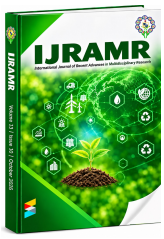
ISSN : 2350-0743

International Journal of Recent Advances in Multidisciplinary Research

Vol. 13, Issue 10, pp.12954-12962, October, 2026
https://doi.org/10.64485/ijramr.6772.10.2026



REVIEW ARTICLE

RESULTS OF FIELD TRIALS OF BASMA-GROUP ORIENTAL TOBACCO VARIETIES IN DAK LAK PROVINCE, VIETNAM, IN 2026

Do Dinh Dung[1], Nguyen Van Chin[1], Nguyen Van Nghia[1], Nguyen Van Van[1], Tao Ngoc Tuan[1], and Nguyen Quoc Tuan[2]

[1]Tobacco Research Institute, Hanoi, Vietnam; [2]Vietnam National Tobacco Corporation, Hanoi, Vietnam

ARTICLE INFO

Article History:
Received 18th July, 2026
Received in revised form
25th August, 2026
Accepted 24th September, 2026
Published online 30th October, 2026

Keywords:

Oriental tobacco; Basma type; Basma 16; Basma X; yield; sensory quality; Dak Lak Province, Vietnam.

Corresponding author:
Do Dinh Du

ABSTRACT

This study evaluated the adaptability, growth characteristics, yield, and leaf quality of seven Oriental tobacco cultivars grown in Ea Bung Commune, Dak Lak Province, Vietnam, in 2026, to identify promising Basma-type cultivars with distinctive aroma profiles for potential cultivation in Vietnam. The experiment included seven cultivars: Krumovgrad 58, Krumovgrad 78C, Krumovgrad 90, Elenski 817, POH 6002, Basma 16, and Basma X. The cultivars were arranged in a randomized complete block design with three replications and a plot size of 50 m². Fertilizer was applied at rates of 50 kg N, 30 kg P_2O_5, and 80 kg K_2O ha^{-1}. The evaluated parameters included growth duration, morphological characteristics, pest and disease incidence, yield, chemical composition, and sensory quality of the cured tobacco leaves. The results showed that the period from transplanting to the final harvest ranged from 85 to 100 days. Krumovgrad 78C produced the highest cured-leaf yield, at 1.66 t ha^{-1}. Basma 16 and Basma X had the highest numbers of harvestable leaves, at 40.8 and 41.7 leaves per plant, respectively, with corresponding yields of 1.487 and 1.464 t ha^{-1}. The proportion of Grade 1 and Grade 2 leaves ranged from 77.2% to 82.5%. Nicotine, reducing sugar, and chlorine contents ranged from 0.64% to 0.95%, 3.7% to 10.1%, and 0.73% to 1.03%, respectively. In sensory evaluations, Basma 16 and Basma X showed favorable distinctive aroma, aroma quality, and aroma complexity, achieving total sensory scores of 35.07 and 35.73 points, respectively. These scores were numerically higher than those of the Hanski 227 sample produced in Dak Lak (34.97 points) and the imported Oriental tobacco sample (32.42 points). However, the relatively high chlorine content of the two Basma cultivars warrants further investigation and optimization of cultivation and postharvest processing practices to improve leaf quality. The findings suggest that Basma 16 and Basma X are promising Basma-type Oriental tobacco cultivars for cultivation under the conditions evaluated in Dak Lak, particularly in terms of distinctive aroma quality. Further trials across multiple growing seasons, along with refined cultivation and postharvest processing practices, are needed to determine the stability of their yield and quality and assess their potential for broader cultivation in Vietnam.

Copyright©2026, Do Dinh Dung et al. *This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.*

Citation: Do Dinh Dung, Nguyen Van Chin, Nguyen Van Nghia, Nguyen Van Van, Tao Ngoc Tuan, and Nguyen Quoc Tuan, 2026. "Results of field trials of basma-group oriental tobacco varieties in dak lak province, vietnam, in 2026***" International Journal of Recent Advances in Multidisciplinary Research, 13,(10), 12954-12962.***

INTRODUCTION

Flue-cured Virginia, air-cured Burley, and Oriental tobacco are the three major tobacco types used in American Blend cigarette (Davis & Nielsen, 1999). In these blends, Virginia and Burley tobaccos generally make up the largest proportions, while Oriental tobacco typically accounts for about 5–10% of the blend. Despite its relatively low proportion, Oriental tobacco plays an important role in imparting a distinctive aroma and a mild smoking character. Its characteristic aromatic properties and relatively low nicotine content make it a valuable component of American Blend cigarette formulations (Kurt, 2021). Oriental tobacco is characterized by small leaves, considerable cultivar diversity, and adaptation to warm, relatively dry climatic conditions. Owing to its small leaf size, harvesting is generally performed manually, followed by sun-curing (Davis & Nielsen, 1999; Bozukov et al., 2021). Globally, Oriental tobacco is cultivated primarily in Türkiye and the Balkan region, particularly in Greece, North Macedonia, and Bulgaria (Universal Leaf Tobacco Company, 2021). Average cured-leaf yields generally range from 1.2 to 2.0 t ha^{-1}. Cultivar distribution varies among production regions according to local agroecological conditions and the characteristics required for commercial production. Representative cultivars include Izmir and Samsun in Türkiye; Basma and Katerini in Greece and the Balkan region; Prilep in North Macedonia; and Krumovgrad in Bulgaria (Nikolova et al., 2026; Universal Leaf Tobacco Company, 2021). Oriental tobacco ranks third in global production volume, following flue-cured Virginia and Burley

tobacco. Before 2010, global Oriental tobacco production exceeded 250,000 tonnes annually. However, production declined substantially thereafter, reaching approximately 103,000 tonnes in 2020 (Universal Leaf Tobacco Company, 2021). During 2021–2025, global production fluctuated between approximately 104,000 and 126,000 tonnes (Universal Leaf Tobacco Company, 2025). This decline has been associated, in part, with changes in agricultural policies in the European Union that encouraged the conversion of tobacco-growing areas to alternative crops. These changes have contributed to shifts in tobacco cultivation area and production. Under these circumstances, the evaluation and selection of suitable cultivars for Vietnam's agroecological conditions are important for diversifying raw-material sources, strengthening domestic production capacity, reducing dependence on imports, and developing the potential for export-oriented production.

