Correlation Analysis of Tea Yield and Meteorological Factors in Ya'an City from 2013 to 2023

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Abstract. Ya'an City is an important ecological tea region in China, and tea production is significantly influenced by meteorological factors such as rainfall, temperature, and air humidity. To explore the impact of meteorological factors on the changes in tea yield in Ya'an City, based on the tea yield and meteorological data including rainfall, average temperature, and relative humidity in Ya'an from 2013 to 2023, the Pearson correlation analysis method was used to analyze the relationship between different meteorological factors and tea yield. The results showed that tea yield was positively correlated with annual rainfall, with a correlation coefficient of 0.556; the correlation coefficient with spring rainfall was 0.507; the correlation coefficient with summer average temperature was 0.457; industrial yield was negatively correlated with annual average humidity, with a correlation coefficient of -0.360; and it was also negatively correlated with spring humidity, with a correlation coefficient of -0.470. Therefore, rainfall has a high correlation with tea yield and is one of the important meteorological factors affecting the changes in tea yield in Ya'an City; temperature comes second, while humidity shows a relatively weak negative correlation. The results of this study are expected to provide a reference for water regulation in tea gardens, prevention of extreme weather, and climate-adaptive management of the tea industry in Ya'an City.

Keywords: Tea yield, Meteorological factors, Pearson correlation analysis, Ya'an City.

1. Introduction

Ya'an City is located in the transition zone from the western edge of the Sichuan Basin to the Qinghai-Tibet Plateau, near 30°N latitude [1]. It is a typical ecological tea region and an important high-quality tea production base in China, as well as one of the world's recognized birthplaces of tea culture. Affected by the combination of monsoon climate and complex terrain, Ya'an City is warm and humid all year round, exhibiting typical characteristics of a subtropical humid monsoon climate. Taking 2023 as an example, the city's annual average temperature is about 14–19 °C, the annual precipitation generally ranges between 1000–1800 mm, the relative humidity remains above 80% all year round, and the whole year is often shrouded in rain and fog. Acidic or slightly acidic soils are dominant locally, providing superior natural conditions for the growth of tea plants [2]. Since 2021, driven by the national rural revitalization strategy [3-4]and Sichuan Province's "Three-Tea" integrated development strategy [5-6], Ya'an's tea industry has maintained a rapid development momentum, with the tea garden area stabilizing at around 66,666.67 hectares [6], and its tea yield and output value ranking among the top in Sichuan Province for a long time. The tea industry is not only an important pillar of Ya'an's agricultural economy, but also an advantageous and characteristic industry that promotes farmers' income growth, optimizes the agricultural industrial structure, and promotes high-quality regional economic development.

Tea plants are perennial leafy economic crops, and their growth and development, budding time, fresh leaf yield, and tea quality are all comprehensively affected by meteorological conditions. Among them, rainfall, temperature, and air humidity are considered the most important meteorological factors affecting tea production [7-8]. Adequate rainfall can improve soil moisture conditions, promote the normal growth of tea plants, and increase the number of new shoot germination and fresh leaf yield; however, continuous heavy rainfall or excessive precipitation can easily lead to soil waterlogging, increased frequency of pests and diseases, and affect tea picking and processing, thereby reducing economic benefits [9-10]. Secondly, temperature also directly affects the photosynthesis, respiration, and bud germination rate of tea plants. Suitable temperatures can

promote the growth of new shoots of tea plants, while sustained high or low temperatures will inhibit the normal physiological activities of tea plants, reducing yield and quality [11-12]. Finally, air relative humidity affects the formation of fresh leaves by regulating the transpiration, water balance, and leaf physiological metabolism of tea plants. A high-humidity environment is conducive to maintaining the softness of tender leaves and promoting the accumulation of quality substances such as amino acids, but excessively high humidity may also induce diseases. Research reported by Chen Dongmei and Wang Weiming shows that there are obvious regional differences in the response of tea plants to meteorological factors in different ecological regions. Temperature is usually the dominant factor affecting tea growth and yield, followed by rainfall and relative humidity, and the degree of influence of various meteorological factors also varies in different growth stages[14-15].

Therefore, this study is based on data of tea yield over the past decade and meteorological data such as rainfall, annual average temperature, and relative humidity to conduct correlation analysis, revealing the influence law of major meteorological factors on the changes in tea yield. At the same time, it provides a scientific basis for scientific tea garden management, stable and increased tea production, and high-quality development of the regional tea industry.

