

Chemical composition and smoking qualities of varieties and lines of tobacco from the Dupnitsa ecotype

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Abstract

Bulgarian oriental tobaccos are characterized by high content, distinct smoking feature and finesse, and are one of the most sought-after tobaccos in cigarette manufacturing. The purpose of the research is to make a chemical assessment, based on which to determine the smoking qualities of varieties and lines of oriental tobaccos from the Dupnitsa ecotype. The yield, class percentage, chemical composition and smoking qualities of Line 503 (high nicotine selection) and Line 504 (low nicotine selection) were investigated. The obtained results were compared with established high-quality varieties - Dupnitsa 160, Katerini and Rila 544 (control). It was established that the studied lines had a higher yield than the control and a quality corresponding to Dupnitsa 160 and Katerini varieties. The chemical composition of the new lines is consistent with typical oriental tobacco values for nicotine, sugars and total nitrogen. The selection lines have a balanced chemical composition and good smoking qualities.

Key words: oriental tobacco; Dupnitsa ecotype; chemical evaluation; smoking qualities

INTRODUCTION

Tobacco is grown in 128 countries around the world. It is mainly used for the production of tobacco products for smoking - cigarettes. Different types and varieties of tobacco are included in the manufacture of cigarettes, which have a general contribution to the formation of the taste and aroma of tobacco smoke (Leffingwell, 2001, Weeks, 1999).

The quality of tobacco is assessed on the basis of generally accepted in practice chemical indicators. They are related to the determination of basic groups of substances: alkaloids (nicotine), carbohydrates (sugars), nitrogen-containing substances (total nitrogen), mineral substances (ash). These groups of substances have the most significant contribution both to the formation of tobacco quality and to the smoking feature of tobacco smoke (Guzelev, 1983).

Chemical components are the major tool for objective evaluation of tobacco. The study of basic and specific chemical components of tobacco is espe-

cially important for monitoring the influence of a number of factors on the formation of tobacco. The extended chemical characteristics give an objective expression of the specific properties of the tobacco (Kasheva et al., 2021).

Through the balance relationships sugars/nicotine, total nitrogen/nicotine etc. an objective assessment of the consumptive (smoking) properties of tobacco can be made (Guzelev, 1983; Staykova et al., 2015).

Oriental tobaccos, due to their high content, bright expressed smoking features and finesse, are used in the world cigarette production as blends and are an indispensable ingredient of all high-quality cigarettes. The chemical composition of oriental tobacco smoke, with its low nicotine and condensate content, suggests that it is less harmful (Leffingwell, 2001; Weeks, 1999).

Oriental tobaccos from the Basmi variety group, Krumovgrad, Dupnitsa, Nevrokop, Eastern Balkan, Ustina and Jebel Basma ecotypes are grown in Bul-

garia, mainly in mountainous and hilly areas with eroded areas (https://www.mzh.government.bg/media/filer_public/2018/02/13/instr-ot-2016.pdf).

Bulgarian oriental tobaccos, characterized by their strong flavor and aroma features, finesse, very good burnability and cigarette yield, and thin main nerve, are ranked as the best quality tobaccos of all tobacco types produced in the world (Guzelev, 1983; Staykova et al., 2015; Kasheva et al., 2021).

Representatives of ecotype Dupnitsa are distinguished by high yield and resistance to abiotic and biotic factors (Stankev & Bozukov, 2015; Malinova & Kasheva, 2022).

PURPOSE

The purpose of the research is to evaluate the smoking qualities of varieties and lines of oriental tobacco from the Dupnitsa ecotype on the basis of main chemical parameters.

MATERIAL AND METHODS

In the period 2021-2022, in the Experimental field - the city of Rila, two new lines of oriental tobacco from the Dupnitsa ecotype were tested in a varietal experiment - Line 503 and Line 504. The lines are in the eleventh generation and are vegetatively and morphologically equal. Rila 544 varieties and two high-quality varieties - Dupnitsa 160 (Stankev, 2007; Stankev & Bozukov, 2015) and Katerini variety (Greece) were used for control - figure 1.

The field trials were established by block method in three replications with an experimental plot size of 10 m² (Zapryanov & Marinkov, 1978).

An assessment of the size of the yield (kg/da) and percentage of classes was carried out. The experimental data were processed by analysis of variance (Zapryanov & Marinkov, 1978).

The main chemical indicators in tobacco were determined according to established methods - nicotine (ISO 15152), sugars (CRM 89) and total nitrogen (BDS 15836). A SEAL Automatic Flow Analyzer, standard substances and reagents were used to perform the studies.

Results are presented as the mean of three replicates and the standard deviation.

