Pedochemical studies on the soils located in the eastern and western sides of the nile delta

Morsi Abd alla Morsi Ebrahim

This study points to the evaluation of the pedochemical characteristics of some soils representing the main geomorphic units in the eastern and western sides of the Nile Delta. Accordingly twenty soil profiles were chosen to represent the different geomorphic units encountered in the eastern and western sides of the Nile Delta. These profiles were morphologically described their physical, chemical and mineralogical properties were evaluated. The obtained data could be summarized in the following:1. Physical and chemical properties:a) Soils of the eastern Nile Delta (region 1): 1- Soils of the young deltaic plain:These soils have clay texture class throughout the entire profile depths with an apparent increase of clay content with depth. CaCO3 and gypsum contents is very low and ranges from 2.16 to 4.74 % and from .81 to 2.0 %, respectively. Organic matter content is generally low and does not exceed 2.05 %. Soil reaction of these soils are mildly alkaline to moderately alkaline. Soils are non-saline as indicating by EC values which ranges from 0.64 to 1.7 dSm”I. The soluble cations are dominated by Ca+2 and Na+ followed by Mg+2 and 1(4, where HCO3” ions is the predominant anions followed by Cl” and SO4.2- Soils of the old deltaic plain:Soil texture of this geomorphic unit ranges from sand in profiles 5 and 8 to sandy clay loam in profile 7. Calciumcarbonate content is commonly low and ranges from 0.86 to 4.74 °A with no specific distribution pattern with depth. Organic matter content is very low and does not exceed 0.89 %, gypsum content is very low ranging from 0.4 to 1.89 %. pH values range from 7.03 to 8.86 indicating that the soils are natural to strongly alkaline. EC values range from 0.95 to 4.88 dSm-I indicating that the soils are non-saline to slightly saline. Soluble cations are in the order: Nat > Ca++ > Mg++ > K+ while in some layers Cat+ ion exceeds Na+. Soluble anions have the order SO4 > HCO3- > Cr.3- Soils of fluvio marine plain:Soil texture varies from clay in the surface layers to loamy sand and sandy clay loam in the deepest layers. CaCO3 content is less than 7.76 % with an irregular distribution pattern with depth. Organic matter and gypsum contents is very low and range from 0.02 to 1.06 % and from 0.31 to 1.86 %, respectively. Soils are mildly alkaline to moderately alkaline (pH 7.48 to 8.2). Soils are non-saline and the soluble cations are characterized by the dominance of Ca++ followed by mg++ and /or Nat, which K ions are the least abundant soluble cations, while the dominant anions are HCO3” followed by SO4 and Cr.4- Soils of wadi El-Tumulat:These soils are characterized by sand textural classes in profile 4, while in profile 6, the texture is sandy clay loam in the top layer and clay in the deepest layers. CaCO3 content ranges from 0.86 to 15.09 %. Gypsum and organic matter contents are extremely low being in the range 0.27 to 0.93 % and 0.01 to 1.02 %, respectively. Soil reaction is mildly alkaline to moderatelyalkaline (pH: 7.74 to 8.12). EC (saturating extract) ranged from 1.01 to 3.64 dSm-1 (non-saline). Soluble cations have the order Na+ > Ca++ > Mg++ > K+, soluble anions have the order HCO3- > SO: > Cl-, while CO3= was absent.5- Soils of the structural plain:These soils are characterized by coarse texture classes (sandy to sandy loam). CaCO3 content ranges from 8.62 to 26.72 % with an increase in the uppermost surface layers. Gypsum content ranges from 0.48 to 5.29 % with an irregular distribution pattern with depth. Organic matter is extremely low, it is not exceeding 1.06 %. Soil reaction lies in the natural to strongly alkaline side. Soils are strongly saline as the EC values varies between 19.29 and 56.68 dSm-1. Soluble cations are in the order Na+ > Ca++ > Mg++ > K+, while soluble anions have the order C1-> SO4 > HCO3.b) Soils of the western Nile Delta (region 2): 1- Soils of the young deltaic

