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STUDY OF QUANTITATIVE CHARACTERISTICS IN ORIENTAL TOBACCO GENOTYPES

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Abstract

Ten genotypes of oriental tobacco (three varieties and seven newly created lines) were investigated for some major morphological and agronomic traits: height of the plant without inflorescence, leaf number per plant, length/width of the middle belt leaves and dry mass yield/plant. The trial was set up in the Experimental field of Tobacco Institute–Prilep in 2016 and 2017, in randomized block design with four replications, using traditional agricultural practices. Measurements of the first three traits were made in the stage of butonization and beginning of flowering, while the dry mass yield was recorded during the treatment of cured tobacco. The results were statistically processed.

The aim of the research is to study the quantitative traits of Oriental genotypes, to determine the stability of the population through their variability and to emphasize the best among the selected assortment.

From the set of genotypes we selected three superior lines with a high degree of homogeneity. The coefficient of variation of quantitative traits in these lines was lower than 10%, which is a sign of their stability. After their acceptance by the Commission for recognition and approval of varieties within the Ministry of Agriculture, Forestry and Water Economy of R. Macedonia, these genotypes will be placed on the market.

Key words: *tobacco, oriental genotypes, quantitative traits, variability*

INTRODUCTION

Plant breeding is a creative activity in which the breeder follows his eternal desire to create new varieties more superior than the existing ones. At the Scientific Tobacco Institute - Prilep there is a centuries-old tradition of continuous successive selection work of tobacco varieties of different types, but generally of types Prilep, Yaka, Dzebel and Basmak - more recently. By 2014, the institute owns 10 varieties of Prilep type, 4 varieties of Yaka type, 4 varieties of Dzebel, 3 varieties of the type Otlya, 1 of the type Virginia and 3 of the type Burley (Kotubin - Aleksoska, 2004). Today, the variety fund is drastically increased and exceeds the number of about 60 varieties.

The breeders from the Institute have published a number of papers on the topic of tobacco breeding, as for example Aleksoski and Korubin-Aleksoska (2011), studied the mode and level of inheritance of green and dry mass yield per stalk in four parental genotypes (Burley - B 2/93, Suchum - S1, Suchum - S2 and Prilep - P-84) and in their six diallel F1 hybrids, and found positive and negative heterosis. The higher heritability index of both types was recorded for dry mass yield. Mitreski (2012), studied height of the stalk with inflorescence in six oriental tobacco varieties of the 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 (2014), made tasting of the cigarettes composed from the same varieties and informed that they have good degustation properties that are typical for oriental tobaccos. The authors (2015) of the same varieties examined some morphological traits and announce that Prilep Basma 82 had the highest average leaf number, and the lowest length and width of the middle belt leaves. Korubin-Aleksoska and Aleksoski (2013), presented investigations on the inheritance of length, width and area of middle belt leaves in oriental tobacco varieties Prilep (P0 10-3/2), Djebel (Pobeda P-2) and Yaka (YK 48), and the semi-oriental Forchheimer Ogrodowny - FO, including their six F1 and six F2 hybrids. The regression graphs reveal partially dominant type of inheritance of the characters and absence of interallelic interaction. Dimitrieski and Miceska (2015), offer information about new prospective variety of the oriental Yaka tobacco, and as the most perspective point out Yaka b 65 - 82/1. Korubin – Aleksoska (2016), explores heredity of the more important quantitative traits of four parental genotypes (Prilep P 10-3/2, Djebel A 42/3, Yaka YV 125/3, Floria FL-1) and their dialectic F1, F2 and BC1 generations, through genetic components of variance. The heritability is very high, indicating that the studied traits are highly heritable. 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. The same authors (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 homozygotness. Dimitrieski, Gveroska (2017), studied some morphological traits, length of the growing season and resistance to powdery mildew disease in some oriental tobacco varieties and lines of the type Prilep. Miceska (2017), investigated some morphological, production and quality characteristics in four new lines of the type Prilep obtained by generative hybridization (P .I. 14-65/1,P.I.14-66/7, P.I. 123-82/2,P.I. 14-67/7) and the variety P12-2/1 as a standard. Regarding the morphological properties (plant height, leaf number, largest leaf size), all lines showed very low variability, which is an indication of morphological uniformity and stability. Korubin – Aleksoska (2017), studied the oriental varieties in order to obtain data on their tolerance to drought. The highest degree of tolerance to drought was observed in genotypes P - 84 (type Prilep) and P - 2 (type Dzebel). These genotypes can be included in the programmes for improvement of the investigated trait.

