Patent Analysis of Herba Dendrobii Cultivation Technology Based on Incopat Analytic System

Lina She[1,a], Yaxue Chen[2,b,*], Li Zhang[3,c]

[1]Kunming university office of academic research, Kunming, 650214, China

[2]Yunnan agricultural university library, Kunming, 650201, China

[3]Yunnan academy of scientific and technical information novelty search center, Kunming, 650051, China

[a] 51422598@qq.com, [b] 554523020@qq.com, [c] 24872537@qq.com

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Abstract: In this paper, incopat patent analysis information system was used to search the patent of Herba Dendrobii cultivation in China, ranking the number of patent applications in each province and in combination with IPC classification, analyzes the different provinces and regions related technology competitiveness, as well as leading patent technology focus in the area and leading enterprise. Conclusion: 1. The applicant did not gather in the research institutes, colleges and universities and the excellent traditional Chinese medicine enterprises, which reflected the superiority of the strong group in the southern city. The first applicant, jiangyin zhenjiang biotechnology co., LTD., has 25 patents, accounting for 23% of the patents.2. A01G, C05G and A01H are the top 3 technologies with the most patents, representing the three strongest development trends of Herba Dendrobii planting technology.3. Zhejiang agricultural and forestry university is the only institution with continuous patent value of 8-10 patent value; The technique of enhancing the polysaccharide content of dendrobium dendrobium was studied in the light of red or red and blue light.

1. Introduction

Herba Dendrobii enjoys the title of “grass jelly”, and the Taoist health classic “Taoist patrology” credits it as the top of “China’s Nine Grass Jellies”, which is a traditional rare Chinese herbal medicine [1]. According to the “Chinese Flora”, there are 74 species and 2 varieties of Herba Dendrobii in China. In recent years, new species have been discovered. So far, 81 species and 2 varieties of Herba Dendrobii have been recorded in China [2, 3]. The most commonly used include Dendrobium officinale, dendrobium stem, Dendrobium fimbriatum and Dendrobium chrysotoxum.

Yunnan has a good provenance advantage, and there are 58 species and 2 varieties of Herba Dendrobii, of which 25 species are unique in the province [4]. However, although Herba Dendrobii in Yunnan has 70-30 rating in quality, there is no70-30 rating in power. There is already analysis on the patents of the Herba Dendrobii industry in China, but only patent analysis in the field of cultivation [5]. Therefore, this paper applies incopat patent analysis information system for the search and quantitative qualitative analysis on the related inventions and utility model patents under application for publishing in the field of Herba Dendrobii cultivation [6-8]. The database completely includes 100 million pieces of patent information from 102 countries and regions in the world [9-10]. Comparison is made on the industrial development gap between Yunnan Province and other advanced provinces. While understanding the national Herba Dendrobii patent layout, the weak links of Herba Dendrobii development in Yunnan Province are compared and adjusted for improvement.

For the retrieved patent for cultivation of Herba Dendrobii, because not all patent application will pass approval, the number of publications is less than the number of applications, but the trend is consistent with the number of applications. Compared with other industry patents, the budding period is relatively late, but the number of late applications has continued to grow rapidly. As the

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birthplace of traditional Chinese medicine, China has gradually increased its emphasis on traditional Chinese medicine, and its guiding role has become increasingly stronger. One of the important links to strengthen the emphasis on the cultivation of medicinal materials is to strengthen the awareness on intellectual property protection of Chinese medicine [11, 12].

