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SOME MORPHOLOGICAL AND BIOLOGICAL CHARACTERISTICS OF THE NEWLY CREATED ORIENTAL VARIETIES AND LINES OF PRILEP TOBACCO

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ABSTRACT

Morphological traits (plant height, leaf number, size and shape) and biological characteristics (length of the growing season) enable phenotypic identification of tobacco variety at first glance. Also, the resistance of tobacco variety to diseases is another biological characteristic of a genotype. Phenotypic expression of the variety is a result of mutual action (interaction) between genotype and the impact of environmental conditions in which the plant grows.

The aim of our investigation is to study 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 in Pelagonia tobacco producing region.

Key words: tobacco, oriental, type Prilep, varieties, lines, morpho-biological characteristics

НЕКОИ МОРФОЛОШКИ И БИОЛОШКИ КАРАКТЕРИСТИКИ НА НОВОСОЗДАДЕНИ ОРИЕНТАЛСКИ СОРТИ И ЛИНИИ ТУТУН ОД ТИПОТ ПРИЛЕП

Морфолошките карактеристики на растенијата од една сорта тутун (висина на растенијата , број , димензии и форма на листовите) и должината на вегетациониот период како биолошко својство овозможуваат на прв поглед фенотипско разпознавање на истата во однос на другите сорти. Исто така и отпорноста на една сорта тутун кон одредени болести е биолошка особина на самиот генотип. Фенотипската изразеност на сортата, е резултат на взаемното дејство (интеракцијата) на генотипот и влијанието на условите на надворешната средина во која растат и се развиваат растенијата .

Имајќи ги во предвид овие сознанија си поставивме за цел во овие истражувања да ги проучиме некои морфолошки карактеристики, должината на вегетациониот период и отпорноста спрема пепелницата на неколку ориенталски ароматични сорти и линии тутун од типот прилеп во производните услови на пелагонискиот реон.

Клучни зборови: тутун, ориенталски , тип прилеп, сорти,линии,морфо-биолошки својства.

INTRODUCTION

Tobacco crop is easily adaptable to different soil and climate conditions, which is confirmed by its wide area of distribution. Still, the distribution of any type or variety of tobacco is limited by the soil and climate conditions (Atanasov D.1962, Uzunoski M.1985). Typical morphological and biological characteristics of tobacco variety or line (plant height, number, size and shape of leaves, length of vegetation period and uniformity of flowering) can be fully expressed only in certain environmental conditions and by application of all necessary cultural practices. Therefore, the reaction to any disease can be also estimated because it depends of local climatic conditions, variety resistance and site selection and rotation (Tobacco Research Board Kutsaga, 2016). The optimum phenotypic expression of typical morphological characters in oriental tobacco varieties and lines enable maximum use of their biological potential, resulting in a high-quality tobacco production recognizable in the market (Gornik R. 1973, Dimitrieski M. 1995). With regard to this, the main goal of our research was to analyze some of the morphological characters, the length of the vegetation period and mildew resistance in several varieties and lines of Prilep oriental tobacco in the producing region of Pelagonia (R. Macedonia).

MATERIAL AND METHODS

Subject of this research were four newly created tobacco varieties and lines resistant to powdery mildew: Prilep112-2/ 1 (Photo 1.), P l. 65/R (Photo 2.), P l.123 82, P l.301 65, and standard P12-2/1.

The newly created resistant lines were obtained by intraspecies hybridization, using foreign resistant varieties and domestic non-resistant oriental varieties and lines as its components. They are genetically stable and consolidated in terms of plant height and leaf number, shape and size.

In 2013 comparative trial was set up in randomized block design with four replications and transplanting was done at 40cm x 15cm spacing. Usual cultural practices, necessary for normal growth and development of oriental tobacco were applied on transplanted tobacco in field. The necessary morphological measurements and phenological observations were also carried out.

Investigations of resistance to powdery mildew in some varieties of tobacco type Prilep were made in the Small Biolab of Tobacco Institute-Prilep during 2013. Disease intensity was assessed on the basis of total number of observed plants and the number of diseased plants (leaves). Observation was made in two occasions: on 06 . 10. 2013 and 19.10. 2013.i.e. when intensity of disease attack in the susceptible varieties was the hiqhest. For estimation of the intensity, the scale with a range 0-5 was used (EPPO,1997). Index of the disease was estimated by the formula of Mc. Kinney (cit. Dimitrieski M. et al. 2006, Miceska G. et al. 2006). According to the symptoms developed in plants and the intensity of attack, all the varieties investigated were classified into 6 categories:

0-Higly resistant- up to 0 % infection
1-Resistant - up to 1 %
2-Moderately resistant-1-5%
3-Poorly susceptible -5-20 %
4-Susceptible -20-40 %
5-Highly susceptible - 40-100%

RESULTS AND DISCUSSION

Morphological characteristics

The presented data show that the average values for the height of the stalk with inflorescence in tobacco lines and varieties investigated (Table 1) vary from 52.35 cm in the standard variety P12-2/1 to 75.48 cm in line P. l.123 82. Variability of this character is small, which can be seen from the degree of the root-mean square deviation ranging from S = 0.78 cm (P l. 301 65) to S = 2.47 cm (P l. 123 82). According to the obtained coefficient of variation, the root-mean square deviation of variants in relation to the average of the mean arithmetic value ranges from CV = 1.11% (P 112-2/1) to CV = 4.32% (P l. 123 82). The number of leaves in the studied lines and varieties varies from 34.5 in P 12-2/1 to 58.35 in the line P l. 123-65/8. The variability of this character is also small, which can be seen from the degree of the root mean-square deviation ranging from S = 0,43 (Prilep 112-2/1) to S = 1.05 (P l. 301 65). According to the obtained coefficient of variation, the root-mean square deviation of variants in relation to the average mean arithmetic value ranges from CV = 1.50% (P l. 123 82) to CV = 4.15% (P 12-2/1).

Table 1. Plant height and leaf number per plant

Varietes Lines	Plant height with inflorescence			Leaf number per plant		
	X	S ± Ss	CV%	X	S ± Ss	CV %
P12-2/1 Ø	52,35	0,81± 0,18	1,52	34,50	0,76± 0,17	4,15
Prilep112-2/ 1	55,20	0,86± 0,19	1,11	52,34	0,43± 0,10	3,25
P l. 65/R	68,26	0,79± 0,17	1,24	54,20	0,73± 0,16	1,82
P l.123 82	75,48	2,47± 0,56	4,32	58,35	0,75± 0,17	1,50
P l.301 65	64,40	0,78± 0,17	1,45	50,84	1,05± 0,23	2,45

X –mean value (cm/leaf number.); S–standard deviation; Ss – standard deviation error; CV- coefficient of variation %

Dimensions of the largest leaf (Table 2) vary from 19.52 cm length and 9.35 cm width (P l.123-65 / 8) to 22.30 cm length and 10.31 cm width in line P l. 301 65. The degree of the root-mean square deviation for this character ranges from S = 0.68 cm (P 12-2/1) to S = 0.85 cm (P 112-2 / 1). The value of the coefficient of variation varies from CV = 2.28% (P l. 65 P) to CV = 3.67% (P l. 123 82), which indicates low variability in relation to the dimensions of leaves, too.

Table 2. The largest leaf size

Varietes Lines	Length cm			Width cm		
	X	S ± Ss	CV%	X	S ± Ss	CV %
P12-2/1 Ø	21,15	0,68± 0,15	2,65	10,15	1,04± 0,23	5,42
Prilep112-2/ 1	20,64	0,85± 0,19	3,45	9,61	0,78± 0,17	6,05
P l. 65/R	20,35	0,79± 0,17	2,28	10,27	0,84± 0,19	4,78
P l.123 82	19,52	0,81± 0,18	3,67	9,35	0,68± 015	5,11
P l.301 65	22,30	0,77± 0,17	2,97	10,31	0,74± 0,16	3,55

X – mean value (cm); S–standard deviation; Ss – standard deviation error; CV- coefficient of variation %

BIOLOGICAL CHARACTERISTICS

The length of the growing period (Table 3) is specific biological character of all varieties of tobacco, which varies in each variety depending on the environmental conditions and the cultural practices applied. All the varieties and lines included in the investigation are uniform with regard to the length of the flowering period. The shortest growing period of 56 days to 50% flowering has the standard variety P12-2/1 and the longest period of 81 day has the line P l. 301 65. The growing season from planting to the end of harvest is 115 days for varieties P12-2/1 and Prilep 112-2/1 to 130 days for the line P l. 301 65

Table 3.Length of the growing season

Varietes	Days from planting to:	
Lines	50% flowering	End of the harvest
P12-2/1 Ø	56	105
Prilep112-2/ l	64	115
P l. 65/R	67	125
P l.123 82	71	125
P l.301 65	81	130

Data on the resistance of investigated varieties to powdery mildew are presented in Table 4. According to the two observations on this biological character, they showed different resistance to this pathogen. Thus, three of the 5 tested varieties and lines of Prilep tobacco showed high resistance to the powdery mildew (P l. 65/R, P l.123 82 and P l.301 65), one was resistant (Prilep112-2/l) and the standard variety P12-2/1 was highly susceptible.

Table 4. Resistance to powdery mildew in some varieties of Prilep tobacco

Varietes	Disease intensity			Resistence
Lines	I estimation	II estimation	Average	
P12-2/1 Ø	58,24	54,90	56,57	Highly susceptible
Prilep112-2/ l	2,82	3,45	3,14	Moderately resistant
P l. 65/R	0,00	0,38	0,19	Resistant
P l.123 82	0,00	0,00	0,00	Higly resistant
P l.301 65	0,00	0,00	0,00	Higly resistant

0-Higly resistant- up to 0 % infection; 1- Resistant - up to 1 %; 2- Moderately resistant-1-5%; 3- Poorly susceptible -5-20 %; 4- Susceptible-20-40 %; 5- Highly susceptible – 40-100 %

Foto 1. Prilep112-2/l

Foto 2. P l. 65 / R

CONCLUSIONS

The investigations on morphobiological characteristics of some oriental aromatic varieties and lines of Prilep tobacco in producing conditions of the Pelagonia region lead to the following conclusions:

- With regard to the morphological characters plant height, leaf number per plant and the largest leaf size, the investigated varieties and lines are phenotypically uniform and stable, with negligible variability expressed through the coefficient of variation CV <10%.

- Regarding the length of flowering stage, all investigated varieties and lines are highly uniform. The shortest growing season of 56 days to 50% flowering was observed in standard variety P12-2/1 and the longest season of 81 days in line P l. 301 65. The growing season from planting to the end of harvest was 115 days in varieties P12-2/1 and Prilep 112-2/1 to 130 days in line P l. 301 65.

- Two of the five investigated varieties and lines of Prielp tobacco were highly resistant to powdery mildew (P l.123 82 and P l.301 65), one was resistant (P l. 65 / R), one was moderately resistant (Prilep112-2/l) and the check variety P12-2/1 proved to be highly susceptible.

As a general conclusion, it may be stated that the newly created varieties and lines can find application in mass production, and the two highly resistant lines of oriental tobacco can be used as genetic component in crossing, to create new varieties resistant to mildew.

REFERENCES

1. Атанасов Д. 1962. Тютюнопроизводство. Пловдив.
2. Горник Р. 1973. Облагородување на тутунот. Прилеп
3. Димитриески М. 1995. Ефекти на ласерската светлина врз приносот и квалитетот на тутунот. докторска дисертација, Скопје.
4. Dimitrieski M., Miceska G., Taskoski P., Gveroska B., 2006. Investigations on the Resistance of Some yaka Tobacco Lines and Varieties to Powdery Mildew. RastenievÍdni nauki / Plant science, Vol.XLII, No 6, p. 521-522. Nacionalen centÍr za agrarni nauki / National centre for agrarian sciences, Sofia. 70 Anniversary of Plant Protection Institute and Annual Balkan Week of Plant Health, 28-31.5.2006
5. EPPO Standards, 1997. Fungicides &Bactericides, Vol 2, March, Paris, France
6. Miceska G., Dimitrieski M., Taskoski P., Gveroska B., 2006. Resistance of Some Varieties and Lines of Tobacco Type Prilep to Powdery Mildew. RastenievÍdni nauki / Plant science, Vol.XLII, No 6, p. 519-520. Nacionalen centÍr za agrarni nauki / National centre for agrarian sciences, Sofia. 70 Anniversary of Plant Protection Institute and Annual Balkan Week of Plant Health, 28-31.5.2006
7. Tobacco Research Board Kutsaga, 2016. Climate change and the resistance of some pests and diseases. www.kutsaga.co.zw

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NEW LINES OF PRILEP TOBACCO AND THEIR MORFOLOGICAL CHARACTERISTICS

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ABSTRACT

Comparative trial was carried out in 2014 in the field of Tobacco Institute-Prilep with some Prilep tobacco varieties in order to study their morphological, productional and quality characteristics. The trial included 4 new lines of the type Prilep obtained by generative hybridization (P .l. 14-65/1,P.l.14-66/7, P.l. 123-82/2,P.l. 14-67/7) and the variety P12-2/1 as a standard. Regarding the morphological properties (plant height, leaf number, largest leaf size), all of the investigated lines and varieties showed very low variability, which is an indication of morphological uniformity and stability. The share of Prilep tobacco in the total tobacco production of R. Macedonia is about 85 % . We hope that the newly created Prilep lines and varieties will find their place in the mass tobacco production of the Republic of Macedonia.

Keywords: tobacco, prilep , lines, morphological characteristics,

НОВИ ЛИНИИ ОД ТИПОТ ПРИЛЕП И НИВНИТЕ МОРФОЛОШКИ КАРАКТЕРИСТИКИ

Компаративното испитување беше спроведено во 2014 година на полето на Институтот за тутун-Прилеп со неколку сорти на тутун од типот Прилеп, со цел да се проучат нивните морфолошки, производни и квалитетни својства. Во опитот беа вклучени 4 нови линии од типот Прилеп добиени по пат на генеративна хибридизација (П.л. 14-65 / 1, П.л.14-66 / 7, П.л. 123-82 / 2, П.л. 14-67 / 7) и сортата П12 -2/1 како стандард. Во однос на морфолошките својства (висина на растението, број на лист, најголема големина на лист), сите испитувани линии и сорти покажаа многу ниска варијабилност, што укажува на морфолошка униформност и стабилност. Во вкупното производство на тутун во Р. Македонија типот прилеп застапен е околу 85%. Се надеваме дека новоформираните линии и сорти од типот прилеп ќе го најдат своето место во масовното тутунопроизводствово Република Македонија.

Клучни зборови: тутун, Прилеп, линии, морфолошки карактеристики

INTRODUCTION

Republic of Macedonia has an important place in tobacco market and with a share of 3% it is among the first eight producers of oriental tobaccos in the world. Tobacco occupies 3.4% of the total arable area in the country and 81.1% of the area planted with industrial crops.

The need to create and introduce new and more productive oriental varieties of tobacco with better quality than the existing ones permanently increases. Such heterogeneous assortment, however, dramatically affects the quality of Prilep tobacco and threatens to destroy its high reputation on the foreign market. These alarming predictions can be avoided only by creation and introduction of new varieties with higher productivity and better quality. As a result of scientific and research work on this problem during the last two decades, the Department of genetics and breeding in Tobacco Institute-Prilep created a great number of new lines of Prilep tobacco with significantly better quality compared to the standard, using the method of hybridization. This method is one of the most appropriate methods in modern genetics and selection for creating the necessary diversity of starting material from which new plant varieties can be created and stabilized (Dimitreski et al., 2015).

With their biological potential and quality characteristics, these varieties will correspond not only to the interests of the primary production but also to the requirements of the market and manufacturers. Therefore, our aim in breeding the new varieties was to obtain optimum yields and to improve the quality of tobacco.

The aim of the paper is to present the most important morphological characteristics of some newly created aromatic varieties of the type Prilep.

MATERIAL AND METHODS

The trial was set up in the field of Scientific Tobacco Institute - Prilep, following the standard methodology - randomized block design with 4 replications. The following Prilep tobaccos were included in the trial: P 12-2/1 as a standard variety and newly created lines P.l. 14-65/1, P.l 14-66/7, P.l 123-82/2, P l. 14-67/7 .

The analysis was made on morphological characteristics of the investigated tobacco lines and varieties were carried out in the field in the phase of full blossoming of tobacco according to standard methods in the selection.

During the growing season, major biometric indicators of the newly created lines of Prilep tobacco and the standard variety P 12-2/1 were observed: plant height, leaf number and dimensions (length and width) of the largest leaf. Variability statistical analysis of the obtained data was made (Najceska C., 2002).

RESULTS AND DISCUSSION

1. Morphological characteristics

The new lines of Prilep tobacco created by means of generative hybridization show some variations in phenotypic characteristics in the first generations, but with further selection certain uniformity was achieved with regard to morphological properties of the obtained progenies.

Dimitrova (1991), studying the variation of plant height and leaf number in some dihaploid lines of oriental tobacco, reported that the coefficient of variation (CV) in the varieties investigated ranges from 4 to 4.5% for plant height and from 3.7 to 5.5% for leaf number per plant.

Phenological investigations of the newly created lines of Prilep tobacco showed high level of uniformity of plants in relation to the studied characters of the standard variety P12-2/1 (Ø).

Namely, the variation of plant height (Table 1) is insignificant and lower compared to the standard. The coefficient of variation (CV) for plant height ranges from 1.22% (P. l. 14-67 / 7) to 2.75% (P. l. 14-65 / 1) and 4.38% (P l2-2/1).

The lowest mean square deviation was calculated in line PP. 14-67 / 7 (δ ± 0.66 cm) and the highest in line P.l. 123-82 / 2 (δ ± 2.45 cm).

2. Leaf number per plant

Variation of the values for leaf number per stalk (Table 1) was lower in the newly created lines compared to the standard. The highest number of leaves was counted in line P.l. 123-82/2 (58) and the lowest in P 12-2/1 (Ø). The lowest mean square deviation was calculated in P.l. 123-82/2 (δ ± 0,66) and the highest in line P.l. 14-67/7 (δ ± 5,78), while the coefficient of variation ranges from 1,39% (P.l. 123-82/2) to 5.93% (P12-2/1), which means that all newly created lines have a lower square deviation and coefficient of variation in relation to the standard (P12-2/1 Ø).

Low values of the variability indices can be explained by the high degree of consolidation of the investigated characters. According to Dimitrova S. (1998), stabilization of varieties within narrow limits is a result of the long selection process during creation and breeding of tobacco varieties and lines.

Table 1. Morphological characteristics

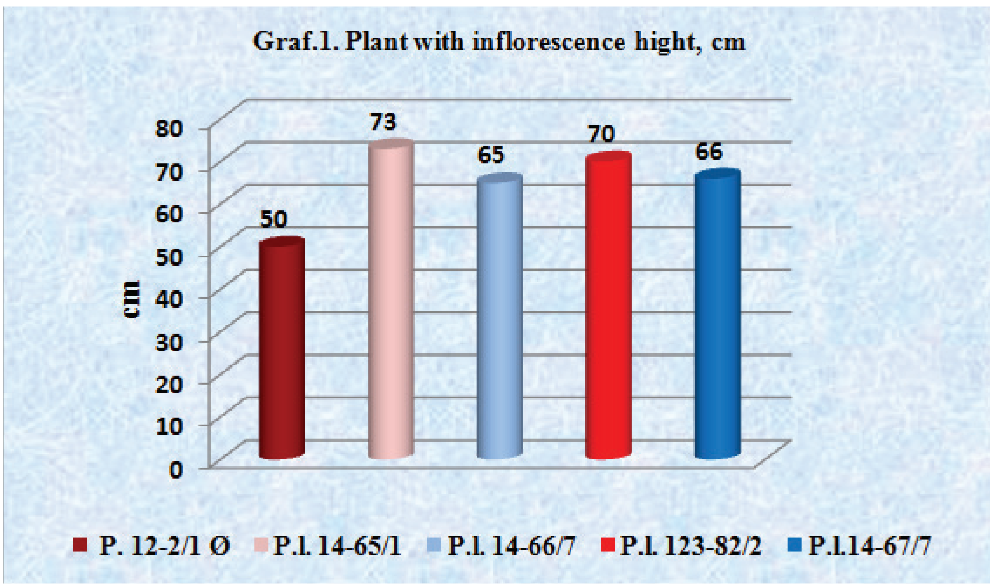
Varietes Lines	Plant height with inflorescence cm			Leaf number per plant		
	$\bar{x}$	δ ± Sδ	CV%	$\bar{x}$	δ ± Sδ	CV %
P. 12-2/1 Ø	50	2.20±0.49	4.38	34	3.56±0.44	5.93
P.l. 14-65/1	73	2.00 ±0.45	2.75	57	0.76±0.19	1.52
P.l. 14-66/7	65	2.17±0.36	2.5	53	0.76±0.19	1.52
P.l. 123-82/2	70	2.45±0.38	2.4	58	0.66±0.18	1.39
P.l.14-67/7	66	0.66±0.23	1.22	54	5.78±0.53	4.26

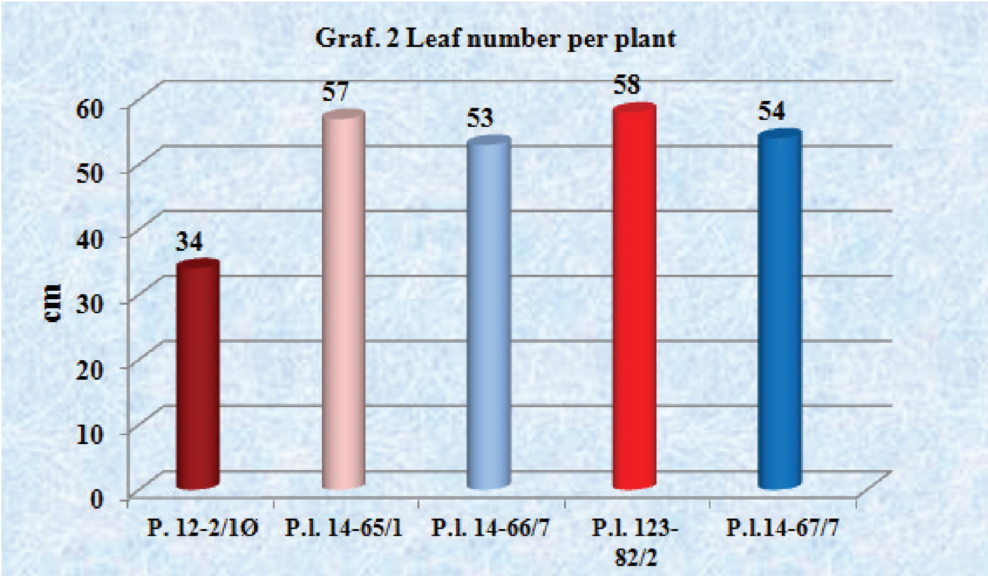
$\bar{x}$ - mean value
δ - standard deviation
Sδ - average error of standard deviation
CV - coefficient of variation

3. Dimensions of the largest leaf

Data presented in Table 2 reveal that the largest leaf size (length : width) ranges from 21.5 cm length (P.l. 123-82/2) and 9.9 cm width (P.l. 14-67/7) to 23.8 cm length (P12-2/1) and 10.4cm width (P.l. 14-65/1).

With regard to variations, it can be concluded that investigated tobacco lines have smaller variations in the size of the largest leaf compared to the standard. The coefficient of variation (CV) ranges from 0.74% (length) and 0.08% (width) in line P.l. 14-67/7 to 3.92% (length) and 6.8% (width) in the standard variety P12-2/1 (Table 2).





The mean square deviation of the largest leaf length ranges from δ ± 0.03 cm (P 14-67/7 and P.l.14-65 / 1)) to δ ± 0.38cm (P12-2/1) and a width of δ ± 0.01cm (P.l. 14-67/7, P12-2/1) to δ ± 0.04 cm (P.l. 14-65/1).

Phenological investigations during the growing season showed high uniformity of plants in the newly created lines of Prilep tobacco. According to Miceska et al. (2006), low values of the parameters such as mean square deviation and coefficient of variation indicate high uniformity of plants with respect to morphological characters. The newly created lines of Prilep tobacco are stable, knowing that the variation is insignificant if CV <10% (Shanin, 1977, cit. Najceska C., 2002).

Table 2. Morphological characteristics

Varietes Lines	Plant height with inflorescence cm			Leaf number per plant		
	$\bar{x}$	δ ± Sδ	CV%	$\bar{x}$	δ ± Sδ	CV %
P. 12-2/1 Ø	23,8	0.38±0.20	3.92	10,1	0.01±0.15	6.9
P.l. 14-65/1	21,8	0.03±0.04	0.82	10.4	0.04±0.04	1.93
P.l. 14-66/7	22,1	0.07±0.06	1.22	10,2	0.02±0.02	1.36
P.l. 123-82/2	21,5	0.04±0.03	0.79	10,3	0.02±0.03	1.36
P.l.14-67/7	22,8	0.03±0.04	0.74	9,9	0.01±0.02	0.08

$\bar{x}$ - mean value- cm
δ - standard deviation
Sδ - average error of standard deviation
CV - coefficient of variation

CONCLUSIONS

Based on the results of investigation, we came to a conclusion that the newly created lines of Prilep tobacco are morphologically uniform and they can be used for further breeding.

Using the method of generic hybridization and plant selection, high level of uniformity was achieved in height of the plants with inflorescence, leaf number and dimensions of the largest leaf, with coefficient of variation being <10%.

