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Effect of Soil Application of Zinc Fertilizer on Growth and Yield of Wheat at Bakrajow and Kanypanka locations in Sulaimani Governorate.

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Abstract:

This study was conducted during growing season of 2010 - 2011, to study the effect of four levels of Zinc as Zn- EDTA (0, 20, 40, 60 kg Zn ha^{-1}) on growth traits and yield of wheat variety *ovanto* at two different agricultural locations (Bakrajow and Kanypanka) using Randomized Complete Block Design (R.C.B.D.) with three replicates. The results showed that the increase in rates of Zn causes an increase in grain yield, grain zinc content and zinc uptake by plant, from both of locations. However the results showed that the relative yield was decreased with increasing of zinc application rate from both of locations.

Key words: Zinc fertilizer and Wheat Production, Zinc uptake, grain yield

1. Introduction:

Zinc is one of the essential micro nutrient for plants, animals and human [1]. Zn is needed by plants in small amount but the critical concentrations or if the available amount is not adequate, the plants and/ or animals will suffer from physiological stress brought about by the dysfunction of several enzyme systems and other metabolic functions in which zinc plays apart [2], He reported that the zinc which is available to plants is that present in the soil solution or is adsorbed in a labile form. The soil factors affecting the availability of zinc to plants are those which control the amount of zinc in the soil solution and its sorption-desorption from/ into the soil solution. These factors include: the total zinc content, pH, organic matter content, calcium carbonate content, redox conditions, microbial activity in the rhizosphere, soil moisture status, concentration of other elements, concentration of macro-nutrients, especially phosphorus and climatic condition.

Higher plants absorb Zn as divalent cations (Zn^{2+}) which acts either as a metal component of enzymes or as a functional structural, or a regulatory cofactor of a large number of enzymes [3], [4].On the other hand zinc deficiency is a global nutritional constraint for plant growth, particularly in calcareous soils of arid and semi arid regions [5]. One of the most important micronutrient deficiencies is attributed to zinc deficiency that is worldwide problem in human nutrition.

Wheat as one of the most critical nutrient sources for human and animals which plays an important role in production of food combinations worldwide. Among necessary elements for growth and development, zinc has been considered as one of fundamental elements for natural growth of wheat and other crops [6]. Soils with low organic material content and pH above 7 have potentially high zinc deficiency and in such a situation the problem is easily fixable using insoluble zinc granular fertilizers [7].

The objective of the present investigation is to study the effect of zinc application on growth and yield of wheat in calcareous soil.

2. Materials and Methods:

To consider effects of Zinc fertilizer application (to soil) on growth and yield of wheat in calcareous soil, the experiment was conducted at two different locations, the first one at Bakrajow Agricultural Research farm (743 masl 35°32ˉ37.7ˮ N 45°20ˉ53.9ˮ E) and the second one at Kanypanka Agricultural Research farm (580 masl 35°22ˉ37ˮ N 45°20ˉ33ˮ E) under rain-fed condition during winter growing season of 2010-2011. To study the effect of four levels of Zinc as Zn-EDTA 15% Zn (T_1=0, T_2= 20, T_3=40 and T_4= 60 kg Zn ha^{-1}) were added to the soil in deep of 25 cm at a sowing time . The field experiment was set as Randomized Complete Block Design (R.C.B.D) with three replicates. The means were compared statistically according to Duncan multiple ranges using 0.05 as significant level, and the plot area was 6 m^2. On 27 and 29 December 2010 the plots were sown with seeding rate 140 kg ha^{-1} by direct seeding of wheat variety *Ovanto* at Bakrajow and Kanypanka locations. 200 kg ha^{-1} nitrogen fertilizer was added and splitted to two equal doses which were applied at the seeding time and after 20 days of germination. 200 kg P_2O_5 ha^{-1} as triple super phosphate TSP and 150 kg K_2O as KCl were applied at the seeding time. The plants from Kanypanka location were harvested on 19th/June/2011, while at Bakrajow location the harvest was conducted on 21st/ June/2011. Soil samples were taken from all experimental units at (0 to 30 cm) depth, then air dried thoroughly mixed, ground passed through a 2 mm sieve, and stored in plastic bottles prior to analysis. Some physical and chemical properties of the soils are given in (Table 1). Electrical conductivity (EC) and pH were measured for the soil saturation extract with EC-meter, model (WTW 82362 Weilheim, Germany) and a pH-meter, model (Microprocessor pH meter, Hanna pH 211) respectively. Organic matter was determined by dichromate oxidation (Walkley and Black method) as described by [8]. The total calcium carbonate equivalent was determined by a rapid titration method [9].Cation Exchange Capacity (CEC) was determined by saturation with 1*M* NH_4OAc at pH 8.1[10].Soluble HCO_3^-, Cl^- and Ca^{2+} + Mg^{2+} titration methods [11].Na^+ and K^+ were determined by using (Flame Photometer). $SO_4^{2-}$was indirectly determined from combined Ca and Mg by titration with (0.02*M*) EDTA di-sodium salt according to [12]. Available P was determined by [13]. The particle size was determined according to international pipette method as described by [14].