2. Technical Domain Composition Analysis

According to IPC (International Patent Classification), technical classification of Herba Dendrobii cultivation is carried out [13, 14]. The top ten technical categories are the technical fields in which Herba Dendrobii cultivation and planting patents are mainly distributed, involving a total of 1,034 patents. The proportion of IPC technical composition is ranked from large to small. The number of IPC technology patents and their proportions (Figure 1) are respectively: (1) gardening represented by A01G; cultivation of vegetables, flowers, rice, fruit trees, grapes, hops or edible seaweed, the number of patents is 679, the proportion is as high as 66%, accounting for more than half of the total, which is undoubtedly a research and development hotspot in this field, demonstrating strong research and development trend. (2) a mixture of one or more fertilizers and substances with un-specific fertilizer efficiency represented by C05G, such as mixture of pesticides, soil conditioners and wetting agents; fertilizer characterized by shape, the number of patents is 106, accounting for 10 %, which represents a sub-hot spot for research and development in the field of Herba Dendrobii cultivation. (3) New plants or methods for obtaining new plants represented by A01H; it represents the field of plant regeneration by tissue culture technology, 87 patents have been applied in this field, accounting for 8% of the total number of patents in the Herba Dendrobii cultivation industry. (4) Fertilizers made from waste or garbage represented by C05F. The number of patents is 47, accounting for 5% of the total patents in the Herba Dendrobii cultivation industry. (5) Planting; sowing; fertilization represented by A01C, the number of patents is 37, accounting for 4%. (6) Microorganisms or enzymes; compositions thereof; reproduction, preservation or maintenance of microorganisms; variation or genetic engineering represented by C12N; (7) Preservation of human body, animal and plant body or part thereof represented by A01N; biocide, for example, as a disinfectant, as a pesticide, as a herbicide; plant growth regulator patent ratio is 2%, patent number is 16. (8) Device for capturing, trapping or intimidating animals, eliminating harmful animals or harmful plants represented by A01M. The number of patents is 15. (9) Killing, pest repellent, pest attraction or plant growth regulating activity of chemical compounds or preparations represented by A01P, and the number of patents is 15. (10) Microorganisms related to the determination or test method of enzymes or microorganisms represented by C12R, and the number of patents is 9.

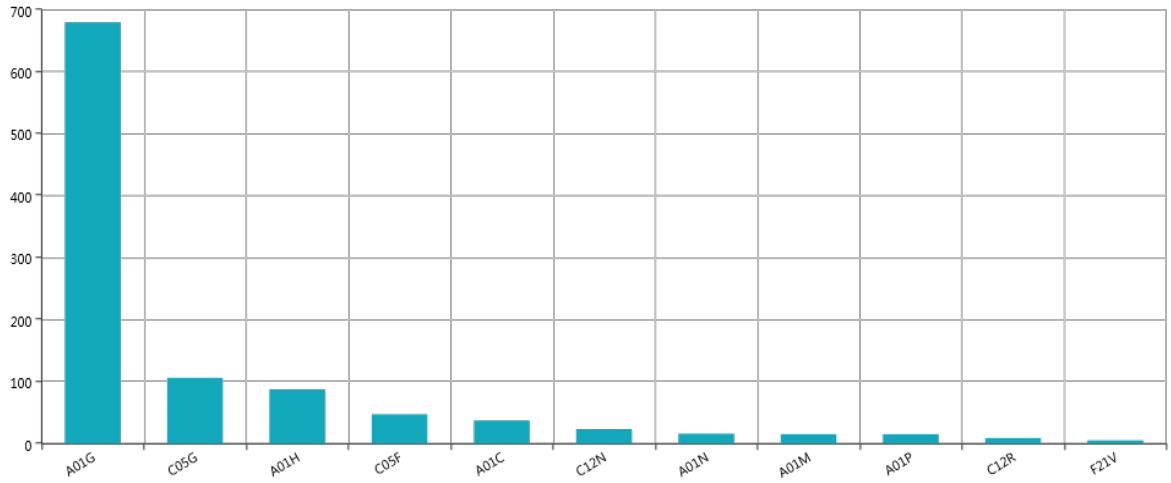

Figure 1 Patent IPC classification of Herba Dendrobii cultivation (subclass).

The number of patent applications for Herba Dendrobii cultivation in various places can reflect the economic competitiveness of the Herba Dendrobii cultivation industry [15]. The number of

patents of Herba Dendrobii cultivation techniques in different provinces and cities is ranked (Table 1). Among the top ten provinces and cities, Guangxi Province has applied for 180 patents, with the total number of applications and the number of several sub-technical classification applications (the various sub-technical letters have the same meaning as before) ranking the first. Among the number of patent applications in Guangxi, the local 4 companies account for a large proportion: For example, Lingyun County Changsheng Xiancao Biotechnology Development Co., Ltd. has applied for 8 patents, Liuzhou Hongji Agricultural Science and Technology Co., Ltd. has applied for 7 patents, Guangxi Junyu Original Materia Medica Biotechnology Co., Ltd. has applied for 5 patents, and Liuzhou Gengqing Technology Co., Ltd. has applied for 4 patents.

