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Fertility Status of Soils of Patuakhali Science and Technology University in Bangladesh

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ABSTRACT: Soil is a heterogeneous body and different soil have different fertilizer requirement for crop production depending on fertility status. This research work was conducted to evaluate the fertility status of the soils of the research field of Patuakhali Science and Technology University (PSTU). The soils of PSTU were collected and analyzed for the determination of following soil parameters viz. particle size distribution, texture, pH, organic matter, total nitrogen, available phosphorus, available sulphur and exchangeable potassium. The results showed that the particle size distribution of the collected soils varied significantly with each other. A remarkable variation was observed in textural classes of the soils. The textural classes of the soils were sandy loam, clay and clay loam. The soils were neutral to slightly alkaline in reaction and the pH ranged from 7.01 to 7.73. The organic matter content was very low and ranged from 0.50 to 0.96%. The soils were found to be deficient in total nitrogen with a range of 0.06 to 0.11%. The available phosphorus, available sulphur and exchangeable potassium content of collected soils ranged from 8.76 to 15.90 ppm, 1.04 to 3.06 ppm and 0.12 to 0.26 meq/100 g soil, respectively. The fertility status of the soils was very low to medium level due to very low organic matter content.

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KEYWORDS: Soil fertility, texture, organic matter, PSTU, Bangladesh.

INTRODUCTION

Patuakhali Science and Technology University (PSTU) is one of the most important universities of Bangladesh for higher education in agriculture. This university plays a vital role in agricultural research in the southern coastal area of Bangladesh. This area is low-lying with most heights less than 8 meters above sea level. Localized flooding occurs during the monsoon season in this area. It covered by the Ganges Tidal Floodplain with clayey soil being the most common type of soil (Naher *et al.*, 2011). Agriculture is the main source of income in this area as well as whole Bangladesh. The majority of the population in Bangladesh lives in rural areas where agriculture is the main source of income (Miah *et al.,* 2020). The food demand in this area is increasing day by day due to increasing population. Since there is no way to increase the amount of land under, crop yield per unit area must be increased by effective crop and soil management (Ahmed, 2003). Over the last 2-3 decades, a lot of pressure has been placed on its soil to produce more food for the increasing population all over Bangladesh (Sarker *et al.,* 2020). Most farmers of the research area prefer to exploit the land instead of maintaining soil fertility. Straw is utilized as fuel and fodder, and crops are often picked at the root level. When the stubbles are grazed or uprooted for fuel, the amount of organic matter in the soil decreases and nutrients are depleted (Sheel *et al.*, 2015). This depletion could have been caused by farmers' ineffective fertilizer management. The farmers are urgently attempting to enhance agricultural productivity by using an increasing amount of chemical fertilizers and pesticides. But they are not getting expected results from their land although applying more fertilizer of all kinds. The farmers of Patuakhali as well as our whole country utilize fertilizers carelessly and inefficiently since they are unaware of the intrinsic nutrient condition of the soil. On the other hand, nitrogen (N), phosphate (P) and potassium (K) fertilizers contributed more to crop yield in the dry season but the role of phosphate (P) fertilizers did not considered in wet season (Haque *et al.*, 2019). This shows that long-term, intensive farming practices have disrupted the physical and chemical qualities of soil. In order to overcome this problem, it is crucial to assess the fertility status of our soils at the farmer level (Sheel *et al.*, 2015). In view of the above reason, the current study was conducted for better understanding of the soil fertility status of PSTU research field.

MATERIALS AND METHODS

Sampling site

The soil samples were collected from research field of PSTU which is located in between 22°27'49" and 22°27'54" north latitudes and in between 90°22'54" and 90°23'22" east longitudes. The details of the collected soil samples are given in Plate 1 and Table 1.

