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MORPHOLOGICAL PROPERTIES AND VARIABILITY IN SOME BURLEY TOBACCO VARIETIES

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ABSTRACT

The morphological properties that characterize the type of tobacco or the variety in one type are known as qualitative and quantitative. The quantitative properties are regularly conditioned from the impact of a larger number of genes and also they depend from the environment factors. The investigations are done in 2015 and 2016 on experimental field in the Scientific Tobacco Institute in Prilep, with four repetitions with following varieties: Posejdon (control), BD-1, B-1246 and one new perspective line DP-1710.

The aim of this investigationes is to show the variability of the most important quantitative properties: height of the plant with inflorescence, the number of leaves per plant and the length and width of the biggest and the smallest leaf from the middle harvesting belt in tobacco type Burley.

The results from the research are processed statistically by these parameters: average value ($\bar{x}$), average value error ($Sx\bar{}$), standard deviation (S), variation coefficient (CV) and variation width (WV). From the research, we established that the subject varieties are stable enough, the variability is very low because everywhere the variation coefficient was lower than 10%. However, the newly created line DP-1710 is with the slightest variation in the tested properties. Among other things, it is on average the highest ($\bar{x}$ = 188 cm) and has the largest leaves ($\bar{x}$ = 63 cm), which is a positive feature in coarse tobacco of this type.

Keywords: tobacco, type Burley, quantitative properties, variability

МОРФОЛОШКИ ОСОБИНИ И ВАРИЈАБИЛНОСТ КАЈ НЕКОИ ТУТУНСКИ СОРТИ ОД ТИПОТ БЕРЛЕЈ

Својствата што го детерминираат типот на тутунот или сортата во еден тип, се познати како квалитативни и квантитативни. Квантитативните (метрички) својства се редовно условени од влијанието на поголем број гени со адитивен ефект, а во голема мера се зависни од факторите на надворешната средина. Испитувањата се извршени во 2015 и 2016 година во Научниот институт за тутун – Прилеп, на полски опит во четири повторувања, со следниве сорти: Посејдон (контрола), БД-1, Б-1246 и една новосоздадена перспективна линија ДП-1710.

Целта на овој труд е да го прикажеме варирањето на поважните квантитативни својства: височина на растението со соцветие, бројот на листови на едно растение и должината и широчината на најголемиот и најмалиот лист од средниот беридбен појас кај тутунот од типот берлеј.

Резултатите се варијационо-статистички обработени преку параметрите: средна вредност ($\bar{x}$), грешка на средната вредност ($Sx\bar{}$), стандардна девијација (S), варијационен коефициент (CV) и варијациона ширина (VŠ). Од истражувањата утврдивме дека предметните сорти се доста стабилни, односно варирањето е многу мало, бидејќи варијационит коефициент секаде покажа вредност помала од 10%. Новосоздадената

линија ДП-1710 е со најмала варијабилност по однос на испитуваните својства. Меѓу другото таа во просек е највисока ($\bar{x}$ = 188 cm) и има најголеми листови ($\bar{x}$ = 63 cm) што е позитивно својство кај крупнолисниот тутун од овој тип.

Клучни зборови: тутун, тип берлеј, квантитативни својства, варијабилност

INTRODUCTION

Tobacco belongs to the group of strategic crops in the agricultural economy in the Republic of Macedonia. The cultivation of tobacco is conducted on an area between 12.000 and 15.000 ha with an annual production of 20 to 25 million kilograms of tobacco raw material with good quality. From the aspect of the typical representation, over 95% from this fields belong to aromatic oriental tobacco type Prilep and Yaka, while the large ones (Virginia and Burley) almost cannot be seen in the fields. By the end of the 90s of the last century these types were grown here which reduced the tobacco raw material import. But they were necessary for the production of the most popular "american blend" cigarettes. In this cigarette, the type Burley is involved with 35% (Mickovski, 2004). According to Devcic et al. (1984), the largest manufacturer in the world of this tobacco type are USA, Mexico, Japan, Italy and Spain. We need to point out that in Macedonia there are areas with perfect conditions for growing tobacco type Burley with good quality, so this makes a challenge for this type to be brought again in the production. Lately, the scientists form the Scientific Tobacco Institute - Prilep are picking and creating types that can meet all needs of the cigarette factories. That's why the subject and the purpose of this research is the variability of the most quantitative properties of the tobacco type Burley which have good combinational abilities and this is a condition for making new more productive and more qualitative from already existing. This is the only way to bring back the interest for this tobacco type and the factories will have no problem to absorb the tobacco raw material and plus the financial effects will be guaranteed for everyone in the tobacco industry in the Republic of Macedonia.

