Plant Archives Volume 20 No. 2, 2020 pp. 6317-6320 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF STIMULATING SEEDS AND SOAKING PERIODS ON THE SEED GERMINATION AND SEEDLING TRAITS OF SORGHUM

Zaidoun S.J. Hadi and Razaq L. Attiya*

Agriculture College, University of Kerbala, Iraq.

Abstract

A laboratory experiment was conducted in the seed technology laboratory of the field crops department / College of Agriculture / University of Karbala aiming to investigate the effect of stimulating seeds and soaking period on the percentage of the standard seed germination as well as on the length of the radicle and plumule, in addition, to determine the best concentration for seed stimulation using the Completely Randomized Design (CRD) with the order of factorial experiment of two factors and three replicates. The first factor was the seed stimulation treatments, comprising dry seed (not soaked), soaking seeds in distilled water, soaking seeds in gibberellic acid (GA3) at three concentrations (60, 90 and 120mg.l^{-1}), soaking seeds in calcium chloride at two concentrations (10 and 20 mg.l^{-1}) and soaking seeds in nano calcium at two concentrations (30 and 40mg.l^{-1}), while the second factor was the soaking periods involving 6hours, 12 hours and 24 hours. Having the sorghum seeds planted, the results showed the significant superiority of the treatment including seed stimulation with gibberellic acid at the concentration of 120mg.l^{-1} giving the highest average of the laboratory seed germination percentage (87.33%), radicle length (7.256cm) and plumule length (9.572cm) compared to the treatments involving soaking seeds in other chemical solutions as well as the dry seeds (not soaked) which showed the lowest results for the mentioned traits respectively.

Key words: soaking period, seed germination, sorghum

Introduction

Among the most important problems facing growing sorghum *Sorghum bicolor* L. Moench is poor seed germination and heterogeneous growth (Hamza and Mohswen, 2017) which are considered the main reason behind the yield decrease as an essential difference has been observed between the percentage of seeds laboratory germination and the percentage of the field seedling emergence (AL-Baldawi and Hamza, 2017). Hence, it is evident that rapid, homogeneous, and high-percentage germination of the seeds founds a good field establishment leading to yield increment. Thus, relying on this base, seed priming technology was developed to improve seed germination and emergence (Lal *et al.,* 2018) as stimulating seeds with this technique showed extraordinary resultsin enhancing seeds germination and seedling emergence of sorghum (Jaddoaand Najem, 2107).

Phytohormones are considered the most important endogenous substances for modulating physiological and molecular responses, a critical requirement for plant survival as sessile organisms, Phytohormones act either attheir site of synthesis or elsewhere in plants following their transport (AL-Taey and Saadoon, 2014, AL-Taey *et al.*, 2010).

The method in which growth regulators are added to the plant is one of the factors affecting different plant responses showing the growth regulator activity. Several studies proved the activeness of stimulating seeds with gibberellic acid as stimulating sorghum seeds with GA3 improved the seed germination, enhanced their performance, and increased the germination speed (AL-Taey, 2017; Mokhtari and Hasan, 2018) besides, it significantly increased the laboratory germination rate (AL-hade, 2019). It also significantly affects the radicle and plumule length. Seed stimulation is not restricted to the growth regulators as there are many studies referred to using various osmotic solutions for seed stimulation; for instance, treating with sodium chloride enhanced the maize seed germination (Kumari *et al.,* 2017; Toman *et al.*, 2020). Therefore, this study was conducted aiming

***Author for correspondence :** E-mail : razzaq.ateha@uokerbala.edu.iq

to increase and enhancing the germination properties of sorghum seeds and probing the effect of the treatments involving seed stimulation and soaking periods on the germination percentage and seedling traits of sorghum.

Materials and methods

A laboratory experiment was conducted at the seed technology laboratory affiliated to the field crops department / College of Agriculture / University of Karbala as a factorial experiment involving two factors and three replicates relying upon the completely randomized design (CRD) for data analysis. The first factor was seed stimulation treatments included dry seeds, seeds soaked in distilled water, seeds soaked in GA3 at the concentrations 60, 90, and 120 $mg.l^{-1}$, seeds soaked in calcium chloride at the concentrations 10 and 20 $mg.l^{-1}$ and seeds soaked in nano-calcium at the concentrations 30 and 40$mg.l^{-1}$ while the second factor was the treatments of seeds soaking period involving three periods 6 hours, 12 hours and 24 hours. Having the required solution concentrations prepared, the seeds were soaked for the mentioned periods and then, 150 seeds of each treatment were placed in paper towels in Petri dishes considering replicating each treatment three times.

