PLANT NUTRITION AND FERT

ISSN 1008-505X
CN 11-3996/S

植物营养与肥料学报 » 2008, Vol. 14 » Issue (2) :242-251 DOI:

黄土旱塬不同施肥水平下麦玉轮作的产量与土壤水分效应模拟研究

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Modeling the effects of winter wheat and spring maize rotation under different fertilization treatments on yield and soil water in rain-fed highland of Loess Plateau

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摘要 在模拟精度验证基础上，应用WinEPIC模型模拟研究了黄土高原旱塬地1957—1998年期间不同施肥水平下麦玉轮作方式“春玉米→春玉米→冬小麦→冬小麦→冬小麦→冬小麦”的产量变化和土壤水分效应。模拟结果表明：1）无肥、低肥、中肥和高肥处理下，麦玉轮作方式的模拟产量均呈现波动性降低趋势，其平均值分别为1.573、3.272、3.877和4.318 t/hm2，其适宜的施肥量范围为N 90～120 kg/hm2、P 30～60 kg/hm2；2）4种施肥处理下，麦玉轮作田逐月土壤有效含水量均呈现波动性降低趋势，平均每年分别减少8.5、10.3、12.3和12.0 mm，无肥、低肥和中肥处理间土壤有效含水量差异十分显著；3）在模拟初期（1957—1962）出现了土壤湿度逐年降低、土壤干层逐年加厚的干燥化过程，在模拟中后期（1975—1980，1993—1998）均出现了稳定的土壤干层，无肥和低肥处理土壤干层分布于2—3和2—4 m土层，中肥和高肥肥处理均分布于2—5 m土层，表现出随肥力和作物产量水平的提高，土壤干层厚度逐渐加深。

关键词： 黄土高原 作物轮作 WinEPIC模型 产量 施肥 土壤水分 黄土高原 作物轮作 WinEPIC模型 产量 施肥 土壤水分

Abstract:

The WinEPIC model was used to simulate the effects of winter wheat and spring maize rotation “spring maize→spring maize→winter wheat→winter wheat→winter wheat→winter wheat” under different level fertilization treatments on yield and soil water at Changwu rainfed highland of the Loess Plateau. The results showed that the simulated crop yield of the wheat-maize rotation under no fertilization, low fertilization, medium fertilization and high fertilization treatment decreased significantly with fluctuation, and the average yield was 1.573, 3.272, 3.877 and 4.138 t/ha, respectively. The suitable fertilization rates were N at 90−120 kg/ha and P_2O_5 at 30−60 kg/ha. Simulated monthly available soil water amount of all 4 fertilization treatments declined with annual and seasonal fluctuations, and the average annual decreasing rate was 8.5, 10.3, 12.3 and 12.0 mm, respectively. Differences of soil water amount among no fertilization, low fertilization and medium fertilization treatments were very significant. Soil moisture decreased and desiccated soil layers thickened gradually at the beginning of simulation (1957−1962). Stable desiccated soil layers occurred during middle (1975−1980) and end (1993−1998) of simulation. Distribution depth of desiccated soil layers was 2−3 m of no fertilization treatment, 2−4 m of low fertilization treatment and 2−5 m of both medium and high fertilization treatments, indicating that desiccated soil layers thickened with increasing fertilization and crop yield.

Keywords:

Received 2007-03-15;

引用本文:

王学春[1]， 李 军[1,2*]， 樊廷录[3].黄土旱塬不同施肥水平下麦玉轮作的产量与土壤水分效应模拟研究
[J] 植物营养与肥料学报, 2008,V14(2): 242-251

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[J] Acta Metallurgica Sinica, 2008,V14(2): 242-251