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ARTICLE

Characterization of acquisition of physiological quality in soybean seeds from desiccated plants

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ABSTRACT: Desiccation interrupts the acquisition of physiological quality in soybean seeds, as this quality peaks at R9. However, this interruption can be mitigated by the stage in which herbicide is applied and which herbicide is used. The aim of this study was to characterize the acquisition of physiological quality in soybean seeds from plants desiccated by herbicides at different stages. A completely randomized experimental design was used in a 3×6 factorial arrangement, consisting of three phenological stages (R6, R7.1, R7.3) and six different desiccant treatments (Diquat 1.5 $L.ha^{-1}$; Glufosinate 1.5 $L.ha^{-1}$ and 2.0 $L.ha^{-1}$; Diquat 1.0 $L.ha^{-1}$ + Glufosinate 1.0 $L.ha^{-1}$; Saflufenacil 140 $g.ha^{1}$ + Glufosinate 1.0 $L.ha^{-1}$; and Saflufenacil 140 $g.ha^{-1}$ + Diquat 1.0 $L.ha^{-1}$), with four replications. The following evaluations were made: desiccation rate, germination, desiccation tolerance (DT), longevity (P50), viability after one year of storage, and thousand seed weight. Seeds are able to germinate and have DT when plant desiccation through application of Diquat, Diquat + Glufosinate, Saflufenacil + Diquat, and Saflufenacil + Glufosinate occurs at R6, and for Glufosinate, at R7.1. The use of Diquat + Glufosinate and their combination with Saflufenacil showed less impact on acquisition of soybean seed longevity, which was better when application was made at R7.3.

Index terms: forced maturation, germination, herbicides, longevity, vigor.

RESUMO: A dessecação interrompe a aquisição da qualidade fisiológica de sementes de soja, que atinge seu máximo em R9. Contudo, isto pode ser mitigado pelo estádio de aplicação e o herbicida utilizado. Objetivou-se caracterizar a aquisição da qualidade fisiológica de sementes de soja de plantas dessecadas por herbicidas em estádios distintos. O delineamento experimental foi inteiramente casualizado em esquema fatorial 3X6, sendo três estádios fenológicos (R6, R7.1, R7.3) e seis aplicações de dessecantes (Diquat 1,5 $L.ha^{-1}$; Glufosinato 1,5 $L.ha^{-1}$ e 2 $L.ha^{-1}$; Diquat 1,0 $L.ha^{-1}$ + Glufosinato 1,0 $L.ha^{-1}$; Saflufenacil 140 $g.ha^{-1}$ + Glufosinato 1,0 $L.ha^{-1}$; e Saflufenacil 140 $g.ha^{-1}$ + Diquat 1,0 $L.ha^{-1}$), com quatro repetições. Avaliaram-se: taxa de dessecação, germinação, tolerância à dessecação (DT), longevidade (P50), viabilidade após um ano de armazenamento e peso de mil sementes. A aquisição da germinação e DT de sementes de plantas dessecadas por Diquat, Diquat+Glufosinato, Saflufenacil+Diquat e Saflufenacil+Glufosinato ocorre quando a aplicação é feita em R6, e para Glufosinato, em R7.1. O uso de de Diquat + Glufosinato e a combinação destes com Saflufenacil apresentou menor impacto na aquisição da longevidade de sementes de soja, sendo maior quando aplicados em R7.3.

Termos para indexação: maturação forçada, germinação, herbicidas, longevidade, vigor.

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INTRODUCTION

The physiological quality of seeds is composed of expression of the interaction of four components: germination, desiccation tolerance, vigor, and longevity, which are acquired in a sequential manner at the maturation and late maturation phases of seed development (Bewley et al., 2013). This latter phase can be artificially accelerated through the use of herbicides with desiccant properties; however, this impairs the acquisition of seed physiological quality (Chamma et al., 2023), due to the change brought about in the natural pattern of acquisition of physiological properties.

The pattern of acquisition of physiological quality in soybean seeds has been characterized by Lima et al. (2017), indicating that germination is completely acquired at the R7.1 stage, followed by desiccation tolerance in R7.2; and vigor and longevity are progressively acquired, with maximum potential in R9. According to Lima et al. (2017), even with accumulation of reserves ending in R7.3, acquisition of vigor and longevity proceeds, and they are complete at the end of the late maturation phase, at the R9 stage.