MATERIAL AND METHODS

The investigations were made on three varieties and one new line form the type Burley: Posejdon control variety (Ø), BD-1, B-1246 and the line DP-1710. The first three varieties are originally from other countries and some of them are still growing in their homelands and in other countries too (Posejdon was grown in Macedonia before). Despite now they are represented on smaller fields, they are still current because of its good quality and they are also used for selection about this tobacco type. The control type Posejdon (Photo 1) is created from Igor Bolsunov in the research station in Fürstenfeld in Austria. The type BD-1 (Photo 2) originally comes from Serbia and was created from Dobrivoje Jovanovik, the leader of the Department of Genetics and Selection within the Development Sector in Tobacco Industry in Nis. The type B-1246 (Photo 3) comes from Bulgaria and until recently it was fairly represented in the tobacco producing areas because of the recognizable quality of the obtained tobacco raw material. The new line DP-1710 (Photo 4) was created in the Scientific Tobacco Institute - Prilep by crossing and selecting of two Burley tobacco varieties. The experiment was set in the Experimental Field of the Scientific Tobacco Institute - Prilep in 2015 and 2016, on a deluvial - colluvial soil in four repetitions. Tobacco is seeded manually at a distance of 80 x 50 cm. For basic fertilization, NPK fertilizer with combination 8:22:20 is

used in quantity of 350 kg/ha. During the vegetation, the necessary agrotechnical operations are carried out to ensure normal growth and development of plants (feeding with nitrogen fertilizer, trampling and treating tobacco according to the program of the Tobacco Institute - Prilep for the protection of tobacco from diseases, pests and weeds). The tobacco in the experiment is sprinkled three times with a floating norm of 400 m3 of water per hectare. Measurement of the quantitative properties (height of the plant with inflorescence, number of leaves and length and width of the largest and smallest leaf of the middle belt of the plant) were carried out in the field in the phase of full blossoming of tobacco according to standard methods in the selection, (the mean value $\bar{x}$) for each property is determined on the basis of fifteen randomly selected plants of each variety in the experiment. The obtained data from the measurements are statistically processed through parameters of variability of properties (Najcevska, 2002), and the results are shown in tables.

Photo 1. Posejdon

Photo 2. BD-1

Photo 3. B-1246

Photo 4. L. DP-1710

RESULTS AND DISCUSSION

The investigated quantitative properties of the Burley type tobacco varieties are also known as morphological. They have great meaning in tobacco selection and genetics because they determinate the type and the varieties that belongs to him. Despite this, the number and the size of the leaves are determined the yield and the quality of tobacco. They are dictated by their own genotype, but are also dependent on soil-climatic conditions in the region where tobacco is grown, as well as from applied agrotechnics during vegetation. We mentioned that the results from the research are shown in table, separately for each property just to be shown better, compared with the examined varieties and the new line and also coming up with a conclusion.

Height of the plant with inflorescence

The height of the tobacco plant is a varieties feature. According this property, Uzunoski (1985), separated tobacco varieties in three groups:

1. Variety with low growth, its height is up to 70 cm (Prilep, low Otlja);
2. Varieties with middle growth, with plant height with the inflorescence from 70 - 130 cm (Yaka, Dzebel);
3. Varieties with high growth, its height is over 130 cm (Virdzinija and Burley). Risteski et al. (2007), made a research on six varieties and they point out that the height of the plant with inflorescence approximately goes from 142 cm for variety B1317 to 194 cm for the variety B-98/N CMS. The results for this quantitative property are shown in Table 1.

Table 1. Height of the plant with inflorescence (cm)

Varieties	n	$\bar{x}$	$S\bar{x}$	S	CV (%)	WV
			2015			
Posejdon Ø	15	180	0.89	3.44	1.90	175-187
BD-1	15	172	0.88	3.42	1.99	164-175
B-1246	15	168	0.96	3.70	2.20	163-174
L. DP-1710	15	188	0.63	2.45	1.30	185-195
			$LSD_{0.05}$ = 5.59			
			$_{0.01}$ = 7.97			
			2016			
Posejdon Ø	15	178	0.52	3.23	1.90	174-183
BD-1	15	166	0.79	3.38	1.99	162-173
B-1246	15	159	0.95	3.59	2.20	157-169
L. DP-1710	15	184	0.59	2.17	1.30	180-191
			$LSD_{0.05}$ = 5.50			
			$_{0.01}$ = 7.90			

From the table we can see that with approximate height of 188 cm (2015) the highest is the new line DP-1710, while the lowest with 159 cm (2016) is B-1246. In terms of variation, it is noted that all investigated varieties are stable in this capacity, since the value of the variation coefficient is very low (everywhere below 10%), and ranges from 1.30 to 2.20%. However, the smallest variability was observed in DP-1710.

