Inheritance, Innovation and High-quality Development of Herbaceous Edible Oils in Hubei Province under the Strategy of Strengthening the Country with Intellectual Property

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Abstract Only by improving the production capacity of domestic herbal edible oil can China ensure the safety of the supply chain of the important industrial chain of vegetable edible oil in China and practice the big food concept. In addition to rice, maize, and soybean for using as grain and oil, there are eight kinds of herbaceous edible oil crops in Hubei Province, including rape, peanut, sesame, sunflower, perilla (perilla seed), cotton, linen and tiger nut (*Cyperus esculentus*). This paper studies the main industries of herbaceous edible oil crops and their intellectual property resources in Hubei Province, and analyzes the main problems of its inheritance, innovation and high-quality development under the strategy of strengthening the country with intellectual property. Finally, it proposes the countermeasures of carrying forward and inheriting traditional knowledge and traditional culture, maintaining the biodiversity of crops, strengthening the creation of new plant varieties and breeding patents, and opening up the whole chain of intellectual property rights.

Key words Herbaceous edible oil crops, Vegetable edible oil, Big food concept, Intellectual property right, Hubei Province

1 Introduction

On September 23, 2021, the *Outline for Building a Strong Intellectual Property Power (2021 - 2035)* was issued by central committee and State Council of China. It deployed six key tasks to support the strategy of strengthening the country with intellectual property and set forth strengthening the construction of the system and improving the level of protection, and proposed to build a powerful engine for high-quality development. Cultural heritage intellectual property rights such as biological genetic resources and traditional knowledge promote the inheritance of farming culture, scientific and technological innovation intellectual property rights such as new plant varieties, invention patents and utility model patents support the drive of scientific and technological innovation, and design patents (especially packaging and containers), geographical indications, trademarks and other brand intellectual property rights promote the development of regional branding[1-5].

China's grain and plant edible oils are still difficult to ensure the safety of the industrial chain and supply chain by self-production alone, and have been highly dependent on imports for many years. According to statistical data of General Administration of Customs of China, the total import volume of edible vegetable oil in China reached 10.39 million t in 2021, making a record high. Setting up the big food concept[6-9], building a diversified food supply system[10], and maintaining the safety of food and vegetable edible oil are the important foundation of national security and social stability, the practice of the overall national security concept[11-12], and the premise of building a strong agricultural country[13] and promoting Chinese-style modernization[14].

China is rich in the herbaceous edible oil crops resources. In addition to rice, maize, and soybean for using as grain and oil, there are eight kinds of herbaceous edible oil crops, including rape, peanut, sesame, sunflower, perilla (perilla seed), cotton, linen and tiger nut (*Cyperus esculentus*), and safflower, *etc.* Cotton, linen, and marijuana are both fiber and edible oil crops. Perilla and safflower are used as both traditional Chinese medicine and edible oil. Hubei Province is rich in herbaceous edible oil crops resources, and the annual yield of rapeseed, cottonseed, peanut and sesame ranks among the top in the country. Therefore, we study the strategies of inheritance, innovation and high-quality development of herbaceous edible oil crops in the province under the strategy of strengthening the country with intellectual property.

2 Main industries of herbaceous edible oil crops in Hubei Province

In addition to rice, maize, and soybean for using as grain and oil, there are eight kinds of herbaceous edible oil crops in Hubei Province, including rape, peanut, sesame, sunflower, perilla (perilla seed), cotton, linen and tiger nut (*C. esculentus*). Among them, the planting scale of rape, peanut, sesame and cotton is relatively large, and the establishment of national important agricultural product production protection zones for rapeseed and cotton is 1 000 thousand ha, and the 133.33 is 1 000 ha. In 2021, the planting area of rapeseed in Hubei was 1 094.02 thousand ha, which was slightly higher than 1 000 ha of the national important agricultural product production protection area of rape-

Received: October 6, 2023 Accepted: December 15, 2023

Supported by Special Soft Science Research Project for Hubei Province Science and Technology Innovation Talents and Services (2022EDA060).

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seed in Hubei Province. Its total yield was 2 517.79 thousand t (Table 1), and the average unit area yield was 2.30 t/ha. The main producing areas of rapeseed are Jingzhou, Huanggang, Jingmen and Xiaogan cities. The ten main production counties in the province are Jianli City, Xiantao City, Shayang County, Gongan County, Tianmen City, Zhongxiang City, Honghu City, Huangmei County, Jiangling County and Xishui County, and there are national advantageous and characteristic industrial clusters of rape in Jianghan Plain of Hubei Province. The peanut planting area in Hubei Province was 244.67 thousand ha, the total yield was 862.67 thousand t (Table 1), and the average yield was 3.53 t/ha. The main peanut producing areas are Xiangyang City, Huanggang City, Xiaogan City and Jingmen City, and the top ten producing counties in the province are Xiangzhou District, Hongan County, Zaoyang City, Macheng City, Dawu County, Tianmen City, Yicheng City, Zhushan County, Huangpi District and Zhongxiang City. The planting area of sesame in the province was 77.34 thousand ha, and its total yield was 130.67 thousand t (Table 1), with an average yield of 1.69 t/ha. The main sesame producing areas are Xiangyang City, Huangshi City, Shiyan City and Huanggang City, and the ten main producing counties in the province are Yangxin County, Xiangzhou District, Daye City, Zaoyang City, Xiantao City, Jiangxia District, Yunxi County, Yunyang District, Songzi City and Zhuxi County. The cotton planting area in Hubei Province was 120.71 thousand ha, which was slightly less than the area of 133.33 thousand ha in the cotton national important agricultural product production and protection area in Hubei Province, and its total yield was 108.88 thousand t (Table 1), with an average yield of 0.90 t/ha. The main cotton producing areas are Jingzhou City, Huanggang City, Xiantao City and Xiaogan City, and the top ten producing counties in the province are Gongan County, Xiantao City, Tianmen City, Songzi City, Jianli City, Xinzhou District, Yicheng City, Shishou City, Huangmei County and Xishui County.

Table 1 Planting area and total yield of herbaceous edible oil crops in Hubei Province

City/prefecture	Rapeseed		Peanut		Sesame		Cotton	
	Area//10^3 ha	Yield//10^3 t	Area//10^3 ha	Yield//10^3 t	Area//10^3 ha	Yield//10^3 t	Area//10^3 ha	Yield//10^3 t
Wuhan	38.74	87.02	13.14	43.82	6.70	11.81	9.64	7.92
Huangshi	36.74	84.55	5.40	17.90	5.68	19.35	2.98	2.75
Shiyan City	46.84	93.02	18.06	57.43	12.80	18.39	0	0
Yichang City	84.78	191.08	11.15	33.98	2.07	3.61	3.11	3.16
Xiangyang City	39.94	99.98	61.80	237.34	17.95	23.16	8.27	7.37
Ezhou City	12.24	29.24	2.30	7.92	0.31	0.54	3.87	3.40
Jingmen City	128.78	322.10	16.11	61.04	4.56	6.98	3.24	3.22
Xiaogan City	78.65	195.65	29.13	83.87	3.27	5.12	8.68	7.99
Jingzhou City	203.49	498.55	1.62	6.31	5.61	11.46	34.28	30.37
Huanggang City	155.49	369.01	46.58	171.35	9.65	12.25	22.65	19.95
Xianning City	88.30	151.15	8.53	33.51	3.30	5.86	3.36	2.88
Suizhou City	25.12	54.03	11.35	39.08	1.22	2.00	3.99	3.01
Enshi Prefecture	46.68	89.91	8.82	19.65	0.34	0.36	0	0
Xiantao City	53.80	122.93	1.24	4.29	2.17	6.18	9.05	9.47
Qianjiang City	15.76	37.60	1.31	5.70	0.92	2.21	1.36	1.30
Tianmen City	38.46	91.74	8.11	39.45	0.80	1.35	6.23	6.10
Shennongjia	0.20	0.24	0.02	0.03	0	0.02	0	0
Total	1 094.02	2 517.79	244.67	862.67	77.34	130.67	120.71	108.88

Note: The data were from *2022 Rural Statistical Yearbook of Hubei Province*.

