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# INVESTIGATION OF INTRODUCED VARIETIES OF BURLEY TOBACCO TYPE

Yovko Dyulgerski

*Tobacco and Tobacco Products Institute (TTPI), Markovo, Bulgaria*
*e-mail: yovk_dulg@abv.bg*

## ABSTRACT

Twenty newly introduced Burley tobacco types are examined for their biological and economic traits and their economic worth is assesed. According to the results, variety North Carolina 3 gave the best biometric data. The shortest vegetative period has variety Burley 16 and the longest varieties Burley Manyleaves and North Carolina 2. Varieties Burley Va 509 and NCBH 129 had the highest percentage of first class. The highest-yielding variety Burley Manyleaves has the lowest percentage of first class. Although the yield of most of the tested varieties may be considered satisfactory, in terms of the percentages of classes, the results of most of them do not meet Burley's tobacco standards. Overall, the varieties North Carolina 3, Kentucky 35, Burley Va 509 and NCBH 129 stand out with the best economic and biological performance that can be used as a good starting material for the creation of new tobacco varieties of the type Burley.

**Key words:** Burley tobacco, introduced varieties, biometrical and economic indicators

## ИСТРАЖУВАЊЕ НА ИНТРОДУЦИРАНИ СОРТИ ТУТУН ОД ТИПОТ БЕРЛЕЈ

Истражувани се биолошките и економските карактеристики на дваесет интродуцирани Берлејски сорти тутун и се проценува нивната економска вредност. Според резултатите најдобри биометриски податоци дала сортата North Carolina 3. Најкраток вегетативен период има сортата Burley 16, а најдолг сортите Burley Manyleaves и North Carolina 2. Најголем процент на прва класа е забележан кај сортите Burley Va 509 и NCBH 129. Сортата Burley Manyleaves со највисок принос има најмал процент на прва класа. Може да се констатира дека приносот на повеќето испитани сорти е задоволителен, но во однос на процентите на класи, резултатите од повеќето од нив не ги задоволуваат стандардите за тутун од типот Берлеј. Генерално, сортите North Carolina 3, Kentucky 35, Burley Va 509 и NCBH 129 се издвојуваат со најдобри економски и биолошки перформанси кои можат да се употребат како добар почетен материјал за создавање на нови сорти тутун од типот Берлеј.

**Клучни зборови:** тутун Берлеј, интродуцирани сорти, биометриски и економски показатели

## INTRODUCTION

In both, production and quality of the received raw material, the Burley tobacco in Bulgaria is significantly inferior in the leading producer countries. This emphasizes the need for introduction, creation and implementation of new, more efficient varieties that meet the needs of both manufacturers and the cigarette industry (Bozhinova, 2005; Dyulgerski, 2011; Yonchev, 2014, Nikolova and Drachev, 2006). Introduction of varieties means bringing them in new natural climatic conditions, beyond the limits of their natural range of distribution (Tchinchev, 1988, Nikolov et al., 2004). The introduction has two main directions: direct varieties and varieties as starting material for the implementation of a breeding program for solving the variety problem (Tchinchev, 1990; Bridges et al., 2011, Risteski et al., 2007, 2012).

Without the introduction, without receiving and studying the latest world achievements of tobacco selection, it is impossible to increase the biological potential of native varieties (Pophristev, 1981). At TTPI,an intensive research is being conducted on introduced varieties (Dyulgerski, 2011; Drachev et al. 2007; Dimanov and Masheva, 2011). Each variety is found to react differently depending on environmental conditions (Tchinchev, 1989).

The purpose of this study is to make biological and economic characteristics of introduced Burley tobacco varieties and to evaluate the prospects and possibilities for their use in breeding programs.

## MATERIAL AND METHODS

For the achievement of defined goals, during the period 2009 - 2013, in experimental fields of TTPI – Markovo twenty introduced Burley tobacco varieties of varietal group Burley tobacco are tested. Most of them are introductions from the USA, but also from other countries - Greece, Italy, Poland, Germany, France, and Hungary. Three of the studied varieties are male sterile - North Carolina 2, R - 610 and PF - 561, and the North Carolina 3 variety is a fertile hybrid in $F_1$.

Subject of research and analysis are the most important biometrical, economic and chemical parameters in Burley tobacco. Following biometric measurements on the plant are performed: height, number and size (length and width) of leaves of lower and middle harvest belt, and phenological observations for the length of the vegetative period. Economic indicators are calculated yield per hectare and percentage of first, second and third class. All the options apply a uniform technology of cultivation. The harvesting of tobacco is performed on whole plants and the air curing is performed in a heating base of TTPI. Field trials are set according to the methodology of Zapryanov and Dimova (1995).

The explored variants are compared each other and Burley 21 variety was used as standard for Burley tobacco to 2010. Mathematical treatment of the data is made to the accompanying products SPSS 20. Experimental data are processed by a process of analysis of variance (Anova), a difference between the variant are established by ranking test of Dunkan (1995).

## RESULTS AND DISCUSSION

### I. Biological traits
### 1. Biometric traits

The data obtained from the biometric measurements presented in Table 1 revealed that the highest height of the plants was measured in variety Burley Menyleaves, and second after it is variety North Carolina 2. The lowest height has variety Burley 16. Variety Burley Menyleaves is characterized by a plant height that is too large for the variety group. All other variants have optimal values for Burley tobacco.

In unison with the highest plant height, the largest number of leaves has variety Burley Menyleaves - 37 leaves. By this indicator it is very much superior compared to the other varieties. The male-sterile variety North Carolina 2 is second ranked with 33 leaves. The hybrid variety North 3 Carolina also has good data on this indicator (Table 1).

Table 1. Data from biometric indicators of studied variants average for the period of study

| Variety | Height in cm | Number of leaves | Length of 7 leaf in cm | Width of 7 leaf in cm | Length of 13 leaf in cm | Width of 13 leaf in cm | Vegetative period in days |
|---|---|---|---|---|---|---|---|
| Burley 21 | 167.3$^{d}$ | 27.3$^{cd}$ | 58.5$^{b}$ | 29.7$^{b}$ | 61.2$^{bc}$ | 30.8$^{b}$ | 80$^{bcde}$ |
| Manyleaves | 192.2$^{a}$ | 37$_{a}$ | 55.4$^{f}$ | 25.6$^{e}$ | 56.8$^{e}$ | 27.6$^{c}$ | 93$^{a}$ |
| Burley 64 | 163.8$^{e}$ | 26.8$^{cd}$ | 58.3$^{cd}$ | 30.8$^{bc}$ | 61b$^{c}$ | 31.7$^{ab}$ | 77$^{defg}$ |
| NC 2 | 184.7$^{b}$ | 33.4$^{b}$ | 57.7$^{a}$ | 30.1$^{ab}$ | 61.8$^{b}$ | 32.6$^{a}$ | 90$^{a}$ |
| NC 3 | 175.2$^{c}$ | 29.3$^{c}$ | 61.8$^{b}$ | 32.8$^{a}$ | 64.8$^{a}$ | 33.3$^{a}$ | 82$^{bcd}$ |
| R - 610 | 172.5$^{cd}$ | 28.2$^{c}$ | 60$^{bc}$ | 32.2$^{ab}$ | 62.1$^{b}$ | 32.6$^{a}$ | 84$^{bc}$ |
| PF- 561 | 168.2$^{d}$ | 27.4$^{cd}$ | 59.3$^{c}$ | 31.5$^{b}$ | 60.7$^{bc}$ | 32$^{ab}$ | 85$^{b}$ |
| Burley 440 | 164.6$^{de}$ | 25.3$^{de}$ | 57.8$^{de}$ | 30.2$^{cd}$ | 60$^{cd}$ | 30.7$^{b}$ | 75$^{efgh}$ |
| Burley 16 | 154.8$^{g}$ | 23.7$^{ef}$ | 61.4$^{b}$ | 31.6$^{b}$ | 60.5$^{bcd}$ | 30.6$^{b}$ | 69$^{j}$ |
| Kentucky 14 | 162.2$^{ef}$ | 24.5$^{def}$ | 58.8$^{cd}$ | 29.7$^{cd}$ | 60.2$^{cd}$ | 31.2$^{ab}$ | 79$^{cdef}$ |
| Kentucky 17 | 166$^{de}$ | 25.8$^{de}$ | 59.4$^{c}$ | 30.5$^{bcd}$ | 60.8$^{bc}$ | 31.7$^{ab}$ | 77$^{defg}$ |
| Kentucky 35 | 168.4$^{d}$ | 27$^{cd}$ | 60.6$^{bc}$ | 31.7$_{b}$ | 62.6$^{ab}$ | 33$^{a}$ | 76$^{efgh}$ |
| Burley Va 09 | 167.4$^{d}$ | 27.4$^{cd}$ | 60.3$^{bc}$ | 31.8$^{b}$ | 62.7$^{ab}$ | 32.8$^{a}$ | 75$^{efgh}$ |
| Burley Va 28 | 164.8$^{de}$ | 25.8$^{de}$ | 58.7$^{cd}$ | 30.2$^{cd}$ | 61b$^{c}$ | 30.8$^{b}$ | 79$^{cdef}$ |
| Chulinec | 165.5$^{de}$ | 26.1$^{d}$ | 58.5$^{cd}$ | 29.7$^{cd}$ | 61.3$^{bc}$ | 31.2$^{ab}$ | 76$^{efgh}$ |
| NCBH 129 | 168.3$^{d}$ | 26.6$^{d}$ | 60.2$^{bc}$ | 31.2$^{bc}$ | 62.5$^{ab}$ | 32.5$^{a}$ | 75$^{fgh}$ |
| Burley NSZ | 162.4$^{ef}$ | 24.8$^{de}$ | 58$^{cde}$ | 29.3$^{d}$ | 61.4$^{bc}$ | 32$^{ab}$ | 72$^{hij}$ |
| Burley 100 | 160.3$^{f}$ | 24.6$^{def}$ | 57.6$^{de}$ | 29$^{d}$ | 61.7$^{b}$ | 32.3$^{a}$ | 73$^{hij}$ |
| E 531 | 161$^{ef}$ | 24.2$^{ef}$ | 64.6$^{a}$ | 33.4$^{a}$ | 62$^{b}$ | 31.7$^{ab}$ | 71$^{ij}$ |
| BB 163 RSR | 165.7$^{de}$ | 26.2$^{d}$ | 59.7$^{c}$ | 30.7$^{bc}$ | 62.4$^{ab}$ | 32.3$^{a}$ | 74$^{ghij}$ |
| LSD $_{5\%}$ | 5.7 | 2.8 | 2.4 | 2.2 | 2.6 | 2.3 | 5 |

Varieties Burley Menyleaves and Burley Va 509 can successfully be used in breeding programs to increase the number of leaves in newly selected Burley tobacco varieties and lines.

Regarding the length of the leaves of the lower harvesting belt the best result shows variety E -531 significantly superior compared to other variants. Second is variety North Carolina 3. Most variants are superior compared to the control variety Burley 21 (Table 1).

Variety Burley Menyleaves was too short regarding the varietal trait length of leaves from the lower harvesting belt. The other varieties satisfy the selection requirements for this indicator.

And by the trait width of the leaves, variety Burley E-531 stands out as largest, again followed by the variety North Carolina 3. Burley E -531 variety has the largest leaf size in the lower harvesting belt, followed by the variety North Carolina 3 (Table 1).

Most variants outperformed the control variety by this indicator. With the exception of the variety Burley Menyleaves, which has too narrow leaves in the lower harvesting belt, all other variants give good indicators of leaf width in the lower harvesting belt.

Regarding the length of the leaves in the middle harvesting belt, the largest length was measured in North Carolina 3 variety, which is far superior to the other options. Second and third with a slight difference are Burley Va 509 variety and Kentucky 35 (Table 1).

Burley Menyleaves variety leaves were the shortest for the varietal characteristic length of leaves from the middle harvesting belt. The other options satisfy the selection requirements for this indicator. Most variants are superior to the control variety Burley 21 regarding this characteristic.

For the trait leaf width of the middle harvesting belt, the highest values are measured in variety North Carolina 3, which is far superior to the other variants. Second and third with a slight difference are the Kentucky 35 and Burley Va 509 (Table 1).

And by this indicator, in variety Burley Menyleaves are measured the smallest values. The other options satisfy the selection requirements for this indicator. Most variants are superior compared to the control Burley 21 in leaf width.

With the exception of variety Burley Menyleaves, the obtained results in other variants in terms of leaf size, are relatively favorable. North Carolina 3 is the variety with the largest plant leaves.

Varieties E-531, Burley Va 509, Kentucky 35 and BB 163 RSR may be used as donors to increase leaf sizes in Burley tobacco in breeding programs.

The biometric data of varieties Burley 21 and Burley 64 are similar. Variety Burley Menyleaves has the largest number of leaves, but they have the smallest dimensions. The best biometric data from an economic standpoint have varieties North Carolina 3, partly Burley Va 509 and Kentucky 35.

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**2. Length of growing period**

The data obtained from the phenological observations show that variety Burley 16 is represented by the the shortest growing period - 69 days, and varieties Burley Menyleaves and North Carolina 2 by the longest - 91 and 90 days respectively. The first variety is characterized by too short, and the other two by too long growing period. The other two male sterile varieties also are developed in a longer growing period (Table 1).

Although a hybrid variety, North Carolina 3 is characterized by a relatively long growing period. The remaining varieties are characterized by a shorter vegetative period than the standard variety Burley 2 (Table 1).

Variety Burley 16 can be used for hybridization in breeding programs, as a donor for shortening the length of the vegetative period, and variety Burley Menyleaves - for its extension.

