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Germination and vigor of buffel grass seeds stored in environmental conditions

Germinação e vigor de sementes de capim-buffel armazenadas em condições ambientais

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ABSTRACT: One of the main limitations for the cultivation of forages refers to seed dormancy, which can compromise the emergence of seedlings in the field and the establishment of pastures. Therefore, the objective was to evaluate the germination and vigor of buffel grass seeds cv. Aridus stored under environmental conditions. The experimental design used was completely randomized, with six evaluation periods (0, 6, 12, 18 and 24 months after harvest) and four replications. Right after the harvest, and at each evaluation period, the seeds were evaluated for water content, germination and vigor. The water content of the seeds did not differ. There were increases in the percentage of seed germination from the initial evaluation period up to 17.96 months, reaching an estimated maximum value of 62.74%. The buffel grass seeds showed progressive increases in seedling emergence and in the emergence speed index (IVE) evaluated over the storage time. It is recommended that pastures of buffel grass cv. Aridus are formed using seeds stored between 13.97 to 18.98 months under environmental conditions, as they present greater germination and vigor.

Keyword: *Cenchrus ciliares* L. Dormancy. Pastures. Storage.

RESUMO: Uma das principais limitações para o cultivo de forrageiras refere-se à dormência das sementes, que pode comprometer a emergência das plântulas no campo e o estabelecimento das pastagens. Portanto, objetivou-se avaliar a germinação e o vigor de sementes de capim-buffel cv. Aridus armazenadas em condições ambientais. O delineamento experimental utilizado foi inteiramente casualizado, com seis épocas de avaliação (0, 6, 12, 18 e 24 meses após a colheita) e quatro repetições. Logo após a colheita, e em cada época de avaliação, as sementes foram avaliadas quanto ao teor de água, à germinação e ao vigor. Os teores de água das sementes não diferiram entre si. Foram verificados acréscimos na percentagem de germinação das sementes do período inicial de avaliação até 17,96 meses, atingindo um valor máximo estimado de 62,74%. As sementes de capim-buffel apresentaram aumentos progressivos na emergência de plântulas e no índice de velocidade de emergência (IVE) avaliados ao longo do tempo de armazenamento. Recomenda-se que pastagens de capim-buffel cv. Aridus sejam formadas utilizando-se sementes armazenadas entre 13,97 a 18,98 meses em condições ambientais, por apresentarem maior germinação e vigor.

Palavras-chave: *Cenchrus ciliares* L. Dormência. Pastagem. Armazenamento.

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INTRODUCTION

The convenience of pasture exploitation and lower production costs for this type of food, compared to the concentrated foods used in confinements, among other factors, justify the utilization of pastures as the main source of food for ruminants in the country.

With the purpose of establishing pastures that can effectively increase the exploitation of livestock in the Brazilian Semiarid, numerous grasses have been used, with varying degrees of success, among which buffel grass (*Cenchrus ciliares* L) stands out, a grass that has the greatest potential forage under semi-arid conditions (PORTO *et al*., 2012). However, despite its great importance, the quality of the seeds of this species is not always satisfactory and research in this area is scarce.

For pasture formation, buffel grass becomes a good strategy; its tolerance to a wide range of environmental conditions is probably involved in its success in occupying different habitats, such as arid and semi-arid regions, where rainfall patterns are unpredictable. Therefore, seeds with different dormancy levels increase the chances of a successful regeneration for the propagation of this species (SHARIF-ZADEH; MURDOCH, 2000; TINOCO-OJANGUREN *et al*., 2016).

The buffel grass seeds present dormancy and this physiological phenomenon can compromise an adequate pasture formation, considering that forage seed lots with a high percentage of dormancy, may result in low density of plants in the uniform establishment of the pasture, allowing the increase of the weed population in pasture areas. Under these conditions, there will be an increase in costs for the establishment of pasture, either with the greatest need for seeds per area or with practices for the control of the weed population.

