Capability classification of the calcareous soils at the north-western coast of Egypt as related to pedogenetic classification

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The study area occupies a portion of the North western coastalbelt of the Mediterranean sea which is considered among the accessibleareas attaining the most promising lands for agricultural expansionbeyond the Nile valley and Delta. It extends from Alexandriaon the east to Ras El-Dabba on the west, between latitudes 30° 40and 31° 10 N and longitudes 28° 20 and 29° 50 E.The physiographic features of the area are presented with particularemphasis to the major features of the environments pertainingto the land use, namely; climate, geology, geomorphology, ground waterconditions and vegetation.The aim of the current work is to demonstrate the applicabilityof qualitative and quantitative systems for assessing land capabilityon basis of most soil properties relevant to pedogenetic classification.To fulfil the aim of the study, 29 soil profiles stretchingalong the study area are chosen to cover the major soil mapping unitsencountered in the area in regard to geomorphologic aspects. Theseprofiles are morphologically described and 85 soil samples werecollected to represent the morphological variations within the entiredepths of profiles. These samples were evaluated for theirrelevant physical, chemical and mineralogical properties.Besides, field infiltration tests were conducted adjacent tothe most representative soil profiles. The obtained data revealthat though the studied soils have interrelated origin, yet theirprofiles display a wide range of variability in their properties,depending on locality, lithology, landforms and depositional environments.The most prominent feature is that particle size distributionand textural classes vary considerably from one profile to anotherand even in the subsequent layers of some profiles. Consequently,the soil mapping units are distinguished on basis of gemorphology(landforms) and textural variations.Briefly, the obtained results are summarized as follows.1- Texture varies widely from sand to clay. The soils are nonsaline to extremely saline with an apparent dominance of Na+ and C1-in the soil extract. Soil reaction is neutral to alkaline. Cationexchange capacity varies widely from about 3 to 23 me/l00g with adominance of Ca on the exchange complex. Organic matter content isvery low, not exceeding 1.4%. The macronutrients(NPK) levels areseemingly low, indicating inadequacy of N and,to some extent,P whileK level lies within the sufficient range.2- Rating of morphological properties was figured out usingthe relative horizon distinctness and horizon index. Modifications ofthe morphological rating systems was provided through the inclusionof missing data concerning CaC03 and salinity which have significantimportance in the studied soils. Their results indicate apparentdiscontinuity and stratification of profile layers as shown by thevariations in RHO and horizon indexes.3- CaC03 content ranges widely from 17.77 to 94.48% withapparent increase of carbonate in the finer soil fractions exceptfor the oolitic dunes.4- Amorphous inorganic materials content ranges from 1.1 to4.6, 0.05 to 0.5, and 0.4 to 4.6%for 5i02, A1203 and Fe203, respectively.The vertical distribution of these components does notfollow any specific pattern pertaining to lithology, locality orlandform. The regional distribution indicates an increase of silicadue west in contrast to alumina while both components increases fromthe sea shore southwards. Amorphous iron have a common patterncharacterized by a pronounced increase with the fineness of texturalclasses and also in the deepest layers of profiles.5. Chemically extractable micronutrients vary widely from 0.36to 2.31, 0.05 to 1.82,0.5 to 3.9, 0.5 to 14.8 and 0.05

to 9.04 ppmfor hws-8, EOTA-extractable Cu, Zn, Mn and Fe, respectively. Theselevels indicate that the coarser the texture the lower is hws-B andvice versa. Conversely, higher EOTA-extractable Cu and Zn is associatedwith finer texture. A regional distribution of these elementsindicates that the weighted means of hws-B and EDTA-extractable Cutend to decrease westwards to El-Hammam then become almost constantwhile they increase southwards from the sea shore inland. For Znand Mn, the maximum weighted means correspond to the soils of BurgEl-Arab and decrease progressively due East and West while weightedmean of Fe displays a steady decrease on passing from Maryut soilswestwards. The similarity of weighted means in some profiles representingdifferent geomorphic units may indicate an interrelatedorigin of the studied soils. The relationship between micronutrientsand soil variables was also evaluated through statistical analysis.6- Mineralogy of the sand fraction reveals that the light fractionis generally dominated by quartz with less pronounced amounts offeldspars (orthoclase, plagioclase and microcline). The heavy residueis composed essentially of opaques followed by pyroboles, epidote,ubibuitus and parametamorphic minerals in different frequencies.The vertical distribution of these minerals verifies the multi-depositionalregime of the non uniform parent material already establishedthrough rating of morphological properties.7~ Mineralogy of the clay fraction shows that palygorskite dominatesthe mineralogical composition of clays irrespective of location,mode of formation or depositional environments. The relation of clayminerals to lithology, landform and depositional environments werealso correlated with soil origin and genesis.8- Moisture characteristics coincide very well with texturalvariations among soil profiles and layers.9- Infiltration studies of the representative profiles indicatea rapid to moderately slow infiltration class depending ontextural variations and succession of layers throughout profiledepth. The effect of soil variables on infiltration parameterswas evaluated statistically.10- Soil classification was carried out following the mostrecent American system ”Soil Taxonomy, 1975” down to the familylevel. Briefly, the soils are placed as Typic and Lithic Torripsamments.Typic and Lithic Torriorthents, Typic Calciorthids andTypic Salorthids. On basis of particle size class within theprofile control section,mineralogy, soil moisture and temperatureregimes, soils belonging to the former taxonomic units are differentiatedinto five families.11- Based on the foregoing soil characteristics and recognizedagricultural limitations, qualitative land capability classificationwas performed using the USDA system (1973), Parson’s system (1962)and FAD framework of land suitability classification (1976). Accordingto these systems thesoils are placed under classes III to VII,II to V and S1 ’ S2 ’ S3 ,N1 and N2 ’ respectively.Quantitative land capability classification is also workedout following both the modified Storie index (1933) and Sys and,Verheye system (1978). Accordin9 to these systems the soils of thestudy area are grouped into classes C, D and E and 51’ 52’ 53’N1 and N2, respectively. Each of these systems of land capabilityclassification is critically criticised and its applicabilityon the study area is discussed. Moreover, modificationsfor the quantitative systems to suit the highly clacareous conditionsof the arid and semi-arid lands are suggested.