Changes in Climatic Factors Influencing the Growth Period of Corn in Fengjie County

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Abstract Under the background of global climate change, we analyze the change tendency of average temperature and amount of precipitation influencing the corn's growth period. The results show that from March to August, the monthly temperatures show an upward trend, but the rise is different in different months, and the maximum temperature rise is in May. Precipitation in different months has different trends. Climate change brings about favorable conditions at high altitudes in Fengjie, reduces production due to the temperature drop after the beginning of autumn, and increases the pressure on the corn supply.

Key words Fengjie, Corn, Growth period, Temperature, Precipitation

Fengjie County is a county of Chongqing Municipality, People's Republic of China. It is on the Yangtze River; located within a couple hundreds kilometers upstream from the Three Gorges Dam, it is within the dam's affected area. The county's most famous geographical feature is the Qutang Gorge, the first of the Yangtze's Three Gorges. It is the place where Still Life was shot, a film by Jia Zhangke that won the 2006 Venice Film Festival (Golden Lion). Fengjie County is located in the northeast of Chongqing, bordering Wushan County in the east, Enshi City (Hubei) in the south, Yunyang County in the west and Wuxi County in the north. It is 500 km (310 mi) away from downtown Chongqing, and administers 30 townships, 363 administrative villages and 23 residential committee. By the end of 2008, the population of the county is 1.04 million with male population of 540,000 persons, accounting for 51.9% and female population of 500,000 persons, accounting for 48.1%. The area of land cultivated is 58933 ha. and with a per-capita land area of 0.85 mu. Fengjie features a warm and humid subtropical southeast monsoon climate. The frost-free period increases with height above sea level and precipitation increases with height above sea level[1]. Corn is one of the staple foods for farmers in Fengjie County and it is also the main raw material in food industry and livestock feed industry. The annual planting area is about 23500 ha, and the yield is about 6000 kg/ha, ranking second in the county's crop yield[2]. Under the background of climate change, corn production will face greater challenges. Therefore, this paper analyzes the temperature and precipitation conditions for the growth of corn in Fengjie County, in order to provide theoretical support for the future corn production in the county.

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1 Materials and methods

1.1 Data sources This study uses 58 years of daily weather data in the period 1956 - 2013 collected from Fengjie ground meteorological station. Since temperature and precipitation are the two factors that influence the growth of corn most, so we choose the average temperature and precipitation as two important meteorological factors. According to the literature, the corn growth period is from late March to early April, and the harvest period is usually in August[3]. Therefore, this study chooses March to August as the corn growth period to study trends over the years.

1.2 Statistical methods The daily data each month are first averaged and then the monthly data are averaged. Through the raw data, we obtain the mean value of fluctuations in climate and the anomaly may reflect the yearly trends[4]. We build a linear regression equation between X_i and t

$$X_i = a + bt_i \quad i = 1, 2, \cdots, n \tag{1}$$

where X_i is the sample size used for climate variable n; time is denoted by t, corresponding to X_i; a is regression constant; b is regression coefficient. a and b can be calculated using the least squares method. We use Excel 2007 for data processing, and employ correlation analysis methods for statistical analysis.

2 Results and analysis

2.1 Temperature trends Average daily temperature of each month, climatic trend rate and correlation coefficients are shown in Table 1. From March to August, the monthly temperatures showed an upward trend, but the rise was different in different months. The maximum temperature occurred in May, and the average temperature rose by 1.97 ℃ over 58 years. The minimum rise was in July, an increase of 0.29 ℃ over 58 years. The anom-

alies of monthly mean temperature for the corn growth period in Fengjie County are shown in Fig. 1. Before 2000, there were some fluctuations in the average temperature each month, but after 2000, the average temperature significantly rose, which was consistent with the global warming trends[5]. According to the corn planting requirements in northeast, corn can be planted in March for many years under the average temperature of 11.81 ℃. From Fig. 1 (a), it can be seen that before 2000, the temperature was stabilized at 10 ℃ in March, meeting the basic requirements, while after 2000, the annual average temperature in March was generally higher than 1 ℃, and it could be considered early sowing. May to June was a critical period for corn ear development and pollination, and the average temperature during this period also showed an upward trend. The temperature in July to August rose marginally, and thus early corn sowing could adapt to changes in Fengjie County. The temperature dropped rapidly in the mountains after autumn, resulting in unripe corn and low yields. The use of early sowing can effectively circumvent this link, and the warming in high altitude mountains of Fengjie County is conducive to the corn growth.

