5 (U)
BMX Apolo RR	89.3ab A	81.3 abc A	77.3 abc A	93.3 ab A	84.0 abc A	84.4 (U)
BMX Potência RR	98.6 a A	80.0 abc AB	72.0 abc B	85.3 abcd AB	84.0 abc AB	71.6 (U)
BMX Alvo RR	54.6 def B	84.0 ab A	76.0 abc A	96.0 a A	94.6 a A	74.9 (U)
Roos Camino RR	85.3 ab A	85.3 ab A	88.0 ab A	90.6 abc A	89.3 a A	95.3 (U)
BMX Ativa RR	45.3 f D	96.0 a A	90.6 a AB	69.3 abcd C	73.3 abcd BC	62.4 (U)
NA 5909 RG	56.0 cdef B	93.3 a A	88.0 ab A	80.0 abcd A	40.0 e B	50.9 (U)
BMX Turbo RR	62.6 bcdef AB	82.6 ab A	80.0 abc A	81.3 abcd A	50.6 de B	67.5 (U)
TMG 7161 RR	62.6 bcdef B	81.3 abc AB	82.6 abc AB	62.6 d B	92.0 a A	70.6 (U)
CV (%)	11.56					α=0.95

* Means followed by the same letter in the column for genotypes, and capitalized on the line for production environments the seeds did not differ statistically Tukey at 5% probability. * F to favorable environments. * U unfavorable environments. * Wi Annicchiarico method (1992).

Table 3: Genotype x environment for the cultivation of soybean seed production for the dry mass character seedling and phenotypic stability by the method of Annicchiarico (1992).

Soybean Genotype	Environment cultivation for the production of soybean seeds					
	Santa Rosa	Tenente Portela	Campos Borges	Sarandi	Arroio Grande	Annicchiarico
	F	U	U	F	U	Wi
BRS Tordilha RR	14.9 abc AB	13.2 a B	10.5 a C	17.0 abcd A	10.0 cd C	90.1 (U)
FPS Paranapanema RR	10.9 cd A	12.2 aA	10.6 aA	11.8 ef A	9.6 cd A	71.6 (U)
Fepagro 37 RR	16.4 aA	12.4 a B	9.6 a B	12.8 cdef AB	9.5 cd B	73.1 (U)
FPS Solimões RR	10.9 cd A	11.8 aA	10.1 aA	11.6 f A	9.3 cd A	71.0 (U)
Fepagro 36 RR	15.7 ab AB	9.6 a C	9.8 a C	12.4 def BC	16.5 aA	60.7 (U)
FPS Netuno RR	14.5 abc A	10.2 a B	10.1 a B	17.4 abc A	8.2 d B	71.4 (U)
FPS Iguaçu RR	12.6 abc B	11.9 a B	12.9 a B	17.7 ab A	10.4 cd B	86.3 (U)
FPS Urano RR	14.6 abc AB	11.2 a BC	10.0 a C	16.5 abcde A	12.3 abcd BC	94.9 (U)
FPS Júpiter RR	13.9 abc A	13.2 aA	9.5 a B	13.5 bcdef A	8.9 cd B	74.1 (U)
AMS Tibagi RR	7.5 d C	10.3 a ABC	9.3 a BC	13.5 bcdef A	11.9 abcd AB	56.8 (U)
BMX Magna RR	13.6 abc A	12.0 a AB	11.5 a AB	12.9 bcdef A	8.4 d B	73.4 (U)
A 6411 RG	15.4 abc A	11.5 a B	10.6 a BC	12.9 cdef AB	7.8 d C	67.9 (U)

BMX Apolo RR	12.7 abc AB	11.1 a AB	10.0 a B	14.4 abcdef A	12.2 abcd AB	89.7 (U)
BMX Potência RR	13.8 abc A	8.7 a B	8.9 a B	13.1 bcdef A	13.3 abc A	67.2 (U)
BMX Alvo RR	12.5 abc AB	10.2 a B	9.9 a B	14.6 abcdef A	10.7 bcd B	91.0 (U)
Roos Camino RR	14.0 abc AB	10.7 a B	10.9 a B	16.9 abcd A	10.9 bcd B	93.0 (U)
BMX Ativa RR	11.0 bcd B	10.6 a B	10.3 a B	18.5 aA	10.9 bcd B	76.0 (U)
NA 5909 RG	11.4 bcd B	10.0 a B	9.7 a B	16.4 abcde A	12.4 abcd B	78.3 (U)
BMX Turbo RR	14.4 abc ABC	12.0 a BC	11.0 a C	16.4 abcde A	15.3 ab AB	91.0 (U)
TMG 7161 RR	12.8 abc AB	9.7 a B	10.3 a B	15.6 abcdef A	9.4 cd B	81.3 (U)
CV (%)	13.14					α=0.95

* Means followed by the same letter in the column for genotypes, and capitalized on the line for production environments the seeds did not differ statistically Tukey at 5% probability. * F to favorable environments. * U unfavorable environments. * Wi Annicchiarico method (1992).

