

IMPACT OF PLANT GROWTH INHIBITORS ON THE GROWTH AND YIELD OF SORGHUM

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ABSTRACT

Field experiment was carried out during the spring and fall seasons of 2019 at the Abu Ghraib Research Station of the Agricultural Research Office/ Ministry of Agriculture, was aimed to investigate the effect of plant growth inhibitors on growth and yield of several sorghum varieties. Randomized Complete Block Design within split plot arrangement with three replications was used. The main plot consists of three growth inhibitors (Cycocel, Ethiphon, and Mebiquat), which were added at stages six and eight leaf stage, in addition to the control treatment (distilled water only), the sub plot was included three cultivars (Mabrouk, Buhooth 70 and Giza 113). The results showed in both seasons significant interaction between cultivars and growth inhibitors in most of the studied traits. The plants of the variety Giza 113 sprayed with Ethiphon recorded the lowest period of reaching physiological maturity, the highest average dry matter yield, and the highest weight of 1000 grains (89.00 days, 17.32 ton ha⁻¹, and 39.33 gm) respectively. The same variety recorded the highest content of chlorophyll in the leaves and the highest grain yield due to the effect of Mebiquat (49.50 spad, 3.93 ton ha⁻¹. The cultivar Buhooth 70 with the effect of Cycocel achieved the highest average of dry matter yield of 33.27 ton ha⁻¹.

Keywords: growth inhibitors, *Sorghum bicolor*, grain yield , grain yield .

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تأثير معيقات النمو النباتية في نمو وحاصل الذرة البيضاء

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المستخلص

نفذت تجربة حقلية خلال العروتين الربيعية والخريفية لعام 2019 في محطة أبحاث ابوغريب التابعة لدائرة البحوث الزراعية/ وزارة الزراعة، بهدف دراسة استجابة عدة اصناف من الذرة البيضاء لإضافة معيقات النمو النباتية. استعمل تصميم القطاعات الكاملة المعشاة بترتيب القطاعات الالواح المنشقة وبثلاثة مكررات، تضمنت الالواح الرئيسية معيقات النمو (السايكوسيل و ائيفون و مبييكوات) والتي تم اضافتها عند مرحلتين ست وثمان اوراق فضلا عن معاملة المقارنة (ماء مقطر فقط)، اما الالواح الثانوية تضمنت ثلاثة اصناف (مبروك و بحوث 70 و جيزة 113). أظهرت النتائج في العروتين وجود تداخل معنوي بين الاصناف ومعيقات النمو في اغلب الصفات قيد الدراسة. اذ سجلت نباتات الصنف جيزة 113 المرشوشة بالائيفون أقل مدة لبلوغ مرحلة النضج الفسلجي واعلى متوسط لحاصل المادة الجافة واعلى وزن 1000 حبة (89.00 يوما ، 17.32 طن ه⁻¹ ، 39.33 غم) بالتتابع ، وسجل الصنف ذاته اعلى محتوى من الكلوروفيل في الالواق واعلى حاصل حبوب بتأثير المبييكوات (spad 49.50 ، 3.93 طن ه⁻¹). حقق الصنف بحوث سبعين بتأثير السايكوسيل أعلى متوسط لحاصل المادة الجافة بلغ 33.27 طن ه⁻¹.

كلمات مفتاحية: معيقات النمو، حاصل الحبوب، مكونات الحاصل .

البحث مستل من رسالة ماجستير للباحث الثاني

INTRODUCTION

Sorghum (*Sorghum bicolor* (L.) Monech) is one of the cereal crops able to grow at different environments due to its physiological and morphological characteristics, and that the main use of this crop in most producing countries, especially developing countries, is food for human in various forms, as for the developed countries, the use of sorghum grains for animal feeding, and its important forage crop (7). The global area cultivated of this crop for the year 2018/2019 was about 40.12 million hectares and the production was 59.81 million tons, with yield was 1.49 ton ha⁻¹ (15). In Iraq, the cultivated area for grain reached 1906 hectares, with an average production 1.2 ton ha⁻¹ (14). Despite the important advantages of the sorghum, its production in Iraq is still limited, due to the problems facing its production, represented by the reluctance of farmers to cultivate it, due to planting old local varieties. Forage varieties are almost limited in Iraq and their production of seeds is low per unit area. The scientific basis for sorghum experiments are to study the genotypes and its adaptability for environmental conditions with available nutrients. The use of growth inhibitors with certain concentrations could be lead to improve the growth characters and regulate plant height, and then increasing the manufactured nutrients and moving them from the source to the sink (seed) to improve the characters of the yield and its components, instead of increasing the vegetative growth by reducing the period from emergence to flowering. This study was aimed to investigate effect of growth inhibitors to some traits of three sorghum varieties.