3 Intellectual property resources of herbaceous edible oil crops in Hubei Province

Agricultural intellectual property rights related to herbaceous edible oil crops in Hubei[15-16] mainly include traditional knowledge, biological genetic resources, new plant varieties, patents, geographical indications, and trademarks.

3.1 Traditional knowledge There are abundant traditional knowledge of herbaceous edible oil crops in Hubei Province, including traditional planting techniques of oil crops, traditional land use system and culture, traditional oil production techniques, farming culture, agricultural intangible cultural heritage, time-honored brands, and traditional medical knowledge of perilla. Among them, the provincial intangible cultural heritage includes traditional oil extraction techniques (VIII-23) and oil tea soup production techniques (VIII-35).

3.2 Biological genetic resources In addition to rice, maize, soybean and grain and oil crops, there are mainly 8 kinds of biological genetic resources of edible oil herbs in Hubei Province.

(i) Rape. The rape cultivars in China can be generally divided into *Brassica campestris*, *Brassica juncea* and *Brassica napus*[1-3]. In the National Crop Germplasm Resources Sharing Platform, there are 8 505 kinds of rapeseed germplasm resources, including 3 650 kinds of *B. napus* (including 91 genetic materials, 26 local varieties, 2 892 of breeding varieties and 641 kinds of strains), 2 809 *B. campestris* (37 genetic materials, 2 506 local varieties, 243 breeding varieties, and 23 strains), 1 858 kinds of

Brassica juncea Coss. var. *gracilis* Tsen et Lee and *Brassica juncea* Coss. var. *foliosa* Bailey (including 22 wild resources, one genetic material, 1 485 local varieties, 310 selected varieties, 46 strains and 14 other varieties), 159 kinds of *Brassica carinata* A. Braun (including one local variety, 12 strains, and 146 other varieties), and 19 kinds of *Brassica nigra* L. According to the Query System of Available Crop Germplasm Resources, the National Oil Crop Germplasm Resources Medium-term Bank (Wuhan) preserves 500 kinds of available rape germplasm resources, including 399 breeding varieties, 49 local varieties, 51 strains, and one other variety (T26 of *Brassica carinata* A. Braun), including 457 kinds of *B. napus*, 24 kinds of *B. campestris*, 18 kinds of *B. juncea* and *B. juncea* Coss. var. *foliosa* Bailey, and one *Brassica carinata* A. Braun.

Hubei is rich in rape biological genetic resources. Since 2005, 17 rape varieties, 1 leaf rape variety and 9 vegetable rape varieties have been approved by Hubei Provincial Department of Agriculture and Rural Affairs. There are more than 200 national and local rape varieties, mainly Chinese *B. campestris*. Among them, the main varieties of *B. campestris* are 160 local varieties, mainly Badong White Rape, Badong Local Rape, Badong Alpine Rape, and Badong Wild Rape. *B. juncea* and *Brassica juncea* Coss. var. *foliosa* Bailey mainly include Badong Bitter Rape-1, Hefeng Mustard, Hefeng Bitter Rape, Laifeng Bitter Rape, Laifeng Mawei, Xuanen Bitter Rape, Changyang Spicy Rape and other local variety resources. *B. napus* mainly includes Muyu Big Rape, Changyang Big Rape and other local varieties.

(ii) Peanut. Peanut (*Arachis hypogaea* L.) is an annual herb of the genus *Arachis* Linn. in the Leguminosae family. Peanut is suitable for high temperature, dry, warm climate and sandy soil, and originated in Brazil, South America. Peanuts are widely distributed in China, mainly in Shandong, eastern Liaoning, Leizhou Peninsula in Guangdong, Huanghuai River area and coastal hills and sandy areas along the southeast coast, especially in Shandong, Hebei, Henan, and Huaibei areas in Jiangsu and Anhui provinces.

In the National Crop Germplasm Resources Sharing Platform, there are 661 peanut germplasm resources. Among them, there are 657 local varieties and 4 others (Peanut Suoyin, Liuyin, Longhua 163 and Rihua Chaodaguo).

According to the *Query System of Available Crop Germplasm Resources*, the National Oil Crop Germplasm Resources Medium-term Bank (Wuhan) preserves 500 peanut germplasm resources available for use, including 155 wild resources, 47 genetic materials, 15 breeding varieties, 17 introduced resources, 44 local varieties and 222 strains. Hubei is rich in peanut biological genetic resources. Since 2005, Hubei Provincial Department of Agriculture and Rural Affairs has examined and approved 12 peanut varieties. There are mainly more than 40 kinds of local peanut resources, such as Tongcheng local peanut, Tongcheng Peanut 2, Tongshan local peanut, Tongshan Peanut 1, Tongshan Peanut 2, Tongshan Zhujie Peanut, Tongxian small peanut and so on.

(iii) Sesame. Sesame (*Sesamum indicum* L.) is an annual herb of genus *Sesamum* in family Pedaliaceae. It has the characteristics of liking warm and moist environment, drought resistance, cold resistance, fear of waterlogging, heat and humidity intolerance, and high requirements for light, originating in South Africa. Sesame was introduced into the Central Plains from Xinjiang (Western Regions) in the Western Han Dynasty, and is now mainly distributed in the middle and lower reaches of the Yellow River and the Yangtze River, especially in Henan, Hubei, Anhui, Jiangxi, and Hebei provinces. In the National Crop Germplasm Resources Sharing Platform, there are 7111 sesame germplasm resources. Among them, there are 7 kinds of wild resources, 6 198 local varieties, 302 breeding varieties and 604 strains.

According to the *Query System of Available Crop Germplasm Resources*, the National Oil Crop Germplasm Resources Medium-term Bank (Wuhan) preserves 200 sesame germplasm resources, including 2 breeding varieties and 198 local varieties. Hubei is rich in biological genetic resources of sesame. Since 2005, 13 sesame varieties have been examined and approved by the Hubei Provincial Department of Agriculture and Rural Affairs. There are mainly local variety resources such as Eping Sesame, Wenquan Black Sesame, Xiangzhi No. 2 Selection, Xiangheizhi 2078, Zhongzhi 15 and Zhongzhi 27.