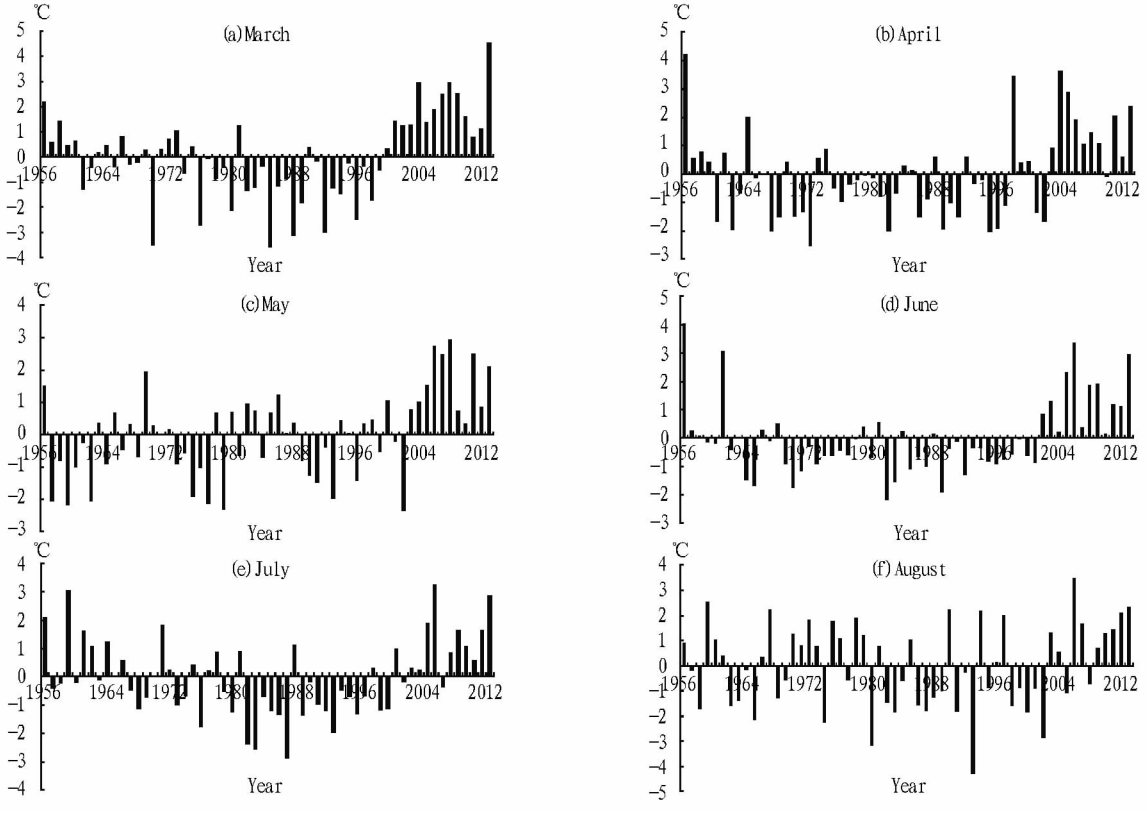

Fig. 1 Anomaly of the average temperature for the corn growth in Fengjie County

Table 1 The changes in average monthly temperature for the corn growth period in Fengjie County

	Mar.	Apr.	May.	Jun.	Jul.	Aug.
Average daily temperature(℃)	11.81	17.04	20.88	24.33	27.25	27.28
Climate trend rate (℃/10a)	0.26	0.21	0.34	0.18	0.05	0.08
The correlation coefficient	0.26	0.23	0.44	0.23	0.06	0.09

2.2 Precipitation trends Daily average monthly precipitation, climate trend rate and correlation coefficients are shown in Table 2. From March to May, and in August, precipitation showed a downward trend. From June to July, precipitation showed an increasing trend. March was critical to the growth of corn seedling, but the precipitation was only 1.63mm, and the annual precipitation over 58 years declined by 0.754mm, therefore drought often occurred in Fengjie County and seriously affected the early corn growth. Although the temperatures are suitable for sowing corn, the precipitation decline hampers the seedling growth, and therefore there is a need to increase irrigation and water conservancy facilities, especially in high mountains, in order to prevent the adverse effects of drought on agricultural production. The anomaly of daily average precipitation each month for corn growth period in Fengjie County is shown in Fig. 2 . There were too many extreme precipitation events each month in different years, so the regularity was not strong.

