Spatial variability of sulphur fractions in soils of agro-climatic zone-II, Himachal Himalaya, India

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Estimating spatial variability of soil nutrients and their fractions is important for understanding their dynamic distribution under various pools. The present study was carried out to examine the spatial distribution of soil sulphur (S) fractions in agro-climatic zone-II (mid hills sub-humid) of Himachal Himalaya, India. The data were analysed with a classical and geostatistical approaches. The soil organic carbon varies from 2.8 to 22 g/kg and the S-fractions are positively correlated with organic carbon. The total-S varies from 72.6 to 513.9 mg/kg with a mean value of 260.9 mg/kg. The descriptive analysis showed that the coefficient of variation ranged from 8.5% to 52.9%. Semivariogram modelling represents that the best-fitted model was exponential and the nugget-to-sill ratio $\{(C_0/C_0 + C)\}$ explains the spatial dependency, suggesting a moderate spatial dependence. The principal component analysis represents the three principal components that explain the 91% variance in the dataset. The higher concentration of sulphur is well correlated with soil organic carbon. The present study provides information to understand sulphur dynamics through their partitioning among various pools for effective soil resource management.

Keywords: Geostatistics, GIS mapping, kriging technique, spatial variation, sulphur fractions.

dynamic pools that need to be determined for areas under different cropping sequences and environmental conditions. The average S-content in the earth's crust is between 0.06 and 0.10%, whereas in Indian soils, the total-S varies from 0.0019 to 0.40% (ref. 3). Sulphur availability to plants is governed mainly by the equilibrium between its available and potentially available reserves[4].

Sulphur is mainly required during grain filling and vegetative growth, and further, its demand is driven by the type of species and developmental stages of the crop[5]. In addition, S is the structural component of various amino acids, vitamins and cofactors that help in the synthesis of oils and activation of enzymes that ultimately influence the well-being of plants and dependent animals and humans[6]. Therefore, S deficiency is a key factor limiting crop growth and yield. A large portion of soil S exists in organic compounds, which must be mineralized to sulphate form (SO_4^{-2}) to make it available for plants. This mobile form is also prone to leaching, erosion and subsequent depletion due to weathered coarse soil and loss of organic carbon[7,8]. Moreover, the S-deficient soil holds back the performance of other nutrients namely N, P and K; so their impacts cannot be ignored for affecting food security and agriculture production. Further, S-deficiency also causes poor utilization of N, P and K and