

RESULTS OF THE INVESTIGATION ON SOME BIO-MORPHOLOGICAL CHARACTERISTICS OF DOMESTIC AND INTRODUCED VARIETIES OF BURLEY TOBACCO

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ABSTRACT

During the two-years investigation (2010 and 2011), six Burley varieties were included in order to study some biologically-morphological characteristics such as time of flowering and resistance to some economically significant diseases, dimensions of the leaves from the middle belt (5th, 10th and 15th), the height of the stalk with the inflorescence and the number of leaves. In order to confirm the correctness of the results, they were statistically processed. Results on the investigated characteristics show unambiguous dominance of the varieties Pelagonec CMS F₁ and B-98/N CMS F₉ over all the other varieties in the trial. The results can contribute a lot in producer's choice of tobacco variety, because they give certain guarantee and safety for a successful production cycle of this type of tobacco.

Key words: tobacco, varieties, Burley, flowering, diseases, leaves, stalks, dimensions.

РЕЗУЛТАТИ ОД ИСПИТУВАЊЕТО НА НЕКОИ БИО-МОРФОЛОШКИ СВОЈСТВА НА ДОМАШНИ И СТРАНСКИ СОРТИ ТУТУН ОД ТИПОТ БЕРЛЕЈ

Во двегодишните испитувања (2010 и 2011 год.) беа вклучени шест берлејски сорти со цел подетално да се испитаат некои нивни биолошко-морфолошки како: време на цветање и отпорност на некои стопански позначајни болести, димензии на листовите од средниот појас (5^т, 10^т, и 15^т), висината на стракот со соцветие и бројот на листовите. Со цел да се потврди точноста на резултатите, истите беа и статистички обработени. Добиените резултати за испитуваните својства покажуваат недвосмислена доминација на сортите Пелагонец ЦМС F₁ и Б-98 /N ЦМС F₉ над сите други сорти во опитот. Овие резултати можат многу да придонесат при изборот на сорта од страна на производителот, бидејќи влеваат извесна гаранција и сигурност за успешен произведен циклус на овој тип тутун.

Клучни зборови: тутун, сорта, берлеј, цветање, болести, листови, стракови, димензии.

INTRODUCTION

The Burley type worldwide, according to its size and production quantities, is right after the Virginia type and is still irreplaceable constituent in cigarette blend. Because of the low costs during its production compared to some other types of tobacco (e.g. Virginia), on the world stock market it has a relatively low price,

which directly affects the forming of the final price of cigarettes.

Through our two year-investigations and the results obtained, more precise image of the characteristics of each variety is achieved (e.g. time of flowering, resistance to diseases, number of leaves etc.)

MATERIAL AND METHODS

Six varieties were taken as a material for work in the two-year investigations (2010 and 2011), three of which were introduced (B-21 Ø USA, Banket 21, Zimbabwe and B-1317 Bulgaria), all of them in a fertile form, and three were domestic varieties (lines), two of which were in CMS form (B-98/N CMS F₀ and Pelagonec CMS F₁) and B-136/07 (fertile). The classical American Burley type B-21 was used as a check variety. The trial was set up in the field of Tobacco Institute-Prilep on colluvial type of soil. Processing of the areas used in the trial began with autumn ploughing in about 40 cm depth, and in the spring they were fattened with artificial fertilizer NPK– 8:22:20 with 300 kg/hand, after which they were ploughed two times. Before transplanting, the soil was treated with herbicide incorporated in the earth. On the surface prepared this way, the healthy seedling was transplanted by hand in four replications at randomized block system, with 90x50 cm spacing. The tobacco plant was hoed up twice and before every hoeing each stalk was given about 5g 26% KAN. During the vegetation, according to the needs

a few additional irrigations were made as well as protection of the plantation with checked preparations. Days required from transplanting to the beginning of flowering of tobacco varieties in the plantation, 50 % flowering and the end of flowering were recorded during the vegetation. The susceptibility of tobacco varieties to some economically significant diseases (TMV, PVY and *Phytophthora parasitica* var. *nicotianae*), was monitored and recorded, and the data were statistically processed by the method of calculation of arithmetic mean of relative numbers with different number of statistical units in plot (Filiposki, 2011).

