

# THE PRESENT STATUS OF BLUEBERRY GROWING IN CHINA

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**Abstract:** The general situation of blueberry (*Vaccinium* L. spp.) growing in China is reported. There are two major growing regions: one in the Northeast of China, mainly in Jilin Province, and the other in the vast territory of acidic red soils in the South of the Yangtze River. Wild species used as fruits are only distributed in the Northeast of China. Introduction of cultivated cultivars started in the 1980's and altogether more than 60 cultivars have been introduced. The capacity of propagation of seedlings by cuttings and tissue culture is more than one million per year in each of the two regions. Suitable cultivars have been selected for two regions and the yield and fruit quality of the plantations in both regions, including in Jilin, Jiangsu and Guizhou provinces are equal to the native products from North America respectively. This indicates the great potential for the development of blueberries in China.

**Key words:** blueberry (*Vaccinium* L. spp.); introduction; propagation; growing; blueberry in China

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**中国蓝浆果生产现状** 於虹<sup>1,2</sup>, 王传永<sup>2</sup>, 顾姻<sup>2</sup>, 贺善安<sup>2,①</sup> [1. 南京农业大学, 江苏南京 210095; 2. 江苏省·中国科学院植物研究所(南京中山植物园), 江苏南京 210014], *J. Plant Resour. & Environ.* 2005, 14(2): 42-48

**摘要:** 全面报道了蓝浆果(*Vaccinium* L. spp.) 在中国的生产情况, 共分为南、北两大区域。北区是指以吉林省为主的东北地区, 南区指长江以南广阔的酸性红壤土地地区。果用野生种只分布在东北地区。自 20 世纪 80 年代起开始引种欧美栽培品种, 共达 60 余个。在北区以吉林农业大学为主, 在南区以江苏省·中国科学院植物研究所为主, 采用组培和扦插方法繁殖, 南、北两区均各有年产百万株以上苗木的能力。在南、北两区的适宜地区, 如吉林、江苏和贵州等省, 都已选出各自的适栽品种, 栽培后的产量和果实质量分别均可达到国外优良水平, 显示了蓝浆果在中国发展的巨大前景。

**关键词:** 蓝浆果; 引种; 繁殖; 生产; 中国蓝浆果

Blueberries have emerged as the top antioxidant capacity fruit when compared with 40 other available fruits and vegetables. The potential health benefits of blueberries include promoting urinary tract health, prevention of cardiovascular disease, improving eyesight, inhibiting an enzyme involved in promoting cancer, antibacterial agents, anti-aging, and improving memory. They are now the most important small fruit in the world because of their very effective functions for human health. This is becoming a new hot point of the development of healthy fruits in China, too.

## 1 The distribution of native and cultivated blueberries in China

### 1.1 The natural distribution of wild lowbush blueberries and oriental blueberry

Blueberries belong to the genus *Vaccinium* L. . .

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family Ericaceae. There is a total of about 450 species of this genus in the world and 91 species and 24 subspecies and varieties are found in China. Their areas of distribution are mostly in the South and the Northeast of China (Fig. 1). Among them only two species, *Vaccinium uliginosum* L. (whortleberry or bog

bilberry) and *V. vitis-idaea* L. (lingonberry), are edible fruits and are mainly distributed in Northeast China. *V. bracteatum* Thunb. (oriental blueberry) is distributed widely in South China, the young leaves of which are used to make black rice, a kind of stained food, on the traditional festival in May.