In Vietnam, annual demand for Oriental tobacco leaf is estimated at approximately 1,500 tonnes, most of which is met through imports. To reduce import dependence and strengthen domestic raw-material supply, the Tobacco Research Institute has undertaken research and cultivar evaluation programs for Oriental tobacco. By 2025, the Institute had successfully introduced the Hanski 227 cultivar into production in Dak Lak Province, initially covering 30.2 ha. In 2026, the production area expanded to 118 ha, with an estimated output of 260 tonnes of tobacco leaf. The resulting raw material has been used by domestic cigarette manufacturers and assessed as being of acceptable quality, enabling partial substitution for imported Oriental tobacco. Nevertheless, further diversification of the cultivar portfolio and improvement of raw-material quality are needed to support sustainable domestic production and meet the requirements of cigarette manufacturers. Among Oriental tobacco groups, Basma is of particular interest because of its small leaf size, desirable raw-material quality, and characteristic aroma (Kurt, 2021; Saygili et al., 2021; Nikolova et al., 2025). Evaluating Basma cultivars under the agroecological conditions of Dak Lak Province is therefore important for determining their adaptability, yield potential, and raw-leaf quality. Such evaluations can provide a scientific basis for identifying promising cultivars for large-scale production, diversifying the domestic Oriental tobacco supply, and improving the availability of raw materials with desirable characteristics for cigarette manufacture. Accordingly, in 2026, the Tobacco Research Institute conducted field trials of seven Oriental tobacco entries in Dak Lak Province. These comprised two cultivars, Basma 16 and Basma X, which had previously been evaluated during 2021–2023; four Bulgarian-origin cultivars, namely Krumovgrad 58, Krumovgrad 78C, Krumovgrad 90, and Elenski 817; and one male-sterile entry originating from Brazil. The objective of this study was to evaluate the growth, yield, and raw-leaf quality of these entries under the agroecological conditions of Dak Lak Province and to identify one or two promising cultivars with desirable raw-material quality, the characteristic aroma associated with Basma tobacco, and suitability for local production.

MATERIALS AND METHODS

Experimental site: The field trial evaluating Oriental tobacco cultivars was conducted in Ea Bung Commune, Dak Lak Province, Vietnam, from December 2025 to May 2026.

The study area has climatic and soil conditions considered suitable for Oriental tobacco production. The mean annual temperature is approximately 24°C, with an average maximum temperature of approximately 35°C and an average minimum temperature of 18–20°C. During the experimental period (December 2025–May 2026), weather conditions were predominantly hot and dry, with abundant sunshine, limited rainfall, and low relative humidity. Relative humidity ranged from 35% to 78%, while rainfall ranged from 0.4 to 17.3 mm. These conditions were generally favorable for tobacco growth and the subsequent curing process. Soil analysis at the experimental site showed that total nitrogen (N) ranged from 0.94 to 1.22 mg g^{-1}, total phosphorus expressed as P_2O_5 ranged from 0.10% to 0.17%, and total potassium expressed as K_2O ranged from 0.54% to 0.67%. The concentrations of available soil nutrients were 4.45–5.05 mg per 100 g soil for nitrogen, 26.85–33.81 mg per 100 g soil for phosphorus, and 5.52–7.59 mg per 100 g soil for potassium. In addition, total soil organic matter ranged from 1.46% to 2.17%, soil pH measured in K_{Cl} ranged from 4.22 to 5.49, and soil chloride content ranged from 17 to 22 ppm. Overall, these soil characteristics indicate that the experimental site is considered suitable for Oriental tobacco cultivation.

Plant materials and fertilizers: Seven Oriental tobacco cultivars were evaluated in this study: Krumovgrad 58, Krumovgrad 78C, Krumovgrad 90, Elenski 817, POH6002, Basma 16, and Basma X. The fertilizers used in the experiment were ammonium nitrate (NH_4NO_3) as the nitrogen source, calcium dihydrogen phosphate [$Ca(H_2PO_4)_2$] as the phosphorus source, and potassium sulfate (K_2SO_4) as the potassium source.

Experimental design and crop management: Seeds were sown in a disease-free nursery. Seedlings at the four- to six-true-leaf stage were transplanted to the field at the prescribed planting densities for each cultivar group. For POH6002, Basma 16, and Basma X, plants were spaced 12 cm apart within rows, with 30 cm between rows, corresponding to a planting density of approximately 280,000 plants ha^{-1}. For Krumovgrad 58, Krumovgrad 78C, Krumovgrad 90, and Elenski 817, the within-row spacing was 15.5 cm, with 40 cm between rows, corresponding to a planting density of approximately 160,000 plants ha^{-1}. Based on the soil analysis results and previous experiments conducted in Dak Lak during 2021–2023, the fertilizer application rate was established at 50 kg N, 30 kg P_2O_5, and 80 kg K_2O ha^{-1} (Do Dinh Dung et al., 2022, 2023, 2024).

The experiment was arranged in a randomized complete block design (RCBD) comprising seven cultivars and three replications. Each experimental plot had an area of 50 m^2. All other agronomic practices, including crop maintenance, topping, harvesting leaves at the appropriate stage of maturity, curing, and storage of the cured tobacco, were applied uniformly across all treatments to ensure consistency and facilitate objective comparisons among cultivars.

Assessment criteria and evaluation methods: Oriental tobacco cultivation practices were implemented in accordance with the technical guidelines of the Bulgarian Tobacco and Tobacco Products Research Institute (Bozukov et al., 2021; Do Dinh Dung et al., 2023). The growth, development, yield, and quality traits of the Oriental tobacco cultivars were monitored and evaluated in accordance with the Institute

Standard TCCS 03:2024/VTL, entitled *Evaluation of the Cultivation Value and Use Value of Oriental Tobacco Cultivars* (Tobacco Research Institute, 2024).Cured tobacco leaves were graded according to Bulgarian State Standard 9271-85 (Bulgarian State Standard, 1985). The major chemical constituents of the tobacco leaf samples were analyzed at the Analytical Laboratory of the Tobacco Research Institute using the relevant Vietnamese standards. Nicotine content was determined according to TCVN 7103:2002 (ISO 2881:1992) (Ministry of Science and Technology, 2002b); total nitrogen content was determined according to TCVN 7252:2003 (Ministry of Science and Technology, 2003b); reducing sugar content was determined according to TCVN 7102:2002 (CORESTA 38:1994) (Ministry of Science and Technology, 2002a); and chlorine content was determined according to TCVN 7251:2003 (Ministry of Science and Technology, 2003a).

