


国家水稻科技工程系列著作



水稻抗涝研究与减灾技术

Shuidao Kanglaoyanjiu yu Jianzai Jishu

汪汉林等/著

 湖南科学技术出版社

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序

袁隆平

“水稻大面积高产综合配套技术研究、开发与示范”(95-001-01,简称国家水稻科技工程)课题,系国家“九五”重中之重的科技攻关项目,由湖南省科学技术厅组织实施。课题共设置了“优质食用稻高产综合配套技术研究示范”、“高蛋白饲料稻高产综合配套技术研究开发”、“双季稻高产栽培技术体系研究与示范”、“水稻抗灾减灾应用技术研究示范”、“水稻大面积高产优质高效技术开发示范及其产业化工程”五大专题,同时选择了“优质高产早籼良种”、“高蛋白超高产早籼良种”、“亚种间超高产杂交晚稻新组合”和“双季稻超高产栽培技术”四项难题面向全国公开招标。选定湖南省醴陵、湘乡、临澧三个县(市)为重点示范基地,建立了 667hm² 超高产样板田、6 667 hm² 试验区、66 667 hm² 示范区和拓展到周边县(市)的 666 667 hm² 辐射区。

针对课题研究起点高、科技攻关任务重、开发示范规模大的特点,相继成立了由湖南省人民政府副省长潘贵玉同志任组长的课题协作领导小组,由湖南省农业科学院副院长青先国研究员为主持人的课题研究协作组。组织了水稻育种、栽培、土壤、肥料、植保、生理、生态、畜牧、农机、农产品加工和农业经济、科技管理、计算机应用等近 20 个学科的 200 多位专家和技术干部,进行多学科、多层次的科技攻关研究和开发示范。其规模之大、内容之广、影响之深在湖南省是前所未有的。

五年来,在国家科技部大力支持和湖南省课题协作领导小组的组织下,200多位科技工作者进行了卓有成效的工作,攻关研究取得重大进展。首先,加大了品种选育、筛选的力度,培育筛选出具有很强市场竞争力、广泛生态适应性的一批优质食用稻、高蛋白饲料稻高产品种和抗旱、抗涝、抗寒水稻高产良种,为促进我国南方稻区水稻品种结构优化,确保大面积高产稳产奠定了坚实基础。其次,成功地研制了优质食用稻、高蛋白饲料稻高产综合开发技术体系。在优化组装优质食用稻、高蛋白饲料稻高产栽培技术体系及其相应技术规范的同时,在特种优质组合米配方、高蛋白“糙米型”优化饲料配方研究以及深加工技术方面取得突破,为食用稻、高蛋白饲料稻产业开发提供了强有力的技术支撑。第三,在一次性施肥和全程化控等单项技术取得突破的基础上,配套形成了双季稻超高产综合栽培技术体系,探明了高产双季稻产量形成的机理,建立了相应的双季稻超高产栽培与管理的专家决策支持系统,以促进水稻生产管理的科学化、标准化、规范化和信息化,确保双季稻大面积高产与高效。第四,在探明双季稻地区干旱、洪涝、寒害发生发展规律的同时,研究出了水稻抗旱减灾、抗涝减灾、抗寒减灾的综合配套技术体系,为水稻抗灾减灾提供了技术保证。第五,将现有攻关研究取得的突破性关键技术进行高度集成、优化组装、综合配套和推广应用,建立了21世纪水稻高标准超高产样板田、高产试验区、高产示范区和高产辐射区,在更高水平、更大规模上提高了科技在水稻生产中的贡献率和显示度。

《国家水稻科技工程系列著作》共分10册,200多万字,有学术专著、论文集和科普著作三种形式,概括总结了五大专题、四项难题、三个基点示范县(市)攻关研究的成果。全书凝聚了100多位中青年作者的智慧和汗水,体现了作者坚持理论联系实际、团结协作、脚踏实地、潜心研究、献身科学的精神。书中内容丰富,观点明确,逻辑严密,可读性强。从学术理论的角度阐述了许多新思想、新观点,同时在生产实践应用方面介绍了许多新技术、新方

法,攻关研究的科技创新意识融于书中。《国家水稻科技工程系列著作》的出版,对湖南省乃至我国南方双季稻区水稻高产优质高效生产和产业化开发的理论和实践具有重要指导意义,同时也有利于加强与国内外同仁的交流与合作。

2001年3月

(序作者袁隆平为中国工程院院士)