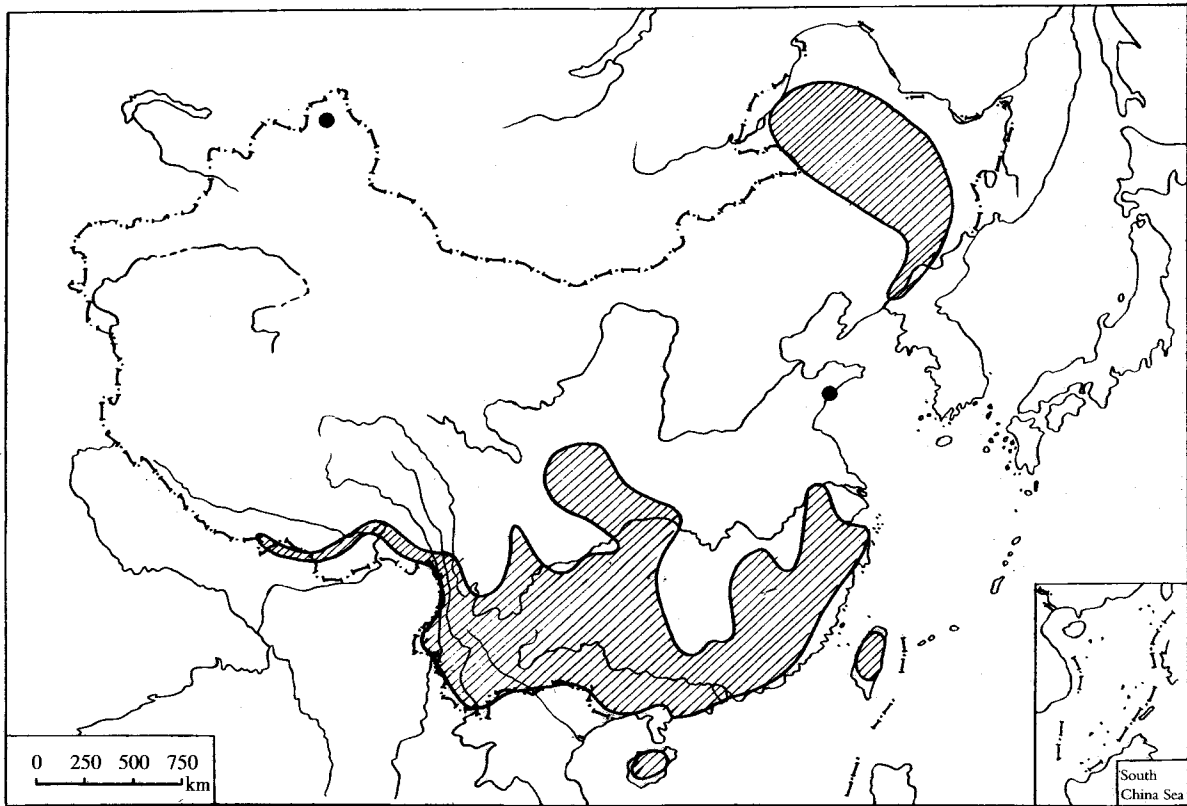


Fig. 1 Distribution of species of the genus *Vaccinium* L. in China (After Fang<sup>[1]</sup>, with revision)