For orthodox seeds, such as soybean, a series of physical and physiological transformations that occur during late maturation of the seeds is necessary to survive the dry state (Leprince et al., 2017). For example, the cytoplasm of the seeds that at the beginning of development was in a liquid state changes to the glassy state (Ramtekey et al., 2022). This cytoplasmic transition involves compounds acquired during maturation, such as LEA (late embryogenesis abundant) proteins, raffinose family oligosaccharides (RFOs), heat shock proteins, and antioxidants, which protect cell membranes and organelles so that the seeds can survive over time (Ballesteros et al., 2020). Therefore, late maturation is an extremely important phase for acquiring longevity and, consequently, for maintaining viability and vigor over the storage period (Basso et al., 2018).

At the end of the late maturation phase, soybean seeds are harvested when they reach a moisture content near 12%, with all physiological properties already acquired. Although this phase has its importance, the seeds remain exposed to biotic and abiotic stresses, which can lead to considerable loss of physiological quality, as observed by Pinheiro et al. (2023).

To minimize such losses, the production sector has applied herbicides with desiccant action to allow earlier mechanized harvest (Almeida et al., 2023; Botelho et al., 2023). However, as shown by Chamma et al. (2023), this practice impairs acquisition of seed physiological quality, particularly the acquisition of longevity.

There are several herbicides with desiccant properties and that differ in the mode, mechanism, and time of action (Marchi et al., 2008). As the acquisition of physiological quality is related to the duration of the maturation and late maturation phase (Leprince et al., 2017), it may be that the longer the period for leaf loss, the longer the additional time for seed maturation, and thus, the greater the gradual acquisition of physiological quality. Yet, the mode of action of each herbicide may affect mother plant and seed physiology, changing the pattern of acquisition of physiological properties.

Based on that, we raise the following questions: Do other herbicides not tested by Chamma et al. (2023), with different modes and times of action, have the same impact on physiological quality? Does the acquisition of physiological quality respond the same way to the different herbicides tested when they are applied at different stages of development?

As the application of desiccants is a reality and their use is quite widespread in soybean seed production fields, alternatives need to be adopted in order to minimize the losses related to seed physiological quality. Characterization of how acquisition of the physiological properties occurs over the forced maturation period provides important information so that the interruption and the impact generated by desiccation can be mitigated. For example, inferences can be made regarding the mode and the time of action of each herbicide and their relationship to seed physiological quality through an understanding of how acquisition of properties can be altered. Thus, it is possible to mitigate the effects of desiccation by identifying the relationship between the herbicide used and the stage of development at application. That would allow acquisition of physiological quality to occur in a way nearer the natural pattern of the species.

Therefore, the aim of the present study was to investigate the acquisition of physiological quality of soybean seeds from plants desiccated by different herbicides at different phenological stages.

MATERIAL AND METHODS

The experiment was conducted at the CropSolutions Experimental Station (Rodovia Estrada Velha km 8) in the municipality/county of São Gabriel do Oeste, MS, Brazil, at -19.458322 S and 54.611792 W, at 645 m asl, in the period from October 2021 to March 2022. The area used is classified as a *Latossolo Vermelho Distrófico*, with lightly rolling topography, cerrado stage, and a clayey texture.

A completely randomized experimental design was used in a 3×6 factorial arrangement, consisting of three phenological stages for application of the desiccants (R6, R7.1, R7.3) and six different desiccant treatments (Table 1), with four replications. The phenological stages were identified based on Ritchie et al. (1994), Lima et al. (2017), and Basso et al. (2018) through the leaf and pod traits and seed morphology (Table 2). Desiccants were applied at the R6, R7.1, and R7.3 stages on 11, 22, and 27 February 2022, respectively, using a backpack sprayer with a boom, under CO_2 pressure, with six flat fan spray nozzles (AVI 11001) spaced at 0.5 m, with a spray volume of 120 $L.ha^{-1}$.

The cultivar used was BMX Aporé of indeterminate growth habit and maturity group 7.5. The seeds were treated with Standak Top (2 $mL.Kg^{-1}$) and Cruiser (2 $mL.Kg^{-1}$) and sown at a rate of 12 seeds per meter on 20 October 2021. The daily information on rainfall and maximum, mean, and minimum temperatures during the experiment are illustrated in Figure 1.

Table 1. Description of the doses and of the combinations of the treatments with desiccant herbicides applied at three phenological stages: R6, R7.1, and R7.3.

Desiccant	Dose – $L.ha^{-1}$ or $g.ha^{-1}$
Diquat	1.5 L
Glufosinate	1.5 L
Glufosinate	2.0 L
Diquat + Glufosinate	1.0 L + 1.0 L
Saflufenacil + Diquat	140 g + 1.0 L
Saflufenacil + Glufosinate	140 g + 1.0 L

Table 2. Description of the reproductive stages of soybean, based on Ritchie et al. (1994), Lima et al. (2017), and Basso et al. (2018) leading to loss of vigor. Longevity is routinely evaluated by the ability to germinate after storage. It increases progressively during seed maturation, after the acquisition of desiccation tolerance. However, the capacity to germinate represents only a part of the success of crop establishment. How seed maturation affects the resistance of several traits, as vigor, associated with seedling establishment, against deterioration was evaluated during seed filling and post-abscission phase of soybean BRS 284 seeds. Three new phenological stages between 7.1 and 7.2 (7.1.1, 7.1.2 and 7.1.3): leaf and pod traits and seed morphology.

