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Evaluation of Soil Fertility for Crop Production in Beel Chiroil, Pabna, Bangladesh

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Abstract
The study area is at Beel, Chiroil, Chatmohar, Pabna, Bangladesh. Ten soil sampling locations were selected from this area. Based on soil type and existing cropping patterns, soil samples were collected after harvesting the crops from each selected location of the study area. All soil samples (ten) were collected as per Soil Samples Collection Method of Soil Resources Development Institute (SRDI). The collected soil samples were submitted to the Central Laboratory of SRDI. The test results of the soil samples found that, the soil of the study area contained neutral soil pH (6.87), medium organic matter (3.58%), nitrogen (0.198 Meq/100g), potassium (0.256 Meq/100g) and zinc (1.15 µg/g), low phosphorus (13.503µg/g), sulfur (19.83 µg/g) and boron (0.28 µg/g) and very high iron (53.14 µg/g), calcium (20.288 Meq/100g) and magnesium (10.167 Meq/100g) on average. Interpretation of the soil test results indicate that, fertility condition of the research field will provides a good basis of fertilizer recommendation for the study area farmers. A recommendation of fertilizer doses is prepared according to Fertilizer Recommendation Guide, 2018 of Bangladesh Agricultural Research Council (BARC). The research also helps to suggest some suitable cropping patterns for the study area.

Keywords: Soil fertility, Fertilizer recommendation, Cropping pattern.

Introduction

Soil fertility is an important factor for crop production. Productive soil and good seed is capable of producing good crop. The demand of the plant for other macronutrients mainly depends on the nitrogen supply (Dobermann et. al., 1996). The fertilizer application informs that, nitrogen applications tend to be high in relation to the amount of potassium and phosphate used. This is partly the results of lower price of urea and partly the lack of knowledge among farmers relating to the application of balanced fertilizer. This is not only wasteful, but also causes nitrate pollution with excessive nitrogen (Mohaddesi et al., 2011). Adequate supply of nitrogen is beneficial for nitrogen, carbohydrates and protein metabolism, promoting cell divisions and enlargement. In Bangladesh, Soil fertility is declining gradually due to excessive use of chemical fertilizer especially nitrogen fertilizer.

Similarly, good supply of phosphorus is usually associated with increased exploration and supply of nutrients and water to the growing plant parts, resulting in increased growth and yield traits, thereby ensuring more seed and dry matter yield (Matti and Jana, 1985). Potassium nutrition in plant promotes panicle development, spikelet fertility, leaf area and leaves longevity, stem strength and plant tolerance to diseases and pests. Sulfur plays an important role in the biochemistry and physiology of the rice plant, mainly in chlorophyll synthesis. Zinc is critical for many physiological functions including the maintenance of structural and functional integrity of biological membranes and the facilitation of protein synthesis (Singh et al., 2012). Application of balanced and optimum level of plant nutrients is essential to preserve soil productivity through all possible sources of organic, inorganic and biological components in an integrated fashion. Nutrients must be applied as fertilizer or manure, when soil does not supply sufficient nutrients for optimum crop productivity. By knowing the nutrient requirement of the crops and potential nutrient supply of soil, the proper nutrient rate can be determined. Soil test of the study area were done to recommend the proper doses of fertilizer and suitable cropping patterns. Soil analysis is usually carried out to know the status of available forms for all nutrients. In this study, soil analysis was done: (i) to provide index of nutrient availability in soil (ii) to predict the probability of obtaining a profitable response of fertilizer application (iii) to provide a basis for development of fertilizer recommendation. (V) Recommendation of fertilizer doses based on the interpretation of soil samples test result.

Methodology

Soil analysis is usually carried out to know the status of available forms for all nutrients, except nitrogen. Soil analysis was done in three steps (a) Collection of soil samples (b) Preparation of soil samples (c) Analysis of soil samples. The steps are described below.

a. Collection of soil samples

Soil sample were collected after harvesting of the crops of the study area at Beel Chiroil, Chatmohar, Pabna, Bangladesh. Ten samples were collected from ten selected locations of the study area based on soil type. Existing cropping patterns were recorded. All soil samples were collected as per Soil Samples Collection Method of Soil Resources Development Institute (SRDI), Ministry of Agriculture. The collected soil samples were submitted to the Central Laboratory, SRDI, Krishi Kamar Sarak, Farmgate, Dhaka.

b. Preparation of soil samples

Air-drying

The soil samples were placed in a thin layer on a clean piece of paper on a shelf in the soil preparation room and left until it were air dry for one week. Visible roots and fragments were removed from the soil samples and discarded. During drying the windows were kept open at the time of working hours and fans were operated continuously.