Anhui Province ranks the second, which has 159 patent applications for Herba Dendrobii cultivation; Zhejiang Province has 146 patents, ranking the third; Yunnan has 117 patent applications, ranking the fourth. Jiangsu Province has applied for a total of 78 patents, ranking the fifth. Secondly, the next five are Guangdong with 71 patent applications, Guizhou with 64 patent applications, Fujian with 47 patent applications, Sichuan with 33 patent applications, and Shanghai with 30 patent applications.

In comprehensive analysis, the gaps in patent ownership among the top three application regions of Guangxi, Anhui and Zhejiang are not big, showing a trend of running neck and neck; however, the number of patents in Guangxi ranking the first is six times that of Shanghai at the lowest, and the overall patent competitiveness in each region is uneven. Yunnan has the largest number of applications in A01C field, ranking the fourth in the field among the various provinces and cities. For regions and institutions that are far ahead in the number of patents on Herba Dendrobii cultivation, technical transformation assistance can be strengthened, and sub-technology with less patent applications in this field can be studied, such as technology fields from A01C to C12R. For regions with few patent applications in Herba Dendrobii cultivation, the patent administration departments of provinces and municipalities should strengthen research on intellectual property rights and introduce relevant incentive measures, incorporate patent numbers into the technological innovation evaluation system, and give certain financial support to promote local increase in the number of patent outputs and accelerate economic development of the industry.

3. Applicant Ranking Analysis

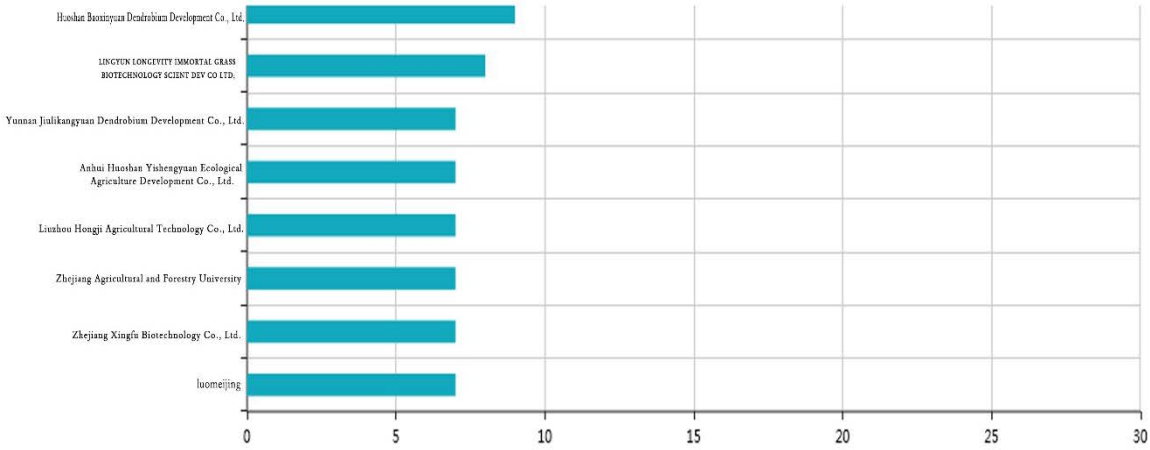

Figure 2 Patent ranking of the top 11 applicants.

Applicant's indexing ranking on the retrieved patent data of Herba Dendrobii cultivation is carried out (Figure 2), and patent applicants ranking the forefront in patent applications are obtained. Through the analysis of patent applicants, leading companies and competitors in the industry can be tapped out, and the distance between oneself and the competitor can be analyzed. Plotting is made on the number of patents owned by the top eleven applicants, and there are a total of 105 related patents. Corporate applications are in the majority, and there are also many college and individual applications. It is worth noting that the applicants are not centered on Chinese medicine research

institutes (such as China Academy of Chinese Medical Sciences), universities and colleges and excellent Chinese medicine enterprises with strong R&D strength, but strong groups in southern cities demonstrate dominant research and development advantages, and some enterprises have paid attention to the protection of intellectual property rights in advance.

