

J.A. VOZZO

Tropical Tree
SEED MANUAL

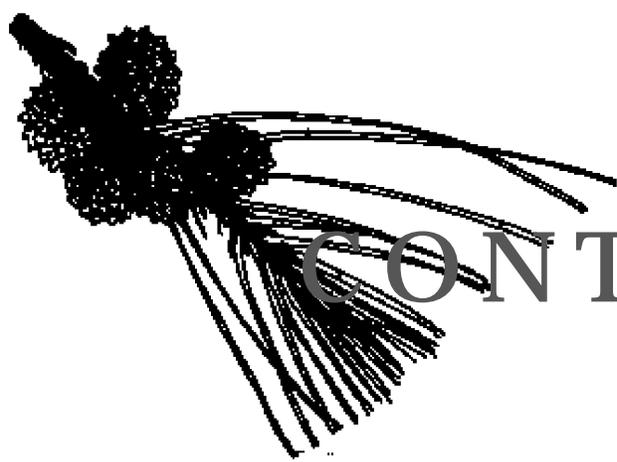
United States Department of Agriculture

Forest Service

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CONTENTS

Dedication	6
Acknowledgment	7
Abstract	8
Introduction	9

PART I Technical Chapters

<i>Chapter 1</i>	Tropical Tree Seed Biology	13
<i>Chapter 2</i>	Collection	119
<i>Chapter 3</i>	Storage	125
<i>Chapter 4</i>	Orthodox and Recalcitrant Seeds	137
<i>Chapter 5</i>	Dormancy and Germination	149
<i>Chapter 6</i>	Pathology	177
<i>Chapter 7</i>	Ecology	191
<i>Chapter 8</i>	Ethnobotany	215
<i>Chapter 9</i>	Notes on Tropical Dendrology	221

PART II Species Descriptions

Introduction	239
Descriptions	241
Supplemental Species Drawings	785
References	807
Glossary	861
Authors	871
Indices	
Common Names	875
Genus/Species Names	887
Family Names	896
Associated Organisms	897
Conversion Factors	899

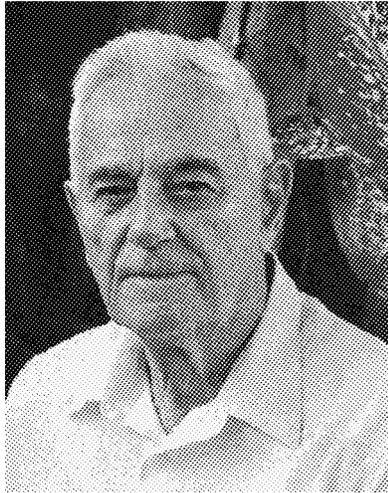
DEDICATION

Dr. Frank H. Wadsworth has been actively and continuously researching tropical silviculture for the U.S. Department of Agriculture Forest Service since 1942.

Before his impressive career in the Tropics began, Dr. Wadsworth investigated forest succession at the confluence of the Koyukuk and Yukon rivers in Alaska.

After brief assignments with the USDA Forest Service in Nebraska and Arizona, he began his tropical focus with a dissertation on the management of the Caribbean National Forest in Puerto Rico. This dissertation earned him a Ph.D. from the University of Michigan.

Dr. Wadsworth was Research Officer for the Tropical Forest Experiment Station in Rio Pedras, PR until 1956, when it became The Institute of Tropical Forestry (ITF) and he was appointed Director. He remained Director until 1978. Under his leadership, the ITF staff researched and reported on hundreds of tropical tree species, planted species on diverse and degraded sites, supported 16 annual 3-month tropical forestry courses for international participants, and published *The Caribbean Forester*—a trilingual, quarterly journal that dis-



seminates information pertaining to technical forestry.

When ITF became IITF—International Institute for Tropical Forestry—in 1978, Dr. Wadsworth became head of Special Studies for International Cooperation, where he remains as an active researcher and consultant. As a leading consultant in

every country of tropical America, Dr. Wadsworth has published more than 100 scientific articles, authored both reference and technical books on tropical forestry, and remains in demand as a speaker relating his experiences with and opinions about technology transfer.

I have personally known Dr. Wadsworth since July 1964 when he was an advisor for my own research dissertation in Rio Piedras, PR. I continue to seek and value his advice.

I am proud to dedicate this *Tropical Tree Seed Manual* to Dr. Frank H. Wadsworth as further recognition of his distinguished career in tropical forestry.

