ISSN 0494-3244

Тутун/Tobacco,Vol. 65, N^0 1-6, 8-15, 2015 UDC: 633.71-152.61:631.164.24(497.7)"2011/2014"

Original Scientific paper

STABILITY OF THE DRY YIELD IN SOME NEW AND OLD DOMESTIC TOBACCO VARIETIES IN THE REPUBLIC OF MACEDONIA

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ABSTRACT

Investigations were carried out with five commercial oriental varieties of Prilep tobacco (P–23, P–84, NS–72, P–66–9/7 and P–79–94) and five old domestic oriental tobaccos of the types: Prilep (P 10–3/2 and P 12–2/1), Djebel (Dj № 1) and Yaka (YK 7–4/2 and KY), to study dry mass yield per stalk. The trial was set up in the Experimental field of Tobacco Institute–Prilep in 2011, 2012, 2013 and 2014, in randomized block design with three replications, using traditional agricultural practices.

The aim of investigations was to evaluate the variability of some autochthonous and commercial tobacco varieties through biometric analysis of the above quantitative trait and thus to give assessment of their stability and guidance for their further spread and maintenance. The study will show the differences in yield between old and new varieties, by which it will confirm the improvements in tobacco selection.

The high significance in yield between varieties is genetical indicator of their mutual difference. Differences between the years of research are not significant, which is an indication that dry mass is highly heritable trait and varietal characteristic. Statistical parameters of variability are low, which is an indication of stable and homozygous genotypes, adapted to agro–ecological conditions of the region. Results on the standard deviation and variability coefficient were lower in 2014, because the seed sown in this crop was obtained from a single stalk for each variant isolated in 2011 and the same procedure was used in 2012 and 2013. The obtained data reveal that all investigated varieties are stable but the most stable one is P–66–9/7, which also has the highest yield. Minimal and insignificant advantage in stability was recorded in the old non-commercial varieties. The average yield of the new varieties was 173% higher than that of the old domestic varieties. This is the best confirmation of the successful work of Tobacco Institute in the selection of oriental aromatic tobaccos. By evaluation of varietal stability, the breeder gets better knowledge on their homozygosity and higher reliability in choosing parental pairs for the implementation of selection programs.

Keywords: tobacco (Nicotiana tabacum L.), yield, standard deviation, variability coefficient.

СТАБИЛНОСТ НА ПРИНОСОТ НА СУВ ТУТУН КАЈ НЕКОИ НОВИ И СТАРИ ДОМАШНИ СОРТИ ВО РЕПУБЛИКА МАКЕДОНИЈА

Испитувани се пет комерцијални ориенталски сорти од типот прилеп (П–23, П–84, НС–72, П–66–9/7 и П–79–94) и пет стари домашни ориенталски тутуни од типовите: прилеп (П 10–3/2 и П 12–2/1), џебел (Џ бр.1) и јака (ЈК 7–4/2 и КЈ), за приносот на сува маса по страк. Опитот беше поставен на експерименталното поле при Научниот институт за тутун–Прилеп во 2011, 2012, 2013 и 2014 година, по случаен блок–систем во три повторувања, со примена на традиционални агротехнички мерки.

Целта на истражувањата е да се процени варијабилноста на горенаведеното квантитативно својство кај комерцијалните и автохтоните сорти тутун со примена на биометричка анализа, а со тоа да се добијат сознанија за нивната стабилност и напатствија за нивно натамошно ширење и одржување. Проучувањата ќе ги покажат разликите во приносот помеѓу новите и старите сорти, со што ќе се потврди напредокот во селекцијата на тутунот.