RESULTS AND DISCUSSION

Data on the average amount of rainfall during the tobacco growing season are presented in fig. 2. The large amount of precipitation in the month of June 2021 (116 mm) is impressive, which leads to better rooting and rapid development of plants. The months of July and August have little rainfall, resulting in very high quality produce.

The growing season of 2022 is characterized by more precipitation than the thirty-year norm and 2021 (July, August). Due to the high humidity, there is an increased viral disease, which negatively affects the yield and quality of dried tobacco.

YIELD

The values for yield and quality of dry tobacco are presented in Table. 1. The studied lines formed a higher yield during the test years (between 30 % and 51 %) compared to the control.

The difference in average yield (Table 1) between the new lines and the control is proven at a probability of 0.1% for 2021, but for 2022 it is not

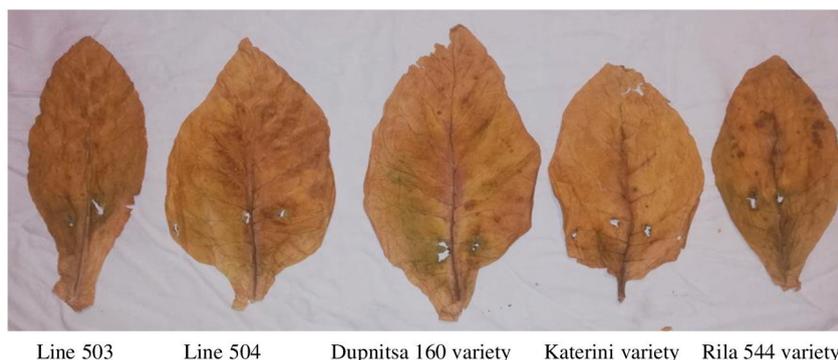


Figure 1. New lines of tobacco and established varieties of ecotype Dupnitsa and ecotype Katerini

proven due to the fact that the experimentally obtained value for F (2.26) does not exceed the value of F tabular (3), due to the strong variation of yields in individual reiterations.

The quality of the dried tobacco of Line 503 and Line 504 is high, which corresponds with that of the Dupnitsa 160 and Katerini quality controls. Depending on the climatic conditions, the percentage of first class varies within 24 - 35 %, and third class - 2 - 5 %.

CHEMICAL COMPOSITION OF TOBACCO

When smoking, the product of consumption is tobacco smoke, the chemical composition of which is determined by the composition of the tobacco leaf and the nature of the combustion (Guzelev, 1983).

In recent years, the market demand for oriental tobaccos has a nicotine content of 1.50 - 2%, which also determines the selection guidelines. On the other hand, due to the tendency to reduce the nicotine content in tobacco smoke, the creation of low-nicotine varieties of tobacco is also necessary (Guzelev, 1983; Burns, 2008). In this regard, the direction of selection is, on the one hand, towards varieties with a high nicotine content (Line 503), and on the other hand, low-nicotine tobaccos (Line 504).

To establish the smoking qualities of the studied selection lines, the content of nicotine, sugars and total nitrogen was determined. The amount of the investigated components was compared with high-quality established tobacco varieties of the Dupnitsa ecotype.

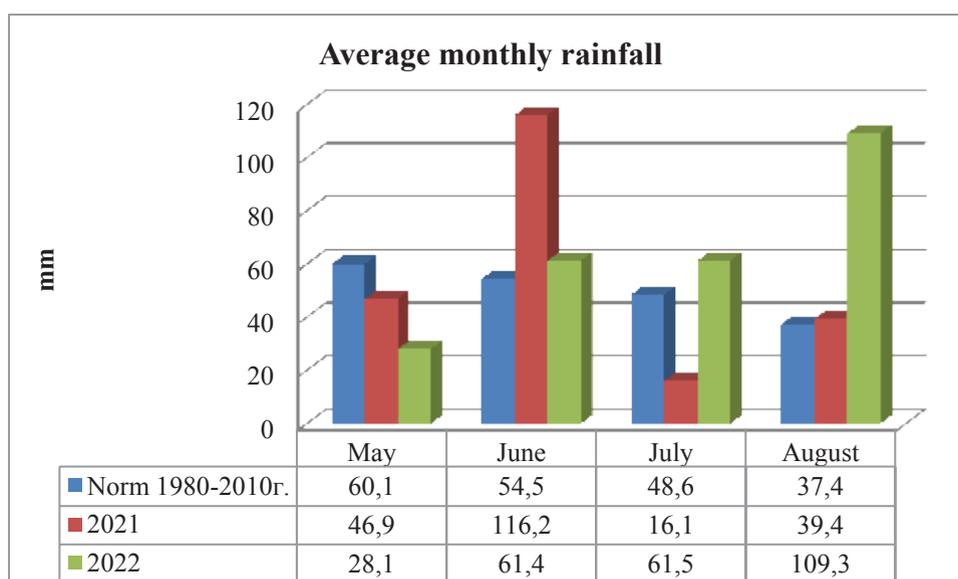


Figure 2. Average monthly rainfall during the tobacco growing season for the period 2021 – 2022

