Effect of salinity on the yield and minerals of mung bean

A.K.M. Faruk-E-Azam, M. Maniruzzaman and F.H. Ansarey[1]

Department of Agricultural Chemistry, Patuakhali Science & Technology University, [1]Agribusiness, Advance Chemical Industries, 245 Tejgaon I/A, Dhaka-1208

Abstract: A study was carried out in the Department of Agricultural Chemistry, Patuakhali Science & Technology University (PSTU), Patuakhali on the effect of salinity on yield and mineral compositions of mung bean (BARI Mung-1) during January-July 2014. Mung bean yield from farmers field and soil pH and EC were recorded. Mung beans and soils were analysed for P, K, Ca, Mg, S, Zn, B, Cu and Mn. The yield of Mungbean ranged from 400.0 to 741.0 kg ha^{-1}. The highest yield was observed at Bazita (741.0 kg ha^{-1}) at soil pH 4.6 and EC 4.56 dS^{m-1} and the lowest yield was found at Mohipur (400.0 kgha^{-1}) at very high saline (at soil pH 4.1 and EC 23.53 dS^{m-1}). Mung bean yield was found higher at low saline to moderately saline soils compared to non saline soil. But the yield was remarkably poor at very high saline condition. Rmarkable variation was not observed among the mineral compositions of mung bean with locations and also with salinity. K, Ca, Mg and S concentrations in mung bean were found higher and P, Zn, B, Cu and Mn were lower at high salinity, but there was no remarkable variation in most of the mineral compositions at low salinity. All the soils were found acidic except the soil at Muradia. The soils at Jhatibunia, Lakkhipura, Bazita and Muradia were detected as low saline but the soil at Mohipur was detected as very high saline. Soil EC up to 5 dSm^{-1} did not affect native soil nutrients status. The concentrations of soil P, Ca, Zn, B, Cu and Mn were detected at below the mean values and K, Mg and S contents were found at above the mean values at very high salinity.

Key words: Mung bean, salinity, mineral composition.

Introduction

Salt water inundation occurs when fields are flooded with sea water, brackish water, or tidal surge water from the Bay. Salt contaminated soils have several effects on crops. The first is osmotic where high salt levels in the soil solution will draw water out of germinating seedlings and the roots of plants, causing desiccation. The second concern is the toxic effect of salt water components. Excess sodium is toxic to crop plants. In addition, chloride from salt water can be toxic to many crops. Soils that have had salt water leach into them will have high osmotic conditions (high dissolved solutes) and high levels of sodium. Levels of overall salts, sodium, and chloride will be reduced with leaching from rainfall, but this may take a considerable amount of time, depending on the amount of rainfall, soil type, water table, and the presence or absence of salt water intrusion in the ground water. On a sandy loam soil, salt levels may be reduced to tolerable levels within a year's period of time. In areas where salt water ponded for long periods of time, also expect effects to last for several years. Common soluble salts include calcium, magnesium, potassium, sodium, chloride, sulfate, and nitrate. Nutrients supplied by inorganic fertilizers are usually soluble, directly contributing to the salts in the soil.

Thus some proper measures should be proposed to reduce effects of salinity intrusion on agricultural activities. The trends along tidal gradients indicate the importance of tidal frequency and amplitude on soil properties (Cai *et al*., 2003). Salinity caused an adverse effect on contents of N, P and K in plant and positive effect on contents of Ca, Mg and Na. Manganese and Zn contents were decreased by salinity (Noufal, 2000). Mungbean (*Vigna radiata* L. Wilczek) is one of the important pulse crops grown principally for its protein rich edible seeds. For developing country like Bangladesh, pulses constitute the major concentrated source of dietary proteins. It contains an important dietary ingredient of the oriental food. It is rich in easily digestible form of protein. As a pulse crop of Bangladesh it ranks fifth both in acreage and total production. It is the best in nutritional value, having 59.9 percent carbohydrate, 24.5 percent protein and 1.2 percent fat. Mungbean is also characterized by its ability to improve the physical, chemical and biological properties of soil. It can also increase the soil fertility through biological nitrogen fixation from atmosphere. The green plant and hay are utilized as fodder. So, it may be considered as an inevitable component of sustainable agriculture. Mungbean contributed 6.5 percent of the total pulse production in our country. Salinity is a major environmental stress affecting plant growth and results in severe agricultural loss. These adverse effects may be attributed to non-availability of water, disturbance in nutrients, causing deficiency and ion toxicity to plant. Extra expenditure of energy for osmotic adjustment or in repair system induces growth reduction.Tolerance in various crops has been associated with their ability to exclude sodium chloride from shoot. Salinity decreases agricultural production through a lack of fresh irrigation water and through soil degradation. In general, soil salinity is believed to be mainly responsible for low land use as well as lower cropping intensity in this area (http://www.greenmagz.info/halt-rampal-save-sundarban/).

Thus some proper measures should be taken to reduce effects of salinity intrusion on agricultural activities in this area. Systematic research has not yet been done on salinity intrusion in this area. Therefore, this study has been done to acquire knowledge on this vital issue for framing guide lines of agricultural land management in this tidal area. Data generated in the study will be treated as base line information.

