

# Preface

---

During the twentieth century tobacco has become one of the most economically important agricultural crops in the international marketplace. Not only do farmers in over 100 countries depend upon tobacco as a major source of cash income, but an entire industry, from a diverse manufacturing sector to distribution and retail outlets, has grown to be a major economic force in many industrial and developing countries. Along with the growth in the tobacco industry, local and national governments in many countries have reaped added benefits through the collection of tax revenues. The growth in the tobacco industry has been supported by numerous scientific and technical advances in the last century. Indeed, one could speculate that without these achievements the tobacco industry would not have reached the level of global importance it has today.

Despite the rather remarkable advances for tobacco as an agricultural industry, it would seem that few other industries have faced as many challenges and changes in recent years. The globalization of the tobacco industry, new legislation and efforts by external forces have greatly altered the environment in which the tobacco industry operates. While many in the tobacco industry have continued to strive to produce a high quality tobacco leaf for superior consumer products, the new, dynamic environment has made it difficult to keep that focus. Indeed, many individuals throughout the tobacco industry are focusing on new issues to more effectively meet the needs of this ever-changing environment. These challenges should be considered positive, as it will be through effectively meeting these challenges that the tobacco industry will provide for the next hundred years.

The industry has experienced cyclic supplies of quality leaf for a long time – some years have a high volume of leaf, others a rather low volume. Naturally, as supply cycles world prices fluctuate significantly. The tobacco farmer is at the mercy of these production cycles and the industry has responded with attempts to minimize this cyclic production to a more constant supply flow. The impact of external issues such as the anti-smoking efforts makes it difficult to predict future demand, but nevertheless, the production of a stable

supply of high quality leaf tobacco will remain important to growers and others throughout the industry.

Many factors have contributed to fluctuations in the global supply of tobacco leaf. The common trend seems to be a short supply, followed by price increases, followed by over-production. This trend can be exacerbated by a number of factors. In some countries, policies designed to support production will contribute to excess production and an over-supply of tobacco leaf. For example, regulations in the USA that limit quota reductions may actually enhance the magnitude of the over-supply part of the cycle on a worldwide basis. Also, the supply side of the equation is affected by changes in government regulations that affect tobacco and by differences among countries in regulations that affect the movement of tobacco throughout the world markets. On the other hand, tobacco diseases and insects, unfavorable weather, increased production expenses, the need to conserve soils and low prices will drive down tobacco production.

On a worldwide basis, the demand for tobacco continues to increase, although not at the pace set a few years ago. Cigarette consumption in many developed countries, the USA in particular, has tended to decline over the past decade, but this downward trend appears to be leveling out. Further government regulations, including restrictions on advertising, could have a further negative effect on the demand for tobacco products. To achieve some stability in the global supply of tobacco and to ensure that growers will continue to produce a high quality leaf, scientific advancements must continue, and growers and others in the industry must adapt and plan to meet the needs of the consumer.

In recent years, this is perhaps best exemplified by the price-conscious consumer driving up the demand for 'value brand' products in some countries. Such 'house' brands require careful monitoring and taste test screening of less expensive tobaccos. The industry found that although consumers request a lower-priced product, they are not and should not be willing to accept a taste trade-off.

Shifts in global demands for new or existing products, primarily blended cigarettes and cigars, are

changing tobacco production requirements. These changes may necessitate that the tobacco industry place special emphasis on scientific advancements in variety development, agronomic practices, pest control and leaf curing to meet the needs of consumers in many different countries. This would make tobacco product manufacture a more segmented industry, but it would permit the industry to be more responsive to each market.

While consumer preferences drive raw product requirements, it is the purchaser of the leaf that must implement many of these changes. Leaf quality and price are often deciding factors in the implementation effort. As we move to the future of tobacco products, as well as other consumer products, we will see an increasing use of biotechnology to enhance a product's usability and value. Because of certain unique characteristics of the tobacco plant, it has been widely used in genetic studies for over 75 years. Rapid advancements in knowledge of genetics and technological creativity have provided remarkable tools to genetically improve the tobacco plant. These improvements could be targeted towards fine-tuning the plant to achieve certain characteristics including improved agronomic performance and pest resistance.

Many of the advancements in tobacco science have arisen from research conducted at public institutions including universities and government agencies. A reduction in public support for future tobacco research has already occurred in some countries. This will undoubtedly make it more difficult to address the research needs of growers and manufacturers, as well as hamper the development of the next generation of tobacco scientists. Broad-based support for research will have to come from within the industry, and consequently, research programs must be carefully evaluated for their cost effectiveness, value to the industry and the ease of supplying the research results at the farm level.