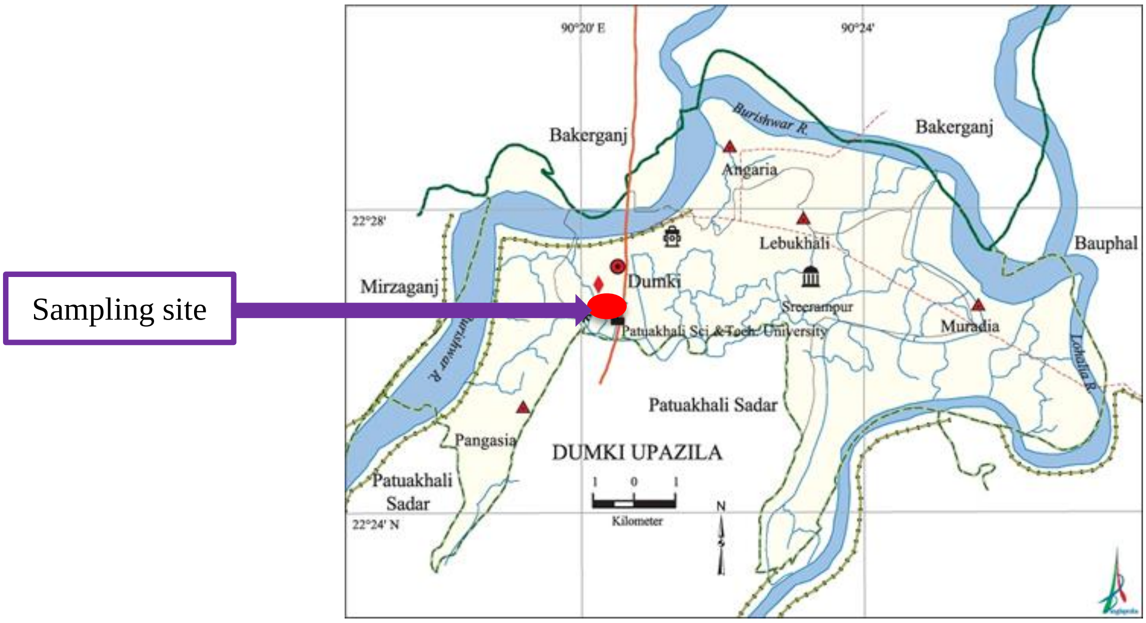

Plate 1: Dumki upazila map with sapling site

Table 1: Site of collected soil samples

Sample Number	Sampling site
01	GPB research field (North side research field of M. Keramot Ali Hall)
02	Research field of farm (West side research field of M. Keramot Ali Hall)
03	Research field of farm (South side research field of M. Keramot Ali Hall)
04	AGR research field (South side research field of Bangabandhu Sheikh Mujibur Rahman Hall)
05	HRT research field (South side research field of Sreejani Bidhya Niketan)

Here, GPB means Genetics and Plant Breeding, AGR means Agronomy, HRT means Horticulture

Collection and preparation of soil samples

Five composite soil samples were collected from the research field of PSTU. At first ten soil samples with a depth of 0-l5 cm were collected from each research field by means of an auger. The collected soil samples were carried to the laboratory of the Department of Soil Science, PSTU. Then the soil samples were air dried and ground to pass through 2-mm sieve. Each composite sample was then prepared by mixing the sieved 10 samples.

Soil analysis

Particle size distribution was determined using a hydrometer, soil texture was determined by plotting the data of particle size distribution on a triangular diagram (Plate. 2), soil pH was determined using glass electrode pH meter, organic carbon was determined using wet oxidation, total nitrogen was determined using the Kjeldahl method, available phosphorus was determined using the Bray and Kurtz method, available sulphur was determined using the turbidimetric method of titration and exchangeable potassium was determined using flame photometer (Mukta *et al.*, 2023).

