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MORPHOLOGICAL PROPERTIES OF SOME DOMESTIC AND INTRODUCED BURLEY TOBACCO VARIETIES (LINES) IN AGROECOLOGICAL CONDITIONS OF PRILEP

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ABSTRACT

Two-year investigations (2008-2009) were carried out in the region of Prilep with six domestic and introduced varieties (lines) of Burley tobacco. Investigations were prompted by the needs of Macedonian fabrication for this type of raw, which has been fully supplied from imports. Although the region of Prilep is considered less suitable for production of Burley, results have shown that domestic varieties Pelagonec CMS F1 and B-98/N CMS F8 can be grown with great success. According to the number and size of the 5th, 10th and 15th leaf, these varieties can achieve high yields and quality typical for Burley tobacco.

Key words: burley tobacco, production of burley

МОРФОЛОШКИ СВОЈСТВА НА НЕКОИ ДОМАШНИ И СТРАНСКИ СОРТИ (ЛИНИИ) ТУТУН ОД ТИПОТ БЕРЛЕЈ ОДГЛЕДУВАНИ ВО АГРОЕКОЛОШКИТЕ УСЛОВИ ВО РЕОНОТ НА ПРИЛЕП

Истражувањата направени во 2008 и 2009 во агроеколошките услови на Прилеп со 6 домашни и странски сорти (линии) тутун од типот берлеј беа поттикнати од потребите на македонската фабрикација за суровина од овој тип, која во моментов целосно се увезува. Овие истражувања покажаа дека и во реонот на Прилеп, кој не важи за реон погоден за производство на типот берлеј, домашните сорти Пелагонец ЦМС F_1 и Б-98/N ЦМС F_8, можат да се одгледуваат со успех. Резултатите од бројот и димензиите на анализираните листови (5 ^{от}, 10 ^{от} и 15 ^{от}) упатуваат на тоа дека од овие сорти можат да се очекуваат добри приноси и квалитет карактеристични за овој тип тутун.

Клучни зборови: тутун берлеј, производство на берлеј

INTRODUCTION

Morphological properties are important category for determination of tobacco types and varieties. To a lesser or greater extent, these properties vary from type to type and they are genetically controlled. Unsuitable agroecological conditions and cultural practices, however, can lead to big variations of both bio-morphological and chemical composition of the obtained raw. Such variations appear despite the existence of genetic control and they are indication of tobacco plasticity. Therefore, it is very important to have a knowledge on the basic prerequisites for stable tobacco production, with minimum variations of its morphological and production characteristics.

Up to 2002, Burley tobacco in R. Macedonia was mainly located in the southeast region of the country. It was grown in small, almost symbolic quantities (only 156 tons in 1993) and after 2002 Macedonian fabrication became completely dependent on Burley tobacco imports. In the period that followed, several Burley varieties were created in Tobacco Institute - Prilep, with yields and quality which guarantee a stable and profitable production. Creation of new varieties is a long-term determination of the Institute and it makes continuous efforts in this field. Two-year field experiments have to be conducted before applying to the National Commission for approval of the new varieties.

MATERIAL AND METHODS

Investigation included six varieties (lines) of domestic and foreign origin: check variety B-21 CMS F_8 (US), was compared to fertile varieties BB-16 (France), B-1317 (Bulgaria), B-136/07 and varieties Pelagonec CMS F1 and B-98/N CMS F8 (Tobacco Institute-Prilep, Macedonia). Two-years investigation (2008 - 2009) was conducted on colluvial soil in the field of the Institute. First autumn plowing was made at 40 cm depth and fertilization was made in spring, with 300 kg/ha NPK 8 : 22 : 20 and two additional plowings. Herbicide was applied prior to transplanting. Healthy seedlings were planted manually, in 4 replications, with random distribution of varieties at 90 x 50 cm spacing. Due to the poorer nitrogen content, 26% KAN (5 g/stalk) was added at the second hoeing of the soil. The number and amount of additional irrigations (3-5, with 30 - 40 l/m^2) depended on weather conditions. Average stalk height and leaf number were obtained from 5 stalks of each variety, on the lower and middle belt leaves (5th, 10th and 15th). Tobacco was regularly treated with products for protection throughout the whole period of growth Meteorological data were obtained from the Internal Meteorological Station of the Institute.

RESULTS AND DISCUSSION

Soil and weather conditions

Depending on conditions and countries in which they worked, some authors (Gornik 1953; Haslam, Skott 1963, Georgievski 1971, Benkovic 1981, Pamukov 1992, Apostolova 1996 and Pelivanoska 1999) recommend growing of Burley tobacco in soils rich in humus (2 - 5%) and microelements, with low pH, well aerated, and water-permeable.

