Short Research Article

RESULTS OF TRIAL ORIENTAL TOBACCO VARIETIES PLANTING IN NINH THUAN AND DAK LAK PROVINCE, VIETNAM IN 2021

ABSTRACT

Oriental tobacco trial was planted to evaluate the possibility of producing Oriental tobacco in Vietnam. Vietnam Tobacco Institute of Research tested six oriental tobacco varieties in Ninh Son district under Ninh Thuan province in 2019 - 2020. Those varieties originated from Bulgaria country where were breed and multiplied for other countries adaptability research evaluation. The test results showed that oriental tobacco varieties were good growing and proper for soil and climate conditions in Ninh Thuan province. Using the trial varieties selected, we have collected the best two varieties to expand the growing area in Ninh Thuan and Dak Lak provinces in the year 2021 within those, there was inclusion of Basma 16 and Hanski 227 varieties. In 2021, the planting density of Basma 16 was 280.000 plants/ha, and Hanski 227 was 110.000 plants/ha. Based on results of the soil analysis, the fertilizer formula in Ninh Thuan province consisted of 2 levels as PB1 (30N + $0P_2O_5$ + $50K_2O$ kg/ha) and PB2 (40N + $0P_2O_5$ + $50K_2O$ kg/ha); whilst for Dak Lak province, the fertilizer formula was PB1 (30N + $30P_2O_5$ + $50K_2O$ kg/ha), PB2 was 40N + $30P_2O_5$ + $50K_2O$ kg/ha with N: (NH_4NO_3), P: ($Ca(H_2PO_4)_2$) and K:(K_2SO_4). The experiments were pairs designed, with every formula of 500 m^2. The trial results of 2021 showed that in two levels of fertilizer, the dry yield, nicotine content, sugar content, and chlorine content of oriental tobacco varieties in Ninh Thuan province ranged from 1.44 - 1.70tons/ha, 0.68 - 1.33%, 19.2 - 22.2%, and 1.41 - 1.80%; meanwhile in Dak Lak province were 1.57 - 1.82 tons/ha, 1.0 - 1.39%, 9.8 - 12.0%, and 0.27 - 0.31%. Based on the results analysis of chemical compositions in tobacco leaves and smoking properties, the oriental tobacco in Dak Lak have good quality and similar to the oriental tobacco import from Bulgari, Turkey and Greece. In contrast, in Ninh Thuan, oriental tobacco was not having good quality but hot smoke and poorly burning. So, the Dak Lak province was a good region for oriental tobacco in Vietnam with formulas of trial fertilizer above applied. In 2022, we will continue to expand the growing region of oriental tobacco in Dak Lak province to limit importation of oriental tobacco products from foreign countries.

Keywords: Oriental tobacco variety, Basma 16, Hanski 227, Vietnam.

1. INTRODUCTION

Tobacco plants grown in the world are categorized into two groups such as yield and quality types. Virginia and Burley tobacco types have high yield, while oriental tobacco's are high in qualities.Oriental tobacco's are selected especially for it's aroma tasting flavour (Ahmet Kınay et al., 2020). The oriental tobaccos have a much milder flavour, contain less nicotine, and fewer carcinogens than other varieties (DAVIS et al., 1999). The oriental tobacco is a small plants; labour intensive; many varieties; grown in hot and dry conditions; cured in the sun; harvested by hands manually as is small; have aromatic and elastic leaves that are important to American blend cigarettes.

The oriental tobaccos are popularly grown in some primary countries such as Turkey, Greece, FYRO Macedonia, and Bulgaria. In Turkey, there are main two oriental tobaccos as Izmir and Samsun varieties; In Greece and the Balkans are Basma & Katerini varieties; Macedonia: Prilep variety; Bulgaria: Krumovgrad variety. For the Basma variety, it has broad leaf size, leaf shape, body & oil, color, smoke, and reasonable yield kg/ha, respectively as medium, elongated oval shape, medium - heavy body, high oil, good elasticity, deep yellow to orange with a reddish hue, strong dark aroma and with a sweet taste of 1.200 - 1.500 kg/ha (OZER E, 2018). According to KARAIVAZOGLOU; 2010, the yield and quality parameters of the Basma Z/7 variety were affected by the degree of leaf ripeness, harvest, and after curing. The oriental variety leaves harvested after the mature physiological growth had a higher quality index (as measured by the grade index) and more desirable chemical composition than leaves harvested too early or too late. Based on the changes in leaf yield, quality, and chemical characteristics/composition after sun-curing, the optimal harvest time of leaves was the stage of early senescence, just after the full-physiological maturity stage. Preliminary results suggested that changes in nitrate concentration in fresh leaves may provide a simple test for the initiation of harvest. Sap nitrate concentration in the fully expanded bottom leaves should be less than 0.9 -1.0% at the

