ARTICLE / INVESTIGACIÓN

Effect of seed soaking with Brassinolide on the vitality and vigor of Sorghum seed cultivars

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Abstract: A laboratory experiment was conducted at the Seed Technology Laboratory of the Department of Field Crops - College of Agriculture - the University of Anbar with the goal of To study the effect of seed soaking with the growth regulator brassinolide on the viability and vigor of seeds of cultivars sorghum, using a Complete Random Design (CRD). The first factor was soaking the seeds with the growth regulator brassinolide at concentrations of (200, 400, and 600) mg L-1 in addition to the control treatment (soaking with distilled water only) for the laboratory experiment with four repetitions. The second factor was three maize varieties White (Inqath, Rabah, and Lilo). The experiment results revealed that the stimulus treatment with brassinolide growth regulator at a concentration of 600 mg L-1 was significantly superior, with the highest averages for most of the studied traits, including germination speed (73.33 percent), standard laboratory germination rate (94.43 %), root length (16.08 cm), and feather length (15.36 cm). Besides, seedling strength (2968.2) and dry weight (0.0545 mg) in comparison to the control treatment (soaking in distilled water only), which had the lowest averages for the parameters evaluated. In terms of cultivars, the cultivar outperformed the rest of the cultivars in most of the measured attributes, with the highest standards. The cultivar was a Rabah in terms of germination speed (67.72 percent), germination percentage (87.67 %), stalk length (13.21 cm), gesture strength (2371.1), and dry weight (0.0513). Mg). The Inqath cultivar excelled in root length, recording the greatest average of (13.90 cm). The results revealed a significant effect of the interaction between the study parameters in most of the analyzed qualities. Based on the findings of this study. It can be concluded that stimulating the seeds with the growth regulator brassinolide generally resulted in an increase and improvement of all evaluated features, which reflected positively on seed viability and vigor.

Key words: Sorghum bicolor, growth regulator, seedling viability.

Introduction

Sorghum bicolor (L.) Moench is a grassland family cereal, fodder, and industrial crop that ranks sixth in the world regarding planted area and production. It is used as human food, and because it is gluten-free, it is regarded as a staple food for those who are allergic to this ingredient, and it is anti-gluten[1]. It is also utilized as an essential ingredient in poultry diets for animal feed production. The cultivation of its seeds is accompanied by a large decline in the percentage of field emergence, which may be due to environmental or genetic factors and poor soil service and management, as evidenced in the seedbed.

This demonstrates a disparity between laboratory and field findings compared to other field crops, and this problem persists despite efforts to discover solutions[2]. The rate and speed of germination contribute to a good field establishment, which positively impacts yield. As a result, seed stimulation technology using growth regulators has been employed to increase seed performance during germination and to achieve speedy and homogenous germination[3]. Many studies have confirmed the role of growth regulators in expanding and improving yield. One of these organizations is Brassinolide, a polyhydric steroid compound with many physiological effects as it regulates the process of photosynthesis, elongation, and cell division. As well as affects the chlorophyll pigments and the rate of flowering and maturation, affecting the amount of Quotient[4].

The use of a good variety suitable for the region aids in increasing the rate of sorghum crop production; thus, the purpose of this study was to learn about the effect of stimulating seeds with Brassinolide and its role in the vitality and activity of seedlings and field establishment of sorghum cultivars, as well as to determine the best level of Brassinolide and the best variety in terms of laboratory germination speed and percentage.

Materials and methods

During the winter season of 2022, the experiment was conducted in the Seed Technology Laboratory of the Department of Field Crops - College of Agriculture - University of Anbar, using a completely random design (CRD) with two factors, the first included three sorghum cultivars (Rabeh, Lilo, and Inqath), and the second included soaking the cultivar seeds for 12 hours in the plant growth regulator brassinolide and three concentrations with the comparison treatment soaking in distilled water only (0, 200, 400, 600) mg L-1 and in four replications, each with 12 experimental units. After sifting from contaminants using a sieve with a diame-

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ter of (0.8) mm and sterilizing inside an electric oven at a temperature of 250 ° C for 4 days, the seeds were sowed in square-shaped plastic dishes of dimensions (22 × 22) cm and height (13 cm) using glass sand. Timepieces[5]. The sand is then combined with distilled water and deposited at the height of 3 cm within the plastic dishes. Thirty seeds were put within the experimental unit and placed in the plant at 25 ° C. The first germination count was taken four days later. The dishes were then left in the facility until the 10-day examination period expired, at which point they were removed. The following traits were evaluated.

