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LEVELS OF UREA FERTILIZER ON GERMINATION AND VIGOR OF *UROCHLOA BRIZANTHA* cv PIATÃ SEEDS

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ABSTRACT

The use of high-quality seeds is a premise for the implantation of pasture under sustainable farming systems to livestock production. The usual practice is to mix Urochloa seeds with nitrogenous to use these inputs. The objective of this study was to evaluate the effect of contact time (0, 3, 6, 12, 24, 48, and 72 hours) and amounts (50, 100, and 150 kg N^{-1}) of urea on Urochloa brizantha seeds physiological quality. A completely randomized experimental design was used, with three replicates. Seedling emergence, germination of normal and abnormal seedlings, and dead seeds were evaluated. It was found that after 3 hours of contact, all seeds lose quality. The number of dead seeds presented a significant ($p < 0.001$) and negative correlation (91.7%) for the number of normal seedlings. The mix ratio between urea and seed affects the seed deterioration index, expressing lower seedlings emerged, concerning control treatment. The highest level of urea (150 kg N^{-1}) decreased the emergence index by 23.3% related to the use lowest dose (50 kg N^{-1}). It is concluded that the reduction in viability and vigor begins after 3 hours of contact with fertilizers, so the number of unviable seeds highly increases after 48-hours of contact.

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INTRODUCTION

The pasturage is major agricultural land use in Brazil, largely cultivated with grasses of the genus Urochloa (syn: *Brachiaria spp*). Among these areas, significant part is under advanced process of agronomic and biological degradation (Torres *et al*., 2019; Valle Junior *et al*., 2019). Many areas are located in low fertility soils, or are degraded due to improper management practices use. It is known that integration of crop and livestock systems represents a rational production alternative that promotes the recovery of pastures, which several benefits to farm activity are generated (Carvalho *et al*., 2018). The integrated systems increase straw input, boosting organic matter that promotes high water and nutrient retention capacity, providing better forage plant development conditions, optimizing the water and soil efficiency use (Lopes, Guilherme 2016; Moraes *et al*., 2016; Philp *et al*., 2019).

In order to implement integrated systems, a technique used is intercropping of annual plants with grasses, often, in the Brazilian Cerrado, using maize, sorghum and soybean with brachiaria (Cagna *et al*., 2019). In simultaneous intercropping systems, an alternative of implantation is the joint sowing of the brachiaria and the application of mineral fertilizers, which may be during the implantation of the graniferous crop or over-sowing during the side dressing (Mateus *et al*., 2016; Almeida *et al*., 2017). Side dressing nitrogen fertilization is a consolidated agronomic practice for several crop species (Spackman *et al*., 2019), as it provides nutrientsat the most appropriate time, associating the plant demand (Panison*et al*., 2019). Species of the Urochloa genus can be sown in both cases, direct sowing and side dressingfertilization on corn crop (Dan *et al*.; 2011). Sowing brachiaria after the establishment of the main crop aims to establish a pasture with high bromatological value and biomass yield (Taffarel *et al*., 2018), with less interference inthe yield of the main crop and save in

the same time, labor and fuel. The use of seeds with high physiological quality is one of the requirements for the formation of a well-established crop (Johann *et al*., 2019). In this context, the mixture of seeds with fertilizers represents a stress factor and an increase in seed deterioration rate (Amaral *et al*., 2019). Mineral fertilizers have several characteristics that promote decrease in seed physiological quality (Mateus *et al*., 2007) causing loss of viability and vigor (Lima *et al*., 2010). The objective of this study was to evaluate the viability and physiological quality of *Urochloa brizantha* cv Piatã seeds under several contact periods and doses of urea.

MATERIAL AND METHODS

High quality seed of *Urochloa brizantha* (*Brachiaria brizantha*), cv Piatã, were used as sowing materials. A nitrogen fertilizer, urea, containing 46% N, with a salinity index of 76% in relation to sodium nitrate was used to mix with the seeds. For the definition of the proportions a sowing rate for *Urochloa brizantha*, pure seeds presenting 90% of viability value were used. The tested proportions between seeds and fertilizer were based on the mass of each component. In the case of fertilizer, we used the recommendations for different regions and conditions of corn production (Ribeiro *et al*., 1999; Souza and Lobato, 2004, Comissão…, 2004; Pauletti and Motta, 2017). In this sense, the effects of six contact times (3, 6, 12, 24, 48 and 72 hours) were evaluated associated to three proportions of pure seeds with urea (50, 100 e 150 kg de N ha^{-1}) on viability (germination) of the seeds and seedling vigor. An additional treatment of *Urochloa* seed without exposure to fertilizer as control treatment (control) was inserted using a completely randomized statistical design. Emergence test was performed using trays containing sandy soil (16% clay) from a pasture area in advanced degree of agronomic and biological degradation.