Materials and Methods

Collection and preparation of soil and mung bean samples: Soil samples and data on mungbean yield from the farmers field were collected from seven selected saline and non saline areas of Patuakhali district. Composite samples both for soil and mung bean grain were made.The areas were: 1. Kalagachhia, Mirjagonj, 2. Jhatibunia, Mirjagonj, 3. Lakkhipura, Mirjagonj, 4. Pairakunja, Mirjagonj, 5. Bazita, Betagi, 6. Muradia, Dumki and 7. Mohipur, Khepupara.

Analytical Methods: Soil pH was measured with the help of a glass electrode pH meter (Jackson, 1962). EC: Electrical conductivity (EC) was determined by conductivity meter (Tandon, 1995).

Available P was estimated by Olsen method (Olsen *et al*., 1954). Exchangeable K was determined using flame photometer (Page *et al.,* 1982). Available S content was determined by extracting the soil with $CaCl_2$ (0.15%) as described by Page *et al*., (1982). Available Ca, Mg, Zn, B, Cu and Mn contents in soil were determined by DTPA extraction method as directed by Hunter (1984). The extractable elements were measured by AAS using air-acetylene flame and matrix matched standards.

Mineral contents of Mung bean analysis: Di-acid mixture was used for the digestion of mung bean grain and then the analytical methods were followed as flows: Phosphorus was determined by colorimetric method (Tandon, 1995). K was determined by flame photometric method (Golterman, 1971 and Ghosh *et al.,* 1983). Available S content was determined by the method as described by Page *et al*., (1982). Calcium, Mg, Zn, B, Cu and Mn were analyzed by atomic absorption spectrometric method (APHA, 2005).

Statistical analysis: The statistical analyses of the data obtained from chemical analyses of vegetables and soil samples will be performed. Correlation studies will be done following the statistical package for agricultural research as described by Gomez and Gomez (1984).

Results and Discussion

Yield of mungbean obtained from different locations: The yield of Mungbean was ranged from 400.0 to 741.0 kg ha^{-1}. The highest yield was observed at Bazita (741.0 kg ha^{-1}) at soil pH 4.6 and EC 4.56 dS^{m-1} and the lowest yield was found at Mohipur (400.0 $kgha^{-1}$) at very high saline (at soil pH 4.1 and EC 23.53 dS^{m-1}) (Table 1). The maximum yield was found might be due to high levels of native P, K, Ca, Mg, Zn and B etc. plant nutrient elements present in the cited area. Proper intercultural operations may also responsible for this higher yield. From the generated data, mungbean yield was found higher at low saline to moderately saline soils compared to non saline soil. But the yield was remarkably poor at very high saline condition. So it might be concluded that high salinity reduces the yield.

Table 1. Yield and mineral composition of Mungbean

Locations	Yield $Kgha^{-1}$	P	K	Ca	Mg	S	Zn	B	Cu	Mn
		……………………………$MgKg^{-1}$…………………………..								
Kalagachhia	494.0	2970.0	66.5	13.7	42.0	773.0	43.0	23.0	17.0	2.5
Jhatibunia	459.3	2950.0	69.0	14.0	41.9	774.0	42.5	22.5	16.5	2.8
Lakkhipura	455.0	2960.0	67.0	14.8	42.5	771.0	43.0	22.8	16.8	2.9
Pairakunja	510.0	3002.0	68.5	15.5	43.8	772.0	44.8	23.5	15.9	2.6
Bazita	741.0	2955.0	68.0	15.0	43.0	775.0	45.0	23.8	15.5	2.7
Muradia	525.0	2965.0	70.0	16.0	44.0	776.0	44.0	24.0	16.0	2.0
Mohipur	400.0	2900.0	78.0	17.2	48.0	788.0	38.0	20.4	14.0	1.8
Range	400.0-741.0	2900.0-3002.0	66.5-78.0	13.7-17.2	41.9-48.0	771.0-788.0	38.0-45.0	20.4-24.0	14.0-17.0	1.8-2.9
Mean	512.04	2957.43	69.57	15.17	43.60	775.57	42.90	22.86	15.96	2.47
STDEV	109.17	30.46	3.90	1.20	2.10	5.74	2.36	1.21	1.01	0.42
CV%	21.32	1.03	5.61	7.91	4.82	0.74	5.50	5.29	6.33	17.00

Phosphorus and K contents of mungbean: The P and K contents in mung bean were ranged from 2900.0 to 3002.0 mg Kg^{-1}. The highest amount of P was found in Mungbean grown at Pairakunja in non saline soil and the lowest was found at Mohipur but the highest K content was obtained from Mohipur and the lowest amount was detected at Kalagachhia. It was observed that K was found highest at very high saline soil area but at the same condition P concentration was found lowest (Table 1).

Calcium, Mg and S contents of mungbean: The Ca, Mg and S levels of mung bean were ranged from 13.7 to 17 mg Kg^{-1}, 41.9 to 48 $mgKg^{-1}$, 771.0 to 782.0 mg Kg^{-1}, respectively. The Highest Ca, Mg and S contents were found at Mohipur and the lowest Ca, Mg and S were detected at Kalagachhia, Jhatibunia and Lakkhipura, respectively. Rmarkable variation was not observed among the mineral compositions with locations & also with salinity (Table 1).

