

Response of sorghum cultivars (*Sorghum bicolor* L.) to spraying different concentrations of salicylic acid

Mustafa Raddad Drig Atwi

Mohamed Alwan Hashem

College of Agriculture - University of Al-Muthanna, Iraq

Email : agrpl.grad.mustafaradad@mu.edu.iq

Received on 18/11/2022 Accepted on 18/12/2022 Published on 1/3/2023

Abstract

A field experiment was carried out at the second agricultural research station – College of Agriculture – University of Al-Muthanna during spring season 2022, to find out response of cultivars of sorghum (Rabih, Khair, Inqath) to spraying concentrations of salicylic acid. The experiment included 12 treatments represent between three cultivars (Rabih, Khair, Anqadh) and spraying of four concentrations of salicylic acid (0, 60, 90, 120)ppm, The Experiment was designed in split plots according to R.C.B.D with three replicates, The main plots included three cultivars of sorghum, while the secondary sub plots It included four levels of salicylic acid. Results showed that cultivar of Khair was superior at the traits Stem diameter, leaf area, no. of grains per ear which gave (20.35 mm, 303.00 cm² and 1214 grain per- ear-1) respectively. As for salicylic acid the concentration 120 mg. L-1 was significant on the (no. grains per- ear, weight of 1000 grain and harvest index which gave (1461 grain per- ear -1, 33.30 g and 29.79 %) respectively. while the cultivar Khair excelled in the trait of leaf area and stem diameter (303.9 cm² and 20.35 mm) respectively, as well as a significant effect of the level 120 ppm in the trait (number of days from planting to 75% flowering, number of leaves per plant, number of grains in ear, and Weigh of 1000 grains, grain yield, biological yield, harvest index (it amounted to 93.78) days, 9.45 leaf⁻¹, 1494 grain ear⁻¹, 32.96 g, 3.46 tons ha⁻¹, 12.59 tons ha⁻¹, 29.76%) sequentially. Significant effect of the interaction between the factors on the number of grains in the ear, as the combination (cultivars Inqath × level 120 ppm) recorded the highest average amounted to 2017 grain ear⁻¹.

.Keywords: Salicylic acid, cultivars, Rabih, Khair, Inqath.

Introduction

Sorghum crop belongs to the poaceae family and ranks fifth among cereal crops in Iraq and the world in terms of

importance, cultivated region and production after wheat, barley, rice and maize (Directorate of Agricultural Statistics 2016). Its cultivation is spread in

the semi-arid regions Tropical and subtropical (FAO.2009), where the global region planted with sorghum reached 44.44 million hectares and the total global production was 463.63 million tons. The African continent occupies the first place in the world in terms of cultivated region, then Asia America either in the Arab world, (Ministry of Agriculture, (2014) and that the leading governorates in the production of sorghum crop in Iraq is (Maysan, Diwaniyah and Dhi Qar) with an average productivity of 1.62, 1.40 and 1.11 tons ha⁻¹, respectively (Central Organization for Statistics and Information Technology, (2007 Sorghum grains are used in human and animal nutrition, In poor countries, they enter as human food when mixed with wheat flour by 50%. In developed countries such as the United States of America, their grains are used in human food industries such as starch and its derivatives, because they contain nutritional ingredients. Sorghum has high percentage of protein in it , in addition to that these grains are a source of vitamin B (Rana *et al.*, 2013).

The diameter of the stem represents the number and thickness of the vascular bundles present in it, and its widening comes from increasing the thickness of the two layers of wood and bark as well as the pulp tissue. The increase and widening of these bundles leads to an increase in the amount of water and nutrients transported through them, which makes them contact

and benefit the cell and tissue in all parts of the plant and give a greater opportunity To be the seeds that represent the downstream and gather nutrients (Yassin 2018), And the flag leaf is considered the plant's nutrients factory, being the main plant organ in the photosynthesis process, and the importance of the leafy area lies in highlighting the productive capacity of the plant. The leaves also manufacture sugar within their plant tissues, which is transmitted from the leaves to storage places in the plant tissues (Abboud *et al.*, 2017)

Materials and working methods

A field experiment was carried out during the spring season (2022) at the second agricultural research and experiment station of the College of Agriculture - University of Al-Muthanna, located in Al Bandar region- Samawa district (about 3 km) from the center of Al-Muthanna Governorate.