Preface

Yuan Longping

The Program—The Exploitation and Demonstration of the Study on the Synthetic and Supporting, Package Techniques of the High Yield Rice over an Extensive Area (in brief ,The National Rice Scientific Project) ,being organized by Hunan Scientific and Technical Committee , is a great scientific research program which is one of the focal points of “Ninth-Five-Year plan”. It contains five special subjects ,namely “The Study , Demonstration and Exploitation of the Package Techniques of the High Output of High Quality Edible Rice”; “The Study ,Demonstration and Exploitation of the Package Techniques of the High Output of High Protein Forage Rice”; “The Study , Demonstration and Exploitation of the Systematic Culture Techniques for Super-high yield of Double Harvest Rice”; “The Study ,Demonstration and Exploitation of the Application Techniques of Rice Plague-resistance”, and “The Study , Demonstration and Exploitation of the Techniques of High Quality , High Efficiency , and High Yield Rice over an Extensive Area & The Industrialization Project”.Meanwhile ,four difficult items ,I .e . “Improved Variety of Early Season Indica Rice with High Quality and High Yield” , “Improved Variety of Early Season Indica Rice with High Pro-

tein and Super-high Yield", "New Combination of Super-high Yield Late Season Hybrid Rice of Inter-subspecies", and "Culture Techniques of Super-high Yield Double Harvest Rice", have been identified and selected after nationwide competition. The three counties of Hunan Province, i.e. Liling, Xiangxiang and Linli are chosen to be key experimental and demonstration bases. And the super-high yield standard demonstration field with 667hm², the experimental area with 6 667hm², the demonstration area with 66 667hm² and the extensive demonstration area reaching up to the neighboring counties with 666 667hm² have been set up.

In view of the characteristics of program as high starting point, heavy tasks of surmounting scientific difficulties and wide scope of exploitation and demonstration, a provincial level coordinating and leading committee headed by Mrs. Pan Guiyu, Vice Governor of Hunan Province, and a cooperating group headed by Mr. Qing Xianguo, a senior scientist and deputy president of Hunan Academy of Agricultural Sciences, have been formed in succession. More than two hundred experts and specialists from nearly twenty subjects including rice breeding, planting, soil & manure, plant protection, physiology, ecology, husbandry, agricultural machinery, agricultural products processing, agricultural economy, scientific and technical administration, computer are involved to carry out the scientific research and exploitation with multi-disciplinary approach under different gradations. The program is hitherto unknown because of high standard, broad scale but great influence not only in Hunan Province but also nationwide.

Under the leadership of the provincial coordinating and leading committee, over two hundred scientists and technicians have achieved remarkable success and made great progress in five years. Firstly, a batch of high quality edible rice, high yielding variety of high protein

forage rice and improved variety of high yield rice with drought ,flood and cold-resistance has been released and commercialized . They have wider ecological adaptability and great market competition ability . Their work has laid a solid foundation for the promotion of rice variety structure in the rice area of Southern China and can guarantee high and stable yield of rice over an extensive area . Secondly ,a technical system has been successfully developed to exploit the high quality edible rice and high yield & high protein forage rice . The high yield culture technique system of high quality edible rice and high protein forage rice and their corresponding technical standards have been improved . Also , great breakthroughs have been achieved in the betterment of the formulation of special high quality series of rice ,the study of improving the formula of high protein “brown-rice-type” forage and the techniques of deep and refining processing . For this , strong technical support has been provided for the exploitation and industrialization of high quality edible rice and high protein forage rice . Thirdly ,based on the achievements in the individual techniques such as once-for-all fertilizing and chemical regulation in the whole growth stages ,synthetically culture technique system of super-high yield double harvest rice has been formed ;the mechanism of formation of the high output of double harvest rice has been ascertained ;a corresponding policy-making supporting in the culture of high yield double harvest rice system formed by the experts and an administration has been established ,which can make the administration of rice production standardized ,normalized and informed . Thus the high output and efficiency of double harvest rice can be ensured . Forth ,the frequency of the occurrence and development of drought ,flood and frigid in the double harvest rice area has been verified and at the same time a synthetically supporting technique system has been developed to resist those disasters and reduce the damage by

them , which provides technical guarantee for the resistance and reduction of the disasters .Fifth ,the key techniques considered as breakthroughs that have been achieved in the research have been highly integrated ,improved ,synthesized ,disseminated ,and applied .Hence high standard and super-high yield rice demonstration field for twenty-first century ,high yield rice experimental area ,high yield rice demonstration area and high yield rice extensive area have been set up .In such a way ,the devotion and application of techniques in rice production have been improved to higher level and wider scope .

A Series of Works of the National Rice Scientific Project consists of ten volumes ,over two million words . It contains monographs ,theses and scientific writings and summarizes five special subjects ,four difficult items and the achievements made in the research at the three key experimental and demonstration bases . It is written with the wisdom and hard work of more than one hundred young and middle-aged authors . Authors insist on integrate theories with practice , unite and cooperate with each other ,and reflect their spirits of a down-to earth style of work , concentrating on their studies and devoting themselves to scientific research throughout the book . The book is rich in contents and clear in views and it is quite logical and surely readable . Many new ideas and views are elaborated from the point of probing into academic theories . Lots of new techniques and methods about rice production as well as the application of theories are introduced . The sense of making scientific innovations is reflected throughout the book . A Series of Works of the National Rice Scientific Project Publication can be a great directive towards the high output , high quality and efficient rice production in the double harvest rice area of Hunan Province as well as the south of China . It has a great importance in directing the theories of rice industrialization and exploitation as well as the commercialization .Moreover it will

help in enhancing the exchange of idea and cooperation with colleagues at home and abroad .

