ISSN 3142-6247
Тутун/Tobacco, Vol. 72, Nº 7-12, 3-9, 2025 UDK: 633.71-152.61:575.22(497.785)“2022/2023“
Original Scientific Paper

INVESTIGATIONS FOR QUANTITATIVE TRAITS IN A COMPARATIVE EXPERIMENT WITH ORIENTAL TOBACCO GENOTYPES

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ABSTRACT

Five genotypes of oriental tobacco (four newly created lines and one standard variety) were examined for height of stalk without inflorescence, number of leaves per stalk, length of the leaves from middle belt of the stalk, yield of green leaf mass per stalk and yield of dry leaf mass per stalk. The trial was set up in the experimental field of the Scientific Tobacco Institute – Prilep in 2022 and 2023.
The aim of the research was to study the more important quantitative traits of the oriental genotypes, to determine the degree of uniformity of the populations through their variability and to identify the best genotypes among the selected material.
From the analysis of the results obtained in the comparative experiment, it can be concluded that the lines L-c and L-d are high-yielding, phenotypically and genotypically uniform and stable which is important for their future recognition as varieties.

Keywords: *Nicotiana tabacum* L., oriental lines, morphological traits, agronomic traits, variability.

ИСПИТУВАЊА ЗА КВАНТИТАТИВНИТЕ СВОЈСТВА КАЈ КОМПАРАТИВЕН ОПИТ СО ОРИЕНТАЛСКИ ГЕНОТИПОВИ ТУТУН

Испитувани се пет ориентални генотипови тутун (четири новосоздадени линии и една стандардна сорта) за висина на стракот без соцветие, број на листови по страк, должина на листовите од средниот појас, принос на зелена лисна маса по страк и принос на сува лисна маса по страк. Опитот беше поставен на Експерименталното поле при Научниот институт за тутун – Прилеп во 2022 и 2023 година.
Целта на испитувањата е да се проучат поважните квантитативни својства на ориенталските генотипови, да се одреди степенот на униформност на популациите преку нивната варијабилност и да се истакне најдоброто од селектираниот асортиман.
Од анализата на резултатите добиени од Компаративниот опит може да се заклучи дека линиите L-c и L-d се високоприносни, фенотипски и генотипски изедначени и стабилни што е важно за нивно признавање како сорти во иднина.

Клучни зборови: *Nicotiana tabacum* L., ориентални линии, морфолошки особини, агрономски особини, варијабилност.

INTRODUCTION

Tobacco (Nicotiana tabacum L.) is a strategic crop for the Republic of North Macedonia. The creation of new varieties, the improvement of existing varieties, chemical and technological analyses of tobacco raw material, as well as the production and sale of tobacco seeds are the competences of the Scientific Tobacco Institute - Prilep. The companies for tobacco purchase are obliged to buy tobacco seeds only from the Scientific Tobacco Institute in Prilep. The scientific workers at the Institute are completely dedicated to the tobacco crop that has been cultivated in these areas for centuries. Every year, in the Department of Genetics, Selection and Seed Control, experiments related to the breeding of tobacco are set up, crossings are carried out and new lines are analyzed, all with the aim of obtaining superior varieties, which is the main task and desire of every breeder.

