Universidade Federal Rural do Semi-Árido
Pró-Reitoria de Pesquisa e Pós-Graduação
http://periodicos.ufersa.edu.br/index.php/sistema

ISSN 0100-316X (impresso)
ISSN 1983-2125 (online)

# PRODUCTION AND PHYSIOLOGICAL QUALITY OF SOYBEAN SEEDS IN ORTHIC QUARTZARENIC NEOSOIL OF THE CERRADO REGION[1]

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**ABSTRACT** - The aim of this study was to evaluate the effect of the sowing periods in production, productivity component and physiological quality of seeds of three soybean cultivars (TMG133RR, P98Y70RR and NS7670RR) in Orthic Quartzarenic Neosoil in the cerrado region. The design used was a randomized block a factorial scheme design with four repetitions, and each plot with useful space consisted of three rows of four meters length, spaced at 0.45 meters. Field evaluations were the final stand, the height of the plants, height of the first pod insertion, the mass of 100 seeds and productivity. Already in the lab seeds were evaluated for germination and vigor (first germination count, emergency, emergence speed index, length and dry mass of the aerial part of the plant and roots, electrical conductivity, accelerated aging and tetrazolium test). It concludes that it is possible to use Orthic Quartzarenic Neosoils, located in the Cerrado region at altitudes higher than 600 m, in years and places with good water distribution in the spring-summer seasons, for grain and soybeans production, but as a first goal, the crop should be sown in the first 20 days of November otherwise it should take place in early December.

**Keywords**: *Glycine max* (L.) Merrill. Vigor. Sowing period.

# PRODUÇÃO E QUALIDADE FISIOLÓGICA DE SEMENTES DE SOJA EM NEOSSOLO QUARTZARÊNICO ÓRTICO EM REGIÃO DE CERRADO

**RESUMO** - O objetivo deste trabalho foi avaliar o efeito de épocas de semeadura na produção, componentes de produtividade e qualidade fisiológica de sementes de três cultivares de soja (TMG133RR, P98Y70RR e NS7670RR) em Neossolo Quartzarênico Órtico na região do cerrado. O delineamento utilizado foi em blocos casualizados num esquema fatorial com quatro repetições, sendo cada parcela com área útil constituída por três linhas com quatro metros de comprimento, no espaçamento de 0,45 m. As avaliações no campo foram estande final, altura de plantas, altura de inserção da primeira vagem, massa de 100 sementes e produtividade. No laboratório, as sementes foram avaliadas quanto à porcentagem de germinação e vigor (primeira contagem de germinação, emergência, índice de velocidade de emergência, comprimento e massa seca de parte aérea e raiz, condutividade elétrica, envelhecimento acelerado e tetrazólio). Conclui-se que é possível a utilização de Neossolos Quartzarênicos Órticos, localizados em região de cerrado com altitude superior a 600 m, em anos e locais com boa distribuição hídrica na primavera-verão, para produção de grãos e sementes de soja, sendo que no primeiro objetivo, a cultura deve ser semeada nos primeiros 20 dias de novembro e no segundo caso, essa deve ocorrer no inicio de dezembro.

**Palavras chave**: *Glycine max* (L.) Merrill. Vigor. Época de semeadura.

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# INTRODUCTION

Soybean (*Glycine max* (L.) Merrill) is the most important oilseed and has economic value in national and international markets (SILVA et al., 2006); therefore, producing and using high quality seeds are very important to the success of this culture. The cultivation of soybean in Brazil is highlighted in the grains scenario, as it is one of the basic foods, and consists of an accessible source of protein and minerals for the general population.

The legume is currently the subject of an intense research activity that aims to obtain information enabling the increase of productivity (SCHEEREN et al., 2010). The investment in the growth of cultivars with higher yield potential and resistance to adversity along with the adoption of more appropriate techniques for soil management such as no-tillage systems and crop-livestock integration has improved the performance and helped to leverage the soybean production in the country, increasing the questions about the possibility of cultivating in areas previously considered unsuitable for crops such as Orthic Quartzarenic Neosoils. However, as new materials are released, it is essential to study their behavior depending on the time of sowing, especially in areas considered of major climate risk. According to Guimarães et al. (2008), this is an important variable that can interfere significantly with the development and production yield of the crop.