Biological parameters were calculated according to [15], [16]. As follow:

Relative yield = (yield of control / yield of fertilized treatment) x100…………....... (1)

Response %=[(fertilized yield – control yield) / fertilized yield] x 100……………… (2)

Table. 1: Some physical and chemical properties of soil used in field experiments.

Properties		Location	
		Bakrajow	Kanypanka
Particle Size Distribution(PSD) g kg^{-1}	Sand	115.4	234.0
	Silt	523.6	572.0
	Clay	361.0	196.0

Textural Class		SiCL	SiL
pH		7.90	7.60
EC_e dS m^{-1} at 25°C		0.40	2.60
Soluble ions mmolc L^{-1}	Ca^{2+}	1.70	12.00
	Mg^{2+}	0.31	4.60
	Na^{+}	0.48	4.20
	K^{+}	0.19	6.10
	HCO_3^{-}	2.95	3.20
	Cl^{-}	0.21	16.10
	SO_4^{2-}	0.81	20.10
Cation Exchange capacity $cmol_c$ kg^{-1}		29.76	22.10
Available Zn mg kg^{-1}		0.565	1.563
Organic matter. g kg^{-1}		17.60	22.03
Available Phosphorous mg kg^{-1}		6.50	9.00
$CaCO_3$ equivalent g kg^{-1}	Total	328.00	225.00

3. Results and Discussion:

Number of tillers per hill:

The highest number of tillers per hill(4.66) was recorded from T_2 while the lowest value (4.00) was obtained from T_4 for Bakrajow location but for Kanypanka location the highest numbers of tillers per hill (4.76) was recorded from T_2 while the lowest (4.32) was obtained from T_4. The effects of all treatments on numbers of tillers per hill were identical to each other (Table 2).

Plant height:

The highest plant height (78.33 cm) was observed in T_1 but the lowest plant height (74.66 cm) in T_4 for Bakrajow location, while for Kanypanka location the highest plant height (78.16 cm) was observed from T_3 and the lowest plant height (77.16) was recorded from T_1. The plant heights were found identical to each other for both Bakrajow and Kanypanka location (Table 2).

Weight of 1000 grains:

The maximum weight of 1000 grains (53.86 g) was obtained from T_3 treatment and the minimum value (52.26g) was found from T_2 treatment at Bakrajow location, while in Kanypanka location the maximum weight of 1000 grains(48.26g) was obtained from T_4 treatment and minimum value(46.53g) was found from T_2 treatment (Table (2). From the above results it has been observed that the application of Zn fertilizer has not a significant effect on number of tillers per hill, plant height and the weight of 1000 grains in both locations because the soil is calcareous soil and contain an excess of Ca^{2+} ions. These Ca^{2+} ions undergo reactions with the applied zinc and make it unavailable for plant uptake these results were agree with finding bye [17].

Grain yield:

The grain yield was generally higher in Kanypanka location than Bakrajow location. The highest grain yield was found from T_4 (871.68 kg ha^{-1}) and the lowest was found from T_1 (733.35 kg ha^{-1}) at Bakrajow location, while the highest grain yield was found from T_4 (1208.36 kg ha^{-1}) and the lowest was found from T_1 (1025.02 kg ha^{-1}) at Kanypanka location Table(3).

Table. 2: Effect of Zn application on number of tillers per hill, plant height and weight of 1000 grains.