Number of leaves per plant

The number of leaves of the plant depends on its genetic structure of the variety and the growing conditions. It is considered that the number of leaves is one of the most stable tobacco quantitative properties. According to Atanasov (1972), the number of leaves is a variety feature and represents highly consistent quantitative property. Dyulgerski (2016), examined the new lines from the type Burley in Bulgaria and confirmed that the highest number of leaves has line 1540 (average 31.6) and the lowest number of leaves has line 1525 (26.3 leaves per stalk).

Standard variety Pliska with 27.7 leaves is on the fifth place from all eights examined varieties. Devcic et al. (1984), were researching domestic and foreign tobacco varieties from type Burley in more areas in Croatia and they came to a conclusion that the Posejdon variety has 30 leaves per plant, while Culinec 1 has 28 leaves. Here in our research also concluded that Posejdon has the highest number of leaves 29 (2015) and 28 (2016), but we counted that DP-1710 has 28 leaves per stalk (2015, 2016).

Table 2. Number of leaves per plant

Varieties	n	$\bar{x}$	$S\bar{x}$	S	CV (%)	WV
			2015			
Posejdon Ø	15	29	0.29	1.13	3.90	27 - 31
BD-1	15	27	0.30	1.16	4.30	25 - 29
B-1246	15	27	0.34	1.31	4.85	24 - 29
L. DP-1710	15	28	0.20	0.77	2.75	27 - 30
			$LSD_{0.05}$ = 1.72			
			$_{0.01}$ = 2.05			
			2016			
Posejdon Ø	15	28	0.17	1.11	3.90	27 - 30
BD-1	15	26	0.25	1.14	4.30	23 - 28
B-1246	15	25	0.29	1.29	4.85	23 - 30
L. DP-1710	15	28	0.18	0.68	2.75	28 - 30
			$LSD_{0.05}$ = 1.55			
			$_{0.01}$ = 1.98			

As for the variability of this feature, the statistical parameters showed high stability in the varieties. The coefficient of variation ranges from 2.75% in DP-1710 to 4.85% in B-1246. The control variety has a variation of 3.90%. The standard deviation (S) is small and ranges from 0.68 (2016) to 1.31 (2015).

Length of the largest leaf per plant

The length of the leaves in every tobacco type is very important property because it's in a relationship with the quality of tobacco raw material. In Burley, the larger the leaves are the higher the yield is and the quality is much better. Boceski (2003), points out that the length and the width and also the surface of the leaves during drying is reduced by 20 to 30%, which is very important in the technology of processing the tobacco. Risteski and Kochoska (2013), in their researches made on six domestic and foreign types of tobacco indicate that the length of the tenth leaf (the largest leaf of the plant), in the control variety B-21 is 53.5 cm, in the B-1317 it is 54.5 cm, and the longest leaf (67.7 cm), has the variety Pelagonec CMS. Thre results from our measuring and the

variability are presented in Table 3. Subject varieties have long leafs which is characteristic for type Burley, with a note that the longest leaf of the plant has the line DP-1710 ($\bar{x}$ = 63 cm).The standard deviation is from 1.77 in the new line to 2.02 in the B-1246, with a CV within the range of 2.81 to 3.41%, so it can be said that the variability is insignificant.

Table 3. Length of the largest leaf (cm)

Varieties	n	$\bar{x}$	S$\bar{x}$	S	CV (%)	WV
2015						
Posejdon Ø	15	60	0.51	1.96	3.27	56-63
BD-1	15	61	0.47	1.83	3.00	58-63
B-1246	15	59	0.52	2.02	3.41	56-62
L. DP-1710	15	63	0.46	1.77	2.81	60-66
			$LSD_{0.05}$ = 2.46			
			$_{0.01}$ = 3.92			
2016						
Posejdon Ø	15	58	0.50	1.94	3.25	55-58
BD-1	15	60	0.47	1.85	3.00	48-62
B-1246	15	57	0.50	2.71	3.40	55-58
L. DP-1710	15	62	0.44	1.82	2.81	58-64
			$LSD_{0.05}$ = 2.33			
			$_{0.01}$ = 4.57			

Width of the largest leaf per plant

The width of the leaves as same as the length depends on the soil-climatic conditions and on the applied agrotechnics during the growing period. Risteski and Kocoska (2013), indicate that the largest leaf of the plant on six examined Burley varieties ranged from 28.2 cm to B-21, up to 40.2 cm in the variety Pelagonec CMS, which had the widest leaves in the experiment. The results that we have from our research are presented in Table 4.