plain:These soils have clay textural class throughout the entire profile depth. CaCO3 content is very low and ranges from 4.31 to 5.6 % with an irregular distribution pattern with depth. Regarding gypsum soil profile is considered low gypsum content. Organic matter content ranges from 0.34 to 2.86 %. Soil reaction is mildly alkaline and the soils are slightly saline. The dominant soluble cations are Na+ followed by Ca++, Mg++ and K+, while soluble anions dominated by SO4 followed by Cl- and HCO3-.2-soils of old deltaic plain:These soils are characterized by the coarse tex ural classes (sand, loamy sand and sandy loam). CaCO3 content 's very low due to the natural of parent material and ranges from 0.86 to 5.17 %. Gypsum content ranges from 0.08 to 5.17, w Ile organic matter content is extremely low (not exceed 0.3 %). Soil reaction is mildly alkaline to moderately alkaline li.H 7.55 —8.26). EC values range from 0.72 to 17.12 dSm-I (n m n-saline to strongly saline). Ca++ ion and /or Na+ dominate sol • le cations followed by Mg++ and K+, SO4= and Cl" ions domin to soluble anions followed by HCO3".3-Soils of fluviomarine plain:The soils of thio geomorphic unit have clay y textural classes throughout the entire profile depth. CaCO3 co tent varies from 8.02 to 13.36 % and tends to decrease with dept . Gypsum and organic matter contents are very low and range fr m 0.46 to 2.14 % and 0.24 to 2.01 %, respectively. Soil eaction is moderately alkaline (pH 7.83 to 8.15). Soils are no -saline to moderately saline (EC 2.15 — 8.71 dSni1). Soluble cati m ns follow the descending order Na+ > Mg++ > Ca++ > K+, wh le soluble anion dominated by SO4= followed by Cl" and HCO3".4-Soils of alluvial deposits of desert wadi:Textural class of these soils are sandy clay loam. CaCO3 contents are generally high and range from 13.9 to 22. 6 % with an increase with depth. Gypsum content is extremely low with percentages not exceed 1.56 %. Organic matter conte t is very low. pH values range from 7.81 to 7.91 indicating tha the soilsare mildly alkaline to moderately alkaline, EC measurements indicate that the soils are slightly saline. Soluble cations are in the order Na+ > Ca++ > Mg++ > K+, and soluble anions have the order SO4= > Cl- > HCO35- Soils of inland dunes:These soils have textural classes varies from sand to sand clay loam. CaCO3 content varies in narrow limits from 4.3 to 8.19 %. Gypsum content is very low and not exceeds 0.84 %, and organic matter content is extremely low (0.03 to 0.41 %). Soil reaction is mildly alkaline to strongly alkaline (pH 7.6 —8.46). EC values ranged from 0.59 to 5.79 dSm-I indicating that the soils are non-saline to slightly saline. Soluble cations are dominated by Ca++ followed by Mg++, Na+ and K+, while soluble HCO3" and /or Cl" ions are the predominant anions followed by SO4.2.Grain size analysis:from the grain size parameters, the data of sorting, Skewness and Kurtosis reveal that water and wind or both are share together in the sedimentation of the soils under study. Applying the discriminant functions of Sahu (1964) reveals that the sediments forming the investigated soils are mostly deposited under aqueous environments.3.Trace elements status:3.1. Soils of the eastern Nile Delta: 1- Total iron:Total iron content ranges from 5250 to 66500 mg ke. The highest content is detected in the young deltaic plain and olddeltaic plain soils, while the lowest content is formed i the soils of structural plain. Soils of fluvio marine and wadi El Tumulate exhibit moderate content of total Fe.2-Total Mn:Total Mn ranges from 125 to 950 mg kg 1. T e highest content characterized the soils of young delta' • and old deltaic plain, whereas the lowest content is total o structural plain soils. Fluvio marine and wadi El-Turn lat have intermediate content of total Mn.3-Total zinc:Total Zn ranged between 22.5 and 77.5 mg kg . Soils of wadi El-Tumulat and young deltaic plain attains th highest content of total Zn, while soils of structural plain isply the lowest content. Moderate amounts of total Zn are fo ed in the soils of old deltaic plain and fluvio marine plain.4-Total copper:Total Cu ranged from 7.5 to 42.0 mg kg-I. The elatively low amounts of total Cu is in the soils of young delt is plain, fluvio marine and structural plain, while the highest a ntent of total Cu is formed in the soils of wadi El-Tumulat.3.2. Soils of the western Nile Delta: 1- Total iron:Total Fe content ranged from 5000 to 58500 m kg-1. It may be noticed that the total Fe content in the western elta soils followed the order:Young deltaic > fluvio marine > old deltaic > aluvial wadi > inland dunes.2- Total manganese:Total Mn ranged between 125 to 1125 mg kg 1. It can be noticed that the coarse textural soils in inland dunes and desert wadi are characterized by the lowest total Mn content, while the highest amounts of total Mn are obtained in the fine textured soils in young deltaic and fluvio marine plain.3-Total zinc:Total Zn content ranges from 9 to 75 mg kg-1. The distribution of total Zn can be arranged in the following order:Young deltaic > fluvio marine > old deltaic > inland dunes > desert wadi.4-Total copper:Total Cu in the studied soils ranges

