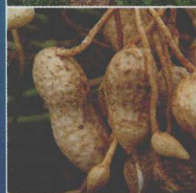
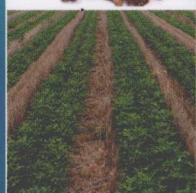
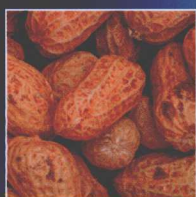


The Cultural Theory and Technology for High-Yielding
Peanut under Wheat-Peanut Cropping System

麦油两熟制花生 高产栽培理论与技术



王才斌 万书波 / 著

Wang Caibin & Wan Shubo



科学出版社
www.sciencep.com

麦油两熟制花生高产栽培理论与技术
The Cultural Theory and Technology
for High-Yielding Peanut under
Wheat-Peanut Cropping System

王才斌 万书波 著
Wang Caibin & Wan Shubo

科 学 出 版 社

北 京

内 容 简 介

本书系统提炼和总结了二十多年来麦油两熟制花生高产栽培技术及其相关理论的最新研究成果,着重介绍了影响两熟制花生产量的关键因子及其解决途径,光、温等主要气象因子对花生生理代谢和生长发育的影响以及两熟制条件下高产花生的生育特点和生理生态指标。全书以解决两熟制条件下花生光、热不足和营养不良问题为主线,分别从生态、植株、技术三个层面,阐述了麦油两熟制花生高产栽培的基本理论与关键技术。全书内容注重系统与新颖相结合,理论与实践相结合。

本书可作为相关科研、推广及教育工作者的参考用书。

图书在版编目(CIP)数据

麦油两熟制花生高产栽培理论与技术=The Cultural Theory and Technology for High-Yielding Peanut under Wheat-Peanut Cropping System/王才斌,万书波著. —北京:科学出版社,2009

ISBN 978-7-03-024634-9

I. 麦… II. ①王…②万… III. 花生-栽培 IV. S565.2

中国版本图书馆 CIP 数据核字(2009)第 081092 号

责任编辑:李韶文 王 静/责任校对:陈玉凤

责任印制:钱玉芬/封面设计:耕者设计工作室

科 学 出 版 社 出 版

北京东黄城根北街16号

邮政编码:100717

<http://www.sciencep.com>

新 蕾 印 刷 厂 印 刷

科学出版社发行 各地新华书店经销

*

2009年6月第 一 版 开本:B5(720×1000)

2009年6月第一次印刷 印张:10 插页:1

印数:1—1 200 字数:200 000

定价:39.00 元

(如有印装质量问题,我社负责调换〈环伟〉)



大垄宽幅麦套种（出苗期）



小垄宽幅麦套种（幼苗期）



麦田夏直播（播种期）



小垄宽幅麦花生套种



大垄宽幅麦套种小麦的机械收割

前 言

继全球石油安全、粮食安全之后,食用油安全又成为一个事关国家战略的重要课题。目前我国食用油的战略安全隐患,不仅表现在原材料供应环节中作物种植面积的急剧减少上,更存在于生产和加工环节中国际巨头的垄断以及高达近60%的依存度。花生是我国重要的油料作物,年产荚果1500万t以上,约占油料总产量的50%。进一步提高花生产量对保障我国食用油安全意义重大。

黄淮海地区是我国花生主产区,近年来,随着耕地面积的减少,春花生面积逐年下降,粮油兼顾的小麦花生两熟制种植面积迅速扩大,逐渐成为该地区花生生产的主要种植方式,其中河南、江苏、安徽三省两熟制花生面积占花生总面积的90%以上,山东、河北两省两熟制花生面积占花生总面积的45%以上。与两熟制种植面积的快速发展相比,两熟制条件下花生栽培技术相对滞后。两熟制中,花生产量低、品质差等问题直接影响了花生的生产效益。

为了解决上述问题,山东省花生研究所自20世纪80年代中期开始集中精力开展小麦花生两熟制高产栽培技术及其相关理论的探索。经过二十多年研究与实践,初步形成了以“改革种植模式,增加花生光热量;建立麦油高效复合群体,增加冠层光截获量;实行麦油一体化计算机平衡施肥,满足两季对营养需求”为核心内容的两熟制高产高效栽培技术体系,经示范推广后,在保障小麦持续增产的前提下,花生产量大幅度增加,麦套和夏直播花生大面积分别实现了5250~6000kg/hm²和4500~5500kg/hm²,小面积分别达到7500kg/hm²和6750kg/hm²,经济效益和社会效益显著。