The sensory quality of the Oriental tobacco leaf samples was evaluated using a scoring method based on the draft Vietnamese Standard (TCVN) for the sensory evaluation of Oriental tobacco leaf. Sensory attributes were assessed in accordance with the procedures specified in the draft standard. Experimental data were compiled and organized using Microsoft Excel and statistically analyzed using Statistics software, version 8.2.

RESULTS AND DISCUSSION

Growth Duration of Oriental Tobacco Cultivars: To evaluate the growth characteristics and adaptability of Oriental tobacco cultivars introduced from Bulgaria and Brazil under the agroecological conditions of Dak Lak Province, Vietnam, a field experiment was conducted in 2026. The time from transplanting to key growth stages and the final harvest for each cultivar is presented in Table 1. The results presented in Table 1 indicate variation in growth duration among the Oriental tobacco cultivars, as reflected by the time required to reach key growth stages and complete harvesting. The number of days from transplanting to budding in 50% of the plants ranged from 52 to 67 days, whereas the time from transplanting to the maturity of the first leaf ranged from 50 to 64 days. The period from transplanting to final harvest ranged from 85 to 100 days. Among the evaluated cultivars, Krumovgrad 78C required the longest period to reach 50% budding (67 days), followed by Basma 16 and Basma X (66 days each). These cultivars also exhibited relatively late first-leaf maturity, occurring 63–64 days after transplanting, and reached final harvest 100 days after transplanting. In contrast, POH 6002 had the shortest growth duration, reaching 50% budding at 52 days, first-leaf maturity at 50 days, and final harvest at 85 days after transplanting. Elenski 817 also exhibited a relatively short growth duration, with corresponding periods of 56, 55, and 90 days, respectively.

Krumovgrad 58 and Krumovgrad 90 showed similar growth durations, reaching 50% budding 61 days after transplanting, first-leaf maturity at 60 days, and final harvest at 95 days. These results indicate differences in the timing of growth and maturity among the evaluated cultivars. POH 6002 and Elenski 817 were relatively early-maturing, whereas Krumovgrad 78C, Basma 16, and Basma X required longer periods to complete the production cycle. Overall, the evaluated Oriental tobacco cultivars reached final harvest within 85–100 days after transplanting under the agroecological conditions of Dak Lak Province during the 2026 growing season. The observed variation in growth duration provides a basis for considering cultivar suitability for local production schedules. However, a comprehensive assessment of adaptability and the stability of growth duration requires these results to be considered alongside growth performance, yield, and raw-leaf quality, preferably across multiple growing seasons or years.

Growth and Morphological Characteristics of Oriental Tobacco Cultivars: Plant height, total leaf number, and leaf dimensions are important morphological traits associated with plant growth, canopy structure, yield, and tobacco leaf quality. The growth and morphological characteristics of seven Oriental tobacco cultivars evaluated in Dak Lak Province, Vietnam, in 2026 are presented in Table 2.

Plant height: Plant height varied among the evaluated cultivars under the agroecological conditions of Dak Lak. Biological plant height ranged from 140.2 to 164.1 cm, whereas plant height after topping ranged from 128.4 to 152.0 cm. Krumovgrad 58 and Krumovgrad 90 exhibited the greatest biological heights, at 164.1 and 159.2 cm, respectively. Their corresponding heights after topping were 152.0 and 146.4 cm. In contrast, Basma 16 had the lowest biological plant height (140.2 cm), followed by Elenski 817 (145.5 cm) and Basma X (146.6 cm). Overall, the Basma cultivars tended to be shorter than Krumovgrad 58 and Krumovgrad 90. This pattern indicates differences in plant architecture among the cultivars, particularly when plant height is considered together with total leaf number.

Total leaf number per plant: Total leaf number ranged from 29.2 to 47.7 leaves plant^{-1}. Basma X produced the highest number of leaves (47.7 leaves plant^{-1}), followed by Basma 16 (46.8 leaves plant^{-1}) and Krumovgrad 78C (45.2 leaves plant^{-1}). According to the statistical groupings presented in Table 2, these three cultivars belonged to the group with the highest leaf numbers. In contrast, Elenski 817 and Krumovgrad 58 had the lowest leaf numbers, at 29.2 and 30.4 leaves plant^{-1}, respectively. Krumovgrad 90 produced 32.0 leaves plant^{-1}, whereas POH 6002 produced 34.7 leaves plant^{-1}. Thus, Basma 16 and Basma X combined relatively short plant stature with higher mean leaf numbers than Krumovgrad 58, Krumovgrad 90, and Elenski 817.

Leaf dimensions and fresh leaf weight: Leaf dimensions differed among the evaluated cultivars. Leaf length ranged from 20.1 to 29.2 cm, while leaf width ranged from 10.0 to 17.5 cm. Basma 16 and Basma X had the smallest leaves, with lengths of 20.8 and 20.1 cm and widths of 10.1 and 10.0 cm, respectively. These measurements are consistent with the small-leaved morphology characteristic of the Basma group. Krumovgrad 90 had the largest leaves, with a length of 29.2 cm and a width of 17.5 cm. Elenski 817 also exhibited relatively large leaves, measuring 27.5 cm in length and 16.4 cm in width. Krumovgrad 58 and POH 6002 had leaf lengths of 26.1 and 25.8 cm, respectively, and corresponding widths of 15.1 and 12.9 cm. Krumovgrad 78C had intermediate leaf dimensions, with a length of 23.2 cm and a width of 14.4 cm. Fresh leaf weight ranged from 4.0 to 8.0 g leaf^{-1}. Krumovgrad 90 had the highest fresh leaf weight (8.0 g leaf^{-1}), followed by Elenski 817 (7.0 g leaf^{-1}) and Krumovgrad 58 (6.7 g leaf^{-1}). In contrast, Basma X had the lowest fresh leaf weight

Table 1. Growth duration of Oriental tobacco cultivars in Dak Lak Province in 2026

