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Performance and Evaluation of Hanski 227 Oriental Tobacco in Dak Lak Region, Vietnam from 2022 - 2024

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

With the results of selecting Oriental tobacco varieties suitable for natural conditions in Vietnam, with potential for raw material quality and raw material production capacity in Vietnam, from 6 oriental tobacco varieties originating from Bulgaria, the Tobacco Institute has been testing in Ninh Thuan province from 2019 to 2021, and Dak Lak from 2021 to 2022. The results of the trial planting show that oriental tobacco varieties are good growth, and are quite suitable for the soil and climate conditions in Ninh Thuan and Dak Lak provinces, and have selected 2 the best oriental tobacco varieties as Basma 16 and Hanski 227. In which, Hanski 227 variety is evaluated to have outstanding prospects due to its good growth ability, high yield, characteristic aroma and good smoking properties. The Hanski 227 variety has less harvested leaves, larger leaf size and mass

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than Basma 16 variety, so the labor costs for cultivation, harvesting and preliminary processing are lower. To evaluate the ability to expand the oriental area in Vietnam, we continue to trial planting the Hanski 227 oriental variety in Dak Lak in 2023 - 2024, with a fertilizer level and a planting density corresponding to 50N + 30P₂O₅ + 80K₂O (N: NH₄NO₃, P: (Ca(H₂PO₄)₂ and K: K₂SO₄) and 110,000 plants/ha. The experimental trial results show the Hanski 227 variety has good growth, high yield, and good quality, with yield fluctuating 1.52 - 1.66 tons/ha, nicotine content: 0.81 - 1.38%, and reducing sugar content: 8.9 - 12.1%, and the oriental material has a characteristic aroma and good smoking properties. Based on the trial results shows that the quality of Hanski 227 grown in Dak Lak are the same the oriental tobacco importing from Bulgaria, Türkiye and Greece. Therefore, the Dak Lak province is the most suitable region for producing good quality oriental tobacco in Vietnam compared to Ninh Thuan region. Because materials in Ninh Thuan has the high chlorine content reducing material quality. In 2025, we continue to grow the Hanski 227 oriental tobacco variety in Dak Lak region on a large area and complete the preliminary processing process, with the goal of producing Oriental tobacco raw materials domestically, with appropriate production costs.

Keywords: Oriental tobacco; trial production; hanski 227; dak lak.

1. INTRODUCTION

Oriental tobacco is grown worldwide for the purpose of blending raw materials that provide a characteristic natural aroma [1]. Oriental tobacco raw materials have a much milder flavor, lower nicotine and reducing sugar content than other tobacco varieties [2]. Oriental tobacco is a small-stemmed, small-leafed plant; requires a lot of manual labor; is planted at high density; grows in hot climates, with temperatures gradually increasing at the end of the season and low air humidity; is dried in the sun; is harvested by hand because the leaves are small; the leaves have a natural aroma and are elastic, suitable for blending American mixed tobacco tastes [3].

Oriental tobacco is widely grown in some major countries such as Turkey, Greece, North Macedonia and Bulgaria [4]. In countries that produce Oriental tobacco, the soil has a significant impact on quality. The soils suitable for Oriental tobacco are usually poor in nutrients, low in humus and low in yield, but the tobacco leaves are of good quality and very aromatic. Tobacco grown on deep tillage soils, clay to loam, and rich in nutrients gives high yields, but is less aromatic. Oriental tobacco is generally grown on soils with low fertility, especially at low N levels when the plants are mature. Aroma is an important factor in the quality of the product. It largely depends on the terrain and climatic conditions where they are grown [5,6].