Morphological measurement was made only of the leaves that belong mostly to the middle belt (5th, 10th and 15th), which accounts for 60-70% of the total leaf mass of the stalk. The height of the stalk with inflorescence and the total number of leaves per stalk were also analyzed. Measurements data were statistically processed by the analysis of variance method, set up in randomized blocks system (Filiposki 2011).

RESULTS AND DISCUSSION

Length of vegetation period of tobacco plant (flowering)

Before seed formation, there is a period of flowering and pollination. Rubin (1971) found out that the first flower to open is the central (ultimate) flower. The time needed for flowering at different types and varieties of tobacco is different. As a rule, the varieties with lower number of leaves bloom faster. Hawks (1994) said that the variety NC 22 NF “does

not bloom”, but it forms 30 leaves more than the ordinary varieties. It started forming flowers when the length of the day was not shortened to the maximum. Naumoski et. al. (1977) reported that by the end of flowering stage, tobacco plant has already formed about 90% of its vegetative mass. According to Donev (1973), by removal of flowers from the stalk, the root activity is

accelerated and new flowers appear. According to the data in Table 1, there are no drastic differences between the varieties in the trial from the time of transplanting to the time of beginning of flowering, with a remark that in 2011 the time needed for flowering in all varieties with no exceptions was somewhat longer compared to that in 2010. This is probably due to the more

rainless periods in 2011, especially in July and August.

At average, the check variety B-21 and the variety Banket 21 started to bloom first (for 61.5 and 61.0 days from the day of transplanting, respectively). The last to bloom was the variety Pelagonec CMS F₁ (65.5 days) which is for 4.5 days later than the check variety B-21.

Table 1 Length of vegetation period of tobacco plant (flowering)

Varieti	Crop	Beginning of flowering from transplanting in days	Average 2010/2011	Absolute difference from the average	50% flowering from transplanting in days	Average 2010/2011	Absolute difference from the average	End of flowering from transplanting in days	Average 2010/2011	Absolute difference from the average
B-21 Ø	2010	60	61.5	/	67	69.0	/	72	74.5	
	2011	63			71			77		
B-1317	2010	61	62.5	+1.0	69	70.5	+1.5	75	77.0	+2.5
	2011	64			72			79		
Banket 21	2010	58	61.0	-0.5	63	65.0	-4.0	67	69.5	-5.0
	2011	64			67			72		
B-136/07	2010	61	62.0	+0.5	66	68.5	-0.5	72	75.0	+0.5
	2011	63			71			78		
B-98/N CMS F ₉	2010	63	64.0	+2.5	68	71.0	+2.0	78	79.0	+4.5
	2011	65			74			80		
Pelagonec CMS F ₁	2010	64	65.5	+4.5	73	74.0	+5.0	77	79.5	+5.0
	2011	67			75			82		

With the other varieties in the trial, the time needed for the beginning of flowering was between 62.0 in B-136/07 to 64.0 in B-98/N CMS F₉. The number of days until 50% of flowering was the least in the variety Banket 21 (65.0), which is 4.0 days less compared to the check variety B-21 which passed this stage for 69.0 days. The longest period for 50% of flowering was needed in the variety Pelagonec CMS F₁ (74.0 days), which is 5.0 days more compared to the check variety. In other varieties of the trial, this period ranged from 68.5 days in B-136/07

to 71.0 days in B-98/N CMS F₉.

The period to the end of flowering was first finished in the variety Banket 21 in 69.5 days, i.e. 5 days less compared to the check variety B-21 which needed 74.5 days for this period. The longest period (79.5 days) to the end of flowering was needed for variety Pelagonec CMS F₁, and it is 5 days more compared to the check variety B-21. In other varieties of the trial, this period ranges between 75.0 days in B-136/07 to 79.0 days in B-98/N CMS F₉.

Diseases of tobacco plant during the vegetation

During its life cycle the tobacco plant, is often attacked by different diseases generated by viruses, bacteria and pathogenic fungi. The raw material derived from diseased stalks is with a low quality and with limited using value in fabrication. During our investigations, monitoring of the varieties resistance to TMV, PVY and *Phytophthora parasitica* var. *nicotianae* was included. According to Mickoski (1984), TMV is easily transmissible virus which causes severe damages lowering the yield up to 30%, and the diseased leaves are of a bad quality. The same author describes PVY as a very destructive

virus disease present worldwide, causing serious damages on tobacco plant as well as on potato, pepper, tomato etc. Buzančić (1984) reported that PVY was first described by Smith in 1931, and as a transmitter he points out the aphid.

