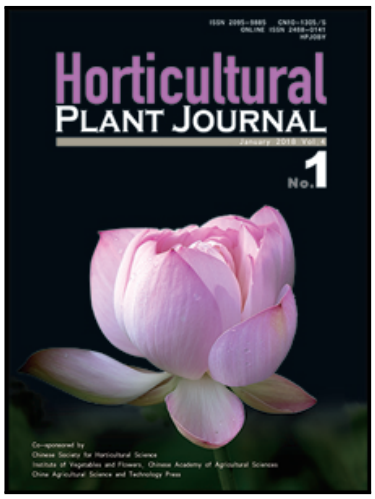

Soil Nutrient Status and Leaf Nutrient Diagnosis in the Main Apple Producing Regions in China

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Soil Nutrient Status and Leaf Nutrient Diagnosis in the Main Apple Producing Regions in China

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Abstract

Soil and leaf nutrient analysis are widely used as effective methods of diagnosing nutrient deficiency in fruit trees, the results of which are used to properly manage fertilizer application. Therefore, a survey was conducted for assessment of the soil nutrient status and leaf nutrient concentration in 2 827 apple orchards in the Bohai Bay and Loess Plateau apple production regions of China. The soil organic matter, alkali hydrolyzable N, available P, and available K were 10.91 g·kg^{-1}, 73.21 mg·kg^{-1}, 70.22 mg·kg^{-1}, and 169.23 mg·kg^{-1} in the Bohai Bay region, respectively, and 11.72 g·kg^{-1}, 56.46 mg·kg^{-1}, 14.91 mg·kg^{-1}, and 135.78 mg·kg^{-1} in the Loess Plateau region, respectively. Soil organic matter was at a medium-to-low level in both regions, whereas the soil alkali hydrolyzable N was low. In the Bohai Bay region, soil available P was high, but soil available K was deficient. In contrast, both soil available P and K were insufficient in the Loess Plateau region. The Diagnosis and Recommendation Integrated System (DRIS) diagnostic results indicated that the most deficient elements were Ca and K in low-yielding orchards (<35 t·hm^{-2}) of the Bohai Bay region followed by Fe, N, and Zn; however in the Loess Plateau region, the most deficient elements were P and K followed by N, Zn, and Cu. The findings imply that the application of Ca, K, Fe, N, and Zn fertilizer should be increased in the Bohai Bay region, whereas P, K, N, Zn, and Cu fertilizer should be enhanced in the Loess Plateau region. Meanwhile, use of organic manure is recommended to improve soil quality in the two apple producing regions.

Keywords: apple; soil nutrition; leaf nutrient; nutrient deficiency; diagnosis

1. Introduction

Over the last 20 years, apple production in China has been on the rise. From 1983 to 2016, the area of the apple-tree growing increased from 0.7 to 2.4 million hm^2 (FAO, 2017). However, the fertilizer recommendations for the regions with rapidly expanding production have been lacking, resulting in farmers applying large amounts of inorganic fertilizers to ensure high yields. From 2003 to 2016, the cultivation area of apple trees in China increased by 17.4%, whereas the consumption of fertilizer grew by 208.9% (Meng et al., 2015). Subsequently, nutrient imbalances or deficiencies have been identified in apple orchards in recent years due to poor soil fertility and long-term imbalances caused by such fertilization (Shu, 2003; Yang et al., 2008; Ge et al., 2011).

Apple trees require a balanced and adequate supply of macro- and micronutrients for growth and yield. Optimum economic and sustainable apple yields can only be achieved with judicious use of fertilizers (Zhu, 2002). Nutrient disorders and deficiencies, such as nitrogen (N)/potassium (K) imbalance, K deficiency, magnesium (Mg) deficiency, and boron (B) deficiency, are common in different apple growing regions in China and affect productivity (Havlin et al., 2005). Fertilizer recommendations for apple, as for

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