

Study on Olive Development in China

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Abstract: This paper analyzes from three parts: 1. the whole situation of olive distribution in China; 2. olive development in Sichuan; 3. the conditions for olive growing in Anning River Valley region. (Sichuan is a province in southwest of china. Anning River region is in southwest of Sichuan, Xichang is its center.). Last, discuss the affect of summer rainfall climate on growing development of olive tree.

Key words: Olive tree • Growing • China • Climate

INTRODUCTION

Generally speaking, China has a contrary climate with Mediterranean region. In China, rain and heat happen in summer at the same time caused by the continental monsoon climate, while in Mediterranean region, summer is very drought and winter is wet with lots of rainfall. Some scholars think China is not suitable for development of olive. Some of them said China is a forbidden area for olive. But 40 years introduction practices show that parts of China are suitable to develop olive and have a large production potential. Although the climate in China affected by continental climate obviously is very different from source region of olive, our territory is complex and across north and south of latitude 50 degrees, which decide the diversity of climate and ecotype [1]. So any similar ecotype of abroad can be found in China, especially in Sichuan, the climate featured by "One mountain at Four Seasons, different weather within 10 km" caused by low latitude and high altitude complex and diverse topography with three-dimensional climate and significant regional differences in climate characteristics.

Combination of climate conditions and soil physicochemical property indicates that China has suitable region for olive growing, but the regions are clustered distribution, which restricts intensive and scale development. At the present time, Sichuan has a largest scale of olive production and the situation is the best in China. And Anning River Valley is regarded as the most suitable for olive by all olive workers.

Note: the data in my report have some discrepancy because of the different sources, collected in different period and the complex and multiplex climate. So all the data only can be for reference, can not reflect the real condition of olive growing fields.

The Whole Situation of Olive Distribution in China:

Olive adapt the Mediterranean climate, in winter, the water and low temperature can satisfy its flower differentiation; in summer, the sunlight is rich; and the soil is alkalescency and rich in calcium. In most parts of China, especially the south, temperature is very high and comes a lot of rain in summer, sunlight is short, soil is harden, winter is drought bad for the bud formation. However we have a vast territory and the climate is complicate, some regions can satisfy olive growing. Some suitable regions are determined by the old generation olive workers. There are three most suitable regions (Fig.1) [2].

The most suitable region has three zones: 1. Jingsha River dry valley zone includ Xichang of Sichuan, Binchuan and Yongsheng of Yunnan and so on. 100,000 hm² fields can be used for growing olive; 2. Bailong River low hill zone in West Qinling Mountain area includ Wudu of Gansu, Wenxian and Kangxian and so on. 40,000 hm² fields is suitable olive growing. 3. Yangtse Gorges zone includ Yichang, Badong, Dazhou and so on. 150,000 hm² fields can grow olive.

The secondary regions include above the vally of Hanshui in Qinling, Sichuan basin fringe area, such as Mianyang, Nanchong, Dazhou, Guangyuan. And so on.

The practice shows that most of the olive orchards with high and stable yield distribute in these suitable regions.

The suitability is studied by gray system theory based on average temperature, relative humidity, precipitation and sunlight hours. Now analyze the climate of main olive introduction region (Sichuan, Gansu, Yunnan, Shanxi, Hubei) in China.

In determination of suitable regions, more attention were paid to the thresh temperature, sunlight hours, relative humidity. Thresh temperature affect flower differentiation, if the temperature is not low enough,

