

HUNAN EUCALYPTUS

湖南桉树



李志辉 主编

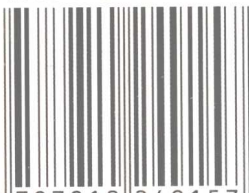
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李志辉 等编著

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序

今后五年到十年,是我省经济、生态和社会发展的重要时期,也是林业大有作为的时期。全省林业工作的总体思路是:瞄准一个目标,建立两大体系,实施九大工程,促进“三化”建设。一个目标:全省到 2010 年森林覆盖率达到 55%,到 2025 年森林蓄积量达到 5.5 亿立方米。两大体系:建立比较完备的林业生态体系和比较发达的林业产业体系。举全省之力抓好九大工程,即:退耕还林工程、野生动植物保护及自然保护区建设工程、防护林体系建设工程、“三难地”绿化攻坚工程、生态公益林保护工程、速生丰产林建设工程、林产工业工程、森林生态旅游工程、优质种苗和花卉工程。促进“三化”建设:促进全省工业化、农业产业化和城镇化建设的步伐。其中的速生丰产林建设工程是我省林业产业体系建设中的骨干工程,也是促进全省工业化发展的“原料工程”,增强林业经济实力的“希望工程”。计划到 2010 年,在 78 个县再建设 2100 万亩速生丰产林,其中新造 1000 万亩,改造 1100 万亩,新造面积中包括桉树 20 万亩。

《湖南桉树》这一专著的出版发行,为速生丰产林建设提供了一本好的教科书,必将大大促进和提高湖南桉树的发展水平。该书对我省 20 多年来引种栽培桉树的研究成果和经验进行了系统整合和总结,并提出了湖南桉树引种栽培区划,各区自然条件、引种规模、水平和潜力,确定了各区适宜栽培的主要桉树种类、种源和经营方向,根据林木速生丰产的原理,在中试、推广的过程中,对遗传、立地和林分结构的控制,对苗木规格、整地方式,造林密度、配置方式、林地施肥、幼林培育、病虫害防治等影响林木生长的各项因子,都进行了组装配套,提出了一整套丰产栽培模式。筛选出耐寒、速生的优良种源 45 个,优树 50 多株,通过扦插繁殖、组培(桉树克隆技术)、组培苗以苗繁苗技术,为桉树优良无性系的繁殖打下了坚实基础,为我省发达的林业体系建设提供了原材料的资源基础。资源培育技术是找准适宜的树种,大规模推广桉树可以一树兴多业。

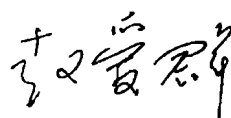
一是林纸业。桉材属短纤维,与我省的马尾松长纤维混合,可以生产任何一种高质量的纸。

二是人造板工业。桉树是很好的胶合板、刨花板树种,可以制造各种容重的纤维板,而且不需去树皮。制造高密度纤维板不需加胶。

三是家俱制造业、建筑业以及木地板等装饰业。桉材坚硬、耐腐,是生产木地板的最好材料。随着阔叶林资源的减少,特别是天然林禁伐,人工培育硬木家俱材、建筑材以及木地板板材等装饰材料已迫在眉睫。

桉树还是很好的薪材树种和防护林、水土保持林树种。

桉树生长快(6年一个轮伐期),产量高(亩收入在万元以上),材质好,用途广(全树是宝)的阔叶树种,它是山区人民致富奔小康的财源树种,大力发展桉树已是当务之急。



2002年11月

前 言

桉树具有速生、丰产的特点,近 20 年来,在中亚热带地区广为引种栽培。中国桉树引种始于 1890 年,已有 100 多年的历史,引种栽培面积达 $6.7 \times 10^5 \text{hm}^2$,四旁植桉 1.8×10^9 多株,已成为第二大桉树引种栽培国。