**II. Economical indicators**

The results presented in Table 2 show that the highest yield of 3420 kg/ha has variety Burley Menyleaves, which compared to the standard variety Burley 21 is 25% higher. This yield is due to the large number of leaves. North Carolina 3 is ranked as second, outperforming the standard variety by 15%. The yield in varieties Kentucky 17 and Kentucky 35 is over 3000 kg/ha. Half of the examined varieties have higher yield compared to the standard variety. The lowest yield has variety Burley 16 (Table 2).

The highest percentage of first class is presented in varieties Burley Va 509 and NCBH 129.

Table 2. Yield and percentage of classes of the studied variants and percentage of the standard Burley 21 variety average for the period of study

| Variety/line | Yield kg/ha | Percentage of standard | Classes in % | | |
|---|---|---|---|---|---|
| | | | I | II | III |
| Burley 21 | 2723$^{ef}$ | 100 | 33 | 49 | 18 |
| Manyleaves | 3423$^{a}$ | 125,7 | 4 | 54 | 42 |
| Burley 64 | 2871$^{d}$ | 105,4 | 27 | 56 | 17 |
| NC 2 | 2987$^{c}$ | 109,7 | 11 | 70 | 19 |
| NC 3 | 3140$^{b}$ | 115,3 | 32 | 52 | 16 |
| R - 610 | 2613$^{gh}$ | 95,7 | 21 | 63 | 16 |
| PF- 561 | 2527$^{i}$ | 92,8 | 19 | 64 | 17 |
| Burley 440 | 2673$^{fg}$ | 98,2 | 20 | 69 | 11 |
| Burley 16 | 2551$^{hi}$ | 93,7 | 17 | 66 | 17 |
| Kentucky 14 | 2643$^{g}$ | 97,1 | 22 | 63 | 14 |
| Kentucky 17 | 3083$^{bc}$ | 113,2 | 27 | 63 | 10 |
| Kentucky 35 | 3007$^{c}$ | 110,4 | 29 | 60 | 11 |
| Burley Va 509 | 2850$^{d}$ | 104,7 | 34 | 54 | 12 |
| Burley Va 528 | 2763$^{e}$ | 101,5 | 25 | 61 | 14 |
| Chulinec | 2827$^{de}$ | 103,8 | 23 | 65 | 12 |
| NCBH 129 | 2787$^{e}$ | 102,4 | 31 | 58 | 11 |
| Burley NSZ | 2581$^{h}$ | 94,8 | 27 | 56 | 15 |
| Burley 100 | 2703$^{f}$ | 99,3 | 19 | 63 | 18 |
| E 531 | 2663$^{fg}$ | 97,8 | 21 | 66 | 13 |
| BB 163 RSR | 2777f$^{g}$ | 97,6 | 34 | 55 | 9 |
| LSD $_{5\%}$ | 8,3 | | | | |

These two varieties are the only ones that slightly exceed the control variety Burley 21 in the percentage of the first class, and the other varieties show significant differences compared to the control. With the lowest percentage of the first class is the highest-yielding variety - Burley Menyleaves. It is also the variety with the highest percentage of third class and generally the variety with the lowest quality. In most varieties, the percentage of the first class is too low.

The lowest percentage of first class has the highest-yielding variety - Burley Multiple. It is also the variety with the highest percentage of third class and generally the variant with the lowest quality. In most variants, the percentage of the first class is too low.

Overall, yield for the tested varieties is found to be satisfactory. However, in terms of percentage of classes, the results of most of them do not meet Burley's tobacco standards. The results that we obtained for the most of the traits have lower values compared with those obtained by American authors, who studied some of these varieties in the United States (Calvert et al., 2000; Donald, 2000; Hoyt et al., 2004; Moore, 2004; Palmer et al., 2007; Pearce et al., 2014; Sasscer, 1996; Smith and Whitley, 2004; Snell, 2006; Wilkinson et al., 2002), but they are largely analogous to those of Mutafchieva (2009).

None of the options examined met the requirements of IASAS (Executive Agency for Seed Testing, Approbation and Seed Inspection) for presentation as a new Burley tobacco. As a result of a comprehensive evaluation of the studied traits, donors of valuable biological qualities are selected for use in hybridization to create new Burley tobacco varieties.

## CONCLUSIONS

1. From the economic point of view, best biometric characteristics have varieties North Carolina 3, Burley Va 509 and Kentucky 35.
2. Variety Burley 16 has the shortest growing period and varieties Burley Menyleaves and North Carolina 2 the longest. All tested varieties are presented with a shorter vegetative period than the control Burley 21, which is an advantage.
3. The highest yield is represented by Menyleaves variety, and the highest percentage of the first class have varieties Va 509 and NCBH 129.
4. The complex evaluation of the results showed that varieties North Carolina 3, Kentucky 35, Burley Va 509 and NCBH 129 stand out by the best economic and biological characteristics.
5. Donors of valuable biologic properties are established to be used as a component in hybridization to create new varieties of Burley tobacco.

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# QUANTITATIVE PROPERTIES OF SEMI-ORIENTAL TOBACCO VARIETIES IN 2019

Karolina Kochoska

*University "St. Kliment Ohridski" - Bitola, Scientific Tobacco Institute- Prilep, Kicevska, bb, 700 Prilep, Republic of North Macedonia*
*e-mail: karolina.kocoska@uklo.edu.mk*

## ABSTRACT

The Department of genetics, selection and seed control at Scientific Tobacco Institute-Prilep has been working on maintenance of the existing collection of already created varieties.
In 2019, the quantitative properties of three semi-oriental varieties were examined: O. 9-18/2 check, O. 110 and O. Zlatovrv. These varieties are creations of Scientific Tobacco Institute - Prilep. Seedling and field production of the mentioned varieties and lines was performed in the experimental field of STI-Prilep. The trial was set up using the method of randomized blocks in seven replications. The aim of the study was to show the quantitative properties: length of growing period, height of stalk, number of leaves, length and width of true middle and under top leaf.
As a result of intensive breeding of this tobacco type, varieties O. 110 and O. Zlatovrv have their own characteristic morpho-biological properties. Characteristic for the semi-oriental tobacco type.

**Key-words:** tobacco,semi-oriental, varieties, morpho-biological.

# КВАНТИТАТИВНИ СВОЈСТВА НА ПОЛУОРИЕНТАЛСКИ СОРТИ ТУТУН ВО 2019 ГОДИНА

Во Научниот Институт за тутун – Прилеп во Одделението за генетика селекција и семеконтрола постоечката колекција постојано се одржува со веќе создадените сорти.
Во 2019 година беа испитувани квнтитативните својства на три полуориенталски сорти: О. 9-18/2 контрола, сортата О. 110 и О. Златоврв сите креации на Научниот институт за тутун – Прилеп. Расадското и нивското производство на наведените сорти и линии беше изведено во опитното поле на НИТ-Прилеп. Опитот беше поставен по методот на Случаен блок систем систем во 7 повторувања. Целта на испитувањето ни беше да се прикажат квантитативните својства: должина на вегетација, висина на страк, број на листови, должина и ширина на вистински среден и подврвен лист.
Како резултат на интензивното оплеменување на овој тип тутун, сортите О. 110 и О. Златоврв се одликуваа со со свои карактеристични морфолошко - биолошки, кои се карактеристични за полуориенталски тип тутун.

**Клучни зборови:** тутун, полуориенталски, сорти, морфо-биолошки

## INTRODUCTION

Semi-oriental tobaccos belong to the group of additional tobacco types. They are characterized by low midrib content, good manufacturing yield and good taste while smoking. By increasing the production, especially of the newly created varieties which are characterized by better yield and quantitative traits, higher economic effect can be achieved in cigarette manufacture. Therefore, semi-oriental tobaccos should be present in higher amounts in cigarette blends. As an additional type of tobacco, semi-oriental tobaccos are characterized by delicate leaf tissue, lower percentage of participation in the main leaf rib and good manufacturing yield. In fabrication, this tobacco type has a special use value of neutral tobacco raw material and is characterized by full, sweet to neutral taste, which does not burn or scratch the throat when smoking. One of the first semi-oriental types of tobacco is Otlja. It is assumed that it was transported to our country from Poroj (Greece). It got its name from the village Otlja, which is located near Kumanovo, where it was mostly produced. The most famous and widespread variety of the local varieties of this tobacco type was Otlja 9-18/2. This variety was selected by R. Gornik. Other semi-oriental varieties that are recognized by the Commission for variety registration at the Ministry of Agriculture, Forestry and Water Economy and grown in Macedonia are: Otlja 87, Otlja 110-88/3, Maja 36 and O. Zalatovrv, recognized in 2010. In 2019, VCU test of varieties O. 110 and O. Zlatovrv was made. The results were submitted to the Ministry of Agriculture, Forestry and Water Economy. If we take into account the favourable conditions in North Macedonia, the heterogeneous composition of the soil, relief and climatic conditions, this tobacco type can be re-introduced by planned production and used as tobacco for filling. Dimitrieski (2004) states that the range of distribution of one tobacco type or variety is determined within the limits of certain soil and climatic conditions. Utilization of the maximum biological potential of the type i.e. variety and obtaining high quality tobacco raw material is possible only in certain environmental conditions and by applying the necessary modern cultural practices. Filiposki et al. (1992) state that, according to the physical properties, the soils in Prilep region that are covered by the hydro system Prilepsko pole, are easy to cultivate and are fully suitable for the production of small-leaf and semi-oriental tobacco.

## MATERIAL AND METHODS

Investigations were carried in the experimental field at Scientific Tobacco Institute-Prilep, in 2019. Three semi-oriental varieties were included as material for examination: Otlja 9-18/2 standard (Figure 1), Otlja 110 (Figure 2) and O. Zlatovrv (Figure 3). The method of random-block system was used. The trial was set up in seven replications at a row spacing of 50cm×25cm, area of calculated plot 3.25 $m^2$ and total plot area 3.4 $m^2$. The seedlings were produced in the usual way in cold prepared seedbeds, covered with polyethylene fabric, in the nursery of Scientific Tobacco Institute-Prilep. During the investigations, elite seed material from the mentioned varieties and lines was used. The necessary cultural practices were applied in the field in order to get a healthy and normally developed seedling: machine fertilization with NPK (8:22:20) - 300 kg/ha. During the growing season the experiment was irrigated three times. Gornik (1973) points out that the type and variety of tobacco are inextricably linked. It is therefore important not only to know in detail the properties of a particular tobacco type, but also the potential of the variety for a particular tobacco type, under appropriate environmental conditions.

During the growing season we observed the following biological properties of the varieties:

beginning of flowering, 50% flowering and 100% flowering. Following morphological properties were examined on 10 plants, typical representatives of the variety: height of the plant, number of leaves per plant and length and width of the leaves (true middle and under top leaf). The results were statistically processed and tested with LSD method. (Najceska, 2002; Filiposki, 2011).


Figure 1. Otlja 9-18/2 standard


Figure 2. Otlja 110


Figure 3. O. Zlatovrv

## RESULTS AND DISCUSSION

### Length of the growing period of tobacco

Table 1 provides data on the length of the growing period. The shortest vegetation period has the standard variety Otlja 9-18/2, i.e. beginning of flowering in 40 days, 50% flowering in 45 days and 100% flowering is registered in 65 days. Varieties O. 110 and O. Zlatovrv have a slightly longer growing period. Variety O. Zlatovrv is characterized by the longest growing period. The beginning of flowering in this variety was registered in 73 days, 50% flowering was in 79 days and 100% flowering in 86 days. The relative difference compared to the control is 32.31% larger.

In 2001 and 2002 it was stated that the length of time from planting to the beginning of flowering ranges from 51 days in the standard variety (Otlja 9 - 18/2) to 78 days in O. Zlatovrv, Kochoska (2006). The length of the growing period from seedling to 50% flowering ranges from 55 days in the standard variety (Otlja 9 - 18/2) to 86 days in O. Zlatovrv. According to the obtained data (Table 1), we conclude that the variety O. 110 and O. Zlatovrv have a longer growing period compared to the standard variety.

Table 1. Length of the growing period from the beginning of flowering to 100% flowering in semi-oriental tobacco varieties.

| Varieties | Beginning of the flowering from transplanting date in days | Absolute difference from the average | Relative difference from the average | 50% flowering from transplanting date in days | Absolute difference from the average | Relative difference from the average | 100% flowering from transplanting date in days | Absolute difference from the average | Relative difference from the average |
|---|---|---|---|---|---|---|---|---|---|
| O . 9-18/2Ø | 40 | / | 100.00 | 45 | / | 100.00 | 65 | / | / |
| O. 110 | 65 | +15 | 162.5 | 70 | +25 | 155.55 | 75 | +10 | 115.38 |
| O. Zlatovrv | 73 | +23 | 182.5 | 79 | +34 | 175.55 | 86 | +21 | 132.31 |

### Plant height and number of leaves

Plant height is a variable property, which moves within certain limits that are constant and characteristic for certain types and varieties. In the examinations (Table 2), the height of the whole plant, together with the inflorescence was taken into account. According to the measurements, the lowest height was measured in standard variety Otlja 9-18/2 (102.6 cm) and the highest average height in variety O. Zlatovrv (175cm), which is characterized by relative difference of 70.57% compared to the check variety. Variety O. 110 has an average height of 127cm and a relative difference of 23.78% compared to the control variety. Varieties O. 110 and O. Zlatovrv showed a statistical significance of 1% compared to the standard variety. Uzunoski (1985) states that the height of the plants of the standard variety O. 9-18/2 ranges from 50-70 cm, and at high Otlja it ranges from 80-100 cm.

