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# SALINE TOLERANCE OF VINE VEGETABLE CROPS GROWN IN SOUTHERN COASTAL REGION FOR NUTRITIONAL SECURITY

**A. K. M. Faruk-E-Azam[1]* and M. F. Hasan[2]**
[1]Department of Agricultural Chemistry, [2]Department of Horticulture
Patuakhali Science and Technology University, Dumki, Patuakhali-8602
*****Corresponding author's e-mail: azampstu@yahoo.com

**ABSTRACT**

A study was conducted on saline tolerant vegetables with their mineral constituents for nutritional security during July 2020 to June 2021. Edible portions of bottle gourd, sweet gourd, sponge gourd, snake gourd and ridge gourd were collected from three selected locations of Borguna and Patuakhali districts. The locations were Sawdagarpara of Borguna district as well as Pakhimara of Khepupara upazilla and Dumki of Patuakhali district. 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 $m^{-1}$) and this might be due to high rainfall during the study year. The vegetable were analyzed for P, K, Ca, Mg and S. In saline area cooperatively lower accumulation of P and higher accumulations of K, Ca, Mg and S were found in most of the vegetable than that of non-saline area. 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 value up to 6.2dS$m^{-1}$) and they can be recommended to grow commercially in the study area for nutritional security. The trend of minerals accumulation in most of the vegetable was Ca>Mg>P>K>S. On the basis of total minerals content the trend of vegetable was found as bottle gourd>ridge gourd>snake gourd>sponge gourd> sweet gourd.

**Key words:** Salinity, vine vegetable crops, coastal region

## Introduction

The southern coastal area is facing disaster frequently. One and half million hectares are taken out of production each year as a result of high salinity levels in the soil (Munns and Tester, 2008). The salt-laden soils alone have significant global dimension as about one billion hectares spread in more than 100 countries are suffering from this abiotic stress (Banyal *et al*., 2019). Vegetables are to bring from other parts of the country to meet up the daily requirement in southern coastal region. In Bangladesh, the average per capita daily vegetable intake is 56g, whereas the recommended intake is 250g per day (FAO, 2015). Few research works have been conducted to evaluate the mineral composition and potentiality of vegetables. The Production of vegetables particularly soil and water management, fertilizer application, cultural practices, controlling pest etc. are not yet standardized here in coastal area. Little or no useful information about saline tolerant vegetable production in the southern coastal area exists and there is an obvious need for research (Shannon and Grieve, 1999). Considering the importance of vegetable in alleviating the problem of micronutrient deficiencies and in view of the need to increase the production of vegetables by all possible means some research activities were initiated by BARI during the early eighties to find out ways to boost vegetable production in the homesteads (Rahman, 2008). Bottle gourd is a vegetable high on water and is a rich source of Vitamin C, K and Ca. It helps in maintaining a healthy heart and brings down bad cholesterol levels. *(https://food.ndtv.com › food-drinks › 7-incredible-benefit..)*. Sweet gourd is highly nutritious and particularly rich in vitamin A. Eating pumpkin can help to look younger (beta-carotene in pumpkin helps protect us from the sun's wrinkle-causing UV rays), but the pulp also makes a great, all-natural face mask that exfoliates and soothes. Sponge gourd is quite lower in immersed fats as well as calories. It contains high amounts of dietary fiber, vitamin C, riboflavin, zinc, thiamine, iron, and magnesium (March 2017, https://you.stonybrook.edu› thetrivedieffect › 2017/03/15). Ridge gourd is one of the very low calorie vegetables- carrying just 15 calories per 100 g and contains 94% moisture. It is low in saturated fat, cholesterol and calories that aids in weight loss. It contains a low amount of carb and has insulin such as peptides and moreover, it is hypoglycemic, which helps maintain the blood sugar levels.

