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RESPONSE OF MINERALS ACCUMULATION IN CUCUMBER AND YARD LONG BEAN IN RESPECT OF SOIL SALINITY

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ABSTRACT

A study was conducted to produce saline tolerant vegetables with their mineral constituents for nutritional security during July 2020 to June 2021. Edible portions of cucumber and yard long bean were collected from each of the three locations of Borguna and Patuakhali districts. Soils of each location were collected to detect pH and EC values. Sawdagarpara, Taltoli, Borguna district and Pakhimara, Khepupara, Patuakhali districtwere selected as saline area and Dumki, Patuakhali was remarked as non-saline area on the basis of soil salinity. It is noted that the soils of Borguna generally contains high saline in dry season; but during the sampling period the soil at Sawdagarpara observed moderately saline (EC value 6.2 dS m^{-1}). The vegetable were also analyzed to detect P, K, Ca, Mg and S contents. In saline area cooperatively lower accumulation of P and higher accumulations of K, Ca, Mg and S were found in the vegetable than that of non-saline area. This year the soil salinity did not raise as high levels as the other years and this might be due to the higher rainfall. Therefore, the discussed vegetable could be grown in saline area for sufficient mineral compositions. Considering the achieved findings the studied vegetables can tolerate moderate salinity (soil EC up to 6.2dSm^{-1}) and they can be recommended to grow commercially in the study area for nutritional security. The trend of minerals accumulation in the vegetable was Ca>Mg>P>K>S. On the basis of total minerals content the trend of vegetable was found as Cucumber> yard long bean.

Key words: Salinity, vegetable crops, nutritional security, coastal region

Introduction

Vegetables are sources of minerals and vitamins. There is acute scarcity of vegetables in the south central coast of Bangladesh. Vegetables are to bring from other parts of the country to meet up the daily requirement in southern coastal region. Traditional indigenous vegetables are the most economically efficient source of micro nutrients in terms of both land required and production costs per unit area. Promotion of production and consumption of nutrients (Fe, Ca, Mg, K, P, S, Vit-A, Vit-C etc.) enriched vegetable will improve intakes, the overall diet, and health status. Traditional indigenous vegetables are the most economically efficient source of micronutrients in terms of both land required and production costs per unit. Promotion of production and consumption of such micronutrient (iron, calcium, vitamin A and ascorbic acid) rich foods will improve intakes, the overall diet, and health status (Mwanri *et al*., 2011). Vegetables are important for food security in Bangladesh. Nearly 100 different types of vegetables, comprising both local and exotic types, are grown in Bangladesh. However, the availability of vegetables is only about 20 percent of the recommended requirement of 200 g/person/day. Landless and marginal farmers are the most disadvantaged and vulnerable group suffering from insecurity of food and nutrition. Again, bbout 2% of the lands farmed by dry-land agriculture, and more than 45 million hectares of irrigated land (at least 20% of total irrigated acreage) have already been damaged by salt (Lauchli, and Munns, 2008).

High salinity affects plants in several ways: water stress, ion toxicity, nutritional disorders, oxidative stress, alteration of metabolic processes, membrane disorganization, reduction of cell division and expansion, genotoxicity (Hasegawa *et al*. 2000 and Zhu, 2007). The tolerance of plants to salinity is mainly influenced by climate, particularly the abundance or lack of rainfall to leach salts from soils, soil types and drainage characteristics within the root zone which influence the ease of leaching and salt accumulation (Lindsay

Evans, 2006). Salinity is an ever-present threat to crop yields, especially in countries where irrigation is anessential aid to agriculture. Although the tolerance of saline conditions by plants is variable, crop species are generally intolerant of one-third of the concentration of salts found in seawater (Flowers, 2004). High soil salinity can also cause nutrient imbalances, result in the accumulation of elements toxic to plants, and reduce water infiltration if the level of one salt element sodium is high. Climate and irrigation also influence salinity tolerance. Generally, fruits, vegetables, and ornamentals are more salt sensitive than forage or field crops. Climate and irrigation also influence salinity tolerance. As soil dries, salts become concentrated in the soil solution, increasing salt stress. Therefore, salt problems are more severe under hot, dry conditions than under cool, humid conditions (Tanji, 1990).