Mickoski (1984) describes *Phytophthora parasitica* var. *nicotianae* as a destructive disease which mostly attacks tobacco plants of the types Virginia and Burley, and as a cause of it he points out the fungus *Phytophthora parasitica* var. *nicotianae*. The degree of disease in the varieties investigated can be seen in Table 2.

Table 2 Diseases during the vegetation

Variety	Crop	Total number of plants	TMV virus			PVY virus			<i>Phytophthora parasitica</i> var. <i>nicotianae</i>		
			Infected plants	Percentage of infected plants	Average for the two years	Infected plants	Percentage of infected plants	Average for the two years	Infected plants	Percentage of infected plants	Average for the two years
B-21	2010	51	4	7.83	3.92	2	3.92	1.96	-	-	0.00
	2011	53	-	-		-	-		-	-	
B-1317	2010	52	4	7.69	3.85	-	-	0.00	-	-	2.04
	2011	49	-	-		-	-		2.00	4.08	
Banket 21	2010	40	1	2.50	1.25	-	-	0.00	2.00	5.00	2.50
	2011	45	-	-		-	-		-	-	
B-136/07	2010	50	2	4.00	6.00	2	4.00	2.00	3.00	6.00	3.00
	2011	50	4	8.00		-	-		-	-	
B-98/ N CMS F ₉	2010	51	1	1.96	0.98	-	-	0.00	-	-	0.00
	2011	44	-	-		-	-		-	-	
Pelagonec CMS F ₁	2010	48	-	-	0.00	-	-	0.00	-	-	0.00
	2011	48	-	-		-	-		-	-	

Data from Table 2 show that the health condition of the varieties is good, i.e. they have a low percentage of plants infested by viruses or by the fungus *Phytophthora parasitica* var. *nicotianae*. The highest percentage of plants is

infected with the virus disease tobacco mosaic (TMV), ranging from 0.98% in B-98/N CMS F₉, to 6.00% in B-136/07, while in Pelagonec CMS F₁ there are no symptoms of infection with this disease.

In the types B-1317, Banket 21, B-98/N CMS F₉ and Pelagonec CMS F₁ no necrotic strain of tobacco (PVY) can be seen. In the varieties B-21 and B-136/07 the percentage of infection is only 1.96% and 2.00%, respectively. In average, the percentage of infected plants with *Phytophthora parasitica* var. *nicotianae* in

B-136/07 is between 2.04 % and 3.00 %. In other varieties this disease does not appear.

It can be said that the variety B-136/07 has the highest percentage of plants infected with TMV, PVY and *Phytophthora parasitica* var. *nicotianae*, while in the variety Pelagonec CMS F₁ none of the above diseases appears.

Characteristics of the 5th leaf

Morphological characteristics of tobacco, besides being genetically controlled and different for every type or variety, greatly depend on the soil and climate conditions, the applied

cultural practices, the presence of diseases etc. Characteristics of the 5th leaf in the varieties included in our two year-investigations are presented in Table 3.