Cultivar	Days from transplanting to 50% budding	Days from transplanting to first leaf maturity	Days from transplanting to final harvest
Krumovgrad 58	61	60	95
Krumovgrad 78C	67	64	100
Krumovgrad 90	61	60	95
Elenski 817	56	55	90
POH 6002	52	50	85
Basma 16	66	63	100
Basma X	66	63	100

Table 2. Growth and morphological characteristics of Oriental cultivarsin Dak Lak Province in 2026

Cultivar	Biological plant height (cm)	Plant height after topping (cm)	Total leaves (leaves plant^{-1})	Leaf length (cm)	Leaf width (cm)	Fresh leaf weight (g leaf^{-1})
Krumovgrad 58	164.1^{a}	152.0^{a}	30.4^{c}	26.1^{ab}	15.1^{bc}	6.7
Krumovgrad 78C	153.9^{ab}	142.8^{abc}	45.2^{a}	23.2^{bc}	14.4^{cd}	5.3
Krumovgrad 90	159.2^{a}	146.4^{ab}	32.0^{bc}	29.2^{a}	17.5^{a}	8.0
Elenski 817	145.5^{bc}	128.4^{d}	29.2^{c}	27.5^{a}	16.4^{ab}	7.0
POH 6002	154.6^{ab}	149.0^{a}	34.7^{b}	25.8^{ab}	12.9^{d}	5.0
Basma 16	140.2^{c}	130.8^{cd}	46.8^{a}	20.8^{c}	10.1^{e}	4.7
Basma X	146.6^{bc}	135.3^{bcd}	47.7^{a}	20.1^{c}	10.0^{e}	4.0
CV (%)	4.16	5.03	5.37	9.38	6.41	—
CVC	11.26	12.58	3.63	4.11	1.57	—

Note:CVC denotes the critical value for comparison. Within each column, means followed by the same superscript letter are not significantly different at the 5% significance level. CV, coefficient of variation. The statistical comparison procedure should be specified in the Methods section.

Table 3. Pest and disease infestation in Oriental tobacco cultivarsin Dak Lak province in 2026

Cultivar	[1]Damage severity		Disease incidence (%)			
	Tobacco budworm	Tobacco Aphids	Blackshank	Bacterial wilt	Tomato yellow leafcurl virus	Cucumber mosaic virus
Krumovgrad 58	-	-	1.77	-	-	-
Krumovgrad 78C	-	-	1.80	-	-	-
Krumovgrad 90	-	-	1.83	-	-	-
Elenski 817	-	-	1.34	-	-	-
POH 6002	-	-	2.30	-	-	-
Basma 16	-	-	3.20	-	-	-
Basma X			2.13			

Notes: [1]Pest damage severity: (–): Negligible damage, with a damage rate of less than 1%; (+): Slight damage, with a damage rate of 1–5%; (++): Moderate damage, with a damage rate of 5–10%; (+++): Severe damage, with a damage rate of 10–25%; (++++): Very severe damage, with a damage rate of >26%.

Table 4. Yield components and yield of Oriental tobacco cultivars evaluated in Dak Lak Province, Vietnam

Cultivar	Harvested leaves (leaves plant^{-1})	Fresh-to-dry weight ratio	Yield (t ha^{-1})	Grade 1 + 2 leaves (%)
Krumovgrad 58	27.2 bc	7.61	1.58 ab	81.5
Krumovgrad 78C	40.2 a	7.69	1.67 a	80.6
Krumovgrad 90	27.4 bc	7.37	1.58 ab	82.5
Elenski 817	25.6 c	7.31	1.57 ab	81.3
POH 6002	30.6 b	7.10	1.49 ab	79.1
Basma 16	40.8 a	7.37	1.49 ab	78.8
Basma X	41.7 a	7.66	1.44 b	77.2
CV (%)	6.16	-	6.60	-
CVC	3.65	-	1.81	-

Note: CVC, critical value for comparison. Within a column, means followed by the same letter are not significantly different at the 95% confidence level.

Table 5. Chemical composition of Oriental tobacco from cultivars in Dak Lak Province, Vietnamin 2026

Cultivar	Nicotine (%)	Reducing sugars (%)	Chloride (%)
Krumovgrad 58	0.64	5.4	0.73
Krumovgrad 78C	0.72	7.2	0.75
Krumovgrad 90	0.78	8.1	0.80
Elenski 817	0.95	8.5	0.82
POH 6002	0.64	3.7	0.81
Basma 16	0.82	6.4	1.01
Basma X	0.83	10.1	1.03

Note: Chemical composition was determined using leaf samples collected from the middle stalk position (C).

Table 6. Sensory evaluation of Oriental tobacco varieties grown in Dak Lak Province, Vietnam in 2026

Variety	Smoking points							
	Aroma profile	Aroma quality	Aroma structure and characteristics	Taste	Heavy smoking	Burning	Color	Total score
Krumovgrad 58	8.94	4.39	4.36	10.73	2.47	2.25	1.60	34.74
Krumovgrad 78C	8.56	4.19	4.14	10.00	2.43	2.25	1.60	33.16
Krumovgrad 90	8.94	4.50	4.42	10.40	2.45	2.25	1.60	34.56
Elenski 817	8.74	4.32	4.34	10.20	2.36	2.40	1.60	33.96
POH 6002	8.89	4.42	4.39	10.37	2.33	2.40	1.40	34.19
Basma 16	9.22	4.53	4.56	10.40	2.37	2.40	1.60	35.07
Basma X	9.47	4.68	4.53	10.70	2.35	2.40	1.60	35.73

Table 7. Chemical composition of Oriental tobaccoCultivar/sample

Cultivar/sample	Nicotine (%)	Reducing sugars (%)	Chloride (%)
Basma 16	0.82	6.4	1.01
Basma X	0.83	10.1	1.03
Hanski 227	1.11	10.9	0.48
Imported Izmir-type tobacco (Türkiye)	0.66	4.7	0.45

Table 8. Sensory evaluation of Oriental tobacco varieties grown in Dak Lak Province, Vietnam, in 2026 and imported tobacco

Cultivar/sample	Smoking points							
	Aroma profile	Aroma quality	Aroma structure and characteristics	Taste	Heavy smoking	Burning	Color	Total score
Basma 16	9.22	4.53	4.56	10.40	2.37	2.40	1.60	35.07
Basma X	9.47	4.68	4.53	10.70	2.35	2.40	1.60	35.73
Hanski 227 SX	9.24	4.47	4.47	10.60	2.38	2.40	1.40	34.97
Imported Izmirtobacco (Türkiye)	8.28	4.11	4.11	9.80	2.32	2.40	1.40	32.42

(4.0 g leaf^{-1}), followed by Basma 16 (4.7 g leaf^{-1}). These results indicate a general tendency for cultivars with larger leaves to have greater fresh leaf weight, whereas the Basma cultivars had smaller and lighter leaves.

