UDC 633.71 ISSN 0494-3244

ТУТУН

TOBACCO

Vol. 69	Nº 7-12

BULLETIN OF TOBACCO SCIENCE AND PROFESSION

ТУТУН TOBACCO	Vol. 69	Nº 7-12	pp. 1-58	PRILEP REPUBLIC OF NORTH MACEDONIA	JULY DECEMBER	2019

Tutun/Tobacco, Vol.69, N0 7-12, 3-7, 2019

ISSN 0494-3244
UDK: 633.71-152.75:575.22(497.2)"2015/2017"
Original Scientific Paper

EVALUATION OF YIELD AND STABILITY OF VIRGINIA TOBACCO PARENTS AND HYBRIDS

Marina Drumeva-Yoncheva[1], Dochka Dimova[2]

[1]*Tobacco and Tobacco Products Institute (TTPI), Markovo, Bulgaria*
[2]*Agricultural University-Plovdiv*
e-mail: mdrm@abv.bg

ABSTRACT

The study was conducted in the period 2015-2017 at the Tobacco and Tobacco Products Institute, Markovo. Twelve Virginia tobacco genotypes were included in a field experiment - six parents, five new breeding hybrids and the standard Virginia 0514 in a block design with four replications and 27 m^2 experimental plot. The aim of the present study was to evaluate the yield and yield stability of the studied genotypes. By determining the index of yield stability it was found that the new breeding hybrids H 27, H 33 and H 126 showed the highest dry tobacco yield (343.58; 336.90; 331.00 kg /da, respectively) and yield stability index (Ysi) (respectively 22+; 20+; 19+).

Key words: tobacco Virginia, yield stability

ЕВАЛУАЦИЈА НА ПРИНОСОТ И СТАБИЛНОСТА НА РОДИТЕЛИТЕ И ХИБРИДИТЕ ОД ТИПОТ ВИРЏИНИЈА

Проучувањата беа спроведени во периодот 2015-2017 година во Институтот за тутун и тутунски производи - Марково. Опитот беше поставен по блок-систем во четири повторувања на опитна парцела од 27 m2 и во него беа вклучени дванаесет генотипови од типот Вирџинија - шест родителски, пет новосоздадени хибриди и Вирџинија 0514 како стандард. Целта на ова проучување беше да се оцени приносот и стабилноста на приносот на испитуваните генотипови. Со одредување на индексот на стабилност на приносот, откриено е дека новите хибриди H 27, H 33 и H 126 покажале најголем принос на сув тутун (343,58; 336,90; 331,00 kg/da, соодветно) и индекс на стабилност на приносот (Ysi) (22+; 20+; 19+ соодветно).

Клучни зборови: **тутун Вирџинија**, **стабилност на приносот**

INTRODUCTION

Tobacco (*Nicotiana tabacum* L.) is a crop that is still important for the Bulgarian economy. There are four varietal groups of tobacco in our country: Oriental - Basma and Kaba Kulak and large-leaved - Virginia Flue-cured and Burley - Air Cured varieties. In Bulgaria there are microareas where in the presence of suitable varieties, combined with good agricultural equipment, it is possible that the production of Virginia tobacco has a stable yield and high quality of the raw material.

Yield stability is one of the main goals in the selection of various crops, including tobacco (Naumenko, 2011).The creation of high-yielding tobacco varieties with wider adaptability is an integral part of any selection program (Sheraz Ahmed et al., 2019). Genotypes providing high average yields with minimal genotype-environment interaction (GEI) are becoming increasingly important compared to those with only high yields (Sadeghi et al., 2011).

It is especially important that the newly created varieties have increased plasticity and stability, which would be a good testimonial to their relative perseverance in the manifestation of their genetic capabilities for yield and quality (Dimova et al., 2006). Zuoxin Tang et al., (2020) reported a proven correlation between flue-cured tobacco yield and climatic conditions.

In the selection and production of any crop, including tobacco, yield and quality are some of the most important economic indicators of the variety's value (Drazic et al., 2012, Dyulgerski, 2016, Risteski et al. 2017; Dyulgerski and Docheva, 2017).

Various parameters for assessing phenotypic stability are known (Eberhard and Russell, 1966, Shukla, 1972). The parameter of Kang (1993) -Ysi (Dimova et al., 2006, Rachovska et al., 2002, Rachovska et al., 2011) has become a simpler and more reliable method for simultaneous assessment of yield and stability. It provides a generalized assessment of yield and stability, which is extremely useful for ranking the tested genotypes by economic value. The aim of the present study was to evaluate the yield and yield stability of five hybrids and their parents of Virginia tobacco.

MATERIAL AND METHODS

The study was conducted in the period 2015-2017 at the Tobacco and Tobacco Products Institute, Markovo. Twelve Virginia tobacco genotypes were included in a field experiment - six parents, five new breeding hybrids and the standard Virginia 0514 (Table 1) in a block design with four replications and 27 m^2 experimental plot. An assessment of the studied variants in terms of yield and stability was made. The studied genotypes (parents and hybrids) were assessed comprehensively on the analyzed traits using the Kang parameter 1993 (Rachovska et al., 2002). The computer program IPCSSVKYSI (Interactive program for calculating Shukla's stability variance and Kang's yield stability index - Ysi), developed by Kang and Magari (1995) was used to determine the stability index.

Table 1. Parental genotypes and F_1 hybrids

Genotypes	Breeding method	Origin
Coker 254	variety	USA
Virginia 385	variety	Poland
L 825	line	Czechia
L 0543	line	Bulgaria
L 0842	line	Bulgaria
Virginia 0594	variety	Bulgaria
H 27 (Coker 254xVirginia 385)	F_1	Bulgaria
H 33 (Virginia 0594xVirginia 385)	F_1	Bulgaria
H 51 (Virginia 0594xL 825)	F_1	Bulgaria
H 126 (Virginia 385x Л 0543)	F_1	Bulgaria
H 135 (L 0543xL 0842)	F_1	Bulgaria
Virginia 0514 - standart	F_1	Bulgaria

RESULTS AND DISCUSSION

The results of the analysis of variance show that there are proven differences between the 12 genotypes tested (106.81**), the climatic conditions during the study years (130.54**) and the established genotype-environment interaction (8.51**) (Table 2).

In the present study the leading factors causing the change in yield fluctuation are the conditions over the years and the features of the studied genotypes. Dispersion by years is the strongest (S^2 = 11,866.51), which is indicative of the influence of environmental conditions on yield formation. The established proven differences are a prerequisite for evaluating the studied variants not only in terms of yield, but also in terms of the stability of its manifestation.

Table 2. Analysis of variance of summarized data of yield

Source of Variation	FG	SQ	S^2	$F_{exp.}$	$F_{tabl.}$	
					$P_{5\%}$	$P_{1\%}$
(Total)	143	157330.9				
Genotypes	11	106760.7	9705.52	106.81**	1.91	2.34
Year	2	23733.0	11866.51	130.54**	3.07	4.29
Genotype x Year	22	17023.7	773.80	8.51**	1.66	1.98
(E)/(Error)	108	9813.5	90.87			

FG – degrees of freedom, SQ – sum of squares, S2 – variance, F exp, Ftabl. – criteria of Fisher

In Table 3 are presented the results of the evaluation of the tested variants for yield and stability using the Kang parameter, 1993–(Ysi). The hybrid H 27 shows the highest yield, followed by H 33, H 126, Virginia 385. During the study period they show a higher yield than the Virginia 0514 standard. The newly created hybrid H 27 has not only the highest yield, but the stability index is also the highest (22+).

Hybrids H 33 and H 126 are in the second and third place in terms of stable yield with stability index (Ysi = 20^+ and 19^+, respectively). From the summary assessment of yield and stability the studied hybrids H 27, H 33 and H 126 realize relatively stable their productive potential, regardless of the changing climatic conditions by years.

Variety Virginia 385 and hybrid combination H 51 showed a stability index of the standard level of 18^+. This means that these genotypes would be influenced a little more strongly by the changing climatic conditions in the realization of their productive potential.

Line L 825 has realized the lowest yield, showing the lowest stability index. This defines it as poorly adaptable to changing environmental conditions during the years of study.

Table 3. Evaluation of the tested variants by yield and yield stability

№	Genotype	Yield kg/da	Yield rank	Adjustment to rank	Adjusted	Stability Variance	Stability Rating	Index (Ysi)
1	H 27	343.58	6	2	8	1826.47	0	22^+
2	H 33	336.90	5	2	7	2135.25	-2	20^+
3	H 126	331.00	7	2	9	3651.45	0	19^+
4	Virginia 385	305.17	10	-2	8	1685.75	-3	18^+
5	Virginia 0514 st.	294.17	6	-2	4	1948.35	-2	18^+
6	H 51	293.66	10	-6	4	1859.20	-2	18^+
7	H 135	287.75	4	-1	3	3265.60	-6	9
8	Virginia 0594	283.08	5	-2	3	2986.79	0	9
9	L 0842	282.58	3	3	6	2365.45	-5	6
10	L 0543	273.16	3	-3	0	1995.36	-10	4

CONCLUSIONS

The conducted research shows that the conditions over the years and the particularity of the studied genotypes have a determinative importance on the formation of the yield.

The newly created hybrids H 27, H 33 and H 126 showed the highest yield (343.58; 336.90; 331.00 kg/da, respectively) and stability index (Ysi) (22^+; 20^+ ;19^+ respectively).

The indicator for simultaneous evaluation of materials in terms of yield and stability (Ysi) defines them as better and promising for breeding scheme.

REFERENCE LIST

1. Dimova D., Dimitrova M., Rachovska G., 2006. Evaluation of yield and stability of perspective wheat breeding lines. Field Crop Studies, Izsledvania varhu polskite kultuti. T III-1,19-24 (Bg)
2. Dimova, D., Valcheva D., Zapryanov S., G. Mihova G., 2006. Ecological plasticity and stability of yield from winter barley varieties. Field Crop Studies, Izsledvania varhu polskite kultuti. T III-2, 197-203 (Bg)
3. Drazic S., I. Risteski, K. Filiposki, K. Kocoska., 2012. Result of studies on recently developed Virginia tobacco genotypes under different growing conditions in Serbia. Тутун/Tobacco, Vol. 62, №1-6, 03-08.

4. Dyulgerski Y., 2016. Assesment of biological indicators and production characteristics of perspective lines Burley tobacco. Тутун/Tobacco,Vol. 66, N 1-6, 13-21.
5. Dyulgerski Y. , Docheva M., 2017, Production characteristics and chemical idicators of perspective lines of Burley tobacco. Тутун/Tobacco, Vol. 67, № 1-6, 41-47.
6. Eberhard, S.A., Russel W.A. 1966, Stability Parameters for Comparing Varieties. Crop Science, 6, 36-40.
7. Kang M. S., 1993, Simultaneous Selection for Yield and Stability in Crop Performance Trials & Consequenences to Growers. Agron. J. 85; 754-757.
8. Kang M, Magari R. 1995, Stable a basic Program for Calculating Stability and Yield - Stability Statistics. Agronomy Journal Abstract. https://dl.sciencesocieties.org/publications/aj/abstracts/
9. Naumenko S. 2011, Features of breeding varieties of tobacco cultivars Virginia and Burley in Russia. Avtoreferat, Krasnodar, Russia. www.dissercat.com. (Ru)
10. Rachovska G., B. Bozhinov, D. Dimova, 2002. Evaluation of yield and stability of mutant lines of winter common wheat, Jubilee Scientific Session, Volume III Scientific Reports, pp. 64-67
11. Rachovska G., Dimova D., **Kolev** K., **Kostov** K., Ur, Zl., 2011. Evaluation of yield and stability of Bulgarian varieties of common winter wheat. Selskostopanska nauka. XLIII, № 1 (Bg)
12. Risteski I., Kocoska K., Pelivanovska V., 2017. Results of investigation of genotype and its influence on the yield, quality and economic effect of Virginia tobacco in R. Macedonia. Agriculture & Forestry, Vol. 63 Issue 1: 205-210, Podgorica.
13. Sadeghi S. M., Samizadeh H., Amiri E., Ashouri M., 2011. Additive main effects and multiplicative interactions (AMMI) analysis of dry leaf yield in tobacco hybrids across environments. African Journal of Biotechnology. Vol. 10 (21), pp. 4358-4364, 23 May 2011
14. Sheraz Ahmed, Fida Mohammad, Naqib Ullah Khan, Qaizar Ahmed, Samrin Gul, Sher Aslam Khan, Mohammad Hossein Romena, Mulusew Fikere, Imtiaz Ali and Ajmalud Din., 2019. Assessment of Flue-Cured Tobacco Recombinant Inbred Lines under Multi-Environment Yield Trials. International Journal Of Agriculture & Biology. Vol. 22, No. 3, 578–586. https://espace.library.uq.edu.au/
15. Shukla G.K., 1972. Some statistical aspects of partitioning genotype environmental components of variability. Heredity, 29 (2). pp. 237-245.
16. Zuoxin Tang, Lulu Chen, Zebin Chen, Yali Fu, Xiaolu Sun, BinbinWang, Tiyuan Xia., 2020. Climatic factors determine the yield and quality of Honghe fluecured tobacco. Scientifc Reports. 10:19868. http://www.nature.com/scientificreports DOI https://doi.org/10.1038/s41598-020-76919-0

ISSN 0494-3244
Tutun/Tobacco, Vol.69, N⁰ 7-12, 8-15, 2019 UDK: 632.954:633.71(497.775)"2019"
Original Scientific Paper

EFFECTS FROM THE APPLICATION OF THE HERBICIDE LEOPARD 5 EC IN TOBACCO

Petre Tashkoski

St. Kliment Ohridski University - Bitola,
Scientific Tobacco Institute - Prilep, Kicevski pat bb, 7500 Prilep,
e-mail: taskoskip@yahoo.com

ABSTRACT

Weeds directly affect the tobacco's yield and quality by reducing it, because they are tobacco's competitors when it comes to food and space, they hinder the execution of work operations and host a large number of pests and pathogens - microorganisms that transmit various diseases. In addition to herbicides that are being used before transplanting tobacco (pendimetalin, klomazon), the herbicide quizalofop is used in tobacco vegetation. The purpose of the study was to check its effectiveness in the control of grass weeds in tobacco. The tests were performed on tobacco that is largely affected by the fibrous weed cockspur or common barnyard millet - Echinochloa crus-galli, for which the herbicide Leopard 5 EC with an active substance Quizalofop-p-ethyl 50 g/l was used at a dose of 2 l/ha. Before the treatment, the average number of weeds per 1 m^2 was 1477.33 with a weight of the green mass of 3728.00 g. Ten days after treatment, there were 1306,66 weeds of 1 m^2, with a total weight of 1050.66 g, and 30 days after treatment the weeds were completely dried, without the emergence of phytotoxicity in tobacco. The effectiveness from the use of the herbicide Leopard 5 EC for control of this weed in tobacco, was 71.93%. It can also be applied in the control of other types of grass weeds during vegetation after transplanting tobacco in the field.

Keywords: tobacco, weeds, herbicides, quizalofop, Leopard 5 EC.