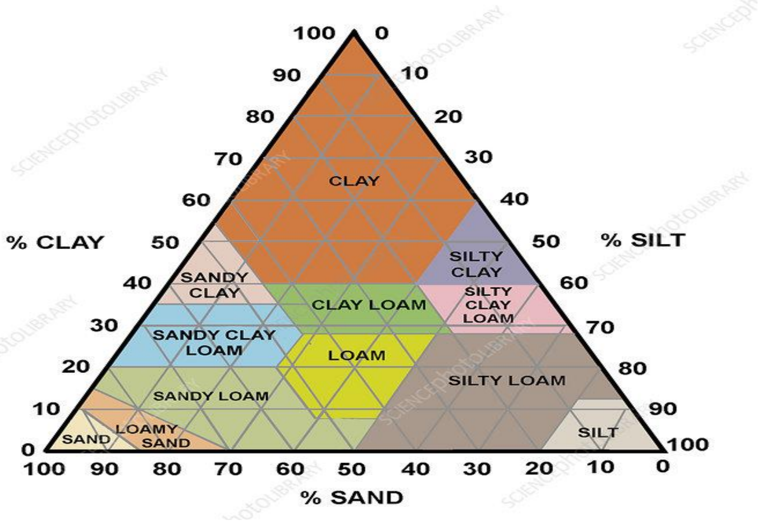

Plate 2: Triangular diagram of textural classes of soil (Marshall, 1947)

Statistical analysis

The statistical analysis was done by computer based program STAR (Statistical Tool for Agricultural Research) following the basic principles (Gomez and Gomez, 1984). Significant effects were determined by analysis of variance (ANOVA) and means were compared at 5% level of significance by Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Particle size distribution and soil texture

The particle size distribution and textural classes of collected soils are presented in Table 2. There was a significant variation observed in particle size distribution (sand, silt and clay contents) of collected soils in the study area. In general, the soil of GPB research field and AGR research field recorded the highest amount of sand (59.8% and 57.8%, respectively) followed by silt (30.0% and 30.0%, respectively) and clay (10.2% and 12.2%, respectively) with textural classes were sandy loam. It might be due to both the field was raised from low land to high land by using sand particles previously. Among all the samples, the soils of research field of PSTU farm content highest amount of clay (54.8% and 44.8%, respectively) followed by silt (25.0% and 32.5%, respectively) and sand (20.2% and 22.7%, respectively) with textural classes were clay due to these fields were low land and become submerged one-third of the year. But the soil of HRT research field content highest amount of silt (40.0%) followed by clay (34.8%) and sand (25.2%) with textural class was clay loam which was reflected by the presence of finer soil particles**.**

Table 2: Physical properties of the collected soils of PSTU

Sample number	**Particle size distribution**			**Textural class**
	Sand (%)	**Silt (%)**	**Clay (%)**	
01	59.8 a	30.0 c	10.2 e	Sandy loam
02	20.2 e	25.0 d	54.8 a	Clay
03	22.7 d	32.5 b	44.8 b	Clay
04	57.8 b	30.0 c	12.2 d	Sandy loam
05	25.2 c	40.0 a	34.8 c	Clay loam
CV%	0.85	1.04	0.65	
Level of Significance	***	***	***	
SE(±)	0.26	0.27	0.17	

Here, Same letter in a column represents insignificant difference at $p < 0.05$

CV= Coefficient of variation, SE (±) = Standard error

Soil pH

There was a statistically significant variation found in the pH of the collected soils of the study area. All the soils were found neutral to slightly alkaline in reaction (BARC, 2012) with pH values ranging from 7.01 to 7.73, where the pH of GPB research field (sample number 01) showed the highest value and farm research field (sample number 02) showed the lowest value (Table 3). The pH of the collected soils is suitable for agricultural crop production as well as microbial growth (Hossin *et al.*, 2022). The results coincided with the findings of Tanu *et al.* (2017). They observed that the pH of Patuakhali and Barguna Districts of Bangladesh varied from 6.21 to 7.88.

Organic matter

The organic matter of the soils varied significantly and ranged from 0.50 to 0.96%, where AGR research field (Sample number 04) showed the highest value and GPB research field (sample number 01) showed the lowest value (Table 3). According to BARC (2012), organic matter in the soils was very low. The very low organic matter content in the soils was due to less input of organic residues in the study area. Every soil should have at least 2% organic matter for better crop production. But the soils of the study area did not contain organic matter up to the mark. For better crop production organic matter should be in the study area. Organic matter content can be enriched by the addition of green manuring crops, cowdung and compost in soil.