Reproductive stage	Leaf and pod traits	Seed morphology
R6	Leaves and pods completely green	Green seed with green embryonic axis
R7.1	Beginning of yellowing of leaves and pods	Green seed with yellowish embryonic axis
R7.3	Completely yellowish pods and the surrounding leaves at 70% yellowing	Completely yellowish seed coat with shiny surface. Seeds are disconnected from the fruit (pod)

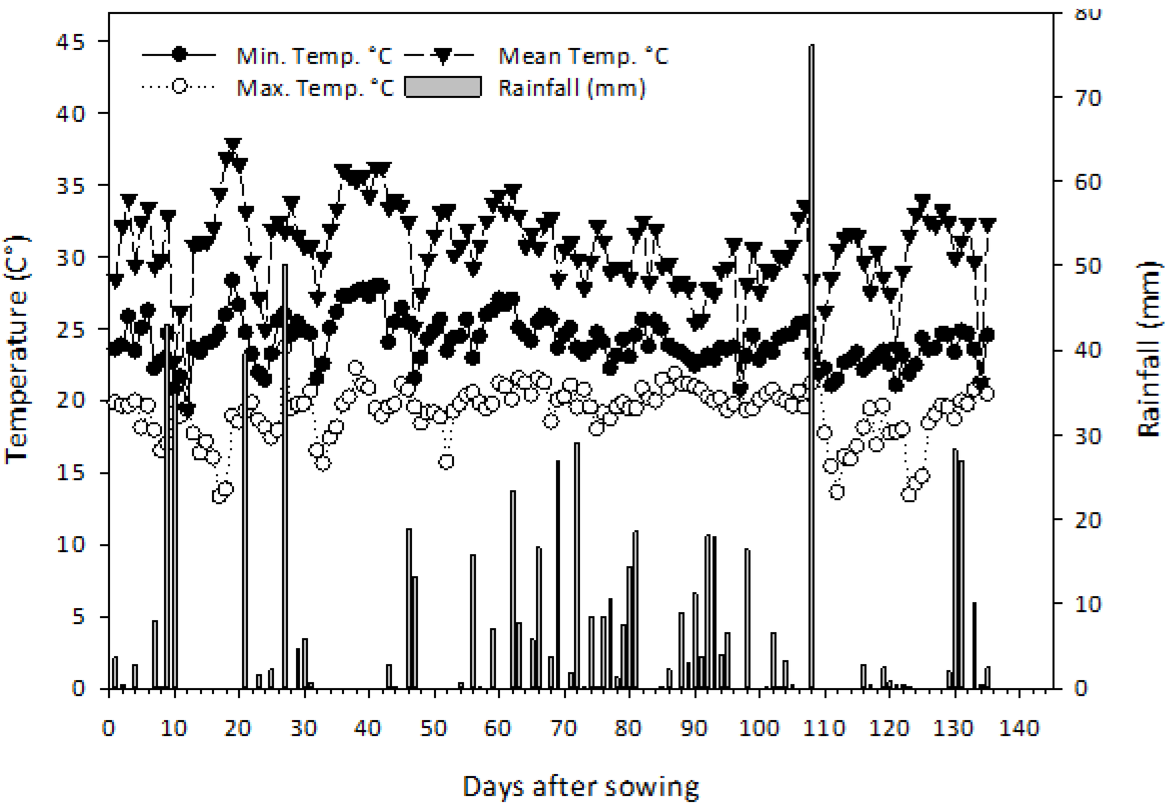

Figure 1. Daily variations of rainfall (mm) and of the maximum, mean, and minimum temperatures (°C) during the experiment, recorded in São Gabriel do Oeste, MS, Brazil, in the period from October/2021 to March/2022.

For each treatment, a plot was set up with total area of 13.5 m^2, six 5.0-m length rows spaced at 0.45 cm, following the management recommendations for the soybean crop. Based on soil analysis and on recommendations for the use of soil amendments and fertilizers in Mato Grosso do Sul, limestone was applied at the rate of 2.28 t.ha^{-1}, base fertilization with 220 Kg.ha^{-1} of the formulation 07-37-06 (NPK) + 2.35% Ca + 8.2% S + 0.1% B + 0.2% Mn + 0.27% Zn, and top dressed with 150 Kg.ha^{-1} of KCl when the crop reached the V4 stage.

