ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Concentration of N, P and K in potato tubers organically fertilized which sprinkled with Zn, Mn at different stage growth.

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ABSTRACT

A field experiment of spring season 2012 was carried out in horticulture dept – college of Agriculture – university of Baghdad, to study the response of organically fertilized potatoes to foliar fertilization of Zn at 60 mg l^{-1} and Mn at 30 mg l^{-1} separately and together at (60 mgL^{-1} + Mn at 30 mg L^{-1}) at three stages of growth: vegetative growth, tuber initiation and tuber bulking and interaction between them, RCBD was used at three replication, Results showed that sprinkling with (Zn + Mn) have given higher concentration of N, P, K in tubers at 1.40, 0.28 and 2.24% respectively, Highest values of nitrogen was 1.13% and potassium was 0.235% when both nutrient were sprinkled at vegetative stage, While the highest concentration of phosphorous 0.270% obtained at tuber bulking stage when sprinkled both nutrient, treatment (both nutrient sprinkling on vegetative stage) gave higher concentration at 1.48, 0.33, 2.40% of N, P and K in tuber respectively.

Keywords: Potato, Zinc, Manganese, Organic, Foliar application.

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INTRODUCTION

Potato (*Solanum tuberosum* L) is one of the most important in the world according to the data of food and Agriculture Organization of united Nation (Flis et al., 2012), Micronutration elements play a critical role in plant lead to increase of leaf area index and there by increased light absorption and increase the amount of dry matter accumulation and economic yield (Ravi et al., 2008). Foliar feeding minimizes environmental pollution and improves nutrient utilization through reducing the amounts of fertilizers added to the soil (Abou-El- nour, 2002), Foliar fertilization not only improves plant growth traits, crop yields and nutrients up take by crops (Maitlo et al., 2006) but also enhances nutrient use efficiency of crops (Fageria et al., 2009). Zinc (Zn) is Known to have an important role either as metal component of enzymes or as functional, structural or regulatory cofactor of a large number of enzymes (Grotz and Guerinot, 2006), Zinc have an important rol in the production of biomass furthermore, Zinc may be required for chlorophyll production, pollen function, fertilization and germination (Kaya and higgs, 2002 and Pandey et al., 2006). Manganese is one of the main micronutrient, which has an important role in plant, low levels are absolutely necessary for normal nutrition and development of plants (Clarkson, 1988 and Migocka and Klobus, 2007), Manganese has important role on activates several enzymes which involve to oxidation reaction, carboxylation, carbohydrates metabolism, phosphorus reaction and citric acid cycle (Jackson et al., 1978; Mukhopdhyay and Sharma, 1991 and Millaleo et al,. 2010). Several researches indicated appositive influence of micronutrient (Zn + Mn) application increase of yield and quantitative parameters of crops (Mousavi et al., 2007) on potato. In most of the Iraqi soils pH is high, in this type of soils solvability of microelements is less and cause decline absorbency these elements and finally requirement of plant to this elements is increasing (Uygur and Rimmer, 2000). Mohamadi (2002) found that application of Zn along with Mn to from foliar application caused increase in efficiency and quality of potato crop, Al – Fadlly (2016) reported that using Fe and Zn affected of weight of potato tuber, tuber yield of plant and total tuber yield.

Therefore, the present aims to evaluate the efficiency of using foliar application of Zinc and manganese and the combination in three stage growth on concentration of NPK in tuber potatoes.

MATERIALS AND METHODS

The study area is located in Department of Horticulture, College of Agriculture, Abu – Grabs University of Baghdad – Iraq in spring season 2012 on clay loam soil. The physical and chemical analysis of the experimental soil are show in table 1, The experiment included 12 treatments with two factors, Factor one is control spraying water only (T_0) , spraying 60 mg Zn l^{-1} (T_1), spraying 30 mg Mn l^{-1} (T_2) and spraying mixture Zn + Mn (60 + 30) mg l^{-1}, Factor two is sprayed at three stage of potato growth which were vegetative growth (F_1), tuber initiation (F_2) and tuber bulking (F_3). The experiment was laid out in factorial randomized block design with three replication, Field was divided into three block, each block was divided to 12 experimented plots, The area of each experimental plot was 6.75 m^2 (3 ridges 0.75 m width and 3 m in length), left a distance 1 m between blocks and experimental plots. Compost of mixture equal amount of waste cow, sheep and poultry with 50 Ton L^{-1} (AL- Fadlly, 2011) which decomposition add to all experimental unite, Specification set out in table 2. Compost adds to each ridge before burred tuber 10 day silt in top of ridges with 30 cm depth 20 cm width and covered with soil. In 18 January 2012 tuber class desire were sown in top of rides deeply at 10 – 12 cm, 25 cm the distance between tubers (Muharem and Abdul, 1987). F_1 treatments sprayed in vegetative stage at 9 April 2012, In 20 April sprayed F_2 treatments at initiation stage and F_3 treatment sprayed at tuber bulking stage in 1 May 2012. At maturity stage on 26 May 2012 tubers were harvested. Five plants from each net plot were tagged to record data, the content of nitrogen (N), phosphorus (P) and potassium (K) in dry mass of potato tubers were determined, Total nitrogen was measured by the kjeldahl method (Bremener and Mulvancy, 1982). Total phosphorus was determined calorimetrically using ascorbic acid method described by (Watanabe and Olsen, 1965) and concentration of potassium (K) was determined in digested material using flam photometers as described by (Eppendrof and Hing, 1970). Data were analyzed statistically through the analysis of variance (ANOVA) using SAS system (SAS, 2001) and comparison among the average was calculated using the LSD test at significance level of 0.05.