(iv) Sunflower. Sunflower (*Helianthus annuus* L.) is a herbaceous plant of genus *Helianthus annuus* L. in family Asteraceae. It is native to North America and has the characteristics of warm and cold-resistant, suitable for cold climate, drought-resistant and low soil requirements. Sunflowers were introduced into China in the middle of the Ming Dynasty, and are now distributed in Northeast, Northwest and North China, especially in Inner Mongolia, Xinjiang, Jilin, Liaoning, Heilongjiang, and Shanxi provinces. It can be divided into oil sunflower, edible sunflower and ornamental sunflower according to their uses.

In the National Crop Germplasm Resources Sharing Platform, there are 3 295 sunflower germplasm resources. Among them, there are 15 wild resources, 1 357 local varieties, 91 breeding varieties and 1 832 strains. According to the *Query System of Available Crop Germplasm Resources*, sunflower germplasm resources were not preserved in the national crop germplasm resources bank (nursery).

Hubei is rich in sunflower biological genetic resources, mainly including Baokang sunflower-1, Baokang sunflower-2 (RIXRK002028), Baokang sunflower-2 (RIXRK002769), Baokang sunflower-3, Baokang sunflower-4, Enshi sunflower seed, Enshi sunflower, Hubei Academy of Agricultural Sciences investigation 0 A, Xingshan Gaoluozi, Xingshan sunflower seed, Xuan'en sunflower, Yichang sunflower, Zhongying sunflower, Zhushan sunflower, Zhushan small sunflower, Zhuxi big sunflower, Ziqiu sunflower seeds, Zigui sunflower seeds and other local variety resources.

(v) Perilla (perilla seed). Perilla [*Perilla frutescens* (L.) Britt.], an annual herb belonging to the genus *Perilla* of the family Labiatae, has the characteristics of warm and humid climate, strong humidity tolerance, strong waterlogging tolerance, drought intolerance and wide adaptability to soil. It originated in China and has been planted for more than 2 000 years. Perilla is widely cultivated all over the country, mainly in Hebei, Henan, Shandong, Shanxi, Jiangsu, Zhejiang, Hubei, Sichuan, Guangdong, Guangxi

and other provinces, with abundant wild resources in the south.

The genus *Perilla* includes one variety and two variants *P. frutescens* (L.) Britt. var. *crispa* Deane, *P. frutescens* (L.) Britt. var. *acuta* (Thunb) Kudo. In the National Crop Germplasm Resources Sharing Platform, there are 537 kinds of perilla germplasm resources. Among them, there are 6 wild resources, 5 genetic materials, 384 local varieties, 2 kinds of breeding varieties and 140 strains.

According to the *Query System of Available Crop Germplasm Resources*, perilla germplasm resources were not preserved in the national crop germplasm resources bank (nursery). Hubei is rich in wild perilla resources, mainly including Zhuxi perilla, Shennongjia perilla, Baokang perilla, Zigui perilla, Xuan'en perilla, Xianfeng perilla, Xianfeng perilla, Hefeng perilla and other local varieties.

(vi) Cotton. Cotton is an annual herb or perennial shrub of that genu Gossypium of the family Malvaceae, and is divided into four major cultivar species: *Gossypium herbaceum* L., *Gossypium arboretum* L., *Gossypium hirsutum* L., *Gossypium barbadense* L.[17-18]. *Gossypium arboreum* L. belongs to herbaceous plant plant, *Gossypium arboretum* L., *Gossypium hirsutum* L., *Gossypium barbadense* L. belong to herbaceous plant.

In the National Crop Germplasm Resources Sharing Platform, there are only 153 kinds of cotton germplasm resources, only four series of cotton wild resources, such as Punctatum, Morrilli, Yucatanense and Richmondii.

According to the *Query System of Available Crop Germplasm Resources*, the National Cotton Germplasm Medium-term Bank (Anyang) preserves 800 kinds of cotton germplasm resources available for use, including 241 breeding varieties, one local variety and 558 strains.

Cotton planting in China is divided into three major cotton areas, namely, the Yangtze River Basin cotton area, the Yellow River Basin cotton area and the northwest inland cotton area. Hubei belongs to the Yangtze River Basin cotton area. In history, *G. arboreum* was mainly planted, and now herbaceous *G. hirsutum* is mainly planted. Hubei Province is rich in biological genetic resources of cotton, especially *G. hirsutum* and Asian cotton (*G. arboreum*). Since 2005, the Hubei Provincial Department of Agriculture and Rural Affairs has certified 86 cotton varieties, mainly local variety resources such as Gang 0996, Ezhi 5, Emian ZY6, Ekangmian 13 and Chumian 608.

(vii) Linen. Linen (*Linum usitatissimum* L.) is an annual herb of the genus *Linum* in famly Linaceae, with the characteristics of cool and humid climate, cold resistance, fear of high temperature, suitable for slightly acidic or neutral soil, originated in the Mediterranean region. According to the use, flax can be divided into three types: oil linen, oil and fiber linen, and fiber linen. Linen was introduced into China in the Qing Dynasty and is now cultivated everywhere, especially in the north and southwest, mainly in Heilongjiang, Xinjiang, Inner Mongolia, Jilin, Liaoning, Shanxi, Shaanxi, Shandong, Hubei, Hunan, Guangdong, Guangxi, Sichuan, Guizhou and Yunnan provinces.

In the National Crop Germplasm Resources Sharing Platform, there are 6 262 kinds of linen germplasm resources. Among them, there are one wild resource, 3 427 genetic materials, 575 local varieties, 349 breeding varieties, 1 609 strains and 301 others.

According to the *Query System of Available Crop Germplasm Resources*, the National Medium-term Bank of Bast Fiber Crop Germplasm Resources (Changsha) preserves 300 kinds of linen germplasm resources available for use, including 249 genetic materials, one breeding variety and 50 strains. There is a certain area of linen planting in Hubei Province, but the resource advantage of linen landraces is not significant. At present, the national local varieties of linen mainly originate from Heilongjiang, Inner Mongolia, Xinjiang and other places.

(viii) Ttiger nut. Tiger nut (Cyperus esculentus var. Sativus Boeckeler) is a perennial herb of the genus *Cyperus* L. in family Cyperaceae. It has the ecological characteristics of warm sunshine, humid climate, drought tolerance, temperature tolerance, barren tolerance, saline-alkali tolerance, strong adaptability and tuber propagation, and is originated in North Africa and the Mediterranean coast.

In the 1960s, China successfully planted tiger nut in Beijing, Inner Mongolia, Liaoning, Guangdong, Guangxi, Fujian, Xinjiang, Gansu and other regions. As a new oil source, tiger nut is listed in the *National Planting Structure Adjustment Plan (2016 – 2020)*.

Neither the National Crop Germplasm Resources Sharing Platform nor the *Query System of Available Crop Germplasm Resources* preserves the available tiger nut germplasm resources. The tiger nut planting started not long ago in Hubei Province, the planting area is small, tiger nut biological genetic resources are not rich, only a few tiger nut varieties such as "Zhongyousha No. 1".

3.3 New plant varieties Among 8 kinds of herbaceous edible oil crops in Hubei Province, the tiger nut (*Cyperus esculentus* var. *sativus* Boeckeler) was still not included into the *List of New Varieties of Agricultural Plants of the People's Republic of China*, other 7 kinds were included and have implemented the protection of new agricultural plant varieties in China. *Helianthus* L. is also protected by new varieties of forest and grass plants.