For Brazilian conditions, the sowing time varies depending on the cultivar, region and environmental conditions of the agricultural year, generally presenting a recommended range from October to December. While growing lots with the purpose to produce seeds it is desired that the phases of maturation and harvesting do not coincide with periods of high temperature and heavy rain, as these events trigger a series of deteriorating and limiting factors for harvesting high-vigor seeds.

The production of high-quality seeds is one of the challenges raised in the soybean cultivation are-as, especially in areas that are new to the cultivation of legumes, with low clay content. Whereas the performance of soybean is influenced by many environmental factors, such as rainfall, temperature, soil moisture, relative humidity, and mainly due to the sensitivity to the photoperiod, sowing time has a decisive influence on the amount and the quality of production (MOTTA et al., 2002). However, it is not always that the sowing period recommended for good productivity coincides with the production of satisfactory quality seeds.

Although research work is being carried out in various soybean-producing areas of the country, in order to establish the most appropriate sowing period for the production of seeds (MOTTA et al., 2002; DALLACORT et al., 2008), these studies are important, trying to establish better conditions for obtaining better quantity and quality of seeds (ALBRECHT et al., 2009).

This study aimed to evaluate the effect of the sowing periods in production, productivity component and physiological quality of seeds of three soybean cultivars in Orthic Quartzarenic Neosoil in the cerrado region.

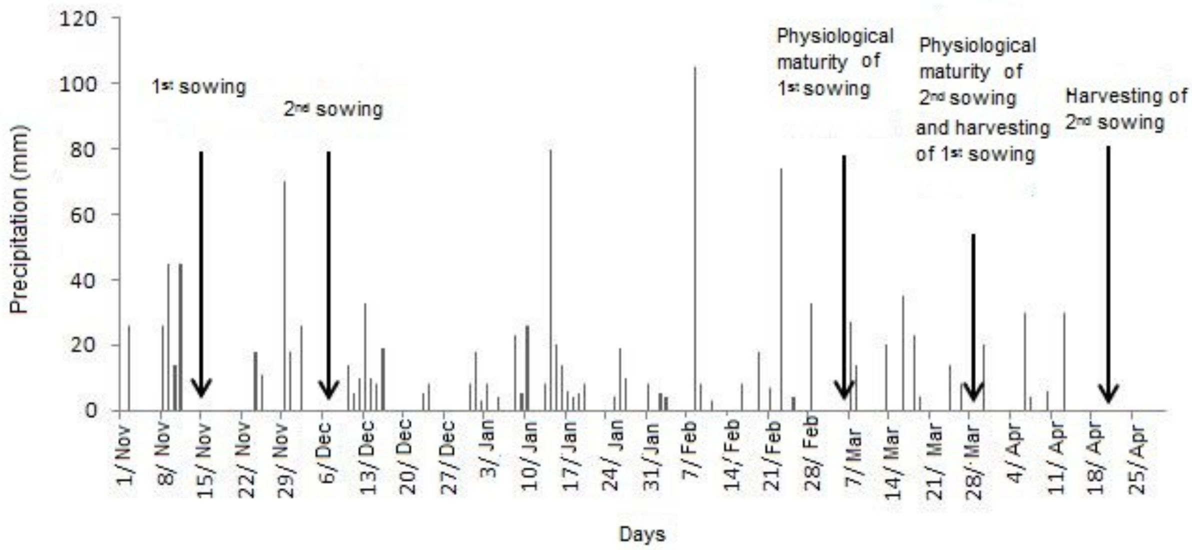
# MATERIAL AND METHODS

The work was carried out in a partnership between the Agricultural Research Support Foundation (Chapadão Foundation), the Kirei farm located in the municipality of Paraíso das Águas, northeast of the State of Mato Grosso do Sul, and the Federal University of Mato Grosso do Sul (UFMS), Campus of Chapadão do Sul.

The location of the experiment shows geographical coordinates of approximately 20º26'S, 52º52'O and altitude of 703 m. The climate is Aw, according to KOEPPEN climate classification, and the annual precipitation ranges from 1200 to 1500 mm, with a dry period of four to five months, with more intense rains from November to February. The soil of the site has a sandy texture and is classified in the Brazilian System of Soil Classification (SANTOS et al., 2013) as Orthic Quartzarenic Neosoil, presenting low natural fertility characteristics, deepness, excessive draining and low water holding capacity.