Table 1. Yield and quality of dry tobacco (2021-2022)

Variety / Line	Yield, kg/da		Quality, %					
			2021			2022		
	2021	2022	I	II	III	I	II	III
Line 503	324+++	279	35	63	2	30	67	3
Line 504	337+++	293	34	64	2	24	71	5
Dupnica 160	261	300	33	65	1	23	70	7
Katerini	238	235	33	64	3	24	69	7
Rila 544 - control	222	224	25	66	9	28	68	4

2021 - $GD_{5\%} = 2,18 \times 19,02 = 41,2$ kg

$GD_{1\%} = 3,06 \times 19,02 = 58,2$ kg

$GD_{0,1\%} = 4,32 \times 19,02 = 82,2$ kg

The importance of nicotine in tobacco and cigarettes is expressed in its specific physiological action. With a nicotine content of up to 1% in tobacco, the physiological strength is characterized as weak, between 1 and 1.6% - as medium, and above 1.6% - as strong.

Soluble carbohydrates are one of the most important components of oriental tobaccos, determining their characteristic flavor.

Nitrogen-containing substances in tobacco are represented by the following groups of substances - proteins, amino acids, nitrates, ammonia, etc. The amount of total nitrogen is negatively related to the quality of the tobacco (Leffingwell, 2001; Weeks, 1999; Guzelev, 1983).

The results for the content of nicotine, sugars and total nitrogen are presented in the table. 2. The content of nicotine and sugars in Line 503, growing season 2021 is $1.73\pm 0.05\%$ and $21.76\pm 0.22\%$, respectively, and approaches that of the established varieties Dupnitsa 160 (nicotine - $1.71\pm 0.05\%$, sugars - $21.72\pm 0.22\%$) and Katerini (nicotine - $1.82\pm 0.05\%$, sugars - $21.47\pm 0.21\%$). Line 503 is characterized by a higher content of nicotine and sugars than the control variety Rila 544 (nicotine - 1.19 ± 0.03 , sugars - 19.09 ± 0.19). The total nitrogen content of Line 503 was $1.40\pm 0.03\%$ and was lower than that of the es-

tablished varieties, which varied between 1.56 ± 0.03 - Rila 544 variety and 1.65 ± 0.03 - Dupnitsa 160.

During the 2022 growing season, an increase in the nicotine content of Line 503 was found to be $1.96\pm 0.05\%$ compared to the previous growing season. A higher total nitrogen content was also found ($1.76\pm 0.04\%$). The sugar content is $16.92\pm 0.17\%$ and is about 5% lower than the previous year.

During the 2021 growing season, the chemical parameters of the high-nicotine Line 503 show a similar quantitative composition to that of the Dupnitsa 160 and Katerini varieties. Line 503 is higher in nicotine and sugars and lower in total nitrogen than the control variety Rila 544. In 2022, by chemical composition, Line 503 is distinguished by the highest nicotine content, low sugars and total nitrogen, approaching that of the control variety Rila 544.

In 2021, Line 504 was characterized by the lowest nicotine content ($0.67\pm 0.02\%$) and total nitrogen ($1.27\pm 0.03\%$) of all tobacco samples examined. The nicotine content is two to three times lower than that of the varieties Dupnitsa 160, Katerini and Rila 544. The amount of specific sugars in Line 504 is $28.81\pm 0.29\%$ and exceeds the other lines and varieties by about 7%.

In the 2022 growing season, Line 504 had almost twice the nicotine content compared to the previ-

Table 2. Basic chemical components in varieties and lines of tobacco from the Dupnitsa ecotype and their balance ratios