commencement of harvesting for optimal yield and quality. The sap nitrate test, determined by a commercially available field test, can be used as the indicator of fresh leaf ripeness. Another field experiment was conducted in 2012 and 2013 at the Agricultural University of Athens to compare the growth, yield, nicotine and sugar contents of three Greek sun-cured tobacco cultivars planted by two between-row spacing (distances of 10 and 20 cm between rows). Results showed that wider row spacing resulted in a lower yield than closer row spacing for all three cultivars. Productivity of wider-row spacing ranged from 1315 to 1920 kg/ha; for narrower-row spacing: 1545 to 2090 kg/ha in the trial of three varieties. Chemical analysis revealed that nicotine content was also affected by cultivar type, row spacing, and ranged between 3.40 and 5.19%. Narrow row spacing reduced the nicotine content, while sugar content was only affected by cultivar type. The narrower row spacing produced a low nicotine content for blending purposes (D.J. Bilalis et al., 2015). According to Karolina Kocoska et al., 2016, the nicotine content increases from the lower to the upper belts of leaves. The study results obtained in the field of Scientific Tobacco Institute with three Basma varieties show that the nicotine content increases from the lower to the upper belts leaves in Fo MK-1 variety where the lower belt has 1.77% average content of nicotine, the middle belt 2.23% and the upper belt 2.19% similarly to MK-1, MB-3 nicotine content ranges from 1.64% in the lower to 1.97% in the middle and 1.81% in the upper belt level. The average values of sugar increase from the lower to the upper belts, ranging from 8.66% in the lower belt of the variety MB-2 to 22.65% in the upper belt level of the variety MK-1.

In countries producing oriental tobacco types, the soils considerably influence the quality. The properly/good soils for oriental tobacco is often stony, gravelly, thin and not very productive and it's tobacco is good mild and very aromatic. Tobaccos grown in deeper soils, clayey, good soil, and more humid are stronger than poorly soil but less aromatic. The oriental tobaccos are grown on generally low fertility soils, especially at low levels of N at maturing. The aromatic is an essential characteristic of quality product. It largely depends on the pedological and climatic conditions where they are/were grown. N fertilization experiments in Zimbabwe showed that the highest yield with the best possible quality N applied was only 10 to 15 kg N/ha in relatively fertile soils. In Yugoslavia, when there is a lack of manure, growers use a small amount of nitrate-nitrogen (20-30 kg N/ha), with superphosphate (100 kg P_2O_5/ha) and potassium sulphate (60 kg to 100 kg K_2O/ha). In Zimbabwe it is 5 to 10 kg N/ha (calcium ammonium nitrate), 40 to 80 kg P_2O_5/ha (superphosphate), and 30 to 50 kg K_2O/ha (sulphate) (J. Chouteau et al., 1988). Bulgarian oriental tobacco has high ecological purity, aromatic qualities and relatively low nicotine content (0.4 – 2.4 mg/g) and is suitable for flavouring and improving Virginia tobacco blends (Bozukov, 2015, 2016) without unwanted genetic modification (Bozukov, 2015, 2016). To develop oriental tobacco in Vietnam, the Tobacco Research Institute imported six varieties from Bulgari for trial planting in Ninh Thuan 2020 such as Basma 16, Basma H, Kozarsko 339, Hanski 227, Dupnitsa 733, and Rila 89 (Bozukov et al., 2021).