Kochoska (2006) states that the height of the plants in the irrigated variant of the type Otlja ranges from 82.5 cm in the standard variety Otlja 9-18/2 to 166.1cm in O. Zlatovrv. The number of leaves varies depending on the

variety, the growing conditions and the applied cultural practices within the genetic potential of the tobacco variety Atanasov (1962). Lowest average number of leaves has standard variety Otlja 9-18/2 (29), and the largest number of leaves has variety O.110 (40), whose relative difference is 35.49% higher than the check variety. Variety O. Zlatovrv has an average number of leaves 35, and a relative difference of 18.43% higher compared to the check variety. Regarding the number of leaves, only variety O. 110 showed a statistical difference of 1% compared to the check variety. Uzunoski (1985) points out that the number of leaves on a plant varies between different varieties from 10 to 70 and more. According to Uzunoski, cultivated tobacco varieties can be grouped into three groups regarding the number of leaves: group with a small number of leaves (up to 22), group with a medium number of leaves (23-35) and group with a large number of leaves (over 35 leaves). The examined variety Otlja 9-18/2 can be classified in the group with medium number of leaves, the other two varieties O. 110 and O. Zlatovrv are classified in the group of varieties with a large number of leaves.

Table 2. Stalk height in semi-oriental varieties with inflorescence and number of stalk leaves

| Varieties | Height of the stalk with inflorescene in cm | Absolute difference from the average | Relative difference from the average | Rank | Number of leaves | Absolute difference from the average | Rresult from the average | Rank |
|---|---|---|---|---|---|---|---|---|
| O. 9-18/2 Ø | 102.6 | / | 100.00 | 3 | 30 | / | 100.00 | 3 |
| O. 110 | 127 | +24.4** | 123.78 | 2 | 40** | +10.4 | 135.49 | 1 |
| O. Zlatovrv | 175 | +72.4** | 170.57 | 1 | 35 | +5.4 | 118.43 | 2 |
| | | Height of the stalk | | | Number of leaves | | | |
| LSD | | 5% * = 2.06 cm<br>1% **= 2.89 cm | | | | 5% * = 5.80 cm<br>1% ** = 8.15 cm | | |

## Length and width of the true middle and under top leaf

The size of the leaf is the length and width of the leaves. These two indicators depend on the variety and the method of cultivation. According to the data in Table 3, variety O. 110 (36 cm long and 22.7 cm wide) is characterized by the smallest length and width of the true middle leaf. Variety O. Zlatovrv is characterized by the greatest length and width of the true middle leaf (length 45.1 cm and width 28.8 cm). Only variety O. Zlatovrv showed statistical significance of 1% compared to the check variety for the property length of the true middle leaf.

According to Kocoska (2006), the smallest length of the true middle leaf has the line O. 61- 9/2 (26.9 cm), and the largest O. Zlatovrv 33.2 cm. The smallest width of the true middle leaf has O. 9-75/7 (16.9cm), and the largest width has O. Zlatovrv (19.0cm). According to Chushkaroski (1983), regarding the length of the leaves per belt in type Otlja, middle belt leaves are the longest.

Table 3. Length and width of the true middle leaf

| Variety | Length of the true middle leaf | | | | Width of the true middle leaf | | | |
|---|---|---|---|---|---|---|---|---|
| | in cm | Absolute difference cm | Relative difference % | Rank | in cm | Absolute difference cm | Relative difference % | Rank |
| O. 9-18/2 Ø | 37.3 | / | 100.00 | 2 | 26.4 | / | 100.00 | 2 |
| O. 110 | 36.0 | -1.3 | 96.51 | 3 | 22.7* | -4.0 | 85.98 | 3 |
| O. Zlatovrv | 45.1 | +7.8** | 120.91 | 1 | 28.8 | +2.4 | 109.09 | 1 |
| | length of the true middle leaf | | | | width of the true middle leaf | | | |
| LSD | 5% * = 2.31 cm<br>1% ** = 3.29 cm | | | | 5% * = 3.09 cm<br>1% ** = 4.34 cm | | | |

The smallest length and width of the under top leaf was observed in variety O. 110 (20.7 cm long and 12.8 cm wide) and the greatest in variety O. Zlatovrv (27.0 cm long and 17 cm wide).

According to Dimitrieski et al. (2004), the length of the under top leaf in green condition ranges from 16.4 cm in the standard variety Otlja 9-18/2 to 18.0 cm in O. Zlatovrv.

Table 4. Length and width of the under top leaf

| Variety | Length of the under top leaf | | | | Width of the under top leaf | | | |
|---|---|---|---|---|---|---|---|---|
| | in cm | Absolute difference cm | Relative difference % | Rank | in cm | Absolute difference cm | Relative difference % | Rank |
| O. 9-18/2 Ø | 24.2 | / | 100.0 | 2 | 15.0 | / | 100.00 | 2 |
| O. 110 | 20.7 | -3.5 | 85.54 | 3 | 12.8 | -2.2 | 85.33 | 3 |
| O. Zlatovrv | 27.0** | +2.8 | 111.57 | 1 | 17.0** | +2.0 | 113.33 | 1 |
| | Length of the under top leaf | | | | Width of the under top leaf | | | |
| LSD | 5% * = 1.40 cm<br>1% ** = 1.97 cm | | | | 5% * = 1.24 cm<br>1% ** = 1.74 cm | | | |

## CONCLUSIONS

Based on the data obtained from the one-year examination of the three semi-oriental varieties, we can make the following conclusions:

- Standard variety Otlja 9-18/2 is characterized by the shortest growing period i.e. beginning of flowering in 40 days, 50% flowering in 45 days and 100% flowering in 65 days. Variety O. Zlatovrv is characterized by the longest growing period i.e. beginning of flowering in 73 days, 50% flowering in 79 days and 100% flowering in 86 days.
- The height of both varieties O. 110 and O. Zlatovrv is greater compared to the check variety. According to the measurements, the lowest height has standard variety Otlja 9-18/2 (102.6cm), while the highest average height has variety O. Zlatovrv (175cm).
- According to the number of leaves, standard variety Otlja 9. 18/2 is characterized by the lowest average number of leaves (30), and the variety O. 110 by the largest number of leaves (40). Variety O. Zlatovrv has an average number of 35 leaves.
- The smallest length and width of the true middle leaf has variety O. 110 (36cm long and 22.7cm wide), and the greatest length and width of the true middle leaf has variety O. Zlatovrv (length 45.1cm and width 28.8cm).
- The length and width of the under top leaf is the smallest in variety O.110 (20.7cm long and 12.8cm wide) and the largest in variety O. Zlatovrv (27cm long and 17cm wide).
- From the obtained data we can conclude that as a result of intensive breeding of this tobacco type, varieties O. 110 and O. Zlatovrv have their own morpho-biological properties compared to the check variety, that are characteristic of semi-oriental type of tobacco.

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# MONITORING OF *HELICOVERPA ARMIGERA* USING PHEROMONE TRAPS

Vesna Krsteska

*University "St. Kliment Ohridski" - Bitola, Scientific Tobacco Institute- Prilep, Kicevska, bb, 700 Prilep, Republic of North Macedonia*
*e-mail: vkrsteska@yahoo.com*

## ABSTRACT

Pheromone traps are widely used in numerous pest insects for monitoring purposes. *Helicoverpa armigera* is an important pest of tobacco. For detecting initial population and monitoring of flight dynamics of *H. armigera* on tobacco (2019/2020) were used sticky, sex pheromone traps- RAG.
During tobacco vegetation starting date for males trapping is beginning of July. Usual flight pattern on tobacco is during July, August and September. Determining of the greater number of moths indicate when inspections of pest's immature stages on tobacco plant need to be more frequent and consequently when to start with pest control measures. A total of 108 adults were caught in 2019 and 79 in 2020. Four peaks of population per year are determined.
Pheromone traps can be of great help in predicting potentially severe infestations of a given pest at a designated location in the same year, and timely implementation of plant protection measures on tobacco.

**Key words:** *H. armigera,* tobacco, pheromone traps

# СЛЕДЕЊЕ НА *HELICOVERPA ARMIGERA* СО ПОМОШ НА ФЕРОМОНСКИ ЛОВИЛКИ

Феромонските ловилки наоѓаат широка примена при мониторингот на штетните видови на инсекти. *Helicoverpa armigera* е значаен штетник на тутунот. Заради откривање на првичната популација и следењето на динамиката на летот на *H. armigera* на тутунот (2019/2020) се користеа лепливи, сексуални феромонски стапици- RAG.
За време на вегетацијата на тутунот, времето на започнување на ловење на мажјаците е почетокот на јули. Вообичаената шема на летање на тутунот е во јули, август и септември. Утврдувањето на поголем број на молци во феромонските ловилки наведува кога инспекциите на незрелите стадиуми од штетникот на тутунските растенија треба да бидат почести, следствено, кога да се започне со мерките за контрола на штетникот. Вкупно 108 возрасни беа фатени во 2019 година и 79 во 2020 година. Четири пикови на популацијата се утврдени годишно.
Феромонските стапици можат да бидат од голема помош во предвидување на потенцијално сериозните наезда на одреден штетник, на одредена локација во истата година, и за навремено спроведување на мерките за заштита на растенијата врз тутунот.

**Клучни зборови:** *H. armigera,* тутун, феромонски ловилки

## INTRODUCTION

The tobacco (cotton) bollworm, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae), is among polyphagous insect pest of many economically important crops worldwide (Camprag and Sekulic, 2002; Camprag et al., 2004; Fitt, 1989; Krsteska et al., 2007; Krsteska, 2019; Lammers and MacLeod, 2007; Zalucki et al., 1994).

*H. armigera* is an important pest of tobacco plants causing damages to the buds, flowers, top leaves especially severe damages it can made on tobacco seed (Krsteska et al., 2007, 2016).

The moth is a typical migrating species. The adults fly long distances, and these can be tracked by radar (Krsteska et al., 2014, 2015).

Males and females can be detected by using sex pheromone traps, light traps (Krsteska and Stojanoski, 2016; Vasilev et al., 1996).

Sex pheromones have been proclaimed throughout the technologically advanced regions of the world as having great potential for managing insect pests through manipulation of their mating behavior; annihilation by mass trapping; and monitoring and surveys which facilitate control through early detection of pests allowing the timely application of pesticides (Mitchell, 1986).

Pheromones are increasingly efficient at low population densities, they do not adversely affect natural enemies, and therefore they can bring about a long-term reduction in insect populations that cannot be accomplished with conventional insecticides (Witzgall et al., 2010).

## MATERIAL AND METHODS OF WORK

The investigation was carried out in the experimental field of Scientific tobacco institute in Prilep on a standard variety "P66", during tobacco vegetations in 2019 and 2020.

The male moths of *H. armigera* are monitored by using sticky, sex pheromone traps (RAG, Csalomon®).

The plastic trap has the shape of a triangular prism, and in field condition it is installed on wire (hanging on the tree). The bottom sticky liner is 16.5 cm long and 11 cm wide. Pheromone baits are fastened with cotter pin in the top-middle part of plastic trap, on 8-cm space in between the lure and sticky liner.

Two traps were placed, or one trap on every two hectares of tobacco fields with homogeneous lands.

The pheromone traps are placed up the level of the top of the tobacco vegetation, at 1.5 meter height from the ground. The traps are set up on the branches of bushes or trees near fields because moths prefer to aggregate in hedges along the edge of open fields.

During the investigation, trapped adult male moths were collected at three-day intervals.

Pheromone lures are very sensitive tool. They can be affected by field exposure on actual weather conditions (heat and direct sunshine) and pheromone trap starts slowly to decrease its attractive activity (after 4-6 weeks).

During the investigation, the lure (rubber septum with pheromone baits) was changed after month to get the most accurate results.

The bait contains the female sex hormone and direct trap's touching by hand may cause repellent effect reducing trap catch.

The sticky liner was changed after every 15 days. The sticky insert can become saturated with captured specimens within a relatively short period at high population densities, so frequent renewal of sticky inserts was necessary.

Pheromone traps were controlled from July 1 until October 1 both years.

## RESULTS AND DISCUSSION

*Helicoverpa armigera* Hüebner, 1809 (Lepidoptera: Noctuidae), is successfully developed on tobacco plants. The larvae feed on reproductive organs of tobacco plants, where they cause serious damages. Flower buds and flowers are damaged, bore holes are visible at the base of flower buds, and they may fall. Larger larvae enter into the seed capsules and consume developing seed (Figure 1). Every year, the larvae of *H. armigera* cause substantial quantitative and qualitative losses. In severe infestations larvae, may destroy them completely: flower buds, flowers, seed with capsules also top leaves (leaving only the main veins). Secondary fungal infection which enters through the feeding holes can lead to rotting.

Figure 1. Larva of *H. armigera*

*H. armigera* is a polyphagous species and it is a widespread species throughout the territory of our country. The moth is nocturnal, migratory and disperse rapidly on many types of weeds and crops, including tobacco (Figure 2).

Figure 2. *H. armigera* male moth

For management of tobacco bollworm greater attention should be paid on biological parameters of *H. armigera*, including adult movement. Monitoring of *H. armigera* moths by use of sex pheromone traps was conducted from summer to fall in 2019 and 2020. Male moths were collected at three-day intervals and processed in laboratory conditions. The sticky, sex pheromone traps (RAG, Csalomon®) capture only male moths (Figure 3 and 4).

Figure 3. Captured moth with sticky, sex pheromone trap

Figure 4. Captured moth with sticky, sex pheromone trap

Pheromone traps are sensitive tools to detect initial populations of *H. armigera*. On tobacco field usual starting date for trapping of tobacco bollworm is beginning of July (Table 1).

