

# Intellectual Property Protection, Inheritance, Innovation and Development of Woody Edible Oilseeds in Hubei Province

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**Abstract** Only by developing woody edible oilseeds industry can we ensure the safety of the important industrial chain and supply chain of vegetable edible oil in China. There are 13 kinds of woody edible oil plants in Hubei, including *Camellia oleifera* Abel (oil tea), *Juglans regia* L. (walnut), *Olea europaea* L. (olive) and *Paeonia suffruticosa* (oil peony). This paper studies the main industries of woody edible oilseeds in Hubei Province and their intellectual property resources, and analyzes the main problems in their intellectual property protection, inheritance, innovation and development. Finally, it proposes some strategies, including carrying forward the traditional knowledge related to woody edible oilseeds, innovating the "agricultural chip", creating key counties of national woody edible oil seeds, and developing industrial clusters with national advantages and characteristics.

**Key words** Woody edible oilseeds, Vegetable edible oil, Grain and oil Safety, Big food concept, Intellectual property rights, Hubei Province

## 1 Introduction

China is rich in woody oil tree species<sup>[1–4]</sup> and has wide distribution of more than 200 species. Among them, there are more than 50 species with seed oil content of 50%–60%. Except for a few woody plants such as *Sapium sebiferum* (L.) Roxb., *Vernicia fordii* (Hemsl.) Airy Shaw, and *Cinnamomum longipaniculatum* (Gamble) N. Chao ex H. W. Li, which are industrial oil plants, most of them are woody edible oilseeds. In 2022, the yield of woody edible oilseeds in China was about 983.42 million t, accounting for 26.9% of the yield of edible oil in China. Woody edible oilseeds have the advantages of high yield, long profit period, no occupation of arable land, strong disaster resistance and simple management<sup>[5–8]</sup>. Developing woody edible oilseeds industry can improve the supply capacity of domestic vegetable edible oil<sup>[5–7]</sup> and ensure the safety of the important industrial chain and supply chain of vegetable edible oil. Vigorously developing woody edible oilseeds can not only increase oil production, but also use trees to prevent wind and fix sand, conserve soil and water, which is conducive to agricultural production and economic development in mountainous areas.

China's vegetable edible oil has been highly dependent on imports for many years, and according to statistics from the General Administration of Customs of China, China's cumulative imports of edible vegetable oil reached 10.39 million t in 2021. Supporting the development of woody edible oilseeds is an important way to give full play to the advantages of forest resources, increase the supply of domestic vegetable edible oil, and build a diversified

food supply system. The General Office of the State Council issued the *Opinions on Accelerating the Development of Woody Oil Industry* (Guo Ban Fa<sup>[2014]</sup> No. 68). The *Forest and Grassland Industry Development Plan* (2021–2025) issued by the State Forestry and Grassland Administration requires that by 2025, the planting area of woody oil will reach about 18 million ha, and the annual yield of woody edible oil will reach 2.5 million t, of which *Camellia oleifera* Abel (oil tea) will have a planting area of 6 million ha and an annual yield of tea oil of 2 million t. On January 5, 2023, the State Forestry and Grassland Administration, the National Development and Reform Commission, and the Ministry of Finance jointly issued the *Three-Year Action Plan for Accelerating the Development of the Oil Tea Industry* (2023–2025). No. 1 Central Document in 2023 requires supporting the development of woody oilseeds, implementing a three-year action to accelerate the development of the oil tea industry, and implementing the tasks of oil tea expansion and low-yield and low-efficiency forest transformation. In the 12 kinds of woody edible oilseeds that the state develops energetically at present, Hubei has the advantage of 9 kinds of biological heredity resources, including *Juglans regia* L. (walnut), *Olea europaea* L. (olive), *Paeonia suffruticosa* (oil peony), *Eucommia ulmoides* Oliver, *Rhus chinensis* Mill., *Acer truncatum* Bunge, *I. polycarpa* Maxim. var. *vestita* Diels, *Swida wilsoniana* (Wanger.) Sojak. However, it is not suitable for planting *Xanthoceras sorbifolium* Bunge, *Amygdalus pedunculata* Pall and *Elaeagnus mollis* Diels. The 14<sup>th</sup> Five-Year Plan for the Development of Woody Oilseeds in Hubei Province has clearly defined the important tasks of industrial development, such as vigorously developing oil tea, walnut and other planting and processing industries, exploring the development of oil peony, olive and *I. polycarpa* industry, strengthening the quality supervision of woody oil seedlings, and vigorously promoting the standardized afforestation of improved varieties of woody oilseeds.

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Intellectual property is a powerful engine for the high-quality development of agriculture<sup>[9–13]</sup>. Biological genetic resources, traditional knowledge and other cultural heritage intellectual property rights promote the inheritance of farming culture, new plant varieties, invention patents, utility model patents and other scientific and technological innovation intellectual property rights escort scientific and technological innovation drive, design patents (especially packaging and containers), geographical indications, trademarks and other brand intellectual property rights promote regional brand development. Therefore, we studied the development strategy of intellectual property protection, inheritance and innovation of woody edible oilseeds in Hubei Province.

2 Main industries of woody edible oilseeds in Hubei Province

In Hubei Province, there are mainly 13 kinds of woody edible oil plants, including oil tea, walnut, olive, oil peony, *E. ulmoides* Oliver, *R. chinensis* Mill., *A. truncatum* Bunge, *I. polycarpa* Maxim. var. *vestita* Diels, *S. wilsoniana* (Wanger.) Sojak, *Torreya grandis* ‘Merrillii’, *Litsea pungens* Hemsl. And *Sambucus williamsii* Hance, and the first four are the major kinds. The total yield of oil tea seed in Hubei was 257 620 t (Table 1). The main production areas are Xianning City, Huanggang City, Xiangyang City and Huangshi City. The top ten production counties of oil tea seed in the whole province are Tongcheng County, Dawu County, Tongshan County, Gucheng County, Yangxin County, Macheng City, Guangshui City, Daye City, Zaoyang City and Yingshan County. The total yield of walnuts in Hubei Province is 100 350 t (Table 1). The main production areas are Shiyan City, Yichang City, Xiangyang City and Enshi Prefecture. The top ten production counties of walnut in Hubei Province are Xingshan County, Fang County, Baokang County, Zigui County, Yunxi County, Yunyang District, Nanzhang County, Zhushan County, Yiling District and Enshi City.