2. Materials and Methods

2.1. Overview of the Study Area

Ya'an City is located in western Sichuan Province, in the transition zone between the western edge of the Sichuan Basin and the eastern edge of the Qinghai-Tibet Plateau, serving as an important ecological barrier region in the upper reaches of the Yangtze River. Its geographical coordinates range from 28°51′10″ to 30°56′40″ N and 101°56′26″ to 103°23′28″ E. The terrain and landforms of Ya'an City are complex, with mountains, hills, and river valleys distributed alternately, and obvious altitude differences, forming distinct three-dimensional climate characteristics, which provide a good ecological foundation for the development of the characteristic tea industry.

Ya'an City belongs to the subtropical humid monsoon climate zone, characterized by distinct seasons and abundant rainfall, which can meet the water and air humidity demands during the growth process of tea plants.

Tea plants are acid-loving plants and are suitable for growing in a soil environment with a pH value of about 4.5–6.5. The widely distributed acidic mountainous soils in Ya'an City provide good soil conditions for high-quality tea production. Acidic soils dominate the mountainous and hilly areas of Ya'an City, with deep soil layers, rich organic matter, and good soil permeability, which are suitable for the root development of tea plants.

In recent years, Ya'an City has continuously promoted the large-scale, standardized, and brand-based development of the tea industry, and tea has become an important pillar industry for local agricultural economic development. According to relevant statistical data, in 2024, the total area of tea gardens in Ya'an City reached 69,000 hectares, the output of dry made tea was about 121 million kg, and the comprehensive output value of the tea industry reached 25.4 billion yuan. The tea industry has played an important role in promoting farmers' income growth, advancing rural revitalization, and enhancing regional economic development levels.

2.2. Data Sources and Analysis Methods

① Data sources: Tea yield data comes from the website "Gotohui Data" (https://www.gotohui.com/), average temperature and rainfall data come from the Ya'an Yearbooks from 2013 to 2023 (https://tjj.yaan.gov.cn/xinwen/list/cd4a16afaf3b2e2976ed11a087467359.html), and humidity data comes from the website "Mirror Earth" (https://mirror-earth.com/).

② Analysis methods: The Pearson correlation analysis method was used to analyze the correlation between tea yield and meteorological factors such as annual rainfall, annual average temperature, and annual average relative humidity, and a two-tailed significance test was performed, with $p < 0.05$ as

the criterion for statistically significant differences. Excel was used as the data processing software, and R was used as the plotting software.

3. Correlation Analysis between Meteorological Factors and Tea Yield

3.1. Correlation Analysis between Annual Average Rainfall and Tea Yield

As shown in Figure 1, the ranking of tea yield among districts and counties in Ya'an City from 2013 to 2023 is: Mingshan District > Yucheng District > Tianquan County > Yingjing County > Baoxing County > Lushan County > Shimian County > Hanyuan County. The district with the highest tea yield is Mingshan District, with a peak of about 60 million kg; the lowest is Hanyuan County, with a trough of about 500,000 kg. From this, it can be seen that Mingshan District and Yucheng District are major tea-producing areas in Ya'an City. Mingshan District can reach up to 60 million kg, with a yield level far higher than other regions, making it the core tea production area of Ya'an City. Yucheng District can reach up to 39 million kg, ranking second in yield with a rapid growth rate. As can be seen from Figure 2A, the ranking of annual precipitation among districts and counties in Ya'an City from 2013 to 2023 is: Yingjing County > Baoxing County > Tianquan County > Lushan County > Yucheng District > Mingshan District > Shimian County > Hanyuan County. Overall, Yingjing County has the highest annual precipitation, reaching up to 2200 mm, while Hanyuan County has the lowest annual precipitation, with a minimum of 700 mm. Meanwhile, in the major tea-producing area of Yucheng District, the maximum annual precipitation is 1400 mm, and the minimum annual precipitation is 900 mm; in Mingshan District, the maximum annual precipitation is 1300 mm, and the minimum precipitation is 800 mm. As shown in Figure 2B, the results of the rainfall correlation analysis indicate that tea yield is positively correlated with annual rainfall, with a Pearson correlation coefficient of 0.556; the correlation coefficient with spring rainfall is 0.507, both showing moderate positive correlations.