Every year, Vietnam usually imports about 1000 tons of oriental tobacco for producing blended

cigarettes. Now, Vietnam does not have oriental tobacco growing regions to serve the demands of tobacco factories in domestic production. To develop oriental tobaccos in Vietnam, the Vietnam Tobacco Institute imported six varieties from Bulgaria for trial planting in Ninh Thuan in 2019 - 2020. But, the smoking results showed that oriental tobacco grown in Ninh Thuan burned poorly by the high chloride content in the leaves. Because irrigation water in Ninh Thuan had high chloride content. In 2021, the Tobacco Institute planted two oriental varieties Basma 16 and Hanski 227 in Dak Lak province, where the climate conditions were suitable, and the water source did not contain chlorine. The results of trial planting show the dry yield and grade 1 + 2 of the Basma 16 variety reached 1.57 - 1.66 tons/ha and 75.9 - 76.3%, respectively; 1.73 - 1.82 tons/ha and 85.2 - 86.5% with Hanski 227 variety. The main chemical composition of oriental tobacco was proper for oriental tobacco with nicotine content a range from 1.0 to 1.3%, reducing sugar: 9.8 - 12% and chlorine: 0.27 - 0.31%. Compared with imported oriental tobacco with nicotine at 0.9%, sugar at 7.2% and chlorine: at 0.81%. The flavour, taste and burn of oriental tobacco grown in Dak Lak were better than those imported oriental tobacco from Bulgaria, Turkey and Greece by Vietnam's factories. Oriental tobacco grown in Dak Lak had flavour points ranging from 11.9 to 12.7 points, taste: 9.1 to 9.2 points and burning: 4.4 points, while imported tobacco with flavour was 10.8 points, taste: 8.3 points and burn: 3.1 points [7]. Based on some of the above research results, we have selected the Hanski 227 oriental tobacco variety to grow the large area in Dak Lak region from 2022 - 2024.

2. MATERIALS AND METHODS

2.1 Research Site

The trial cultivation of the oriental tobacco Hanski 227 is conducted in Ea Sup district, Dak Lak region - Vietnam from December 2022 to May 2023, and December 2023 to May 2024. This area has suitable climate and soil conditions for producing oriental tobacco, with an average temperature of every year is 24°C, a max average temperature of 34°C, and min average temperature of 18 - 20°C. The tobacco growing season is dry, hot sun, little rain and low air humidity. The average air humidity ranges from 35 - 78% and rainfall: 1.6 - 14.8 mm, which are favourable for the growth and development, and curing of oriental tobacco.

Soil analysis data in Dak Lak region: Total N: 0.49 - 1.09 mg/g, P₂O₅: 0.02 - 0.07%, and K₂O: 0.06 - 0.52%. The available N (mg/100 g of soil): 4.36 - 7.8, P₂O₅: 4.51 - 39.96, and K₂O: 3.45 - 15.39; total organic matter: 0.52 - 1.41% and pH_{KCL}: 4.56 - 7.04, and chlorine content: 7 - 33 ppm.

2.2 Materials and Research Objects

The oriental tobacco variety planted in Dak Lak region is Hanski 227. Fertilizers: Using the fertilizer level of 50N + 30P₂O₅ + 80K₂O, fertilizer types: N: NH₄NO₃, P: Ca (H₂PO₄)₂ and K: K₂SO₄, and the fertilizer rate: 1: 0.6: 1.6.

2.3 Experimental Design

Seeds of Hanski 227 oriental tobacco variety are sown in a disease-free nursery. After reaching 4 - 6 leaves, seedlings are planted in 03 large experimental fields, with an area of each field: 2.000 m², with a total area: 6.000 m². Planting density of Hanski 227 variety is 110.000 plants/ha with a distance of 50 cm x 17 cm.

