#7598 SOME ESSENTIAL NUTRIENTS, ACTIVE LIMESTONE AND PH STATUS OF NORTH AND CENTER TUNISIAN SOILS

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ABSTRACT

Tunisia is a North African country characterized by a Mediterranean climate in the north and Saharan climate in the south part of the country, which resulted in a high geo-morphological diversity of its soils. Indeed, the soils in Tunisia are characterized by high variability of their fertility status that is affected mainly by abiotic and biotic constraints such as salinity, drought, erosion and low soil organic carbon (Mhiri, 2018). Thereby, soil fertility is largely linked to geographical location, making recommendation of chemical fertilization for small holder difficult. This study aims to generate maps at national level characterizing current nutritional status of the soil in order to facilitate the recommendation of integrated soil fertility management and land use planning according to the specificity of the soils and agro-climatic conditions.

MATERIALS AND METHODS

Seventy (70) soil samples collected from different agro-ecological zones was analyzed in the laboratory to determine assimilable phosphorus (P), exchangeable potassium (K), active limestone content ($CaCO_3$), and pH. In each site, samples were taken from the 0-20 cm ground layer from four points (North, South, East, West, and Center) forming a square with a diagonal of 10 m. Samples were then homogenized, air-dried and sieved (2 mm).

The content of P was determined according to Olsen method (Gautheyrou and Gautheyrou, 1966), the content of K using the flame photometric method, active limestone according to Drouineau-Galet method (Gautheyrou and Gautheyrou, 1966) and the pH using 1:5 w/v soil suspensions in the water at 25°C.

To determine the spatial variability of the different parameters (phosphorus, potassium, pH, and active limestone), a geo-statistical analysis was performed. Semi-variograms have been constructed and four different soil maps have been generated by the Ordinary Kriging interpolation method using SPATIAL ANALYST extension of the software "ArcGIS Pro". The method adopted is commonly used as interpolation methods, where the spatial prediction of the unmeasured point X_0 is given by predicting the value $Z^*(X_0)$, which equals the line sum of the observed value $Z(X_i)$. The formula is described as following (Pham et al., 2019):

$$Z^*(X_0) = \sum_{i=1}^{n} \lambda_i \, Z\,(X_i)$$

With λ_i = weighting coefficient from the measured position to X_0
n = the number of positions within the neighborhood searching.

The method used allowed to generate a graphical representation of the spatial variability of the studied parameters from 70 soil sampling points in Tunisia.

RESULTS AND DISCUSSION

Data Description from Soil Samples Collected

Results showed that assimilable soil P content was a major limiting nutrient with values varying from 31.1 to 208.3 ppm and mean value equal to 96.9 ppm. Soil P dispersion was high with a coefficient of variation (CV) of 40.6%. In addition, results showed that exchangeable soil K status was high (mean value of 166.3 ppm) with a high variability (CV of 35.1%) and values were ranged between 76.9 and 334 ppm. Moreover, pH evaluation showed that soils were alkaline (7.6-8.4). Mean value was of 8.03 and CV was low (1.5%). Soils were mostly calcareous (8.1-24 % $CaCO_3$) with a mean of 14.2%. Values were mainly high in the North-East of the country. Only 25 % of the soils had their active limestone content less than 8% showing a high CV (24.2%).

Semivariogram Analysis Results

Based on the semivariogram analysis and according to the ratio of nugget to threshold, which determines the spatial dependence, results showed that phosphorus, potassium and lime and pH have a strong spatial dependence, whereas, pH has a weak spatial dependence.

Spatial Distribution of Soil P, K, Active Ca, and pH

Figures 1, 2, 3 and 4 showed interpolated maps of P and K nutrients availability, active limestone and pH, respectively. Results showed that P availability was increasing from North West to Central West and decreasing from North East to Central East. Potassium availability was very high in North East of Tunisia, very low in the Center East, and good in the remaining areas. Soil active Ca was very high in the North East of Tunisia and high in the remaining regions. Soil pH was high alkaline expertly for Nord West which was moderate.