A desiccant was applied to each plot at the specific phenological stage (highlighted above). The seeds were harvested five days after application of the desiccants. These seeds did not receive any chemical treatment and went directly to cold storage at 10 ℃ and 40% relative humidity (RH).

To characterize the acquisition of physiological quality, the following tests were performed: germination, desiccation tolerance, vigor (first germination count), and longevity, described below:

Moisture content: this was measured using the laboratory oven method at 105 °C for 24 h, according to the Rules for Seed Testing (Brasil, 2009), with four replications of 10 seeds. The results were expressed in percentage, wet basis.

Germination: the seeds were uniformly distributed in rolls of Germitest® paper moistened with distilled water in an amount corresponding to 2.5 times the weight of the dry paper (3 sheets per roll). The rolls were placed in closed plastic bags and kept in a seed germinator set at the temperature of 25 °C. Results were expressed in percentage of normal seedlings, abnormal seedlings, and seeds not germinated after the 5th and 8th days of conducting the test, according to the RAS (Brasil, 2009).

Desiccation tolerance (DT): seeds were considered tolerant to desiccation as of the point at which at least 80% of the seeds, with an initial moisture content of less than 10%, germinated and developed normal seedlings in the germination test.

Seed longevity (P50): before setting up the test, the moisture content of the dry seeds was equilibrated by placing them in 75% RH at 20 °C for 24 h. They were then placed in sealed boxes containing approximately 150 seeds each, without seed overlap. The relative humidity (RH) inside the boxes was 75%, created through a saturated sodium chloride (NaCl) solution. They were stored in a climate-controlled environment at 35 °C according to the methodology described by Zinsmeister et al. (2016). The seeds were removed from the boxes and the germination test was performed, as described above, at different times in the storage period until confirming loss of germination capacity. A sigmoid longevity distribution curve was created from the data obtained for each phenological stage over the storage period. The results of longevity were defined as time (in days) until 50% loss of viability of the seeds during storage (P50), using the Probit equation model: $v = Ki - p/\sigma$ (v = viability in days; Ki = initial germination; p = expected death; and σ = straight line slope) (Ellis and Roberts, 1980).

Germination after one year of storage: seeds from all the treatments were kept in cold storage at 10 °C and 40% RH for one year, and then the germination test was performed, as described above.

Thousand seed weight (1000SW): this was performed through manual counting, using a 100-seed counter, with 8 replications for each treatment. The result was converted to mean weight of 1000 seeds and expressed in grams (Brasil, 2009).

Desiccation rate: this was performed by assigning a score from visually estimating the percentage of defoliation in the plot after the first day of application of the desiccant up to the day of reaching 100% defoliation, for all the phenological stages evaluated.

The data obtained were analyzed regarding normality and homoscedasticity. After that, analysis of variance was used on the experimental data, with the means of the treatments compared by Tukey's test at 5% probability.

RESULTS AND DISCUSSION

This study establishes a direct relationship between acquisition of physiological quality and the application of herbicides with desiccant properties throughout development of the seeds, showing that such products affect the acquisition of seed quality in varied fashion, even when applied at the same phenological stage.

For first germination count (FGC), germination, desiccation tolerance (DT), P50, and germination after one year of storage, a significant interaction was found between the stage of application and the desiccant used. For 1000SW, an isolated effect was found for the application stage and the desiccant (Table 3).

Upon establishing a minimum threshold of 80% normal seedling production, the germination capacity and the DT were acquired for the seeds coming from plants desiccated in R6 for all the treatments, except for the ones in which glufosinate (1.5 $L.ha^{-1}$ and 2 $L.ha^{-1}$) was used. In those cases, the acquisition of these traits occurred when desiccation was performed as of the R7.1 stage. When desiccation was performed at the R7.3 stage, the seeds originating from

Table 3. Mean values of the traits evaluated according to the desiccant treatments and to the phenological stages of application of the desiccant herbicides.

Source of Variation	Trait				
	G	FGC	P50	GAY	1000SW
Stage (S)	470.88*	526.72*	1420.66*	2481.55*	3059.5*
Desiccant (D)	78.62*	127.92*	135.35*	1466.85*	429.35*
S*D	111.28*	158.05*	148.53*	316.15*	76.18
CV (%)	6.04	7.52	6.5	9.7	6.85

Note: *significant at 5% probability by Tukey's test. G: germination; FGC: first germination count; P50: mean time for loss of 50% of viability during storage, GAY: germination after one year of storage; 1000SW: 1000 seed weight.

plants desiccated by all the desiccant products had already acquired those properties, without showing statistically significant differences among themselves (Table 4).