Cucumbers are low in calories but high in many important vitamins and minerals, it contains antioxidants, promotes hydration, may aid ineight loss, may lower blood sugar and could promote regularity. The objectives of the present study were to investigate the salinity tolerance of cucumber and yard long bean and their mineral accumulations for nutritional security in the southern coastal areas of bangladesh.

Materials and Methods

Sampling sites: Vegetable and soils were collected during July 2020 to June 2021 from Sawdagarpara, Taltoli of Borguna district as well as Pakhimara and Dumki of Patuakhali district. Edible portions of cucumber and yard long bean were collected. The samples were brought to the laboratory, processed and reserved accordingly for analyses.

Analytical Methods for soil sample

pH: pH of the soil samples was determined in the Laboratory of Agricultural Chemistry, Patuakhali Science and Technology University (PSTU) by glass electrode pH meter (Ghosh *et al.*, 1983 and Jackson, 1962) as 7.4 for Sawdagarpara as well as 7.3 and 7.1 for Pakhimara and Dumki, respectively.

Electrical conductivity (EC): The electrical conductivity of collected soil samples was determined electrometrically (1:5, soil: water ratio) by a conductivity meter (Tandon, 1995) as 6.2 dSm^{-1} for Sawdagarpara as well as 3.8 and 0.9 dSm^{-1} for Pakhimara and Dumki, respectively.

Chemical analyses of vegetable sample were done for different mineral constituents: The samples were analyzed for P, K, Ca, Mg and S following the standard methods generally practiced in the laboratory. This was done in the Departmental Laboratory of Agricultural Chemistry and Central Laboratory, PSTU, Dumki, Patuakhali.

Analytical Methods for soil and vegetable samples

Table 1. Analytical Methods of soil and vegetable samples for pH, EC and mineral compositions

Parameter	Extraction method/ Reagent		Instrument	Reference
	Vegetables	Soil		
pH	-	1:2.5 (Soil: Distilled water)	pH meter	Jackson (1973)
EC (dSm^{-1})	-	1:5 (Soil: Distilled water)	EC meter	Ghosh *et al*. (1983)
Ca and Mg (mg kg^{-1})	Di acid mixture	1N NH_4OAc (pH 7.0)	Complexometric titrarion	Page *et al*. (1982); APHA (2005)
K	Di acid mixture	1N NH_4OAc (pH 7.0)	Flame emission spectrophotometer	(Page *et al*.,1982)
P (mg kg^{-1})	Di acid mixture	0.5M $NaHCO_3$ solution (pH 8.5)	Spectrophotometer	Olsen *et al*., 1954; (Page *et al.*, 1982); Jackson (1973)
S (mg kg^{-1})	Di acid mixture	$CaCl_2$ (0.15%)	Spectrophotometer	Tandon (1995)

Statistical analysis: The statistical analysis of data obtained from chemical analyses was performed following the statistical package for agricultural research as described by Gomez and Gomez (1984).

Results and Discussion

Accumulations of Ca, K, P, Mg and S in cucumber: The accumulations of Ca and K in cucumber were ranged from 9860.5-10680.5 and 31503.4-33553.0 $MgKg^{-1}$, respectively. The highest accumulations of Ca and K in cucumber were found at the highest EC level (EC 6.2 dSm^{-1} at Sawdagarpara) and the lowest was observed at Dumki (Fig. 1). Cucumber accumulated remarkably high amount of K and this might be due to its salinity tolerance. The accumulations of P, Mg and S in cucumber were ranged from 3400.28-3640.23, 3690.5-3800.4 and 4552.3-4700.2 $MgKg^{-1}$, respectively. The maximum accumulation of both Mg and S was found at the highest EC level (EC 6.2 dSm^{-1} at Sawdagarpara) and the lowest was observed at the lowest EC level (EC 0.9 dSm^{-1} at Dumki). In respect of P accumulation the vice-versa case was observed. The maximum accumulation of P was found at the lowest EC level (EC 0.9 dSm^{-1} at Dumki) and the lowest was at the highest EC level (EC 6.2 dSm^{-1} at Sawdagarpara) (Fig. 2). In cucumber the trend of mineral accumulation was K> Ca> Mg> S >P.