保障粮油安全是我国一项长期而艰巨的任务。本书涉及的内容是作者及其课题组二十多年来对小麦花生两熟制高产栽培相关技术及理论研究结果的系统提炼和总结,希望本书的出版有助于深化和推动我国小麦花生两熟制高产栽培理论与技术的发展,为大幅度提高黄淮海地区粮油产量提供技术支撑,也为相关方向的科研、推广、教学工作者提供参考。

书中小麦花生两熟双高产栽培种植模式的改进(本书的第二章第一节)是我国花生栽培前辈孙彦浩研究员主持完成的。涉及本书内容研究的课题组成员还有吴正锋、成波、郑亚萍、张礼凤、陈殿绪、孙秀山、孙奎香、孙学武、冯昊,以及研究生郭峰、初长江、李应旺等。在此一并致谢!

由于作者水平有限,书中难免存在一些缺点和不足,恳请读者和同仁批评指正。

王才斌 万书波

2008年11月20日

Preface

The security of edible oil becomes an important state strategic problem followed petroleum and grain safety. At present, the state edible oil strategic security problem, not only because of the sudden decrease in raw and processed materials supply link caused mainly by reduction of crop planting area, but also the monopolization of the international macrocephalic organization at produce and process link and above 60% dependence. Peanut is a very important kind of oil crop in our country, with an annual production over 15 000kt account for about 50% that of the total oil crops. So improving peanut production is very significant to guarantee state edible oil security.

Huang-huai-hai region is the main peanut-producing area in China. In recent years, with the reduction of cultivable land area, the area of spring-sowing peanut reduced year by year while the area of wheat-peanut cropping system extended rapidly and wheat-peanut cropping system gradually became a major planting methods in this area. For example, the area of wheat-peanut cropping system accounts for above 90% of the total peanut-planting area in Henan, Jiangsu and Anhui, and also above 45% of the total in Shandong and Hebei. In contrast to the rapid magnification of the area, the cultural technology of peanut in wheat-peanut cropping system is relatively disadvantaged. The peanut yield is lower and the quality is poor in wheat-peanut cropping system, which affects the lower peanut production benefit.

In order to resolve the problems mentioned above, Shandong Peanut Research Institute started to study the double-high yield technology under wheat-peanut cropping system and related theory since the middle of 80s 20th century. A cultural-technology system for high yield and benefit in wheat-peanut cropping system was established, with the core of "reforming planting pattern to increase quantity of light and heat, establishing the high effective compound population of wheat and peanut to enhance the light quantity intercepted and captured by crop canopy, and applying computer-balance-fertilization technique to satisfy the nutritional need of wheat and peanut". After demonstration of the cultural-technology system, the peanut yield was enhanced greatly with the precondition of sta-

ble increase in wheat yield. High yields of 5250—6000kg/hm² and 4500—5500kg/hm² were achieved at large area in intercropped peanut and summer-sowing peanut respectively, and record yields of 7500kg/hm² in intercropped peanut and 6750 kg/hm² in summer-sowing peanut were gotten at experiment plot respectively, which produce significant benefit both in economy and society.

Ensuring the security of grain and edible oil in our country is a long and rather huge task. The content in this book is the systemic abstraction and summarization in study on high-yielding cultural technology and related theory of peanut under wheat-peanut cropping system from authors and their program members in the past twenty years.

Hopefully, the book's publication can help the development of high-yielding cultural technology and related theory of wheat-peanut cropping system, providing technical support to increase yield of grain and oil crop remarkably, and offering reference for the workers engaged in related scientific research, technique extension and teaching.

The reformation of planting pattern for high yield of both wheat and peanut in two-cropping system (in § 1, Chapter II) was completed by research fellow Sun Yanhao, the peanut cultivation senior. The program members of Wu Zhengfeng, Cheng Bo, Zheng Yaping, Zhang Lifeng, Chen Dianxu, Sun Xiushan, Sun Kuixiang, Sun Xuewu and Feng Hao and graduate students Guo Feng, Chu Changjiang and Li Yingwang also joined part of work. We greatly appreciated their excellent work for this program.

Mistakes and shortages in this book are unavoidable because of the limitation of the author's knowledge level. Any comment and suggestion will be highly appreciated.