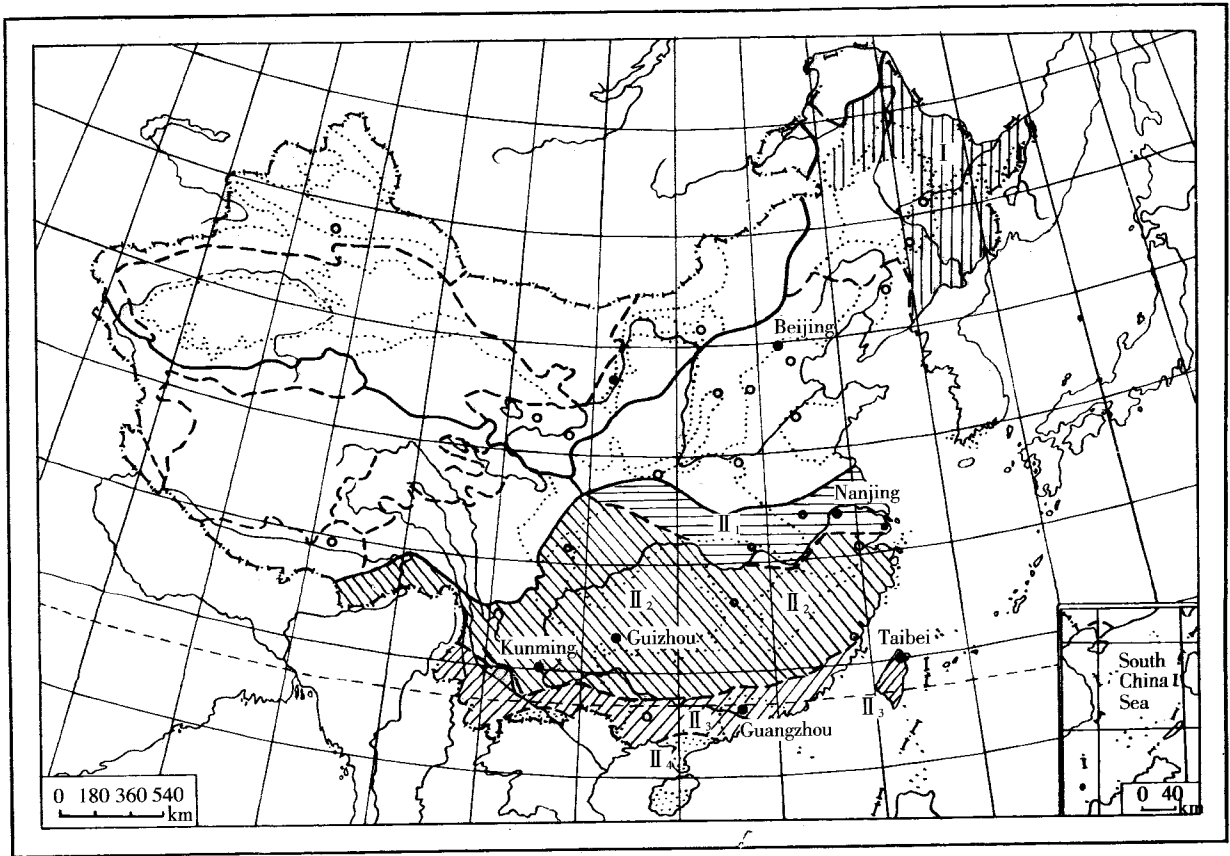
Both *V. uliginosum* and *V. vitis-idaea* are basically distributed in the Da Hinggan Ling and Xiao Hinggan Ling Mountains, Heilongjiang Province and in the Changbaishan Mountains, Jilin Province. They are also extended to Xingjiang and Inner Mongolia. The distribution areas of *V. uliginosum* are about  $5 \times 10^4$   $\text{hm}^2$  and wild fruit deposition is about 60 000 – 80 000 t with an annual production of 1 000 t on average<sup>[2]</sup>. *V. vitis-idaea* occupies about ten thousand hectare and provides an annual fruit production of about 2 000 t. All these wild resources are mainly used for juice, wine, jam and frozen fruits, especially for export trade. As for *V. bracteatum*, its fruits, although edible, are not as tasty and are not harvested for fresh fruits and, are thus of no commercial value.

### 1.2 Introduction of cultivated blueberries

Owing to the limitation of wild resources, experiments in the introduction of cultivated blueberry

varieties began in Jilin Agricultural University in the early 1980's. In Southern China there was no idea of blueberry introduction until the 1980's, although there is quite a huge area of acidic soils. Since then, scientists in the Nanjing Botanical Garden, Mem. Sun Yat-Sen, Jiangsu Province and the Chinese Academy of Sciences initiated the innovative project of introducing blueberries to the vast territory of red soil land of South of the Yangtze Rive (Fig. 2).

So far, there are two main zones of experimental blueberries plantations and growing regions in China. One is lowbush with some highbush blueberries in Jilin and Liaoning provinces, in Northeast China. The other is rabbiteye and southern highbush blueberries in Jiangsu, Guizhou, Anhui and Sichuan provinces etc. South of the Yangtze River (Fig. 3). Between these two cultivation zones there are some small plantations located in the coastal area of Shandong Province where



I : Dark brown soil, black soil and black calcareous soil zone; II<sub>1</sub> : Yellow brown soil belt;  
 II<sub>2</sub> : Red and yellow soils belt; II<sub>3</sub> : Red soil belt; II<sub>4</sub> : Lateritic soil belt

Fig. 2 Distribution regions with acidic soils in China (After «Soils in China»<sup>[3]</sup>, with revision)

the soil pH is about pH 6.5 to pH 7.0.

## 2 The history of the introduction of blueberry cultivars

It has been reported that since 1985 the introduction of blueberry cultivars has been conducted by Prof. Hao Rui's group and by 1999 there were a total 21 cultivars introduced from Canada, the US, Germany and Finland etc. in Jilin Agricultural University<sup>[4]</sup>. Up to this date the group, now headed by Dr. Li Y D, has introduced about 60 cultivars in total, including lowbush, half-highbush, and some rabbiteye blueberries.