The seeds were also arranged in gerbox boxes between two moist paper inside germinators under a controlled photoperiods and temperatures regime to the evaluated specie (8 hours of radiation at 35 °C and 16 hours in the absence of light at 20 °C). The trays were placed in a growth chamber simulating the night temperatures of 20ºC and daytime temperatures of 35ºC, appropriate for the *Urochloa*. The experimental plot consisted of fifty viable and pure seeds. The seeds were previously and manually separated. The separation of the seeds from the fertilizer, after the contact periods evaluated, was performed by wet way, using deionized water. The seeds were subsequently removed from the water using sieve and dried on paper towels under controlled conditions (25ºC). At the end of 21 days, the number of emerged seedlings and dead seeds, abnormal and normal seedlings were determinized in the germination assay (Brasil, 2009). The measured values were transformed into percentages. Abnormal seedlings were considered as those that did not present all primary structures, disproportion among them and shoot or root length less than 20mm. Normal seedlings are those fully developed. The agronomic efficiency of the treatments was verified by the relationship between the values obtained from germination and emergence in beds in relation to the additional treatment, control, without the addition of urea (control). Normality of the residues was verified using the Shapiro Wilk normality test. The analysis of variance was applied, followed by Scott knott test and regression with surface response application.

RESULTS AND DISCUSSION

The viability and vigor of the brachiaria seeds were influenced by the treatments. Exposure time affected all variables analyzed, except the percentage of dead seeds. In turn, effects of urea levels in the mixture for the proportion of germination seedlings and dead seeds were observed. The effect of factor interaction, on any variable, was not verified. The control treatment, without contact with urea, did not differ in germination and abnormal seedling proportions, however in emergence and dead seeds differed significantly (Table 1). All measured parameters negatively affected *Urochloa brizantha* cv.

Table 1. Analysis of variance for seedling emergence, germination, abnormal seedlings and dead seeds of *Urochloa brizantha* Piatã under different contact times and urea doses

Sourceofvariation	DF	Emergence	Germination	Abnormal seedlings	deadseeds
Nitrogenlevels(N)	2	560,16^{NS}	802,31**	5,0478^{NS}	784,01**
Times (T)	5	4437,06**	344,25*	216,61**	146,05^{NS}
N x T	10	616,96^{NS}	113,76^{NS}	8,7478^{NS}	120,28^{NS}
(Factorial)	17	1733,8**	262,56*	69,45^{NS}	205,95*
Addit. vs. Factorial	1	6945,64**	300,03^{NS}	43,99^{NS}	573,82*
(Treatment)	18	2023,38**	264,64*	68,03^{NS}	226,38**
Error	57				
Total	75				

*, **and ^{NS} represent significance at 5 and 1% by the F test and not significance, respectively.

Table 2. Emergence in sand (EMER), germination percentage (GER), abnormal seedlings (AS) and dead seeds (DS)of *Urochloa brizantha*piatãunder urea doses

Levels (N ha^{-1})	EMER	GER	AS	DS
			%	
50	47.96 a	52.54 a	6.54 a	42.92 a
100	42.54 a	54.26 a	5.63 a	40.11 a
150	36.80 b	43.50 b	6.11 a	36.80 b
Piatã (no N)	91.86	59.00	9.50	31.50

Means followed by the same letters, in the column, do not differ from each other by the Scott-Knott test ($p < 0.05$)

Piatã seeds, compared to the values observed for seeds without contact with the fertilizer. However, a distinct behavior of the effect of fertilizer on their respective mixtures was observed. The lower proportions of urea did not differ significantly for seedling emergence and germination index. In turn, increase proportion of nitrogen fertilizer, especially at the highest level, decreased both the number of normal seedlings in germination

and the number of normal seedlings emerged in the sand (Table 2). These results suggest that the increase in osmotic potential around the seeds, due to the high saline concentration of urea, promotes dehydration and hinders the absorption of water by seeds, affecting emergence and germination processes (Mateus *et al*., 2016). Seeds of *Urochloa brizantha* cv Piatã decrease approximately 41% of emergence, losing around 50% of vigor initially observed (91.86%) after 3 hours of contact with urea (Figure 1). The loss of viability and vigor has been found in the literature for several forage plant species evaluated after different exposure times to different mineral fertilizers (Mateus et al., 2007, Dan et al., 2011, Peres et al., 2012, Codognoto et al., 2019; Maciel et al., 2019). However, no studies were found showing variations on physiological quality in function of levels of fertilizer used in the mixture, especially using seeds of high levels of purity and viability (over 95% or higher).

