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EFFECT OF POTASSIUM AND FOLIAR ZINC APPLICATION ON QUALITY OF SWEET POTATO (*IPOMOEA BATATAS* L.) CV. CO- 34 UNDER SUB-HUMID CONDITION OF RAJASTHAN

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ABSTRACT

A field experiment entitled ''Effect of potassium fertilizer and foliar zinc application on quality of sweet potato (*Ipomoea batatas* L.) cv. CO-43'' was conducted at the Department of Vegetable Science, College of Horticulture and Forestry, Jhalawar during the rabi season 2014-2015. The experiment consisted of sixteen treatment combinations having four levels both of potassium (0, 80, 100 and 120 kg/ha) and zinc (0, 10, 20 and 30 ppm) in Factorial Randomized Block Design with three replications. The individual effects showed that sweet potato quality increased with the use of 120 kg K_2O/ha. and 30ppm Zinc. The interaction of potassium and zinc showed that the maximum quality attributes i.e. total soluble solids (12.30 °brix), carotenoids content (3.64 mg/100g), ascorbic acid (18.04 mg/100g), total nitrogen (2.09 %), crude protein (13.04 %), reducing sugar (14.52 %) and non- reducing sugar (6.14 %) of tuber with 120 kg K_2O/ha and 30 ppm Zn treatment than other treatment. From the experiment it appeared that the potassium and zinc both is best for increasing overall quality of sweet potato.

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.), a member of convolvulaceae family, is a perennial crop usually grown as an annual and a starchy staple food crop in the tropical, sub-tropical and frost-free temperate climatic zones of the world. It is believed to have originated in Central America and the North Western part of South America. Sweet potato plays a vital role in the health and nutritional security of human beings to improv the economy of the people of the country. It is a major source of carbohydrate for millions of people, especially in developing countries. It has been established that sweet potato is more nutritious and flavourful. Therefore, it should be grown in greater quantities. It is also an excellent source of complex carbohydrates, high antioxidants, vitamins C, carotenoids content, phosphorus, potassium, calcium, sulphur, iron, copper, boron, zinc, iodine, folic acid, cystine fibre, starch, protein, niacin, tryptophan and tyrosine. The starch in sweet potato easily converts to sugar and provides quick energy. So, it is actually a super food (Griffiths, 2001 and Panda, 2006). Potassium plays a major role in many physiological and biochemical processes; as cell-division and elongation, enzyme activation, synthesis of simple sugars and starch as well as accelerated translocation of carbohydrate, necessary for tubers formation and development (Marschner, 1986 and Beringer *et al.,* 1990).

Zinc is an important component of enzymes that drive and increase the rate of many important metabolic reactions involved in crop growth and development. It exerts a great influence on basic plant life processes such as N_2 metabolism and uptake of N_2 and protein quality, photosynthesis and chlorophyll synthesis, (Potarzycki and Grzebisz, 2009). The aim of this work was to investigate the interactive effect of different level of foliar application of potassium and zinc on quality of sweet potato.