The first applicant, Jiangyin Zhenjiang Biotechnology Co., Ltd., has 25 patents, accounting for 23% of patent number owned by the top 11 applicants, with an obvious leading superiority. In 2010, the company cooperated closely with Zhejiang University, and the latter provided high-quality seedling resources. Firstly, hybrid combination “Shenglan No.8” was replaced by high-quality Dendrobium officinale F1 to cultivate productive seedlings through seedling tissue culture method. The ecological environment of Dendrobium officinale was monitored by Internet of Things and artificially intervened as appropriate. Management efficiency and precision was improved by two-stage cultivation method to enhance stability of Dendrobium officinale cultivation technology so that high-efficiency intensive production of Dendrobium officinale could be achieved. For Dendrobium officinale produced by this growth mode, soluble polysaccharide content of the active ingredient is as high as 30% or more [16].

The second applicant, Sichuan Fengshang Biotechnology Co., Ltd., has 11 patents, accounting for 10% of patent number owned by the top 11 applicants. It is a private enterprise specializing in the research, cultivation and deep processing of rare and precious medicinal plants such as Dendrobium officinale. The company has jurisdiction over Chengdu Jintang County Dendrobium Officinale Industrial Park, Chengdu Ganyulan Brand Operation Management Co., Ltd. and Research Institution on Elite Breeding of Precious Herbs [17].

The fourth enterprise, Huoshan Baoxinyuan Herba Dendrobii Development Co., Ltd., has 9 patents, a leading enterprise specialized in ecological development of Huoshan Herba Dendrobii and Huoshan yellow buds. Taking the name of “Liuwan Sunny Clouds” -a unique landscape of Liuwan Village, the company registers commodity trademarks of original Herba Dendrobii and organic tea [18].

Yunnan Jiuli Kangyuan Herba Dendrobii Development Co., Ltd. ranking the sixth is the largest producer of Dendrobium officinale in Yunnan. It has been successively identified as a provincial and state-level key agricultural industrialization leading enterprise, Yunnan science and technology enterprise, Yunnan traditional Chinese medicine cultivation science and technology demonstration park, Dendrobium officinale elite breeding base. It has passed a series of certifications such as ISO-9001 quality management system, organic, GAP good agricultural practices and GMP. It builds high-standard high-clean tissue culture workshops in strict accordance with GLP standards, and produces traditional Chinese medicine decoction pieces and series of health products such as Dendrobium officinale ultrafine powder [19]. However, the number of patents owned by Yunnan Jiuli Kangyuan Herba Dendrobii Development Co., Ltd. is less than 30% of the first applicant. There is still a huge room for improvement in Herba Dendrobii cultivation. The enterprise can better combine patent quantitative analysis to further promote the research on patent layout.

4. Applicant Application Trend

Table 2 Annual patent applications of the top 10 patent applicants.

	2010	2011	2012	2013	2014	2015	2016
Jiangyin Zhenjiang Biotechnology Co., Ltd	0	0	6	0	0	19	0
Sichuan Fengshang Biotechnology Co., Ltd.	0	0	0	0	0	10	1
Zhao Muhua	0	0	0	0	10	0	0
Huoshan Baoxinyuan Herba Dendrobii Development Co., Ltd.	0	0	0	0	0	0	9
Lingyun County Changsheng Xiancao Biotechnology Development Co., Ltd.	0	0	1	4	0	0	3
Yunnan Jiuli Kangyuan Herba Dendrobii Development Co., Ltd.	0	0	0	0	4	3	0
Anhui Huoshan County Yishengyuan Ecological	0	0	0	0	2	5	0

Agriculture Development Co., Ltd.							
Liuzhou Hongji Agricultural Technology Co., Ltd.	0	0	0	0	7	0	0
Zhejiang A&F University	0	2	3	1	1	0	0
Zhejiang Happiness Biotechnology Co., Ltd.	0	0	0	2	5	0	0