Although seeds do not germinate, dormancy has been considered as a strategy for plants to deal with uncertain environments (GREMER; VENABLE, 2014). In the case of buffel grass, grown worldwide due to its high tolerance to drought (MARSHALL *et al*., 2012), dormancy temporal distributions in its seeds may be indicative of plants adapting to the medium.

Few studies have provided results as to quality and viability variability of buffel grass seeds. Seed storage, the period between harvest and sowing, provides the necessary conditions to overcome dormancy and prolong the longevity of the seed lot (CAMPOS, 2015), since, the germination percentage increases with the duration of the storage period (COSTA *et al*., 2011). Nevertheless, it is known that the storage period has been reported as a factor that reduces the rates of dormant seeds, as found by Eira (1993) in Andropogon gayanus seeds and Condé and Garcia (1985) in Panicum maximum seeds.

Researches aiming to assess dormancy in forage seeds are of paramount importance and can present alternatives to raise production efficiency, in addition to supplying relevant information to trading companies and seed inspection agencies in order to overcome eventual problems related to the commercialization of certain species.

Given the above considerations, the germination and vigor of buffel grass seeds, cv Aridus, stored in environmental conditions were assessed.

2 MATERIALS AND METHODS

2.1 STUDY LOCATION

This study was conducted at the Seed Research Laboratory of the Plant Science Department of the Universidade Federal de Viçosa, Minas Gerais, Brazil, during February 2018 to February 2020. The climate of the region, as per Koppen classification, is the “AW” type, tropical with dry winter. The climatic conditions of the region are represented by average temperatures ranging from 21 to 25ºC, daily relative humidity of 60 to 70%, and average annual rainfall of 900 mm approximately.

2.2 SEEDS COLLECTION AND STORAGE

The buffel grass seeds, cv Aridus, were harvested in February 2018 at a property in the municipality of Janaúba, MG, whose geographic coordinates are: 15°47’50’’ south latitude and 43°18’31’’ west longitude, at an average elevation of 516 m. The region's climate is classified as Aw, tropical with a dry season, according to the Köppen classification (ALVARES *et al*., 2013), with average annual rainfall of 780 mm, average annual temperature of 26 ºC and average relative humidity of the air. 65%.

To obtain mature seeds, the inflorescences were harvested when they had straw color and about 1/3 of natural growth (Figure 1). The inflorescences were dried in the shade and, under laboratory conditions.

Figura 1. Campo de pastagem de capim-buffel com foco na produção de sementes.

The clean seeds were placed inside polypropylene bags and stored in laboratory in non-controlled environmental conditions (± 26°C) for a period of 24 months. The seeds were assessed for quality 0, 6, 12, 18 and 24 months after harvest.

2.3 WATER CONTENT DETERMINATION

Water content was determined in accordance with methodology prescribed in the Rules for Seed Analysis (BRASIL, 2009), in oven, at 105 ± 3ºC, for 24 h, with four repeats of 1.0 gram of seeds; results are expressed as %.

2.4 GERMINATION TEST

The germination test was conducted using four repeats of 50 seeds, distributed on two sheets of germitest® paper, moistened with distilled water in a volume equivalent to 2.5 times their dry weight, in gerbox-type plastic boxes. The boxes containing the seeds were maintained in digital germinators, at alternating temperatures of 20-30ºC and photoperiod of 16-8h, in the dark and exposed to white light, respectively. Assessments were carried out on the seventh and twenty-eighth days after seeding, and results were expressed as percentage of normal seedlings (BRASIL, 2009). On the twenty-eighth day, the percentage of dormant seeds was checked as well.

2.5 VIGOR TESTS

The first germination count was done simultaneously with the germination test, recording the percentage of normal seedlings obtained on the seventh day after seeding (BRASIL, 2009).