Treatments consisted of three soybean culti-vars (TMG133RR, P98Y70RR, and NS7670RR) and two sowing periods: first period (11/15/2012) and the second period (12/07/2012). The soybeans were cultivated in a no-tillage system, with planting on *Crotalaria spectabilis* straws and the rainfall data from all the experimental period (Figure 1) were recorded.

The plots consisted of five lines ten meters long, spaced 0.45m from one another, considering as useful space only the three central rows with four meters long. For treating the seeds, it was used 100 mL $ha^{-1}$ of Standak Top and 100 mL $50kg^{-1}$ seeds of liquid inoculant for soybean - Strains: SEMIA 5019 (*Bradyrhizobium elkanii*) and SEMIA 5079 (*Bradyrhizobium japonicum*). In the sowing, 12 to 13 seeds per meter were used with a spacing of 0.45m; for fertilization, 300 kg $ha^{-1}$ of the 02-20-10 formula was used in sowing and 100 kg $ha^{-1}$ of KCl was used in top-dressing fertilization. The plots received the same treatments on weed control, application of fun-gicides and insecticides, using doses and application intervals as needed.




At the end of the cultivation growth, the following agronomic characteristics were accessed: final stand, average height, the height of first pod insertion, the mass of 100 seeds and productivity. In the laboratory, the germination and vigor [ the first count of germination, emergency, emergency speed index (ESI), electrical conductivity (EC), accelerated aging (AA), tetrazolium test (TZ), length and dry mass of the aerial part of the plants (APL) and roots (MAP)] were evaluated.

Final stand: when harvesting, the crops in the floor space of each plot were counted, and the values were used to obtain the number of plants per hectare.

Average height and height of first pod insertion: ten plants were evaluated considered the height (cm) as being the distance between the ground surface and the apical end of the main shaft.

Mass of 100 seeds (g): was performed according to Brasil (2009), by weighing eight replications of 100 seeds per treatment and adjusting for 13% moisture content.

Productivity: The harvest of the experiment was performed manually in each plot when they had 95% of the pods dry. The pods were threshed in a stationary threshing machine and the seeds cleaned with the aid of screens and packed in paper bags for later weighing the production, determination of moisture and calculation of productivity in kg $ha^{-1}$ at 13% moisture content (wet base).

Germination test and first count: it was conducted with four replicates of 50 seeds for each treatment, in germitest paper. The substrate was moistened with water equivalent to 2.5 times the mass of non-hydrated paper and kept in a germinator set at 25 °C, with count conducted five and eight days after sowing.

Electrical conductivity: there were used four replicates of 25 seeds, which were weighed on an analytical balance, placed in plastic cups containing 75 mL of distilled water and kept in a seed germinator at 25 °C of temperature for 24 hours. After this period, it was made the reading of the electrical conductivity of the soaking solution using a digital conductivity meter.

Accelerated aging: it was conducted with 200 seeds per treatment. The seeds were distributed on aluminum screens fixed on the inside of adapted plastic boxes (gerbox functioning as individual compartments or mini-chambers), where it was placed 40 mL of distilled water at the bottom. The boxes were covered and kept in an aging chamber, set at 41 ºC where they remained for 72 h. After this period, the germination test was set, maintained at 25 °C, with the count of the number of normal seedlings five days after the test was set.

Seedling length: four replicates of 20 seeds per treatment were used, and germitest paper rolls were made and taken to the germinator at 25 ºC. The measurement was carried out for seven days to determine the length of the seedlings.

Dry mass of roots and aerial parts: after normal seedlings that were used to determine the seedlings length were evaluated, the root and the hypocotyl were separated with the aid of a blade, packed in paper bags and taken to a forced-air oven at 80 °C for 24 h, for then weighing the dried mass.

Emergency: it was performed using expanded polystyrene box with Plantmax® substrate irrigated twice a day. The evaluation of the seedlings was performed at ten days after sowing, by the count of emerged seedlings, with four replicates of 25 seeds. The emergence speed index (ESI) (counted every day) was evaluated as well as the final emergence percentage at ten days after the sowing in the tray. For calculating the ESI, the formula suggested by MAGUIRE (1962) was used.