Table 3. Characteristics of the 5th leaf

Variety	Crop	Length in cm	Average 2010/11	Absolute difference from the average	width in cm	Average 2010/11	Absolute difference from the average
B21 Ø	2010	39.5	37.7	/	25.6	24.9	/
	2011	36,0			24.2		
B-1317	2010	48.7 ⁺⁺	47.7	+10.0	32.5 ⁺⁺	29.8	+4.9
	2011	43.5 ⁺⁺			27.2 ⁺⁺		
Banket 21	2010	48.0 ⁺⁺	44.8	+7.1	28.2	27.8	+2.9
	2011	41.7 ⁺⁺			27.5		
B-136/07	2010	53.7 ⁺⁺	51.3	+13.6	39.6 ⁺⁺	35.8	+10.9
	2011	49.0 ⁺⁺			32.0 ⁺⁺		
B-98/N CMS F ₉	2010	53.0 ⁺⁺	51.7	+14.0	30.8 ⁺⁺	29.9	+5.0
	2011	50,5 ⁺⁺			29.0 ⁺		
Pelagonec CMS F ₁	2010	58,0 ⁺⁺	58.2	+20.5	37.0 ⁺⁺	37.6	+12.7
	2011	58.5 ⁺⁺			38.2 ⁺⁺		
		Leaf length				Leaf width	
		2010	2011			2010	2011
LSD 5%		3.0 cm ⁺	3.6 cm ⁺			3.6 cm ⁺	3.6 cm ⁺
	1%	4.2cm ⁺⁺	5.1 cm ⁺⁺			4.2 cm ⁺⁺	5.0 cm ⁺⁺

According to these data, in 2011 – the year with lower amount of precipitations, the dimensions of the analyzed leaf in all varieties in the trial were smaller. However, from the average values it can be seen that the biggest length (58.2 cm) was observed in the variety Pelagonec CMS F₁ which is 20.5 cm longer compared to the check variety B-21, where it reaches 37.7 cm, which is in fact, the smallest

measured length from all varieties in the trial. In the other varieties, this data ranges from 44.8 cm in Banket 21, to 51.7 cm in B-98/N CMS F₉. Compared to the check variety, all varieties investigated in the trial showed statistically significant differences on the level of probability of 1%. The similar situation was recorded for the 5th leaf width, with the highest average (37.6 cm) in the variety Pelagonec CMS F₁, which is

12.7 cm more compared to the check variety with 24.9 cm average width. In other varieties in the trial this data ranges between 27.8% in Banket 21 to 35.8 in B-136/07. Compared to the check variety in the two years of investigation, statistically significant differences on the level of

probability of 1% were recorded in the varieties Pelagonec CMS F₁ and B-136/07, while the varieties B-1317 and B- 98/N CMS F₉, showed such difference only in the 2010 crop. In 2011 the variety B- 98/N CMS F₉, showed statistically significant differences on the level of 5%

Characteristics of the 10th leaf

The tenth leaf belongs to the middle belt, and the zone where it is formed yields leaves with the largest size. Risteski (2006), investigated 6 Burley varieties in the region of Prilep during

1999-2001 and made conclusion that length of this leaf ranged 50-61 cm, the width 27-36 cm and the length: width ratio 1.62-1.88.

Table 4. Characteristics of the 10th leaf

Variety	Crop	Length in cm		Absolute difference from the average	Width in cm		Absolute difference from the average
		2010	Average 2010/11		2010	Average 2010/11	
B-21 Ø	2010	53.1	52.8	/	27.5	27.8	/
	2011	53.5			28.2		
B1317	2010	60.5 ⁺⁺	57.3	+4.5	34.5 ⁺⁺	32.5	+4.7
	2011	54.2 ⁺⁺			30.5 ⁺⁺		
Banket 21	2010	52.8 ⁺⁺	53.6	+0.8	27.5	29.0	+1.2
	2011	54.5 ⁺⁺			30.5		
B-136/07	2010	62.7 ⁺⁺	60.9	+8.1	34.0 ⁺⁺	31.5	+3.7
	2011	59.2 ⁺⁺			29.0 ⁺⁺		
B-98/N CMS F ₉	2010	65.7 ⁺⁺	65.2	+12.4	36.1 ⁺⁺	35.5	+7.7
	2011	64.7 ⁺⁺			35.0 ⁺⁺		
Pelagonec CMS F ₁	2010	71.1 ⁺⁺	69.4	+16.6	40.1 ⁺⁺	40.1	+12.3
	2011	67.7 ⁺⁺			40.2 ⁺⁺		
		Leaf length				Leaf width	
		2010	2011			2010	2011
LSD 5%		3.0 cm +	4.5 cm ⁺			1.8 cm +	3.7 cm ⁺
		1% 4.1cm ⁺⁺	6.3 cm ⁺⁺			1% 2.5 cm ⁺⁺	5.2 cm ⁺⁺

According to the data presented in Table 4, the highest average length of the 10th leaf (69.4 cm) was observed in the variety Pelagonec CMS F₁ - 16.6 cm more in comparison with the check variety B-21 where this data was 52.8 cm. In other varieties from the trial this data ranged between 53.6 cm in Banket 21 and 65.2 cm in B- 98/N CMS F₉, with remark that in the rainless 2010, the length of this leaf was somewhat

smaller compared to that in 2010.

