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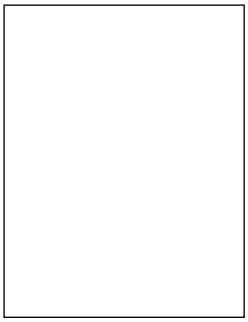

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PII: S1002-0160(17)60303-5
DOI: 10.1016/S1002-0160(17)60303-5
Reference: NA

To appear in:

Received date: NA
Revised date: NA
Accepted date: NA

Please cite this article as: LI Pengcheng, DONG Helin, LIU Aizhong, LIU Jingran, SUN Miao, LI Yabing, LIU Shaodong, ZHAO Xinhua and MAO Shuchun, Effects of Nitrogen Rate and Split Application Ratio on Nitrogen Use and Soil Nitrogen Balance in Cotton Field, *Pedosphere* (2017), 10.1016/S1002-0160(17)60303-5.

PEDOSPHERE

Pedosphere ISSN 1002-0160/CN 32-1315/P doi:10.1016/S1002-0160(17)60303-5

Effects of Nitrogen Rate and Split Application Ratio on Nitrogen Use and Soil Nitrogen Balance in Cotton Field

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ABSTRACT

The Yellow River valley is one of the three largest cotton production areas in China. An experiment was performed in cotton field of Anyang, China from 2013 to 2014 to investigate the effects of nitrogen (N) application rate and the ratio between basal and topdressing N fertilizer on N balance in a soil-plant system, N use efficiency, and cotton yield. Five N rates of 0 (N0), 90 (N90), 180 (N180), 270 (N270), and 360 kg ha^{-1} (N360) were applied with the split ratio of 5/5 (50% basal fertilizer and 50% topdressing fertilizer) and additional 2 split N application ratios of 30%:70% (3/7) and 70%:30% (7/3) at N rate of 270 kg ha^{-1} were set in cotton field. The treatments were recorded as N0, N90 (5/5), N180 (5/5), N270 (5/5), N270 (3/7), N270 (7/3) and N360 (5/5). The results demonstrated that soil NH_4-N content in the 0--60 cm layer and NO_3-N content in the 0--20 cm layer increased with increased N rate at the squaring and boll-opening stages, and then decreased to lower levels at the initial flowering and harvest stages. Soil NO_3-N content in the 20--60 cm layer after the initial flowering stage increased with the increase of topdressing N rate. Soil apparent N surplus varied at different growth stages while the soil apparent N surplus over the entire growth period exhibited a positive relationship at N rates over 180 kg ha^{-1}. Seed cotton yield with N270 (3/7) was the highest of all treatments. Plant N uptake, N agronomic efficiency, and apparent N recovery efficiency of N270 (3/7) were significantly higher than those of N270 (5/5) and N270 (7/3) in both growing seasons. The results suggest both economic and ecological benefits in cotton production in the Yellow River valley could be created, by appropriately reducing total N application rate and increasing the ratio of topdressing to basal N fertilizer at the initial flowering stage.

Key Words: apparent N recovery efficiency, crop yield, N agronomic efficiency, N fertilizer, plant growth, soil apparent N surplus

INTRODUCTION

Nitrogen (N) is one of the most important factors limiting plant growth (Cao *et al.*, 1991; Mokhele *et al.*, 2012) and generally acts as the most important nutrient for enhancing cotton yield (Dong *et al.*, 2012). An adequate supply of N is essential for optimal growth and yield of cotton crops (Boquet and Breitenbeck, 2000). Plant growth and crop production strongly depend on the soil N supply capacity (Chen and Qin, 1995; Zhang *et al.*, 2006; Li *et al.*, 2014). A higher N supply to the soil will lead to higher dependence of crops on the soil and a lower N fertilizer recovery. Sustainable soil and crop management has an effect on reducing soil erosion and N leaching, conserving soil organic matter (Cui *et al.*, 2008), and optimizing cotton yields, but these issues remain a major challenge in current cotton cultivation (Sainju *et al.*, 2006). The extra N is often the major contributor to high-pollution environments, resulting in threats to surface and ground water

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