Abstract

Evaluation of field management practices needs a good knowledge about the spatial variability of soil properties. Due to short range variability of soil properties and lack of a fairly dense network of sampling points because of being costly and time-consuming, the necessity of obtaining an adequate number of sampling points is of great importance. In this research we evaluated the spatial variability of soil physicochemical properties (including soil texture fractions, acidity, electrical conductivity, total nitrogen (N), extractable phosphorus (P), and available potassium (K)) in a 85 hectares experiment field in Sistan dam. An initial number of 113 soil samples collected from the top soil in a relatively regular grid, 70 to 100 m apart. In order to evaluate small scale variability of soil NPK, sampling also done in 3 different places with a sampling distances of about 20 meters within the study area. In order to determine the most suitable size of sampling points for predicting NPK spatial distribution pattern from the 113 initial samples, 3 subsamples with different sample size (i.e. 30, 50 and 70) and 5 replications were taken randomly from the initial sample. For each subsample the statistical and geostatistical analyses were performed separately. For interpolation of soil properties geostatistical approaches including ordinary kriging and lognormal kriging and a more classical method of inverse distance weighting were used. Cross-validation technique with comparison criteria MAE, MBE and RMSE, was used to evaluate the performance of methods used. The results showed that except for soil texture fractions, other soil properties did not have a normal distribution of data and some transformations (e.g. logarithmic and Box-Cox) were applied. Most properties considered, showed a degree of spatial autocorrelation with a spherical or exponential structure. Accounting for small-scale variability, the nugget effect decreased for the majority of soil properties indicating a better spatial autocorrelation for shorter sampling distances. The smallest average deviation of sub-sample semivariograms from the actual semivariogram were achieved through choosing 50, 50 and 70 sample size respectively for N, P and K. Moreover, these subsamples resulted in no reduction of estimation accuracy. Accordingly, these sample sizes were suggested to be adequate for future work over this region. The cross-validation results of estimating N by lognormal kriging using only 50 samples indicated that the averaged root mean square error of estimation is reduced about 8.5 % compared to sample size of 30. For estimating P, the subsample 50 resulted in approximately 11 and 13 percent reduction of estimation error relative to 30 and 70 samples, respectively.

Keywords: Total nitrogen, Extractable phosphorus, Available potassium, Sample size, Semivariogram, Estimation, Sistan

University of Zabol
Graduate School
Faculty of Water and Soil
Department of Irrigation and Drainage

The Thesis Submitted for the Degree of M.Sc
(In The Field Of Irrigation And Drainage)

The effect of Sample Size on Variability of Semivariograms and Estimates of Soil Nutrients in Sistan Plain

Supervisors:
Dr.M. Delbari
Dr.P. Afrasiab

Advisors:
En.M. Amiri

By:
A. Salehian

September 2015