3 Conclusions

Under the background of global climate change, the temperature each month for corn growth period in Fengjie County increases, while precipitation shows different trends. Temperature is conducive to early planting, and it is necessary to avoid temperature

drop after the beginning of autumn and corn yield decline arising from too much rain. After seedling planting, the rainfall decline

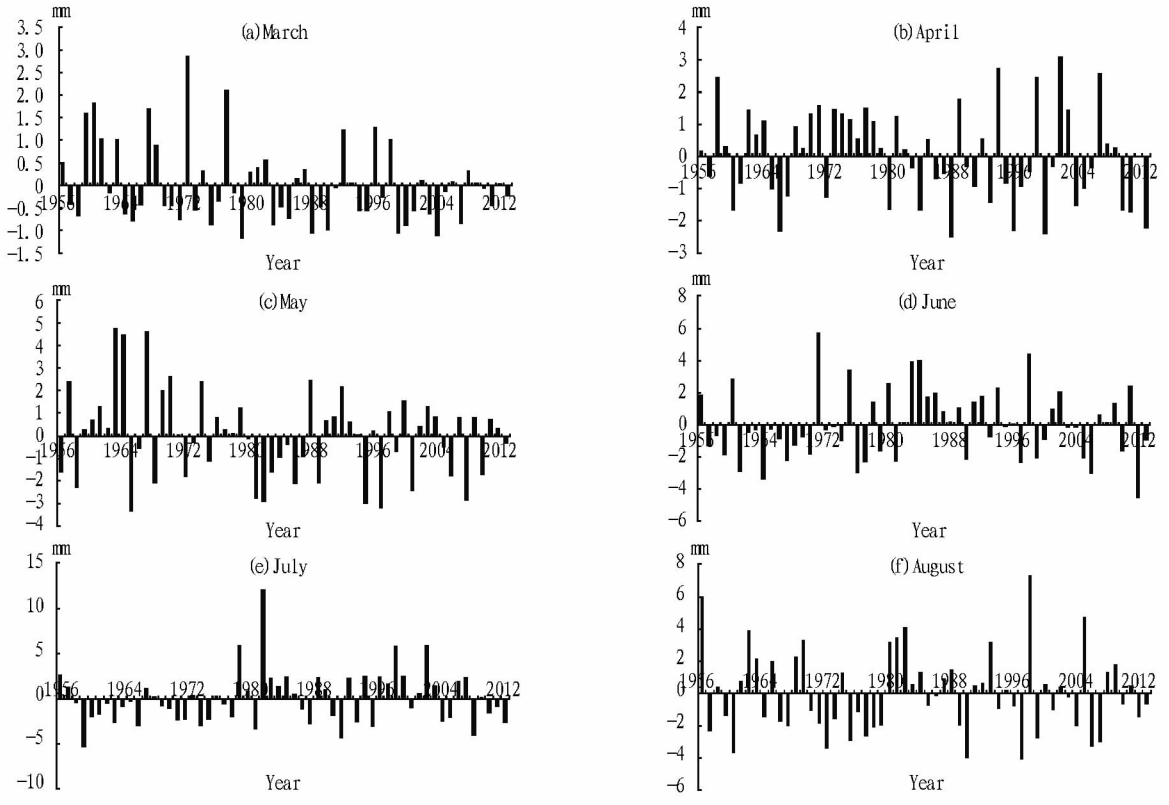

Fig. 2 The anomaly of daily average precipitation each month for corn growth period in Fengjie County

may increase the pressure on corn growth. Therefore, in the future, the changes in climatic factors influencing corn growth period in Fengjie County must be fully considered to improve response measures to increase corn production.

Table 2 Daily average monthly precipitation, climate trend rate and correlation coefficients in Fengjie County

	Mar.	Apr.	May.	Jun.	Jul.	Aug.
Average daily precipitation(mm)	1.63	3.19	5.20	5.28	5.70	4.11
Climate trend rate (mm/10a)	−0.13	−0.12	−0.21	0.04	0.22	−0.07
The correlation coefficient	−0.26	−0.14	−0.19	0.04	0.13	−0.05

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and cultural literacy of rural residents, advocate scientific, healthy, and civilized mainstream consumption value in the whole society, call for scientific and rational consumption, reduce religious consumption and rival consumption, and increase other kinds of rational daily consumptions. Give full play to the demonstration effect of the League members, communists and resident team members of higher level of education and political consciousness in the promotion of healthy and civilized lifestyle. Guide the rural residents in Kongpo to develop a scientific concept of consumption value, increase their income through honest work, improve the daily consumption level and consumption structure, and change the value concept of being cautious in daily consumption but excessive in religious consumption.

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