Every year, Vietnam usually imports about 1000 tons of oriental tobacco for producing blending 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 Tobacco Research Institute imported six varieties from Bulgari for trial planting in Ninh Thuan in 2019 - 2020. The results showed that the yield of dry tobacco from the varieties grown in the region of Ninh Thuan was within the range of yield values from Bulgaria. Dry tobacco had good quality with (high per cent of first-class) grading. The organoleptic test showed that dry leaves of such varieties in the two sites had the typical technological values such as colour, elasticity, density and aroma of oriental tobacco. Nicotine content in the varieties grown in Vietnam was much lower (two/2 – 3/three times) when compared to the one in varieties grown in Bulgaria. Based on some above study results, we have selected two oriental tobacco varieties with high yield and quality to continue trial planting in Ninh Thuan and expanding growing area in Dak - lak in 2021.

2. MATERIALS AND METHODS

2.1. The study site

The trial cultivation of oriental tobaccos was conducted in the Ninh Son district under Ninh Thuan province and Easup district under Dak Lak province in Vietnam from January to June 2021. These test stations have suitable climate and good soil conditions for producing oriental tobacco.

2.2. Material and object

The oriental tobacco varieties: Basma 16 and Hanski 227, were planted with Fertilizer: N: NH_4NO_3, P: $Ca(H_2PO_4)_2$ and K: K_2SO_4.

2.3. Experimental field

Tobacco seeds of oriental tobacco are sown on a free pathogen nursery. The seedlings after reaching 4 - 6 leaves are transplanted in the experimental field with specified spacing distance of planting: Basma 16, the plant to plant spacing: 12 cm, and space between lines: 30 cm, and the plant population density of 280.000 plants/ha in contrast to Hanski 227, plant to plant spacing of about 17 cm and lines spacing 50 cm with the plant population density of 110.000 plants/ha.

Rate of fertilizers: Based on the results of soil analysis and experimental fields in 2019 - 2020 in Ninh Thuan province, and the experts of Research Institute of Tobacco and Tobacco Products - Markovo vill, they built two fertilizer formulas as: In NinhThuan province: PB1: 30N + $0P_2O_5$ + $50K_2O$ kg/ha and PB2: 40N + $0P_2O_5$ + $50K_2O$ kg/ha; Dak Lak province: PB1: 30N + $30P_2O_5$ + $50K_2O$kg/ha and PB2: 40N + $30P_2O_5$ + $50K_2O$kg/ha. Each variety experiments were paired arranged in the field on the same fertilizer with 500m^2 area covering.

2.4. The target surveillance

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, number of leaves, plant height, yield parameters the National Technical Regulation on testing the value of cultivation and use of dried yellow tobacco varieties follow QCVN 01- 85 : 2012 / BNN & PTNT, Vietnam.

Rate of grade: National Standard 9271 - 85 of Bulgaria was used. Analysis of chemical components following standard of Vietnam as Nicotine: TCVN 7103 : 2002 (ISO 2881:1992), total nitrogen: TCVN 7252 : 2003, sugar: TCVN 7102 : 2002 (CORESTA 38 : 1994) and Chlorua (cl): TCVN 7251 : 2003.

Quality assessment based on the Draft TCVN: Oriental raw tobacco - sensory assessment by the scoring method.

Data treatment: Evaluation of the difference between the two levels of fertilization of each variety by comparing the mean values, using the t-test to compare the mean values of two paired samples in MS. Excel (Nguyen Huy Hoang, 2014).

3. RESULTS AND DISCUSSION

3.1. The growth, development of oriental tobacco varieties in Ninh Thuan and Dak Lak provinces

- The growth time of Basma 16 and Hanski 227 varieties

The monitoring results of growth time of the oriental tobacco varieties in Ninh Thuan and Dak Lak provinces were presented in Table 1.

Table 1. The growth time of Basma 16 and Hanski 227 varieties in Ninh Thuan and Dak Lak

Treatment	Time from planting to (*days)*					
	50% buds		First leaves ripen		Last leaves ripen	
	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak
Basma 16 – PB1	70	72	57	63	112	119
Basma 16 – PB2	70	72	57	63	112	119
Hanski 227 – PB1	67	69	56	60	109	116
Hanski 227 – PB1	67	69	56	60	109	116

Time from planting to 50% buds: With the two fertilizer levels of the experiments (PB1 and PB2), time from planting to 50% buds of oriental tobaccos had the same time growth with 70 days after transplanting (DAT) in Ninh Thuan province and 72 DAT in Đak Lak province. For variety, Hanski 227

appeared buds earlier (67 DAT and 69 DAT) than Basma 16 (70 DAT and 72 DAT). The growth of oriental tobaccos in Dak Lak was later than in Ninh Thuan.

