

Original Research Article

doi: <https://doi.org/10.20546/ijcrbp.2018.505.001>

Preliminary Investigation on the Minimal Population of *Magnolia pilocarpa* in the Dabie Mountain Area of Hubei Province

Sijia Zhu¹, Aiguo Zhen², Shan Yang³, Qin Xie⁴, Dong Wang³,
Chengshi Huang¹ and Die Hu^{1*}

¹College of Horticulture and Landscape Architecture, Yangtze University, Jingzhou-434025, Hubei, China

²Yingshan County Forestry Bureau, Huanggang-438700, Hubei, China

³Wuhan Pindao Architectural Garden Engineering Co. Ltd., Wuhan-430040, Hubei, China

⁴New World Development (Wuhan) Gardening and Greening Engineering Co. Ltd., Wuhan-430040,
Hubei, China

*Corresponding author

Article Info

Date of Acceptance:
19 April 2018

Date of Publication:
06 May 2018

Keywords

Dabie Mountain
Hubei province
Magnolia pilocarpa
Minimal population

ABSTRACT

Magnolia pilocarpa is a new species discovered in 1987 from the medicinal plant of *Magnolia liliiflora*. *M. pilocarpa* is the endemic species in Dabie Mountain area, which has medicinal and ornamental value. So far, little is known about this species, and often be mistaken for ordinary *M. liliiflora*. In the present study, we use the ecological investigation methods to investigate the *M. pilocarpa* in Dabie Mountain area, recorded the distribution, number of resource and habitat conditions, then analysis of the sample characteristics and the effects of different factors on the *M. pilocarpa*, which reveals the relevant rule between *M. pilocarpa* with living environment.

Introduction

Minimal population plant is a kind of endangered wild plant with geographical narrowing of distribution, few population and individual quantity. The population is degenerating and the number of individuals continues to decrease which have been lower than the stable survival threshold because of the stress interference from external factors in a long term (State Forestry

Administration, 2011). *M. pilocarpa* belongs to Magnolia, Magnoliaceae. It is a kind of deciduous tree with bark taupe and height between 12 and 15meters (Fu, 2001). The leaves are in the shape of obovate or broadly obovate, 10-17cm long, 8-11cm wide, and the apex is wide and round with dent, short and acute. The base of leaves is in the shape of wedges or wide wedges and in the color of dark green above, light green below. There are about 9-11 lateral veins on each side. The length of

stipule scars is half of that for petiole. The flowering phase of *M. pilocarpa* is from March to April and the fruiting season is from September to October (Wang et al., 2003).

M. pilocarpa is a new species being found in *M. liliiflora* in 1987 (Zhao et al., 1987). It has been listed as a small population plant in Hubei province owing to the small quantity and the narrow habitat. In order to find out total number, distribution and growth of *M. pilocarpa* in Hubei province, we carried out a systematic investigation and objective analysis. As is shown, *M. pilocarpa* has only been found in the Dabie mountain area in Huanggang, so the author investigated *M. pilocarpa* in the Dabie Mountains of Hubei province.

Geographical environment of the Dabie Mountains

The Dabie Mountains are the watershed between the Huai River and the Yangtze River, located in border areas of Henan, Anhui and Hubei province, latitude N30°10'~N32°30', altitude E112°40'~E117°10'. Generally, the altitude is 500~800m, and the main part of the mountain is 1500m above sea level. The elevation of the main peak is 1729m. The mountain forest area accounts for 15% of the whole mountain area, the rest is low mountain and hilly, the mountain valley is wide open, and there are floodplain and terrace plain. The Dabie Mountain is a warm and humid monsoon climate zone in the north subtropical region, with typical mountain climate characteristics and superior forest microclimate, abundant rainfall and mild climate. Annual average temperature is 12.5°C, average precipitation is 1832.8 ml, annual precipitation days is 161 d, air relative humidity is 79% on average, elevation difference is big, and Dabie Mountain forest vegetation changes obviously.

Materials and methods

The survey of time

From January to June in 2017, a comprehensive investigation has been conducted in Luotian

County, Yingshan County and Tuanfeng County in Huanggang City.

