

中国松脂特征 与松属分类

CHARACTERISTICS OF
OLEORESIN AND CLASSIFICATION
OF PINUS IN CHINA

宋湛谦 著



中国林业出版社

序

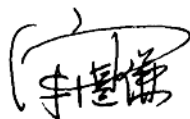
松脂经过初加工可以得到松香和松节油,它们是重要的化工原料。松香、松节油深加工,又可以得到一系列高附加值的精细化学品。中国松脂资源丰富,松脂产量居世界第一位;松香也是中国主要出口商品之一,占世界贸易量 50%。中国的松脂产业已为国民经济作出了较大的贡献。

全世界共有松树 100 多种,中国有 22 种、10 变种,以及国外引种松 30 多种。由于树种不同,松脂的化学组成有所不同,使松香、松节油的质量较大差异。同时,很多树种的松脂存在含量丰富的特殊组分。因此,为了更好地利用松脂这一可再生资源,有必要全面深入研究松属松脂的化学特征。1961 年美国 Mirov N T 教授著有《Composition of Gum Turpentine of Pines》一书,对 77 种松树的松节油组成进行了系统研究。限于当时的分析条件,他未能研究松脂中倍半萜类和双萜类化学组成。但他指出,如进行这方面研究,将进一步有助于松属的化学分类。国内对松属松脂的系统研究甚少。为此,作者于 1987 年起,申请并获批准国家自然科学基金项目《中国松属松脂化学特征及与分类学关系》(3870499)和《松属松脂内中性物化学特征及与分类学关系的研究》(39570577)两项,与刘星高级工程师和梁志勤高级实验师合作,在松树分布中心地带随机采脂,共对 50 个树种数百个松脂样品进行了系统研究,得到大量数据,为松属化学分类提供了重要依据,也为松脂深加工产品的开发提供了理论基础。现将我们 10 多年来的研究成果撰写成本书,以供从事松属分类研究和松脂化学利用的科研、生产管理人员,以及大专院校师生参考。

书中部分样品得到中国林业科学研究院亚热带林业研究

所刘昭惠研究员,云南思茅地区林业科学研究所李炽高级工程师,新疆林业勘察设计院宋芬郁高级工程师,广西林业科学研究院邓绍林高级工程师,西藏林业厅扎西赞吉工程师,俄罗斯采脂研究所和希腊农业科学院林业研究所 Ioannis Spanos 博士的大力帮助,作者在秘鲁采集松脂样品时,得到秘鲁天主教大学 Abram A P 教授和 ADEFOR 组织 Charles Carton 先生支持,在此一并表示衷心感谢。

本书出版过程中得到中国金龙松香集团公司资助,表示衷心感谢。



1998. 6. 1

* 国家自然科学基金资助项目。

Preface

The chemical compositions of gum oleoresins are distinction among different species, which leads a great diversity in properties of rosin and turpentine. Meanwhile, oleoresins of many pine species have their own characteristic components of abundant amounts. In order to utilize properly oleoresin as a renewable resource, it is necessary to investigate comprehensively and deeply the chemical characteristics of oleoresin of genus pinus. The publications of US professor Mirov N T *Composition of Gum Turpentines of Pines* (1961) demonstrated a systematic study on the composition of gum turpentines from 77 species winning great achievements. However, he could not investigate the chemical compositions of sesquiterpenes and diterpenes in the gum oleoresins because of the limited analytical conditions at that time. So the projects *Study on chemical characteristics of gum oleoresins for Chinese pine species and their relation to taxonomy* and *Study on chemical characteristics of neutral components in oleoresins of pine genus and their relation to taxonomy* were applied by the author, and approved by the National Foundation of Natural Science of China since 1987. The research works were carried out in cooperation with senior engineers Liu Xin and Lian Zhiqin. Hundreds of oleoresin samples of more than 50 species were collected randomly in the central regions of each pine species. By a systematic study on these samples a lot of important scientific data was obtained, which provided a reliable support for chemotaxonomy of genus pinus, as well as layed theoretical bases for developing deeply processed products of naval stores. This book describes the scientific research results of the author and his colleague in this field for over 10 years.