Table 4: Genotype x growing environment for soybean seed production (G, max) for the character length of shoot and phenotypic stability by Annicchiarico method (1992).

Genótipos dasoja	Ambientes de produção das sementes					
	Santa Rosa-RS	Tenente Portela-RS	Campos Borges-RS	Sarandi-RS	Arroio Grande-RS	Annicchiarico
	D	F	F	D	F	Wi
BRS Tordilha RR	7.75 aA	7.55 bcde A	8.48 ab A	7.80 abc A	9.60 abc A	93.2 (D)
FPS Paranapanema RR	5.82 abcd B	7.44 cde AB	7.14 ab AB	6.02 cdefg B	8.99 abcd A	78.9 (D)
Fepagro 37 RR	7.22 abc B	10.19 ab A	9.30 aA	8.97 a AB	10.76 ab A	102.5 (F)
FPS Solimões RR	4.73 cd B	6.35 de B	6.02 b B	6.18 bcdefg B	8.81 abcde A	59.2 (D)
Fepagro 36 RR	6.98 abcd AB	7.53 bcde A	7.01 ab AB	5.12 cdefg B	7.77 cdef A	78.7 (D)
FPS Netuno RR	6.80 abcd C	10.34 aA	8.09 ab BC	6.48 abcdefg C	9.94 abc AB	88.4 (D)
FPS Iguaçu RR	4.86 bcd C	6.20 de BC	7.80 ab AB	4.86 efg C	8.30 abcde A	63.0 (D)
FPS Urano RR	5.82 abcd B	8.24 abcd A	7.55 ab AB	6.27 abcdefg AB	6.63 defgh AB	78.8 (D)
FPS Júpiter RR	6.58 abcd B	8.35 abcd B	7.70 ab B	6.63 abcdefg B	10.88 aA	81.7 (D)
AMS Tibagi RR	7.50 ab AB	6.51 de B	8.59 ab A	6.63 abcdefg AB	8.57 abcde AB	83.7 (D)
BMX Magna RR	7.52 ab A	8.91 abcd A	7.56 ab A	7.32 abcde A	7.34 cdefgh A	86.4 (D)
A 6411 RG	8.06 aA	8.47 abcd A	8.78 aA	4.70 efg B	5.25 fgh B	56.4 (D)
BMX Apolo RR	7.79 aA	5.42 e B	7.99 ab A	6.86 abcdef AB	8.83 abcde A	69.7 (D)
BMX Potência RR	7.81 aA	8.88 abcd A	8.63 ab A	8.88 ab A	7.39 cdefg A	84.7 (D)
BMX Alvo RR	6.54 abcd B	9.29 abc A	7.02 ab B	6.92 abcde B	6.26 efgh B	71.7 (D)
Roos Camino RR	8.25 aA	7.48 cde A	8.57 ab A	5.32 cdefg B	8.03 cde A	78.5 (D)
BMX Ativa RR	4.46 d B	7.72 abcde A	8.40 ab A	4.17 fg B	8.10 bcde A	55.6 (D)
NA 5909 RG	7.60 aA	8.14 abcd A	9.32 aA	7.62 abcd A	4.85 gh B	62.5 (D)
BMX Turbo RR	5.84 abcd BC	7.28 cde AB	7.90 ab A	4.93 defg C	4.65 h C	57.0 (D)
TMG 7161 RR	6.58 abcd B	7.64 abcde AB	8.52 ab AB	4.00 g C	9.06 abcd A	64.1 (D)
CV (%)	12.24					α=0.95

Means followed by the same letter in the column for genotypes , and capitalized on the line for production environments the seeds did not differ statistically Tukey at 5% probability. * F to favorable environments. * D for harsh environments . * Wi Annicchiarico method (1992)

Table 5: Genotype x growing environment for soybean seeds (G.max) to the character length of the primary root (CR) and phenotypic stability by Annicchiarico method (1992).