CLIMATE CONDITIONS

Temperature, precipitations and relative air humidity have a strong impact both on tobacco plant growth and development and on its morphological, technological and chemical properties. Data on the climate conditions during the growing season (May-September) in the two years of investigation are presented in Table 1.

Table 1 Meteorological data in the period May-September 2008/2009, in the field of Tobacco Institute-Prilep

Meteorological data	Year	Months					X /∑
		V	VI	VII	VIII	IX	
Mean monthly air temperature, ˚C	2008	16,7	19,9	22,3	23,6	15,8	19,7
	2009	15,8	18,5	21,9	21,4	17,1	18,9
Mean monthly relative humidity of the air, %	2008	60	53	49	50	71	57
	2009	58	57	42	50	54	52
Total precipitations, mm	2008	41,3	10,0	11,0	11,0	110,0	183,3
	2009	55,0	75,0	8,0	43,0	15	196,0

Air temperature - is a very important factor influencing a region's climate. It varies according to the season. Tobacco plant originates from regions with tropic climate and therefore, from the sowing to the end of seed ripening, it requires higher temperatures compared to other crops.

Hawks and Collins (1994), Rubin (1971), Filiposki (2002) and Drazic (1980) reported that optimum temperature range in all stages of tobacco development is 20 ^{0} - 30 ^{0}C. According to the data presented in Table 1, mean monthly air temperatures were lowest in May (16 ^{0}C in 2008 and 15.8 ^{0}C in 2009). Despite deviation from the optimum, above temperatures had no negative effect on growth, because in that period tobacco was in the stage of rooting. Mean monthly temperatures in June were closer to the optimum (19.9^{0}C in 2008 and 18.5^{0}C in 2009), while in July and August they achieved the optimum (21.4 ^{0}C in August 2009 and 23.6 ^{0}C in August 2008). Air temperatures in September, although lower than the optimum (15.8 ^{0}C in 2008 and 17.1 ^{0}C in 2009), had no significant impact on the final results of investigation, because in that period over 80% of leaf mass was formed and harvested. According to the analysis, lower average air temperature from May to September was recorded in 2009 (18.9 ^{0}C) and higher in 2008 (19.7 ^{0}C).

Relative air humidity - is a variable category closely related to precipitations, number and quantity of additional irrigations, air temperature, etc. For good growth of Burley tobacco, higher relative humidity is required.

In the two years of investigations, the highest values of this parameter were recorded in May 2009 (58%) and September 2008 (71%). In June, July and August, when leaves are formed on the stalk, the relative air humidity varies from 42% in July 2009 to 57% in June 2009. The annual values for the period May-September averaged 52% in 2009 to 57% in 2008. However, in the environment where these stalks were growing, the achieved values were higher, in accordance with the requirements for optimum growth of Burly tobacco.

Precipitations - beside temperature, Burley tobacco requires suitable humidity, which in combination with mineral fertilization and photosynthesis would enable maximum size, yield and quality of leaf. Uzunoski (1985) suggests this type to be grown in regions where precipitation amounts between 300 and 650 mm. Donev et al. (1973) reports that additional and heavy irrigations are necessary in all areas where precipitation during the growing season exceeds 260 mm. Pelivanoska (1999) reported that additional irrigations of Burley tobacco in the region of Prilep were necessary because of the low precipitation levels in the vegetation period (112.8 mm in 1997 and 191.1 mm in 1966). According to the presented data, 2009 was characterized by higher sum of precipitations (196.0 mm) compared to 2008 crop and by better distribution of rainfalls (55 mm in May, 75 mm in June, 43 mm in August). Therefore, tobacco was well supplied with water during the warmest days. In July and early September, however, it was necessary to apply additional irrigation of tobacco. In 2008 crop, the sum of precipitations was 183.3 mm, but rains mainly fell when

tobacco requirements for water were smaller (55.0 mm in May and 110.0 mm in September). In June, July and August precipitations dropped to only 10.0 mm and in that period tobacco was irrigated more abundantly.

MORPHOLOGICAL PROPERTIES

Morphological properties of tobacco are genetically determined, but they are also affected by agroecological conditions and applied agrotechniques. Our investigations included different varieties of Burley tobacco. Measurements were made on leaf size (5th, 10th and 15th leaf), stalk height and leaf number.

Characteristics of the 5th leaf

This leaf is positioned in the lower leaf belt, but according to its size it can have significant impact on tobacco yield.