MATERIALS AND METHODS

Field experiment was carried out during the spring and fall seasons of 2019 at the Abu Ghraib Research Station of the Agricultural Research Office/ Ministry of Agriculture, using growth inhibitors (Cycocel, Ethiphon, and Mebiquat) and three varieties (Mabrouk, Buhooth 70, and Giza 113) added six and eight weeks after emergence with concentrations of 500, 500 and 250 mg liter⁻¹, respectively. Split plot design was used with three replications. The main plot consists of three growth inhibitors, whereas the three cultivars allocated to the sub plots. The experiment land was

prepared from plowing, smoothing and leveling, then divided into experimental units with an area of 12 m² for each experimental unit with dimensions of (3 x 4 m). It contained four lines with a distance of 75 cm between lines and 20 cm between plants within lines. The seedlings were thinned to a single plant according to the plant density (66666 plants. ha⁻¹) when the seedling height reached 10-15 cm. The experimental land was fertilized with the addition of nitrogen fertilizer in the form of urea (46% N) at a rate of 200 kg per hectare. One third of the amount was added in planting and the remaining after 40 days of planting, the fertilizer was placed 5 cm from the planting line. As for the compound fertilizer DAP, a complete dose of 400 kg. ha⁻¹ was added at cultivation. The weeds were controlled by manual weeding whenever needed, and the corn stalk borer was controlled with the granular diazone insecticide (10% active ingredient), for two times, the first as a preventive control at the stage of 4-5 leaves and the second 15 days after the first control (10). The planting was carried out on 3/31/2019 for the spring crop and on 7/21/2019 for the fall crop, and the harvest was done according to the maturity time of each variety.

Studied characters

1. The number of days from planting until physiological maturity

It was calculated according to the number of days from planting to physiological maturity by noting the black spot at the bottom of the seed and the yellowing of the leaves.

2. Plant height (cm)

The plant height was measured at the physiological maturity stage, by taking the average height of five plants randomly from the middle lines for each treatment, starting from the soil surface to the top of the head.

3. The chlorophyll content of leaves (SPAD)

This trait was measured (early in the morning) with a Japanese-made Chlorophyll meter of 502 Spad plus, for five plants per experimental unit, five readings of the leaves were taken and the average extracted for it.

4- Dry matter yield (tons ha⁻¹)

It was calculated from the average weight of five plants randomly, which were dried in the oven at a temperature of 65 °C for 72 hours,

then at 105 °C for three hours in the laboratories of the Agricultural Research Department, then the weight was converted on the basis of tons. ha⁻¹, according to the plant density used.

5- Number of grains head¹

The average number of kernels per head was taken for 10 plants randomly from the midlines at the harvest stage.

6- Weight of 1000 grains

One thousand grains were taken randomly from the ten heads of plants which were taken to calculate the number of grains from the midlines and weighed with a sensitive scale.

7- Grain yield (ton ha⁻¹)

The grain yield was measured from the harvest of 10 plants from the midlines and their grain was threshed. The average yield per head was extracted for each experimental unit, and then the total yield was calculated by multiplying the weight of the seeds per plant by the plant density. Then the data were converted into ton ha⁻¹.

RESULTS AND DISCUSSION

The number of days from planting to physiological maturity

The results indicated that the cultivars were differed significantly, cultivar Giza 113 was differed significantly to reach that stage and recorded the lowest average for this trait (89.83 days), and did not differed significantly from the cultivar Mabrouk, which needed 92.75 days to reach this stage (Table 1). Cultivar Buhooth 70 significantly needs more days to reach this stage (117.83 days). The results of Table (2) in the fall season show that the cultivar Buhooth 70 needs an average