As shown in Table 2, starting from 2011, the top 10 patent applicants began to apply for patents. No applicant has maintained continuous patent application every year, and most applicants concentrate patent applications in a certain year. For example, Jiangyin Zhenjiang Biotechnology Co., Ltd. applied for 6 patents in 2012 and 19 patents in 2015, which fails to maintain patent applications every year. Sichuan Fengshang Biotechnology Co., Ltd. applied for 10 patents in 2015 and 1 in 2016. Individual Zhao Muhua applied for 10 patents in 2014, and the 9 patents of Huoshan Baoxinyuan Herba Dendrobii Development Co., Ltd. were applied in 2016. Except that Zhejiang A&F University applied for patents for 4 consecutive years in 2011-2014, other companies fail to maintain patent applications in a similar manner. It suggests that even if each company maintains patent applications every year, there is still much room for improvement in patent applications, and it is necessary to strengthen the emphasis on and orientation in patent applications by key R&D institutions. If local enterprises in Yunnan pay attention to intellectual property rights in the next few years, and maintain continuous patent applications for Herba Dendrobii cultivation, it is expected that it will catch up later in patent number.

5. Applicant's Technical Composition

As can be seen from Table 3, the top 10 applicants' IPCs are ranked. The top ten patent applicants have a total of 109 patents. In technical classification according to IPC, A01G, C05G and A01H are the top 3 technologies with the most patents, which represent three development trends in the cultivation of Herba Dendrobii.

For Herba Dendrobii cultivation technology represented by A01G, the applicants' Herba Dendrobii patent applications are centered in A01G field. The top ten applicants have 92 patents, accounting for 84% of the total patents. Jiangyin Zhenjiang Biotechnology Co., Ltd. has 24 patents, accounting for 22% of the top ten total patents, far exceeding the total number of other single-class IPC patents. The second and third applicants are Sichuan Fengshang Biotechnology Co., Ltd. and individual Zhao Muhua, with respective 11 and 10 patents and accounting for 10% and 9% respectively, which also far exceeds the total number of other single-class IPC patents.

IPC category with second largest application number is C05G (representing mixture of fertilizers in each sub-category; a mixture of one or more fertilizers and substances with un-specific fertilizer efficiency (e.g. mixture of pesticides, soil conditioners, wetting agents and fertilizers characterized by shape). The number of patents is 8, accounting for 7% of the total number of patents owned by the top ten applicants. A01H is IPC category with the third-largest patent application number. The number of patents is 3. It represents new plants or methods for obtaining new plants; plant regeneration technology through tissue culture technology. The number of other IPC technology patents is between 0-1, which is still in its infancy, and patent layout has not started.

As a local Yunnan enterprise, only Yunnan Jiuli Kangyuan Herba Dendrobii Development Co., Ltd. is among the top 10 applicants, which has 7 patents in A01G field. Yunnan enterprises need to strengthen research and application layout in other IPC technology fields. If the enterprises design patent pool of Herba Dendrobii, consideration can be given to layout in IPC class with 0 or fewer patents to bypass competitions.

6. Applicant's Patent Value

The patent value index is an approval of patent value by INCOPAT database, including technical stability, technological advancement and scope of protection. The patent value is measured from these three aspects. There are several other indicators in each aspect [20, 21]. In this way, the patents of the top 10 patent applicants are scored and classified into 1-10 grades according to the

patent value. The patent value increases step by step, and a higher score means greater patent value. As shown in Figure 3 and Table 4, the number of patents in 8-10th grades with the highest value is merely 5. Wherein, Zhejiang A&F University has the highest patent value, which is the only institution with continuous patents in the three grades with the highest patent value, with 1 patent in the 10th grade value, 1 patent in the 9th grade value and 2 patents in the 8th grade value. The patent published by the institution in 2012 discloses a cultivation method for improving polysaccharide content of Dendrobium officinale, which is to cultivate Dendrobium officinale under red light or mixed light of red and blue light. The method can effectively increase polysaccharide content in Dendrobium officinale. Moreover, the polysaccharide content of Dendrobium officinale cultivated according to the method of the present invention satisfies the requirements of the pharmacopoeia, and the content of alkaloids is not lowered. In the 9th grade, there are only Zhejiang A&F University and Zhejiang Happiness Biotechnology Co., Ltd., both of which have 1 patent with high value.

