

Effect of foliar application with some treatments to avoid stress environments on spring planting of maize (*Zeamayze L.*)

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Abstract:

Field experiment was conducted in spring season of 2014 in Abu Gharaq , (8 km northeast of Hilla , within longitude 32.3 latitude and 44.2 east longitude) in silt-clay loam soil to study the effect of spraying two levels of high-potash fertilizer (control and spraying one time at the beginning of flowering) , three levels of urea spraying (control, one time at silk stage and two times at the silk stage and grain filling stage) and two levels of salicylic acid (control and spraying at 10 leaves stage). Randomized complete block design with three replications was used. The experimental unit consisted of four ridges 4 m long and 0.75 m width seeded with Al-Furat hybrid maize. In hills 25 cm apart. The results showed that spraying high-potash fertilizer caused a significant increases in plant ear number , rows no. , number of rows per ear , row grain no. , 500 grain weight and grain yield compared to control, with a percentage increase of 4.8, 4.4, 6.1, 4.1, 0.4%, respectively . Spraying urea also led to significant increases in plant ear no. and grain yield, with a percentage increase of 11.7 and 4.9% and 6.1 and 5.4% at spraying one time and two time respectively compared to control. Spraying urea twice time led to significant increases in ear weight (about 6.9%) and 500 grain weight compared to control. Spray salicylic acid led to a significant increase in row grain no. only. The interactions had a significant effect on most of the traits.

Keywords: maize, foliar fertilizer, high P fertilizer, urea, salicylic acid.

Introduction

Maize (*Zea mays* L.) is an important cereal crops and come in third class after wheat and rice in world production [1]. It is characterized in limit life cycle and higher yield per unit area. Its productivity in Iraq 2 tons.ha⁻¹, while in world 5.2 and in USA 10.3 t.ha⁻¹[2]. Yellow corn is cultivated in in Iraq in two season (spring and autumn) each year. The farmers tends to fall season and avoid spring due to the lack of productivity in unit area in spring season and the limiting factor is the sudden rise in temperature at flowering time , which reduces pollen vitality and the number of grain in ear and its weight .

Fertilization is one of the most important factor affected growth and yields of plant, and the plant responds to foliar fertilizer more quickly compared to ground fertilization, due to the rapid absorption of nutrients [3]. Spraying nitrogen fertilizer on corn plants associated with yield improvement [4]. Foliar fertilizer play an important role in improving vegetative growth and increase production [5,6]. [7] reported that Foliar fertilizer led to increase vegetative growth and dry matter. Salicylic acid is one of growth regulators and one of the non-enzymatic antioxidants that lead to reducing the harm stress as a result of scavenging types of free radicals oxygen's root that oxidize cells and enzymes, and lead to inhibit photosynthesis process [8]. Salicylic acid also plays an important role in encouraging nutrients uptake and control the stomata movement and photosynthesis [9], and it prevents ethylene metabolism and its adverse effect to ABA [10]. Therefore, the experiment was conducted to determine the impact of these factors in improving spring maize cultivation in Babylon province.

Material and Methods

A field experiment of spring cultivation carried out in 2014 in Abu- Gharaq (Babylon province within longitude 32.3 latitude and 44.2 east longitude in silt-clay loam soil) to study the effect of two levels of high-potash foliar fertilizer (control and spraying at the beginning of flowering), three levels of spray urea (control, spraying one time at silk stage and two spraying at silk stage and grain filling stage) and two levels of Salicylic acid (control and spraying at 10 leaves stage). After plowing and preparing the fields to ridges 75 cm apart , compound fertilizer NPK (20:20:20)at the level of 200 kg.ha⁻¹ was added to all experimental units in lines 10 cm down of planting line and covered with soil . Seeding of Furat Fi hybrid at 15/3/2014 on top third-part of ridges 75 cm and 25 cm apart (about 53 333 pl.ha-1). Randomized complete block design with three replicates was used. The experimental unit consists of 4 ridges (4m long and 75 cm width of each ridge), and left 1 m between each experimental unit to another. The spraying was done in early morning until the full wet. At ear maturity , from the internal ridges of each experimental unit ears were taken to calculate ear number per plant , number of rows per ear , number of grain per row ear weight , weight of 500 grain and total dry grain yield . Data were analyzed and averages were compared according to least significant difference (LSD_{0.05}) by using Genstat statistical program.