The time of the leaf mature: The time from planting to first leaves ripen was similar on both fertilizers and both varieties in two experimental areas. Basma 16 was slower ripening than Hanski 227 in Ninh Thuan and Dak Lak from 1-3 days. In Dak Lak province, the first leaves ripen of experimental varieties was slower than in Ninh Thuan from 4 - 6 days and similar to the last ripe leaves.

The difference in the growth of tobacco only depended on the characteristics of the variety, fertilizer, weather conditions. For fertilizer, increasing 10N on nutrient-poor soil with high density will have little effect on tobacco growth.

- Some agro-biological characteristics of oriental varieties

Nitrogen content is necessary for plant height, total leaves, leaf size and leaf weight of oriental tobaccos. Results at table 2 showed that when increasing by $10N_2$, the top height of tobacco plants increased by 2 - 3.9 cm and total leaves: 0.2 - 0.8 leaf. This difference in top plant height and the total number of leaves was not significant statistics ($t_{TN}<t_{0.05} = 1.99$). About the leaves size of the C (middle leaf of a plant), the length and width of oriental tobacco leaves were not statistically significant at the two levels of the fertilizer in the experiment. It can say that adding 10N for oriental tobacco does not change a lot of agro-biological characteristics of the oriental tobacco plant.

For growing regions, leaf size C (C- leaf in the middle of the plant) in Dak Lak province was larger and wider than leaf size C of Ninh Thuan province. The detail as the length and width leaves of C in Ninh Thuan ranged from 19.1 - 27.6 cm and 10.7 - 17.3 cm and compared to Dak Lak was from 19.4 - 31.9 cm and 10.4 - 20.2 cm. Similar to leaf size, the fresh leaf weight of both varieties in Ninh Thuận was lower than in Dak Lak. The fresh leaves weight in Ninh Thuan ranged from 6.5 - 11.3 grams/g, meanwhile in Dak Lak: 6.9 - 15.1 grams/g.

About statistics, adding 10N does not significantly increase the plant height, the total number of leaves, leaf size, and fresh leaf weight in both experimental areas. Survey results of oriental tobacco in 2021 showed that the Dak Lak area had favourable conditions for oriental tobacco plants growing quicker than in Ninh Thuan, and the variety Hanski 227 was proper/good than Bassma 16. The oriental tobacco was good in Dak Lak province: the temperature of Ea Hello - Dak Lak from 12/2020 - 5/2021 ranged from 18.5 - 26.4^{o}C and was similar to the temperature of Turkey (19.2 - 29.3^{o}C) and Greece (18.9 - 26.0^{o}C) (OZER E, 2018).

Table 2. Some agro-biological characteristics of Basma 16 and Hanski 227 in Ninh Thuan and Dak Lak

Treanment	Top height (cm)		Total leaves (leaves)		Leaf size of C				Fresh leaf Weight (grams)	
					Length (cm)		Width (cm)			
	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak
Basma 16-PB1	105.5	115.0	36.8	37.1	19.1	19.4	10.7	10.4	6.5	6.9
Basma 16-PB2	107.6	118.9	37.1	37.9	19.6	21.2	11.0	11.0	7.0	7.6
t_{TN}	*- 1.52*	*- 2.83*	*- 0.67*	*- 2.1*	*-1,79*	*-5,43*	*-1,16*	*-2,25*		
Hanski 227-PB1	117.3	122.9	29.1	31.7	26.8	30.3	16.6	18.5	10.7	12.0
Hanski 227-PB2	119.3	125.7	29.3	32.2	27.6	31.9	17.3	20.2	11.3	15.1
t_{TN}	*- 0.25*	*- 1.50*	*- 0.27*	*- 0.87*	*-2.13*	*-3.39*	*-3.33*	*-5.19*		

Note: t_{TN} vs $t_{0.05} = 1.99$: If $t_{TN} > t_{0.05}$ rejects hypothesis H_o, the difference is statistically significant, otherwise the difference is not significant.

