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Comparative Assessment of Yunnan Sun-Grow Cigar Tobacco Varieties

Zhenchong Wang[1], Laraib Malik[2], Bao Fang[3], Anzhong Zhen[3], Xuebin Duan[4], Xubing Tang[3*], Junru Shen[3*]

[1]School of Agriculture and Life Science, Kunming University. Kunming, 650214, Yunnan, China
[2]Department of Plant Pathology, University of Agriculture Faisalabad, 38000, Pakistan
[3]Yunnan Tobacco Baoshan Spice Tobacco Co., Ltd. Baoshan, 678000, Yunnan, China
[4]Yunnan Siqiang Agricultural Technology Co., Ltd. Kunming, 650213, Yunnan, China
***Corresponding author e-mail**: 583638834@qq.com ; 121831391@qq.com*

ABSTRACT Yunnan has excellent conditions for cigar planting and can produce high-quality tobacco leaves comparable to Cuban cigars. To identify new cigar varieties suitable for promotion in Yunnan's tobacco-growing areas, a total of 22 common and popular cigar varieties were selected as test materials. These included Yunxue No.1, Yunxue No.2, Yunxue No.6, Yunxue No.34, Yunxue No.36, Yunxue No.38, Yunxue No.39, Yunxue No.40, Yunxue No.41, Cuba No.1, Cuba No.2, Hai Yan No.103, Hai Yan No.204, CX14, CX26, De Xue No.4, Chuan Xue No.2, Kangzhou Broad Leaves, Yunxue No.8, De Xue No.3, Chuan Xue No.1, and Chuan Xue No.4. The experiment evaluated agronomic traits such as leaf area, leaf thickness, and chlorophyll content, as well as economic traits like leaf yield, to identify varieties suitable for cigar tobacco cultivation in Yunnan Province. The results showed that Yunxue No.41 had the largest leaf area, De Xue No.3 had the thinnest leaf thickness, and Kangzhou Broad Leaves and Yunxue No.39 had the highest chlorophyll content. Yunxue No.6 was the most prolific variety in terms of yield. These four varieties—Yunxue No.41, De Xue No.3, Kangzhou Broad Leaves, and Yunxue No.6—demonstrated the best overall performance among the 22 tested varieties. They can be used as candidate varieties for further research on supporting cultivation and processing techniques in Yunnan tobacco areas, laying a strong foundation for the future development of the Yunnan cigar industry.

***Keywords**: Cigar; Variety Comparison; Characters; Tobacco; Yield; Industry*

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INTRODUCTION Cigar is a distinctive tobacco product, meticulously crafted by directly rolling cigar leaves. It possesses the notable characteristics of having a flavor that combines bitterness and sweetness, an aroma that is rich and mellow, and providing a strong sense of satisfaction. Currently, the majority of the raw materials utilized by domestic cigars are dependent on imports (Yuan et al., 2022, Abdullayeva et al., 2024). The production of domestic cigars initiated at a relatively late stage, and as a consequence, the overall quality remains relatively low. In foreign countries, Cuba has attained its renowned position as the cigar kingdom. This is attributed to its exceptional geographical and ecological environment (Zhao et al., 2017). The unique combination of its geographical location, soil composition, climate conditions, and other factors has provided Cuba with ideal circumstances for cultivating high-quality tobacco leaves and developing exquisite cigar-making techniques. This has enabled Cuba to establish a prominent reputation and a leading position in the global cigar industry (Wang et al., 2021). Havana is situated within the range of north latitude 19° 53 ′ to 23°16 ′. The average annual temperature there fluctuates between 21 and 28 degrees Celsius.

The annual sunshine hours amount to 1677 to 2540 hours. The average annual precipitation is approximately 793 millimeters, and the average annual number of precipitation days is 53 (Zhao et al., 2017, Billings, 2024). Meanwhile, Longyang District, Baoshan City, Yunnan Province is located within the range of north latitude 24°46′ to 25°38′. The average annual temperature in this area varies from 10 to 23 degrees Celsius. The

annual sunshine hours reach 2200 to 2500 hours (Yuan et al., 2022, LE-YI et al., 2024). The average annual precipitation is around 972 millimeters, and the average annual number of precipitation days is 51. It is evident that both the latitude and the natural conditions in Havana of Cuba and in Yunnan Province are comparable. The combination of factors such as temperature, precipitation, and sunlight hours creates a similar environment. This similarity indicates a tremendous potential for the development of high-quality cigar leaves in these regions. The similar geographical and climatic conditions offer favorable circumstances for the cultivation and growth of tobacco plants that could potentially produce cigar leaves of superior quality (Zhang et al., 2012).

