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INFLUENCE OF POTASSIUM AND ZINC APPLICATION ON GROWTH AND YIELD TRAITS OF SWEET POTATO (*IPOMOEA BATATAS* L.)

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ABSTRACT

A field experiment on sweet potato was conducted during winter season of 2014-15 to study the effect of K and foliar Zn of 16 treatment combinations having four levels of potassium (0, 80, 100 and 120 kg/ha) and zinc (control i.e. water spray, 10, 20 and 30ppm). Cultivar CO-34 was used as the test crop. The individual effects showed that the highest sweet potato yield was obtained from plants received 120 kg K_2O/ha. On the other hand, the highest zinc dose 30ppm recorded the highest production of tuber yield compared with other low doses. The maximum yield attributes viz; length of tuber (19.82 cm), diameter of tuber (5.97 cm) and yield (1102g/ plant) were also obtained for the treatment combination of 120 kg K_2O/ha and 30ppm Zn. While, the treatment 120 kg K_2O and 20ppm Zn had the maximum number of tuber (4.86) thought minimum number of tuber was recorded in control. Finally, it could be concluded that, the best interaction treatment for increasing yield and its components was obtained by fertilization of sweet potato plants with 120 kg K_2O/ha. and foliar application with 30 ppm zinc.

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INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is the seventh world crop after wheat, rice and maize, yam and cassava which has a production of nearly 102 million tons produced from about 8.2 million hectares (Anonomys, 2014). Therefore, it is considered as the most important tuber crop. Moreover, sweet potato is an important vegetable and a good source of antioxidants (Panda and Sonkamble, 2012). Sweet potato is a major source of inexpensive energy; it contains high levels of carbohydrates, carotenoids and amounts of vitamins A, C and minerals (Collins and Walter, 1982). Fertilizer is one of the most important inputs of increasing the productivity of crops (Anonymous, 1997). Potassium appears to be the most important nutrient in the production of sweet potato as its application increases yield by the formation of larger sized tubers (Cakmak, 2005). With a shortage of potassium many metabolic processes are affected, such as the rate of photosynthesis, the rate of translocation and enzyme systems. At the same time, the rate of dark respiration is increased (Mengel, 1997). Potassium deficiencies can limit the accumulation of crop biomass. This is attributed to that, K increases the photosynthetic rates of crop leaves, CO assimilation and facilitates carbon movement (Marschner, 1995). Micronutrients play a catalytic role in nutrient absorption and balancing other nutrients (Singh and Kalloo, 2000). Foliar spraying of microelements is very helpful when the roots cannot uptake necessary nutrients in required quantity from the soil. Zinc is an important element with specific and essential physiological functions in plants; required in small quantities for normal growth and development of plants. Zinc activates the synthesis of tryptophan, the precursor of IAA and it is responsible to increasing the photosynthesis and biomass production thus stimulates growth and yield of plant (Singh and Verma 1991). Deficiency of zinc has been found to reduce leaf size and shortened internodes and hence, limit plant growth. The aim of this work is to investigate effect of potassium and zinc on growth and yield of sweet potato as till traditional practices is followed as it invites low yield. Keeping this in view of the tuber formation and tuber size of sweet potato in information on the above mentioned aspects, the present investigation on influence of potassium and zinc application on growth and yield traits of sweet potato was undertaken.

MATERIALS AND METHODS

The present investigation was carried out at Department of Vegetable Science, College of Horticulture & Forestry, Jhalrapatan city, Jhalawar (Rajasthan) India during 2014-15 as factorial randomized block design (FRBD) with sixteen treatments, each with three replications consisting 48 block (1.5x1.2 m) in which sweet potato cultivar 'CO-34' cutting were planted at a spacing of 60 x 30 cm on drip during October, 2014. The soil of the experimental field was black cotton, pH 6.6, clay and loam in texture, normal in reaction with medium in respect to nitrogen, phosphorus and potassium. The present experiment comprised of 16 treatment combinations including four levels of potassium (0, 80, 100 and 120 kg/ha) as source of muriate of potash and four levels of zinc (control i.e. water spray, 10, 20 and 30 ppm) as source of zinc sulphate. Zinc was two foliar applications at 45 and