湖南省为东、西、南三面山地环绕,北东开口的马蹄形地貌类型,这种地势使冬季北方冷空气易于侵袭,造成全省冬季极端低温比同纬度的长江中下游地区低。20 世纪以来,出现了 7 次 -10°C 以下的低温,共分布 40 个县(市)。至今为止, -10°C 低温的周期约为 14 年。湖南能否发展桉树,人们担忧的是低温。自 1926 年湖南开始引种栽培桉树以来,经历了四个发展阶段。到目前为止,全省共营造各种桉树科研试验林 53.3hm^2 ,丰产示范林和一般营造林达到 1.3 万 hm^2 。主要分布在郴州、永州、衡阳等市的部分县(区)。

近 20 年来,桉树研究课题组进行了桉树引种栽培的普查工作,对湖南 20 世纪 50 年代以来引种桉树的情况进行了全面调查研究,查清了现存桉树主要种类和分布区域,对残存林分和单株进行了生长测定和冻害调查分析,确定了赤桉为全省范围内的引种推广重点种;“七五”至“八五”期间,在湘北、湘西、湘中、湘东高丘、湘南 5 个地理生态区,开展了赤桉优良种源的筛选及若干耐寒种类种源的引种栽培试验。共引入 58 种 122 个种源。现所保存的种类分别经受了不同程度的低温和冰冻的考验,为引种试验区及相似地理生态区筛选出了一批耐寒或较耐寒、速生或较速生的优良种类与种源。中试推广的主要种类 15 个、种源 45 个。在引种、中试推广过程中,初选了 51 株优树,所选优树的种类种源明确,原产地生态条件清楚,这些优良种类种源有较宽的遗传基础,为我省桉树的良种繁育提供了优良的种质资源;在广泛调查总结全省半个多世纪以来,特别是近 20 年来引种栽培桉树的多方面研究成果和经验的基础上提出了湖南省桉树引种栽培区划,基于对各区自然条件的分析,结合全省目前引种桉树的规模、水平和潜力,确定了各区适宜栽培的主要桉树种类种源和经营方向,根据林木速生丰产原理,在中试过程中,应用遗传控制、立地控制和林分结构控制,对苗木规格、整地方式、造林密度、配置方式、林地施肥、幼林抚育等影响林木生长发育的各项因子进行组装,优化了各引种栽培区丰产栽培模式;通过扦插繁殖试验,掌握了赤桉、巨桉和尾叶桉的扦插生根规律,并且对邓恩桉、多枝桉等难生根的桉树的扦插进行了有益的探索。提出了评定生根力的简捷方法及指标。结合扦插试验,对采穗圃的类型、管理、穗条的生长、生产周期及产量进行了摸索,为今后的规模性经营积累了资料,为优良无性系的繁殖打下了较好的基础;分别对赤桉、多枝桉和巨桉进行了优良家系试验。巨桉 80 个家系,12 个种源,通过优选,选择了 2 个优良种源,15 个优良家系;对引种的十几种桉树叶表面的蜡被、气孔分布、油囊结构,进行了显微观测,从而揭示了桉树叶表结构与抗寒性的关系,开展了不同种类、种源 SOD 超氧化物歧化酶活性变化的测定研究,把 SOD 酶活性的高低作为桉树抗寒性强弱的一种生理指标,研究了几种桉树和巨桉家系林的细胞膜脂肪酸含量与抗寒性关系;利用 RAPD 分子标记技术,从 DNA 水平上探讨巨桉的遗传多样性的结构与动态,以及群体的遗传分化程度,这将缩短

林木改良循环选择的时间,大大缩短林木育种周期。为合理开发利用、保存巨桉基因资源及其遗传改良提供科学依据,同时有助于充实桉树育种工作中的亲本筛选和利用的理论基础;测定了邓恩桉、多枝桉、赤桉、巨桉、广叶桉、樟脑桉及小果灰桉各种源的化学成分、热值、力学性质,为湖南各区选择优良的桉树种类种源、制浆及其木材开发利用等的定向培育提供了基础数据;对巨尾桉、巨桉、赤桉等9种桉树的干、枝、叶、皮四组分的大量元素和微量元素进行了测定分析,阐述了地上部分营养元素的含量、积累和分布特征,这为桉树人工林的林地施肥等林地管理提供了科学依据。