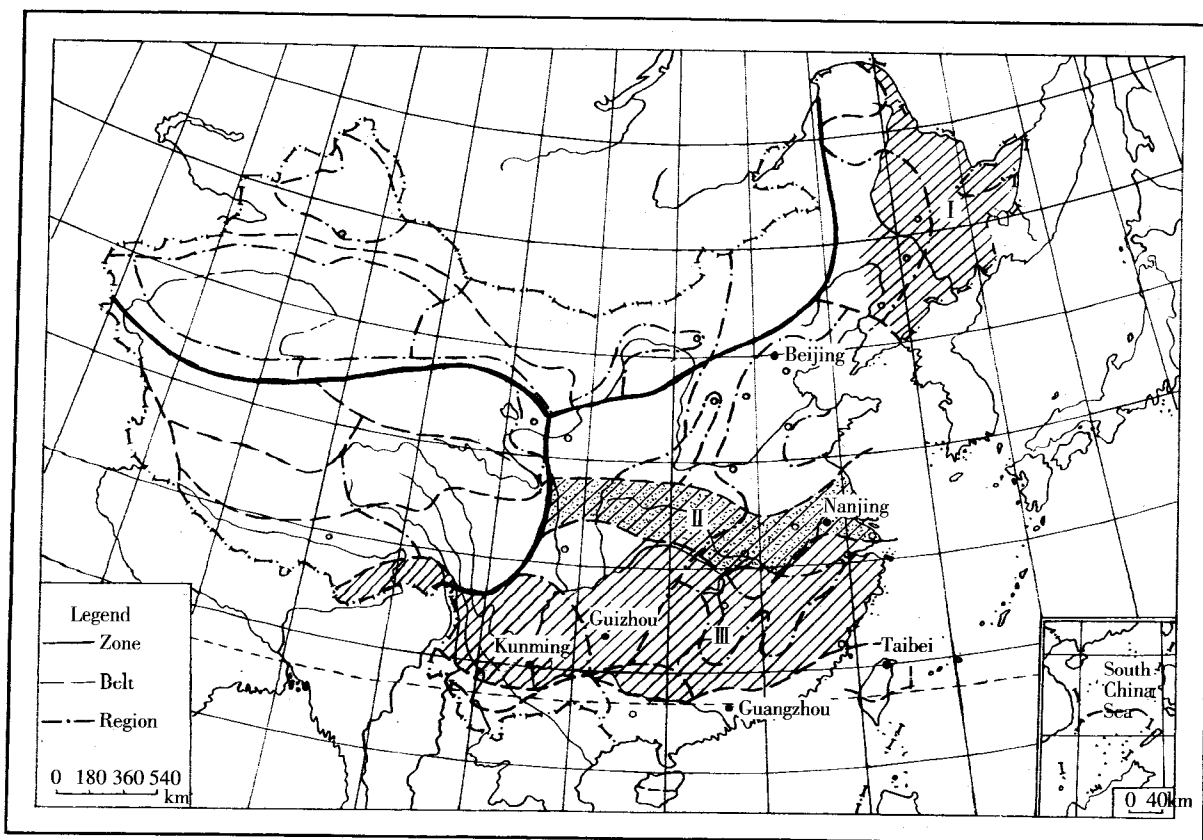
In the South, the introduction of blueberry cultivars was initiated by Prof. Gu Y and her colleagues in 1987. Depending on the ecological conditions of the native blueberry growing areas in North America, rabbiteye blueberry cultivars have been introduced to the Nanjing Botanical Garden mainly

from Georgia and North Carolina, and other places including Oregon, in the US, and European countries, too. More than 30 cultivars, including rabbiteye and southern highbush blueberries, have been introduced and the project is conducted continuously by the younger scientists headed by Dr. Yu H.

## 3 The propagation of blueberry

Propagation is a very important factor for the development of blueberries in the newly introduced regions, especially for many of the rabbiteye blueberry cultivars, of which cuttings are relatively difficult to root.