90 days after transplanting (DAT). The test crop sweet potato (*Ipomoea batatas* L.) cv. CO-34 was also fertilized with Urea and SSP at the rates of 60 kg N_2 and 50 kg P_2O_5 ha^{-1}, respectively during final land preparation. The crop was grown on raised beds at 60 x 30 cm spacing on drip system. Each treatment consisted of 10 plants for which 10-cutting were grown in a two rows of 1.5 meter length. The data was subjected to analysis of variance (ANOVA) for testing the significance of variation due to potassium, zinc and their interaction for different characters as described by Gomez and Gomez (1984). Mean values were calculated and compared using F-test at 5% level of significance.

RESULTS AND DISCUSSION

The results of the effect of potassium and zinc on different characters are presented in Table 1. Significant differences were recorded among the treatments for all the characters. The character wise result has been discussed below:

Length of vine (cm)

Results presented in Table-1 manifested that different levels of potassium had a significant influence on length of vine at 45 DAT, 90 DAT and at harvest. The treatment K_3 recorded significantly the highest length of vine (46.63, 119.42 and 166.26 cm at 45 DAT, 90 DAT and harvest, respectively). Further, its results clearly indicated that application of zinc could not exhibit a significant influence on length of vine at all stage of plant growth. The interaction effect of potassium and zinc levels (K×Zn) was also found non-significant with respect to length of vine. Choudhary, *et al.* (2014) conclusively suggested that application of Zn increased plant height in soyabean. However, the highest value for most of the growth components i.e. length of vine per plant was obtained when the crop was fertilized with 120 kg K_20/ha in combination with 30 ppm Zn and control treatment produced the lowest of sweet potato (El-Hadidi and Mansour, 2008).

Number of branches per vine

The perusal of data revealed that the application of potassium significantly increased the number of branches per vine at 45 DAT, 90 DAT and at harvest (Table 1). The treatment K_3 (120 kg K_2O ha^{-1}) gave significantly highest number of branches per vine (5.77, 14.49 and 20.72 at 45 DAT, 90 DAT and at harvest, respectively), whereas as compared to treatment K_0. The results provided in Table 1 indicated that levels of zinc plays an important role in increasing the number of branches per vine over control. The maximum number of branches per vine *i.e.,* 5.46, 13.81 and 19.88 at 45 DAT, 90 DAT and at harvest, respectively was observed in treatment Zn_3 (30ppm). However, the interaction effect of potassium and zinc levels (K× Zn) was found non-significant with respect to number of branches per vine (Table 1). These results are in accordance with the earlier findings of Uwah *et al.* (2013) and Kumar *et al.* (2010) recorded significant increase in the production of longer vines with application of potassium and zinc.

Number of tubers per plant

An analysis of data showed a significant influence of potassium levels on number of tubers per plant (Table 1). The maximum number of tubers per plant (4.60) was recorded in treatment K_3 (120 kg K_2O/ha), whereas the minimum number of tubers per plant (3.26) was obtained in treatment K_0. Further the treatment Zn_3 (30 ppm) gave the highest number of tubers per plant (4.18) as compared to Zn_0 i.e. control. The interaction effect of potassium and zinc levels (K × Zn) was also found significant with respect to number of tubers per plant. The maximum number of tubers per plant (4.86) was noted in treatment combination K_3Zn_2 (120 Kg K_2O/ha + Zn 20ppm), whereas the minimum number of tubers per plant (2.94) was recorded in treatment combination K_0Zn_0 i.e. control. Bourke (1985) observed that potassium application increased the number of tubers per plant and also produced over sized roots. Similar results were reported by and Abd El-Baky *et al.* (2010) on sweet potato.