(i) Rape. *B. napus*, *B. juncea*, and *B. campestris* were separately included into the second, sixth, and tenth of the *List of New Varieties of Agricultural Plants of the People's Republic of China* on March 7, 2000, May 20, 2005 and April 16, 2016. *B. campestris* and *B. juncea* have not yet been authorized new varieties of national agricultural plants, and Hubei naturally has not obtained new varieties of national agricultural plants of these two types of rape. *B. napus* has been authorized 306 new agricultural plant varieties with variety owners from 15 provinces including Sichuan, Guizhou, Hubei, Anhui, Hunan, Shaanxi, Zhejiang, Henan, Yunnan, Shanghai, Guangdong, Qinghai, Chongqing and Gansu. Hubei and Anhui tied for the third place in the country, winning 40 new varieties of *B. napus* national agricultural plants (Table 2).

(ii) Peanut. Peanut was included into the second batch of the *List of New Varieties of Agricultural Plants of the People's Republic of China* on March 7, 2000. It has authorized 336 new varieties of national agricultural plants, and the owners of the varieties belong to 14 provinces, including Henan, Shandong, Guangdong,

Hebei, Sichuan, Guangxi, Jiangsu, Anhui, Jilin, Hubei, Fujian, Jiangxi, Beijing and Liaoning. Among them, Hubei and Fujian ranked 10th in China, and only three new agricultural plant varieties of peanut were obtained (Table 3).

Table 2 New national agricultural plant varieties of *Brassica napus* obtained by Hubei Province

Applicant/variety owner	Variety number	Application date	Approved number
Hubei Fuyue Agricultural Development Co., Ltd.	Fuyou 2	2006-09-30	CNA002929G
Hubei Gushen Technology Co., Ltd.	Gushenyou 5	2015-04-21	CNA012804G
Hubei Lizhong Seed Technology Co., Ltd.	Liyou 618	2020-07-18	CNA023035G
	Liyou 718	2020-07-19	CNA023036G
	Liyouza 168	2020-11-25	CNA023039G
	Liyouza 178	2020-12-10	CNA023041G
	Liyouza 108	2020-12-12	CNA023042G
Huazhong Agricultural University	Huashuang 4	2004-12-22	CNA001742G
	Huashuang 5	2005-06-07	CNA002467G
	Huayouza 62	2010-06-30	CNA006789G
	Bing 409	2011-10-12	CNA007408G
Jingzhou Jinghua Seed Technology Co., Ltd.	You 201	2007-06-21	CNA003703G
Wuhan CMP Super Seeds Co., Ltd.	T2159	2014-09-04	CNA010311G
Wuhan Liannong Seed Technology Co., Ltd.	616A	2014-09-29	CNA010312G
Wuhan Zhongyou Technology New Industry Co., Ltd.	1019A	2016-12-27	CNA014971G
Wuhan Zhongyou Sunshine Times Breed Industry Technology Co., Ltd.	12X26	2014-06-18	CNA010310G
Oil Crops Research Institute, Chinese Academy of Agricultural Sciences	Zhongshuang 6	2000-09-20	CNA000271G
	Zhongyouza 7	2004-04-14	CNA001407G
	Zhongshuang 10	2004-07-01	CNA001864G
	Zhongshuang 11	2007-08-22	CNA003704G
	Zhongyouza 13	2009-04-10	CNA004110G
	Zhongyou 589	2011-07-27	CNA009498G
	Yangguang 2009	2013-01-08	CNA007419G
	Xiwang 699	2013-11-07	CNA009504G
	Yangguang 1602	2016-07-12	CNA014959G
	Yangguang 1601	2016-07-12	CNA014958G
	Zhongshuang 3370	2016-08-04	CNA014961G
	Zhongyou Baihua 1	2016-08-04	CNA014963G
	ZYP77	2016-08-04	CNA014962G
	6019A	2016-11-07	CNA014967G
	Zhongyou Xitai 1	2018-05-08	CNA019450G
	Zhongyou Weitai 1	2018-05-08	CNA019451G
	Zhongyou Xitai 2	2018-06-15	CNA019453G
	Dadi 195	2018-10-29	CNA021708G
	Zhongyou Xitai 3	2019-12-03	CNA019459G
	Zhongyou Xitai 4	2019-12-03	CNA019460G
	Zhongyouza 39	2020-04-7	CNA019464G
	Xiwang 122	2020-06-12	CNA023033G
	OR88	2020-08-23	CNA019465G
	Xiwang 759	2021-06-20	CNA024238G

Table 3 New national agricultural plant varieties of peanut obtained by Hubei Province

Applicant/variety owner	Variety name	Application date	Approved number
Oil Crops Research Institute, Chinese Academy of Agricultural Sciences	Zhonghua 8	2003-05-21	CNA000995G
	Zhonghua 16	2009-11-04	CNA004969G
	Zhonghua 12	2005-01-28	CNA001838G

(iii) Sesame. Sesame was included into the seventh of the *List of New Varieties of Agricultural Plants of the People's Republic of China* on April 21, 2008. Only 14 new national agricultural plant varieties of sesame have been authorized, and the variety owners belong to Henan, Hubei, Shandong and Anhui provinces. Hubei and Shandong ranked second in China, and only two new

varieties of national agricultural plants of sesame were obtained (Table 4).

(iv) Sunflower. Sunflower was included into the *List of New Varieties of Agricultural Plants of the People's Republic of China* on April 16, 2016. By now, 104 new varieties of agricultural plants have been authorized, and the owners of varieties belong to Inner Mongolia, Beijing, Gansu, Hebei, Jilin, Shanxi, Anhui, Switzerland, Spain and the United Kingdom. However, Hubei has not obtained the national agricultural plant new variety right of sunflower (*Helianthus annuus* L.) the seventh batch of *List of New Varieties of Plants of the People's Republic of China* (*Forest and Grass Part*) on December 8, 2020. So far, no new varieties of national forest and grass plants of *Helianthus* L. have been authorized, and Hubei has not naturally obtained the right of new varieties of national forest and grass plants of *Helianthus* L.

Table 4 New national agricultural plant varieties of sesame obtained by Hubei Province

Applicant/variety owner	Variety name	Application date	Approved number
Xiangfan Academy of Agricultural Sciences	Ezhi 6	2009-02-13	CNA008836G
Oil Crops Research Institute, Chinese Academy of Agricultural Sciences	Zhongzhi 27	2013-10-09	CNA006811G

(v) Perilla (Perilla seed). Perilla was included into the eleventh batch of *List of New Varieties of Agricultural Plants of the People's Republic of China* on February 22, 2019. So far, no new national agricultural plant varieties of perilla have been authorized, and 22 new national agricultural plant varieties of perilla have been applied for. The owners of the varieties belong to 6 provinces, including Guizhou, Hebei, Fujian, Chongqing, Gansu and Shanghai. However, Hubei has not yet applied for the right of new national agricultural plant varieties of perilla.