The obtained lines with uniform morphological properties represent a good starting genetic material for further studies.

REFERENCES

1. Dimitrieski M., Miceska G. 2015. Recessive inheritance of the length of growing period in some oriental tobaccos by monohybrid and backcross methods. IJRSB Vol. 3, Issue 6, pp 1-7
2. Dimitrieski M., Miceska G. 2014.Newly created perspective lines of the oriental aromatic tobacco type Prilep. Agribalkan , Balkan agricultural congres, 8-11.09., Edirne, Turkey, Agribalkan congress book, p. 449
3. Dimitrieski M.; Miceska G.2017: Morpho-biologikal characteristics of some new oriental aromatic varieties and lines of Prilep tobacco in production region of Pelagonia. 16-18 May. 2 nd International Balkan Agricultural Congress in Tekirdağ, Turkey. Book of abstracts. pp 391
4. Димитрова С.,1991. Дихаплоиди од антери на хибриди в F1 от ориенталски тип тютюн и техните качества с оглед на нуждите на селекцията. Генетика и селекција, год. 24, No 4. София 1991.стр. 262-266.
5. Димитрова С.,1998. Агробиолог ична характеристика на ориенталските тютюн сорт Тича 117. Plant science, XXXIV, No 3-4, str. 375-379, Sofia , 1998.
6. Guler Gumus S., 2008. Economic analysis of oriental tobacco in Turkey. Bulgarian Journal of Agricultural Science, 14 , No5, pp 470-475
7. Мицеска Г., 2006. Дихаплоиди од антери на ориенталски тутун и нивните морфолошки својства. Тутун/ Tobacco, Vol. 56, No 5-6, pp. 85-91.
8. Miceska G., Dimitrieski M., 2010. Morfološke karakteristike novih linija orientalnog duhana tip prilep otporan na TMV. 45 ti Hrvatski i 5 ti Međunarodni simpozij agronoma. Opatija, 15-19.02.2010. Zbornik radova . str. 466-469.
9. Stančić I., Petrović S., Živić J., 2011. Yeild and morphological characteristics of some types of CMS hybrids of Prilep tobacco. Biologica nyssana, 2 (1) , pp 35-38.
10. Најческа Ц., 2002. Експериментална статистика применета во земјоделските и биолошките истражувања, Бона, Скопје.
11. Узуноски М., 1985. Производсво на тутун, Скопје.
12. Шанин Й., 1977. Методика на полски опит. С. БАН.

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BREEDING FOR DROUGHT TOLERANCE IN TOBACCO

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ABSTRACT

Nowadays we are witnessing continuous spread of drought as a result of global warming. The need for irrigation increases for all crops, including tobacco. The oriental sun-cured tobacco does not require large amounts of water, but for obtaining a good quality raw material it is necessary to have some precipitation during the growing season. The lack of rain and irrigation water can be overcome by selection of varieties tolerant to drought. Tobacco Institute - Prilep has developed programs for investigation of the assortment and improvement of the existing varieties and creation of new genotypes. The investigation included nine varieties belonging to different types of tobacco, some of which are commercially used in the Republic of Macedonia and some are kept for further breeding. The trial was set up in the Experimental field of the Institute during 2012 and 2013 in randomized blocks with three replications.
The aim of the paper was to study the oriental varieties in order to obtain data on their tolerance to drought and to supply material for further selection. Drought tolerance was determined by classical breeding methods based on phenotypic expression of morphological and production traits. For this purpose, modern breeding programs are using molecular markers in different stages of the selection process. 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 programs for improvement of the investigated trait.

Keywords: tobacco (Nicotiana tabacum L.), oriental varieties; morphological traits; production traits; tolerance to drought.

ОБЛАГОРОДУВАЊЕ НА ТУТУНОТ ЗА ТОЛЕРАНТНОСТ НА СУША

Денес сме сведоци на се´ поголемото распространување на сушата како резултат на глобалното „загревање" на Земјата. Потребите од наводнување на насадите се зголемуваат кај сите култури, па и кај тутунот. За одгледување на ориенталските sun-cured тутуни не е потребно обемно количество вода, но сепак за да дадат квалитетна суровина неопходна е одредена сума на врнежи во текот на неговата вегетација. Во недостиг на врнежи, како и можност за наводнување неопходна е селекција и ширење на сорти толерантни на суша. Научниот институт за тутун - Прилеп во оваа насока има развиено програми за проучување на расположливиот сортимент, подобрување на актуелниот сортов материјал и создавање на нови генотипови. Како материјал за работа земени се девет сорти од различни типови тутун, од кои дел се актуелни за комерцијална употреба во Република Македонија, а дел се за понатамошно облагородување. Опитот беше поставен на Опитното поле при НИТП во текот на 2012 и 2013 година, по случаен блок-систем во три повторувања.
Целта на овој труд е да се извршат истражувања на сорти од ориенталски тип, од кои ќе се добијат сознанија за нивната толерантност кон сушни услови и ќе се обезбеди материјал за идна селекција.
Одредувањето на толерантноста кон суша е базирано на класични селекциони методи засновани на фенотипска експресија на морфолошките и производните особини. Во современите облагородувачки

програми се´ повеќе се користат молекуларни маркери во различни фази во процесот на селекцијата. Највисок степен на толерантност на суша покажаа сортите: П-84 (од тип прилеп) и П-2 (од тип џебел). Овие генотипови би можеле да влезат во програмите за подобрување на даденото својство.

Клучни зборови: тутун (Nicotiana tabacum L.), ориенталски сорти, морфолошки особини, производни особини, толерантност на суша.

INTRODUCTION

Drought is the cause of plant stress, which is an increasing problem of today, caused by the global warming of the Earth. The losses in agricultural production caused by the lack of water on a global scale reach up to 10 billion dollars a year (Guha-Sapir et al., 2004). Drought years in Macedonia are more and more frequent and cause serious losses in yield of all crops, including tobacco. The selection of drought-tolerant genotypes is a very important goal in plant breeding.

From the aspect of breeding, the stress tolerance of the genotypes can be described as ability to maintain a consistently high yield (yield stability), regardless of the adverse environmental conditions. The tolerance to water deficit in the soil is a complex parameter and it can be achieved if the genotype possesses one of the following mechanisms:

- a drought avoidance mechanism - morphological phenomenon achieved by early maturity, obtained by increased metabolic activity and accelerated growth (McKay et al., 2003);

- mechanism to reduce dehydration - physiological adjustment in which plants have low metabolic activity and slower growth, while in the drought period they have high water potential and cell turgor; closing of the stoma is controlled by water availability from the soil and interaction of factors inside and outside the leaf (Medrano et al., 2002), and

- mechanism for dehydration tolerance - tolerance to changes caused by drought at cell and molecule level, and plants achieve it with osmotic regulation. In the CIMMYT breeding program for drought tolerance, Reynolds et al. (1999) reported that osmotic adjustment in tolerant genotypes exposed to drought enables leaf elongation, open stomata and better stomatal conduction and photosynthesis, better root growth and consequently better utilization of soil moisture, later wilting of leaves, better collection of dry matter and, as a consequence of all, higher yields of the crops under stress conditions. Seropian and Planchon (1983), emphasized that the ability to hold stomata open, despite drought stress, is an agronomic form of drought tolerance. McCue and Hanson (1990) concluded that organic osmolytes (osmolytes containing nitrogen and quaternary ammonium compounds, as well as carbohydrate osmolytes, monosaccharides, oligosaccharides and polysaccharides) play a major role in osmotic adjustment.

Many scientists are involved in obtaining tobacco genotypes resistant to drought stress. Thus, Sadeghi et al. (2010) investigated five Virginia tobacco varieties and ten of their hybrids (fifteen genotypes) were evaluated in a RCBD in two different environments (water stress and normal irrigation). Highly significant differences were observed among genotypes for all parameters and for potential and stress yields, indicating the existence of genetic variation and the possibility of selection for drought resistance.

Recently, genetically modified drought tolerant plants have been put into production by applying the principle of plant transformation with genes for enzymes that participate in the biosynthesis of certain osmolytes (osmoprotectants) or antioxidant enzymes. Yang et al. (2005) transformed the tobacco (which is not capable of synthesizing the betaine) with gene for betaine aldehyde dehydrogenase of the spinach. This transformation increased the accumulation of betaine, primarily in chloroplasts, which also improved the tolerance of tobacco to high temperatures. A source of genes for betaine synthesis are most commonly some bacterial species. Gubiš et al. (2007) used P5CS-F129A cDNA and nptII marker gene for tobacco (Nicotiana tabacum L. cv. Bel B and cv. M51) transformation via Agrobacterium tumefaciens strain LBA4404. The obtained transgenic plants with elevated accumulation of osmoprotectants seem to be better adapted to water stress, providing a perspective for future research of stress effects that have a principle role in the functional activity of plants. This study confirmed P5CSF129A to be a candidate gene in crop engineering for enhanced water stress tolerance. Macková et al. (2013), conducted research on the responses to drought stress in tobacco (Nicotiana tabacum L.) plants ectopically expressing the cytokinin oxidase/ dehydrogenase CKX1 gene of Arabidopsis thaliana L. under the control of either the predominantly root-expressed WRKY6 promoter or the constitutive 35S promoter, and in the wild type. The results indicate that modulation of cytokinin levels may positively affect plant responses to abiotic stress through a variety of physiological mechanisms. Shtereva et al. (2017), investigated the effect of prolonged water deficit on four flue-cured (Virginia) tobacco genotypes. Drought stress was induced by subjecting plants to low, moderate and severe regimes. Some growth parameters such as fresh weight, plant growth rate, number, color and area of new developed leaves, as well as proline, hydrogen peroxide (H2 O2) and malondialdehyde (MDA) content as a measure of oxidative stress were investigated to examine the role of genotype in water-deficit tolerance. The results showed that among the genotypes, Virgin D (VD) was the most susceptible to drought, while L 842 and Oxford 207 were moderately tolerant; RG11 was drought-tolerant. This suggests that the correlation between the physiological traits and level of antioxidative response exists and therefore it could be used as a rapid screening test to evaluate the drought tolerance of tobacco.

The aim of this research was to study the available varieties of oriental tobacco and their tolerance to drought, in order to provide material for making patterns for crossbreeding and selection of genotypes resistant to drought stress.

MATERIAL AND METHODS

Varieties of the oriental tobaccos Prilep [P-7 (Fig. 1), P-84 (Fig. 2), P-23 (Fig. 3) and P 65/94 (Fig. 4)], Yaka [YK 7-4 / 2 (Fig. 5), YK-23 (Fig. 6) and YV 125/3 (Fig. 7)] and Djebel [Dj. № 1 (Fig. 8) and Pobeda P-2 (Fig. 9)], were used as material for investigation. Two of them (P 65/94 and YV 125/3) are commercial varieties, and the others are genetic resources that are included in breeding programs for improvement of various traits, in this case of their tolerance to drought. The trial was set up in the Experimental field of Tobacco Institute - Prilep in 2012 and 2013. Analysis was made with unirrigated variants and variants irrigated in the stage of rapid growth (July and August) with 100 mm (100 l/m2), applied by four waterings of 25 mm. Estimates were made on the following traits: stalk height with inflorescence, leaf number and dry mass. Measurements of the former two traits were made in the stage of rapid growth and of the latter after the treatment of fermented tobacco.

During the tobacco growth period in field (May–September) in 2012, the mean monthly temperature was 20.30 ^{o}C, number of rainy days 26 and total precipitation 180 mm. In 2013, the mean monthly temperature was 19.40 ^{o}C, number of rainy days 34 and total precipitation 153 mm.

Fig. 1. Prilep P – 7

Fig. 2. Prilep P -84

Fig. 3. Prilep P-23

Fig. 4. Prilep P 65/94

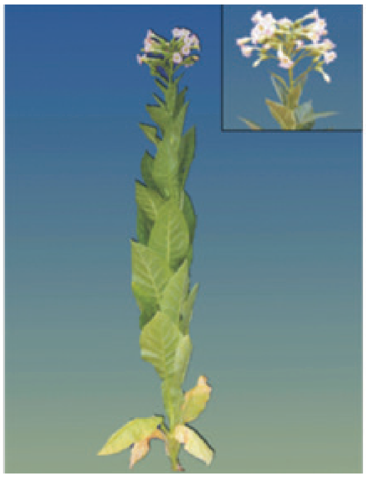

Fig. 5. Jaka, JK 7-4/2

Fig. 6. Jaka, JK-23

Fig. 7. Jaka, JV 125/3

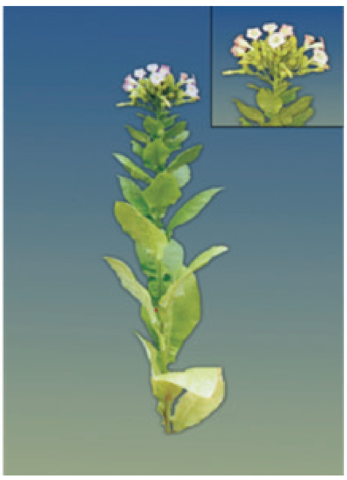

Fig. 8. Djebel Dj N0 1

Fig. 9. Pobeda P-2

RESULTS AND DISCUSSION

The response of genotypes to drought is directly influenced by the environmental conditions and available water amount during the growth period. For this reason, data on precipitation and irrigation during the plant growth are of major importance in this investigation. In 2012, in the period May 1 - September 30, the amount of precipitations was 180 mm, while in July and August it was 32 mm (12 mm in July + 20 mm in August). In the same period, additional watering of 100 mm was applied (four times x 25 mm), or a total of 280 mm in the whole growth period (in July and August - 132 mm). In the period May-September 2013, precipitation amount was153 mm, while in July and August it was 20 mm (11 mm in July + 9 mm in August). Four waterings with a total amount of 253 mm water were applied though the whole growth period, of which 120 mm in July and August. The above data reveal that the total amount of water during the growth period in 2013 was 27 mm lower than in 2012.

Morphological measurements of plant height and leaf number per inflorescence, as well as the measurements of dry mass per stalk clearly show which variety gives high er yield in dry conditions and which in conditions of irrigation, i.e. they are excellent indicator of plant resistance to drought. Table 1 shows the results obtained during the two years of investigation.

The highest stalk was measured in YV 125/3. In 2012 this variety (check variant) reached an average height of 105.34 cm without irrigation and 125.71 cm with irrigation. In 2013 the average height of this variety was 101.34 cm without irrigation, and 125.37 cm with irrigation. Thus, considering the year as environmental factor, the variant of YV 125/3 without irrigation in 2012 was 4 cm higher than in 2013, and the variant with irrigation in 2012 was 0.34 cm higher than in 2013. The lowest average height of the stalk was measured in P-23. In 2012 this variety reached a height of 52.04 cm without irrigation and 64.28 cm with irrigation, while in 2013 it reached a height of 50.84 cm without irrigation and 63.28 cm with irrigation. From the aspect of year as a factor, the varieties without irrigation in 2012 were 1.2 cm higher than those in 2013, and with irrigation they were 1 cm higher in 2012 than in 2013. Data presented in Table 1 and Figure 1 show that all varieties are higher in the variant with irrigation. All varieties in 2012 are higher than in 2013, as a result of the higher amount of water during the growth period. Exceptions from this are the varieties YK 7-4/2 and Dj № 1, which had higher stalk in the variant with irrigation in 2013, caused by unknown environmental factors.

Table 1. Quantitative traits of oriental tobacco varieties grown under different water amounts in the stage of rapid growth (July-August)

Varietes	Quantitative traits					
	Stalk height with inflorescence (cm)		Leaf number per stalk		Dry mass yield (g/stalk)	
	Unirrigated* $(\bar{x}) \pm s\bar{x}$	Irrigated** $\bar{x} \pm s\bar{x}$	Unirrigated * $\bar{x} \pm s\bar{x}$	Irrigated** $(\bar{x}) \pm s\bar{x}$	Unirrigated* $\bar{x}$	Irrigated** $\bar{x}$
2012						
1. P - 7	53,38 ± 0,12	66,40 ± 0,11	44,31 ± 0,15	54,35 ± 0,15	9,71	13.20
2. P - 84	71,17 ± 0,14	77,55 ± 0,07	40,11 ± 0,05	42,15 ± 0,05	20,38	21.73
3. P - 23	52,04 ± 0,11	64,28 ± 0,09	42,46 ± 0,22	50,04 ± 0,22	10,69	16.92
4. P 65/94	60,18 ± 0,21	77,19 ± 0,17	52,20 ± 0,20	59,72 ± 0,20	11,52	23.71
5. YK 7-4/2	80,62 ± 0,27	98,21 ± 0,19	24,82 ± 0,08	32,84 ± 0,08	3,89	6.80
6. YK - 23	90,56 ± 0,39	108,04 ± 0,32	34,26 ± 0,12	40,18 ± 0,12	12,14	15.55
7. YV 125/3	105,34 ± 0,35	125,71 ± 0,31	35,52 ± 0,10	42,25 ± 0,1	12,76	18.07
8. Dj № 1	70,22 ± 0,29	79,72 ± 0,25	22,41 ± 0,05	30,49 ± 0,05	4,33	6.23
9. Pobeda 2	102,00 ± 0,34	110,55 ± 0,25	40,79 ± 0,16	42,36 ± 0,15	14,05	15.78
$LSD_{0.05}$ =	5.79		2.04		1.62	
$_{0.01}$ =	7.98		3.83		2.39	
2013						
1. P - 7	50,27 ± 0,10	65,44 ± 0,15	42,02 ± 0,14	54.00 ± 0,15	8.73	13,44
2. P - 84	68,16 ± 0,14	75,13 ± 0,09	38,44 ± 0,05	42,36 ± 0,05	19.81	21,51
3. P - 23	50,84 ± 0,12	63,28 ± 0,08	40,73 ± 0,20	49,28 ± 1,02	9.74	16,13
4. P 65/94	60.41 ± 0,23	75,57 ± 0,17	50,52 ± 0,18	58,04 ± 0,17	12.05	23,53
5. YK 7-4/2	77,36 ±0,21	100,06 ± 0,19	22,52 ± 0,06	33,54 ± 0,13	3.22	6,72
6. YK - 23	85,29 ± 0,35	105,24 ± 0,34	32,38 ± 0,12	38,91 ± 0,10	10.48	15,46
7. YV 125/3	101,34 ± 0,36	125,37 ± 0,29	34,11 ± 0,12	42,43 ± 0,07	11.89	17,78
8. Dj № 1	68,17 ± 0,31	80,73 ± 0,27	20,73 ± 0,06	28,74 ± 0,07	4.17	6,72
9. Pobeda 2	99,72 ± 0,33	107,83 ± 0,24	39,82± 0,17	43.04 ± 0,12	13.38	15,34
$LSD_{0.05}$ =	5.42		1.81		1.59	
$_{0.01}$ =	7.55		3.47		2.25	

*Unirrigated - Ø: 2012 -12 mm (July) + 20 mm (August) = 32 mm
2013 - 11 mm (July) + 9 mm (August) = 20 mm

**Irrigated - 100 mm: 2012 - 32 mm + 100 mm = 132 mm
2013 - 20 mm + 100 mm = 120 mm

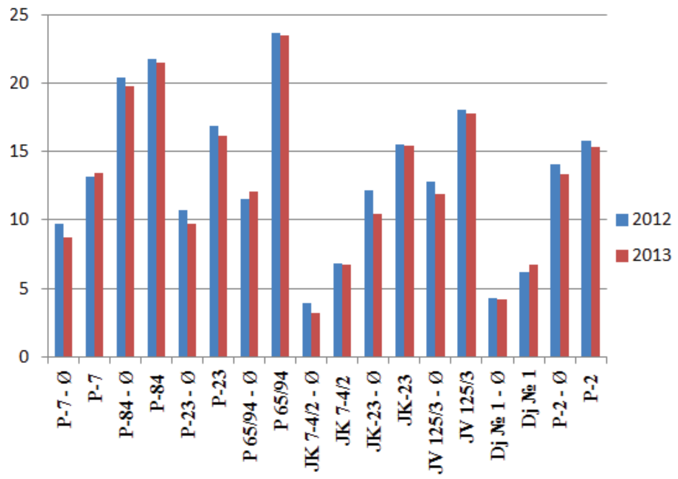

Fig. 1. Height of the stalk in various types of oriental tobacco, grown without irrigation and with irrigation in 2012 and 2013
(Legend: Ø - check variant without irrigation; Y-axis - height of the stalk with inflorescence in cm)

The highest leaf number was counted in P 65/94. In 2012 this variety had 52.2 leaves without irrigation and 59.72 leaves with irrigation, while in 2013 it reached 50.52 leaves per stalk without irrigation and 58.04 leaves with irrigation. With regard to the factor year, in 2012 this variety in both variants (unirrigated and irrigated) gave 1.68 more leaves than in 2013.
The lowest leaf number per stalk was observed in Dj № 1. In 2012 this variety had 22.41 leaves per stalk without irrigation and 30.49 leaves with irrigation, while in 2013 it reached 20.73 without irrigation and 28.74 leaves with irrigation. With regard to the factor year, in 2012 the variant without irrigation gave 1.68 leaves more than in 2013 and the variant with irrigation in 2012 gave 1.75 leaves more than in 2013.
Data presented in Table 1 and Figure 2 reveal that all varieties have a higher leaf number in the variant with irrigation. The varieties: P - 7, P - 23, P 65/94, YK - 23 and Dj № 1 in 2012 have more leaves compared to 2013. The other varieties in 2012 have lower number of leaves compared to 2013, but that difference is minimal and is caused by unknown environmental factors.

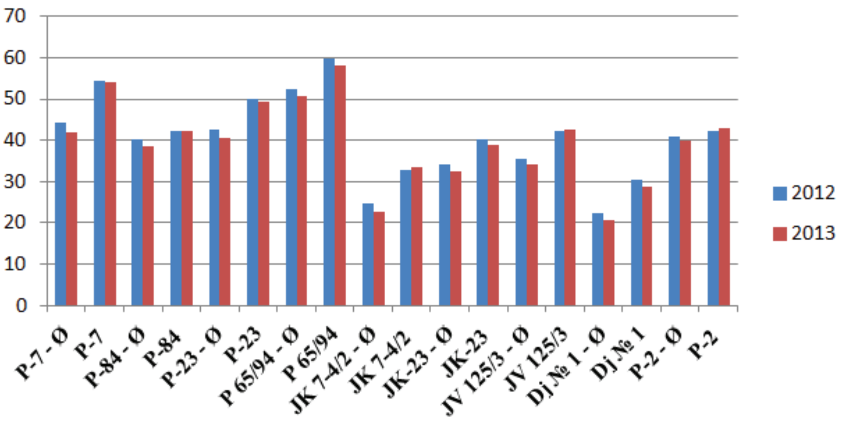

Fig. 2 Leaf number per stalk in various types of oriental tobacco, grown without irrigation and with irrigation in 2012 and 2013
(Legend: Ø - check variant without irrigation; Y-axis – leaf number per stalk)

The highest dry mass yield per stalk was recorded in P-84: in 2012 it reached 20.38 g without irrigation and 21.73 g with irrigation, while in 2013 it reached 19.81 g without irrigation and 21.51 g with irrigation. From the aspect of the factor year, the variants without irrigation in 2012 yielded 0.57 g more dry mass than in 2013, and the variant with irrigation in 2012 gave 0.22 g higher dry mass yield than in 2013.

The lowest dry mass yield per stalk was recorded in Dj № 1: in 2012 it reached 4.33 g without irrigation and 6.23 g with irrigation, while in 2013 it reached 4.17 g without irrigation and 6.72 g per stalk with irrigation. With regard to the year, the varieties without irrigation in 2012 gave 0.16 g more dry mass than in 2013 and the variant with irrigation in 2012 gave 0.11 g more dry mass yield than in 2013.

The results presented in Table 1 and Figure 3 show that all varieties have a higher dry mass yield in the variant with irrigation. All varieties in 2012 gave higher dry mass yield compared to 2013 as a result of the higher amounts of water during the growth period (with the exception of the check variant P 65/94, as well as P-7 and Dj № 1 in the variant with irrigation, which gave higher yields in 2013, as a result of unknown environmental factors).

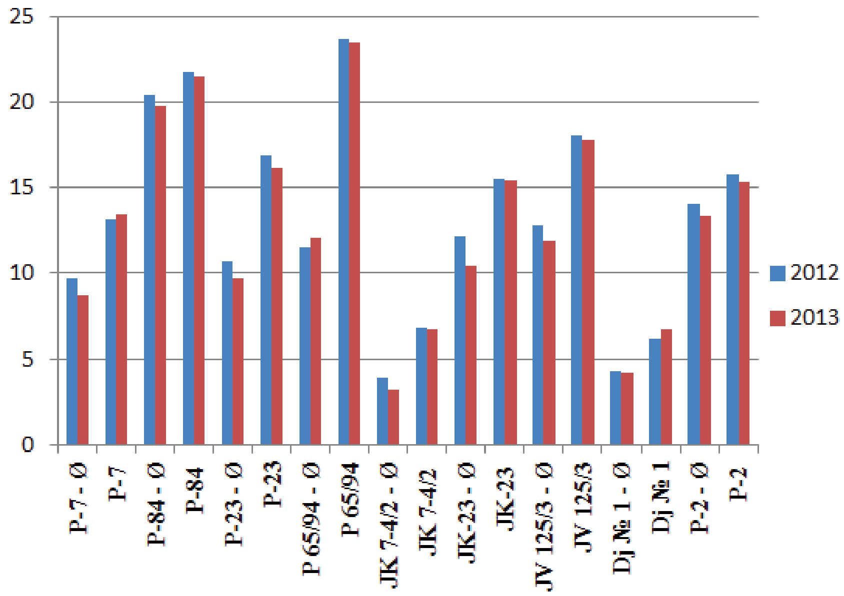

Fig. 3. Dry mass yield per stalk in various types of oriental tobacco, grown without irrigation and with irrigation in 2012 and 2013

(Legend: Ø - check variant without irrigation; Y-axis – dry mass yield of tobacco per stalk in grams)

Table 2 gives a list of varieties in both variants (unirrigated check and irrigated variant) for the three investigated traits in 2012 and 2013. The P-84 variety with its average dry mass yield per stalk is first-ranked in dry conditions, while under irrigation conditions it is second-ranked, and therefore considered tolerant to drought. Pobeda P-2 is second-ranked in dry conditions while under irrigation conditions in 2012 it was in fifth, and in 2013 sixth on the ranking list, and therefore it can be considered as tolerant to drought. This could also be deduced visually, by afternoon inspection of the trial, when the varieties in the check variant seemed fresh and with rapid growth. In making selection programs for creation of drought-resistant varieties, as well as for improving the existing commercail varieties for this trait, P-84 and P-2 can certainly be included as parental genotypes in one direction and back-cross crossing schemes.