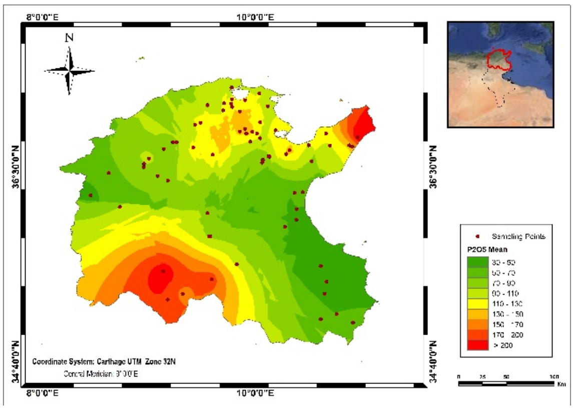

Figure 1. Interpolation map of assimilable P availability in Tunisian soils.

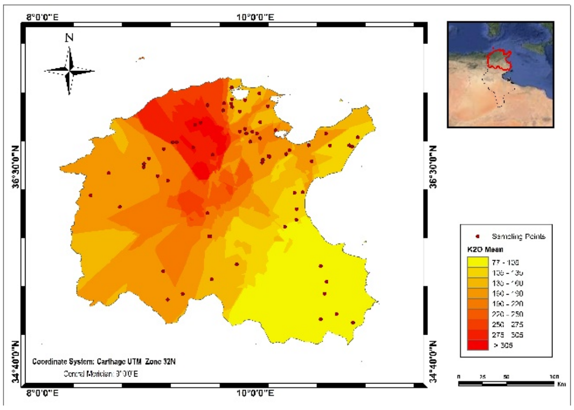

Figure 2. Interpolation map of exchangeable K availability in Tunisian soils.

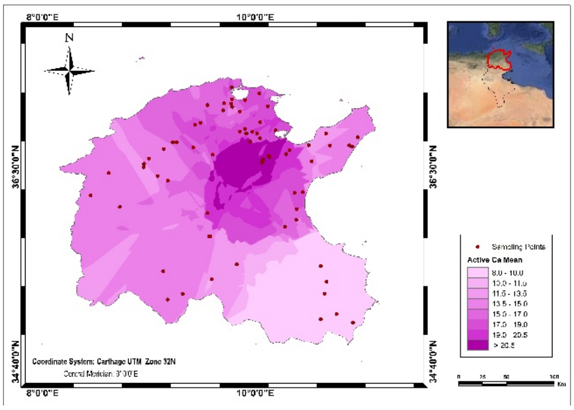

Figure 3. Interpolation map of active limestone content in Tunisian soils.

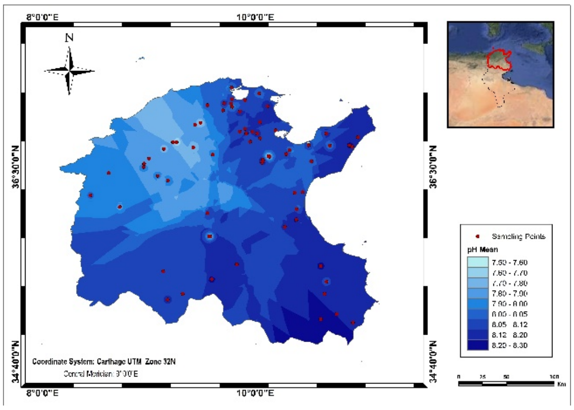

Figure 4. Interpolation map of pH in Tunisian soils.

CONCLUSIONS

Based on this research study it is confirmed that the interpolation approach using the ordinary kriging method gives expressive and explicative maps of the spatial distribution of soils nutrients variability as found by other studies in other countries (Wani t al., 2012; Pham et al., 2019; Seminova et al., 2020). The maps generated can be used as decision making tools for integrated soil fertility management to optimize returns on chemical fertilizers inputs while preserving ecosystems and improving crop productivity and yields.

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