2.4 Monitoring Methods

The cultivation technique of oriental tobacco is based on the technical process provided by the Research Institute of Tobacco and Tobacco Products of Bulgaria. Evaluation of growth, the number of leaves, plant height, and yield parameters follows the National Technical Regulation on testing the value of cultivation and use of dried yellow tobacco varieties following QCVN 01- 85: 2012/BNN & PTNT, Vietnam. Rate of grade: National Standard 9271 - 85 of Bulgaria was used. Analysis of chemical components followed the standard of Vietnam as Nicotine: TCVN 7103: 2002 (ISO 2881:1992), total nitrogen: TCVN 7252: 2003, sugar: TCVN 7102: 2002 (CORESTA 38: 1994) and chlorine (clo): TCVN 7251: 2003. Quality assessment based on the Draft TCVN: Oriental raw tobacco - sensory assessment by the scoring method. Data collection was treated by Software of Excel and Statistics 8.2 [8].

3. RESULTS AND DISCUSSION

3.1 The Growing Time of Hanski 227 Oriental Tobacco Variety in Dak Lak Region from 2022 – 2024

3.1.1 Growing time of Hanski 227 oriental tobacco variety from planting stage to completing harvest

In order to evaluate the prospects of raw material quality and the ability to expand production with Hanski 227 oriental tobacco variety in Dak Lak in seasons of 2022 - 2023 and 2023 - 2024, the project carry out trial production of materials and results monitoring the growth of oriental tobacco in Dak Lak are shown in Table 1.

Table 1. The growth and development of Hanski 227 oriental tobacco variety in Dak Lak region from 2022 – 2024

Season	Experimental field	Time from planting to (days)		
		50% buds of plants	First ripe leaf	Last harvesting leaf
2022 - 2023	Experimental field 1	67	62	100
	Experimental field 2	66	63	101
	Experimental field 3	65	65	99
	Mean	66.0	63.3	100
2023 - 2024	Experimental field 1	59	57	95
	Experimental field 2	60	58	95
	Experimental field 3	60	57	95
	Mean	59.7	57.3	95.0

Time from planting to 50% of plants budding of Hanski 227 variety fluctuates from 65 - 67 DAP (Day after planting) and mean: 66.0 days in the 2022 - 2023 season, and 59 - 60 DAP and mean: 59.7 days in the 2023 - 2024 season [9]. The growing time of the Hanski 227 variety in the 2023 - 2024 season is about 06 days earlier than in the 2022 - 2023 season. The reason is that the weather conditions in the 2023-2024 season have a higher average temperature than in the 2022-2023 season by about 2 - 3°C, leading to the plants can mature earlier.

Time from planting to first leaf ripening of Hanski 227 oriental variety grown in Dak Lak region in 2022 - 2023 is from 62 - 65 DAP (mean: 63.3DAP) and 2023 – 2024: 57 - 58 DAP (mean: 57.3 DAP). Tobacco plants growing in the 2022 - 2023 season ripe later than in the 2023-2024 season by about 06 days.

The average time from planting to final harvest of Hanski 227 oriental tobacco variety in the 2023 -

2024 and 2022 - 2023 seasons corresponds to 95 DAP and 100 DAP [10]. In that, the growing time of Hanski 227 variety in the 2022-2023 season has a total growth period longer than in the 2023 - 2024 season by about 05 days.

3.1.2 Some biological characteristics impact on Hanski 227 tobacco oriental in Dak Lak region

The biological plant height, topping high plant, total leaf, and stem diameter of Hanski 227 have a little change from the 2022 - 2024 seasons, corresponding from 4.3 - 4.4 cm, 128.3 - 130.4 cm, 36.0 - 36.7, and 1.39 - 1.43. The result shows that those of Hanski 227 have stable biological characteristics when planted in the Dak Lak region.