Hence, ridge gourd is an ideal vegetable for controlling diabetes (Yashaswi Pathakamuri, 2020; https://www.nutritionfact.in/nutrition-facts/ridge-gourd-benefits-and-nutritional-facts). Like most flora of the gourd family, the snake gourd vegetables, seeds, leaves and juice extracts are enriched with a multitude of crucial fundamental dietary components like carbohydrates, fats, proteins and fibers, vital trace compounds such as Vitamin A, Vitamin B6, Vitamin C and Vitamin E and minerals and a host of plant substances including phenolic compounds and cucurbitaceous (https://www.netmeds.com/health-library/post/snake-gourd-health-benefits-nutrition-uses-for-skin-and-hair-recipes-side-effects). Considering the importance of vegetable in alleviating the nutritional problem the best nutrient containing vegetable should be selected. In coastal saline area micronutrient content is hampered due to salinity but it is unclear how salinity affects the uptake of micronutrients. The objectives of the present study were to investigate the salinity tolerance of vine vegetable crops and their mineral compositions for nutritional security in the southern coastal area.

## 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 five vine vegetable such as bottle gourd, sweat gourd, sponge gourd, snake gourd and ridge gourd were collected. The samples were brought to the laboratory, processed and reserved accordingly.

### *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 vine vegetables 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) |
| 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) |
| K | Di acid mixture | 1N $NH_4OAc$ (pH 7.0) | Flame emission spectrophotometer | (Page et al.,1982) |
| Ca and Mg (mg $kg^{-1}$) | Di acid mixture | 1N $NH_4OAc$ (pH 7.0) | Complexometric titrarion | Page *et al*. (1982); APHA (2005) |
| 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

**Bottle gourd:** The accumulations of P, K, Ca, Mg and S were ranged from 3122.6-3423.5, 102.2-133.3, 12024.4-14030.2, 21875.5-25623.9 and 810.6-913.4 $MgKg^{-1}$, respectively. Bottle gourd accumulated the maximum P and S at Dumki (EC 0.9 $dSm^{-1}$) and the lowest P and S both were found at Sawdagarpara (EC 6.2$dSm^{-1}$). The uptake of K, Ca and Mg was observed maximum at Sawdagarpara ([1]EC 6.2$dSm^{-1}$) and the minimum was present in bottle gourd grown in non saline soil at Dumki (EC 0.9$dSm^{-1}$). Salinity reduced the accumulations of P and S in bottle gourd (Figs.1-2).

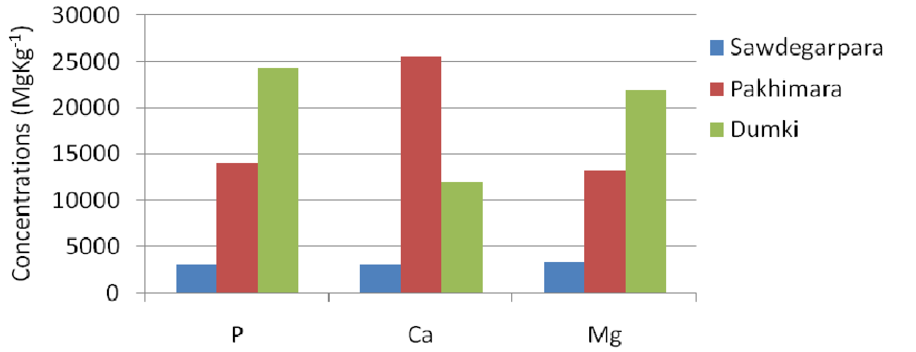


Fig. 1. Mineral constituents of bottle gourd at different locations of Barguna and Patuakhali districts

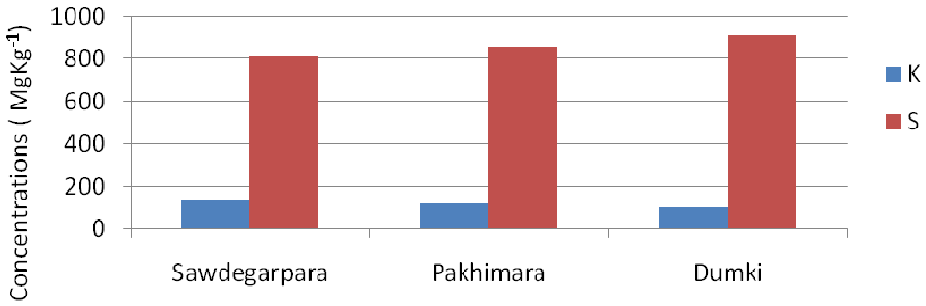


Fig. 2. Mineral constituents of bottle gourd at different locations of Barguna and Patuakhali districts