between 5 and 40 mg kg-11. Generally, soils of young deltaic plain and fluvio marine plain attain relatively high content of total Cu, while soils of desert wadi and inland dunes attain the lowest contents.The vertical distribution of total trace elements is discussed in light of the statistical measures, i.e. weighted mean, trend and specific range, suggested by Oertel and Giles (1963).SUMMARY-206-4. Mineralogical composition of the studied soils: 4.1. Mineralogy of the sand fraction:4.1.1. Light minerals:Quartz predominates the light minerals content pronounced amounts of feldspars, of which plagio orthoclase are the principal members, while microcl least abundant.4.1.2. Heavy minerals:Heavy minerals are dominated by opaques. No are dominated by pyroboles (pyroxeues + amphibole altrastable minerals (zircon, vutile and tourmaline) an Kyanite, silimanite, epidote and biotite are present in amounts, while the remaining minerals are foun pronounced occurrences.Index figure ranges from 2.3 to 11.1 %. More of iluiformity and development of soil profile le conclusion that the soils constituting each p heterogeneous either due to their multi-origin or subsequent variation along the course of sedimention. they are still considered young from the pedological vi4.2. Clay mineralogy:Mineralogical identification of the clay fractio ray diffraction reveals that the dominancy o (montmorillonite) in the young deltaic plain and old soils in the eastern and western sides of the Nile Del fluvio marine plain in the eastern and western sideswith less lase and ne is the-opaques), garnet, Epidote. moderate in lessver, a test ds to the ofile are ue to the Therefore, w point.using X-smectite ltaic plain a. Soils of f the NileSUMMARY-207-Delta are characterized by the dominance of kaolinite and /or smectite, while soils of wadi El-Tumulat are characterized by the dominance of illite followed by smectite. Soils of alluvial deposits of desert wadi are characterized by the dominance of palygorslsite minerals followed by kaolinite.The identified accessory minerals are mainly dominated by quartz and feldspars followed by dolomite, calcite and apatite.5. Soil classification:According to the previously mentioned field analytical results on basis of Soil Taxonomy System (USDA, 1975) and Key of Soil Taxonomy (1998). The soils under consideration are generally classified in to three soil order namely, Vertisols,Aridisols and Entisols.1- order: Vertisolsa)Suborder: Aquerts Great group: EndoaquertsSubgroup: Typic Endoaquerts (profile 12)b)Suborder: TorrertsGreat group: HaplotorrertsSubgroup: Typic Haplotorrerts (profile 10 and 11)2- order: Aridsolsa) Suborder: GypsidsGreat group: CalcigypsidsSubgroup: Typic Calcigypsids (profile 10)b) Suborder:Great group: * Subgroup: * Subgroup:CalcidsHaplocalcidsAquic Haplocalcids (profiles 6 and 13) Typic Haplocalcids (profiles 14 and 9)3- order:a)Suborder: Great group: Subgroup:b)Suborder: Great group: Subgroup:c)Suborder: Great group: Subgroup:EntisolsFluventsTorrifluventsAquic Torrifluvents (profile 2) PsammentsTorripsammentsTypic Torripsamments (profiles 3, 4, 1 OrthentsTorriorthentsTypic Torriorthents (profiles 7, 15, 19, 17 and 18).and 20).6. Land evaluation:6.1. Land capability classification:Application of the capability index for the s udied soil profiles reveals that the studied soil profiles are place d between (I) and (VI) grades as follows:1- Grade (I): Excellent soils, represented by profiles 1 and 7.2- Grade (II): Good soils, represented by profiles 3, 5, 20, 12, 13, 14 and 15.3- Grade (III): Fair soils, represented by profiles 8, 6 and 18.4-Grade (V): Very poor soils, represented by profiles 10.5-Grade (VI): Non agriculture soils, represented by profile 9.The studied soil profiles related to the capability classification of grades; (I) to (III) only are evaluated to determine its suitability for growing 16 crops (6 field crops, 6 vegetable crops and 4 fruit trees). Results reveal that the studied soil profiles include all the suitable classes (Si, S2, S3 and N).