Variety / Line	Chemical components, %			Smoking qualities	
	Nicotine	Sugars	Total nitrogen	Total nitrogen/ Nicotine	Sugars/ Nicotine
Vegetation 2021					
Line 503	1.73 ± 0.05	21.76 ± 0.22	1.40 ± 0.03	0.8	12.6
Line 504	0.67 ± 0.02	28.81 ± 0.29	1.27 ± 0.03	1.9	43.0
Dupnica 160	1.71 ± 0.05	21.72 ± 0.22	1.65 ± 0.03	1.0	12.7
Katerini	1.82 ± 0.05	21.47 ± 0.21	1.63 ± 0.03	0.9	11.8
Rila 544 - control	1.19 ± 0.03	19.09 ± 0.19	1.56 ± 0.03	1.3	16.0
Vegetation 2022 r.					
Line 503	1.96 ± 0.05	16.92 ± 0.17	1.76 ± 0.04	0.9	8.6
Line 504	1.38 ± 0.04	20.37 ± 0.20	1.92 ± 0.04	1.4	14.8
Dupnica 160	1.16 ± 0.03	21.19 ± 0.21	1.78 ± 0.04	1.5	18.3
Katerini	1.29 ± 0.03	21.48 ± 0.21	1.96 ± 0.04	1.5	16.7
Rila 544 - control	1.33 ± 0.04	15.45 ± 0.15	1.80 ± 0.04	1.3	11.6

ous year. The amount of nicotine is $1.38\pm 0.04\%$ and approaches that of the control variety Rila 544 - $1.33\pm 0.04\%$. The content of sugars is $20.37\pm 0.20\%$ and does not differ significantly from Dupnitsa 160 variety ($21.19\pm 0.21\%$) and Katerini variety ($21.48\pm 0.21\%$). The content of total nitrogen in Line 504 is $1.92\pm 0.04\%$, and it is close to that in high-quality varieties ranging from $1.78\pm 0.04\%$ (variety Dupnitsa 160) to $1.96\pm 0.04\%$ (variety Katerini). During the 2022 growing season, Line 504 is chemically close to the control variety Rila 544.

The obtained results for the studied tobacco varieties and lines coincide with the chemical profile of oriental tobaccos from other ecotypes. In a study of oriental tobaccos from the Krumovgrad ecotype, variety Krumovgrad 58, which is a marketed variety of tobacco, the nicotine content is between 1.26% - 2.14%, the sugar content - 13.8 - 19.8%, and the total nitrogen content -1.67% -1.90%. (Kusheva et al., 2021).

SMOKING QUALITIES

Different types of sensations and irritations when smoking cigarettes such as taste, aroma, physiological strength, roughness are known as smoking features of tobacco. These features are determined both by the quantitative composition of the tobacco and by the balance ratios between the individual components (Guzelev, 1983).

The total nitrogen/nicotine balance ratio indicates a well-balanced flavor of tobacco smoke at values of this ratio between 1 and 3. (Guzelev, 1983). From the data presented in the Table 2 it can be seen that for all samples the quantitative ratio between total nitrogen/nicotine is within the limits of 1.0 (variety Dupnitsa 160, rec. 2021) to 1.9 (Line 504, rec. 2021), which indicates well balanced tobacco taste. Slightly below the lower limit of optimal values is Line 503 (0.8 - 2021 vegetation and 0.9 - 2022 vegetation), which is due to the higher nicotine content and lower total nitrogen content.

The results obtained by us show a coincidence with the studies of Staykova et al. (2015), in which the balance ratio total nitrogen/nicotine in selection lines and established varieties of the Krumovgrad ecotype varies from 1 to 2.

The quantitative ratio between soluble sugars/nicotine gives an idea of the fullness and smoothness of the taste and the manifestation of burning and sharpness of the tobacco when smoking. The

optimal values are between 6 and 10. With values below 6, the taste is sharp and rough, and above 10 - it is too light, with insufficient fullness and pungent (Guzelev, 1983).

In Line 503, vegetation 2022, the balance ratio is 8.63 and is in the optimal values, which gives good fullness and smoothness of the tobacco smoke. In the rest of the tested tobaccos, the balance ratio of total sugars/nicotine is slightly above the optimal limits of 6-10, indicating a light taste with insufficient fullness. The highest balance ratio of total sugars/nicotine is characterized by Line 504, vegetation 2022, which shows an extremely light taste and insufficient fullness of tobacco smoke (Table 2). The obtained results can be explained by the low nicotine content and high sugar content of this selection line.

The balance ratio of soluble sugars/nicotine when tracking the chemical composition of Bulgarian oriental tobaccos from the Krumovgrad ecotype, obtained in the studies of Staykova in 2015, is 3 to 17 and does not differ from the results obtained from the selection lines from the Dupnitsa ecotype (Staykova et al., 2015).

CONCLUSIONS

The studied lines form a proven higher yield compared to the control and a quality corresponding to the high-quality varieties Dupnitsa 160 and Katerini.

It was found that the Dupnitsa 160 variety and the Katerini variety were more variable in terms of nicotine content. Line 503 has stable indicators in terms of the indicator nicotine and sugars and more variable in terms of total nitrogen during the two studied vegetations, and Line 504 – more variable in terms of nicotine and total nitrogen.

The selection lines have a balanced chemical composition and good smoking qualities.

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