MATERIALS AND METHODS

An experiment was conducted at the Department of Vegetable Science, College of Horticulture and Forestry, Jhalawar, Rajasthan. Jhalawar is situated between 23.45° and 24.52° North latitudes and 75.27° and 76.56° East longitudes covering an area of 6322.35 Km^2. Jhalawar district falls under Humid South-Eastern Plains under agro-climatic zone V. The climate of Jhalawar is typically sub-humid and characterized by extremes of temperature both in summer and winter with high rainfall and moderate relative humidity. The soil had organic carbon (0.57 %), available nitrogen 218.33 kg/ha, available phosphorus 28.01 kg/ha and available potash 210.67 kg/ha. Well decomposed vermicompost at the rate of 2 kg/sqm was applied at the time of land preparation. Recommended dose of NP (50:60 kg/ha) was applied in the form of Urea and Single Super Phosphate, respectively. We evaluated four doses of K_2O (0, 80, 100 and 120 kg ha^{-1}) and four doses of zinc (control, 10, 20 and 30ppm). The potassium was used as soil application and its source was muriate of potash. However zinc was applied as foliar applications at 45 and 90 days after transplanting and its source was zinc sulphate. The experimental site was laid out as per Factorial Randomized Block Design with sixteen treatments three replication. At the time of planting half dose of N, full dose of P_2O_5 and also K_2O were applied. The crop was top dressed with remaining half dose of N at 45 days after planting (DAP). Plots of 1.5×1.2 m^2 size were prepared. The cuttings measuring 20-30 cm in length were made and planted in the field at a spacing of 60 cm x 30 cm. Thus, 10 plants were accommodated in each plot. The plants were irrigated using a T-Tap dripping line. Plant samples were collected at harvesting stage and tuber samples were analysed for total soluble solids with the help of hand refractometer. A sample (100 g) of the tuber was sliced and dried in oven at 60 ± 5 ºC and per cent dry matter was recorded. Tuber content of carotenoids pigments was determined according to Roy, (1973). Vitamin–C (mg 100 g^{-1} of fresh weight) was estimated using 2, 6-dichlorophenol indophenols visual titration method, as described by Johnson (1948) and nitrogen by using Kjeldahl method (Snell and Snell, 1949). Protein content was calculated by multiplying N content with the factor 6.25. Total sugars percentage was determined according to (Dubois *et al.*1951) and Reducing sugar percentage was determined according to Nelsons Modifications of Somogy is Method (Somogyi, 1952). The experimental data were statistically analyzed by applying "Analysis of Variance" technique for factorial randomized block design. The standard error of mean (SEm ±) and critical difference (CD) at 5 per cent significance level were worked out for each parameter.

RESULTS AND DISCUSSION

Effect of potassium

Potassium fertilizer had positive effect on sweet potato shown in (Table 1). The highest values of qualitative characters (total soluble solids, carotenoids content, ascorbic acid, dry weight of tuber, total nitrogen, crude protein content, reducing sugar and non- reducing sugar) were recorded by the treatment that

Table 1: Effect of potassium fertilizer and foliar zinc application on the quality of sweet potato

Treatment	Total soluble solids (ºBrix)	Dry matter of tuber (%)	Ascorbic acid content (mg/100g)	Carotenoids content (mg/100g)(%)	Nitrogrn (%)	Crude protein	Reducing sugar (%)	Non-reducing sugar (%)
Potassium								
0 kg	8.83	34.5	14.48	2.53	1.51	9.48	8.08	5.03
80 kg	9.34	35.09	14.99	2.85	1.59	9.99	9.89	5.35
100 kg	10.22	35.89	15.87	3.12	1.74	10.87	12.6	5.62
120 kg	11.58	37.25	17.23	3.48	1.95	12.23	14.08	5.98
S.Em±	0.05	0.12	0.11	0.01	0.02	0.09	0.07	0.01
C.D. at 5%	0.13	0.35	0.33	0.03	0.04	0.25	0.21	0.03
Zinc								
0 ppm	9.01	34.68	14.66	2.86	1.54	9.66	10.34	5.36
10 ppm	9.92	35.59	15.57	2.95	1.69	10.57	11.05	5.45
20 ppm	10.08	35.75	15.73	3.05	1.71	10.73	11.56	5.55
30 ppm	10.96	36.72	16.61	3.12	1.86	11.61	11.74	5.65
S.Em±	0.05	0.12	0.11	0.01	0.02	0.09	0.07	0.01
C.D. at 5%	0.13	0.35	0.33	0.03	0.04	0.25	0.21	0.03

Table 2: Effect of interaction between potassium fertilizer and foliar zinc application on the quality of sweet potato