ЕФЕКТИ ОД ПРИМЕНАТА НА ХЕРБИЦИДОТ LEOPARD 5 EC КАЈ ТУТУНОТ

Плевелите директно влијаат врз намалување на приносот и квалитетот на тутунот бидејќи му се конкуренти за храна и простор, го отежнуваат извршувањето на работните операции и се домаќини на голем број штетници и патогени микроорганизми преносители на разни заболувања. Покрај хербицидите кои се употребуваат пред расадување на тутунот (pendimetalin, klomazon), хербицидот quizalofop се употребува во вегетација на тутунот. Целта на испитувањето беше да ја провериме неговата ефикасност за сузбивање на класестите плевели кај тутунот. Испитувањата се направени кај тутун со висока заплевеленост со плевелот обично влакнесто просо-*Echinochloa crus-galli*, за што е користен хербицидот Leopard 5 EC со активна материја Quizalofop-p-ethyl 50 g/l, во доза од 2 l/ha. Пред третирање, просечниот број на плевели на 1 m^2 изнесуваше 1477,33 со тежина на зелената маса од 3728,00 g. После десет дена од третирањето, кај 1306,66 плевели од 1 m^2 измерена е тежина од 1050,66 g, а после 30 дена од третирањето, плевелите се целосно исушени, без да има појава на фитотоксичност кај тутунот. Ефикасноста што ја покажа хербицидот Leopard 5 EC за сузбивање на овој плевел кај тутунот, изнесуваше 71,93%. Истиот може да се применува и во сузбивањето на останатите видови класести плевели во текот на вегетацијата после расадување на тутун на нива

.

Клучни зборови: тутун, плевели, хербициди, quizalofop, Leopard 5 EC.

INTRODUCTION

Tobacco is a major and economically important crop in our country, as well as in many countries around the world. The annual production of approximately 6.91 million tons of tobacco, according to William et al. (2013), is produced mostly in China, India, Brazil, Zimbabwe, Turkey, Indonesia, Russia, Malawi, in the countries of the European Union and the United States. Many types of tobacco are grown worldwide (oriental, semi-oriental, large-leaf, black tobacco), and all are equally exposed to damage by insects, phytopathogenic microorganisms and weeds. Although the damage caused by diseases and pests is of primary importance, weeds are still an important factor whose control required more attention. Weeds cannot cause as much direct damage to tobacco as diseases and pests, but still the presence of weeds greatly affects the yield and quality of tobacco, because they are competitors for food and space, they make the harvest more difficult, and often they host diseases and pests. Therefore, it is necessary to remove the weeds as soon as possible and keep the crop surface clean and without weeds during their vegetative development. Although in most countries the struggle for proper weed management takes place exclusively manually, in more developed countries the use of herbicides is inevitable and mechanical weed destruction is used as a supplement to herbicides. According to William et al. (2013), the number of herbicides that are registered for tobacco use has been constant for several years. There are approximately 50 different chemical compounds registered under different trade names as herbicides intended for tobaccos. Although there are many herbicides for weed control in tobacco, certain herbicides are not registered in all countries, which is an additional problem for tobacco growers.

Two groups of measures are used in the struggle to control and manage weeds (Konstantinovic at al. 2002), namely, indirect measures (measures to warn about the emergence of weeds and the degree of weeding) and direct measures (agrotechnical, physical, biological and chemical measures - application of herbicides). Herbicides for tobacco can be applied before transplanting or after transplanting tobacco, and after weeding. According to their activity, herbicides are classified as selective or non-selective. Selective herbicides kill weeds that attack cultivated plants without inflicting any damage (Chapman et al., 2016). Of these herbicides, propaquizafop and fluazifop-p-butyl are most commonly used to control grass weeds. Non-selective herbicides, or total herbicides, destroy all plants (weeds and crops), therefore they are rarely used in tobacco, i.e. they are used in exceptional cases. In practice, herbicides are most commonly used before tobacco transplanting, by spraying along the entire surface and by incorporation, where the herbicide acts on seed germination.

In our country, for a long time efforts have been made and a lot of research has been done to solve the problem with tobacco weeds by applying herbicides. According to Mickovski (1969), the herbicide Patoran 50WP (a. m. metobromuron) is one of the most effective preparations for the control of broadleaf weeds in tobacco. It has a pronounced physiological selectivity in regard to tobacco and positively influences the yield. High efficiency has been achieved with the herbicide Galex 500EC with the active substance metolahlor+metobromuron for control of grass and broadleaf weeds in tobacco (Mickovski et al., 1979). The most commonly used herbicides before transplanting tobacco (Chapman, 2016) are alachlor, clomazone, smitholachlor, trifluraline, sulfentrazone and pendimethalin, and according to William et al. (2013 and 2014), the most widely used herbicides in tobacco and dark tobacco in the world are alachlor, clomazone, metolachlor, napropamide, pebulat, pendimethalin, setoxidim, sulfentrazone and carfentrazone. According to Katarina Radonić (5), the herbicides Gamit, Devrinol (Razza), Stomp 330-E and Pantera 40 are used for control of annual and perennial narrow leaf and broadleaf weeds in tobacco.

The herbicide Quizalofop-p-ethyl is a selective herbicide that is being used after weed germination, especially for the control of annual and perennial grass weeds in potatoes, soybeans, sugar beets, oilseed beats, peanuts, beets, sunflower, cotton, flax, vegetable crops and other broadleaf crops, (Mahakavi et al., 2014), (Hui Zhang et al., 2017), (2). Quizalofop-P and quizalofop-p-ethyl should not be confused with quizalofop or quizalofop ethyl, because these last two compounds are different than the first two (2). This is a relatively new compound and therefore very little information is available about its toxicity or environmental impact.

On our market, a well-known herbicide with the active substance Quizalofop-p-ethyl 50 g/l, is the herbicide Leopard 5 EC. According to the recommendations of the agent and distributor MAGAN-MAAK DOO Skopje (9), this herbicide can be used to control many types of annual and perennial grass weeds in gardening: tomato, pepper, eggplant, cucumber, cabbage, potato, beans, peas, tobacco, sunflower, turnips, in fruit growing, viticulture and ornamental plants, at a dose of 1-2.5 l/ha for annual grass weeds and 2-4 l/ha for perennial grass weeds.

The goal of this research was to demonstrate the effect of the herbicide Leopard 5 EC that is being used for grass weed control in tobacco, usually the barnyard millet-Echinochloa crus-galli, the results of which will be of particular benefit in tobacco production.

MATERIAL AND METHODS

The study was conducted in 2019 at an individual tobacco producer on an area of 0.75 ha planted with tobacco, where there was a significant presence of weeding with grass weeds. The test is set in production conditions in three iterations in the area of the village Mazhuchiste, a place called "Simagovo". The tobacco of the type Prilep, variety P66-9/7 was planted mechanically on 22.06.2019. Due to the high degree of weeding, mainly with the weed ordinary barnyard millet (Echinochloa crus-galli), the herbicide Leopard 5 EC with the active substance Quizalofop-p-ethyl 50 g/l was used for its control. The treatment with the herbicide was performed during the tobacco vegetation on 26.07.2019. The tobacco is in a phase of vigorous growth, and the weeds are in an advanced stage of their development (phenophase 5-6 leaves, with a height of 15-20 cm). A tractor sprayer of the type "Morava" with a volume of 330 liters was used. Because it is a matter of an annual weed that was growing vigorously, the herbicide was used at a dose of 2 l/ha with a water consumption of 400 l/ha. The effectiveness of the herbicide was assessed on the basis of the weed damage at the treated area. To this end, the method of squares was used (Kostov, 1994), which consists of collecting and counting weed plants per unit area (usually 1 m^2), separately from each variant. After the collection, the weeds are divided into species, they are being counted and their weight is being measured. If the degree of weeding is higher, squares with a smaller dimension are used, however the number of weeds comes down to 1 m2. Prior to the very treatment of the surface, the weeds were counted per unit area (1 m2) and their green mass was measured. In order to evaluate the effectiveness of the herbicide, two observations were made during the vegetation, i.e. collection of weeds and measurement of their weight. The first inspection of weeds was performed on 04.08.2019, and the second one was on 24.08.2019. To calculate the coefficient of efficiency of the herbicide, Kostov's formula (1994) was used, where the average results obtained from the three iterations are taken. In this test the efficiency of the herbicide is assessed on the basis of the mass of the weeds in the control (untreated weeds), in relation to the mass of the dried weed plants from 1 m^2, in the treated area, according to the following formula:

$$KE=Pk-Pt/Pk.100$$

KE = efficiency coefficient
Pk = average weed mass from 1 m2 at the control area
Pt= average weed mass from 1 m2 at the herbicide treated area

RESULTS AND DISCUSSION

The area with tobacco where the test was performed, had a high degree of weeding predominantly with the fibrous weed *Echinochloa crus-galli* known as cockspur or common barnyard millet (Fig. 1). Due to the excessive degree of weeding (Fig. 2 and Fig. 3), a herbicide treatment was required.

Fig. 1 Weed - *Echinochloa crus-galli*

Fig. 2. Tobacco with *E. crus-galli* before treatment

Fig. 3. Tobacco-growing area covered by weed

The results obtained from the weed control test in the transplanted tobacco are presented in a table. Table 1 shows the results regarding the degree of weeding in tobacco, i.e. the number of weeds per unit area, their weight and the efficiency that was achieved with the herbicide.

Table 1. Efficiency of the herbicide Leopard 5 EC for the control of the weed *Echinochloa crus-galli* in tobacco

Assessment	I Iteration		II Iteration		III Iteration		Average	
	No. of weeds/ m^2	Mass g	No. of weeds/m^2	Mass g	No. of weeds/m^2	Mass g	**No. of weeds/m^2**	**Mass g**
Ø - Before treatment 26.07.2019	1056	3808	1920	3648	1456	3728	**1477,33**	**3728,00**
After treatment 4.08.2019	1584	1376	992	704	1344	1072	**1306,66**	**1050,66**
After treatment 24.08.2019	The weeds are almost completely dry						**-**	**-**
Efficiency - % in regard to the mass	**-**	**63,86**	**-**	**80,70**	**-**	**71,24**	**-**	**71,93**

Before commencing the treatment, in order to assess the degree of weeding, weeds were collected from the measured square meter and their green mass was measured. The average number of weeds on an area of 1 m2 before treatment was 1477.33 weeds of E. crus-galli with a green mass weight of 3728.00 g (Table 1). More precisely, the least weeds were counted in the first iteration, 1056 weeds with a weight of 3808 g, while the most weeds, 1920, were counted in the second iteration with a total green mass of 3648 g. In the third iteration, the number of weeds was 1456 with a mass of 3728 g. From the data it can be noticed that in the second iteration, where the number of weeds is highest, actually the lowest weight of the green mass was measured, unlike the first iteration where the number of weeds is lowest, while the highest weight of the green mass was obtained. This is due to the larger space for nutrition that the weeds have in the first iteration, because they are rarer, they are more developed and have greater green mass, unlike weeds with a more vigorous structure, which remain weak, underdeveloped, and for this reason they have lower weight of the green mass.

During the second assessment, which was performed ten days after the treatment, the first symptoms of the action of the herbicide were noticed, with the appearance of chlorosis on the surface of the leaves (Fig. 4, Fig. 5, and Fig. 6). During this assessment, the average number of weeds per 1 m2 was 1306.66 with a weight of 1050.66 g. The least weeds were counted with the second iteration, 992, with a weight of 704 g, and the most weeds, 1584, were counted with the first iteration with a total weight of 1376 g. At the third iteration, the counted 1344 weeds had a weigh of 1072 g. The data obtained by measuring the green mass of the weeds from 1 m2 before treatment with the herbicide and the data obtained by measuring the mass of weeds ten days after treatment, indicate the high effect achieved with the herbicide Leopard 5 EC to control this weed. It is observable that in the treated weeds the mass is almost 3 times lower than in the untreated weeds.

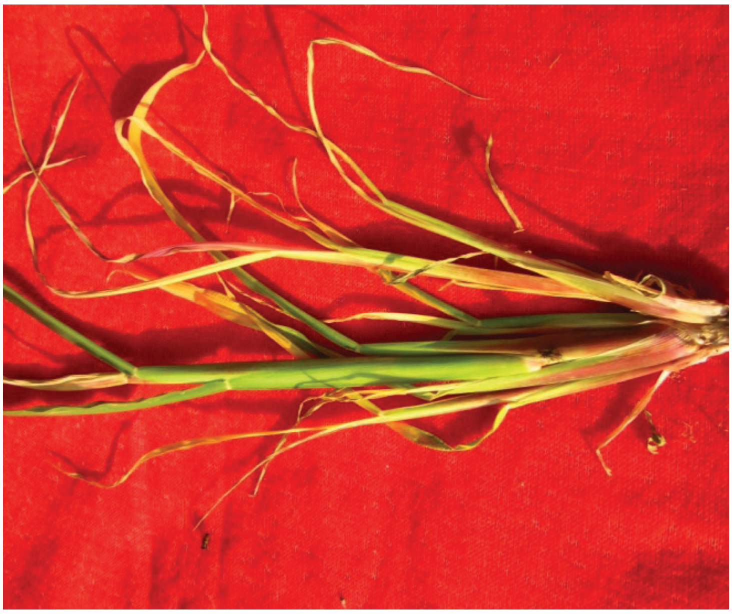


Fig. 4. *E. crus-galli* – after treatment

Fig. 5. Chlorosis of weed leaves

Fig. 6. 10 days after treatment

The next assessment of the condition of the tobacco and the weeds that were treated with the herbicide, was performed 30 days after treatment. Here the weeds per unit area were not counted and we didn't measure the dry mass of the weeds because almost all weeds were completely dry (Fig. 7 and Fig. 8). It should be pointed out that during this treatment, no changes were observed in terms of the tobacco's growth and quality, i.e. no signs of phytotoxicity were observed in the tobacco crop.

Fig. 7. 30 days after treatment

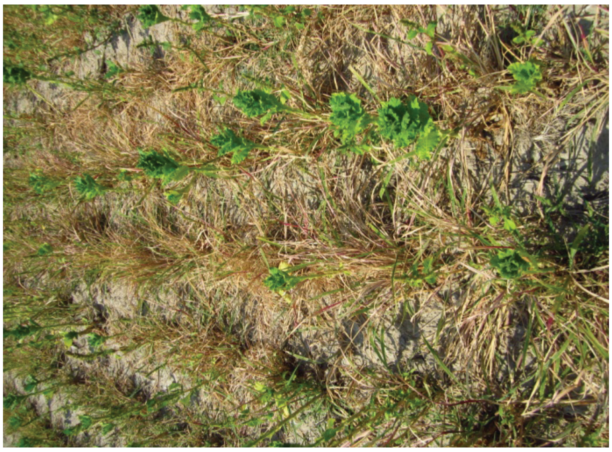


Fig. 8. Treated tobacco-growing area

The obtained data show that with the herbicide Leopard 5 EC used with a dose of 2 l/ha, high efficiency has been achieved in the control of annual grass weed, usually the fibrous millet - *E. crus-galli* in tobacco. After the iterations, the efficiency was within the range from 63.84% in the first iteration, 71.24% in the third iteration, and up to 80.70% in the second iteration. Or on average, an efficiency of 71.93% was achieved for the control of this weed by means of the herbicide Leopard 5 EC. Efficiency of more than 70% was achieved with this herbicide in the studies by Hristeva et al. (2011) in oriental and large-leaf tobacco for grass weed control. The data that was obtained in the weed control study of *E. crus-galli* indicate that this herbicide can most definitely be used to control other types of annual grass weeds that grow in transplanted tobacco during the growing season. Considering the poor selection of herbicides that can be used before tobacco transplanting, in conditions of high weeding with grass weeds, the herbicide Leopard 5 EC is a good choice for additional protection from narrow leaf weeds in tobacco vegetation.

CONCLUSIONS

Although tobacco is considered a very resistant crop, weeds can directly affect its yield and quality, since they are great competitors for food and space and host a large number of pests and pathogens that transmit various diseases. Due to the limited selection of herbicides that are available for use in tobacco compared to herbicides for cereal crops, growers face greater difficulties in controlling weeds, especially grass weeds.