Germination capacity refers to the ability of the seed in giving rise to a new plant (Marcos-Filho, 2015). In the case of orthodox seeds, this ability to germinate in the dry state depends on acquisition of desiccation tolerance (DT) (Leprince et al., 2017). This trait consists of the ability of the seed to lose water, to rehydrate, and then germinate without sustaining irreversible damage (Leprince and Buitink, 2010).

From the physiological perspective, germination capacity is acquired at the R7.1 stage and DT at the R7.2 stage (Lima et al., 2017). However, the results suggest that in application of the desiccants in previous stages, it is possible to preserve the acquisition of these traits. This occurs due to the time of action of each desiccant allowing a gradual transition from one stage to another, thus providing enough time for complete acquisition of these properties.

However, for application at the R7.3 stage, it should be noted that there was an increase in the production of normal seedlings, without statistical differences among the desiccant treatments (Table 4). For that reason, application at the R7.3 stage is recommended here as the safest way for preservation of the germination capacity and DT of the harvested seeds.

These results support the affirmation that even after the acquisition of germination and DT, vigor continues to be acquired throughout development. That trait, evaluated by the percentage of normal seedlings in first germination count, was acquired with greater expression when desiccation was performed at the R7.3 stage (Table 5).

Table 4. Percentage of normal seedlings from soybean seeds from plants desiccated by herbicides, at eight days after setting up the germination test.

Desiccant	Normal seedlings (%)		
	R6	R7.1	R7.3
Diquat	80.5 Bb	89.5 Aab	93.5 Aa
Glufosinate 1.5 L	77.5 Bb	86.5 Aab	95 Aa
Glufosinate 2.0 L	79 Bb	93 Aab	91.5 Aa
Diquat + Glufosinate	85 Bab	95.5 Aa	94.5 Aa
Saflufenacil + Diquat	94 Aa	82.5 Bb	93.5 Aa
Saflufenacil + Glufosinate	93 Aa	92 Aab	94 Aa
CV (%)		6.0	

*Mean values followed by the same lowercase letter in the column and by the same uppercase letter in the row do not differ by Tukey's test at 5%.

Table 5. Percentages of normal seedlings from soybean seeds from plants desiccated by herbicides, obtained in first germination count of the germination test at 5 days (FGC).

Desiccant	FGC (%)		
	R6	R7.1	R7.3
Diquat	73.5 Bb	84.5 Aab	90.5 Aa
Glufosinate 1.5 L	74.0 Bb	80.5 ABab	90.5 Aa
Glufosinate 2.0 L	76.0 Bb	88.5 Aa	87.5 Aa
Diquat + Glufosinate	81.5 Bab	93.0 Aa	92.0 ABa
Saflufenacil + Diquat	92.0 Aa	75.0 Bb	89.0 Aa
Saflufenacil + Glufosinate	90.5 Aa	86.0 Aab	93.0 Aa
CV (%)		7.5	

*Mean values followed by the same lowercase letter in the column and by the same uppercase letter in the row do not differ by Tukey's test at 5%.

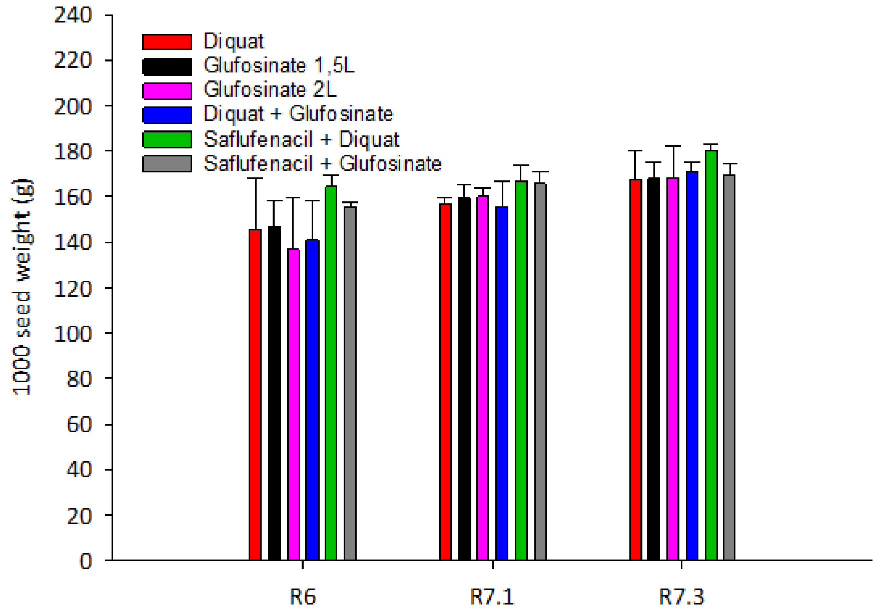

Figure 2. 1000 seed weight (g) of soybean seeds from plants desiccated by different herbicides and herbicide combinations, applied at three plant maturity stages.