The research methods

According to the research method of ecology, due to the sparse distribution of the *M. pilocarpa*, there is no large area of community distribution, so we take the measurement method to investigate. Measurement method: it is suitable for narrow and small distribution area, and the number of plant population is relatively rare, which is convenient for direct counting of target species (Li et al., 2016). After a lot of investigation, more complete information is accumulated. The resources, distribution and scope of *M. pilocarpa* are clear.

Measurement index

The measurement indexes of the single plant *M. pilocarpa* include the ground diameter, the diameter of the chest, the crown width and the height of the tree. Sample area habitat measurements include: geographic coordinates, elevation, canopy density, coverage, slope, slope direction, soil type, and the record-nation of the surrounding associated species: the herb layer, shrub layer, the condition of the tree layer, at the same time record-nation of the growth situation of target species (Sun et al., 2016).

The data statistics of population basic characteristic

A comprehensive survey was conducted on all *M. pilocarpa* in the Dabie Mountain area of Hubei Province. According to the classification criteria of $H > 5m$, $1m < H < 5m$ and $H < 1m$, the individuals of *M. pilocarpa* are divided into the main forest layer, succession layer and update layer (Liu, 2007), which is used to calculate the quantitative characteristics of *M. pilocarpa*. After summary of the investigation data, we made statistics different slope direction, slope position, altitude of different levels of *M. pilocarpa*, and compared the number of *M. pilocarpa* under different habitats, different ecological factors and wild *M. pilocarpa* distribution relationship.

The classification standard of diameter class structure for (Peng 1993; Ma et al., 2013): seedling height $H < 100$ cm is I seedling; Diameter at breast height (DBH) < 3 cm is II young trees; 3 cm diameter or \leq DBH < 12 cm for buck III level; Diameter at breast height $12 \text{ cm} \leq$ DBH < 20 cm for buck IV level; Diameter at breast height (DBH) ≥ 20 cm for V trees.

Results and discussion

The overall distribution of the *M. pilocarpa*

The *M. pilocarpa* is scattered. By referring to data and field research, *M. pilocarpa* which in the Dabie mountains of Hubei province, mainly focused on the five points of Qing Tai Guan forest farm in Luotian county, the scenic spot of Baodao feng, the forest farm of Huang Shizhai, Wujia mountain forest farm in Yingshan county, and Daqi mountain forest farm in Tuanfeng County. In total, there are 54 *M. pilocarpa* in the five sample area. Among them, respectively, there are 23 strains and 18 strains in the Jiu Zihe town and the scenic spot of Baodao feng in Luotian County. With the help of local forestry authorities, a full investigation was carried out.

Distribution of *M. pilocarpa* in different slopes

According to the sample indicated, there are 54 strains of *M. pilocarpa*, of which 35 were grown in sunny slope and 19 in the shady slope. According to the statistics on the number of *M. pilocarpa* in different slopes and different levels, such as main forest floor, update layer and succession layer, *M. pilocarpa* is most widely distributed in sunny slope, which shows that *M. pilocarpa* is more suitable for living under sunny conditions.

Whether it is in the sunny slope or in the shady slope, the number of the updated layers is 0, and even the seedlings are 0. From which we can know that the seed germination of *M. pilocarpa* is difficult, and it is not very adaptable to the external environment. The distribution of *M. pilocarpa* in different slopes is shown in Table 2.

Diameter Distribution of *M. pilocarpa* in Different Sample Areas

The diameter of *M. pilocarpa* in survey areas, for example in the Fig. 1 in which the characteristics of *M. pilocarpa* in each area show distinct differences. In Jiuzi River plot, the majority are big trees, according for 74% while Middle-aged tree take up 21.7%, without seedlings. In Baodao feng scenic spot, trees of all grades are distributed and the number of them is not much different. The number of individual seedling according for 0% of the total number of the plots, while the young trees takes up 27.8% and the adult trees take up 72.2%. In Huang Shizhai forest form, there are only 2 big trees as well as in the Daqishan forest form. However, in the Wujiaoshan forest farm, the majority are adult tree and without seedlings. The *M. pilocarpa* surveyed in Dabie mountain this time, they are mostly big trees, no seedlings, and are distributed sparsely. It is obvious in the Fig. 1 that the distribution in the Baodao feng scenic spot is the most evenly and the community level is the most completely. This shows that in the interference of external environment especially the action of human, the growth of *M. pilocarpa* is becoming more and more difficult the percentage of germination is low, the growth of seedlings become difficult, and the situation of extinction is more and more serious.

