

Nitrate accumulation in semiarid apple orchard on the Loess Plateau of China

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Abstract

Understanding of nitrate accumulation in soil profiles of semiarid regions is helpful to assess the environmental risks associated with nitrate. In the 5-year, 10-year and 20-year apple orchard, the nitrate accumulation were 169, 1683 and 1976 kg N ha⁻¹. A large amount of nitrate was found accumulated in the soil profile with 20-year apple orchard, and high nitrate level appears through the whole soil profile and nitrate peak appears in the top 100 cm and 300–400 cm in the soil profile. Clearly, the amount of nitrate accumulated in the soil profiles, and its tendency of downward movement, appears to potentially be an environmental risk as it may reach groundwater.

Keywords: nitrate accumulation, apple orchard, nitrate-N downward movement

1. Introduction

Apple trees started to plant across the Loess plateau since 1980, a large area of cropland converted into apple orchard. Overuse of chemical fertilizer is the major driver to increase soil productivity in the apple orchard. However, previous studies focused on the impact of fertilizer use on apple yield; few studies have considered the environmental implications of fertilizer use and specifically the impact of fertilizer use on nitrate risk

2. Material and Methods

The 5-year, 10-year and 20-year apple orchard were selected in Shaanxi Province. The soil cores were cut into 5-cm sections. Nitrate content were extracted with KCl and determined by colorimetry using a Bran & Luebbe II AutoAnalyser.

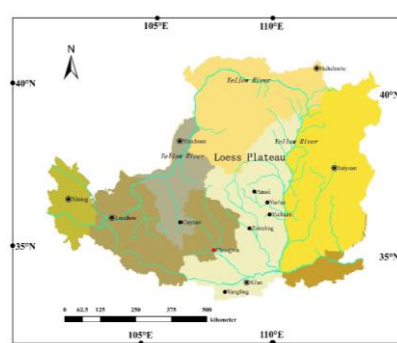


Fig. 1: The location of the study on the Loess Plateau

3. Results

3.1 Nitrate-N distribution in the soil profiles

Nitrate-N content of the soil profile was ranging from 1.2 to 9.1 mg kg⁻¹, 1.54 to 80.2 mg kg⁻¹, and 0.3 to 77.2 mg kg⁻¹ in 5-year, 10-year and 20-year apple orchard, respectively. The peak nitrate-N content for the topsoil was appeared in the 5-years apple orchard, and in 10-years apple orchard for the deep soil.

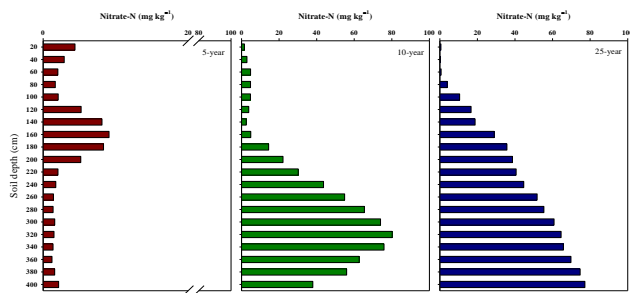


Fig. 2 Nitrate-N concentration in the soil profiles.

3.2 Nitrate-N accumulation in the soil profiles

Nitrate accumulation was significantly increased with the extension of orchard planting years. Nitrate accumulation in 10-year and 20-year apple orchard were 10 times and 12 times that of it in 5-year apple orchard. High nitrate level appeared through the whole soil profile and nitrate peak appears in the 100-200 cm in 5-year apple orchard, and 300–400 cm in 10-year or 20-year apple orchard.

Table 1 The amount of nitrate-N accumulated in the soil profiles

	Nitrate-N accumulated (kg N ha ⁻¹)				Total
	0-100	100-200	200-300	300-400	
5-year	34.0	93.5	21.3	20.3	169.1
10-year	48.9	124.3	697.2	812.7	1683.1
25-year	41.6	360.8	658.6	915.3	1976.3

3.3 Nitrate-N downward movement

Nitrate peak appears in 5-year apple orchard was appeared at about 150 (9.09 mg kg⁻¹) cm, whereas it appears at 320 cm (80.2 mg kg⁻¹), and 400 cm (77.2 mg kg⁻¹), respectively.

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