Table 6. Longevity in P50 (days) of soybean seeds from plants desiccated by different herbicides applied at three different maturity stages of the plants.

Desiccant	Longevity (P50)		
	R6	R7.1	R7.3
Diquat	47 Ba	47 Bb	55 Abc
Glufosinate 1.5 L	50 Aa	50 Aab	54 Ac
Glufosinate 2.0 L	47 Ba	49 ABb	54 Ac
Diquat + Glufosinate	44 Ca	51 Bab	70 Aa
Saflufenacil + Diquat	45 Ca	52 Bab	70 Aa
Saflufenacil + Glufosinate	48 Ba	56 Aa	61 Abc
CV (%)		6.5	

* Mean values followed by the same lowercase letter in the column and by the same uppercase letter in the row do not differ by Tukey's test at 5%.

At the R7.3 stage, the seeds from desiccated plants had greater 1000 seed weight (Figure 2), which indicates greater accumulation of reserves that confer added vigor to the seedlings coming from these seeds (Pereira et al., 2015). Similar results were found by Botelho et al. (2023), where earlier desiccation led to a reduction in 1000 seed weight and reduction in physiological quality.

In relation to the desiccants used, statistically significant differences were observed in acquisition of vigor by seeds coming from plants desiccated with these different products. At R7.3, the application of Diquat, Saflufenacil + Diquat, and Saflufenacil + Glufosinate resulted in more vigorous seedlings. In contrast, the application of Diquat + Glufosinate and of Glufosinate at both doses resulted in seedlings with lower vigor (Table 5).

In a similar manner, seed longevity increased when the plants were desiccated at the R7.3 stage, with statistical differences among the desiccants. For application at this stage, the plants desiccated with Diquat + Glufosinate, Saflufenacil + Diquat, and Saflufenacil + Glufosinate gave rise to seeds that took more days of storage to lose 50% of germination capacity (P50) (Figure 3 and Table 6).

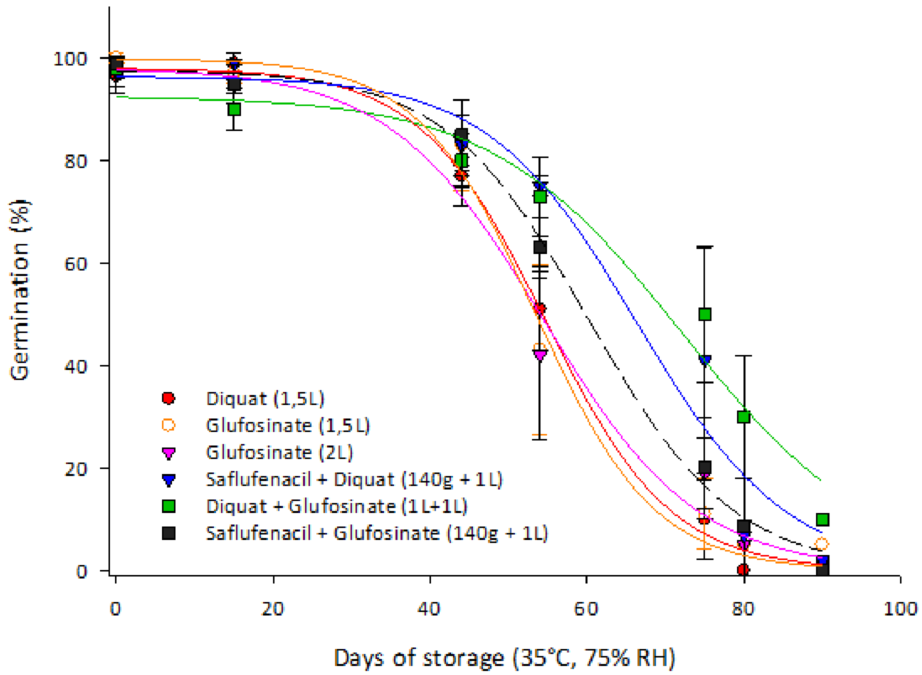

Figure 3. Percentage of germination of soybean seeds from plants desiccated at R7.3 by different herbicides and herbicide combinations, throughout storage at the conditions of 35 °C and 75% RH.