The relationship between the growth of *M. pilocarpa* and the slope aspect

It can be seen from the slope aspect that the distribution of *M. pilocarpa* in the survey areas changes with the slope aspect. We can see from the table 3 that the growth of *M. pilocarpa* in the sunny slope have obvious advantages compared with that in the cloudy slope. The diameter and height of *M. pilocarpa* individual changes with the slope aspect. The average diameter in the sunny slope is 26.06cm which is obviously higher than 12.86cm in the cloudy slope. The average height 9.02cm is also higher than 7.53cm. Therefore the growth of *M. pilocarpa* in sunny slope is better than that in the cloudy slope.

Table 1. Distribution of *M. pilocarpa* in Dabie Mountains.

Distribution area	Latitude and longitude range	Quantity (strain)
Luotian County Jiuzi River Town	E115°42'-E115°43' N31°7'-N31°10'	23
Luotian County Baodao feng Scenic Area	E115°32'-E115°34' N31°06'-N31°07'	18
Luotian County Huang Shizhai Forest Farm	E115°33'59.43" N31°06'16.61"	2
Yinshan County Wujiashan Forest Farm	E115°46'-E115°47' N31°5'-N31°6'	9
Tuanfeng County Daqi Mountain Forest Farm	E115°06'02.78" N30°51'53.11"	2

Table 2 Community level statistics of different slope directions of *M. pilocarpa*.

Slope direction	Community level	Number of strains
Sunny slope	Main forest layer	32
	Successor layer	3
	Update layer	0
Shady slope	Main forest layer	14
	Successor layer	5
	Update layer	0

Table 3. Growth and distribution of *M. pilocarpa* in different slope directions.

Slope direction	Number of strains	Average DBH (cm)	Average tree height (m)
Sunny slope	35	26.06	9.02
Shady slope	19	12.89	7.53

Table 4. Growth and distribution of *M. pilocarpa* in different altitudes.

Altitude (m)	Number of strains	Average DBH (cm)	Average tree height (m)
H>1000	10	16.05	5.83
800≤H≤1000	8	23.31	8.35
600≤H<800	23	24.63	9.41
400≤H<600	5	22.4	8.42
H<400	8	20.02	7.23