3.2. Some insects and diseases on oriental tobacco varieties in NinhThuan and Dak Lak provinces

The assessment of pest infestation levels of imported tobacco varieties from Bulgaria has an important role in insects and pest management on the field to minimize the damage caused for tobacco production quantity and quality.

The table 3 showed that there were three main virus diseases causing problem on oriental tobacco in the trial experiments, consist of Begomovirus, Tobacco mosaic virus - TMV, and Cucumber moisaic virus - CMV. In that, Begomovirus causes leaf curl and crown curl symptoms in tobacco growing areas in Vietnam. In Ninh Thuan and Dak Lak areas, leaf curl and crown curl symptoms are caused by the Tomato yellow leaf curl virus. The disease appeared early from the nursery to the field stage but developed quickly from 30 - 60 days after transplanting. Begomovirus caused moderate harm with a disease incidence of 5.9 - 6.8%, meanwhile in Dak Lak province, it was a disease incidence of 1.8 to 2.6%. The tobacco mosaic virus damages popularly in all growing regions of Vietnam and now causes serious harm for many tobacco varieties. The oriental tobacco in Ninh Thuan province, rate of TMV disease ranged from 4.9 - 5.2%, and in Dak Lak, the disease were not seen in the tobacco field. For the CMV, the disease only caused damage in the Dak Lak area with an incidence of 5.4 - 6.5% and did not appear in the oriental tobacco field in Ninh Thuan area. According to the field survey results of the Vietnam Tobacco Institute, CMV caused damage in the experiment in Dak Lak because the experiment was close to the Solanaceae crops. Those can be the source of the virus disease that infects tobacco fields through the vector insects, aphids. Cautiously do not plant tobacco in the soil of the previous Solanaceae crops or near secondary host plants of diseases and vectors that is one of the best insects and diseases management methods for all kinds of tobaccos.

Table 3. Some Insects and diseases on the oriental tobacco in NinhThuan and Dak Lak

Treatment	[1]Pests				Viral diseases (%)					
	Budworm		Aphids		Begomovirus		[2]TMV		[3]CMV	
	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak
Basma 16 – PB1	+	+	+	+	6.5	2.5	5.0	0.0	0.0	6.5
Basma 16 – PB2	+	+	+	+	6.8	2.6	5.2	0.0	0.0	6.4
Hanski 227 – PB1	+	+	+	+	5.9	1.9	5.1	0.0	0.0	5.3
Hanski 227 – PB2	+	+	+	+	6.0	1.8	4.9	0.0	0.0	5.4

Note: [1]Severe index: (+): < 5% and light damage; (++): 5 - 10% and moderate damage; (+++): > 10 - 25% and severe damage; (++++): > 26% very severe damage. [2]TMV: Tobacco moisaic virus and [3]CMV: Cucumber moisaic virus.

3.3. Yield and quality of oriental tobacco varieties in Ninh Thuan and Dak Lak provinces

- The number of harvested leaves, fresh/dry, yield and grade of oriental tobaccos

The data of table 4 showed the number of harvested leaves of PB2 treatment was higher than the PB1 treatment in both Basma 16 and Hanski 227 varieties in both NinhThuan and Dak Lak province from 0.5 - 0.6 leaves/plants, but the rate of this increase was not significant statistics ($t_{TN} < t_{0.05} = 1.99$).

The fresh/dry ratio reflected the plant's ability to accumulate dry matter so, it also affected tobacco yield. In addition to the factors, such as variety, fertilizer, and soil, the temperature had an important factor in affecting dry matter accumulation. The high day and low night temperature difference will enhance the dry matter accumulation of the plants. In the Ninh Thuan area, the rate of fresh/dry for varieties and fertilizers was not much different and ranging from 6.32 - 6.55 and Dak Lak was from 5.52 - 5.69. The tobacco-growing region in Dak Lak had a high day and low night temperature difference has increased the ability of dry matter accumulation of the plants.