A large number of papers by breeders have been published on the topic of tobacco breeding. Mitreski (2012) studied height of the stalk with inflorescence in six oriental tobacco varieties of type Prilep: P-23, P 12-2/1, NS-72, P 66-9/7, P-79-94 and Prilep Basma 82. The average values for the trait ranged from 59.3 cm in Prilep P 12-2/1 to 148.1 cm in Prilep Basma 82. The same author in co-authorship with Korubin-Aleksoska (2015) of the same varieties examined some morphological traits and announced that Prilep Basma 82 had the highest average leaf number, and the lowest length and width of the middle belt leaves. Dimitrieski and Miceska (2015), provide information about quantitative traits of new prospective variety of the oriental Yaka tobacco where they point out Yaka b 65 - 82/1. Korubin – Aleksoska and Ayaz (2016) investigated height of the stalk with inflorescence, leaf number, length of the middle belt leaves and dry mass yield per stalk in five autochthonous tobacco varieties of types: Prilep (P 10-3/2 and P 12-2/1), Djebel (Dj No 1) and Yaka tobaccos (YK 7-4/2 and KY), and five commercial oriental varieties of Prilep tobacco (P-23, P-84, NS-72, P-66-9/7 and P-79-94). Differences between the genotypes in the investigation period were highly significant, which is a sign of their mutual genotypic and phenotypic diversity. Korubin – Aleksoska and Ayaz (2016) studied ten oriental tobaccos of the types: Basmak (MK-1, MK-2, MB-2, MB-3, MS-8/1, MS-9/3 and YZ-7), Prilep (Prilep Basma-82), Djebel (Xanthi Djebel-1) and Yaka (YV 125/3), for some more important quantitative traits, and gave precise knowledge of the new type Basmak in Macedonia and the Balkans from genetic, morphological and agronomic aspects. All Basmak varieties are characterized by stability and uniformity as a result of their homozygosity. Aleksoski et al. (2023) performed three-year studies for number of leaves per stalk and the length, width and area of the leaves from the middle part of the stalk – traits directly related to the yield in the offspring of the first generation, in four mother parent tobacco varieties of different types (three of the Prilep type and one of the Basmak type), one pollen donor parent Burley B-1-91, and their four F1 hybrids. The hybrids MS 8/1 x B-1/91 and P 18-50/4 x B-1/91 represent very interesting material for future tobacco breeding activities. Aleksoski et al. (2023) studied three oriental varieties (two of the type Prilep and one of the type Yaka), and 7 newly created genotypes, of which four are of the type Yaka and three of the type Prilep. The newly created genotypes of the Prilep type have significantly longer leaves than the two control varieties. The highest yielding among the variants from the type Prilep is line L7. Lines L1, L3 and L4 have a significantly higher yield than the standard variety type Yaka. The aim of this paper is the analysis of the most important morphological and agronomic traits of five

oriental tobacco genotypes placed in a comparative experiment in 2022 and 2023, at the Scientific Tobacco Institute- Prilep.

MATERIAL AND METHODS

The experimental material consisted of four newly created oriental lines (L-a, L-b, L-c and L-d) and the standard variety P 66 9 7 (V-Ø) used for comparison. The experiment was set up in the experimental field at the Scientific Tobacco Institute – Prilep in the randomized block design with four replications. Plant spacing was 45 cm between rows and 15 cm between plants on a total experimental area of 114 m² with 350 plants per line.

The measurements of the morphological traits were measured at the stage of full growth and the beginning of flowering. Green leaf mass yield was measured after each harvest from 20 representative plants. Dry leaf mass yield was determined after tobacco manipulation. All statistical analyses were performed using Fisher's LSD test.

RESULTS AND DISCUSSION

Height of the stalk without inflorescence

The height of the tobacco is a morphological trait that the breeder select depending on the type of tobacco and the way the leaves are harvested.

In our investigations of the five oriental genotypes placed in a comparative experiment in four replications, L-a line is the highest line (114 cm - 2022 and 113 cm – 2023). The other lines and the control variety had approximately the same height, ranging from 91 cm in L-d to 95 cm in V-Ø in 2022, and from 90 cm in L-d to 96 cm in V-Ø in 2023.

The standard deviation ranges from 2.8 cm for L-b (2022) to 7.39 cm for L-d (2022). The coefficient of variability ranges from 3.22% for L-b (2022) to 8.12% for L-d (2022). The low degree of variability is a sign of uniformity and stability of the new lines.

Table 1 shows the mean values, the standard deviation and the coefficient of variability for the height of the stalk without inflorescence in the studied genotypes.

Number of leaves per stalk

The number of leaves in a tobacco plant is directly related to yield and is therefore important trait in tobacco breeding programs. L-d had the lowest number of leaves among the genotypes (49 leaves in 2022 and 48 leaves in 2023), whereas L-c had the highest number (55 leaves in both years. The standard deviation for the genotypes ranges from 1.5 (L-b and L-c – 2022), to 2.7 (L-a – 2022). The coefficient of variability ranges from 3.54% (L-c – 2022) to 6.51% (L-b – 2022). A low coefficient of variability is an indicator of the homozygosity of individuals and the uniformity of the population. Table 1 shows the mean values, the standard deviation and the coefficient of variability for the number of leaves per stalk among the genotypes.