Tetrazolium test: two replicates of 50 seeds were used, which remained in moist germitest paper for preconditioning for 16 hours, then placed in a 0,075% solution of 2,3,5- triphenyl tetrazolium chloride at 40 °C for 3 h in the dark. After this process, the vigor of the seeds was evaluated individually, according to França Neto et al. (1998).

The design used was randomized blocks in a factorial scheme 3 x 2 (cultivars x sowing dates) with four replicates. The data were submitted to analysis of variance and analyzed using the Tukey test at 5% probability.

## RESULTS AND DISCUSSION

The final stand was influenced by the sowing periods, and the second period showed values that were higher than the first ones (Table 1). With early sowing period there was a significant decrease in the number of soybean plants, possibly due to water deficiency early in the cycle that made it difficult to soak the seeds and, consequently, the germination was difficult, as the occurrence of rain after the first period was nine days after sowing (Figure 1). According Peske and Delouche (1985), if there is no precipitation over a period of five to ten days after sowing of the crop, usually the seeds in the soil deteriorate to such a level that they will be unable to germinate and emerge even when the low moisture soil condition no longer exists. Another factor that contributes to the reduction in plant population, especially in sandy soils, is the outbreak of *Elasmopalpus lignosellus*, as highlighted by Tomquelski and Leal (2010).

**Table 1**. Final stand (plants. $ha^{-1}$), height of the plants (cm), height of the first pod (cm), mass of 100 seeds (g) and productivity (kg. $ha^{-1}$) of three soybean cultivars in two sowing periods.

| Cultivars (C) | Final stand (plants. $ha^{-1}$) | Plant height (cm) | Height of the first pod (cm) | Mass of 100 seeds (g) | Productivity (kg. $ha^{-1}$) |
|---|---|---|---|---|---|
| TMG133RR | 232,291 | 87.70 | 10.37 a | 15.25 | 3374.71 |
| P98Y70RR | 224,652 | 84.50 | 9.45 a | 16.65 | 3395.87 |
| NS7670RR | 236,458 | 75.79 | 7.25 b | 16.70 | 3272.62 |
| Periods (E) | | | | | |
| November 15 | 200,462 b | 73.94 | 7.72 b | 16.47 | 3499.94 a |
| December 07 | 261,805 a | 91.38 | 10.33 a | 15.93 | 3195.52 b |
| F (C) | $0.50^{ns}$ | $17.09^{*}$ | $11.73^{*}$ | $28.45^{*}$ | $1.35^{ns}$ |
| F (E) | $39.78^{*}$ | $102.61^{*}$ | $23.25^{*}$ | $8.96^{*}$ | $9.79^{*}$ |
| F (C*E) | $0.30^{ns}$ | $11.11^{*}$ | $0.35^{ns}$ | $8.30^{*}$ | $0.51^{ns}$ |
| CV (%) | 10.31 | 5.1 | 14.69 | 2.69 | 8.96 |

Mean values followed by the same letter in the column are not statistically different from each other in Tukey test at 5% probability. * Significant at the 0.05 probability level, ns: not significant.

For the measuring of the plants height, there was an interaction between factors, in which the highest values were present in the second sowing period for the three cultivars (Table 2), differently from the data obtained by Amorim et al. (2011), in which the November sowing provided a greater plant height in comparison to December; and Barros et al. (2003) who found no significant difference in height with respect to the sowing period. In the first period there was no statistical difference between the cultivars; however, in the second period, NS7670RR had a lower height about the other cultivars.

However, for both sowing periods, the height of the plants was adequate as they were taller than 60 cm, which is the minimum for a good mechanical harvesting according Silveira Neto et al. (2005).