Total nitrogen

The total nitrogen content of the collected soils varied significantly and ranged from 0.06 to 0.11% (Table 3). The total nitrogen content of the collected soils ranked as very low to low (BARC, 2012). The highest value of total N was found in HRT research field (Sample number 05) and the lowest value was found in GPB research field (Sample no. 01). Similar results were found by Sheel *et al.* (2015). It might be due to addition of less organic matter and faster organic matter decomposition in the tropical climate. The nitrogen content of the soils also reduced with decreasing of organic matter content.

Available phosphorus

The available phosphorus content of the tested soils varied significantly and ranged from 8.76 to 15.90 ppm (Table 3). According to BARC (2012) the available phosphorus content ranked as low to medium. Similar results were found by Jerin *et al.,* (2021). This might be due to the low organic matter content of the soils of the study area. In Bangladesh, 41% of soils have phosphorus level below critical and 35% below optimal levels (Sheel *et al.,* 2015).

Available sulphur

The available sulphur content of the soils of the study area varied significantly and ranged from 1.04 to 3.06 ppm (Table 3) and ranked as very low (BARC, 2012). This might be due to low organic matter content in the collected soil samples. In Bangladesh, 68% of soils have sulphur level below critical and 14% below optimal level (Sheel *et al.,* 2015). Sulphur fertilizer application could increase the productivity of soils in the study area.

Exchangeable potassium

The exchangeable potassium content varied significantly and ranged from 0.12 to 0.26 meq/100g soil (Table 3) and ranked as low to medium (BARC, 2012). It might be due continuous cropping without potassium fertilizer application. Similar results were observed Khanam *et al.* (2020) in the soils of Kalapara upazila under Patuakhali district in Bangladesh. The potassium fertilizer should be added in the soils of the study area for getting sustainable crop yield.

Table 3: Chemical properties of the collected soils of PSTU

Sample number	Soil pH	Organic matter (%)	Total nitrogen (%)	Available phosphorus (ppm)	Available sulphur (ppm)	Exchangeable potassium (meq/100g soil)
01	7.73 a	0.50 b	0.06 e	8.76 e	1.04 e	0.12 e
02	7.01 c	0.90 a	0.07 d	10.86 c	1.75 c	0.18 d
03	7.30 b	0.88 a	0.08 c	9.81 d	1.55 d	0.23 b
04	7.03 c	0.96 a	0.09 b	13.38 b	3.06 a	0.21 c
05	7.30 b	0.85 a	0.11 a	15.90 a	2.10 b	0.26 a
CV%	1.76	2.95	1.44	0.38	0.96	1.10
Level of Significance	***	**	***	***	***	***
SE(±)	0.10	0.09	0.003	0.04	0.04	0.005

Here, Same letter in a column represents insignificant difference at $p< 0.05$, CV= Coefficient of variation, SE (±) = Standard error

The soil pH showed a negative association with both total nitrogen and organic carbon with correlation coefficient (r) values of -0.775 and -0.304, respectively and regression lines of $y = -0.5874x + 5.091$ and $y = -0.024x + 0.2569$, respectively (Fig. 1A-1B). Soil organic matter showed a positive correlation with total nitrogen, available sulphur and exchangeable potassium with regression lines of $y = 0.0596x + 0.0332$, $y = 3.09x - 0.6276$ and $y = 0.2182x + 0.0215$, respectively. The correlation coefficient (r) values for these variables were 0.519, 0.729, and 0.300, respectively (Fig. 1C-1E). Total nitrogen in soil exhibited a positive correlation with available sulphur and available phosphorus with correlation coefficient (r) values of 0.612 and 925, respectively and regression lines of y = 24.527x - 0.1112 and y = 141.61x + 0.1301, respectively (Fig. 1F-1G). The available sulphur and available phosphorus of soil showed positive correlation with each other where the value of correlation coefficient (r) was 0.702 with the regression line of y = 2.6891x + 6.6328 (Fig. 1H). Similar results of correlation between different soil properties were found by Masum *et al.* (2017).