3 Intellectual property resources of woody edible oilseeds in Hubei Province

The agricultural intellectual property rights of woody edible oilseeds in Hubei Province mainly include traditional knowledge, biological genetic resources, new plant varieties, patents, geographical indications, and trademarks<sup>[14–17]</sup>.

3.1 Traditional knowledge Hubei Province has rich traditional knowledge about woody edible oilseeds, including traditional planting techniques, traditional land use system and culture, traditional oil specialty manufacturing techniques, farming culture, agricultural intangible cultural heritage, and time-honored brands, as well as peony, *E. ulmoides* Oliver, *R. chinensis* Mill., *L. pungens* Hemsl., *S. williamsii* Hance and other traditional medical knowledge. Among them, the provincial intangible cultural heritage includes traditional oil pressing techniques (VIII-23), including Huangpi Yanglouzi Oil Pressing Workshop Oil Pressing Techniques, Guo’s Oil Pressing Techniques, Yunyang Oil Pressing

Techniques and Yangxin Oil Pressing Techniques.

Table 1 Total yield of oil tea seeds and walnuts in Hubei Province 10<sup>3</sup> t

City/prefecture	Oil tea seeds	Walnuts
Wuhan	8.22	0
Huangshi City	30.20	0.18
Shiyan City	3.15	36.15
Yichang City	1.05	29.72
Xiangyang City	37.27	19.47
Ezhou City	1.54	0
Jingmen City	4.97	1.24
Xiaogan City	27.55	0.01
Jingzhou City	1.55	0.05
Huanggang City	38.55	0.02
Xianning City	77.81	0.02
Suizhou City	17.73	1.36
Enshi Prefecture	8.04	12.03
Xiantao City	0	0
Qianjiang City	0	0
Tianmen City	0	0
Shennongjia	0	0.10
Total	257.62	100.35

Data source; Hubei Rural Statistical Yearbook 2022.

3.2 Biological genetic resource There are mainly 13 species of woody biological genetic resources of edible oil plants in Hubei Province.

(i) Oil tea. Oil tea (*Camellia oleifera* Abel. is a shrub or medium tree of Camellia of Theaceae. It is the main and unique woody edible oilseeds tree in China. It has the characteristics of being warm, afraid of cold, requiring sufficient water and suitable for deep acidic soil. Oil tea is widely cultivated in the mountains and hills of subtropical areas in southern China, especially in 15 provinces such as Zhejiang, Jiangxi, Hubei, Hunan, Anhui, Henan and Guangxi. Hubei Province is rich in oil tea biological genetic resources, and has the advantage area of oil tea agricultural products with Chinese characteristics in Huangpaoshan, Tongcheng County, as well as Yangxin County, Daye City, Zhushan County, Zhuxi County, Danjiangkou City, Changyang County, Dawu County, Anlu City, Songzi City, Jiayu County, Tongcheng County, Tongshan County, Suizhou Zengdu District, Guangshui City and other oil tea national characteristic agricultural products advantageous counties.

(ii) Walnut. Walnut (*Juglans regia* L.) is a deciduous tree of Juglandaceae. It has the characteristics of light-loving, cold-resistant, drought-resistant and disease-resistant, adapting to a variety of soil growth, and loving fertile and humid sandy soil. It originated in Europe and Asia between the Balkan Peninsula and southwestern China. Walnut is distributed in North China, Northwest China and South China. It generally grows on hillsides and hills at an altitude of 400–1 800 meters. It is commonly cultivated in plains and hills in China. The dominant areas mainly include central and western Yunnan, southern Xinjiang, Shanxi and Hebei, eastern Qinghai, southeastern Tibet, Qinba Mountain area, Wuling Mountain area, Dabie Mountain area, Taishan area in Shandong, Tianmu Mountain area in Zhejiang and Anhui,

southeastern Liaoning and other places, mainly produced in Yunnan, Xinjiang, Shaanxi, Shanxi, Hebei, and Hubei provinces. Hubei is rich in walnut biological genetic resources, and there are Yunxi County, Zhushan County, Zhuxi County, Zigui County, Changyang Tujia Autonomous County, Gucheng County, Baokang County and other walnut national characteristic agricultural products advantageous counties.

(iii) Olive. Olive (*Olea europaea* L.), an evergreen arbor of Oleaceae, is a world-famous woody oil and fruit tree species with strong cold resistance and soil suitability, which originated in the Mediterranean Sea. In China, olive is mainly concentrated in subtropical monsoon climate provinces, such as Yunnan, Guangdong, Guangxi, Sichuan, Gansu, Hubei and other places. There are four olive bases: olive area in Dazhou City, Sichuan; olive area in Wudu, Longnan City, Gansu; olive area in the low mountain valley of the Three Gorges of the Yangtze River; olive area in the dry and hot valley of the Jinsha River. Yanyang District, Shiyan City, Hubei Province, Danjiangkou Reservoir Area, is located at 32° north latitude, with unique soil, climate and other resource advantages, with the reputation of "Oriental Mediterranean", is an ideal place for olive growth, is an important olive production base in China, and has olive biological genetic resources such as Ezhi No. 8.

(iv) Oil peony. Peony (*Paeonia suffruticosa* Andr.) is a perennial deciduous shrub of *Paeonia* of Ranunculaceae. It likes warm, cool, dry and sunny environment. It is distributed in Henan, Gansu, Shaanxi, Shanxi, Anhui, Hubei, Sichuan, Yunnan, Xizang, and Xinjiang. The oil peony is an excellent edible oil, and has two series of varieties: *Paeonia ostii* "Feng Dan" T. Hong et J. X. Zhang and *Paeonia rockii* (S. G. Haw & Lauener) T. Hong & J. J. Li. The former originated in Tongling City, Anhui Province, belonging to the cultivar group of south of the Yangtze River, while the latter (Gansu Peony, Northwest Peony) originated in Dingxi City, Gansu Province, and it is suitable for the cold areas in northern China. Hubei is rich in peony biological genetic resources, including the cultivar group of south of the Yangtze River oil peony- "Fengdan".