Most of the minerals were accumulated higher at the highest EC level might be due to their salt tolerance capability at moderate salinity. In bottle gourd the trend of mineral accumulation was Mg> Ca> P>S>K. Consequently Bernstein (1962) suggested that for most vegetable crops the salt-tolerance would be 2$dSm^{-1}$greater in a sulphate system as opposed to chloride system. Salinity can directly affect nutrient uptake, such as Na reduces K uptake (Grattan and Grieve, 1999).

**Sweet gourd:** The accumulations of P, Ca and Mg in sweet gourd were ranged from 3324.8-3612.3, 4634.8-5458.5 and 4823.0-5921.7 $MgKg^{-1}$, respectively. Accumulations of Ca and Mg in sweet gourd were increased with highest EC level (EC 6.2 $dSm^{-1}$ at Sawdagarpara). The concentration of P was found highest at lowest soil EC level (EC 0.9 $dSm^{-1}$ at Dumki) (Fig. 3). The accumulations of K and S sweet gourd were ranged from 82.4-103.2 and 753.2-930.6 $MgKg^{-1}$.

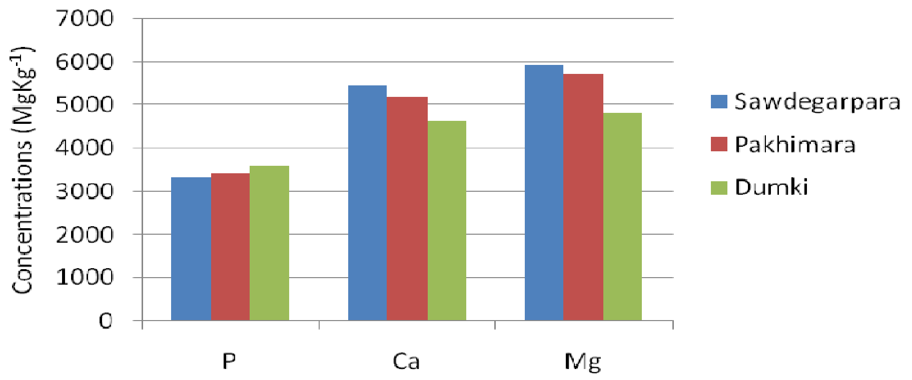


Fig. 3. Mineral constituents of sweet gourd at the study areas

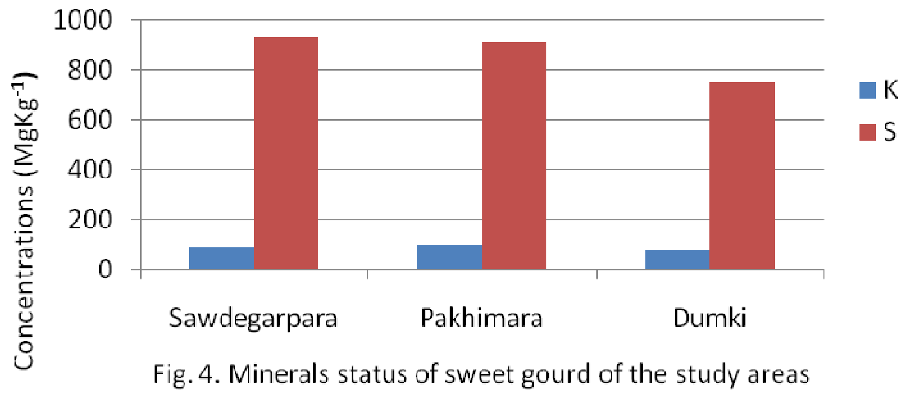


Fig. 4. Minerals status of sweet gourd of the study areas

The highest accumulation of K was found at lower EC level (EC 3.8 $dSm^{-1}$ at Pakhimara) and the lowest was observed at the lowest EC level (EC 0.9 $dSm^{-1}$ at Dumki). The highest accumulation of S was found at the highest EC level of soil (EC 6.2 at Sawdagarpara) and the lowest was found at Dumki (Fig. 4). In sweet gourd the trend of mineral accumulation was Mg>Ca>P>S>K as like as bottle gourd.