In 2019 the first moths were captured by the pheromone traps on July 4. From July 10 to July 15, 2019, in a period of 6 days, 35 moths were caught and this is the first gradation of the adults' flight. Some days there was an individual appearance of moths. From July 28 until August 2 2019, a total of 20 adults were caught and this is the second peak of the *H. armigera* population. In the period from 8.09.2019 to 13.09.2019, 17 moths were caught and this is the third peak of adults' flight. In the period from 20.09.2019 to 25.09.2019, 11 adults were caught but in this period the seed is dry and *H. armigera* attack does not represent a danger to it. On 23.09.2019 the last 3 adults were caught.

Table 1. Captured moths with pheromone traps

| Date of trapping | 2019 | 2020 |
|---|---|---|
| | No of captured adults | |
| 01.07.-03.07. | - | - |
| 04.07.-06.07. | 3 | - |
| 07.07.-09.07. | - | - |
| 10.07.-12.07. | 21 | 2 |
| 13.07.-15.07. | 14 | 12 |
| 16.07.-18.07. | 3 | 3 |
| 19.07.-21.07. | 1 | 1 |
| 22.07.-24.07. | 1 | - |
| 25.07.-27.07. | 2 | 1 |
| 28.07.-30.07. | 10 | 1 |
| 31.07.-02.08. | 10 | 2 |
| 03.08.-05.08. | 3 | 4 |
| 06.08.-08.08. | 3 | 8 |
| 09.08.-11.08. | 3 | 5 |
| 12.08.-14.08. | 2 | 1 |
| 15.08.-17.08. | 1 | 1 |
| 18.08.-20.08. | - | - |
| 21.08.-23.08. | - | 2 |
| 24.08.-26.08. | 2 | 8 |
| 27.08.-29.08. | - | 1 |
| 30.08.-01.09. | - | - |
| 02.09.-04.09. | - | - |
| 05.09.-07.09. | - | 1 |
| 08.09.-10.09. | 2 | 4 |
| 11.09.-13.09. | 15 | 2 |
| 14.09.-16.09. | 1 | 11 |
| 17.09.-19.09. | - | 6 |
| 20.09.-22.09. | 8 | 3 |
| 23.09.-25.09. | 3 | - |
| 26.09.-28.09. | - | - |
| 29.09.-01.10. | - | - |
| **Total** | **108** | **79** |

The pheromone trap catch data in 2020 reveals the commencement of adult moth activity in tobacco in second decade of July (i.e. 12.07.2020). In the period 13.07 - 18.07.2020, 15 moths were caught and this is the first gradation of the adults' flight. Then in a period of about 10 days there was an individual appearance of moths. In the period from July 31 until August 5 2020, the population of *H. armigera* increased slightly, i.e. 6 adults were caught. In the period from August 6 until August 11 2020, a total of 13 moths were caught. During the second half of August tobacco plants were damaged from two heavy hailstorms. From August 24 until August 26, 2020, 8 adults were caught. From 14.09.2020 until 19.09.2020, 17 moths were registered in pheromone traps. After the inspection on September 22 2020, when the last 3 adults were caught, there was no more catch in the hunting plots until October 1.This year was less favorable for the development of the tobacco plants and also for tobacco bollworm. In the beginning of tobacco vegetation, the hunting of the first moths in the pheromone traps determines the presence of *H. armigera* in the tobacco plantations. The presence of the tobacco- bollworm cannot be easily noticed on the tobacco plants in this period. The egg is very small, 0.4 to 0.6 mm in diameter (Figure 5), and larval damages can be confused with those of the species of Orthoptera.

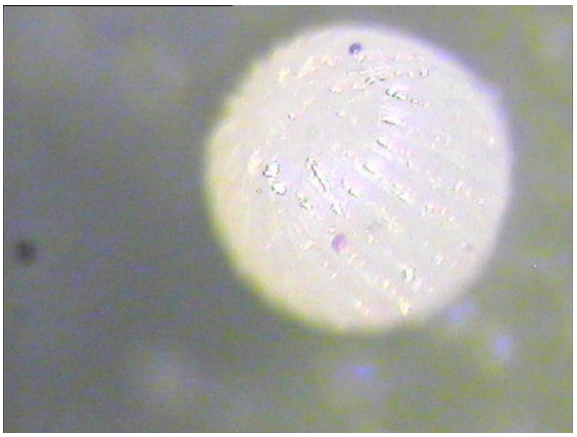

Figure 5. Egg of *H. armigera*

Therefore, the leaves should be carefully examined to determine the presence of larvae or feces (Figure 6). Determining of the greater number of moths in pheromone traps indicate when inspections of pest's immature stages on tobacco plant need to be more frequent and consequently when to start with pest control measures.

Figure 6. *H. armigera* attack on young tobacco stalk

Pheromone traps detect the flight dynamics of the tobacco bollworm throughout the tobacco vegetation. According to Graph 1 and 2 in region of Prilep, usual flight pattern on tobacco is during July, August and September. A total of 108 adults were caught in 2019 and 79 in 2020. *H. armigera* is polycyclic species and well adapted to adverse conditions. Depending on the climatic conditions, 2 to 11 generations annually have been reported (EPPO/CABI, H. armigera, 1997).

In Macedonia in hot summers several generations of *H. armigera* can develop on tobacco (Krsteska, 2019).

During tobacco vegetation, generations of *H. armigera* overlap, some moths grow on tobacco plants, some fly from surrounding crops. According to the flight dynamics, four peaks of insect population per year are determined (Figure 7 and 8).

One of the main advantages of pheromone traps is that they detect and track the actual appearance of a given pest at a designated location and in the same year, thus helping to implement the necessary plant protection decisions.

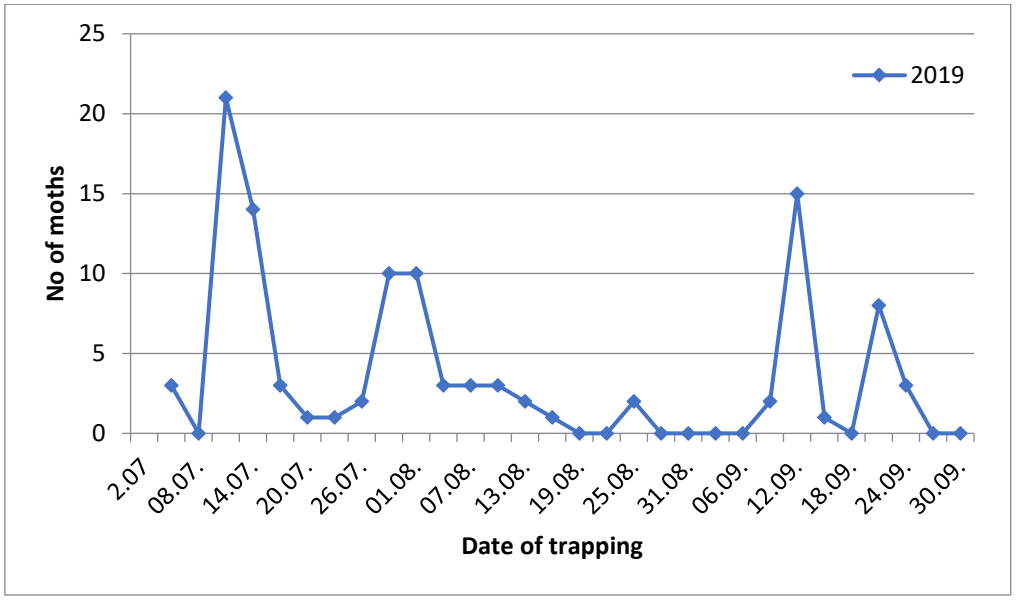


Figure 7. Flight dynamics of moths – 2019

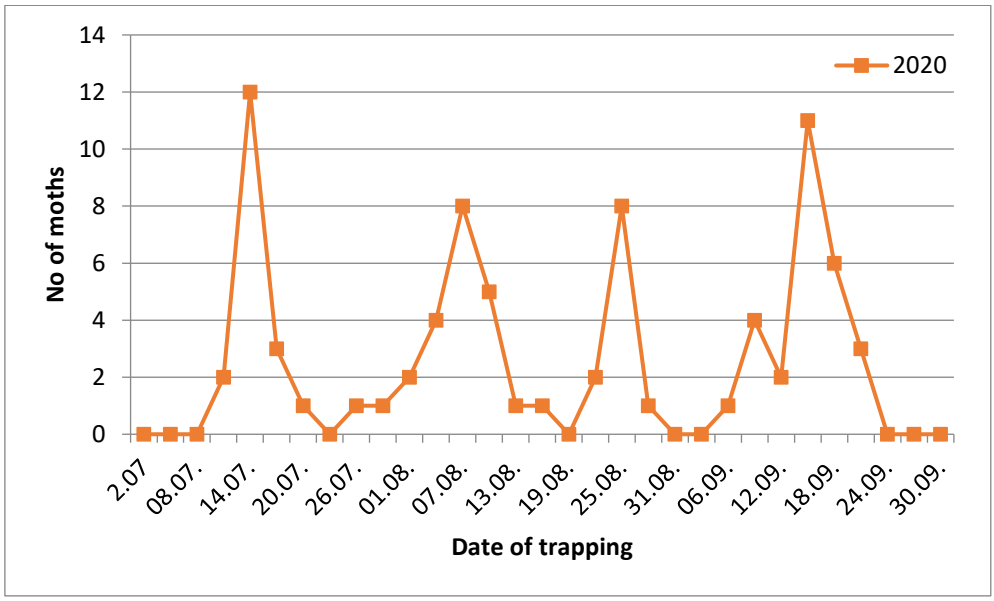


Figure 8. Flight dynamics of moths - 2020

## CONCLUSION

The larvae of *H. armigera* feed on transplanted tobacco in the fields on top leaves then on the reproductive organs of the tobacco: flower buds, flowers, and the seed causing great damage and loss of seeds.

Monitoring of *H. armigera* with pheromone traps can provide an early warning of its invasion of an area or tobacco crop.

The pheromone trap contains the female sex hormone, which attracts male pests. The pest is captured in the pheromone traps from July (when plants produce flowers) until the end of September.

Trapping *H. armigera* is useful for scouting for immature stages in the tobacco crop and timely implementation of measures for tobacco protection.

Monitoring of male moths with pheromone traps is one of the most important components in the integrated pest management of *H. armigera*.

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# EFFECTS OF DIFFERENT DOSES OF NITROGEN ON THE YIELD AND CHEMICAL FEATURES OF BASMAK AND DZEBEL TOBACCO TYPES

Valentina Pelivanoska, Biljana Jordanoska Shishkoska, Marija Srbinoska

*University "St. Kliment Ohridski" - Bitola, Scientific Tobacco Institute- Prilep, Kicevska, bb, 700 Prilep, Republic of North Macedonia*
*e-mail: valentina.pelivanoska@uklo.edu.mk*

## ABSTRACT

Three years study (2014-2016) was carried on the field experiment with three tobacco varieties of the type Basmak: Basmak MK-1, Basmak MB -1, Basmak MS-1/8 and variety of the type Dzebel. Investigation was carried out with three variants: unfertilized, fertilized with 20 kg and 30 kg nitrogen/ha and a constant amount of phosphorus (40 kg/ha) and potassium (60 kg/ha). The best effect on the yield and gross income had variant with 30 kgN/ha, in all tested varieties. The yield increase was 20.06 %, 21.64% and 27.11%, compared to unfertilized variant. The average purchase price of tobacco was increased by only 2.77 % in the variety Basmak MS-1/8, fertilized with 20 kgN/ha. In other variants slight decrease on purchase price was observed with increasing nitrogen rates. Increasing content of humus, total nitrogen and mineral matter, and decreased content of the soluble sugars is observed in all varieties treated with higher nitrogen rate.

**Key words**: tobacco, basmak and dzebel type, yield, chemical characteristics

# ЕФЕКТИ ОД РАЗЛИЧНИТЕ ДОЗИ АЗОТ ВРЗ ПРИНОСОТ И КВАЛИТЕТНИТЕ КАРАКТЕРИСТИКИ НА ТИПОВИТЕ ТУТУН БАСМАК И ЏЕБЕЛ

Беше спроведен тригодишен полски опит (2014-2016) со три сорти тутун од типот басмак: Басмак МК-1, Басмак МБ -1, Басмак МС-1/8 и една сорта од типот Џебел. Истражувањето беше изведено со три варијанти: неѓубрени, ѓубрени со 20 и 30 kg азот/ha, и константна количина на фосфор (40 kg/ha) и калиум (60 kg/ha). Највисок принос и бруто приходот е добиен кај варијантата ѓубрена со 30 kgN/ha, кај сите испитувани сорти. Приносот е зголемен за 20,06 %, 21,64 % и 27,11 %, наспроти неѓубрената варијанта. Просечната откупна цена на тутунот е зголемена за само 2,77 %, кај сортата Басмак МС-1/8, ѓубрена со 20 kgN/ha. Кај останатите варијанти е забележано мало намалување на откупната цена со зголемување на дозите на азот. Кај сите варијанти забележано е зголемување на содржината на никотинот, вкупниот азот и минералните материи и намалување на содржината на растворливите шеќери, со зголемување на дозата на азот.