Seedling emergence was conducted under laboratory environmental conditions (± 26°C), using four repeats of 50 seeds, seeded at a depth of 0.2 cm, in gerbox-type boxes containing, as substrate, sand washed and sterilized in oven for 2h at 200ºC (BRASIL, 2009). The substrate was moistened with a water amount equivalent to 50% of the retention capacity, keeping it in these conditions with daily light irrigations. The count of emerged seedlings was done on the twenty-eighth day after seeding, considering seedlings that had the aerial part (coleoptile) above the substrate; results were expressed as percentages.

The emergence speed index (ESI) was determined together with the emergence test, based on daily counts of number of emerged seedlings until the twenty-eighth day after seeding. At the end of the test, the ESI was calculated through the formula proposed by Maguire (1962).

2.6 BIOMETRY OF NORMAL PLANTS

At the end of the emergence test, with the aid of a pachymeter, the length of seedlings considered normal, from each repeat, was measured, and results were expressed as mm seedling^{-1}. Then, the fresh and dry matters of the seedlings were assessed. For fresh matter, the normal seedlings of each repeat were weighed on precision scale, and results were expressed as mg seedling^{-1}. Afterwards, resulting seedlings were put inside paper bags and oven-dried, with forced air circulation, at 65ºC constantly during 72 hours for dry matter determination; after this period, the samples were left cooling in the desiccator and then weighed again on precision scale, with mean results being expressed as mg seedling^{1}.

2.7 DATA ANALYSIS

The experimental design used was the fully-randomized type; results were subjected to analysis of variance at 5% probability, and then to regression analysis. The regression equations selected were those that concomitantly presented higher coefficient of determination (R2). The statistical program used was sisvar (FERREIRA, 2011).

3 RESULTS AND DISCUSSION

The water content of the seeds, in the different storage periods after harvest, did not differ from each other and presented mean value of 8.8%. The water content of the seeds was close to the ideal value pointed out by Novembre *et al.* (2006) for conservation of forage seeds. A similar water content between different treatments is important so that seed assessment tests are not affected by differences in the metabolic activity, wetting speed and deterioration level of seeds (STEINER *et al*., 2011).

There was quadratic effect for storage time on variables germination and dormant seeds (Figure 2). Germination right after harvest presented estimated value around zero, which can be explained by the high percentage of dormant seeds (100%). This fact can be explained by the fact that the newly harvested buffelgrass seeds present dormancy. Corroborating Oliveira (1993) reports that the embryo dormancy of buffel grass seeds persists for at least six months; in some cases, the embryo may be fully matured before so (OLIVEIRA, 1993). As the storage time was prolonged, there were increases in the germination percentage of the seeds, from the initial period to 17.96 months, reaching a maximum estimated value of 62.74%.