**Sponge gourd:** The accumulations of P, Ca and Mg in sponge gourd were ranged from 3285.6-3432.2, 13822.2-14832.6 and 14852.5-15622.6 $MgKg^{-1}$, respectively. The maximum accumulations of both Ca and Mg in sponge gourd were found at the highest EC level (EC 6.2 $dSm^{-1}$ at Sawdagarpara) and the lowest was observed at Dumki. The highest amount of P was uptake by sponge gourd at low salinity level in Pakhimara (EC 3.8) and the lowest was found at the highest EC level (Sawdagarpara) (Fig. 5). Sponge gourd accumulated high amount of P, Ca and Mg than other elements. The accumulations of P and S in sponge gourd were ranged from 88.7-129.8 and 882.7-963.3 $MgKg^{-1}$. The maximum accumulations of both K and S were found at the highest EC level (EC 6.2 $dSm^{-1}$ at Sawdagarpara) and the lowest was observed at non saline area (EC 0.9 $dSm^{-1}$ at Dumki) (Fig. 6). In sponge gourd the trend of mineral accumulation was Mg> Ca> P > S > K. Gourds are tolerant to salinity, while onion, tomato and chilli are susceptible to this abiotic stress factor. The hybrids of these vegetable crop species which tolerate high levels of NaCl in seedling stage, have a great potential under saline prone areas (Maiti *et al.*, 2010).

**Ridge gourd:** The accumulations of P, Ca and Mg in ridge gourd were ranged from 3612.3-3899.8, 13889.5-14822.4 and 13932.1-14622.9 $MgKg^{-1}$, respectively. The maximum accumulations of both Ca and

Mg in ridge gourd were found at the moderate salinity level (EC 6.2 $dSm^{-1}$ at Sawdagarpara) and the lowest was observed at Dumki. The highest amount of P was uptake by ridge gourd at non saline area (EC 0.9 at Dumki) and the lowest was found at the highest EC level (EC 6.2 $dSm^{-1}$ at Sawdagarpara) (Fig. 7).