The author presents great acknowledgements here to prof. Liu

Shaoxi of the Research Institute of Tropical Forestry, CAF; senior engineer Li Zhi of the Simao Regional Research Institute of Forestry Sciences, Yunnan province; senior engineer Song Fenyu of the Forestry Investigation and Design Academy, Xingiang Autonomous Region; senior engineer Deng Shaolin of the Academy of Forestry Sciences, Guanxi Autonomous Region; Mr. Zhanan Zhanji of the Forestry Department, Tibet Autonomous Region; as well as to the Research Institute of Pine Oleoresin Extraction of Russia, and Dr. Ionnis Spanos of the Research Institute of Forestry of the Agricultural Academy of Greece for their considerable helps in collection of the part of oleoresin samples. The author's thanks are also sent to Professor Abram A P of Cathoric University and Mr. Charles Carton of ADEFOR in Peru for their warm supports while the author was collecting pine oleoresin samples in Peru.

The author's thanks are also sent to Chinese Gold Dragon Rosin Company for their financial support when publishing this book.

SongZhanqian

June 1, 1998

Address: Suo Jin Bei Road #16.

Nanjing 210042. China

E-mail: zqsong@public1. ptt. js. cn

* The work is supported by National Natural Science Foundation of China

目 录

绪论	1
第一章 松属分类	11
第一节 形态分类	11
第二节 化学分类	15
第二章 松脂的采集与分析	20
第一节 松脂采集方法	20
第二节 松脂分析方法	25
第三章 松属各树种松脂的化学特征	34
第四章 白松亚属和油松亚属松脂的化学特征	122
第一节 白松亚属松脂的化学特征	122
第二节 中国油松亚属松脂的化学特征	132
第三节 国外油松亚属松脂的化学特征	142
第五章 各树种松脂的特征组分	168
第一节 白松亚属松脂的特征组分	168
第二节 中国油松亚属松脂的特征组分	168
第三节 国外油松亚属松脂的特征组分	169
第六章 白皮松亚属的建立	180
第七章 有关分类的几个问题	184
第一节 武陵松、长白松和晚松不是变种	184
第二节 具有高 β -蒎烯松脂的云南松	186
第三节 种间嫁接对松脂组成的影响	196
附录 1 松脂主要组分的化学结构	199
附录 2 中国松属分类	203

附录 3 世界松属分类	206
附录 4 松属分种检索表	210
附录 5 松属分亚属检索表	215
参考文献	216

Contents

Preface

Foreword

Chapter 1 Classification of the Genus *Pinus*

Section 1 Morphology taxonomy

Section 2 Chemotaxonomy

Chapter 2 Tapping and Analyzing of Oleoresins

Section 1 Collecting method of oleoresin

Section 2 Analytical method of oleoresin

Chapter 3 Chemical Characteristics of Oleoresins of Each Species

Chapter 4 Chemical Characteristics of Oleoresins from Subgen.

Strobilus and Subgen. *Pinus*

Section 1 Chemical characteristics of oleoresins from Subgen.

Strobilus

Section 2 Chemical characteristics of oleoresins from Subgen.

Pinus in China

Section 3 Chemical characteristics of oleoresins from Subgen.

Pinus abroad

Chapter 5 Characteristic Components of Oleoresin of Each Species

Section 1 Characteristic components of oleoresins from Subgen.

Strobilus

Section 2 Characteristic components of oleoresins from Subgen.

Pinus in China

Section 3 Characteristic components of oleoresins from Subgen.

Pinus abroad

Chapter 6 Establishment of Subgen. *Parrya*

Chapter 7 Some Taxonomic Problems

Section 1 *P. sylvestrisformis*, *P. serotina* and *P. wulingensis* are not varieties.