Genótipos dasoja	Ambientes de produção das sementes					
	Santa Rosa-RS	Tenente Portela-RS	Campos Borges-RS	Sarandi-RS	Arroio Grande-RS	Annicchiarico
	D	F	F	D	F	Wi
BRS Tordilha RR	9.55 abcd A	11.14 ab A	8.06 bcde A	9.34 aA	11.20 ab A	93.2 (D)
FPS Paranapanema RR	3.56 gh C	8.62 abcd AB	8.42 bcde AB	5.56 abcd BC	10.50 abc A	49.5 (D)
Fepagro 37 RR	10.75 ab AB	11.31 ab AB	13.73 aA	8.14 ab C	11.79 aA	110.2 (F)
FPS Solimões RR	4.03 fgh B	5.74 d B	5.41 e B	4.46 bcd C	10.12 abc A	38.2 (D)
Fepagro 36 RR	9.34 abcde AB	11.04 ab A	5.52 de C	6.02 abcd BC	7.24 bcde DC	53.4 (D)
FPS Netuno RR	7.66 bcdefg BC	12.63 aA	6.26 cde C	7.87 ab BC	9.79 abcd AB	70.7 (D)
FPS Iguaçu RR	3.58 gh B	6.34 cd AB	6.48 bcde AB	6.32 abcd AB	8.18 abcde A	45.6 (D)
FPS Urano RR	6.24 cdefgh B	10.92 ab A	9.82 abcd A	6.09 abcd B	5.46 de B	54.7 (D)
FPS Júpiter RR	8.25 abcdef AB	10.33 abc AB	8.30 bcde AB	7.54 abc B	11.25 ab A	99.6 (D)
AMS Tibagi RR	5.44 defgh B	4.90 d B	6.82 bcde B	7.54 abc AB	10.78 abc A	43.3 (D)
BMX Magna RR	12.44 aA	12.12 ab A	7.12 bcde B	6.30 abcd B	9.18 abcde AB	60.1 (D)
A 6411 RG	9.21 abcde AB	11.88 ab A	8.50 bcde BC	5.46 abcd C	6.54 cde BC	60.9 (D)
BMX Apolo RR	9.88 abc A	5.54 d B	7.77 bcde AB	7.41 abcd AB	10.02 abc A	56.4 (D)
BMX Potência RR	10.94 ab A	10.45 abc AB	9.95 abc AB	7.14 abcd B	8.41 abcde AB	82.0 (D)
BMX Alvo RR	5.03 efgh C	10.44 abc A	6.42 bcde BC	9.02 a AB	10.72 abc A	54.2 (D)
Roos Camino RR	7.04 bcdefg B	7.95 bcd B	9.68 abcde AB	6.72 abcd B	11.82 aA	81.4 (D)
BMX Ativa RR	2.12 h B	8.34 bcd A	10.18 abc A	3.03 d B	10.52 abc A	14.1 (D)
NA 5909 RG	6.70 bcdefg B	10.89 ab A	10.76 ab A	4.22 bcd B	5.13 e B	40.1 (D)
BMX Turbo RR	6.64 bcdefg B	6.34 cd B	10.22 abc A	4.54 bcd B	4.93 e B	38.1 (D)
TMG 7161 RR	5.69 cdefgh BC	4.92 d BC	7.22 bcde B	3.28 cd C	11.66 aA	30.2 (D)
CV (%)	18.26					α=0.95

* Means followed by the same letter in the column for genotypes , and capitalized on the line for production environments the seeds did not differ statistically Tukey at 5% probability. * F to favorable environments. * D for harsh environments . * Wi Annicchiarico method (1992)

Table 6: Genotype x environment of cultivation for the production of soybean seeds (G.max) to the emergency character field and phenotypic stability by the method of Annicchiarico (1992) .

Genótipos da soja	Ambientes de produção das sementes					
	Santa Rosa-RS	Tenente Portela-RS	Campos Borges-RS	Sarandi-RS	Arroio Grande-RS	Annicchiarico
	D	F	D	D	D	Wi
BRS Tordilha RR	24.0 c B	50.6 b A	25.3 bcde B	5.3 c C	20.0 cde B	21.6 (D)
FPS Paranapanema RR	4.0 d C	22.6 efg AB	33.3 abcd A	4.0 c C	14.0 def BC	20.3 (D)
Fepagro 37 RR	43.3 ab A	42.6 bcd A	42.6 aA	18.0 bc B	16.0 def B	44.8 (D)
FPS Solimões RR	4.0 d C	27.3 defg A	20.0 cdef AB	14.0 bc BC	17.3 def AB	23.2 (D)
Fepagro 36 RR	16.0 cd B	29.3 defg A	13.3 ef B	12.0 bc B	12.0 def B	43.6 (D)
FPS Netuno RR	24.0 c BC	45.3 bc A	16.0 ef C	35.3 a AB	13.3 def C	31.5 (D)
FPS Iguaçu RR	13.3 cd ABC	18.6 fgh AB	12.0 ef BC	25.3 ab A	4.0 f C	2.46 (D)
FPS Urano RR	6.6 d C	20.6 efg B	34.0 abc A	24.0 ab AB	14.6 def BC	10.6 (D)
FPS Júpiter RR	14.6 cd B	36.0 bcde A	37.3 ab A	22.6 ab B	22.6 cde B	62.9 (D)
AMS Tibagi RR	28.0 bc B	30.0 cdef B	23.3 bcde B	10.0 bc C	44.0 aA	27.2 (D)
BMX Magna RR	56.0 aA	68.0 aA	15.6 ef C	18.0 bc C	34.0 abc B	21.6 (D)
A 6411 RG	55.3 aA	45.3 bc AB	12.6 ef D	35.3 a C	24.0 cde CD	20.1 (D)
BMX Apolo RR	22.6 c AB	30.6 cdef A	18.0 def B	25.3 ab AB	26.6 bcd AB	76.6 (D)
BMX Potência RR	24.0 c AB	28.0 defg A	18.0 def AB	14.6 bc B	27.3 bcd A	62.4 (D)
BMX Alvo RR	24.0 c AB	22.6 efg B	35.3 abc A	14.6 bc B	26.6 bcd AB	54.6 (D)
Roos Camino RR	16.0 cd AB	21.3 efg A	15.3 ef AB	4.0 c B	14.6 def AB	23.9 (D)
BMX Ativa RR	4.0 d B	4.0 h B	12.6 ef AB	21.3 ab A	20.0 cde A	13.3 (D)
NA 5909 RG	4.0 d C	19.3 fgh B	37.3 ab A	24.0 ab B	21.3 cde B	2.7 (D)
BMX Turbo RR	5.3 d B	22.6 efg A	16.0 ef AB	21.3 ab A	10.6 ef AB	14.3 (D)
TMG 7161 RR	5.3 d C	14.0 gh BC	6.6 f C	22.6 ab B	40.0 ab A	33.4 (D)
CV (%)	23.84					α=0.95