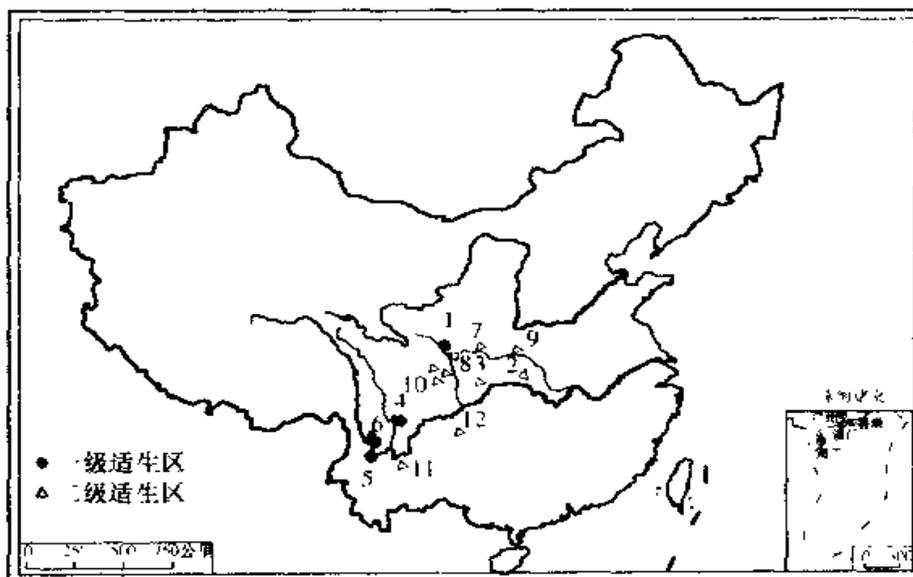


Fig. 1: Representative point of olive distribution in China
 1- Wudu; 2- Badong; 3-Wanxian; 4-Xichang; 5- Binchuan; 6- Yongsheng;
 7- Chenggu; 8- Guangyuan; 9-Yixian; 10- Mianyang; 11-Kunming; 12- Zunyi
 Note: ● is most suitable region; □ is secondary suitable region

Table 1: Climate in main olive introduction regions in China

Province	Place	(E) (N)	Altitude (m)	Temperature (°C)				Rainfall (mm)	Relative humidity%
				Average	Average in January	Min	Max		
Sichuan	Xichang	E102°18' N27°53'	1590	17	9.5	-7.8	36.5	1047.8	61
	Guangyuan	E104°36' N32°12'	800	16.5	4.9	-8.3	38.9	1020	69
	Wanxian	E108°24' N30°46'	186.7	18.1	6.8	-3.7		1185.6	81
Gansu	Wudu	E104°53' N33°24'	1079.1	14.9	3.4	-8.1	39	474	61
Yunnan	Binchuan	E100°38' N25°42'	1430	17.9	9.4	-6.7		573.6	62
	Yongsheng	E102°41' N25°01'	1891	14.7	7	-5.4	31.5	925.8	59
Shanxi	Chenggu	E107°20' N33°01'	487	14.4	2.1	-9.3		801	
Hubei	Wuhan	E114°17' N30°35'	22.8	16.1	3.1	-18.1			
	Badong	E108°24' N30°46'	294.6	17.4	6.4	-9.4	41.4		

Table 2: Weather data of main olive regions in Sichuan

Place	Temperature(°C)					Rainfall(mm)				Relative humidity (%)			
	Av		Min	Max	Av	May-December		November-April		Sunlight hours(h)	5-10		11-4
	Av	Av in January				Average	%	Average	%		Av	Av	
Xichang	17	9.5	-3.8	36.5	1013.1	941	92.9	72.1	7.1	2431	61	71.3	51.3
Guangyuan	16.1	4.9	-8.3	38.9	973.3	855.4	87.9	117.9	12.1	1389	69	72.7	63.8
Qingchuan	13.7	2.5	-9.2	36.2	1027	905.2	88.1	121.8	11.9	1338	76	80	72
Santai	16.8	5.6	-6.3	37.7	855.3	742.2	86.8	113.1	13.2	1391	79	80.5	78.1
Kaijiang	16.7	5.5	-5.5	39.8	1230.1	955.6	77.7	274.5	22.3	1466	80	79.5	80.3

Table 3: Monthly sunlight hours in main olive region in Sichuan (h)

Place	1	2	3	4	5	6	7	8	9	10	11	12
Guangyuan	88	72	98	130	162	154	162	177	97	89	85	85
Santai	71	68	106	135	155	144	174	193	95	78	72	66
Kaijiang	49	51	94	126	133	144	197	229	119	91	70	52
Xichang	234	220	263	253	218	140	178	198	150	157	196	219