Wang Caibin & Wan Shubo

20, Nov, 2008

目 录

前言

第一章 小麦花生两熟制栽培概述	1
第一节 小麦花生两熟制栽培的意义与发展过程.....	1
一、发展小麦花生两熟制的必要性.....	1
二、小麦花生两熟制栽培的发展	2
第二节 小麦花生两熟制发展的主要限制因素及发展对策.....	3
一、限制因素	3
二、加速小麦花生两熟制发展的技术对策	4
第三节 小麦花生两熟制双高产栽培基本原理.....	5
一、实行套种或覆膜夏直播,增加花生生长季节的积温	5
二、花生生育前期的相对耐阴性使套种花生高产成为可能	5
三、适当推迟小麦播期,延长花生饱果期	5
四、适当放宽花生套种行距,充分发挥小麦边行优势	6
五、前后作兼顾,适当控制小麦群体	6
六、根据作物营养特性,适当重施前作肥	6
七、前后茬兼顾,合理搭配品种	6
第二章 小麦花生两熟双高产栽培种植模式	7
第一节 种植模式改进.....	7
一、大垄宽幅麦套种	7
二、小垄宽幅麦套种	8
三、30cm 等行麦套种	9
四、畦田麦夏直播起垄覆膜栽培	9
第二节 种植模式综合评价	10
一、麦油两熟制不同种植方式综合比较	10
二、小麦-花生与小麦-玉米两熟制综合比较	15
第三章 麦油两熟制花生生理生态特征	18
第一节 大垄宽幅麦套种花生生态特征和生育特性	18
一、生态特征	18
二、生理特点	21
三、生育特性	35

第二节 30cm 等行麦套种	39
一、不同生育期植株生育状况	39
二、LAI 和 LAD	40
三、主要器官干物质积累规律	41
四、群体生育指标	42
第三节 畦田麦夏直播	43
一、主茎生长动态	43
二、LAI 消长动态及 LAD	44
三、干物质积累动态	44
四、产量构成因素	45
第四节 不同种植方式花生源库结构分析	46
一、高产花生 LAI 消长规律与高产途径	46
二、花生产量构成因素分析及高产途径	51
第四章 环境和栽培措施对花生生理特性的影响	55
第一节 弱光胁迫对花生光合作用和生长发育的影响	55
一、苗期遮阴对花生光合生理特性的影响	55
二、苗期遮阴对花生生长发育和产量的影响	60
第二节 温度对麦套花生生育的影响	65
一、温度对麦套花生出苗的影响	65
二、温度对麦套花生幼苗期干物质积累和 LAI 的影响	66
三、温度对麦套花生开花的影响	66
第三节 施肥对夏直播花生营养特性及衰老的影响	67
一、对夏直播花生营养特性的影响	67
二、对夏直播花生根系和叶片活力的影响	69
三、对活性氧代谢的影响	71
四、对 LAI 和干物质积累的影响	73
五、对品质的影响	74
第四节 生长抑制剂对夏直播花生衰老及产量品质的影响	75
一、调环酸钙对根系和叶片活力的影响	75
二、调环酸钙对活性氧代谢的影响	76
三、调环酸钙对植株农艺性状、产量和品质的影响	78
第五章 小麦花生两熟制一体化前重型施肥技术	79
第一节 小麦花生两熟制一体化前重型施肥的理论基础	79
一、传统施肥方式的缺陷	79
二、前重型施肥技术的基本原理	81

第二节 小麦套种花生一体化施肥技术	82
一、氮肥	82
二、磷肥	83
三、钾肥	86
第三节 小麦夏直播花生一体化施肥技术	88
一、氮肥	88
二、磷肥	90
三、钾肥	91
四、小麦花生两熟制氮、磷、钾交互效应及优化配置	93
五、有机肥不同用量与分配方式对小麦花生产量的影响	96
六、不同种类肥料对小麦、花生产量和品质的影响	99
第四节 小麦花生两熟制一体化施肥计算机决策系统	101
一、基本模型	101
二、施肥技术	105
三、决策系统的建立与操作	106
四、应用效果	106
第六章 小麦花生两熟制花生综合增产技术	109
第一节 麦套花生	109
一、小麦行距与花生套种期	109
二、花生密度与套期优化配置	111
三、麦套花生精播套期、肥料与密度优化配置研究	113
四、不同品种不同生态地区产量、品质及其稳定性比较	115
第二节 畦田麦夏直播	120
一、秸秆还田培肥土壤	120
二、抢茬早播	122
三、矮化增密	122
主要参考文献	123
附录 山东省地方标准	126
一、鲁东地区宽幅麦套种花生生产技术规程 (DB37/T 926—2007)	126
二、鲁西地区麦田套种花生生产技术规程 (DB37/T 927—2007)	131
三、麦田夏直播花生生产技术规程 (DB37/T 922—2007)	136