Locations	Zn application (kg ha^{-1})	No. of tiller per hill	Plant height (cm)	Weight of 1000 grain (g)
Bakrajow	0	4.33a	78.33a	53.20a
	20	4.66a	77.33a	52.26a
	40	4.33a	76.33a	53.86a
	60	4.00a	74.66a	53.73a
Kanypanka	0	4.43a	77.16a	48.00a
	20	4.76a	77.50a	46.53a
	40	4.62a	78.16a	47.86a
	60	4.32a	77.25a	48.26a

Values in the same column of each location followed by the same letter are not different significantly $p<0.05$

Concentration of Zn in grain and Zn uptake:

The results showed that the Zn content in grain were nearly similar in both locations. The Zn concentration in grain increased with increasing Zn application. So, the highest Zn value was found from the highest Zn application, but the highest Zn content in grain was in plants grown at Kanypanka inspite of Zn application the value (1.70 mg kg^{-1}) was much higher in T_4 at Kanypanka location than T_4 at Bakrajow location which was (0.718 mg kg^{-1}). This was very evident in the Zn uptake by the crop (Table 3).The results showed that the Zn uptake by grain was increase with increasing of Zn application at both locations. So, the highest Zn uptake by grain was in grain plants grown at Kanypanka location. The value (2054.21 mg ha^{-1}) was much higher in T_4 at Kanypanka location than T_4 at Bakrajow location which was (625.86 mg ha^{-1}) (Table3).The reasons of low zinc uptake from both of locations maybe due to fixation of zinc by available calcium ion.

Locations	Zn application (kg ha^{-1})	Grain yield (kg ha^{-1})	Grain Zn concentration (mg kg^{-1})	Grain Zn uptake (mg ha^{-1})	Relative yield (control/fertilized)x 100	Response %
Bakrajow	0	733.35a	0.453a	332.20a	……………	………..
	20	755.02a	0.596a	450.00a	97.13	2.87
	40	855.02a	0.675a	577.14a	85.76	14.23
	60	871.68a	0.718a	625.86a	84.13	15.86
Kanypanka	0	1025.02a	0.435b	445.88b	……….	………
	20	1125.02a	0.455ab	511.88ab	91.11	8.88
	40	1156.7a	0.574ab	663.95ab	88.86	11.38
	60	1208.36a	1.700a	2054.21a	84.48	15.17

Table.3: Effect of Zn application on grain yield, grain Zn concentration , Zn uptake by grain, Relative yield and (Response %)

Values in the same column of each location followed by the same letter are not different significantly $p<0.05$

Effect of Zn fertilizer level on (Response %) and Relative yield:

Result in (Table 3) showed that the relative yield was decreased from 97.13 to 84.13 % for Bakrajow location and from 91.11 to 84.48% for Kanypanka location. While the response percentage for grain yield as it is opposite in trade with relative yield affected by Zn fertilizer level and soil type, the range of response percentage increased with increasing Zn fertilizer level from 2.87 to 15.86% for Bakrajow location and from 8.88 to 15.17% for Kanypanka location.

The response of wheat to Zn fertilization:

The results in Fig. 1. Refer to the significant effect of Zn fertilizer on grain yield of wheat plant in Bakrajow and Kanypanka locations in Sulaimani governorate. These results showed that increasing Zn fertilizer application from 20 to 60 kg Zn ha^{-1} as Zn-EDTA increased significantly the grain yield of wheat from 733.4 to 817.7 kg ha^{-1} for Bakrajow location and from 1025.02 to 1208.36 kg $ha^{-1}$for Kanypanka location comparing with control treatment.

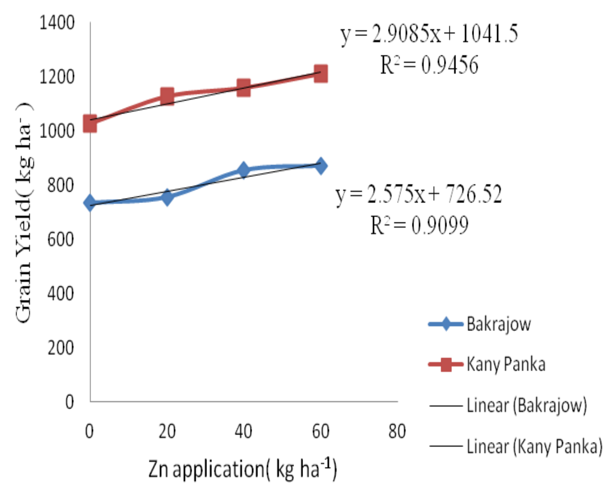

Fig.(1) effect of Zn application on grain yield of wheat.

IV. Conclusions:

According to results obtained from present study, it can be concluded that the increasing in Zn application lead to increase in grain yield and Zn uptake by plant. But the relative yield was decreased with increasing Zn application

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