In Northern China, from 1985 to 1989, experiments of micro-propagation were conducted with cultivars of 'Northsky', 'Northblue', 'Blomidon' and 'Brunswick' in Jilin Agricultural University. It was found that 0.5 - 1.0 mg · L<sup>-1</sup> cytokinin or zeatine



I : Central temperate region; II : Northern subtropical region; III : Central subtropical region

Fig. 3 Suitable regions for blueberry (*Vaccinium L. spp.*) growing in China (After Gu, et al.<sup>[2]</sup>, with revision)

was most effective for zeatin needs to be increased to  $1.5 - 2.0 \text{ mg} \cdot \text{L}^{-1}$ . Then, the micro-shoots were rooted with  $1\ 000 - 2\ 000 \text{ mg} \cdot \text{L}^{-1}$  IBA and NAA. The rooting percentage, from this procedure can be as high as 98%<sup>[5]</sup>. For rooting of the micro-shoots, the humidity is controlled above 90%, the temperature is kept between  $16^\circ\text{C}$  and  $24^\circ\text{C}$ , and light is provided for 16 h per day. After rooting the plants are transferred to a media of pH 4.5 in the greenhouse. Later, the propagation by softwood cuttings was also studied in Jilin Agricultural University. Using a peat medium,  $1\ 000 \text{ mg} \cdot \text{L}^{-1}$  IBA or NAA, and taking cuttings at the proper time achieved a 90% rooting rate in highbush blueberries<sup>[6]</sup>. At present there are several nurseries in Changchun, Shenyang and Dandong and the capacity is said to be about one million micro-propagated plants annually.

The propagation with softwood cuttings is particularly adopted for rabbiteye and southern highbush blueberries in Nanjing Botanical Garden. After several years' of research a new formula of regulator for cuttings, marked CY-1, was created in Nanjing Botanical Garden that raised the rooting rate of

softwood cuttings under misting system in greenhouse to 90% - 95% depending on the cultivar. New planting material propagated under this system has a height of 1.0 - 1.2 m and a diameter of stem of 0.8 - 1.2 cm within 18 months and is much easier to be transplanted (Plate I - 1, 2). The propagation problem is considered basically resolved and the nurseries in the South possess a capacity of one million or more rooted cuttings per year.

#### 4 The performance of blueberry growth and fruiting

In the Northern China, the eastern part of Jilin Province is considered to be the most suitable region for blueberry growing. Its climatic and soil conditions are as follows. The annual precipitation is about 800 - 1 000 mm, growing season is 90 - 130 d, accumulated temperature above  $10^\circ\text{C}$  is  $2\ 000^\circ\text{C} - 2\ 500^\circ\text{C}$ , average temperature of January is  $-10^\circ\text{C}$  and absolute minimum temperature is  $-40^\circ\text{C}$ . The soils are mainly dark forest and bog meadow types with pH 4.0 - pH 6.1. It is reported that the suitable cultivars for the

Changbaishan Mountain area are 'Blomidon', 'Fudy', 'Northcountry', 'Northblue', 'Northland' and 'St. Cloud'. 'Blomidon' is very cold resistant and fruits early. It is used as a standard commercial cultivar and its 5-year average yield reaches  $10 \text{ t} \cdot \text{hm}^{-2}$ . It is found that the lowbush and half-highbush blueberries are more adapted to the conditions of Changbaishan Mountain area and the highbush blueberries are less adapted and productive. For the Changchun area, in the middle of Jilin Province, 'Patriot', 'Bluecup', 'Northland' and 'Northblue' are recommended. However, winter damage is still a serious problem for blueberry growing in Jilin Province<sup>[7-10]</sup>.

In the South, the current blueberry growing areas are located in the northern and central parts of the subtropics. The ecological conditions are quite different from the northern part of China. Take Nanjing, in Jiangsu Province, and Majiang, in Guizhou Province, as examples. The soil conditions are brown soils and acidic red soils. The climatic conditions are average annual temperature (aat)  $15.4^\circ\text{C}$ , absolute maximum temperature (max)  $40.5^\circ\text{C}$ , absolute minimum temperature (min)  $-13^\circ\text{C}$ , annual precipitation (prep)  $1\,013.4 \text{ mm}$  and sunshine rate  $51\%$ , in Nanjing; and aat  $15.0^\circ\text{C}$ , max  $37^\circ\text{C}$ , min  $-10^\circ\text{C}$ , prep  $1\,205 \text{ mm}$  and sunshine rate  $29\%$  in Majiang respectively. For the Nanjing plots in Jiangsu Province, twelve rabbiteye blueberry cultivars were planted in 1987, including: 'Baldwin', 'Bluebelle', 'Brightwell', 'Centurion', 'Choice', 'Climax', 'Delite', 'Gardenblue', 'Powderblue', 'Premier', 'Tifblue' and 'Woodard'. Plants usually grow slowly in the first two years after planting; but from the third year on, the growth of the bushes becomes fast and strong<sup>[11]</sup>. The crown size of seven year old plants of 12 cultivars is on average  $1.87 \text{ m}$  in height and  $1.74 \text{ m}$  in diameter. For the Majiang plots in Guizhou Province, nine cultivars, 'Baldwin', 'Brightwell', 'Climax', 'Gardenblue', 'Premier', 'Powderblue', 'Centurion', 'Tifblue' and 'Bluebelle', were planted in 2000 and 2002. The crown size of three years old plants is on average  $1.23 \text{ m}$  in height and  $0.90 \text{ m}$  in diameter (Plate I-3, 4).