This CORESTA monograph will discuss the inter-relationships among the growth of the tobacco plant, the harvested leaves, their curing, processing and manufacturing, and the properties of the final product. Through each step of the process – from tobacco seed germination to smoke yield – the goal of the entire process is consumer satisfaction. A discussion of the breeding and genetics of the tobacco plant flows into a chapter about the new frontier of biotechnology. Tobacco is an ideal recipient for the introduction and expression of foreign genes for use in plant enhance-

ment or disease resistance. Biotechnology will inevitably have an impact on future tobacco production and utilization. The combined study of the tobacco plant's physiology and the improvement of agronomic practices has enabled and will continue to enable us to enhance the leaf yield. This monograph will outline the general management practices for each of the major tobacco types – flue-cured, light air-cured, Oriental, cigar and fire-cured. The economic losses, management, control, effects on tobacco's chemical composition and leaf usability will be studied in a chapter outlining major tobacco diseases. The minimization of pesticide residues is a worldwide issue and is featured in a discussion of tobacco insect management from production to storage of tobacco products. The basic chemical constituents of the tobacco leaf and the differences among tobacco types are presented in a chapter on leaf chemistry, followed by a discussion of tobacco's physical properties in relationship to manufacturing needs and properties. Tobacco's marketing systems, threshing and redrying, aging, fermentation and storage procedures blend into a monograph section on cigarette design. This monograph will closely examine current practices and new developments in the area of cigarette manufacture and the study of smoke chemistry. Lastly, the topics related to cigars, cigarillos and smokeless tobacco products will be explored. This monograph is intended to offer a broad view of current tobacco knowledge/practices and features sections relating to the future of tobacco.

This monograph highlights the current state of knowledge in the areas just described. To accomplish this, we asked our contributing authors to focus their attention on the up-to-date scientific literature as it relates to each chapter topic. It was not our intention to compile a complete compendium of the literature on tobacco science and technology, nor did we intend to provide a thorough history of tobacco. We do hope, however, that the reader will find that this monograph provides a rich source of information about the art, science and technology of tobacco.

*D. Layten Davis*

R. J. Reynolds Tobacco Company  
Winston-Salem, North Carolina, USA

*Mark T. Nielsen*

University of Kentucky  
Lexington, Kentucky, USA

# List of Contributors

---

- D. Bai*, Imperial Tobacco Ltd, Montreal, Quebec, Canada  
(3 Biotechnology: Uses and Applications in Tobacco Improvement)
- Richard R. Baker*, British American Tobacco, Southampton, United Kingdom  
(12 Smoke Chemistry)
- B. W. Blair*, Tobacco Research Board, Harare, Zimbabwe  
(6B Virus Diseases and 7A Insects and their Management in Tobacco Production)
- D. Blancard*, Institut du Tabac, Seita, Bergerac, France  
(6B Virus Diseases)
- J. D. Brandle*, Agriculture and Agri-Food, Delhi, Ontario, Canada  
(3 Biotechnology: Uses and Applications in Tobacco Improvement)
- L. P. Bush*, University of Kentucky, Lexington, Kentucky, USA  
(8B Alkaloid Biosynthesis)
- John S. Campbell*, John S. Campbell Ltd, Wilson, North Carolina, USA  
(10A Tobacco Marketing Systems)
- Chris Crawley*, Fidus Instrument Corporation, Richmond, Virginia, USA  
(11C Cigarette Production and Quality Assurance)
- L. Davis*, R. J. Reynolds Tobacco Company, Winston-Salem, North Carolina, USA  
(Preface)
- R. Delon*, Institut du Tabac, Seita, Bergerac, France  
(6B Virus Diseases)
- Phil Fisher*, Tobacco Consultant, Louisville, Kentucky, USA  
(11A Tobacco Blending)
- K. C. Flower*, Tobacco Research Board, Harare, Zimbabwe  
(4C Field Practices)
- Donald J. Fowlkes*, University of Tennessee, Knoxville, Tennessee, USA  
(5D Dark Fire-cured Tobacco)
- S. N. Gilchrist*, R. J. Reynolds Tobacco Company, Winston-Salem, North Carolina, USA  
(5C Oriental Tobacco)
- T. Glover*, Tobacco Research Board, Harare, Zimbabwe  
(6B Virus Diseases)
- T. W. Hutchens*, F. W. Rickard Seeds, Inc., Lexington, Kentucky, USA  
(4A Tobacco Seed)
- J. C. Leffingwell*, Leffingwell and Associates, Canton, Georgia, USA  
(8A Basic Chemical Constituents of Tobacco Leaf and Differences among Tobacco Types)
- P. D. Legg*, University of Kentucky, Lexington, Kentucky, USA  
(2 Breeding and Genetics)
- E. D. Massey*, British American Tobacco, R&D, Southampton, UK  
(7B Stored Tobacco: Insects and their Control)
- J. L. McKenzie*, McKenzie and Rains, Winston-Salem, North Carolina, USA  
(11C Cigarette Production and Quality Assurance)
- Robert D. Miller*, University of Tennessee, Knoxville, Tennessee, USA  
(5D Dark Fire-cured Tobacco)
- L. Mueller*, R. J. Reynolds Tobacco GmbH, Cologne, Germany  
(7C Pesticide Regulations and their Impact on Crop Protection Strategies (Minimization of Pesticide Residues))
- Y. Nakanishi*, Japan Tobacco Inc., Yokohama, Japan  
(9 Physical Properties of Leaf Tobacco)
- M. Nielsen*, University of Kentucky, Lexington, Kentucky, USA  
(Preface)
- Alan Norman*, R. J. Reynolds Tobacco Company, Winston-Salem, North Carolina, USA  
(11B Cigarette Design and Materials)
- G. K. Palmer*, University of Kentucky, Lexington, Kentucky, USA  
(5B Light Air-cured Tobacco)
- R. C. Pearce*, University of Kentucky, Lexington, Kentucky, USA  
(5B Light Air-cured Tobacco)
- G. F. Peedin*, North Carolina State University, Raleigh, North Carolina, USA  
(5A Flue-cured Tobacco)

