Spatial soil analysis using geostatistical analysis and map algebra

ABSTRACT

Evaluating soil spatial variability through sampling is an important step in precision farming processes that aids farmers to make informed decisions on the spread of agricultural inputs. Manual sampling is essential in ascertaining soil physical characteristics and could be used to monitor the chemical components like macronutrient nitrogen (N), phosphorus (P), and potassium (K). This type of sampling however could be costly and time consuming in macronutrient sampling. In order to show the ability of manual sampling to capture the essence of variability in the agricultural fields with enough number of samples and therefore, helping the precision farming process, we conducted an experiment on different designs of random, systematic, stratified random, stratified systematic, and different sizes of samples. The experiment was carried out on the geostatistical surfaces (base maps) created from a set of data which belonged to a rice plantation in Malaysia. A krigged map for each of these schemes was created and compared with the N, P, and K base maps. The results showed that the systematic and stratified systematic schemes were the most accurate sampling schemes in terms of estimation of mean. However, both stratified schemes were not successful to create the standard deviation of populations. Concerning the standard error of mean when the schemes were used in linear mixed effect modeling grouped by the sample size, stratified samples could produce lower standard error (except for stratified random sample of P). In terms of reproducing the original spatial variability, only systematic sampling scheme could create better accuracy in most cases. The result also revealed that the most important property of a sampling scheme in the study area is representativeness of samples, and the number of samples does not play an important role in accuracy and map making. Therefore, the data could be equally valid for the precision farming

Keyword: Soil sampling; Map algebra; Spatial variability; Geostatistical analysis