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EFFECT OF FOLIAR POTASSIUM APPLICATION ON CORN YIELD IN TWO IRAQI SOILS

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Abstract

Two field experiments were conducted in two research sites one on a clay soil at Wasit Governorate and the other on a sandy loam soil at Kirkuk Governorate, to study the response of corn crop to foliar potassium application. Trials at the two sites included four levels of potassium 0, 21, 42 and 63 kg K ha^{-1} applied in six split foliar applications. Results of the two sites indicated that potassium fertilization had significant effect on dry matter and grain yields. Foliar potassium application at the rate of 63 Kg K ha^{-1} increased dry matter yield from 8213 (for control) to 10293 kg ha^{-1} (an increase of 25 %) for Wasit Site and from 3923 to 5425 Kg ha^{-1}(an increase of 38 %) for Kirkuk site. Grain yield increased at the rate of 63 kg K ha^{-1} from 4667 (for control) to 9520 kg ha^{-1} with an increase of 104% at Wasit Site and from 6424 to 8473 kg ha^{-1} (with an increase of 32%) for Kirkuk site. Fertilizers productivity ranged between32.4 to 49.6 kg grain Kg^{-1} K fertilizer and 3.7 to 13.7 kg grain kg^{-1} K fertilizer applied for Wasit and Kirkuk sites respectively.

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تأثير الإضافة رشاً للبوتاسيوم في انتاجية الذرة الصفراء في موقعين مختلفين في العراق

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الخلاصة

تم تنفيذ تجربتتين حقليتين في موقعين للبحوث في محافظة واسط في تربةٍ طينية والاخر في تربة زيجة رملية في محافظة كركوك ، لدراسة تأثير الرش بمستوياتٍ مختلفة من البوتاسيوم في انتاجية الذرة صفراء . شملت المعاملات على الرش باربع مستويات من البوتاسيوم صفر و 21 و 42 و63 كغم K $ـ^{-1}$ مقسمة على ست دفعات . بينت النتائج ان الرش بالبوتاسيوم ادى الى زيادة معنوية في حاصل المادة جافة والحبوب في الموقعين . اذ ان الرش بالبوتاسيوم وبالمستوى 63 كغم K هـ$^{-1}$ ادى الى زيادة حاصل مادة الجافة مقارنةً بمعاملة المحايد من 8213 الى 10293 كغم هـ$^{-1}$ اي بنسبة زيادة 25% في موقع كوت ومن 3923 الى 5425 كغم هـ$^{-1}$ اي بنسبة زيادة 38% في موقع كركوك.حاصل الحبوب ازداد قارنةً بمعاملة المحايد من 4667 الى 9520 كغم هـ$^{-1}$ اي بنسبة زيادة 104% في موقع الكوت ومن 642، الى 8473 كغم هـ$^{-1}$ في موقع كركوك. انتاجية السماد كانت بين 32.4 الى 49.6 كغم حبوب كغم$^{-1}$ ماد بوتاسيوم ومن 3.7 الى 13.7 كغم حبوب كغم$^{-1}$ سماد بوتاسيوم في موقعي الكوت و كركوك على توالي .

الكلمات الدالة :
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Introduction