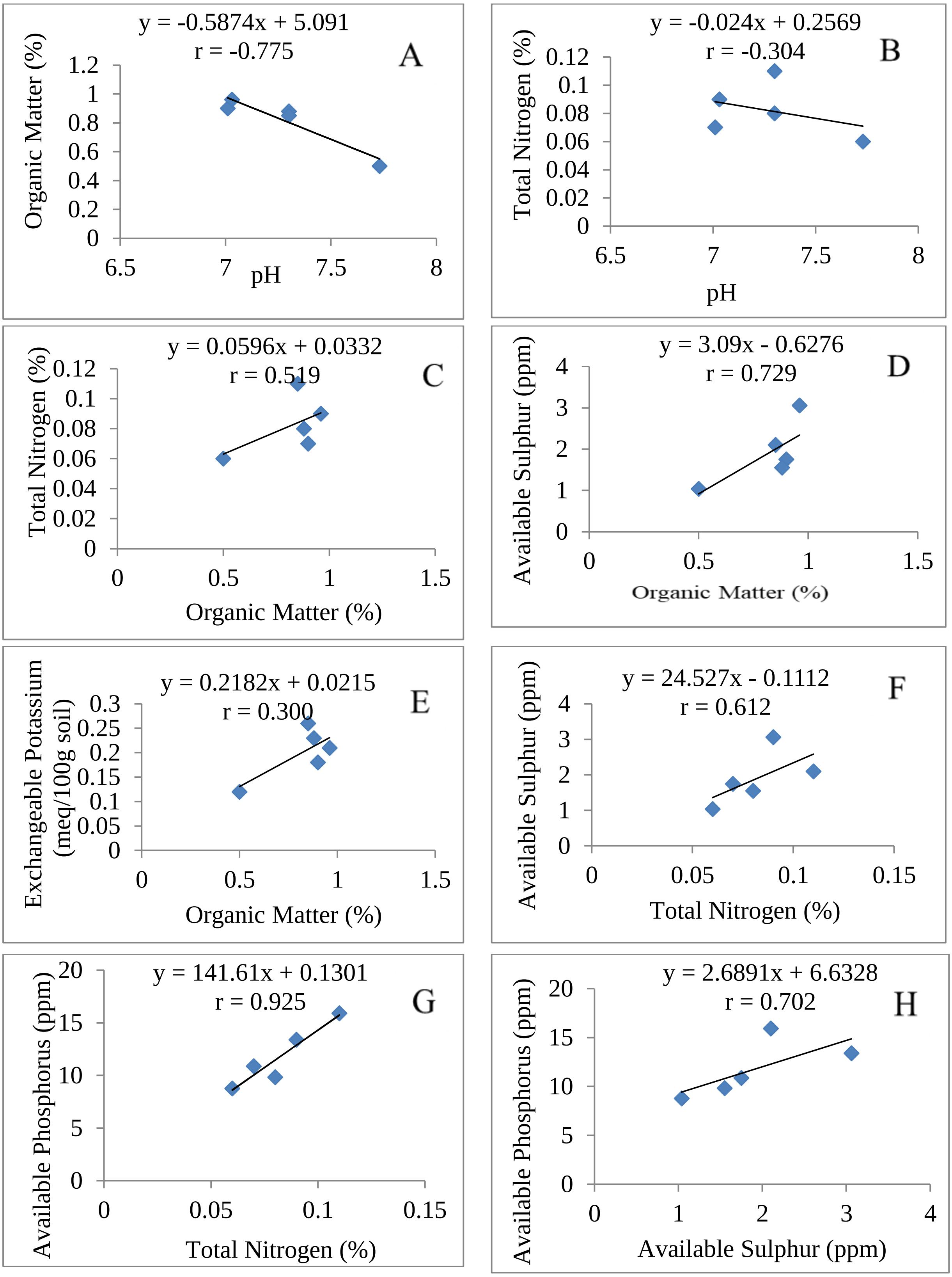

Fig. 1: Correlation between pH and organic matter (A), pH and total nitrogen (B), organic matter and total nitrogen (C), organic matter and available sulphur (D), organic matter and exchangeable potassium (E), total nitrogen and available sulphur (F), total nitrogen and available phosphorus (G), available sulphur and available phosphorus (H) of some soils of PSTU research field.