**Клучни зборови**: тутун, тип басмак и џебел, принос, хемиски карактеристики

## INTRODUCTION

The Republic of Macedonia is known for the production of high quality aromatic oriental tobacco. About 90% of the total tobacco production is intended for export, making it the most important export product of the country, with a foreign exchange inflow of about 70 million euros. Tobacco is a strategic product for Macedonia from an economic, commercial, fiscal, social and demographic aspect. In the last decade, Macedonian tobacco is grown on more than 17.000 hectares, with an average production of 25.000 tons, and engages 18.6 % of the working population (about 160000 breeders). The structure of tobacco production in Macedonia consists of oriental tobacco types Prilep, Yaka and Dzebel, presented with several varieties which account for about 95% of total tobacco production (Kocoska, 2016). Of the listed types, the Prilep type dominates, and the Prilep P66 variety is the most widespread.

As a result of the increased interest of tobacco companies, in the first decade of this century, a project was started to introduce the production of a new oriental tobacco of the Basmak type. Based on the positive results of the multi-year research, several varieties of the basmak type were selected: MK-1, MB-2, MB-3, MS-8/1, etc., and placed in the national variety list.

The yield and quality of tobacco are closely related to genetic potential, soil and climatic conditions (Atanasov, 1972; Mitreski, 2012). Fertilization has an exceptional role in the nutrition of the tobacco plant, and nitrogen is the element that has the strongest influence on the ripening, drying, yield and quality of tobacco (Pelivanoska, 2009). Tobacco is particularly sensitive to the quantities of nitrogen in soil. There are many models that have been developed to predict the release of nitrogen from applied fertilizers (Cheng-Wei et al., 2014; Fan and Li, 2010; Lobell, 2007).

This very important nutrient has a positive impact on yield and quality of tobacco to a certain limit. After that, the yield can be increased but the quality of produced tobacco substantial declines (Akehurst, 1981; Kozumpli, 1986; Filiposki, 1997; Pelivanoska, 1999; Hristoski, 2007). Literary data related to the impact of mineral nutrition on the properties of the new varieties of the Basmak type are very modest, because they have not been examined.

Korubin Aleksoska (2015) conducted research on some important morphological and agronomic characteristics of Basmak type tobaccos compared to Prilep, Jaka and Dzebel varieties.

Taking into account the importance of mineral nutrition, especially nitrogen nutrition, we set ourselves the goal of examining the influence of different doses of nitrogen on the yield and some quality characteristics of the new Basmak varieties (Basmak MK-1, Basmak MB-1, Basmak MS-8/1, and a variety of the type Dzebel, as a control). The results of these research will give a certain contribution to the enrichment of the insufficient literary data and the knowledge about the newly created tobacco varieties of the type Basmak.

## MATERIAL AND METHODS

Experiment was carried out with four oriental tobacco varieties Basmak MK-1, Basmak MB-1, Basmak MS-8/1, and Dzebel $N^0$1. Investigation was conducted on colluvial soil type, in randomized complete block design with three replications, two nitrogen rates (20 and 30 kg/ha) with constant amount of phosphorus (60 kg/ha) and potassium (40 kg/ha). The total area plot is 400 $m^2$ (16,4 m x 24,4 m). In each elementary plot there are 78 stalks, planted in 4 rows (2 for harvesting, 2 for protection), with 40 x 12 cm spacing.

Soil preparation was performed with one autumn (30 cm depth) and two spring plowings (8-20 cm depth). Fertilization was done using 200 kg/ha inorganic mineral fertilizer NPK 10:30:20, and 27% KAN for top up. All necessary agro-technical and plant protection

practices were applied during the vegetation period. After the processes of yellowing and sun-curing, tobacco was graded and weighed. The content of nicotine, total nitrogen, the content of soluble sugars and mineral matter in raw tobacco were determined by standard methods in accredited laboratories of the Scientific Institute for Tobacco - Prilep. During the vegetation irrigations was made depending on the needs of the tobacco plants. Harvesting is done by hand in 5 harvests. The obtained results were statistically processed with ANOVA – LSD test.

## RESULTS AND DISCUSSION

Bearing in mind that small-leaf tobacco is usually grown on poor soils, fertilization is one of the most important agro measures for obtaining reliable production, higher yield and good quality. During this research, an analysis of the results of the effect of nitrogen amounts between the variants of each variety was performed, as well as between the variants of the Basmen varieties with the control variety Dzebel N$^0$1. The variety Dzebel N$^0$1 is used as a control, because it was the initial parent material in the selection of Basmak-type cultivars. From the obtained results for yield per unit area (Table 1), it can be seen that the varieties have the lowest yield in the non-fertilized variant, and with an increase in the amount of nitrogen, the yield of tobacco gradually increases, in each variant, respectively. Namely, at Dzebel N$^0$1 the yield increased from 3.17 to 15.90 %, at Basmak MS-8/1 from 15.26 % to 27.11%, at Basmak MV-1 from 9.59 to 21.64 % and at Basmak MK-1 from 3.36 to 20.06 %, respectively. Based on the obtained yield per unit area, it can be concluded that the Basmak MS-8/1 variety gave the best results, with an average yield of 2350 kg/ha. In the variant fertilized with N20P40K60, the Basmak MS-8/1 variety has a higher yield by 39.94% compared to the same variant in the control variety, Dzebel N$^0$1

Table 1. Average tobacco yield kg/ha (2014-2016)

| Variant | Variety | Year | | | **Average kg/ha** | Index | Index |
|---|---|---|---|---|---|---|---|
| | | 2014 | 2015 | 2016 | | | |
| Ø | Dzebel N$^0$1 | 1657 | 1528 | 1244 | 1476 | 100.00 | 100.00 |
| $N_{20}P_{40}K_{60}$ | Dzebel N$^0$1 | 1594 | 1627 | 1348 | 1523 | 103.17 | 100.00 |
| $N_{30}P_{40}K_{60}$ | Dzebel N$^0$1 | 1855 | 1767 | 1510 | 1711 | 115.90 | 100.00 |
| Ø | Basmak MS -1/8 | 2098 | 1825 | 1624 | 1849 | 100.00 | 125.26 |
| $N_{20}P_{40}K_{60}$ | Basmak MS -1/8 | 2415 | 2195 | 1784 | 2131 | 115.26 | 139.94 |
| $N_{30}P_{40}K_{60}$ | Basmak MS -1/8 | 2618 | 2473 | 1960 | 2350 | 127.11 | 137.37 |
| Ø | Basmak MB-1 | 1603 | 1664 | 1222 | 1497 | 100.00 | 101.37 |
| $N_{20}P_{40}K_{60}$ | Basmak MB-1 | 1760 | 1829 | 1331 | 1640 | 109.59 | 107.68 |
| $N_{30}P_{40}K_{60}$ | Basmak MB-1 | 2000 | 1890 | 1571 | 1820 | 121.64 | 106.39 |
| Ø | Basmak MK-1 | 1630 | 1460 | 1442 | 1510 | 100.00 | 102.32 |
| $N_{20}P_{40}K_{60}$ | Basmak MK-1 | 1532 | 1674 | 1569 | 1591 | 105.36 | 104.49 |
| $N_{30}P_{40}K_{60}$ | Basmak MK-1 | 1904 | 2010 | 1526 | 1814 | 120.06 | 106.00 |

| LSD | 0.5 | 0.1 | 0.01 | LSD | 0.5 | 0.1 | 0.01 |
|---|---|---|---|---|---|---|---|
| Dzebel N$^0$1 | 69.01 | 104.68 | 168.27 | Basmak MB-1 | 79.91 | 121.06 | 194.61 |
| Basmak MS -1/8 | 170.31 | 258.01 | 414.75 | Basmak MK-1 | 211.00 | 319.65 | 513.84 |

Based on the statistical analysis of the yield in all investigated varieties, the fertilization has statistically significant influence on all three probability levels. This justifies the use of mineral fertilizers in the production of fine-leaf tobacco of the Basmak type.

Table 2 presents data on the average price of tobacco in denars per kg of dry tobacco.

The results clearly show that with the increase in nitrogen doses, the price of tobacco slightly decreases in all four investigated varieties. Statistical processing of the results showed that the fertilization does not have a significant impact on the average price of the tested tobacco varieties. The average purchase price of tobacco was increased by only 2.77 %, in the variety Basmak MS-1/8, fertilized with 20 kgN/ha. In all other variants slight decrease on purchase price was observed, with increasing nitrogen rates.The economic effect expressed by gross income (Table 3) of all fertilized varieties showed higher results compared to the control.

Table 2. Average tobacco price, den/kg (2014-2016)

| Variant | Variety | Year | | | **Average kg/ha** | Index | Index |
|---|---|---|---|---|---|---|---|
| | | 2014 | 2015 | 2016 | | | |
| Ø | Dzebel $N^0$1 | 131.42 | 142.66 | 146.87 | 140.32 | 100.00 | 100.00 |
| $N_{20}P_{40}K_{60}$ | Dzebel $N^0$1 | 130.64 | 140.90 | 138.82 | 136.79 | 97.48 | 100.00 |
| $N_{30}P_{40}K_{60}$ | Dzebel $N^0$1 | 131.45 | 138.25 | 141.25 | 136.98 | 97.62 | 100.00 |
| Ø | Basmak MS -1/8 | 134.69 | 148.02 | 159.73 | 147.48 | 100.00 | 105.11 |
| $N_{20}P_{40}K_{60}$ | Basmak MS -1/8 | 133.71 | 164.18 | 156.80 | 151.56 | 102.77 | 110.80 |
| $N_{30}P_{40}K_{60}$ | Basmak MS -1/8 | 131.94 | 151.87 | 157.70 | 147.17 | 99.79 | 107.44 |
| Ø | Basmak MB-1 | 140.84 | 140.78 | 159.72 | 147.11 | 100.00 | 104.84 |
| $N_{20}P_{40}K_{60}$ | Basmak MB-1 | 139.57 | 133.84 | 149.13 | 140.84 | 95.74 | 102.97 |
| $N_{30}P_{40}K_{60}$ | Basmak MB-1 | 133.47 | 144.29 | 143.42 | 140.39 | 95.43 | 102.49 |
| Ø | Basmak MK-1 | 139.62 | 138.12 | 154.20 | 143.98 | 100.00 | 102.61 |
| $N_{20}P_{40}K_{60}$ | Basmak MK-1 | 133.75 | 151.77 | 153.71 | 146.41 | 101.69 | 107.04 |
| $N_{30}P_{40}K_{60}$ | Basmak MK-1 | 127.29 | 147.31 | 144.03 | 139.54 | 96.92 | 101.87 |

| LSD | 0.5 | 0.1 | 0.01 | LSD | 0.5 | 0.1 | 0.01 |
|---|---|---|---|---|---|---|---|
| Dzebel $N^0$1 | n.s. | n.s. | n.s. | Basmak MB-1 | n.s. | n.s. | n.s. |
| Basmak MS -1/8 | n.s. | n.s. | n.s. | Basmak MK-1 | n.s. | n.s. | n.s. |

Table 3. Gross income of tobacco, den/ha (2014-2016)

| Variant | Variety | Year | | | **Average kg/ha** | Index | Index |
|---|---|---|---|---|---|---|---|
| | | 2014 | 2015 | 2016 | | | |
| Ø | Dzebel $N^0$1 | 217696 | 217999 | 182731 | 206142 | 100.00 | 100.00 |
| $N_{20}P_{40}K_{60}$ | Dzebel $N^0$1 | 208291 | 229183 | 187140 | 208205 | 101.00 | 100.00 |
| $N_{30}P_{40}K_{60}$ | Dzebel $N^0$1 | 243886 | 244360 | 213282 | 233842 | 113.44 | 100.00 |
| Ø | Basmak MS -1/8 | 282617 | 270091 | 259476 | 270728 | 100.00 | 131.33 |
| $N_{20}P_{40}K_{60}$ | Basmak MS -1/8 | 322920 | 360403 | 279651 | 320991 | 118.57 | 154.17 |
| $N_{30}P_{40}K_{60}$ | Basmak MS -1/8 | 345428 | 375572 | 309096 | 343365 | 126.83 | 146.84 |
| Ø | Basmak MB-1 | 225837 | 234292 | 195144 | 218424 | 100.00 | 105.96 |
| $N_{20}P_{40}K_{60}$ | Basmak MB-1 | 245610 | 244771 | 198546 | 229642 | 105.14 | 110.30 |
| $N_{30}P_{40}K_{60}$ | Basmak MB-1 | 266918 | 272749 | 225275 | 254981 | 116.74 | 109.04 |
| Ø | Basmak MK-1 | 227583 | 201626 | 222292 | 217167 | 100.00 | 105.35 |
| $N_{20}P_{40}K_{60}$ | Basmak MK-1 | 204860 | 254065 | 241111 | 233345 | 107.45 | 112.07 |
| $N_{30}P_{40}K_{60}$ | Basmak MK-1 | 242391 | 296138 | 219796 | 252775 | 116.40 | 108.10 |

| LSD | 0.5 | 0.1 | 0.01 | LSD | 0.5 | 0.1 | 0.01 |
|---|---|---|---|---|---|---|---|
| Dzebel $N^0$1 | 8567 | 12978 | 20862 | Basmak MB-1 | 6122 | 9274 | 14908 |
| Basmak MS -1/8 | 27100 | 41054 | 65994 | Basmak MK-1 | n.s. | n.s. | n.s. |

The best gross income was obtained from the variety Basmak MS-1/8 (26.83%) fertilized with 30 kg N/ha, compared to the unfertilized variety and 54.17% fertilized with 20 kg N/ha compared to the check. Based on the statistical analysis of the economic effect, with the exception of the Basmak MK-1 variety, in the other studied varieties, fertilization has a statistically significant impact at all three levels of probability.