Results and Discussion

Table 1 shows that spraying corn plants with High potash fertilizer caused a significant increase of plant ear number compared to control with a percentage increase of 4.8%. While salicylic acid had no significant effect but, it tend to increase. On the other hand urea spraying (one or two sprays) caused a significant effect in increase in plant ear number compared to control , and spraying one time gave high number compared with two time and it gave an increase percentage of 11.7 and 5.4% compared to control. The interaction between spraying high potash fertilizer and spraying of salicylic acid

or urea had a significant effect in increasing plant ear number compared to control, and here appeared that spraying each single treatment was superior significantly compared to control. While the interaction between salicylic and urea had no significant effect on this status. The interaction between High potash, salicylic and urea had a significant effect in this trait, and all spraying treatments had a significant effect compared to control. Spraying High potash fertilizer , salicylic acid and urea (one time) was superior compared to all other treatments and gave a percentage increase of 35.2 % compared to control.

Table 1: Effect of nutrients and salicylic spraying and its interaction on plant ear no.

Spraying High potash	Spraying Salicylic	Spraying urea			High potash x salicylic
		control	1 time	2time	
control	control	1.233	1.467	1.400	1.333
	spray	1.400	1.433	1.467	1.433
spray	control	1.467	1.500	1.400	1.456
	spray	1.333	1.667	1.433	1.478
Urea average		1.358	1.517	1.425	
LSD _{0.05}	Urea= 0.063 interaction= 0.434			0.0727	
Interaction of High potash x urea					Potash average
control		1.317	1.450	1.434	1.400
spray		1.400	1.584	1.417	1.467
LSD _{0.05}	Interaction= 0.0891			0.051	
Interaction of salicylic x urea					
control		1.350	1.484	1.400	1.411
spray		1.367	1.550	1.450	1.456
LSD _{0.05}	Interaction= 0.0891			n.s	

Table 2 shows that the spraying high potash fertilizer led to increase rows number per ear significantly compared to control with a percentage increasing of 4.4%. While it was not significant but they tend to increase when spraying salicylic acid and urea. The interaction between high-potash and salicylic acid had no significant effect in this trait, while the interaction of spraying high-potash fertilizer and urea, and spraying salicylic acid and urea had a significant effect in increasing rows number per ear, whereas all spraying interactions had a significant effect compared to control. It appears that spraying salicylic acid with urea tended to decline compared to spraying either of them alone. The triple interaction between spraying high potash salicylic acid and urea had a significant effect in this trait, whereas spraying high potash fertilizer with twice spraying of urea and without salicylic acid gave the highest value and achieved a rate increase of 25.2% compared to control.

Table 3 shows that spraying high potash fertilizer or salicylic acid led to a significant increase in the average of grain number per row compared to control treatment with a percentage increase of 6.1 and 5.3% , respectively. On the other hand spraying urea (single or two) had no significant effect on grain number per row compared to control. The interaction

between high-potash fertilizer and each of spraying salicylic acid or urea had a significant effect in increasing the average of grain number per row . The interaction between spraying salicylic and urea had a significant effect in this status. The triple interaction between spraying high potash , urea and salicylic had a significant effect in this trait , whereas most interactions had significant effect compared to control.

Table 2: Effect of nutrients and salicylic spraying and its interaction on rows no. ear⁻¹

Spraying High potash	Spraying Salicylic	Spraying urea			High potash x salicylic
		control	1time	2time	
control	control	12.48	15.43	15.23	14.35
	spray	14.77	14.67	14.87	14.77
spray	control	14.91	14.43	15.63	15.32
	spray	15.67	14.57	15.10	15.11
Urea average		14.46	15.03	15.21	
LSD _{0.05}	Urea= n.s triple interaction= 1.340				n.s
Interaction of High potash x urea					Potash average
control		13.63	15.05	15.05	14.58
spray		15.29	15.00	15.37	15.22
LSD _{0.05}	Interaction= 0.547				Potash=0.316
Interaction of salicylic x urea					
control		13.70	15.43	15.43	14.85
spray		15.22	14.62	14.98	14.94
LSD _{0.05}	Interaction=0.547				n.s

Table 3: Effect of nutrients and salicylic spraying and its interaction on grain no. row⁻¹