number of days 98.58 days to reach this stage, and did not differed significantly from the variety Giza 113, which needed 98.75 days to reach maturity. Whereas, the cultivar Mabrouk was delayed significantly and needs an average of 102.00 days to reach this stage. The variation among varieties in the number of days from planting to physiological maturity may be due to the differences in their genetic nature, which is reflected in their different response to soil and crop management, and then their differences in this trait, and this is consistent with the results of Al-Dahri (4). The growth inhibitors addition had a significant effect on days to maturity in the fall season, especially Cycocel and Mebiquat, which recorded a lower average for the number of days, reaching 98.67 and 98.78 days, respectively. While the control treatment (distilled water only) did not differed significantly from the two inhibitors, and it was recorded a mean of 99.22 days. Ethephon, it was significantly late and achieved the highest average of 102.44 days. The results also showed a significant effect of the interaction between the cultivars and the growth inhibitors added in this trait. The earliest cultivar was Giza 113 due to the effect of all the added growth inhibitors, compared to the cultivar Buhooth 70 due to the effect of Mebiquat that was late in reaching this stage in the spring season. While in the fall season, the cultivar Giza 113 achieved with the effect of control treatment (distilled water only) and the cultivar Buhooth 70 with the effect of Cycocel the same number of days to reach the stage of maturity with an average of 97.33 days.

Table 1. Mean number of days from sowing until physiological maturity of sorghum cultivars due to the effect of growth inhibitors in the spring and fall seasons 2019

	Growth inhibitor	Cultivars			Growth inhibitor mean
		Mabrouk	Buhooth 70	Giza 113	
Spring season	Control	96.00	117.67	91.67	101.78
	Cycocel	91.67	118.33	89.33	99.78
	Ethiphon	90.33	116.00	89.00	98.44
	Mebiquat	93.00	119.33	89.33	100.56
	Cultivar mean	92.75	117.83	89.83	
	LSD _{0.05}	Cultivar	Interaction		Growth inhibitor
Fall season	Control	102.67	97.67	97.33	99.22
	Cycocel	101.00	97.33	97.67	98.67
	Ethiphon	103.33	101.67	102.33	102.44
	Mebiquat	101.00	97.67	97.67	98.78
	Cultivar mean	102.00	98.58	98.75	
	LSD _{0.05}	Cultivar	Interaction		Growth inhibitor
		1.04	2.21		1.69

Plant height (cm)

The results indicated that there are a significant differences among the cultivars in the plant height (Table 2), cultivar Giza 113 achieved the highest plant height with an average of 200.8 and 226.2 cm for spring and fall seasons respectively, compared to the Mabrouk cultivar, which decreased significantly and recorded a lowest average for this trait, which reached 170.8 and 199.2 cm, for both the spring and fall seasons respectively. Sorghum cultivars were differed in plant height due to their differences in genetic structure, and this is in agreement with the results of Abood (1). Growth inhibitors did not significantly affect this characteristic in the spring season, whereas in the fall season, growth inhibitors had a significant effect on

plant height, as Ethiphon recorded the lowest average plant height of 166.7 cm compared to Cycocel and Mebiquat, which did not differed significantly between them. The effect of the interaction between the varieties and the growth inhibitors was significant in this characteristic, as the lowest plant height was recorded for the two cultivar Mabrouk and Giza 113, which reached 163.3 and 146.7 cm, due to the effect of Ethiphon for the spring and fall seasons respectively. The highest plant height was achieved when adding Mebiquat to the variety Buhooth 70, as it had 206.7 cm in the spring season, while the control treatment recorded the highest plant height in the cultivar Giza 113, reaching 270 cm, for the fall season

Table 2. Mean height (cm) of sorghum cultivars due to the effect of growth inhibitors in spring and fall seasons 2019

	Growth inhibitor	Cultivars			Growth inhibitor mean
		Mabrouk	Buhooth 70	Giza 113	
Spring season	Control	173.3	190.0	201.7	188.3
	Cycocel	176.7	193.3	201.7	190.6
	Ethiphon	163.3	200.0	200.0	187.8
	Mebiquat	170.0	206.7	200.0	192.2
	Cultivar mean	170.8	197.5	200.8	
	LSD _{0.05}	Cultivar	5.52	12.92	
Fall season	Control	236.7	258.3	270.0	255.0
	Cycocel	186.7	226.7	248.3	220.6
	Ethiphon	183.3	170.0	146.7	166.7
	Mebiquat	190.0	226.7	240.0	218.9
	Cultivar mean	199.2	220.4	226.2	
	LSD _{0.05}	Cultivar	6.14	12.31	

Leaf chlorophyll content (SPAD)