* Means followed by the same letter in the column for genotypes , and capitalized on the line for production environments the seeds did not differ statistically Tukey at 5% probability. * F to favorable environments. * D for harsh environments . * Wi Annicchiarico method (1992)

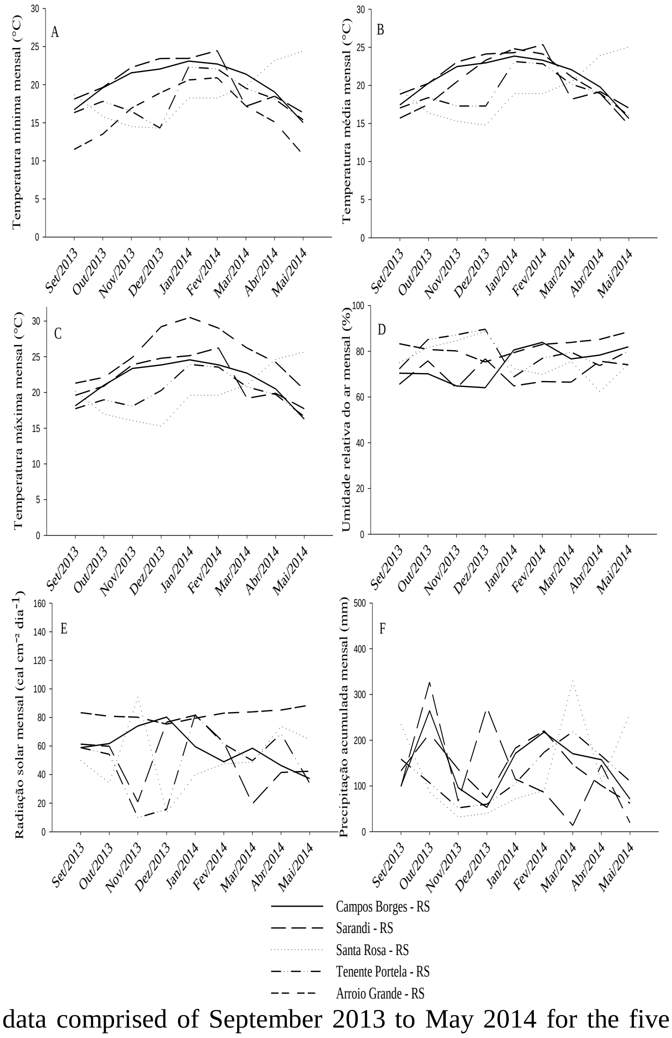

Fig. 1: Meteorological data comprised of September 2013 to May 2014 for the five cultivation environments geared to soybean production (G.max).

Conclusions:

The character seedlingemergence is the most affected by the interaction genotype *x* cultivationenvironment regarding the production of soybean seeds.

Germination, first germination counting, shoot length and primary root length have a greater phenotype stability when assessed by the Annicchiarico method.

The genotype BRS Tordilha RR is the most phenotype-stable genotype.It is superior regarding first germination counting, shoot length and primary root length.

The cultivation environments Tenente Portela-RS, Campos Borges-RS and Arroio Grande-RS are favorable for seedling dry mass, shoot length and primary root length.

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