CONCLUSION

The fertility status of the soils of the study area was very low to medium. Hence, the application of organic and inorganic fertilizers is needed to get expected yields and maintain good soil health.

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REFERENCES

1. Ahmed, B. (2003). Fertility Evaluation of Different Soils of Bangladesh. M.S. Thesis. Department of Soil Science, Bangladesh Agricultural University, Mymensingh, Bangladesh, p. 31.
2. BARC. (2012). Fertilizer Recommendation Guide-2012. Soils Publication No. 41. Bangladesh Agricultural Research Council, Farmgate, Dhaka, pp. 251-260.
3. Gomez, K. A. & Gomez, A. A. (1984). Statistical Procedures for Agricultural Research-*An International Rice Research Institute Book*. Second Edition. A Wiley-Inter Science Publication, John Wiley & Sons, New York.
4. Jerin, I. J., Islam, M. K., Bhuyan, M. I., Majumder, M. S. I., Ferdous, M. & Islam, M. M. (2021). Physicochemical Properties and Nutrient Status of Agricultural Soils in Kuakata, Patuakhali. *Journal of Experimental Biosciences*, 12(1), 59-68.
5. Haque, M.M., Jatish, C., Biswas, M. R., Islam, A., Islam & Kabir, M. S. (2019). Effect of long-term chemical and organic fertilization on rice productivity, nutrient use-efficiency, and balance under a rice-fallow-rice system. *Journal of Plant Nutrition*, 42(20), 2901-2914.
6. Khanam, S., Haque, M. A., Hoque, M. F. & Islam, M. T. (2020). Assessment of Salinity Level and Some Nutrients in Different Depths of Soil at Kalapara Upazila of Patuakhali District. *Annual Research and Review in Biology*, 35(12), 1-10.
7. Marshall, T. J. (1947). Mechanical composition of soils in relation to field description of texture .Common wealth of Australia, *Council for Scientific and Industrial Research*, Melbourne, Australia, Bulletin 224, pp. 20.
8. Masum, R. M., Naher, N., Paul, A. K. & Alam, A. K. M. M. (2017). Effects of Salinity on Soil Properties of Coastal Areas of (Babuganj, Bakerganj, Gournadi and Kalapara) in Bangladesh. *International Journal of Bio-resource and Stress Management*, 8(5), 684-691.
9. Miah, M.D., Hasan, R. & Uddin, H. (2020). Agricultural Development and the Rural Economy: The Case of Bangladesh. In: Barai M. (eds.) Bangladesh's Economic and Social Progress. Palgrave Macmillan, Singapore.
10. Mukta, M. A., Hossin, M. S. and Islam & M. K. 2023. Soil fertility status and its possible sustainable agricultural packages in Bangladesh. *International Journal of Sustainable Agricultural Research*, 10(1), 21-31.
11. Naher N., Uddin M. K., & Alam A. K. M. M. (2011). Impacts of Salinity on Soil Properties of Coastal Areas in Bangladesh. *AGRIVITA*, 33(2), 161-173.
12. Hossin, M. S., Paul, A. K., Hoque, M. F., Mukta, M. A. & Hossain, M. D. (2022). Estimation of Fertility Status of Coastal Soils for Agricultural Planning in Bangladesh. *Haya: The Saudi Journal of Life Science*, 7(5), 142-150.
13. Sarker, M. M. H., Jahiruddin, M. M., Abu Zofar M. & Islam, M. R. (2020). Changing dynamics ofmicronutrients in piedmont soil of Bangladesh. *Eurasian Journal of Soil Science*, 9(1), 43-51.
14. Sheel, P. R., Chowdhury, M. A. H., Ali, M. & Mahamud, M. A. (2015). Physico-chemical characterization of some selected soil series of Mymensingh and Jamalpur districts of Bangladesh. *Journal of Bangladesh Agricultural University*, 13(2), 197-206.
15. Tanu, F. Z., Sanchary, I. J., Ali, S. S., Haque, H. A. & Rahman, M. H. (2017). Intrinsic Physical Properties of Kuakata Coastal Soil in Bangladesh. *Barisal University Journal Part 1*, 4(1), 1-9.