(v) *E. ulmoides* Oliver. *E. ulmoides* Oliver is a medium-sized deciduous tree plant of *Eucommia* in Eucommiaceae, which was originally endemic to China and has been introduced to many botanical gardens in Europe and America. It is mainly distributed in southern Shaanxi, northwestern Hunan, eastern Sichuan, northern Sichuan, northeastern Yunnan, northern Guizhou, western Guizhou, western Hubei, northwestern Hubei, southwestern Henan and other regions in China. It has been successfully introduced to Hebei, Beijing, Tianjin, Shanxi, Ningxia, Liaoning, Jilin (south of Tonghua), Xinjiang (south-central) and Guangxi, Guangdong, northern Fujian. The seeds of *E. ulmoides* Oliver contain 25%–30% oil, which is an excellent edible oil. According to the *National Eucommia ulmoides Industry Development Plan (2016–2030)*, *E. ulmoides* Oliver is distributed in 377 counties (districts and cities) of 27 provinces (districts and cities) in China. Among them, the most suitable cultivation areas are hilly, mountainous and sandy areas in Henan, Hunan, Hubei, Hebei, Anhui, Beijing, Tianjin, Shandong, Shanxi, Shaanxi, Gansu,

Ningxia and Xinjiang (south). Hubei is rich in biological genetic resources of *E. ulmoides* Oliver, including advantageous counties of national characteristic agricultural products such as Zhushan County, Zhuxi County, Xingshan County, Changyang Tujia Autonomous County, Lichuan City, Jianshi County, Badong County, Xianfeng County, Hefeng County, Shennongjia Forest Area.

(vi) *R. chinensis* Mill. *R. chinensis* Mill is a small deciduous tree or shrub of *Rhus* (Tourn.) L. of Anacardiaceae. It is native to China and has the characteristics of light-loving, warm and humid climate, strong adaptability and cold resistance. It grows in sparse forests or shrubs on sunny slopes, valleys and streams at an altitude of 170–2 700 m. The seeds of *R. chinensis* Mill. are excellent edible oil plants, which are distributed in all provinces of China except Northeast China, Inner Mongolia and Xinjiang, especially in Hubei, Hunan, Anhui, Jiangxi, Zhejiang, Yunnan, Sichuan, Guizhou, Guangxi, Guangdong and Taiwan. Hubei is rich in *R. chinensis*. As a biological genetic resource, Wufeng County has become "the first *Rhus chinensis* Mill. county in China" and has a geographical indication of "Wufeng *Rhus chinensis* Mill."

(vii) *A. truncatum* Bunge. *A. truncatum* Bunge is a small deciduous tree of *Acer* L. of Sapindaceae. It has the characteristics of sun-loving, low temperature resistance, drought tolerance, suitable for all kinds of soil, but avoid waterlogging, fear of high temperature exposure and so on. It often grows in sparse forests at an altitude of 400–2 000 m and originates in northern China. It is now distributed in North China, Northeast China, Northwest China, Central South China, and East China. *A. truncatum* Bunge seeds are large in particle size, the oil content is up to 48%, the oil extraction rate by machine is 35%, the *A. truncatum* seeds are high-quality plant edible oil, the *A. truncatum* seeds are semi-dry oil rich in oleic acid and linoleic acid, and the essential fatty acids, namely linoleic acid and linolenic acid, are up to 53%. There are abundant *A. truncatum* Bunge biological genetic resources in Hubei Province, and *A. truncatum* Bunge has been planted in large areas in Xinzhou District of Wuhan City.

(viii) *I. polycarpa* Maxim. var. *vestita* Diels. *I. polycarpa* Maxim. var. *vestita* Diels is arbor of the genus *Idesia* of the family Hydnocarpaceae, grows in deciduous broad-leaved forests in deep and shallow mountainous areas at an altitude of 900–3 000 m, and is produced in Hubei, Hunan, Shandong, Jiangsu, Anhui, Zhejiang, Jiangxi, Fujian, Guangdong, Guangxi, Sichuan, Chongqing, Guizhou, Yunnan and other provinces, as well as in the south of Shaanxi, Gansu and Henan provinces. Its fruit oil content is 20%–30%, seed oil content is 20%–26%, so it is a high-quality woody edible oil seeds. Hubei is rich in *I. polycarpa* Maxim. var. *vestita* Diels. biological genetic resources. Xuzhou Forestry and Agriculture Company has built three national resource banks of *Idesia polycarpa* in Enshi Prefecture, established the core base of *Idesia polycarpa* in Daping Village, Shaxi Township, Lichuan City, built 66.67 demonstration bases of *Idesia polycarpa* in Yingshan and Dawu, and built 400 demonstration bases of *Idesia polycarpa* in Baokang and several forest farms in Xiangyang. Hubei Province will build Tongzi into a 100 billion yuan industrial chain for farmers in mountainous areas of Hubei Province to run

towards a well-off society.

(ix) *S. wilsoniana* (Wanger.) Sojak. *S. wilsoniana* (Wanger.) Sojak a large deciduous tree of *Swida* Opiz in family Cornaceae, with the characteristics of light-loving, cold-resistant, acid soil and limestone soil, wide adaptability, and is distributed in Shaanxi, Gansu, Zhejiang, Jiangxi, Fujian, Henan, Hubei, Hunan, Guangdong, Guangxi, Sichuan, Guizhou and other provinces. *S. wilsoniana* (Wanger.) Sojak is a kind of woody oil plant. Its pulp and kernel contain more oil. The oil yield is about 30% when the oil is extracted by indigenous method. The fatty acid composition of *S. wilsoniana* (Wanger.) Sojak. oil is mainly linoleic acid and oleic acid, which has high edible value. Hubei is rich in *S. wilsoniana* (Wanger.) Sojak biological genetic resources. In Muqiaoxi Village, Gaojiayan Town, Changyang County, there are four *S. wilsoniana* (Wanger.) Sojak trees grafted with *Lagerstroemia indica*.