Studied traits

Standard laboratory germination percentage %

It was estimated, ten days after placing the seeds in a germinator (ISTA, 2013), as a percentage resulting from dividing the number of normal seedlings by the total number of seeds

Radicle and plumule length (cm)

After the 10-days period of the laboratorial examination had ended, five normal seedlings were chosen randomly, and having the radicles eradicated from the seed at the contact point and the plumule eradicated from the point contact to the epicotyl, their lengths were measured with a ruler (AOSA, 1988).

Statistical analysis

Data of the studied traits were statistically analyzed and the means were compared relying upon the Least Significant Difference (L.S.D) at the probability level of 0.05 (Steel *et al.,* 1981).

Results and discussion

Standard laboratory germination percentage %

Table 1 shows that the treatment of stimulating the seeds with 120 $mg.l^{-1}$ of gibberellic acid was significantly superior compared to the other stimulation treatments as it gave the highest percentage of the standard laboratory germination reached 87.33% while the control treatment (dry seeds) gave the lowest germination percentage (62.67%). The superiority this treatment is due to the gibberellic acid effect on increasing the germination percentage through enhancing the activity of digestive enzymes that digest different types of materials in the seed and transmit them to the embryo to resume the growth (Sheykhbaglon *et al.,* 2014). This finding was confirmed by the study of AL-hade and Alselawy (2019) that stimulating the seeds with gibberellic acid significantly increased the standard laboratory germination percentage.

Table 1: Effect of stimulating seeds and soaking period on the percentage of the standard laboratory seed germination (%).

Treatment	Soaking periods			Mean
	6 hours	12 hours	24 hours	
Dry seeds	62.00	63.33	62.67	62.67
Distilled water	68.67	72.67	70.67	70.67
60$mg.l^{-1}$ GA3	80.67	84.67	82.00	82.44
90$mg.l^{-1}$ GA3	83.33	86.67	84.00	84.67
120$mg.l^{-1}$ GA3	85.33	89.33	87.33	87.33
10$mg.l^{-1}$ $Cacl_2$	73.33	76.00	74.67	74.67
20$mg.l^{-1}$ Cacl2	76.00	78.00	76.67	76.89
30$mg.l^{-1}$ CA	72.67	75.33	73.33	73.78
40$mg.l^{-1}$ CA	74.00	76.67	76.00	75.56
Interaction L.S.D 0.05		4.006		Treatment L.S.D 0.05 2.313
Mean	75.11	78.07	76.37	
Soaking periodL.S.D 0.05		1.335		

Soaking seed periods affected this trait significantly as the germination percentage average of the seeds soaked for 12 hours was 78.07% while the treatment of soaking the seeds for 60 hours gave the lowest germination percentage as a little as 75.11% on average. This result is consistent with what was obtained by Iqbal *et al.,* (2014) that soaking seeds for 12 hours in different solutions was superior in all studied traits compared to the control treatment.

Concerning the interaction between the treatments of stimulation and soaking seeds period, the treatment of soaking in 120 $mg.l^{-1}$ of gibberellic acid for 12 hours was superior in this trait giving the highest germination percentage reached 89.33% on average while the control treatment (dry seeds) gave the lowest average reached 62.00%.

Radicle length (cm)

Table 2 illustrates the significant superiority of the treatment of gibberellic acid at the concentration of 120 $mg.l^{-1}$ giving the highest radicle length averaged 7.256

Table 2: Effect of stimulating seeds and soaking period on the radicle length (cm).

Treatment	Soaking periods			Mean
	6 hours	12 hours	24 hours	
Dry seeds	5.017	5.033	5.067	5.033
Distilled water	5.583	5.750	5.667	5.667
60mg.l^{-1} GA3	6.467	7.117	6.717	6.767
90mg.l^{-1} GA3	6.833	7.083	6.733	6.839
120mg.l^{-1} GA3	7.133	7.750	6.883	7.256
10mg.l^{-1} $Cacl_2$	6.433	7.033	6.450	6.633
20mg.l^{-1} Cacl2	6.700	7.300	6.833	6.944
30mg.l^{-1} CA	6.317	6.800	6.617	6.583
40mg.l^{-1} CA	6.717	6.617	6.350	6.556
Interaction L.S.D 0.05		0.638		Treatment L.S.D 0.05 0.368
Mean	6.335	6.724	6.367	
Soaking periodL.S.D 0.05		0.213		

Table 3: Effect of stimulating seeds and soaking period on the plumule length (cm).