Високата сигнификантност во приносот помеѓу сортите е генетски показател за нивната меѓусебна различност. Разликите помеѓу годините на истражување не се сигнификантни, што значи дека приносот на сува маса е високонаследно својство и сортова одлика. Статистичките параметри на варијабилност се ниски, што е показател за стабилноста и хомозиготноста на генотиповите, адаптирани на агроеколошките услови во регионот. Резултатите за стандардната девијација и коефициентот на варијабилност се пониски во 2014 година, бидејќи семето посеано во оваа реколта беше добиено од еден страк за секоја варијанта изолиран во 2011, и на ист начин во 2012 и 2013 година. Добиените податоци откриваат дека сите испитани сорти се стабилни, но најстабилна е П–66–9/7, која исто така има највисок принос. Минимална и незначителна предност во стабилноста е откриена кај старите некомерцијални сорти. Просечниот принос на новите сорти е 173% повисок од оној на старите домашни сорти. Овој показател е најдобра потврда за успешната работа на Институтот за тутун во селекцијата на ориентални ароматични тутуни. Преку евалуација на стабилноста на сортите, селекционерот добива поголемо сознание за нивната хомозиготност и поголема сигурност во изборот на родителски парови за имплементирање на селекционите програми.

Клучни зборови: тутун (Nicotiana tabacum L.), принос, стандардна девијација, коефициент на варијабилност.

INTRODUCTION

Since the beginning of mankind and cultivation of wild species, man makes efforts to change their traits in order to produce desired characteristics. The principal aim of the breeders has been to improve agricultural crops towards higher yield, better quality and higher resistance to diseases, pests and ambient stresses.

Scientific Institute of Tobacco–Prilep was established in 1924 and its main breeding activity is selection of oriental, small-leaf, aromatic tobaccos. The aim of this paper is to study the yield and variability of some domestic and new commercial tobacco varieties, and to get a vision on progress in the selection of oriental tobacco in the country.

MATERIAL AND METHODS

Investigations were made on dry mass yield per stalk in five new commercial varieties of the type Prilep (P–23, P–84, NS–72, P–66–9/7 and P–79–94) and five old domestic varieties of the types: Prilep (P 10–3/2 and P 12–2/1), Djebel (Dj № 1) and Yaka (YK 7–4/2 and KY–Kishinska Yaka), and also on variability of this trait by calculating the standard deviation and coefficient of variation (Najcevska, 2002).

During tobacco vegetation in field (May – September) in 2011, mean monthly temperature was 19,040C, number of rainy days was 32 and total precipitation was 180 mm. In the same period in 2012, mean monthly temperature was 20,30C, number of rainy days 26 and total precipitation 180 mm. In 2013 mean monthly temperature was 19,40C, number of rainy days 34 and total precipitation 153 mm, and in 2014 mean monthly temperature was 18,30C, number of rainy days 33 and total precipitation 223 mm.

General characteristics of the new tobacco varieties

The new commercial sun-cured varieties created in the Scientific Tobacco Institute–

Prilep present a high quality raw material for the domestic and world market. Due to their pleasant aroma and harmonious chemical composition they enter in the mixtures of the highest–quality cigarette brands.

Prilep P–23 – created by Kostadin Nikoloski and Milan Mitreski, through hybridization and selection in Tobacco Institute–Prilep; recognized by the Ministry of Agriculture, Forestry and Water Management of the Republic of Macedonia in 1995 (Korubin–Aleksoska, 2004). It has elliptical–conical habitus, with 50–55 leaves densely arranged on stem (Figure 1).

Prilep P–84 – created by Kiril Naumovski and Ana Korubin–Aleksoska, through hybridization and selection; recognized in 1988 in former Yugoslavia, as one of the first varieties of Prilep tobacco. Characterized by cylindrical–elliptical habitus with approximately 40–42 sessile leaves, elliptical in shape (Figure 2)

Prilep NS–72 – created by Dushko Boceski and Simeon Karayankov; recognized in 1984 in former Yugoslavia as one of the first varieties of Prilep tobacco obtained by crossing (Korubin–Aleksoska et al., 2012); characterized by cylindrical–elliptical habitus with approximately 50 sessile leaves, elliptical in shape (Figure 3).

Prilep P–66–9/7 – created in Tobacco Institute–Prilep by Miroslav Dimitrieski and Gordana Miceska; recognized by the Ministry of Agriculture, Forestry and Water Management of R. Macedonia in 2004 (Dimitrieski, Miceska, 2011; Korubin–Aleksoska et al., 2012); characterized by elliptical–conical habitus, with 54–60 ovate leaves, sessile and evenly distributed on the stem. It has been the most frequently grown tobacco variety in R. Macedonia in recent years (Figure 4).