The aim of this paper is to show the way of assessment the stability of newly created lines of the Prilep and Yaka types, and then selecting the best for placing them in a comparative trial for varietal confirmation by the Commission for recognition and approval of varieties at the Ministry of Agriculture Forestry and Water Economy of R. Macedonia. The recognized varieties can be put into circulation.

MATERIAL AND METHODS

As a material for work, three oriental varieties were taken from which two of the type Prilep (P-66-9/7 – Fig. 1 and P-84 – Fig. 2) and one of the type Yaka (YV 125/3 – Fig. 3), as well as 7 newly created genotypes, of which four are of the type Yaka (L1 - YK 23-09/07 – Fig. 4, L2 - YK 8-07 / 11 – Fig. 5, L3 - YK 23-12/85 – Fig. 6 and L4 - YK 9-08/80 – Fig. 7) and three of the type Prilep (L5 – P 6-03/59 – Fig. 8, L6 – P 16-03/63 - Fig. 9 and L7 – P 10-07/57 – Fig. 10). The variety P-66-9/7 due to its mass application in tobacco production in Macedonia is taken to control the comparison with line of the type Prilep. P-84 was taken as a second control because it showed great resistance to drought. YV 125/3 is a control for lines of the type Yaka.

The experiment was set up in 2016 and 2017 on the Experimental Field of the Scientific Tobacco Institute - Prilep after a random block system in four repetitions. From the complete measurements, for this paper are separated: the height of plants without inflorescence, the number of leaves per plant, the length and width of the middle-belt leaves, and dry mass yield per plant. The obtained data are statistically processed through parameters of variability of traits and variance analysis (Najceska, 2002).

Figure 1. Prilep, P-66-9/7

Figure 2. Prilep, P-84

Figure 3. Yaka, YV 125/3

Figure 4. L1 – YK 23-09/07

Figure 5. L2 – YK 8-07 / 11

Figure 6. L3 – YK 23-12/85

Figure 7. L4 – YK 9-08/80

Figure 8. L5 – P 6-03/59

Figure 9. L6 – P 16-03/63

Figure 10. L7 – P 10-07/57

RESULTS AND DISCUSSION

In order to get acquainted with the genetic stability of the newly created lines, measurements of the quantitative traits were made in 2016 and 2017 and on the basis of the obtained values an analysis and their ranking was performed.

From the results shown in Table 1, the highest height of the plant without inflorescence was observed at the orienteal line of the type Yaka L3 (131 cm - 2016; 128 cm - 2017). This line is higher than the control variety YV 125/3 (118 cm - 2016; 116 cm - 2017), and the difference between them is highly significant. Also, the L4 line is significantly higher than YV 125/3, while L1 and L2 are significantly lower. The smallest height is distinguished in oriental variety of the type Prilep P-84 (62 cm - 2016; 60 cm - 2017), which is significantly lower than the standard variety P-66-9/7 (70 cm - 2016; 62 cm - 2017) taken for control line of the type Prilep. The newly created genotypes L5 and L7 are higher, while L6 is lower than the control variety, and the differences are highly significant. All average values in 2017 are lower compared to those in 2016, due to the fact that 2017 was extremely dry during the vegetation.