Table 2 Characteristics of the 5th leaf

Variety	Crop	5th leaf length, cm	2008/2009 Average	Difference from the average		5th leaf width, cm	2008/2009 Average	Difference from the average	
				Absolute	Relative			Absolute	Relative
B-21 CMS F_8	2008	40,4	42,0	-	100,00	25,6	27,1	-	100,00
	2009	41,6				28,7			
Pelagonec CMS F_1	2008	46,8	49,4	+7,4	117,62	31,0	33,8	+6,7	124,72
	2009	52,1				36,6			
B-98/N CMS F_8	2008	49,1	49,7	+7,7	118,33	34,6	35,2	+8,1	129,89
	2009	50,4				35,8			
B-136/07	2008	47,5	48,2	+6,2	114,76	33,6	33,1	+6,0	122,14
	2009	48,9				32,6			
B-1317	2008	39,6	38,9	-3,1	92,62	24,6	24,9	-2,2	91,88
	2009	38,2				25,2			
BB-16	*2008*	*39,3*	*39,3*	*-2,7*	*93,57*	*24,4*	*24,4*	*-2,7*	*90,04*
	2009	39,4				24,7			

According to the presented data, the largest length of the 5th leaf was obtained in B-98/N CMS F8 - 49.7 cm, which is 7.7 cm i.e. 18.33% more compared to the standard variety (42.0). The lowest leaf length of 38.9 cm was recorded in B-1317, which is 3.1 cm less than the standard. 5th leaf length in other varieties of the trial ranged from 39.3 cm in BB-16 to 49.4 cm in Pelagonec CMS F1.

The highest values for 5th leaf width were measured again in B-98/N CMS F8 -35,2 cm, which is 8.1 cm (29.89%) more than the standard (27.1 cm). The lowest width of 24.4 cm was measured in BB-16, which is 2.7 cm

(9.96%) less than the standard. In other varieties included in the trial, the width of the 5th leaf ranged from 24.9 cm in B-1317 to 33.8 cm in Pelagonec CMS F1.

Characteristics of the 10th leaf

10th leaf is positioned in the middle belt area, distinguished by the largest leaf size.

Table 3 Characteristics of the 10th leaf

Variety	Crop	length cm	2008/2009 Average	Difference from the average		5th leaf width cm	2008/2009 Average	Difference from the average	
				Absolute	Relative			Absolute	Relative
B-21 CMS F_8 Ø	2008	51,5	51,7	-	100,00	35,8	31,3	-	100,00
	2009	51,9				26,9			
Pelagonec CMS F_1	2008	68,1	66,2	+14,5	128,04	38,9	38,1	+6,8	121,70
	2009	64,4				37,4			
B-98/N CMS F_8	2008	62,2	61,9	+10,2	119,72	41,2	37,4	+6,1	119,49
	2009	61,6				33,6			
B-136/07	2008	57,2	57,7	+6,0	111,60	35,7	34,7	+3,4	110,86
	2009	58,2				33,7			
B-1317	2008	50,0	50,9	-0,8	98,45	32,5	32,2	+0,9	102,87
	2009	51,8				32,0			
BB-16	2008	41,3	42,8	-8,9	82,78	23,8	23,4	-7,9	74,76
	2009	44,4				23,0			

According to the Table, the longest 10th leaf was measured in the variety Pelagonec CMS F1 - 66.2 cm, which is 14.5 cm (28.04%) more than the standard variety (51.7 cm).

In variety VV-16 this leaf was shortest and achieved only 42.8 cm, which is 8.9 cm (17.22%) less compared to the standard variety. In other varieties in the trial, length of the 10th leaf ranged from 50.9 cm in B-1317 to 61.9 cm in B-98/N CMS F8.

The highest values for width of the 10th leaf were measured in Pelagonec CMS F1-38,1%, which is 6.8 cm (21.70%) more than the standard (31.3 cm). The lowest width of 23.4 cm was measured in BB-16, which is 7.9 cm (25.24%) less than the standard. In other varieties, width of the 10th leaf ranged from 32.2 cm in B-1317 to 37.4 cm in B-98/N CMS F8.

Characteristics of the 15th leaf

!5th leaf is also positioned in the middle belt area of the stalk and it is highly estimated in fabrication.