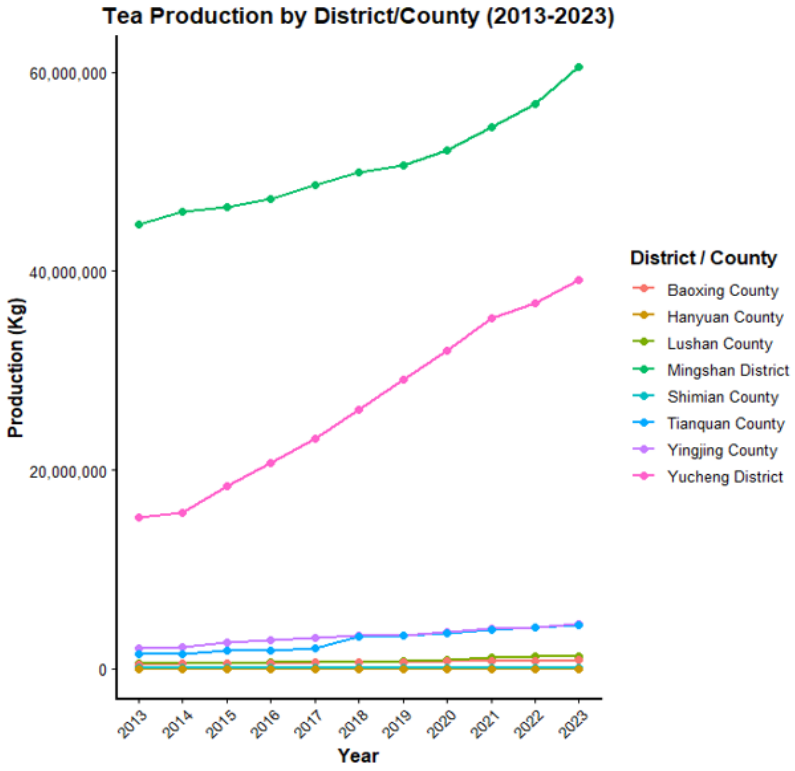


Figure 1. Tea Production by District/County in Ya'an (2013–2023)

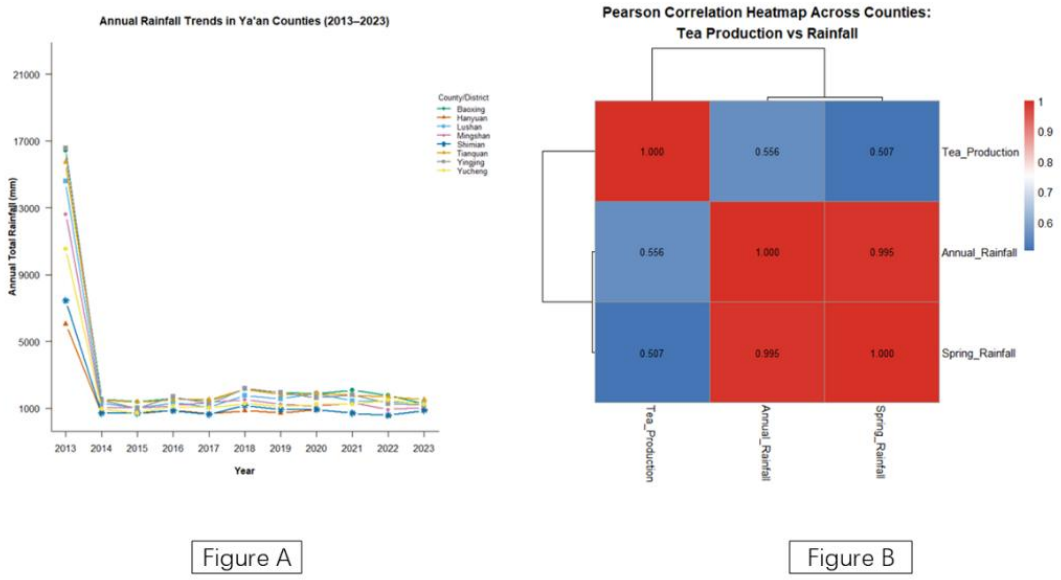


Figure 2. Changes in precipitation and its correlation with tea yield in Ya'an City from 2013 to 2023