The tests were performed on a tobacco-growing area with a high degree of weeding with the ordinary fibrous weed – barnyard millet (*Echinochloa crus-galli*). For this purpose, the herbicide Leopard 5 EC with the active substance Quizalofop-p-ethyl 50 g/l was applied, with a dose of 2 l/ha.

By assessing the weeding on the tobacco-growing area before treatment it was found that the average number of weeds per 1 m2 is 1477.33, with a weight of 3728.00 g.

Within a period of ten days after treatment, an average of 1306.66 weeds per 1 m2 were counted, with a weight of 1050.66 g.

During the assessment which was performed 30 days after treatment, it was concluded that all weeds are almost completely dried.

No signs of phytotoxicity in the tobacco crop were observed during the vegetation.

An efficiency of 71.93% was achieved with the herbicide Leopard 5 EC for the control

of the weed *E. crus-galli*.
Due to the high efficiency demonstrated by the herbicide for the control of this weed in tobacco, we believe that it will have wider practical application for the control of other types of weeds in the vegetation after transplanting tobacco in the field.

REFERENCE LIST

1. Chapman Koga and Rutendo Nyabadza, 2016. Weed control in tobacco production. Features, Opinion & Analysis, 13 October.

2. EXTOXNET - Extension Toxicology Network. Quizalofop-p-ethyl. Publication Date: 9/93. https://pmep.cce.comell.edu/

3. Hristeva Ts., Dekalsk T., Masheva V. 2011. Effectiveness of some herbicide combination for weed management in tobacco production and soil microbiological monitoring for ecological risk. Institute of tobacco and tobacco products, Plovdiv, Agricultural academy, Sofia (Bulgaria).

4. Hui Zhang, Mengya Li, Jie Li, Guangli Wang, and Yuan Liu. 2017. Purification and properties of a novel quizalofop-*p*-ethyl-hydrolyzing esterase involved in quizalofop-*p*-ethyl degradation by *Pseudomonas* sp. J-2. Microb Cell Fact. 2017; 16: 80.

5. Katarina Radonjić, Bachelor of Engineering. Protection of tobacco from pests, diseases and weeds. PSS VRBAS-Vrbas (Agricultural Advisory Services) Vrbas. https://victorialogistic.com/poljoprivreda/virusi-i-korovi-u-duvanu.

6. Konstantinović B., Meseldžija Maja. 2002. Tobacco weeds and the possibility of their control with herbicides. Biljni lekar, Vol. 30, br. 5, str. 428-434.

7. Kostov T. 1994. General agriculture with agroecology (Practicum). ISBN 9989-43-012-8. Ss. Cyril and Methodius University – Skopje.

8. Mahakavi T., Bakivaraj R., Baskaran L., Nusrat Rashid, Sankar Ganesh K. 2014. Effect of herbicide (Quizalofop-p-ethyl) on growth photosynthetic pigments, enzymes and yield responses of blackgram (Vigna mongo L.). International letters of natural sciences, Vol. 9, pp. 58-65.

9. MAGAN-MAAK DOO Skopje. https://www.maganmak.com.mk/leopard

10. Mickovski J. 1969. Weed control in tobacco by using Patorana preparations. Agronomy Journal: Journal of the Croatian Society of Agronomists, Vol. 31 N° 5-6, pg. 363-374.

11. Mickovski J., Rizinski S. 1979. Testing of the efficacy of the Galex 500EC preparation for tobacco weed control. Plant protection, ISSN: 0514-5872.

12. William A. Bailey. 2013. Herbicides used in tobacco. Department of Plant & Soil Sciences, University of Kentucky, Research and Education center, Princeton, KY, USA.

13. William A. Bailey and Robert C. Pearce. 2014. Evaluation of experimental herbicides for no-till dark tobacco. Tobacco Science: January 2014, Vol., pp. 1-7.

ISSN 0494-3244
Tutun/Tobacco, Vol.69, N^0 7-12, 16-27, 2019 UDK: 633.71-153.037:632.48]:632.9
Review article

RHIZOCTONIA SOLANI - THE CAUSING AGENT OF DAMPING OFF DISEASE AND ITS INTEGRATED MANAGEMENT IN TOBACCO SEEDLINGS

Biljana Gveroska

"St. Kliment Ohridski" University- Bitola,
Scientific Tobacco Institute-Prilep, Kicevska bb, 7 500 Prilep, Republic of North Macedonia
email: bgveros@yahoo.com

ABSTRACT

Healthy and quality tobacco seedlings are the base for successful tobacco production. Therefore, seedling protection is one of the most important measures that should be applied to obtain healthy and quality seedlings, successful transplanting, avoid problems with diseases and pests in the fields and obtaining a healthy and quality tobacco raw material.
The damping off is the most destructive disease in the seedlings production. The most common causing agent is the pathogenic fungus *Rhizoctonia solani*.
The knowledge of symptoms of the disease as well as morphology and biology of this causing agent, way of infection and resistance, epiphytotical properties of the pathogen etc, have the great importance for its successful control.
Its integrated management means consideration of all available plant protection methods and subsequent integration of appropriate measures that reduce the population of harmful organisms and keep the use of plant protection products to levels that are economically and ecologically justified. It refers to prevention or prophylaxis as well as the measures used to treat already diseased plants, therapy.
Its integrated management is complex and involve numerous agrotechnical measures, physical, mechanical as wel as the use of biocontrol and chemical control.

Key words: damping off disease, *Rhizoctonia solani,* integrated management

RHIZOCTONIA SOLANI - ПРЕДИЗВИКУВАЧ НА БОЛЕСТА СЕЧЕЊЕ И МЕРКИ ЗА ЗАШТИТА НА ТУТУНСКИ РАСАД

Здравиот и квалитетен тутунски расад е основа за успешно производство на тутун. Заштитата е една од најважните мерки што треба да се применат за да се добие здрав расад, да се постигне успешно расадување, да се избегнат проблемите со болести и штетници на нива и да се добие здрава и квалитетна тутунска суровина.
Болеста сечење е најдеструктивна болест во производството на расад. Најчестиот предизвикувач е патогената габа *Rhizoctonia solani*. Познавањето на симптомите на болеста како и морфологијата и биологијата на овој предизвикувачки агенс, начинот на инфекција и отпорност, епифитотиолошките својства на патогенот и сл., имаат огромно значење за негово усшешно сузбивање.
Интегралната заштита (во овој случај, на тутунскиот расад од овој патоген) значи вклучување на сите мерки за заштита на растенијата со цел намалување на популацијата на штетниот организам и употребата на производи за заштита на растенијата на ниво на економска и еколошка оправданост. Тоа се однесува на превенција или профилакса, како и на мерките што се користат за лекување на веќе заболените растенија, терапија.
Интегрална заштита во однос на овој патоген е сложена и вклучува бројни агротехнички мерки, физички, механички, како и употреба на биолошка борба и хемиска заштита.

Клучни зборови: сечење, *Rhizoctonia solani,* интегрална заштита

INTRODUCTION

Modern tobacco production aims to ensure good yields and quality of tobacco raw material. For that purpose, a number of agro-technical measures are applied.

Seedlings production is the first, initial and one of the most important links in tobacco production on which the entire further tobacco production depends. To produce healthy and successful seedlings is the basis for success in the later stages of tobacco production and finally obtaining a healthy and quality tobacco raw material.

Seedlings are also subject to a number of external influences, due to which they are attacked by a large number of pests and diseases. Therefore, seedling protection is one of the most important measures that should be applied to obtain healthy and quality seedlings, successful transplanting and avoid problems with diseases and pests in the fields.

One of the most important measures in the fight against tobacco diseases is prevention. If, despite the undertaken measures, the disease still appears, in that case it is necessary to take other measures for protection of the tobacco seedlings.

The knowledge of diseases and their causing agents are of great importance for successful protection and production of healthy seedlings.

DAMPING OFF – THE MOST DESTRUCTIVE DISEASE IN TOBACCO SEEDLINGS

According to importance of healthy and quality seedlings to tobacco production, as the basis for success in the later stages of tobacco production and finally obtaining a healthy and quality tobacco raw material, the emergence of damping off disease can really destroy production. The damage and losses are obvious and hence, determining the causing agent is the first step in protecting against this disease.

Pythium debarianum and *Rhizoctonia solani* are mentioned as the most common causing agents of the damping off disease. The symptoms are very similar and difficult to distinguish. Accurate determination is possible only by microscopy of infected material. However, the dominant causing agent in these areas is the fungus *R.solani*.

Such data are presented for some of the European countries. Kurzawienska (1980) based on laboratory tests, points out that in Poland, *R. solani* (accompanied by *Botrytis cinerea)* have been found to be the most important causing agents of damping off in tobacco beds. According to Ivancheva et al. (1978) in Bulgaria, the causing agent that dominate in tobacco beds, actually is the fungus *R.solani* (Мицковски, 1984).

RHIZOCTONIA SOLANI - THE CAUSING AGENT OF DAMPING OFF DISEASE

This destructive pathogen is worldwide pathogen responsible for serious damage of many economically important agricultural and horticultural crops (Grosh, 2003). It mostly affects the plants of the families *Solanaceae* and *Papilionaceae*. According to Lucas (1975, loc. cit. Мицковски, 1984) the disease caused by *R. solani* occurs every year. The specific symptom is observed in the acute phase - when the seedlings immediately rot and fall over the soil surface. In a small number of cases, some of the plants (before appearing of symptoms) survive the infection, but after transplanting, the growth of these plants is slower compared to healthy ones, and the symptoms also appear in the fields. In our country, it occurs on the seedlings and very rarely (al-

most never) on the tobacco in the field.
This fungus in our conditions appears in all stages of seedlings development - from germination to the stage of vigorous growth. *Rhizoctonia* is difficult to control because it survives for many years as sclerotia in soil or as mycelium in an organic matter under numerous environmental conditions (Grosh, 2003). The fungus has a wide host range, ie, limited rotational controls, there are no resistant cultivars and the fungus can grow and survive without a live plant host – it has "saprophytic ability." It cannot be eliminated but can be suppressed to a level that doesn't cause economic loss.

Symptoms of the damping off caused by *Rhizoctonia solani*

A dark brown watery spot begins to appear on the ground part of the stem, which spreads under favorable conditions. The tissue necrotizes, the supply of water and nutrients is disabled, due to which the plants die. The infection spreads to the surrounding plants, appearance of many diseased plants i.e. infected areas in the beds. These areas expand and merge, so that a big part of the tobacco seedlings are destroyed. Thus, the seedling production is degraded (Ph. 1 and 2).

Photo 1. Symptoms of disease in the beds

Photo 2. Infected plant by R. solani

Morphology and biology of *Rhizoctonia solani*

The name *R. solani Kuhn* is often mentioned in the literature for this parasite. The causing agent of this disease is also known as *Hypochnus cucumeris (Frank), Hypochnus solani* (Prill and Dalacrois), *Corticium solani* (Prill and Delacroix), *Corticium vagum sensu* (Burt), *Pellicularia filamentosa* (Pat., Rogers), *Ceratobasidium filamentosum* (Pat, Olive), and *Thanatephorus praticola* (Kotila, Fiente) (Мицковски, 1984).
R. solani is actually an anamorph (asexual stage) of the pathogen. Its teleomorph (sexual stage) is *Thanatephorus cucumeris* (Frank) (Ivanović, 1992).
According to Parmeter (1970, loc. cit. Мицковски, 1984), a large number of nuclei are observed in the young hyphae of this fungus. The hyphae of *R. solani* are wide and thick (8-12 microns) at first colorless, but with aging they turn dark brown. One septum is always present near the base of the hyphae. The hyphae branch near the septum at right angles, with slight bending at the point of branching. Basically the hy-

phae are compacted with brown pigmentation (Ph. 3 and 4).

Only mycelium develops on infected plants and infection is performed by hyphae. It forms neither vegetative nor generative organs for reproduction. The sublime shape of the fungus (basidia with basidiospores) is confirmed on to the potato tubers.

Pseudosclerotia are a conservation organ, sometimes formed on artificial culture, or in rotten plants. Some of these bodies are barely visible, while others are larger (up to 6 mm in diameter). They are more or less flattened, irregular, brown or black and have a smooth surface. Sclerotic embryos develop by increasing branching and partitioning of the common hyphae. Older pseudosclerotia are composed of freely intertwined brown chlamydospores with dense contents. Sometimes the remnants of infected parts of the host plant are intertwined with sclerotic hyphae. The basidia form directly on the gray mycelia.

Photo 3. R. solani –pure culture

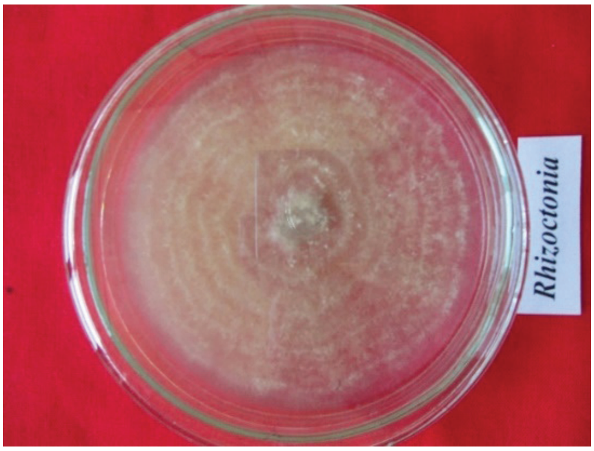


Photo 4. R. solani –mycelium

R.solani can be isolated from the tissue of infected plants, soil and rhizosphere as well as from rotten remains of plants. It can be developed in a liquid and solid environment, on standard or specialized substrates. Many researchers have studied the effect of temperature on the development of the disease. The fungus develops over a wide temperature range. According to Алексиќ, *R.solani* develops in vitro at a temperature of 25^{o}C. Its development stopped at temperatures below 5 ^{o}C and above 30^{o}C. For its development this fungus requires moderately wet, but can sometimes occur on relatively dry soils (Мицковски, 1984).

Infection and resistance

The development of *R. solani* is stimulated by the secretions from the germinating seeds and the root veins of the tobacco plant. The nature of these substances is not sufficiently known, but it is believed that carbohydrates and amino acids play an important role. These substances allow the hyphae to develop towards the root system of the plant or stimulate the penetration of sclerotia or basidiospores. When the connection is made, *R.solani* can penetrate the plant tissue directly or through the natural openings of the injured areas.

The parasite often attaches tightly to the host plant and develops at a distance along its surface, enclosed in an adhesive sheath before forming an appressorium. Penetration occurs intercellular or by direct penetration into the epidermal wall. The infiltrated hypha branchs through the plant tissue, the affected tissues get brown (necrotize) and die. This necrotic reaction of the host occurs either from diffusely distributed metabolites of fungi or its toxins, or it occurs from the cells of the plants themselves, as a reaction to penetration of hyphae (Doomanetal 1968, loc. cit. Мицковски, 1984). Infection of the seeds occurs at the same way i.e. by penetration into the seed coat that is in contact with the soil.

Plant resistance to this pathogen is associated with the preventing of penetration or spreading throughout the organs. There are mechanisms that prevent the parasite from entering into the plant cells, or penetration is disabled due to lack of physical and chemical stimulants. After penetration, complete penetration of the fungus can be partially prevented by excreted toxins and enzymes, thus localizing the infection only to limited parts of the plant incentives.