Table 1: Some physical and chemical properties of soil of field experiment

Property		Value	Unit	Ref
pH		7.59	-	Richards, 1954
Ec (1:1)		3.15	dSm^{-1}	
Particle Size	Sand	171.50	g, kg^{-1} soil	Black,1965
	Silt	512.64		
	Clay	315.86		
Texture		Silt Clay Loam		
Bulk density		1.36	g. cm^{-3}	
Gypsum		5.24	g kg^{-1} soil	Richards, 1954
CEC		26.80	C mol^{+} kg^{-1} soil	FAO, 2007
SOM		18.20	g kg^{-1} soil	Page *et al*,. 1982
Carbonate minerals		182.52		FAO, 2007
Soluble cat ion	Ca^{+2}	8.40	C mol^{+} kg^{-1} soil	Page *et al*,. 1982
	Mg^{+2}	5.13		
	K^{+1}	0.55		
	Na^{+1}	3.95		
A available Nutrient Element	N	36.00	mg. Kg^{-1} soil	
	P	11.35		
	K	161.64		
	Zn	1.73		
	Mn	2.19		

Table 2: Chemical analyses of organic manures used

Parameter	Value	Unite
pH (1:5)	6.3	-
Ec (1:5)	30.37	ds m^{-1}
C/N ratio	16.33	-
Organic C	325	g kg^{-1}
Organic N	19.90	
Organic P	11.99	
Organic K	17.46	
Zn	220.16	ppm
Mn	174..34	
Ca	22.00	Meg L^{-1}
Mg	11.00	
Organic matter	50.32	%
Humic	1.43	
Volvic	0.188	
Human	6.98	

RESULTS AND DISCUSSION

Nitrogen concentration in tubers

Statistical analysis results table 3. Showed the significant effect of foliar application of Zn and Mn separately and (Zn + Mn) together on the concentration of N in tubers, where T_3 foliar application (Zn + Mn) was superior on all other foliar treatment, also it gave the highest concentration of N at 1.4% in an increase of 64.71% as compared to control T_o (water only foliar application) that was 0.85% at an increase of 30.84% when compared to T_1 (Zn foliar application) at 1.07% and increase of 20.68% compared to T_2 (Mn foliar application) at 1.16% N concentration. T_2 was superior on T_1 in N concentration at 8.41% increase. Time of application has no significant effect on N concentration in tubers, while interaction of Zn + Mn and time of application was a significant impact in increasing N concentration in tubers, Where T_3F_1 (application of Zn + Mn at vegetative growth stage) was superior on all other interaction treatments and gave the highest N concentration in tubers at 1.48% and increase of 85% when compared to T_0F_1 (water foliar application at vegetative growth stage) that was 0.8%.

Table 3: Effect foliar application Zn, Mn and (Zn + Mn) on concentration N in tubers %

Mineral application / Time of application	T_0	T_1	T_2	T_3	Mean
F_1	0.80	1.10	1.16	1.48	1.13
F_2	0.85	1.04	1.21	1.39	1.12
F_3	0.94	1.07	1.13	1.35	1.12
Mean	0.85	1.07	1.16	1.40	
L.S.D 0.05%	T	F	T*F		
	0.04	0.37	0.07		