- Tommy Ringberger*, Swedish Match Sverige AB, Stockholm, Sweden  
(14 Smokeless Tobacco)
- L. Ryan*, Philip Morris Europe, Neuchâtel, Switzerland  
(10C Tobacco Storage)
- J. A. Shepherd*, Tobacco Research Board, Harare, Zimbabwe  
(6C Nematode Pests of Tobacco)
- H. D. Shew*, North Carolina State University, Raleigh, North Carolina, USA  
(6A Fungal and Bacterial Diseases)
- P. B. Shoemaker*, North Carolina State University, Raleigh, North Carolina, USA  
(6A Fungal and Bacterial Diseases)
- B. W. Smeeton*, R. J. Reynolds Tobacco Company, Winston-Salem, North Carolina, USA  
(2 Breeding and Genetics)
- W. D. Smith*, North Carolina State University, Raleigh, North Carolina, USA  
(4B Seedling Production)
- T. C. Tso*, Ideals Inc, Beltsville, Maryland, USA  
(1 Seed to Smoke)
- G. Wagner*, University of Kentucky, Lexington, Kentucky, USA  
(8C Leaf Surface Chemistry)
- Inger Wahlberg*, Swedish Match Sverige AB, Stockholm, Sweden  
(14 Smokeless Tobacco)
- M. R. Ward*, Advanced Technologies (Cambridge) Limited, Cambridge, United Kingdom  
(7C Pesticide Regulations and their Impact on Crop Protection Strategies (Minimization of Pesticide Residues))
- Bill Ward*, Export Leaf Tobacco Company, Wilson, North Carolina, USA  
(10B Green Leaf Threshing and Redrying Tobacco)
- W. W. Weeks*, North Carolina State University, Raleigh, North Carolina, USA  
(8D Relationship between Leaf Chemistry and Organoleptic Properties of Tobacco Smoke)
- Adeler Frederik Wehlburg*, ASP Enterprises, Inc., Guayaquil, Ecuador  
(13 Cigars and Cigarillos)

# Acknowledgements

---

The editors express appreciation to CORESTA and to CORESTA's Scientific Commission for providing the opportunity to publish this Tobacco Monograph. The assistance of Francois Jacob is especially noteworthy.

The contributions of all chapter authors and H. Burton, who coordinated the leaf chemistry chapter, are greatly appreciated.

H. Papenfus and E.A. Wernsman contributed significantly to the original idea for this monograph. In addition, H. Papenfus was involved with the selection of the chapter topics.

The excellent assistance of Ann Niten, who formatted and incorporated numerous revisions into the monograph, and the dedicated efforts of Veda Davis, who proofed the entire monograph and revisions, are recognized.

We also thank Patty Turner for her assistance in organizing and preparing the monograph. Special thanks are extended to H. Chung and the RJRT

Library staff for their work in locating the correct reference citations.

Further, we acknowledge the contributions of Sue Moore, Blackwell Science Senior Editor, who was very helpful and encouraging during the preparation and publication phases of this monograph.

Appreciation is expressed to the persons who reviewed the manuscripts. They include R. Black, L.P. Bush, J. Chappell, D. Fleming, B. Fortnum, C. Green, D. Hill, A. Johnson, B. Kennedy, C. Lily, W. Lloyd, R.C. Long, R. Manning, R. Monk, Jr, W. Nesmith, R. Pearce, H. Papenfus, T. Parish, T.J. Porter and A. Rodgman.

Finally, we acknowledge the importance to the authors of this monograph of the previous publication *Tobacco* by B. C. Akehurst (Longman Group Limited, Essex, UK). Numerous sections utilize information as evidenced by the citations. That book has served as a major reference for this industry for over three decades.