Treatment	Total soluble solids (ºBrix)	Dry matter of tuber (%)	Ascorbic acid content (mg/100g)	Carotenoids content (mg/100g)	Nitrogen (%)	Crude protein (%)	Reducing sugar (%)	Non-reducing sugar (%)
$K_0 Zn_0$	7.33	33	12.98	2.36	1.27	7.93	7.84	4.86
$K_0 Zn_1$	7.72	33.39	13.37	2.49	1.34	8.37	7.93	4.99
$K_0 Zn_2$	9.46	35.13	15.11	2.61	1.61	10.11	8.26	5.11
$K_0 Zn_3$	10.81	36.48	16.46	2.67	1.83	11.46	8.31	5.17
$K_1 Zn_0$	8.89	34.56	14.54	2.75	1.52	9.54	9.14	5.25
$K_1 Zn_1$	10.23	35.9	15.88	2.82	1.74	10.88	9.32	5.32
$K_1 Zn_2$	8.55	34.22	14.2	2.89	1.47	9.2	10.47	5.39
$K_1 Zn_3$	9.69	35.7	15.34	2.93	1.65	10.34	10.67	5.43
$K_2 Zn_0$	8.59	34.26	14.24	3.03	1.47	9.24	10.74	5.53
$K_2 Zn_1$	10.43	36.1	16.08	3.09	1.76	11.08	12.97	5.59
$K_2 Zn_2$	10.9	36.57	16.55	3.14	1.84	11.55	13.26	5.64
$K_2 Zn_3$	10.96	36.63	16.61	3.23	1.89	11.61	13.45	5.73
$K_3 Zn_0$	11.25	36.92	16.9	3.30	1.9	11.9	13.6	5.8
$K_3 Zn_1$	11.29	36.96	16.94	3.42	1.91	11.94	13.96	5.92
$K_3 Zn_2$	11.39	37.06	17.04	3.55	1.92	12.04	14.26	6.05
$K_3 Zn_3$	12.39	38.06	18.04	3.64	2.08	13.04	14.52	6.14
S.Em±	0.14	0.09	0.24	0.22	0.03	0.17	0.15	0.02
C.D. at 5%	0.40	0.26	0.70	0.65	0.09	0.50	0.42	0.07

received 120 kg K_2O/ha. Among the major nutrients, potassium is required in high amounts due to its important role on plant physiology. K contributes to many aspects, for example it stimulates enzyme activities, promotes protein synthesis, improves photosynthesis, supports osmoregulation, regulates opening and closure of stomata and participate nutrients translocation (Marschner, 1995 and Mengel, 2007). With regard to these functions, an adequate supply of K in the sweet potato to plant dictates improvements of tubers quality. Potassium has a crucial role in promoting synthesis of photosynthates and their transport to the tubers, and enhancse their conversion into starch, protein and vitamins (Mengel and Kirkby, 1987). The above findings are in accordance to the results reported by El-Hadidi and Mansour (2008) in sweet potato, Tiwari, *et al*. (1982) and Al-Shevsku, (1990) in potato.

Effect of zinc

Data presented in Table (1) revealed that foliar application of zinc (30 ppm) significantly increased the total soluble solids, carotenoids content, dry weight of tuber, ascorbic acid, total nitrogen, crude protein content, reducing sugar and on-reducing sugar in tuber as compared to the control. Zn is vital to the crop nutrient as it plays a structural constituent or regulatory co- factor of a wide range of different enzymes and proteins in many important biochemical pathways and these are mainly concerned with carbohydrate metabolism, both in photosynthesis and in the conversion of sugars to starch, protein metabolism, auxin metabolism, pollen formation and the resistance to infection by certain pathogens (Alloway, 2008). Zinc is a key constituent of many enzymes and proteins. Early development of tubers is also influenced by Zn. In the process of cell differentiation after flowering high levels of IAA or Zn in the plant increases cell differentiation. (Cakmak, 2000).These results are in harmony with those obtained by Abd El-Baky *et al*. (2010) in sweet potato, Ahmed *et al*. (2011) in potato, Choudhary e*t al*. (2014) in soyabean, Parmar *et al*. (2016) in potato.

Effect of interaction

The effect of interaction between potassium and zinc are presented in (Table 2). The interaction showed that increasing rate of both potassium fertilizer (from 0 to 120 kg K_2O/ha) and zinc application (from 0 to 30 ppm Zn) resulted in a positive effect on qualitative characters of sweet potato. Generally, the highest value of interaction effect were recorded with treatments that received 120 kg K_2O/ha with 30 ppm Zn. whereas, the lowest values were obtained with low potassium level (0 kg K_2O/ha) with control of zinc (0 ppm Zn), In light of the foregoing results it is inferred that at optimum supply, the interactive effect of K and Zn would be positive. Optimum K supply to soil would favour the absorption and translocation of Zn in plant and ultimately enhances the efficiency of zinc fertilizer. These findings are also corroborated with the findings as reported by El-Hadidi and Mansour, (2008) and Abda El-baky *et al*. (2010) in sweet potato and Tiwari, *et al*. (1982) in potato.

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