Resistance is often related to the physical properties of the plant tissue that affect the spreading of the pathgen through the plant. But the plant's ability to limit the spread of the pathogen once the infection has already started seems to be related to the increased intensity of respiration in its tissue. Factors that reduce plant vigor, whether environmental, chemical or biological, reduce its resistance (Flentie 1957, loc. cit. Мицковски, 1984).

Epiphytotical properties of the pathogen

Epiphytotical properties of a pathogen depend on the favorable environmental conditions for its development, the possibilities for its spread, as well as the change of cultivation of the crop. *R. solani* as a saprophytic fungus can use many organic substances as energy sources and so, for months to live on the waste of dead or rotten plants. It can be maintained in the soil with both the reproductive organs and the mycelium. Sclerotia are an important organ for the spread of infection. They can also be transmitted by seeds. Sclerotia, mycelium and basidia are easily transmitted by wind or irrigation water.

R.solani is a soil microorganism that can mainly provide active saprophytic existence in the soil and survive in the absence of the host plant for several months and years, colonizing organic matter. The substrate enriched with NaNO2 is very suitable for saprophyte lifestyle (Papavizas and Davey,1961, loc. cit. Мицковски, 1984).

Mycelium that lacks carbon or nitrogen may develop, but its ability to infect the plant stem is greatly reduced. Cellulose as the most common substance in the soil can be colonized and decomposed, which undoubtedly affects the stimulation and maintenance of the pathogen.

Soil moisture, aeration, texture and organic matter have a strong impact on the parasite. The highest saprophyte activity is achieved at relatively low soil moisture. The optimum soil temperature for saprophyte development is different on different soil types. The fungus usually develops at 16-20^{o}C at a depth of 0.5-3.0 cm. The highest concentration of CO_2 reduces the activity of the fungus, as the parasitic phase is much more sensitive than the saprophytic one. Dry sclerotia remains infectious for 6 years. Maintenance increases at higher temperatures or higher humidity during conservation.

INTEGRATED MANAGEMENT OF DAMPING OFF DISEASE IN TOBACCO SEEDLINGS

Integrated Pest Management means careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment (EU Commision, 2020).

Measures that prevent the contact between the pathogen and the host plant are called hygienic measures. These measures, as well as measures with aim to prevent the occurrence of the disease, are known as preventive measures for protection or prophylaxis. Measures used to treat already diseased plants are known as therapy.

Integral plant protection (as a complex of measures) consists of the application of:

- Agrotechnical measures
- Mechanical measures
- Physical measures
- Biological measures
- Chemical measures
- Legally measures

Agrotechnical measures

This type of measure prevents the multiplication of large numbers of parasites, pests and weeds in agricultural crops, and thus reduces yield losses. These measures have a preventive character of protection. They are the following:

- **Choosing a place to grow**

This agro-technical measure is of special importance. When growing tobacco, the type of soil should be taken into account (to avoid heavy clayey, saline soils), the location of the surface and, if possible, chemical analyzes for soil fertility. To prevent the occurrence of damping off disease, the beds should be on a sloping ground, drained and to allow air circulation (Vućo, 2007).

- **Crop rotation**

From the protection point of view, the crop rotation has an important role in preventing the occurrence of plant diseases, pests and weeds. Due to the frequent cultivation of plants as a monoculture, which is specific to tobacco, plant debris in the soil remains with a number of causing agent of various diseases and pests, which is a potential danger of epiphytotics in certain pathogens. Plant debris is also a primary source of infection for the new harvest. The intensity of the attack will be reduced only by crop rotation, ie by growing other crops that are not from the same family, ie. do not host a particular pathogen or pest.

There are numerous examples of successful disease prevention (including damping off in different agricultural plants) by applying crop rotation with other crops, aromatic plants, as well as annual and perennial crop rotation (Khan et al., 2019).

- **Tillage of the soil**

It directly or indirectly destroys pathogens, insects and weeds because many of them are plowed (especially with autumn plowing) deeper into the soil where they do not have favorable conditions for development. So, it means that reduces the primary sources of infection. Plowing before sowing is also very important to reduce, and especially to prevent the early occurrence of damping off, especially if the soil contains an inoculum of *R. solani* from previous crops (Nunez, 2006). With regular additional processing, weeds are destroyed, which are hosts for a large number of pests and pathogens in tobacco.

• **Sowing time and sowing norm**

Sowing time is of particular importance and primarily determines the stages of development (Khan et al., 2019). Sowing time should allow rapid germination and development, but of course it should not be a wet and cold period (Nunez, 2006).

The right choice will ensure the vigor of the seedlings, which is in addition to disease resistance. By sowing at the optimal time, the seedlings are more developed, thus avoiding critical periods for attack in a curent phenophase.

In addition to the optimal sowing periods, it should be taken a care with the sowing depth and the sowing norm. When sowing tobacco seeds, it should be used a smaller amount of seeds per 1 m^2 to avoid the dense seedlings, which is one of the main reasons for the occurrence of damping off. It also prevents transmition of the diseased seedlings to the fields.

• **Selection of varieties and hybrids**

The use of resistant varieties and hybrids in order to reduce the occurrence of plant diseases (including damping off), is of particular importance for the integrated plant protection as well as tobacco. It is the cheapest method of protection, without residues in production and without harmful consequences for the environment. When choosing varieties, resistance varieties should always be preferred, which will reduce production costs. This is the most modern and most promising protection measure.

The use of resistant varieties and hybrids is of particular importance for reducing the occurrence of plant diseases (including damping off). It is the cheapest and the contemporary method of protection, without residues in production and without harmful consequences for the environment. It also reduce production costs. Resistant varieties should be preferred when choosing varieties. This is the most modern and most promising protection measure.

• **Spatial insulation**

This agro-technical measure (although its bigger importance for the transplanted tobacco) has an impact on the protection of the seedlings, too. The pathogen *R. solani* has many plant species as its hosts, especially from the family Solanaceae (potato, tomato, pepper). Hence, these planted areas are favorable opportunity for the damping off disease occurrence in tobacco beds (danger of spreading the pathogen during irrigation and various operations). There is also the possibility of viruses spreading.

• **Fertilization**

Quality nutrition is a guarantee for growing the healthy seedlings. However, if large amounts of nitrogen are used, weak plants are obtained that can be attacked by a number of pathogens. Excessive nitrogen fertilization is known to increase plant susceptibility. Hence, there is a particularly great danger of damping off. In order to prevent its occurrence, the nutrition of the seedlings should be in accordance with the stage ie needs of the seedlings.

Recently, modern biostimulants (which represent different formulations of components) are present on the market. They improve plant's physiological processes as well as the growth and plant vigor. At the same time, they have a fungicidal effect. Their application has a special contribution for protection of the tobacco seedlings from the occurrence of the damping off.

According to the goals of modern protection of tobacco seedlings, Scientific Tobacco Institute - Prilep has tested some bioproducts applied through appropriate application models.

• **Irrigation**

Proper irrigation contributes to the production of healthy and quality seedlings. However, excessive irrigation is especially harmful for the seedlings because the densed plants (big numbert of plant per area) retains water, thus increasing all predisposing factors for infection (microclimate, transmission and retention of the pathogen in the soil and ground etc.). Therefore, irrigation should be moderate, carried out carefully and timely, in accordance with the real needs at the appropriate stage of the seedlings development.

• **Weed control**

R. solani as a saprophytic fungus can persist on many weeds, thus increase the natural inoculum and the risk of seedling infection. Also, the presence of weeds reduces the possibility of proper nutrition of the seedlings and thus increases the susceptibility of plants to the pathogen. The large presence of weeds also creates a microclimate that is conducive to achieve an infection and development of the disease.

By weeds control, in fact, there are efforts to reduce all predisposing factors for infection and thus the risk of disease. Hence, these agrotechnical measures for tobacco seedlings protection is a justified.

• **Timely preparing and tempering for transplantation**

Delaying of preparing and tempering of seedlings to be rooted and transplanted (especially if irrigation is continued) increases the possibility of damping off disease. During that period, no protection is provided, so, the seedlings are in danger of other fungal diseases (blue mold, brown spot, etc.). Perceiving this danger, seedlings have to be properly tempered, planning for the rooting which has to be timely achieved.

Sanitary measures

Numerous hygienic-technical measures should be practiced in the seedling production to prevent the development of the pathogenic fungus *R. solani*, to prevent the infection of the seedlings and the spreading of the infected poins in the beds. Thus, the diseased seedlings should not be manipulated, but it should be taken out of the beds. This should preferably be done by one person and the others to uproot the healthy seedlings.

Mechanical measures

They should enable the destruction of the plant organs through which the parasite spreads but also reduce the inoculum to a minimum for the next season. Most often, as mentioned earlier, this includes the manual removal of infected plants and their destruction - burial or (better) burning outside the beds.

It is necessary to inspect the infected areas in the beds and completely “clean” them to prevent spreading the infection, merging them and therefore, huge damages. According to (Vućo, 2007), such a mechanical operation is necessary before treating the beds.

Physical measures

These measures include the use of light, heat, low and high temperatures and the application of various kind of rays.

Thermal disinfection of the soil performed by dry heating or water vapor is a hygienic measure that destroys the spores of many fungal pathogens. This would be especially useful for soil pathogens such as *R. solani*. But there is no developed method of its application in tobacco production.

Solar energy allows partial disinfection of the soil, so exposing the seedlings to light (especially in the early stages) influences not only the development, but also has a

certain indirect protective effect.
Thermotherapy is used in seed production to kill pathogens, thus avoiding the introduction of the pathogen by sowing. Because tobacco seeds are stored for up to several years, this measure is unacceptable. Also, *R. solani* is a pathogen in the soil, so the adequacy of this method of protection is debatable.

Biocontrol

Biocontrol is the use of biocontrol agents or products of their metabolism in the suppression of harmful agents. Biocontrol agents (can be fungi, bacteria or viruses) act through a number of mechanisms in such as: competition for space and food, antagonism or antibiosis, mycoparasitism, induced resistance and etc. Propagated appropriately or, favoring their development in the environment itself, do the biocontrol. The genus *Trichoderma* show antagonistic relationships on the number of fungal pathogens in plants (Harman, 1996).
The reducing effect, as well as the nature of the action of *Trichoderma* sp. on several pathogens, including *R. solani* in tobacco was proved by Гвероска (2009), Gveroska and Ziberoski (2011), Gveroska (2015). *T. harzianum* has been shown to has the best reducing effect.
The application of these biocontrol agents can be effective in in standard conditions of agricultural production, especially when using herbicides. According to Gveroska (2015), this biocontrol agent can be used in such conditions, with appropriate "compensation" of the first reducing effect of the herbicide on the population of the biocontrol agent.
The modern directions of tobacco protection in the Republic of North Macedonia require its inclusion in the protocols for integrated managent system with the most appropriate application model of *T. harzianum* (Gveroska, 2020).
The biological control of pathogens, beside the microorganisms-antagonists includes various biological preparations based by enzymes, plant extracts, antibiotics, various low molecular weight compounds, etc., as well as microorganisms with specific activity. Thus, the primary activation of certain rhizobacteria can be supplemented by fungicidal action, which can be used to protect pathogenic fungi. Such a role is played by the rhizosphere ammonifying bacteria *Bacillus subtilus* Ch13 which has a promising role in protection against the pathogen *R. solani*. Another strain – *B. subtilus QST 713* recently has been also included in biological control.
Good results in control of damping off disease has the preparations based on EM technology, ie the technology of effective microflora. Its basic principle is based on the application and increasing the population of efficient and beneficial microorganisms in the soil, which expels degenerative microorganisms, especially soil pathogens. There are also probiotics with a "strengthened" formula which, in addition to the four groups of active microorganisms included in the basic formula of probiotics (lactic acid bacteria, photosynthetic bacteria, actinomycetes and yeasts) are constantly evolving and supplementing with other bioactive components.
From all the above data and scientific facts, it can be concluded that biocontrol is one of the basic ways to reduce the use of chemicals and environmental management in the direction of sustainable agricultural production.

Chemical measures

Seed treatment with fungicides is considered a good protection option, especially in the early developmental stages of seedlings (Khan et al., 2019; Nunez, 2006). However, pathogen-specific fungicides should be used for this purpose. On the other hand, since it is a soil pathogen, this procedure is difficult and its justification is questioned.

In addition to the application of other measures to protect tobacco seedlings from damping off caused by the pathogen *R. solani*, the most acceptable and fastest way is the chemical, ie the application of fungicides. Unfortunately, for a long time there were no preparations for the suppression of *R. solani* (except a.i. thiophanate-methyl which at this point is noт approved).

The studies of (Csinos et al., 1998) for the control of this pathogen, the active ingredients flutolanil, iprodione, fluazinam and tebuconazole are pointed. At one time, in our country there were attempts to use some fungicides in the protection of tobacco seedlings.

There were any investigations in Macedonia as effort to use some fungicides in the protection of tobacco seedlings - such as Pilarič 75% - 0,2% WP and Bravo 500 SC-0,2% -a.i. chlorothalonil, Folicur EW-250 - 0,1% -a.i. tebuconazole , Score 250 EC- 0.05% -a.i. difenoconazole, Quadris 25 SC- 0,1% -a.i. azoxystrobin and the others (Gveroska, 2008, 2012).

Later, good efficacy (in artificial inoculation with *R. solani*) was achieved with the fungicide Signum 33 WG (a.m. boskalid + piraklostrobin) in the concentrations of 0.1 and 0.15%, and especially with Quadris 25 SC (a.m. azoxysistrobin - 0.2 and 0.15%). Recently, new active substances and, accordingly, fungicides have appeared on the market. Despite their registration for use in other crops, the most are effective in controlling this pathogenic fungus and they have a great commercial application. These are the active substances Azoxystrobin, Boscalid + Pyraclostrobin and Ametoctradin + Methiram (Gveroska, 2018).

The application of chemical protection in tobacco production is in line with modern guidelines for sustainable agricultural production and the principles of environmental protection (EU Commission, 2020). Specifically, monitoring the onset of diseases, intensity of attack, accurate (not premature) application of chemical protection, application of reduced doses (according to low intensity of attack), reduced frequency of treatment, monitoring of the threshold of harmfulness, risk assessment of / not treatment as well as the risk of resistance, etc. Particular care is taken when applying active substances - to be less toxic. Also, the application of biopreparations is moving upwards.

It is necessary to apply all modern protection measures to achieve the goal - sustainable tobacco production

Legally measures

Legally measures regulate the use of pesticides in agriculture, and hence in tobacco production. They are in accordance with the legislation of each producer country, but also the country (and company) that imports tobacco raw material.

The legislation regarding the placing of plant protection products on the market and their application is in line with the modern protection of tobacco and the goal – selection and the true choice of active ingredients, reduction of the number of treatments and use of preparations in small quantities, but with a large efficiency. Tobacco production stands for no use active ingredients that belong to class I toxicity to the World

Health Organization (and from II - in exceptional conditions).
Modern chemical protection as part of the IPM of tobacco has an ultimate goal - to ensure economically and environmentally acceptable tobacco production and obtaining quality tobacco raw material.

CONCLUSIONS

The damping off in tobacco seedlings is the most destructive disease due to which seedlings production has great damage.
Rhizoctonia solani is the most common causing agent of the damping off disease. A number of measures are taken for its control in order the damages to be at the lowest level.
The fight against this pathogen is difficult due to its pronounced ability for saprophyte development and the presence of a large number of hosts.
Integrated management of *Rhizoctonia solani* (as well as other diseases and pests) is a set of measures to be taken to obtain a healthy tobacco seedling.
Biocontrol is a modern and environmentally friendly way of protection that provides long-term benefits for tobacco production.
Chemical measures, ie the use of fungicides (with the right choice and safety application) are part of the measures for protection against damping off disease.
Applying all the principles and integrated protection measures, sustainable production of tobacco seedlings and tobacco can be ensured.

