WEEDS OF COTTON:
Characterization and Control

THE COTTON FOUNDATION

Reference Book Series

The Cotton Foundation was created in 1955 to foster innovative research and education for the cotton industry. Supported by membership dues and special grants from leading agribusiness companies, the Foundation plays an integral role in focusing attention on high priority needs. Members include many of America's finest manufacturers and suppliers of machinery, plant health chemicals, planting seed, testing instruments, consulting and financial services, trade media, processing materials, and other inputs used to enhance cotton production, processing and marketing.

The alliance of agribusiness and the cotton industry strengthens the ability of both to reach common objectives–enhanced markets and profitability. Understanding that sales and services to cotton are closely linked to the vitality of the cotton industry, corporate suppliers are eager to participate in the Foundation. Membership dues and grants go entirely to support research and educational programs. The Foundation's offices are located at the National Cotton Council's headquarters in Memphis, Tennessee, and staffing is provided by the Council.

The Foundation is pleased to publish **WEEDS OF COTTON: Characterization and Control,** the second in the series of cotton reference books. The first volume, **COTTON PHYSIOLOGY,** was published in 1986, and the third, **COTTON INSECTS AND MITES: Characterization and Management,** is planned for availability in 1993.

Andrew G. Jordan, Ph.D.
Executive Director
The Cotton Foundation
1918 North Parkway
Memphis,Tennessee 38112

ACKNOWLEDGEMENT

Publication of this book was made possible by a grant to The Cotton Foundation from BASF Agricultural Products, a major supplier to the cotton industry. BASF supports this and other programs for cotton through The Cotton Foundation.

BASF Corporation is a diversified chemical company with a strong tradition of technological excellence. The firm is part of the worldwide BASF Group of companies, headquartered in Germany.

The BASF commitment to agriculture is typified by the company's 1911 development of the Nobel Prize-winning technique that allows mass production of affordable fertilizers. Following the establishment of BASF Corporation in the U.S., the company developed the first plant growth regulator available to American cotton growers. Cotton plants treated with PIX® plant regulator are more compact, resulting in the interrelated benefits of higher boll numbers, early maturity and the reduction of boll rot. In addition, BASF Agricultural Products manufactures Poast Plus® herbicide, a postemergence product for grass control that offers cotton growers added flexibility in their weed control programs.

In other crop areas, BASF markets Basagran®, Blazer®, Galaxy®, Laddok® and Poast® postemergence herbicides.

BASF is proud to be a member of The Cotton Foundation and sponsor of **WEEDS OF COTTON: Characterization and Control**, the second book in The Cotton Foundation's cotton reference book series. The sponsorship is a reflection of the company's belief that continued support of technology and material developments that promote production of more cost-effective, higher-yielding cotton will make a stronger cotton industry.

WEEDS OF COTTON:
Characterization and Control

Editors
CHESTER G. McWHORTER AND JOHN R. ABERNATHY

Executive Editor and Publishing Coordinator
JAMES M. BROWN

Number Two
THE COTTON FOUNDATION
REFERENCE BOOK SERIES

The Cotton Foundation, Publisher
Memphis, Tennessee, U.S.A.
1992

The Cotton Foundation
1918 North Parkway
Memphis, Tennessee 38112, U.S.A.

Library of Congress Cataloging-in-Publication Data

Weeds of cotton: characterization and control/editors, Chester G. McWhorter and John R. Abernathy.
p. cm.—(The Cotton Foundation reference book series; no. 2)
Includes bibliographical references and indexes.
ISBN 0-939809-02-8 (hard cover): $45.00
1. Cotton—Weed control. 2. Cotton—Weed control—United States.
I. McWhorter, C. G. II. Abernathy, J. R. III. Series.

SB608.C8W44 1992
633.5' 1958–dc20 92-6771
CIP

ISBN 0-939809-00-1 (The Cotton Foundation Reference Book Series)
ISBN 0-939809-02-8 (Number Two)

Published 1992

Printed in the United States of America

TABLE OF CONTENTS

FOREWORD

Major weeds are highly competitive and may deprive crops, and even other weeds, of nutrients, water, light and space. In the case of cotton, uncontrolled weeds will impact both yield and quality adversely. Weeds can interfere with planting, efficient application of pesticides and irrigation water, boll opening and drying and harvesting. Weeds also may harbor or act as alternate hosts for cotton insect and disease pests. In addition, some weeds produce and and release inhibiting substances that adversely affect neighboring crop and weed plants.

Today, cotton is grown in an environment shared by some 30,000 or so species of weeds. Fortunately, in a given field or season, the number of troublesome species usually is limited to ten or less.

Weed control was not looked upon as a separate science until after the introduction of selective herbicides in the late 1940s and early 1950s. Prior to that time, weed research to develop new control methods was very limited and spread among several scientific disciplines.