3.2. Correlation Analysis between Annual Average Temperature and Tea Yield

As shown in Figure 3A, the ranking of average temperature in Ya'an City from 2013 to 2023 is: Hanyuan County > Shimian County > Yucheng District > Tianquan County > Lushan County > Mingshan District > Yingjing County > Baoxing County. Overall, Hanyuan County has the highest annual average temperature, at about 16.8 °C; Baoxing County has the lowest annual average temperature, at about 13.8 °C. In the major tea-producing area of Yucheng District, the maximum annual average temperature is about 16.2 °C, and the minimum is about 15.0 °C; in Mingshan District, the maximum annual average temperature is about 15.9 °C, and the minimum is about 14.9 °C. As shown in Figure 3B, the temperature correlation analysis results show that tea yield is positively correlated with temperatures at different time scales. Among them, the correlation coefficient between tea yield and summer average temperature is 0.457, the correlation coefficient with annual average temperature is 0.308, and the correlation coefficient with spring average temperature is 0.274.

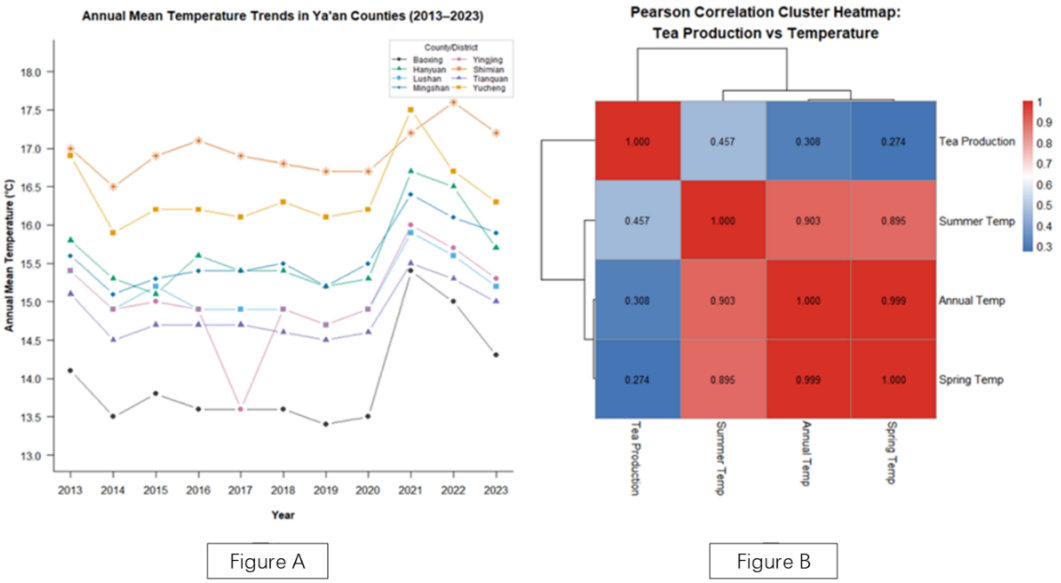


Figure 3. Changes in average temperature and its correlation with tea yield in Ya'an City from 2013 to 2023

3.3. Correlation Analysis between Annual Average Humidity and Tea Yield

As shown in Figure 4A, the ranking of average relative humidity in Ya'an City from 2013 to 2023 is: Yingjing County > Baoxing County > Yucheng District > Tianquan County > Lushan County > Mingshan District > Shimian County > Hanyuan County. Overall, Yingjing County has the highest annual average relative humidity, and Hanyuan County has the lowest annual average relative humidity. In the major tea-producing area of Yucheng District, the maximum annual average relative humidity is about 83.0%, and the minimum annual average relative humidity is about 80.0%; in Mingshan District, the maximum annual average relative humidity is about 81.5%, and the minimum annual average relative humidity is about 75.2%. As shown in the humidity correlation analysis results in Figure 4B, tea yield is negatively correlated with spring humidity, annual average humidity, and summer humidity. Among them, the correlation coefficient between tea yield and spring humidity is -0.470, the correlation coefficient with annual average humidity is -0.360, and the correlation coefficient with summer humidity is -0.240.