Treatment	Soaking periods			Mean
	6 hours	12 hours	24 hours	
Dry seeds	7.167	7.067	7.017	7.083
Distilled water	7.867	7.967	8.200	8.011
60mg.l^{-1} GA3	9.117	9.900	8.850	9.289
90mg.l^{-1} GA3	9.083	10.133	9.383	9.533
120mg.l^{-1} GA3	9.283	10.067	9.367	9.572
10mg.l^{-1} $Cacl_2$	8.700	9.650	8.850	9.067
20mg.l^{-1} Cacl2	9.233	9.917	8.983	9.378
30mg.l^{-1} CA	8.683	8.867	8.700	8.750
40mg.l^{-1} CA	8.350	9.150	9.000	8.833
Interaction L.S.D 0.05		1.004		Treatment L.S.D 0.05 0.579
Mean	8.609	9.191	8.706	
Soaking periodL.S.D 0.05		0.334		

cm compared to the other treatments of seed stimulation, especially the control treatment (dry seeds) that gave radicle length of 5.33 cm. The superiority of this treatment may be due to the gibberellic acid effect on increasing the process of cell division and enlargement thus it enhances the germination and seedling growth and increases the leaf area (Nimir *et al.,* 2015). This result is consistent with the results referred to by Foghani *et al.,* (2018) that stimulating seeds with gibberellic acid increased the radicle length significantly.

The soaking period affected the radicle length significantly as the period soaking them for 12 hours was superior giving the highest average of radicle length reached 6.724 cm while soaking seeds for 6 hours gave the lowest radicle length average reached 6.335cm. The superiority of the soaked for 12 hours may be attributed to seed imbibition with the stimulation solution properly in sense that not affect the seed physiological activity and osmosis pressure reversely since soaking for a longer time would affect the seed vitality negatively that consequently affects the root and reducing the length, the result that is consistent with what was mentioned by Hamza, Mohswen, (2017) that soaking in GA3 reducing the soaking time. Regarding the interaction between seed stimulation and the soaking period, we notice in the same table that the treatment of soaking the seeds in 120 mg.l^{-1} of gibberellic acid for 12 hours was superior in this trait producing the highest root length averaged 7.750cm while the lowest root length was 5.017cm produced by the control treatment (dry seeds).

Plumule length

Table 3 shows the superiority of treatments dealt concerned with seeds stimulated with 120 and 90 mg.l^{-1} of gibberellic acid giving the highest average of plumule length reached 9.572 and 9.533cm respectively compared to the control treatment (dry seeds) that gave the lowest pumule length averaged 7.083cm. The superiority of these two treatments may be due to the gibberellic acid role in increasing the cell division and enlargement that resulted in producing larger seedlings. This finding is consistent with those of Najim (2016) that stimulating seeds with gibberellic acid increases the plumule length.

Table 3 also illustrates that the seed soaking period affected the plumule length significantly. Soaking the seeds for 12 hours was superior in this trait giving the highest average value of the plumule length reached 9.191cm compared to the period of soaking for 6 hours that gave the lowest of the plumule length average reached 8.609cm. This result is consistent with those obtained by Kumari *et al.,* (2017) that soaking corn seeds in gibberellic acid for 12 hours increases both the radicle and plumule lengths.

For the interaction between seed stimulation and the soaking period, the interaction treatment of soaking the seeds in 90 mg.l^{-1} of gibberellic acid for 12 hours was superior that gave the highest plumule length value averaged 10.133cm while the lowest plumule length was 7.017cm produced by the control treatment.

References

AL-Baldawi, M.H.K. and J.H. Hamza (2017). Seed priming effect onfield emergence and grain yield in sorghum. *J. of Central European.,* **18(2):**.

AL-Hade, M., S. Q (2019). Effect of seed storaged priming with

different storage periods on seed vigour, growth and yield of (*Sorghum bicolor* L. *Moench*). Athesis of master of Agricultural Sciences. Field Crop, Sciences College of Agriculture -University of Kerbala.

AL-Hade, M., S. Q and L.A. Razaq (2019). Effect of seed stimulation and seed age of sorghum on the germination and traits of seedlings. *P, A*. **19(2):** pp.4477-4482.

AOSA (Association of Official Seed Analysts) (1988). Rules for testing seeds. *J. Seed Tech.,* **12(3):** 109.