The investigations on the variability of the trait in varieties and lines showed low values. The coefficient of variability (CV) ranges from 2.49% (2017) in L3 to 10.82% (2017) in L4. The higher values of lines L4 and L5 point to the fact that they need additional successive selection which will enable their homogenization and stabilization. Lower values in 2017 are a sign of proper selection, directed to the stabilization of new genotypes. There is an exception in the populations of L4 and L7, but the difference is minimal and due to undefined environmental factors.

The highest number of leaves per plant has P-66-9/7 and L3 (57 - 2016), which can be seen from Table 2. The least leaves have the standard variety YV 125/3 (41 - 2017). The higher number of leaves in the lines from the Yaka type is highly significant (with the exception of L2, where the significance is 5%). From the analysis of the number of leaves per plant in the two years of investigation, small differences can be observed, which points to the fact that it is a high-hereditary trait. The greatest difference occurs in P-66-9/7, from which can be conclude that this variety is sensitive to drought stress, and for its successful cultivation is necessary timely watering.

The values of the variability of the traits in the investigated genotypes are very low. The highest coefficient of variability has line L1 (9.79% - 2016; 7.82% - 2017), and the lowest varieties P-84 (3.02% - 2016) and YV 125/3 (2.18% - 2017). From the newly created Yaka genotypes, the L1 (5.41% - 2016; 3.36% - 2017) has the lowest coefficient of variability, while from Prilep genotypes L6 (4.99% - 2016; 4.59 - 2017). In all newly created variants, the variability in the number of leaves per plant in 2017 is lower than in 2016, which is another confirmation of the proper selection aimed at stabilizing them.

Table 1. Height of the plant without inflorescence (cm)

Genotypes	n	2016			2017		
		$\bar{x} \pm S\bar{x}$ (cm)	σ	CV (%)	$\bar{x} \pm S\bar{x}$ (cm)	σ	CV (%)
1. P-66-9/7 Ø	20	70.49 ± 0.53	2.37	3.41	62.25 ± 0.37	1.66	2.69
2. P-84	20	61.94 ± 0.63	2.82	4.56	59.65 ± 0.41	1.85	3.11
3. JV 125/3 Ø	20	117.87 ± 1.82	8.14	6.96	115.8 ± 0.67	3	2.59
4. L1	20	115.67 ± 1.28*	5.71	4.93	112.39 ± 1.18*	5.28	4.72
5. L2	20	113.12 ± 1.18**	5.27	4.69	108.77 ± 0.77**	3.44	3.14
6. L3	20	130.62 ± 0.97**	4.32	3.33	128.12 ± 0.72**	3.20	2.49
7. L4	20	126.12 ± 2.81**	12.55	10.04	120.75 ± 2.92**	13.06	10.82
8. L5	20	88.55 ± 2.16**	9.65	10.81	84.84 ± 1.75**	7.83	9.12
9. L6	20	65.42 ± 0.67**	3	4.59	57.37 ± 0.56**	2.5	4.35
10. L7	20	92.87±1.29**	5.76	6.18	89.87 ± 1.25**	5.58	6.22
		$LSD_{0.05}$ = 1.73 $_{0.01}$ = 3.12			$LSD_{0.05}$ = 2.34 $_{0.01}$ = 4.21		