REFERENCE LIST

1. Csinos AS, Stephenson MG. 1998. Evaluation of fungicides and tobacco cultivar resistance against *Rhizoctonia solani* incited target spot. Crop Protection: 373-377.
2. Europian Commision. 2020. Integrated Pest Management (IPM). https://ec.europe.eu
3. Grosh R. 2003. Report: Biological control of Rhizoctonia solani in organic farming with bacterial and fungal antagonists. Geschäftsstelle Bundesprogramm Ökologischer Landbau, Bundenstalt für Landwirtschaft und Ernährung (BLE) (Gr).
4. Gveroska B. 2008. Effectiveness of selected fungicides in the control of the pathogenic fungus Rhizoctonia solani in tobacco seedlings. Plant Protection XIX: pp. 113-119.
5. Гвероска Б. 2009. Влијание на *Trichoderma sp*. врз развојот на причинителот на сечење кај тутунскиот расад- *Rhizoctonia solani.* Тутун/Tobaco 59: 30 -36 .
6. Gveroska B. Ziberoski J. 2011. The influence of *Trichoderma harzianum* on reducing root rot disease in tobacco seedlings caused *by Rhizoctonia solan.* Int. J. Pure Appl Sci.Technol: 2-11.
7. Gveroska B. 2012. Investigation on the effectiveness of some fungicides in the control of *Rhizoctonia solani* in conditions of artificial inoculation. Тутун/Tobacco 62: 87-94.
8. Gveroska B. 2015. *Trichoderma harzianum* in tobacco seedlings with the use of a herbicide. International Journal of Agriculture Innovations and Research Volume 3, Issue 3, pp. 936-941.
9. Gveroska B. 2015. New fungicide opportunities in the control of *Rhizoctonia solani* in tobacco seedlings. Тутун/Tobacco 65: 29-37
10. Gveroska B. 2018. Effective control of the tobacco seedlings from damping off disease in dual infection in beds. Тутун/Tobacco 68: 38-47.

11. Gveroska B. 2020. Application of *Trichoderma harzianum* in tobacco seedlings protection. ”St. Kliment Ohridski” University Bitola, Scientific Tobacco Institute, brochure (https://www.researchgate.net/publication/344351084_Application_of_TRICHODERMA_in_tobacco_seedlings_protection)
12. Harman GE. 1996. *Trichoderma* for Biocontrol of Plant Pathogens: From Basic Research to Comercialized Products. Conference on Biological Control, Cornell community, April 11-13.
13. Ivanović M. 1992. Mikoze biljaka. Nauka, Beograd.
14. Khan SM. Ali S. Nawaz A. Bukhari SAH. Ejaz S. Ahmad S. 2019. Integrated Pest and Disease Management for Better Crop. Pages 385-428, in: Agronomic Crops, Volume 2: Management Practices. M. Hasanuzzaman, Springer Nature Singapore Pte Ltd.
15. Мицковски Ј.1984. Болести на тутунот. Стопански весник,Скопје.
16. Nunez J. 2006. Steps minimize seedling diseases Western Farm Press,California.
17. Vućo J. 2007. Sprecavanje poleganja rasada i kontrola bolesti. Savremeni povrtar 21: 40-43.

ISSN 0494-3244
Tutun/Tobacco, Vol.69, N0 7-12, 28-36, 2019 UDK: 631.416:633.71(497.774/.775)
Original Scientific Paper

IDENTIFYING THE CHARACTERISTICS OF CHEMICAL ELEMENTS IN SOILS FROM TOBACCO GROWING AREAS

Biljana Jordanoska Shishkoska[1], Valentina Pelivanoska[1]

[1] St. Kliment Ohridski University – Bitola, Scientific Tobacco Institute - Prilep, of Republic of North Macedonia
e-mail: biljana.jordanoska@uklo.edu.mk

ABSTRACT

Presence of chemical elements in the surface soil is the end product of complex geological and anthropogenic processes. The study describes the characteristics of chemical elements and their associations from 150 soil samples where oriental tobacco is grown. Frequency distribution is presented via mean, variance, skewness, kurtosis and element associations are presented by hierarchical clustering procedure. Multivariate analysis was done by steady hypothesis of differentiating production areas by grouping of elements. The results indicate that studies on characteristics of chemical elements can deepen the knowledge of geochemical dispersion, hence their association. It can be concluded that according to statistical distribution, given data may be separated due their natural and anthropogenic contributions. The findings can contribute to the establishment of the soil quality baseline and management of regional environment, although further and systematic monitoring is crucial.

Key words: tobacco, soil, geochemical elements, associations

ИДЕНТИФИКУВАЊЕ НА КАРАКТЕРИСТИКИТЕ НА ХЕМИСКИТЕ ЕЛЕМЕНТИ ВО ПОЧВИТЕ ОД ПОДРАЧЈАТА КАДЕ СЕ ОДГЛЕДУВА ТУТУН

Присуството на хемиските елементи во површината на почвата е краен производ на сложени геолошки и антропогени процеси. Студијата ги опишува карактеристиките на хемиските елементи и нивната поврзаност од 150 примероци од почва каде што се одгледува ориентален тутун. Распределбата на фреквенцијата е претставена преку средна вредност, варијанса, искривеност, а интеракциите на елементите се претставени со хиерархиска процедура за групирање. Мултиваријатната анализа е направена со хипотеза за диференцирање на производните области со групирање на елементите. Резултатите покажуваат дека студии за карактеристиките на хемиските елементи можат да го продлабочат знаењето за геохемиска дисперзија, па оттука и нивната поврзаност. Може да се заклучи дека според статистичката дистрибуција, дадените податоци може да се одделат според нивниот природен и антропоген придонес. Наодите можат да придонесат за воспоставување основна линија за квалитетот на почвата и управување со регионалната средина, иако понатамошното и продолжено следење е од клучно значење.

Клучни зборови: тутун, почва, геохемиски елементи, асоцијации

INTRODCTION

Distribution of the chemical elements in surface media is end product of various geological processes and anthropogenic activities. Both processes can occur in various scales, spatial and temporal, and are affected by the local physical-chemical conditions (Cheng, 2012). In areas where there is little anthropogenic impact on atmospheric deposition, elements in soils originate from the parent substrate, while in urban and agricultural areas the presence of higher content of various elements in soil is a result of their continuous introduction into ecosystems. Different migration mechanisms and other factors result in the complex distribution patterns of different elements in the surface and subsurface soil samples. Studies based on spatial and frequency distributions of chemical elements and their associations contribute to understanding the geological processes (De Caritat et. al., 2013; Coker, 2010; Grunsky, 2010). On the other side they contribute to identification of anthropogenic sources (Barandovski et al., 2012; Stafilov et al., 2010a, Stafilov et al., 2010b; Bačeva et al., 2011; Balabanova et al., 2011).

The distribution and spatial variation of the chemical elements in agricultural soils depends on the extent to which they are introduced, their movement and dissolution in the soil, how much the plants will absorb and their accumulation in the soil. Most metals are not biodegradable and are subject to transformation into water-insoluble and soluble organometallic complexes, so their uptake into the soil may be greater than their losses. As a result, contamination of agricultural land is increasing and is a huge problem for both the environment and humans. Arable soil contains a large number of metallic, organic, inorganic and organometallic compounds. It is a collector where trace elements and other contaminants accumulate rapidly, but their concentration decreases very slowly.

Chemical elements are quantified in different terms, usually as frequency distribution, spatial distribution and element associations. According to many studies, trace elements do not follow normal od lognormal distribution (Cheng et al., 1994, Allegre et al., 1995). Elements with similar geochemical mobility usually occur together in dispersion processes, so they exhibit similar distribution patterns (Hawkes et al., 1962). These associations of elements can be indicative tool for interpretation of element distributions, thereby they can improve the knowledge of the dispersion process of geochemical elements. The case study presents distribution characteristics of trace elements in soil samples from oriental tobacco growing regions and statistical approach based on variance-covariance matrix of the multivariate chemical dataset. A certain approach is given that explores frequency of different chemical elements and identification of their characteristics from these perspectives. The findings can improve our knowledge of the geochemistry in the study area and can contribute to the establishment of the soil quality baseline and management of regional environment, although further and systematic investigation is crucial.

MATERIALS AND METHODS

Study area

Soil samples are taken from: Pelagonia region (PR), Southeastern region (SER) and Vardar Valley (VV) at 150 sampling sites. The largest production is concentrated in Pelagonia region (Kabranova and Arsov, 2009). There are three mines in the region rich in lignite. All of the ash-forming elements are present in varying concentrations in the Macedonian lignite and combustion waste products (Yossifova et al., 2009). The Pelagonian massif is a crystalline core with a continental type of Earth's crust built mostly of the oldest Precambrian formations (Barandovski et al., 2012). This geotectonic unit is separated from the neighboring units by regional and deep faults (north – Prilep field, south on lower elevation - Bitola field) (Jordanoska et al., 2014, 2018). South-eastern region represents a part of the Vardar structural zones during the Caledonian, subjected to strong tectonic processes during the Herzynian orogenesis and Alpine orogenesis (Rakicevic et al., 1968) with Precambian gneisses, Pliocene Lacustrine river terraces and alluvial sediments. In this part of the country the appearance of some metals (Au, Mg, Al, Sc, Ti, V, Cu) in the air is related to the presence of a copper mine and flotation plant, "Bučim", near to the Radoviš town (Balabanova et al., 2010; Stafilov et al., 2010b; Balabanova et al., 2011). Influence from the former iron mine, "Damjan", has also been determined in this area (Serafimovski et al., 2010).

The Vardar zone is a large and important lineament structure of the Balkan Peninsula. Vardar Zone is the result of the destruction of the Grenville Earth's crust when it received its present-day shape during the Alpine period (Barandovski et al., 2012). Vardar valley tobacco production region is known for its lead and zinc industrial activity in the nearest past (Jordanoska et al., 2014). Several investigations of soil, vegetables and fruits produced in the region of Veles, concerned with contamination by lead, zinc and cadmium (Stafilov et al., 2010b, 2010c; Bačeva et al., 2011, 2012; Pančevski et al., 2016; Stafilov and Šajn, 2016, Stafilov et al., 2018).

Analyses of soil material

Soil samples were sampled at fixed depth (0-30 cm) in each field with two replicates (Hawks and Collins, 1987). The following elements were analyzed: Al, Ba, Ag, As, Ca, Cd, Co, Mo, Cr, Cu, Fe, Li, Mg, Mn, Na, Ni, Pb, Sr, V and Zn. As, Cd, Co and Mo content were under the detection limits and therefore they are not presented. Soil samples were digested by HF method (ISO 14869-1). The investigated elements were analyzed by atomic emission spectrometry with inductively coupled plasma AES-ICP (Varian, 715-ES).

Data processing

The data were treated statistically with the program IMB Statistics SPSS v. 19. The statistical approach followed the frequency distribution characteristics of analyzed elements (mean, variance, skewness, kurtosis). Mean represents the central tendency of analyzed data, variance reflects how far is set of random numbers spread out of their statistical mean. Coefficient of variation is calculated as the ratio of the standard deviation and the mean. While skewness is the asymmetry of the probability distribution of the mean and kurtosis is used for identification of extreme values in given distribution. Multivariate factor analysis was used to establish associations of the chemical elements and to reduce the variables. Product moment correlation coefficient (r) was used, as well as varimax method for orthogonal rotation (Reimann et al., 2002).

RESULTS AND DISCUSSION

Statistical parameters that characterize the frequency distribution properties of chemical content of soil samples are given in Table 1. As we can see in the table, all analyzed trace elements are positively skewed. The histograms of the log transformed data (Fig. 1) show that approximately lognormal distributions can be observed only at Mn, V and K. All other elements show similar and very large values for coefficient of variation. These observations relate all these elements to the different geological processes that might be the reason for great distributional patterns.

Table 1. Statistical parameters that characterize the frequency distribution properties of the analzed elements

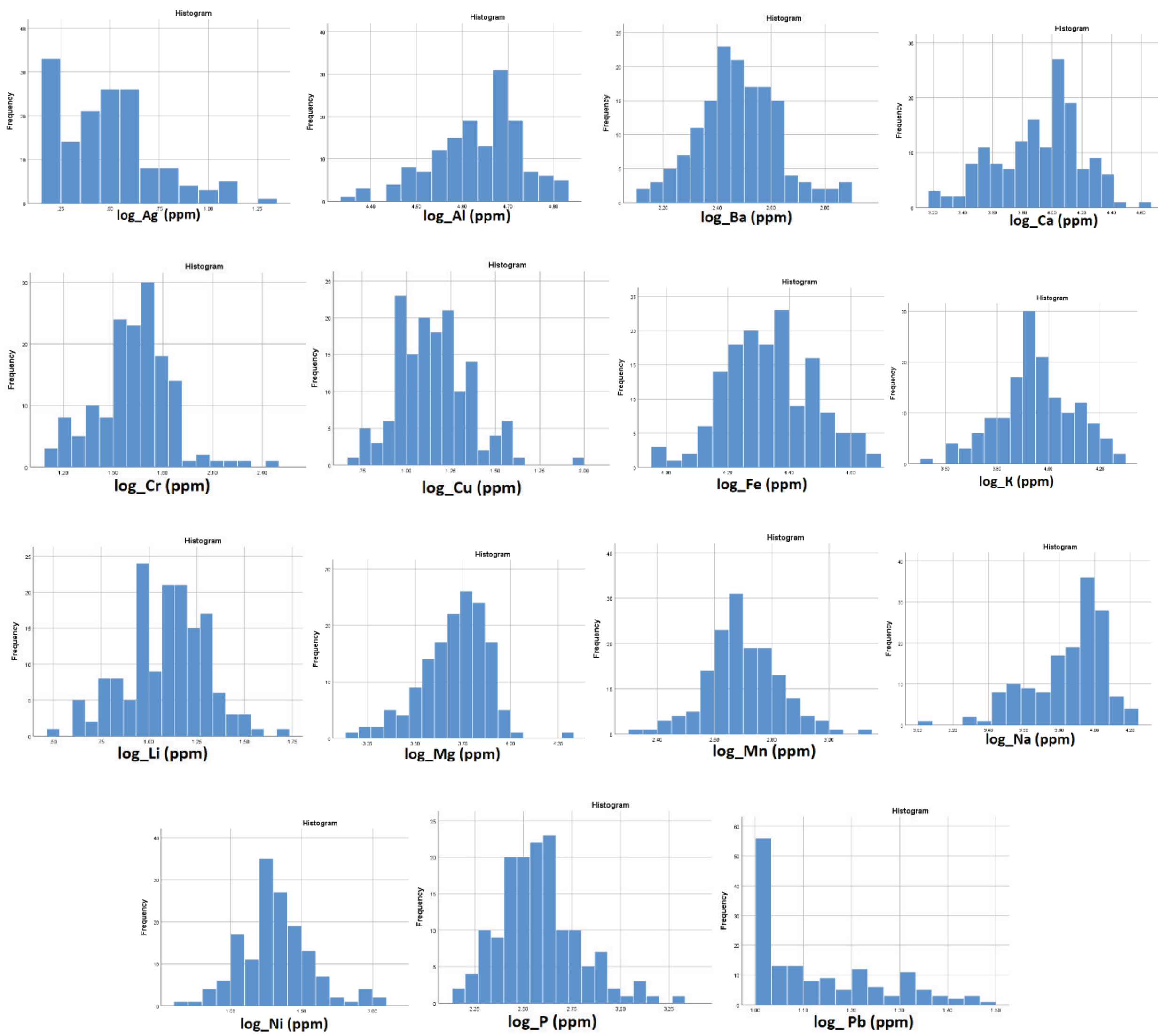
(n=150). The values for Al, Ca, Fe, K, Mg and Na are given in %, for the rest of the elements in mg/kg, X_g – geometrical mean, Md - median, *Sa*– standard deviation, CV- coefficient of variation

	X_g	Md	S_a	Skewness	Kurtosis	Minimum	Maximum	CV
Ag	0.5	0.5	0.2	0.82	0.42	0.2	1.3	50
Al	4.4	4.4	1.0	0.18	-0.15	2.3	6.8	22
Ba	318	296	116	1.47	3.23	133	764	36
Ca	9.9	9.3	6.2	1.41	3.55	1.5	41	63
Cr	49	44	32	3.92	24.56	13	292	65
Cu	18	15	9.6	1.46	2.08	5	53	54
Fe	2.3	2.2	0.8	0.88	0.61	0.9	4.9	34
Li	14	13	7.0	1.82	6.50	3.0	53.0	51
Mg	0.5	0.5	0.2	1.90	10.79	0.1	2.0	40
Mn	527	496	163	1.27	3.07	218	1268	31
Na	0.8	0.8	0.3	0.16	-0.18	0.1	1.7	41
Ni	25	20	18.9	2.87	10.23	5.0	124	76
Pb	14	12	4.9	1.29	0.95	10	30	35
Sr	122	107	83.0	2.31	8.12	23	537	68
V	63	56	28.6	2.12	7.27	20	217	46
Zn	65	50	127	10.85	124.5	21	1534	193

The content of the all analyzed elements (Table 1) are comparable to those obtained from the study on agricultural soils of Europe (VROM 2000, Salminen et al. 2005; Soriano-Disla et al. 2012). Data reduction was done by using factor analysis. Factor analysis is important characteristic in grouping elements. This was done because of the great number of variables that were analyzed during the research period (150 sample locations and 16 chemical elements).