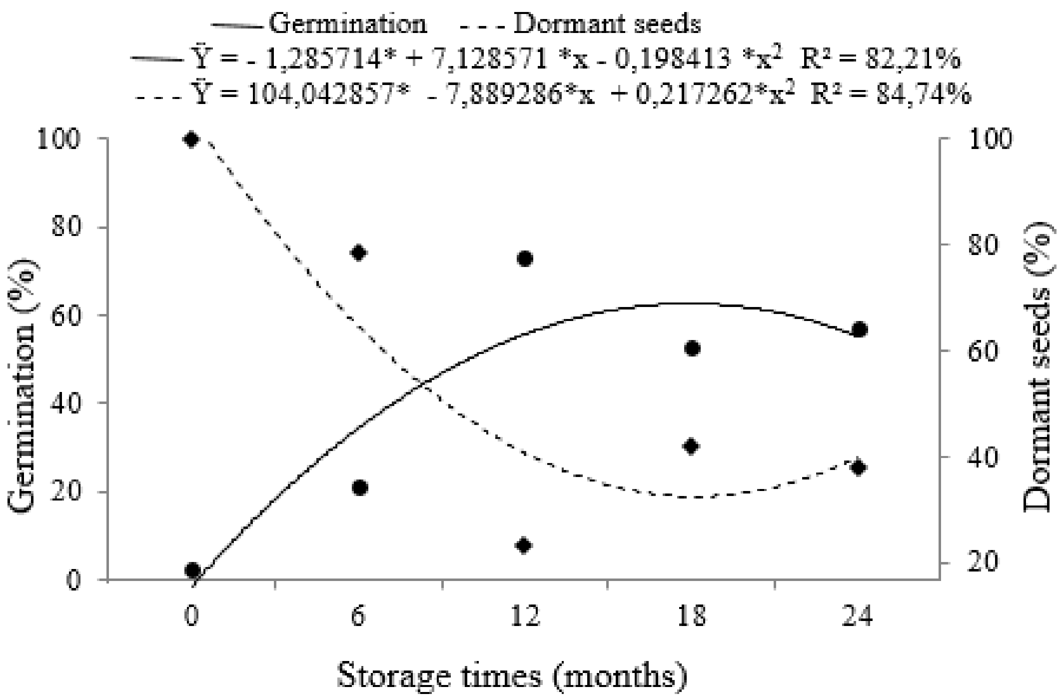


Figure 2. Germination and dormant buffel seeds, cv Aridus, stored in environmental conditions for 24 months after harvest.

Although water seems to have no influence on the quality of the seeds in this study, the storage period is closely related to their physiological quality. According to Whiteman and Mendra (1982), in tropical forage grasses, dormancy expression in freshly-harvested seeds is associated with physical and physiological causes, overcome during storage. In the specific case of buffel grass, seed dormancy has been attributed to the immaturity of the embryo and to the presence of phenolic compounds, including anthocyanins, found in chaffs (VILELA, 2007).

As storage time was prolonged, increases were found in the germination percentage of the seeds. This proves that the dormancy of forage seeds can be naturally overcome, even after they are harvested directly from the bunch. Entretanto, após 17,96 meses de armazenamento, houve redução na germinação das sementes, tal fato ocorreu devido is due to natural deterioration processes of seeds, which possibly results from the inherent characteristics of the species.

Increases in the germination of seeds of other grasses, such as millet (GASPAR; NAKAGAWA, 2002) and *Brachiaria decumbens* cv. Basilisk (GONZÁLES *et al.,* 1994), have been observed with six months of storage. As for freshly-harvested *Brachiaria humidicola* seeds, they should stay in storage for six to nine months (COSTA *et al*., 2011), as a way of reducing dormancy level.

Regarding the dormancy variable, it is observed that right after the harvest, the seeds were 100% dormant, however, during storage the seed dormancy was naturally overcome. The lowest percentage of dormancy of 23% was verified at 18.98 months of storage (Figure 2). The loss of dormancy is driven by the detection of environmental signals, such as temporal changes in humidity and temperature, that the seeds can “feel” through a series of mechanisms.

The results of the first germination count test showed linear behavior as a function of storage time, with a greater value at 24 months after storage (51.5%), corresponding to an increase of 2.40% monthly (Figure 3). It is worth noting that due to the initial seed dominance, only after three months of storage, which was counted as a percentage of the first count, this fact can be justified due to the dormancy that the buffel grass seeds present immediately after harvest.