The first factor: Varieties of sorghum (Rabih, Khair, Inqath) and the following symbols (V1, V2, and V3) were given sequentially.

The second factor: salicylic acid with three levels in addition to the comparison (0, 60, 90 and 120) and the following symbols were given (S0, S1, S2, S3) sequentially. This sample was taken for the purpose of conducting some analyzes Chemical and physical before carrying out the experiment (Table 1)

Table (1) some physical and chemical properties of field soil before planting		
Analysis type	the value	measuring unit
Electrical conductivity (Ece)	7.9	Desi Siemens M-1

PH	7.33	_____
N	10.19	mg kg ⁻¹
P	12.37	
K	121.4	
Clay	30	%
Sand	48	
Silt	22	
OM	1.57	%
soil texture	sandy mixture	_____

Experiment design

The experiment was carried out according to the order of the split plots, using completely randomized plots, using two factors and with three replications. The main plots included the cultivars, while the sub plots included the salicylic levels, and each replicator contained 12 experimental units, so the number of experimental units in the experiment was 36 experimental units.

Field operations

The experiment was planted manually at the end of March 30_2022 in the depth of the distance between one meadow and another 20 centimeters. The experimental land was fertilized at a rate of 320 kg hectares⁻¹ in the form of urea (N% 46) and at a rate of 200 kg P₂O₄ ha⁻¹ in the form of triple super phosphate (P21%) and at a rate of 100 kg ha⁻¹K₂O in the form of potassium sulfate (K41.5)), taking into account the ready quantity of elements in the soil before adding, the nitrogen fertilizer was added by four batches in the following stages (emergence , branches, elongation, lining) as for the amount of

phosphorous and potassium, they were all added when planting (Ali et al., 2014).

Recording data

Ten plants were selected randomly from each entry for recording the observation of all traits. The average of observation recoded on these ten plants were considered for statistical analysis. The traits on which observations were recorded are stem diameter (mm), leaf area (cm²), Number of grains per ear, Weight of 1000 grains (g) and Harvest index (%). The data were statistically analysis using the Genstat 12 programme. Comparisons were also made by testing the least significant difference at a significant level of 0.05.

Results

1- stem diameter (mm)

The results in table (2) indicated a significant effect in stem diameter trait, while there was non-significant differences for sprayed of salicylic acid and there interaction. The cultivars Khair gave a highest average which amounted 20.35 mm, which did not differ significantly from the cultivar Rabih which recorded an average of 19.73 mm, whereas the cultivars Anqadh gave the lowest average which was 13.01 mm, that is may be due to

the nature of genotypes, these results consistent with finding of Yassin, 2018.

It is noted from the results in Table 2) that the best cultivars recorded the highest

average of 20.73 mm, which did not differ significantly from the Rabih cultivars, which recorded an average of 19.73 mm, while the Inqath cultivars recorded the lowest average of 13.01 mm.

Table (2) Effect of cultivars, concentration of salicylic acid and their interaction on stem diameter

Cultivar	Concentration of salicylic acid mg.L-1				Mean of cultivars
	0	60	90	120	
Rabih	19.69	18.91	19.76	20.57	19.73
Khair	20.13	21.9	21.43	18.74	20.35
Inqath	12.61	12.8	14	13.34	13.01
Mean of salicylic acid	17.48	17.36	18.40	17.55	
0.05L.S.D	cultivars	Salicylic levels		Overlap	
	5.43	N.S		N.S	

1-2 leaf area (cm²)

Results in table (3) showed significant differences for cultivars on leaf area trait, superiority of the Khair cultivar in this trait which gave an average of 303.90 cm², while the lowest average which was 119.70 cm² for Anqadh cultivar, The reason may be due to attributed the genetic nature of the varieties that affect gene expression and thus affect the plant growth traits, these results agreement with finding

(Alfaran, 2020). As for concentration of salicylic acid and interaction between the factors the results at the same table indicated there is no significant effect was showing on leaf area trait.