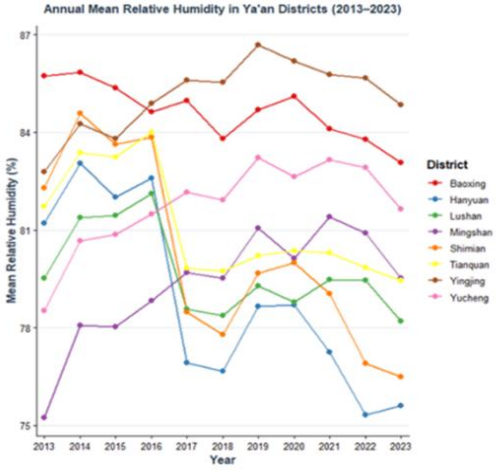


Figure A

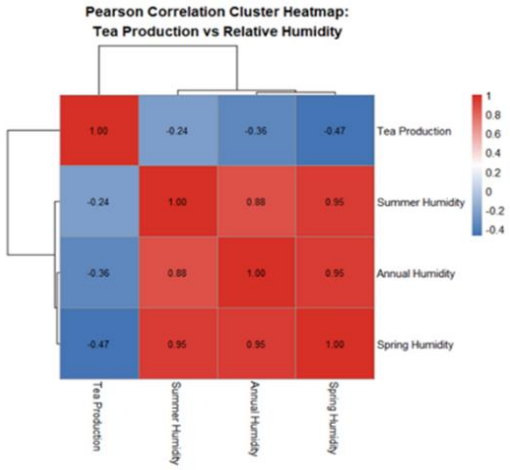


Figure B

Figure 4. Changes in average humidity and its correlation with tea yield in Ya'an City from 2013 to 2023

4. Discussion

4.1. Analysis of the Most Important Climate Factors Affecting Tea Yield

Synthesizing the correlation analysis results of the three types of climatic factors, it is found that rainfall is the climatic factor most highly correlated with tea yield in Ya'an City.

Among them, the Pearson correlation coefficient between annual rainfall and tea yield reaches 0.556, which is higher than the temperature and humidity factors, indicating that moisture conditions have a more obvious impact on tea production in Ya'an City.

According to research reported by Xu Jianpeng and Yu Hong, rainfall is closely correlated with tea yield [16-17]. Therefore, it can be known that because Ya'an's tea gardens are mainly distributed in mountainous and hilly regions, the root system of tea plants is relatively shallow and sensitive to changes in soil moisture. Adequate precipitation can increase soil water content, promote roots to absorb mineral elements, and provide a guarantee for the germination and growth of tea buds. Secondly, spring in Ya'an City is an important period for tea picking and new shoot formation, and spring precipitation can directly affect the yield of spring tea. This study found that spring rainfall is highly correlated with annual rainfall ($r = 0.995$), indicating that spring moisture conditions may be an important factor affecting tea yield. According to research reported by Ma Yuming and Li Yan, the other two climatic factors are still correlated with tea yield, but not the most strongly correlated [18-19].

4.2. Correlation Analysis between Humidity Factors and Tea Yield

From the analysis results, humidity factors have the lowest correlation with tea yield.

Although Ya'an City belongs to a high-humidity area, the change in humidity does not show an obvious positive correlation with tea yield, and is even negatively correlated. This may be due to the following reasons:

① Ya'an's multi-year average humidity is already at a high level, and moisture conditions basically meet the needs of tea plants, so the promoting effect brought by increased humidity is limited;

② Excessively high humidity easily forms a damp environment, reduces the light conditions of the tea garden, and simultaneously increases the probability of disease occurrence;

③ Tea yield is not only affected by climate, but also affected by agricultural measures such as variety selection, fertilization management, picking methods, and mechanization levels, so the impact of humidity may be weakened by other factors.

Li Shirui, Zhou Wei, and Zhang Wenjin have reported on the correlation between humidity and tea yield [20-22].

4.3. Comprehensive Meteorological Factor Analysis

Changes in tea yield are not only controlled by climatic factors, but also affected by the policy environment, market demand, and emergencies.

During the period from 2013 to 2023, Ya'an City as a whole showed a trend of climatic warming and humidification, with the average temperature gradually rising and precipitation conditions generally stable, providing a good ecological environment for the growth of tea plants. From the correlation analysis results, rising temperatures and increasing precipitation generally promoted the increase of tea yield.

As reported by Li Shasha, Peng Yanxia, and Cao Lilixue: In recent years, the increase in extreme weather events, such as heavy rainfall and high-temperature weather, may cause water accumulation in tea gardens, increased pests and diseases, and delayed picking periods, affecting the stability of tea production [23-25].