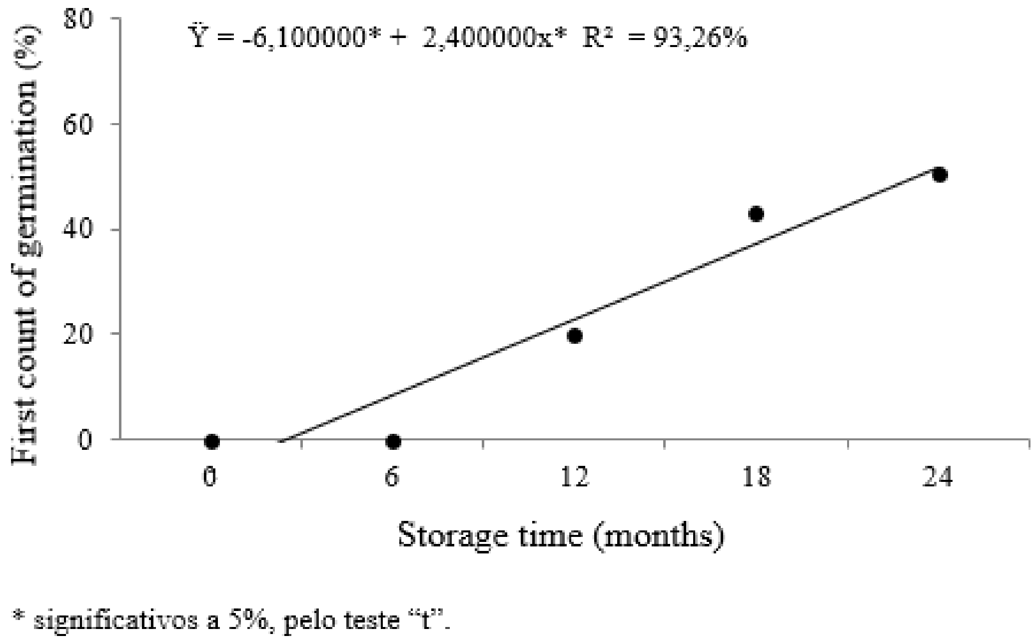


Figure 3. First germination count of buffel grass seeds, cv Aridus, stored in environmental conditions for 24 months after harvest.

The seeds presented progressive increases as to seedling emergence and emergence speed index (ESI), assessed over storage time, shown by the adjusted regression model of quadratic behavior (Figure 4).

The results obtained in the emergence test evidence that the highest percentage occurred at 18.98 months of storage, with approximately 63.13% of emerged seedlings (Figure 4), period from which values decreased, reaching 58.68% of emerged seedlings at 24 months of storage, with reduction of 7.05%.

For the ESI, there was no increase right after harvest, due to the physiological dormancy that buffel grass seeds present initially; the maximum estimated value reached was 7.49% at 16.40 months of storage (Figure 4); subsequently, decreases of 23.04% were found for the ESI, ending up with estimated values of 5.71%