Table 2. Ranking of quantitative traits of oriental tobaccos grown under drought and in irrigated conditions

Variety	Ranking of quantitative traits					
	Stalk height with inflorescence		Leaf number per stalk		Dry mass yield (g/stalk)	
	Unirrigated	Irrigated	Unirrigated	Irrigated	Unirrigated	Irrigated
2012						
1. P - 7	8	8	2	2	7	7
2. P - 84	6	6	5	6	1	2
3. P - 23	9	9	3	3	6	4
4. P 65/94	7	7	1	1	5	1
5. YK 7-4/2	4	4	8	8	9	8
6. YK - 23	3	3	7	7	4	6
7. YV 125/3	1	1	6	5	3	3
8. Dj № 1	5	5	9	9	8	9
9. Pobeda 2	2	2	4	4	2	5
2013						
1. P - 7	9	8	2	2	7	7
2. P - 84	6	7	5	5	1	2
3. P - 23	8	9	3	3	6	4
4. P 65/94	7	6	1	1	3	1
5. YK 7-4/2	4	4	8	8	9	8
6. YK - 23	3	3	7	7	5	5
7. YV 125/3	1	1	6	6	4	3
8. Dj № 1	5	5	9	9	8	8
9. Pobeda 2	2	2	4	4	2	6

CONCLUSIONS

The lowest height of the stalk with inflorescence in 2012 was recorded in P-23 and in 2013 in P-7 (unirrigated variant) and P-23 (irrigated variant). The lowest leaf number per stalk in the two years was recorded in Dj № 1 and the highest in P 65/94. The lowest yield was obtained with YK 7-4/2 and the highest in P 65/94 (irrigated variant).

The variety P-84 is second-ranked for dry mass yield under irrigated conditions, but first-ranked in dry conditions, and therefore it is considered as drought tolerant. Pobeda P-2 is fourth-ranked variety under irrigated conditions, but second-ranked in dry conditions and it can be also considered as drought tolerant.

P-84 and Pobeda P-2 can be used as parental genotypes in creation of hybrids from which, by successive selection, new drought tolerant varieties will be obtained. Also, they can be used in backcross breeding to improve this trait in commercial varieties susceptible to drought.

REFERENCES

1. Gubiš J., Vaňková R., Červená V., Dragúňová M., Hudcovicová M., Lichtnerová H., Jureková Z., 2007. Transformed tobacco plants with increased tolerance to drought. South African Journal of Botany, 4, 505-511. doi.org/10.1016/j.sajb.
2. Macková H., Hronková M., Dobrá J., Turečková V., Novák O., Lubovská Z., Motyka V., Haisel D., Hájek T., Prášil I.T., Gaudinová A., Štorchová H., Ge E., Werner T., Schmülling T., Vanková R., 2013. Enhanced drought and heat stress tolerance of tobacco plants with ectopically enhanced cytokinin oxidase/dehydrogenase gene expression. J Exp Bot., 10, 2805-2815. doi: 10.1093/jxb/ert131
3. McCue K.F., Hanson A.D., 1990. Drought and salt tolerance. Towards understanding and application. Trends Biotech., 8, 358-362.
4. McKay J.K., Richards J.H., Mitchell-Olds T., 2003. Genetics of drought adaptation in Arabidopsis thaliana. I. Pleiotropy contributes to genetic correlations among ecological traits. Mol. Ecol., 12, 1137-1151.
5. Medrano H., Escalona J.M., Bota, J., Gulias, J., Flexas, J., 2002. Regulation of photosinthesis of C3 plants in response to progressve drought: stomatal conductance as a reference parametar. Annals of Botany, 89, 895-905.
6. Reynolds M., Skovmand B., Trethowan R., Pfeiffer W., 1999. Evaluating a conceptual model for drought tolerance. [In: Ribaut JM (ed) Using molecular markers to improve drought tolerance.] CIMMYT, Mexico, DF, 49–53.
7. Sadeghi S.M., Samizadeh H., Amiri E., Ashouri M., Mohammadian N., 2010. An identification of drought tolerant genotypes in Virginia tobacco. Ecology, Environment and Conservation Paper, 2, 115-121.
8. Seropian C., Planchon C., 1983. Physiological responses of six bread wheat and durum wheat genotypes to water stress. Euphytica, 33, 757-767.
9. Shtereva L., Stoimenova E., Drumeva-Yoncheva M., Michailova B., Kartzeva T., Vassilevska-Ivanova R., 2017. Response of Virginia (flue-cured) tobacco genotypes to water-deficit stress. Arch Biol Sci., 1, 119-127. DOI:10.2298/ABS160202085S
10. Yang X., Liang Z., Lu C., 2005. Genetic engineering of the biosynthesis of glycinbetaine enhances photosynthesis against high temperature stress in transgenic tobacco plants. Plant Physiology, 138, 2299-2309.

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Original scientific paper

STUDY OF SOME MORPHOLOGICAL CHARACTERS OF BURLEY TOBACCO VARIETIES AND LINES

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ABSTRACT

Investigations were made in 2014 and 2015 in the field of the Scientific Tobacco Institute - Prilep with six tobacco varieties and lines in fertile and CMS form, originating from the United States, Bulgaria and Macedonia. The investigations were initiated to satisfy the needs of Macedonian manufacturers for Burley tobacco, which so far has been obtained only from imports. Results of the investigations showed that even in the region of Prilep, which is not very suitable for production of Burley tobacco, domestic male sterile hybrid lines B-209/13 CMS F1 and B-225/13 CMS F1 can be successfully cultivated in conditions of good farming practices (fertilization, irrigation, etc.). The analysis of the 5th, 10th and 15th leaf and total leaf number lead to the conclusion that these lines can give good yields and quality typical of Burley tobacco.

Keywords: tobacco, Burley, leaves, dimensions.

СТУДИЈА ЗА НЕКОИ МОРФОЛОШКИ СВОЈСТВА КАЈ СОРТИ И ЛИНИИ ОД ТИПОТ БЕРЛЕЈ

АПСТРАКТ

Истражувањата направени се во 2014 и 2015 година во кругот на Научниот Институт за тутун – Прилеп. Во опитот беа вклучени 6 сорти и линии од САД, Бугарија и Македонија во фертилна и ЦМС форма. Испитувањата беа поттикнати од потребите на македонската фабрикација за суровина од овој тип на тутун, која во моментов целосно се увезува. Резултатите од овие истражувања покажаа дека и во реонот на Прилеп, кој не важи за реон погоден за производство на типот берлеј, домашните машкостерилни хибридни линии Б-209/13 ЦМС F1 и Б-225/13 ЦМС F1 во услови на добра агротехника (ѓубрење, наводнување и др.) можат да се одгледуваат со успех. Резултатите од анализираните листови (5 ти, 10 ти и 15 ти) и вкупниот број на листови, упатуваат на заклучокот дека од овие линии можат да се очекуваат добри приноси и квалитет, карактеристични за типот берлеј.

Клучни зборови: тутун, берлеј, листови, димензии

INTRODUCTION

Burley tobacco started to spread thoughout the world after 1864, when it was first selected as a new type of Maryland broadleaf tobacco in the United States. Accordinging to Bolsunov (1957), in Europe it was first introduced in Switzerland in 1930 and therefrom spread to other countries. Gornik (1953) was the first who presented Burley tobacco in Yugoslavia, giving a detailed description of the type. In R. Macedonia, first investigations and efforts to introduce Burley tobacco were made by Uzunoski M. during 1962-1965, but humble start of production dates from the late 70ies of the last century. In the period 1992 – 2001, the average production of this tobacco was only 62.1 t and after 2001 it was completely stopped, without sound argument.

Despite this, the Scientific Tobacco Institute - Prilep continued with breeding new varieties and lines of Burley tobacco, of which four hybrid male sterile varieties have been recognized. The best among them are B 2/93 CMS F1 and Pelagonec CMS F1. Pelivanoska (1999) reported that B 2/93 CMS F1 in Ohrid and Struga region gave a good quality yield of over 6000 kg/ha, by applying adequate agricultural practices. Hristoski (2014) reported a yield of 4009 kg/ha with the variety Pelagonec CMS F1 in the field of Tobacco Institute - Prilep during 2010-2011, applying usual farming practices. Such yields are due primarily to the number of leaves and dimensions of these varieties.

Tobacco Institute has continued the investigations on Burley tobacco up to the present and the obtained results are presented in journals, meetings, symposia etc.

MATERIALS AND METHOD

Working material during the two-year investigations (2014-2015) consisted of six genotypes (varieties and lines) in fertile and CMS form: the American fertile variety Ny-71, which served as a check, and fertile varieties SA-130 (USA), B-963 (Bulgaria), line B-193/13 and the sterile hybrid lines B-209/13 CMS F1 and B-225/13 CMS F1, all three created in Tobacco Institute - Prilep. In both years of investigation, autumn ploughing was carried out to a depth of 40 cm. In spring, the soil was fertilized with 300 kg/ha NPK 8:22:20, followed by two more ploughings. Before planting, the soil was treated with herbicide, incorporated into the soil using Cambridge roller. Healthy seedlings were transplanted manually, with random distribution of varieties, in 4 replicates, at 90 × 50 cm planting density. Prior to the first and second hoeing, the stalks were nourished with 3-4 g 26% KAN. In periods of water shortage, several irrigations were applied for normal growth and development of tobacco. Reliable products were applied for protection against diseases and pests. Morphological measurements were performed on 5 stalks of each genotype included in the trial, out of which the average values were calculated. The analyzed leaves were mainly from the middle belt position (5th, 10th, 15th leaf), which accounts for 60-70% of the total leaf mass per stalk. The analyses were made on leaf length and width, stalk height in cm and total leaf number of each genotype. The obtained data (average values) were statistically processed using the method of analysis of variance and LSD test (Najcеska, 1997).

RESULTS AND DISCUSSION

Leaf length

Leaf length is a character closely associated with tobacco yield. In Burley tobacco, the longest leaves are those from the middle belt. Leaves that reach a length of 40 cm can be classified as a I class tobacco. This character is also genetically controlled and differs depending on the varieties and lines (genotypes). Data on the 5th 10th and 15th leaf length in varieties and lines included in our investigations are presented in Table 1.

Table 1. Length of the 5th, 10th and 15th leaf

Variety / Line	Year	5th leaf			10th leaf			15th leaf		
		cm	Average 2014/15	Difference in cm	cm	Average 2014/15	Difference in cm	cm	Average 2014/15	Difference in cm
	2014	43.6			53.0			49.5		
Hy-71 Ø			44.7	/		54.7	/		50.7	/
	2015	45.8			56.5			52.0		
	2014	47.5			66.5**			52.4		
B-963			48.7	+4.0		67.0	+12.3		53.6	+2.9
	2015	50.0**			67.5**			54.8		
	2014	56.3**			72.0**			56.8**		
SA-130			57.8	+13.1		74.1	+19.4		59.4	+8.7
	2015	59.3**			76.2**			62.1**		
	2014	52.9**			66.5**			57.3**		
B-197/13			53.9	+9.2		67.8	+13.1		59.0	+8.3
	2015	55.0**			69.2**			60.8**		
	2014	56.3**			68.6**			67.7**		
B-209/13 CMS F_1			57.6	+12.9		69.9	+15.2		67.8	+17.1
	2015	59.0**			71.2**			68.0**		
	2014	53.4**			73.7**			61.0**		
B-225/13 CMS F_1			54.3	+9.6		74.2	+19.5		62.1	+11.4
	2015	55.3**			74.7**			63.3**		

	5th leaf length		10th leaf length		15th leaf length	
	2014	2015	2014	2015	2014	2015
LSD	5% * = 5.45 cm	2.65 cm	5% * = 4.69 cm	2.97 cm	5% * = 4.69 cm	2.95 cm
	1% **= 7.54 cm	3.68 cm	1% ** = 6.49 cm	4.12 cm	1% ** = 6.49 cm	4.07 cm

According to the data in Table 1, the longest 5th leaf was recorded in variety SA-130 (57.8 cm) and the shortest in the check variety Hy-71 (44.7 cm). In other varieties and lines, the average length of the 5th leaf ranged from 48.7 cm in B-963 to 57.6 cm in B-209/13 CMS F1. Statistically significant differences for the 5th leaf length were obtained compared to the check. In 2014, all varieties and lines except for the variety B-963 showed significant differences at a level of 1%. In 2015 all varieties and lines achieved statistically significant differences at a level of 1%. Kocoska et al. (2016) in her investigations on Burley tobaccos in the region of Prilep during 2009-2011 revealed that the 5th leaf length ranged from 43.8 cm in the variety B-21 to 55.0 cm in variety Pelagonec. Beljo (1996) reported that leaves with a length of 41-60 cm belong to the group of medium long leaves, while those of 61-80 cm are ranked in the group of long-leaf tobaccos.

The longest 10th leaf was measured in line B-225/13 CMS F1 (74.2 cm) and the shortest in the check variety Hy-71 (54.7 cm). Length of the 10th leaf in other varieties and lines included in the trial ranged from 67.0 cm in B-963 to 74.1 cm in SA-130. In both years of investigation, all varieties and lines

achieved statistically significant difference at 1% level compared to the check. Hristoski (2014) reported that the length of the 10th leaf in Burley tobaccos in the region of Prilep ranged from 54.3 cm to 65.0 cm.
The average length of the 15th leaf ranged from 50.7 cm in the check variety Hy-71 to 67.8 cm in line B-209/13 CMS F1. In the other varieties and lines it ranged from 53.6 cm in variety B-963 to 62.1 in line B-225/13 CMS F1. Except for the variety B 963, all other varieties and lines reached statistically significant differences at 1% level compared to the check. Risteski et al. (2010) reported that the 15th leaf length in 7 varieties and lines of Burley tobacco in the region of Prilep ranged from 33.0 cm in BB-16 to 62.6 cm in Pelagonec CMS F1. Risteski (2006) found that the average leaf length of 6 varieties in the region of Prilep in the period 1999-2001 ranged from 51.0 to 62.0 cm.

Leaf width

Different values were also obtained for leaf width of the varieties and lines included in the trial. Data in Table 2 show that the highest average width of the 5th leaf was recorded in lineB-225/13 CMS F1 (39.9 cm) and the lowest in the check variety Hy-71 (32.8 cm). In the remaining varieties and lines the width of the 5th leaf ranged from 33.1 cm in line B-197/13 to 39.0 cm in variety SA-130. Statistically significant differences compared to the check were obtained for this character. Thus, in 2014, statistically significant differences at 5% level were estimated in variety SA-130, but 1% significance was obtained only in line B-209/13 CMS F1. In 2015, 1% significance was achieved in varieties B-963 and SA-130 and lines B 209/13 B F1 and CMS-225/13 CMS F1.
Hristoski (2014) reported that the width of the 5th leaf of Burley tobaccos in the region of Prilep ranged from 28.7 cm to 37.9 cm.
The highest average width of the 10th leaf was recorded in variety B-963 (45.5 cm) and the lowest in the check variety (35.9 cm). In other varieties and lines this character ranged from 36.3 cm in line B-197/13 to 44.6 cm in line B-225/13 CMS F1. In 2014, statistically significant differences at a level of 1% compared to the check were recorded in variety B-963 and lines B-209/13 CMS F1 and B-225/13 CMS F1. 5% level of significance was recorded in variety SA-130. In 2015, all varieties and lines except for the line B-197/13 achieved statistically significant difference at 1% level. Kočoska et al. (2016), in her three-year investigations on Burley tobacco varieties, reported that the average 10th leaf width ranged from 32.4 cm in B-21 to 37.2 cm in variety Pelagonec CMS F1.
The highest 15th leaf width was measured in line B-209/13 CMS F1 (35.4 cm). The lowest width of the 15th leaf was found in line B-197/13 (26.3 cm), while in other varieties and lines the width ranged from 27.1 cm in variety SA-130 to 30.3 cm in line B-225/13 CMS F1. Statistically significant differences compared to the check were recorded only in line B-209/13 CMS F1. This significance was at 5% level in 2014 and 1% level in 2015. Risteski (2006) reported that the average width of the 15th leaf in Burley tobacco varieties from the region of Prilep in the period 1999-2001 ranged from 23.2 cm in B-21 to 28.3 cm in Pelagonec CMS F1.

Table 2. Width of the 5th, 10th and 15th leaf

Variety / Line	Year	5th leaf cm	5th leaf Average 2014/15	5th leaf Difference in cm	10th leaf cm	10th leaf Average 2014/15	10th leaf Difference in cm	15th leaf cm	15th leaf Average 2014/15	15th leaf Difference in cm
Hy-71 Ø	2014	32.8	32.8	/	35.8	35.9	/	28.2	29.1	/
	2015	32.8			36.0			30.0		
B-963	2014	36.6	36.8	+4.0	45.6++	45.5	+9.6	27.5	28.3	-0.8
	2015	37.1++			45.5++			29.2		
SA-130	2014	38.8+	39.0	+6.2	41.2+	41.9	+6.0	26.3	27.1	-2.0
	2015	39.3++			42.6++			28.0		
B-197/13	2014	32.1	33.1	+0.3	36.7	36.3	-0.4	25.2	26.3	-2.8
	2015	34.2			36.0			27.5		
B-209/13 CMS F_1	2014	36.9	37.5	+4.7	42.7**	42.8	+6.9	35.3*	35.4	+6.3
	2015	38.1**			43.0**			35.5**		
B-225/13 CMS F_1	2014	39.2**	39.9	+7.1	45.2**	44.6	+8.7	29.8	30.3	+1.2
	2015	40.5**			44.0**			30.8		
		5th leaf width			10th leaf width			15th leaf width		
		2014	2015		2014	2015		2014	2015	
LSD		5% * = 4.48 cm	1.54 cm		5% * = 4.85 cm	2.81 cm		5% * = 6.05 cm	2.96 cm	
		1% **= 6.35 cm	2.14 cm		1% ** = 6.72 cm	3.89 cm		1% ** = 8.38 cm	3.17 cm	

Stalk height and leaf number

Different types of tobacco have different height of the stalk. Although this character is genetically controlled, it is significantly influenced by agro-ecological conditions, cultural practices etc. According to Beljo (1996), tobaccos with 161 - 180 cm stalk height belong to the group of moderately high tobaccos, those from 181 to 220 cm are high tobaccos and above 220 cm - very high tobaccos.

Just like stalk height, the number of leaves is genetically controlled character, but it is highly affected by agro-ecological conditions, applied cultural practices, etc. The yield of various tobacco varieties is also closely related with this character. Uzunoski (1985) reported that leaf number in different types and varieties varies from 10 to 70 and more. Hows (1978) found that some varieties have over 30 leaves more than the standard varieties. The author explains this phenomenon as genetic process related to day length. Results on stalk height and leaf number are presented in Table 3.

Table 3. Stalk height with inflorescence and Leaf number per stalk

Variety	Year	Stalk height with inflorescence, cm	Average 2014/15	Absolute differences from the average	Range	Leaf number	Average 2014/2015	Abs. differences from the average	Range
Hy-71 Ø	2014	183	180	/	5	24.0	24.3	/	3
	2015	178				24.6			
B-963	2014	196	192	+12.0	4	22.0	22.5	-1.8	4
	2015	188				23.0			
SA-130	2014	170	166	-14.0	6	20.3	21.4	-2.9	6
	2015	163				22.6			
B-197/13	2014	205	200	+20.0	3	21.7	22.3	-2.0	5
	2015	196*				23.0			
B-209/13 CMS F_1	2014	266**	249	+69.0	1	25.3*	25.6	+1.3	2
	2015	233**				26.0*			
B-225/13 CMS F_1	2014	255**	240	+60.0	2	28.0**	29.0	+4.7	1
	2015	225**				30.0**			

	Stalk height			Leaf number	
	2014	2015		2014	2015
LSD	5 % * = 24.04 cm	5 % * = 13.72 cm	LSD	5 % * = 1.25 leaves	5 % * = 1.02 leaves
	1 % ** = 33.29 cm	1 % ** = 19.00 cm		1 % **=1.73 leaves	1 % ** = 1.42 leaves

According to the data above, the highest stalk height (249 cm) was measured in line B-209/13 CMS F1 (249 cm) and the lowest in variety SA-130 (166 cm). The average stalk height in the check variety was 180 cm and in other varieties and lines it ranged from 192 cm in variety B-963 to 240 cm in line B-225/13 CMS F1. Statistically significant differences compared to the check were recorded in lines B-197/13, B-209/13 CMS F1 and B-225/13 CMS F1. In 2014 and 2015, lines B-209/13 CMS F1 and B-225/13 CMS F1 showed statistically significant differences at 1% level, while in 2015 the line B-197/13 had 5% significance.

Dulgerski (2004), in his investigations with 8 varieties and lines of Burley tobacco in the period 2002/2003 in Bulgaria reported an average stalk height ranging from 151.6 cm in L-1344 to 202.3 cm in L-1362. Risteski (2006) found that stalk height of the Burley varieties grown in the region of Prilep in 1999-2001 ranged from 156 to 189 cm. Stojanov and Apostolova (1999) reported that stalk height of the newly created variety B-1317 was 158 cm.

Table 3 also shows that leaf number in varieties and lines included in the trial ranged from 21.4 in variety SA-130 to 29.0 in line B-225/13 CMS F1, compared to the check Hy-71 where this number was 24.3. In other varieties this character ranged from 22.3 in B-197/13 to 25.6 in B-209/13 CMS F1. Statistically significant differences compared to the check were recorded only in lines B-209/13 CMS F1 and B-225/13 CMS F1 and in both years they were at a level of 1%. In line B-209/13 CMS F1, statistically significant differences were recorded only at a level of 5%. Dulgerski et al. (2015) tested 5 Burley varieties in Bulgaria and reported that the number of leaves ranged from 25.2 in variety B-21 to 31.5 in line-1334. Kocoska et al. (2016) reported that umber of leaves in the investigated Burley tobacco varieties in the region of Prilep (2009/2011) ranged from 26.9 in B-21 to 32.7 in Pelagonec CMS F1. Hristoski (2014) found that the average leaf number per stalk in three Burley varieties in the region of Prilep ranged from 26.8 to 32.5.

CONCLUSIONS

- The highest average length of the 5th leaf was recorded in variety SA-130 (57.8 cm) and the lowest in the check variety Hy-71 (44.7 cm).
- The highest average length of the 10th leaf was measured in line B-225/13 CMS F1 (74.2 cm) and the lowest in the check variety (54.7 cm).
- The highest length of the 15th leaf was reported in line B-209/13 CMS F1(67.8 cm) and the lowest in the check variety (50.7 cm).
- The highest width of the 5th leaf was measured in line B-225/13 CMS F1 (39.9 cm) and the lowest in the check variety Hy-71 (32.8).
- Variety B-963 has the highest average width of the 10th leaf (45.5 cm) and the check variety Hy-71 has the lowest width (35.9 cm).
- The highest average width of the 15th leaf was measured in line B 209/13 CMS F1(35.4 cm) and the lowest in line B-197/13(26.3 cm).
- The highest average height of the stalk was recorded in line B-209/13 CMS F1 (249 cm) and the lowest in variety SA-130 (166 cm).
- The average number of leaves was the highest in line B-225/13 CMS F1 (29.0) and the lowest in variety SA-130 (21.4).
- The morphological measurements lead to a conclusion that, in most of the characters, lines B-209/13 CMS F1 and B-225/13 CMS F1 dominate over the other varieties.

REFERENCES

1. 1. Beljo J., 1992. Oplemenjivanje duhana – dostignuća i izazovi. Tutun-Tobacco, 7-12, 179-190, Institut za tutun-Prilep.
2. Beljo J., 1996. Postupak za identifikaciju kultivara duhana. Izvješče o znanstvenom i stručnom radu u 1994, 21, 55-67, Duhanski institut Zagreb.
3. Bolsunov I., 1957. Oplemenjivanle duhana u evropskim zamljama. Tutun, 5, 227-235. Institut za tutun-Prilep.
4. Dulgerski J., 2004. Rezultati od konkursnoto ispitavane na sortove tjutjun tip berlejy. Jubiley na naucna konferencija s mezdunarodno ucastie, 60 god. ITTI-Plovdiv, Book of proceedings, 142-147.
5. Dulgerski J., Kirkova S., 2015. Perspective line of burley tobacco variety - line 1334. Tutun/Tobacco, 1-6, 16-22, Scientific Tobacco Institute-Prilep.
6. Gornik R., 1953. Proizvodnja duhana tipa burlej. Duhanski institut-Zagreb.
7. Hawks S. N. Ir., 1978. Osnovi proizvodnje virginiskog duhana. TIPP -Ognjen Prica-Virovitica, Zagrb.
8. Hristoski Z., 2014. Proucuvanje na proizvodnite svojstva na surovinata od nekoi sorti od tipot berlej so poseben osvrt na kvalitetnite svojstva nositeli na upotrebnata vrednost na surovinata (doktorska disertacija). Naucen institut za tutun-Prilep.