J.A. Vozzo

Research Plant Physiologist

ACKNOWLEDGEMENT

The *Tropical Tree Seed Manual* (TTSM) is the product of international cooperation and contributions. In 1990, the members of the North American Forestry Commission of the United Nations Food and Agriculture Organization authorized compilation of a tropical tree seed reference manual for use among its membership in Canada, the United States, and Mexico. Under the direction of Dr. J. L. Whitmore, USDA Forest Service (Forest Service), the project was later expanded to include tropical tree species found in all of tropical America from Canada to Colombia. Since work on the project began in April 1996, 63 scientists from 19 countries have responded by providing species descriptions, chapters, translations, drawings, herbarium specimens, and references both unpublished and published.

The Forest Service supported the project by permitting employees to establish international contacts, compile the data, and oversee production and by funding the botanical drawings, Spanish-English translations, operations, editing, and printing of the English edition. Specifically, I want to thank the National Reforestation, Nurseries, and Genetic Resources (RNGR) Team and the Washington Office Cooperative Forestry group for their support with the English-Spanish translations. I value the advice and counsel of Dr. George Hernandez, Dr. Tom Landis, and Dr. Ron Overton of the Forest Service.

The TTSM would not have been produced without the help of all of these people. My sincere gratitude goes especially to Dr. James M. Guldin, USFS; the Red de Herbarium de Mesoamerica y el Caribe, particularly Dr. Mireya Correa A., Lic. AnaLu E. de MacVean; Dr. Cyril Hardy Nelson Sutherland; Dr. Ricardo Rueda; and M.Sc. Jeanine Velez Gavilan. I thank Gustavo Serrano for the original botanical drawings of all species, and Francisco Hodgson for the illustrations in Chapter 1. Special thanks to Maria Arun Kumar for her patience with the Spanish-English translations, and to Brenda Grebner for the draft and final versions of all submissions. I also thank Pamela Bowman, a technical editor with the Forest Service, Sonja Beavers, Mary Jane Senter, USFS, and George Avalos, USDA for their invaluable comments and suggestions. Dr. K.F. Connor and Mrs. Penny Byler made available additional Forest Service resources to complete this project.

Dr. Rosa Elena Molina Achecar de Vozzo warrants special mention for her many hours of patience, cooperation, and translations...all volunteered.

The greatest fault of this manual will not be misspelled words, unintentionally erroneous data reports, or negligent omissions. It will be my inability to acknowledge all the people and institutes who helped make TTSM possible.

J.A. Vozzo

Research Plant Physiologist

ABSTRACT

The *Tropical Tree Seed Manual* is a one-volume reference manual for students, technicians, and scientists that provides comprehensive, internationally compiled data about tropical trees. The emphasis is on species of the Americas; however, a number of tropical tree species from other countries are also included. The manual is divided into two parts. The first part consists of nine chapters written by authorities in each area. The second part presents descriptions of 197 botanically and economically important tropical tree species. The manual is published in both English and Spanish. It contributes to the academic and scientific communities by collating and organizing a wealth of internationally significant research and practical data into one publication. It should be used with similar references on seed technology and handling to give students, technicians, and scientists a thorough understanding of tropical tree seeds.

Keywords: collection, ecology, ethnobotany, germination, pathology, recalcitrance, seeds, storage, tropical forestry

INTRODUCTION



The North American Forestry Commission (NAFC) is a component of the United Nations Food and Agriculture Organization that addresses international forestry. The NAFC members (Canada, Mexico, and the United States) initiated a proposal to improve forestry applications by providing guidelines on tropical tree seed handling to nursery and plantation managers. The project was approved with the implied support of each member country. The NAFC chairperson, Jacob L. Whitmore of the USDA Forest Service, secured authorization in April 1996 for the Forest Service to proceed with the planning and organization of a tropical tree seed reference manual.

The concept was later expanded to include a technical section and descriptions of tropical tree species in the Neotropics and tropical Asia, Africa, Australia, and India, and a compiler was identified to coordinate the project. There was no intent to include all tropical tree species, only those of economic or biologic interest to forestry applications in Canada, Mexico, the United States, and Central America.

The information published here resulted primarily from previously known data; however, much of it had not been reported outside its area of origin. Through experience, nursery and plantation managers have learned about the biology and handling techniques of their significant species, but they lack information about species they have not planted. The *Tropical Tree Seed Manual* (TTSM) provides them with a reference for investigating the feasibility of introducing new species into their economies. It also provides a practical starting point for comparative morphology and literature references for those scientists conducting research within tropical forestry. Finally, students will find the technical chapters useful as an introduction to and a current review of the issues involving tropical tree seeds.