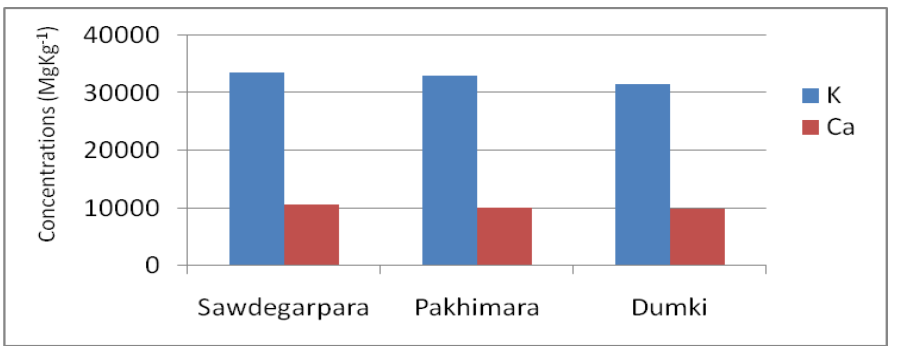

Fig. 1. Minerals in cucumber at different areas

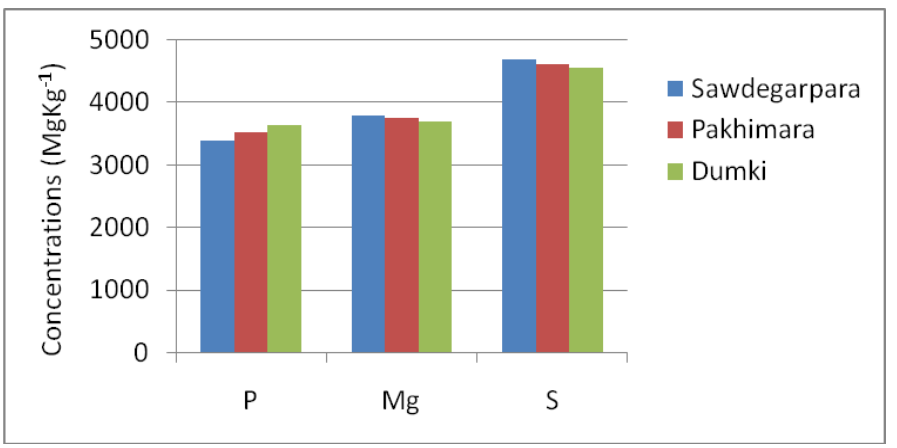

Fig. 2. Minerals in cucumber at different locations

Salinity is considered as one of the main stress factors, which impact the horticultural crops. The obtained results indicated an increase in free radical scavenging capacity in grafter cucumber under salinity stress, which helps in the maintenance of the cellular membrane under stress conditions. The effect can be correlated with better protection mechanisms in the grafted plant due to increased activity of antioxidant enzymes, endogenous phytohormones, and stimulated by the deviation in the expression level of studied genes which improved the defense mechanism against oxidative damage due to salinity (Nabil I. Elsheery *et al*., 2020).

Accumulations of Ca, K, P, Mg and S in Yard long bean: The accumulations of P, Ca and Mg in yard long bean were ranged from 5116.5-5400.3, 10224.8-11182.6 and 11972.6-12562.4 $MgKg^{-1}$, respectively. The highest accumulation of Ca in yard long bean was found at the lowest soil EC level (EC 0.9 dSm^{-1} at Dumki) and the lowest was observed at lower EC level (EC 3.8 dSm^{-1} at Pakhimara). The maximum accumulation of Mg in yard long beanwas found at the highest soil EC level (EC 6.2 dSm^{-1} at Sawdagarpara) and the lowest was observed at the lowest EC level (EC 0.9 dSm^{-1} at Dumki). The highest uptake of P was found at the lowest soil EC level (EC 0.9 dSm^{-1} at Dumki) and the lowest was observed at Sawdagarpara (Fig. 3). It was observed that Ca accumulation in yard long bean was exception than the other vegetable. This might be due to the physiological activity of yard long bean, variation of cultivation procedure, gypsum fertilizer application in the respective field and other environmental conditions. The accumulations of both K and S in yard long bean were ranged from 69.6-83.4and 809.1-878.2 $MgKg^{-1}$.