Yield is one of the most important criteria determining the development prospects of the variety in the trial area. Results of the experiment showed that the production yield of Hanski 227 were higher than Basma 16 variety from 8,7 - 11.1%. For example, with the Hanski 227, yield ranged from 1.62 - 1.82 tons/ha and 1.44 - 1.66 tons/ha for Basma 16. When adding 10N for tobacco, the products of the oriental tobacco (PB2) increased from 4.6% to 5.4%

The grade of 1+2 leaves in Ninh Thuan province was higher than in Dak Lak province. For example, the grade of 1+2 leaves in Ninh Thuan province ranged from 81.0 - 90.5% and 75.9 - 86.5 in Dak Lak

province. For the tobacco variety, the grade of 1+2 leaves of Basma 16 was from 75.9 - 81.3% and compared to Hanski 227 was from 85.2% to 90.5%.

The weather conditions are necessary to transplant the oriental tobacco that helps the oriental tobacco grow well. It gives high yield and good quality, especially the aroma. Through surveys over the two years, 2020 - 2021, weather conditions of the Ninh Thuan and Dak Lak area were favourable for growth, harvesting and sun-cured oriental tobacco. In the Ninh Thuan, the temperature of transplanting, the growth and sun-cured stage ranged from 24.9 - 28.2^{o}C; with the average air humidity: 68 - 75% and the lowest air humidity of days was from 35 - 45%; the rainfall: 0.0 - 85.8 mm, in that, the harvest and the sun-cured stage there was no raining. The Dak Lak had a temperature of 20.7 - 25.3^{o}C, average air humidity: 73 - 80%, the lowest air humidity of days: 20 - 45%, and rainfall: 1.6 - 14.8 mm. This weather conditions in both areas is the same in some of the oriental tobacco growers in the world such as Greece and Turkey.

Table 4. The harvested leaves, fresh/dry, yield and grade of 1+2 leaves of the oriental varieties

Treatment	[1]Harvested leaves (leaves)		Fresh/dry ratio		Yield				Leaf grade 1+2 (%)	
					Ninh Thuan		Đak Lak			
	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak	Tons /ha	Increase (%)	Tons /ha	Increase (%)	Ninh Thuan	Đak Lak
Basma 16 – PB1	32.1	32.2	6.32	5.51	1.44		1.57		81.0	75.9
Basma 16 – PB2	32.6	32.7	6.43	5.59	1.51	4.6	1.66	5.4	81.3	76.3
Hanski 227 – PB1	23.4	23.5	6.44	5.65	1.62		1.73		90.5	85.2
Hanski 227 – PB2	23.9	24.1	6.55	5.69	1.70	4.7	1.82	4.9	90.1	86.5

[1]Number of harvested leaves: Ninh Thuan: Basma 16: t_{TN}=-3.87, Hanski 227: t_{TN}=-1.17; Dak Lak: Basma 16: t_{TN}=-0.92, Hanski 227: t_{TN}=-1.38. t_{TN} vs $t_{0.05}$ = 1.99: If $t_{TN} > t_{0.05}$ rejects hypothesis Ho, the difference is statistically significant, otherwise the difference is not significant.

- Chemical compositions

The results in table 5 showed that the nicotine content of Basma 16 and Hanski 227 in Ninh Thuan and Dak Lak provinces was good for the oriental tobacco variety quality, ranging from 0.68 to 1.39%. The sugar content of Basma 16 and Hanski 227 in Ninh Thuan province was slightly high, ranging from 17.8 - 20.7% meanwhile in Dak Lak province, sugar content ranged from 9.8 - 12%. The low sugar content of oriental tobacco varieties in Dak Lak makes better smoke characteristic/quality.