Section 2 *P. yunnanensis* with oleoresin containing high β -pinene content

Section 3 Effect of grafting between species of pines on chemical compositions of oleoresins

Appendix 1 Chemical Structure of Main Components from Oleoresins

Appendix 2 Classification of the Genus *Pinus* in China

Appendix 3 Classification of the Genus *Pinus* in the World

Appendix 4 Index of Species of the Genus *Pinus*

Appendix 5 Index of Subgenus of the Genus *Pinus*

References

绪 论

松属为世界上木材和松脂生产的主要树种,广泛分布于北半球。在欧亚大陆,西起欧洲西部(18°W),经南欧、东欧、西伯利亚,东至远东沿海(141°E);从北极地区(72°N),南达地中海南部和北非(33°N),亚洲最南部至苏门答腊(2°S)。在北美,西起阿拉斯加(137°W),东至北美东部沿海(62°W);从加拿大西北部(65°N),南达加勒比海地区($12^{\circ}45'\text{N}$)。在南半球没有松树的自然分布,但是,经过人工引种栽培,在南美洲、大洋洲和非洲地区松树也已经逐渐成为重要的造林树种之一(图1)。松属适应性强,生长迅速,育苗造林容易,成材早,材质好,富含松脂,用途广泛。全世界松属树种约100余种。

松属是中国分布最广的乔木树种,全国各省区都有分布。松林面积约1600万 hm^2 (表1)。据《中国植物志》记载,中国松树有22种、10变种;引种栽培16种、2变种。近年来,又陆续引种国外优良树种。据不完全统计,中国引种国外松已超过30种。

马尾松是中国分布最广的松属树种。从江苏、安徽、河南、陕西以南,长江中下游各省区,南达福建、广东、台湾,西至四川、贵州、云南等省都有分布(图2)。华山松分布于宁夏、山西、河南、陕西、甘肃、湖北及云、贵、川等省区(图3)。油松从吉林、辽宁、河北、河南、山东、经华北至西北地区(图4)。白皮松分布于山西、河南、陕西、甘肃、四川、湖北等地(图5)。在中国东北地区,有红松(图6)、偃松、赤松、兴凯湖松、樟子松、长白松等;西南地区有云南松(图4)、思茅松、高山松、乔松、毛枝五针松等;华南地区有华南五针松、海南五针松、大明松、南亚松、雅加松等;华东地区有黄山松(图7)等。另外,在安徽、湖北的大别山区有大别山五针松;在湖北、四川和陕西的大巴山区有巴山松;在西藏有西藏白皮松和西藏长叶松;在新疆有新疆五针松;在台湾有台湾五针松、台湾果松。在众多的松属树种中有11种为中国特有树种,它们是大别山五针松、海南五针松、华南五针松、台湾五针松、台湾果松、毛枝五针松、白皮松、高山松、巴山松、油松、黄山松等。

表 1 中国松属资源状况
Table 1 The present situation of pine resources in China

省 (区) Provinces (Autonomous region)	松林面积 (10 ⁴ hm ²) Pine area	蓄积量 (10 ⁴ m ³) Growing stock
广东 Guangdong	125	7500
广西 Guangxi	324	19440
云南 Yunnan	400	37000
福建 Fujian	154	10400
江西 Jiangxi	179	
湖南 Hunan	165	3680
湖北 Hubei	218	5750
山西 Shanxi	23	1350