Table 7. Percentage of normal seedlings obtained in the germination test of soybean seeds from plants desiccated by different herbicides and their combinations at three maturity stages after one year of storage under the conditions of 10 °C and 40% RH.

Desiccant	Germination (%)		
	R6	R7.1	R7.3
Diquat	72 ABbc	64 Bbc	84 Aa
Glufosinate 1.5 L	43 Bd	41 Bd	77 Aab
Glufosinate 2.0 L	43 Cd	60 Bc	81 Aab
Diquat + Glufosinate	77 ABab	81 Aa	85 Aa
Saflufenacil + Diquat	89 Aa	66 Bab	84 Aa
Saflufenacil + Glufosinate	79 ABab	69 Bab	85 Aa
CV (%)		9.7	

* Mean values followed by the same lowercase letter in the column and by the same uppercase letter in the row do not differ by Tukey's test at 5%.

After one year of storage, the seeds from plants desiccated at R7.3 yielded a higher percentage of normal seedlings than the seeds from plants desiccated at R7.1; and the seeds from treatments with Glufosinate 1.5 $L.ha^{-1}$ and $2L.ha^{-1}$ resulted in the lowest values (Table 7).

Longevity is the trait that expresses seed capacity to preserve germination and vigor over time, and for soybean, it is acquired during the final maturation phase (late maturation), reaching its peak at the last phenological stage, R9 (Basso et al., 2018). In that phase, the desiccation process occurring in a natural manner leads soybean seeds to reach moisture content near 10% of their dry weight, which may take around 7 to 14 days depending on the environmental conditions and the cultivar (Lima et al., 2017).

At the end of desiccation, the seed cytoplasm that was originally in a liquid state passes to a glassy state, which consists of a liquid of high viscosity that imposes low mobility of molecules (Sano et al., 2016). Along with that, there is an accumulation of protective molecules and a set of defenses against oxidative stresses, such as soluble sugars, LEA proteins, and tocopherols, which allow seeds to survive in the dry state over time (Righetti et al., 2015).

Contrary to expectations, the herbicides that took more time for desiccation at R7.3 (Saflufenacil + Glufosinate and Glufosinate 1.5 $L.ha^{-1}$ and 2 $L.ha^{-1}$) (Figure 6), though offering more time for imposition of the glassy state and accumulation of protective molecules, did not all result in greater acquisition of longevity. In addition, the environmental conditions that these seeds desiccated by Diquat + Glufosinate, Saflufenacil + Diquat, and Saflufenacil + Glufosinate were under were the same as those of other treatments at the final harvest phase, and thus, without importance in terms of generating deterioration able to affect physiological response (Figure 1).

It is possible that the combination of Diquat + Glufosinate, as well as individual combination of each of them with Saflufenacil, resulted in a synergistic effect on desiccation. Synergism is a consequence of interaction among herbicides, providing several benefits, including reduction in doses and an increase in the efficiency of defoliation (Diesel et al., 2018). The Diquat dose was reduced by 25% when associated with Saflufenacil and Glufosinate, while for Glufosinate, there was a reduction of up to 50% when associated with Diquat and Saflufenacil. These reductions helped to mitigate the effect of phytotoxicity, without compromising the effectiveness of desiccation, since all the treatments achieved nearly 100% defoliation (Figure 4).

In general, seeds from plants desiccated by glufosinate-ammonium had a greater impact on acquisition of physiological quality, showing reduction in longevity and vigor. As this herbicide can travel across short distances, contact of the active ingredient with the seeds may result in a phytotoxic effect (Delgado et al., 2015).

Other authors observed greater reduction in the physiological quality of seeds from plants desiccated by glufosinate-ammonium compared to seeds from plants desiccated by Diquat, Saflufenacil (Zuffo et al., 2020), and Paraquat (Guimarães et al., 2012). As we observed, the application of these herbicides shows less potential for damage when applied after the detachment of the seed in the pod (Albrecht et al., 2022). In fact, application before R7.3 results in a sharp drop in yield, lower 1000 seed weight, lower vigor (Lamego et al., 2013), and reduced longevity (Chamma et al., 2023).

Although after the R7.3 stage there is an increase in vigor and longevity due to continuous acquisition of these traits up to R9 (Lima et al., 2017), it is known that adverse conditions in the field, such as moisture oscillations, pests, and diseases, can be extremely damaging to quality (Leprince et al., 2017), and in some cases, a better strategy is early removal of seeds through the use of desiccants to preserve physiological properties.

The results shown reinforce the importance of critical selection of the correct stage for application and the choice of the herbicide, so as to preserve, as much as possible, the integrity of acquisition of physiological properties, since the desiccation practice interrupts acquisition of these traits (Chamma et al., 2023).