Monitoring the leaves representing the central leaf of the plant in the trial production fields of the Hanski 227 variety from 2022 - 2023 is shown in Table 3. The length of the central leaf of the

Table 2. Some biological characteristics of the Hanski 227 oriental tobacco variety testing in Dak Lak from 2022 – 2024

Crop season	Experimental field	Biological plant height (cm)	Topping high plant (cm)	Total leaf	Stem diameter (cm)
2022-2023	Experimental field 1	140.3	127.9	36.1	1.39
	Experimental field 2	145.0	129.7	36.0	1.38
	Experimental field 3	143.2	127.2	36.0	1.40
	Medium	142.8	128.3	36.0	1.39
CV%		4.3			4.9
2023-2024	Experimental field 1	148.0	132.7	36.0	1.45
	Experimental field 2	143.0	127.3	37.0	1.44
	Experimental field 3	147.0	131.3	37.0	1.41
	Medium	146.0	130.4	36.7	1.43
CV%		4.4			5.8

Table 3. Leaf size of Oriental Hanski 227 tobacco variety testing in Dak Lak from 2022 – 2024

Crop season	Experimental field	Leaf size (cm)	
		Length	Width
2022-2023	Experimental field 1	32.9	19.7
	Experimental field 2	31.6	20.3
	Experimental field 3	32.2	19.6
	Medium	32.2	19.8
CV%		6.3	7.3
2023-2024	Experimental field 1	33.2	20.7
	Experimental field 2	29.8	21.6
	Experimental field 3	32.1	20.9
	Medium	31.7	21.1
CV%		5.7	6.5

Hanski 227 variety in the 2022 - 2023 ranges from 31.6 - 32.9 cm and 29.8 - 32.2 in the 2023 - 2024 crop season. The width of the central leaf ranges from 19.6 - 20.3 cm in 2022 - 2023 and 20.7 - 21.6 cm. The results show the average leaf length of Hanski 227 in the 2022-2023 and 2023-2024 crop seasons has little difference, ranging from 31.7 - 32.2 cm. The characteristics of the variety shown in the research content in Dak Lak in previous crop seasons. But the leaf width of this variety in 2023 - 2024 is larger than in 2022- 2023 by about 1.3 cm. General assessment: Hanski 227 oriental variety in planting in Dak Lak from 2022 - 2024 is good growth and development, highly stable, and suitable for the environment of Dak Lak region.

3.1.3 Insects and diseases causing the Hanski 227 oriental tobacco variety

The surveying results show the tobacco budworms (*Helicoverpa assulta* Guene), aphids (*Myzus persicae* Sulzer), Curly tip (*Tomato yellow leafcurl virus*), and leaf mosaic (*Tobacco mosaic virus*) harming the Hanski 227 variety in Dak Lak from 2022 - 2024 is assessed the negligible to mild damage. But the black sank (*Phytophthora parasitica* D.) and bacterial wilt (*Ralstonia solanacearum* S.) cause mild to quite severe damage (Table 4), with disease rate corresponding to 5.7 – 19.5% and mean 141%, and 4.3 - 15.5% and mean 10.9% in 2022 - 2023; 1.2 - 1.9% and mean 1.5%, and 4.5 - 6.1% and mean 5.3%. In general, in Dak Lak in 2022-2024, black sank and bacterial wilt disease damage from mild to quite severe, especially the field is not rotation with rice.

3.1.4 Yield and grade 1+2 of the Hanski 227 oriental tobacco variety

The number of harvested leaves of Hanski 227 in Dak Lak in the 2022-2023 season ranges from 28.7 - 28.9 leaves and a mean of 28.8 leaves; in the 2023 – 2024 season: 28.7 – 29.5 leaves and a mean of 29.1 leaves. The number of harvested leaves of Hanski 227 in two seasons is not significantly difficult.

The fresh leaf weight of Hanski 227 in the 2023 - 2024 season is lower than the 2022 - 2023 season by about 1g. For example, the fresh leaf weight of Hanski 227 in 2023 - 2024 ranges from 10.7 - 11g and mean 10.8g, and in the 2022 -

2023 season ranging from 11.3 - 12g and mean 11.8g.

The fresh/dry ratio of the Hanski 227 variety has a fairly low fresh/dry ratio, at 6.67 - 6.84 kg fresh leaves for 1.0 kg dry leaves in the 2022-2023 season and 6.14 - 6.35 kg fresh leaves for 1.0 kg dry leaves in the 2023-2024 season. Due to the dry and hot weather, the fresh/dry ratio of the 2023 - 2024 crop (average 6.26 kg fresh/1 kg dry) is lower than that of the 2022-2023 crop (average 6.76 kg fresh leaves/1 kg dry).