Contents

Preface

Chapter I The Wheat-Peanut Cropping System Outline	1
1 Significance and Developing Process of Wheat-Peanut Cropping System	1
1.1 Significance of Developing Wheat-Peanut Cropping System	1
1.2 Developing Course of Wheat-Peanut Cropping System	2
2 Main Limiting Factors and Developing Countermeasures of Wheat-Peanut Cropping System	3
2.1 Main Limiting Factors	3
2.2 The Contradiction of Obtaining Double-High Yield of both Wheat and Peanut in the Two Cropping System	4
3 Principles for Achieving Double-High Yield of both Wheat and Peanut in the Two Cropping System	5
3.1 Adoption of Intercropping or Film Mulching Planting in Summer to Increase the Light and Heat Quantity in Peanut Growing Season	5
3.2 Characteristics of Shading-Tolerance of Peanut at Earlier Period to Make the High Yield of Intercropping Peanut Possible	5
3.3 Postponing Wheat Sowing Time to Extend Pod Filling Stage of Peanut ...	5
3.4 Widening Peanut Intercropping Row Spacing to Exert fully the Advantage of Wheat Fringe Row	6
3.5 Giving Attention to Wheat and Peanut, Controlling the Wheat Population Appropriately	6
3.6 Applying More Manure and Fertilizer to Wheat According to the Nutrition Absorption Characteristics of Wheat and Peanut	6
3.7 Giving Attention to Wheat and Peanut, Arranging Varieties in Reason ...	6
Chapter II Planting Methods for High Yield of Both Wheat and Peanut in Two-Cropping System	7
1 Improvement of Planting Methods	7
1.1 Peanut Intercropped with Wheat in Wide-Ridge	7
1.2 Peanut Intercropped with Wheat in Narrow-Ridge	8

1.3	Peanut Intercropped with Wheat in 30cm Row Spacing	9
1.4	Summer-Sown Peanut in Ridging and Film Mulching	9
2	Comprehensive Evaluation of Planting Methods	10
2.1	Comprehensive Comparisons of Different Planting Methods of Wheat-Peanut Cropping System	10
2.2	Comprehensive Comparisons between Wheat-Peanut Cropping System and Wheat-Corn Cropping System	15
Chapter III	Physiological and Ecological Characteristics of Peanut in Wheat-Peanut Cropping System	18
1	Ecological and Developing Characteristics of Intercropped Peanut with Wide-ridge	18
1.1	Ecological Characteristics	18
1.2	Physiological Characteristics	21
1.3	Growth and Development Characteristics	35
2	Peanut Intercropped with Wheat in the Equal Row Space	39
2.1	Plant Growth and Development Status of Peanut at Different Growing Stage	39
2.2	LAI and LAD	40
2.3	Dry Matter Accumulation Rule of Main Organs in Peanut	41
2.4	Growth and Development Indexes of Community	42
3	Summer-Sowing Peanut after Wheat	43
3.1	The Growth Dynamic of Peanut Main Stem	43
3.2	Dynamic Change of LAI and LAD	44
3.3	Dynamic of Dry Matter Accumulation	44
3.4	Yield Components	45
4	Source-Sink Characteristics of Peanut in Different Planting Methods	46
4.1	The Dynamic Change of LAI of High-Yielding Peanut and Ways for Obtaining High Yield	46
4.2	Yield Component Analysis and Ways for Obtaining High Yield	51
Chapter IV	Influence of Environment and Cultivation Measure on Physiology Characteristic of Peanut in Wheat-peanut Cropping System	55
1	Influence of Weak Light on Photosynthesis and Growth Characteristics of Peanut	55
1.1	Influence of Shading at Seedling Stage on Physiology Characteristics of Peanut	