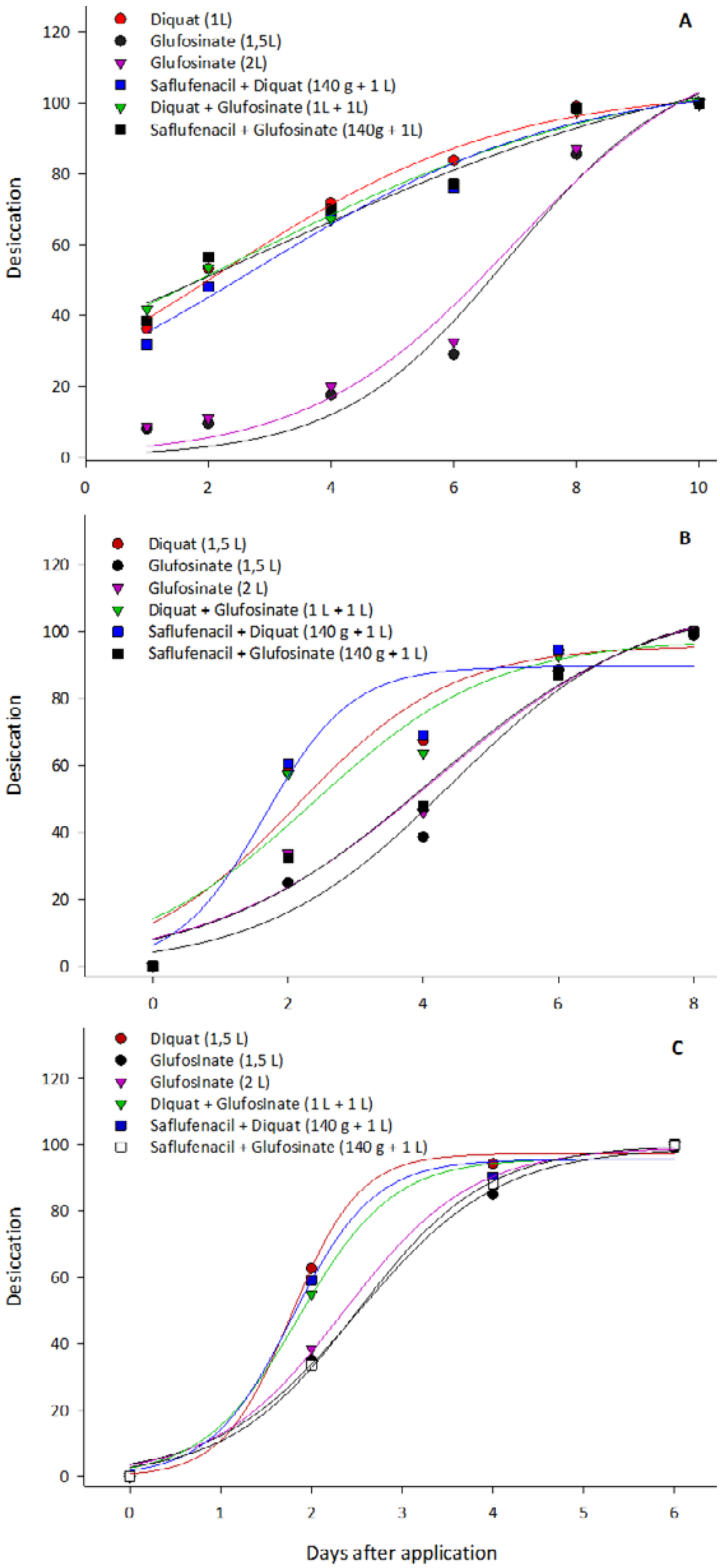

Figure 4. Percentage of defoliation after different periods (0 to 10 days) from application of the desiccants at each phenological stage, until reaching 100% defoliation: R6 (A), R7.1 (B), R7.3 (C).

CONCLUSIONS

The acquisition of germination and of desiccation tolerance of soybean seeds produced on plants desiccated by Diquat, Diquat + Glufosinate, Saflufenacil + Diquat, and Saflufenacil + Glufosinate occurs when application is made as of the R6 stage. For seeds of plants desiccated by Glufosinate (doses of 1.5 $L.ha^{-1}$ and 2.0 $L.ha^{-1}$), acquisition occurs when desiccation is carried out as of the R7.1. stage. The mixtures of Diquat + Glufosinate and the mixtures of these individual products with Saflufenacil exhibited less impact on acquisition of longevity in soybean seeds. Acquisition of seed vigor and longevity is greater when desiccation is carried out at the R7.3 stage for all the herbicides.

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