The quality of tobacco mostly depends of the chemical composition, especially the total alkaloids, proteins, soluble sugars, minerals and their interaction (Pelivanoska, 2012). Also, the chemical composition depends of the genetic material, the type, the variety, the conditions of the breeding, the harvesting time, the processes of drying and fermentation, diversity, the climatic conditions and above all, the applied agricultural practices (Petrov, 1987; Alic-Dzemidzic et al., 1999). Table 4 present the average values of the tested parameters: nicotine and total nitrogen content. From the obtained results, it can be seen that the content of nicotine and total nitrogen in the studied varieties is the lowest in the control variant, and the highest in the variant fertilized with the highest amount of nitrogen. The average nicotine content ranges from 1.50% (control) to 1.65% ($N_{30}P_{60}K_{40}$), the total nitrogen content from 1.67 % to 2.16 % respectively.

Table 4. Nicotine content and total nitrogen content (2014-2016), in %

| Variety | Nicotine content, in % | | | | | Total nitrogen, in % | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Variant | | | Average | % | Variant | | | Average | % |
| | Ø | $N_{20}P_{60}K_{40}$ | $N_{30}P_{60}K_{40}$ | | | Ø | $N_{20}P_{60}K_{40}$ | $N_{30}P_{60}K_{40}$ | | |
| Dzebel N$^0$1 | 1.70 | 1.73 | 1.80 | 1.74 | 100.0 | 1.78 | 1.94 | 2.19 | 1.97 | 100.0 |
| Basmak MS 1/8 | 1.42 | 1.49 | 1.57 | 1.49 | 85.63 | 1.66 | 1.94 | 2.05 | 1.88 | 95.43 |
| Basmak MB-1 | 1.43 | 1.50 | 1.63 | 1.52 | 87.35 | 1.46 | 1.65 | 1.90 | 1.67 | 79.69 |
| Basmak MK-1 | 1.47 | 1.52 | 1.61 | 1.53 | 87.93 | 1.80 | 2.03 | 2.39 | 2.07 | 105.7 |
| Average | 1.50 | 1.56 | 1.65 | 1.57 | 90.22 | 1.67 | 1.89 | 2.13 | **1.90** | **84.77** |
| % | 100.0 | **104.0** | **110.0** | | | **100.0** | **113.17** | **127.54** | | |
| LSD | 0.05=0.037 | 0.01=0.056 | 0.001=0.090 | | | LSD 0.05=0.10 | 0.01=0.16 | 0.001=0.25 | | |

The quality of oriental tobacco largely depends on the content of soluble sugars. The higher content of soluble sugars gives better taste of the tobacco, because during the combustion tobacco gives substances that influence the flavours and taste of tobacco, neutralizing the negative impact of protein and forming an acidic reaction to tobacco smoke (Mitreski, 2012). High quality oriental tobaccos should contain 14-18% soluble sugars (Uzunoski, 1985).

Table 5. Content of soluble sugars and mineral matter, in %

| Variety | Soluble sugars, in % | | | | | Mineral matter, in % | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Variant | | | Average | % | Variant | | | Average | % |
| | Ø | $N_{20}P_{60}K_{40}$ | $N_{30}P_{60}K_{40}$ | | | Ø | $N_{20}P_{60}K_{40}$ | $N_{30}P_{60}K_{40}$ | | |
| Dzebel N$^0$1 | 17.63 | 16.45 | 14.06 | 16.5 | 100.0 | 12.29 | 12.95 | 13.93 | 13.06 | 100.0 |
| Basmak MS 1/8 | 17.00 | 15.75 | 13.96 | 15.57 | 97.0 | 12.37 | 12.92 | 13.41 | 12.90 | 98.77 |
| Basmak MB-1 | 16.17 | 15.06 | 14.03 | 15.08 | 93.95 | 11.70 | 13.01 | 13.76 | 12.82 | 98.16 |
| Basmak MK-1 | 15.86 | 14.90 | 13.51 | 14.75 | 91.90 | 12.86 | 13.76 | 14.36 | 13.66 | 104.59 |
| Average | 16.66 | 15.54 | 13.89 | 15.36 | 95.7 | 12.31 | 13.16 | 13.86 | 13.11 | 100.38 |
| % | **100.0** | **93.27** | **83.37** | **92.19** | | 100,0 | **106.90** | **112.59** | 106.46 | |
| LSD | 0.05=NS | | | | | 0.05=0.41 | 0.01=0.62 | | 0.001=0.99 | |

The average content of soluble sugars, of the studied varieties ranges from 14.75 % (Basmak MK-1) to 16.5% (Dzebel $N^0$1), which indicates that the tobacco raw material has a high quality. The content of mineral matter ranges from 12.82 % (Basmak MB-1) to 13.66 % (Basmak MB-1). According to the content of mineral matter, the tested varieties belong to the tobaccos group with medium quality. Tobaccos wich containing more than 15% of mineral matter are with bad quality, from 11 to 14 % are with medium quality and quality tobaccos are those that contain from 8 to 11 % of mineral matter (Gyuselev, 1965).

Based on the statistical analysis, it can be noted that fertilization has a significant impact on the chemical properties of the tested varieties.

## CONCLUSIONS

Based on the obtained results it can be concluded that the average yield and gross income, per unit of production area increases with increasing of the nitrogen doses, and the average price per kilogram of tobacco decreases slightly in all investigated varieties. The most pronounced increase was noted in the variety Basmak MS- 1/8. In this parameter, statistically significant influence of the fertilization was noted on all three levels of significance. Various rates of nitrogen in fertilizers, has a certain influence on the chemical composition of tobacco. In all examined varieties, higher content of nicotine, total nitrogen and mineral matter was observed, as well as a reduction in the content of reduced sugars by increasing the nitrogen dose.This means that with the further increase in nitrogen quantities, the harmony of the chemical properties of tobacco can be significantly worsened.

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# ORGANIZATION OF TOBACCO PRODUCTION AS A FAMILY BUSINESS - EXISTENCE OR PROFIT

Silvana Pashovska[1], Roza Galeska[2]

*[1] University "St. Kliment Ohridski" - Bitola, Scientific Tobacco Institute- Prilep, Kicevska, bb, 700 Prilep, Republic of North Macedonia*
*[2] Data sistemi - Prilep*
*e-mail:silvana.pasovska@uklo.edu.mk*

## ABSTRACT

Developing a modern family business where tobacco production would be a core business must rely on developed management with all its accompanying elements such as: planning, organizing the work, managing the production and controlling it with appropriate motivation of the engaged members. Only in this way, greater efficiency and effectiveness in operation, reduction of production costs, increase of productivity and improvement of operating results, will be achieved.
When we talk about tobacco production as a family business in Macedonia, we can say that we are talking about individual producers who have invested their own funds in tobacco production and hire family members as labor. They use their own or leased land. Good organization of the family business is imposed as an opportunity to make a profit, which is the result of a good strategy of the whole process. This overcomes the fact that tobacco production is only a condition for existence.

**Key words:** organization, profit, family business, tobacco production, strategy

# ОРГАНИЗАЦИЈА НА ТУТУНОПРОИЗВОДСТВОТО КАКО СЕМЕЕН БИЗНИС – ЕГЗИСТЕНЦИЈА ИЛИ ПРОФИТ

Развивањето на современ семеен бизнис со основна дејност тутунопроизводство мора да се потпира врз развиен менаџмент со сите негови придружни елементи како: планирање, организирање на работата, водење на производството и контрола на истото со соодветна мотивација на ангажираните членови. Само на таков начин ќе се постигне поголема ефикасност и ефективност во работењето, намалување на трошоците за прозиводство, зголемување на продуктивност и подобрување на резултатите од работењето.
Кога станува збор за семеен бизнис во тутунопроизводството во Македонија може да се каже дека станува збор за индивидуални производители кои ги вложиле сопствените средства за производство на тутун и користат сопствено или земјиште под закуп, а во областа на трудот користат ангажираност на членовите на семејството. Точно организираноста како семеен бизнис, го надминува фактот дека тутунот е само услов за егзистенција и се наметнува како можност за остварување на профит кој е резултат на добра стратегија на целокупниот процес.

**Клучни зборови:**организација, профит, семеен бизнис, тутунопроизводство, стратегија

## INTRODUCTION

As an agricultural crop, tobacco has a special place in agricultural production from an economic and social aspect and is one of the most important export products in our country. Tobacco production accounts for 5% of total exports and almost 30% of exports in the agricultural sector. This is especially important in rural areas where tobacco production is an important source of finance and provides a livelihood for this part of the population.

It is grown and thrives on poorer quality soils where other crops do not give adequate yields. Thus, the primary production of tobacco is located on areas with low creditworthiness, mostly downgraded areas, modest with nutrients, minerals and organic matter, because the tobacco is a modest and hardy plant with minimal needs for growing. Due to such natural characteristics for its production, it covers the smallest part of arable land, and provides multiple incomes, like no other agricultural crop. Macedonia has favourable climatic and soil conditions for growing tobacco. Tobacco production provides a livelihood for about 35.000 families and it is an important factor in supplementing the domestic budget and an important export product that affects the state budget.

Family businesses are a pillar of many world economies. Despite the turbulent times, due to their flexibility and adaptability, they can move fast from small family businesses to huge corporations with strong financial power. Global trends are reflected in our country, of course adapted to the available conditions and capacities, so family businesses today are a pillar of the Macedonian economy. In the field of tobacco production, the organization of the activity as a family business is a good basis for a solid existence and even greater profit. Natural conditions, available agricultural areas, tradition and possibilities for providing existence or supplementing the family budget, are an important precondition for developing a modern family business in tobacco production in the Republic of North Macedonia. The future of tobacco production will largely depend on the good agrarian policy of the country, but also on the conditions for subsidies that would encourage the young population to engage in tobacco production. It would also help to raise tobacco production to the level of a family business through the use of innovation, entrepreneurship, good planning and management of available resources for greater efficiency and effectiveness of legal entities. In this context, the questions that arise are whether Macedonia has enough labor force and whether that labor force is willing to engage in tobacco production, or more young people are focused on securing their livelihood not only outside the agricultural sector, but also abroad.

Although Macedonia is a small continental country, it is a "golden triangle" for the production of small-leaf oriental tobacco. Today, the entire production in Macedonia is based on the production of small-leaf oriental tobacco. In the last ten years (2010-2019), oriental tobaccos from the aromatic types Prilep, Yaka, Basmak and Dzebel (Table 1) are mainly represented in tobacco production. Large-leaf tobaccos from the types Virginia and Burley are not grown at all. The table and the average represented data show that in this 10-year period the most produced type was Prilep, 84% of the total tobacco production. 14% of the production belongs to the type Jaka, then 1.8% to the type Basma and insignificant part to the types Dzebel and Otlja, 0.2%.

Table 1. Participation of the seed material by types for the period 2010-2019

| Harvest | Prilep | | | | | | | | Yaka | | | | Dzebel | | Basmak | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P-66-9/7 | % | NS-72 | % | P-79/94 | % | P-156/1 | % | JV -125/3 | % | JK-43 | % | Dz-38 | % | kg | % | Oriental kg |
| 2010 | 478 | 48 | 47 | 5 | 81 | 8 | 28 | 3 | 231 | 23 | 31 | 3 | 8 | | 78 | 9 | 992 |
| 2011 | 431 | 48 | 42 | 5 | 100 | 11 | 5 | | 246 | 27 | 20 | 2 | 8 | | 49 | 6 | 901 |
| 2012 | 869 | 64 | 56 | 4 | 40 | 3 | 5 | | 289 | 21 | 40 | 3 | | | 57 | 4 | 1356 |
| 2013 | 975 | 71 | 34 | 2 | 80 | 6 | 0 | | 190 | 14 | 67 | 5 | | | 26 | 2 | 1372 |
| 2014 | 1020 | 83 | 26 | 2 | 15 | 1 | 0 | | 109 | 9 | 60 | 5 | | | 6 | | 1236 |
| 2015 | 1175 | 82 | 27 | 2 | 15 | 1 | 0 | | 158 | 11 | 50 | 3 | | | 9 | | 1434 |
| 2016 | 908 | 85 | 28 | 3 | 10 | 1 | 0 | | 76 | 7 | 50 | 5 | | | 0 | | 1072 |
| 2017 | 1045 | 90 | 18 | 2 | 0 | | 0 | | 57 | 5 | 37 | 3 | | | 0 | | 1157 |
| 2018 | 1434 | 95 | 61 | 4 | 0 | | 0 | | 5 | 0.3 | 10 | 0.6 | | | 5 | | 1515 |
| 2019 | 1360 | 93 | 43 | 2 | 0 | | 0 | | 42 | 3 | 25 | 2 | | | 0 | | 1480 |
| Average | 969.5 | 78 | 38.2 | 3 | 34.1 | 3 | 3.8 | 0.3 | 140.3 | 11 | 39 | 3 | 1.6 | 0.1 | 23 | 1.8 | |
| | Prilep 84% | | | | | | | | Yaka 14% | | | | Dzebel 0.1% | | Basmak 1.8% | | |

Source: Scientific tobacco institute - Prilep

In addition to the data above, it is necessary to emphasize the fact that in the last three years, variety Prilep 66 participates by 93% in total tobacco production and by 97-98% within the type Prilep. Its production has increased the competitiveness and demand of this renowned commodity type on the market. This conclusion can be confirmed by the continuous stable tobacco production (about 25.000 t) and by the export of seed material of this variety in Serbia and Turkey. There is also interest in introducing the variety Prilep 66 in the tobacco production by other Balkan countries.

## MATERIAL AND METHODS

The topic that is subject of analysis and research in this paper, imposed the need to consider the most important macroeconomic parameters in Macedonia, the number of tobacco producers, level of education, amount of produced tobacco and planted areas.