Cotton was one of the first major crops for which producers recognized the need for, and importance of expanded research—both applied and basic—to develop new weed control technology. They recognized that one of the first needs was to have scientists trained in weed science and interested in using that training to develop the needed technology for cotton. In the 1950s and early 1960s, the Foundation for Cotton Research and Education (now The Cotton Foundation) funded several graduate assistantships in weed science. Two of the early recipients were Dr. John T. Holstun and Dr. Chester G. McWhorter. Dr. Holstun is deceased, but he made tremendous contributions during his shortened career.

Dr. McWhorter, a co-editor of this cotton reference book, still is making major contributions. He was president of the Weed Science Society of America 1983 and editor of the Society's 1987 monograph entitled *Methods of Herbicide Application*. Dr. McWhorter was recognized in 1989 by the U.S. Department of Agriculture as recipient of the ARS Distinguished Scientist of the Year Award.

The cotton industry played a significant role in early weed research in several other ways. During the 1960s, several state and federal pioneering weed research programs were funded in part by the Cotton Producers Institute, the forerunner to Cotton Incorporated. The cotton industry also played a major role in the successful efforts in the 1960s that provided federal funds to significantly increase weed research by both land grant institutions and USDA.

The cotton industry also played a role with regard to major contributions by the other co-editor of this book, Dr. John R. Abernathy. However, the relationship was more indirect. A short prelude is in order.

The High Plains of Texas often is referred to as the "biggest cotton field in the world." The 25 counties around Lubbock constitute the largest contiguous area of cotton production in the world.

A grant from the Cotton Producers Institute to Texas A&M University in the

1960s made it possible to establish the first full time weed research program for cotton in the Texas High Plains. After several years of productive research, the first scientist in that position moved on to university administrative work at College Station. Dr. Abernathy filled that position in 1973 and has made significant contributions to cotton weed management technology. In 1985, he became resident director of research at the Texas A&M Research and Extension Center at Lubbock. He also served as president of the Weed Science Society of America in 1991.

It is very appropriate that Drs. McWhorter and Abernathy served as co-editors of this book, **WEEDS OF COTTON: Characterization and Control.**

The National Cotton Council is pleased to have played a significant role in initiating The Cotton Foundation Reference Book Series. The first book in the series, *COTTON PHYSIOLOGY,* recently was reprinted for the second time. The three printings attest to the widespread interest in reference books on cotton. We believe the interest in **WEEDS OF COTTON: Characterization and Control,** the second in the series of books, will be as great.

As with the first book, the usefulness of **WEEDS OF COTTON: Characterization and Control** as a reference book will go beyond the traditional researcher, teacher and student. Private agricultural consultants and agricultural chemical industry representatives will find it to be a valuable source of information. Modern-day cotton producers also will find this book to be both interesting and useful. They are the ones who are not satisfied with just having technology to use. They want to know how it works and why. This helps them to refine and adapt new technology to their own specific conditions and situations. Innovative producers want to relate technology to economic returns and environmental concerns.

The National Cotton Council and The Cotton Foundation are indebted to the editors, Dr. Chester G. McWhorter and Dr. John R. Abernathy, and to the other 28 scientists who served as authors of the 15 chapters. These scientists have dedicated considerable time and effort in making this a book everyone can be proud of. A listing of all the contributors is shown on pages xxi through xxv.

James M. Brown, Ph.D.
Manager, Production Technology (Retired)
National Cotton Council
Consultant
The Cotton Foundation
1918 North Parkway
Memphis,Tennessee 38112

PREFACE

Weeds are familiar plants to most people; however, authorities in many disciplines have struggled for decades to develop an all-encompassing definition for these plants. Weed definition has never been a problem for the cotton farmer who classifies any plant in the field other than cotton as being a weed. From the time that cotton became a major crop in the United States in the late 1700s, the removal of weeds by hand represented more than 50 percent of the labor input required for production of the crop. Even as late as 1950 it was acknowledged that 50 to 60 percent of the total labor requirement in cotton production was for hand hoeing. The first attempts to use herbicides in the 1950s and early 60s were primarily to reduce the need for the large amounts of hand labor.

When farmers from other regions of the United States first visit the Cotton Belt, they observe that cotton producers may be overzealous in their attempt to control weeds as they appear to obtain near perfect weed control. Cotton yields are reduced from weed competition, especially competition during the first six weeks of the growing season, but producers are also concerned about losses in cotton lint quality because of weeds at harvest. The presence of weeds at harvest, especially grasses, will stain cotton lint and will cause trash from weeds to be mixed in lint, thus greatly reducing its value. This concern for high lint quality may cause cotton producers to seek a higher level of weed control than would be expected in other agronomic crops.

