Journal of Root Crops, 2012, Vol. 38 No. 1, pp. 78-80
Indian Society for Root Crops
ISSN 0378-2409

Effect of K and Na Interaction on Yield and Yield Attributes of Chinese Potato (*Plectranthus rotundifolius*)

Potassium is one of the major nutrients required for the growth of all plants. Root and tuber crops, especially, have a high requirement for K compared to cereals. It plays a key role in the root yield of tuber crops by increasing photosynthetic efficiency. Sodium is reported to be essential only for obligate halophytes. Even though Na is not considered as an essential element for higher plants, beneficial effects have been reported in many plants by application of Na salts, especially in soils with low K status. Tisdale et al. (1992) reported that under limited K supply, Na can perform some of the normal functions of K such as maintenance of ionic balance, which is necessary for physiological processes. It was observed by Ivahupa et al. (2006) that Na ameliorated symptoms of K deficiency and increased growth in tuber crops like tannia and sweet potato.

Chinese potato (*Plectranthus rotundifolius*) is a minor tuber crop grown in the tropics, especially in India and Srilanka. It has a comparatively high requirement of K than the other elements. But K fertilizer (muriate of potash) is being imported in India and therefore is costly. Hence it was imperative to find out a cheaper and indigenous material, which can be used as a substitute for muriate of potash. Studies conducted earlier by Sudharmaidevi and Padmaja (1999) in cassava have shown that Na (as common salt) used as a partial substitute for K (as muriate of potash) increased yields of cassava tubers. Hence a study was undertaken to find out the effects of interaction of K and Na on the growth performance of Chinese potato. The effect of K: Na interaction on yield and yield attributes of Chinese potato is discussed in this paper.

A field investigation was carried out at College of Agriculture, (Kerala Agricultural University) Vellayani in Chinese potato var. Sree Dhara. There were seven treatments and three replications in Randomized Block Design. All possible combinations of K @ 50 and 100 kg ha^{-1} and Na @ 50, 75 and 100 kg ha^{-1} were tested along with the control (full recommended dose of K @ 100 kg ha^{-1}). Potassium was supplied as muriate of potash (50% K) and Na was supplied as common salt (39.3% Na). Cattle manure, N and P were applied uniformly in all plots @ 10 t ha^{-1}, 60 kg ha^{-1} and 60 kg ha^{-1} respectively. The soil of the experimental site (Rhodic Haplustult) was acidic in reaction (pH 5.6) with an electrical conductivity of 0.01 dS m^{-1}. Texture of the soil was sandy loam with medium status of available N and K and high status of available P. Number and weight of tubers per plant were recorded at harvest. Tuber index was calculated as the number of tubers required to get 1 kg tuber weight. Starch content of the tuber was estimated as per the procedure described by Chopra and Kanwar (1976).

Significant variation was observed in tuber yield and yield attributes (Table 1). The highest yield was obtained from the treatment, K and Na in 50:50 combination, followed by 50:75 combination. The yield from 50:50 combination was superior to that of 100% K (alone) treatment revealing a synergistic effect of K and Na interaction. Application of Na stimulated the growth of wheat, rice, spinach, sugar beet, red beet, swiss chard, turnip, cabbage, cotton and some other crops (reviewed in Wakeel et al., 2011). Na can alleviate K deficiency to a certain extent and can partially replace K, particularly in its osmotic functions in the vacuole. Thus, Na can promote plant growth even when K is deficient or not. Yield increase when K and Na were given in combination has also been reported by several investigators (Aslam, 1975; Isroismail, 2007). In the present study, in plants treated with K alone, such a synergistic effect could not be observed, which resulted in lower growth rate and tuber yield. Number of tubers also varied significantly among treatments (Table 1). The treatment, 100% K: 100% Na resulted in the greatest number of tubers per

Table 1. Effect of K: Na interaction on yield, yield attributes and starch content of Chinese potato

Treatments	Number of tubers per plant	Weight of tuber (g $plant^{-1}$)	Tuber index	Tuber yield (t ha^{-1})	Starch content (%) (FW basis)
100% K alone	50	216.00	230	24.00	20.87
50% K + 50% Na	57	275.47	207	30.60	23.13
50% K + 75% Na	59	270.00	217	30.00	18.33
50% K + 100% Na	62	263.67	237	29.30	18.37
100% K + 50% Na	52	227.93	228	25.33	17.93
100% K +75% Na	66	197.10	335	21.90	23.30
100% K + 100% Na	75	223.67	336	25.33	16.93
CD (0.05)	4.55	13.12	12.2	6.25	3.83

