罗 纨,李 山,贾忠华,刘文龙,潘延鑫,武 迪.兼顾农业生产与环境保护的农田控制排水研究进展[J].农业工程学报,2013,29(16):1-6

兼顾农业生产与环境保护的农田控制排水研究进展

Advances in research of controlled drainage for crop production and environmental protection

投稿时间： 2012-12-26 最后修改时间： 2013-07-26

中文关键词：排水,水质,灌溉,水位管理,盐分,节水

英文关键词:drainage water quality irrigation water table management salinity water saving

基金项目:国家自然科学基金（51079122）；水利部公益性行业科研专项经费项目（201201005）

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中文摘要:

农田控制排水（又称地下水位管理）是一种通过调控农田排水量以达到减少污染物输出并保证农业生产的环境友好型水管理措施。该措施的发展经历了不同的阶段，从最早的保墒增产到后来的污染物削减以及节约灌溉用水等功能，对其研究和应用的不断深入，对于变化环境下农田排水的设计和管理都具有重要意义。该文回顾了农田控制排水发展的历史，阐述了该措施的各项功能及其研究方法和应用特点。结果认为，农田控制排水是新形势下农田排水的必要手段，通过对排水出口水位的调控可以达到调节农田水分，减少营养物流失，节约灌溉用水，增加雨水资源利用等多重目的，是存在排水问题地区农业生产可持续发展的最佳水管理措施。目前各地对于控制排水研究的热点问题是寻求一种适合当地农业生产形式的排水水位调控方案，使其具有可操作性、易于推广。

英文摘要:

Abstract: Controlled drainage, also known as water table management, is an environmental friendly agricultural water management practice. It has been widely advocated in recent years to reduce drainage discharge in order to reduce agricultural non-point source pollution while ensuring crop production. Further research and application of the controlled drainage are of great importance to drainage system design and water management in a changing environment. In this paper, we reviewed the development history, multiple functions and research advances of the controlled drainage in China and the world. The development of controlled drainage technique has experienced several stages, advancing from its original purpose of water conservation to later goals of nutrient loss reduction, and irrigation water saving etc. Implementation of controlled drainage can be performed easily with water level control structures installed at the outlet of drainage ditch or pipe. However, properly schedule water level adjustment at the outlet remains a challenge, considering the variable weather conditions and different crop drainage requirements. In saline agricultural environment, controlled drainage has to meet the requirement of salinity control. Existing research has demonstrated that controlled drainage can achieve multiple benefits in reducing nutrient losses and conserving water in humid regions, and controlling soil salinity and saving irrigation water in arid and semi-arid regions. Controlled drainage in coastal regions has additional benefits of reducing rain water losses and lowering the risk of salt water intrusion. While controlled drainage research in China is relatively lagged behind, this water table management technique has long been used by grass root farmers to reduce drainage intensity for less irrigation requirement. For many areas in China, where rice and dry foot crop are rotationally cultured, controlled drainage has the advantages of adjusting drainage intensity flexibly to meet moisture level requirement of different crops. The present need in controlled drainage is to make appropriate water level control schedules that are easy to implement and consistent with local crop production requirement. Computer modeling has been widely used to examine long term effect of controlled drainage on hydrology and nitrogen losses. DRAINMOD model is the mostly used simulation tool that predicts outcome of different drainage system layout under variable weather, soil and cropping conditions; the nitrogen module-DRAINMOD_NII enables the model to predict nitrogen losses from drained agricultural fields under different water management, tillage and fertilization practices. Lacking of field observations is the major obstacle in applying modeling approach for controlled drainage research in China. In summary, we conclude that controlled drainage is a necessary practice for modern agricultural drainage; providing benefits in regulating soil moisture in the drained fields, reducing nutrient losses, saving irrigation water use and increasing rainwater use, controlled drainage is the best practice for drainage water management for sustainable agricultural development.

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