(vi) Cotton. Cotton is a kind of herb used for both fiber and edible oil, and cottonseed is one of the main dual-purpose oils. *Gossypium* L. was included into the sixth batch of the *List of New Varieties of Agricultural Plants of the People's Republic of China* on May 20, 2005. By now, 536 new national agricultural plant varieties of *Gossypium* L. have been authorized, and the variety owners belong to 16 provinces, including Henan, Xinjiang, Shandong, Hebei, Jiangsu, Hubei, Hunan, Guangdong, Beijing, Anhui, Shanxi, Liaoning, Shaanxi, Sichuan, Zhejiang and Gansu. Among them, Hubei ranked sixth in China, and 21 new varieties of national agricultural plants were obtained (Table 5).

Table 5 New national agricultural plant varieties of *Gossypium* L. obtained by Hubei Province

Applicant/variety owner	Variety name	Application date	Approved number
Hubei Huazhixia Seed Co., Ltd.	Hua M2	2018-09-17	CNA016741G
Hubei Huimin Agricultural Technology Co., Ltd.	Huahui 2	2013-07-30	CNA008826G
	Huahui 4	2013-11-20	CNA010361G
Hubei Huimin Seed Co., Ltd.	Ezamian 11 F1	2005-09-28	CNA002946G
	Tai D5F1	2005-09-28	CNA001948G
	Tai D6F1	2005-09-28	CNA001949G
Hubei Jingchu Seed Industry Co., Ltd.	Chuza 180F1	2005-07-21	CNA002937G
	Chuza 380 F1	2005-07-21	CNA002473G
	Jingzhu 201	2005-07-21	CNA002618G
Institute of Economic Crops, Hubei Academy of Agricultural Sciences	C111	2010-12-06	CNA006093G
	EK288	2008-11-17	CNA004562G
	EZ9	2016-04-01	CNA014137G
	ZD2040	2019-12-16	CNA017586G
	Emian ZY6	2014-10-24	CNA010941G
Huazhong Agricultural University	Huazamian H318	2009-09-17	CNA004983G
Huanggang Academy of Agricultural Sciences	Gangzamian 8F1	2008-09-03	CNA004116G
Jingzhou Academy of Agricultural Sciences	Jingmian 93	2018-07-27	CNA020692G
	Jingzamian 142F1	2008-07-16	CNA004980G
	Jingzamian 166F1	2008-07-16	CNA004979G
	Jingzamian 88F1	2008-07-16	CNA004981G
Yao Changbing	R808	2005-12-29	CNA002620G

(vii) Linen. Linen was included into the sixth batch of the *List of New Varieties of Agricultural Plants of the People's Republic of China* on May 20, 2005. So far, five new varieties of agricultural plants have been authorized to linen, and the owners of the varieties belong to Gansu and Hunan provinces. However, Hubei has not been granted the right to new varieties of national agricultural plants of linen.

3.4 National invention patent and national utility model patent (i) Rape and rapeseed oil. Rape and rapeseed oil in Hubei Province have won 3 360 national invention patents and 857 national utility model patents. Among them, 383 national invention patents and one national utility model patent were obtained in the

field of plant breeding (IPC classification A01H); 1 268 national invention patents and 295 national utility model patents were obtained in the field of agriculture (IPC classification A01); in the field of food (IPC classification A21 and A23), 724 national invention patents and 75 national utility model patents were obtained. Rapeseed oil (also known as rapeseed oil) has won 1 075 national invention patents and 238 national utility model patents.

(ii) Peanut and peanut oil. Peanut and peanut oil in Hubei Province have won 3 548 national invention patents and 1 004 national utility model patents. Among them, 92 national invention patents and 0 national utility model patent were obtained in the field of plant breeding; 721 national invention patents and 161 national utility model patents were obtained in the field of agriculture; 1 295 national invention patents and 204 national utility model patents were obtained in the field of food. Peanut oil has won 762 national invention patents and 118 national utility model patents.

(iii) Sesame and sesame oil. Sesame and sesame oil in Hubei Province have won 1 691 national invention patents and 371 national utility model patents. Among them, 52 national invention patents and 0 national utility model patent were obtained in the field of plant breeding; 170 national invention patents and 34 national utility model patents were obtained in the field of sesame in agriculture; 906 national invention patents and 89 national utility model patents were obtained in the field of food. Sesame oil has won 634 national invention patents and 126 national utility model patents.

(iv) Sunflower and sunflower oil. Sunflower and sunflower oil in Hubei Province have won 774 national invention patents and 145 national utility model patents. Among them, 33 national invention patents and 0 national utility model patent were obtained in the field of plant breeding; 107 national invention patents and 13 national utility model patents were obtained in the field of agriculture; 262 national invention patents and 16 national utility model patents were obtained in the field of food. Sunflower seed oil (also known as sunflower oil) has won 384 national invention patents and 26 national utility model patents.

(v) Perilla and perilla seed oil. Perilla oil and perilla seed oil in Hubei Province have won 539 national invention patents and 33 national utility model patents. Among them, 3 national invention patents and 0 national utility model patent were obtained in the field of plant breeding; 25 national invention patents and 2 national utility model patents were obtained in the field of agriculture; 199 national invention patents and 4 national utility model patents were obtained in the field of medicine and health (IPC classification A61); it has won 255 national invention patents and 3 national utility model patents in the field of food. Perilla seed oil (also known as perilla oil) has won 116 national invention patents and 3 national utility model patents.

(vi) Cotton and cottonseed oil. Cotton and cottonseed oil in Hubei Province have won 2 852 national invention patents and 1 710 national utility model patents. Among them, 188 national invention patents and 4 national utility model patents were obtained in the field of plant breeding; 968 national invention patents and 321 national utility model patents were obtained in the field of agriculture; In the textile field (IPC classification D01, D02, D03, D04, D05, D06 and D07), cotton has obtained 278 national invention patents and 425 national utility model patents; in the food field, cotton has obtained 0 national invention patent and 0 national utility model patent. Cottonseed oil (also known as cotton oil) has won 301 national invention patents and 46 national utility model patents.

(vii) Linen and linen seed oil. Hubei has won 1 474 national invention patents and 407 national utility model patents of linen and linen seed oil. Among them, 37 national invention patents and 0 national utility model patent were obtained in the field of plant breeding; 105 national invention patents and 9 national utility model patents were obtained in the field of agriculture; 150 national invention patents and 82 national utility model patents were obtained in the field of textile; 503 national invention patents and 8 national utility model patents were obtained in the field of food. Linen seed oil (also known as linen oil) has won 398 national invention patents and 62 national utility model patents.

(viii) Tiger nut and tiger nut oil. Hubei has won 31 national invention patents and 5 national utility model patents of tiger nut and tiger nut oil. Among them, 1 national invention patent and 0 national utility model patent were obtained in the field of plant breeding; 8 national invention patents and 2 national utility model patents were obtained in the field of agriculture; 14 national invention patents and 1 national utility model patent were obtained in the field of food. The tiger nut oil has won 18 national invention patents and 1 national utility model patent.

3.5 Design patent National design patents related to herbaceous edible oil crops mainly belong to the international design classification system-the ninth category of packaging and containers in the Locarno Classification system. There are not many national design patents in Hubei herbaceous edible oil crops, including 37, 36, 29 and 7 national design patents involving sesame, peanut, rape and cotton packaging and containers, and 1 sunflower and 1 tiger nut. The national design patents for packaging and containers in Hubei Province do not involve perilla and linen.