The results of Table 3 show that the cultivar Giza 113 was significantly superior in leaf chlorophyll content and achieved the highest mean of 46.6 and 56.93 SPAD, and it did not differed significantly from the cultivar of Buhooth 70. While, the cultivar Mabrouk was significantly lowest and recorded the lowest mean for this trait 44.28 and 55.01 SPAD, for both the spring and fall seasons respectively. This differences among the cultivars in the chlorophyll content of the plant may be due to the differences in their genetic structure, and

this is consistent with the results of Saleh (13). The interaction between the cultivars and the growth inhibitors had a significant effect on this characteristic. The cultivar Giza 113 with the effect of Mebiquat and Cycocel achieved the highest mean for the chlorophyll content (49.50 and 58.43 SPAD), while the treatment (Mabrouk x Mebiquat) and the treatment (c Mabrouk x control treatment) recorded the lowest content for chlorophyll in sorghum plants, it was 41.77 and 53.43 SPAD, for both the spring and fall seasons respectively.

Table 3. Mean leaf chlorophyll content (SPAD) for sorghum cultivars with the effect of growth inhibitors in the spring and fall seasons 2019

	Growth inhibitor	Cultivars			Growth inhibitor mean
		Mabrouk	Buhooth 70	Giza 113	
Spring season	Control	43.37	44.40	45.13	44.3
	Cycocel	46.97	44.93	46.07	45.99
	Ethiphon	45.03	47.43	45.70	46.05
	Mebiquat	41.77	44.53	49.50	45.26
	Cultivar mean	44.28	45.32	46.6	
	LSD _{0.05}	Cultivar	Interaction		Growth inhibitor
Fall season		1.77	3.60		Ns
	Control	53.43	54.57	55.63	53.43
	Cycocel	56.30	57.20	58.43	56.30
	Ethiphon	55.03	56.17	54.67	55.03
	Mebiquat	55.30	56.63	56.93	55.30
	Cultivar mean	55.01	56.14	56.49	55.01
LSD _{0.05}	Cultivar	Interaction		Growth inhibitor	
	1.19	2.89		NS	

Dry matter yield (ton ha⁻¹)

Results of Table 4 indicated that the two cultivars Giza 113 and Buhooth 70, were significantly superior in this characters, with an average of 15.46 and 28.23 ton ha⁻¹, for both seasons respectively, and they did not differed significantly among them for both seasons. While the cultivar Mabrouk was recorded less dry matter with an average of 6.37 and 16.19 ton ha⁻¹, for both seasons respectively. The reason for the superiority of the two cultivars Giza 113 and Buhooth 70 in this character may be due to their superiority in plant height (Table 2), and these results are in agreement with results of Macedo *et al* (11). It also revealed from the same table that the growth inhibitors addition had a significant effect on the dry matter yield of the plant in the fall season, especially Cycocel, which scored the highest mean of 26.35 ton ha⁻¹) and did not differed significantly from the control

treatment (distilled water only) and the Mebiquat that scored mean (25.62, 25.88 ton ha⁻¹) respectively. While Ethiphon decreased significantly and achieved the lowest mean dry weight of the plant (16.73 ton ha⁻¹). The results showed that there was a significant effect of the interaction between the cultivars and the inhibitors added in the spring and fall seasons (Table 4). The cultivar Giza 113 with the effect of Ethiphon achieved the highest mean which reached 17.32 ton ha⁻¹, while the cultivar Mabrouk decreased significantly due to the effect of Cycocel and recorded the lowest mean reaching 6.23 ton ha⁻¹ in the spring season. In the fall season, the variety Buhooth 70 with the effect of Cycocel achieved the highest mean dry matter yield (33.27 ton ha⁻¹). While the Mabrouk cultivar with the effect of Ethiphon decreased significantly and it recorded the lowest mean (12.00 ton ha⁻¹).

Table 4. Mean dry matter yield (ton ha⁻¹) for sorghum cultivars with the effect of growth inhibitors in the spring and fall seasons 2019

	Growth inhibitor	Cultivars			Growth inhibitor mean
		Mabrouk	Buhooth 70	Giza 113	
Spring season	Control	7.15	13.97	16.25	12.46
	Cycocel	6.23	14.67	15.05	11.99
	Ethiphon	6.52	13.56	17.32	12.47
	Mebiquat	5.59	14.65	13.23	11.16
	Cultivar mean	6.37	14.22	15.46	
	LSD _{0.05}	Cultivar	Interaction		Growth inhibitor
Fall season		2.36	5.33		Ns
	Control	17.61	29.75	29.51	17.61
	Cycocel	17.01	33.27	28.76	17.01
	Ethiphon	12.00	19.81	18.39	12.00
	Mebiquat	18.13	30.11	29.40	18.13
	Cultivar mean	16.19	28.23	26.51	16.19
	LSD _{0.05}	Cultivar	Interaction		Growth inhibitor
	3.33	8.10		6.92	