.....	55
1.2 Influence of Shading at Seedling Stage on Growth and Yield of Peanut ...	60
2 Influence of Temperature on Growth and Development Intercropped Peanut	65
2.1 Influence of Temperature on Seedling Emergence of Peanut	65
2.2 Influence of Temperature on Dry Matter Accumulating Amount and Leaf Area of Peanut at Seedling Stage	66
2.3 Influence of Temperature on Blossoms of Peanut	66
3 Effect of Fertilization on Nutrition Characteristic and Senescence of Summer-Sowing Peanut	67
3.1 Effect of Fertilization on Absorption of Nitrogen, Phosphorus and Potassium	67
3.2 Effect of Fertilization on Activity of Root and Leaf	69
3.3 Effect of Fertilization on Active Oxygen Metabolism	71
3.4 Effect of Fertilization on Dry Matter Accumulating Amount and Leaf Area	73
3.5 Effect of Fertilization on Peanut Quality	74
4 Effect of Growth-Inhibiting Substance on Yield, Quality and Senescence of Summer-Sowing Peanut	75
4.1 Effect of Prohexadione Calcium on Activity of Root and Leaf	75
4.2 Effect of Prohexadione Calcium on Active Oxygen Metabolism	76
4.3 Effect of Prohexadione Calcium on Agronomic Characteristic, Yield and Quality	78
Chapter V The Integrated Fertilizer Application Techniques in Wheat-Peanut Cropping System	79
1 The Theory of Integrated Fertilizer Application Techniques in Wheat- Peanut Cropping System	79
1.1 The Limitations of Traditional Fertilizer Application Techniques	79
1.2 The Theory of Integrated Fertilizer Application Techniques in Wheat-Peanut Cropping System	81
2 The Integrated Fertilizer Application Techniques of Intercropping Peanut in Wheat-Peanut Cropping System	82
2.1 The Nitrogenous Fertilizer	82
2.2 The Phosphate Fertilizer	83
2.3 The Potassium Fertilizer	86

3	The Integrated Fertilizer Application Techniques for Summer-Sowing Peanut	88
3.1	The Nitrogenous Fertilizer	88
3.2	The Phosphate Fertilizer	90
3.3	The Potassium Fertilizer	91
3.4	Interaction and the Optimized Collocation of N, P, K in Wheat-Peanut Cropping System	93
3.5	Effect of Different Amount and Distribution of Manure on Yield of Wheat and Peanut	96
3.6	Effect of Different Fertilizer on Yield and Quality of Wheat and Peanut	99
4	Computer Decision-making System for Integrated Fertilization Techniques in Wheat-Peanut Cropping System	101
4.1	The Basic Model	101
4.2	Fertilizer Application Techniques	105
4.3	Establishment and Operation of Computer Decision-Making System	106
4.4	Application Results	106
Chapter VI	Comprehensive Technology for Improving Yield of Peanut in Wheat-Peanut Cropping System	109
1	Peanut Intercropped With Wheat	109
1.1	Row Spacing of Wheat and Intercropping Date of Peanut	109
1.2	The Optimized Collocation of Plant Density and Intercropping Date	111
1.3	The Optimized Collocation of Intercropping Date, Fertilizing Rate and Plant Density of Intercropped Peanut with Wheat under Refined-Sowing Method	113
1.4	Stability Comparison of Yield and Quality of Different Varieties at Different Ecological Area	115
2	Summer-sowing Peanut after Wheat	120
2.1	Fertilizing Soil by Returning Wheat Straw to Farmland	120
2.2	Sowing Peanut soon after Wheat Harvest and Close Planting in Reason	122
2.3	Dwarf Cultivation and Close Planting	122
	References	123
	Appendix: Shandong Local Standard	126
1.	The Production Technology Regulation of Intercropped Peanut with	

Wheat in Wide-Ridge at East of Shandong (DB37/T 926—2007)	
.....	126
2. The Production Technology Regulation of Intercropped Peanut with Wheat in West of Shandong (DB37/T 927—2007)	131
3. The Production Technology Regulation of Summer-Sowing Peanut (DB37/T 922—2007)	136

第一章 小麦花生两熟制栽培概述

粮油是人类赖以生存的基本生活资料，也是我国大宗食品的基础原料，关系着我们国家的国计民生。花生是我国重要的油料作物，全国花生油年均产量 230 万 t，占国产植物油的 1/4。花生传统种植方式为春播，大约占花生总种植面积的 60%~70%。随着我国国民经济的发展和人民生活水平的不断提高，对农产品需求量的持续增加与可耕地面积不断下降的矛盾日益突出。减少一年一季的春花生，发展小麦花生两熟制生产，是缓解粮油争地矛盾，保障粮油安全的有效途径，有着广阔的发展前景。