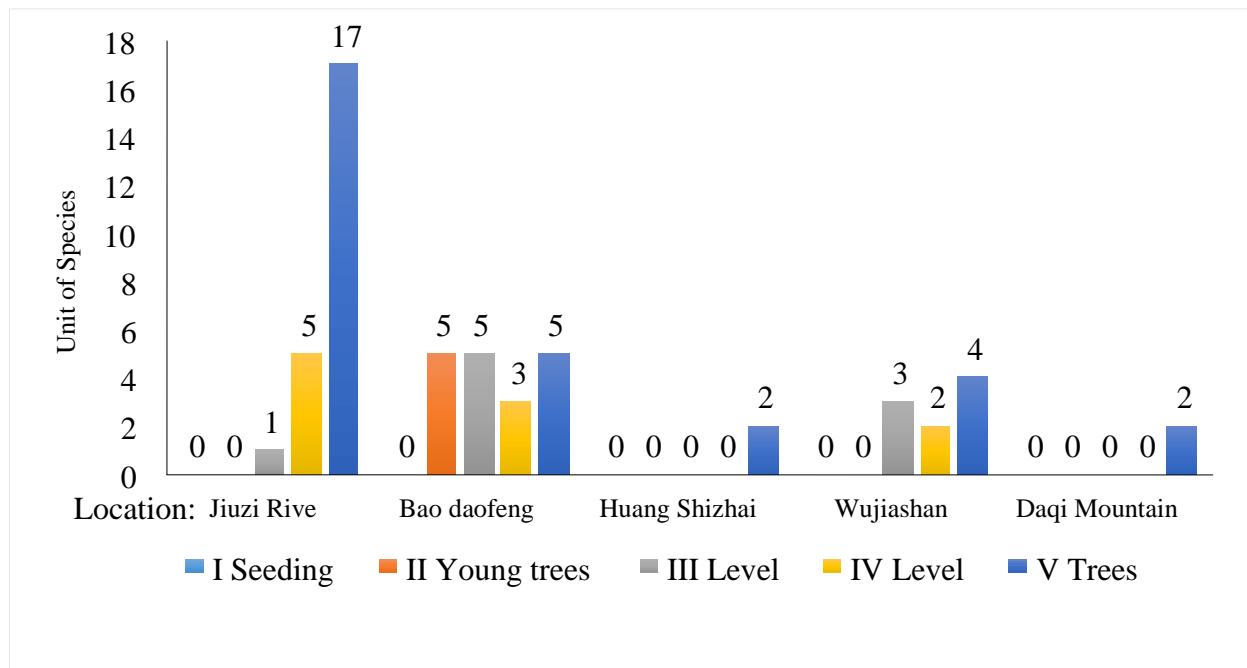


Fig. 1: Structure chart of various big and small steps of *M. pilocarpa* in Dabie Mountain.

The relationship between the growth potential of the *M. pilocarpa* and the different altitudes

From the perspective of the altitude, the distribution of the individuals in the survey sample is different due to the changes in altitude (Table 4). Most of *M. pilocarpa* are located between 600m-800m, there are 23 strains, which accounts for 42.6% of the total. *M. pilocarpa* districts averagely in other altitude district. There are 10 strains in total whose height is over 100m. Among them, there are 5 seedlings with average chest diameter of 1.5cm and average height of 2m, and there are no obvious distinctions in each elevation so it can be concluded that the altitude has weak effects on the growth of *M. pilocarpa*.

With the rapid increase of population and the continuous enhancement of human activities, more and more natural vegetation have been destroyed, biological diversity has also fallen sharply, and many species are now endangered. Endangered species are the result of a combination of external and internal factors. External factors mainly include fragmentation and loss of habitat, global climate change, various natural disasters and human factors,

etc. These factors directly affect the living condition of the species, which is the direct cause of the endangered species. The internal factors mainly include adaptation, viability, reproduction and the failure of heritability. These factors seriously threaten the growth and reproduction of the species (Xu, 2016), which is the important cause of the endangered species. Therefore, it is a precondition for effective protection of plants to find out the endangering mechanism.

The cause of *M. pilocarpa* dying

According to field investigations, most villagers in Luotian and Yingshan did not know *M. pilocarpa*, even less aware of its value and importance, and did not protect it as a precious tree species, and even conducted extensive logging. In addition, from the present situation and historical changes of the distribution area of *M. pilocarpa*, human beings to meet their own survival needs, the phenomenon of man-made wasteland and deforestation is very serious, man-made severe disturbance led to a serious loss of natural regeneration ability of *M. pilocarpa*, and the distribution area is also sharply reduced. The

distribution pattern has undergone significant changes and is now mainly scattered.

The ecological adaptation range of *M. pilocarpa* is very narrow, and it is mainly distributed in the Dabie Mountains area of Hubei Province. It is suitable for the subtropical monsoon mountain climate and its distribution area is limited.

In addition, *M. pilocarpa* population is poor in its reproductive ability, and its seeds are easily destroyed and lost a part after landfall. The seeds of *M. pilocarpa* are very good food for birds. Many seeds have already been eaten by birds when they have just been ripe on the trees.

Protection measures and suggestions

Investigation on wild *M. pilocarpa*

Firstly, a targeted investigation of the wild *M. pilocarpa* resources should be carried out to ascertain the distribution, quantity, habitat, and protection of the wild *M. pilocarpa* resources and establish the *M. pilocarpa* Resource Information Base. The dynamic monitoring of the region with more concentrated distribution and scientific implementation of the protection of wild plants are the groundwork for further development of artificial breeding resources and promotion of sustainable development of resources (Huang, 2003).

Strengthening the management of the legal system and implementing universal protection

To avoid the destruction of the habitat of *M. pilocarpa* and other illegal acts that occurs due to the temptation of the economy. We should implement strictly the "wild plants protection regulation" and the "forest law", effectively protecting the *M. pilocarpa* and preventing the unlawful action. *M. pilocarpa* trees should be listed for protection and the management charge should be determined. Popularizing the education of endangered plants protection at the same time, increasing the *M. pilocarpa* habitat protection, making the whole people participate in the

protection (Yang et al., 2014).