如上所述,本书的研究内容,是以湖南桉树资源保护与开发利用为立足点,以栽培植物遗传育种学、生理学、生物化学、土壤酶学、土壤微生物学和分子生物学为理论发展方向,是教学、科研和生产相结合的产物。

本书属于国家《桉树纸浆用材树种良种选育及培育技术研究》科技攻关、湖南省自然科学基金(《耐寒桉树材性与营林措施关系研究》、《耐寒桉树的分子分类及鉴定》)和湖南省林业厅《耐寒桉树良种选育》课题的部分研究内容。

本书所研究内容,从立项、调查、实验设计、成果验收鉴定,直到编写出版,始终得到湖南省科学技术厅、湖南省林业厅、中国林业科学研究院桉树研究与开发中心有关领导的关怀、支持和帮助,这是本书得以问世的保证。特别是中国林业科学研究院桉树研究与开发中心的杨民胜主任、湖南省林业厅葛汉栋厅长、赵爱群副厅长、李定一副厅长、中国林业科学研究院桉树研究与开发中心谢耀坚副主任、湖南省林业厅造林处、科技处、种苗站、推广站对本书出版发行的大力支持,还得到了湖南省各市、县林业局的支持,作者谨表衷心感谢。

本书在出版过程中,得到了中南林学院国家重点学科——“森林培育学科”的资助,作者表示衷心的感谢。

由于作者才疏学浅,书中定有不少遗漏,欠妥和错误之处,热诚欢迎专家和读者批评指正。

李志辉
中南林学院
2002年11月

PREFACE

Eucalyptus has the characters of fast growing and fertility.

In the recent 20 years, it has been widely cultivated in the subtropical area of China. Since 1890, Eucalyptus begins to introduce to China, which has been more than 100 years. The planting area is up to $6.7 \times 10^5 \text{ hm}^2$, and 18 billion eucalyptus was planted on four sides. China is the third largest country in the World for planting eucalyptus.

Hunan province is surrounded by mountains from east, west, south, the terrain features of U-shape with its northeast makes the northern cold air mass of winter easy to encroach upon, and results in the whole province's extreme lowest temperature of winter is lower than the temperature of amid and downstream region of Yangtze River in the same latitude. Since the 20th century, it has emerged 7 times of -10°C below of low temperature, which totally distribute 40 counties, the cycle of -10°C low temperature is about 14 years. People wondered if Hunan province could develop eucalyptus because of low temperature. Since 1926, in which Hunan began to introduce eucalyptus, it has covered 4 developing stages. So far the whole province has developed 53.3 hm^2 of eucalyptus experimental field, and fertility forest stand add up to $1.3 \times 10^4 \text{ hm}^2$. They mainly distribute in Chenzhou, Yongzhou, Hengyang and other counties.

In recent 20 years, our research group has done the general investigation for eucalyptus, and has completely investigated the checked pure eucalyptus main species on hand and the distribution area, and has done the growth measure of survival forest stand, and single plant, and has done the investigated analysis of frost damage. And has recognized the *E. camalaulensis* for the important species of introducing in the whole province, during the "7·5" to "8·5" period, it has been done selecting the good provenance of *E. camalaulensis* and the intruding planting test of the some cold resistance provenance, in the 5 geography ecosystem area Xiang North, Xiang West, Xiang Center, hilly land of east Xiang south. Totally introduced into 58 species and 122 provenances. The remain species kept, nowadays respectively undergo the aniso-degree test that in deep freeze, for the good species and provenances that introducing test and resembled the ecosystem area ward bolting the proptosis the cold resistance, fast growing. It popularized 15 main species and 45 provenances in amid phase test. In the popularize process of introducing planting, middle phase test, *firstly* it selected 51 plus tree. All these good provenance have wide inheritance foundation, which offered good seed authority for our province, it has been half century, especially these 20 years, we offered the plan for eucalyptus introduction cultural division in Hunan province. Based on the analyzing of each district's nature environment and considering the introducing planting eucalyptus' scale, level, sum potential of the whole province recently, it decided the main species