Table 2. Number of leaves per stalk

Genotypes	n	2016			2017		
		$\bar{x} \pm S\bar{x}$ (cm)	σ	CV (%)	$\bar{x} \pm S\bar{x}$ (cm)	σ	CV (%)
1. P-66-9/7 Ø	20	57.25 ± 0.40	1.78	3.12	54 ± 0.56	2.51	4.65
2. P-84	20	42.45 ± 0.29	1.28	3.02	42.2 ± 0.3	1.33	3.14
3. JV 125/3 Ø	20	41.65 ± 0.28	1.28	3.06	41.3 ± 0.2	0.9	2.18
4. L1	20	45.25 ± 0.55**	2.45	5.41	45.35 ± 0.34**	1.53	3.36
5. L2	20	42.95 ± 0.83*	3.72	8.66	43.6 ± 0.4*	1.8	4.13
6. L3	20	57 ± 1.14**	5.08	8.91	59.2 ± 0.77**	3.43	5.79
7. L4	20	53.5 ± 1.17**	5.24	9.79	54.25 ± 0.95**	4.24	7.82
8. L5	20	49.8 ± 0.65**	2.91	5.84	50.4 ± 0.53**	2.37	4.71
9. L6	20	48.05 ± 0.54**	2.40	4.99	47.35 ± 0.49**	2.17	4.59
10. L7	20	46.3 ±0.73**	3.26	7.04	46.1 ± 0.52**	2.32	5.04
		$LSD_{0.05}$ = 1.03 $_{0.01}$ = 1.85			$LSD_{0.05}$ = 1.52 $_{0.01}$ = 2.74		

With the longest length of middle-belt leaves, in both years of investigation, the line L7 is characterized (Table 3). The average value of the trait in 2016 is 31.7 cm, and in 2017 it is 31.65 cm, and the difference in comparison with the control variety P-66-9/7 is highly significant. Also, L5 and L6 lines have significantly longer leaves. The difference between the genotypes from type Yaka is very small, in L1 it is insignificant, and in L2, L3 and L4 the significance is 5%. From the results in the two years of investigations it can be seen that the differences are minimal, which is a sign of the high inheritance of the trait.

Low variability of the length of middle-belt leaves is an indicator of the stability of the trait, i.e. the low impact of environmental factors on its magnitude. The highest coefficient of variability has the line L3 (9.85% - 2016; 9.47% - 2017), and the lowest L1 (4.99% - 2017). Newly created lines in 2017 have lower variability than those in 2016, which is an indicator of improving their stability.

Table 3. Length of the leaves from the middle belt (cm)

Genotypes	n	2016			2017		
		$\bar{x} \pm S\bar{x}$ (cm)	σ	CV (%)	$\bar{x} \pm S\bar{x}$ (cm)	σ	CV (%)
1. P-66-9/7 Ø	20	20.4 ± 0.44	1.96	9.61	20 ± 0.32	1.41	7.07
2. P-84	20	20.6 ± 0.35	1.56	7.58	20.5 ± 0.39	1.73	8.45
3. JV 125/3 Ø	20	21.82 ± 0.46	2.06	9.46	21.55 ± 0.24	1.09	5.08
4. L1	20	21.68 ± 0.42	1.87	8.64	21.5 ± 0.24	1.07	4.99
5. L2	20	20.65 ± 0.3*	1.35	6.55	20.3 ± 0.27*	1.21	5.95
6. L3	20	20.4 ± 0.45*	2.01	9.85	20.2 ± 0.43*	1.91	9.47
7. L4	20	20.68 ± 0.36*	1.59	7.7	20.58 ± 0.34*	1.53	7.42
8. L5	20	22.25 ± 0.38**	1.7	7.64	22 ± 0.3**	1.34	6.1
9. L6	20	22.05 ± 0.54**	1.94	8.78	21.9 ± 0.32**	1.45	6.6
10. L7	20	31.7 ±0.5**	2.24	7.06	31.65 ± 0.48**	2.15	6.8
		$LSD_{0.05}$ = 0.85 $_{0.01}$ = 1.53			$LSD_{0.05}$ = 0.91 $_{0.01}$ = 1.63		

The results in the width of the leaves from the middle-belt, shown in Table 4, inform about the similarity of the variants in relation to this trait. The broadest leaves have YV 125/3 (11.78 cm - 2016; 11.67 cm - 2017) and the newly created L1 line (11.48 cm - 2016; 11.15 cm - 2017). The smallest width has the leaves on the L7 (8.3 cm - 2016; 8.25 cm - 2017). The differences between the years of investigation are minimal, thus confirming the high inheritance of this trait.