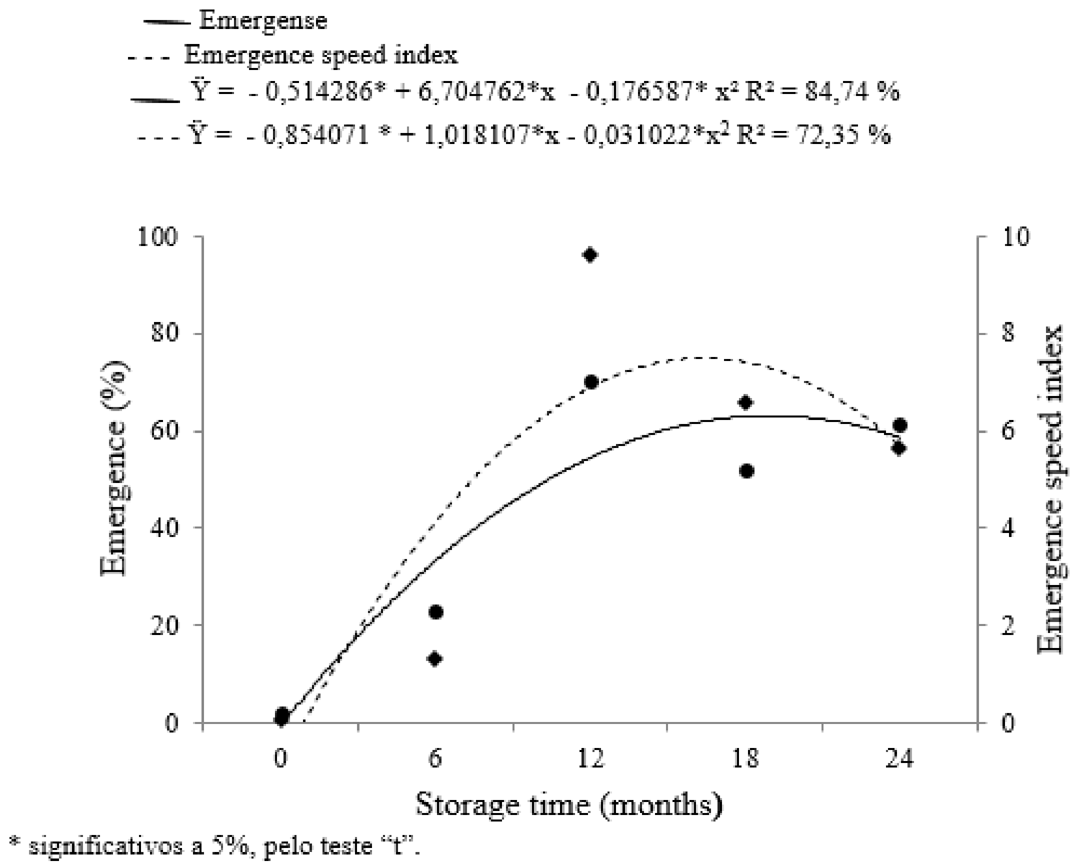


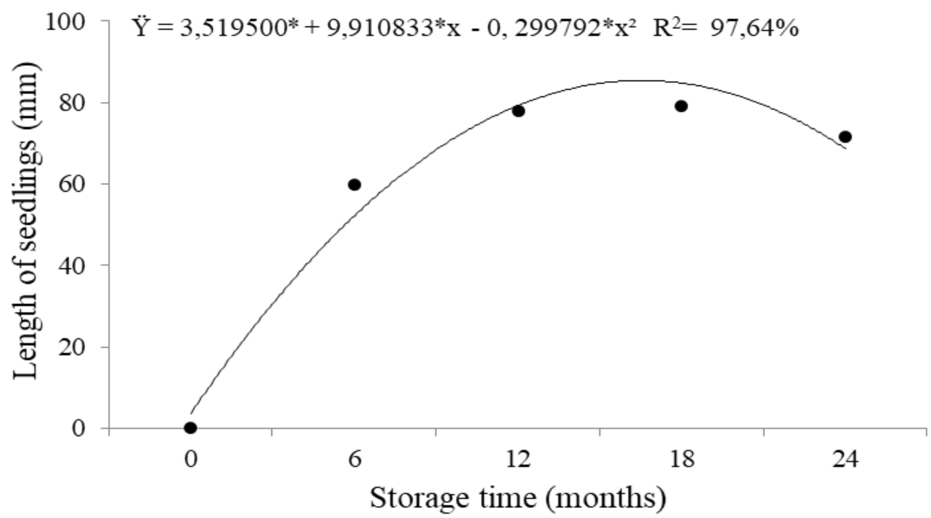
Figure 4. Emergence and emergence speed index of seedlings from buffel grass seeds, cv Aridus, stored in environmental conditions for 24 months after harvest.

The results of the variables emergence and seedling emergence index confirm once again that the buffel grass seeds can be harvested directly from the bunches and stored for up to 18.98 months without compromising their physiological quality. However, it should be considered that long storage periods can lead buffel grass seeds to lose their vigor, since, after overcoming dormancy, the seeds remain in a natural deterioration process.

Seeds with higher ESI have a higher speed in the emergence process, a fact of great relevance in regions with short rainfall periods, such as semi-arid ones, for allowing a better utilization of rain during the pasture implantation period. In summary, although it is not desirable from the productive point of view, in nature, dormancy is seen as a way of preserving species, as it allows dispersion at different times and germination in more favorable environmental conditions, since, according to the process evolutionary, dormancy assumed the role of ensuring greater storage potential (BARBEDO *et al*., 2013).