Length of tuber (cm)

Results presented in Table 1 showed that different doses of potassium had a significant effect on increasing the length of tuber per plant over control (K_0). The treatment K_3 recorded significantly the highest length of tuber (16.77 cm) and the lowest length of tuber (13.27cm) was recorded under treatment K_0 (control). The treatment Zn_3 (30ppm Zn) produced significantly maximum length of tuber (18.12 cm) and the minimum length of tuber (12.47cm) was observed in treatment Zn_0.The interaction effect of potassium and zinc levels (K×Zn) was found significant with respect to length of tuber (Table 1). The treatment combination K_3Zn_3 showed the highest length of tuber (19.82 cm) and it was remained at par with treatment combinations K_3Zn_2 and K_0Zn_3.Whereas the treatment combination K_0Zn_0 gave the lowest length of tuber, which was found at par with treatment combinations K_0Zn_1 and K_0Zn_2. Edmond (1971) reported that potassium produces more chunky tubers. Chunky tubers are more desirable than elongated tubers in sweet potato.

Diameter of tuber (cm)

Results presented in Table 1 revealed that different levels of potassium exerted a significant effect on diameter of tuber. The treatment K_3 (120 kg K_2O) recorded significantly the maximum diameter of tuber per plant (5.69 cm) whiles the lowest diameter of tuber (3.81 cm) was recorded under treatment K_0 (0 kg K_2O). The treatment Zn_3 (30ppm) produced the maximum diameter of tuber per plant (5.16 cm) and the minimum diameter of tuber per plant (4.52 cm) under treatment Zn_0 (control). The interaction effect of potassium and zinc levels (K×Zn) also showed a significant influence on diameter of tuber per plant (5.97 cm) was observed in treatment combination K_3Zn_3 (120 kg K_2O + 30 ppm Zn), respect However, the treatment combination K_3Zn_2 (120 kg K_2O + 20 ppm Zn) under was found at par with K_3Zn_3. Contrary to this. Size of the tuber as affected by the application of potassium is normal because of the function of K is to translocate the carbohydrates from the place of photosynthesis to the tuber. The increase of size of the tuber could not only the effect of potassium fertilizer but also the combination of zinc El-Hadidi and Mansour (2008). Similar results were reported by Davenport *et al.* (1999) on potato and Abou El-Khair *et al.*, (2011) on sweet potato ,

Tuber yield per plant

Results presented in Table 1 showed that application of

Table 1: Effect of potassium and zinc on growth and yield attributes of sweet potato cv. CO-34

Treatments	Length of vine per plant (cm)			Number of branches per vine			Number of tubers per plant	Length of tuber (cm)	Diameter of tuber (cm)	Yield per plant(g)
	45 DAT	90 DAT	at harvest	45 DAT	90 DAT	at harvest				
Potassium (K)										
K_0 – 0 kg K_2O	35.24	79.35	129.27	4.03	10.52	14.65	3.26	13.27	3.81	533
K_1– 80 kg K_2O	36.28	104.85	142.71	4.51	11.34	16.48	3.78	14.74	4.66	695
K_2 – 100 kg K_2O	42.59	111.86	153.32	5.05	12.70	18.32	4.44	15.30	5.18	828
K_3 – 120 kg K_2O	46.63	119.42	166.26	5.77	14.49	20.72	4.60	16.77	5.69	971
S.Em±	0.99	1.83	3.34	0.13	0.25	0.62	0.05	0.37	0.06	10.27
C.D. at 5%	2.85	5.30	9.65	0.38	0.73	1.79	0.15	1.07	0.12	20.21
Zinc (Zn)										
Zn_0 – 0 ppm Zn	39.48	100.35	143.93	4.30	10.95	15.29	3.72	12.47	4.52	693
Zn_1 – 10 ppm Zn	39.62	102.12	145.59	4.72	11.94	17.23	4.02	13.83	4.77	734
Zn_2 – 20 ppm Zn	40.36	106.40	148.98	4.88	12.34	17.78	4.16	15.65	4.89	768
Zn_3 – 30 ppm Zn	41.30	106.61	153.06	5.46	13.81	19.88	4.18	18.12	5.16	833
S.Em.±	0.99	1.83	3.34	0.13	0.25	0.62	0.05	0.37	0.06	10.87
C.D. at 5%	NS	NS	NS	0.38	0.73	1.79	0.15	1.07	0.12	20.21
Interaction (K × Zn)										
K_0Zn_0	30.07	72.40	125.51	3.10	8.23	10.90	2.94	10.92	3.21	473
K_0Zn_1	31.37	71.80	126.55	3.86	10.07	14.17	3.30	11.35	3.71	523
K_0Zn_2	31.84	83.02	129.45	4.01	10.44	14.70	3.24	12.18	3.92	545
K_0Zn_3	35.70	90.18	135.56	5.16	13.33	18.83	3.58	18.62	4.41	590
K_1Zn_0	36.43	107.50	139.57	4.23	10.68	15.20	3.23	12.28	4.40	626
K_1Zn_1	35.10	105.87	142.39	4.51	11.31	16.60	3.80	13.97	4.61	681
K_1Zn_2	36.73	105.01	143.38	4.63	11.63	17.00	3.97	15.93	4.65	717
K_1Zn_3	36.87	101.00	145.49	4.67	11.72	17.13	4.10	16.77	4.96	758
K_2Zn_0	42.20	109.03	155.32	4.68	11.80	16.73	4.27	12.69	5.13	780
K_2Zn_1	41.83	112.52	154.63	4.94	12.40	18.00	4.40	14.47	5.16	813
K_2Zn_2	43.30	114.64	150.91	5.05	12.68	18.40	4.57	16.77	5.15	837
K_2Zn_3	43.03	111.25	152.41	5.54	13.89	20.13	4.53	17.28	5.29	880
K_3Zn_0	46.20	112.46	155.32	5.19	13.08	18.33	4.43	14.00	5.33	892
K_3Zn_1	47.17	118.30	158.77	5.58	13.99	20.13	4.57	15.54	5.60	919
K_3Zn_2	46.57	122.92	172.17	5.82	14.60	21.00	4.86	17.71	5.86	971
K_3Zn_3	46.60	124.00	178.76	6.49	16.28	23.40	4.52	19.82	5.97	1102
S.Em±	1.97	3.67	6.68	0.26	0.50	1.24	0.10	0.74	0.11	20.11
C.D. at 5%	NS	NS	NS	NS	NS	NS	0.30	2.14	0.32	40.12

