Gesellschaft für Walderhaltung
und Waldbewirtschaftung mbH

刘 勇 等著

苗木质量调控理论与技术

PRINCIPLES AND METHODOLOGY FOR SEEDLING QUALITY MODIFICATION AND CONTROL

中国林业出版社

内容提要

本书以作者10多年来对苗木培育理论与技术的深入研究为基础，广泛吸收国内外该领域最新研究成果，系统而深入地提出了苗木质量调控理论与技术。全书以苗木质量为中心，对苗木质量评价、苗木质量调控、苗木质量保护及适地适苗造林等方面的理论与应用技术进行了广泛深入的论述。对提高我国苗木生产水平，保证造林质量具有积极的意义。本书既有深入的理论分析，又有浅显的实用技术，信息量大，是林业工作者，尤其是育苗、造林专业技术人员、科研人员、大专院校教师及学生的重要参考书。

ISBN 7-5038-2222-8

9 787503 822223 >

ISBN7-5038-2222-8/S · 1252

定价：19.00元

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Edited by: Liu Yong etc.

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CHINA FORESTRY PUBLISHING HOUSE

图书在版编目(CIP)数据

苗木质量调控理论与技术/刘勇等著. —北京:中国林业出版社,1999.4

ISBN 7-5038-2222-8

Ⅰ.苗… Ⅱ.刘… Ⅲ.苗木-质量管理 Ⅳ.S723

中国版本图书馆 CIP 数据核字(1999)第 02929 号

中国林业出版社出版发行

(100009 北京西城区刘海胡同 7 号)

北京地质印刷厂印刷

1999 年 4 月第 1 版 1999 年 4 月第 1 次印刷

开本:850mm×1168mm 1/32 印张:7.625

字数:198 千字 印数:1～1000 册

定价:19.00 元

《苗木质量调控理论和技术》编委会

EDITORIAL BOARD OF PRINCIPLES AND METHODOLOGY FOR SEEDLING QUALITY MODIFICATION AND CONTROL

前 言
PREFACE

我国是一个少林的国家，森林覆盖率仅为13.92%，现有森林在木材及其他林产品生产量和环境保护能力等方面，远远满足不了我国国民经济和社会发展的需要。为了改变这种局面，我国开展了大规模的人工造林，每年造林面积达500多万公顷。然而，造林成活率和保存率不高，人工林生长量也不理想，原因当然是多方面的，其中造林用苗的质量问题是一个重要方面。由于对苗木质量认识不深、管理不严和保护方法不当，生产上“活人栽死苗”的现象时有发生。因此加强对苗木质量研究具有重要现实意义。

自本世纪70年代末、80年代初以来，国内外在苗木质量方面做了大量工作，对苗木质量的认识有了新的飞跃。这些研究成果对提高林业工作者在苗木质量方面的认识，加强对苗木质量的管理都是非常重要的。作者经历了自80年代初以来的整个苗木质量研究过程，并对苗木质量进行了长达十多年的研究，但自己过去的研究只注重某些方面，缺乏系统性和完整性。通过国家高等学校博士学科点专项科研基金课题“造林树种苗木抗逆性调控及机理的研究”，才使自己在苗木质量研究上形成了相对完整的思路。

研究过程中得到恩师沈国舫教授、宋廷茂教授和尹伟伦教授的精心指导和热情帮助。北京林业大学的郑彩霞副教授，博士生彭祚登等参与了部分研究工作。对本研究给予过大力帮助的还有北京林业大学的林平老师。在研究成果成书之际，仅表深深谢意。

由于作者的知识和水平有限，深感对“苗木质量调控理论与

技术”这一命题的研究还很不够，书中的错误及不足之处在所难免，恳请读者批评指正。

本书是“造林树种苗木抗逆性调控及机理的研究”项目的部分成果，该项目得到高等学校博士学科点专项科研基金资助，在此表示感谢。

本书的出版得到德国GWB咨询集团的大力支持和资助。The publishing of this book is subsidized by Gesellschaft für Walderhaltung und Waldbewirtschaftung mbH (GWB), Germany. The address of GWB: Forsthausstrasse 19, D-64754 Hesseneck, Germany. Fax No. (0049) 6276-912052.

