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Condition in the Greenhouse Based on the Entropy Evaluation Method

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Abstract

When developing an appropriate agricultural water conservation project, numerous plant-soil system indicators should be considered. The entropy evaluation method has great potential for improving agricultural management strategies. The tomato was used as the plant material to investigate the effect of different buried depths of subsurface drainage pipes (30, 45, 60, 75, 90, and 105 cm) on greenhouse plant-soil systems. The tomato's marketable yield, fruit sugar to acid ratio, soil electrical conductivity, nitrogen loss rate, and crop water and fertilizer use efficiency were all observed. The entropy evaluation method was used to choose the best buried depth for subsurface drainage pipes based on these indicators. Tomato yield and soil electrical conductivity had comprehensive weights of 0.43 and 0.34, respectively, in both the objective and subjective weights calculations, indicating that they were more important than other indices.

Keywords: Drainage pipes • Entropy evaluation • Tomato yield

Introduction

Waterlogging catastrophes have a significant impact on the productivity of irrigated agriculture, primarily as a result of rising water consumption, low water use efficiency, and poor natural drainage conditions. There are currently three widespread strategies worldwide: Subsurface drainage, vertical well drainage, and ditch drainage. In terms of lowering the level of groundwater, subsurface drainage is superior to ditch drainage. Additionally, the subsurface pipe takes up less space, which is advantageous for mechanized operations. Subsurface drainage, which first appeared in the United Kingdom and was later widely adopted by the United States, the Soviet Union, Japan, the Netherlands, Czechoslovakia, and Poland, regulates the status of water, fertilizer, gas, and heat in soil, thereby increasing crop productivity and expanding the area of cultivated land. As a result, introducing and promoting new technology like subsurface drainage can play an important role in the sustainable development of irrigation agriculture. Subsurface drainage was initially utilized to lower the level of ground water. Subsurface drainage has so far been successful at getting rid of salt and water. Subsurface drainage has been widely used in coastal waterlogging and shallow saline-alkali areas in Zhejiang, Shandong, Xinjiang, and Ningxia. Subsurface drainage reduces salt because "salt comes along with water and salt goes with water" is a common saying in China.

Discussion

The deep soil layer is penetrated by the fully dissolved salt, which is then discharged through the drain pipe. As a result, the salt content of the soil is effectively reduced, the level of groundwater is controlled, and the physical and chemical properties of the soil are improved. The management of subsurface drainage has the potential to alter the state of farmland sludge brought on by waterlogging, increase the activity of soil microorganisms, encourage the deep rooting of crop roots, make it easier for deep soil nutrients to be absorbed, and speed up the process by which crops grow. Subsurface drainage results in the following after the farmland's surface water is quickly removed: boosting the earth's temperature and enhancing the soil's aeration; boosting the activity of soil microbes, enhancing the effectiveness of fertilizer, encouraging crop root growth, and increasing yield [1,2].

The layout of the subsurface drainage pipe is determined by a number of indicators; typically, pre-experiments should be carried out at an early stage of the construction of agricultural water conservation structures. Several indicators, including crop yield, quality, soil salinity and nutrient distribution, and groundwater level, are typically observed in the pre-experiment under various layout schemes of subsurface drainage. The optimization of subsurface drainage plans will become a decision-making issue with multiple objectives and multiple indexes as a result of the large number of indicators and schemes. It is necessary to rely on statistical methods like the entropy weight method, the projection pursuit method, and the principal component analysis method when subjective judgments cannot determine the most effective drainage pipe layout. The basic tenet of the entropy method states that a higher degree of variation in the index value will result in a lower information entropy, a higher weight, and more information. On the other hand, a more modest level of distinction in the record esteem produces more noteworthy data entropy, and this file has a more modest weight and gives less data. Because the entropy weight method is based on actual project data, both the decision result and the calculation result will be more objective. The entropy method is widely used to solve multi-objective decision-making problems due to its simplicity [3-5].

Conclusion

Our initial experiments showed that greenhouse saline soils could be improved by subsurface drainage. However, the depth needs to be further calibrated because the initial experiments only included two levels of drainage pipe buried depth. The comprehensive effects of various buried depths on subsurface drainage were evaluated using the entropy weight method in this study. In order to serve as a theoretical basis for local practice in scheduling the layout scheme of subsurface drainage and to evaluate the effects of the entropy method in developing agricultural water management schemes, the purpose of this study was to determine the optimal buried depth of drainage pipes and provide references for other projects that are comparable.

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Conflict of Interest

None.

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