Relationships among plant height, leaf number, and morphological traits: When plant height and total leaf number were considered together, Basma 16 and Basma X were notable for their high leaf numbers of 46.8 and 47.7 leaves plant^{-1}, respectively, despite their relatively low biological plant heights of 140.2 and 146.6 cm. Based on plant height and leaf number, mean internode length was estimated to be approximately 3.0 cm for the two Basma cultivars, compared with approximately 3.4 cm for Krumovgrad 78C, 4.4 cm for Elenski 817 and POH 6002, and 5.2 cm for Krumovgrad 58 and Krumovgrad 90. These observations suggest that the Basma cultivars have a relatively compact plant architecture, characterized by shorter stature, a greater number of leaves, and smaller leaf dimensions.

These morphological characteristics are relevant when evaluating cultivars belonging to the Basma group. However, total leaf number should not be interpreted directly as the number of harvestable leaves or as an indicator of cured-leaf yield. These outcomes also depend on the proportion of harvestable leaves, cured-leaf weight, and leaf quality after curing and processing. Overall, the evaluated cultivars exhibited considerable variation in their morphological characteristics. Krumovgrad 58 and Krumovgrad 90 tended to be taller and had larger, heavier fresh leaves, whereas Basma 16 and Basma X were relatively short, produced more leaves per plant, and exhibited the characteristic small-leaf morphology of the Basma group. These differences provide a basis for further evaluation of yield, cured-leaf quality, and cultivar suitability for Oriental tobacco production in Dak Lak Province.

Pest and Disease Incidence in Oriental Tobacco Cultivars in Dak Lak Province: Pests and diseases pose major threats to tobacco production in cultivated areas. Identifying Oriental tobacco cultivars with tolerance to major pests and diseases is important for diversifying the cultivar portfolio and promoting safe and sustainable tobacco production in Dak Lak Province. The results in the field trial indicated that the evaluated cultivars exhibited low levels of infestation by several major pests and diseases under field conditions. Tobacco budworms and tobacco aphids caused negligible damage across all evaluated cultivars, with infestation rates below 1%. These insect pests were observed from transplanting to the pre-flowering stage. Overall, under the field conditions in 2026, tobacco budworms and aphids did not cause appreciable damage to the growth and development of the Oriental tobacco cultivars evaluated in Dak Lak Province.

Regarding diseases, black shank was the principal disease observed in the experimental field, with symptoms appearing 30–40 days after transplanting. Disease incidence among the evaluated cultivars ranged from 1.34% to 3.20% (Table 3). Elenski 817 had the lowest disease incidence (1.34%), followed by Krumovgrad 58 (1.77%), Krumovgrad 78C (1.80%), Krumovgrad 90 (1.83%), Basma X (2.13%), and POH 6002 (2.30%). Basma 16 exhibited the highest disease incidence, at 3.20%. Other diseases, including bacterial wilt, tomato yellow leaf curl disease, and cucumber mosaic disease, were observed sporadically and caused negligible damage. Overall, the results indicated that pest infestation and the incidence of several major diseases were low in the evaluated Oriental tobacco cultivars under the experimental conditions in Dak Lak Province in 2026. These findings provide a preliminary basis for further evaluating cultivar performance in terms of growth, yield, raw-leaf quality, and pest and disease responses under local production conditions. However, additional trials across multiple growing seasons and locations

are needed to establish the stability of these responses and determine the relative tolerance of the cultivars to major pests and diseases.

Yield and Raw Leaf Quality of Oriental Tobacco Cultivars: The yield components and yield of the seven Oriental tobacco cultivars evaluated in Dak Lak Province in 2026 are presented in Table 4. The results showed variation in the number of harvested leaves per plant among the evaluated cultivars, ranging from 25.6 to 41.7 leaves plant^{-1}. Basma X had the highest number of harvested leaves (41.7 leaves plant^{-1}), followed by Basma 16 (40.8 leaves plant^{-1}) and Krumovgrad 78C (40.2 leaves plant^{-1}). These three cultivars belonged to the same statistical group according to the mean comparison at the 95% confidence level. POH 6002 produced 30.6 harvested leaves plant^{-1}, whereas Krumovgrad 58 and Krumovgrad 90 produced 27.2 and 27.4 leaves plant^{-1}, respectively. Elenski 817 had the lowest number of harvested leaves, at 25.6 leaves plant^{-1}. These results indicate that the Basma cultivars and Krumovgrad 78C had relatively high numbers of harvested leaves compared with the other cultivars.

The fresh-to-dry weight ratio reflects the amount of fresh leaf material required to produce a unit of dry tobacco leaf and provides an indication of weight loss during curing. Among the evaluated cultivars, POH 6002 had the lowest ratio (7.10), followed by Elenski 817 (7.31), and Krumovgrad 90 and Basma 16 (both 7.37). Higher ratios were recorded for Krumovgrad 58 (7.61), Basma X (7.66), and Krumovgrad 78C (7.69). Thus, POH 6002 had the lowest fresh-to-dry weight ratio, whereas Krumovgrad 78C had the highest. However, this parameter should be interpreted in conjunction with cured-leaf yield and post-curing quality to provide a comprehensive assessment of production performance. Regarding cured-leaf yield, Krumovgrad 78C recorded the highest value, at 1.67 t ha^{-1}, followed by Krumovgrad 58 and Krumovgrad 90 (both 1.58 t ha^{-1}), Elenski 817 (1.57 t ha^{-1}), and POH 6002 and Basma 16 (both 1.49 t ha^{-1}). Basma X had the lowest yield, at 1.44 t ha^{-1}. According to the statistical grouping, Krumovgrad 78C belonged to the highest-yielding group and differed significantly from Basma X. However, the results do not support the conclusion that Krumovgrad 78C differed significantly from all other cultivars, as several cultivars shared the same grouping letter.