According to factor analyses, five factors have been identified and matrix of rotated factor loadings is given in Table 2. Factor 1 (V, Fe, Mn) and Factor 2 (Sr, Ba, Na, Al, Ca) are factors representing lithogenic and geogenic association. All analyses elements in these two factors are strictly connected to the nature of the pedogenic materials, only Ba indicates small anthropogenic influence, although Ba is part of acid magmatic rocks and commonly ranges in concentration from 400 to 1200 mg/kg, Kabata-Pendias, 2011. This author also points out that the Ba budget in rural soils shows a steady increase from aerial sources and P fertilizers increases its output.

Factor 3 (Cr, Ni and Mg) and Factor 4 (Li and Pb) and Factor 5 (Zn and Cu) are is mixed associations of elements. The presence of high clay content and human activities can increase the normal content of Cr in soil (Micó et al., 2006). The geogenic origin of the most environmentally studied elements Cu, Zn and Pb most often is associated with sulfur minerals which oxidize relatively quickly, whereas the element cation separates from the sulfur in the early stage of mineral degradation (He et al., 2005). In the later stage of pedogenesis Cu and Zn are often in the composition of manganese oxides, and lead in the composition of iron oxides and hydroxides. Sedimentary rocks have the largest share in the surface layers of the earth's crust. Natural geological processes on different parent rocks result in higher concentrations of heavy metals compared to their average content in the ground (Intawongse et al., 2006).



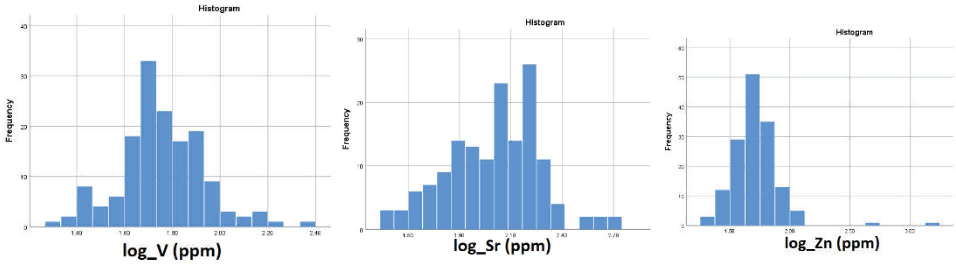


Fig. 1. Histograms of 18 selected chemical elements after logarithmic transformation

Table 2. Rotate component matrix for 16 selected elements in soil samples, Com- Communality (%), Var- Variance (%)

Element	F1	F2	F3	F4	F5	Com
V	**0.926**	0.051	0.193	-0.054	0.084	90.8
Fe	**0.899**	-0.016	0.32	0.048	0.065	91.8
Mn	**0.771**	0.128	0.177	0.207	0.042	68.7
Sr	0.004	**0.923**	-0.017	-0.134	-0.009	87.1
Ba	-0.055	**0.789**	0.234	0.293	0.024	76.7
Na	-0.228	**0.651**	-0.516	-0.066	-0.033	74.8
Al	0.326	**0.619**	-0.169	0.143	-0.142	55.9
Ca	0.444	**0.608**	0.042	-0.229	0.007	62.1
Cr	0.306	0.005	**0.886**	0.036	0.004	87.9
Ni	0.125	-0.128	**0.878**	0.007	0.201	84.5
Mg	0.487	0.271	**0.656**	0.152	0.089	77.1
Li	-0.037	-0.148	0.186	**0.78**	-0.087	67.5
Pb	-0.015	-0.094	0.015	**0.746**	0.036	56.6
Ag	0.186	0.091	-0.156	0.241	0.214	17.1
Zn	-0.052	-0.051	0.111	-0.034	**0.951**	92.4
Cu	0.508	-0.115	0.32	0.177	**0.706**	90.3
Var	28.48	17.31	10.33	7.41	7.02	70.5

CONCLUSIONS

Distribution patterns of the chemical elements in the surface environment are complex due to the diverse processes of geological and anthropogenic activities. This study is focused on the frequency distribution characteristics of chemical elements analyzed from soil samples that are used for tobacco cultivation (arable soil).

The presented study indicates on the frequency distributional characteristics as a tool for predicting elemental associations, as elements with similar mobility tend to occur together and exhibit similar distribution patterns. According to statistical distribution, given data may be separated due their natural and anthropogenic contributions. Five factor components were obtained, two grouped in geogenic, three in mixed (geogenic-anthropogenic) association. According to the content of all analyzed elements none of the obtained factors has confirmed the strict correlation to anthropogenic influence.

These findings can improve our knowledge of the geochemistry in the study area if the approach validates spatial distribution characteristics. Furthermore, this can contribute to the establishment of the soil quality baseline and management of regional environment.

REFERENCE LIST

1. Allegre C. J., Lewin E., 1995. Scalling laws and geochemical distributions, *Earth Planet Sci. Lett.,*132, 1-13.
2. Bačeva K., Stafilov T., Šajn R., Tănăselia C., Ilić Popov S., 2011. Distribution of chemical elements in attic dust in the vicinity of ferronickel smelter plant, *Fresenius Environmental Bulletin*, 20, 2306-2314.
3. Bačeva K., Stafilov T., Šajn R., Tănăselia C., 2012. Moss biomonitoring of air pollution with heavy metals in the vicinity of a ferronickel smelter plant, *Journal of Environmental Science and Health, Part A*, 47, 1-13.
4. Barandovski L., Frontasyeva M.V., Stafilov T., Šajn R., Pavlov S.S., Enimiteva V., 2012. Trends of atmospheric deposition of trace elements in Macedonia studied by the moss biomonitoring technique, *Journal of Environmental Science* and *Health*, *Part A*, 47, 2000-2015.
5. Balabanova B., Stafilov T., Šajn R., Bačeva K., 2012. Characterization of heavy metals in lichen species *Hypogymnia physodes* and *Evernia prunastri* due to biomonitoring of air pollution in the vicinity of copper mine, *International Journal of Environmental Research,* 6, 779-794.
6. Balabanova B., Stafilov T., Bačeva K., Šajn R., 2010. Biomonitoring of atmospheric pollution with heavy metals in the copper mine vicinity located near Radoviš, Republic of Macedonia, *Journal of Environmental Science and Health Part A Toxic/Hazardous Substance & Environmental Engineering*, 45, 1504-1518.
7. Balabanova B., Stafilov T., Šajn R., Bačeva K., 2011. Distribution of chemical elements in attic dust as reflection of lithology and anthropogenic influence in the vicinity of copper mine and flotation, *Archives of Environmental Contamination and Toxicology*, 6, 173-184.
8. Cheng Q., 2012. Multiplicative cascade processes and information integration for predictive mapping, *Nonlinear Process*, 19, 57-68.
9. Cheng Q., Agterberg F.P., Ballantyne S. B., 1994. The separation of geochemical anomalies from background by fractal methods, *Journal of Geochemical Explorer*, 51, 109-130.
10. Coker W. B., 2010. Future research directions in exploration geochemistry. *Geochemistry exploration environment analysis,* 10, 75-80.
11. De caritat P., Grunsky E. C., 2013. Defining element associations and inferring geological processes from total element concentrations in Australian catchment outlet sediments: Multivariate analysis of continental scale geochemical data. *Applied Geochemistry*, 33, 104-126.
12. Grunsky E. C., 2010. The interpretation of geochemistry data. *Geochemistry exploration environment analysis,* 10, 27-74.
13. Hawkes H. E., Webb J. S., 1962. *Geochemistry in mineral Exploration*, Applied publishing Ltd, Willmete IL, USA.
14. Hawks Jr. S.N., Collins W.K., 1987. *Principles of Flue-Cured Tobacco Production*, Univer-

sity Press, San Francisco, California.

15. He, Z. L., Yang, X.E., Stoffella, P.J., 2005. Trace elements in agroecosystem and impacts on the environment. *Journal of Trace Elements in Medicine and Biology,* 19, 125-140.
16. Intawongse, M., Dean, J. R., 2006. Uptake of heavy metals by vegetable plants grown on contaminated soil and their bioavailability in the human gastrointestinal tract. *Food Additive and Contaminants*. 23(1), 36-48.
17. IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.
18. ISO 14869-1, 2001. Soil quality, Dissolution for the determination of total element content, *Part 1: Dissolution with hydrofluoric and perchloric acids*.
19. Jordanoska B., Stafilov T., Pelivanoska V., Bačeva K., 2014. Assessment of the content of chemical elements in soil and its properties used for tobacco cultivation in the Republic of Macedonia. *Bulgarian Journal of Agricultural Science*, 20, 29-40.
20. Jordanoska B., Stafilov T., Pelivanoska V., 2018. Accumulation and availability of trace elements from soil into oriental tobacco grown in Macedonia, *Environmental Engineering and Management Journal*, 17(6), 1491-1500.
21. Kabata-Pendias A., 2011. *Trace Elements in Soils and Plants*, 4th Edition, Taylor & Francis Group, LLC, Boca Raton - London - New York.
22. Kabranova, R., Arsov Z., 2009. Territorial and natural priorities of Macedonia -important factor for tobacco production development. *Proceedings EAAE Seminar The Role of Knowledge, Innovation and Human Capital in Multifunctional Agriculture and Territorial Rural Development* (*Proceedings of Symposium, Belgrade, December 9-11, 2009*). Belgrade, Serbia.
23. Micó, C., Peris M., Sánchez J., Recatalá L., 2006. Heavy metal content of agricultural soils in a Mediterranean semiarid area: the Segura River Valley (Alicante, Spain). *Spanish Journal of Agricultural Research*, 4, 363-372.
24. Pančevski Z., Stafilov T., Bačeva K., 2016. Distribution of heavy metals in the garden soil and vegetables grown in the vicinity of lead and zinc smelter plant, *Journal of Scientific and Engineering Research*, 3, 94–104.
25. Rakicevic, T., Dumurdzanov N., Petkovski M., 1968. Basic geological map of SFRJ. Sheet Stip.M 1:100, 000 (map and interpreter), Federal geological survey, Beograd.
26. Reimann C., Filzmoser P., Garret R. G., 2002. Factor analyses applied to regional geochemical data: problems and possibilities. *Applied geochemistry*, 17, 185-206.
27. Salminen R., Batista M.J., Bidovec M., Demetriades A., De Vivo B., De Vos W., Duris M., Gilucis A., Gregorauskiene V., Halamic J., Heitzmann P., Jordan G., Klaver G., Klein P., Lis J., Locutura J., Marsina K., Mazreku A., O'Connor P.J., Olsson S. A., Ottesen R.T., Petersell V., Plant J.A., Reeder S., Salpeteur I., Sandstrom H., Siewers U., Steenfelt A., Tarvainen T., 2005. *Geochemical Atlas of Europe, Part 1, Background Information, Methodology and Maps,* Geological Survey of Finland, Espoo, Finland.
28. Serafimovski, T., Stefanova V., Volkov A. V., 2010. Dwarf copper-gold porphyry deposits of the Buchim-Damjan-Borov Dol ore district, Republic of Macedonia. *Geology of Ore Deposits*, 52, 179–195.
29. Soriano-Disla J.M., Janik L., McLaughlin M.J., Forrester S., Kirby J., Reimann C., 2012. The use of diffusive reflectance mid-infrared spectroscopy for the prediction of the concen-

tration of chemical elements estimated by X-ray fluorescence in agricultural and grazing European soils, *Applied Geochemistry*, 29, 135–143.

30. Stafilov T., Balabanova B., Šajn R., Bačeva K., Boev B., 2010a. *Geochemical Atlas of Radovi*š and the Environs and the Distribution of Heavy Metals in *the Air*, Faculty of Natural Sciences and Mathematics, Skopje.
31. Stafilov T., Šajn R., Boev B., Cvetković J., Mukaetov D., Andreevski M., Lepitkova S., 2010b. Distribution of some elements in surface soil over the Kavadarci Region, Republic of Macedonia, *Environmental Earth Sciences*, 61, 1515-1530.
32. Stafilov T., Šajn R., Pančevski Z., Boev B., Frontasyeva M.V., Strelkova L.P., 2010c. Heavy metal contamination of surface soils around a lead and zinc smelter in the Republic of Macedonia, *Journal of Hazardous Materials*, 175, 896-914.
33. Stafilov T., Šajn, R. 2016. *Geochemical Atlas of the Republic of Macedonia*, Faculty of Natural Sciences and Mathematics, Skopje.
34. Stafilov T., Šajn R., Arapčeska M., Kungulovski I., Alijagić J., 2018. Geochemical properties of topsoil around the coal mine and thermoelectric power plant, *Journal of Environmental Science and Health, Part A*, 53, 793–808.
35. VROM (Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer), 2000. *Circular on Target Values and Intervention Values for Soil Remediation,* Ministry of Housing Spatial Planning and the Environment, Barendrecht, The Netherlands.
36. Yossifova, M., Lerouge, C., Deschamps, Y., Serafimovski T., Tasev, G. 2009. Inorganic chemical characterization of the Bitola, Oslomej and Berovo coals and their waste products from burning, Republic of Macedonia. *Geolines*, 22, 95-102.