The mean results of seedling length showed quadratic behavior when assessed during the storage period of the seeds (Figure 5). As a result of the dormancy present in freshly-harvested seeds, seedling length values were null in the initial period of assessment (Figure 4). It is worth noting that the greatest lengths (85.42 mm) were seen in seeds stored for 16.53 months. However, soon after this period, there are reductions of 19.58% in seedling growth, with estimated values of 68.69% mm in length at 24 months of storage (Figure 5).

It is then proved that more vigorous seeds, with better physiological performance, give rise to seedlings with higher development rates and mass gain, for presenting greater capacity of tissue transformation (AMARO *et al*., 2015).



* significativos a 5%, pelo teste "t".

Figure 5. Length of seedlings from buffel grass seeds, cv Aridus, stored in environmental conditions for 24 months after harvest.

The fresh and dry matter results of seedlings increased progressively over the storage time of the seeds, adjusting themselves to a regression model of quadratic behavior (Figure 6).

Maximum accumulation of fresh matter (19.45 mg) and dry mater (4.36 mg) of seedlings was verified when the seeds were stored for 14.74 and 13.97 months, respectively (Figure 6); as of the maximum accumulation point, there were reductions of 37.89 and 47.25%, respectively, until 24 months of storage.

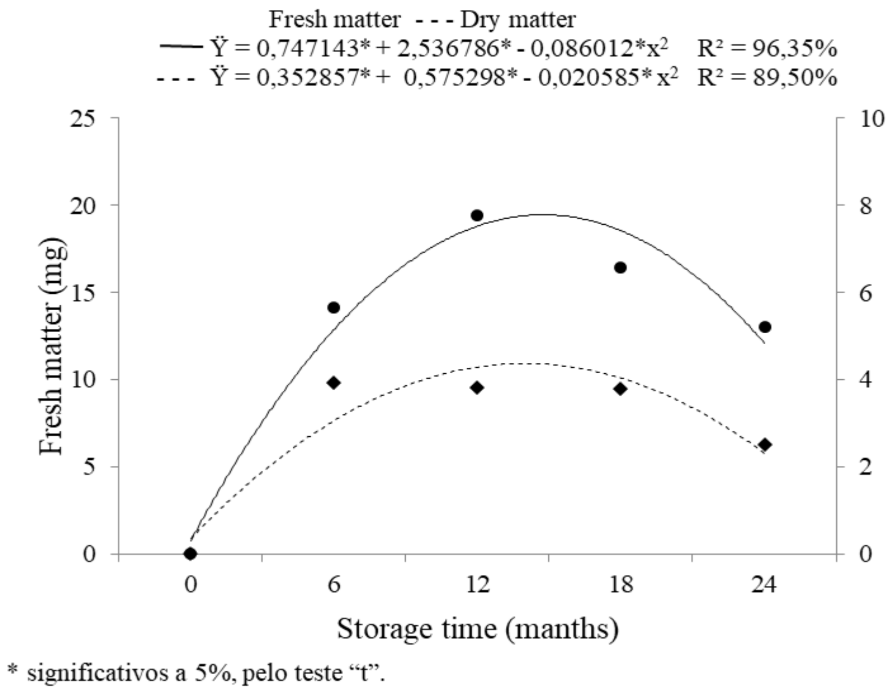


Figure 6. Fresh and dry matter of seedlings from buffel grass seeds, cv Aridus, stored in environmental conditions for 24 months after harvest.

According to Nakagawa (1994), during germination, vigorous seeds promote a greater transfer of fresh matter from their reserve tissues to the embryonic axis, originating heavier seedlings due to greater matter accumulation. In light of the foregoing, storage time influences positively the germination of forage-species seeds (ALVES *et al*., 2017).

4 FINAL CONSIDERATIONS

Buffel grass pastures, cv Aridus, should be formed by using seeds stored between 14 and 19 months in environmental conditions, for presenting greater germination and vigor.

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