Notably, Krumovgrad 78C achieved the highest yield despite not having the largest leaves. This result may be associated with its relatively high number of harvested leaves (40.2 leaves plant^{-1}). In contrast, although Basma 16 and Basma X produced the highest numbers of harvested leaves, their yields were only 1.49 and 1.44 t ha^{-1}, respectively. These findings indicate that the number of harvested leaves alone does not determine yield; leaf size, individual leaf weight, and dry matter accumulation also contribute to overall productivity. Across the evaluated cultivars, cured-leaf yield ranged from 1.44 to 1.67 t ha^{-1}, indicating a relatively narrow range of absolute yield differences. Regarding leaf grade distribution, the combined proportion of Grade 1 and Grade 2 leaves ranged from 77.2% to 82.5%. Krumovgrad 90 had the highest proportion of Grade 1 and Grade 2 leaves (82.5%), followed by Krumovgrad 58 (81.5%), Elenski 817 (81.3%), and Krumovgrad 78C (80.6%). POH 6002 and Basma 16 recorded values of 79.1% and 78.8%, respectively, whereas Basma X had the lowest proportion, at 77.2%. These findings indicate that all evaluated cultivars produced relatively high proportions of Grade 1 and Grade 2 leaves, with Krumovgrad 90 showing the most favorable grade distribution. Overall, Krumovgrad 78C showed advantages in cured-leaf yield and the number of harvested leaves, whereas Krumovgrad 90 had the highest proportion of Grade 1 and Grade 2 leaves. Basma 16 and Basma X were characterized by high numbers of harvested leaves but relatively low yields, consistent with the small-leaf morphology associated with the Basma group. Therefore, cultivar selection should not be based on yield alone but should also consider the proportion of higher-grade leaves, characteristic aroma, and chemical composition of the cured leaf. For Basma-type tobacco, its distinctive aroma is an important quality attribute that should be evaluated alongside quantitative agronomic and quality parameters to determine its suitability for use in cigarette blending.

Chemical Composition of Oriental Tobacco Leaf: Chemical composition is an important indicator for evaluating the quality of Oriental tobacco leaf, particularly in terms of nicotine, reducing sugars, and chloride content. The chemical composition of the seven Oriental tobacco cultivars evaluated in Dak Lak Province in 2026 is presented in Table 5. The results showed differences in nicotine and reducing sugar contents among the evaluated cultivars, reflecting their distinct chemical characteristics. Nicotine content ranged from 0.64% to 0.95%. Elenski 817 had the highest nicotine content (0.95%), followed by Basma X (0.83%), Basma 16 (0.82%), Krumovgrad 90 (0.78%), and Krumovgrad 78C (0.72%). Krumovgrad 58 and POH 6002 had the lowest nicotine content, both at 0.64%. Overall, nicotine levels in the evaluated cultivars were relatively low, consistent with the characteristics commonly reported for Oriental tobacco leaf (Kurt, 2021; Bozhinova et al., 2023).

Reducing sugar content ranged from 3.7% to 10.1%. Basma X had the highest reducing sugar content (10.1%), followed by Elenski 817 (8.5%), Krumovgrad 90 (8.1%), Krumovgrad 78C (7.2%), and Basma 16 (6.4%). Krumovgrad 58 contained 5.4% reducing sugars, whereas POH 6002 had the lowest content, at 3.7%. These differences indicate variation in the chemical characteristics of the raw leaf among cultivars. In Oriental tobacco, reducing sugars are among the constituents associated with taste characteristics and flavor balance. However, sensory quality depends not only on reducing sugar content but also on the balance among chemical constituents and the characteristic aroma of each cultivar. Chloride content ranged from 0.73% to 1.03% and was higher in the Basma cultivars than in most of the Bulgarian-origin cultivars. Specifically, Basma X and Basma 16 contained 1.03% and 1.01% chloride, respectively. Among the Krumovgrad cultivars, chloride content ranged from 0.73% in Krumovgrad 58 to 0.80% in Krumovgrad 90. Elenski 817 and POH 6002 contained 0.82% and 0.81% chloride, respectively. Thus, Basma 16 and Basma X had the highest chloride contents among the evaluated cultivars. Chloride content is an important quality parameter because it can affect the burning characteristics and usability of tobacco leaf. High chloride concentrations may impair combustibility and adversely affect tobacco aroma (Darvishzadeh et al., 2011; Nikolova et al., 2026). Therefore, the relatively high chloride contents of Basma 16 and Basma X should be considered when assessing their raw-leaf quality and suitability for cigarette blending. Overall, the evaluated cultivars differed in their chemical composition. Elenski 817 had the highest nicotine content, Basma X had the highest reducing sugar content, and Krumovgrad 58 had the lowest chloride content.

In contrast, Basma 16 and Basma X exhibited higher chloride contents than the other cultivars. These differences provide a basis for comparing the chemical quality of the evaluated cultivars. Nevertheless, cultivar selection should integrate chemical composition with sensory evaluation, particularly characteristic aroma, as well as yield and the proportion of higher-grade leaves, to determine the suitability of each cultivar for Oriental tobacco production in Vietnam.

Sensory Evaluation and Smoking Quality of Oriental Tobacco Varieties: Aroma is a key attribute that determines the sensory quality of Oriental tobacco, as it contributes to the distinctive characteristics of this tobacco type when used in American Blend cigarette formulations (Nikolova et al., 2025; Nikolova et al., 2026). Table 6 presents the sensory evaluation results for the varieties tested in 2026. The results in Table 6 indicated differences among the tested varieties across the sensory attributes evaluated. Among them, Basma 16 and Basma X exhibited outstanding aromatic characteristics, including aroma profile, aroma quality, and aroma structure and characteristics. Specifically, Basma X achieved the highest score for aroma profile (9.47 points), followed by Basma 16 (9.22 points). Krumovgrad 58 and Krumovgrad 90 both scored 8.94 points, followed by POH 6002 (8.89 points), Elenski 817 (8.74 points), and Krumovgrad 78C, which recorded the lowest score (8.56 points). Regarding aroma quality, Basma X achieved the highest score (4.68 points), followed by Basma 16 (4.53 points) and Krumovgrad 90 (4.50 points). Similarly, for aroma structure and characteristics, Basma 16 had the highest score (4.56 points), followed by Basma X (4.53 points), with both varieties outperforming the remaining entries. Aroma scores of Krumovgrad 90 and POH 6002 scored 4.42 and 4.39 points, respectively, whereas Krumovgrad 78C recorded the lowest score (4.14 points). These findings indicate that Basma 16 and Basma X have advantages in terms of aromatic characteristics, supporting their potential for selection as raw materials with the characteristic aroma profile of the Basma tobacco group.

