


国家水稻科技工程系列著作



水稻一次性 全层施肥法

shuidao yicixing quanceng shifeifa

张杨珠 黄运湘 李合松 等 / 著

 湖南科学技术出版社

国家水稻科技工程系列著作



水稻一次性 全层施肥法

湖南科学技术出版社

国家水稻科技工程系列著作

水稻一次性全层施肥法

著 者:张杨珠 黄运湘 李合松等著

责任编辑:陈澧晖

出版发行:湖南科学技术出版社

社 址:长沙市湘雅路 280 号

<http://www.hnstp.com>

邮购联系:本社直销科 0731-4375808

印 刷:长沙市科技印刷厂

(如有质量问题请直接与本厂联系)

厂 址:长沙市新唐家巷 10 号

邮 编:410008

出版日期:2002 年 7 月第 1 版第 1 次

开 本:850mm×1168mm 1/32

印 张:6.75

插 页:6

字 数:165000

书 号:ISBN 7-5357-3206-2/S·426

套书定价:188.00 元

本册定价:18.00 元

(版权所有·翻印必究)



国家水稻科技工程系列著作编委会

顾问：季益贵

主任委员：青先国

副主任委员：周上游

委员：李建国 周坤炉 周瑞庆 邹应斌 陈良碧 马国辉

Editorial Board of A Series of Works of the National Rice Scientific Project

Consultant: Ji Yigui

Director: Qing Xianguo

Deputy Director: Zhou Shangyou

Members: Li Jianguo Zhou Kunlu Zhou Ruiqing Zou Yingbin Chen Liangbi
Ma Guohui

本书著作人员：张杨珠 黄运湘 李合松 邹应斌
冯跃华 孙玉焕 黄见良 黄升平

依靠科技提高
農業經濟效益

滿貴玉
 己卯仲夏

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”、“高蛋白饲料稻高产综合配套技术研究”、“双季稻超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”、“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 667hm^2 超高产样板田、 $6\ 667\text{hm}^2$ 试验区、 $66\ 667\text{hm}^2$ 示范区和拓展到周边县(市)的 $666\ 667\text{hm}^2$ 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均具有重要指导意义,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 Protein 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 667hm^2 , the experimental area with $6\ 667\text{hm}^2$, the demonstration area with $66\ 667\text{hm}^2$ and the extensive demonstration area reaching up to the neighboring counties with $666\ 667\text{hm}^2$ 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 and 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. First, 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. Second, 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. Third, 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 in-

formed. Thus the high output and efficiency of double harvest rice and can be ensured. Fourth, 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 tech-

niques 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

我国是世界上第一水稻生产大国。全国有水稻土面积2533.3万 hm^2 , 占我国粮食耕地面积的 29%。其分布遍布全国各地, 但其 93% 主要分布在我国长江流域和华南地区。该地区温、光、水、热资源丰富, 稻田耕作制度以双季稻多熟制为主, 稻田土壤复种指数大, 土地生产力高。我国的稻谷产量占全国粮食总产的 44%, 但却养活了我国 60% 的人口。由此可见, 水稻生产在我国粮食生产和人民生活中占有极其重要的地位。

水稻施肥技术是水稻栽培技术体系的重要组成部分, 是各项栽培技术措施中增产效益最显著的技术, 在发展水稻生产、提高水稻单产方面起着非常重要的作用。并且, 这种作用将随着水稻高产品种的推广和水稻单产的提高愈益显著。建国以来, 我国在水稻施肥技术的研究与应用推广方面取得了令人瞩目的成就, 已建立了“促前控中施肥法”、“稳前攻中施肥法”、“两攻一保(或多次匀施)施肥法”、“测土配方施肥法”、“氮素调控法”、“碳铵深施法”以及“无水层犁沟条施基肥与以水带氮的追肥深施相结合的稻田氮肥的基、追肥配套施用技术”等, 并已得到了大面积的推广应用, 对发展我国的水稻生产, 提高稻谷产量和肥料利用率等做出了重大贡献。但是, 这些技术在操作上都是以基肥和追肥技术配套施用为特征的分次施肥技术, 均过于繁琐、费工费时, 不易掌握其技术要点和灵活应用, 若操作不当, 易造成施肥量不适, 养分损失量过