Plate no. 1: Genral view of experinmental trial

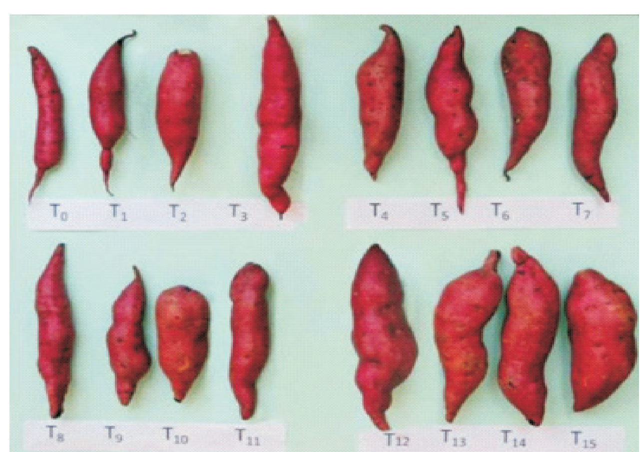

Plate no. 2: Genral view of treatment

potassium and zinc had a pronounced effect on tuber yield over control. Treatment K_3 (120 kg K_2O/ha) resulted in significantly highest tuber yield (971g/plant). While the lowest tuber yield (533g/plant) was recorded under the treatment K_3. The treatment Zn_3 (30 ppm Zn) recorded significantly the highest tuber yield (833g/plant). Further the interaction effect between potassium and zinc levels (K×Zn) was found also significant for tuber yield per plant (Table 1). The treatment combination K_3Zn_3 gave the maximum tuber yield (1102 g/ plant) and the minimum tuber yield (473 g/plant) was observed in treatment combination K_0Zn_0, respectfully. Potassium might have taken part in active photosynthesis and translocation of carbohydrates, which improved the size of tuber and utilized in rapid tuber development and production (Mengel and

Kirkby, 2001). Similarly, foliar spray of zinc might have affected the physiological processes and cellular mechanism resulting into higher production (Kumar and Sen, 2005). However, earlier findings of sweet potato plants respond positively to individual or combination application of potassium and foliar zinc and produced maximum production of tubers. (Abd El-baky *et al.,* 2010).

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