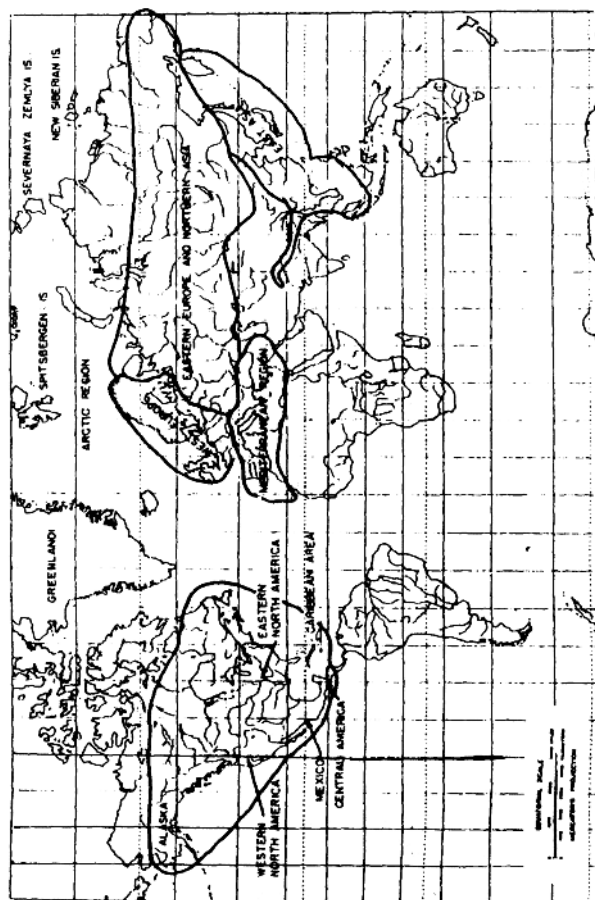


图 1 世界松属分布图

Fig. 1 Distribution of *Pinus* Species of the World

(From *Geographic distribution of the pine of the world*)