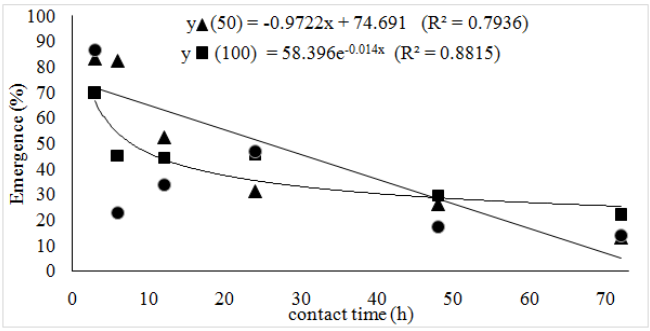

Figure 1. Emergence (%) of *Urochloa brizantha* cv piatã seeds in sand soil under seed/urea mix proportions and contact times

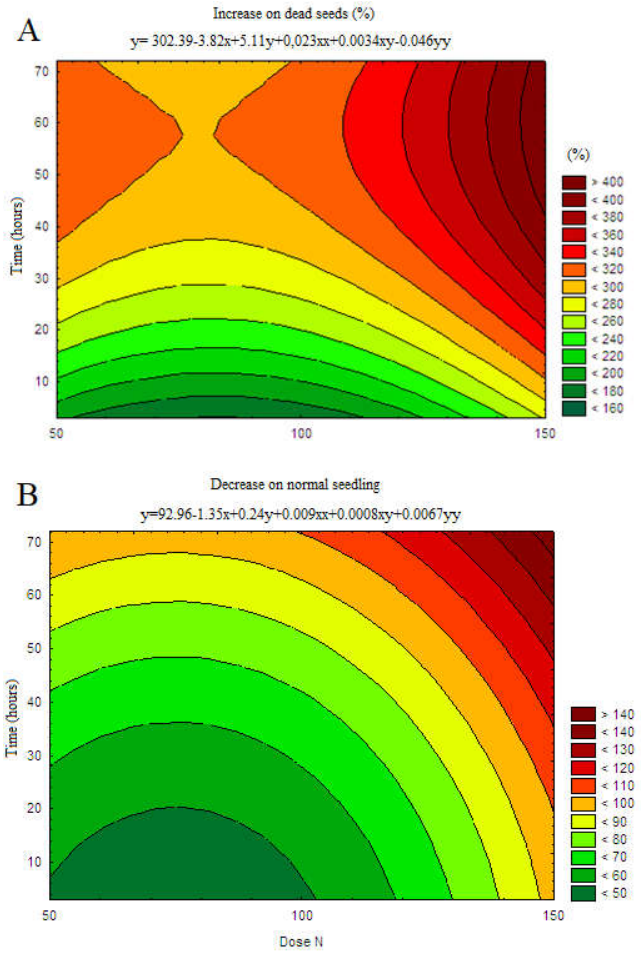

Figure 2. Isolines for increases in the percentage of dead seeds (A) and normal seedlings (B) by the combination of nitrogen doses and contact times between *Urochloa brizantha* Piatã seeds and urea

The seeds of the *Urochloa brizantha* Piatã showed a pronounced loss of vigor due to time and not to the higher fertilizer dose (Figure 1). Similar result was found in seeds of *Urochloa ruziziensis* by Codognoto et al. (2019) who observed linear losses on *Urochloa* emergence. In turn, Dan et al. (2011) observed in lot with lower quality alinear lossin vigor of ruziziensis seeds by the increasing contact of urea. A depletive effect on seed germination was verified as a function of the contact time of the seeds with the nitrogen fertilizer and in relation to the seed / urea mixture ratio (Figure 2). Both tested factors (urea and time) increased the percentage of non-germinated seeds (dead), and the decrease in the percentage of normal seedlings. The higher amount of mineral fertilizers can promote around the seeds an electrolytic gradient impacting the osmotic potential at seeds surfaces. Under these stress conditions, seeds can increase the formation of reactive oxygen species (ROS), which are highly deleterious to cells and tissues when at high levels, and can promote oxidation of DNA, proteins, cell membranes, and, in cases more severe, cell death (Soares and Machado, 2007; Kokila et al., 2014). The intensification of ROS production, which can reach toxic levels and, thus, promote membrane peroxidation, electrolyte leakage, cell death and, consequently, reduce seedling germination and vigor (Tunes et al., 2011). The values of the correlation coefficients obtained between the test results are shown in Table 3. Highlighting the results obtained in the normal seedlings and dead seed tests, it was found that there was a negative and significant correlation (r = -0.83). For germination, there was a significant and positive correlation between the results of abnormal seedling decrease and dead seeds. In summary, it could be observed that correlation coefficients were highly significant between the dead seed and normal seedling decreasing. The lowest correlation coefficients were observed between the results of the decrease of normal and abnormal seedlings.

Conclusion

The vigor of *Urochloa brizantha* cv Piatãdecreases logarithmically in contact with urea. It is recommended to use the mixture of the seeds/urea within the first 3 hours of contact under a storage environmental conditions of 25ºC and the use of a high physiological quality seed lot. The amount of urea in the blend affects the viability and vigor of *Urochloa brizantha* cv Piatã seeds.

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