(x) *Torreya grandis* 'Merrillii'. *T. grandis* 'Merrillii' is a perennial evergreen tree of the genus *Torreya* Arn. of the family Taxaceae. It is endemic to China and rare in the world. It mainly grows in the humid areas of southern China, especially in Zhejiang, Anhui, Fujian, Hubei and Hunan. *T. grandis* 'Merrillii' seeds contain essential oils with more than 20 aromatic components, which are natural and high-quality raw materials for high-grade aromatic oils and extracts. Hubei is rich in *T. grandis* 'Merrillii' biological genetic resources, especially in Tongshan County. The cultivation history of *T. grandis* 'Merrillii' trees in Xiapu Town of this county is more than 1 000 years. In Linshang, Sanbao, Songjia and other places in Xiapu Town alone, there are more than 1 333 ha of ancient *T. grandis* 'Merrillii' tree communities, more than 100 ancient *T. grandis* 'Merrillii' trees over 1 000 years old, and more than 1 000 ancient *T. grandis* 'Merrillii' trees over 100 years old.

(xi) Hickory nut. Hickory nut (*Carya cathayensis* Sarg.) is a *Carya* Nutt. plant of Juglandaceae. It was originally distributed in Lin'an, Chun'an, Anji and Tonglu of Zhejiang Province and Ningguo, Shexian, Jixi and Jingde of Anhui Province, and has been cultivated in Enshi, Shiyan, Jingzhou and Shennongjia of Hubei Province. There are about 20 species of *Carya* Nutt. (Including American hickory nut), among which 4 species are native to China. American hickory nut [*Carya illinoensis* (Wangenh.) K. Koch] has been widely introduced in Hubei Province. The hickory nut is a high-quality woody oil. Hubei is rich in biological genetic resources of hickory nut (including American hickory nut).

(xii) *Litsea pungens* Hemsl. It is a small deciduous tree of *Litsea* Lam in family Lauraceae. It has the characteristics of light-loving, warm to high temperature and humid climate, drought resistance, barren resistance, poor soil selection and cold resistance. It is produced in Hubei, Hunan, Zhejiang, Jiangsu, Jiangxi, Guizhou, Sichuan, Yunnan, Henan, Gansu, Shaanxi, and Shanxi. The seeds of *L. pungens* Hemsl. contain 48.2% of fatty oil, from which *L. pungens* Hemsl. oil can be extracted. Hubei is rich in *Litsea* Lam biological genetic resources, especially in Yichang City and Enshi Prefecture, except *L. pungens* Hemsl., there are also Yichang *Litsea ichangensis* Gamble and Hubei *Litsea*

*hupehana* Hemsl.

(xiii) *Sambucus williamsii* Hance. *S. williamsii* Hance is a deciduous shrub of the genus *Sambucus* of the family Elderaceae. It has the characteristics of light-loving, shade-tolerant, cold-tolerant, drought-tolerant and strong adaptability. It mainly grows at an altitude of 540 – 1 600 m. It originated in China and is now widely distributed in Asia and Europe. It is produced in nearly 30 provinces in Northeast China, North China, Northwest China, Central South China, East China, South China and Southwest China. *S. williamsii* Hance seeds are a new oil source rich in  $\alpha$ -linolenic acid. Hubei is rich in *S. williamsii* Hance biological genetic resources, especially in Dabie Mountain area, Qinba Mountain area, Wuling Mountain area, and Hubei Dabie Mountain National Nature Reserve.

**3.3 New plant varieties** Among 13 woody species of main edible oil plants in Hubei, ten related genera and species, namely, oil tea, walnut, oil peony, *E. ulmoides* Oliver, *A. truncatum* Bunge, *I. polycarpa* Maxim. var. *vestita* Diels, *T. grandis* 'Merrillii', hickory nut, *L. pungens* Hemsl., *S. williamsii* Hance have been protected by new plant variety rights in China. However, species or genus names of olive (*Olea europaea* L.), *Rhus chinensis* Mill.), and *Cornus wilsoniana* Wangerin are not listed in the *List of New Varieties of Plants of the People's Republic of China (Forest and Grass Part)* and the *List of New Varieties of Agricultural Plants of the People's Republic of China*.

(i) Oil tea. Oil tea (*Camellia oleifera* Abel) belongs to *Camellia* L. in family Theaceae Mirb. *Camellia* L. plant was listed in the first batch of *List of New Varieties of Plants of the People's Republic of China (Forest and Grass Part)* on April 22, 1999. There are 166 new varieties of national forest and grass plants of *Camellia* L., involving 10 provinces of Guangdong, Zhejiang, Hunan, Shanghai, Yunnan, Guangxi, Fujian, Jiangxi, Liaoning and Shaanxi. However, Hubei has not obtained the right of new varieties of national forest and grass plants of this genus.

(ii) Walnut. *Juglans* L. includes three groups (about 20 species) and was listed into the second batch of *List of New Varieties of Plants of the People's Republic of China (Forest and Grass Part)* on February 2, 2000. There are 70 new varieties of national forest and grass plants of *Juglans* L., involving 11 provinces. Among them, Hubei is second only to Shandong, Beijing, Sichuan, Xinjiang and other four provinces, ranking fifth in the country with Shanxi, and only four new varieties of forest and grass plants in this genus were obtained (Table 2).