Number of grains head⁻¹

The results showed that there were significant differences between the cultivars of sorghum (Table 5), as the cultivar Giza 113 achieved the highest mean for this trait, reaching 1652 and 2136 grains head⁻¹. While Mabrouk cultivar scored the lowest mean of 1353 and 1675 grains head⁻¹ for both seasons respectively. These results are in line with the results of Gebrekorkos *et al.*, (9). The results shown in the same Table that the inhibitors (Cycocel and Mebiquat) sprayed on the plant recorded the highest mean number of grains head⁻¹, reaching 1680 and 2225 grains head⁻¹, for both inhibitors and the two seasons, respectively. While the Mebiquat and Ethiphon scored the lowest mean for the trait, which amounted to 1385 and 1347 grains head⁻¹ for both inhibitors seasons, respectively. Perhaps the superiority of plants sprayed with Cycocel and Mebiquat may be due to their superiority in the chlorophyll content (Table 3) in the spring season, or perhaps the increase in

the number of leaves and their remaining effective. This an indications of an increase in the absorption of nutrients and their accumulation in the leaves when the environmental conditions match with the growth stage, and thus the supply of the florets with the elements necessary to complete the fertilization process and thus increase the number of grains. These results are in line with the results of Zhang *et al.*, (17). The second way interaction between the cultivars and the inhibitors sprayed on the plant in the spring season, the cultivar Buhooth 70 sprayed with Cycocel achieved the highest mean for this trait was 1829 grains head⁻¹. Whereas, in fall season the cultivar Giza 113 with the effect of Mebiquat achieved highest mean (2625 grain head⁻¹). While, the cultivar Mabrouk sprayed with Mebiquat and Ethiphon recorded the lowest mean of the trait (1255 and 1046 grains head⁻¹), for both the two treatments and seasons, respectively.

Table 5. Mean number of grains per head for sorghum cultivars with the effect of growth inhibitors in the spring and fall seasons 2019

	Growth inhibitor	Cultivars			Growth inhibitor mean	
		Mabrouk	Buhooth 70	Giza 113		
Spring season	Control	1338	1435	1541	1438	
	Cycocel	1393	1829	1819	1680	
	Ethiphon	1425	1427	1725	1525	
	Mebiquat	1255	1379	1522	1385	
	Cultivar mean	1353	1518	1652		
	LSD _{0.05}	Cultivar	60.5	Interaction	138.1	Growth inhibitor
Fall season	Control	1925	2513	2136	1925	
	Cycocel	2000	2116	2297	2000	
	Ethiphon	1046	1509	1488	1046	
	Mebiquat	1730	2319	2625	1730	
	Cultivar mean	1675	2114	2136	1675	
	LSD _{0.05}	Cultivar	224.0	Interaction	406.7	Growth inhibitor

One thousand grains weight (gm)

The results showed that cultivar Giza 113 scored the highest average of 35.75 and 33.56 gm, and did not significantly differed from the cultivar Buhooth 70, which scored an average of 35.17 and 33.20 gm, for both seasons respectively. While the cultivar Mabrouk had the lowest average at 24.25 and 19.49 gm, for both the spring and autumn seasons respectively (Table 6). The reason for the differences among the cultivars may be due to the differences in their genetic makeup and their suitability to environmental conditions. The superiority of the cultivar Giza 113 is due to high chlorophyll content of leaves (Table 3) that contributed to the increase in the manufactured materials and their transfer to the sink (grain), these results are consistent with the results of Abood and Salh (2). The added growth inhibitors had a significant effect, as the plants sprayed with Ethiphon and Cycocel were superior by producing the highest average of 34.22 and 30.15 gm, for both inhibitors and the two seasons, respectively. While the plants sprayed with

Cycocel and Ethiphon recorded the lowest mean of 30.33 and 25.92 gm, for the two seasons, respectively. The reason for the superiority of the plants sprayed with Ethiphon in the spring season may be due to their early flowering, in addition to the period from flowering to maturity (grains filling stage), which contributed to the increased transfer of materials manufactured in the leaves and their transfer to seeds. Whereas, the reason for the superiority of plants sprayed with Cycocel, it may be due to their superiority in the highest chlorophyll content of their leaves (Table 3), these results are consistent with the results of Seyed Sharifi (14). The results showed that there was significant interaction between the cultivars and growth inhibitors, as the plants of Giza 113 sprayed with Ethiphon and Cycocel achieved the highest average for this trait, reaching 39.33 and 37.45 gm, while the variety Mabrouk sprayed with Mebiquat and Cycocel scored the lowest mean (22.67 and 16.56 gm), for both treatments and the spring and fall seasons respectively.