ISSN 0494-3244
Tutun/Tobacco, Vol.69, N⁰ 7-12, 37-43, 2019 UDK: 633.71-153:581.192(497.775)"2018"
Professional paper

THE EFFECT OF MINERAL FERTILIZATION ON SOME ORIENTAL VARIETIES OF YAKA TOBACCO

Jordan Trajkoski[1], Milan Mitreski[1], Robin Mavroski[1], Marijan Trajkoski[2]

[1] St. Kliment Ohridski University – Bitola, Scientific Tobacco Institute - Prilep, Republic of North Macedonia
[2]Tobacco Company Prilep
e-mail: trajkoski89@gmail.com

ABSTRACT

The research was conducted at the Scientific Tobacco Institute in Prilep. The experiment was set up in three replications with four fertilization variants by the method of randomized blocks. Four oriental tobacco varieties of Yaka type were examined: YV 125/3, YK-48, YZ-7, MS-9/3. The subject of this study was the impact of fertilization on dry tobacco yield in kg/ha, average price per denars/kg and gross income per denars/ha. The obtained results showed that highest yield was observed in the variety YK-48, fertilized with 20 kg N/ha (2924 kg), which is 28% more than unfertilized control. Generally, fertilization has decreasing effect on average price, except variety YZ-7, where fertilized variant N1 gave positive results, increasing the average price by 4% compared to the control. The obtained economic effect per unit area is highest in variety JK 48, variant N_2, where the gross income is increased by 24%, compared to the control.

Keywords: fertilization, Yaka type, yield, average price, gross income

ВЛИЈАНИЕ НА МИНЕРАЛНАТА ИСХРАНА КАЈ НЕКОИ ОРИЕНТАЛСКИ СОРТИ ТУТУН ОД ТИПОТ ЈАКА

Истражувањата се извршени во Научниот институт за тутун во Прилеп. Опитот беше поставен во три повторувања со четири варијанти на ѓубрење по методот на рандомизирани блокови. Испитувани се четири ориенталски сорти тутун од типот јака: JV 125/3, JK-48, J3 - 7, MC-9/3. Предмет на испитувањата беше влијанието на ѓубрењето врз принос на сув тутун во kg/ha, просечна цена во ден/kg и бруто приходот во ден/ha. Добиените резултати покажаа дека најголем принос е забележан кај сортата YK-48, ѓубрена со 20 kg N/ha (2924 kg), што е за 28% повеќе од контролната. Општо земено, ѓубрењето влијае врз намалување на просечната цена, освен кај сортата YZ-7, каде што варијантата N1 даде позитивни резултати, зголемувајќи ја просечната цена за 4% во однос на контролата. Добиениот економски ефект по единица површина е најголем кај сортата JK 48, варијанта N_2, каде бруто приходот е зголемен за 24% во однос на контролата.

Клучни зборови: ѓубрење, тип јака, принос, просечна цена, бруто приход

INTRODUCTION

Tobacco plant is a strategic agricultural crop in our country and tobacco industry is one of the better organized agricultural industries. The importance of tobacco production can be seen through the fact that over 30,000 families exist from this production. The production of tobacco in the Republic of Macedonia ranges from 23,000 to 25,000 tons in the last five years and it is one of the largest in the Balkans. The soil is a medium where tobacco plants grow and develop, so its composition is of particular importance for obtaining healthy, qualitative and quantitative production. In the chain of cultural practices applied in tobacco production, fertilization is important process with a direct effect on economical characteristics. Proper fertilization will supply tobacco plant with optimum amount of nutrients in order to obtain a high-quality tobacco raw. This research aims to determine the impact of fertilization on the technological properties of the mentioned varieties that are of special interest and current in mass production in the Republic of Macedonia.

MATERIALS AND METHODS

Four oriental varieties of Yaka tobacco (YV 125/3, YK-48, YZ-7, MS-9/3) were used as material for investigation of the effect of fertilization. The trial was set up in the field of Tobacco Institute – Prilep in 2018 on diluvial - colluvial soil. The examination was conducted in randomized block design with three replications. The plot was suitably prepared with one autumn and three spring ploughings. The fertilization was applied with the second spring ploughing using the complex mineral fertilizer NPK 8:22:20 in four variants:1. Ø-not fertilized, 2. $N_{10} P_{27.5} K_{25}$ (N_1), 3. $N_{20} P_{55} K_{50}$ (N_2) and 4. $N_{30} P_{82.5} K_{75}$ (N_3) kg/ha, pure elements.

During tobacco vegetation in field, all cultural practices needed to obtain normal growth and development of plants were applied. In July and August, the trial was irrigated once each month, using a system of wing sprinkles with irrigation rate of 25 l/m^2 water. After the harvest, manually stringed tobacco was sun-cured in traditional curing barns.

The economic assessment of tobacco is performed according to the yield and quality of each variety, following the Rulebook for qualitative and quantitative assessment of raw tobacco in leaf for oriental - aromatic types of tobacco ("Official Gazette" of RM No. 16/2007 and No. 144/2010). The economic parameters are determined and calculated, based on the measurement and classification of dry tobacco: dry tobacco yield kg/ha, average price den/kg and gross income den/ha.

SOIL CONDITIONS

The production of high quality tobacco raw material depends on soil type. The soil, due to its mechanical composition and nutrient content, is an environment in which the tobacco plant grows, develops and gives its genetic potential. The research was conducted on a diluvial-colluvial soil, which is the most present soil type in tobacco production area in Prilep and is characterized by the following profile stratigraphy:

(I) 0 - 30cm: Arable humus accumulative horizon, yellow brown colour, loamy sand texture, non-carbonate, presence of roots throughout the layer, structureless.

(II) 30 - 75 cm: Red brown colour, sandy loamy texture, dense, non-carbonate, pres-

ence of skeleton particles.
(III) 57 - 83 cm: Yellow brown colour, sandy loamy texture , non-carbonate.
(IV) 83 - 100 cm: Yellow brown colour, structureless, rich in skeleton particles, sandy clay loam texture
(V) > 100 cm: Yellow brown colour, structureless, presence of skeleton.
The agrochemical properties of the soil on which the trial was set up, are shown in Table 1.

Table 1. Agrochemical properties of the soil

Horizon	Depth (cm)	Humus (%)	$CaCo_3$ (%)	pH		Available nutrients mg/100 gr		N (%)	C:N
				H_2O	KCl	P_2O_5	K_2O		
I	0 - 30	0.53	-	6.00	4.96	7.25	13.3	0.055	5.59
II	30 - 57	0.43	-	5.94	4.78	1.75	19.2	0.055	4.53
III	57 - 83	0.39	-	6.15	4.95	1.9	18.5	0.055	4.11
IV	83 - 100	0.26	-	6.29	5.05	1.25	13.3	0.049	3.08
V	> 100	0.24	-	6.70	6.01	2.00	9.3	0.046	3.03

From the data presented in Table 1 it can be stated that the soil has low humus content, low content of total N, moderately acid, slightly acid to neutral pH reaction, low to extremely low concentration of available P_2O_5 and medium to good content of physiologically active K_2O.

RESULTS AND DISCUSSION

Results of the investigations are presented in tables for each parameter separately, for the sake of better clarity and more precise conclusions.

The effect of mineral fertilizers on dry tobacco yield

Dry tobacco yield per unit area is very important indicator and is directly related to gross income, because tobacco as an industrial crop is grown primarily for its leaf mass.
In the research on the impact of some cultural practices on tobacco yield and quality in 5 varieties of Prilep tobacco, Hristoski (2006) concluded that P-12-2/1 gave an average yield of 2513 kg/ha, P-23 gave 2951 kg/ha and NS-72 reached 2966 kg/ha.

Table 2. The effect of mineral fertilizers on dry tobacco yield (kg/ha)

N°.	Variant	Replication				%
		I	II	III		
1	Ø YV 125/3	2476	2340	2219	2345	100
2	N_1	2816	1982	2520	2439	104
3	N_2	2610	2811	2958	2793	119
4	N_3	3010	2020	2958	2663	114
5	Ø YK-48	2177	1758	2911	2282	100
6	N_1	2512	2623	2361	2450	107
7	N_2	3236	2370	3167	2924	128
8	N_3	2587	2669	2361	2539	111
9	Ø YZ-7	2495	2420	2334	2416	100
10	N_1	2980	2763	2303	2682	111
11	N_2	2849	2930	2811	2863	119
12	N_3	3075	2775	2303	2718	113
13	Ø MS-9/3	2162	1758	2334	2085	100
14	N_1	2198	2260	2194	2217	106
15	N_2	2390	2252	2512	2385	114
16	N_3	2407	2528	2194	2376	114

As can be seen from the table, the highest yield was observed using fertilized variant N_2 in variety YK-48 (2924 kg), which is 28% more compared to the check.

The effect of mineral fertilizers on average tobacco price

The average tobacco price correlates the tobacco quality. The higher the tobacco quality, the higher the purchase price.

Peshevski et al. (2011) analysed the purchase, export and import price and pointed out that the export price of tobacco and tobacco products had the greatest stability. In fact, the export price is growing with the same intensity every year, nearly following the increasing of the US dollar value. In contrast, major fluctuation was observed in the purchase price. The authors stated that the average purchase price of oriental tobacco in the Republic of Macedonia for the period 2001-2010 was 2.18 €/kg.

As can be seen from Table 3, the use of mineral fertilizer had a different effect on the quality of the tobacco raw material, and thus on the average price of the examined varieties. Fertilization negatively affected the average price of tobacco raw material from varieties YV 125/3 and YK-48, while

Table 3. The effect of mineral fertilizers on average tobacco price

N⁰.	Variant	Replication				%
		I	II	III		
1	ØYV 125/3	165.38	163.21	166.72	165.1	100
2	N_1	160.84	147.20	154.83	154.29	93
3	N_2	158.53	162.58	154.83	158.64	96
4	N_3	163.20	152.74	151.29	155.74	94
5	Ø YK-48	160.11	174.63	158.75	164.5	100
6	N_1	152.81	166.00	159.19	159.33	97
7	N_2	146.53	160.88	159.19	155.51	95
8	N_3	162.44	153.27	154.96	156.89	95
9	Ø YZ-7	156.54	143.87	145.86	148.76	100
10	N_1	154.66	153.48	154.17	154.10	104
11	N_2	153.23	148.44	146.55	149.40	100
12	N_3	148.48	156.2	148.05	150.89	101
13	Ø MS-9/3	169.23	15347	153.1	161.26	100
14	N_1	160.37	149.42	156.00	155.26	96
15	N_2	163.73	159.13	150.44	157.77	98
16	N_3	162.54	157.64	169.31	163.16	101

the fertilized variant N1 gave positive results for variety YZ-7, increasing the average price by 4% compared to the check. The fertilized variant N_3 gave positive results in variety YZ-7 and variety MS-9/3 increasing the average price by 1% compared to the control.

The effect of mineral fertilizers on gross income

Gross income per unit area (ha) correlates with the quantity of tobacco, its quality and price.

Table 4 presents the impact of mineral nutrition on the gross income of the examined varieties of Yaka tobacco.

Table 4. The effect of mineral fertilizers on gross income den/ha

N⁰.	Variant	Replication				%
		I	II	III		
1	Ø YV 125/3	409480	381911	369951	387159	100
2	N_1	452925	291750	390171	376364	97
3	N_2	413763	457012	457987	443081	114
4	N_3	491232	308534	447515	414683	107
5	Ø YK-48	348559	306999	462121	375389	100
6	N_1	368083	421988	375847	380999	101
7	N_2	494493	393420	504154	465880	124
8	N_3	420232	409077	365860	398343	106
9	Ø YZ-7	390567	348165	340437	359404	100
10	N_1	456625	410139	337504	400690	111
11	N_2	440626	449696	433371	441188	123
12	N_3	456576	433455	340959	410119	114
13	Ø MS-9/3	365875	269800	357335	336227	100
14	N_1	359878	359633	330065	349776	104
15	N_2	383284	336493	391872	370295	110
16	N_3	391233	398513	371466	387668	115

From the data presented in the table it can be stated that fertilization with mineral fertilizers has a positive effect on the gross income, except of the variety YV125/3. In this case, fertilizer variant N_1 gave a decrease in the gross income compared to the unfertilized control. Namely, the fertilized variants in the examined varieties have a higher gross income compared to the check. The most pronounced increase of 24% was observed in fertilized variant N_2 in variety YK-48.

CONCLUSIONS

The following conclusions can be drawn from the results of our research on the impact of fertilization on tobacco yield, average price and gross income:

1. The mineral fertilization has a positive effect on tobacco yield per unit area. Fertilization of variety YV 125/3 with 20 kg of pure nitrogen gave an increase of 17% compared to the control. The highest increase of 28% had variety YK-48, while varieties YZ-7 and MS-9/3 had 19 % yield increase.
2. Moderate and proper fertilization has a positive effect on the quality of tobacco raw material and thus on the average price. Increased fertilization with pure nitrogen leads to reduction in quality and thus to the average price of tobacco, which is the case with the analysed varieties of Yaka tobacco. Positive results and an increase of 4% in the average price was found in variant N_1 in YZ-7.
3. From our research it can be concluded that fertilization with mineral fertilizers has a positive effect on the gross income of the analysed varieties of Yaka tobacco. Variant N_2, i.e. application of 20 kg pure nitrogen, gave the highest gross income in varieties YK-48 and YZ-7, while in variety YV-125/3 the same variant gave a decrease in the gross income. In variety MS-9/3, the best result was achieved by the fertilized variant N_3, which gave an increase of 15 % compared to the check.

REFERENCE LIST

1. Boceski D., 2003. Poznavanje I obrabotka na tutunskata surovina. Institut za tutun – Prilep
2. Mitreski M., 2012. Komparativni prouchuvanja na povainite proizvodni, tehnoloshki i kvalitetni svojstva na nekoi sorti tutun od tipot prilep. Doktorska disertacija, Naucen institute za tutun – Prilep.
3. Patche L., Georgievski K., 1987. Poznavanje na tutunskata surovina – Stokoznaenje, Stopanski vesnik, Skopje.
4. Pravilnik za kvalitativna I kvantitativna procena na suroviot tutun vo list za orientalskite – aromaticni tipovi na tutun. („Sluzben vesnik“ na RM br. 16/2007 i br. 144/2010).
5. Pesheski M., Filiposki B., Zivkovic D., Stojanoska S., 2011. Inportant features of tobacco production in the Republic of Macedonia. Tutun/Tobacco, Vol. 61, N^0 1-12, pp. 49-58, Scientific Tobacco Institute – Prilep.
6. Uzunoski M., 1985. Proizvodstvo na tutun, Stopanski vesnik, Skopje.
7. Hristoski Z., (2006). Vlijanieto na nekoi agrotehnichki merki vrz kvantitativnite I kvalitativnite karakteristiki na pet sorti tutun od tipot prilep. Magisterski trud, Institut za tutun – Prilep

ISSN 0494-3244
Tutun/Tobacco, Vol.69, N⁰ 7-12, 44-55, 2019
UDK: 005.511:633.71
Original Scientific paper

NECESSITY OF MAKING WORK PLAN FOR TOBACCO PRODUCTION

Silvana Pashovska[1,] **Trajko Miceski**[2]

[1] " St.Kliment Ohridski " University, Bitola, Scientific Tobacco Institute, Prilep, Republic of North Macedonia
e-mail: silvana.pasoska@uklo.edu.mk
[2] " Goce Delcev " University, Stip, Republic of North Macedonia, retired full professor

ABSTRACT

The work plan covers all the phases of operation, i.e. autumn preparation of the substrate (soil) for seedling and tobacco production, sowing and cultivation of the seedlings, tobacco planting, adjustment of the cultural practices in the production and cultivation of tobacco, tobacco harvest, tobacco curing, storage, preparation (packaging and carrying) to the place of purchase, charging, plan for distribution of the received funds for the sold tobacco and plan - preparation for the new harvest.

In essence, a well-made work planis always in function of greater efficiency and effectiveness of operation, through timely and proper implementation of sequential activities, monitoring and minimizing costs, optimal maximization of profits, as well as improving the lifestyle with proper schedule of working and free time.