According to Mauad et al. (2010), increased plant density provides increased intraspecific competition for light, resulting in a greater height of the plant. The cultivars TMG133RR and P98Y70RR had the highest height of insertion of the first pod, differing from the NS7670RR; and between sowing periods, the second period was taller in this parameter in relation to the first period (Table 1). The insertion of the first pod is an important feature because it determines the adjustment of the harvester's cutter bar height to obtain maximum efficiency in the process. According to Carvalho et al. (2010), the minimum height of the first pod should be 10-12 cm in flat topography soils and 15 cm in the more tilted land. Only cultivar TMG133RR reached the minimum height for flat topography soils. The other cultivars were shorter than 10 cm.

**Table 2**. Breakdown of the interaction between cultivars × sowing periods for plant height, the mass of 100 seeds, emergency, emergence speed index (ESI), root length, dry mass of the root and accelerated aging.

| Cultivars | Plant height (cm) | |
|---|---|---|
| | Nov 15 | Dec 07 |
| TMG133RR | 74.50 aB | 100.91 aA |
| P98Y70RR | 74.91 aB | 94.08 aA |
| NS7670RR | 72.41 aB | 79.16 bA |
| | Mass of 100 seeds (g) | |
| TMG133RR | 15.12 bA | 15.37 bA |
| P98Y70RR | 17.40 aA | 15.90 abB |
| NS7670RR | 16.87 aA | 16.52 aA |
| | Emergency (%) | |
| TMG133RR | 95.0 aA | 92.0 aA |
| P98Y70RR | 86.0 bB | 97.0 aA |
| NS7670RR | 100.0 aA | 93.0 aA |
| | ESI | |
| TMG133RR | 5.21 aA | 4.70 bA |
| P98Y70RR | 4.71 aB | 5.94 aA |
| NS7670RR | 4.96 aA | 5.06 bA |
| | Root length (cm) | |
| TMG133RR | 5.36 aA | 4.39 abB |
| P98Y70RR | 5.18 aA | 5.19 aA |
| NS7670RR | 5.07 aA | 3.44 bB |
| | Dry mass of the root (g) | |
| TMG133RR | 0.0448 aA | 0.0213 aB |
| P98Y70RR | 0.0217 bA | 0.0326 aA |
| NS7670RR | 0.0364 abA | 0.0287 aA |
| | Accelerated aging (%) | |
| TMG133RR | 77.0 aA | 64.0 bB |
| P98Y70RR | 65.0 bB | 80.0 aA |
| NS7670RR | 83.0 aA | 76.0 aA |

Mean values followed by the same letter, in lowercase in the column and uppercase in the line, do not differ by Tukey test at 5% probability.

The interaction between the factors was significant for the mass of 100 seeds, and for productivity there was an effect of sowing periods (Table 1). In November sowing (Table 2), the cultivars P98Y70RR and NS7670RR presented the highest mass for 100 seeds, differently from TMG133RR. In the second time, again NS7670RR did not differ from P98Y70RR, and the latter did not differ from TMG133RR. The only cultivar that showed a difference in the mass of 100 seeds between the sowing periods was P98Y70RR, which was cultivated the first period and excelled about the second period (Table 2).

The productivity was influenced by the sowing period, as there was a reduction of 8.7% in December sowing. Even with a small number of plants per hectare, the productivity of the cultivars sown in November stood out; this fact may be related to the moderate energy expenditure of the plants subjected to higher density for the effective filing of grains, and to the fact that short stature cultivars have lower intraspecific competition for light and more energy can be allocated to achieve high grain mass (Table 1). This data are in agreement with Komori et al. (2004), who found that regardless of the cultivar or maturation cycle, in December soybean crop there was a significant reduction of production in comparison to November. Similarly, Fieltz and Rangel (2008) analyzing the factors of water deficit and photoperiod together, stated that November sowings are more suitable for the production of soybean in the region of Dourados-MS.

There was no statistical difference in the first count and germination (Table 3). As for emergency and ESI, there was interaction between the factors. The emergency test showed that seeds of the cultivar P98Y70RR, when sown in November, had lower quality, while the cultivar NS7670RR showed the most vigor, without a significant difference from TMG133RR. However, when sown in December, there was no statistical difference among cultivars (Table 2).