Table 4: Main climate factors of Anning River vally

Place	Temperature (°C)		Rainfall(mm)	Sunlight hours (h)	Relative humidity (%)
	Av	Min			
Xichang	17.1	-3.4	1042.6	2421.8	61
Mianning	14.2	-10.7	1093.6	2019.5	69
Dechang	17.7	-3	1058.7	2147.8	64
Huili	15	-4.9	1157.8	2403.3	65
Miyi	19.4	-2.2	1118.6	2319	65

olive tree will not flower, but the temperature is too low, cold injury will happen. Sunlight hours affect yield and oil content. Relative humidity affects the growth of flower and fruit, high relative humidity cause disease and insect easily.

Compare with Mediterranean region, the main difference of climate in China are as follows: rain season is contrary; relative humidity is high; sunlight hour is not short. But similarity does not mean advantages and dissimilarity is not surely harmful. Sometimes dissimilarity is more favorable [3].

Olive Development in Sichuan: For now, only Sichuan and Gansu provinces have olive research and production base. Sichuan develops the best and with a certain scale. Now the conditions of Sichuan were introduced as follows:

Xichang, Guangyuan, Qingchuan, Santai and Kaijiang are the main olive growing region in Sichuan. Form Table 2, the average temperature of these regions is between 13.7°C 17.0°C, average temperature in January is 2.5°C 9.5°C, thresh minimum temperature is -9.2°C-3.8°C, maximum temperature is 36.2°C 39.8°C. There is widespread agreement among researchers that -3°C-4°C is good for bud differentiation, some of them think temperature can not be lower than -12°C. The practice show that most of the cultivars selected can adapt the environment; have not caused any serious cold injury; the temperature can satisfy the flower differentiation and its growing.

We can see from the Table 2, the precipitation is between 855.3mm and 1230.1mm in olive regions of Sichuan and the rain season comes in summer (May to December), up to over 77% of the total rainfall, especially

in Xichang, the rainfall in summer is up to 92.9%. Although it is contrary with Mediterranean area, water in summer can improve the yield. In source region, if olive orchard was irrigated, the yield will increase 30%~50%. Rich water in summer result in vigorous summershoot and early-bearing and high-yield.

Seen from Table 2, the relative humidity is between 61%~80% and higher in May to December because of the rich rainfall and high temperature. All regions except Xichang, the humidity is surpass the suitable value (61% 63%).

Table 3 and Fig. 4 show that only Xichang has enough sunlight hours (2431h), the sunlight hours in other regions are short for olive growth, which will affect the quality of fruit and the oil content. So only in Xichang, oil content can be up to 28%, in other regions, the oil content is below 15%.

Neutral and calcareous soil is good for olive growth. Such soil is wide distributed in Sichuan. Considering the physicochemical property of the soil and requirements of olive, the suitable soils are distributed dispersed [4].

All the regions are in east or margins of Sichuan basin and southwest of Sichuan, where the differences of climate in different areas are very large because of the complex and varied terrains and landforms. In different region, the Altitude affects the gradient of temperature. In development planning of olive growing, we definite the suitable altitude in different regions based on the suitable climate and vertical distribution of soils. Xichang: 1500 1750m, because the whole altitude is about 1500m; Guangyuan: below 800m; Hill regions (Kaijiang, Santai): below 600m. The gradient should be less than 25degrees [5].

