Response of maize to spraying with gibberellin and thiamine at different growth stages

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Abstract

The field experiment was conducted on one of the private farms located in Al- Musauib project area, 40 km north of Babylon Governorate, during the spring and autumn seasons of 2022. To know the effect of spraying gibberellin and thiamineand spraying stages on the growth and yield of corn. Where the main plot included three stages of addition and they were (the stage of formation of 4 leaves, the stageof formation of 8 leaves, the stage of flowering) and symbolized by the symbol (A1, A2, A3). The subplot included spray concentrations and were as follows (spraying with distilled water only, gibberellin at a concentration of 100 mg.L^{-1} and thiamine (vitamin B1) at a concentration of 100 mg.L^{-1} and the interaction between gibberellin at a concentration of 100 mg.L^{-1} and thiamine 100 mg.L^{-1}) and symbolized by (B0, B1, B2, B3) and the results were as follows :The results showed that the stages of spraying had a significant effect, where the stage of formation of 8 leaves (A2) was significantly excelled and gave the highest rate for most of the studied traits and for both season respectively, the number of grains per cob was (1171.42 and 925.76) grains. cob^{-1}, the weight of 300 grains was (83.35 and 76.71) g, the percentage of protein was (7.54 and 8.69)%, the percentage of oil (47.40 and 44.52)%, the total plant yield (181.07 and 175.01) kg.ha^{-1}.B3 treatment was significantly excelled on the rest of the other treatments and gave the highest mean of both season, respectively, for the traits of the number of grains per cob(1322.18 and 1059.95) grains. cob^{-1}, weight of 300 grains (86.38 and 81.73) g, protein percentage (8.15 and 9.30) %, oil percentage (50.44 and 44.83)%, total plant yield (201.56 and 195.49) kg.ha^{-1}.The interaction treatments(A2 + B3) excelled and gave the highest values for most growth, yield and qualitative traits.

Introduction

Corn crop (*Zea mays* L.), which belongs to the Poaceae family, is one of the most important grain crops that are grown on a very large scale in the world, where it comes in importance after wheat and rice in terms of area and production, because of its multiple uses in human and animal nutrition. , and its entry into many industrial fields [5] and it was found that the enzymatic system falls under the influence of plant hormones, especially gibberellic acid [9], where the physiological effect of gibberellins is due to its control of enzymatic activity and its activation of metabolic processes such as increasing soluble carbohydrates through It activates enzymes such as amylase a- amylase, protease, peroxidase, and the manufacture of carboxylase, and gibberellins activate the formation of nucleic acids, and treatment with gibberellins contributes to the transfer of manufactured nutrients to a greater degree towards the growth site. Its expansion [6] . As for thiamine (vitamin B1), one of the important vitamins for growth, and it is one of the water-soluble vitamins. Vitamin B1 was considered a growth hormone because it moves from one part of the plant to other parts, that is, it is synthesized in the leaves and then transmitted to the root [15] In view of the foregoing, the research aims to:the effect of spraying stages on the growth and yield of corn. effect of thiamine concentration on the growth and yield of maize. effect of the interaction between the concentrations of Gibberellin and Thiamine on the growth and yield of corn