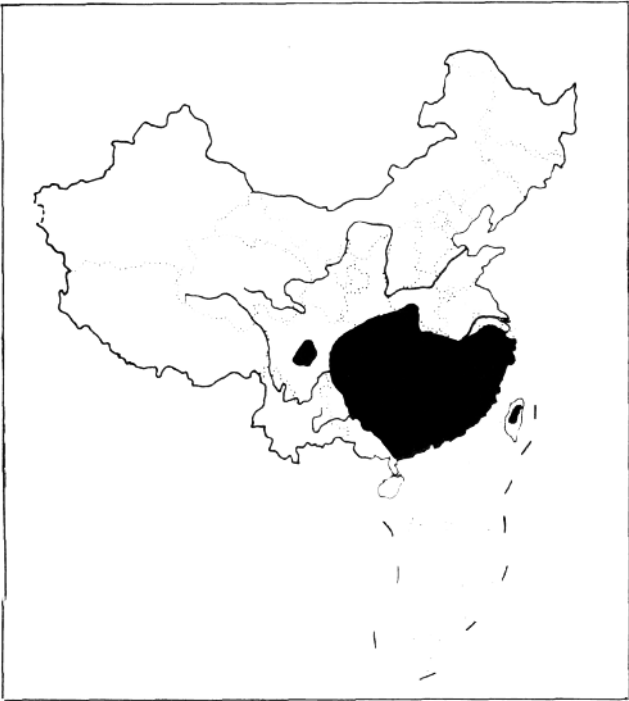


图 2 马尾松分布图

Fig. 2 Distribution of *Pinus massoniana*



图 3 华山分布图

Fig. 3 Distribution of *Pinus armandi*

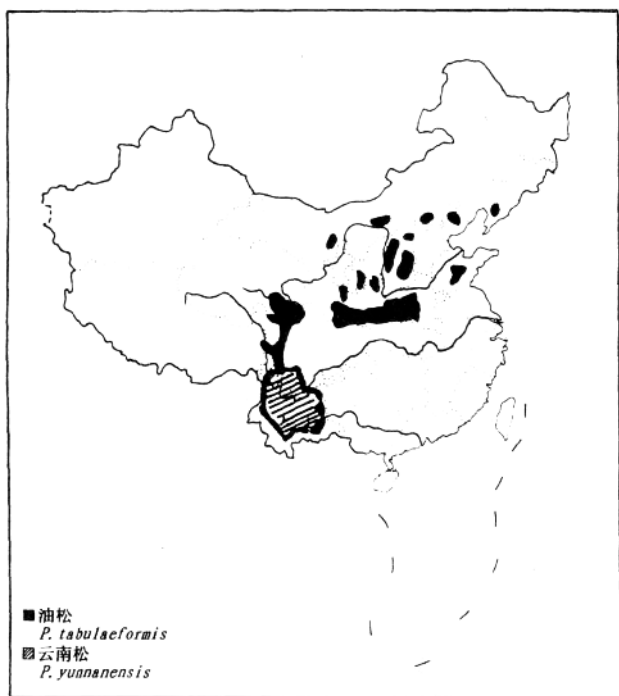


图 4 油松、云南松分布图

Fig. 4 Distribution of *Pinus tabulaeformis* and *Pinus yunnanensis*

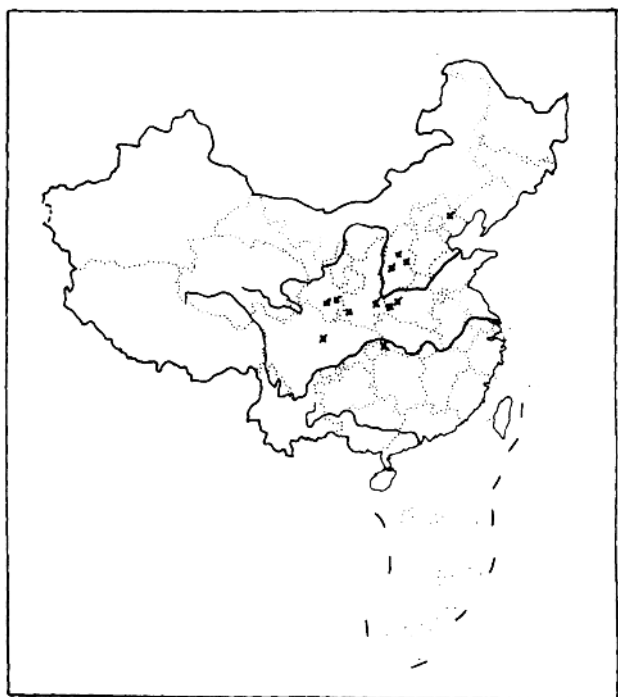


图 5 白皮松分布图

Fig. 5 Distribution of *Pinus bungeana*

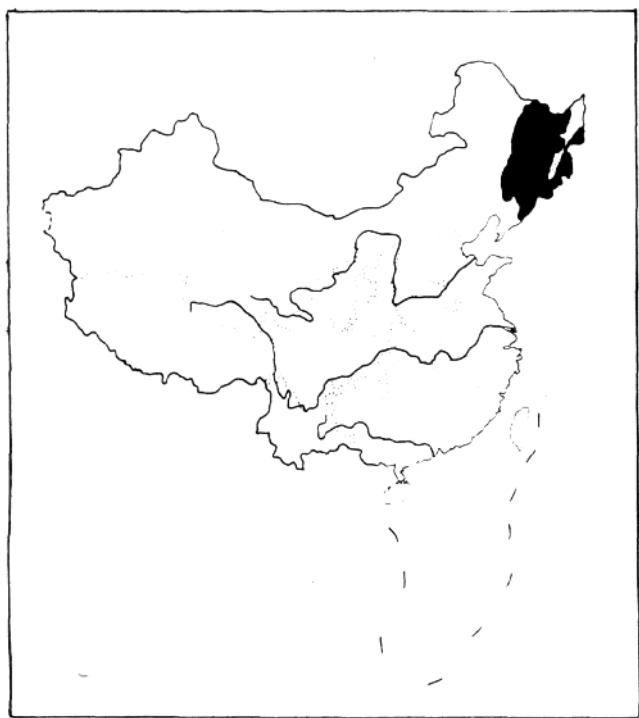


图 6 红松分布图

Fig. 6 Distribution of *Pinus koraiensis*