The 2022-2023 season has a yield of 15.03 - 15.50 tons/ha and a mean of 15.27 tons/ha, and 2023-2024: 15.22 - 18.40 tons/ha. IN 2023-2024, the average yield of the Hanski 227 variety is higher than the 2022-2023 crop by about 9%, which can be explained by the lower incidence of black sank and bacteria wilt diseases is lower than in the 2022 - 2022 season.

Grade 1+2 of Hanski 227 variety in the 2023 - 2024 season is higher than 2022 - 2023. In 2022 – 2023, grade 1+2 fluctuates from 77.8 - 80.0% crop and 81.9 - 84.6% in the 2023-2024 crop. Grade 1+2 of the Hanski 227 variety in the 2023 - 2024 season has a higher percentage than in the 2022 - 2023 season (78.9%) by 4.7% due to the 2023 - 2024 little rain as 2022 - 2023, which was favourable for the picking and drying stage.

3.2. Chemical Composition and Smoking Properties of Hanski 227 Oriental Tobacco Variety

3.2.1 Chemical composition of Hanski 227 oriental tobacco variety

The tobacco material samples of Hanski 227 in the trial production fields have nicotine content at a level typical of oriental tobacco materials, reaching 1.38% in 2022 - 2023 and 0.81% in 2023 - 2024. Reducing sugar content in both seasons in Dak Lak region is typical of the oriental material type, reaching 12.1% in 2022-2023 and 8.9% in 2023-2024. In particular, the chlorine content in the oriental leaf in Dak Lak region is lower than the control from Macedonia, with the chlorine content of Dak Lak ranging from 0.57 - 0.66%, while the controls are above 1.8%, which reduces burning ability, and the aroma of the oriental material.

Table 4. The Insects and diseases causing Hanski 227 oriental tobacco variety in Dak Lak region from 2022 – 2024

Crop	Experimental field	Infection rate (%)					
		Tobacco budworm	Tobacco aphid	Black sank	Bacterial wilt	Curly tip	Leaf mosaic
2022-2023	Experimental field 1	-	-	19.5	15.5	-	-
	Experimental field 2	-	-	5.7	4.3	-	-
	Experimental field 3	-	-	17.2	12.8	-	-
	Medium	-	-	14.1	10.9	-	-
2023-2024	Experimental field 1	-	-	1.2	4.5	-	-
	Experimental field 2	-	-	1.5	5.5	-	-
	Experimental field 3	-	-	1.9	6.1	-	-
	Medium	-	-	1.5	5.3	-	-

Note: (-) The level of harm is negligible

Table 5. Yield and grade 1+2 of hanski 227 variety testing in Dak Lak region from 2022 – 2024

Crop	Experimental field	Number of harvested leaves (leaves)	Fresh leaf weight (g)	Fresh/dry leaf ratio	Yield (tons/ha)	Leaf ratio level 1+2 (%)
2022-2023	Experimental field 1	28.8	12.0	6.84	15.03	77.8
	Experimental field 2	28.7	11.3	6.78	15.50	78.8
	Experimental field 3	28.9	12.0	6.67	15.28	80.0
	Medium	28.8	11.8	6.76	15.27	78.9
2023-2024	Experimental field 1	28.7	11.0	6.14	18.40	84.6
	Experimental field 2	29.1	10.7	6.29	15.22	81.9
	Experimental field 3	29.5	10.7	6.35	16.33	84.4
	Medium	29.1	10.8	6.26	16.65	83.6

Table 6. Chemical composition of Hanski 227 oriental tobacco variety testing in Dak Lak region from 2022 – 2024