9. Kocoska K., Risteski I., 2016. Results of investigation on some bio morphological traits of burley tobacco varieties. VII International Scientific Agricultural Symposium "Agrosym 2016" Jahorina. Book of proceedings, 580-586.
10. Najceska C., 1997. Selekcija na rastenijata so semeproizvodstvo (praktikum). Zemjodelski fakultet-Skopje.
11. Naumovski K., Boceski D., Grdanoski M., Karajankov S., Ackoski B., 1977. Sovremeno proizvodstvo na tutun, NIK-Nasa Kniga-Prilep.
12. Pelivanoska V., 1999. Vlijanie na navodnuvanjeto i mineralnata ishrana vrz prinosot i kvalitetot na tutunot od tipot berlej (doktorska disertacija). Naucen institut za tutun-Prilep.
13. Risteski I., 2006. Sortnata struktura, nacinot na berbata I susenjeto, neophoden factor za podobruvanje na kvalitetot I zgolemuvanje na proizvodstvoto od tipot berlej vo Republika Makedonija (doktorska disertacija). Naucen institut za tutun-Prilep.
14. Risteski I., Kocoska K., Hristoski Z., 2010. Morphological properties of some domestic and introduced burley tobacco varieties (lines) in agroecological conditions of Prilep. Тутун / Tobacco, 7-12, 71-78, Scientific Tobacco Institute-Prilep.
15. Stojanov B., Apostolova E., 1999. Nov sort Brlej 1317. Blgarski tjutjun, 4-6, 15-17.
16. Uzunoski M., 1985. Proizvodstvo na tutun. НУБ ,, Кл. Охридски ” Skopje.

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Original scientific paper

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 ($S\bar{x}$), 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 ($S\bar{x}$), 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 варијациониот 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	$\overline{x}$	$S\overline{x}$	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

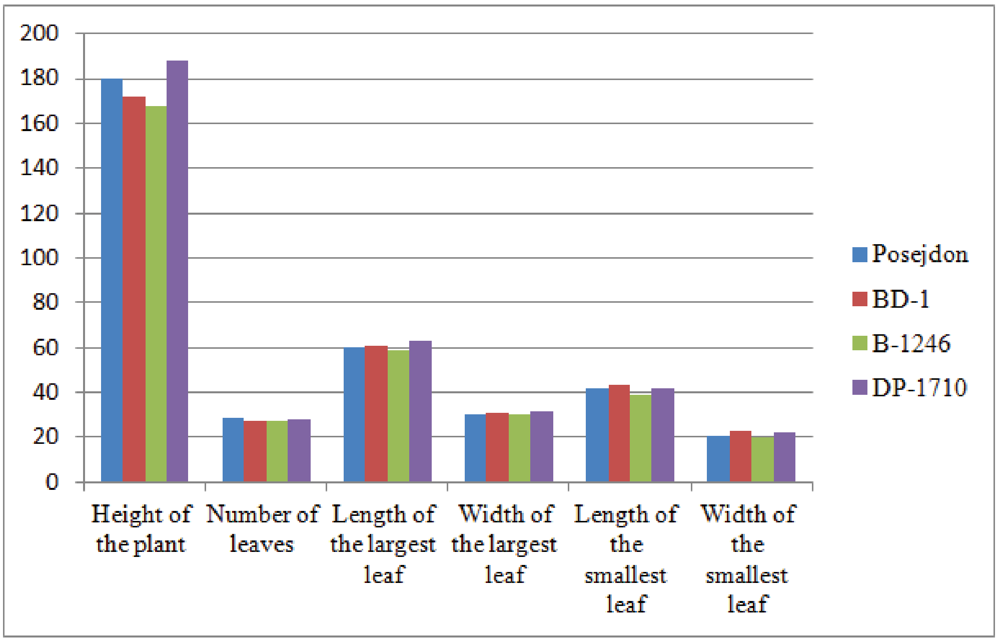
The width of the smallest leaf of the middle belt, along with the length, has an impact on the overall yield and quality of the raw tobacco material from type Burley. The variability of this property is shown by the statistical parameters in Table 6.

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.

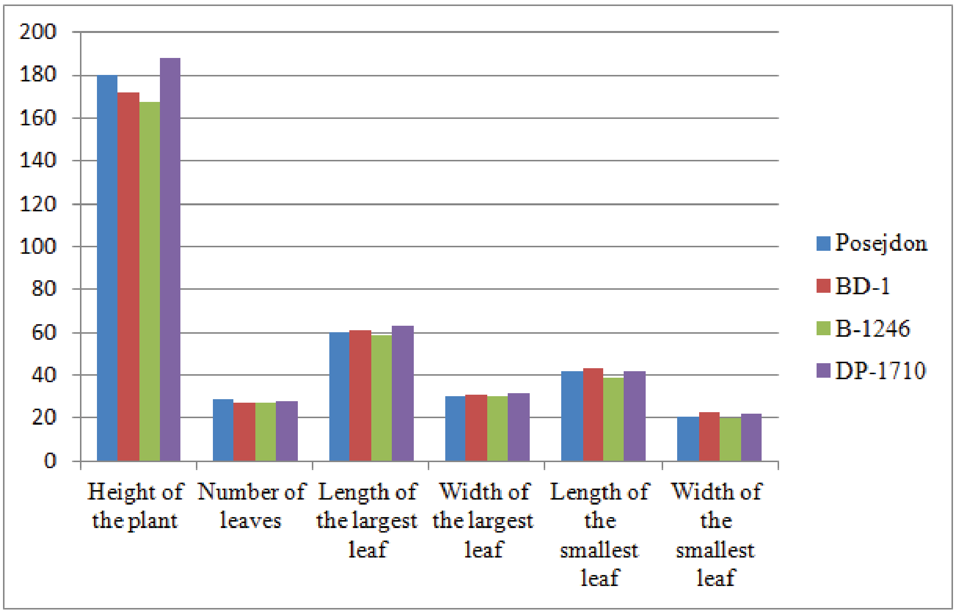
Table 6. Width of the smallest leaf per plant from the middle belt (cm)

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 (x̄ = 188 cm, 2015), and the lowest is the variety B-1246 (x̄ = 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 (x̄ = 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 (x̄ = 63 cm).

Measurements have shown that the broadest leaves in the middle belt of plants has the line DP-1710 (x̄ = 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.

REFERENCES

1. Atanasov, D., 1972. Tobacco Production. ITTI Plovdiv.
2. Boceski, D., 2003. Knowledge and processing of tobacco raw material. Institute for Tobacco - Prilep, II supplemented edition, pp. 210.
3. Devčić, K., Triplat, J., Benković, F., 1984. Sorte Burley Selected at the Tobacco Institute of Zagreb. Tutun/Tobacco, No. 1-2, pp. 3-10.
4. Dyulgerski, Y., 2016. Assessment of biological indicators and production characteristics of perspective lines burley tobacco. Tobacco/Tobacco, 1-6, pp. 13-21.
5. Mickovski, J., 2004. Tobacco in the Republic of Macedonia. Society for Science and Art - Prilep, pp. 162.
6. Najcevska, C., 2002. Experimental statistics applied in agricultural and biological research. Book publishing house Bona-Skopje, pp. 49-71.
7. Risteski, I., Kochoska, K., Hristoski, Zh., 2007. Results of examinations of some foreign and newly created domestic Burley varieties of tobacco in CMS and fertile form. Tobacco / Tobacco, No. 9-10, pp. 200-208.
8. Risteski, I., Kochoska, K., 2013. Results of Comparative Experiment with Berleian Varieties of Tobacco. Report on the Project Tasks of the Scientific Research Work in 2011, University "St. Kliment Ohridski "- Bitola, Scientific Institute for Tobacco - Prilep, pp. 20-24.
9. Uzunoski, M., 1985. Tobacco production. Economic newspaper - Skopje, pp. 96

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PRODUCTION CHARACTERISTICS AND CHEMICAL INDICATORS OF PERSPECTIVE LINES OF BURLEY TOBACCO

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ABSTRACT

Production characteristics and chemical indicators of seven samples of Burley tobacco, including six newly created lines and the standard variety Pliska were studied. Research results show that Line 1546 gave the highest yield per hectare over the three year- investigation. This line yields the highest percentage of first class and lowest percentage of third class. All newly created lines surpassed the standard variety in yield and in percentage of high classes. Line 1546 and Line 1543 may be defined as relatively high-yielding and high-quality tobaccos. The chemical composition of the abovementioned lines is strongly affected by environmental conditions. The most balanced chemical composition during the investigated period was found in Line 1546. Relatively favorable chemical composition was also recorded in Line 1543 and Line 1538. The final evaluation of production and chemical characteristics shows that all newly created lines are superior to the standard Pliska variety, which is an indication of a successfull selection work. By the complex of production and chemical characteristics, the most prominent was Line 1546 and therefore it can be recommended for testing in production and submitted for recognition as a new variety of Burley tobacco.

Keywords: Burley tobacco, newly created lines, production characteristics, chemical indicators

ПРОИЗВОДНИ КАРАКТЕРИСТИКИ И ХЕМИСКИ СВОЈСТВА НА НЕКОИ ПЕРСПЕКТИВНИ ЛИНИИ ТУТУН ОД ТИПОТ БЕРЛЕЈ

АПСТРАКТ

Испитувани се економските и хемиските својства на седум берлејски тутуни, меѓу кои шест новосоздадени линии и стандардната сорта Плиска. Резултатите од истражувањето покажуваат дека линијата 1546 дава највисок принос по хектар, во просек за време на истражуваниот период и за трите години на истраживање. Од оваа линија се доби највисок процент на прва и најнизок процент на трета класа. Сите новосоздадени линии су супериорни над стандардните варијанти, како во поглед на приносот така и во процентот на високи класи. Линиите 1546 и 1543 можат да се дефинираат као релативно високоприносни и висококвалитетни. Хемискиот состав на проучуваните линии е под силно влијание на природните услови. Во истиот период, со најповолен хемиски состав се одликува линијата 1546. Релативно поволен хемиски состав имаат и линиите 1543 и 1538. Конечната оценка на економските и хемиските својства покажува дека сите новосоздадени линии ја надминуваат стандардната сорта Плиска, што укажува на успешна селекциона работа. По своите економски и хемиски параметри, најистакната е линијата 1546 и затоа може да се понуди за тестирање и за признавање како нова сорта тутун од типот берлеј.

Клучни зборови: берлејски тутун, новосоздадени линии, производни и хемиски својства

INTRODUCTION

Bulgaria is traditional producer of oriental tobaccos, but the production of large leaf tobaccos has also significantly increased in the last few years (Dyulgerski, 2011) and in 2015 they accounted for over 40% of the total tobacco production in Bulgaria. Along with Virginia tobacco, Burley tobacco is representative of the large leaf tobaccos in the country (Bozukov, 2012).
Although Burley tobacco has good prospects in Bulgaria, the yield and quality of the domestic raw material is rather inferior to that in the traditional producing countries (Bozukov, 2012). The main reasons for this are the old varieties in production (Dimanov and Masheva, 2011). The currently implemented Burley varieties are outdated and do not meet the new requirements of farmers and manufacturers (Dyulgerski, 2011).
The raw material of Burley tobacco produced in the country can be defined as intermediate (Davis and Nielsen, 1999; Popova et all, 2006). Imported tobacco usually outperforms the local tobaccos in most of the indicators (Docheva and Stoilova, 2011; Milanova et al., 2013). Their main disadvantages are: low nicotine content – 1.5 - 2%, high content of soluble sugars - over 0.7%, high level of chlorine and ammonia and disbalance of important chemical components (Nikolov, et al., 2004; Stoilova and Bojinova, 2007).
The lack of high-quality varieties is the main reason for the unenviable situation of the large leaf tobacco in Bulgaria, which prevents the country to have a competitive manufacturer in the international market (Bozukov, 2012; Dimanov and Masheva, 2011; Dyulgerski, 2011).
It is therefore imperative to carry out large-scale selection-research creation and implementation process of highly efficient new varieties (Dyulgerski, 2011; Dimitrieski et al., 2006; Palmer et al, 2007; Pearce et al., 2014). This is the way to maintain production of Burley tobacco in Bulgaria.
The aim of this investigation is to evaluate the production characteristics and the most important chemical indicators of some new Burley lines and the possibilities for their use in selection programs, as well as possible submission of the best of them for production testing and recognition as new varieties of Burley tobacco.

MATERIAL AND METHODS

For achievement of the defined goal, in the period 2012 - 2014 seven samples of Burley tobacco were tested in the experimental field of Tobacco and tobacco products Institute (TTPI) - Markovo (Line 1505, Line 1510, Line 1529, Line 1538, Line 1543, Line 1546 and Pliska 2002 variety used as a standard). Subject of our research and analysis were some most important economic (yield per hectare and percentage of first, second and third class) and chemical parameters (percentage of nicotine, soluble sugars, total nitrogen, ashes and ammonia) of Burley tobacco. The following procedures were applied for the chemical analysis:
- Nicotine, % (ISO 15152, 2003);
- Soluble sugars, % - (ISO 15154, 2003);
- Total nitrogen, % (BDS 15836, 1988);
- Ashes, % (ISO / FDIS 2817, 1999)
- Ammonia, % (BDS 15836, 1988).

Uniform cultural practices were applied in all variants. The harvesting of tobacco was performed on whole plants and the air drying was performed in curing barns of the Institute. Field trials were set up according to the methodology of Zapryanov and Dimova (1995).
Statistical analysis of the data is made using Statistical Package SPSS 20. Experimental data were processed by the analysis of variance (Anova) and differences between pairs of means using Dunkan’s multiple range test (1995). The tested variants were compared both among each other and with the variety Pliska 2002 used as a standard for Burley tobacco from 2010.

RESULTS AND DISCUSSION

I. Production characteristics

1. Yield

The highest yield per hectare in 2012 was obtained in Line 1546, followed with proven difference by Line 1543 (Table 1). The lowest yield was obtained in the standard variety Pliska, which is in the same group with Line 1505. In 2013 again, the highest yield was obtained in Line 1546, followed by Line 1543. The lowest yield was obtained in the standard variety Pliska. In this year all tested variants gave the lowest yield among the three years of investigation. In 2014 the highest yield was obtained in Line 1546, followed by Line 1543. Again, the lowest yield was obtained in the check variety Pliska, followed by Line 1505. During this year all lines gave the highest yield among the three years of investigation. According to the results, the tested variants show stability in terms of yield over the years.

During the period of investigation, Line 1546 gives the highest average yield per hectare (Table 1). With proven difference, its results are superior to those of the next in ranking - Line 1543. Line 1546 is the only option that allows more than 3500 kg/hectare. The yield of the Line 1546 outperforms the standard variety by almost 37%, and the next Line 1537 by 28%. The lowest yield was recorded in the standard variety Pliska 2002 (Table 1) and Line 1505 outperforms it slightly, with unproven difference.

Results of Line 1543 and especially Line 1546 can be defined as favorable in terms of yield and these two lines can be defined as relatively high-yielding.

All newly created lines gave better yields compared to the standard variety. This is an indication of successful selection work on this most important agronomic character. Although Line 1510, Line 1529 and Line 1538 exceed the yield of the standard variety by more than 10%, their results do not fully satisfy the requirements of Burley tobacco with regard to this character.

2. Percentage of classes

In terms of percentage of classes, a strong influence was observed of the factor - year (Table 1). Significant differences between variants were recorded during the three years of investigation, but the most favourable results were obtained in 2013 and the most unfavourable in 2014. Exception from this is the check variety Pliska, which gaves the best results in 2014 and worst in 2013.

In the three years of investigation, the highest percentage of first class and the lowest percentage of third class was recorded in Line 1546. In this line there was even no third class in 2013 and 2014, while Line 1543 was the second in rank, with small difference from the first class. In the three years of investigation, the lowest percentage of first class and highest percentage of third class was obtained in the standard variety Pliska.

In average, the highest percentage of first class was obtained in Line 1546 - 44% (Table 1). This line shows stability in percentage of classes through all three years of investigation and it also has the lowest percentage of third class - only 1%.

The second in rank, with only a small difference from the first, was Line 1543 with 41% of first class. This line also gave a very low percentage of third class (Table 1). Line 1546 and Line 1543 can be defined as relatively high-quality tobaccos.

The standard variety Pliska 2002 gave the lowest percentage of first class compared to all tested variants. Only in this variety the percentage of third class was equal to that of the first class (Table 3). Line 1529 showed somewhat better results with regard to this character but it is still very close to the standard variety and therefore it can be considered as unsatisfactory.

All the variants gave significantly higher percentage of first-class than the standard variety. The results for this character can be considered satisfactory as a whole, because in all variants the percentage of second class exceeds that of the first (Table 1).

Line 1546 and Line 1543 can be defined as relatively high-yielding and high-quality tobaccos. In relation to the economic characteristics, they deserve the highest rating.

All newly created lines strongly outperform the standard variety, both in terms of yield and in percentage of classes. This indicates that the selection work on the improvement of production characteristics has achieved its goals.

Table 1. Production characteristics of tested variants by years and the average for the period of study

Variety/Line	Yield kg/ha	Percentage compared to standard variety Pliska	Classes %		
			I	II	III
		2012			
Pliska	2584d	100	14	74	12
Line1505	2653d	103	18	74	8
Line 1510	3134c	121	29	68	3
Line 1529	3147c	122	18	76	6
Line 1538	3072c	119	26	69	5
Line 1543	3361b	130	41	57	2
Line 1546	3566a	138	44	56	-
GD5%	186				
		2013			
Pliska	2527e	100	10	73	17
Line1505	2611d	103	26	69	5
Line 1510	3106c	123	34	63	3
Line 1529	3081c	122	21	73	6
Line 1538	2978c	118	32	66	2
Line 1543	3273b	130	45	55	-
Line 1546	3482a	138	48	52	-
GD5%	162				
		2014			
Pliska	2724f	100	18	70	12
Line1505	2751f	101	20	70	10
Line 1510	3317c	122	23	65	12
Line 1529	3274d	120	17	70	13
Line 1538	3162e	116	33	59	8
Line 1543	3403b	125	37	57	6
Line 1546	3686a	135	40	56	4
GD5%	42				
		Average for the period of study			
Pliska	2612d	100	14	72	14
Line1505	2672d	102	21	72	7
Line 1510	3186bc	122	29	65	6
Line 1529	3167c	121	19	69	12
Line 1538	3071c	118	27	68	5
Line 1543	3345b	128	41	56	3
Line 1546	3578a	137	44	55	1
GD5%	151				

II. Chemical indicators

In terms of chemical composition, strong influence was observed of the factor year (Table 2). In 2012 the most favorable chemical composition was obtained in Line 1546, which had the highest content of nicotine and total nitrogen and the lowest content of sugars and ammonia. Relatively favorable chemical characteristics were observed in Line 1543. In other variants, results regarding chemical characteristics are, on the whole, satisfactory.

In 2013 the results were similar to those of 2012. Again, the most favorable characteristics were obtained in Line 1546, followed by Line 1543 and, in average, the best chemical characteristics were obtained in most of the variants.

In 2014, there were significant differences regarding the chemical composition compared to the previous two years. In all variants the percentage of nicotine was significantly lower, which is unfavorable indicator. Significantly higher percentage of ammonia and lower percentage of ashes was recorded, which is also unfavorable. The percentage of total nitrogenwas also lower, but there the difference was not so significant. Only the low percentage of soluble sugars, except in Line 1529, can be considered as positive feature. In general, the chemical composition in 2014 was rather unfavorable in all studied variants. This indicates that the chemical composition of all tested lines was strongly affected by environmental factors.

In average, the highest and most favorable nicotine content over the three-year investigation was achieved in Line 1546, with a proven difference (Table 2). This tobacco does not exceed 3% nicotine and it should be considered as satisfactory. The results for Line 1543 and Line 1538 are also satisfactory since they gave 2.5% nicotine in the tested samples. Line 1543 and Line 1538 are ranked second and third, with only negligible differences between them.

The lowest nicotine content was measured in the standard variety Pliska and Line 1529 is above it, with only a slight difference. The nicotine content in these two variants is below 2%. The other variants occupy an intermediate position.

The highest and at the same time the most unfavorable content of sugars in this period was found in the standard variety Pliska. Very close to this result was Line 1529. The lowest and most desirable from a consumer perspective was the sugar content of Line 1546, followed by minimal and unproven difference by Line 1543.

In total nitrogen content, all the variants satisfy the requirements for Burley tobacco, but once again the best results were recorded in Line 1456. This also applies to the content of ashes and ammonia.

In general, the most unfavorable chemical composition was recorded in the check variety Pliska and in Line 1529, while the most balanced one – in Line 1546. Due to the low content of nicotine, however, the end result for this line should be considered as relatively favorable, but not fully satisfying the criteria of Burley tobacco. Relatively good chemical composition was also recorded in Line 1543 and Line 1538. Line 1510 occupies an intermediate position.

The complex assessment of economic and chemical characters shows that all newly selected lines are superior to the standard variety Pliska. This is an indication of properly performed selection work. Line 1543 and especially Line 1546 appeared to be variants with the highest economic and breeding value.

Because of the high and stable yield per hectare, satisfactory percentage of first class and relatively balanced chemical composition, Line 1546 can be submitted to the IASAS (Executive agency for variety testing, field Inspection and seed control) for recognition as a new variety.

Table 2. Chemical indicators of studied variants by years and average for the period of study

Variety/Line	Nicotine %	Soluble sugars %	Total nitrogen %	Ashes %	Ammonia %
			2012		
Pliska	2.27±0.05	0.98±0.03	3.53±0.07	16.24±0.24	0.38±0.007
Line1505	2.34±0.05	0.95±0.03	3.60±0.07	17.21±0.25	0.36±0.007
Line 1510	2.23±0.05	0.83±0.02	3.44±0.07	16.56±0.24	0.35±0.007
Line 1529	2.14±0.05	0.80±0.02	3.38±0.07	18.43±0.27	0.33±0.007
Line 1538	2.41±0.06	0.76±0.02	3.69±0.07	17.18±0.25	0.34±0.007
Line 1543	2.68 ±0.06	0.69±0.02	3.75±0,07	16.83±0.24	0.31±0.007
Line 1546	3.07±0.07	0.67±0.02	3.94±0.07	17.43±0.25	0.28±0.005
			2013		
Pliska	2.04±0.04	0,93±0.02	3.14±0.07	16.42±0.24	0.36±0.007
Line1505	2.28±0.05	0.84±0.02	3.31±0.07	17.54±0.25	0.34±0.007
Line 1510	2.40±0.06	0.86±0.02	3.19±0.07	16.98±0.24	0.37±0.007
Line 1529	2.36±0.05	0.87±0.02	3.54±0.07	17.96±0.25	0.36±0.007
Line 1538	2.62±0.06	0.81±0.02	3.63±0.07	16.30±0.24	0.33±0.007
Line 1543	2.87±0.07	0.74±0.02	3.58±0.07	16.34±0.24	0.30±0.006
Line 1546	3.35±0.08	0.72±0.02	3.78±0.07	17.71±0.25	0.27±0.005
			2014		
Pliska	1.59±0.03	0.78±0.02	3.32±0.07	14.44±0.21	0.56±0.01
Line1505	1.99±0.04	0.40±0.01	3.43±0,07	15.60±0.23	0.46±0.009
Line 1510	1.51±0.03	0.42±0.01	3.31±0.07	14.38±0.21	0.61±0.01
Line 1529	1.42±0.03	0.96±0.03	3.45±0.07	15.38±0.23	0.54±0.01
Line 1538	2.74±0.06	0.84±0.02	3.74±0.07	14.65±0.21	0.69±0.01
Line 1543	2.34±0.05	0.56±0.01	3.51±0.07	13.77±0.20	0.40±0.008
Line 1546	2.23±0.05	0.45±0.01	3.52±0.07	14.54±0.21	0.37±0.007
			Average for the period of study		
Pliska	1.93^{b}	0.90^{a}	3.33^{c}	15.70^{a}	0.43^{a}
Line1505	2.20^{ab}	0.73^{a}	3.41^{bc}	16.78^{a}	0.39^{a}
Line 1510	2.07^{b}	0.70^{a}	3.31^{c}	15.97^{a}	0.44^{a}
Line 1529	1.97^{b}	0.88^{a}	3.46^{bc}	17.26^{a}	0.41^{a}
Line 1538	2.59^{ab}	0.80^{a}	3.69^{ab}	16.04^{a}	0.45^{a}
Line 1543	2.63^{ab}	0.66^{a}	3.61^{ab}	15.65^{a}	0.34^{a}
Line 1546	2.88^{a}	0.61^{a}	3.75^{a}	16.56^{a}	0.31^{a}
GD5%	0.69	0.94	0.26	2.55	0.21

CONCLUSION

Line 1546 gives the highest yield per hectare in average for the period of investigation and it also yields the highest percentage of first class. All newly created lines highly outperform the results of the standard variety both in terms of production and in percentage of classes. This is an indication of a successful selection work.