Table 4 Characteristics of the 15th leaf

Variety	Crop	length cm	2008/2009 Average	Difference from the average		5th leaf width cm	2008/2009 Average	Difference from the average	
				Absolute	Relative			Absolute	Relative
B-21 CMS F_8 Ø	2008	54,7	51,3	-	100,00	30,1	26,4	-	100,00
	2009	48,0				22,8			
Pelagonec CMS F_1	2008	65,0	62,6	+11,3	122,02	31,6	30,6	+4,2	115,91
	2009	60,2				29,6			
B-98/N CMS F_8	2008	57,8	57,6	+6,3	112,29	32,0	31,0	+4,6	117,42
	2009	57,4				31,0			
B-136/07	2008	55,2	55,3	+4,0	107,80	32,3	30,5	+4,1	115,53
	2009	55,4				28,8			
B-1317	2008	53,1	53,0	+1,7	103,31	27,9	27,8	+1,4	105,3
	2009	52,9				27,8			
BB-16	2008	33,0	33,0	-18,3	64,33	16,0	17,2	-9,2	65,15
	2009	33,1				18,5			

According to the data presented, the largest length of the 15th leaf was obtained in Pelagonec CMS F1- 62.6 cm. It is 11.3 cm i.e. 22.02% longer compared to the standard variety (51.3cm). The lowest leaf length of 33.0 cm was recorded in BB-16, which is 18.3 cm (35.67%) less than the standard. In other varieties of the trial, 15th leaf length ranged from 53.0 cm in B-1317 to 57.6 cm in B-98/N CMS F8. .

The largest width of 15th leaf was measured in B-98/N CMS F8 - 31.0 cm, which is 4.6 cm (17.42%) more than the standard (26.4 cm). The smallest width of 17.2 cm was measured in BB-16, which is 9.2 cm (34.84%) less than the standard. In other varieties of the trial, the width ranged from 27.8 cm in B-1317 to 30.6 cm in Pelagonec CMS F1.

Stalk height and leaf number

Stalk height is distinction of the type, but some other factors, like agroecological conditions and applied cultural practices, also influence this character. According to Dulgerski (2009), the optimum stalk height in large-leaf tobaccos, to which Burley tobacco also belongs, ranges from 145 to 180 cm, and leaf number from 26 to 32. Uzunoski, (1985) reports that leaf number and size has a direct influence on tobacco yield.

According to the data (Table 5), highest values for stalk height were recorded in the variety B-98/N CMS F8 - 186.3 cm, which is 39.1 cm (26.56%) more compared to the average stalk height of the standard variety (147.2 cm). In other varieties included in the trial, the average stalk height was higher and ranged between 148.0 cm in BB-16 to 185.5 cm in B 136/07. The highest leaf number was obtained in Pelagonec CMS F1, where 33.3 leaves per stalk were recorded, and it is for 4.7 leaves (16.43 %) higher than the standard variety. The lowest leaf number - 27.2 was recorded in B-136/2, which is for 1.4 leaves (4.90%) lower than the standard variety. In other varieties of the trial, the average leaf number ranged between 28.5 in B-1317 and 31.2 in B-98/N CMS F8.

Table 5 Stalk height and leaf number

Variety	Crop	Height of the stalk with inflorescence	2008/2009 Average	Difference from the average		Leaf number	2008/2009 Average	Difference from the average	
				Absolute	Relative			Absolute	Relative
B-21 CMS F_8 Ø	2008	152,5	147,2	-	100,00	29,8	28,6	-	100,00
	2009	142,0				27,4			
Pelagonec CMS F_1	2008	177,6	175,3	+28,1	119,08	33,6	33,3	+4,7	116,43
	2009	173,0				33,0			
B-98/N CMS F_8	2008	191,6	186,3	+39,1	126,56	31,4	31,2	+2,6	109,09
	2009	181,0				31,0			
B-136/07	2008	190,0	185,5	+38,3	126,02	27,0	27,2	-1,4	95,10
	2009	181,0				27,4			
B-1317	2008	160,4	164,2	+17,0	111,55	28,6	28,5	+0,1	99,65
	2009	168,0				28,4			
BB-16	2008	145,0	148,0	+0,8	100,54	29,4	29,2	+0,6	102,09
	2009	151,0				29,0			

CONCLUSIONS

The results of two-year investigations lead to the following conclusions:

- Soil and climate conditions during investigations were not very suitable for production of Burley tobacco and therefore additional irrigations and fertilization were required.

- The largest leaf size (length and width of the 5th, 10th and 15th leaf) was recorded in the varieties Pelagonec CMS F8 and B-98/N CMS F1.

- The highest stalk with inflorescence was recorded in B-98/N CMS F8 (186.3 cm) and the smallest in the standard variety B-21 CMS F8 (147.2 cm).

- The highest leaf number was recorded in Pelagonec CMS F1 (33.3) and the lowest in B-136/07 (27.2).

- Results of the investigations revealed dominance of Pelagonec CMS F8 and B-98/N CMS F1 over the other varieties included in the trial.

- Characteristics of the investigated varieties are typical for Burley tobacco and in agro-ecological conditions of the Prilep's region they can be preserved only by application of suitable cultural practices.

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