Length of the leaves from the middle belt of the stalk

The length of the leaves is a varietal characteristic and one of the most important criteria for classifying tobacco. Therefore, breeders pay particular attention to this trait in tobacco breeding programs.

L-c and L-d (≈ 23 cm – 2022 and 2023) have the smallest length of the leaves from the middle belt. L-b (31.54 cm – 2022 and 32.35 cm – 2023) is characterized by the longest leaves, which represents the F9 generation of a cross of two oriental varieties, one of which has narrow and long leaves. The standard deviation ranges from 1.2 cm for L-c (2022) to 2.55 cm (2023) for the standard variety V-Ø. The coefficient of variability ranges from 5.28% for L-b (2022) to 10.29% for L-d (2022). All CV values are less than 10 with the exception of the one for L-d at 2022 (which is also close to the limit), indicating a uniform population.

The mean values, standard deviation and coefficient of variability for the length of the leaves from the middle belt of the stalk in the studied genotypes are shown in Table 1.

Table 1. Morphological characteristics of oriental tobacco genotypes placed in a comparative experiment at the Scientific Tobacco Institute - Prilep (2022 and 2023)

	Genotypes	Height of the stalk without inflorescence (cm)			Number of leaves per stalk			Length of the leaves from the middle belt of the stalk (cm)		
		$\bar{x}$	σ (±)	CV (%)	$\bar{x}$	σ (±)	CV (%)	$\bar{x}$	σ (±)	CV (%)
2022										
1.	L-a	114	4.15	3.77	51	2.70	4.86	29.4	1.84	6.51
2.	L-b	92	2.80	3.22	52	1.50	3.54	31.54	1.65	5.28
3.	L-c	93	5.00	6.25	55	1.50	3.54	23.09	1.20	5.67
4.	L-d	91	7.39	8.12	49	2.47	4.41	23.05	2.15	10.29
5.	V-Ø	95	6.03	7.35	54	2.30	5.00	24.9	2.52	8.98
	LSD 0.05 =	5.25			3.33			1.46		
	0.01 =	7.37			4.67			2.05		
2023										
1.	L-a	113	4.12	3.72	50	2.75	4.84	29.1	1.84	6.50
2.	L-b	92	2.82	3.25	53	1.52	3.50	32.35	1.63	5.29
3.	L-c	94	5.01	6.25	55	1.51	3.50	23	1.22	5.65
4.	L-d	90	7.37	7.42	48	2.45	4.45	23.52	2.15	9.89
5.	V-Ø	96	6.05	8.05	54	2.30	5.02	24.9	2.55	8.97
	LSD 0.05 =	3.51			3.53			1.57		
	0.01 =	4.93			4.95			2.21		

Legend: L - line, V - variety, Ø - control, $\bar{x}$ - mean value, σ - standard deviation, CV - coefficient of variability

The stability and uniformity of the genotypes that are the subject of this research can be confirmed from Figure 1, which shows the morphological traits in the two years of investigation.