Excellent varieties are the crucial means of production in tobacco production and the internal factor for obtaining high-quality tobacco leaves. The quality of tobacco is not merely influenced by the variety and the level of cultivation management (Quan et al., 2020). It is also significantly restricted by diverse ecological environments. Different tobacco varieties, when grown under the identical ecological conditions, exhibit varying yields and qualities (Yang et al., 2016). For instance, some varieties might thrive and produce a bountiful harvest with superior quality, while others might struggle and yield less satisfactory results. In actual production scenarios, only by effectively combining the distinctive characteristics of the varieties with the local natural conditions and the specific climate characteristics can the full potential of the varieties be realized (Yuan et al., 2022). This means taking into account factors such as soil composition, temperature variations, precipitation patterns, and sunlight duration. Only through such a meticulous and strategic approach can the best performance and quality of the tobacco be achieved, maximizing the benefits and output of the production process (Song, 2014). Therefore, in light of the natural and ecological conditions of the tobacco-growing areas in Yunnan, screening for excellent cigar varieties that are suitable for the local region becomes of paramount importance. This process serves as the foundation for optimizing the layout of tobacco varieties within the province.

By identifying and introducing varieties that are well-suited to the local climate, soil composition, and other environmental factors, it is possible to enhance the overall productivity and quality of tobacco cultivation. This, in turn, promotes the sustainable development of their tobacco leaves (Zhao et al., 2017). A sustainable development approach ensures that the tobacco industry in Yunnan can continue to thrive and contribute to the local economy without depleting natural resources or causing significant environmental damage. It allows for a balanced and long-term perspective in tobacco production, taking into account not only immediate yields but also the long-term health and stability of the ecosystem and the industry as a whole (Xie et al., 2014, Ali et al., 2024b, Ali et al., 2024a). Therefore, a total of 22 cigar varieties were carefully selected in this experiment. The main purpose of this selection was to precisely determine the varieties that are most suitable for cigar tobacco planting in Yunnan Province.

By conducting this comprehensive analysis and determination, it is aimed to offer a solid theoretical basis. This basis is intended to contribute significantly towards enhancing the yield of cigar tobacco leaves in Yunnan Province. Additionally, it is designed to improve their quality and also increase the industrial availability of these tobacco leaves. Such efforts are crucial for the development and optimization of the cigar tobacco industry in the Yunnan Province region.

MATERIALS AND METHODS

The experiment was conducted in Longyang, Yunnan Province (east longitude 98°43, north latitude 24°46), from February to June 2023. The average field temperature was 21.1℃, the average monthly rainfall was 166mm, and the monthly average sunshine was 162.3h, which had no adverse effect on the growth and development of cigar plants. The soil type in the experimental site was sandy, the soil particles were coarse, large interparticles, fast water seepage speed, poor water retention and good air permeability, easy to cultivate, the terrain was flat, the previous crop is corn. The soil pH 5.8, organic matter 24.5g/kg, total nitrogen 1.02g/kg, quick potassium 128mg/kg, organophosphorus 88.7mg/kg, conducive to the growth of cigar plants.

Experiment design

The trial design used a random block design with 22 varieties with 3 replicates for each treatment and a single plot area of 23.1 m2. Sixty plants were planted in each cell (repeated), and 200-well seedling plates were selected to cultivate non-toxic and strong seedlings. Cigar plants were transplanted on February 23, 2023, topping at 55d after transplanting, leaving 16~20 leaves.

The test base fertilizer was used at 150g/m2 Organic fertilizer (6% total nutrient, 60% organic matter) produced by Nongwang Biological Fertilizer Co., Ltd., 37 g / m2Phosphate fertilizer, nitrogen application levels were set to 12, 15 and 18 g/m2Corresponding to the application of 37,45, and 60 g/m2 For tobacco compound fertilizer (N:P2O5:K2O=10:10:25), mix the middle fertilizer; 5-7 d, 30 g/m2 Nitrogen and potassium fertilizer and 0.3 g/m2 Pour boron fertilizer with water (dissolved into mass fraction 1.0% fertilizer liquid) with deep application; 20 d after transplanting, nitrogen levels is set to 12,15 and 18g/m2 respectively Corresponding to the application of 37,45 and 60 g/m2 Special compound fertilizer for tobacco, 22,36 and 40 g/m2,And each additional nitrogen and potassium fertilizer 10 g/m2 After crushing, pour water with the help of deep application device (mass fraction 1~2%).