Studied laboratory characteristics

Germination speed (%)

This trait was measured after four days of placing the seeds in the sprout, and the results were converted into a percentage using the following equation[6].

Germination speed at first count %

The germination speed at the first count was calculated using the following equation:

GSFC= (number of natural seedlings at first count / total number of planted seeds) × 100 (1)

Standard laboratory germination percentage (%)

This trait was measured after ten days of planting by calculating the total number of natural seedlings, and the results were converted into a percentage using the following equation[6].

Standard laboratory germination percentage %

The Standard laboratory germination percentage using the following equation:

SLGP=(number of natural seedlings at the final count / total number of sown seeds) ×100 (1)

The length of the stalk and root (cm)

The length of the stalk and rootstock of ten natural seedlings was measured using a graduated ruler after the typical laboratory germination examination time of 10 days from planting. The lengths of each replication were measured from the leaflet to the end of the stem, then added and divided by the number of seedlings whose lengths were measured to produce the averages[7].

Dry Weight of Seed (gm)

The length of the stalk and rootstock of ten natural seedlings was measured using a graduated ruler after the typical laboratory germination examination time of 10 days from planting. The lengths of each replication were measured from the leaflet to the end of the stem, then added and divided by the number of seedlings whose lengths were measured to produce the averages[7].

Seed efficiency

This characteristic was calculated according to the equation mentioned in (8).

Seedling strength

The seedling strength was calculated using the following equation:

SD=(average root length + average stalk length) × percentage of standard laboratory germination.

Results

Germination speed

Table 1 shows that the concentrations of the growth regulator brassinolide and cultivars and the interaction between the two study factors significantly affect how fast seeds germinate. Table 1 shows a significant rise in the concentrations of the growth regulator brassinolide. The higher the concentration of Brassinolide, the quicker the germination rate. The concentration of 600 mg L^{-1} had the highest average for this trait, at 73.33 percent, compared to the control treatment, which was soaking the seeds in distilled water. This may be because Brassinolide, a growth regulator, speeds up the process of cell division and elongation and makes enzymes work better, which speeds up the germination process. From the same table, we can see that there are big differences between the cultivars when it comes to this trait. The cultivar Rabah had the highest average germination speed of 67.72 %, while the cultivars Inqath and Lilo had lower averages of 62.50 and 62.82 %, respectively. The winning cultivar is very competitive regarding growth needs, which is what (9) found. For the interaction between the two factors of the study, there was a significant difference in this trait. The Rabah cultivar with a concentration of 600 mg L^{-1} had the highest mean of 79.20 %, while the Inqath cultivar's comparison treatment (soaking with only distilled water) had a lower average of 47.80 %.

Sorghum cultivars (cv.)	Concentrations mg L^{-1} (Co)				Mean
	0	200	400	600	
Inqath	47.80	62.30	68.55	70.47	62.30
Rabah	50.85	63.38	77.45	79.20	67.72
Lilo	52.38	62.82	66.55	70.30	62.82
Mean	50.34	62.60	70.85	73.33	
LSD 0.05	cv.	Co	cv. × Co		LSD 0.05
	2.11	2.44	4.32		

Table 1. Effect of seed soaking with Brassinolide on the germination speed (%) of sorghum seed cultivars.