The variability of the width of the leaves from the middle belt is very small, and a confirmation of this is the low value of the coefficient of variability. He ranges from 1.93%

(2016) in YV 125/3 to 13.77% (2016) in L6. The low variability values for trait are the indicator for high inheritance and stability. The newly established lines in 2017 have a lower variability than that in 2016, which is still one indicator for balancing the trait.

Table 4. Width of the leaves from the middle belt (cm)

Genotypes	n	2016			2017		
		$\bar{x} \pm S\bar{x}$ (cm)	σ	CV (%)	$\bar{x} \pm S\bar{x}$ (cm)	σ	CV (%)
1. P-66-9/7 Ø	20	10.2 ± 0.09	0.41	3.98	9.96 ± 0.08	0.34	3.45
2. P-84	20	10 ± 0.13	0.57	5.67	9.8 ± 0.09	0.41	4.14
3. JV 125/3 Ø	20	11.78 ± 0.05	0.23	1.93	11.67 ± 0.06	0.26	2.21
4. L1	20	11.48 ± 0.27	1.23	10.72	11.15 ± 0.19	0.85	7.65
5. L2	20	10.8 ± 0.14	0.64	5.93	10.68 ± 0.12	0.53	4.97
6. L3	20	10.35 ± 0.21*	0.95	9.18	10.2 ± 0.16*	0.73	7.17
7. L4	20	9.95 ± 0.23**	1.01	10.16	9.72 ± 0.19**	0.84	8.68
8. L5	20	9.15 ± 0.15*	0.67	7.35	8.92 ± 0.12*	0.53	5.95
9. L6	20	9.77 ± 0.3	1.34	13.77	9.55 ± 0.25	1.13	11.81
10. L7	20	8.3 ± 0.22**	0.98	11.8	8.25 ± 0.18*	0.8	9.68
		$LSD_{0.05} = 1.01$ $_{0.01} = 1.82$			$LSD_{0.05} = 1.04$ $_{0.01} = 1.87$		

The highest yield on the dry mass per plant among the parental genotypes has P-66-9/7 (20.15 g - 2016; 19.07 g - 2017), while between the newly created genotypes L7 (22.53 g - 2016; 21.37 g - 2017). The difference in values between the control of Prilep type and the line L7 is significant in 2016 and high-significant in 2017. Between the lines of Yaka type, significantly higher yield have L1, L3 and L4. The yield of the whole genotype set in 2017 is lower than that in 2016 (with the exception of L3), but the minimum differences do not have any significance. The data of the dry mass yield in the two years of investigations are shown in Table 5.

Dry mass yield per plant (g)

Years	Genotypes									
	P1	P2	P3	L1	L2	L3	L4	L5	L6	L7
2016	20.15	17.89*	17.52	20.28**	17.74	21.12**	19.7*	19.21	19.05	22.53*
2017	19.07	17.83*	17.24	19.87**	17.56	21.15**	18.91*	19.12	18.93	21.37**

2016: $LSD_{0.05} = 1.40$ $_{0.01} = 2.53$

2017: $LSD_{0.05} = 1.19$ $_{0.01} = 2.15$

CONCLUDING REMARKS

The highest average height in the two years of investigation has the newly created line L3 (131 cm - 2016; 128 cm - 2017). In comparison with YV 125/3, the lines L1 and L2 are significantly lower, and L3 and L4 are significantly higher. The minimum average height has P-84 (62 cm - 2016; 60 cm - 2017), and from the lines of Prilep type has L6. The variability YV 125/3 and lines from Yaka type have higher height of varieties and lines from Prilep type. Differences in values between the two years in variants are minimal, which is a sign of a high degree of ecological stability.

Highest number on the leaves has P-66-9/7 (57 - 2016; 54 - 2017) and L3 (57 - 2016; 59 - 2017). All lines from Yaka type have significantly higher number of leaves than the standard variety YV 125/3. The lines from Prilep type have significantly lower number of leaves than the control P-66-9/7.