## 5 The production of blueberry

The planting distance used in the Northern China is  $0.5 \text{ m} \times 1.0 \text{ m}$  for lowbush blueberry,  $0.8 \text{ m} \times 1.0 \text{ m}$  for half-highbush blueberry and  $1 \text{ m} \times 2 \text{ m}$  for highbush blueberry. In the South, it is  $1.5 \text{ m} \times 2.5 \text{ m}$  for both rabbiteye and southern highbush blueberries.

In Northern China, the average yield of a 5-year-

plantation reaches  $10 \text{ t} \cdot \text{hm}^{-2}$ <sup>[10]</sup>. Generally, the yield per hectare of half-highbush and highbush is lower than lowbush blueberries. In the South, the yield of rabbiteye and southern highbush blueberries is estimated to be  $15 \text{ t} \cdot \text{hm}^{-2}$  and it could be up to  $20 \text{ t} \cdot \text{hm}^{-2}$ . In Nanjing, the yield per plant is  $0.5 - 1.0 \text{ kg}$  in the third year after planting. Measurement in the fifth year showed that the yield per hectare reaches  $7 - 24 \text{ t}$ . Over the seventh year, the yield per hectare was more than  $15.0 - 22.5 \text{ t}$ . The average fruit weight is about  $1 - 2 \text{ g}$ . The fruit of 'Premier' is the largest among cultivars tested and the average fruit weight is  $1.96 \text{ g}$ <sup>[12,13]</sup>.

In Majiang, the yield per plant is  $0.70 - 1.35 \text{ kg}$  in the third year after planting, and the highest yield is up to  $1.62 \text{ kg}$ . It is similar to the yield recorded in Nanjing. So that, the yield for mature plantations could be ten or more tons per hectare (Plate I-5, 6).

It has been reported that in the coastal area of Shandong Province, there is also a plantation of about  $50 \text{ hm}^2$  for growing highbush blueberries, with a possible harvest of several hundred tons of fruit in 2004. According to the authors' point of view, this area is not a suitable region for blueberry growing.

## 6 The prospects of blueberry growing in China

Blueberry growing is affected by a series of conditions including ecological, economic, social and cultural practices. Among them, the acidic soils, enough heat and water and plenty of laborers are important. It is well known that  $60\%$  or  $70\%$  of the total cost for blueberry growing is for labor. All of these conditions are adequate in the proposed Chinese blueberry growing areas, especially in the South. During the duration of the past 16 years, there have been some damage from pests and diseases but they were not serious. The major trouble is from birds. Although there could be more pests and diseases in the future, there is no doubt that the blueberry industry will have a bright future in China. Considering the economic value of blueberries it could be a "cash crop" for making farmers rich in South China for the time being.

Up to now, except for the wild blueberry fruit resources produced in Northeast China there is really no blueberry market in China. There is a lot of imported fruit in the market, but not blueberries. China has a huge population of 1.3 billion. If about  $10\%$  of the population consume  $1 \text{ kg}$  per year, the total amount would be 130 thousand tons per year.

This will require at least ten thousand hectares of blueberry orchards. Provided the expanding speed of blueberry culture is average about five hundred hectares per year, then the period for reaching ten thousand hectares should be at least 15 years or more. In addition, there is still the opportunity for international trade. This indicates that there is ample room in both domestic and international markets.

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#### Explanation of plate

**Plate I** 1. Propagation greenhouses with misting system; 2. Plantation for cuttings with trickle system; 3. Introduction collection of 18 years old trees; 4. Blueberry shrubs on slopes at Guizhou Province; 5. Fruiting trees at Nanjing, Jiangsu Province; 6. Fruits in maturing at Guizhou Province.

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Plate I



See the explanation of the end of text