(iii) Oil peony. Peony belongs to the genus *Paeonia* L. It is a perennial deciduous shrub. Oil peony is found only in two categories: the Jiangnan variety group of Fengdan (Tongling peony, *Paeonia ostii* T. Hong et J. X. Zhang) and the northwestern variety group of purple-spotted peony [Gansu peony, *Paeonia rockii* (S. G. Haw & Lauener) T. Hong & J. J. Li]. *Paeonia suffruticosa* Andr was listed into the first batch of the *List of New Varieties of Plants of the People's Republic of China (Forest and Grass Part)* on October 14, 2004. *Paeonia* L. was listed into the fourth batch of the *List of New Varieties of Plants of the People's Republic of China (Forest and Grass Part)* on October 14, 2004. *Melastoma* L. was listed into the fifth batch of the *List of New Varieties of*

*Plants of the People’s Republic of China (Forest and Grass Part)* on January 22, 2013. There are 33 new varieties of peony national forest and grass plants, involving Beijing, Gansu and Shandong provinces. There are 201 new varieties of *Paeonia* L. in China, involving Beijing, Gansu, Jiangsu, Shandong, Shanghai and

Henan provinces. There are 14 new varieties of national forest and grass plants of *Melastoma* L., which only involve Guangdong Province. However, Hubei has not obtained new variety right of *Paeonia suffruticosa* Andr., *Paeonia* L., and *Melastoma* L.

**Table 2** New varieties of *Juglans* L. national forest and grass plants in Hubei Province

Variety owner	Variety name	Variety right number	Authorization date
Walnut Technology Extension Center of Baokang County, Hubei Academy of Forestry	Chulin Baofeng	20220321	2022 – 12 – 29
Walnut Technology Extension Center of Baokang County, Hubei Academy of Forestry	Chulin Baoxin	20220406	
	Chulin Baosheng	20180322	2018 – 12 – 11
Walnut Technology Extension Center of Baokang County, Hubei Academy of Forestry, Institute of Forestry, Chinese Academy of Forestry	Chulin Baokui	20170112	2017 – 10 – 17

(iv) *E. ulmoides* Oliver. *E. ulmoides* Oliver was listed into the fifth batch of *List of New Varieties of Plants of the People’s Republic of China (Forest and Grass Part)* on January 22, 2013. There are 21 new varieties of *E. ulmoides* Oliver National Forest and Grass plants, involving Henan and Beijing. However, Hubei has not been granted the right to a new variety of national forest grass plant for this species.

(v) *A. truncatum* Bunge. *A. truncatum* Bunge belongs to genus *Acer* L. in family Sapindaceae Juss. *Acer* L. plant was listed into the third batch of *List of New Varieties of Plants of the People’s Republic of China (Forest and Grass Part)* on December 2, 2002. There are 67 new varieties of national forest and grass plants in the *Acer* L., involving Shandong, Zhejiang, Jiangsu, Beijing, Liaoning, Henan, Sichuan, Anhui, Hunan and the United States. However, Hubei has not obtained the right of new varieties of national forest and grass plants of this genus.

(vi) *I. polycarpa* Maxim. var. *vestita* Diels. *I. polycarpa* Maxim. var. *vestita* Diels belongs to the genus *Idesia* in family Flacourtiaceae. The *Idesia* plant was listed into the fifth batch of *List of New Varieties of Plants of the People’s Republic of China (Forest and Grass Part)* on January 22, 2013. There is only one new variety of forest and grass plants in *Idesia*, involving Sichuan Province. However, Hubei Province has not obtained the right of new varieties of national forest and grass plants of this genus.

(vii) *T. grandis* ‘Merrillii’. *T. grandis* ‘Merrillii’ belongs to *Torreya* Arn. in family Taxaceae Gray. *Torreya* Arn was listed into the fifth batch of the *List of New Varieties of Plants of the People’s Republic of China (Forest and Grass Part)* on January 22, 2013. There are 8 new varieties of national forest and grass plants in the *Torreya* Arn., involving Zhejiang Province. However, Hubei Province has not obtained the right of new varieties of national forest and grass plants of this genus.

(viii) Hickory nut. The hickory nut (*Carya cathayensis* Sarg.) belongs to *Carya* Nutt. in family Juglandaceae DC. ex Perleb. *Carya* Nutt was listed into the fifth batch of the *List of New Varieties of Plants of the People’s Republic of China (Forest and Grass Part)* January 22, 2013. So far, no new varieties of national forest and grass plants of *Carya* Nutt have been authorized, and Hubei naturally has not obtained the right of new varieties of national forest and grass plants of this genus.

(ix) *L. pungens* Hemsl. *L. pungens* Hemsl. belongs to *Lit-*

*sea* Lam. in family Lauraceae. *Litsea* Lam. was listed into the fifth batch of the *List of New Varieties of Plants of the People’s Republic of China (Forest and Grass Part)* January 22, 2013. So far, no new varieties of national forest and grass plants of *Litsea* Lam have been authorized, and Hubei naturally has not obtained the right of new varieties of national forest and grass plants of this genus.

(x) *S. williamsii* Hance. *S. williamsii* Hance belongs to *Sambucus* L. in family Adoxaceae. *Sambucus* L. was listed into the fifth batch of the *List of New Varieties of Plants of the People’s Republic of China (Forest and Grass Part)* January 22, 2013. There are 9 new varieties of national forest and grass plants in the *Sambucus* L., involving Shandong and Henan provinces. However, Hubei Province has not obtained the right of new varieties of national forest and grass plants of this genus.

**3.4 National invention patents and national utility model patents**

(i) Oil tea and tea oil. Hubei oil tea and tea oil have won 606 national invention patents and 432 national utility model patents. Among them, 10 invention patents and 0 utility model patent were obtained in the field of plant breeding (IPC classification A01H); 124 invention patents and 60 utility model patent were obtained in the field of agriculture (IPC classification A01). Tea oil (also known as camellia oil, camellia seed oil) has won 39 invention patents and 19 utility model patents.

(ii) Walnut and walnut oil. Hubei walnut and walnut oil have won 915 national invention patents and 275 national utility model patents. Among them, 8 invention patents and 1 utility model patent were obtained in the field of plant breeding; 101 invention patents and 26 utility model patents were obtained in the field of agriculture; 466 invention patents and 72 utility model patents were obtained in the field of food (IPC classification A21 and A23). Walnut oil has won 129 invention patents and 56 utility model patents.