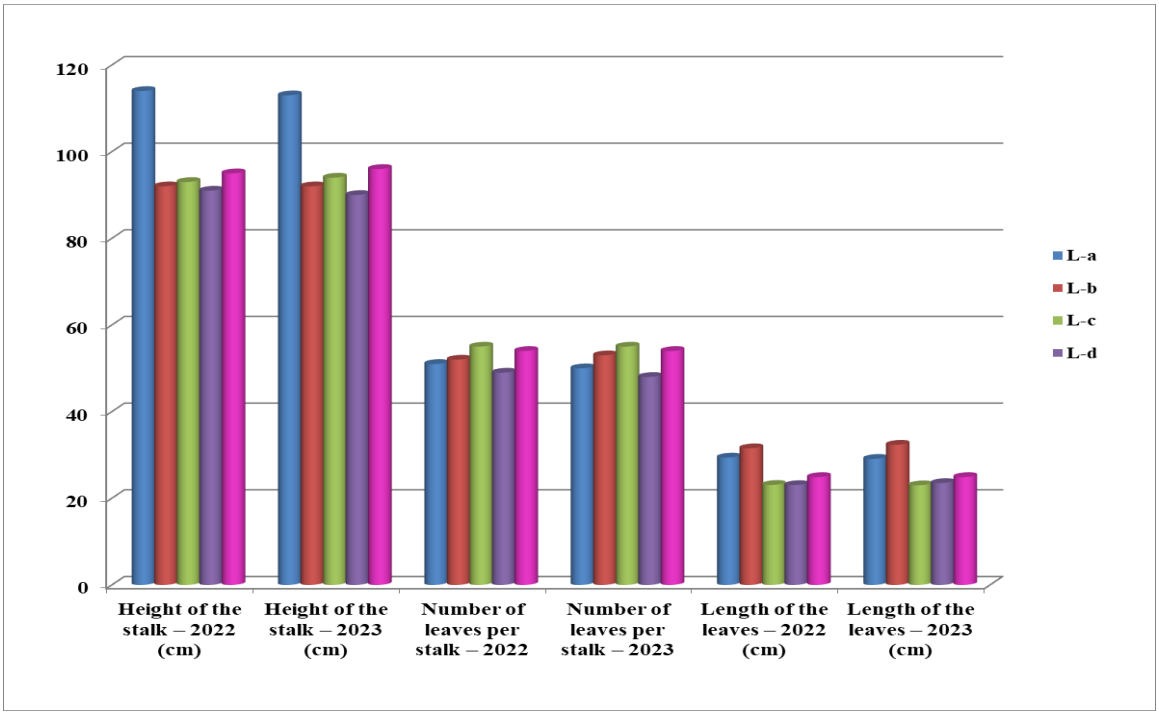


Figure 1. Morphological traits of genotypes in 2022 and 2023

Green leaf mass yield per stalk

Increasing yield is one of the main objectives of every breeder. In the case of tobacco, we are working on increasing the leaf yield, while taking care not to deteriorate the quality properties of the tobacco raw material. The highest green leaf mass yield per stalk was recorded for L-c (225 g – 2022 and 226 g – 2023). Compared to the control, the difference in yield was significant in 2022 and highly significant in 2023. The other lines showed lower yields, ranging from 165.25 g (L-a) to 199.50 g (L-d) in 2022 and from 167.50 g (L-a) to 198.00 g (L-d) in 2023.

For this trait, the standard deviation and the coefficient of variability were not calculated, because the values were obtained by dividing the sum of the total yield by the number of stalks from which the tobacco was collected, for each repetition.

The mean values for the yield of green leaf mass per stalk among the genotypes are shown in Table 2.

Dry leaf mass yield per stalk

The line L-c shows the highest yield of dry leaf per stalk (36.03 g – 2022 and 36.65 g – 2023), following L-d (35.70 g - 2022 and 34.95 g – 2023). Compared to the control variety, the yield differences are highly significant. For the dry leaf yield, as well as for the green leaf yield, the standard deviation and the coefficient of variability were not calculated for the same reasons. The mean values for the yield of dry leaf mass per stalk of the genotypes are shown in Table 2.

The differences in the agronomic traits (green and dry leaf mass yield per stalk) among the genotypes in the two years of investigation are shown in Figure 2, indicating that some lines performed consistently better than the standard variety.

Table 2. Yield of green and dry leaf mass from oriental tobacco genotypes planted in a comparative experiment at the Scientific Tobacco Institute - Prilep (2022 and 2023)

Genotypes	Green leaf mass yield per stalk (g)				$\bar{x}$	Dry leaf mass yield per stalk (g)				$\bar{x}$
	Repetitions					Repetitions				
	I	II	III	IV		I	II	III	IV	
2022										
1. L-a	170	153	168	170	165.25	25.6	26.6	25.7	27.4	26.30
2. L-b	160	172	171	175	169.50	26.3	26.8	26.6	25.7	26.40
3. L-c	218	228	226	228	225.00*	36.6	36.7	34.6	36.2	36.03**
4. L-d	190	194	238	176	199.50	33.1	37.1	38.5	34.0	35.70**
5. V-Ø	209	170	223	163	191.25	30	32	33.3	26.4	30.40
LSD 0.05 =	26.19					2.75				
0.01 =	36.76					3.85				
2023										
1. L-a	168	164	167	171	167.50	26.5	27.2	25.7	27.8	26.80
2. L-b	180	176	181	195	183.00	28.6	27.7	29.9	27.8	28.50
3. L-c	228	230	223	223	226.00**	37.4	36.7	36.6	35.9	36.65**
4. L-d	186	209	178	219	198.00	33.1	35.1	36.4	35.2	34.95**
5. V-Ø	209	180	203	171	190.75	29.8	32.8	31.7	27.7	30.05
LSD 0.05 =	21.23					2.10				
0.01 =	29.80					2.94				