Determination method

Agronomic traits: 6 tobacco strains were randomly selected for each treatment, and the maximum leaf length, maximum leaf width, leaf thickness of tobacco plants were measured according to YC/T 142-1998 Tobacco Agronomic Shape Survey Methods. The chlorophyll content was read with the SPAD-502 instrument (KONICA MINOLTA).

Data analysis

Frequency distribution and correlation analysis were performed using SPSS 23.0 software.

Other production measures

Field management: standardized transplanting (field preparation, soil moisture specification, soil moisture requirements, drilling and transplanting), intertillage management (moisture management, planting management, membrane breaking, roof blasting) and pest management, intertillage soil cultivation and weeding twice on March 30 and 38; debudding on April 28 and May 20. Aphid, green worm and tabaci were the main control objects, and insecticides such as thiidiazam and imidacloprid, as well as yellow plate, blue plate and insecticidal lamp. The prevention of disease is mainly to prevent the disease of leaf leaf disease, black tiin disease and bacterial wilt, agents mainly use spring mycin, chlorbromine isocyanuric acid and methyl cream manganese zinc with water root irrigation.

RESULTS AND DISCUSSION

Agronomic traits of different cigar varieties

The maximum leaf area, chlorophyll content and leaf thickness of each cigar were normally distributed. Among them, there was one species with the maximum leaf area of 1150~1300cm2, Yunxue No.39, and three species with 1300~1450cm2, namely De Xue No. 4, De Xue No.3 and Hai Yan No.103. From 1450 to 1600cm2, there were 7 species, namely CX26, Yunxue No.38, Yunxue No. 2, KangZhou broad leaves, Cuba No.2, Chuan Xue No. 1 and Yunxue No.1. There were 6 species with 1600~1750cm2, namely Yunxue No.41, Cuba No. 1, Chuan Xue No.4, Chuan Xue No. 2, Yunxue No.36 and Yunxue No.34. There was one specie with 1750~1900cm2, Hai Yan No.204. The CX14 was available from 1900 to 2050cm2. There was one specie of 2050-2200cm2, Yunxue No.8. Yunxue No.40 had a species of 2200~2350cm2. There was a kind of 2350~2500cm2, Chuan Xue No. 4. There was one species with leaf thickness of 0~29um, Yunxue No. 6, and one species with leaf thickness of 31~33um, Yunxue No. 40. There are 4 species of 35~37um, Yunxue No.36,De Xue No. 4, Cuba No. 1, Chuan Xue No. 1. From 37 to 39um, there were 11 species, Yunxue No.39, Yunxue No.38, Yunxue No.41, Yunxue No.34, Cuba No. 2, KangZhou broad leaves, Chuan Xue No.4,Yunxue No. 1, Yunxue No. 8, Yunxue No.2, Hai Yan No.204. 41~43um, there are 3 species, namely De Xue No. 3, CX26, Chuan Xue No. 2. There are two species with 43~45um, Hai Yan No.103 and CX14. There was one species, Yunxue No.6, with chlorophyll content ranging from 0% to 52%. There was one species, Yunxue No.39, in 55%~58% of the population. There are 4 species in the 61%~64% range, Yunxue No.1, Hai Yan No.103, Yunxue No.36, and Yunxue No.40. 64 %to 67% have 11 species, Cuba No. 1, KangZhou broad leaves, Chuan Xue No. 4, Yunxue No.34, CX26, Chuan Xue No. 1, Hai Yan No.204, De Xue No.3, Chuan Xue No. 2, CX14, Yunxue No.41. 70%~73% of the population have 3 species, Yunxue No. 2, Cuba No. 2, De Xue No. 4. 73%~76% of the population has 2 species, Yunxue No.38 and Yunxue No.8.Different tobacco leaf varieties have different genetic characteristics and great differences in adaptability to ecological and cultivation conditions, and excellent tobacco leaf varieties are the key to producing high-quality tobacco leaves (Yang et al., 2019, Murtaza et al., 2024, Li et al., 2024, Khan et al., 2024). The agronomic traits and quality of cigar leaves are the result of genetic attributes (Tang and Zhang, 2006), arieties, and plant management (Yang, 2022). Among them, variety selection is the most basic factor, but also the most difficult to control and determine the factor, with great uncertainty, which is consistent with the results of this experiment. Plant management techniques are completely controlled and changed by people, and genetic attributes are often restricted by ecological conditions and plant management (Lu, 2007).