3.6 Geographical indications At present, China's geographical indication protection system is not perfect. There are three systems: (i) geographical indication products of the China National Intellectual Property Administration; (ii) geographical indication trademarks of the Trademark Office of the China National Intellectual Property Administration; (iii) geographical indications of agricultural products of the Ministry of Agriculture and Rural Affairs[15-16].

(i) Geographical indication products. In addition to rice, maize, and soybean using as grain and oil, there are four main geographical indication products of herbaceous oil in Hubei Province (Table 6).

(ii) Geographical indication trademark. Hubei has 24 geographical indication trademarks of major herbaceous oilseeds (Table 7).

Table 6 Geographical indication products of herbaceous edible oil crops in Hubei Province

Product	Announcement date	Protection scope of geographical indications
Wuxue Rapeseed Oil	2014 - 07 - 09	12 townships (residential districts) in Wuxue City, Hubei Province: Wuxue Residential District, Kanjiang Residential District, Tianzhen Residential District, Wanzhanghu Residential District, Meichuan Town, Yuchuan Town, Huaqiao Town, Dajin Town, Siwang Town, Shifosi Town, Dafasi Town, and Longping Town
Suizhou Paopaoqing	2014 - 07 - 09	28 towns (residential districts) in Suizhou City, Hubei Province: Dongcheng Residential District, Xicheng Residential District, Nanjiao Residential District, Beijiao Residential District, Wandian Town, Hedian Town, Xihe Town, Luoyang Town, Fuhe Town, Zengdu Residential District; Anju Town, Lishan Town, Xinjie Town, Huantan Town, Junchuan Town, Wanhe Town, Shangshi Town, Tangxian Town, Liulin Town, Wushan Town, Hongshan Town, Changgang Town, Sanligang Town, Wanfu Town, Yindian Town, Huaihe Town, Caodian Town, Xiaolin Town, and Gaocheng Town in Suixian County
Hongshan Caitai	2005 - 12 - 31	3 townships in Wuhan City, Hubei Province: Hongshan Township, Jiufeng Township, Huashan Town in Hongshan District
Dawu Peanut	2012 - 12 - 18	17 townships and towns in Dawu County, Xiaogan City: Chengguan Town, Yangping Town, Fangfan Town, Xincheng Town, Liuji Town, Xiadian Town, Hekou Town, Lvwang Town, Huangzhan Town, Xuanhuadian Town, Fengdian Town, Gaodian Township, Daxin Town, Sanli Town, Dongxin Township, Pengdian Township and Sigu Town

Table 7 Geographical indications of herbaceous edible oil crops in Hubei Province

Trademark classification	Trademark	Registration entity	Registration No.
Certification trademark	Babao Rape	Songzi City Lusheng Local Specialty Industry Development Center	17189441
	Xiangyang Rapeseed	Xiangzhou District Rapeseed Planting and Processing Association of Xiangyang City	17011802
	Maocao Hongcaitai	Ezhou Urban and Rural Famous and Special Products Association	13833910
	Maocao Hongcaitai	Ezhou Urban and Rural Famous and Special Products Association	14229283
	Ehongshan Caitai	Hongshan Rape Industry Association, Hongshan District, Wuhan City	3958379
	Hongshan Caitai	Hongshan Rape Industry Association, Hongshan District, Wuhan City	12861108
	Hongshan Caitai	Hongshan Rape Industry Association, Hongshan District, Wuhan City	49743971
	Zhongxiang Paopaoqing	Zhongxiang Traditional Food Research and Promotion Center	33986481
	Xiangyang Rapeseed Oil	Xiangzhou District Rapeseed Planting and Processing Association of Xiangyang City	17011803
	Zhongxiang Rapeseed Oil	Zhongxiang City Specialty Association	26327614
	Dawu Peanut	Dawu County Peanut Industry Association	14568829
	Hongan Peanut	Hongan County Agricultural Technology Extension Center Station	14650486
	Shayang Peanut	Shayang County Peanut Association	15420396
	Xiaocun Hongyimi Peanut	Xianfeng County Xiaocun Hongyimi Peanut Association	11294236
	Xiaocun Hongyimi Peanut	Xianfeng County Xiaocun Hongyimi Peanut Association	11294237
	Xiangyang Peanut	Xiangzhou District Peanut Planting and Processing Association, Xiangyang City	17389433
	Zhongxiang Peanut	Zhongxiang City Specialty Association	26328027
	Xiangyang Peanut Oil	Xiangzhou District Oils and Fats Association, Xiangyang City	53322356
	Xiangyang Sesame Oil	Xiangzhou District Oils and Fats Association, Xiangyang City	12600677
	Yanglouziwan Sesame Oil	Hubei Food Culture Research Association	12314143
	Zhijiang Cotton	Zhijiang City Agricultural Technology Extension Center	15494308
	Tongcheng Perilla	Tongcheng County Tongcheng Perilla Research Institute	29345555
Collective trademark	Suizhou Paopaoqing	Suizhou Paopaoqing Technology Research Center	9813083
	Liusheng Tiegan Peanut	Zaoyang City Lingmiao Planting Specialized Cooperative	16460530

(iii) Geographical indications of agricultural products. There are 7 geographical indications of major herbaceous and oil agricultural products in Hubei Province (Table 8).

3.7 Trademarks There are four basic types of trademarks registered in the Trademark Office of China National Intellectual Property Administration: ordinary trademarks, collective trademarks, certification marks, and special signs. There are many ordinary trademarks related to herbaceous edible oil crops in Hubei. Special signs refer to the signs used in national or international cultural, educational, scientific research and other social public welfare activities approved by the State Council, not involving the herbaceous edible oil crops of Hubei Province.

In addition to rice, maize, and soybean for using as grain and oil, there are two collective trademarks related to Hubei herbaceous edible oil crops: Suizhou Paopaoqing and Liusheng Tiegan Peanut. There are 22 certified trademarks: Babao Rape, Xiangyang Rapeseed, Maocao Hongcaitai (Registration No.:13833910), Maocao Hongcaitai (Registration No.: 14229283), Ehongshan Caitai, Hongshan Caitai, Hongshan Caitai, Zhongxiang Paopaoqing, Xiangyang Rapeseed Oil, Zhongxiang Rapeseed Oil, Dawu Peanut, Hongan Peanut, Shayang Peanut, Xiaocun Hongmi Peanut (Registration No.: 11294236), Xiaocun Hongmi Peanut (Registration No.: 11294237), Xiangyang Peanut, Zhongxiang Peanut, Xiangyang Peanut Oil. There are 24 collective trademarks

and certification trademarks, all of which are geographical indications (Table 7).

There are 16 well-known trademarks in China: Jiefu, Shendi, Changxiangyuan, Manyicun, Tianzhu, Xisong, Ruyiqing, Graphics (registration No.: 3182631), Fudafang, Tangsao, Renrenkang, Aoxing, Juxiangda, Wanbao, Kongmingcai and Xiangzhiyuan.