Grinding

The entire soil samples were passed through the grinder and subsequently, a 2 mm stainless steel sieve. Only grave particles and stones not passing the 2 mm sieve were discarded. Aggregates not passing the sieve were returned to the grinder and treated again. The grinding and sieving were continued until the

entire soil sample, except gravel particles and stones, had been passed through the sieve. The grinder and sieve were cleaned properly before grinding next soil sample.

c. Analysis of soil samples

To assess the existing soil fertility status of the soil of the study area, soil pH, organic matter and the elements-Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulfur, Boron, Zinc, Iron of the soil were tested. For nitrogen, total status is important for fertilizer scheduling. The soil samples were tested as per methods of Olsen et.al 1954 (for Phosphorus), Olsen et.al.1964 (for sulfur), Schollenberger 1945 (for Zinc, Iron) in the laboratory of Soil Resources Development Institute (SRDI), Dhaka. The procedure of testing of soil pH, organic matter and the elements are described elaborately in the book of 'Analytical Methods of soil, Water, Plant material, fertilizer' of SRDI, 2012.

Interpretation of Soil Test Values

Interpretation of Soil Test Values (very high, high, optimum, medium, low and very low) for Loamy to Clayey Soils for Upland and Wetland Crops described in Fertilizer Recommendation Guide, 2018 of BARC.

Recommendation of fertilizer dose

Yield goal basis fertilizers are recommended for different crops of the study area, according to the soil test report and FERTILIZER RECOMMENDATION GUIDE-2018 of BARC.

Results and Discussion

In the study beel area suitable cropping patterns and effective doses of fertilizer is essential to enhance the output of the crops as well as cropping intensity. For this purpose soil samples were collected and tested in Central Laboratory of SRDI. The test results of the soil samples are shown below in Table 1 and Table2.

Government of the People's Republic of Bangladesh Soil Resource Development Institute (SRDI)
Central Laboratory Krishi Khamar Sarak . Dhaka 1215

Table 1: Soil Test Report of SRDI

Lab No.	Sample No.	Soil pH	OM	N	K	Ca	Mg
			%		Meq/100g		
955	01	7.0	4.37	0.24	0.25	21.14	7.91
956	02	7.1	3.97	0.14	0.35	23.53	15.01
957	03	7.0	3.70	0.24	0.32	24.71	13.75
958	04	6.1	3.43	0.08	0.32	20.20	19.38
959	05	6.5	3.29	0.19	0.45	23.43	11.25
960	06	7.0	1.82	0.17	0.15	22.25	7.29
961	07	7.0	2.08	0.22	0.14	21. 81	6.46
962	08	6.9	3.97	0.16	0..31	22.63	11.46
963	09	7.0	5.18	0.26	0.30	24.68	11.04
964	10	7.1	4.03	0.28	0.28	20.31	9.58

Average	**6.87**	**3.584**	**0.198**	**0.256**	**20.288**	**10.167**

Table 2: Soil Test Report of SRDI

Lab No.	Sample No.	P	S	B	Fe	Zn
		µg/g				
955	01	16.17	66.41	0.02	21.44	0.86
956	02	10.48	22.43	0.09	26.50	0.66
957	03	6.64	21.48	0.02	17.60	1.12
958	04	15.48	0.27	0.20	63.80	1.44
959	05	22.75	1.33	0.82	66.80	1.84
960	06	12.69	12.91	0.50	12.94	0.78
961	07	14.94	3.75	0.30	15.22	0.70
962	08	15.56	6.59	0.24	17.30	0.68
963	09	10.02	18.22	0.21	164.80	1.12
964	10	10.30	44.91	0.40	125.00	2.30
Average		**13.503**	**19.83**	**0.28**	**53.14**	**1.15**

Aus Rice Yield goal-4.0±0.4 t/ha	72-139 (N33-64)	45-60 (P 9-12)	42-200 (K 21-40)	0 -1.9 (Zn 0.0-0.7)	43-55 (S 7- 9)	-

The result of soil samples test indicated that, (i) Soil pH-6.1 to 7.1 (slightly acidic-neutral) and average 6.87 (neutral), (ii) Organic matter-1.82% to 5.18% (medium-high) and average 3.58% (medium), (iii) Nitrogen 0.08% to 0.28% (very low-optimum) and average 0.198 Meq/100g (medium), (iv) Phosphorus 6.64 to 22.75 µg/g (very low-high) and average 13.503µg/g (low), (v) Potassium 0.14 to 0.45 Meq/100g (low-high) and average 0.256 Meq/100g (medium), (vi) Zinc 0.66 to 2.30 µg/g (low-very high) and average 1.15 µg/g (medium), (vii) very low to very high Sulfur 0.27 to 66.41 µg/g and average 9.83 µg/g (low), (viii) Boron 0.02 to 0.82 µg/g and average 0.28 µg/g (low) and (ix) very high in Calcium 20.20 to 24.71 Meq/100 average 20.288 Meq/100g (very high), (x) Magnesium (6.46 to 19.38 Meq/100), average 10.167 Meq/100g (very high) and (xi) Iron (12.94 to 164.80 µg/g) average 53.14 µg/g (very high).