Materials and Methods

3-1- Implementation of the experiment

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A field experiment was conducted during the spring and fall seasons of 2022. In one of the private farms located in Al-Musayyib project area, 40 km north of Babylon province, to study the effect of spraying gibberellin and thiamine and the spraying stages on the growth and yield of corn.The experiment was conducted according to the split plots arrangement, and the treatments were distributed using the randomized complete block design (R.C.B.D) with three replicates. Where the main plot included three stages of addition, and they were (the stage of forming 4 leaves, the stage of forming 8 leaves, the stage of flowering) and symbolized by the symbol (A1, A2, A3).As for the secondary plot, they included spray concentrations and were as follows (spraying with distilled water only, gibberellin at a concentration of 100 mg.L $^{-1}$ and thiamine (vitamin B1) at a concentration of 100 mg.L $^{-1}$ and the interaction between gibberellin at a concentration of 100 mg.L $^{-1}$ and thiamine 100 mg.L $^{-1}$) and denoted by (B0,B1,B2,B3)The experimental land was plowed with two Perpendicular tillage, then smoothed and leveled, and then divided into experimental units measuring 4 x 4 m. The grains of the cultivar (Sorour) were planted in rows, the distance between one line and another was 75 cm, and the length was 4 m and between one pit and another 25 cm, the number of lines per experimental unit was 5 lines, and three seeds were planted in one jar, and the experiment was fertilized at a rate of 120 kg N and 132 kg phosphorus / h. Where he used urea (46% N) as a source of nitrogen and triple superphosphate (46% P2O5) as a source of phosphorus. And the first batch of nitrogen fertilizer was added with all the amount of phosphorus when seedlings appeared. The second batch of nitrogen fertilizer was added one month after planting, and the weeds were controlled three days after planting using the atrazine pesticide (80% effective substance) at a rate of 4 kg / h. The grafts were done two weeks after planting for both pit. The plants were thinned to one plant in each pot after reaching a height of 15-20 cm. The plants were watered as needed. The granular diazinon pesticide (10%) was used as an effective substance to control the corn stem borer Sesamia critica at an amount of 6 kg / ha and in two batches, the first at the stage of (4 to 5) leaves, and the other after (15) days from the first batch, sowing was done for the spring season on 2002/3/17 and the autumn season on 2022/12/7.

Gibberellin and thiamine (vitamin B1) were prepared at a concentration of (100 mg / L $^{-1}$) from the acid, and it was prepared by taking (1) g containing (1) gm of active substance and dissolving it in a liter of distilled water to obtain a stock solution and keeping the solution in a vial dark place and take (100 ml) of the base solution and complete the volume to (1000 ml) in order to obtain a concentration of (100 mg / L $^{-1}$)Each level of gibberellin and thiamine is sprayed until complete wetness on the leaves of plants in the early morning using a knapsack sprinkler with a capacity of 16 liters with the use of a dispersant material for the spray solution at a rate of 3 cm 3 per 20 liters to reduce the surface tension of the water and to ensure complete wetness of the two loops to increase the efficiency The spray solution penetrates the outer surface of the leaf. The soil of the experiment was analyzed before planting by taking random samples from it to a depth of (0-30 cm) to conduct an analysis of the soil's physical and chemical traits in the laboratories of the College of Agriculture, Al-Qasim Green University, as shown in Table (1).

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Table (1): Physical and chemical traits of the experimental field soil

values	units	traits	
7.8	_	PH	
2.77	$Ds.m^{-1}$	Soil electrical conductivity EC	
30.35	ppm	nitrogen	macro elements
6		phosphorous	
205		potassium	
148.40	g/kg	sand	texture
51.01		silt	
341.30		clay	
	Clay loam		

3-2- studies traits:

- Number of grains per cob ($grain.cob^{-1}$)

It is calculated by multiplying the number of rows per cob by the number of grains in the row

weight of 300 grains (g)

The weight of 300 grains was calculated for each experimental unit and its rate was calculated.

Protein percentage (%)

0.2 g of the ground sample was weighed and 5 ml of sulfuric acid was added to it. It was left for 24 hours, then a mixture of sulfuric and perchloric acid was added, and the mixture was then heated for 15-30 minutes until it became clear. Then it was transferred to a volumetric flask with a capacity of 50 ml. It was left until chemical analyzes were performed. The percentage of nitrogen was estimated in the digested samples by the method of distillation and the use of the Kjeldahl apparatus, where the ammonia formed was received in a volumetric flask containing 10 ml of a mixture of boric acid + proof, then the mixture was wiped with (0.02) sulfuric acid until the color turned to scarlet and recorded The volume of the acid and with specific calculations, the percentage of nitrogen in the plant samples is extracted and then converted to the percentage of Protein % = Nitrogen % x 6.25 .