In recent years, Ya'an City has regarded the tea industry as an agricultural characteristic industry and an important grip for rural revitalization, improving the comprehensive benefits of the tea industry through the construction of standardized tea gardens, developing the tea processing industry, and promoting brand construction.

Data shows that in 2024, the total area of tea gardens in Ya'an City reached 69,000 hectares, the output of dry made tea was 121,000 tons, and the comprehensive output value reached 25.4 billion yuan, making the tea industry an important pillar of the local agricultural economy [26].

Policy support has improved tea garden management levels, making the growth of tea yield not only related to natural conditions, but also influenced by enhanced human management capabilities [27-29].

During the period from 2019 to 2022, the growth rate of tea yield in Ya'an City was relatively small. The reason behind this is that the COVID-19 pandemic had a certain impact on tea production and sales [30]. On the one hand, the pandemic caused the transportation and sales channels of tea in some areas to be restricted; on the other hand, the rapid development of new models such as online sales and e-commerce live streaming alleviated traditional sales pressure to a certain extent.

5. Summary of Research Results

From 2013 to 2023, the tea yield in Ya'an City generally showed an upward trend, indicating that the local tea industry has maintained a good momentum of development in recent years.

In terms of climate change: Temperature generally showed a slow upward trend, providing relatively stable heat conditions for tea plant growth; rainfall generally maintained a high level,

providing sufficient moisture for tea gardens; air humidity was maintained at a high level for a long time, but excessively high humidity may increase disease risks. Correlation analysis showed that rainfall had the highest correlation with tea yield ($r = 0.556$), making it an important climatic factor affecting tea yield; temperature factors came second, with summer temperature having a more obvious impact ($r = 0.457$); humidity factors had the lowest correlation and showed a negative correlation. Therefore, tea production in Ya'an City is jointly affected by hydrothermal conditions, among which "rainfall is the factor most highly correlated with tea yield among the meteorological factors selected in this study."

6. Future Development Prospects and Suggestions

In view of the climatic characteristics of Ya'an City such as concentrated spring precipitation, summer high temperatures, and long-term high humidity, future tea industry development should further strengthen climate-adaptive management.

(1) In view of concentrated spring precipitation, strengthen tea garden moisture regulation. Spring is an important period for the sprouting of tea plants and the picking of spring tea in Ya'an City. Drainage ditches, water storage facilities, and soil and water conservation facilities on sloping land should be improved according to precipitation changes. Drainage ditches should be dredged in time before heavy rainfall occurs to reduce water accumulation and soil waterlogging in tea gardens. At the same time, in periods of insufficient precipitation, methods such as straw mulching and growing grass in tea gardens can be adopted to reduce soil moisture evaporation and improve soil moisture-retaining capacity.

(2) In view of summer high temperatures, adopt shading and cooling measures. In areas with perennial high temperatures, shading nets can be reasonably set up according to the terrain of the tea garden and the growth status of the tea plants, and methods such as forest-tea interplanting can be combined to lower the surface temperature of the tea garden and reduce the adverse effects of high temperatures and strong light on the growth of new shoots of tea plants. At the same time, irrigation time should be reasonably arranged to avoid heavy watering during high-temperature periods.

(3) In view of the high-humidity environment, strengthen green prevention and control of diseases. The air humidity in Ya'an City is at a high level for a long time. In continuous rainy weather, the ventilation and light transmission management of tea gardens should be strengthened, diseased leaves and dead branches should be cleared in time, meteorological warnings should be combined to carry out disease monitoring, and green prevention and control measures should be adopted in the early stage of disease occurrence to reduce the risk of disease diffusion in high-humidity environments.

(4) Strengthen the selection of stress-resistant tea plant varieties and meteorological early warning. In view of the differences in temperature, precipitation, and humidity among different districts and counties, tea plant varieties with strong high-temperature resistance, moisture-logging resistance, and disease resistance should be selected in combination with local ecological conditions. At the same time, meteorological monitoring data can be used to establish a tea garden meteorological risk early warning mechanism, and management measures such as irrigation, shading, drainage, and picking should be adjusted in time according to weather processes such as heavy rainfall, high temperatures, and continuous rainy weather, thereby improving the ability of tea gardens to cope with extreme weather.