For the taste attribute, the scores ranged from 10.00 to 10.73 points. Krumovgrad 58 achieved the highest score (10.73 points), closely followed by Basma X (10.70 points). Basma 16 and Krumovgrad 90 both scored 10.40 points, followed by POH 6002 (10.37 points), Elenski 817 (10.20 points), and Krumovgrad 78C (10.00 points). Thus, in addition to its favourable aromatic characteristics, Basma X also demonstrated a relatively high taste score, approaching the highest value recorded for Krumovgrad 58. Based on the combined scores for all sensory attributes, including aroma profile, aroma quality, aroma structure and characteristics, smoking taste, body, combustibility, and colour, Basma X achieved the highest overall score (35.73 points), followed by Basma 16 (35.07 points). The other varieties scored between 33.16 and 34.74 points. Specifically, Krumovgrad 58 scored 34.74 points, Krumovgrad 90 scored 34.56 points, POH 6002 scored 34.19 points, Elenski 817 scored 33.96 points, and Krumovgrad 78C scored 33.16 points. Overall, the sensory evaluation results identified Basma X and Basma 16 as the two most promising varieties in terms of aromatic characteristics and overall sensory scores under the experimental conditions in Dak Lak Province in 2026. Basma X showed advantages in overall sensory score, aroma profile, and aroma quality, whereas Basma 16 achieved the highest score for aroma structure and characteristics. These preliminary findings suggest that both varieties have potential as sources of raw tobacco with the characteristic aroma of the Basma group. However, a comprehensive assessment of their suitability for practical application and commercial production should also consider agronomic performance, the proportion of high-grade leaves, chemical composition, adaptability to local growing conditions, and production costs at commercial scale. Further evaluations across multiple growing seasons are also necessary to determine the stability of their agronomic performance and raw tobacco quality.

Comparison of the quality of Basma with Hanski 227 and imported tobacco: To evaluate the quality of Basma-type Oriental tobacco grown in a field trial in Dak Lak Province, Vietnam, in 2026, the chemical composition of two varieties, Basma 16 and Basma X, was compared with that of Hanski 227, grown in Dak Lak in the same year, and an imported Oriental tobacco sample of the Izmir type from Türkiye, harvested in 2025. The results in Table 7 showed differences in nicotine, reducing sugar, and chloride contents among the tobacco samples. Hanski 227 had the highest nicotine and reducing sugar contents, at 1.11% and 10.9%, respectively. Basma 16 and Basma X had nicotine contents of 0.82% and 0.83%, respectively, while their reducing sugar contents were 6.4% and 10.1%, respectively. The imported tobacco sample had the lowest nicotine and reducing sugar contents, at 0.66% and 4.7%, respectively. Regarding chloride content, Basma 16 and Basma X had values of 1.01% and 1.03%, respectively, which were higher than those of the reference samples. In contrast, the chloride contents of Hanski 227 and the imported sample were 0.48% and 0.45%, respectively. These results indicate that the Basma varieties had substantially higher chloride contents than Hanski 227 and the imported sample in terms of the measured values. The high chloride contents observed in both Basma varieties warrant further investigation to support the refinement of cultivation practices and improve raw tobacco quality. Further studies should identify the potential sources of chloride accumulation, including soil, irrigation water, and fertilizers, and investigate the effects of irrigation management on chloride uptake and accumulation in tobacco plants. The findings could provide a basis for developing appropriate agronomic practices to reduce chloride accumulation in leaves and improve the quality of Basma-type Oriental tobacco.

The sensory evaluation results showed that Basma 16 and Basma X grown in Dak Lak Province had good sensory quality, particularly in terms of their aromatic characteristics. The scores for aroma profile, aroma quality, and aroma structure and characteristics ranged from 9.22 to 9.47, 4.53 to 4.68, and 4.53 to 4.56 points, respectively. These values were comparable to or higher than those of Hanski 227 SX, which scored 9.24, 4.47, and 4.47 points, respectively, and were higher than those of the imported tobacco sample (8.28, 4.11, and 4.11 points, respectively). Regarding taste, body, and combustibility, the two Basma varieties achieved scores comparable to those of Hanski 227 SX. Specifically, the taste scores of Basma 16 and Basma X were 10.40 and 10.70 points, respectively, compared with 10.60 points for Hanski 227 SX. Their body scores were 2.37 and 2.35 points, respectively, compared with 2.38 points for Hanski 227 SX. All three varieties received a combustibility score of 2.40 points. These scores were generally comparable to or higher than those of the imported tobacco sample. The overall sensory scores of Basma 16 and Basma X were 35.07 and 35.73 points, respectively, exceeding those of Hanski 227 SX

(34.97 points) and the imported tobacco sample (32.42 points). Basma X achieved the highest overall sensory score and showed particularly favourable scores for aroma profile, aroma quality, and taste. These findings indicate that both Basma varieties have potential to produce Oriental tobacco raw material with good sensory quality under the growing conditions in Dak Lak Province. Overall, the field trial conducted in Ea Bung Commune in 2026, Dak Lak Province, provided preliminary evidence that Basma 16 and Basma X can adapt to local cultivation conditions and produce satisfactory yields and favourable sensory quality, particularly in terms of their characteristic aroma. The raw material from these varieties may be suitable for use in blending high-quality cigarette products. However, further evaluation across multiple growing seasons is required to confirm their suitability for commercial production and the consistency of their performance in terms of yield, leaf grade distribution, chemical composition, chloride content, and overall raw tobacco quality.