(iii) Peony and peony seed oil. Hubei peony and peony seed oil have won 521 national invention patents and 59 national utility model patents. Among them, 34 invention patents and 0 utility model patent were obtained in the field of plant breeding; 79 invention patents and 3 utility model patents were obtained in the field of agriculture; 295 invention patents and 5 utility model patents were obtained in the field of medicine and health (IPC classification A61). Peony oil (also known as peony seed oil, Fengdan

oil, Fengdan seed oil) has obtained 58 invention patents and 29 utility model patents.

(iv) Olive and olive oil. Hubei olive and olive oil have won 870 national invention patents and 169 national utility model patents. Among them, 6 invention patents and 0 utility model patent were obtained in the field of plant breeding; 46 invention patents and 11 utility model patents were obtained in the field of agriculture. Olive oil has won 38 invention patents and 8 utility model patents.

(v) *T. grandis* ‘Merrillii’ and *T. grandis* ‘Merrillii’ seed oil. Hubei *T. grandis* ‘Merrillii’ and *T. grandis* ‘Merrillii’ seed oil have won 16 national invention patents and 2 national utility model patents. Among them, 1 invention patent and 0 utility model patent were obtained in the field of plant breeding; 4 invention patents and 1 utility model patent were obtained in the field of agriculture; 8 invention patents and 0 utility model patent were obtained in the field of food. *T. grandis* ‘Merrillii’ seed oil (also known as *T. grandis* ‘Merrillii’ oil and *T. grandis* ‘Merrillii’ seed oil) has won 3 invention patents and 0 utility model patent.

(vi) Hickory nut and hickory nut oil. Hubei hickory nut and hickory nut oil have won 52 national invention patents and 13 national utility model patents. Among them, 0 invention patent and 2 utility model patents were obtained in the field of plant breeding; 13 invention patents and 5 utility model patents were obtained in the field of agriculture; 22 invention patents and 2 utility model patents were obtained in the field of food. Hickory nut oil (also known as hickory nut seed oil) has won 3 invention patents and 0 utility model patent.

(vii) *E. ulmoides* Oliver and *E. ulmoides* Oliver seed oil. Hubei *E. ulmoides* Oliver and *E. ulmoides* Oliver seed oil has won 712 national invention patents and 33 national utility model patents. Among them, 1 invention patent and 0 utility model patent were obtained in the field of plant breeding; 24 invention patents and 6 utility model patents were obtained in the field of agriculture; 499 invention patents and 16 utility model patents were obtained in the field of medicine and health. *E. ulmoides* Oliver oil (also known as *E. ulmoides* Oliver seed oil) has won 11 invention patents and 0 utility model patent.

(viii) *R. chinensis* Mill and *R. chinensis* Mill seed oil. Hubei *R. chinensis* Mill and *R. chinensis* Mill seed oil has won 222 national invention patents and 15 national utility model patents. Among them, 3 invention patents and 0 utility model patent were obtained in the field of plant breeding; 23 invention patents and 7 utility model patents were obtained in the field of agriculture; 126 invention patents and 4 utility model patents were obtained in the field of medicine and health. The *R. chinensis* Mill oil (also known as *R. chinensis* Mill seed oil and gallnut oil) has won 1 invention patent and 0 utility model patent.

(ix) *L. pungens* Hemsl. and *L. pungens* Hemsl. oil. Hubei *L. pungens* Hemsl. and *L. pungens* Hemsl. oil has won 118 national invention patents and 5 national utility model patents. Among them, 0 invention patents and 0 utility model patent were obtained in the field of plant breeding; 27 invention patents and 0 utility model patent were obtained in the field of agriculture; 34 in-

vention patents and 0 utility model patent were obtained in the field of medicine and health. The *L. pungens* Hemsl. oil (also known as *L. pungens* Hemsl. seed oil) has won 4 invention patents and 10 utility model patent.

(x) *S. williamsii* Hance and *S. williamsii* Hance seed oil. Hubei *S. williamsii* Hance and *S. williamsii* Hance seed oil has won 33 national invention patents and 0 national utility model patents. Among them, 0 invention patents were obtained in the field of plant breeding, 2 invention patents were obtained in the field of agriculture, and 17 invention patents were obtained in the field of medicine and health. *S. williamsii* Hance oil (also known as *S. williamsii* Hance seed oil) has won 2 invention patents and 0 utility model patent.

(xi) *C. wilsoniana* Wangerin and *C. wilsoniana* Wangerin seed oil. Hubei *C. wilsoniana* Wangerin and *C. wilsoniana* Wangerin seed oil have not been granted national invention patents and national utility model patents.

(xii) *A. truncatum* Bunge and *A. truncatum* Bunge seed oil. Hubei *A. truncatum* Bunge and *A. truncatum* Bunge seed oil has won 21 national invention patents and 4 national utility model patents. Among them, 1 invention patent and 0 utility model patent were obtained in the field of plant breeding; 2 invention patents and 2 utility model patents were obtained in the field of agriculture. *A. truncatum* Bunge oil (also known as *A. truncatum* Bunge seed oil) has won 15 invention patents and 0 utility model patent.

(xiii) *I. polycarpa* Maxim. and *I. polycarpa* Maxim. oil. Hubei *I. polycarpa* Maxim. and *I. polycarpa* Maxim. oil has obtained 33 national invention patents and 4 national utility model patents. Among them, 1 invention patent and 0 utility model patent were obtained in the field of plant breeding; 16 invention patent and 2 utility model patents were obtained in the field of agriculture. *I. polycarpa* Maxim. oil has won 16 invention patents and 2 utility model patents.

**3.5 National design patent** National design patents related to woody edible oilseeds, belonging to the international design classification system-Locarno classification system Class 9 packaging and containers. There are few national design patents in Hubei. Among them, there are 43, 33, 12, 11, 6, 4 and 1 national design patents for packaging and containers involving oil tea, walnut, olive, peony, *E. ulmoides* Oliver, hickory nut, *L. pungens* Hemsl. The national design patents for packaging and containers in Hubei Province do not involve *T. grandis* ‘Merrillii’, *R. chinensis* Mill, *S. williamsii* Hance, *C. wilsoniana* Wangerin, *A. truncatum* Bunge, *I. polycarpa* Maxim.