Chemical composition of the tested variants is strongly affected by environmental factors. The most balanced chemical composition in average for the period of investigation was recorded in Line 1546.

Line 1546 and Line 1543 stand out as variants with the highest economic and selection value.

Line 1546 has the most favorable economic and chemical characters and can be submitted for production testing and recognition as a new variety of Burley tobacco.

REFERENCES

1. Bozukov Ch., 2012. Situation and Prospects of tobacco in Bulgaria. Report-presentation of the First Agricultural Business Forum "Challenges, Opportunities and Prospects for the sector," hotel "Hilton", Sofia, 27.09.2012.
2. Davis L., M. Nielsen., 1999. Tobacco: Production, Chemistry and Technology, Blackwell Science, Oxford, UK.
3. Dimanov D., Masheva V., 2011. New varieties of oriental tobaccos of groups Basma, Bulgarian tobacco, number 6, 23-27.
4. Dimitrieski M., Miceska G., Risteski I., Kososka K., 2006. Variability of chemical composition in semi-oriental tobacco type otlia depending on the variety and the way of growing, Tobacco, Vol 56, № 5-6, 92-98.
5. Docheva M., Stoilova A., 2011. Gas chromatographic determination of nicotine and water condensate of smoke, Bulgarian tobacco, issue 5, 18-20.
6. Dunkan V., 1995. Multiple – range and multiple F – test Biometrics.
7. Dyulgerski Y., 2011. Selection and genetic research of Burley tobacco, Thesis.
8. Milanova T., Kirkova S., Srbinoska M., Alexieva P., 2013. Studies on RIP - papers, conference with international participation, HT-SUB, X, 168-172.
9. Nikolov E., Masheva V., Hristeva Tz., 2004. Assessment of value in the selection of varieties of tobacco from East Balkan origins and Tekne, Genetic analysis of the content of sugars in the raw tobacco Stara Zagora. S.2, CH.2, 245-249.
10. Nikolov E., Masheva V., Hristeva Tz., 2004. Assessment of value in the selection of varieties of tobacco from East Balkan origins and Tekne, Genetic analysis of the content of nicotine in the raw tobacco, Stara Zagora. S.2, CH.2, 250-253.
11. Palmer G., Pearce B., Bailey A., 2007. Selecting Burley Tobacco Varieties for Variety Descriptions, 9 – 11.
12. Pearce B., Denton P., Bailey A., Miller B., 2014. Selecting Burley tobacco Varieties, Tobacco production guide, Kentucky and Tennessee, 5-8.
13. Popova V., Drachev D., Nicolova V., 2006. Investigation on the burning properties of Burley tobacco grown in different regions of Bulgaria, Tobacco. Vol. 56, № 7 – 8, 159 – 164.
14. Snell. W., 2006. Estimating the value of Burley Tobacco Quota. Departament of Agricultural Economics, University of Kentucky, 1-4.
15. Stoilova D., Bojinova R., 2007. Accumulation of nicotine and other nitrogen-containing substances in Burley tobacco, Agricultural University - Plovdiv, Scientific Works, Volume LII, Agri 2007,19-22.
16. Zapryanov H., Dimova D., 1995. Manual exercise in experimental work with biometrics, Zemizdat.

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FUNGICIDAL AND STIMULATING EFFECT OF BIOPREPARATION TRIANUM P ON TOBACCO SEEDLINGS

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ABSTRACT

Fungi of the genus Trichoderma are biological control agents applied in the control of pathogens, but they are also multifunctional and have a stimulating effect on root and plant growth.
Trianum P is biopreparation which active ingredient are living spores of Trichoderma harzianum T22.
The aim of this study was to determine the effect of this preparation on tobacco seedling, the most effective model of application and the possibility of its application in the standard mode of planting.
The highest effectiveness in the control of damping off disease in tobacco seedling was recorded in variants where the seed was treated, with and without herbicide application.
The highest stimulating effect of Trianum P on tobacco seedling was recorded in the variant where the seed was stored in suspension of the preparation and two additional treatments, characterized by the highest total length and root length.
Trianum P with its fungicidal and stimulating effect on tobacco seedling has a good perspective in the sustainable production of tobacco.
Keywords: Trianum P, damping off disease, fungicide effect, development, stimulating effect

ФУНГИЦИДНО И СТИМУЛАТИВНО ДЕЈСТВО НА БИОПРЕПАРАТОТ TRIANUM P ВРЗ ТУТУНСКИОТ РАСАД

Габите од родот Trichoderma се биоконтролни агенси кои имаат значајна примена во биолошката борба, но исто така се карактеризираат со мултифункциско дејство и дејствуваат стимулативно врз развојот на коренот и растението.
Trianum P е биопрепарат чија активна материја се живи спори од Trichoderma harzianum T22.
Целта на ова истражување е да се утврди влијанието на препаратот врз тутунскиот расад, најефикасниот модел на апликација и можноста за примена при стандарднен начин на сеидба.
Најдобра ефикасност во контролата на болеста сечење кај тутунскиот расад покажаа варијантите со третирано семе, со и без употреба на хербицид.
Стимулативното дејство на Trianum P врз тутунскиот расад е најизразено кај варијантата каде семето е чувано во суспензија од препаратот и два дополнителни третмани, што се карактеризира со најголема вкупна должина и должината на коренот.
Биопрепаратот Trianum P со своето фунгицидно и стимулативно дејство врз тутунскиот расад има добра перспектива во одржливото производство на тутун.
Клучни зборови: Trianum P, сечење, фунгициден ефект, развој, стимулативен ефект

INTRODUCTION

Fungi of the genus Trichoderma are antagonists and biocontrol agents of pathogens and their use is of particular importance, but they also have multifunctional effect on the plant.

They are found in soil and root system, constantly multiplying stimulated by root exudates and activating numerous biocontrol mechanisms which attack the pathogen. In the complexity of actions, antibiosis, mycoparasitism and food competition are considered the main mechanisms in biological control. On the other hand, these agents have a stimulating effect on root and plant growth.

Trichoderma spp. are found in soil and root system and are beneficial to plants (Goes, 2002; Contreras-Cornejo et al., 2009). The most important benefit of Trichoderma is that they directly attack and control the causing agents of diseases, i.e. they have direct effect on plants (Chet et al., 2006).

They are opportunistic, avirulent plant symbionts as well as parasites of other fungi. Colonizing the root, Trichoderma spp. activate numerous mechanisms that attack pathogens and stimulate the growth of plants and roots (Harman, 2004, 2006; Benitez et al., 2004; Howell, 2003). Trichoderma is effective in the control of numerous plant pathogens (Harman, 2004, 2006).

The biocontrol agents are effective, eco-friendly and low-cost agents that minimize the harmful effects of chemicals (Benitez et al., 2004).

Contemporary research data indicate that plant growth and biochemical processes are strongly affected by Trichoderma species. The colonization with Trichoderma spp. increases plant growth, crop yield, resistance to abiotic factors and nutrient uptake and utilization (Saba et al., 2012).

The beneficial effects of Trichoderma are elaborated in the research of Hermosa et al. (2012).

According to Shoresh et al. (2010), some species have direct effect on plants, increasing the growth potential through nutrient uptake, fertilization, seed germination and stimulation of defense mechanisms against biotic and abiotic factors. T. harzianum can solubilize several nutrients (Altomare et al., 1999) and colonization of root with T. asperellum increases the availability of P and Fe (Yedidia et al., 2001). Such effects of Trichoderma species on plant growth were also reported by Harman (2000).

The antagonistic activity against pathogens and the stimulation of soil fertility makes Trichoderma species a good alternative to harmful fumigants and fungicides (Monte, 2001). Today, there are advanced technologies for their application in agriculture. There are numerous preparations, but the best known among those that use antagonistic microorganisms are the preparations based on various strains of Trichoderma.

T. harzianum strain T-22 is widely accepted for disease protection instead of chemical fungicides because it is more secure for the farmers, provides longer and cheaper protection and allows better growth of root system compared to pesticides application (Harman, 2004).

The T-22 strain has the following characteristics: efficient control of a large number of soil diseases, improved growth and development of plant root and increased absorption of water and nutrients from the soil, rapid growth on roots of all cultivated plants, good development in various soil types, tolerance to wide temperature and pH range and compatibility with a large number of active ingredients.

Bandjo (2016) also reported that Trichoderma harzianum T22 provides good resistance to soil diseases, strengthens the plant and stimulates its growth and provides long-lasting protection. It is efficient in various substrates and safe for humans, wild life and environment.

Trichoderma harzianum T-22 in a form of

water soluble powder or granules for direct use is registered as a biostimulator and plant protection agent in many countries, including the Republic of Macedonia, under trade name Trianum P.
The purpose of this study is to determine the effect of T. harzianum T22 on tobacco, i.e. the effect of the biofungicide Trianum P in the control of damping off disease and its impact on development of tobacco seedling. The research should also identify the most effective application model in the standard way of sowing.
The results of these investigations will determine its place in the sustainable tobacco production.

MATERIAL AND METHODS

Investigations on the influence of biopreparation Trianum P on tobacco were carried out in Scientific Tobacco Institute-Prilep, in seedbed conditions, with the following variants:

Ø Check - standard treatment with herbicide and nutrition, without fungicide application
1. Treatment after 15 days
2. Treatment after 15 days (post-sowing - herbicide)
3. Pre-sowing
4. Pre-sowing (post-sowing - herbicide)
5. Seed treated with Trianum P
6. Seed treated with Trianum P (post-sowing - herbicide)

Seed amount of 6.75 g/10 m2 i.e. 0.67 g/m2 was used for planting. All variants were set up in 3 replications and each replication was 3.33 m2.
Since the purpose of this research was to determine not only the effect of the preparation, but also the possible application in standard way of sowing (with herbicide), all the variants were repeated, i.e. set up with the use of herbicide.
Heriticide Gamit (a.i. clomazone) in a rate 0.07 ml/m2 was used after sowing.

Application of the biopreparation Trianum P

Trianum P biological fungicide was applied at a recommended rate of 15 g/10 m2, i.e. 1.5 g/m2 using 2.5-5l water/m2.
- Soil in variants 3 and 4 was treated prior to sowing with Trianum P at the same rate, i.e. 5 g/3.33m2 using 10 l of water. According to the instructions, the preparation was previously dissolved in 1: 5 ratio and added to the water by mixing.
- Seed for varieties 5 and 6 was prepared for sowing the previous day. 5 g of the product was dissolved in 25 ml water. The seed was stored in the suspension for 24 hours.

Variants 1 and 2 were treated 15 days after sowing, at the same rate as other variants.
During the growing season, two more treatments were carried out on the seedling at 15-20 day intervals, by which all stages of seedling growth were covered. Thus, seedling of the variants 1 and 2 received 2 treatments and that of other variants 3 treatments.
Health condition of tobacco seedling was monitored throughout the growing season.
Assessment on the intensity of damping off disease was made 10 days after the third treatment, by measuring the infected area in each replication of the variants. The results are expressed in percentage of infected area.
Seedling size was measured after the treatments: 10 plants from each replication and each variant were randomly selected and total length of seedlings and roots was measured. The value of the corresponding parameter from each replication is presented, as well as the average replication value.

RESULTS AND DISSCUSION

Influence of Trianum P on the intensity of damping off disease

High intensity of attack was observed in the check variety (Table 1), which was not treated with fungicides, but the nitrogen nutrition led to increased susceptibility to pathogens and spread of infection. It was confirmed by Gveroska (2016).

Delayed treatment with Trianum P showed negative effect on multiplication of T. harzianum T22 and on the expression of biocontrol mechanisms, resulting in highest percentage of infected area, which was even higher in variant 2 than in the check. Gveroska (2013), comparing the Trichoderma applications prior to sowing and 15 days after sowing, determined the advantage of the first two models over the third one.

In other variants investigated, the intensity of attack was lower as a result of the two additional treatments with biofungicide. The variants where treatment began 15 days after had one treatment less, which certainly had some influence on creating the conditions for growth and multiplication of the biocontrol agent population.

Table 1. Influence of Trianum P on the intensity of damping off disease

Mark	Variant	Percentage of infected area			
		Replication			
		I	II	III	Mean value
Ø	Check (herbicide, saltpeter; without fungicide)	7,15	4,50	9,91	7,19
1	Sowing without herbicide; Treatment after 15 days	4,12	2,15	8,23	4,83
2	Sowing with herbicide; Treatment after 15 days	18,02	3,04	4,61	8,56
3	Sowing without herbicide; Pre-sowing soil treatment	6,42	1,46	0,59	2,82
4	Sowing with herbicide; Pre-sowing soil treatment	1,50	2,22	1,28	1,67
5	Sowing without herbicide; Seed treated with Trianum P	1,35	0,79	1,22	1,12
6	Sowing with herbicide; Seed treated with Trianum P	0,59	0,77	1,19	0,85

The lowest values for disease attack were found in the variants where seed was stored in suspension of the preparation and with two additional treatments. In the variant with treated seed and with herbicide use, the values were insignificant (Table 1). This situation is affected by the greater possibility of development and multiplication of Trichoderma population due to the possibility of seed colonization and monitoring the growtht of root system, stimulated by root exudates (Handelsman and Stabb, 1996; Harman 2000; Howell et al., 2000).

Disease attack values were also lower in

variants where the preparation was applied in soil, compared to the check and the variants treated after 15 days (Table 1).
However, with regard to variants 5 and 6 and 3 and 4, higher intensity of damping off disease was observed in those treated with herbicide (variants 4 and 6).
T. harzianum is multiplied in the soil as a natural environment where the possibility of herbicide influence is lower because it is bound to the organic matter from the fertilizer. Such results for herbicide effect on the population of T. harzianum are in agreement with previous studies (Gveroska, 2014), according to which the small digression of the population caused by herbicide application is compensated or even increased during the additional treatments.
The biopreparation Trianum P, containing Trichoderma harzianum T22, has fungicidal effect on the causing agent of damping off disease on tobacco seedling. This is in agreement with the results of Chacon et al. (2006) and Devaki et al. (2008) who reported antagonistic action of T. harzianum on Pythium sp. It also has biocontrolling effect on Rhizoctonia solani, as confirmed by Monte (2001), Harman (2000, 2004, 2006), Chet et al. (2006) and Wilson et al. (2008).

The influence of Trianum P on development of tobacco seedling

According to the data presented in Table 2 and 3, it can be concluded that Trianum P, despite its strong fungicidal effect, promotes the development of tobacco seedling. Thus, root length ranges from 5.26 cm in variant 1 (first treatment of seedlings carried out 15 days after sowing, without herbicide) to 14.51 cm in variant 6 - seed stored in suspension of the preparation, with herbicide application).

Table 2. Influence of Trianum P on seedling length (cm)

Mark	Variant	Replication			Mean value
		I	II	III	
Ø	Check (herbicide,saltpeter; without fungicide)	12,58	13,47	11,85	12,63
1	Sowing without herbicide; Treatment after 15 days	5,75	5,60	4,42	5,26
2	Sowing with herbicide; Treatment after 15 days	11,80	11,98	10,38	11,38
3	Sowing without herbicide; Pre-sowing soil treatment	8,65	6,39	5,28	6,94
4	Sowing with herbicide; Pre-sowing soil treatment	12,5	12,61	11,8	12,30
5	Sowing without herbicide; Seed treated with Trianum P	7,80	8,75	7,90	8,09
6	Sowing with herbicide; Seed treated with Trianum P	15,00	15,25	13,28	14,51

It can be seen that tobacco seedling in variants treated with herbicide is larger compared to the variants without herbicide application. This situation is expected, knowing the importance of the competitive relation of weeds and plants.

Among variants 2, 4 and 6, where herbicide was applied after sowing, the longest seedling was observed in variant 6, where the seed was stored in suspension of the preparation.

Among variants without herbicide application - 1. 3 and 5, the seedling with the smallest length was observed in variant 1, treated 15 days after sowing and the highest length was measured in variant 5, where the seed was stored in suspension of the preparation.

Still, the application of biofungicide together with the seed directly affected the multiplication of Trichoderma harzianum T22 and its multifunctional activity significantly affected the growth of the seedling. These fungi are commonly used in treatment of seed, to improve its health condition and to allow a long-term improvement of plant quality. If properly quantified, they can represent a powerful accelerating system of the physiological processes of plant (Saba et al., 2012). From the results in Table 3 the same conclusions can be drawn as for the seedling length, i.e. appropriate application and further treatment of the seedling can affect the root length.

Table 3. Influence of Trianum P on the length of seedling’s root (cm)

Mark	Variant	Replication			Mean value
		I	II	III	
Ø	Check (herbicide,saltpeter; without fungicide)	2,73	3,13	1,92	2,59
1	Sowing without herbicide; Treatment after 15 days	1,75	1,65	0,62	1,34
2	Sowing with herbicide; Treatment after 15 days	2,33	3,58	2,26	2,72
3	Sowing without herbicide; Pre-sowing soil treatment	2,43	1,75	1,3	1,83
4	Sowing with herbicide; Pre-sowing soil treatment	2,58	2,45	2,38	2,47
5	Sowing without herbicide; Seed treated with Trianum P	2,05	2,28	2,43	2,25
6	Sowing with herbicide; Seed treated with Trianum P	3,73	3,30	3,10	3,38

In variants where herbicide was applied after sowing, higher root length was measured compared to the variants without herbicide application.

With regard to the model of application, the maximum root length was measured in the variant where seed was stored 24 hours in suspension of the preparation, with two additional treatments (Table 3).

Additional treatments were also made in variants 3 and 4, with pre-sowing soil treatment, but the root length was still lower.

Delayed treatment with the preparation disabled the stimulating effect, which is understandable given the reduced ability of multiplication of Trichoderma population, as compared to that in other treatments.

Results on the stimulating effect of Trianum

P are in accordance with the claims of Harman (2000) and Contreras-Cornejo (2009) that Trichoderma enhances root growth and increases crop yield, proliferation of secondary roots, fresh mass and leaf surface. Yedidia et al. (2001) also reported increase of dry matter, stalk length and leaf surface.

The correct application model of Trianum P is important not only for achieving the fungicidal effect but also for the stimulating effect. Sowing with seed stored for 24 hours in suspension of the preparation is the best application model that will provide a double effect.

The results of our research confirmed the conclusion of Saba et al. (2012) that Trichoderma spp. are endophytic plant symbionts widely accepted in seed treatment for disease control, improved plant growth and increased yield.

CONCLUSIONS

- Trianum P biofungicide confirmed its fungicidal effect.
- The highest effectiveness in the control of damping off disease in tobacco seedling was recorded in variants with treated seed, with and without application of herbicide.
- Pre-sowing soil treatment can be, to a certain extent, an alternative to the treated seed.
- The herbicide application did not show any adverse effects in these variants.
- Delayed treatment (first treatment of the seed after emergence) gives the worst results. In variants where first treatment was made 15 days after sowing, the lowest fungicidal effect was found.
- The best model of application is to treat the seed with the preparation (storage in suspension) before sowing and at least two additional treatments of the seedling.
- The Trianum P biofungicide has stimulating effect on tobacco seedling growth.
- The length of the root system, as well as the total length of seedling depends on the model of biofungicide application.
- In all models of Trianum P application, the values are higher with the use of herbicide.
- The highest length of seedling is measured in the variant where seed was stored in suspension of the preparation, with two additional treatments.
- When the preparation was applied in the soil, also with additional treatments, the seedling reached the same length as in the check variant (with saltpeter nutrition).
- Seedlings of the variant where seed was stored in the suspension of the preparation with two additional treatments of seedling had the highest length of the root.
- The other two models of application did not cause significant change in root length of the check variant.
- Trianum P with its fungicidal and stimulating effect on tobacco seedling has a good perspective in the sustainable tobacco production.

REFFERENCES

1. Altomare C., Norvell, W. A., Bjorkman T. & Harman G. E., 1999. Solubilization of phosphates and micronutrients by the plant-growthpromoting and biocontrol fungus Trichoderma harzianum Rifai 1295-22. Appl Environ Microbiol 65, 2926–2933.
2. Банџо С., 2016. Начин на примена на Trichoderma harzianum во градинарското производство, Проект на УСАИД за адаптација на земјоделството кон климатските промени.
3. Benítez T., Rincón M.A., Limón C.M., Codón C.A., 2004. Biocontrol mechanisms of Trichoderma strains. International microbiology, Vol 7: 249-260.
4. Contreras-Cornejo H.A., Macías-Rodriques L., Cortés-Penagos C., López-Bucio J., 2009. Trichoderma virens, a Plant Beneficial Fungus, Enhances Biomass Production and

Promotes Lateral Root Growth through an Auxin-Dependent Mechanism in Arabidopsis. Plant Physiology, Vol 149, No 3, p. 1579-1592.

5. Chacon M.R., Galan O.R., Benitez T., Sousa S., Manuel R., Liobell A., Delgado –Jarana J., 2006. Microscopic and transcriptome analyses of early colonization of tomatto roots by Trichoderma harzianum. Common Agric Appl Biol Sci, 71 (3 PtB): 1017-9 17390853.
6. Chet I., Viterbo, A., Brotman Y., Lousky T., 2006. Enhancement of plant disease resistance by the biocontrol agent Trichoderma. Life Science Open Day, Weizmann Institute of Science.
7. Devaki N.S., Bhat S.G., Manjunatha K.R., 2008. Antagonistic Activities of Trichoderma harzianum Against Pythium aphanidermatum and Pythium myriotylum on Tobacco. Journal of Phytopathology, Vol. 133, Issue 1, pp. 82-87.
8. Goes L.B.,. Lima da Costa, A. B., Freire L.L.C., Oliveria N.T., 2002. Randomly Amplified Polymorphic DNA od Trichoderma Isolates and Antagonism Against Rhizoctonia solani. Braz. arch.biol.technol, Vol. 45, No 2, p.151-160.
9. Gveroska B., 2013. Relation of Trichoderma spp. quantity in soil to reducing the damping off disease in tobacco seedlings. Bulgarian Journal of Agriculture Science, 19 (No.4) pp.671-679.
10. Gveroska B., 2014. Trichoderma harzianum in Tobacco seedlings with the use of a herbicide. International Journal of Agriculture Innovations and Research, Volume 3, Issue 3, pp. 950-955.
11. Gveroska B., 2016. Application of Bacillus subtillis Ch13 in the control of damping off disease in tobacco seedlings. International Journal of Development Research Vol. 06, Issue, 09, pp.9322-9326.
12. Handelsman, J., Stabb, E.V., 1996. Biocontrol of Soilborne Plant Pathohens. The Plant Cell, Vol. 8, p.1855-1869.
13. Harman G. E., 2000. Myths and dogmas of Biocontrol. Changes in perceptions derived from research on Trichoderma harzianum T 22. Plant Disease, Vol. 84, pp. 377-393.
14. Harman G.E., Howell C.R., Viterbo A., Chet I., Lorito M., 2004. Trichoderma species – opportunistic, avirulent plant symbionts, Nature Review Microbiology, 2(2004), pp. 43-56.
15. Harman, G. E., 2006. Overview of Mechanisms and Uses of Trichoderma spp., Phytopathology 96, pp. 190-194.
16. Hermosa R., Viterbo A., Chet I., Monte E., 2012. plant-beneficial effects of trichoderma and of its genes. Microbiology 158, pp. 17–25.
17. Howell C.R., 2003. Mechanisms employed by Trichoderma Species in the Biological Control of Plant Diseases: The History and Evolution of Current Concepts. Plant Disease , Vol 87, No 1, pp. 4-10.
18. Monte E., 2001. Understanding Trichoderma: between biotechnology and microbial ecology. Int. Microbiol., Vol 4, p. 1-4.
19. Saba H., Vibhash D., Manisha M., Prashant KS., Farhan H., Tauseef A., 2012. Trichoderma – a promising plant growth stimulator and biocontrol agent. Mycosphere 3(4), pp. 524–531.
20. Shoresh, M., Harman, G. E. & Mastouri, F., 2010. Induced systemic resistance and plant responses to fungal biocontrol agents. Annu Rev Phytopathol 48, 21–43.
21. Wilson P.S., Ketola E.O., Ahvenniemi P.M., Lehtonen M.J., Valkonen P.T., 2008. Dynamics if soilborne Rhizoctonia solani in the presence of Trichoderma harzianum: effects on stem canker, black scurf and progeny tubers of potato. Plant Pathology, 57, 152-161.
22. Yedidia I., Srivastva, A. K., Kapulnik Y. & Chet I., 2001. Effect of Trichoderma harzianum on microelement concentrations and increased growth of cucumber plants. Plant Soil 235, pp. 235–242.

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Original scientific paper

HARVESTING AND CURING BURLEY AND VIRGINIA TOBACCO STALKS FOR BIOMASS

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ABSTRACT

Rational production and processing of tobacco plant must include the entire biomass, both the main product leaves as well as residuesthat remain after harvest. Tobacco stalks (TSs) are an abundant biomass resource which is otherwise treated as waste. It is noteworthy that, at 40 % moisture content, about 5 tons of tobacco stalks per hectare and year are produced only in six months duration and can potentially be tapped for production of pellets. The possibility of harvesting and drying of tobacco stalks and using them as material in mixed biomass pellets production was investigated. After harvesting of the leaves, part of the stalks were collected and cured in greenhouse and shade. Also, 10 stalks of both tobacco types were cut into 3 fractions - lower, middle and upper, and the curing process continued only in the greenhouse. The time required for whole stalk curing of Virginia and Burley tobacco in a greenhouse is shorter compared to the stalks cured under shade, 44 and 40 days respectively. Data on greenhouse curing of tobacco stalks in fractions show that Burley tobacco is cured faster, taking1 8 days for the upper, 38 days for the middle and 46 days for the lower parts, which is 5 to 7 days faster compared to the fractions of Virginia tobacco cured in a greenhouse. If one hectare area is planted with Virginia tobacco type with a population of 22 222 plants, we obtained average yield of 5411 kg of dry stalks/ha. When the Burley tobacco type is planted with a same population of plants, yield of dry stalks per hectare was 3867 kg.