Potassium is one of the three major essential nutrients which plants absorb in amount similar more or less to that of nitrogen. Potassium content in plant tissue not only is higher than that of other cations but it is also the most important cation in many physiological and biochemical processes of plants. The mobility and participation of K in the activation of important enzyme reactions are two important fundamental characteristics of this element (Havlin et al ,2005). The uptake of K is frequently as high as or even higher than the uptake of nitrogen, for example, a corn crop producing a grain yield of 12.6 metric tons ha^{-1} removes about 23 kg of K in the grain (IPI, 2001). However, fertilizers use and applications became increasingly unbalanced, and N: K ratios went down from 1.0:0.74 in the sixties to 1.0:0.27 at the end of last century, as a global trend (Krauss, 2003).The main reason for this unbalanced is that potassium has to be imported in many countries of the world and for this reason potassium fertilizers are quite expensive especially when we talked about sulfate sources. If we compare this situation with nitrogen fertilizers especially urea, we realized that urea manufactured locally in many countries and it is fairly cheap .This situation quite true in Iraqi agriculture (Al-Zubaidy and Ali 1999, Al- Khafaji *et al* 2000).The other reason is related to the old - new hypothesis which says that arid and semiarid region have enough potassium and there is no need for its application. Field experiments in Iraq and in other places in the world proved that this hypothesis is not always true especially under intensive agriculture (i.e. Plastic houses) and when N and P fertilizers applied in high amounts with no application of K fertilizers. These situations signify the importance of K application for better plant growth and yield. However, potassium recommendation still to be established in different Iraqi sites due to lack of studies in this subject .Although, Fertilizer recommendations for most crops still need to be established and differ according to soil and crop variety, Al-Abidi,(2010) recommended 320 Kg N, 87 Kg P and 66 Kg K ha^{-1} for corn . Salih and Salman,(2011) recommended 220 Kg N, 47 Kg P and 66 Kg K ha^{-1} for the same crop . Therefore, further studies still are needed.On the other hand ,experiments using kinetics indicated that even when the capacity of K is medium to high the rate of release or the rate of K movement to plant roots is fairly slow to cope with crop demands even if K chemically available (Barber,1984;Ali et al 2011). Most Iraqi soils classified as low to moderate in its content of available K according to Bashoore ,et al.(2007) for arid soils , and very low in its rate of release (Al Obidi 1996, AlZubaidy,2003, Alsammaray,2005).These results were reflected on the response of a number of crops (field and vegetable crops) to K fertilizers application (Alsaady, 2007, Ali *etal*,2008 ;Ali et al 2009). Foliar application of some nutrients can be an excellent supplement to soil –applied nutrients (Havlin et al, 2005).The most important factor which can affect the efficiency of foliar applied potassium foliar is the solubility of potassium fertilizers sources. However, sources such as power-fert (10-10-40) and other completely soluble potassium sources can be as good as or even better than soil applied potassium. Results of some investigations conducted in Iraq in different soils and crops proved that foliar potassium application gave a comparable results to that of soil applied (Jassim,2005 ;Alsaady ,2007). Therefore, the aim of this investigation is to evaluate the effect of potassium foliar application on yield of corn and potassium fertilizer productivity in two different sites.

Material and Methods

Two field experiments were conducted at two sites namely Wasit (170 km south of the capital of Iraq, Baghdad) and Kirkuk (280 km north east of Baghdad) at the research field of the Ministry of Agriculture, to study the response of corn crop to foliar application of different levels of potassium fertilizer in two sites of Iraq under different soil properties. Soil samples from A horizon (0-30 cm) were taken from both sites, dried, grounded to pass 2 mm sieve and analyzed for some physical and chemical soil properties according to methods outlined in Black (1965) and Page *et al*.,(1982).Results of the analyses listed in Table 1 .Treatments for both sites included 4 rates of potassium 0, 21, 42, and 63 Kg K ha^{-1} using 0-0-50 potassium fertilizer, applied as foliar in 6 split applications started at 35 days from sowing with an interval of 7 days between one spray and other .All treatments received 180 Kg N ha^{-1} as urea applied in two split applications (after 2 and 6 weeks from sowing) to soil and 44 Kg P ha^{-1} applied at the time of seed sawing. All treatments were replicated 3 times in a Randomized Complete Block Design, RCBD. Corn (*Zea mays* L) Al-Bohooth 106 cultivar seeds were seeded at 15th of July 2010 at Wasit site while Ipaa 5018 cultivar were seeded at Kirkuk site at 20th of July 2010 .Corn seeds for both sites were sown in lines 75 cm apart among lines and 20 cm among seed holes .Each experimental unit consisted of 4 lines 5 m in long. Kirkuk site was irrigated through sprinkler irrigation while Kut site was irrigated through traditional border irrigation. Besides, all required management practices were done at proper times and the insecticide Dizenon (60%) was applied after 3 weeks of germination and repeated 3 weeks later. At maturity stage whole plants from middle lines in each replicate were taken for determination of dry matter and grain yield. Fertilizer productivity was calculated

according to equation recommended by Ali *et al* (2009):

Fertilizer productivity (Kg grain Kg^{-1} K fertilizer applied = $\frac{grain\ yield\ of\ fertilized - grain\ yield\ of\ control}{ammount\ of\ K\ fertilizer\ applied}$

Data were analyzed using SAS(SAS,2001) and differences among treatments tested according to LSD0.05 (Steel and Torri ,1980).