As a basic hypothesis in the research, the following is set: To come to the conclusion that the organization of tobacco production as a family business on a wider scale, provides livelihood, but also profit for the tobacco producers in the Republic of North Macedonia. In order to reach this conclusion, which contains the main hypothesis, the method of the survey method and the $x^2$-test, the contingency method, the mathematical-statistical and comparative method, as well as tabular and graphical presentation of the obtained results, were used.

A survey was also conducted among the active tobacco producers and the obtained data were processed. The survey as a research method was conducted by formulating questionnaires with standardized and clearly formulated questions that were given to tobacco producers of different age groups. Their answers provided a concrete picture of the impact of demographic factor on tobacco production process and whether it can be organized as a successful family business that will provide sufficient income for the family. The research was conducted with several individual tobacco producers from the municipalities of Prilep, Dolneni and Krivogashtani. The subject of this

research were 80 tobacco producers under the age of 40 and 80 tobacco producers over the age of 40, for which special survey questionnaires were prepared. $x^2$ - test and contingency coefficient were used for data processing, in order to determine the relationship between the variables that are of interest in this research. $x^2$ is the sum of squared differences of the examined and expected (theoretically given) frequencies placed in relation to the expected frequencies and is calculated according to the formula:

$$x^2 = \sum \frac{(f_i - f_0)^2}{f_0}$$

Where: fi - are examined frequencies obtained by empirical research or experimentation; fo - are expected or theoretical frequencies (frequencies that are expected under a certain hypothesis);

The examined frequencies are obtained from the conducted empirical research, while the expected frequencies are obtained by multiplying the sum of the row by the sum of the column and the obtained result is divided by the total sum of frequencies.

The value for $x^2$- test is interpreted on the basis of the theoretical $x^2$ distribution, created by Karl Pearson. He created the table of critical values for chi square test for the appropriate number of degrees of freedom and the appropriate probability, i.e. significance threshold. The significance threshold refers to the permissible error or risk and the most commonly used probability level is p = 0.05 and p = 0.01. This paper uses a probability level of 0.05, i.e. 5%.

When frequencies are arranged in rows and columns, degrees of freedom (n) are calculated as follows:

$$n = (k-1)(r-1)$$

n = degrees of freedom; k = number of columns; r = number of rows.

In this empirical study, the frequencies are arranged in two columns and three rows, resulting in 2 degrees of freedom. The tabular value of $x^2$ for 2 degrees of freedom and significance threshold 0.05 is 5.991.

When the calculated value of the $x^2$- test is greater than the critical value in the table, which in our case has a value of 5,991, we come to the conclusion that the statements of tobacco producers under and over the age of 40 years differ. Conversely, when the calculated value of $x^2$ is less than the tabular value, in that case the statements of the two groups of tobacco producers are similar, i.e. there is no big difference, which can be seen from the comments on the individual questions.

As can be seen, the $x^2$- test determines the probability of a correlation between two variables, not the height of the correlation. Such a correlation is measured by the contingency coefficient (C) which is calculated according to the formula

$$C = \sqrt{\frac{X^2}{N + X^2}}$$

where $x^2$ is a calculated value for $x^2$; N is the total number of frequencies.

The contingency coefficient can have a value from 0 to 1. When this coefficient is closer to 1, the interdependence modality of the examined variables is stronger, and when the calculated coefficient is closer to 0, then the interdependence is weak.

## RESULTS AND DISCUSSION

Tobacco production in recent years in the EU is declining, primarily due to the introduction of the quota system and the specific way of subsidizing, which is realized by area, not by produced tobacco. That is why the production from 440.000 tons in 1991, dropped to below 140.000 tons in 2018, although four new countries that are producers of tobacco joined. This declining production trend also includes small-leaf oriental tobacco. Oriental tobacco is mostly grown on the territory of Balkan countries: Turkey, Bulgaria, Greece and North Macedonia. Globally, India, China and Thailand are emerging as producers of smaller quantities of oriental tobacco, but also small quantities of oriental tobacco are produced in Russia, Kazakhstan, Uzbekistan, Tajikistan and some Mediterranean countries (Lebanon, Tunisia, Algeria and Morocco). Since 2013, Macedonia has grown into the second largest producer of oriental tobacco after Turkey.

In the data of UNITAB ( European association of tobacco growers ) it is entered that the total tobacco production in the EU for 2018 is 134.038 tons. Only 21.250 tons belong to oriental tobaccos and they are grown in two EU member countries - Greece and Bulgaria. In both countries, the production has been drastically reduced in recent years, which can be seen from the following table which provides data on the production of small-leaf oriental tobacco in several Balkan countries, that are also major producers of oriental tobacco (Table 2).

Table 2. Production of oriental tobacco in the Balkan countries from 2013-2020

| Year | Turkey | Macedonia | Greece | Bulgaria |
|---|---|---|---|---|
| 2013 | 80 000 | 27 800 | 24 000 | 17 000 |
| 2014 | 61 000 | 27 600 | 26 000 | 16 000 |
| 2015 | 55 000 | 24 000 | 22 000 | 12 000 |
| 2016 | 55 000 | 25 400 | 18 500 | 9 000 |
| 2017 | 68 000 | 23 000 | 19 000 | 9 500 |
| 2018 | 55 000 | 25 500 | 13850 | 7400 |
| 2019 | 52 000 * | 26 200 | 15 700 | 5 200 |
| 2020 | 41 000 | 26 000 | 13 000 | 4 250 |
| Average | 58375 | 25687.5 | 19250 | 9993.75 |

Source: Star Agritech International; published October 2018; with additional editing by TOBACCO ASIA

Table 3. Planted area, yield, production in tons and number of concluded contracts

| Year | Planted area (ha) | Yield (kg/ha) | Production in tons (t) | Number of concluded contracts |
|---|---|---|---|---|
| 2010 | 20.300 | 1.492 | 30.280 | 40.743 |
| 2011 | 19.693 | 1.348 | 26.537 | 33.234 |
| 2012 | 19.656 | 1.392 | 27.333 | 29.090 |
| 2013 | 19.178 | 1.453 | 27.859 | 42.367 |
| 2014 | 17.758 | 1.553 | 27.578 | 34.445 |
| 2015 | 16.128 | 1.503 | 24.237 | 28.454 |
| 2016 | 16.379 | 1.554 | 25.443 | 27.380 |
| 2017 | 15.961 | 1.434 | 22.885 | 29.132 |
| 2018 | 16.582 | 1.541 | 25.547 | 34.104 |
| 2019 | 16.719 | 1.573 | 26.234 | 20.997 * |
| 2020 | 16.592 | 1.574 | 26.112 | 19.702** |

Source: Ministry of Agriculture, Forestry and Water Economy, Republic of North Macedonia

While in other countries tobacco production is declining, our country can boast of relative stability in terms of production, planted areas, yield per hectare and the number of contracts (Table 3).

When we emphasize the fact that Macedonia is primarily an argar country, we are talking about the percentage of active population engaged in agriculture, which is far above the European average (4.2% EU-2017 versus 16.2% Macedonia). The percentage of active population engaged in agriculture in 2019 is 13.9%. Out of a total of 111.033 people engaged in agriculture, 35% (38.478) are unpaid family workers, 49% are self-employed and about 15% are full-time employees. About 17% (18.379) of the total agricultural workforce is employed on a part-time or seasonal basis.

The percentage of the share of agricultural sector in GDP is high, which is around 10%. (Table 4).

Table 4. Gross domestic product and share of the agricultural sector in GDP in%

| Indicator | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GDP in million euros | 6.095 | 6.772 | 6.767 | 7.109 | 7.544 | 7.585 | 8.150 | 8.562 | 9.072 | 9.723 | 10.010 | 10.744 | 11.262 | 10.823 |
| GDP per capita in euros | 2.982 | 3.308 | 3.300 | 3.459 | 3.665 | 3.680 | 3.948 | 4.141 | 4.382 | 4.691 | 4.827 | 5.175 | 5.423 | 5.238 |
| share of the agricultural sector in GDP | 9.9 | 11.4 | 10.3 | 10.1 | 9.4 | 9.1 | 10 | 10.1 | 9.7 | 9.1 | 7.9 | 8.5 | 8.1 | 9.1 |

Source: State Statistical Office, Republic of North Macedonia

One of the biggest problems in the agricultural sector in our country is the aging of the workforce. According to the structural survey by the State Statistical Office made in 2016, only 4% of agricultural holders are young people under the age of 35 (or 7.254), 34% are between the age of 35 and 54 (61.724) and the majority - 62% or 111.268 are older than 55. The ratio between the number of young holders of agricultural holdings (under 35 years) and the number of holders older than 55 years is 0.07 and is very unfavorable (European average of 0.09 is also unfavorable). This is due to low incomes (average net salary in agriculture is 240 euros per month or about 11 euros per day), unfavorable working conditions and deteriorating living conditions in rural areas. All of this discourages young people from pursuing careers in agriculture, and as a result of their mobility and less emotional connection to the country and the countryside, they are increasingly emigrating from the country into urban areas. According to data from the Agency for Financial Support of Agriculture and Rural Development (AFSARD), only 13.5% of the total number of agricultural holdings that applied for financial support in 2018 were represented by young farmers aged between 18 and 40 years.

The second big problem besides the age structure is the educational structure in agriculture. According to the structural survey from 2016, most of the farmers have completed or uncompleted primary school (44.5% or 80.269 people) and secondary school (43.3% or 77.996 people). Only 9.359 of them, or 5.2% have formal education in agricultural sciences. This means that most of the agricultural workforce lacks formal agricultural education, but also training, managerial and business skills.

To answer the question whether tobacco producers in Macedonia organize production as a family business and whether they make a profit from it, we conducted a survey through appropriate survey questionnaires among 80 tobacco producers under the age of 40 and 80 tobacco producers over the age of 40 (Table 5-10, Figure 1-6).

Table 5. Question number 1 to survey respondents: Do you think that in our country there are favorable agro-technical conditions for tobacco production?

| Asked questions | Offered answers | Individual answers | | | |
|---|---|---|---|---|---|
| | | Respondents under the age of 40 | | Respondents over the age of 40 | |
| | | Value | % | Value | % |
| 1. Do you think that in our country there are favorable agro-technical conditions for tobacco production? | Yes | 66 | 82.5 | 71 | 88.75 |
| | No | 5 | 6.25 | 4 | 5.00 |
| | No answer | 9 | 11.25 | 5 | 6.25 |
| Total | | 80 | 100 | 80 | 100 |
| | | Calculated $x^2$- test = 1.436 C = 0.0805 | | | |

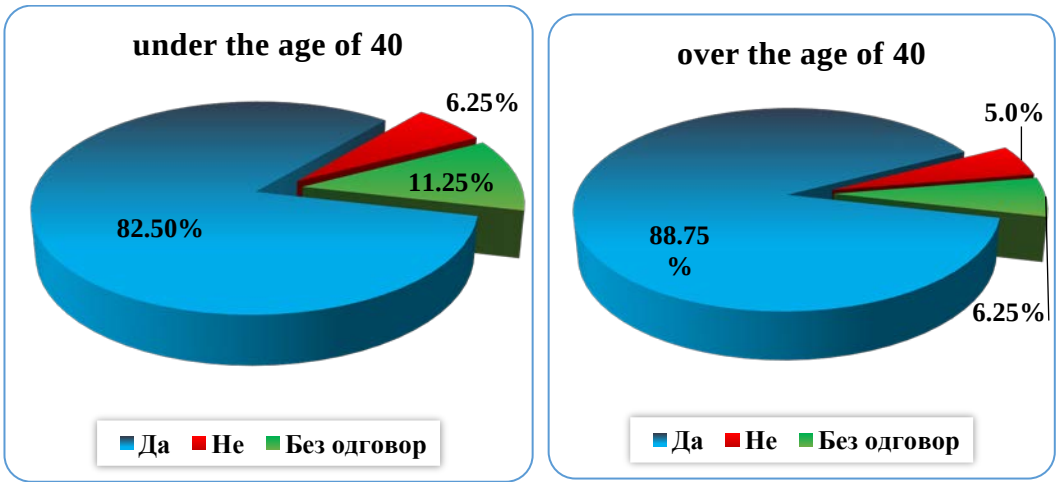


Figure 1. Question number 1 to survey respondents: Do you think that in our country there are favorable agro-technical conditions for tobacco production?

Table 6. Question number 2 to survey respondents: Do you think that there are enough people for the production and home processing of tobacco?

| Asked questions | Offered answers | Individual answers | | | |
|---|---|---|---|---|---|
| | | Respondents under the age of 40 | | Respondents over the age of 40 | |
| | | Value | | Value | % |
| 2. Do you think that there are enough people for the production and home processing of tobacco? | Yes | 52 | 65 | 52 | 65 |
| | No | 25 | 31.25 | 24 | 30 |
| | No answer | 3 | 3.75 | 4 | 5 |
| Total | | 80 | 100 | 80 | 100 |
| | | Calculated $x^2$- test = 0.163 C = 0.027 | | | |

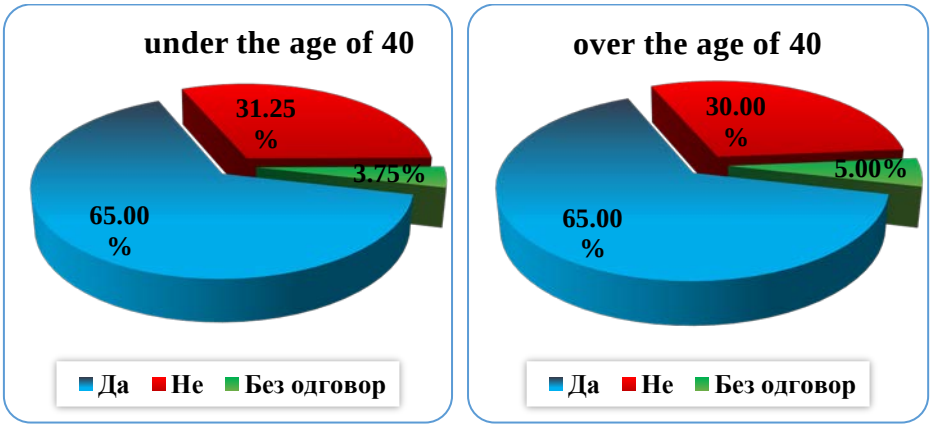


Figure 2. Question number 2 to survey respondents:Do you think that there are enough people for the production and home processing of tobacco?