第一节 小麦花生两熟制栽培的意义与发展过程

一、发展小麦花生两熟制的必要性

1. 两熟制栽培是我国国情的需要

目前我国耕地总面积为 0.89 亿 hm^2 ，人均 0.067 hm^2 ，仅为世界平均水平的 1/4，另外，我国约有 1/3 的省份人均耕地不足 0.067 hm^2 ，有 666 个县人均耕地面积低于联合国 0.05 hm^2 的警戒线，有 463 个县人均耕地低于联合国 0.03 hm^2 的危险线。据权威部门预测，在未来的若干年内（至少在 21 世纪上半叶），我国人口增长仍将保持在每年 1000 万左右，按照这一速度，到 2035 年前后，中国人口将达到 16 亿。如何在有限的土地上生产出更多的粮油产品来满足人们日益增长的物质需要，是农业科研面临的现实问题。间套作是充分利用土地、光热资源增加作物产量的重要途径，减少一年一季的春花生，发展小麦花生两熟制生产，是缓解粮油争地矛盾，保障粮油安全的有效途径。

2. 两熟制栽培是未来花生生产发展的方向

节约资源是实施农业可持续发展的核心内容。一年一季春花生近 2/3 的时间被白白浪费掉，对土地和光热资源利用率低。小麦-花生两熟制，可提高复种指数，更有效地利用现有资源，提高单位土地的生产量，缓解粮油争地矛盾，是未来花生生产发展的方向。

3. 两熟制栽培是一种高效生态的农业种植方式

首先,两熟制栽培有利于提高土壤肥力。花生根瘤菌固定的 N 素除供给当茬花生外,约有 $1/3 \sim 2/5$ 通过残根落叶等方式遗留在土壤中,使土壤中 N 素水平得以提高,是良好的前茬作物。据试验,花生茬种小麦比玉米茬增产 26.4%,比甘薯茬增产 34.9%。其次,两熟制栽培可显著减轻小麦和花生的病虫害危害,如小麦全蚀病、花生叶斑病、线虫病等。据试验,在小麦全蚀病的发病地,实行小麦花生轮作相对于小麦玉米轮作来说,小麦增产 5.4%~16.4%,小麦全蚀病越重,增产越明显。再次两熟制可有效缓解连作对花生带来的生育障碍。另外,两熟制栽培可以更充分吸收利用土壤不同层次的土壤养分。小麦属于须根系作物,对耕作层养分吸收利用率高;花生为直根系,入土较深,能较好的吸收利用土壤深层的养分。另外,花生的主根和早期出生的次生根较小麦等禾本科须根系作物粗壮,当花生根系腐朽后,在土壤中留下许多“管道”,这些“管道”成为土壤水、气的通道,增加了土壤的通透性。

二、小麦花生两熟制栽培的发展

1. 经验种植期

20 世纪 50~60 年代后期,我国麦套种和夏直播花生基本处于经验种植时期,多数年份种植面积不足 20 万 hm^2 ,农民凭习惯和经验种植,种植方法多为行行套种,单产不足 1000 kg/hm^2 。主要集中在湖南、湖北、四川等省。河南、山东等省只有少量种植,如河南省 1965 年花生播种面积 14.44 万 hm^2 ,麦套种和夏直播花生面积仅占 10%,山东省 1963 年麦套种花生面积 6.6 万 hm^2 ,也仅占全省花生种植面积的 10%左右。

2. 总结推广期

20 世纪 70~80 年代中期,随着我国人口不断增长和垦地的不断减少,粮油争地矛盾日益突出,小麦花生两熟制栽培逐渐引起人们的重视。花生主产区的科研单位、农业技术推广部门对各地两熟制种植方式与栽培技术进行了系统的总结,筛选出一些适合不同生态地区和生产条件的小麦花生两熟制种植方式与高产技术,如河南省的“隔行套种二隔一的宽行密植栽培技术”、四川省的“小行和宽窄行麦套花生配套技术”、山东省的“大沟麦和小沟麦套种花生栽培技术”等,并进行了广泛的示范与推广等,推广应用后,大面积单产小麦达到 3000 kg/hm^2 以上,单产花生达到 3750 kg/hm^2 以上,这推动了以麦套花生为主的小麦花生两熟栽培的发展,有效缓解了粮油争地矛盾。