Economic traits of Yang planting of different cigar varieties

The yield of 22 cigar varieties were normally distributed, and Yunxue No.40 had a yield of 0~1.4kg/m2. There were 3 species with 1.4~1.6kg/m2, Cuba No. 1, Yunxue No.38 and Chuan Xue No. 1. There were 7 species with 1.6~1.8kg/m2, namely Yunxue No.2, Yunxue No.1, Yunxue No.39, Hai Yan No.103, Chuan Xue No. 4, Hai Yan No.204, CX14 and CX26. There were 6 species with 1.8~2.0kg/m2, including De Xue No.4, Chuan Xue No. 2, Cuba No. 2, KangZhou broad leaves, Yunxue No.41 and Yunxue No.36. There was one species with 2.2~2.4kg/m2, Yunxue No.34. There was one species of 2.4-2.6 kg/m2, Yunxue No. 8. There was one species of 2.8-3.0 kg/m2, called De Xue No. 3. 3.0~3.2kg/m2 is Yunxue No.6.In the growth process of tobacco plants, the growth period and agronomic traits can directly reflect the whole growth state of tobacco leaves. Different cigar varieties have different growth periods, which will also lead to changes in their agronomic traits, which are mainly affected by temperature changes. Cigar varieties suitable for local ecological environment with the delay of their transplanting period, the higher the temperature, the faster the growth of tobacco plants, resulting in insufficient accumulation of active accumulated temperature and effective accumulated temperature required for growth, and ultimately the deterioration of the agronomic traits of tobacco plants (Yuan et al., 2022). In addition, with the delay of the transplanting period, the yield and quality of cigars have a downward trend (Zhang, 2018). Therefore, the selection of cigar varieties suitable for local ecological environment has an important impact on the yield and quality of tobacco leaves. Studies have shown that in addition to the transplanting period, planting methods also have a certain impact on the growth of tobacco plants (Zong et al., 2022, Rashid et al., 2024, Mushtaq et al., 2024). The photosynthesis of tobacco plants was inhibited by short sunshine hours and less soil nutrient absorption. When pure sun planting is adopted, the light is too strong, so that tobacco plants can not grow well (Zhu et al., 2024). This experiment showed that sun cultivation had an effect on plant height and leaf size of tobacco plants, which was similar to the results of Zhou et al., (2014). Appropriate sunlight planting can significantly increase the yield and output value of tobacco (Zhang et al., 2021), This experiment shows that sunlight planting is conducive to increasing the yield and output value of cigars. The study of He et al., (2021). The results showed that too weak light intensity would reduce the number of tobacco plants and the yield of tobacco leaves. Zhao et al., (2017) pointed out that excessive light intensity would significantly reduce tobacco yield. Li et al., (2013) found that reducing light intensity is conducive to improving the yield and quality of tobacco leaves.

Table 1: Correlation analysis of studied traits

Traits	BT	CC	LA	Yield
BT	1	0.154	0.709	0.544
CC	0.154	1	0.102	0.881*
LA	0.709	0.102	1	0.227
Yield	0.544	0.881*	0.227	1

Blade thickness= BT, Chlorophyll content= CC, Leaf area=LA.