**Table 3**. Germination, first germination count (FGC), emergency and emergence speed index (ESI) of three soybean cultivars in two sowing periods.

| Cultivars (C) | Germination (%) | FGC (%) | Emergency (%) | ESI |
|---|---|---|---|---|
| TMG133RR | 92.00 | 89.00 | 94.00 | 4.95 |
| P98Y70RR | 89.00 | 89.00 | 92.00 | 5.33 |
| NS7670RR | 92.00 | 88.00 | 97.00 | 5.01 |
| Periods (E) | | | | |
| November 15 | 94.00 | 92.00 | 93.66 | 4.96 |
| December 07 | 88.00 | 86.00 | 94.00 | 5.23 |
| F (C) | $0.45^{ns}$ | $0.04^{ns}$ | $2.25^{ns}$ | $1.40^{ns}$ |
| F (E) | $4.22^{ns}$ | $2.94^{ns}$ | $0.02^{ns}$ | $1.94^{ns}$ |
| F (C*E) | $0.60^{ns}$ | $1.64^{ns}$ | $7.96^{*}$ | $6.81^{*}$ |
| CV (%) | 7.64 | 9.94 | 5.05 | 9.39 |

Mean values followed by the same letter in the column are not statistically different from one another in Tukey test at 5% probability. * Significant at the 0.05 probability level, ns: not significant

In relation to ESI, there was no statistical difference among cultivars in the first sowing; however there was a significant difference for cultivar P98Y70RR in December sown with the best performance, and there was no significant difference between cultivars NS7670RR and TMG133RR. Cultivar P98Y70RR presented differences in the two periods, and when sown in December, it reached the highest ESI values (Table 2).

In the evaluation of vigor by APL and MAP, it was observed that there was no statistical difference between the sowing periods (Table 4). The cultivar NS7670RR showed the highest values, not differing from TMG133RR. The test for measuring seedling length or any of its part has been considered efficient to detect differences in physiological quality of seeds of various species, including soybeans.

**Table 4**. Aerial part length (APL), root length (RL), dry mass of aerial part (MAP), dry mass of root (MR), electrical conductivity (EC), accelerated aging (AA) and tetrazolium test (TZ) of three soybean cultivars in two sowing periods.

| Cultivars (C) | APL (cm) | RL (cm) | MAP (g) | MR (g) | EC ($\mu S.cm^{-1}.g^{-1}$) | AA (%) | TZ (%) |
|---|---|---|---|---|---|---|---|
| TMG133RR | 4.05 ab | 4.87 | 0.1150 ab | 0.0330 | 74.33 b | 70.25 | 82.50 a |
| P98Y70RR | 3.40 b | 5.19 | 0.0885 b | 0.0271 | 96.63 a | 72.00 | 61.50 c |
| NS7670RR | 4.97 a | 4.26 | 0.1656 a | 0.0325 | 75.88 b | 79.25 | 75.50 b |
| Periods (E) | | | | | | | |
| November 15 | 4.29 | 5.20 | 0.1309 | 0.0342 | 82.94 | 74.66 | 72.00 |
| December 07 | 3.99 | 4.34 | 0.1151 | 0.0275 | 81.62 | 73.00 | 74.33 |
| F (C) | $7.04^{*}$ | $5.82^{*}$ | $3.98^{*}$ | $0.53^{ns}$ | $19.56^{*}$ | $4.71^{*}$ | $51.32^{*}$ |
| F (E) | $0.73^{ns}$ | $14.52^{*}$ | $0.48^{ns}$ | $1.70^{ns}$ | $0.16^{ns}$ | $0.43^{ns}$ | $1.83^{ns}$ |
| F (C*E) | $0.89^{ns}$ | $4.44^{*}$ | $0.66^{ns}$ | $3.68^{*}$ | $0.39^{ns}$ | $11.09^{*}$ | $0.59^{ns}$ |
| CV (%) | 10.3 | 11.6 | 15.1 | 11.1 | 9.7 | 8.427 | 5.8 |

Mean values followed by the same letter in the column are not statistically different from one another in Tukey test at 5% probability. * Significant at the 0.05 probability level, ns: not significant.

The root length system of soybean seedlings showed better growth in the first period, except for the cultivar P98Y70RR, which did not show any difference in the two periods. When sown in November there were no differences between cultivars, but in December, P98Y70RR differed from NS7670RR, but not from TMG133RR, which did not differ from NS7670RR (Table 2).