AL-Taey, D.K.A. and A.H. Saadoon (2014). Effect of treatment of Salicylic acid and water Salinity on the Growth and Nitrate Accumulation with nitrate reductase activity in the Leaves of Spinach, *Spenaciaoleracea* L. *Journal of Babylon University, Pure and Applied Sciences,* **3(22):** 1188-1203.

Al-Taey, D.K.A., S.S.M. AlAzawi and M.H. Husien (2010). Effect of Spraying Acetyl Salicylic Acid on the Plant Tolerance for Salt Stress & Survival Percentage after Transplanting of Orange (*Citrus sinensis*). *Babylon Journal University -Pure and Applied science*, **18(4):** 1513-1520.

AL-Taey, D.K.A. (2017). Alleviation of Salinity Effects by Poultry Manure and Gibberellin Application on growth and Peroxidase activity in pepper. *International Journal of Environment, Agriculture and Biotechnology,* **2(4):** 1851-1862.

Forghani, A.H., A. Almodares and A.A. Ehsanpour (2018). Potentialobjectives for gibberellic acid sweet sorghum (*Sorghumbicolor* L. Moenchcv. Sofra). **61:** pp: 113-124.

Hamza, J.H. and K.M.A. Mohswen (2017). Effect of seed soaking with GA_3 on emergence and seedling growth of corn under saltstress. *The Iraqi Journal of Agri. Sci.,* **650-659(3):** 48.

Iqbal, M.A., A.M. Saleem and B. Ahmad (2014). Effect of Seed Invigoration Techniques on Germination and Seedling Growth of Chinese Sweet Sorghum. Department of Agronomy, Faculty of Agriculture, University of Agriculture Faisalabad-38040, Pakistan.

ISTA (International Seed Testing Association) (2013). International Rules for Seed Testing. Adopted at the Ordinary Meeting (2004). Budapest, Hungary to become effective on 1st January. 2005. The International Seed Testing Association. (ISTA).

Jaddoa, K.A. and R.R. Najem (2017). Effect of seed priming on germination, emergence of seedling and grain yield of sorghum. *The Iraqi journal of agricultural sciences,* **899-908(4):** 48.

Kumari Neha, P. Kumar and M. Singh (2017). Effect of halo priming and hormonal Priming on seed germantion and seedling vigour. *Journal pharmacognosy and phyochemistry,* **6(4):** 27-30.

Lal, S.K., K. Sudhir, S. Vijay, M. Sahil, V. Panditi, R. Babu, B. Bhabesh, J. Donald, F. Dhirendera and K.R. Malireddy (2018). Advances in Seed Priming PP41-50.

Mokhtari, N.E.P. and Y.E. Hasan (2018). Influence of different priming mater Ials on germination of Sorghum hubrids (*Sorghum bicolor* L. moench) *x Sorghum sudanense staph. seeds,* 2018. **27(5):** 3081-3086.

Najim, R.R. (2016). Effect of seed priming on germination, emergence of seedlings, growth and grain yield of sorghum. M. Sc. Department of Field Crop Sciences College of Agriculture - University of Baghdad.

Nimir, N.E.A., L. Shiyuan, Z. Guisheng, G. Wenshan, M. Baoluo and Yongh (2015). Comparative effect of gibberellic acid, kinetin and salicylicacidon emergence, seedling growth and the antioxidant defence system of sweet sorghum (*sorghumbicolor*) under salinity and temperature stresses. Crop and pasture. *Sci.,* **66:** 145.

Pinheiro, C.L., T.N. Hellen, S.F. Araujo, M.S. Brito, J.S. Maia and S.M.F. Viana (2018). Seed Priming and Tolerance to Salt and Water Stress in Divergent Grain Sorghum Genotypes. *American J. of Plant Sci.,* **9:** 606-616.

Steel, R.G.D. and J.H. Torrie (1981). Principles and Procedures of Statisti. Mcgraw. Hill book Co., Inc. N.Y. pp.485.

Sheykhbaglou, R., R. Saeede, A. Omid and S. Mohammad (2014). The Effect of salicy Acid and Gibberellin on seed Reserve Utilization, Germination and Enzyme Activity of Sorghum (*Sorghum bicolor* L.) seeds Under Drought Stress. *J. of stress. Physio. and Bioche.,* **10(1):** 5-13.

Toman, S.S., D.K.A. Al-Taey, A.R. Al-Tawaha, S.N. Sirajuddin, I. Rasyid and A.A. Hassan (2020). Effect of foliar application and mineral fertilizer on growth parameters and content auxins, G.A. and C.K. in cucumber leaves. IOP Conf. Ser. *Earth Environ. Sci*., **492:** 012009.