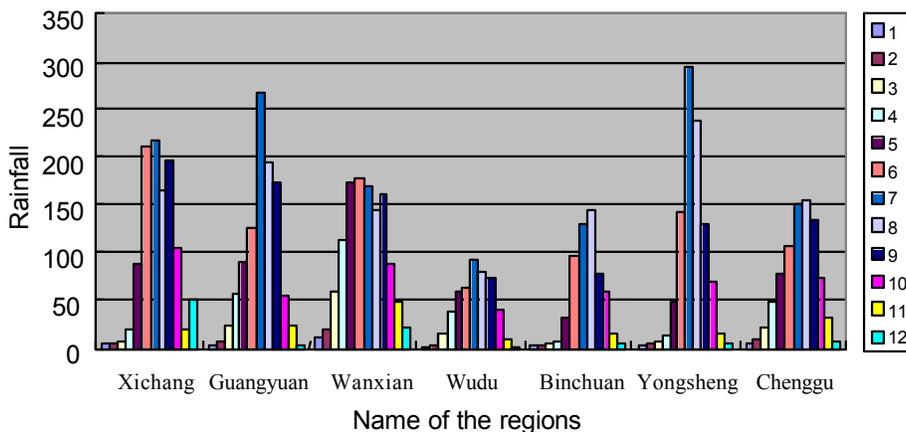


Fig. 2: Monthly rainfall of the main olive regions in China

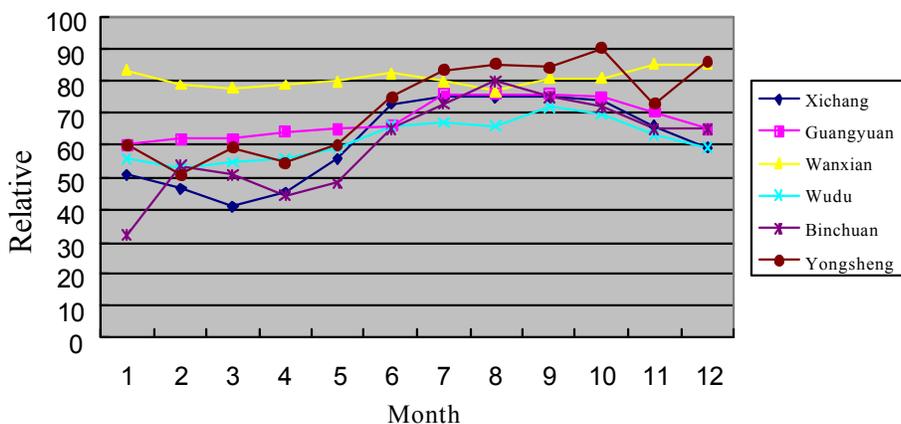


Fig. 3: Monthly relative humidity of the main olive regions in China

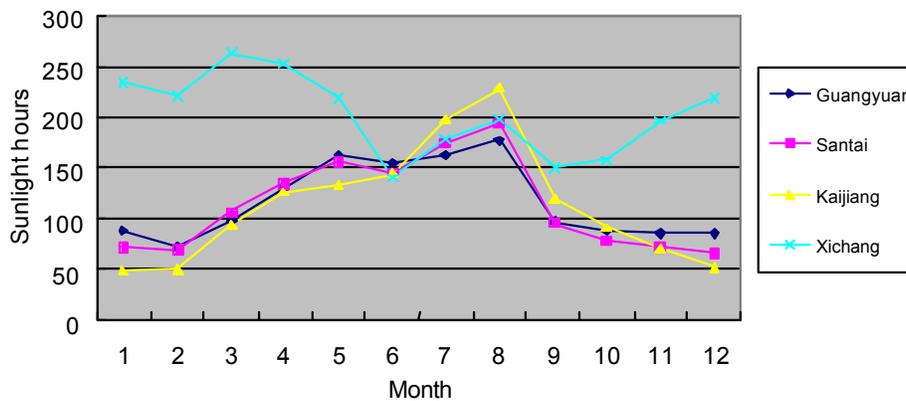


Fig. 4: Monthly sunlight hours in main olive region in Sichuan

Table 5: Main meteorological factors of Anning river valley from January to December

Month	Temperature (°C)	Rainfall (mm)	Sunlight hours (h)	Relative humidity %
1	8.7	5.7	218.9	57.2
2	10.9	6.9	201.6	52
3	15.5	8.1	251.9	47.4
4	19.3	21.7	245.7	48
5	21.6	72.2	211.1	57
6	21.3	216.2	127.9	73.2
7	22.7	238.6	159.8	78.2
8	22	211.4	172.7	79
9	19.9	187.8	136.2	78.8
10	16.7	102.8	140.7	77.4
11	12.5	37.7	189.7	70.2
12	9.4	8	206.1	66