Prilep P–79–94 – created in Tobacco Institute–Prilep by Milan Bogdanceski; recognized by the Ministry of Agriculture, Forestry and Water Management of R. Macedonia in 2001 (Korubin–Aleksoska, 2004); characterized by cylindrical–elliptical habitus with 56–60 sessile leaves densely distributed, especially in the upper part of stem (Figure 5).

Fig. 1. P–23

Fig. 2. P–84

Fig. 3. NS–72

Fig. 4. P–66–9/7

Fig. 5. P–79–94

General characteristics of the old domestic tobacco varieties

The cultivation of old tobacco varieties in this region began long ago, during the Ottoman Empire. The centuries–long presence led to their adaptation to the present agro–ecological conditions. Through successive natural selection they have acquired resistance to drought and diseases and can rightly be called autochthonous. Today, the old varieties make a valuable material for breeding activity in the Institute.

Prilep P 10–3/2 – created by Rudolf Gornik from Tobacco Institute–Prilep (Горник, 1973); characterized by cup-like habitus, with 30–36 sessile leaves (Figure 6).

Prilep P 12–2/1 – created by R. Gornik; characterized by cup–like habitus, with 34–38 sessile leaves (Figure 7).

P 10–3/2 and P12–2/1 – produced since the 30–ies of the last century; phenotypic and genotypic characters are very similar; derived by individual selection (Borojević, 1981), from the local tobacco variety Djumaj–bale from Gorna Djumaja–Bulgaria.

Djebel Dj № 1 – created by R. Gornik, in the first half of the last century; derived by individual selection from the local variety Xanthian Yaka grown in the Djebel tobacco producing region in Bulgaria; characterized by a cylindrical habitus, with 26–30 sessile leaves erected toward the stalk (Figure 8).

Yaka YK 7–4/2 – created by R. Gornik and released in mass production in 1932. Derived by mass selection from Xanthian Yaka originating from Xanthy–Greece; aplant with narrow, spindle shaped–elliptic habitus; with 26–32 sessile leaves (Figure 9).

KY (Kishinska Yaka) is believed to be introduced from Moldova (Uzunoski, 1985). Environmental conditions had a great influence on the morphology and chemistry of this genotype and it took decades–long selection to create this uniform and stable variety. It is characterized by elongated–elliptic habitus; with about 40 sessile leaves (Figure 10).

Fig. 6. P 10–3/2

Fig. 7. P 12–2/1

Fig. 8. Dj № 1

Fig. 9. YK 7–4/2

Fig. 10. KY

RESULTS AND DISCUSSION

The highest dry mass yield per stalk among the investigated tobacco genotypes was found in P–66–9/7. The lowest yield among the new varieties was recorded in P–23. The yield of the old varieties was 175% lower compared to the newly-created. The highest yield among them was recorded in Kishinska Yaka and the lowest in Dj № 1. In 2014, dry mass yield in P–66–9/7 was 24,47 g/stalk, which is 353% higher than the yield of Dj № 1 – 6,93 g/stalk in 2012 (Table 1).

The four–year biometric investigations of the new and old domestic tobacco varieties for the investigated quantitative trait show low standard deviation and low degree of variability, which indicates stability and uniformity as a result of their homozygotness.