**3.6 Geographical Indications** The protection system of geographical indications (GI) in China is imperfect, and there are three main systems at present<sup>[14-17]</sup>.

(i) GI products. Hubei geographical indication products have 3 kinds of woody oil: Macheng camellia oil, Fuchuan camellia oil, Xiangyang *E. ulmoides* Oliver, as shown in Table 3.

(ii) GI trademarks. There are 18 geographical indication trademarks related to woody oil and oil in Hubei, all of which are certification trademarks (Table 4).

Table 3 GI products of woody edible oilseeds in Hubei

Product	Announcement time	GI protection scope
Macheng camellia oil	2010 – 04 – 06	Macheng of Huanggang City
Fuchuan camellia oil	2010 – 12 – 29	Yangxin County of Huangshi City
Xiangyang <i>E. ulmoides</i> Oliver	2015 – 12 – 29	Baokang County, Nanzhang County, Gucheng County of Xiangyang City

Table 4 GI trademarks of woody edible oil seeds in Hubei

Trademark	Registration entity	Registration number
Songzi Oil Tea	Songzi Lusheng Local Industry Development Center	22605079
Huangpaoshan Oil Tea	Tongcheng County oil tea Industry Association	13476391
Suizhou Oil Tea	Suizhou Forest Seedling Management Station	48513903
Tongshan Oil Tea	Tongshan County Oil Tea Association	30514038
Zaoyang Oil Tea	Zaoyang Oil Tea Industry Association	14059449
Zhaoshan Tea Oil	Ezhou City Zhaoshan Tea Oil Association	12356019
Zhaoshan Tea Oil	Ezhou City Zhaoshan Tea Oil Association	12356020
Yunyang Walnut	Walnut Professional Association of Yunyang District, Shiyan City	22604820
Beidou Walnut	Xingshan County Fruit Industry Association	19882464
Xingshan Thin-shelled Walnut	Xingshan County Forestry Science Research Institute	6825032
Fang County Walnut	Fang County Medicinal and Edible Plant Association	18497769
Zigui Walnut	Zigui County Forestry Science and Technology Association	14897777
Yunxi Walnut Oil	Yunxi County Guzha Edible Oil Research Association	16898386
Yun County Olive	Yunyang District Olive Association in Shiyan City	31325493
Tongshan <i>Torreya grandis</i> ‘Merrillii’	Tongshan County <i>Torreya grandis</i> ‘Merrillii’ Industry Association	18893352
Yichang <i>Litsea pungens</i> Hemsl.	Yichang Forest Products Professional Technology Association	28932535
Wufeng <i>Rhus chinensis</i> Mill.	Wufeng <i>Rhus chinensis</i> Mill. Industry Association	14543413
Xiangyang <i>E. ulmoides</i> Oliver	Xiangyang Characteristic Agricultural Products Production and Marketing Association	36468936

(iii) Geographical indications of agricultural products. There are two kinds of geographical indications of agricultural products related to woody edible oilseeds in Hubei Province: Yunxi *E. ulmoides* Oliver and Yichang *Litsea pungens* Hemsl (Table 5).

Table 5 Geographical indications of woody edible oilseeds agricultural products in Hubei

Agricultural products	Registration year	Registration entity	GI protection scope
Yunxi <i>E. ulmoides</i> Oliver	2016	Yunxi County Agricultural Technology Extension Center	18 townships (districts) in Yunxi County of Shiyan City: Chengguan Town, Tumen Town, Xiangkou Township, Shangjin Town, Dianzi Town, Guanfang Township, Hubeikou Hui Autonomous Township, Jingyang Township, Jiahe Town, Yangwei Town, Jianchi Township, Guanyin Town, Ma'an Town, Liulang Township, Hejia Town, Anjia Township, Sanguandong Forest Area and Huaishulin Special Farm
Yichang <i>Litsea pungens</i> Hemsl.	2017	Yichang Forest Products Professional Technology Association	13 counties and districts in Yichang City: Yuan'an County, Xingshan County, Zigui County, Changyang Autonomous County, Wufeng Autonomous County, Yidu, Dangyang City, Zhijiang City, Yiling District, Xiling District, Wujiagang District, Dianjun District, and Yuting District, involving a total of 89 mountainous townships

**3.7 Trademarks** Trademarks registered by the Trademark Office of China National Intellectual Property Administration are divided into four basic types: ordinary trademarks (ordinary goods trademarks, ordinary service marks), collective trademarks, certification marks, and special signs. There are many ordinary trademarks related to woody edible oilseeds in Hubei. Special signs refer to the symbols used in national or international cultural, educational, scientific research and other social welfare activities approved by the State Council, and do not involve Hubei woody edible oilseeds. There are no collective trademarks related to woody edible oilseeds in Hubei, but there are 18 certification trademarks related to woody oils (Table 4). These 18 certification trademarks are all geographical indications certification trademarks.

**4 Main problems in the intellectual property protection, inheritance, innovation and development of Hubei woody edible oilseeds**

**4.1 Serious loss of traditional knowledge and genetic resources of local varieties** Traditional planting technology, traditional land use system and culture, traditional oil specialty manufacturing technology, farming culture, traditional medical knowledge, intangible cultural heritage, old brands and other traditional knowledge related to woody edible oilseeds, as well as local genetic resources, are seriously lost. There are only provincial intangible cultural heritage of traditional oil pressing techniques (VIII-23), including Huangpi Yanglouzi Oil Pressing Workshop Oil Pressing Techniques, Guo's Oil Pressing Tech-

niques, Yunyang Oil Pressing Techniques and Yangxin Oil Pressing Techniques.

#### 4.2 Weak ability to create new plant varieties and patents

There are only four national new varieties of forest and grass plants in Juglans in woody edible oilseeds, and related national invention patents and utility model patents (especially in plant breeding, agriculture and other fields), few national design patents, and weak ability to create new plant varieties and patents.