大,养分利用率低,环境污染严重。

20世纪90年代以来,随着我国社会主义市场经济体制逐步建立和完善以及农村第二、第三产业和乡镇企业的不断发展和壮大,农民就业向多元化方向发展,种田不再是农民就业的惟一机会。市场经济向农业生产,特别是向以水稻种植业为主的粮食生产,发起了挑战。在这种新的农村社会形势下,农业生产不仅要求高产优质,而且追求省工、低耗、易操作。基于这一客观要求,建立一种易操作、省工、省时的新型水稻施肥技术体系势在必行。

“水稻一次性全层施肥技术研究示范”是国家“九五”重中之重的科技攻关项目——水稻大面积高产综合配套技术体系研究与示范中的专题之一。通过研究,我们针对我国广大双季稻生产地区的施肥现状及其存在的问题,通过对高产稻田肥力特性和施肥效应、高产双季稻的生育和营养特性以及现代肥料制造技术的系统研究,提出了双季稻一次性全层施肥技术(简称水稻一次性施肥法),即根据高产双季稻的生育和营养特性,按照平衡施肥原理和现代肥料制造技术,将双季早稻或晚稻一生中所需要的养分经科学配方,制成专用配方肥,于插秧前一次作基肥施入,结合耕作措施,使土肥相融,从而达到以肥肥土,以土肥稻的目的。同时我们坚持一边试验研究,一边示范推广的技术路线,1997年在国家水稻科技工程基地——醴陵市示范成功后,1998~2000年在湖南省组织了大面积示范与推广应用,取得了显著的增产增收与省工节支效果。截至2000年底,该项技术在湖南省推广应用面积已达140万 hm^2 ,增产稻谷6亿kg,增收节支8亿元,是该地区近10年来推广应用面积最大的新型技术措施。

水稻一次性全层施肥法的建立一改我国传统的水稻分次施肥技术,是水稻施肥技术的改革和创新,为实现水稻生产的简单化、工艺化和规范化展示了广阔的前景,符合21世纪农业生产的发展方向,几年来的推广应用实践充分证明了这一点。但是,该项技术

在不同生产条件下和不同作物上的具体应用,还有许多工作要做。
竭诚希望各位同仁加强交流和合作,促进这一研究向纵深发展。

著 者

2002 年 3 月

目 录

第一章 水稻一次性全层施肥法研究综合报告	(1)
水稻一次性全层施肥技术的研究与示范推广	(1)
第二章 水稻一次性全层施肥法的基础理论研究	(22)
湖南省醴陵市早、晚稻施肥现状的调查分析	(22)
湖南省稻田土壤固定态铵的研究	(26)
湖南省稻田土壤无机磷形态的分级研究	(41)
湖南省稻田土壤有机磷形态的分级研究	(48)
湖南省稻田土壤硫素状况研究	(57)
天然养分载体的保肥供肥特性研究	(64)
高产土壤条件下双季杂交稻施磷效应研究	(74)
高产土壤条件下双季杂交稻施钾效应研究	(83)
第三章 水稻一次性全层施肥法的技术效应分析	(91)
河沙泥田双季稻一次性全层施肥技术效应研究	(91)
红黄泥田双季稻一次性全层施肥技术效应研究	(109)
应用示踪法对水稻一次性全层施肥技术效应的研究	(121)
紫泥田双季稻一次性全层施肥技术的效应研究	(130)
潮沙泥田双季稻一次性全层施肥技术效应研究	(136)
黄泥田双季稻一次性全层施肥技术的效应研究	(147)
一次性全层施肥法对早稻产量及其构成因素的影响	