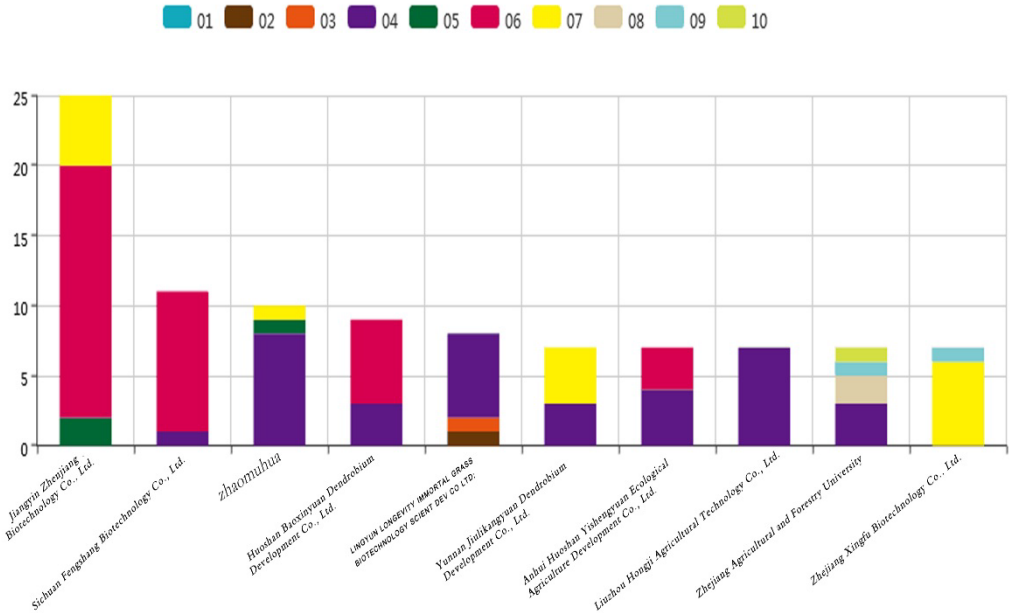

Figure 3 Patent value of each applicant.

The patent value of most R&D institutions is concentrated at 7th, 6th, and 4th grades. There are 16 patents in the 7th grade, 37 patents in the 6th grade, and 35 patents in the 4th grade. The number of patents is relatively concentrated. Jiangyin Zhenjiang Biotechnology Co., Ltd. with the largest number has 18 patents in the 6th grade, and Sichuan Fengshang Biotechnology Co., Ltd. has 10 patents in the grade. Individual Zhao Muhua has 8 patents in the 4th grade. Yunnan Jiuli Kangyuan Herba Dendrobii Development Co., Ltd. has 4 and 3 patents at 7th and 4th grade, respectively.

It suggests that in the field of cultivation and planting of Herba Dendrobii, if applicants want to maintain patent competitiveness, increase the patent number with 8-10th grade value, or increase their own value to the next grade, they need strengthen patent technical difficulty, technical advancement to enhance patent stability, reduce evasion by competitors to seize greater market size and market share. Local enterprises in Yunnan have a moderate degree of patent value, and they also need to pay attention to strengthening the application and protection of patents with strong market exclusivity.

7. Conclusion

There are general problems in patent application by the R&D institutions in the field of Herba Dendrobii cultivation, which can be improved with focus to boost development of the industry: 1. The applications are generally concentrated on Herba Dendrobii cultivation technology represented by A01G. It is necessary to increase application for other IPC technologies for the overall industrial technology layout. 2. The regions with top ten patent applications show large difference of up to 6

folds in industry development. The enterprise groups with strong R&D capabilities in the southern provinces of Guangxi, Anhui and Zhejiang constitute the main patent application force. 3. The institutions fail to have patent applications every year, showing concentrated application in a certain year. 4. The patent value is not high. Although Jiangsu Jiangyin Zhenjiang Biotechnology Co., Ltd. ranks the first among the top applicants in patent number, the patent value is basically in the intermediate value stage of 5-7. The main technology is to improve ecological environment of Herba Dendrobii for intensive production and higher content of soluble polysaccharide. Although Zhejiang A&F University has few patents, the patent value is the highest. It is the only institution that has patents at the highest grade of patent value. It mainly adopts mixed-light cultivation of Dendrobium officinale to enhance polysaccharide content and has achieved the Pharmacopoeia standard. Therefore, in the future, applying for cultivation technology patents for polysaccharide content improvement in Dendrobium officinale will be an important technology development idea and industrial layout direction.