7. Conclusion

Based on the tea yield and meteorological data of Ya’an City from 2013 to 2023, this study used Pearson correlation analysis to examine the relationships between tea yield and rainfall, temperature, and relative humidity. The results show that tea yield in Ya’an City generally increased during the study period, while meteorological conditions showed a gradual warming trend, relatively stable precipitation, and persistently high relative humidity.

Among the selected meteorological factors, rainfall showed the strongest positive correlation with tea yield. The correlation coefficient between annual rainfall and tea yield was 0.556, while the correlation coefficient between spring rainfall and tea yield was 0.507. Temperature also showed positive correlations with tea yield, with summer average temperature showing a correlation coefficient of 0.457, which was higher than those of annual average temperature (0.308) and spring average temperature (0.274). In contrast, relative humidity showed negative correlations with tea yield, with correlation coefficients of -0.470 for spring humidity, -0.360 for annual average humidity, and -0.240 for summer humidity.

Overall, the results indicate that water conditions were relatively important among the meteorological factors examined in this study, with rainfall showing the highest correlation with tea yield, followed by temperature, while humidity showed a relatively weak negative correlation. However, tea yield is influenced not only by meteorological conditions but also by agricultural management, policy support, market conditions, and unexpected events. Therefore, future tea production in Ya'an should combine meteorological monitoring with adaptive management measures, particularly strengthening water regulation during periods of concentrated rainfall, shading and cooling during high-temperature periods, disease prevention under high-humidity conditions, and the selection of stress-resistant tea varieties. These measures may help improve the stability and climate adaptability of tea production in Ya'an City.

References

[1] Sichuan Provincial Bureau of Statistics. Sichuan Statistical Yearbook [M]. Beijing: China Statistics Press, 2024.

[2] Lou W, Sun K, Zhao Y, et al. Impact of climate change on inter-annual variation in tea plant output in Zhejiang, China [J]. International Journal of Climatology, 2021, 41(S1): E479-E490.

[3] The Central Committee of the Communist Party of China and the State Council Issued the "Planning for Comprehensive Rural Revitalization (2024–2027)" [N]. Workers' Daily, 2025-01-23.

[4] The Central Committee of the Communist Party of China, State Council. Opinions on Comprehensively Promoting Rural Revitalization and Accelerating Agricultural and Rural Modernization [N]. People's Daily, 2021-02-22.

[5] Mingshan: "Three-Tea" Integration Composes a New Chapter, Regional Cooperation Displays a New Look [N]. Sichuan Daily, 2024-07-25.

[6] Ministry of Agriculture and Rural Affairs, State Administration for Market Regulation, All-China Federation of Supply and Marketing Cooperatives. Guiding Opinions on Promoting the Healthy Development of the Tea Industry [N]. Bulletin of the Ministry of Agriculture and Rural Affairs of the People's Republic of China, 2021(10): 19-22.

[7] BENTI T, DEBELA A, BEKELE Y, et al. Effect of seasonal variation on yield and leaf quality of tea clone (Camellia sinensis (L.) O. Kuntze) in South West Ethiopia [J]. Heliyon, 2023, 9(3): e14051.

[8] CARR M K V. The role of water in the growth of the tea (Camellia sinensis) crop: A synthesis of research in Eastern Africa. 2. Water productivity [J]. Experimental Agriculture, 2010, 46(3): 351-379.

[9] Zhao Hui, Mi Hongtao, Du Zhixuan, et al. Study on Suitable Planting Climatic Zoning of Tea Plants in Henan Province [J]. Journal of Tea Science, 2016, 36(3): 285-294.

[10] AHMED S, STEPP J R, ORIANS C, et al. Effects of extreme climate events on tea (Camellia sinensis) functional quality validate indigenous farmer knowledge and sensory preferences in tropical China [J]. PLoS ONE, 2014, 9(10): e109126.

[11] JAYASINGHE S L, KUMAR L. Potential impact of the current and future climate on the yield, quality, and climate suitability for tea (Camellia sinensis (L.) O. Kuntze): a systematic review [J]. Agronomy, 2021, 11(4): 619.

[12] Ju Yingqin, Chen Cheng, Cheng Dingfang, et al. Analysis of Meteorological Impacts on Growth, Development and Yield Elements of Ying shan Ming Cha [J]. Agricultural Science and Technology and Communication (China Agricultural Science Bulletin), 2023, 39(28): 83-91.

