ISSN: 2641-6379
DOI: 10.33552/WJASS.2026.10.000734
World Journal of Agriculture and Soil Science
Iris Publishers

Research Article

Research on the Technology of Food-Tobacco Integration for Improving Quality and Efficiency

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Received Date: August 21, 2026

Published Date: September 01, 2026

Abstract

In order to explore effective technical paths for improving the quality and efficiency of tobacco field, and promoting the green and sustainable development of the tobacco industry, based on the ecological regulation of "agriculture and tobacco integration", the integrated and application demonstration of the tobacco quality improvement and efficiency enhancement technology through the integration of tobacco and grain was carried out at the Lishan Tobacco Station in Fukuquan City, Qiannan Prefecture, Guizhou Province. Through the research on key technical links such as the suitable varieties and the optimal sowing period of sweet potatoes under the tobacco-sweet potato intercropping, the yield-quality of the tobacco and economic effectiveness of tobacco field were analyzed. The results show that in terms of economic characteristics, the three treatments A1V1, A1V2 and A2V1 were superior to the other treatments; in terms of the chemical composition of tobacco leaves and their coordination, the three treatments A1V1, A1V2 and A2V1 were closer to the standards of high-quality tobacco leaves. Considering the yield and the economic effectiveness of the tobacco fields, finally, A1V2 was the best, followed by A1V1. Therefore, it is recommended to choose varieties V1 and V2 and carry out intercropping of sweet potato seedlings from May 15th to 30th.

Keywords: Flue-cured tobacco; food and tobacco integration; improving quality and efficiency

Introduction

The tobacco industry is an important economic sector in Fukuquan City, Qiannan Prefecture, Guizhou Province. It serves as a crucial foundation for the high-quality development of modern tobacco agriculture. The cultivation of a single crop cannot meet the needs of modern agricultural development. To achieve increased income, it is necessary to integrate grain and tobacco, enhance the overall agricultural efficiency, and provide effective guarantees for the quality improvement and upgrading of the agricultural industry [1]. Previous research results indicate that, the integrated cultivation model of "tobacco-sweet potato" can effectively

promote the growth of tobacco plants and significantly reducing the occurrence diseases [2,3]. Qiannan Prefecture in Guizhou Province is an important high-quality tobacco production area. Luping Town, as a typical tobacco-growing village in the county, has representative terrain, climate, soil conditions and farming habits within the region.

Moreover, the local area is actively exploring the development model of grain-tobacco integration (such as tobacco-bean, tobacco-sweet potato intercropping), providing an ideal practical site for this research. This study systematically evaluates the technical system for improving the quality and efficiency of tobacco based on grain-tobacco integration, aiming to establish production technical norms for intercropping tobacco - sweet potatoes and promote their application, providing theoretical support and practical demonstrations for the improvement of tobacco leaf quality and comprehensive benefits under the grain-tobacco integration model.

Materials and Methods

Materials

Using the tobacco variety "Yunyan 87", and the sweet potato varieties "Shangtu 19", "Qianyu 26" and "Qianyu 11" as materials. The experiment was conducted from April to October 2025 at Liushan Tobacco Station in LuPing Town, Qianan Buyi and Miao Autonomous Prefecture, Guizhou Province.

Experiment Design

The experiment adopted a randomized block design. Different varieties of sweet potatoes (A1 was the commercial sweet potato variety 19, A2 was the Guizhou sweet potato variety 26, A3 was the Guizhou sweet potato variety 11) and the time of transplanting the sweet potato seedlings (V1 was May 15th, V2 was May 30th, V3 was June 15th) were used in the intercropping of tobacco-sweet potatoes. Tobacco alone was used as the control (CK). A total of 5 treatments were set up; each treatment plot was 18 square meters, with 3 replications. The row and plant spacing of tobacco was 120 cm × 50 cm. Transplanting was carried out in mid-April, and tobacco leaf harvesting ended on August 10th. Sweet potatoes or soybeans were intercropped on the tobacco ridges on both sides of the tobacco plants (with a distance of 30 cm from the tobacco plants), and the sweet potatoes were harvested at the end of September. The management measures of the tobacco fields were in accordance with the local tobacco production technical plan, and no additional fertilization was provided for the intercropping.

Measurement Indicators and Methods

Tobacco Yield-Quality

The determination of the indicators (economic characteristics and chemical composition) was carried out according to the methods described in the literature [4].

Economic Effectiveness

The calculation formula is as follows: Total cost = Cost of tobacco planting + Cost of sweet potatoes planting, Total income = Tobacco output × Tobacco price + sweet potatoes output × Price of sweet potatoes, Net income = Total income - Total cost.

Result and Analysis

The Effect of Intercropping on the Quality of Tobacco Leaves

The Effect of Intercropping on the Economic Characteristics of Tobacco Leaves

There are significant differences among the various treatments. In terms of the proportion of medium and above grade tobacco in the total output, treatments A1V1, A1V2 and A2V1 outperformed the other treatments (Table 1).

Table 1: The Economic characteristics of intercropping tobacco-sweet potatoes system.