Table 8 Geographical indications of herbaceous edible oil crops of agricultural products in Hubei Province

Agricultural product	Registration Year	Registration entity	Protection scope of geographical indications
Wuxue shuangdi rape	2015	Wuxue Agricultural Technology Extension Center	12 Shuangdi rape planting areas in Wuxue City, Hubei Province: Meichuan Town, Yuchuan Town, Dajin Town, Dafasi Town, Siwang Town, Shifosi Town, Huaqiao Town, Longping Town, Wuxue Subdistrict Office, Zhanjiang Subdistrict Subdistrict Office, Tianzhen Subdistrict Office, and Wanzhanghu Subdistrict Office
Jingmen rape	2020	Jingmen Agricultural Technology Extension Center	8 counties and districts in Jingmen City, Hubei Province: Dongbao District, High-tech Zone, Duodao District, Shayang County, Zhongxiang City, Jingshan County, Qujialing Management District, and Zhanghe New District, involving 53 towns and subdistrict offices
Hongshan Caitai	2018	Hongshan Caitai Industry Association, Hongshan District, Wuhan City	7 residential districts (townships) in Hongshan District, Wuhan City, Hubei Province: Hongshan Residential District, Jiufeng Residential District, Qingling Residential District, Huashan Residential District, Bajifu Residential District, Zuoling Residential District, and Tianxing Township
Suizhou Paopaoqing	2010	Suizhou City Paopaoqing Farmers Professional Cooperative	16 townships in Zengdu District, Suizhou City, Hubei Province: Dongcheng, Xicheng, Nanjiao, Beijiao, Wandian, Hedian, Xihe, and Anju, Lishan, Xinjie, Huantan, Junchuan, Wanhe, Shangshi, Tangzhen, and Liulin in Suixian County
Xiaocun Hongyimi peanut	2010	Xianfeng County Xiaocun Hongyimi Peanut Association	12 villages in Xianfeng County, Enshi Prefecture: Xiaocun Village, Yangti Village, Limu Village, Shuishanping Village, Lizixi Village, Xinglonggou Village, Baiguo Village, Zhongxinchang Village, Tianba Village, Dacun Village, Weilong Village and Tudixi Village
Hongan peanut	2013	Hongan County Peanut Research Institute	12 townships and towns (farms) in Hongan County of Huanggang City: Chengguan Town, Qiliping Town, Ercheng Town, Gaoqiao Town, Miersi Town, Xinghua Township, Shangxinji Town, Baliwan Town, Taipingqiao Town, Yongjiahe Town, Huajiahe Town and Huolianfan Tea Farm
Zhongxiang peanut	2013	Jingmen City Chuhua Peanut Processing Specialized Cooperative	18 townships and towns (residential districts and management areas) in Zhongxiang City of Jingmen City: Yangzi Town, Changshou Town, Fengle Town, Huji Town, Shuanghe Town, Phosphate Mine Town, Wenji Town, Lengshui Town, Shipai Town, Chaihu Town, Jiukou Town, Changtan Town, Dongqiao Town, Kedian Town, Zhangji Town, Jiuli Hui Township, Yingzhong Street Office and Guanzhuang Lake Management Area

4 Main problems in intellectual property protection, inheritance, innovation and development of herbaceous edible oil in Hubei

4.1 Weak protection and inheritance of intellectual property rights of cultural heritage The protection and inheritance of intellectual property rights of cultural heritage such as biological genetic resources and traditional knowledge related to herbaceous edible oil crops in Hubei are not effective, and the protection of germplasm resources such as wild resources, genetic materials, breeding varieties, introduced resources, inbred lines, local varieties, strains and synthetic populations has not attracted due attention. There are only two provincial intangible cultural heritage projects (VIII-23 and VII-35), and there are no national intangible cultural heritage, important agricultural cultural heritage in China and the world, and no Hubei and China time-honored brands.

4.2 Weak creative ability of intellectual property rights of scientific and technological innovation There are few new varieties of plants in the herbaceous edible oil crops of Hubei Province, and there are few national invention patents and utility model patents in the whole industry chain, and the creation ability of scientific and technological innovation intellectual property rights such as new varieties of plants, invention patents and utility model patents is weak.

4.3 Imperfect protection of intellectual property rights of brand marks The intellectual property protection of national design patents (especially packaging and containers), geographical indications, trademarks and other brand indications related to Hubei herbaceous edible oil crops is imperfect, there are fewer national design patents for packaging and containers, and many famous and high-quality products have not yet implemented geographical indications. The existing geographical indication products, geographical indication trademarks and geographical indications of agricultural products all lack the corresponding national standards for geographical indication products, with only one local standard, *Geographical Indication Products Dawu Peanut* (DB42/T 999-2014). There are few market entities using special geographical indications, no national demonstration zones for the protection of geographical indications

products have been established, no Chinese geographical indications protected by the European Union, few regional public trademarks such as collective trademarks and certification trademarks, and few superior trademarks in Hubei Province and well-known trademarks in China.

4.4 The whole chain of intellectual property creation, application, protection, management and service needs to be opened The whole industry chain of herbaceous edible oil crops in Hubei Province has weak ability to create intellectual property rights of cultural heritage, scientific and technological innovation and brand marking, insufficient application, imperfect protection, lagging management and service, and the whole chain of intellectual property rights needs to be opened up.

5 Intellectual property protection, inheritance, innovation and development strategy of herbaceous edible oil in Hubei Province

5.1 Carrying forward and inherit traditional knowledge and traditional culture, and promoting the project of inheritance and development of Chinese excellent traditional culture It is recommended to investigate the traditional knowledge resources of the whole industry chain of herbaceous edible oil crops in Hubei Province, especially the traditional planting techniques, the geographical indications and humanistic factors of traditional famous and excellent specialties (including traditional making techniques), intangible cultural heritage, traditional workshops and old brands, traditional land use system and culture, and farming culture, so as to promote the development of the whole industry chain, as well as traditional medical knowledge such as perilla. Besides, it is recommended to actively apply for national and provincial intangible cultural heritage, China and globally important agricultural cultural heritage, Hubei time-honored brand and Chinese time-honored brand, and promote the integration of traditional knowledge and traditional culture related to herbaceous edible oil crops with rural revitalization, protection of traditional Chinese villages and ethnic villages, and development strategy of traditional Chinese medicine. In addition, Hubei Province should promote and inherit these traditional knowledge and traditional culture, so as to promote the Chinese cultural resources survey project, the agricultural culture inheritance and protection project, the intangible cultural heritage inheritance and development project, the Chinese time-honored brand protection and development project, the traditional Chinese medicine culture promotion project, the Chinese traditional village protection project and other Chinese excellent traditional culture inheritance and development projects, so as to promote the prosperity of rural culture, the promotion of cultural self-confidence and self-improvement, and the creation of new glory of socialist culture.

5.2 Protecting biological genetic resources and maintaining crop biodiversity It is recommended to investigate the biological genetic resources of herbaceous edible oil crops in Hubei Province, collect and sort out the wild resources, genetic materials, breeding varieties, introduced resources, inbred lines, local varieties, strains, synthetic populations and other germplasm resources. Hubei Province should give full play to the protection functions of herbaceous edible oil crops biological genetic resources in national nature reserves, national forest parks, national scenic spots, national geological parks, biodiversity observatories, and Shennongjia National Park, establish national and provincial herbaceous edible oil crops crop germplasm resources banks (nurseries), preserve available germplasm resources, and maintain the biodiversity of herbaceous edible oil crops.