Compared to the check variety B-21, statistically significant differences at 1% probability level in both years if investigation were achieved by the varieties Pelagonec CMS F₁ and B-136/07, and the variety B-1317 only in 2010 reached statistical significance of 1%. The highest average width of 40.1 cm was observed in the variety Pelagonec CMS F₁, which is 12.3

cm more compared to the check B-21 which had the smallest width of this leaf compared to all other varieties - only 27.8 cm. In other varieties from the trial, the average width of this leaf ranged from 29.0 in Barket variety to 35.5 cm in B-98/N CMS F₉. Only the varieties Pelagonec

CMS F₁ and B-98/N CMS F₉ in both years of investigation reached statistically significant differences at 1% probability level. The varieties B-136/07 and B-1317 showed such differences only in the crop 2010.

Characteristics of the 15th leaf

The fifteenth leaf is also located in the middle belt of the stalk and as a raw material it is highly appreciated in the fabrication. The characteristics of this leaf can be seen from the data presented in Table 5.

Thus, in 2011, the year with less precipitations, this leaf was somewhat smaller in size compared to that in 2010. The variety Pelagonec CMS F₁ again had the highest average length - 61.1 cm, which is 13.4 cm more than the smallest average length of 47.7 cm recorded in the check variety B-21. In other varieties of the trial, the width of this leaf ranged from 49.0 cm in Barket 21 to 59.5 cm in B-98/N CMS F₉. In both years of investigation, only the

varieties Pelagonec CMS F₁, B-98/N CMS F₉ and B-136/07 reached statistically significant differences at 1% level of probability, compared to the check B-21, while the variety B-1317 showed such differences only in 2010.

The largest average width of the 15th leaf (33.5 cm) was recorded in the B-98/N CMS F₉, i.e. 9.9 cm more compared to the check which had the smallest width (23.6 cm). In other varieties of the trial, this data ranged between 23.7 cm in the variety Barket 21 and 32.4 cm in Pelagonec CMS F₁. Statistically significant differences of the investigated varieties compared to the check variety B-21 are completely identical as those presented for the character leaf length.

Table 5. Characteristics of the 15th leaf

Variety	Crop	Length in cm	Average 2010/11	Absolute difference from the average	Width in cm	Average 2010/11	Absolute difference from the average
B-21 Ø	2010	49.5	47.7	/	23.5	23.6	/
	2011	46.2			23.7		
B-1317	2010	56.7 ⁺⁺	52.4	+4.7	28.9 ⁺⁺	26.2	+2.6
	2011	48.2 ⁺⁺			23.5		
Barket 21	2010	49.5 ⁺⁺	49.0	+1.2	24.0	23.7	+0.1
	2011	48.5 ⁺⁺			29.2 ⁺⁺		
B-136/07	2010	57.2 ⁺⁺	55.4	+7.7	29.2 ⁺⁺	28.4	+4.8
	2011	53.7 ⁺⁺			27.7 ⁺⁺		
B-98/N CMS F ₉	2010	60.0 ⁺⁺	59.5	+11.8	35.4 ⁺⁺	33.5	+9.9
	2011	59.1 ⁺⁺			31.7 ⁺⁺		
Pelagonec CMS F ₁	2010	63.1 ⁺⁺	61.1	+13.4	32.8 ⁺⁺	32.4	+8.8
	2011	59.2 ⁺⁺			32.0 ⁺⁺		
		Leaf length				Leaf width	
		2010	2011			2010	2011
LSD 5%	5%	3.1 cm ⁺	2.9 cm ⁺			1.6 cm ⁺	2.5 cm ⁺
		1%	4.3 cm ⁺⁺	4.1 cm ⁺⁺			1%

Height of the stalk with inflorescence and leaf number per stalk

The height of the stalk and the leaf number are typical characters in tobacco and they are genetically regulated. However, there are some other factors that have particular influence on these characters, such as agro-ecological conditions and the application of cultural practices. Дюлгерски (2009) suggests an optimal stalk height of 145 - 180 cm in large-leaf tobaccos, and a number of 26-32 leaves in Burley tobacco. Data on stalk height with inflorescence and leaf number in the investigated varieties are presented in Table 6.