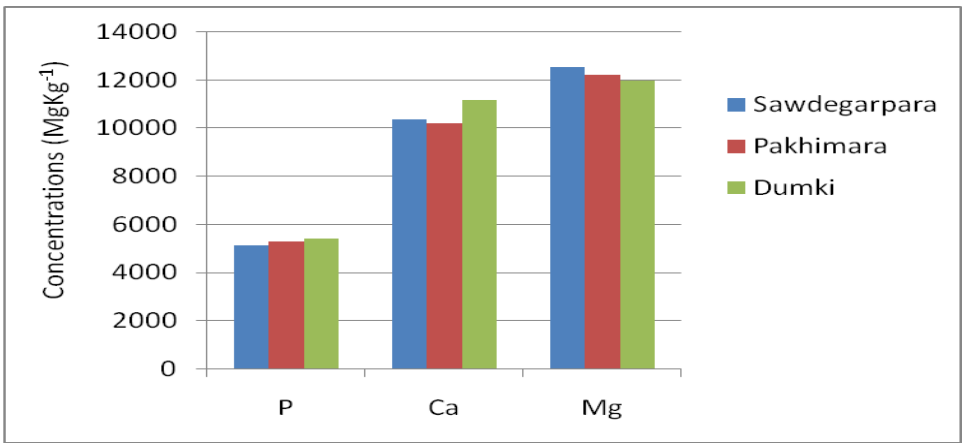

Fig. 3. Minerals in yard long bean at the study areas

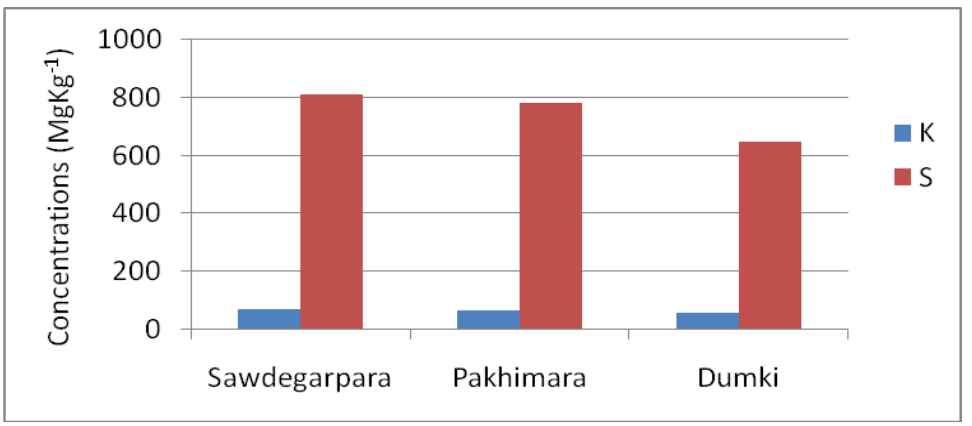

Fig. 4. Minerals in yard long bean at the study areas

The maximum accumulation of both K and S was found at the highest EC level (EC 6.2 dSm^{-1} at Sawdagarpara) and the lowest was observed at the lowest EC level (EC 0.9 dSm^{-1} at Dumki) (Fig. 4). Most of the minerals were accumulated higher at the highest EC level might be due to their salt tolerance capability at moderate salinity. In yard long bean the trend of mineral accumulation was Mg> Ca>P>S>K.

Conclusion

Cucumber accumulated remarkably high amount of K than other elements and this might be due to its salinity tolerance and crop physiology. In cucumber the trend of mineral accumulation was exceptional like K> Ca> Mg> S >P. It was observed that Ca accumulation in yard long bean was exception than the other vegetable. The maximum Ca accumulation was found at non saline soil of Dumki. It might be due to gypsum application or physiological cause. Most of the minerals were accumulated higher at the highest EC level might be due to their salt tolerance capability at moderate salinity. On the basis of total minerals content the trend of vegetable was found as cucumber> yard long bean. The trend of minerals accumulations was Mg> Ca> P>S>K in yard long bean.

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