5.3 Strengthening the creation of new plant varieties and breeding patents, and promoting scientific and technological innovation in the field of "agricultural chips" Hubei Province should take advantages of biological genetic resources, set up an innovative platform for the herbaceous edible oil crops of seed industry in the whole province, adopt modern biotechnology, implement the "five major actions" for the revitalization of seed industry, such as the protection and utilization of germplasm resources, the innovation of seed industry, the support of seed enterprises, the promotion of seed industry bases, and the purification of seed industry market, so as to promote the development of seed industry, also focus on the "four links" of modern seed industry upgrading project, such as resource protection, breeding innovation, testing and evaluation, and breeding of improved varieties, to promote scientific and technological innovation in the field of "agricultural chips".

5.4 Improving the protection of geographical indications, integrating and cultivating regional public goods brands It is necessary to investigate the resources of famous and special products in the whole industrial chain of Hubei herbaceous edible oil crops, analyze the natural and human factors of their geographical indications, actively apply for geographical indication products with the China National Intellectual Property Administration, register geographical indication collective trademarks and geographical indication certification trademarks with the Trademark Office of China National Intellectual Property Administration, and register geographical indications of agricultural products with the Ministry of Agriculture and Rural Affairs, so as to promote the protection of geographical indications. In addition, it is recommended to establish provincial and municipal local standards and national standards corresponding to geographical indications, encourage market participants within the scope of geographical indications protection to use geographical indications products, geographical indications trademarks and special geographical indications of agricultural products, prepare to build national geographical indications products protection demonstration zones for herbaceous edible oil crops, and establish national geographical indications protection demonstration zones for agricultural product, promote international cooperation in the protection of geographical indications, and integrate and cultivate regional public goods brands with geographical indications as the key link.

5.5 Strengthening the registration of collective trademarks and certification trademarks, and creating superior trademarks in Hubei Province and well-known trademarks in China Hubei Province should strengthen the registration of regional public trademarks such as collective trademarks and certification trademarks in the whole industry chain of herbaceous edible oil crops in Hubei Province, especially the collective trademarks and certification trademarks of geographical indications, cultivate regional public trademarks and their brands, and create superior trademarks in Hu-

bei Province and well-known trademarks in China.

5.6 Opening up the whole chain of intellectual property rights and improving the level of intellectual property protection Hubei Province should strengthen the protection of intellectual property rights of cultural heritage, scientific and technological innovation and brand labeling in the whole industrial chain of herbaceous edible oil crops in the province. In addition, it is recommended to promote the level of the whole chain of intellectual property creation, application, protection, management and service, and take agricultural intellectual property rights as the guide of geographical indication industry, rapeseed and cotton national important agricultural product production protection zones, rapeseed national superior characteristic industrial clusters in Jianghan Plain, Hubei Province, and provincial double-low high-quality rapeseed protection zones, to promote the high-quality development of the whole industry of herbaceous edible oil crops.

References

[1] GAO L, PENG YM, WU LY, *et al.* National production zone for rapeseed protection and industrial cluster of rape in Hubei Province[J]. Asian Agricultural Research, 2023, 15(9): 1 - 10.

[2] GAO L, WU LY, PENG YM, *et al.* Rape breeding and its intellectual property protection in China[J]. Agricultural Bio-technology, 2023, 12(3): 23 - 30.

[3] GAO L, PENG YM, WU LY, *et al.* Geographical indication intellectual property protection and regional public brand construction of rape industry in China[J]. Asian Agricultural Research, 2023, 15(6): 7 - 13.

[4] GAO L, SUN ZG, HE YQ, *et al.* Construction of china osmanthus city and intellectual property right protection in Xianning City in the context of three new developments[J]. Asian Agricultural Research, 2022, 14(9): 1 - 6, 15.

[5] GAO L, SUN ZG, HE YQ, *et al.* Inheritance, innovation and high-quality development of tea industry in Xianning City, Hubei Province[J]. Asian Agricultural Research, 2022, 14 (8): 15 - 20, 27.

[6] HU XP, LIAO YJ, MAO Y. On the focus of food security in China from the perspective of an all-encompassing approach to food[J]. Rural Economy, 2023(7): 55 - 62. (in Chinese).

[7] CHEN MS, QIN L, CHENG GY. Practicing a greater food approach: Challenges, goals and pathways for food system transformation in China[J]. Issues in Agricultural Economy, 2023(5): 4 - 10. (in Chinese).

[8] CHENG GQ. The greater food approach: Structural change, policy implications and practice logic[J]. Issues in Agricultural Economy, 2023(5): 49 - 60. (in Chinese).

[9] GAO DG, WANG JH. The big food concept solves the "three difficult problems" of China's food security and consolidates the foundation of food security in an all-round way[J]. China Grain Economy, 2023(5): 40 - 42. (in Chinese).

[10] LONG WJ, FAN SG. Building a diversified food supply system with a big food approach[J]. Research of Agricultural Modernization, 2023, 44(2): 233 - 243. (in Chinese).

[11] LI QF. Implementing the overall concept of national security: Time consideration, scientific connotation and practical requirements[J]. Creation, 2023, 31(7): 7 - 11. (in Chinese).

[12] MAO LX, LI X. Positioning, practice and influence of Chinese food security from the perspective of integrated national security[J]. Science and Technology of Cereals, Oils and Foods, 2023, 31(4): 1 - 9.

[13] JIANG CY. Building a Strong Agricultural Country[M]. Beijing: Oriental Publishing House, 2023. (in Chinese).

[14] LIN YF, HUANG QF, NING GN, *et al.* Understanding Chinese Modernization: Scientific Connotation and Development Path[M]. Beijing: CITIC Press, 2023. (in Chinese).

[15] XU MM, BAI YL, WANG JJ, *et al.* Intellectual property protection and new development pattern construction of Xinjiang jujube[J]. Asian Agricultural Research, 2023, 15 (7): 1 - 8.

[16] XU MM, WANG JJ, BAI YL, *et al.* Intellectual property protection and high-quality development of grape industrial clusters in Xinjiang[J]. Asian Agricultural Research, 2023, 15 (5): 1 - 7.

[17] XU MM, XIONG WZ, HE YQ, *et al.* Cotton breeding in Xinjiang and its intellectual property protection[J]. Agricultural Biotechnology, 2022, 11(4): 116 - 123.

[18] XU MM, HE YQ, XIONG, WZ *et al.* Intellectual property protection and high-quality development of cotton industry in Xinjiang[J]. Asian Agricultural Research, 2022, 14(6): 4 - 11.

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[7] CHEN KJ. Digital new infrastructure and the improvement of the total factor productivity of china's circulation industry: Theoretical analysis and empirical research [J]. Business Economic Research, 2021(23): 5 - 8. (in Chinese).

[8] WANG HB. The logic of empowering farmers' livelihood in the process of rural revitalization [J]. Journal of South China Agricultural University (Social Science Edition), 2023, 22(4): 58 - 68. (in Chinese).

[9] WANG XJ. Exploring the technological innovation effects of digitalization on embedded circulation services [J]. Business Economic Research, 2022(18): 178 - 180. (in Chinese).

[10] ZHAO X, ZHANG ZY. Transformation of the circulation industry: Driven by digitalization, reconstruction of business logic, and integration and innovation of industries[J]. Journal of Hainan University (Social Sciences Edition), 2023, 41(1): 184 - 193. (in Chinese).