According to the results of the soil fertility and land type rice, wheat, rabi crops, mustard, khesari, maize, mugbean, blackgram, jute can be grown successfully in the study area as per season. Based on the Fertilizer Recommendation Guide-2018 of BARC (BARC, 2018), fertilizer doses for different crops are recommended as per interpretation of the analyzed soil samples (shown in Table 3).

Table 3: Nutrient Recommendation as per BARC, 18

Crops	Fertilizer Recommendation(Kg/ha)					
	Urea	TSP	MoP	Zinc sulphate	Gypsum	Boric acid
Boro Rice Yield goal-7.5±0.75 t/ha	133-261 (N 61-120)	85-120 (P 17-24)	78-152 (K 39-76)	0-3.1 (Zn0.0 - 0.13)	81-111 (S 13-18)	-

Aman Rice Yield goal-5.0±0.5 t/ha	67-130 (N 31-60)	55-75 (P 11-15)	52-100 (K 26-50)	0-2.2 (Zn 0.0-0.8)	56-74 (S 9-12)	-
Wheat (Irrigated) Yield goal-4.5±0.45 t/ha	89-174 (N 41-80)	85-120 (P 17-24)	62-120 (K 31-60)	0-3.1 (Zn 0.0-1.3)	69-92 (S 11-15)	4.6- 8.0 (B 0.8-1.4)
Maize Yield goal-6.0±0.6 t/ha	100-195 (N 46-90)	125-180 (P 25-36)	50-96 (K 25-48)	0-3.9 (Zn 0,0-1.4)	110-167 (S 19-27)	0-80 (B 0.0-1.4)
Jute (Deshi) Yield goal-3.5±0.35 t/ha	57-109 (N 26-50)	45-60 (P 9-12)	42-80 (K 21-40)	0-4.2 (Zn 0.0-1.5)	69-92 (S 11-15)	6.3-11.5 (B 1.1-2.0)
Jute (Tosha) Yield goal-6.0±0.6 t/ha	67-130 (N 31-60)	55-75 (P 11-15)	52-100 (K 26-50)	0-5.6 (Zn 0.0-2.0)	106-147 (S 17-24)	6.3-11.5 (B 1.1-2.0)
Mugbean Yield goal-2.0±0.2 t/ha	15-26 (N 7-12)	65-90 (P 13-18)	18-31 (K 9-16)	0-2.8 (Zn 0.0-1.0)	56-73 (S 9-12)	4-6.9 (B 0.7-1.2)
Black gram Yield goal-1.5±0.15 t/ha	15-26 (N 7-12)	55-75 P11-15	14-24 (K 7-12)	-	43-56 S 7-9	-
Grass Pea Yield goal-1.5±0.15 t/ha	13-21 (N 6-10)	55-75 (P 11-15)	14-24 (K 7-12)	-	43-56 S7-9	-
Mustard Yield goal-2.0±0.2 t/ha	90-174 (N 41-80)	125-72 (P 25-36)	62-120 (K 31-60)	0-4.17 (Zn 0.0-1.5)	118-166 S19-27	3.4-11.5 (B 0.6-2.0)
Pani Kachu Yield goal-30.0±3.0 t/ha	67-130 (N 31-60)	105-150 (P 21-30)	66-128 (K 33-64)	-	68-94 (S11-15)	-

When zinc sulphate is used sulfur is also supplied (approximately 18% S in $ZnSO_4.H_2O$). Thus, if Zinc sulphate is used which contains18% sulfur then this calculated amount of sulfur will have to be subtracted from the amount of sulfur contained in Gypsum. In the study area no need to apply cow dung/ poultry manure as the organic matter is sufficient in this beel area and also no need to apply iron, calcium and magnesium contained fertilizer as it is very high in this area.

Conclusion

The soil samples test result gives useful data for recommendation of proper doses of fertilizer and selecting some suitable cropping patterns for the study area farmers. The existing cropping patterns of the beel area are: (a) Wheat-Fallow-Fallow (b) Wheat-Fruit garden (c) Wheat-Fallow-T.Aman rice (d) Boro rice-Fallow-T.Aman rice and (e) Kheshari-Jute-T.Aman rice. But for successful crop production

the existing cropping patterns of the study area should be changed into: (i) Mustard-B.Aus rice-B. Aman rice (ii) Wheat-Maize-Mugbean or Blackgram (iii) Wheat-Fruit garden (iv) Rabi crops-B. Aus rice-Mugbean or Blackgram for medium high land and a(i) Rabi crops-B.Aus rice-T.Aman rice (ii) Rabi crops-Fallow-Jute for medium low land and (i) Boro rice-Fallow-Deep water rice (ii) Boro-Fallow-Pani kachu for low land.

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