March ,2001

(Yuan Longping :academician from China National Academic Engineering)

前 言

水稻是世界上种植面积仅次于小麦、总产量最高的主要粮食作物。全球水稻种植面积 1.42 亿 hm^2 , 约占粮食作物总面积的 21%; 稻谷总产量 3454 亿 kg , 约占粮食作物总产量的 26%。

水稻是我国种植面积最大, 总产量最高的主要粮食作物, 全国有 60% 的人口以稻米为食。我国水稻常年种植面积约 3300 万 hm^2 , 占世界水稻总面积的 23.2%, 占我国粮食作物总种植面积的 40%; 总产量约 1800 亿 kg , 占世界水稻总产量的 52%, 占我国粮食作物总产量的 50%。

洪涝灾害是人类所面临的严重自然灾害之一。据联合国粮农组织的报告和国际土壤学协会绘制的世界土壤图估算, 全球水分涝渍胁迫土壤约占 12%。我国自 1951~2000 年的统计资料表明: 全国平均每年受涝面积为 830 万 hm^2 , 其中成灾面积 455 万 hm^2 , 平均每年损失粮食约 30 亿 kg , 直接经济损失 120 亿~220 亿元。

我国的洪涝灾害大多分布在我国南方多雨潮湿的江河谷地、平原湖区和北方的低洼沼泽地带。因此, 水稻涝渍灾害是关系到我国乃至世界粮食生产安全的大问题, 水稻的抗涝减灾越来越受到人们尤其是农业科技工作者的关注和重视。

目前, 世界上一些国家防洪抗涝大多以疏通河道、修筑水库和开沟排水等工程措施为主, 栽培措施仅限于深水稻。几十年来, 我国在防洪抗涝方面取得了一定的成绩, 为我国水稻的保收增产、确保粮食生产安全打下了较坚实的基础。在洪涝灾害的基础理论方面, 不少学者进行了专题研究, 基本弄清了洪涝的类型、成因、时空分布和危害机理。与此同时, 对水稻耐涝品种的培育、品

种的耐涝机制以及抗涝减灾技术措施也进行了探讨,但由于起步较晚,对这项工作还缺乏深入的、系统的研究。如在水稻涝害的次生胁迫方面还研究得甚少;在抗涝减灾技术方面,还没有一套用于生产实际的行之有效的技术,特别是生物技术。

“水稻抗涝研究与减灾技术”是国家“九五”重大科技攻关项目——水稻大面积高产综合配套技术研究开发与示范课题的专题之一。经过“九五”、“十五”(8年)的研究,圆满完成了课题的设计任务,取得了一些阶段性成果并整理撰写成本书。

本书共五章。第一章,作物洪涝灾害总论。第一、第二节从作物的最基本要素水分着笔,论述了水分、农业降水与作物的关系。第三节阐明了洪涝灾害的概念;论述了我国洪涝的类型、成因、指标、时空分布特征和防御措施。第四节简单明了地叙述了水稻的抗涝与减灾。第二章,水稻抗涝减灾的研究回顾。介绍了水稻抗涝减灾的研究目的、意义、背景和经过,概括了所取得的阶段性研究成果。第三章,水稻抗涝减灾的理论与技术。第一节介绍了水稻洪涝灾害的现状与研究动态,论述了避洪农业与生态农业减灾;进而以湖南为例,论述了湖南农业的洪涝灾害问题及对策。第二节论述了水稻耐淹涝特性及其与亲本的关系;洪涝灾害的次生胁迫危害;水稻洪涝胁迫后的生理生化特性特征变化。第三节论述了淹涝胁迫条件下的水稻高产栽培技术、优化施肥技术、病虫害防治技术以及灾后补救措施;进而形成了一套“壮苗、旺根、储糖、控芽”以及“低氮高钾”、“灾后补救”的水稻抗涝减灾技术体系。与此同时,还论述了应用分子育种技术,提出了选育耐涝水稻品种的理论和方法。第四章,不同地貌类型水稻抗涝减灾的效应。介绍了江河谷地型、平原湖区型、低洼沼泽型和湖滩洲地型四种地貌类型稻田抗涝减灾的技术效应。第五章,水稻抗涝减灾的应用前景。介绍了水稻抗涝减灾的应用形势和抗涝减灾技术在两省(湖南、湖北)六个基点的应用效果。

由于我们的研究起步较晚,本研究无论是基础理论,还是

应用技术;无论是广度还是深度均存在不够,还有很多问题需要继续进行研究;又由于我们的水平有限,本书的撰写一定存在不少缺陷,需要继续完善,故我们恳切希望各位专家、同行友好多提意见,促进水稻抗涝研究与减灾技术向纵深发展。

著 者

2006 年 9 月

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