Keywords: Virginia, Burley, tobacco, stalks, biomass, harvesting, curing, pellets.

БЕРЕЊЕ И СУШЕЊЕ НА СТЕБЛА ОД ТУТУН ТИП ВИРЏИНИЈА И БЕРЛЕЈ ЗА БИОМАСА

Рационалното производство и преработка на тутунското растение мора да ја вклучи целата биомаса, главниот производ листовите, како и остатоците кои остануваат по бербата. Тутунските стебла (ТС) се значаен извор на биомаса која инаку се третира како отпад. Може да се забележи дека само за шест месеци се произведени околу 5 тони тутунски стебла на хектар со 40% содржина на влага што го покажува нивниот потенцијал за производство на пелети.

Истражувана е можноста за собирање и сушење на стеблата од тутун и нивно користење како материјал во резептурите за производство на пелети. По бербата на листовите дел од стеблата беа собрани и цели сушени во стакленак и под сенка. Исто така, 10 стебла оддвата типови тутун се поделени во 3 дела - долен, среден и горен, а процесот на сушење се изведува во стакленак.

Времето потребно за сушење на целите тутунски стебла во стакленик кај типовите Вирџинија и Берлеј е пократко во споредба со времето потребно за сушење на стебла под сенка, 44 и 40 дена, соодветно.

Податоците за сушење во стакленик на тутунските стебла во делови покажуваат дека стеблата од тутун тип Берлеј се сушат побрзо, 8 дена за горниот, 38 дена за средниот и 46 дена за долниот дел, што е за 5 до 7 дена побрзо во споредба со стеблата кај тутун тип Вирџинија.
Ако површина од еден хектар е засадена со тутун тип Вирџинија со популација од 22 222 растенија, добивме просечен принос од 5411 kg сува стебла/ha. Кога типот на тутун Берлеј засаден со иста популација на растенија, приносот на суви стебла по хектар изнесува 3867 kg.

Клучни зборови:Вирџинија, Берлеј, тутун, стебла, биомаса, берба, сушење

INTRODUCTION

Agricultural residues are the non-usable materials like stalk, leaves, husks, some roots and stems that remain after the harvest of the crops. The advantage of agricultural residues is that they do not require the use of additional land space because they are grown together with the crops (O'Callaghan, 2015; Mussatto and Dragone, 2016).

Tobacco is an industrial crop grown and culturally managed for high quality grade leaf for manufacturing a number of tobacco products. Every year, after leaves harvesting large amounts of tobacco residues (stalks and stems, roots and seed pods) are produced.Conventional methods for disposing tobacco residues include burning or discarding them in the field, not only bringing about serious environmental pollution issues but also resulting in the wastage of renewable biomass resources (Agrupis and Maekawa 1999).

Tobacco stalks (TSs) make up significant proportion of the total biomass waste after leaves harvesting. The yield of stalks in tobacco production is around 20% (Yang et al., 2012), far more than any other tobacco waste (stems and roots). Therefore, certain economic benefits can be achieved by appropriate utilization of tobacco stalks as potential biomass material.

Biomass for energy production refers to plant biomass that is composed of cellulose, hemicellulose, and lignin. Although agricultural residues are abundant and usually low-priced, the crucial challenge in converting biomass is to produce value-added chemicals at high selectivity and yields at economical cost (Larson, 2003). Tobacco stalk is composed largely of cellulose, a polymer of glucose; hemicellulose, a complex polymer of which the main chain consists primarily of xylans or glucomannans; and lignin, a complex phenolic polymer (Agrupis et al., 2000; Shakhes et al., 2011). The highest concentration of cellulose is in the tobacco stalks 35-40% of dry substance (Peševski et al., 2010). Such chemical composition is suitable for the production of pellets (Peševski et al., 2010,), biofuels (Radojičić et al., 2014) or energy (Martin, et al., 2008). In terms of chemical composition the lower part of the stalks contains higher cellulose and lignin than the middle and upper part which is expected since the latter is less mature, hence, less fibrous and less lignified (Srbinoska et al., 2013).

Harvesting implies in field gathering of selected plant material to the storage site. Harvesting may include sizing and connecting with other activities. Most often may include drying, additional transport and temporary storage (Larson, 2003).

The moisture content of the biomass varies with the time of the harvest and for some crops can introduce additional processing cost, due to need to dry biomass before further processing. Because of the high moisture content in raw stalk, the drying is one of the conditioning operations that are applied to material to achieve the necessary moisture content.

Morphological properties of stalks are genetically determined, but they are also affected by agroecological conditions and applied agricultural practices. Burley and flue-cured tobacco tended to have higher leaf and stalk dimension, and leaf area per plant than the oriental tobacco (Palmer and Pearce, 1999).

Tobacco stalks from different tobacco types is widely available in Prilep region and can potentially be tapped for production of mixture for pellets. The main parameters for achieving a high quality pellets are said to be a lignocellulosic, homogeneous and a well-conditioned raw material (Doring, 2013).
The aim of the study was to assess the use of stalks from two varieties of Burley and Virginia tobacco types as a material for production pellets.
More specifically, the objectives were to determine how the following factors influence the relative cost-effectiveness of producing pellets:
- to quantify the yield of tobacco stalks and its potential;
- to propose a procedure for harvesting tobacco stalks and
- to investigate the possibilities for curing the material in a simple and economical way.

MATERIAL AND METHODS

A field experiment was established in 2016 at the Experiment field of Scientific Tobacco institute Prilep with two varieties of tobacco belonging to the Burley and Virginia tobacco types (Fig. 1). Soil on which the trials were set up was of colluvial-alluvial type. This region is characterized by continental Mediterranean climate, with an average annual precipitation of about 750 mm.

Soil Management

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.Two hoeing and one feeding with KAN (3-4 g/stalk) were made and irrigations were applied depending on climate conditions and plant requirements. During the vegetation period, several treatments were applied against diseases and pests and additional watering.

Sample collection

Tobacco type Burley and Virginia were transplanted at 90 x 50 cm spacing, i.e. at planting density of about 22 000 plants per ha. Four rows were planted in each test plot and the harvesting and yield measurement were carried out on the 2 middle rows, i.e. on 50 plants.The size of the stalks, their distribution, their properties in the field and the yield were studied before stalks picking. Tobacco stalks were harvested on 22 and 23 September. Prior to cutting, stalks of approximately the same height and thickness were marked. Stalks were cut 10 cm above the soil. Cutting was followed by removal of suckers and inflorescence (Fig. 2).
All harvestedsamples can be carried out of the field. The weight of each individualwhole stalk wasrecorded for wet (fresh) yield determination using precise balance.
Ten stalks of each type were placed in a greenhouse (Fig. 3) and under shade (Fig. 4). Also, 10 stalks of both tobacco types were cut into 3 fractions - lower, middle and upper, and the curing process continued only in the greenhouse (Fig. 5).
The time (days) for which the stalks have reduced the initial moisture it and achieving moisture content of 15-20 % was recorded. In variant where the upper, middle and lower part of the stalk were dried separately, only the time required for curing each fraction in both Virginia and Burley tobacco was recorded After curing the weight of each individual whole stalk was recorded for determination of dry yield.

Fig.1.Tobacco trial crop 2016

Fig.2. Tobacco stalk harvesting

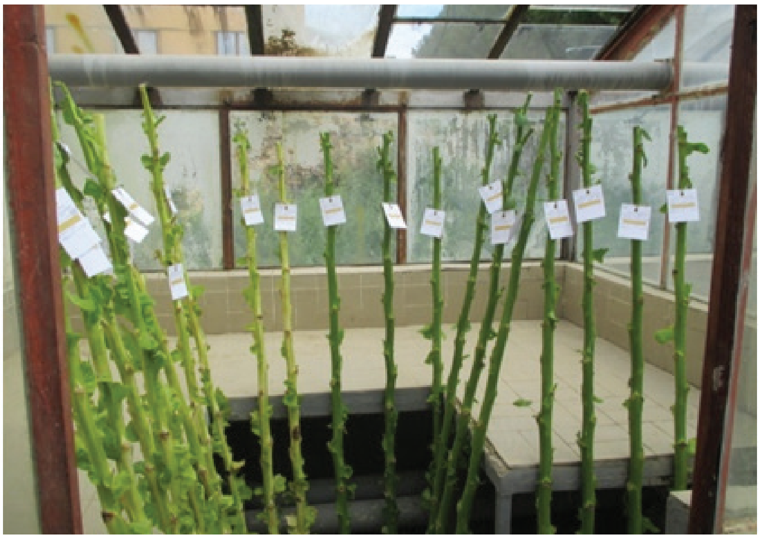


Fig.3. Tobacco stalk curing in greenhouse

Fig.4. Tobacco stalk curing in shade

Fig.5. Tobacco stalk curing in fractions

RESULTS AND DISCUSSION

Based on observations of the amount of the soil stacked on the roots during, it was decided to investigate the possibility of collecting only the aerial part of the stalks, leaving the roots in the field. It was anticipated that the collected material would be free of soil and with less moisture content. These factors would make its drying and storage easier and its use for energy production.

Stalks of Burley tobaccos are strong, around 185-200 cm high, and with 32 to 36 leaves. While the height of the stalks of Virginia tobacco varies from 182 to 195 cm, and the number of leaves from 26 to 33 (Risteski et al., 2013; Risteski and Kočoska, 2012). Agro-ecological conditions in Prilep region allows the plant to be fully matured before leaves harvest and stalks properly developed.

The time (days) for which the stalks have reduced the initial moisture it and achieving moisture content of 15-20 % was recorded. The harvested tobacco material had thin, non-woody stalks that were acceptable for use after curing. The stalks showed a reduction in stalk thickness as a result of curing in greenhouse and under shade

Length of the growing period in Burley tobacco, which is harvested by the end of August, should not exceed 115-120 days (Risteski et al., 2013; Risteski and Kočoska, 2012). Stalks harvesting were performed on 22.09.2016 and curing of stalks in greenhouse were finished on 10.12.2016. The stalks intended for curing under the shade were harvested at 23.09 and ended on 20.01.2017.Total time required for curing the stalks in a greenhouse is 78 days, and under the shade 118 days.

For Virginia tobacco length of the growing period can be somewhat longer than Burley tobacco, because the way of curing (flue curing) allows longer persistence of stalks in the field (Risteski et al., 2013; Risteski and Kocoska, 2011). To compare the method of harvesting and the time required to cure, the Virginia type stalks are harvested at the same time as those of the Burley type. The stalks were taken at 22.09 and the curing in greenhouse ended on 20.12.2016. The stalks intended for curing under the shade were harvested at 23.09 and ended on 3.02.2017.Total time required for curing the stalks in a greenhouse is 88 days, and under the shade 132 days.

The time required for whole stalk curing of Virginia tobacco in a greenhouse is 44 days shorter compared to the stalks cured under shade. The time required whole stalk curing of Burley tobacco in a greenhouse is 40 days shorter compared to the stalks cured under shade. The cured stalks in greenhouse are ligneous and have a pulp structure, and free from fungal attack or other degradation.

The time required for whole stalk curing of Virginia and Burley tobacco in a greenhouse is shorter compared to the stalks cured under shade, 44 and 40 days respectively.

Regarding the stalks in shade the local climate allowed sufficient time for the stalks to dry. As a result of these conditions, the tobacco stalks could be collected dry enough for storage but the time is longer.

Mean wet and dry mass values of stalks are shown in Table 1 and Table 2. Data on cured tobacco stalks show the time required for curing in a greenhouse and under shade, as well as fresh: dry weight ratio.

The average plant population of Virginia tobacco is 22.222 stalks per hectare and the average weight of wet stalks is 1039 g per stalk and 23088 kg per hectare, for both method of curing. The average weight of cured stalks is 243.5 g per stalk or 5411 kg per hectare. The fresh : dry weight ratio for whole stalk of Virginia tobacco is somewhat lower (4.23) than for the shade-curing (4.47) (Table 1).

The average plant population of Burley tobacco is 22.222 stalks per hectare and the average weight of wet stalks is 1102 g per stalk and 24560 kg per hectare, for both method of curing. The average weight of cured stalks is 174 g per stalk or 3867 kg per hectare. Fresh : dry weight ratio in the whole stalks of Burley tobacco cured in a glass house is higher (7.33) than the variant cured under shade (6.54) (Table 2). This ratio is higher compared to that in Virginia tobacco, probably due to the higher content of water in the raw stalks of Burley tobacco.

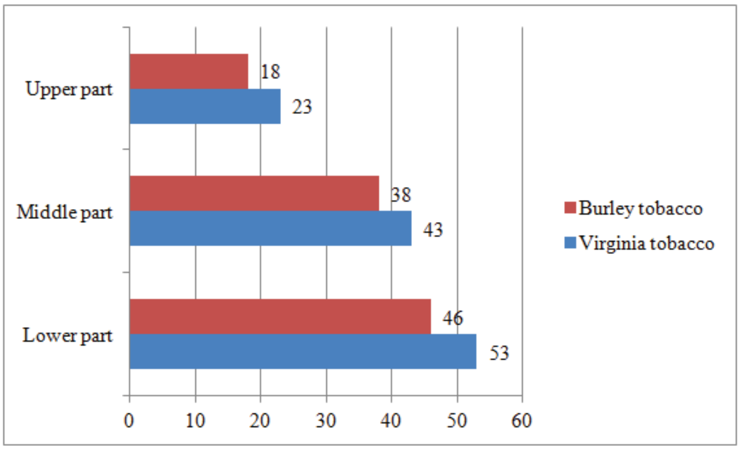
If one hectare area is planted with Virginia tobacco type with a population of 22 222 plants, we obtained average yield of 5411 kg of dry stalks/ha. When the Burley tobacco type is planted with a same population of plants, yield of dry stalks per hectare was 3867 kg.

Table 1.Weight of whole stalk of Virginia tobacco (g)

Greenhouse				Shade			
No.	**Fresh weight**	**Dry weight**	**Fresh : dry ratio**	**No.**	**Fresh weight**	**Dry weight**	**Fresh : dry ratio**
1	1090	250	4.36	1	1050	280	3.75
2	1060	240	4.42	2	1150	250	4.60
3	970	230	4.22	3	1100	290	3.79
4	1100	280	3.93	4	1100	270	4.07
5	1030	270	3.81	5	1100	320	3.44
6	1050	240	4.37	6	1120	210	5.33
7	950	220	4.32	7	950	230	4.13
8	1150	300	3.83	8	900	170	5.29
9	1070	210	5.09	9	900	170	5.29
10	950	240	3.96	10	1000	200	5.00
Average	**1042**	**248**	**4.23**	**Average**	**1037**	**239**	**4.47**

Table 2.Weight of whole stalk of Burley tobacco (g)

Greenhouse				Shade			
No.	**Fresh weight**	**Dry weight**	**Fresh : dry ratio**	**No.**	**Fresh weight**	**Dry weight**	**Fresh : dry ratio**
1	1000	140	7.14	1	1280	240	5.33
2	980	130	7.54	2	1300	210	6.19
3	970	130	7.46	3	1050	140	7.50
4	970	110	8.82	4	1090	170	6.41
5	920	110	8.36	5	1120	140	8.00
6	970	130	7.46	6	1250	240	5.21
7	1050	150	7.00	7	1300	190	6.84
8	950	140	6.78	8	1350	200	6.75
9	1060	160	6.62	9	1150	210	5.95
10	1050	170	6.18	10	1230	170	7.23
Average	992	137	7.33	Average	1212	211	6.54



Graph.1. Curing of 10 stalks by fractions (lower, middle, upper part) in a greenhouse (days)

Data on greenhouse curing of tobacco stalks on fractions show that Burley tobacco is cured faster, taking18 days for the upper, 38 days for the middle and 46 days for the lower parts, which is 5 to 7 days faster compared to the fractions of Virginia tobacco cured in a greenhouse (Graph.1). The highest weight in both Virginia and Burley tobacco was recorded in the lower part of the stalk, and the lowest weight was measured in the upper part.

The optimal successes in pellets production are only achieved if the raw material is relatively constant in its particle structure, the water content and the chemical composition. It is noteworthy that, at 40 % moisture content, about 5 tons of raw tobacco stalks per hectare and year are produced only in six months duration (Srbinoska et al., 2013). Fresh : dry weight ratio in the variant cured in a glass house is higher (7.33) than the variant cured under shade (6.54). This ratio is higher compared to that in Virginia tobacco, probably due to the higher content of water in the raw stalks of Burley tobacco.

The stalks from tobacco types Virginia and Burley applied as lignocellulose material is appropriate raw material for production of different kinds of mixed pellets.

CONCLUSIONS

The time required for whole stalk curing of Virginia tobacco in a greenhouse is 44 days shorter compared to the stalks cured under shade. Also, fresh:dry weight ratio for this variant is somewhat lower (4.23) than for the shade-curing (4:47).

The time required whole stalk curing of Burley tobacco in a greenhouseis 40 days shorter compared to the stalks cured under shade. Fresh : dry weight ratio in the variant cured in a glass house is higher (7.33) than the variant cured under shade (6.54). This ratio is higher compared to that in Virginia tobacco, probably due to the higher content of water in the raw stalks of Burley tobacco.

If one hectare area is planted with Virginia tobacco type with a population of 22 222 plants, we obtained average yield of 5411 kg of dry stalks/ha. When the Burley tobacco type is planted with a same population of plants, yield of dry stalks per hectare was 3867 kg.

Data on greenhouse curing of tobacco stalks in fractions show that Burley tobacco is cured faster, taking 18 days for the upper, 38 days for the middle and 46 days for the lower parts, which is 5 to 7 days faster compared to the fractions of Virginia tobacco cured in a greenhouse. The highest weight in both Virginia and Burley tobacco was recorded in the lower part of the stalk,

and the lowest weight was measured in the upper part.
The stalks from tobacco types Virginia and Burley applied as lignocellulose material is appropriate raw material for production of different kinds of mixed pellets.

REFERENCES

1. O'Callaghan K. 2015. Technologies for the utilisation of biogenic waste in the bioeconomy, Food Chem. pp.198.
2. Mussatto S.I., Dragone G.M. 2016. Biomass pretreatment, biorefineries, and potential products for a bioeconomy development, in: S.I. Mussatto (Ed.), Biomass Fractionation Technol. 3. Lignocellul. Feedstock Based Biorefinery, Elsevier, pp. 1e22.
3. Agrupis S.C., Maekawa E. 1999. Industrial utilization of tobacco stalks (I) Preliminary evaluation for biomass resources. Vol. 53.Holzforshung, pp. 29-32.
4. Yang Z., Zhang S., Liu L., Li X., Chen H., Yang H., Wang X. 2012. Combustion behaviours of tobacco stem in a thermogravimetricanalyser and a pilot-scale fluidized bed reactor. Bioresour. Technol. 110, 595–602.
5. Larson D.L. 2003. Biomass Harvesting Systems in Encyclopedia of Agricultural, Food, and Biological Engineering D. R Heldman pp. 80-84
6. Agrupis S.C., Maekawa E., Suzuki K. 2000. Industrial utilization of tobacco stalks (II) Preparation and characterization of tobacco pulp by steam explosion for pulping. Vol. 46. Journal of Wood Science, pp. 222-229.
7. Shakhes J., Marandi M.A.B., Zeinaly F., Saraian A., Saghafi T. 2011. Tobacco residues as promising lignocellulosic materials for pulp and paper industry.Vol. 9.BioResources No. 4, pp. 4481-4493.
8. Peševski M., Iliev B., Živković D., Jakimovska-Popovska V., Srbinoska M., Filiposki B. 2010. Possibilities for utilization of tobacco stems for production ofenergetic briquettes. Journal of Agricultural Sciences. 55 (1), 45-54.
9. Radojičić V, Ećim-Djurić O.,Srbinoska M, Djulančić N, Kulić G. 2014. Possibilities of Virginia tobacco stalks utilization. Tutun/Tobacco Vol. 64, No 7-12,71-76
10. Martin S., Fernandez T., Garcia A., Carrilo E., Thomsen A. B. 2008. Wet oxidation pretreatment of tobacco stalks and orange waste for bioethanol production.Preliminary results. Cellulose Chem. Technol., 42 (7-8). pp. 429-434.
11. Srbinoska M., Filiposki K., RisteskiI., Pelivanoska V., Rafajlovska V., Krsteska V. 2013. Tobacco stalks as renewable raw material for agro-industrial utilization. Proceeding of 65 years International Symposium for Agriculture and Food XXXVII Faculty-economy meeting IV Macedonian Symposium for Viticulture and Wine production VII Symposium for Vegetable and Flower production 734-742.
12. Palmer G. K., Pearce R.C. 1999. Field Practices in Davis D. L, Tobacco Production, Chemistry and Technology. pp. 76-103.
13. Doring S. 2013. Power from Pellets Technology and Applications. Chapter 2 Biomass Types for Pellet Production. Springer-Verlag.13-29.
14. Risteski I., Kočoska K. 2012. Results of broadleaf tobacco breeding in Scientific Tobacco-Institute. Proceeding of 65 years International Symposium for Agriculture and Food XXXVII Faculty-economy meeting IV Macedonian Symposium for Viticulture and Wine production VII Symposium for Vegetable and Flower production 643-648.
15. Risteski I., Kočoska K., Srbinoska M. 2013.Directions and goals in the selection of large-leaf tobaccos in the Scientific Institute of Tobacco Prilep - Republic of Macedonia Agriculture &Forestry.Vol. 59. Issue 2: 73-81

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Original scientific paper

EFFECTS OF DIFFERENT LEVELS OF FOLIAR NPK FERTILIZER ON AGRONOMIC PROPERTIES OF TWO ORIENTAL TOBACCO VARIETIES

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ABSTRACT

Tobacco production is decreasing in Turkey and it is necessary to get more yields per unit area to meet the current demands without spoiling the quality. Therefore, fertilization has become a significant issue in oriental tobacco. Oriental tobaccos reach to high quality levels over sloped and barren sites and yield-increasing plant nutrition practices reduce the quality most of the time. Foliar fertilizers on the other hand increase both the yield and quality with less fertilizer. In this study, 12-5-40 NPK foliar fertilizer was used in 0, 125, 250, 375, 500 and 625 g/da doses on two oriental-type tobacco cultivars (Esendal and Kızılırmak). The effects of different levels of foliar fertilizer on yield and quality were investigated. The dose for maximum yield from Esendal and Kızılırmak cultivars were respectively calculated as 475.25 g/da and 623 g/da; the dose for maximum quality grade was respectively calculated as 445 g/da and 594 g/da. Current findings revealed that quality might also be improved together with increasing yields.

Keywords: Tobacco, foliar nutrition, yield, quality grade, regression

ЕФЕКТИ НА РАЗЛИЧНИТЕ НИВОА НА ФОЛИЈАРНИ НПК ЃУБРИВА ВРЗ АГРОНОМСКИТЕ СВОЈСТВА НА ДВЕ ОРИЕНТАЛСКИ СОРТИ ТУТУН

Производството на тутун во Турција опаѓа и поради тоа неопходно е да се добие поголем принос од единица површина, за да се задоволи моменталната побарувчака, без да се наруши неговиот квалитет. Затоа, ѓубрењето е доста значајно за ориенталскиот тутун. Ориенталскиот тутун достигнува висок квалитет кога се одгледува на наклонети и сиромашни површини, приносот се зголемува со зголемување на исхраната на растенијата, а квалитетот најчесто се намалува. Од друга страна пак, фолијарната исхрана го зголемува и приносот и квалитетот со помалку ѓубриво. Во оваа студија е користено фолијарно ѓубриво 12-5-40 НПК, со дози од 0, 125, 250, 375, 500 и 625 g/da, на две ориенталски сорти тутун (Esendal and Kızılırmak). Испитуван е ефектот на различните дози на фолијарно ѓубре. Пресметана е доза за максимален принос од Esendal and Kızılırmak, од 445.25 g/da и 623 g/da, респективно, а за максимален квалитет се пресметани дози од 445 g/da и 594 g/da респективно. Овие истражувања упатуваат на тоа дека квалитетот може да се подобри заедно со зголемувањето на приносот.

Клучни зборови: тутун, фолијарна исхрана, принос, квалитет, регресија

INTRODUCTION

Tobacco plays a significant role in economies of the countries where it is produced and consumed. Today, tobacco is cultivated in more than 100 countries. In every region where it is produced, it gained specific characteristics and thus different types of products are produced. Tobacco has provided significant contributions to cigarette industry and state budgets. Turkey has a leading position in oriental-type tobacco production.