Establishing the reserve and the *M. pilocarpa* germplasm resource nursery

It is better to protect the resources of *M. pilocarpa* in the wild in situ. Then we should establish the *M. pilocarpa* resource reserves to improve the habitat gradually and expand the population of *M. pilocarpa*. At the same time, the germplasm resources nursery of *M. pilocarpa* in Dabie Mountain Luotian will be established. By means of introduction and cultivation, the germplasm resources can be preserved for a long time, and the application of artificial cultivation and popularization will be actively carried out so as to ensure the sustainable development of the resource utilization of *M. pilocarpa* to achieve the sustainable development (Zhen et al., 2016).

Enhancing scientific research

We are actively carrying out basic research on the morphology, cytology and molecular biology of the magnolia and further clarifying the reasons for the near-death of *M. pilocarpa*. The selection of the best varieties are achieved by rod insertion, tissue culture, cross breeding and molecular marker assisted selection, which is able to provide practical measures for the protection and exploitation of the resources of *M. pilocarpa* (Lin, 2008).

Conflict of interest statement

Authors declare that they have no conflict of interest.

Acknowledgement

This work was supported by the national second survey for key protected wild plant resources (Protect of minimal population in Hubei province). Thank you for great support and assistance of forestry bureau in Luotian County, Yingshan County and Tuanfeng county of Huanggang, Hubei Province.

References

- Fu, D. L., 2001. Study on the resources varieties and new plant breeding of *Magnolia liliiflora*. Doctoral thesis, Zhongnan Forestry University.
- Huang, H. Y., 2003. Present situation and prospect of wild plant protection in China. *Guangxi Forest. Sci.* 32(2), 107-110.
- Li, J. L., Sun, B., Fei, Y., Zhou, M.Q., Zhou, C. Y., 2016. A preliminary study on the population and biological community characteristics of natural *Phoebe zhennan* in Hubei Lichuan. *J. Yangtze Univ. (Natural Sci. Edn.)*. 13(33), 11-15.
- Lin, L., 2008. Discussion on the deficiencies of legal protection of wild plant resources in China and the counter measures. *J. Northwest A & F Univ. (Social Sci. Edn.)*. 8(1), 109-113.
- Liu, T., 2007. Study on Population Ecology of Natural *Taxus cuspidata* in Dongbei. Doctoral thesis, Northeast Forestry University, Haerbin.
- Ma, Y. P., Chen, G., Grumbine E, D., et al., 2013. Conserving plant species with extremely small population (PSESP) in China. *Biodiv. Conserv.* 22, 803-809.
- Peng, S. L., 1993. A discussion on the fluctuation of plant community. *Chin. J. Appl. Ecol.* 4(2), 120-125.
- State Forestry Administration, 2011. Project planning of conservation and protection of wild plants in minimal region of China (2011-2015) State Forestry Administration, Beijing.
- Sun, Y. F., Zhang, Y., 2013. Discussion on investigation methods of wild plant resources in Heilongjiang Province. *Prot. Forest Sci. Technol.* Sep. 87.
- Wang, Y. L., Li, Y., Zhang, S. Z., et al., 2003. RAPD relationship of several *Magnolia* plants. *J. Hortic.* 30(3), 299-302.
- Xu, Z. D., 2016. Study on the population and biological community characteristics of natural *Phoebe zhennan* in Hubei Lichuan. Doctoral thesis, Yangtze University, Hubei.
- Yang, W. Z., Kang, H. M., Xiang, Z. Y., Zhang, S. S., Peng, Z. N., 2014. Methods and techniques for conserving wild plant species with extremely small population. *J. West China Forest. Sci.* 5, 24-29.
- Zhao, Z. Z., Xie, Z. W., Shen, J., 1987. A new name for a new species and a variant of medicinal *Magnolia liliiflora*. *Acta Pharmaceut. Sin.* 22(10), 777-780.
- Zhen, A. G., Li, S. S., Yang, J. J., Yang, F. N., Fang, Y. P., 2016 Investigation of rare and endangered plants in Yingshan town of Hubei Province. *J. Huang. Normal Univ.* 36(6), 37-40.

How to cite this article:

Zhu, S., Zhen, A., Yang, S., Xie, Q., Wang, D., Huang, C., Hu, D., 2018. Preliminary investigation on the minimal population of *Magnolia pilocarpa* in the Dabie Mountain area of Hubei Province. *Int. J. Curr. Res. Biosci. Plant Biol.* 5(5), 1-7. doi: <https://doi.org/10.20546/ijcrbp.2018.505.001>