plant. Even though the number of tubers was the highest, the weight of tubers per plant was lower in this treatment. This indicated that the size of the tubers became smaller when higher levels of Na were included in the treatment. Attenburrow and Waller (1980) also reported that with increasing NaCl concentration and conductivity, fruit quality of tomato improved, but fruit size declined. The weight of tuber per plant was higher in all the plots that received 50% K in combination with different levels of Na. Tuber index also varied with treatments and the treatment 50% K: 50% Na resulted in the lowest tuber index. As this treatment produced good quality tuber there was less number of tubers to make one kilogram weight. The highest tuber index was observed in the treatment 100% K: 100% Na. This indicated that whenever the Na content in the treatment was above 50% the tubers became smaller which ultimately led to lower tuber weight. The starch content of tuber also differed significantly among treatments. The highest starch content was obtained from the plants that received 100% K and 75% Na. This was followed by the treatment 50% K: 50% Na. Sudharmaidevi and Padmaja (1996) also reported that there was stimulation in starch production of cassava tubers, when 50% K was replaced with Na of common salt. Sharma and Singh (1992) also reported that addition of Na in the culture medium could compensate for K-deficiency effect on sugars, starch and N fractions in cabbage leaves. But in a similar study conducted in cassava, Susan John et al. (2007) could not observe significant difference in starch content of tubers with or without substitution. In the present study this beneficial interaction for production of starch could be obtained up to 75% Na level, but beyond that an adverse effect was observed. This may be due to degradation of starch under high Na level as observed by Amirjani (2011) in rice. He reported that the activity of sucrose phosphate synthase, acid invertase and starch phosphorylase increased due to exposure to salinity and the increased activity of starch phosphorylase under salinity resulted in starch degradation and mobilisation of sugars. From this study it can be concluded that application of Na and K at 50:50 combination can stimulate starch synsthesis and increase the tuber yield in Chinese potato.

References

Amirjani, M.R 2011. Effect of salinity stress on growth, sugar content, pigments and enzyme activity of rice. *Int. J. Bot.*, 7(1): 73-81.

Aslam, M. 1975. Potassium and sodium interrelations in growth and alkali cation content of safflower. *Agron. J.,* **67**: 262-264.

Attenburrow, D.C. and Waller, P.L. 1980. Sodium chloride: Its effect on nutrient uptake and crop yields with tomatoes in NFT (nutrient film technique). *Acta Hort.*, **98**: 229-236.

Chopra, S.L. and Kanwar, J.S. 1976. *Analytical Agricultural Chemistry*. Kalyani Publishers, Ludhiana, New Delhi. 329p.

Isroismail. 2007. Application of Na and partial substitution of K-Na in different varieties of sugarcane planted on inceptisol soil. *Sugar Tech.*, **9** (4): 256-262.

Ivahupa, S. R., Asher, C.J., Blamey, F.P.C. and O'Sullivan, J.N. 2006. Effects of sodium on potassium nutrition in three tropical root crop species. *J. Pl. Nutr.*, **29** (6):1095-1108.

Sharma, C.P. and Singh, S. 1992. Sodium ameliorates the effect of potassium deficiency in cauliflower leaves. *Hort. Sci.*, **27** (11): 1203-1205.

Sudharmaidevi, C.R. and Padmaja, P. 1996. Effect of partial substitution of muriate of potash by common salt on the tuber quality parameters of cassava (*Manihot esculenta* Crantz). *J. Root Crops,* 22 (2): 23-27.

Sudharmaidevi, C.R. and Padmaja, P. 1999. Effect of K and Na applied in different proportions on the growth, yield and nutrient content of cassava (*Manihot esculenta* Crantz). *J. Indian Soc. Soil Sci.,* **47** (1): 84 – 89.

Susan John, K., Venugopal, V.K. and Manikantan Nair, M. 2007. Dry matter production, nutrient uptake, tuber quality and soil nutrient status as influenced by substitution of common salt for muriate of potash for cassava in an oxisol of Kerala, *J. Root Crops*, **33** (1): 20-25.

Tisdale, S.L., Nelson, W.L. and Beaton, J.D. 1992. *Soil Fertility and Fertilizers.* Mac Millan Publishing Company, New Delhi, pp.392-393.

Wakeel, A., Farooq, M., Qadir, M. and Schubert. S. 2011. Potassium substitution by sodium in plants. *Critical Rev. Plant Sci.*, **30**: 401–413.

S. Neenu [1]
C.R. Sudharmaidevi[2]

[1] Division of Soil Chemistry and Fertility,
Indian Institute of Soil Science, Nabibagh,
Berasia Road, Bhopal 462 038,
Madhya Pradesh, India

[2] Department of Soil Science and Agricultural Chemistry,
College of Agriculture, Vellayani,
Thiruvananthapuram 695 522, Kerala, India
Corresponding author: S.Neenu,
e-mail: neenusibi@gmail.com

Received: 24 March 2011; Accepted: 30 May 2012