Oil Percentage (%)

It was estimated using the Soxhlet device and according to what is mentioned in [8] according to the following equation:

The percentage of oil in the grains % = (weight of the oil extracted from the grains of the sample / the weight of the dry sample) x 100

Plant yield

After extracting the average plant yield from dry grains (with a moisture content of 15.5%), the rate was multiplied by the plant density to obtain the grain yield per unit area ($ton.ha^{-1}$)

-3- Statistical analysis

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The data were analyzed statistically according to the analysis of variance method, and the arithmetic means were compared using the least significant difference test (L.S.D) at a probability level of 0.05 with the (Genstat) program [5]

Results and discussion

number of grains per cob (grain.cob^{-1})

Table (2) showed that the stages of spraying gibberellin and thiamine had a significant effect on the number of grains per cob . The stage of formation of 8 leaves (A2) excelled and gave the highest average number of grains per cob for the two needles, which reached 1171.4 and 925.76 grains.cob-1, respectively. This was followed by the formation of 4 leaves (A1), which gave an average number of grains per cob for both season, which amounted to 1029.5 and 857.13 grains.cob^{-1}, respectively.While the flowering stage (A3) gave the lowest mean number of grains per cob, reaching 915.60 and 704.10 grains.cob^{-1} for both season, respectively. Also, spraying gibberellin and thiamine had a significant effect on the number of grains per cob.The treatment of spraying thiamine and gibberellin (B3) excelled and gave the highest average number of grains per cob and for cob reached 1322.18 and 1059.95 grains.cob^{-1}, followed by the treatment of spraying gibberellin with a concentration of 100 mg.L^{-1} and gave an average number of grains per cob of 1183.21 and 936.14 grains.cob^{-1} for both season.While the control treatment (B0) gave the lowest mean number of grains per cob, which amounted to 731.63 and 535.68 grains. cob-1both season, respectively. The results of the same table also showed that the interaction between spraying stages and spray concentrations had a significant effect on the number of grains per cob. The interaction treatment composed (8 leaf formation stage + spraying of gibberellin and thiamine at a concentration of 100 mg.L^{-1}) excelled and gave the highest mean number of grains per cob of 1454.5 and 1189.14 grains.cob^{-1} for the two ears respectively, while the control treatment gave the lowest average number of grains per cob for both season they amounted to 647.70 and 462.38 grains.cob^{-1}, respectively.The increase in the number of grains per cob may be due to the increase in the number of grains per row (Table (9)It may also be due to the action of gibberellins and thiamine as coenzymes [10] within a series of complementary steps to this process of carbohydrate fragmentation to liberate energy and participate in the process of photosynthesis, where it affects the speed of transport from source to downstream, and thus increases the accumulation of processed carbohydrates stored in grains This is consistent with what we have reached, and this is consistent with [2] when spraying gibberellin on yellow corn,[1] and [7] and [3] on barley.

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Table (2) Effect of spraying concentrations of gibberellin and thiamine, and spraying stages and the interaction between them, on the number of grains per row of corn plant for both season

averag e) A(	autumn season				averag e) A(	spring season				spray stages (A(
	Gibberellin and thiamine spray (mg.L-1) (B(					Gibberellin and thiamine spray (mg.L-1) (B(				
	B3	B2	B1	B0		B3	B2	B1	B0	
857.13	1100.12	904.57	961.44	462.38	1092.48	1368.74	1144.28	1209.23	647.67	A1
925.76	1189.14	811.16	1103.56	599.18	1171.42	1454.48	1042.12	1376.36	812.73	A2
704.10	890.58	636.93	743.42	545.48	915.53	1143.32	820.28	964.04	734.51	A3
	1059.95	784.22	936.14	535.68		1322.18	1002.22	1183.21	731.63	averag e) B(
A*B= 132.19		=B 57.63		A=123. 47	A*B125.2=		=B 65.3	A=102 .3	L.S.D 0.05	

Weight 300 grains (g)