刘 勇

1999年3月

ABSTRACT

Forest coverage rate in China is only about 13.92% and the distribution of these forests is very uneven, most of the forests are located in Northeast and Southwest of China. The existing forests are unable to fulfill the demands of Chinese people for timber production, environment protection and recreation. To solve the problem, large areas (more than 5.3 million hectare) were reforested each year. Survival rate and growth of these plantations, however, were mostly inadequate and in some places planting have to be done many times in the same planting site. Among reasons for the failure of the plantations, seedling quality is one of the major aspects. Many forestry technicians involved in these afforestation activities had a poor knowledge and understanding about seedling quality, thus the management of seedling was not efficient. Sometimes seedlings were planted which had already lost their viability due to lack of protective measures during the period of lifting, transporting and planting. This is called "a live man plants dead trees". Therefore the technical skills about seedling quality have to be urgently improved in order to guarantee the success of many afforestation projects in China.

Chapter 1 Seedling quality evaluation

Traditionally, seedling morphology, especially seedling

height and diameter, is the most important parameter for seedling quality evaluation. In order to understand seedling quality thoroughly, more indicators were introduced in this book, such as height to diameter ratio, seedling weight, seedling root system, shoot to root ratio, terminal bud, quality index etc.. Every indicator reflects a different aspect of seedling quality which will help people when assessing seedling quality and when culturing seedlings. After studying the relationships between different morphological indicators, between seedling morphology and physiology, and between seedling morphology indicators and their effect on afforestation, it was found that the various information given by these indicators were overlapped each other. Apart from seedling height and diameter, the number of lateral roots longer than 5 cm was found to be another important indicator that could be used in daily practices to assess seedling quality.

Comparing to seedling morphology, seedling physiology is more sensitive to stress and the changes of physiology are directly relating to seedling viability. The field of assessing seedling quality by physiology indicators has been intensively studied since the end of 70s and early 80s and hence considerable new knowledge about seedling physiology has been accumulated through these studies. However, most of the forestry technicians in China are still unfamiliar with this knowledge. In this chapter seedling physiology has been elucidated in terms of water relation, nutrient content, carbohydrate reserve, electrical resistance, chlorophyll content, TTC method for testing root viability, bud dormancy and some other physiological indicators. Major emphasis is given to demonstrate the importance of these in-

dicators to seedling viability, the relationships between seedling physiology and seedling viability, and finally the influence of seedling physiology on the success of subsequent afforestation.

Root growth potential (RGP) has been recommended as one of the most accurate and reliable indicators for seedling quality (viability) evaluation. By compiling the results from the author's studies related to various tree species in China, this book specially deals with topics like the test method of RGP, the relationships between RGP and species, and seedling above ground part, and root system, and afforestation effects. Different species have their own special RGP pattern in relation to the changing seasons, which has a significant influence on the capacity for seedling survival after outplanting.

After thoroughly studying the seedling quality in relation to aspects of morphology, physiology and viability, the author puts forward a seedling quality evaluation and control system to combat seedling quality problems encountered in the Chinese forestry sector. Some main features of this system are:

1. Selecting seedlings to match the planting site. Seedlings produced by different methods possess different quality in terms of seedling types, morphology, physiology and stress resistance ability. Using proper seedlings according to the planting site condition can reduce the risk of plantation failure.

2. Assessing seedling quality through multiple indicators and integrated measure. Though a tree seedling is a complex organism, most of the indicators are, under normal conditions, strongly correlated among each other. However, each indicator mainly reflect one aspect of seedling in abnormal conditions such as drought stress, cold, nutrient deficiency. Therefore it is in-

dispensable to use multiple indicators and integrated measure to assess seedling quality. At present, in Chinese forestry the following factors need to be considered when assessing seedling quality: seed quality, seedling type and age, seedling morphology, seedling physiology and RGP.

