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RESEARCH ARTICLE

Spatial variability of soil nutrients and influencing factors in a vegetable production area of Hebei Province in China

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Abstract This study was conducted to determine soil nutrient spatial variability and the factors influencing it in a vegetable production area using traditional statistics and geo-statistics. The study area encompassed 55 ha and consisted of 182 farmer's plots belonging to six production groups in the Yutian county of China. Two hundred and seventeen soil samples were collected on a 50×50-m grid at depths of 0–20 cm prior to the plots being sown for cabbage. Vegetable production history, including varieties, rotation systems and fertilizer use, at the sampling sites was also examined. Soil pH, organic manure (OM), NO_3^-–N, available P, K, Zn, and other nutrients and particle size were measured. The results showed that N, P, K and Zn were the main limiting nutrient factors in the soil. Distinct semi-variance structures of spatial variability were observed for soil NO_3^-–N, available P, K and Zn, with the range of spatial correlation being 204–348 m. Significant spatial distribution similarity was found for soil NO_3^-–N, P, K and Zn, with relatively high contents of all these nutrients in some areas of the study area and relatively low contents in other areas. The correlation of soil NO_3^-–N, P and K content with vegetable production history and fertilizer application rates (N, P_2O_5 and K_2O) suggested that vegetable variety and history of fertilizer use are important factors to be considered in the development of a soil nutrient management program in the study area.

Keywords Fertilizer use · GIS · Soil nutrients · Spatial variability · Vegetable production area

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Introduction

Vegetable production area is increasing in China, and the rational use of fertilizer can generally result in large economic benefits. However, the excessive use of chemical fertilizer, especially nitrogen and phosphorus fertilizers, has increased recently. These issues seriously affect vegetable quality, economic income and environmental quality (Li et al. 2000). According to a survey conducted in Beijing, the nitrogen (N) application rate for each vegetable crop averaged 674 kg ha^{-1}, with an N:P_2O_5: K_2O ratio of 1:0.68:0.31. The survey also indicated that while the use of