[13] Wu Quancong, Chen Fangjing, Lei Yonghong, et al. Analysis of Occurrence and Influencing Factors of Tea Blister Blight in Lishui City [J]. Journal of Tea Science, 2013, 33(2): 169-174.

[14] Chen Dongmei, Han Wenyan, Zhou Xianfeng, et al. Prediction of Tea Yield in Zhejiang Province Based on Adaptive Boosting BP Model [J]. Journal of Tea Science, 2021, 41(4): 564-576.

[15] Wang Weiming, Lin Dongyi, Hong Xiaoyan, et al. Construction of Tea Yield Model and Planting Management Based on Phenological Period Climate Factors [J]. Chinese Journal of Eco-Agriculture (Chinese and English), 2025, 33(11): 2245-2258.

[16] Xu Jianpeng, Wang Hui, Wu Qiong. Characteristics of Climate Resource Changes in Southern Anhui Tea Growing Season and Its Impact Analysis [J]. Guangdong Agricultural Sciences, 2021, 48(4): 14-22.

[17] Yu Hong, Wang Xianyun, Yang Xiaohui, et al. Study on the Relationship between Spring Tea Yield and Microclimate in Jigongshan Tea Garden, Henan [J]. Chinese Journal of Eco-Agriculture, 2009, 17(1): 94-99.

[18] Ma Yuming, Chen Jie, Jin Zhifeng, Hao Lu. Forecasting of Tea Yield and Harvest Period Based on AquaCrop Model [J]. Chinese Journal of Eco-Agriculture (Chinese and English), 2021, 29(8): 1339-1349.

[19] Li Yan, Zhou Wei, Jin Zhifeng, et al. Climate-Land Integrated Suitability Zoning and Quality Evaluation of Small-leaf and Large-leaf Tea Plant Cultivation in Southern China Tea Region [J]. Journal of Applied Meteorological Science, 2026, 37(2): 183-195.

[20] Li Shirui, Wang Zhihai, Yang Zaiqiang, et al. Analysis of Tea Production Status and Climate Resource Characteristics in Southern China Tea Region [J]. Arid Meteorology, 2014, 32(6): 1007-1014.

[21] Zhou Wei, Li Yan, Chen Yanli, et al. Climate-Land Comprehensive Impact National Small and Medium-leaf and Large-leaf Tea Plant Cultivation Suitability Zoning [J]. Transactions of the Chinese Society of Agricultural Engineering, 2026, 42(10): 300-310.

[22] Zhang Wenjing, Liang Yurong, Zhang Fangzhou, et al. Effects of Shading on Yield and Quality of Oolong Tea [J]. Journal of Tea Science, 2004, 24(4): 276-282.

[23] Li Shasha. Early Tea Is Not "Early", Sichuan Tea Expands with "New" [N]. Sichuan Daily, 2025-03-19.

[24] Peng Yanxia. Ya'an Experienced 4 Rounds of High-Temperature Heat Waves and 6 Regional Rainstorms in July [N]. Ya'an Daily, 2026-08-05.

[25] Cao Lilixue. Production and Sales of Alpine Spring Tea Are Both Thriving [N]. Ya'an Daily, 2025-04-04.

[26] Anonymous. Sichuan Ya'an: Tea Picking Becomes Culture, Tea Hometown Turns into Scenic Spot [N]. Guangming Daily, 2025-09-08(05).

[27] Zhang Tianxing. More than 20,000 Mu of Tea Gardens in Mingshan District Realize Standardized Management and Protection, Unified Prevention and Control Empowers Science and Technology to Revitalize Tea and Improve Quality [N]. Ya'an Daily, 2026-08-27(03).

[28] Xiong Wei. Policy Empowerment, Ya'an Explores a New Model of Tea Garden Trusteeship to Solve the Management and Protection Difficulties of Smallholders [N]. Sichuan Daily, 2025-05-12(07).

[29] Yang Yu. Transforming Low-Yield and Low-Efficiency Tea Gardens, Ya'an Tea Base Transforms Toward Green Standardization [N]. Sichuan Daily, 2024-10-21(09).

[30] Gao Meilin. Sichuan Ya'an Tea Industry Bucked the Trend, Achieved Stable Production and Increased Income with Excellent Results [N]. Ya'an Daily, 2021-01-28.