Table 4. Width of the largest leaf per plant (cm)

Varieties	n	$\bar{x}$	S$\bar{x}$	S	CV (%)	WV
2015						
Posejdon Ø	15	30	0.30	1.16	3.87	29-32
BD-1	15	31	0.25	0.96	3.09	30-33
B-1246	15	30	0.31	1.18	3.89	28-32
L. DP-1710	15	32	0.19	0.74	2.27	32-34
			$LSD_{0.05}$ = 0.78			
			$_{0.01}$ = 1.54			
2016						
Posejdon Ø	15	30	0.28	1.12	3.90	28-32
BD-1	15	28	0.25	0.84	3.10	28-32
B-1246	15	28	0.34	1.15	3.90	27-32
L. DP-1710	15	32	0.18	0.71	2.25	30-33
			$LSD_{0.05}$ = 0.66			
			$_{0.01}$ = 1.35			

It is clearly seen from the table that, on average, the widest leaves has line DP-1710 ($\bar{x}$ = 32 cm, 2015, 2016), followed by BD-1 with 31 cm (2015), while BD-1 and B-1246 had the same width on the largest plant leaf of 28 cm (2016). The standard deviation is in the range of 0.71 (2016) in the new line to 1.18 cm in B-1246 (2015), while the CV is from 2.25 to 3.90%.

Length of the smallest leaf per plant from the middle belt

The leaves of the middle belt of Burley tobacco type are the largest, the highest quality and have a high use value in the processes of processing and fabrication. Therefore, we have measured the length and width of the smallest leaf of this belt in order to determine the number of leaves that can be harvested, taking into account their utilization in the fabrication. In practice it is considered that tobacco dry leafs have length below 25cm and that they are useless, also are increasing production costs, and when purchasing tobacco, they are assessed in the lowest class or are not taken at all by purchasers. Bearing this in mind, it is not recommended harvesting the sum of the top insertions of tobacco of this type. The results of the examination of this property are presented in Table 5.

Table 5. Length of the smallest leaf per plant from the middle belt (cm)

Varieties	n	$\bar{x}$	$S\bar{x}$	S	CV (%)	WV
			2015			
Posejdon Ø	15	42	0.37	1.41	3.37	40-45
BD-1	15	43	0.36	1.39	3.32	40-45
B-1246	15	39	0.39	1.51	3.88	36-41
L. DP-1710	15	42	0.27	1.03	2.46	40-44
			$LSD_{0.05}$ = 2.14			
			$_{0.01}$ = 3.75			
			2016			
Posejdon Ø	15	42	0.35	1.40	3.35	38-44
BD-1	15	42	0.30	1.35	3.25	39-44
B-1246	15	38	0.32	1.44	3.80	36-40
L. DP-1710	15	42	0.25	1.17	2.40	39-43
			$LSD_{0.05}$ = 2.12			
			$_{0.01}$ = 3.68			

There are no major differences in values in the table, which means that the smallest middle-bar leaves will have good use value in further processes of tobacco processing. Variability in varieties in this capacity is low because CV is well below 10% and it ranges from 2.40 in DP-1710, to 3.88% in B-1246.

Width of the smallest leaf per plant from the middle belt

The width of the smallest leaf of the middle belt, along with the length, has an impact on the overall yield and quality of the raw tobacco material from type Burley. The variability of this property is shown by the statistical parameters in Table 6.

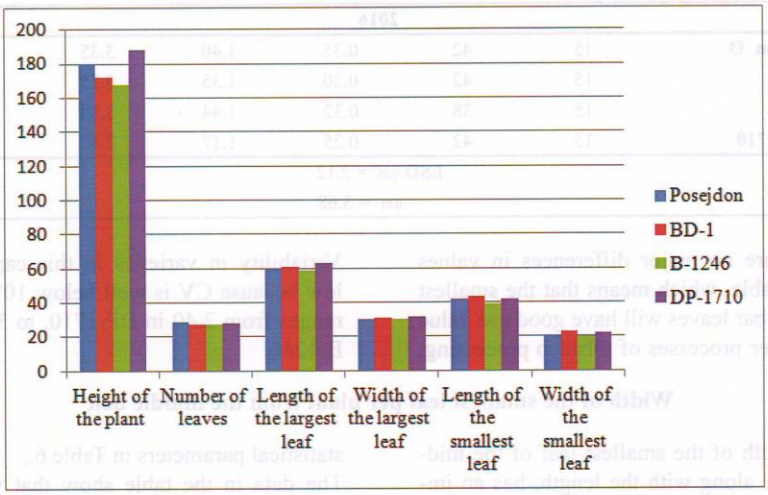
The data in the table show that with the slightest variation in this feature is the variety BD-1 which has a CV with a value of 2.50%, a standard deviation of 0.60 cm

and a variation width of 2 cm (24-22 = 2), while the minimum measured width is 22 cm and the maximum is 24 cm. The general conclusion is that the investigated varieties and the newly created line are stable in this capacity.