Table 6. Mean number of grains per head for sorghum cultivars with the effect of growth inhibitors in the spring and fall seasons 2019

	Growth inhibitor	Cultivars			Growth inhibitor mean
		Mabrouk	Buhooth 70	Giza 113	
Spring season	Control	25.33	35.33	33.33	31.33
	Cycocel	23.00	35.67	32.33	30.33
	Ethiphon	26.00	37.33	39.33	34.22
	Mebiquat	22.67	32.33	38.00	31.00
	Cultivar mean	24.25	35.17	35.75	
	LSD _{0.05}	Cultivar	Interaction		Growth inhibitor
Fall season	Control	20.60	33.02	35.45	29.69
	Cycocel	16.56	36.45	37.45	30.15
	Ethiphon	18.60	29.01	30.16	25.92
	Mebiquat	22.18	34.32	30.78	29.09
	Cultivar mean	19.49	33.20	33.56	
	LSD _{0.05}	Cultivar	Interaction		Growth inhibitor
	2.479	4.574		2.498	

Grain yield (ton ha⁻¹)

The results indicate the significant differences among cultivars in the grain yield (Table 7). The cultivar Giza 113 significantly superior by producing the highest average grain yield of 3.65 and 4.86 ton ha⁻¹, with an increase of 107.38 and 19.28% in the spring season and 131.43 and 9.71% in the fall season over the two cultivars Mabrouk and Buhooth 70, respectively. The superiority of Giza 113 in the grain yield is due to its superiority in the number of kernels per head and the weight of the kernel (Tables 5 and 6). These results are in agreement with those of Bahar *et al.* (5) and Najm (12), they found that the cultivars of sorghum differed significantly among them in grain yield. The sprayed plants with growth inhibitors had a significant effect on the grain yield (Table 7). Plants sprayed with Cycocel produced the highest average grain yield of 3.26 and 4.57 ton ha⁻¹, for both seasons,

respectively. While the plants sprayed with distilled water in the spring season recorded the lowest mean of 2.50 ton ha⁻¹, and in the fall season the plants sprayed with Ethiphon recorded the lowest mean of 2.72 ton ha⁻¹. The superiority of plants sprayed with Cycocel is due to their superiority in the number of grains head⁻¹ in the spring season and the weight of 1000 grains in the fall season (Tables 5 and 6). This finding is in agreement with those of Seyed Sharifi *et al.* (14) and Chandrashekhara *et al.*, (6). The results showed a significant interaction between the cultivars and the growth inhibitors in the grain yield, as the plants of the cultivar Giza 113 sprayed with Mebiquat and Cycocel achieved the highest average reaching 3.93 and 5.45 ton ha⁻¹, compared to Mabrouk, which scored the lowest average of 1.24 and 1.09 ton ha⁻¹, by the effect of Mebiquat and Ethiphon, and for both the spring and fall seasons respectively.

Table 7. Mean of grain yield (ton ha⁻¹) for sorghum cultivars with the effect of growth inhibitors in the spring and fall seasons 2019

	Growth inhibitor	Cultivars			Growth inhibitor mean	
		Mabrouk	Buhooth 70	Giza 113		
Spring season	Control	2.08	2.24	3.18	2.50	
	Cycocel	2.24	3.83	3.71	3.26	
	Ethiphon	1.46	3.62	3.77	2.95	
	Mebiquat	1.24	2.56	3.93	2.58	
	Cultivar mean	1.76	3.26	3.65		
	LSD _{0.05}	Cultivar	0.316	Interaction	0.58	Growth inhibitor
Fall season	Control	2.63	4.11	4.37	3.70	
	Cycocel	2.19	5.13	6.38	4.56	
	Ethiphon	1.29	2.89	3.94	2.71	
	Mebiquat	2.54	4.57	5.35	4.15	
	Cultivar mean	2.17	4.18	5.02		
	LSD _{0.05}	Cultivar	0.35	Interaction	0.74	Growth inhibitor

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