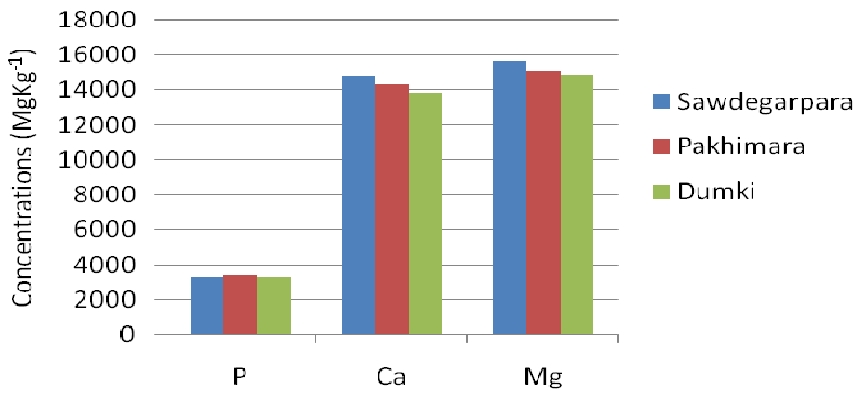


Fig. 5. Minerals in sponge gourd at the study areas

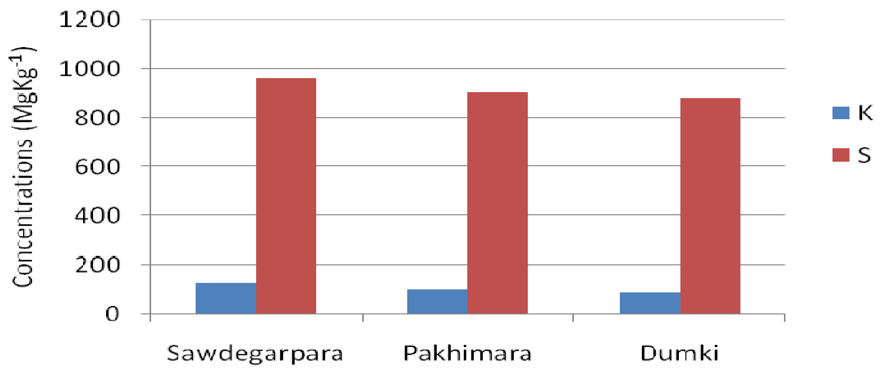


Fig. 6. Minerals in sponge gourd at the study areas

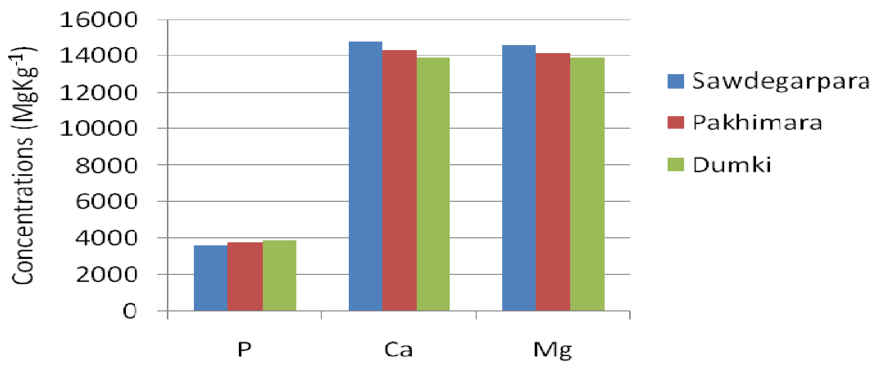


Fig. 7. Minerals of ridge gourd at different areas

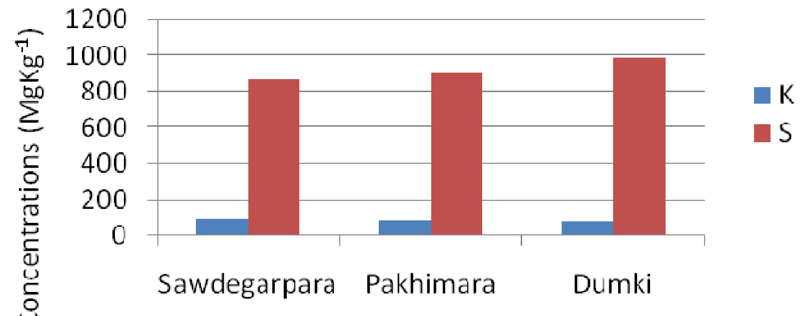


Fig. 8. Minerals in ridge gourd at different areas

Ridge gourd accumulated high amount of P, Ca and Mg than other elements. The accumulations of P and S in ridge gourd were ranged from 79.2-97.9 and 869.1-989.5 $MgKg^{-1}$. The maximum accumulation of K was found at the moderate salinity level (Sawdagarpara) and the lowest was observed at non saline area (Dumki). The highest amount of S was uptake by ridge gourd at non saline area (EC 0.9 at Dumki) and the lowest was found at the highest EC level (Sawdagarpara) (Fig. 8). Sulphur accumulation in ridge gourd was found as an exceptional case. In other vegetable S uptake was observed higher in saline area. In ridge gourd the trend of mineral accumulation was Ca> Mg> P > S > K. The greater salt tolerance in var. Dilpasand was due to the coordinated impact of ion exclusion, higher accumulation of proline, better capacity to manage electron transport and antioxidant capacity (Chukwuma *et al*., 2021).

**Snake gourd:** The accumulations of P, Ca and Mg in snake gourd were ranged from 3108.8-3607.6, 13367.1-13828.8 and 14834.2-15634.8 $MgKg^{-1}$, respectively. The maximum accumulations of both Ca and Mg in snake gourd were found at the moderate salinity level (EC 6.2 $dSm^{-1}$ at Sawdagarpara) and the lowest was observed at non-saline area. The highest amount of P was uptake by snake gourd at non saline area (EC 0.9 at Dumki) and the lowest was found at the highest EC level (Sawdagarpara) (Fig. 9).