The chlorine content is an element that harms tobacco quality and affects the burning of tobacco leaves. The higher the chlorine content in tobacco leaves, the burning of tobacco is lower on the other hand, with the high chlorine content, tobacco leaves will have a fishy taste when smoked and strongly reduced tobacco quality. The results of table 5 showed that the chlorine content of tobacco leaves in the Ninh Thuan area was of high level, ranging from 1.41 - 1.8% and affected the burning degree of tobacco leaves. The analysis result showed that the soil in the Ninh Thuan area had high chlorine content (Soil: 13ppm and irrigation water: 6 - 7 mg/litre) that reduced the quality of oriental tobacco. Therefore, the Ninh Thuan region will have a difficult situation to continue developing tobacco growing areas in the coming years due to high chlorine content in soil and irrigation water. Compared to 2019, the chlorine content of tobacco leaves was too high, ranging from 1,6 - 2.03%. The reason was that the irrigation water in the reservoir had too high chlorine content at 4.460 mg/litre, and the standard was only 350mg/litre. In 2020, the Tobacco Research Institute changed the source irrigation water to be with low chlorine content. So the chlorine content of tobacco leaves in the Phu Thuan district, the Ninh Thuan province ranged from 0.51 - 0.62%, with the chlorine content in the soil: 15ppm and water: 5.5mg/litre. For the My Hiep district, Ninh Thuan province had the chlorine content of tobacco from 1.35 - 1.81% (the chlorine content in the soil: 34ppm and water: 290 - 452 mg/litre). It showed that there is high chlorine content in the soil, especially in irrigation water with great impact on the ability to accumulate chlorine in tobacco leaves.

To limit the influence of chlorine on tobacco quality, in 2021, the Tobacco Research Institute has tested more tobacco varieties in the Easup district, Dak Lak province with low chlorine content in soil (8 ppm)and irrigation water (6 - 8 mg/litre). The results showed that the chlorine content in tobacco

leaves was low, ranging from 0.26 - 0.31%. The low chlorine content increased the quality of tobacco, especially its flavour aroma of tobacco in Ninh Thuan province.

Table 5: The chemical compositions of oriental tobacco varieties in Ninh Thuan and Dak Lak

Treatment	Nicotine (%)		Sugar(%)		Chlorine (%)	
	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak	Ninh Thuan	Đak Lak
Basma 16 – PB1	0.79	1.00	20.7	10.3	1.47	0.27
Basma 16 – PB2	0.68	1.08	17.8	9.8	1.80	0.27
Hanski 227 – PB1	0.95	1.06	17.9	12.0	1.56	0.31
Hanski 227 – PB2	1.33	1.39	20.4	11.4	1.41	0.26

Note: Leaves chemical composition analysis: leaf C: Leaves in the middle of the plant

- The smoking characteristics of oriental toabcco varieties

Table 6. The smoking properties of oriental tobacco varieties in Ninh Thuan and Dak Lak

Area	Treatment	Smoking properties (points)					
		Aroma	Taste	Smoke strength	Burning	Colour fibers	Total points
Ninh Thuan	Basma 16 – PB2	9.8	7.4	3.7	1.8	4.0	26.7
	Hanski 227 – PB2	10.9	8.4	4.1	1.8	5.0	30.2
Đak Lak	Basma 16 – PB2	11.8	8.7	4,3	3.8	3.8	32.4
	Hanski 227 – PB2	12.3	9.5	4,4	4.0	5.0	35.2

For the oriental tobacco, aroma has the most important factor to evaluate the quality of oriental tobacco production. Because the oriental tobacco is usually used in American blend cigarettes as aroma control. The results at table 6 showed that the aroma, taste, and colour of tobacco fibers of the Hanski 227 were better than Basma 16 variety in both Dak Lak and Ninh Thuan provinces. The details of aroma, taste, and colour of tobacco fibers of Hanski 227 ranged from 10.9 - 12.3 points, 8.4 - 9.5 points, and 5.0 points, respectively; and for the Basma 16 respectively were from 9.8 - 11.8 points, 7.4 - 8.7 points, and 3.8 - 4.0 points. For both growing regions, the oriental tobaccos in Dak Lak region had the smoke characteristics/quality better than in Ninh Thuan region, with total points Dak Lak were 30.2 - 35.2 points and Ninh Thuan: 26.7 - 30.2 points. The aroma of tobacco in Dak Lak region was typical for oriental tobacco and is similar to imported materials.