The highest length of leaves from the middle belt, in the control variants has YV 125/3 (22.82 cm - 2016; 21.55 cm - 2017), and in the lines has L7 (31.7 cm - 2016; 31.65 cm - 2017). Dimensions for the length of the leaves in the control and the lines of Yaka type are

very similar, so the difference are minimal or significant for 5%. The newly created variants of the Prilep type have significantly longer leaves than the two control varieties.

The largest width of the leaves from the middle belt has YV 125/3 (11.78 cm - 2016; 11.67 cm - 2017). L1 has the widest leaves between the lines (11.48 cm - 2016; 11.15 cm - 2017). The tightest leaves has L7 (8.3 cm - 2016; 8.25 cm - 2017).

With highest yield on dry mass per plant among the standard varieties is P-66-9/7 (20.15 g - 2016; 19.07 g - 2017), while among the lines L7 (20.53 g - 2016; 21.37 g - 2017). Genotypes L1, L3 and L4 have a significantly higher yield than YV 125/3.

Two-year investigations for variability of the traits in varieties and lines shows low values. The coefficient of variability (SV) for the height of the plant without inflorescence ranges from 2.59% (YV 125/3 - 2017) to 12.55% (L4 - 2016), for the number of leaves per plant from 2.18% (YV 125/3 - 2017) to 9.79% (L4 - 2016), for the length of the leaves from the middle-belt from 4.99% (L1 - 2017) to 9.85% (L3 - 2016), and for the width of the leaves from the middle-belt from 1.93% (YV 125/3 - 2016) to 13.77% (L6 - 2016). The results indicate high genetic homogeneity, i.e. stability and uniformity of the newly created lines.

The highest yielding among the variants from the type Prilep is line L7 (22.53 g / plant - 2016; 21.37 g / plant - 2017), while between variants from the type Yaka is L1 (20.28 g / plant - 2016; 19.87 g / plant - 2017) and L3 (21.12 g / plant - 2016; 21.15 g / plant - 2017). These lines can be entered in the comparative labours for varietal recognition by the Ministry of Agriculture, Forestry and Water Economy of R. Macedonia.

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ПРОУЧУВАЊА НА КВАНТИТАТИВНИТЕ СВОЈСТВА КАЈ ОРИЕНТАЛСКИ ГЕНОТИПОВИ ТУТУН

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Резиме

Испитувани беа десет генотипови на ориентални тутуни, од кои три сорти и седум Испитувани беа десет генотипови на ориентални тутуни, од кои три сорти и седум новосоздадени линии, за поважните морфолошки и агрономски својства: висина на растението без соцветие, број на листови по растение, должина и ширина на листовите од средниот појас и принос на сува маса по растение. Истражувањата беа направени на опит по случаен блок-систем во четири повторувања, поставен на опитното поле при Научниот институт за тутун – Прилеп во текот на 2016 и 2017 година. Опитот беше одгледуван со примена на вообичаени агротехнички мерки. Мерењата на првите четири својства беа направени во периодот на бутонизација и почеток на цветање, а приносот на сува маса беше евидентиран при манипулацијата на сувиот тутун. Резултатите беа статистички обработени.

Целта на овој труд е да се проучат квантитативните својства кај ориенталските генотипови, преку нивната варијабилност да се одреди стабилноста на популацијата и да се истакне најдоброто меѓу избраниот сортимент.

Од поставените генотипови издвоивме три посупериорни линии кои покажаа висок степен на хомогеност. Коефициентот на варијабилност на квантитативните својства им е понизок од 10%, што е знак за нивната стабилност. По нивното признавање од страна на Комисијата за признавање и одобрување на сорти при Министерството за замјоделство, шумарство и водостопанство на Република Македонија, овие генотипови ќе може да се пуштат во промет.

Клучни зборови: *тутун, ориенталски генотипови, квантитативни својства, варијабилност*