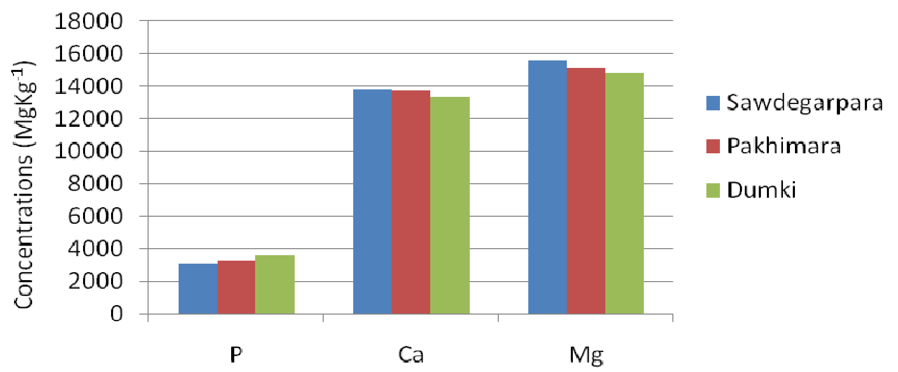


Fig. 9. Minerals status in snake gourd at different areas

Snake gourd accumulated high amount of Ca and Mg than other elements which indicated saline tolerant. The accumulations of P and S in snake gourd were ranged from 76.9-99.5 and 791.5-862.2 $MgKg^{-1}$. The maximum accumulations of both K and S in snake gourd were found at the moderate salinity level (Sawdagarpara) and the lowest was observed at non-saline area (Dumki) (Fig. 10). In snake gourd the trend of mineral accumulation was Ca> Mg> P > S > K.

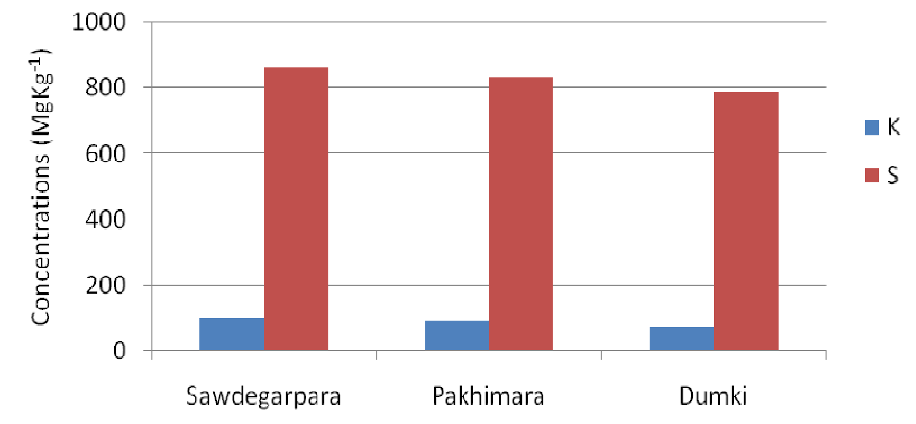


Fig. 10. Minerals status in snake gourd at different areas

## Conclusion

In saline area comparatively lower accumulation of P and higher accumulations of K, Ca, Mg and S were found in most of the vegetable than that of non-saline area. The trend of minerals accumulations was Mg> Ca> P>S>K in bottle gourd and sponge gourd. The trend of minerals accumulations Ca> Mg> P>S>K was found in sweet gourd ridge gourd and snake gourd. Sponge gourd accumulated high amount of P, Ca and Mg than other elements. Ridge gourd and snake gourd accumulated high amount of P, Ca and Mg than other elements. Sulphar accumulation in ridge gourd was found as an exceptional case. On the basis of total minerals content the trend of vegetable was found as bottle gourd>ridge gourd>snake gourd>sponge gourd> sweet gourd.

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