Germination percentage

The results of the analysis of variance are shown in table 2. There is a significant difference between the concentrations of the growth regulator brassinolide and the standard laboratory germination percentage trait. Still, there are no significant differences between the two study factors. The results of table 2 show that there are significant differences between the concentrations of the growth regulator brassinolide. The concentration of 600 mg L^{-1} gave the highest average for this trait, 94.43 %, while the comparison treatment (soaking with only distilled water) gave the lowest average, 69.80 %. The growth regulator brassinolide may be to blame for this because it speeds up the process of germination, which shows up in the germination rate. The same table shows that there are big differences between the cultivars. For example, the cultivar Rabeh had the highest average for this trait at 87.67 percent, while the cultivars Inqath and Lilo had lower averages at 82.47 and 84.94 %, respectively. This is because the varieties have different genetic classes.

Root length (cm)

Table 3 shows that the concentrations of the growth regulator brassinolide, the cultivars, and the interaction between them all have a big effect on the length of the roots table 3 shows that there are significant differences between the concentrations of the growth regulator brassinolide for this trait. The concentration of 600 mg L^{-1} gave the highest mean of 16.08 cm, while the comparison treatment (soaking with only distilled water) gave a lower standard of 9.87 cm. The same table shows that there are significant differences between the cultivars. The cultivar with the highest mean Inqath for the trait reached 13.90 cm, while Rabeh and Lilo had lower averages of 13.25 cm and 13.50 cm, respectively. This is because the genetic makeup of the different varieties is different. The effect of the interaction between the two factors of the study was significant, as the Inqath variety with a concentration of 600 mg L^{-1} gave the highest average of 16.28 cm compared with the comparison treatment (soaking with distilled water only) for the same variety, which recorded the lowest average of 9.58 cm.

Plant stalk Length (cm)

As can be seen from table 4, the growth regulator brassinolide and the cultivars interact significantly to affect feather length, as can be seen from the analysis of variance data. It's clear from table (4) that brassinolide concentrations varied significantly for this attribute, with the maximum average of 15.36 cm reported for the concentration of 600 mg L^{-1} vs. the lowest average of 8.22 cm for the comparator treatment (soaking with distilled water only). The role of Brassinolide in aiding cell elongation and speed of division may be one explanation for this association between brassinolide and feather length. Cultivars Inqath and Lilo had lower averages of 11.46 and 12.19 cm for the characteristic, but Rabeh had the most significant average of 13.21 cm. This is owing to the cultivars' different genetic compositions. The study's interaction between the two variables had a considerable impact, as Compared to the comparison treatment (soaking in distilled water only) for the Inqath variety, which recorded the lowest average of 6.63 cm, the two cultivars Inqath and Rabeh with a concentration of 600 mg L^{-1} had the highest average.

Sorghum cultivars (cv.)	Concentrations mg L^{-1} (Co)				Mean
	0	200	400	600	
Inqath	68.55	84.12	86.97	90.22	82.47
Rabah	71.73	85.88	94.95	98.12	87.67
Lilo	69.12	83.38	92.30	94.95	84.94
Mean	69.80	84.46	91.41	94.43	
LSD 0.05	cv.	Co	cv. × Co		LSD 0.05
	1.82	2.10	N.S		

Table 2. Effect of seed soaking with Brassinolide on the percentage of laboratory germination (%) of sorghum seed cultivars.

Sorghum cultivars (cv.)	Concentrations mg L^{-1} (Co)				Mean
	0	200	400	600	
Inqath	9.58	14.26	15.48	16.28	13.90
Rabah	9.75	11.65	15.55	16.04	13.25
Lilo	10.29	12.92	14.85	15.93	13.50
Mean	9.87	12.94	15.29	16.08	
LSD 0.05	cv.	Co	cv. × Co		LSD 0.05
	0.14	0.16	0.28		

Table 3. Effect of seed soaking with Brassinolide on the root length (cm) of sorghum seed cultivars.