Plant nutrition greatly affects the quality and quantity in tobacco production (Barzegarkhou, 2007). Fertilizers are used in tobacco culture not only to increase the yields, but also to improve quality. In previous studies about macro nutrients (NPK), it was indicated that tobacco needed potassium the most (Benette et al. 1954; Todorovski 1970; Tariman and Majumder 1977; Elçin 2007). Lichev and Arsov (1967) experimented 2.5-5 kg/da N, 4-8 kg/da P2O5 and 4-8 kg/da K2O plant nutrients in Dijebel oriental tobacco varieties. Although 2.5 kg/da N treatment had positive effects on yield and quality, 5 kg/da N treatment negatively influenced the quality. While 4 kg/da P2O5 treatment improved the quality, 8 kg/da P2O5 treatment decreased both the yield and the quality.

Chen et al. (2009) carried out a research in China to prevent the quality losses in tobacco because of excessive fertilization, to reduce negative impacts on environment and produce a quality tobacco leaf. Researchers tried to develop a model fertilization program and determine proper irrigation water quantities. The proper soil moisture was identified as 75.8–80.5% and a model fertilization program was composed of N: 39.30–44.16 kg/ha, P2O5: 64.30–72.34 kg/ha and K2O: 232.77–258.41 kg/ha. Mylonas et al. (1981) investigated the effects of N and K on yield and quality of oriental-type Samsun tobacco cultivar grown in Katerini region of Greece. Researchers reported significant increases in leaf total N, total alkaloid, Ca and Mg contents and spoiled color and elasticity with increasing N doses. Researchers indicated the ideal fertilizer doses for the region as 2-6 kg/da N and 3-9 kg/da K.

In a study on Virginia tobacco in Düzce, different K forms [control (N+P); KCI (N+P+KCI); KNO3 (N+P+KNO3); K2SO4 (N+P+K2SO4) and S (N+P+S)] were used and the effects of these different forms on yield and quality parameters of Flue-cured (Virginia) K-110 cultivar were investigated. In that study, K (30 kg K2O/da), N (20 kg/da) and P (15 kg P2O5/da) were applied and it was observed that KNO3 and K2SO4 treatments yielded relatively better outcomes for entire parameters (Tepecik 2001). Maksimović (1989) carried out a study to investigate the effects of fertilization and topping on yield and quality of Virginia tobacco grown in sandy-clay soils of Yugoslavia. Besides control plots, researcher applied different NPK doses (24-160/40-80/80-220 kg/ha) and reported the most economic income from 80-80-120 kg/ha NPK treatment.

N is used in formation of entire plant proteins, chlorophyll and enzymes. Potassium on the other hand is required not only for growth but also quality. Phosphorus plays an important role in curing and improvement of burning and neutralization of chlorite-like materials with negative impacts on burning. Among NPK fertilizers, previous researches indicated that tobacco plants needed potassium the most and phosphorus the least. Based on these previous studies, a fertilizer of 12-5-40 NPK was used in present study.

There is an inverse relationship between increasing fertilizer doses and quality of oriental tobaccos. Increasing fertilizer doses, especially N and P negatively influence the quality. Foliar fertilization was experimented in this study to prevent excessive fertilizer use and to improve both the yield and quality. According to Yan-Ting et al. (2009), "Foliar application is becoming an important fertilization method. But soil application cannot be replaced by foliar application of fertilizers. Foliar spray can be only as an quality grade assistant method to soil application because the quantity of nutrients supplied is limited. In recent years, foliar fertilizers developed promptly both in quantity and variety, but the quality is poor in China. So the techniques of foliar application need to be improved". ZaiQiu and Jianlin (2009) indicated that foliar fertilizer applications would remarkably improve photosynthesis and leaf gas exchange of tobacco. Photosynthetic rate, transpiration rate, stomatal conductance under foliar fertilizer conditions was higher than those under no application in tobacco. Wen-Xu et al. (2012) reported significant superior characteristics of tobacco composed leaf fertilizers over the similar products and indicated that they had significant positive effects on apparent quality of tobacco leaves.

The present study was designed along with the previous researches and carried out to determine the effects of different foliar NPK (12-5-40) doses on plant and technological characteristics of oriental tobacco plants.

MATERIALS AND METHODS

Oriental-type Esendal and Kızılırmak tobacco varieties, which were developed through selections for Black Sea region, were used as the plant material of this study. Tobacco plants need potassium the most and phosphorus the least (Özçam, 1989). Therefore different doses of 12-5-40 (NPK) composed fertilizer were considered in this study.

Effects of 6 different doses (0, 125, 250, 375, 500 and 625 g/da) on yield and quality were investigated. Doses were applied before first harvest. The research was carried out in Bafra, Turkey with the largest tobacco production in the region. Experiments were conducted in 2015 with randomized blocks design and 3 replications. Number of leaves, leaf width, leaf length and dry leaf yield were measured. For quality criteria, expert assessments were made and quality grade values were determined. Since lower leaves were not considered in oriental-type tobaccos, they were plucked and removed. Then, the remaining leaves were counted and recorded as number of leaves. Length and widths of the leaves over the 2nd hands were measured. Following the harvest, leaves were sun-dried and dry leaf yields were determined. Quality grade, as a quality criterion, was assessed through quality values assigned by tobacco experts based on leaf hands, amount of breakage, color, structure and smell (Ekren and Sekin 2008). Resultant findings were evaluated separately in two cultivars and assessed through a variance analysis within each cultivar. Regression analysis was performed with yield and quality grade values to get a dose recommendation. With the aid of regression models, functional relationships between fertilizer doses (independent variable) and yield and quality grade (dependent variables) were evaluated and the dose with the maximum yield was determined. Dose-yield relation was expressed by an equation of $Y=a+bx-cx2$. By using regression equation, coefficient of determination (R2) indicating the effects of different fertilizer doses on yield and quality grade values was calculated. The equation of $Xmax=-b/2c$ was then used to identify the fertilizer dose with the maximum yield and quality grade (Yurtsever, 1984).

RESULTS AND DISCUSSION

Results of variance analysis are provided in Table 1 for Esendal cultivar and Table 2 for Kızılırmak cultivar. The differences in treatment doses were found to be significant at 1% level for entire parameters of Esendal cultivar and plant height, yield and quality grade parameters of Kızılırmak cultivar.
Effects of different fertilizer treatments on investigated parameters and statistical mean groups are provided in Table 3. In Esendal cultivar, the lowest plant height was observed in control treatment and the doses of 125, 250, 375 and 500 g/da yielded higher plant heights. In Kızılırmak cultivar, again control treatment had the least plant height and the greatest plant height was observed in 375 g/da treatment with 130.27 cm.

Table 1. Variance analysis of the effects of different dose of foliar fertilizer (NPK) treatments for Esendal cultivar

Esendal	df	Mean Squares					
		Plant Height	Number of Leaves	Leaf Width	Leaf Length	Yield	Quality Grade
Block	2	15.96	10.68	0.15	2.36	30.63	5.37
Dose	5	72.52**	31.68**	2.04**	7.57**	918.88**	465.51**
Error	10	10.061	1.63	1.94	0.92	9.15	11.37
CV (%)		2.31	3.72	4.74	5.21	2.15	7.01

df: Degrees of freedom; CV: Coefficient of variation; **Significant at 0.01 probability level

Table 2. Variance analysis of the effects of different dose of foliar fertilizer (NPK) treatments for Kızılırmak cultivar

Kızılırmak	df	Mean Squares					
		Plant Height	Number of Leaves	Leaf Width	Leaf Length	Yield	Quality Grade
Block	2	15.96	10.68	0.15	2.36	30.63	5.37
Dose	5	72.52**	31.68**	2.04**	7.57**	918.88**	465.51**
Error	10	10.061	1.63	1.94	0.92	9.15	11.37
CV (%)		2.31	3.72	4.74	5.21	2.15	7.01

df: Degrees of freedom; CV: Coefficient of variation; **Significant at 0.01 probability level

Considering the effects of different doses on number of leaves, the values were not significantly influenced by the treatments in Kızılırmak cultivar, but fertilizer treatments yielded higher number of leaves. In Esendal cultivar, the greatest number of leaves (36.99 leaves per plant) was achieved in 125 g/da treatment. Especially nitrogenous fertilizers have significant effects on vegetative growth. Since leaf is a vegetative organ, total number of leaves may increase with increasing nitrogen doses. The difference in number of leaves of the cultivars was remarkable. Number and form of leaves are limited parameters and vary based on cultivars. Such differences are mostly resulted from genetic differences. It is possible to see a similar case in leaf width and length. The greatest leaf width and length values in Esendal cultivar were observed in 375 g/da treatment. The increase in leaf width and length of Kızılırmak cultivar with increasing fertilizer doses was not found to be significant.

Table 3. The effects of different dose of foliar fertilizer (NPK) treatments on yield parameters of tobacco plants

Treatments	12.5.40 NPK (g/da)						
	0	125	250	375	500	625	Mean
Plant Height (cm)							
Esendal	128.60c	139.07ab	137.93ab	140.80a	141.87a	134.33bc	137.10
Kızılırmak	111.27c	123.67b	120.60b	130.27a	114.33c	122.93b	120.51
LSD	*Esendal; 5.77, Kızılırmak; 5.65*						
Number of leaves							
Esendal	27.97c	36.99a	34.44b	35.88ab	35.80ab	35.12ab	34.37
Kızılırmak	30.01	34.60	31.89	34.76	31.09	33.49	32.64
LSD	*Esendal; 2.32, Kızılırmak; 4.26*						
Leaf Width (cm)							
Esendal	8.33c	9.17b	9.1bc	10.80a	8.93bc	9.46b	9.30
Kızılırmak	8.13	8.23	8.56	9.83	9.46	9.03	8.87
LSD	*Esendal; 0.82, Kızılırmak; 1.67*						
Leaf Length (cm)							
Esendal	16.10c	18.63b	18.76b	21.03a	17.9b	18.43b	18.48
Kızılırmak	15.10	15.53	16.67	19.40	18.73	17.10	17.09
LSD	*Esendal; 1.74, Kızılırmak; 3.72*						
Yield (kg/da)							
Esendal	107.11d	136.15c	146.90b	147.87b	154.21a	151.19ab	140.57
Kızılırmak	114.62d	124.50c	138.21ab	142.45a	135.18b	136.13b	131.85
LSD	*Esendal; 5.50, Kızılırmak; 5.77*						
Quality grade (%)							
Esendal	30.56d	40.19c	42.22c	55.20b	63.70a	57.04b	48.15
Kızılırmak	43.15c	58.85b	61.21b	71.94a	80.74a	72.22a	64.07
LSD	*Esendal; 6.13, Kızılırmak; 9.28*						

The greatest issue to be pointed out in oriental tobaccos is to improve the quality while increasing the yields. Oriental tobaccos come to the forefront with their expertise quality and they are essential component of cigarette blends. It was indicated in several previous studies that increasing fertilizer doses applied to increase the yield in oriental tobaccos negatively influenced the quality and there was an inverse relationship between the fertilizer doses and quality. However, such knowledge is valid for soil fertilizer treatments. The remarkable outcome of this study was the increase in both yields and quality with foliar fertilizer treatments. The effects of foliar fertilizer treatment on yield and quality are provided in Table 3. Quality grade (a quality criterion) increased to some extend with increasing yields.

It should also be pointed out that soil fertilizer treatments require quite higher amount of fertilizers than foliar treatments. In other words, less fertilizer is applied in foliar treatment and thus improvements are achieved in yields together with quality with less fertilizer. Previous studies support the current findings (Hu et al. 2007; Fu et al. 2009; Wang et al. 2012).

The greatest yield and quality grade in Esendal cultivar was obtained from 500 g/da treatment, the greatest yield in Kızılırmak cultivar was obtained from 375 g/da treatment and the greatest quality grade in Kızılırmak cultivar was obtained from 500 g/da treatment.

Research findings were subjected to regression analysis to have a dose recommendation for high yield and quality grade. In regression analysis to set fort the relationship between fertilizer dose and yield, R2=0.9545 for dry leaf yield of Esendal cultivar and R2=0.9235 for dry leaf yield of Kızılırmak cultivar. Such values indicate the significance of the effect of regression on total variance. The functional relationship between fertilizer doses and yield was identified as Y=110.2979+0.1901x-0.0002x2 for Esendal and as Y=113.9218+0.1247x-0.0001x2 for Kızılırmak cultivar (Figure 1). With these equations, maximum yield levels and the fertilizer doses to get these levels can be estimated. Based on these equations, Xmax= 475.25 g/da for Esendal and Xmax= 623.5 g/da for Kızılırmak cultivar. The maximum yield with these doses was calculated as 155.47 kg/da for Esendal and 152.79 kg/da for Kızılırmak cultivar.

In regression analysis indicating the relationship between fertilizer dose and quality grade, R2=0.9243 for Esendal and R2=0.9027 for Kızılırmak cultivar. As it was in yield parameter, regression had quite high impact ratio in total variation. The equations explaining the functional relationship between fertilizer doses and quality grade values were identified as Y=43.1707+0.1188x-0.0001x2 for Esendal and as Y=29.4218+0.0890x-0.0001x2 for Kızılırmak cultivar (Figure 1). With these equations, maximum quality grade and the fertilizer dose to get this quality grade can be estimated. According to these equations, Xmax= 445 g/da for Esendal and Xmax= 594 g/da for Kızılırmak cultivar.

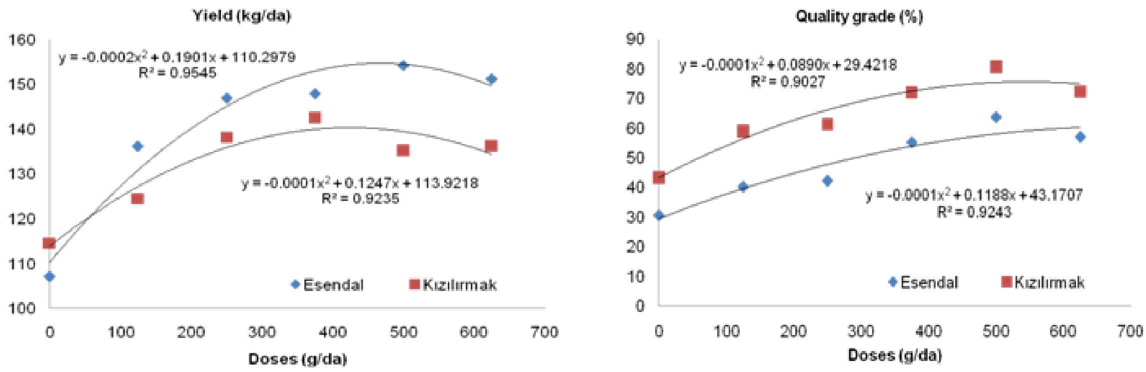

Figure 1. Regression curves for yield and quality grade values of Kızılırmak and Esendal cultivars

CONCLUSION

Nowadays, tobacco production is decreasing in Turkey since millennium. Thus, fertilization has become a significant issue in oriental tobacco because of the production decreasing. Oriental tobaccos reach to high quality levels over sloped and barren sites and yield-increasing plant nutrition practices reduce the quality most of the time. According to the result that quality might also be improved together with increasing yields.

REFERENCES

1. Benette R.R., Nau H.H., Hawks S.H., 1954. Fertilizing burley tobacco for high quality and yield. N. C. Agric. Serv. Circ. 379.
2. Barzegarkhou M.H., 2007. Determining critical period of tobacco weed control and relation with yield and quality of flue-cured tobacco (Nicotiana tabacum L.). Tobacco Research

Institute Publishers, Rasht, Iran.
3. Chen Y., Liu G., Xi H., Zhang C., 2009. Favorable soil moisture and fertilization model for tobacco cultivation. Nongye Gongcheng Xuebao/Transactions of the Chinese Society of Agricultural Engineering, 25(2): 42-49.
4. Ekren S., Sekin S., 2008. Investigation of chemical and expertise characteristics of Akhisar region tobaccos and relations with the leaf yield. Ege Univerisity Journal of Agricultural Faculty, 45 (3): 165-173.
5. Elçin F., 2007. Plant breeding and soil fertility, Ondokuz Mayis University Journal of Agricultural Faculty. 57: 260-268.
6. Fu Z., Wang J., 2009. Effects on foliar fertilizer to leaf gas exchange of tobacco (Nicotiana tabacum L.). Chinese Agricultural Science Bulletin. 18: 245-248.
7. Hu J., Zheng W., Yongqiang Y., Xuejie W., Yongjie Q., 2007. Effect of spraying different leaf fertilizers on the growth and quality of fire-cured tobacco. Journal of Anhui Agricultural Sciences. 32: 10355-10377.
8. Lichev S., Arsov K., 1967. Studies on the effect of tobacco fertilizing on slopy and eroded grounds in djebel tobacco growing. Area Plant Science, 1: 12-30.
9. Maksimović S., 1989. Effect of Fertilizers of and inflorescence removal on yield and quality of virginia tobacco. Agrohemija, 1(3): 47-61.
10. Mylonas V.A., Athanasiadis V.N., Sidiropoulos I.G., 1981. Effects of nitrogen and potassium on certain agronomic and chemical characteristics of Samsun tobacco in Greece. Beitr. Z. Tabakforsch Int. 11(1): 50-54.
11. Özçam A., 1989. Different fertilizers and treatments for yield and quality on Egean tobaccos. Journal of Institute of Tekel, 32:185.
12. Tariman C., Majumder Y., 1977. Effects of nitrogenous and potassium fertilizers on the yield and quality of Samsun Maden tobacco variety (Nicotiana tabacum L.); Bangladesh J. Sci. (Ind. Res.) 12: 81-90.
13. Tepecik M., 2001. The effects of different potassium levels on Flue Cured tobacco cultivars. Ege University Institute of Science, Master Thesis, Bornova- İzmir. Turkey.
14. Todorovski P.J., 1970. Influence of increasing rates of nitrogen, phosphate and potassium fenilizers on the yield and quality of Otlja type tobacco; 5th lnt.Tob. Sci. Congr. (Proc.), Hamburg, 1970, 176.
15. Wang L., Zuozuo L., Fei Q., Yan H., Xiaoh F., Liran S., 2012. Effects of different foliar fertilizer on the yield and quality of tobacco in Fuzhou. Journal of Anhui Agricultural Sciences. 24: 12048-12058.
16. Wen-Xu L., Zhili J., Zhenwu L., 2012. Study on effects of compound foliar fertilizer on reducing nicotine content, improving aroma and quality of flue-cured tobacco (Nicotiana glauca L.). Journal of Anhui Agricultural Sciences. 30: 14695-14697.
17. Yan-Ting, L., L. Xiuying, X. Yan, Z. Bing Qiang, W. Li-xia., 2009. Advances in study on mechanism of foliar nutrition and development of foliar fertilizer application. Scientia Agricultura Sinica. 42 (1):162-172.
18. Yurtsever N., 1984. Experimental statistics methods. Soil and Fertilizer Reseach Institute publications. Publication No: 121, Ankara, Turkey.
19. ZaiQiu F., Jianlin W., 2009. Effects on foliar fertilizer to leaf gas exchange of tobacco (Nicotiana tabacum L.). Tobacco, 8:245-248.

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PRICE POLICIES IN PRIMARY TOBACCO PRODUCTION

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ABSTRACT

A retrospective analysis of price in tobacco industry in all its stages shows prices as administratively determined and monopolistic category. They have been formed in accordance with social plans and were poorly influenced by the market laws, i.e. by the law of supply and demand – one of the most important factors in price formation. In this sense, the pricing policy consists of various types of prices, depending on the measures and instruments of economic policy, as well as the development of certain economic structures in the country and positioning of tobacco production as a whole. The prices in tobacco industry, particularly in the primary sector, were guaranteed. In literature, they can be found as protective prices, contract prices, purchase prices etc., but in general, the essence and purpose of these prices is the same - to guarantee the security of tobacco farmers. In practice, the aim of these prices is to stimulate and maintain certain level of primary production (tobacco, etc.) which is of strategic and national importance for society, motivated by its economic, social and political significance.

Keywords: price policies, primary tobacco production, price analysis, market instrument, purchased tobacco

ЦЕНИТЕ ВО ПРИМАРНОТО ПРОИЗВОДСТВО НА ТУТУН

Во долгогодишната практика гледано ретроспективно,во тутунското стопанство во сите негови фази цените во минатото се формирале по административен пат и имале карактер на монополски цени. Тие се формирале во рамките на оппштествените планови и може да се рече дека на нив слабо влијаел законот на пазарот,пред се законот на понудата и побарувачката кој е битен фактор во формирањето на цената. Во таа смисла, во политиката на цени и нивното формирање егсистираат повеќе видови на цени во зависност од мерките и инструментите на економската политика и политиката на развој на одредени стопански структури во земјата,како и нејзиното структурално насочување на производството во целина. Конкретно,во тутунското стопанство,а особено во неговиот примарен сектор егзистирале гарантирани цени. Во литературата под овие цени се подразбираат и поимите: заштитни цени,договорни цени,откупни цени итн., но битно е дека суштината и целта на овие цени е иста-гарантираат сигурност кај производителите. Овие цени во практиката имаат за цел да стимулираат и задржат одредено ниво на примарно производство(тутун и др.) од стратегиско и национално значење за општеството,мотивирано со економско,социјално и политичко значење.

Клучни зборови: политика на цени, тутунопроизводство, ценовна анализа, маркетинг инструмент, откуп на тутун

INTRODUCTION

During the administrative period, prices as a major market instrument were under the direct responsibility of the state authorities. They determined the basic policy of prices for products of wider interest, with the possibility of negotiation on primary distribution of prices among subjects in the reproductive cycle, in order to provide a more equitable distribution of income starting from the primary to the final production. In tobacco industry, companies perform all functions of production and trade. In primary production, for example, there are three stages which include 16 working processes:
- Production of tobacco seedlings, with 7 working processes
- Field production, with 11 working processes, and
- Domestic manipulation, with working processes.

The above stages and working processes are dominant in the creation of cost structure of the primary tobacco production. Crucial factor in maintaining stable and continuous production is the height of the production value achieved by the producers. Tobacco production is highly sensitive to changes of price and is very elastic with respect to this change. Creators of price policy in the primary tobacco production should abandon the traditional idea that the price of raw tobacco is a social category, because practice has proved that it is an economic category which directly affects the production.

SOME ASPECTS OF PRICES IN THE PRIMARY TOBACCO PRODUCTION OF R. MACEDONIA

The influence of prices upon primary production of tobacco can be determined by comparison between pre-transition and transition periods and the period of free negotiation and formation of prices on tobacco market.

The effect of prices and their economic impact on primary production can be seen from the data on production and average prices of tobacco type Prilep in the periods 1982-1984 and 1993-1997.

Table 1. Price movement of Prilep tobacco (MKD/kg, before the transitional period

Price	1982	1983	1984
1.Support price	252,285	132,65	164,10
2. Productional price	160,40	208,71	371,05
3. Yield in tons	21312	30028	30855

Transitional period					
Price	1993	1994	1995	1996	1997
1.Support price	42,0	82,0	82,0	82,0	82,0
2. Productional price	16,16	52,43	56,65	74,48	140,00
3. Yield in tons	24000	18862	15683	14958	25000

Source: Analysis of Yugotutun Skopje

As a rule, support prices are given for one year or more, to cover the costs and secure profitability to tobacco growers and they are always lower than the production costs. When support prices do not secure profitability, tobacco production stagnates and economic interest of tobacco producers is threatened. Data in Table show dramatic decrease of tobacco production in the transition period as a result of maintaining the support prices at the same level for almost four year and neglecting the economic interest of tobacco growers. In this period, production costs were smaller than the support price. It can be stated that .government guaranteed the suppot price, particularly in the period 1993-1997 when lower production prices were achieved. Difference between the production cost and support price was compensated by the government.

With privatization of tobacco enterprises in R. Macedonia after 1997, the system of support prices was abandoned and a new law was passed which created general economic climate in which tobacco companies can freely negotiate on the prices of production. The purchase of tobacco from the 1997 crop shows that buyers were obliged to have a license and to buy tobacco by the Rules for tobacco purchase. In this case it was not respected and the entire crop was estimated as a first grade tobacco. In 1997-2004 the big liberalism with regard to varietal purity continues, so that many varieties of Prilep tobacco were produced and accepted by the Commission for recognition of varieties, along with tobacco varieties created in development departments of tobacco companies. Every year, tobacco buyers ask from manufacturers to produce authentic varieties with high purity and quality. Such tobacco can be created only in competent institutions, like the Scientific Tobacco Institute – Prilep. In this way, the unsuitable tobacco varieties will be eliminated from the market and the oriental tobacco type will achieve fair price for its quality. In 2006-2007 there was increased demand for tobacco on the world market and purchasers tried to use this opportunity to achieve higher price for tobacco. Actually, according to the leading experts, this was just a short-term phenomenon, i.e. tobacco raw is stationed in a chain of locations and the condition of tobacco material from all these locations should be known before the supply reaches the purchaser. The relatively good harvest in 2008 further consolidated the situation with tobacco raw on the world market. Poorly estimated harvest by tobacco dealers contributed to the increase of purchase price of tobacco. This phenomenon can be presented through the average price of tobacco raw.