Treatment	Yield (kg/ha)	Medium-premium tobacco proportion (%)	Treatment	Yield (kg/ha)	Medium-premium tobacco proportion (%)
A1V1	2247.90 (2.76%)	75.16 (-0.01%)	A2V3	2117.14 (-3.21%)	68.94 (-8.28%)
A1V2	2182.8 (-0.21%)	79.86 (6.23%)	A3V1	1983.36 (-9.33%)	75.14 (-0.04%)
A1V3	2164.95 (-1.02%)	67.95 (-9.6%)	A3V2	2110.25 (-3.53%)	73.16 (-2.67%)
A2V1	2125.65 (-2.82%)	76.48 (1.74%)	A3V3	2071.83 (-5.28%)	68.59 (-8.76%)
A2V2	2155.22 (-1.47%)	65.94 (-12.28%)	CK	2187.45	75.17

The Effect of the Chemical Composition and Its Coordination of Tobacco Leaves

All the total nitrogen, nicotine (except A2V1), potassium (except A3V3), and chlorine in the samples met the standards for high-quality tobacco leaves. However, the total sugar content in all the treatments was relatively high, and the reducing sugar content was only slightly closer to that of high-quality tobacco leaves in the A3V1 treatment (the other treatments were all higher) (Table2).

Table 2: The Chemical composition of C3F on intercropping tobacco-sweet potatoes system.

Treatment	Total sugar	Reducing sugar	Total nitrogen	Nicotine	K	Cl
A1V1	31.69±0.88	24.31±4.16	2.12±0.04	2.09±0.56	2.08±0.02	0.23±0.01
A1V2	29.45±2.53	23.00±1.34	1.96±0.08	1.64±0.42	2.11±0.26	0.42±0.03
A1V3	28.25±1.11	25.99±0.55	2.05±0.26	1.64±0.09	2.14±0.23	0.37±0.01
A2V1	27.53±3.31	25.42±1.96	1.85±0.28	1.42±0.10	2.15±0.06	0.42±0.06
A2V2	31.59±0.90	25.73±5.04	1.56±0.08	1.99±0.30	2.90±0.03	0.34±0.06
A2V3	30.00±2.00	21.48±6.18	1.63±0.20	1.74±0.06	2.06±0.05	0.50±0.15
A3V1	30.01±1.95	19.47±2.96	2.10±0.10	1.70±0.04	2.10±0.28	0.30±0.01
A3V2	28.67±1.71	22.98±2.92	1.46±0.23	2.07±0.09	2.00±0.11	0.45±0.02
A3V3	28.38±2.62	20.93±3.78	1.65±0.10	1.99±0.50	1.88±0.24	0.37±0.01
CK	26.39±2.68	20.30±3.03	2.66±0.56	2.56±0.09	2.20±0.04	0.31±0.02
Excellent quality tobacco	18-22	16-18	1.5-3.5	1.5-3.5	≧2.0	≦1.0

The contents of reducing sugar/total sugar, reducing sugar/nicotine (except for the CK treatment) and potassium/chlorine met the standards for high-quality tobacco leaves. However, nicotine/total nitrogen only met the standards for A1V2, A1V3, A2V1, and A3V1(Table 3).

Table 3: The Chemical composition coordination of C3F on intercropping tobacco-sweet potatoes system.

Treatment	Reducing sugar/ Total sugar	Nicotine/ Total nitrogen	Reducing sugar/ Nicotine	K/Cl	Treatment	Reducing sugar/ Total sugar	Nicotine/ Total nitrogen	Reducing sugar/ Nicotine	K/Cl
A1V1	0.95	0.91	14.04	6.64	A2V3	0.96	0.76	14.59	3.66
A1V2	0.79	0.86	10.17	7.19	A3V1	0.77	1.19	9.62	4.63
A1V3	0.82	0.86	11.61	5.76	A3V2	0.83	1.38	10.74	3.75
A2V1	0.91	1.44	9.51	6.29	A3V3	0.86	0.75	12.79	7.66
A2V2	1.02	1.26	13.89	2.03	CK	0.82	0.76	10.62	4.64
Excellent quality tobacco	≤1	≥0.9	8-12	≥4	excellent quality tobacco	≤1	≥0.9	8-12	≥4

The Effect of Intercropping on the Economic Effectiveness of Tobacco Field

The combination is best for A1V2, followed by A1V1(Table 4).

Table 4: The Economic effectiveness of tobacco field on intercropping tobacco-sweet potatoes system (Unit: RMB/ha).

Treatment	The additional cost compared to CK	The additional profit compared to CK		The additional net profit compared to CK
		Tobacco	Sweet potatoes	
A1V1	9000	1560	8601	1161
A1V2	9000	1515	8838	1653
A1V3	9000	1470	8508	978
A2V1	9000	1785	7830	615
A2V2	9000	1575	7911	486
A2V3	9000	1500	7812	312
A3V1	9000	1845	5541	-1614
A3V2	9000	1605	5178	-2217
A3V3	9000	1680	5214	-2106

Conclusion

In terms of economic traits, the three treatments A1V1, A1V2 and A2V1 outperformed the others. In terms of chemical composition and coordination, the three treatments A1V1, A1V2 and A2V1 were relatively close to the standards of high-quality tobacco leaves. Considering the yield of sweet potatoes and the economic benefits of the tobacco fields, ultimately, A1V2 was the best, followed by A1V1.

Author Contribution

Jun Zhong wrote the manuscript and the first author. Xizhong Zhang and Qiang Li are the co-corresponding author. All authors contributed to manuscript revision, read, and approved the submitted version.

Funding

This study was supported by the China Tobacco Guizhou Industrial Co Ltd Qiannan state Company project (2025-522700-2-7-0071) and Hunan Agricultural University project (25KJ010).

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest

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