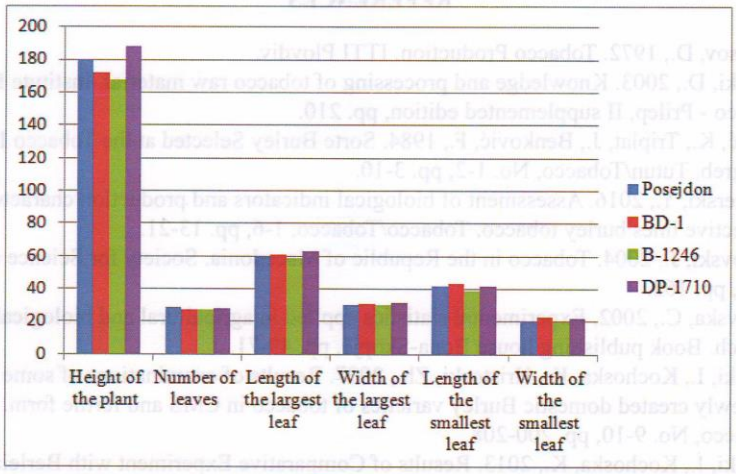
Table 6. Width of the smallest leaf per plant from the middle belt (cm)

Varieties	n	$\bar{x}$	$S\bar{x}$	S	CV (%)	WV
			2015			
Posejdon Ø	15	21	0.21	0.80	3.79	19-22
BD-1	15	23	0.17	0.64	2.77	22-24
B-1246	15	20	0.22	0.83	4.14	18-21
L. DP-1710	15	22	0.18	0.70	3.19	20-23
			$LSD_{0.05}$ = 0.67			
			$_{0.01}$ = 1.18			
			2016			
Posejdon Ø	15	20	0.19	0.70	3.70	18-22
BD-1	15	23	0.15	0.60	2.50	20-24
B-1246	15	19	0.20	0.75	4.10	16-20
L. DP-1710	15	21	0.16	0.65	3.15	19-22
			$LSD_{0.05}$ = 0.62			
			$_{0.01}$ = 1.16			

The investigated quantitative properties measured in 2015 are shown on the Graph 1. and in 2015 are shown on the Graph 2.



Graph 1. Graphic display of the morphological properties in some varieties of type Burley (2015)



Graph 2. Graphic display of the morphological properties in some varieties of type Burley (2016)

CONCLUSIONS

With the highest height is the newly created line DP-1710 ($\bar{x}$ = 188 cm, 2015), and the lowest is the variety B-1246 ($\bar{x}$ = 159 cm, 2016). The variation coefficient showed that with the slightest variation in this property is line DP-1710, while the control variety Posejdon with a CV of 1.90% is in second place.

The most leaves have Poseidon ($\bar{x}$ = 29, 2015). The second place belongs to the line DP-1710 with 28 leaves per plant. The variability of this feature is very small, which confirms the opinion of experts in this area that the number of leaves of the plant is a variety feature and is among the most stable quantitative properties of tobacco.

Variation of the length of the largest plant leaf is the lowest in the new line DP-1710 (2,81%), and the highest in B-1246 (CV = 3.41%). At the same time, DP-1710 has the largest leaves ($\bar{x}$ = 63 cm).

Measurements have shown that the broadest leaves in the middle belt of plants has the line DP-1710 ($\bar{x}$ = 32 cm). The variability of the properties in the investigated varieties is small, since the highest value of the standard deviation is only 1.18 cm, and the highest CV is in Posejdon and B-1246 with a value of 3.90%.

The investigated quantitative properties of tobacco are dictated by the genetic structure of the variety, and conditioned by the minor genes (polygens), but depend on the soil-climatic conditions in the region where the tobacco is produced, as well as from the applied agrotechnics during vegetation.

The subject varieties of the type Burley are genetically stable and the variation of the tested properties is insignificant (CV everywhere is below 10%), which means that they are a good material for in-planting and creating new varieties. The new line DP-1710 proved to be very stable with more positive properties, so it is expected to be entered in the National Variety List of the Republic of Macedonia.

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