The highest stalk with inflorescence

(191.5 cm) was achieved in the variety Pelagonec CMS F₁, which is 41.0 cm more compared to the check variety B-21 (150.5 cm). In other varieties of the trial, the average height of the stalk with inflorescence ranged between 153.5 cm in Banket 21 and 188.6 cm in B-98/N CMS F₉. In both years of investigation, statistically significant differences at 1% probability level for this character compared to the check variety B-21 were recorded for the varieties Pelagonec CMS F₁, B-98/N CMS F₉ and B-136/07, while B-1317 showed such statistic difference only in 2010.

Table 6. The height of the stalk with inflorescence and number of leaves

Variety	Crop	Stalk height with inflorescence	Average 2010/11	Absolute difference from the average	Range	Leaf number	Average 2010/2011	Absolute difference from the average	Range
B-21 Ø	2010	148.5	150.5	/	6	22.7	23.8	/	5
	2011	152.5				24.7			
B-1317	2010	171.5 ⁺⁺	167.7	+17.2	4	28.7 ⁺⁺	26.8	+3.0	3
	2011	164.0				25.0			
Banket 21	2010	153.5	153.5	+3.0	5	22,7	23.1	-0.7	6
	2011	153.6				23.5			
B-136/07	2010	185.7 ⁺⁺	178.8	+28.3	3	28,0 ⁺⁺	26.7	+2.9	4
	2011	172.0 ⁺⁺				25.5			
B-98/N CMS F ₉	2010	188.5 ⁺⁺	188.6	+38.1	2	32.7 ⁺⁺	32.9	+9.1	2
	2011	88.7 ⁺⁺				33.2 ⁺⁺			
Pelagonec CMS F ₁	2010	190.5 ⁺⁺	191.5	+41.0	1	34.0 ⁺⁺	34.0	+10.2	1
	2011	192.5 ⁺⁺				34.0 ⁺⁺			
		Stalk height				Leaf number			
		2010	2011			2010	2011		
LSD 5%	7.4 cm ⁺	11.9cm ⁺			LSD 5%	1.0 лист ⁺	2.3 лист ⁺		
1%	10.3cm ⁺⁺	16.6 cm ⁺⁺			1%	1.4 лист ⁺⁺	3.2 лист ⁺⁺		

It can be seen from the data that the highest leaf number (34.0) was observed in the variety Pelagonec CMS F₁, which is 10.2 leaves more compared to the check B-21, and the lowest leaf number (23.1) was observed in Banket 21. In other varieties of the trial, this data ranges from 23.8 leaves in the check variety B-21 to 32.9

leaves in B-98/N CMS F₉. Statistically significant differences of the varieties in comparison with the check B-21 at 1% probability level in both years of investigation were observed only in the varieties Pelagonec CMS F₁ and B-98/N CMS F₉. The varieties B-136/07 and B-1317 reached such significance only in 2010.

CONCLUSION

According to the results of the two-year investigations, the following conclusions have been made:

- In average, the variety Banket 21 starts the flowering stage first (61.0 days) and ends it first (69.5 days). The last to start and end the flowering is the variety Pelagonec CMS F₁ (79.5 days).

- The variety Pelagonec CMS F₁ was the most tolerant to TMV, PVY and Phytophthora parasitica var. nicotianae, compared to the other varieties in the trial.

- The varieties Pelagonec CMS F₁ and

B-98 / N CMS F₉ have the largest length and width of the 5th, 10th and 15th leaf.

- The average number of leaves (34.0) is the highest in variety Pelagonec CMS F₁ and the lowest (23.1) in the variety Banket 21.

- The biggest height of the stalk (191.5 cm) was achieved in variety Pelagonec CMS F₁ and the smallest (150.5 cm) in the check variety B-21.

- The investigations show unambiguous dominance of the varieties Pelagonec CMS F₁ and B-98/N CMS F₉ over the other varieties in the trial.

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