Table (3) showed that the stages of spraying gibberellin and thiamine had a significant effect on the weight of 300 grains . The stage of formation of 8 leaves (A2) excelled and gave the highest average weight of 300 grains for both season, which amounted to 83.35 and 76.71 g, respectively, followed by the stage of formation of 4 leaves (A1) and gave an average weight of 300 grains for both season were 80.16 and 73.52 g, respectively While the flowering stage (A3) gave the lowest mean weight of 300 grains, which amounted to 75.60 and 69.66 g for both season, respectively. Also, spraying gibberellin and thiamine had a significant effect on the weight of 300 grains(73) g ,Then the treatment of gibberellin spraying with a concentration of 100 mg.L^{-1} gave an average weight of 300 grains of 83.02 and 76.38 g for both season, respectively, while the control treatment (B0) gave the lowest average weight of 300 grains of 69.38 and 62.73 g for both season respectively.The results of the same table also showed that the interaction between spraying stages and spraying concentrations had a significant effect on the weight of 300 grains. respectively . While the control treatment gave the lowest average weight of 300 grains for both season, which amounted to 67.11 and 60.47, respectively, it is due to the role of gibberellins in activating the formation of nucleic acids, and the treatment with gibberellins contributes to the transfer of processed foodstuffs to a greater degree towards the growth site.This is due to the spraying of thiamine and gibberellin, which works to increase the traits of vegetative growth, represented by the number of leaves and the leaf area in Tables (3 and 4).Thus, photosynthesis increases, and gibberellin also works on carbohydrate fragmentation and energy liberation, and increases the speed of transport from source to downstream, thus increasing the accumulation of processed and stored carbohydrates in grains[10] Consequently, the grain weight increased, and this is consistent with Al-Hadithi (2008) when spraying gibberellin on wheat and [12] in his experiment of spraying gibberellin acid at a concentration of (0,100,200,300) mg.L^{-1} and knowing its effect on the growth and yield of wheat. [1] in their

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experiment to study the effect of spraying gibberellin at concentrations of (0.300) mg / L on maize.

Table (3) Effect of spraying the concentrations of gibberellin and thiamine, and the spraying stages and the interaction between them, on the weight of 300 grains of corn for both season

average)A(	autumn season				average)A(	spring season				spray stages (A(
	Gibberellin and thiamine spray (mg.L-1) (B(					Gibberellin and thiamine spray (mg.L-1) (B(				
	B3	B2	B1	B0		B3	B2	B1	B0	
73.52	80.55	76.67	76.39	60.47	80.16	87.20	83.31	83.03	67.11	A1
76.71	86.41	72.13	83.87	64.43	83.35	93.05	78.78	90.51	71.08	A2
69.66	78.23	68.27	68.87	63.29	75.60	78.90	78.05	75.51	69.95	A3
	81.73	72.36	76.38	62.73		86.38	80.05	83.02	69.38	average)B(
A*B4.420=		=B 1.952		A4.102=	A*B12.424=		=B 5.298	A=N.S	L.S.D 0.05	

Percentage of protein (%)

Table (4) showed that the stages of spraying gibberellin and thiamine had a significant effect on the percentage of protein and for both season .The stage of formation of 8 leaves (A2) excelled and gave the highest rate of protein for arrowroot, which reached 7.54 and 8.69%, respectively. Followed by the stage of formation of 4 leaves (A1), which gave an average protein percentage for both season of 6.64 and 7.76%, respectively, while the flowering stage (A3) gave the lowest average protein percentage of 6.30 and 7.45% for both season, respectively.Also, the spraying of gibberellin and thiamine had a significant effect on the percentage of protein. The treatment of spraying thiamine and gibberellin (B3) was superior and gave the highest average for the percentage of protein and aurin reached 8.15 and 9.30%, followed by the treatment of spraying gibberellin with a concentration of 100 $mg.L^{-1}$. It gave an average protein percentage of 7.43 and 8.58% for the two loops, respectively, while the comparison treatment (B0) gave the lowest average protein percentage of 5.16 and 6.30% for both season, respectively.The results of the same table also showed that the interaction between spraying stages and spraying concentrations had a significant effect on the protein percentage. The combination treatment (8 leaf formation stage + spraying of gibberellin and thiamine at a concentration of 100 $mg.L^{-1}$) excelled and gave the highest average protein percentage of 9.57 and 10.72% for the two grapes, respectively. While the control treatment gave the lowest average protein percentage for both season, which amounted to 4.73 and 5.88, respectively.