Sorghum cultivars (cv.)	Concentrations mg L^{-1} (Co)				Mean
	0	200	400	600	
Inqath	6.63	9.91	13.73	15.56	11.46
Rabah	9.45	12.33	15.50	15.56	13.21
Lilo	8.59	11.34	13.88	14.96	12.19
Mean	8.22	11.19	14.37	15.36	
LSD 0.05	cv.	Co	cv. × Co		LSD 0.05
	0.097	0.112	0.193		

Table 4. Effect of seed soaking with Brassinolide on the stalk length (cm) of sorghum seed cultivars.

Seed vigor

The results of the analysis of variance referred to in table 5 show that there were significant differences in the coordination of the growth regulator brassinolide; the concentration of 600 mg L^{-1} recorded the highest mean, 2968.2 compared with treatment (drip soaking only) the concentration of 600 mg L^{-1} was superior to the length of the root and feather and the percentage of laboratory germination In this example, this indicates a difference in the genotype of the varieties. The effect of the interaction between the study and the evaluation was 600 mg L^{-1}; the highest mean was 3100.0, compared with the treatment (soaking by distillation only) of the salvage variety; the lowest average was 1111.2.

Dry weight of seed (mg)

The results of the analysis of variance in table 6 indicate that there were significant differences in dry weight between the concentrations of the growth regulator brassinolide and the cultivars, and the interaction was not significant for the two study factors table 6 shows that there are significant differences between the concentrations of the growth regulator brassinolide for this trait, as the concentration 600 mg L^{-1} recorded the highest average of 0.0545 mg compared with the comparison treatment (soaking with distilled water only) which gave a lower average of 0.0018. The same table indicates that there are significant differences between the cultivars, as the cultivar Rabah gave the highest mean of the trait, which amounted to 0.0585, in comparison with the two cultivars Inqath and Lilo, which recorded lower averages of 0.0435 and 0.0459 respectively, and this is due to the difference in the genetic composition of the cultivars.

Discussion

The winning cultivar is very competitive regarding growth needs, which is what (9) found. However, the concentration of 600 mg L^{-1} gave the highest average for the germination percentage, while the comparison treatment (soaking

Sorghum cultivars (cv.)	Concentrations mg L^{-1} (Co)				Mean
	0	200	400	600	
Inqath	1111.2	2033.1	2540.1	2875.4	2139.2
Rabah	1376.9	2058.7	2948.6	3100.0	2371.1
Lilo	1304.9	2022.4	2652.0	2932.3	2227.9
Mean	1264.3	2038.1	2713.6	2968.2	
LSD 0.05	cv.	Co	cv. × Co		LSD 0.05
	91.3	52.7	45.6		

Table 5. Effect of seed soaking with Brassinolide on the seedling strength of sorghum seed cultivars.

Sorghum cul-	Concentrations mg L^{-1} (Co)				Mean
	0	200	400	600	
Inqath	0.0345	0.0435	0.0460	0.0500	0.0435
Rabah	0.0395	0.0523	0.0550	0.0585	0.0513
Lilo	0.0395	0.0470	0.0527	0.0550	0.0459
Mean	0.0378	0.0476	0.0513	0.0545	
LSD 0.05	cv.	Co	cv. × Co		LSD 0.05
	0.0018	0.0020	N.S		

Table 6. Effect of seed soaking with Brassinolide on the dry weight of seedlings (mg) of sorghum seed cultivars.

with only distilled water) showed the lowest average; this is in line with what (10,11) results. The concentration of 600 mg L^{-1} gave the highest root length, and the comparison treatment gave a lower mean; these results are the same as (12,13) that may have found what they did because of the role of Brassinolide, which helps cells grow longer and divide more quickly, which makes the rootstock longer. Brassinolide has been shown to affect feather length in previous studies (12-14) significantly. Whereas the concentration 600 mg L^{-1} recorded the highest average dry weight of seed compared with the comparison treatment, which gave a lower average. These results are consistent with what was reached by previous references, who confirmed in their study a significant effect of Brassinolide on the length of the shoot and rootstock[15,16].

Conclusions

It can be concluded that soaking the seeds with the growth regulator brassinolide, in general, resulted in an increase and improvement of all evaluated features, which reflected positively on seed viability and vigor.

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