CONCLUSION

The 2026 field trial conducted in Dak Lak Province, Vietnam, revealed differences in growth duration, yield, and quality among the seven Oriental tobacco cultivars. Cured-leaf yield ranged from 1.44 to 1.67 t ha^{-1}. Krumovgrad 78C recorded the highest yield (1.67 t ha^{-1}), whereas Krumovgrad 90 had the highest proportion of Grade 1 and Grade 2 leaves (82.5%). Basma 16 and Basma X were characterised by small leaves and high numbers of harvestable leaves, typical of the Basma group. Basma 16 and Basma X exhibited promising sensory quality, with overall sensory scores of 35.07 and 35.73 points, respectively, exceeding those of Hanski 227 SX (34.97 points) and the imported Izmir-type Oriental tobacco sample (32.42 points). Basma X achieved the highest overall sensory score, aroma profile score, and aroma quality score, while Basma 16 received the highest score for aroma structure and characteristics. These findings indicate the potential of both cultivars for use in cigarette blending. However, the chloride contents of Basma 16 and Basma X (1.01–1.03%) were higher than those of the reference samples. Further trials across multiple growing seasons and locations are needed to confirm the stability of their agronomic performance and leaf quality, as well as to investigate cultivation practices that could reduce chloride accumulation in the leaves. Overall, Basma 16 and Basma X are promising candidates for Oriental tobacco production in Vietnam, particularly because of their distinctive aromatic characteristics.

RECOMMENDATIONS

The Tobacco Research Institute will continue small- and large-scale field trials of promising Basma-type Oriental tobacco cultivars in Dak Lak Province to further evaluate their adaptability under larger-scale production conditions. In parallel, cultivation and sun-curing protocols will be further developed and optimized to improve cured-leaf yield and quality and ensure consistency across growing seasons.

The development of domestic Oriental tobacco production areas will help supply high-quality raw materials to cigarette manufacturers, gradually reduce dependence on imported tobacco, and improve production efficiency in Vietnam's tobacco industry.

REFERENCES

Bozhinova, R., Nikolova, V. & Nikolov, N. (2023). Investigation on the mineral composition and burning properties of oriental tobacco of Krumovgrad ecotype. Bulgarian Journal of Soil Science, Agrochemistry and Ecology, 57(1), 35–44.

Bozukov, H., Kasheva, M. & Kochev, Y. (2021). Experimental growing of Bulgarian oriental tobacco varieties in the Republic of Vietnam. Bulgarian Journal of Crop Science, 58(1), 50–54.

Bulgarian State Standard. (1985). Bulgarian State Standard 9271-85: Processed and fermented Bulgarian Oriental tobacco. General Agency of Standardisation, Sofia, Bulgaria.

Darvishzadeh, R., Alavi, S. R. & Sarafi, A. (2011). Genetic variability for chlorine concentration in oriental tobacco genotypes. Archives of Agronomy and Soil Science, 57(2), 167–177. https://doi.org/10.1080/03650340903286414

Davis, D. L. & Nielsen, M. T. (Eds.). (1999). Tobacco: Production, Chemistry and Technology. Blackwell Science, Oxford.

Do Dinh Dung, Nguyen Van Chin, Ho Thai Binh, Nguyen Van Lu, Nguyen Van Van, Tao Ngoc Tuan & Pham Ha Thanh. (2022). Results of trial Oriental tobacco varieties planting in Ninh Thuan and Dak Lak Province, Vietnam in 2021. Journal of Experimental Agriculture International, 44(2), 78–87. https://doi.org/10.9734/jeai/2022/v44i230801

Do Dinh Dung, Nguyen Van Chin, Bui Quoc Viet, Nguyen Van Van, Tao Ngoc Tuan & Pham Ha Thanh. (2023). Results of trial transplanting of Oriental tobacco varieties in Dak Lak Province, Vietnam in 2022. Journal of Experimental Agriculture International, 45(7), 105–112. https://doi.org/10.9734/jeai/2023/v45i72139

Do Dinh Dung, Nguyen Van Chin, Ngo Van Du, Nguyen Van Van, Tao Ngoc Tuan & Pham Ha Thanh. (2024). Performance and evaluation of Hanski 227 Oriental tobacco in Dak Lak Region, Vietnam from 2022–2024. Annual Research & Review in Biology, 39(10), 28–35. https://doi.org/10.9734/arrb/2024/v39i102137

Dursun Kurt, Yılmaz, G. & Kınay, A. (2020). Effects of environmental variations on yield of Oriental tobaccos. International Journal of Agriculture and Wildlife Science, 6(2), 310–324. https://doi.org/10.24180/ijaws.680296

Kurt, D. (2021). Impacts of environmental variations on quality and chemical contents of Oriental tobacco. Contributions to Tobacco & Nicotine Research, 30(1), 50–62.
https://doi.org/10.2478/cttr-2021-0006

Ministry of Science and Technology. (2002a). TCVN 7102:2002 (CORESTA 38:1994): Tobacco—Determination of reducing sugars by continuous flow analysis.

Ministry of Science and Technology. (2002b). TCVN 7103:2002 (ISO 2881:1992): Tobacco and tobacco products—Determination of alkaloid content—Spectrometric method.

Ministry of Science and Technology. (2003a). TCVN 7251:2003: Tobacco and tobacco products—Determination of soluble chloride content.

Ministry of Science and Technology. (2003b). TCVN 7252:2003: Tobacco and tobacco products—Determination of total nitrogen content.

Nikolova, V., Nikolov, N., Popova, V., Petrova, T., Dyulgerski, Y. & Bozhinova, R. (2025). Technological profile and quality level of tobaccos from Basmi variety group dominating the Bulgarian market. BIO Web of Conferences, 170, 01018. https://doi.org/10.1051/bioconf/202517001018

Nikolova, V., Nikolov, N., Bozhinova, R. & Popova, V. (2026). Chemical composition of Oriental tobacco of Krumovgrad ecotype in relation to quality and combustibility. Bulgarian Journal of Agricultural Science, 32(2), 344–355.

Saygili, I., Kinay, A., Kurt, D. & Kandemir, N. (2021). Genetic and agronomic diversity of Basma tobacco (Nicotiana tabacum L.) landrace in Turkey. Biotechnology, Agronomy, Society and Environment, 25(4), 279–290. https://doi.org/10.25518/1780-4507.19398

Tobacco Research Institute. (2024). TCCS 03:2024/VTL—Guidelines for testing the cultivation and use value of Oriental tobacco varieties. Hanoi, Vietnam.

Universal Corporation. (2021). 2021 Annual Report. Universal Corporation, Richmond, Virginia, USA.

****