The Condition for Olive Growing in Anning River Valley Region: As mentioned earlier, not only the temperature but also the sunlight hour and relative humidity in Xichang is similar to source areas of olive. All the olive workers agreed that Anning river Valley region (Xichang, Mianning, Dechang, Huili, Miyi) centers on Xichang is most suitable for olive growing in China [6]. Now analyze the suitability of this region as follow:

Physiological differentiation of olive bud happened in December to the following year February, which needs certain low temperature. Some research indicates that 12.5°C is the critical condition to end bud dormancy. December to February is the coldest in Anning River region. During this period, monthly average temperature is 8.7°C 10.9°C, the average rainfall is 20mm, relative humidity is between 52% 66%, total sunlight hours are 626.6h (Table 4 and Table 5). Dry air and strong ultraviolet radiation are good for bud physiological differentiation.

Morphological differentiation happened after physiological differentiation, which need a stable temperature and 10°C 15°C is the most suit. Bud starts Morphological differentiation at end of February to middle third of March. The temperature can satisfy the requirement in Anning River region. But in March, the rainfall is only 8.1mm, air humidity is 47.4%, all these conditions are unfavorable for olive flower growth. And this is the main reason to cause flower falling and fruit dropping.

Olive florescence is in April in Anning River region. Meanwhile, wind is common and temperature is over 15°C, these conditions are god for pollen spreading. However, the rainfall is only about 20mm; air humidity is below 50%,

which are bad for pollination and fertilization. So it is necessary to take top fruit sprayer to improve the air humidity.

June to December is the period for oil accumulation and August to December is very critical, 50% oil will be accumulated during this period. So long sunlight hour and low humidity are favorable for oil formation. Although the rainfall comes in June to December in this region and the humidity is higher, the sunlight hour is long and day-night temperature difference is big. So the oil content can be up to over 22.2%.

Analysis on Existed Problems of Olive Development in China:

- All the suitable regions distributed on both sides of the river in hill areas, where the soil erosion is serious, stands are poor.
- Olive is regard as economical forest in China not the fruit. Forestry bureaus of government are responsible for organizing the farmers to grow it and growing olive often is part of returning farmland to forest project. So it decided that olive growing regions have poor ecological condition, high altitude, big gradient and bad traffic condition; lack planning and design work in growing.
- In some regions, more attention is put on planting, quantitative but ignores the management and quality result in the cultivars are in a chaos and background is in mess. Although the growing area is large, lack of professional technicians, so the management is inefficient.
- Summer shoot is vigorous because of the summer rainfall lead to a large tree. Vegetative growth suppresses the reproductive growth. Few flowers or no flower are very common.

DISCUSSION

Vegetative growth and the reproductive growth exist at the same time and compete against each other. No good fruits without good development, while thriving vegetative growth will inhibit reproduction [7]. Long sunlight hours and lack rainfall is the main feature of Mediterranean where is the main fruits producing region of Europe. Yanyuan, Xiaojin and Hanyuan of Sichuan province are also the main fruits producing region of China where are rich in sunlight and lack of rainfall,

drought. So the trees grow slowly, the nodes distance is short; more nutrition is used for reproductive growth, which lead high yield. Our mistake is put the timber forest theory on olive tree-pay more attention on vegetative grow and ignore the reproduction.

Rich sunlight is good for flower bud differentiate. Moderate drought inhibits vegetative growth and is good for reproductive growth. During the critical period of flower bud differentiate, too much fertilizer and sunlight will promote growth development and not good for flower bud differentiate, which results in big tree with low yield. In China the main olive growing regions, enough rainwater and heat in autumn promote the thrive growth of autumn shoots and consume more nutrition. In spring, it is serious to fall a lot of flowers and fruits because of the drought. Long nodes distance, thin shoots, few fruits are the main characters of our olive tree.

The key technique to develop olive in China is control the autumn shoot. The best method is control water and adds fertilizer before critical period of flower bud differentiate to increase nutrition level of the tree and guarantee bud differentiation. Adjust the nutrition distribution by artificial in florescence. Pay more attention to pollination and fertilization. Additionally, purify the cultivars of olive is our first imperative thing in China.

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