Until the mid 1900s the only form of weed control, other than hand hoeing, was with animal-drawn cultivators. It was not unusual for cotton to be cultivated weekly for the first 10 to 12 weeks of the growing season. Producers began shifting to tractor-mounted cultivators in the late 1930s and this shift was completed in the late 1940s when nearly all cultivation was with tractor-mounted cultivators. During this evolutionary period, producers made use of other mechanical means of control that included flame cultivators, rotary weeders, cross-cultivation and mechanical choppers. They also made extensive use of geese, especially to control grass species. These practices often helped reduce costs but even so, large quantities of hand labor still were needed to control weeds within the cotton drill.

Farmers were anxious to reduce the need for hand labor by using herbicides when they first were introduced in the early 1950s. Early cotton injury experiences caused many producers to be very cautious in their use of herbicides. It was not until the early 1960s that the use of herbicides showed rapid and consistent growth. Many highly selective herbicides were developed and marketed in the 1960s. By the mid 1970s, most of the cotton produced in the United States involved the use of one or more herbicides.

As the acreage treated with herbicides increased in the 1960s and 70s, ecological shifts occurred whereby weeds, such as prickly sida, that had been almost nonexistent in cotton fields became major weed problems. Perennials, such as

purple and yellow nutsedge, silverleaf nightshade and perennial vines, became much more troublesome because they did not have to compete with other weeds. These ecological shifts caused many researchers to devote more effort toward developing control technology for weeds that were not troublesome in the 1950s and also to develop predictive capability as to what new weeds may be troublesome in the future. Studies of this type are an important part of many research efforts in the United States at present. Accurate taxonomic identification of weeds also became more important.

Cotton farmers have been unique, as compared to the producers of other crops, in their desire to use innovative weed control technology. This was demonstrated not only by the early use of geese, flame cultivation, cross-cultivation and post-emergence-applied herbicidal naptha, but also by their early widespread use of herbicides applied in postemergence-directed sprays. Cotton producers adopted postemergence-directed application first and continue widespread use of this practice today.

Many highly selective herbicides have been introduced and marketed during the last three decades, but producers still do not have a herbicide for control of broadleaf weeds that can be applied as a broadcast over-the-top-spray as in other crops. This has forced cotton producers to continue to use postemergence-directed sprays to control broadleaf weeds that escape preemergence treatment. So many efficient herbicides were introduced in the 1960s that this decade has been referred to as the "golden decade" and the "fabulous 60s". At that time the "state-of-the-art" of weed control in cotton with herbicides was probably at a much more advanced stage than in other crops. Unfortunately, the introduction of new, highly selective herbicides for use in cotton decreased while those that became available for use in soybeans, corn and other crops increased dramatically. As a result, many of the herbicides introduced in the 1960s, such as trifluralin, fluometuron, DSMA/MSMA, linuron and paraquat, have continued to be valuable in cotton production into the 1990s.

In the 1950s and the 1960s, much of the research related to weed science in cotton production was devoted to the evalution of new herbicides and in the integration of these into existing weed control programs. The expanded use of herbicides in cotton production inthe 1960s and 70s led to expanded research on efficient application technology, the exact nature of weed interference, economic losses caused by different weeds, and on the residual effect caused by the use of herbicides. Expanded research also has been seen on the more basic aspects, such as the relationship of herbicide chemistry to mode of action and herbicide-soil-groundwater relationships as well as the more applied aspects, such as developing teamwork in weed management. These and other aspects are covered in this monograph and it is our intent that this publication provide a record on the state-of-the-art weed control technology in cotton to this point in history.

We express our appreciation to the many authors who contributed their time to make this publication possible. Hopefully, this book will not only serve as a background reference in the area of weed science in cotton, but it may also serve as the genesis for new ideas that lead to better weed management in this very important crop.

Editors:

Chester G. McWhorter, Ph.D.
Research Leader
USDA, ARS
Stoneville, Mississippi 38776
and
John R. Abernathy, Ph.D.
Resident Director of Research
Texas Agricultural Experiment Station
Texas A&M University
Lubbock,Texas 79401

CONTRIBUTORS

	Current Address if Different
Dr. John R. Abernathy Professor and Resident Director Texas A&M University System Route 3, Box 219 Lubbock,TX 79401-9757	
Dr. Carl G. Anderson Extension Economist-Cotton Marketing Department of Agricultural Economics Texas A&M University College Station,TX 77843-2124	
Dr. Ralph S. Baker Agricultural and Forestry Experiment Station Mississippi State University Delta Research and Extension Center P.O. Box 197 Stoneville, MS 38776	(Retired)
Dr. Philip A. Banks Agricultural Consultant Marathon-Agricultural and Environmental Consulting, Inc. 3001-A Majestic Ridge Las Cruces, NM 88001	
Dr. William L. Barrentine Plant Physiologist Agricultural and Forestry Experiment Station Mississippi State University Delta Research and Extension Center P.O. Box 197 Stoneville, MS 38776	
Dr. Rodney W. Bovey Research Agronomist U.S. Dep. Agric., Agric. Res. Serv. Department of Rangeland Ecology and Management Texas A&M University College Station,TX 77843	