Zinc, B, Cu and Mn contents of mungbean: The Zn, B, Cu and Mn contents of mungbean at different saline and non saline soils were ranged from 41.0 to 45.0 mg Kg^{-1}, 22.0 to 24.0 mg Kg^{-1}, 14.0 to 17.0 mg Kg^{-1} and 1.8 to 2.9 mg Kg^{-1}, respectively. The maximum Zn, B, Cu and Mn were found at Bazita, Muradia, Kalagachhia & Jhatibunia, respectively and the minimum level of all the metals were found at Mohipur (Table 1).

These poor concentrations of micronutrients might be due to the very high salinity in Mohipur soil. Though K, Ca, Mg and S contents were found higher and P, Zn, B, Cu and Mn were detected lower at high salinity, but there was no remarkable variation in most of the mineral compositions with low salinity.

The pH and EC status of soils: The pH and EC were ranged from 4.1 to 7.4 and $1.71dSm^{-1}$ to $23.53dSm^{-1}$, respectively. The highest pH and EC values were detected in the soils at Muradia and Mohipur, respectively and the lowest values were found in the soils at Mohipur and pairakunja, respectively (Table 2). All the soils were found acidic except the soil at Muradia. Soils at Kalagachhia and Pairakunja were found non saline. The soils at Jhatibunia, Lakkhipura, Bazita and Muradia were detected as low saline but the soil at Mohipur was detected as very high saline (EC 23.53 dS^{m-1}) (Table 2). The cause of salinity was might be due to saline water intrusion. The maximum salinity found at Mohipur soil because the location is most near to sea shore.

The K, Ca and Mg status of soils in the study area: The concentrations of K, Ca and Mg in the soils were ranged from 62.9 to 156.0, 1402.0 to 4996.0 and 340.8 to 1027.2 mg Kg^{-1}, respectively. The highest amount of K, Ca and Mg was detected in the soils at Bazita and the lowest was found at Lakkhipura, Mohipur and muradia, respectively (Table 2).

Table 2. pH, EC and ionic constituents of soil

Locations	pH	EC	P	K	Ca	Mg	S	Zn	Cu	B	Mn
		dSm^{-1}	…………………………			$MgKg^{-1}$	…………………………..				
Kalagachhia	5.5	1.91	2.81	93.6	2456.0	451.2	98.77	1.89	6.86	1.18	26.53
Jhatibunia	5.5	4.25	1.74	81.9	2266.0	460.8	171.22	0.70	6.13	0.44	19.86
Lakkhipura	5.0	5.58	3.31	62.4	2440.0	487.2	180.73	1.07	5.57	1.26	31.27
Pairakunja	4.8	1.71	2.22	89.7	2002.0	426.0	81.18	1.70	5.60	1.55	24.05
Bazita	4.6	4.56	7.70	156.0	4996.0	1027.2	123.72	3.14	5.69	1.57	23.30
Muradia	7.4	3.99	1.25	97.5	4866.0	340.8	167.13	0.88	4.11	0.88	10.03
Mohipur	4.1	23.53	1.45	117.0	1402.0	946.8	163.67	1.22	5.45	0.63	14.48
Range	4.1- 7.4	1.71- 23.53	1.25- 7.70	62.4- 156.0	1402.0- 4996.0	340.8- 1027.2	81.18- 180.73	0.70- 3.14	4.11- 6.86	0.44- 1.57	10.03- 31.27
Mean	5.27	6.50	2.93	99.73	2918.29	591.43	140.92	1.51	5.63	1.07	21.36
STDEV	1.06	7.6	2.23	29.77	1421.10	275.06	39.47	0.83	0.83	0.44	7.23
CV%	20.11	116.92	76.11	29.85	48.70	46.51	28.01	54.97	14.74	41.12	33.85

Phosphorus and S status: The levels of P and S were ranged from 1.25 to 7.70 mg Kg^{-1} and 81.18 to 180.73 mg Kg^{-1}. The highest level of P and S was present in soil at Bazita and Lakkhipura and the lowest was found in soils at Muradia and Pairakunja, respectively (Table 2).

Zinc, Cu, B and Mn status of soils: The Zn, Cu, B and Mn levels in the soils were ranged from 0.70 to 3.18, 4.11 to 6.86, 0.44 to 1.57 and 10.03 to 31.27 mg Kg^{-1}, respectively. The highest amount of Zn and B both were found in the soil of Bazita and the lowest was detected at Jhatibunia, the highest amount of Cu was found at Kalagachhia and the lowest was observed at Muradia and the highest Mn was found at Kalagachhia and the lowest was found at Muradia.

It was observed that soil EC up to around 5 dSm^{-1} do not affect native soil nutrients status. The concentrations of P, Ca, Zn, B, Cu and Mn were detected at below the mean values and K, Mg and S contents were found at above the mean values at very high salinity.

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