It is noticed from the results in Table 3) that the cultivar Khair outperformed, as it recorded the highest average of 303.9 cm², while the two cultivars, Rabih and Inqathrs, recorded the lowest average of 192.8 (and 119.7 cm²) respectively.

Table (3) Effect of cultivars, concentration of salicylic acid and their interaction on the leaf area (cm²) trait.

Cultivar	Concentration of salicylic acid mg.L-1				Mean of cultivars
	0	60	90	120	

Rabih	178.5	202	187.5	203.5	192.8
Khair	295.3	274.9	325	320.6	303.9
Inqath	122.7	123.7	113.1	119.5	119.7
Mean of salicylic acid	198.8	200.2	208.5	214.5	
0.05L.S.D	cultivars	Salicylic levels		Overlap	
	87.81	N.S		N.S	

2. Yield components

2.1 no. of grains per ear

The results in table (4) showed a significant effect cultivars, concentrations of salicylic acid and their interaction on the number of grains per ear.

It is noticed from the results in Table 4) that the cultivar “Inqath” outperformed, as it recorded the highest average of 1617 kernels of ear-1, while the two cultivars of Khair and Rabih scored the lowest average of 1214) and 1187 of kernels of ear⁻¹) sequentially, which did not differ significantly between them, perhaps the reason In addition to the genetic differences.

As for the salicylic acid concentration 120 mg.L⁻¹ was superior, as it recorded the highest no. of grains per ear with an average of 1461 grains ear⁻¹, while the control concentration recorded the lowest average was 1160 grains ear⁻¹,

the reason may be attributed to the role of salicylic acid in regulating many physiological processes, including photosynthesis by increasing the number of leaves which gave optimal products of photosynthesis which raising the efficiency of the photosynthesis process, it increases the products of metabolism and provides an appropriate opportunity to reduce of abortion in the florets by reducing the state of competition between them for the food product which prompted the direction of increasing the number of grains, these results are in agreement with Dahl and Kazim, (2017).

The results in same table showed a significant effect for interaction, as the combination (Variety Anqadh x 120 mg.L-1) recorded the highest average which was 2017 grain ear-1, while the combination (Rabih cultivar × 120 mg.L-1) recorded the lowest average was 1067 grain ear-1. This may be due to the different response of the cultivars to salicylic acid to increasing the number of grains.

Table (4) Effect of cultivars, concentrations of salicylic acid and their interaction on the number of grains per ear.

Cultivar	Concentration of salicylic acid mg.L-1				Mean of cultivars
	0	60	90	120	

Rabih	1103	1148	1429	1067	1187
Khair	1071	1165	1321	1298	1214
Inqath	1306	1662	1483	2017	1617
Mean of salicylic acid	1160	1325	1411	1461	
0.05L.S.D	cultivars	Salicylic levels		Overlap	
	222.1	163.6		295.8	

2.2 Weight 1000 grain (g).

The results of table (5) showed that there was a significant effect of salicylic acid concentrations, while there was no significant effect of the cultivars and their interaction on weight 1000 grains trait.

The concentration 120 mg.L-1 was exceeded, as it recorded the highest

average which was 33.30 g, whereas the control concentration 0 mg.L-1 recorded the lowest average amounted to (25.35 g), the reason may be due to the period of grain filling and the role of salicylic acid in encouraging the transfer of metabolic materials from the source (vegetative growth) to sink (the grains), which leads to an increase on weight of grains.

Table (5) Effect of cultivars, concentration of salicylic acid and their interaction on weight of 1000 grains.

Cultivar	Concentration of salicylic acid mg.L-1				Mean of cultivars
	0	60	90	120	
Rabih	26.07	29.65	32.41	35.43	30.89
Khair	25.15	27.09	28.25	31.31	27.95
Inqath	24.83	29.12	28.20	33.15	28.82
Mean of salicylic acid	25.35	28.62	29.62	33.30	
0.05L.S.D	cultivars	Salicylic levels		Overlap	
	N.S	2.58		N.S	

2.3. Harvest index

In table (6) the results of showed there was a significant effect of salicylic acid concentrations on harvest index, the concentration 120 mg.L-1 gave the highest average was 29.79 % which did not differ significantly from the (60 and 90 mg.L-1), concentrations as the average concentrations reached (29% and 26.86%) respectively, while the control concentration 0 mg.L-1 recorded the lowest average which was 23.52 %, the

reason may be due to attributed to the role of salicylic acid to raising the efficiency of the plant to absorbing nutrients and transferring them to the vegetative growth and grains, which leads to an increase in the biological yield and yield of grains and thus increase the harvest index. As for cultivars and interaction between the factors there are no significant effect was showing on this trait.