Table 2. Average price of tobacco raw (2006-2010)

Year	MKD/kg	$/MKD	$/kg
2006	118,78	41,65	2,85
2007	129,91	43,56	2,98
2008	137	46,45	2,95
2009	192	42,45	4,52
2010	168	47,60	3,52

Source: Lj.Poposki "Tobacco Company Prilep - the rise and decline",
Society of Science and Art –Prilep, 2014

The above data reveal that after 2006 the purchase price of tobacco raw was growing and reached the peakl in 2009, to immediately fall at 168 MKD / kg in 2010. This condition occurred when the dollar exchange rate was the lowest and quite oscillating (from the lowest rate of 41,65 MKD in 2006 to 47,60 MKD in 2010). The analysis of production price of tobacco raw in 2009 shows that it is enormously large compared to 2008, and the MKD price is enormously diminished, calculated in dollars ($ 42.45 / MKD). The oscillation can be seen from the data in the following table:

Table 3. Oscillations in the price of tobacco (2001-2010)

Year	Export price $/kg	Production price $/kg	Share of the production price in %	Difference in prices (%)
2001	3,40	1,80	52,9	47,1
2002	4,33	1,64	37,8	62,2
2003	4,54	2,59	57,0	43,0
2004	4,34	2,95	68,1	31,9
2005	4,64	2,43	52,3	47,7
2006	1,94	2,85	146,9	-46,0
2007	3,55	2,98	83,0	17,0
2008	3,05	2,95	96,0	4,0
2009	4,36	4,52	103	-3,0
2010	4,76	3,52	74,0	26,0

Source: Derived data and analysis of the work of Ltd Tobacco, Tutunski kombinat – Prilep

Interested situation was observed in the crop season of 2009, when tobacco buyers neglected the standard rules for purchase and overestimated the production price of tobacco in relation to the export price, which is used for alimentation of the production price and processing costs. The presented data show negative effect on the difference in prices (-3%). After recognizing this error and in attempt to compensate the loss from 2009, in 2010 tobacco was bought from the farmers by lower purchase price. In order to avoid such situations, the following statement should be taken into account:

- Good knowledge of the absorption potential of domestic and international tobacco market with regard to quantities, structure and commercial types and varieties of tobacco;
- Regular monitoring of the ongoing production of tobacco raw ;
- Monitoring of the commodity structure of tobacco raw through:

1. Movement of beginning inventories of tobacco
2. Movement of the current production
3. Exports of tobacco raw
4. Imports of tobacco raw
5. Consumption of tobacco raw
6. Ending inventories

The two extremes that emerged in tobacco purchase (2007 and 2009) were reported by external experts and tobacco dealers who pointed out that the quality of tobacco raw was variable and impaired. In this context, Mr. Richard English, manager of Philip Morris, in his paper "Offer and demand of oriental tobacco" from 1992, warned that the quality of tobacco raw was not improved, but the prices were still going up, which make it necessary to take constructive steps by the manufacturers and the farmers in order to increase and maintain the share of oriental tobacco in the world market. This means that it is necessary to initiate corrective actions in the area of pricing, quality and marketing.

After 2010, the production of tobacco raw in Macedonia has been stable, and so are the prices of purchased tobacco, which depend on the harvest - whether it is successful, average or above average in terms of quality of tobacco raw. So, purchase prices depend on the oscillations of quality by years, but they are growing even if an extreme occurs in some harvests, due primarily to the weather conditions in the current year. Production of tobacco and movement of prices in 2010-2015 are presented in Table 4:

Table 4. Average price of tobacco (2010-2015)

Year	Purchased tobacco (t)	Average price MKD/kg
2010	26393	136,6
2011	21024	164,8
2012	27993	180,2
2013	30997	152,6
2014	24857	117
2015	20000	185

Source: Ministry of Agriculture, Forestry and Water Economy

The harvest of 2016 is distinguished by the highest quality tobacco production. It is predicted that over 24000 t tobacco will be purchased at an average price of 197 denars, which is high enough to satisfy the wishes of tobacco growers and to be a stimulation for higher production and better quality. The movement of purchase prices by classes in the period 2013 2015 is presented in Table 5:

Table 5. Movement of purchase price by classes

Price	2013	2014	2015
I	248	249	270
II	178	178	189
III	136	136	136
IV	55	55	55

Source: Prices agreed with tobacco growers

From the data on prices agreed between tobacco growers and buyers it can be concluded that there are no big changes in purchase prices. These prices determine the yield of purchased tobacco, as presented in Table 6:

Table 6. Yield of purchased tobacco in %

Classes	I	II	III	IV
2013	10,0	57,4	25,2	7,4
2014	4,3	28,4	44,0	23,3
2015	10,0	65,0	23,0	22,0

Source: analysis of Tutunski Kombinat - Prilep

Data show that tobacco raw is mainly purchased in three purchase classes, while the fourth class has a tendency to decrease, so that the total purchase is realized at an average price that gravitates around the second class.

CONCLUSION

1. Despite the fluctuations in purchase prices during the transition and pre-transition period, there is a tendency towards more objective correlation between the average price and the quality of purchased tobacco. In addition to the upward moving purchase prices, stabilization of tobacco production is also supported by the government subsidies to the farmers.
2. The achieved average price of over 250 MKD, along with the allowed subsidies, is a guarantee for sustainable and stable tobacco production.
3. Both the producers and buyers of tobacco are obliged to have consolidated cooperation and relations, in order to sustain the initiated trend in tobacco production and trade and to achieve the best possible prices.

REFERENCES

1. Colin Gilligan and Richard M.S. Wilson,2012. “Strategic marketing planning” ,USA
2. Попоски Љ.,2012."Производната цена на тутунот-сложен фактор во економијата на производителот ",Друштво за наука и уметност-Прилеп
3. Попоски Љ.,2015."Тутунски атлас",Друштво за наука и уметност-Прилеп
4. Paul Newbold, William L. Carlson, Betty Thorne,2010. "Statistics for business and economics”,USA
5. Здружение на производители на тутун во лист,Стопанска комора,2015
6. Податоци од Министерство за земјоделство,водостопанство и шумарство
7. Tobacco Journal International0/2016
8. FAOSTAT(Food and agriculture organization of the United Nations statistics), 2016/2017

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Review article

IMPACT FACTOR

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ABSTRACT

The most common way of evaluating scientific work is through citation analysis. This is how the scientific achievements of authors, co-authors, institutions and states are valued. Every researcher strives to publish his results in a magazine with a good reputation. One of the basic indicators for determining the status of a scientific journal is the so-called Impact Factor – IF (a factor of influence), which is a measure of the frequency of citations of published articles in a certain period. Impact Factor is a potential indicator of the validity of an article because it is assumed that there was a strict review procedure before its publication. The true value of the article is obtained after its printing by the volume of citations from the presented results to the value of IF for the magazine in which it is printed.

The aim of this paper is to familiarize the reader with the basic databases of various scientific and research activities through which scientists connect, to clarify the notion and significance of the impact factor, which valorizes the popular scientific journals, as well as to explain precisely the more specific terms which span all spheres in the field of science.

The numerical value of the Impact Factor is calculated by the sum of quotations from the last two years divided by the number of published papers in the journal in the same period. In the same way you can calculate IF for the last five years. The study data presented in the paper is a dynamic biometric value that is constantly directed towards emphasizing the best quality in all areas of research activity in the world.

Keywords: IF (Impact Factor), TRIF (Thomson Reuters Impact Factor), WoS (Web of Science), JCR (Journal Citation Report).

ФАКТОР НА ВЛИЈАНИЕ

Најчест начин на вреднување на научното творештво е преку направени цитатни анализи. Така се вреднуваат научните достигнувања на авторите, коавторите, институциите и државите. Секој истражувач се стреми своите резултати да ги објави во списание со реноме. Еден од основните показатели за одредување на статусот на научното списание е т.н. Impact Factor – IF (фактор на влијание), кој претставува мерка за фреквентноста на цитираноста на публикуваните статии во одреден период. Impact Factor-от е потенцијален показател за валоритетот на дадена статија бидејќи се претпоставува дека постоела строга рецензентска постапка до нејзиното публикување. Вистинската вредност на статијата се добива по нејзиното печатење, со обемот на цитатите од пласираните резултати преку кои таа влијае на вредноста на IF за списанието во кое е оптпечатена.

Целта на овој труд е да се запознае читателот со основните бази на податоци за различни научноистражувачки дејности преку кои се поврзуваат научните работници, да се разјасни поимот и значењето на импакт

факторот со кој се валоризираат популарните научни списанија, како и прецизно да се објаснат повеќе поими кои ги пратат сите сфери во полето на науката.
Одредувањето на нумеричката вредност на Impact Factor-от се врши така што збирот на цитатите од двете последни години се дели со бројот на публикуваните трудови во списанието во истиот период. На ист начин може да се пресметува IF за последните пет години. Проучуваните податоци изнесени во трудот претставуваат динамична биометриска величина која што е постојано насочена кон потенцирање на најквалитетното од сите области на истражувачката дејност во светот.

Клучни зборови: IF (импакт фактор - фактор на влијание), TRIF (Thomson Reuters Impact Factor), WoS (Web of Science), JCR (Journal Citation Report).

INTRODUCTION

Scientific work is frequently evaluated by measuring the scientific productivity achieved through citation analysis. Analyzes of citations of the published scientific research results include measurements of the number and type of citations, self-citations or independent citations. Thus, the scientific achievements of authors, co-authors, institutions and states are valued. It is very important which journals the results of the research are be published in, as this entails different impressions of the scientific data presented and the registration of their further citation. Therefore, often when evaluating the scientific work of the researcher (or the institution), the status of the journal in which the results are published, as well as the status of the papers in which those results are quoted, is used as an indicator.

One of the basic indicators for determining the status of a scientific journal is the so-called Impact Factor – IF. Impact Factor of the magazine is a measure of the frequency through which the citation of the published articles in a certain period is shown. This helps determine the quality of the magazine, but not the quality of a particular article or the quality of the scientist as an individual. The impact factor can only be a potential indicator of the valority of an article, since it is assumed that there was a strict review procedure before its publication. The real value of the article is obtained after its printing, with the scope of the quotes from the results that it results in, which affects the value of the IF for the magazine in which it is printed.

IF as a scientometric indicator is only one of the indicators that contributes to the overall assessment of the scientific work of the researcher, institution, area, journal, etc. However, it is not recommended to observe it separately, instead it should be observed alongside the subject area, the length of the author's working life, scientific productivity, co-authorships, the total number and type of quotations as well as other relevant parameters.

The purpose of this paper is to process and summarize modern data to precisely determine the many terms that accompany this field, following the direction of highlighting the quality of scientific research activity on a worldwide level.

RESULTS AND DISCUSSION

Term of Impact Factor

The term Impact Factor (IF) means an influence factor that is incorporated into several commercial academic-based rating databases that register the quotations of journals and articles inside them (each base for itself separately). Impact factor is calculated each year for all journals that are referenced in the respective databases and for all journals that were cited in those databases. Based on the obtained results and the set criteria, certain magazines are selected and entered into the database of new magazines, while some existing ones are excluded from it.

Impact Factor is a very important criterion for the reputation of scientific journals. Today, the higher IF is a sure direction when choosing an adequate magazine for printing scientific work, as well as an aspiration to perfecting and modernizing a magazine. It is often used as an expression of the relative importance of a magazine in a particular area. Chapters with a higher IF are usually considered "more important" than those whose factor is of lesser value.

Definitions

- Journal Impact Factor (JIF) for scientific journals is defined as the number obtained by dividing the total number of citations of articles (papers) published in the previous two years and cited in the current year, with the number of published papers in the previous two years [3].
- Impact Factor (IF) is a structured quotation index, a searchable collection of bibliographic data, supplemented with abstracts of scientific publications or articles in journals, keywords, references (a list of quoted papers) and quotation data, or for scientific papers which are citated by previous scientific papers [5].
- The Impact Factor (IF) or Journal Impact Factor (JIF) for scientific journals is a measure that reflects the previous annual number of citations cited in recently published scientific papers in a given journal [5].

Review of the meaning of Impact Factor

Impact Factor (IF) is the most common indicator for valuing magazines. When using IF, one should pay attention to the way in which it is calculated, what kind of documents are being used, what kind of articles the magazine deals with etc.
IF is also used when comparing magazines. In this case, care should be taken not to compare magazines from different scientific areas.
IF is a more reliable indicator in natural and applied sciences than in social sciences. In magazines in the field of humanities, IF is not calculated because most authors do not use journals as a source of citation, and available literature crosses the boundaries of the two-year and five-year period (time for which IF is calculated).

Determination of Journal Impact Factor (JIF)

The determination of the numerical value of the Journal Impact Factorot (JIF) is calculated by the sum of quotations from the last two years divided by the number of published papers in the journal in the same period [5], [7].

For example, the Journal Impact Factor (IF) of a given scientific journal for 2016 is determined by the following formula:
Example: The magazine "X" indicated in

$$\mathrm{IF}_{2016} = \frac{Number\ of\ citations\ from\ 2014 + number\ of\ citations\ from\ 2015\ (cited\ in\ 2016)}{Number\ of\ papers\ in\ 2014 + number\ of\ papers\ in\ 2015}$$

the Web of Science (WoS) and published in 2016, from 2011 to 2015 was quoted 6014 times, of which 2182 times were quoted from works printed in 2014 and 642 times were quoted from works printed in 2015 . In 2014 the magazine published 191 papers, and in 2015, 218 papers. By applying the above formula, IF for 2016 was 6.9.

$$IF_{2016} = \frac{\mathbf{2182}\ \boldsymbol{citations\ from}\ \mathbf{2014 + 642}\ \boldsymbol{citations\ from}\ \mathbf{2015}\ (\boldsymbol{cited\ in}\ \mathbf{2016})}{\mathbf{191}\ \boldsymbol{papers\ in}\ \mathbf{2014 + 218}\ \boldsymbol{papers\ in}\ \mathbf{2015}} = \frac{2824}{409} = 6{,}904645477 \approx 6{,}9$$

For reputable journals from different areas, there is an information journal Journal Citation Report, where five year IF's are also calculated by the previously described method, with the use of five-year data instead of two years. The calculation of the five-year IF for the magazine "X" is done in the same way as for the two-year period, except the calculation also adds the data for 2011, 2012 and 2013. For example, in 2016 there were 814 quotations from 2011, 1,474 quotations from 2012, and 902 quotations from 2013. In 2011, 207 papers were published, in 2012 183 were published, and in 2013 179 papers were published. The calculation will be as follows:

$$IF_{2016} = \frac{\mathbf{814}\boldsymbol{c}.(\mathbf{2011}) + \mathbf{1474}\ \boldsymbol{c}.(\mathbf{2012}) + \mathbf{902}\ \boldsymbol{c}.(\mathbf{2013}) + \mathbf{2182}\ \boldsymbol{c}.(\mathbf{2014}) + \mathbf{642}\ \boldsymbol{c}.(\mathbf{2015})\ (\boldsymbol{ct.in}\ \mathbf{2016})}{\mathbf{207}\ \boldsymbol{p}.(\mathbf{2011}) + \mathbf{183}\ \boldsymbol{p}.(\mathbf{2012}) + \mathbf{179}\ \boldsymbol{p}.(\mathbf{2013}) + \mathbf{191}\ \boldsymbol{p}.(\mathbf{2014}) + \mathbf{218}\ \boldsymbol{p}.(\mathbf{2015})} = \frac{6014}{218} = 6{,}149284 \approx 6{,}15$$

From the analysis of the two-year and five-year IF it can be concluded that the difference between them is approximately one, which means that in the last two years, "X" has seen an increase in quoting of scientific papers, which increases the reputation of the magazine.

Thomson Reuters Impact Factor

Thomson Reuters Impact Factor is a commercial metric factor, which is published annually by Thomson Reuters's scientific business through the Journal Citation Reports (JCR). JCR provides a number of parameters and quantitative tools for ranking, grading and categorizing, as well as comparing magazines [12].

Web of Science

Web of Science (WoS) is the database of the most significant quoted indexes (database index), which covers 10-12% of the most prestigious and most well read world scientific literature, subject to very strict selection and quality control of the scientific work [13].
WoS covers the period from 1900 to the present. This database is one of Thomson Reuter's creation platforms called Web of Knowledge (WoK). Currently WoK is a major research platform that offers great assistance in the sphere of finding, analyzing and sharing information in all scientific areas. In WoK, besides Web of Science (WoS), other bases are included, such as: Biosis Citation Index, CAB Abstracts, Conference Proceedings Citation Index, Current Contents Connect, Food Science Technology Abstracts, Global Health, Inspec, Journal Citation Reports, Medline , Zoological Record, etc.

The creator of the Web of Science's citation (index) database is Eugen Garfield. He founded the Institute of Scientific Informatics of Philadelphia, and in the 60s of the XX century strives to create a source of the latest scientific literature at an international level, which will enable easier search for the growing number of published papers. Thus, the multidisciplinary database of the Science Citation Index, which was run exclusively by magazines, emerged and is a source of scintomenetic research. The initial collection of 600 magazines produced the core of world science and represented 5-8% of all scientific publications. Today, for a growing number of world communities, WoS is the most prestigious source of publications and data on scintiometric research. This is a priority for scientists precisely because of the publication of the papers in one of the magazines indexed by WoS. Since 2002, WoS (with 14 scientific journals) has been transferred to the private company Thomson Reuters, making the rules for inclusion of magazines in the database altered. The biggest changes in this sphere were made in 2007 and 2008, when WoS included a number of magazines for smaller states from the non-English region. Thus, since 2012, when 62 scientific journals were included in the database, their number is constantly growing and today covers more than 10% of the total number of world scientific journals.

The most used indexes of the WoS service are the following:

Science Citation Index Expande (SCI Expanded) - denotes the field of natural sciences, medicine and technology. The data in this database date from 1900 [9].

Social Sciences Citation Index (SSCI) - covers the field of social science [10].

Arts and Humanities Citation Index (A & HCI) - indexes magazines from the field of humanities and arts. Its availability dates from 1975 [1].

The number of magazines that are entered simultaneously in the three WoS indexes is small.

WoS indexes all papers of the included journals into the database without choosing them. The bibliographic processing is done on all scientific papers, but also on various articles, such as: books, abstracts from scientific gatherings, and so on. It can make bibliometric analyzes of different characters, including the total quotation of papers by individual authors, or the papers from individual journals in a certain period of time, as well as the citation without self-cytats, the h-index (indicator of valuation of Scientific work and journal, introduced by physicist Hirsch in 2005 [4]), etc. The papers are also analyzed according to the language they are published, the year of publication, the area they belong to, and so on.

In addition to the listed indexes, the WoS Service also contains the Conference Proceedings Citation Index - Science, Conference Proceedings Citation Index - Social Science & Humanities [2], and from 2015, a Book Citation Index is included which includes monographic publications by major popular publishers [11].

Journal Citation Reports

Journal Citation Reports (JCR) is a publication that is published annually by Clarivate Analytics (followed by Thomson Reuters's intellectual property and scientific business) and informs of quotations in the scientific journals [6]. It was created in 1975 on the basis of magazine data, the number of published papers, and the quotation analysis analyzed by Web of Science. Eugen Garfield created a special statistical database, called Journal Citation Reports (JCR), as a quantitative tool for ranking, valuing, categorizing and comparing magazines. As an indicator of the valorization of magazines, Impact Factor-IF is most often used (factor of influence).

JCR classifies scientific journals, and Median IF ranks individual journals within the scientific area to which they belong.
JCR consists of two units: The Sciences Edition (SE) and The Social Sciences Edition (SSE). Currently JCR, as a separate service, is based on quotes collected from SCI Expanded and SSCI. For magazines in A & HCI, JCR is not calculated IF.
According to the above, Journal Citation Reports (JCR) is a reliable and relevant database for the evaluation of scientific journals and a guide to the publication of scientific results and scientific thought.

Impact Factor Magazines from the field of agriculture

There are a huge number of magazines in which papers in the field of agronomy can be printed. The basis of selection for the researcher is primarily based on the field of scientific research, but always includes the height of Impact Factor. Web of Science abounds in magazines that satisfy these criteria, that is, there are magazines ranked with different Impact Factor.
Table 1. shows the journals with Journal Impact Factor (JIF) in which scientific papers are published primarily in the field of agriculture (plant sciences, nutrition, botany, plant pathology, microbiology, biochemistry, etc.) [8].

Table 1. List of Scientific Magazines with Journal Impact Factor (JIF) in the field of crop production

Scientific magazines	JIF
Asian Journal of Plant Science & Research	0.92 4.64 (5 Yr JIF)
Journal of Natural Product and Plant Resources	0.9 4 (5 Yr JIF)
Journal of Nutrition & Food Sciences	1.49 2.56 (5 Yr JIF
Journal of Plant Pathology & Microbiology	1.62 2.13 (5 Yr JIF)
Journal of Biodiversity Management & Forestry	0.781
VEGETOS: An International Journal of Plant Research	6.02
Journal of Plant Physiology & Pathology	2.396
Journal of Phylogenetics & Evolutionary Biology	1.95
Natural Products Chemistry & Research	1.7
Journal of Plant Biochemistry & Physiology	1.55
Advances in Crop Science and Technology	1.55
Medicinal & Aromatic Plants	1.42
Rice Research: Open Access	1.35
Forest Research: Open Access	1.25
American Journal of Phytomedicine and Clinical Therapeutics	1.15
Agrotechnology	1.04
Journal of Horticulture	0.72
Research & Reviews: Journal of Botanical Sciences	0.36

CONCLUSIONS

Impact Factor (IF) is one of the modalities of evaluating scientific productivity and an indicator of the value of journals. The determination of the numerical value of the IF is done in such a way that the sum of the quotations from the last two years is divided by the number of published papers in the journal in the same period.

Thomson Reuters Impact Factor is a commercial metric factor that is published annually by Thomson Reuters's scientific business through the Journal Citation Reports (JCR) publication that provides information on quotations in scientific journals.

The Web of Science (WoS) database contains the most important cited data from the most prestigious and most well read world scientific literature, subject to a very strict review procedure of selection and quality control of the scientific work.

The data studied - the subject of this paper, represent a dynamic biometric base aimed at constantly highlighting the best quality of all areas of research activity on a global level.

REFERENCES

1. Arts and Humanities Citation Index: https://en.wikipedia.org/wiki/Arts_and_Humanities_Citation_Index#See_also;last edited on 11.2.2017
2. CPCI - Clarivate Analytics - Web Of Science: http://wokinfo.com/products_tools/multidisciplinary/webofscience/cpci/; data from 20017
3. Evaluation based on scientific publishing: - Journal Impact Factor, IF: http://libguides.oulu.fi/c.php?g=124852&p=816807; data from 2.4.2009
4. Hirsch J. E., 2005: An indeks to quantify an individual’s scientific research output. Proc Natl Acad Sci USA. 102: 16569-16572; http://www.pnas.org/content/102/46/16569.full
5. Impact factor - Wikipedia (the free encyclopedia): http://en.wikipedia.org/wiki/Impact_factor; last edited on 9.6.2017
6. Journal Citation Reports: http://wokinfo.com/training_support/training/journal-citation-reports/; data from 20017
7. Measuring Your Impact: Impact Factor, Citation Analysis, and other Metrics: Journal Impact Factor (IF);http://researchguides.uic.edu/if; last updated on 13.06.2017
8. Plant Sciences Journals List - 2016 Impact Factors Rankings: www.omicsonline.org/Plant-Sciences/CitationReports; data from 20017
9. Science Citation Index Expande: https://www.google.com/#q=Science+Citation+Index+Expanded+(SCI+Expanded); data from 20017
10. Social Sciences Citation Index: https://en.wikipedia.org/wiki/Social_Sciences_Citation_Index; last edited on 21.1.2017
11. The Book Citation Index: http://wokinfo.com/products_tools/multidisciplinary/bookcitationindex/; data from 20017
12. The Thomson Reuters Impact Factor: http://wokinfo.com/essays/impact-factor/; data from 20017
13. Web of Science - Wikipedia (the free encyclopedia): https://en.wikipedia.org/wiki/Web_of_Science; last edited on 7.4.2017

INSTRUCTIONS TO AUTHORS

"Tutun/Tobacco" is published biannually (double issues).
Since the publication is of an international character, all manuscripts should be submitted in English. Authors whose native language is not English should have their papers checked by research workers from the related fields who have good proficiency in the English language. All manuscripts must be proofread prior to submission. Language and style of the manuscripts are responsibility of the author.
The publication presents:original scientific papers,review articles, short reports, professional papers and other works related to tobacco science and practice.
Original scientific papers-should contain original scientific research results, previously unpublished. They must be presented in a manner enabling the experiment, i.e. research method, to be repeated and accuracy of the analysis, results and conclusions confirmed.
Review articles-should contain critical surveys of the accomplishments in the fields encompassed in the Journal, papers by an individual researcher or a group of researchers with the purpose to undertake, analyze, evaluate or synthesize previously published information. They should present the latest ideas and theories or new scientific achievements.
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Manuscripts should follow the format INTRODUCTION, MATERIAL AND METHODS, RESULTS AND DISCUSSION AND CONCLUSION, for experimental research where events are presented in chronological order.

Titles in the text (INTRODUCTION, MATERIAL AND METHODS, RESULTS...) should be centered, boldfaced, written with capital letters, font size 12; **Subtitles** should be written with initial capital letter, boldfaced, 12-point font size, aligned to the center;
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Address of the institution–full postal address of the institution, as well as the e-mail of the principal author; italic,centered.

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Tables should be numbered with Arabic numeralsaccording to their sequence in the text. The table title should be always above the table,centered, in 10 pt font, with one empty row between the title and the table and another one between the table and the text.Tables should be simple and should not duplicate the information given in figures.

Reference to the Table, example: It could be seen from Table 1...., or: The nicotine content in tobacco is 0.98% (Table 4).

Illustrations should be numbered consecutively in Arabic numerals, with centered titles below each of them.

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Weybrew J.A., Wan Ismail W. A., Long R. C., 1983. The cultural management of flue-cured Tobacco quality.Tob. Sci. 27, 56-61.
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