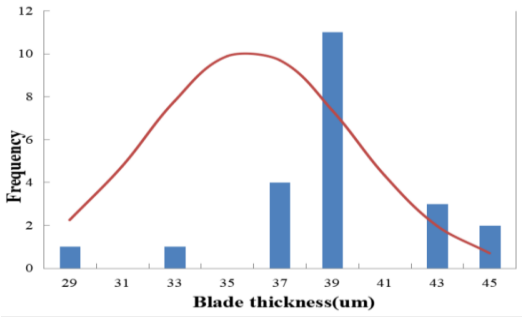

Figure 1: Normal distribution of blade thickness

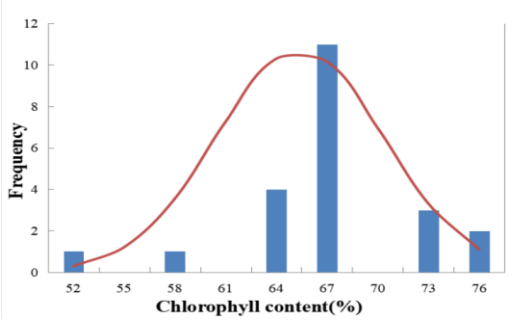

Figure 2: Normal distribution of chlorophyll content

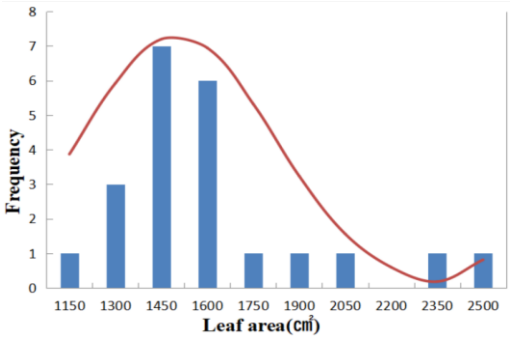

Figure 3: Normal distribution of leaf area

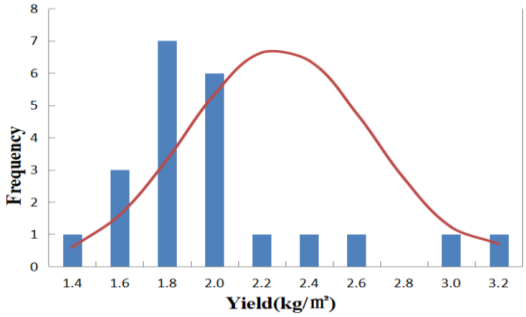

Figure 4: Normal distribution of yield

Correlation analysis of sun planting of different cigar varieties

Leaf thickness, chlorophyll, leaf area and yield are the key factors affecting the quality of cigars. Correlation analysis was carried out on the leaf thickness, chlorophyll content, leaf area and yield data of 22 cigar varieties. The results showed that there was a significant correlation between yield and chlorophyll content, and the other variables also showed a positive correlation, but it did not reach the significant standard (Table 1).Therefore, priority must be given to ecological conditions, especially local climatic conditions, when cigar cultivation is carried out. As a temperature-loving crop, the temperature of tobacco should be controlled within 10~35°C (Zhong, 1987, Zeng et al., 2024, Saeed et al., 2024), and the ambient temperature higher than 35°C will cause the growth of tobacco plants to be hindered (Wang et al., 2007). According to the research of Ju Yingqin (Ju et al., 2022), the average temperature during cigar planting period varies from 16 °C to 27°C, the relative humidity ranges from 78% to 83%, and the monthly sunshine duration ranges from 45 to 130 h. After that, suitable cigar varieties are planted according to the local temperature, and the appropriate light intensity is studied in order to obtain the best quality tobacco leaves.

CONCLUSION

The results demonstrated that Yunxue No.41 exhibited the most substantial leaf area among all the varieties. Specifically, its leaves spread out widely, providing a larger surface area for photosynthesis. Meanwhile, De Xue No.3 had the slenderest leaf thickness, indicating a certain characteristic in its leaf structure. Moreover, KangZhou broad leaves and Yunxue No.39 boasted the highest chlorophyll content, which implies their superior ability in capturing and converting light energy for growth and development. As for productivity, the most productive cigar variety was identified as Yunxue No.6. These four varieties manifested outstanding performance in both agronomic and economic traits. They demonstrated a strong adaptability to the local environment and conditions, achieving better yields and superior quality. Clearly, they displayed evident advantages when compared to other varieties available. It is recommended that these four varieties should be regarded as reserve planting options in the Yunnan cigar area. Additionally, experiments and demonstrations should be conducted in this area to closely observe their stability and yield adaptability. Further research should also be carried out on their supporting cultivation and modulation technical measures. The ultimate goal is to achieve the promotion and application of both excellent varieties and effective methods.

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