- Comparing between the orientai tobaccos in Dak Lak province and oriental tobacco importing

Table 7. The chemical compositions of oriental tobacco samples

Treatment	Nicotine (%)	Sugar (%)	Nitơ TS (%)	Chlorine (%)
Basma 16 DL	0,95	8.9	1.74	0.29
Hanski 227 DL	1.29	10.6	1.80	0.24
Sample control	0.85	7.2	2.3	0.81

According to the data in table 7, the chemical compositions of oriental tobacco in Dak Lak province and imported tobacco samples did not differ from each other much. The particulars of the chlorine content in tobacco in Dak Lak was significantly lower than the imported samples. The high chlorine content of the imported oriental tobaccos affected the burning of tobacco and the smoking characteristics of cigarettes. For example, the nicotine and sugar content of Basma 16 and Hanski 227 ranged from 0.95 - 1.29% and 8.9 - 10.6%, respectively, and compared to sample control: 0.85% and

7.2%. For the chlorine content, the oriental tobacco in Dak Lak with chlorine content was from 0.24 - 0.29%, while the sample control was 0.81%.

About the smoking characteristic of oriental tobacco, result in table 8 showed that the aroma and taste of oriental tobaccos in Dak Lak province were better than the sample control, in that, aroma and taste of oriental tobaccos in Dak Lak ranged from 11.9 - 12.7 points and 9.1 - 9.2 points, respectively, compared to sample control was 10.8 points and 8.3 points. The burning degree of oriental sample control is less than the oriental tobacco in Dak Lak, with 3.1 points compared to the burn degree of oriental samples in Dak Lak was 4.4 points. The smoking characteristic of two oriental tobacco varieties trial planted in Easup district, Dak Lak province had good quality and better than some oriental tobacco samples imported from foreign countries.

Table 8. The smoking properties of the oriental tobacco samples

Treatment	Smoking properties (points)					
	Aroma	Taste	Smoke strength	Burning	Colour fibers	Total points
Basma 16 DL	11.9	9.1	4.6	4.4	5.0	35.0
Hanski 227 DL	12.7	9.2	4.4	4.4	4.5	35.2
Sample conrtol	10.8	8.3	4.2	3.1	3.3	29.6

Note: Sample control was imported from Bulgaria, Turkey, Greece and average of 5 samples; DL: Dak Lak province

So after two years of trial tobacco plant (2019 - 2020) in Ninh Thuan province with six varieties, including Basma 16, Basma H, Kozarsko 339, Hanski 227, Dupnitsa 733, Rila 89. Therefore the results showed that two trial varieties grew well in Ninh Thuan, such as Basma 16 and Hanski 227. Those varieties gave high yield and a good grade per hectar planted. However, tobacco leaves grown in Ninh Thuan province had a high chlorine content, which reduced the burning ability of tobacco. The poorly burning tobacco, no fire, black ash seriously affect the tobacco quality. The Ninh Thuan province is near the sea lead to soil with and irrigation water having high chlorine content. To continue the trial planting and determine the area suitable for oriental tobacco, in 2021, we have conducted more trial planting in the Easup district, Dak Lak province, where weather and soil conditions are proper/good/ favourable for growth and sun-cured oriental tobacco. The results analysis of chlorine content in soil and water in Dak Lak province was suitable for oriental tobacco growth. The result of three years of testing tobacco in Ninh Thuan and Dak Lak, the Vietnam Tobacco Research Institute has identified two oriental tobacco varieties suitable for Dak Lak conditions, namely Basma 16 and Hanski 227. These varieties have high yields, good quality and have a typical characteristic flavour for oriental tobacco. The Dak Lak region has favourable weather and soil conditions for growing oriental tobacco plants and expanding the growing area in the coming years.

Fig 1. The oriental tobacco varieties were trial planted in 2021

4. CONCLUSION

Through three oriental tobacco trial planting years, the Tobacco Research Institute has selected two oriental tobacco varieties for good growth, high yield, and good quality; low susceptibility degree with insects and diseases; and proper/good with soil and weather conditions in the Dak Lak region, Vietnam. The quality of oriental tobacco in the Dak Lak is the same for the tobaccos import that are popularly used at cigarette factories. To make the good quality oriental tobacco productions, the Research Institute of Tobacco has initially perfected the fertilizer formula, the process of growing, harvesting, sun-cured, and storing oriental tobacco.
To develop products of the oriental tobacco quality, the tobacco Institute will continue trial planting and expanding the oriental tobacco area in Dak Lak province in next time to provide tobacco products for cigarette factories to limit importing the oriental tobacco from the foreign countries.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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