**4.3 Unclear resources of woody oil tree species** The woody oil tree species resources in Hubei are rich and diverse, but the relevant census lags behind, and the woody oil resources are not clear, which hinders the development and promotion of science and technology, the layout of industrial development, the construction of production bases, and the industrialization of management, and hinders the development of woody oil industry.

**4.4 Few varieties, small scale, low yield and low efficiency in the development of woody oil plants** There are few varieties of woody oil plants developed in Hubei Province, mainly concentrated in oil tea, walnut, olive, oil peony, while *E. ulmoides* Oliver, *R. chinensis* Mill, *A. truncatum* Bunge, *I. polycarpa* Maxim. var. *vestita* Diels, *S. wilsoniana* (Wanger.) Sojak, *T. grandis* 'Merrillii', hickory nut, *Litsea pungens* Hemsl., *S. williamsii* Hance have not received due attention. Except for the oil tea of the whole province and the olive of Shiyan City, which have a certain scale, the other scales are relatively small. The yield per unit area of woody oil plants in the whole province is low, and the economic benefit is not high.

### 5 Intellectual property protection, inheritance, innovation and development strategies of woody edible oilseeds in Hubei province

**5.1 Promoting the traditional knowledge related to woody oil and inherit the farming culture** It is recommended to collect and sort out the traditional knowledge related to woody edible oilseeds, such as traditional planting technology, traditional land use system and culture, traditional oil specialty manufacturing techniques, farming culture, traditional medical knowledge, intangible cultural heritage, and time-honored brands. In addition, it is recommended to actively apply for China's important agricultural cultural heritage, national and provincial intangible cultural heritage projects, "Hubei time-honored brands", *etc.*, to promote the inheritance and development of intangible cultural heritage, the protection project of traditional Chinese villages, the protection and development project of China's time-honored brands, the inheritance and protection project of agricultural culture, *etc.*, to carry forward relevant traditional knowledge and cultural heritage, and inherit farming culture.

**5.2 Conducting general survey of woody oil tree species resources to optimize the layout of industrial development** Hubei Province should collect and sort out woody edible oilseeds biological genetic resources, especially wild resources, genetic materials, inbred lines, local varieties, introduced resources, strains, selected varieties, synthetic populations, *etc.*, and establish national and provincial woody edible oilseeds germplasm resource

banks (nurseries) to maintain the diversity of woody oil tree species resources, and optimize the layout of industrial development according to the resources of woody oil tree species, natural geographical environment and planting history.

**5.3 Creating excellent new varieties and core patented technologies, and doing a good job in the innovation of "agricultural chips"** It is necessary to focus on the investigation of Hubei woody edible oilseeds seed industry and its new plant varieties, national invention patents, national utility model patents and other scientific and technological innovation intellectual property resources, foster new forestry management entities, create national-level and provincial-level seed industry enterprises, and promote the development of Hubei. Establish national regional seed breeding bases, national seed production counties, combine biological genetic resources, traditional knowledge and other cultural heritage intellectual property resources, create new varieties and core patented technologies, do a good job in the innovation of "agricultural chips", and promote seed industry upgrading projects.

**5.4 Establishing high-quality production demonstration bases and building key counties for national woody edible oilseeds** Hubei Province should investigate woody edible oilseeds relevant geographical indications and evaluate the development potential of woody edible oil plants such as oil tea, walnut, olive, oil peony, *E. ulmoides* Oliver, *R. chinensis* Mill, *A. truncatum* Bunge, *I. polycarpa* Maxim. var. *vestita* Diels, *S. wilsoniana* (Wanger.) Sojak, *T. grandis* 'Merrillii', hickory nut, *L. pungens* Hemsl., *S. williamsii* Hance in the whole province (especially in Wuling Mountain area, Dabie Mountain area, Qinba Mountain area and Mufu Mountain area), and establish a number of standardized, intensive, large-scale and industrialized high-quality production demonstration bases, and build key counties for woody edible oil seeds throughout the country.

**5.5 Implementing the action of accelerating the development of oil tea industry and promoting the construction of Huangpaoshan oil tea agricultural product advantage area with Chinese characteristics in Tongcheng County** From the aspects of promoting the expansion of oil tea and the transformation of low-yield and low-efficiency forests, speeding up the construction of high-standard oil tea forests, promoting the construction of breeding bases for improved varieties, optimizing the layout of processing and production, strengthening the promotion and transformation of scientific and technological innovation, cultivating business entities, and strengthening brand building, Hubei Province has implemented the action of accelerating the development of oil tea industry, especially in Tongcheng County, Tongshan County, Jiayu County, Yangxin County, Daye City, Zhushan County, Zhuxi County, Danjiangkou City, Changyang County, Dawu County, Anlu City, Songzi City, Zengdu District of Suizhou City, Guangshui City and other oil tea national characteristic agricultural products advantage counties. From the aspects of standardized production base, processing base, warehousing and logistics base, science and technology support system, regional brand and marketing system, Hubei Province promotes the construction of Huangpaoshan oil tea agricultural product advantage area with Chinese characteristics in Tongcheng County.



## 5.6 Constructing national advantageous and characteristic industrial clusters and accelerating the development of woody oil industry

Hubei Province should take Wuling Mountain, Dabie Mountain, Qinba Mountain and Mufu Mountain as the core areas, build the whole industry chain of woody oil, strengthen the guidance of scientific and technological innovation, cultivate new momentum of industrial development, and build the regional brand of woody oil. It is recommended to build relevant national agricultural modern industrial parks and strong towns of agricultural industry. Hubei Province should promote the upgrading of industrial form from "small specialty" to "big industry", the transformation of spatial layout from "plane distribution" to "cluster development", the transformation of main body relationship from "homogeneous competition" to "win-win cooperation", and create a national characteristic industrial advantage area and industrial cluster with reasonable structure and complete chain of woody oil industry in Hubei Province. Combined with the strategy of strengthening the country with intellectual property and the strategy of rural revitalization, it is necessary to accelerate the development of the woody oil industry and ensure the security of the important industrial chain and supply chain of vegetable edible oil.

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