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Table (4) Effect of spraying the concentrations of gibberellin and thiamine and the spraying stages and the interaction between them on the percentage of protein of the yellow corn plant for both season

average)A(	autumn season				average)A(	spring season				spray stages (A(
	Gibberellin and thiamine spray (mg.L-1) (B(					Gibberellin and thiamine spray (mg.L-1) (B(				
	B3	B2	B1	B0		B3	B2	B1	B0	
7.76	8.76	8.04	8.35	5.88	6.64	7.61	7.02	7.20	4.73	A1
8.69	10.72	7.73	9.63	6.68	7.54	9.57	6.58	8.48	5.54	A2
7.45	8.43	7.28	7.76	6.35	6.30	7.28	6.13	6.61	5.20	A3
	9.30	7.68	8.58	6.30		8.15	6.58	7.43	5.16	average) B(
A*B= 0.218		=B 0.133		A=0.126	A*B0.287=		=B 0.180	A0.141=	L.S.D 0.05	

total plant yield

Table (6) showed that the stages of spraying gibberellin and thiamine had a significant effect on the plant yield for both season. The stage of formation of 8 leaves (A2) excelled and gave the highest average yield of 181.07 and 175.01 ton.ha^{-1} for both season, respectively, followed by the stage of formation of 4 leaves (A1), which gave an average yield for both season. 167.48 and 161.75 ton.ha^{-1} respectively, while the flowering stage (A3) gave the lowest average yield of 157.09 and 151.03 ton.ha^{-1} for grapevines, respectively. Also, spraying gibberellin and thiamine had a significant effect on plant yield. The treatment of thiamine and gibberellin (B3) was excelled and gave the highest rate of yield for both season 167.48 and 161.75 ton.ha^{-1} respectively. 201.56 and 195.49 ton.ha^{-1} respectively, followed by the treatment of gibberellin at a concentration of 100 mg.L^{-1}, which gave an average yield of 183.47 and 177.40 ton.ha^{-1} for the two loops, respectively, while the control treatment (B0) gave the lowest average yield of 122.41 and 116.35 ton.ha^{-1} for the two loops, respectively.The results of the same table also showed that the interaction between spraying stages and spraying concentrations had a significant effect on plant yield. Whereas, the control treatment gave the lowest mean for both season, which was 106.66 and 100.60 ton.ha^{-1} respectively.The reason for the excelled of spraying gibberellin and thiamine can be attributed to the fact that the yield of grain is a complex quantitative traits that is controlled by a large number of genetic factors as well as environmental factors such as temperature, humidity and other factors. The production of one plant of grain depends on two necessary concomitant steps, namely the occurrence of pollination and fertilization and the amount of building. photosynthesis in the period between fertilization and crop maturity to store nutrients in grains, and since gibberellins have an important role in improving plant growth [14] and increasing fertilization and flowering, and thus increasing yield Table (15) and this agrees with [1] and [13] when spraying thiamine on white corn, and Faisal et al. (2012) in their experiment when spraying thiamine on broad bean plants

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Table (6) Effect of spraying the concentrations of gibberellin and thiamine and the spraying stages and the interaction between them on the total plant yield of yellow corn for both season

average) A(	autumn season				average) A(	spring season				spray stages (A(
	Gibberellin and thiamine spray (mg.L-1) (B(					Gibberellin and thiamine spray (mg.L-1) (B(				
	B3	B2	B1	B0		B3	B2	B1	B0	
161.75	191.45	175.47	179.49	100.60	167.48	197.51	180.20	185.55	106.66	A1
175.01	214.71	160.41	202.21	122.70	181.07	220.78	166.47	208.27	128.76	A2
151.03	180.32	147.54	150.51	125.75	157.09	186.38	153.60	156.58	131.82	A3
	195.49	161.14	177.40	116.35		201.56	166.76	183.47	122.41	average) B(
A*B= 8.610		=B 4.924		A=6.053	A*B= 12.357		=B 5.672	A=11.233	L.S.D 0.05	

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