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基于土壤水盐阈值的河套灌区玉米灌水制度

Irrigation schedule for maize based on soil moisture and salt content threshold in Hetao irrigation district

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中文摘要:

在引黄水量大幅减少且大范围实施节水工程的条件下，为使农田水土环境仍能保持良性健康发展，该文以内蒙古河套灌区隆胜试验区为研究对象，开展引黄灌区玉米生育期适宜灌水决策模拟研究。在田间试验的基础上，对土壤含水率和土壤含盐量的观测数据进行了统计分析，土壤含水率与含盐量观测值均呈中度变异性。利用克里格插值方法按土壤表层盐分空间变异将研究区分为南北2个区，分别在2个区域内建立了土壤水盐数值模型SWAP，分别对2个区域的土壤水盐模型进行了率定与检验。根据相关研究结果和研究区多年实测值综合得到不同生育期的农田生态安全阈值，即土壤含水率的适宜值与作物耐盐阈值（以土壤含盐量阈值表示）。以土壤含水率与土壤含盐量阈值为限制因子，以节水控盐为目的，利用率定与检验后的SWAP模型模拟了不同灌水量条件下玉米不同生育阶段的土壤含水率、含盐量变化，预测了不同水文年满足玉米生长的土壤水盐安全阈值的用水方案，从精细微观的角度提出相应水文年农田水土环境安全用水范围值。基于SWAP模型的决策结果：枯水年（降雨量90 mm）安全用水量为263～311 mm；平水年（降雨量140 mm）198～227 mm；丰水年（降雨量200 mm）106～138 mm；各水文年的用水量较基准年（枯水年）的节水指数分别为：0.01～0.17、0.04～0.16和0.06～0.27。成果可为当地及相近地区农田水土环境可持续发展提供科学依据，对于河套灌区农业生产和水资源的开发利用具有重要的意义。

英文摘要:

Abstract: Water shortage and soil secondary salinization seriously affect agricultural production in the arid areas of North China. Under the conditions of sharp reduction in the amount of water used from the Yellow River and large scale implement of water saving program, it is important to maintain a farmland ecological environment and soil health. The objective of this research was to use SWAP model to simulate optimal water use for corn during its entire growing season. The Longshen experimental area in Hetao Irrigation District was selected as the area for the research. The experimental area was further divided into south district and north district according to the spatial variation of soil salinity data collected in combination with calculation using geostatistical method of kriging interpolation. A soil water-salinity numerical model SWAP was established in both the districts. After calibration and validation, the model was used to simulate the soil water and salinity content across various hydrological years under different quantity of irrigation water in various maize growing stages, and to predict the minimum amount of water needed for irrigation to achieve the minimum salt accumulation in soil under different hydrological years. Meanwhile, the safety thresholds of soil water and salinity content for farmland at different growth stages were established to save water and control salt content by analyzing the related literatures. The safety thresholds were the maximum values of the soil moisture and salt that crops could tolerate. The range values of the safety water using amount were put forward for the field water and soil environment under different hydrological years from a exquisite and microcosmic perspective. The results predicted by the SWAP model showed that the water consumption in low flow year (precipitation ≤90 mm) was 263-311 mm, and the water consumption in normal flow year (precipitation ≤140 mm) was 198-227 mm, but the water consumption in high flow year (precipitation ≤200 mm) was 106-138 mm. The water saving index in the low flow, normal and the high flow year comparing with the baseline year (precipitation ≤90 mm) were: 0.01-0.17, 0.04-0.16 and 0.06-0.27, respectively. The results above provided information for sustainable use of water for irrigation in the farmland of local and nearby areas. It will be of great significance not only for the agricultural production and utilization, but also for the development of water resources in Hetao irrigation district.

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