Analyzing MR, it was found that the cultivar TMG133RR, when sown in November, presented higher values about December. In the first period, TMG133RR showed higher values but did not differ from NS7670RR. In December, however, there was no difference in the dry mass of the cultivars' roots

(Table 2).

In the EC tests, there were only statistical differences among cultivars. The cultivar TMG133RR did not differ from NS7670RR, presenting lower values, indicating a lower degree of deterioration (greater vigor) compared to P98Y70RR (Table 4). Vieira et al. (2004) found that seeds with values up to 90 µS. $cm^{-1}$. $g^{-1}$ may provide satisfactory performance in field conditions that are under ideal conditions. TZ test showed that there was also no influence of the sowing period on the vigor of the seeds evaluated by this technique (Table 4). The cultivar TMG133RR showed greater vigor, differing significantly from the other cultivars, and P98Y70RR showed the lowest vigor.

The interaction was significant for the AA test, in which in the November sowing, the cultivars TMG133RR and NS7670RR presented the highest values, not differing from each other; in December, NS7670RR did not differ from P98Y70RR and showed the highest values (Table 2). This test is interesting because lower quality seeds, when submitted to high temperature and humidity, deteriorate faster than the vigorous ones and show a lower standard germination after the accelerated aging period.

Even though the cultivar P98Y70RR presented high productivity and a significant gain in grain weight when sowed in the first period, resulted in low-quality seeds evaluated by AA. Therefore, this variety is more sensitive to adverse conditions (high humidity and high temperature after physiological maturity) to obtaining high-quality seeds, and TZ test and accelerated aging test are good indicators of seed quality for this variety. Therefore, for this region, the sowing period recommended for good yield does not match the period indicated to obtain high-quality seeds.

With the objective of producing grains for the region, Anselmo et al. (2011), after evaluating the interaction of 20 soybean genotypes in eight environments, showed that the period of sowing and edaphic-climatic factors were decisive for grain yield, sowings carried out until 20 November, regardless of soil characteristics allowed for higher grain yield, and clayey soils are more favorable. However, despite the low water retention of Orthic Quartzarenic Neosoils, they have the potential of producing soybeans that are superior to 3400 kg $ha^{-1}$. Such productivity was found in this study and also by Anselmo et al. (2011) until November 20. However, soybean planting to produce seed should be made at a later period.

This productivity may be related to the amount of rainfall after the physiological maturity of seeds. When the seeds were sown in November there was a higher volume of precipitation (145 mm) between physiological maturity (March 6) and the harvest; while in December sowing, in this phase, it rained 90 mm (Figure 1), being likely that soybean seeds have benefited from the reduction of precipitation close to the harvesting phase in the second period. However, more studies assessing the quality of seeds about sowing dates and genotype-environment interaction should be carried out, as late sowing can influence the storage of reserves (oil and protein) in the seeds.

Environmental factors, such as high temperature and water stress, which may be associated with planting in a later period, affect the yield and seeds mass. This may have happened with December sowing, but the reduction of the seeds' mass, and possibly their reserves, did not affect their quality as in the two periods evaluated, and they were more influenced by the climatic characteristics in the period between physiological maturity and harvest. According to Hu and Wiatrak (2012), the reduction of seed mass occurs because air temperatures above the ideal promote a reduction in the photosynthetic rate. Furthermore, the occurrence of water stress during the reproductive stage reduces the production of photoassimilates, affecting the vegetative growth and increasing the abortion of flowers and pods. However, sowing in December in this region provided adequate temperature and photoperiod in a vegetative growth period, not promoting growth reduction for the tested cultivars.

Despite the fact that the literature points out that one of the downsides of late sowing for seed production is the difficulty with mechanical harvesting due to the reductions in plant height and height of first pod insertion (PELÚZIO et al., 2006; STÜLP et al., 2009), this does not occur when soybeans are sown in early December. However, it is noteworthy that to do that it is necessary to adequate correction and fertilization, and the adoption of a no-tillage system with cover crops cultivation in autumn-winter.

# CONCLUSION

It is possible to use Orthic Quartzarenic Neosoils for the production of soybean grains and seeds, but for the first objective, the culture should be sown in the first 20 days of November, and in the second case, it should occur at the beginning of December.

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