The TTSM is intended as a useful reference for practical and academic ventures into tropical forestry. It is a one-volume reference manual for nursery and plantation managers, scientists, and students that provides comprehensive, internationally compiled data. By including previously unpublished reports, data, illustrations, and international references

in a single book, time-consuming literature searches will be reduced or eliminated.

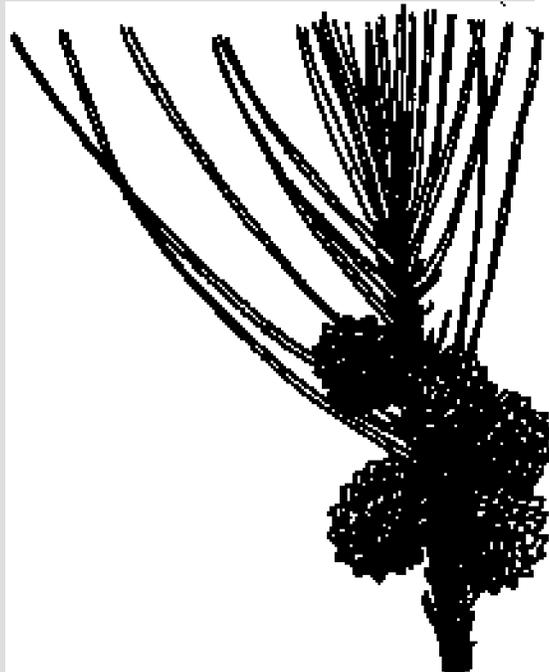
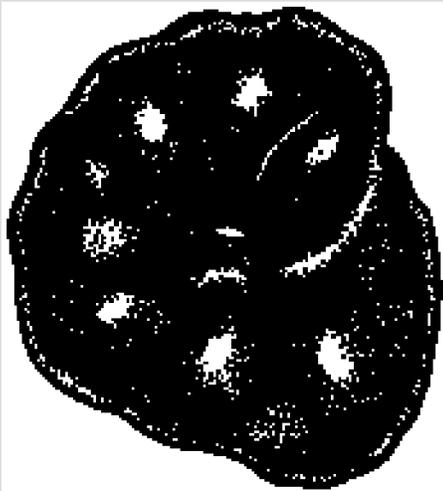
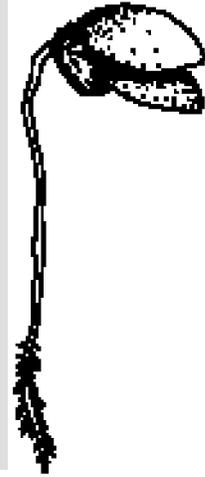
The first part consists of nine technical chapters written by authorities in each subject: biology, collection, storage, orthodox and recalcitrant seeds, dormancy and germination, pathology, ecology, ethnobotany, and dendrology. Each chapter provides an independent and comprehensive discussion, but together they form a single, complete text solely dedicated to tropical tree seeds. The current and historical information thus provided can be used for both teaching and research.

The second part of the manual presents descriptions of 197 botanically and economically important species in a standard format. The most widely used and well-known species are described in depth, while lesser known species are not. Authors have attempted to include all known information on each species, thus absence of information indicates limited knowledge about a species. All nomenclature is according to references from the Missouri Botanical Gardens.

For practicality and easy searching, the referenced literature in TTSM is listed in one separate section. Common names, synonyms, and associated organisms are also cross-referenced. The international effort to produce the TTSM is represented by 63 contributors from 19 countries, and brief autobiographies of contributors are included.

The TTSM is published in both English and Spanish. Particular styles in both languages are mediated into chapters and species descriptions for a common, but bilingual, volume. For example, all units are in metric values and a conversion table is included. Common names are not limited to English and Spanish, but also include names in any language indigenous to a country with a particular species.

The TTSM contributes to the academic and scientific communities by collating and organizing an internationally significant research and practical subject into one reference. It should be used with similar references on seed technology and handling to give students and technicians a thorough understanding of tropical tree seeds.



TECHNICAL CHAPTERS

The nine technical chapters were selected to give a comprehensive overview of current tropical tree seed technology as written by internationally recognized authorities. All chapters together offer a supplement text for the study or reference of tropical tree seeds. However, each chapter may be used alone to pursue a specific field of interest. This objective necessarily produces an overlap of subjects between chapters. The overlap is not as repetitive as it is descriptive from the viewpoints of the authors as they develop dominant research references.