3. Assess seedling quality periodically in order to consider dynamic characteristics. The critical periods for assessing seedling quality and viability will be: (1) before lifting to decide whether the seedlings have reached the acceptable standard or not; (2) after lifting, to decide how to classify seedlings; (3) after transporting and before planting, to find out seedling viability.

4. Establishing seedling quality modification and control system. The practice of seedling evaluation so far in China only deals with the elimination of already raised, but unqualified seedlings, which obviously is a passive measure for seedling quality management. Considering that seedling quality is reflecting cultural conditions and measures applied during seedling raising, it is possible to modify and control seedling morphology and physiology according to the requirements of the planting site. Seedling production, therefore, become a planting site oriented and an active measure for quality evaluation and control.

Chapter 2 Seedling quality modification through culturing measures

The following control measures for seedling morphology are discussed in this chapter:

* seed quality related to seedling quality ;

* different seed treatments and their effects on seedling quality ;

* how to select sowing date to modify seedling morphology;

* how to get target seedlings through modifying seedling density;

* how to establish proper irrigation and fertilization regimes for producing qualified seedlings;

* cultivation measures for the root system: undercutting, wrenching, lateral pruning, and box pruning;

* top pruning;

* transplanting.

About 45% of the land area in China belong to dry and semi-dry zones, which include the North and the Northwest of China, Inner Mongolia, the Qinghai and Tibetan Plateau. Thus drought is the first problem encountered when carrying out afforestation activities in these areas. To increase survival rate of the plantations, seedlings with high quality, especially with the characteristic of drought resistance, are needed. Therefore regulation measures for seedling physiology and stress resistance are considered very important in nursery.

The mechanism of seedling stress resistance has two aspects: The first is the change of seedling morphology, especially in the aspects of growth, structure, and arrangement of leaf and root. The second is mainly about seedling physiology reaction and adaptability. The following measures for modifying seedling physiology and stress resistance are discussed: seedling density, water stress treatment, seed treatment, root undercutting, light treatment, chemical treatment, biological treatment,

Chapter 3 Seedling viability protection

Seedling viability protection mainly refers to the care taken of seedlings after lifting and before planting. For seedlings, lifting is a big shock and means a great change of living environment. Due to the cut of a large part of seedling roots and removal of seedlings from soil, the physiological activities of seedlings will decrease to a minimum level. Seedlings will easily loose their viability if the protection measures are not provided properly and promptly.

Seedling physiology change significantly after lifting. Seedling water loss, especially from the roots, is the major course for decreasing viability and finally leading to death. Therefore, studies about seedling water relation and root physiology after lifting and seedling physiology during storage are intensively discussed in this chapter.

The techniques for effective protection of seedling viability during lifting, grading, packing and storage, transporting, and planting are discussed in detail.

Chapter 4 Matching stock to planting site

Seedlings produced by different methods vary in morphology and physiology and therefore their adaptability is also different. In order to match stock to planting site, first of all stock types and their characteristics in relation to seedling adaptability have to be understood. The following stock types are studied and compared in their adaptability to planting conditions:

1. Bare-root seedlings
2. Containerized seedlings
3. Transplanted seedlings
4. Transplanted container seedlings
5. Transplanted wild seedlings
6. Plug+1 seedlings
7. Seedlings produced by seed
8. Seedlings produced by asexual measures
9. Seedlings with mycorrhizae

Beside stock types, stock size, age and others, morphology and physiology are also important factors when selecting seedling for a special planting site. The knowledge about the mechanism of rooting and the effects of environment conditions on seedling survival and growth is necessary to understand seedling and survival relationships. This is the basis for stock selection in view of the future planting sites.

Another way to match stock to planting site is to select stock type, age, size and seedling physiology based on the planting site condition. Appropriate sites and difficult sites are discussed in the text.

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