Table 1. Mean value and variability of the dry mass yield per stalk in new commercial and old domestic tobacco varieties from the Republic of Macedonia

Tobacco varieties	Dry mass yield per stalk (g)											
	2011			2012			2013			2014		
	$\bar{x}\pm s\bar{x}$	δ	V (%)	$\bar{x}\pm s\bar{x}$	δ	V (%)	$\bar{x}\pm s\bar{x}$	δ	V (%)	$\bar{x}\pm s\bar{x}$	δ	V (%)
New commercial tobacco varieties												
1. P-23	16,72 0,44	4,14	7,95	17,15 0,39	1,76	5,15	17,11 0,16	0,72	6,37	17,61 0,23	0,51	5,07
2. P-84	18,92 0,35	3,32	5,72	19,73 0,30	1,35	3,64	19,23 0.17	0,75	6,12	19,86 0,21	0,63	5,18
3. NS-72	19,21 0,62	5,92	6,66	19,75 0,43	1,91	6,38	19,34 0,12	0,54	6,92	21,88 0.97	0,24	5,79
4. P-66-9/7	21,82 0,67	6,33	6,27	24,18 0,38	1,71	5,99	24,37 0,12	0,54	6,23	24,47 0,55	0,14	5,23
5. P-79-94	17,12 0,85	8,10	6,81	17,58 0,42	1,87	4,45	17,99 0,12	0,52	3,53	18,48 0,81	0,31	4,55
Old domestic tobacco varieties												
6. P 10-3/2	10,57 0,15	0,72	6,37	10,72 0,13	0,59	5,81	10,54 0,12	0,55	5,71	11,48 0,12	0,38	5,21
7. P 12-2/1	12,73 0,25	0,75	6,12	13,12 0,17	0,66	5,06	12,97 0,11	0,46	5,16	13,65 0,14	0,26	4,86
8. Dj № 1	7,04 0,12	0,54	6,92	6,93 0,11	0,47	6,93	7,39 0,07	0,44	6,03	8,02 0,09	0,17	5,78
9. YK7-3/2	9,88 0,12	0,54	6,23	10,18 0,17	0,51	4,96	9,55 0,12	0,56	4,36	10,83 0,13	0,21	4,25
10. KY	14,71 0,14	0,52	3,53	15,25 0,12	0,52	3,26	15,01 0,10	0,50	3,79	15,91 0,13	0,45	3,11

LSD0,05 = 0,66
LSD0,01 = 1,18

According to the data presented in Table 2 and comparison by years, in 37 out of 60 combinations, differences in yield for each variety are not significant, in 14 the significance is 5% and in 9 there is 1% significance. Comparing 2011 with 2012 and 2011 with 2013, highly significant difference was found only in P–66–9/7 and 5% significance in P–84 (2011-2012) and in P–79–94 (2011–2013). Difference in yield between 2012 and 2013 has no statistical significance. Highly significant differences between 2012 and 2014 were found in NS–72, and between 2013 and 2014 in NS–72 and YK 7–4/2. Highly significant differences were recorded between 2011 and 2014, where the significance of 1% occurred in NS–72, P–66–9/7, P–79–94 and KY, and significance of the remaining varieties is 5%. According to the above results, somewhat higher yield was obtained in 2014, due to the higher precipitation during the growing season. General conclusion would be that yield is highly heritable trait and varietal characteristic.

Table 2. Significance of differences in dry mass yield per stalk between years (from the values in Table 1)

Varieties		Years						
		2011 – 2012	2011 – 2013	2011 – 2014	2012 – 2013	2012 – 2014	2013 – 2014	
1.	P-23	(0,43)	(0,39)	(0,89)*	(0,04)	(0,46)	(0,50)	
2.	P-84	(0,81)*	(0,31)	(0,94)*	(0,50)	(0,13)	(0,63)	
3.	NS-72	(0,54)	(0,13)	(2,67)**	(0,41)	(2,13)**	(2,54)**	
4.	P-66-9/7	(2,36)**	(2,55)**	(2,65)**	(0,19)	(0,29)	(0,10)	
5.	P-79-94	(0,46)	(0,87)*	(1,36)**	(0,41)	(0,90)*	(0,49)	
6.	P 10-3/2	(0,15)	(0,03)	(0,91)*	(0,18)	(0,76)*	(0,94)*	
7.	P 12-2/1	(0,39)	(0,24)	(0,92)*	(0,46)	(0,53)	(0,68)*	
8.	Dj № 1	(0,11)	(0,35)	(0,98)*	(0,63)	(1,09)*	(0,63)	
9.	YK 7-3/2	(0,30)	(0,33)	(0,95)*	(0,33)	(0,65)	(1,28)**	
10.	KY	(0,54)	(0,50)	(1,20)**	(0,04)	(0,66)	(0,70)*	

Differences in yield between varieties presented in Table 3 show high significance in 42 out of 45 combinations, 5% significance in one combination (P 10–3/2 x YK 7–4/2) and no significance in two combinations (P–23 x P–79-94 and P–84 x NS–72). This indicates that the investigated varieties significantly differ among themselves in dry mass yield per stalk.