Acknowledgement

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Table 1 IPC classification of patents for Herba Dendrobii cultivation in various provinces and cities and the number of patents.

IPC classification	Guangxi	Anhui	Zhejiang	Yunnan	Jiangsu	Guangdong	Guizhou	Fujian	Sichuan	Shanghai
A01G	112	96	108	85	55	49	44	41	24	14
C05G	28	29	14	4	5	5	6	3	3	3
A01H	9	12	8	10	9	8	7	0	1	1
C05F	14	8	6	3	2	1	5	2	0	4
A01C	5	2	5	10	3	2	2	1	2	2
C12N	3	1	2	2	1	2	0	0	0	3
A01N	4	5	0	0	0	2	0	0	0	0
A01M	1	2	3	3	2	0	0	0	3	0
A01P	4	4	0	0	0	2	0	0	0	0
C12R	0	0	0	0	1	0	0	0	0	3
Total	180	159	146	117	78	71	64	47	33	30

Note: the various sub-technical letters have the same meaning as before.

Table 3 IPC composition of the top 10 applicants.

	Jiangyin Zhenjiang Biotechnology Co., Ltd.	Sichuan Fengshang Biotechnology Co., Ltd.	Zhao Muhua	Huoshan Baoxinyuan Herba Dendrobii Development Co., Ltd.	Lingyun County Changsheng Xiancao Biotechnology Development Co., Ltd.	Yunnan Jiuli Kangyuan Herba Dendrobii Development Co., Ltd.	Anhui Huoshan County Yishengyuan Ecological Agriculture Development Co., Ltd.	Liuzhou Hongji Agricultural Technology Co., Ltd.	Zhejiang A&F University	Zhejiang Happiness Biotechnology Co., Ltd.
A01G	24	11	10	9	7	7	6	6	6	6
C05G	0	1	2	2	0	0	2	1	0	0
A01H	1	0	0	0	1	0	0	1	0	0
C05F	0	0	0	0	1	0	0	0	0	0
A01C	0	1	0	0	0	0	1	0	0	0
C12N	0	0	0	0	0	0	0	0	0	0
A01N	0	0	0	0	0	0	0	1	0	0
A01M	1	1	0	0	0	0	1	0	0	1
A01P	0	0	0	0	0	0	0	1	0	0
C12R	0	0	0	0	0	0	0	0	0	0

Table 4 Patent value of each applicant.

Value Level	Jiangyin Zhenjiang Biotechnology Co., Ltd.	Sichuan Fengshang Biotechnology Co., Ltd.	Zhao Muhua	Huoshan Baoxinyuan Herba Dendrobii Development Co., Ltd.	Lingyun County Changsheng Xiancao Biotechnology Development Co., Ltd.	Yunnan Jiuli Kangyuan Herba Dendrobii Development Co., Ltd.	Anhui Huoshan County Yishengyuan Ecological Agriculture Development Co., Ltd.	Liuzhou Hongji Agricultural Technology Co., Ltd.	Zhejiang A&F University	Zhejiang Happiness Biotechnology Co., Ltd.
01	0	0	0	0	0	0	0	0	0	0
02	0	0	0	0	1	0	0	0	0	0
03	0	0	0	0	1	0	0	0	0	0
04	0	1	8	3	6	3	4	7	3	0
05	2	0	1	0	0	0	0	0	0	0
06	18	10	0	6	0	0	3	0	0	0
07	5	0	1	0	0	4	0	0	0	6
08	0	0	0	0	0	0	0	0	2	0
09	0	0	0	0	0	0	0	0	1	1
10	0	0	0	0	0	0	0	0	1	0