Samples	Nicotine (%)	Reducing sugar (%)	Chloride (%)
2022 - 2023	1.38	12.1	0.66
2023 - 2024	0.81	8.9	0.57
Control 1 (Macedonia)	1.83	7.2	1.00
Control 2 (Macedonia)	1.81	7.1	1.01

Note: Chemical composition analysis of leaves C: Leaves in the middle of the plant

Table 7. Smoking properties of the Hanski 227 oriental tobacco variety trial production in Dak Lak from 2022 - 2024

Samples	Smoking points (points)					
	Aroma	Taste	Heavy smoking	Burning	Colour fiber	Total points
2022 - 2023	12.2	9.4	4.5	3.1	4.1	33.3
2023 - 2024	12.5	9.5	4.3	3.2	4.3	33.8
Control 1 (Macedonia)	11.5	9.2	4.5	2.5	3.5	31.2
Control 2 (Macedonia)	11.4	9.0	4.5	2.5	3.5	30.9

3.2.2 Sensory evaluation through oriental tobacco smoking

The Hanski 227 oriental tobacco material samples in 2 crop seasons (2022 - 2023 and 2023 - 2024) have a good aroma, medium to good aroma intensity, quite harmonious and uniform. Sample of in 2023 - 2024 has a better characteristic aroma than sample of 2022 - 2023. Domestically produced samples have a better characteristic aroma than imported samples (with a medium to good aroma) from Macedonia.

Oriental tobacco is a type of tobacco used for flavouring in the production of American-style cigarettes, so the flavour of this material is evaluated the most highly. The aroma of the material in both seasons is above 12 points and higher than the control (11.4 - 11.5 points), typical of oriental tobacco. In particular, the burning ability of the oriental of Dak Lak is better than the control, with the burning level of materials in Dak Lak at about 3.1 – 3.1 points and controls at 2.5 points. For the total points, 02 material samples of oriental in Dak Lak have total points reaching 33.3 - 33.8 points), while materials of Macedonia only reach 30.9 - 31.2 points. So both material samples of Hanski 227 variety in 2 crop seasons are assessed to have a good aroma, typical of Oriental raw material, good aroma intensity, good taste, rich, good weight, good suction properties, and are assessed to have a characteristic aroma and better suction properties than the 2 imported samples.

Hanski 227 oriental tobacco variety in trial planting has good growth and development in

Dak Lak region, has a fair yield, high level of 1+2 leaves and typical of oriental tobacco type about nicotine, reducing sugars, and good aroma. The oriental tobacco quality in Dak Lak is higher than oriental tobacco, which is imported from Macedonia. All oriental tobacco material produced in Dak Lak in the 2023 - 2024 season, with a yield above 5 tons is exported to China, and we are built a process of proper cultivation and curing for Hansky 227 oriental tobacco.

4. CONCLUSION AND RECOMMENDATION

After 2 years of trial cultivation of Oriental tobacco Hanski 227 in Dak Lak region, the Vietnam Tobacco Institute has selected Oriental Hanski 227 tobacco, which has good growth ability, high yield and good quality; low susceptibility to insects and diseases; and is suitable for soil and weather conditions in Dak Lak, Vietnam. The quality of oriental tobacco materials in Dak Lak is good and equivalent to imported samples from Macedonia, and all yield of oriental material produced in the 2023 – 2024 season is exported to China.

To create good quality raw materials for production in Vietnam, the Tobacco Institute has perfected the fertilizer formula, the process of growing, harvesting, drying and preserving Oriental tobacco. In addition to its growth ability, productivity, and raw material quality, the Hanski 227 variety is also rated higher than other varieties in terms of lower raw material production costs due to its small number of harvested leaves, large leaves, and low planting density.

To serve the domestic demand and export of oriental tobacco materials, the Tobacco Institute continues to expand the area of oriental tobacco cultivation in Dak Lak region in 2024 - 2025, with an area of about 20 hectares and continuing to improve the drying process to improve the quality of raw materials.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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