The surveyed farmers were asked the following questions and according to the chi-square test the following results were obtained: Both groups of tobacco producers agree that Macedonia has favorable conditions for tobacco production. The values of the calculated $x^2$-test are 0.163, which is due to the relatively similar answers given by the respondents. The answers are in favor of the thesis that Macedonia has enough work force and so think the majority of respondents, in cases when it comes to their tobacco production.

Table 7. Question number 3 to survey respondents: Will you, as a tobacco producer, continue with further production of tobacco?

| Asked questions | Offered answers | Individual answers | | | |
|---|---|---|---|---|---|
| | | Respondents under the age of 40 | | Respondents over the age of 40 | |
| | | Value | % | Value | % |
| 3. Will you, as a tobacco producer, continue with further production of tobacco? | Yes | 52 | 65 | 59 | 73.75 |
| | No | 16 | 20 | 11 | 13.75 |
| | No answer | 12 | 15 | 10 | 12.5 |
| Total | | 80 | 100 | 80 | 100 |
| | | Calculated $x^2$- test = 1.549 C = 0.0836 | | | |

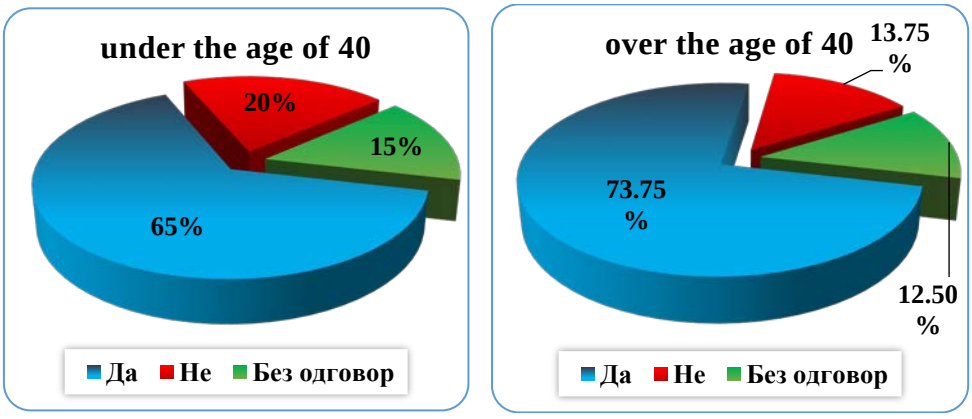


Figure 3. Question number 3 to survey respondents: Will you, as a tobacco producer, continue with further production of tobacco?

65% of young people under the age of 40 and 73.75% of respondents over 40 answered positively, while 20% of respondents under 40 and 13.75% of those over 40 gave a negative answer. 15% of respondents in the first group and 12.5% in the second group had no answer.

The calculated $x^2$-test is below the limit of 5.991 and is 1.549. The answers and the test show that in both groups there is still a mood for tobacco production, although it is lower in young people than in the elderly population.

Table 8. Question number 4 to survey respondents: Do you think there are opportunities for maintenance and development in terms of the demographic factor?

| Asked questions | Offered answers | Individual answers | | | |
|---|---|---|---|---|---|
| | | Respondents under the age of 40 | | Respondents over the age of 40 | |
| | | Value | % | Value | % |
| 4. Do you think there are opportunities for maintenance and development in terms of the demographic factor? | Yes | 54 | 67.5 | 50 | 62.5 |
| | No | 18 | 22.5 | 18 | 22.5 |
| | No answer | 8 | 10 | 12 | 15.0 |
| Total | | 80 | 100 | 80 | 100 |
| | | | | Calculated $x^2$- test = 0.954 C = 0.0657 | |

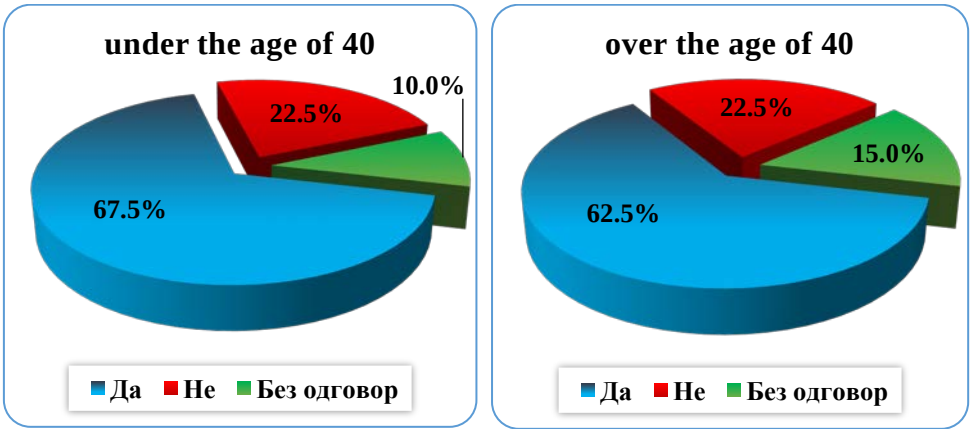


Figure 4. Question number 4 to survey respondents: Do you think there are opportunities for maintenance and development in terms of the demographic factor?

Regarding this question, 67.5% of the first and 62.5% of the second group believe that tobacco production has good conditions for development in terms of demographic factor. 22.5% of the respondents in both groups answered negatively, while 10% of the first group and 15% of the second group had no answer. Calculated $x^2$- test is 0.954, so in the opinion of the respondents, the demographic factor is not a problem for developing a business in the field of tobacco production.

Table 9. Question number 5 to survey respondents: Do you plan to improve your tobacco production by developing a family tobacco business?

| Asked questions | Offered answers | Individual answers | | | |
|---|---|---|---|---|---|
| | | Respondents under the age of 40 | | Respondents over the age of 40 | |
| | | Value | % | Value | % |
| 5. Do you plan to improve your tobacco production by developing a family tobacco business? | Yes | 38 | 47.5 | 40 | 50 |
| | No | 28 | 35 | 31 | 38.75 |
| | No answer | 14 | 17.5 | 9 | 11.25 |
| Total | | 80 | 100 | 80 | 100 |
| | | | | | Calculated $x^2$- test = 1.29 C = 0.0763 |

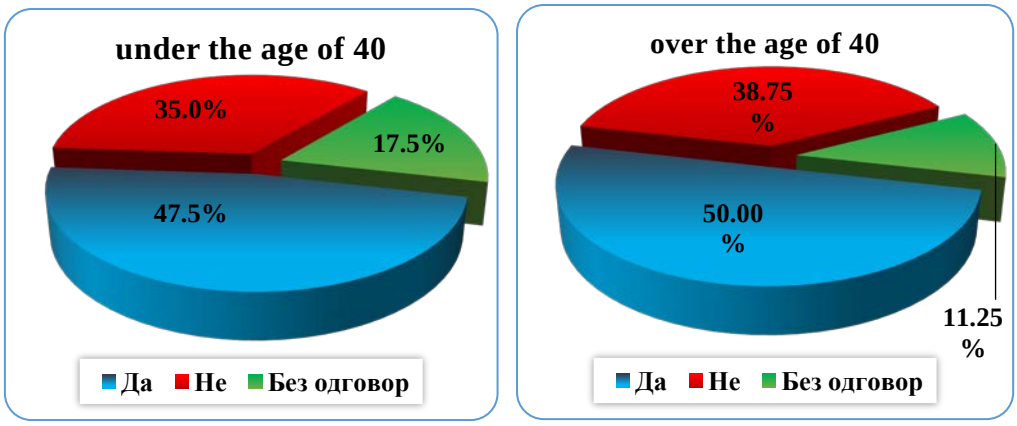


Figure 5. Question number 5 to survey respondents: Do you plan to improve your tobacco production by developing a family tobacco business?

These numbers are also positive, but it would be better if they were higher. Of course, the reason for this should be sought in government policies, business conditions, purchase conditions, payment of subsidies, the amount of the price of purchased tobacco, etc. First of all, it is important to organize education of tobacco producers, especially young people, focused on the ways to successfully manage the business and prepare an appropriate business plan. So they will feel more incentive to work and see a future in this area.

Table 10. Question number 6 to survey respondents: Do you think that young people would get a job in a foreign country faster than if they stayed in our country and produced tobacco?

| Asked questions | Offered answers | Individual answers | | | |
|---|---|---|---|---|---|
| | | Respondents under the age of 40 | | Respondents over the age of 40 | |
| | | Value | % | Value | % |
| 6. Do you think that young people would get a job in a foreign country faster than if they stayed in our country and produced tobacco? | Yes | 57 | 71.25 | 51 | 63.75 |
| | No | 17 | 21.25 | 17 | 21.25 |
| | No answer | 6 | 7.5 | 12 | 15.0 |
| Total | | 80 | 100 | 80 | 100 |
| | | | | | Calculated $x^2$- test= 2.333 C = 0.102 |

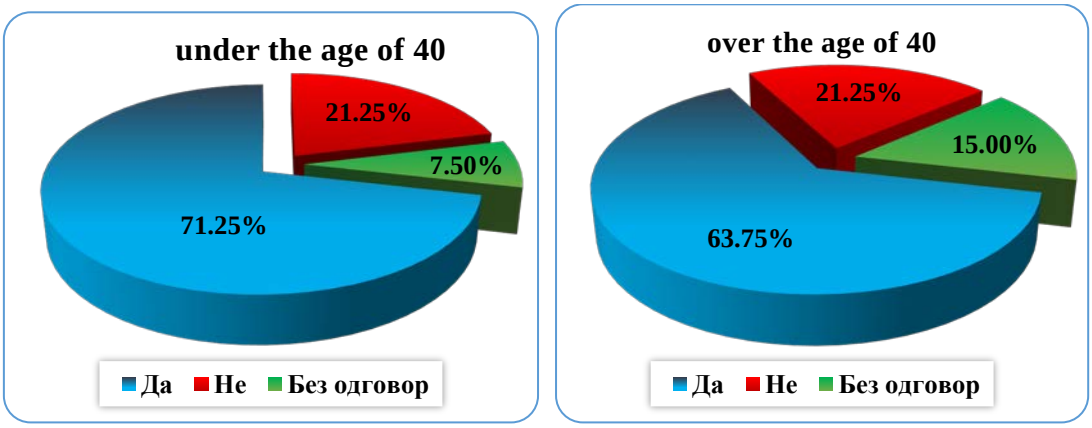


Figure 6. Question number 6 to survey respondents: Do you think that young people would get a job in a foreign country faster than if they stayed in our country and produced tobacco?

Calculated $x^2$-test is 2.333, and the contingency coefficient C is 0.102. The answers coincide with the current climate in our country, because young people would rather seek their livelihood in a foreign country than be engaged in tobacco production. In order to change this trend, young people in the tobacco industry should see an activity from which they can exist and make a profit. In this regard, the state should play its role by taking measures to improve the living conditions of the population, especially young people who are engaged in agriculture, tobacco production and to raise their standard of living.

## CONCLUSIONS

Tobacco is a leading export agricultural product and there is still interest in its production. In conditions when in neighboring Bulgaria, Greece and Albania the quantities of the produced tobacco are drastically reduced, whether due to diversification of production or due to the imposition of quotas of EU member states (Greece and Bulgaria), Macedonia can maintain the existing level of tobacco production and to increase it with very little effort. Key factor would be the demographic factor i.e. the population.

The results of the survey point to the following conclusions:

1. Tobacco producers from both groups (under and over 40 years old) agree that Macedonia has favorable agrotechnical conditions for the production and cultivation of tobacco, and confirmation of the fact is that Macedonia is a traditional producer of some of the highest quality varieties of tobacco, especially fine-leaf tobacco. ;
2. The values of the calculated $x^2$-test 0.163, which is due to the relatively similar answers given by the surveyed persons. The answers support the thesis that despite the large number of people who have gone abroad, Macedonia still has sufficient labor force and this is what the majority of respondents think, in cases where it is about their tobacco production;
3. In the Republic of North Macedonia, there is still a willingness to produce tobacco, although it is lower among young people than among the older population;
4. In the field of tobacco production, if there is sufficient stimulation and support from the state, the demographic factor is not yet a problem for organizing this line of production as a family business;
5. In order to stimulate and direct young people towards the development and modernization of tobacco production, additional education in this field is necessary, especially in the area of management, organization and preparation of an appropriate business plan;
6. In order to change the trend of emigration of young people and their orientation to agriculture and specifically to tobacco production, support from the state in the form

of greater subsidies and incentives that would encourage production and improve the living standard of the population is necessary.

Increasing the efficiency and effectiveness of the family business in tobacco production can only be achieved through long-term work. This will mean the cultivation of larger areas, inclusion of seasonal labor, reduction of unemployment, more funds for tobacco producers, but also a greater inflow into the state budget.

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