Table 3. Significance of differences in dry mass yield per stalk between varieties (from the values in Table 1)

	Combinations	Differences		Combinations	Differences
1.	P-23 – P-84	(2,28)**	24.	NS-72 – KY	(4,77)**
2.	P-23 – NS-72	(2,89)**	25.	P-66-9/7 – P-79-94	(5,92)**
3.	P-23 – P-66-9/7	(6,56)**	26.	P-66-9/7 – P 10-3/2	(12,88)**
4.	P-23 – P-79-94	(0,64)	27.	P-66-9/7 – P 12-2/1	(10,59)**
5.	P-23 – P 10-3/2	(6,32)**	28.	P-66-9/7 – Dj № 1	(16,37)**
6.	P-23 – P 12-2/1	(4,03)**	29.	P-66-9/7 – YK 7-3/2	(13,60)**
7.	P-23 – Dj № 1	(9,81)**	30.	P-66-9/7 – KY	(8,44)**
8.	P-23 – YK 7-3/2	(7,04)**	31.	P-79-94– P 10-3/2	(6,96)**
9.	P-23 – KY	(1,88)**	32.	P-79-94 – P 12-2/1	(4,67)**
10.	P-84 – NS-72	(0,61)	33.	P-79-94 – Dj № 1	(10,45)**
11.	P-84 – P-66-9/7	(4,28)**	34.	P-79-94 – YK 7-3/2	(7,68)**
12.	P-84 – P-79-94	(1,64)**	35.	P-79-94 – KY	(2,52)**
13.	P-84 – P 10-3/2	(8,60)**	36.	P 10-3/2 – P 12-2/1	(2,29)**
14.	P-84 – P 12-2/1	(6,31)**	37.	P 10-3/2– Dj № 1	(3,49)**
15.	P-84 – Dj № 1	(12,09)**	38.	P 10-3/2– YK 7-3/2	(0,72)*
16.	P-84 – YK 7-3/2	(9,32)**	39.	P 10-3/2 – KY	(4,44)**
17.	P-84 – KY	(4,16)**	40.	P 12-2/1 – Dj № 1	(5,78)**
18.	NS-72 – P-66-9/7	(3,67)**	41.	P 12-2/1 – YK 7-3/2	(3,01)**
19.	NS-72 – P-79-94	(2,25)**	42.	P 12-2/1 – KY	(2,15)**
20.	NS-72 – P 10-3/2	(9,21)**	43.	Dj № 1 – YK 7-3/2	(2,77)**
21.	NS-72 – P 12-2/1	(6,92)**	44.	Dj № 1 – KY	(7,93)**
22.	NS-72 – Dj № 1	(12,7)**	45.	YK 7-3/2 – KY	(5,16)**
23.	NS-72 – YK 7-3/2	(9,93)**			

CONCLUSION

- Standard deviation and coefficient of variation have minimum values in some new commercial varieties (P–23, P–84, NS–72, P–66–9/7, P–79–94) and old domestic varieties (P 10–3/2, P 12–2/1, Dj № 1, YK 7–4/2, KY – Kishinska Yaka), indicating low variability i.e. high stability of dry mass yield per stalk, which confirms the presence of homozygosity and high genetic stability.
- The newly–created varieties have 175% higher yield than the old domestic varieties, as a result of the successful selection work of Tobacco Institute–Prilep, with special reference to quality, which is inversely proportional to yield and which breeders must not neglect in the selection of tobacco.
- Data about stability of tobacco varieties presented in this paper mean higher safety in their selection and inclusion in future selective programs of the Institute.

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