Phosphorus concentration in tubers:-

Statistical analysis results table 4. showed the significant effect of foliar application of Zn and Mn separately and (Zn + Mn) together on the concentration of p in tubers where T_3 foliar application (Zn + Mn) was superior all other foliar treatment, also it gave the highest concentration of p at 0.28% an increase of 39.81% at an increases of 15.20% when compared to (Zn foliar application) at 0.25% and increase of 2.13% compared to T_2 (Mn foliar application at 0.28% concentration), Time of application has significant effect on p concentration tuber, where f_3 treatment (tuber bulking stage) was superior on all time application, also it gave the highest concentration of p 0.27% in an increase of 14.89% as compared to F_1 foliar application at shoot stage, F_2 foliar application at tuber initiation stage was superior on F1in p concentration at 0.27% and increase of 17.78%. Interaction between (Zn + Mn) application and time of application has a significant impact increasing p concentration in tuber, where T_3F_1(application of Zn + Mn at shoot growth stage) was superior on all other interaction treatments and gave the highest p concentration in tuber at 0.33%.

Table 4: Effect foliar application Zn, Mn and (Zn + Mn) on concentration P in tubers %

Mineral application / Time of application	T_0	T_1	T_2	T_3	Mean
F_1	0.170	0.260	0.280	0.330	0.235
F_2	0.210	0.240	0.290	0.320	0.265
F_3	0.238	0.250	0.277	0.315	0.270
Mean	0.206	0.250	0.282	0.288	
L.S.D 0.05%	T	F	T*F		
	0.006	0.005	0.010		

Potassium concentration in tubers

Table 5 shows the significant effect of foliar fertilization of Zn + Mn each separately and together with sprinkling periods and their interaction on the concentration of potassium in tubers of potatoes where T3 treatment (60 mg Zn L^{-1} + 30 mg Mn L^{-1} sprinkling) has given higher potassium concentration in tubers at 2.24% with an increase of 27.27 % compared to least concentration in control treatment F_0 at 1.76 %, Also Mn foliar treatment T_2 was superior as compared to T_1 Zn foliar treatment gave higher potassium in at 2.05 % and 6.77 % increase percentage as compared to potassium concentration in tubers of Zn foliar application at 1.92%, data of foliar application effected was significant in potassium concentration in tubers where foliar application at vegetative growth was superior potassium concentration at 2.03%, 2.53% and 3.57% increase when compared to potassium concentration in tubers at tuber initiation and tuber bulking stages at 1.98 % and 3.57 % potassium concentration respectively, there was no significant difference between both foliar application at tuber initiation and tuber bulking stages in concentration of potassium in tubers, Interaction Zn and Mn with data of foliar application was significant in potassium concentration in tubers where T_3F_1 (Zn + Mn) foliar application at vegetative growth) by giving potassium concentration in tubers at 2.40 % which 41.18 % increase compared to least concentration of potassium in tubers in interaction treatment T_0F_0 at 1.70 %.

Micronutrient elements play a critical role in plant that lead to increase of leaf area index and there by increased light absorption and increase the amount of dry matter accumulation and economic yield (Ravi et al., 2008), Foliar fertilization not only improves plant growth traits, crop yields and nutrient uptake by crops (Maitlo et al., 2006) but also enhances nutrient use efficiency of crops (Fageria et al., 2009), Numerous studies separately have reported that utilization is increasing performance and quality of potato tubers (Ranjbar and Malakoty, 2000; Mohamadi, 2000; Mousavi et al., 2007),

Table 5: Effect foliar application Zn, Mn and (Zn + Mn) on concentration K in tubers %

Mineral application / Time of application	T_0	T_1	T_2	T_3	Mean
F_1	1.70	1.98	2.07	2.40	2.03
F_2	1.76	1.89	2.10	2.18	1.98
F_3	1.82	1.90	2.00	2.14	1.96
Mean	1.76	1.92	2.05	2.24	
L.S.D 0.05%	**T**	**F**	**T*F**		
	0.04	0.04	0.08		

Kelling and Speth (2001) reported that utilization of elements like Zn and Mn together form resource sulfate Zn and Mn increased and quality of potato crop. Mohamadi (2000) found that application of Zn along with Mn to from foliar application caused increase in efficiency and quality of potato crop. Several researched indicated a positive influence of micronutrient (Zn, Mn) application increase of yield and quantitative parameters of crops (Mosavi et al., 2007) on potato. Al-Fadlly (2016) Found the mean weight of tuber, mean yield tuber per plant and total yield tuber increased when spread with Zn and Mn at vegetative stage.

CONCLUSION

Foliar application of Zn and Mn at (60 ppm Zn + 30 ppm Mn) gave the highest rate of N and K concentration in potatoes tuber at vegetative stage and highest rate of K concentration at bulking stage.

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