Spraying High potash	Spraying Salicylic	Spraying urea			High potash x salicylic
		control	1time	2 time	
control	control	37.33	39.33	42.67	39.78
	spray	43.67	41.00	43.67	42.78
spray	control	42.33	41.33	45.67	43.11
	spray	45.33	44.67	43.33	44.44
Urea average		42.17	41.58	43.61	
LSD _{0.05}	Urea=2.288 interaction=4.575				2.641
Interaction of High potash x urea					Potash average
control		40.50	40.17	43.17	41.28
spray		43.83	43.00	44.50	43.78
LSD _{0.05}	Interaction= 3.235				1.868
Interaction of High potash x urea					Potash average

control	39.83	40.33	44.17	41.44
spray	44.50	42.89	43.50	43.63
LSD _{0.05}	Interaction= 3.235			1.868

Table 4 shows that spraying high potash fertilizer led to increase the average ear weight significantly compared to control with a percentage increase of 6.12%. While they tend to increase, but it was not significant at spraying salicylic acid. On the other hand urea spray led to increase the average weight of ear, and it was significant when urea sprayed twice compared to control , with a percentageincrease of 6.9% compared with control. The interactions between high-potash fertilizer spray and each of spray salicylic acid or urea, and also salicylic acid with urea had a significant effect in increasing the average weight of ear . The triple interaction between spraying high potash , urea and salicylic acid had a significant effect in this trait, whereas the treatment of spraying high-potash , salicylic acid and urea (one spray) was superior with a percentage increase of 16.4% compared to control.

Table 4: Effect of nutrients and salicylic spraying and its interaction on ear weight

Spraying High potash	Spraying Salicylic	Spraying urea			High potash x salicylic
		control	1time	2 time	
control	control	184.5	192.8	204.1	193.8
	spray	187.8	202.7	208.5	199.7
spray	control	202.7	207.9	211.6	207.4
	spray	205.7	214.7	210.7	210.4
Urea average		195.2	204.5	208.7	
LSD _{0.05}	Urea=9.39	interaction=18.77			10.84
Interaction of High potash x urea					Potash average
control		186.2	197.8	206.3	196.8
spray		204.2	211.3	211.1	208.9
LSD _{0.05}		Interaction= 13.27			7.66
Interaction of salicylic x urea					salicylic average
control		193.6	200.4	207.9	200.6
spray		196.8	208.7	209.6	205.0
LSD _{0.05}		Interaction=13.27			n.s

Table 5 shows that spraying high potash fertilizer led to increase the average weight of 500 grain significantly compared to control with a percentage increasing of 4.1%. While it tend to increase, but it was not significant when spraying salicylic acid. On the other hand spraying urea (one or two sprays) led to increase grain weight significantly compared to control, with a percentage increase of 3.9 and 4.8% compared to control, respectively. The interaction between spraying high-potash and salicylic acid had no significant effect in this status, while the interaction between high-potash and urea, as well as salicylic acid with urea had a significant effect in increasing the average weight of 500 grain. The triple interaction between High potash , salicylic and urea had a significant effect in this trait, whereas the interaction

between high potash salicylic and urea (twice spray) was superior in this trait and with a percentage increase of 9.5% compared to control.

Table 6 shows that spraying high-potash fertilizer led to increase grain yield per unit area significantly compared to control, with a percentage increase of 4.0%. while it tend to increase, but was not significant when spraying salicylic acid. On the other hand spraying urea (one or two spray) caused a significant effect in increasing grain yield per unit area

compared to control, without significant differences between single or twice spraying , with a percentage increase of 6.1 and 5.4% compared to the control respectively. The interaction between high-potash and each of salicylic or urea had a significant effect in increasing grain yield per unit area. While the interaction between spraying salicylic acid and urea had no significant effect in this status. The triple interaction between high potash salicylic acid and urea had a significant effect in this trait, whereas high-potash , salicylic acid and urea (one spray) gave higher grain yield (6.801 t.ha⁻¹) with a percentage increase of 15.2 % compared to control.