Table (1): Some chemical and physical properties of the soils of the two sites

Soil Properties	Units	Kirkuk site	Kut site
pH	-	8.2	7.4
EC (1:1)	dS m^{-1}	0.12	4.2
$CaCO_3$		170	240
OM	g Kg^{-1}	20.0	11.6
Available N(NO_3+NH_4)		85.0	45.0
Available P	mg Kg^{-1}	3.86	4.0
Available K		100	160
Sand		600	180
Silt	g Kg^{-1}	260	340
Clay		140	480
Texture		Sandy loam	Clay soil

Results and Discussion:

Results of Wasit site trial indicated that potassium applications had significant effect on dry matter and grain yield and fertilizers productivity. Application of 63 Kg K ha^{-1} increased grain yield by 104 % (Table 2) compared to control treatment. Potassium fertilizer productivity ranged between 32.4 to 49.6 Kg grains Kg^{-1} potassium fertilizer applied (Table 2).This productivity is higher than that obtained by Ali et al,(2009) ,where the potassium productivity in their study ranged from 9.9 to 20.3 Kg grain Kg^{-1} potassium fertilizer applied. In general, this kind of response supports the important of foliar potassium application even in soils having medium content of available K (160 mg Kg^{-1} soil, Table 1).

Table 2 Effects of potassium foliar application on dry matter , grain yield of corn and potassium productivity (Wasit Site)

Kg K ha^{-1}	Dry matter yield (Kg ha^{-1})	Grain yield	Fertilizers productivity (Kg grain Kg^{-1} potassium fertilizers applied)
0	8213 b	4667 c	-
21	8400 b	7147 b	49.6
42	8587 ab	8267 ab	36.0
63	10293 a	9520 a	32.4
$LSD0_{.05}$	1772	2211	

Means with the same letter are not significantly different.

Results of Kirkuk site (Table 3) gave similar trend in response of grain yield to potassium application. Application of 63 kg K ha^{-1} increased grain yield by 32% compared to control treatment .Potassium productivity ranged between 1.6-6.7 kg grain per kg potassium fertilizer applied (Table 3).This kind of response although lower than that of Wasit site but still signify the important of potassium application. The lower response at Kirkuk site in spite of its low available potassium content (Table 1) as compared to what is indicated for arid soils (Bashoor, etal,2007), can be attributed to crop variety, environmental conditions, soil potassium supplying power, and method of irrigation. It was indicated by some workers that response of corn plants to potassium application can be affected by method of irrigation (Al-Saady, 2007; Ali et al, 2009).

Table 3 Effects of potassium foliar application on dry matter , grain yield of corn and potassium productivity (Kirkuk Site)

Kg K ha^{-1}	Dry matter yield (Kg ha^{-1})	Grain yield (Kg ha^{-1})	Fertilizers productivity (Kg grain Kg^{-1} potassium fertilizers applied)
0	3923 b	6424 b	-
21	4160 b	6611 b	3.7
42	4972 ab	7225 b	8.0
63	5425 a	8473 a	13.7
$LSD0_{.05}$	1103	1064	-

Means with the same letter are not significantly different.

It can be concluded that corn crop responded to potassium foliar applications in different Iraqi sites with good grain yield and fertilizers productivity .This kind of response to potassium application confirm results of other experiments with corn in different Iraqi soils and different corn varieties (Alsaady, 2007; Ali et al ,2008 ;Ali etal,2009) .

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