

基础类成果

现代灌溉水肥精量调控 机理与方法

【创新性】

突破单一空间尺度水肥诊断的局限性，首次提出卫星-无人机-地面联合的天地一体化作物水肥状况监测技术，建立非均匀地表条件下区域作物灌溉施肥决策技术；首次揭示不同形态养分运移特性的差异及动力学机制，提出滴灌均匀系数分区标准，构建了面向水肥利用全过程和水肥气热多要素的滴灌水肥精量调控理论；建成国内首套具有自主知识产权的变量灌溉系统，首次提出采用差异化灌水下限生成灌溉分区处方图的非充分变量灌溉技术，发明变量水深精准控制方法和传感器布置准则；发展了畦田施肥灌溉地表水流溶质运动模拟方法，创建了基于浅水方程组数学结构改性的地表非恒定流模拟方法，解决了难以模拟撒施条件下水流-溶质运动的难题。

【影响力】

成果被国际农业工程学会、国际肥料工业协会、美国土木工程学会、美国农业与生物工程学会、美国农学会等国际权威学会纳入实用技术手册。发表论文 200 余篇，SCI 收录 70 余篇，“drip irrigation”和“uniformity”方向的论文数量世界范围内排名第一，“fertigation”方向论文数量世界范围内排名第二，单篇论文 SCI 引用最高达 142 次。获发明专利 20 项，软件著作权 30 件。成果被 9 项国家/行业标准吸收或采纳。获得国际灌排委员会节水技术奖 1 项、国际微灌奖 1 项、国家科技进步二等奖 2 项、省部级一等奖 4 项，团队成员入选国家“万人计划”科技创新领军人才。

主要完成人：李久生、栗岩峰、白美健、赵伟霞、魏征
受奖单位：水利所

THE MECHANISM AND METHOD FOR PRECISE REGULATION OF WATER AND FERTILIZER IN MODERN IRRIGATION

【Innovation】

It broke the limitations of water and fertilizer diagnosis in single spatial scales, initially proposed monitoring technology for the water and fertilizer status of crops with satellite-drone-ground integration, and developed irrigation and fertilization decision-making technology for regional crops under non-uniform surface conditions; revealed the differences of transport properties of nutrients in different forms and their dynamic mechanisms for the first time, put forward the partitioning criteria for the drip irrigation uniformity coefficient, and built the precise water and fertilizer regulation theory for drip irrigation facing the whole process of water and fertilizer utilization and multiple elements, such as water, fertilizers, gas, heat, etc.; established China's first variable rate irrigation system with independent property rights, initially proposed insufficient variable rate irrigation technology that adopts differentiated lower limits of irrigation to produce the irrigation partition prescription maps, and invented the precise control method for variable water depth and the norms of sensor layout; developed the simulation method for the surface flow solute movement of border fertilization and irrigation, created the unsteady flow simulation method for the surface based on the mathematical structure modification of shallow water equations, and solved the problem of the water-solute movement under the condition where the broadcast application is hardly simulated.

【Influence】

The research achievements have been included into the practical technical manuals of international authoritative institutions, such as the International Commission of Agricultural Engineering, the International Fertilizer Industry Association, the American Society of Civil Engineers, the American Society of Agricultural and Biological Engineers, the American Society of Agronomy, etc.; the project issued nearly 200 papers, of which 70 were included into SCI, and the number of papers relating to drip irrigation and uniformity ranked No. 1 worldwide while that relating to fertigation ranked No. 2 worldwide. A single paper has been cited for at most 142 times by SCI. It obtained 20 invention patents and 30 software copyrights. Its achievements have been absorbed or adopted by nine national/industrial standards. The project won one water-saving technology award conferred by the International Commission on Irrigation and Drainage, one Microirrigation Award, two second prizes of the National Science and Technology Progress Award and four provincial and ministerial first prizes, while the team members were selected as leading talents in scientific innovation under the country's Ten-thousand Talents Program.

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