Table 5: Effect of nutrients and salicylic spraying and its interaction on 500 grain weight

Spraying High K	Spraying Salicylic	Spraying urea			High potash x salicylic
		control	1 time	2 time	
control	control	116	121	124	120.3
	spray	115	123	123	120.3
spray	control	122	125	126	124.3
	spray	124	127	127	126.0
Urea average		119.3	124	125	
LSD _{0.05}	Urea= 4.97	interaction=9.94			n.s
Interaction of High potash x urea					Potash average
control		115.5	122	123.5	120.3
spray		123	126	126.5	125.5
LSD _{0.05}		Interaction= 7.03			4.06
Interaction of salicylic x urea					salicylic average
control		119	123	125	123.3
spray		119.5	125	126.5	123.7
LSD _{0.05}		Interaction= 7.03			n.s

Table 6: Effect of nutrients and salicylic spraying and its interaction on plant ear no.

Spraying High potash	Spraying Salicylic	Spraying urea			High potash x salicylic
		control	1 time	2 time	
control	control	5.904	6.312	6.328	6.181
	spray	6.192	6.528	6.4678	6.396
spray	control	6.413	6.574	6.571	6.519
	spray	6.202	6.803	6.676	6.560
Urea average		6.172	6.554	6.511	
LSD _{0.05}	Urea=0.2941	interaction= 0.5883			0.3396
Interaction of High potash x urea					Potash average
control		6.048	6.420	6.398	6.289
spray		6.307	6.688	6.625	6.540
LSD _{0.05}	Interaction= 0.4160				0.2401
Interaction of High potash x urea					Salicylic average
control		6.159	6.44	6.450	6.35
spray		6.197	6.665	6.573	6.478
LSD _{0.05}		Interaction= 0.4160			n.s

From the results it is shown that spraying high potash fertilizer had a significant effect on increasing yield components (plant ear number , rows number per ear, grain number per row, weight of 500 grain and yield of grain compared to control. Spraying urea one or two time led to a significant effect on increasing plant ear number and grain yield , and spraying urea two time led to increase ear weight and 500 grain weight significantly compared to control. This may be due to the rapid processing of nutrients NPK in addition to the rare elements that provided by high-phosphorus fertilizer during spraying, which can compensate for the plant needs during the period of critical growth, especially during the period of grain filling and leads to increase grain weight and yield[11]. This is consistent with the results of[12]when sprayingmaize with compound fertilizer , it led to increase plant ear number ,grain number per ear, 1000-grain weight and grain yield. And agreed with [13]who found that spraying K fertilizer on corn plants led to a significant increase in grain yielddue to the effect of K as one of the three most important nutrients for the plant, which is important in the aspects of physiological and biochemical plant and is important in increasing the effectiveness of the action of enzymes in plant [14].

The results also were consistent with the results of [15] that foliar fertilizer can offset the decrease in nutrients provided that the leaves area were large during the spraying to receive larger amount of fertilizer . And urea spray can extend the plant with nitrogen and minimize the negative impacts to add soil fertilizer by reducing the amounts added to 6-8% , reduce ground water pollution and the environment as a result of leaching [16]. This is consistent with [17] that spraying urea led to increase grain weight. This is due to nitrogen as one of the important nutrients in growth and the quantity and quality of production in corn [17], and its deficiency lead to yellowing and stunting of the plant. Nitrogen is essential in building proteins , enzymes , accompanying enzymatic , nucleic acids and cytochromes [18]. Phosphorus also is one of the elements involved in the structure of nucleic acids energy-rich compounds, so if the absorption phosphorus-ready level in soil is not sufficient by installing it with soil to insoluble compounds which reduces the efficiency of fertilizer added and therefore

spraying it on the plant treats the case of a lack of this element plant, especially during the critical stages of growth. In addition to its indirect role through stimulated a series of processes in the cell, which in turn enhances photosynthesis, which in turn leads to increased water absorption and thus increase the absorption of nutrients through the roots, which is reflected positively in the growth and grain yield [19].

Salicylic acid caused a significant increase in row grain number and this may be due to that salicylic led to increase photosynthesis rate of 8.13%, which was reflected in the increase in leaf area and yield[9], or that the increase may due to an increase sink capacity (number and weight of grain), and increase the photosynthesis process as a result of the stability of chlorophyll and increase the production and transport of organic compounds from the source to the sink[20]. These results were consistent with the results of [21, 20] that sprayingsalicylic led to increase 1000-grain weight ,ear grain number and yield, [22 , 23]. Salicylic also helps to increase the speed of the integration of soluble sugars to multiple sugars [23].

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