Dr. James M. (Jim) Brown (Retired)
National Cotton Council of America
Consultant
The Cotton Foundation
1918 North Parkway
Memphis,TN 38182-9030

Dr. Charles T. Bryson
Botanist
U.S. Dep. Agric., Agric. Res. Serv.
Southern Weed Science Laboratory
P.O. Box 350
Stoneville, MS 38776

Dr. Gale A. Buchanan
Director
Coastal Plain Experiment Station
University of Georgia
Tifton, GA 31793

Dr. John D. Byrd, Jr.
Extension Specialist
Agronomy Department
Mississippi State University
Mississippi State, MS 39762

Dr. Will D. Carpenter
Vice President and General Manager
New Products Division
Monsanto Agricultural Company
800 N. Lindbergh Boulevard
St. Louis, MO 63167

Dr. James M. (Mike) Chandler
Professor
Department of Soil and Crop Sciences
Texas A&M University
College Station,TX 77843

Dr. Harold D. Coble
Professor
Department of Crop Science
North Carolina State University
Raleigh, NC 27695

Mr. Fred T. Cooke, Jr.
Agricultural Economist
Agricultural and Forestry Experiment Station
Mississippi State University
Delta Research and Extension Center
P.O. Box 197
Stoneville, MS 38776

Mr. Claude W. Derting
Product Development Specialist
Monsanto Agricultural Company
Route 1, Box 168-A
Whiteville,TN 38075

Dr. Stephen O. Duke
Director
U.S. Dep. Agric., Agric. Res. Serv.
Southern Weed Science Laboratory
P.O. Box 350
Stoneville, MS 38776

Dr. E. Ford Eastin
Head
Agronomy Department
Coastal Plain Experiment Station
University of Georgia
P.O. Box 748
Tifton, GA 31793

Dr. Billy J. Gossett
Agronomist
Agronomy Department
Clemson University
Clemson, SC 29631

Dr. Paul E. Keeley
Plant Physiologist
U.S. Dep. Agric., Agric. Res. Serv.
U.S. Cotton Research Station
17053 Shafter Avenue
Shafter, CA 93263

Dr. Harold M. Kempen
Farm Advisor, *Emeritus*
University of California
Cooperative Extension Service
1031 S. Mt. Vernon Avenue
Bakersfield, CA 93307

Dr. William C. Koskinen
Soil Scientist
U.S. Dep. Agric., Agric. Res. Serv.
Soil and Water Management Research Unit
Soil Science Department
University of Minnesota
St. Paul, MN 55108

Mr. William D. Mayfield
Extension Agricultural Engineer
Cotton Mechanization and Ginning
Extension Service, U.S. Dep. Agric.
7777 Walnut Grove Road, Box 5
Memphis,TN 38120

Dr. Chester G. McWhorter
Plant Physiologist and Research Leader
U.S. Dep. Agric., Agric. Res. Serv.
Application Technology Research Unit
P.O. Box 350
Stoneville, MS 38776

Dr. Morris G. Merkle (Retired)
Professor
Department of Soil and Crop Sciences
Texas A&M University
College Station,TX 77843-2474

Dr. Thomas B. Moorman
Microbiologist
U.S. Dep. Agric., Agric. Res. Serv.
Herbicide Interactions in Plants and Soils Research Unit
P.O. Box 350
Stoneville, MS 38776

U.S. Dep. Agric., Agric. Res. Serv.
National Soil Tilth Laboratory
2150 Pammel Drive
Ames, IA 50011

Dr. Don S. Murray
Professor
Department of Agronomy
272 Agricultural Hall North
Oklahoma State University
Stillwater, OK 74078

Dr. Charles E. Snipes
Agronomist
Agricultural and Forestry Experiment Station
Mississippi State University
Delta Research and Extension Center
P.O. Box 197
Stoneville, MS 38776

Dr. James R. Supak
Extension Agronomist-Cotton
Texas A&M Research and Extension Center
Route 3, Box 213AA
Lubbock,TX 79401-9746

Dr. Ronald J. Tyrl
Professor of Botany and Curator of the Herbarium
Department of Botany
018 Life Sciences East
Oklahoma State University
Stillwater, OK 74078

Dr. Laval M. Verhalen
Professor
Department of Agronomy
472 Agriculture Hall North
Oklahoma State University
Stillwater, OK 74078

Dr. Allen F. Wiese (Retired)
Professor, *Emeritus*
Texas Agricultural Experiment Station
Texas A&M University
P.O. Drawer 10
Bushland,TX 79012