Table (6) Effect of cultivars, concentrations of salicylic acid and their interaction on harvest index trait.

Cultivar	Concentration of salicylic acid mg.L-1				Mean of cultivars
	0	60	90	120	
Rabih	27.26	25.84	28.10	30.68	27.97
Khair	22.24	27.32	24.99	26.74	25.32
Inqath	21.08	33.85	27.50	31.96	28.60
Mean of salicylic acid	23.52	29	26.86	29.79	
0.05L.S.D	cultivars	Salicylic concentrations		Overlap	
	N.S	4.83		N.S	

grains ear-1, 33.30 g, 29.79%) respectively.

Conclusions

The cultivar Khair was the best among the cultivars, by its indication of giving the highest averages for stem diameter and leaf area, which amounted to (20.35 mm and 303.9 cm²) respectively.

The concentration of 120 mg.L-1 was the best among the concentrations in order to give the highest averages of the number of grains per ear, the weight of 1000 grains and harvest index as it reached (1461

References:

Agricultural Statistics Directorate. (2016). Crop production estimation. The Ministry of Planning . central Statistical Organization . Iraq.

FAO. (2009). Quarterly Bulletin of Statistical. Food and Agriculture Organization of United. Rome.57: 91-92.

Ministry Of Agriculture . (2014) . Statistical booklet for agricultural crop data. Agricultural Research Department.

Agricultural Economics Research Division. second edition.

Central Agency for Statistics and Information Technology (2007). Ministry Of Agriculture . Agricultural Research Department. Agricultural Economics Research Department. Baghdad . The Republic of Iraq.

Rana, D.S.B., Sing, K., Gupta, A. K. and Arya, S. 2013. Responses of fodder (Sorghum bicolor L.) Moench. to zinc iron. Forage Res.39(1):45-47.

Mohammed. Saja Abdullah.(2017). Effect of spraying potassium levels on growth, yield and components of two sorghum cultivars. Master Thesis. faculty of Agriculture. Al-Muthanna University.

Ali, Nouredine Shawqi, Hamdallah Suleiman Rahi and Abdel-Wahhab Abdel-Razzaq Shaker (2014). Soil fertility. House of practical books for printing, publishing and distribution.

Yassin, Labib Ibrahim. (2018). Effect of planting date on growth characteristics and yield of two sorghum cultivars. Master Thesis. faculty of Agriculture. Baghdad University.

Al-Faraan, Jamil Sabah Shadhan. (2020). Growth and yield of some sorghum cultivars under different levels of agricultural sulfur. Master Thesis . faculty of Agriculture . Albasrah university.

Al-Shammari, Ali Hussein Awad, Karim Hannoun Mohsen and Bahaa Al-Din Muhammad Mohsen.2021. Effect of spraying with some nano-fertilizers on yield of three sorghum genotypes. Al-Muthanna Journal of Agricultural Sciences .8 4).

Dahl, Ihsan Nawaf and Zaid Murad Kazem. (2017) . Effect of salicylic acid on growth and yield of bread wheat under drought conditions. Karbala Journal of Agricultural Sciences - Journal of Science.413.)

Ahmed, H. Waqas. L; M. F. Jan ; M. D. Ahmedzai. (2018). Effect of salicylic acid on yield and yield components of maize under reduced irrigation. Agr. Research and Technology. 15(2):1-5.

Badrawi. Mujtaba Muhammad Mahdi Jawad. (2021). Response of bread wheat to spraying with different concentrations of salicylic acid and tryptophan. Master Thesis. faculty of Agriculture . Albasrah university.