and provenance of eucalyptus where it was suitable for plantation and the sum operate direction, according to principle of fast growing and fertility, in the middle test, applied inheritance control, forestland control and stand control, assembled the factors that affect the woods growth, such as seedling standards, tillage method, afforestation density, the arrangement method, forestland fertilizer, tending of young growth, and approved the each introducing planting area fertility cultivation modal. Over the cuttage experiment, we mastered the regularity of rooting of cuttings about *E. camalaulensis*, *E. grandis*, *E. urophylla* and did beneficial exploring of *E. dunnii* and *E. viminalis* and other eucalyptus which are hard to grow root. Put forward the shortcut ways and targeted for evaluating the root-growing ability. Combining the cuttage experiment, we have tried to find out the type of the scion pluchhing nursery, cuttings orchard management. Cutting growing, production period and output, which will accumulate us stuff for the scope management and tie good asexual propagation down good foundation. Experiment respectively on *E. camalaulensis*, *E. viminalis* and *E. grandis* for good family's test. *E. grandis* has 80 families and 12 provenances, we selected 2 good provenances and 15 good families, by micro-observing on the surface of leaves, stoma distribution and oil gland bag constrution, after which, we announced the relation between the surface construction of eucalyptus' leaves and cold resisted. Evolved the research on different species and provenances about the SOD activity, took SOD activity high or low as a physiology indication of the cold-resistance, studied the relation between the cold-resistant and the composition and content of fatty acids of some species of eucalyptus and *E. grandis*' families, using the RAPD technique to study the various and genetic diversity of *E. grandis*.

And this will shorten the period of the forest breeding. *Providing* scientific basis for the utilization, gene conservation and tree improvement, also is beneficial to enrich the theory foundation of selection and utilization, measuring the chemical composition, caloricity and mechanics characteristics of *E. dunnii*, *E. viminalis*, *E. camaldulensis*, *E. grandis*, *E. amplifolia*, *E. camphora* and *E. proplinqua*, providing basis data for the directive breeding, assay and analysis the general elements and trace elements in the stem, branch, leaf, bark of 9 species of eucalypts such as *E. grandis* × *E. urophylla*, *E. grandis*, *E. camaldulensis*, expound the nutriment elements' abundance, accumulation and distribution for the part out of the ground, which provides scientific base for the forest management and fertilization.

The research contents of this book as mentioned above, took the conservation and exploit of resources for the stand, with the plant genetic and breeding, physiology, biochemistry, soil enzymology, soil microbiology and the molecular biology for the direction of theory development. It was the resultants of teaching, research and production combining into together.

This book belongs to part of the research contents that in the following subjects: national "The study on breeding selected and planting for the eucalyptus pulpwood", the fund of

Hunan natural science “The research on the relation between the material’s character of the cold-resistant eucalyptus and management”, “The molecular classification and identification of the cold-resistant eucalyptus”, the forestry department of Hunan province selected breeding of the cold-resistant eucalyptus.

The research contents of the book have received the concerns, support and auspices from Hunan science and technique department, Hunan forestry department, National eucalyptus research and development center (CAF), from the setting item, survey, experiment design, achievement check to the compile and publish. This was the assurance that the book published, especially the great support of the following persons and department on the publish and issue of the book: Yang Minsheng, the head, Xie Yaojian, the vice-head of the eucalyptus R and D center(CAF), Ge handong head of Hunan forestry department and Hunan forestry department culture section, technology section, seeding station. Also, we have been supported by city forestry bureau and county forestry bureau of Hunan Province.

Thanks for the subsidization of “forestry cultivating subject”-National key subject in the Central South Forestry University.

Acknowledgement to all the people who supported the whole editor work, the subject to author is crude and unlearned, the book maybe have a few omissions, shortcomings or mistakes. We sincerely wish the experts and readers to give criticize on the defect and correct the mistakes in the book.

Li Zhi hui
Central South Forestry University
2002.11

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