Legend: L - line, V - variety, Ø - control, $\bar{x}$ - mean value

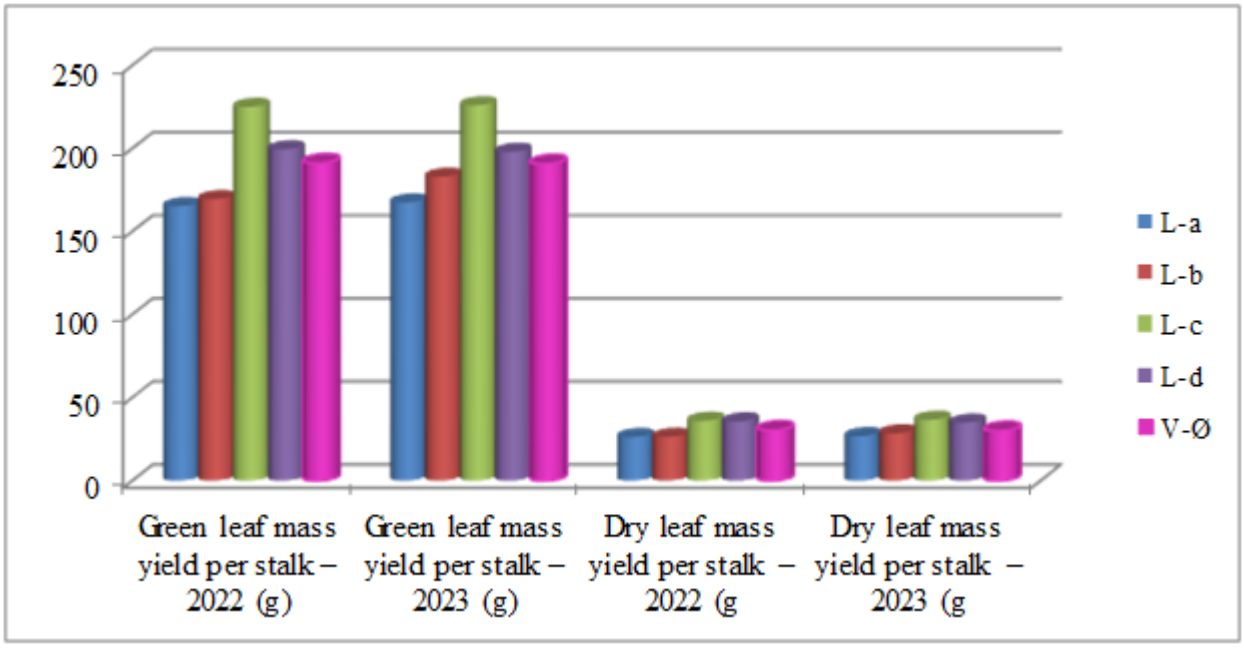


Figure 2. Agronomic traits of genotypes in 2022 and 2023

CONCLUSIONS

From the presented analysis for the most important morphological and agronomic traits the following conclusions can be drawn:

- Line L-a is the highest line without inflorescence (114 cm), L-c has the greatest number of leaves (55 leaves for both years), and L-c and L-d are distinguished by the shortest leaves from the middle belt of the stalk (about 23 cm which is shorter than the standard variety).
- The three morphological traits showed coefficients of variability of approximately 10% or lower in both years of investigation, indicating a high degree of uniformity of the new lines
- L-c had the highest green leaf mass yield per stalk, with a significantly higher yield than the control variety in 2022 and a highly significantly higher yield in 2023.
- L-c and L-d gave the highest yield of dry leaf mass per stalk. Compared to the control, both lines have a significantly higher yield.
- From the analysis of the results obtained from the comparative experiment, it can be concluded that lines L-c and L-d are high-yielding, phenotypically and genotypically uniform and stable, making them promising candidates for future varietal recognition.

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