Keywords: plan, business activity, strategy, making decisions, results, monitoring and improvement.

НЕОПХОДНОСТ ОД ИЗРАБОТКА НА ДЕЛОВЕН ПЛАН ЗА ПРОИЗВОДСТВО НА ТУТУН

Деловниот план ги опфаќа сите фази на работењето, односно од есенската подготовка на подлогите (почвите) за производство на расад и тутун, самото сеење и одгледување на расадот, расадување на тутунот, прилагодување на агротехничките мерки во производството и одгледувањето на тутун, берењето на тутунот, негово сушење, складирање, чување, припремање (пакување и носење) до одреденото откупно место, наплаќање на тутунот и план за распределба на добиените парични средства за продадениот тутун и план - припрема за новата реколта.
Добро изработениот деловен план, во суштина, е секогаш во функција на поголема ефикасност и ефективност на работењето, преку навремено и правилно остварување на редоследните активности, следење и минимизирање на трошоците и оптимално максимиизирање на остварените добивки, како и подобрување на начинот на живеење со правилен распоред на работното и слободното време.

Клучни зборови: план, деловна активност, стратегија, одлучување, резултати, следење и подобрување.

INTRODUCTION

The work plan for tobacco production is a kind of time mirror of the planned and current operation of the tobacco production subject (individual tobacco producer, farm, small enterprise or other organizational form) which, at the same time, is a tool for orientation, reminder, indicator, communicator between past, current and future activities.

It is an analyser of the working results and an instigator of timely response in order to improve the situation.

Work planning must be comprehensive and reflect everything that will be done in the future. Namely, the efficiency of working stems from the good planning. The experience shows that everyone who runs a business, i.e. every host, can save money if everything is planed well, because it allows the entire planned process of tobacco production to be performed on time and at a lower cost.

Carefully prepared work plan is the essence of success in any business, i.e. in any work activity, such as tobacco production.

Tobacco production work plan is a kind of economic working document which specifies: what are the working activities that have to be realized, their time sequence, their regular execution and execution needs, the expected time results for their monitoring and the expected results at the end of the annual tobacco production process.

Working activities foreseen for the next three to five years are usually conceived in the work plan. However, the real work plan is more detailed description of the working activities for a period of one year, i.e. for theone-year harvest period of tobacco production (T. Miceski, Project 1998-2000).

In fact, the work plan of tobacco production has to show the way how the tobacco producer will achieve the set goals and how will work on achieving its set mission. It refers to the basic activity, i.e. tobacco production and to theother additional activities for which its technical mechanization will be used and in an efficient and effective way the rest of the time during the daywill be fulfilled (T. Miceski, Project 2001-2003).

Before operating, the work plan is used to refer to the course of the operation, and during operating, it is used as a check for the fulfillment of the planned activities while giving a view of the achieved results, indicating a correction or satisfaction with the achievements.

RESULT AND DISCUSSION

The work plan of tobacco production is a text - a document that contains all the planned activities of tobacco production. It talks about its perspectives, its development potential and at the same time specifies the direction of the business activities (T. Miceski, Bussines and work plan, 2014).

In fact, the work plan is a set of planning activities that should be translated into decisions whose implementation will take place within the stipulated time period. It is also a means of visual communication (R. Grozdanic, Business plan for beginners, 2007).

It is useful to keep in mind that the work plan does not give ready-made ideas to tobacco producers, but it initiates them to generate new ideas themselves, to improve and advance a separate or each phase of the tobacco production process.

Although the work plan is only a way to present information, i.e. it is a practical test of a modest idea, it can still contribute a lot to the development of a large and successful business activity.

Regardless of the goals that the respective tobacco producer has in front of him, a well-made business plan, in essence, is always in function of greater efficiency in the operation, as well as in achieving maximum financial profit.

Defining and meaning of the work plan

The work plan is a kind of vision of the tobacco producer, the path from desire to realization. It incorporates the goals, analyzes the basic weaknesses and the most significant advantages of the planned activities and in accordance with them, the basic strategies for its implementation are determined (L. Barjaktarovic, Z. Jovic, M. Milojevic, Poslovnefinansija, 2021).
The work plan is a document that serves as an initiating plan and a standard with which the current results by the tobacco production phases can be compared. Regular comparison of the planned and the realized activities enables to identify the problems and to intervene in time. Regular comparison and correction of certain procedures, helps the ongoing development of tobacco production activities at the desired level, towards achieving the set goals.
The terms business plan and work plan are often equated. However, there are some differences between them. Thus, while the work plan is a regular plan and is prepared (complemented) almost every year and is focused on the current operation, the business plan enables management of the business activities of the organizational entity (farm, enterprise, etc.) and management of new business ventures. The business plan is made extraordinary, when starting or expanding a business (T. Miceski, Work plan, 2014).
For these reasons, the following table highlights some of their differences.

Table 1. Differences between the work plan and the business plan

Work plan	***Business plan***
It is made (corrected, complemented) every year	It is made (corrected, complemented) every year
It is related to the annual time periods, by date, and to the weather conditions (with the possibility of tolerance for a short period of time- only a few days)	It is related to the annual time periods, by date, and to the weather conditions (with the possibility of tolerance for a short period of time- only a few days)
It includes all tobacco production activities and ongoing ancillary activities during the annual harvest.	It includes all tobacco production activities and ongoing ancillary activities during the annual harvest.
It is made on the basis of planning of already known activities through their promotion.	It is made on the basis of planning of already known activities through their promotion.
It is aimed at the internal environment of the tobacco production activity.	It is aimed at the internal environment of the tobacco production activity.
The purpose of the work plan is to harmonize all business activities of the tobacco production activity.	The purpose of the work plan is to harmonize all business activities of the tobacco production activity.

More detailed planning of the current activities of the harvest year and each annual promotion.	More detailed planning of the current activities of the harvest year and each annual promotion.
It is managed according to the annual planned activities without radical corrections.	It is managed according to the annual planned activities without radical corrections.

The business plan is a kind of tool for managing the entire tobacco production process, which does not guarantee the success of the process, but only helps the tobacco producer to direct its business activities properly.

Work plan as a basis for the next harvest tobacco production activity

The purpose of the planned activities and data entered in the work plan is to inform the users of the plan (tobacco producer and his associates) about what they perform.

That includes informations about: the range of production, the main product i.e. tobacco (type of tobacco and range of additional agricultural - industrial products, beginning, course and end of the harvest production year, all basic activities related to production, processing and realization (delivery-sale of tobacco and additional products, all costs and benefits, investments, benefits, etc.)

Within the work plan, the company must clearly outline its development policy and the purpose of determining its future business position (J. Todorovic, D. Duricin, S. Janosevic, Strategijskimenadzment, 2018).

This means that the business activity of the tobacco production entity must:

- express the attitudes of the tobacco production entity towards the anticipated changes in the environment, i.e. the world requirements of the activity
- be based on the harvest year and on the possible, unexpected weather changes;
- initiate consistency in decisions for the development of the tobacco production entity;
- harmonize the goals, business activities and opportunities of the enterprise;
- provide transparency of all information to the interested associates of the tobacco producer about the harvest production process and
- ensure continuity of business activities and development of the organizational tobacco production entity in a higher form of organization, i.e. in a farm or small enterprise.

By defining the work plan and its basic goals and monitoring the results, the business owner will be able to easily monitor the operation and progress of his business activity, and thus the organizational entity to redefine the work if something goes in wrong direction (T. Miceski, Business and work plan, 2014).

The work plan sets the goals and directions for the current activities of the tobacco production and its future development. It is based on thorough planning and detailed analysis of specific parameters, in order to properly conduct tobacco production activities, throughout its process and allows the improvement of the core business by initiating opportunities for expansion with additional activities.

In this context, it is necessary for the basic work plan to reflect the organization of operations. The organization of operations as one of the most important factors in today's modern business contributes to providing better working conditions and achieving more productive results (P.M. Muler, Organisation des Approvisionnement dans l''industrie, 1991).

The main goal and role of the proper organization of the work is to enable the involved members to perform their activities rationally, and thus to achieve better results in the work.

Organizing, in fact, is a process that allows desired goals in the company to be effectively achieved. The realization of those goals is done with the help of all engaged persons, through their motivation, by establishing effective relationships in their behaviour, in order to efficiently perform the tasks.

In tobacco production, the organizational factor is one of the primary factors to which it should be paid special attention in terms of how to set up and perform the necessary phases and activities that complement each other. Thus, the high quality tobacco seed gives high quality seedlings, and the high quality seedlings give high quality tobacco by applying proper and timely agrotechnics. Then it needs to be well cured, manipulated, fermented and processed, in accordance with the needs.

More prominent organizational aspects in tobacco production are the following (T. Miceski, Project 2001-2003).

- correct selection and preparation of the surfaces where the tobacco will be produced;
- production of tobacco seedlings;
- production of tobacco in the fields;
- the application of agrotechnics in the whole production process;
- tobacco harvesting and sawing;
- tobacco curing
- tobacco placing;
- tobacco manipulation;
- organizational aspects of tobaccodelivery (sale);
- assessment of tobacco and its delivery (sale)

Respecting and monitoring the organizational activities contained in the business plan provides less uncertainty and greater success.

EMPIRICAL RESEARCH

In order to get a better overview of the activities of tobacco producers in relation to the preparation of a work plan, we conducted an empirical research.

The subject of the research is partial understanding of whether the tobacco producers should make a work plan at all and whether they actually know its usefulness.

The main purpose of this research is to emphasize the role of the work plan as an instrument for business orientation, and at the same time to find out whether tobacco producers develop and use a work plan in the tobacco production.

In fact, the tobacco producers were asked very clear and direct questions:

- Is tobacco production your main family activity?
- Do you have additional activity, except the tobacco production?
- Do you make a written work plan for the annual tobacco production?
- Do you think that you need training to make a good work plan?

The basic hypothesis of the empirical research is based on the claim that the work plan plays a major role for proper, timely, qualitative, quantitative, economical and effective tobacco production and therefore it is necessary for tobacco producers. The work plan is especially important in those families where tobacco production is a core business.

However, the basic hypothesis would not be complete if both auxiliary hypotheses are not met. They are related to the need for developing a business plan for economical and efficient operation of tobacco producers.

So, the first auxiliary hypothesis was: If tobacco production is the main activity of the tobacco producer, then economical and effective-profitable business results can not be achieved without complete preparation of a work plan of the entity. The second auxiliary hypothesis refers to the need for training for preparation of a work plan of the organizational entity in tobacco production (individual tobacco producer, farm, etc.), if the calculated value of the X2- test is greater than the tabular (theoretical) value with a probability of 0.95, i.e. with 95% probability.

Qualitative and quantitative methodological procedures and methods have been applied in this paper, among which we can emphasize the following: analysis, survey, observation, comparison and statistical processing of data.

In order to obtain more reliable results, whether the tobacco producers should prepare a work plan and whether they need training to prepare a work plan, a cross-sectional calculation was made.

Research results

The main instrument of the empirical research is the survey conducted on the territory of the municipalities: Prilep, Dolneni and Krivogashtani.

96 surveyed tobacco producers were asked four questions with three possible answers: yes, no and no answer (indefinite).

The first two questions refer to finding out whether tobacco production is the main activity of the examined tobacco producers, while in fact, we made an attempt to survey the larger tobacco producers.

The first question was: Is tobacco production your main family activity?

After processing the survey question, the following answers were received: 43 respondents (45% of all respondents) answered yes, which means that the tobacco production is their main activity, 46 respondents (48% of all respondents) answered **no**, 7 respondents (7% of all respondents) answered **no answer (indefinite)**. These are the answers presented in a graphic display:

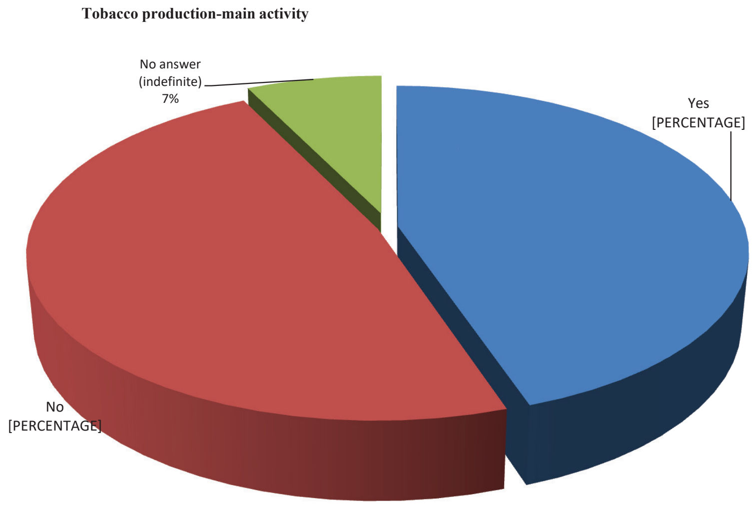


Chart 1. Answers to the first question

The second question was: ***Besides tobacco production, do you also deal with additional activity?***
After processing this survey question, the following answers were received: 48 respondents (50% of all respondents) answered **yes**, which means that they deal with additional activity, 43 respondents (45% of all respondents) answered no, 5 respondents (5% of all respondents) answered **no answer (indefinite)**. Here are their graphically illustrated answers:

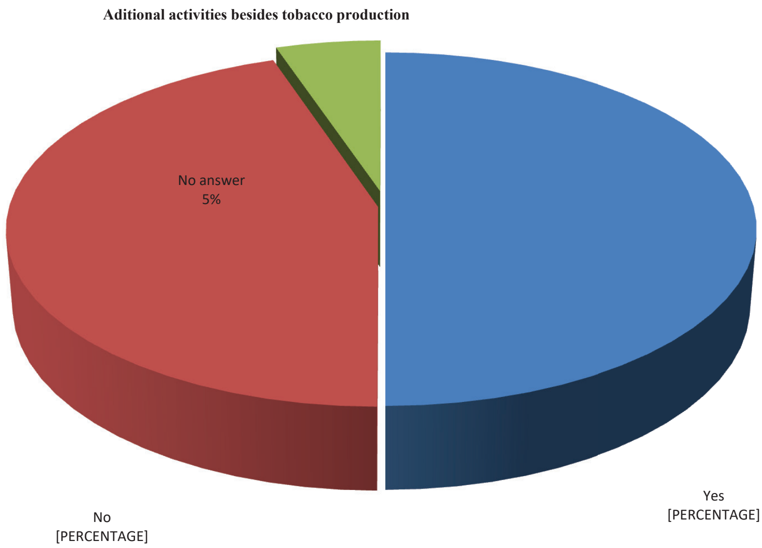


Chart 2. Answers to the second question

By crossing the questions and calculating the correlation, the obtained value for the X^2- test is 0.739 and the tabular value of the contingency coefficient (C) is 5.991. That is:
Calculated value for the X^2- test and the contingency coefficient is:

$$X^2_{0,05\ (calculated\ value)} = 0,739 < X^2_{0,05\ (tabular\ value)} = 5,991$$

$$C = 0,065$$

From the calculated values of the X^2- test, it can be seen that the obtained value (0.739) is less than its tabular (theoretical) value, which concludes that for these examined tobacco producers, tobacco production is not a basic activity, which can be seen from their answers (45%).

The third question was: *Do you prepare a written Work Plan for the annual production of tobacco?*

The following answers were obtained to this survey question related to the second auxiliary hypothesis: 11 respondents (11% of all respondents) answered **yes**, which means that they prepare a written work plan, 63 respondents (66% of all respondents) answered **no**, 22 respondents (23% of all respondents) answered **no answer (indefinite)**. Here are their graphically illustrated answers:

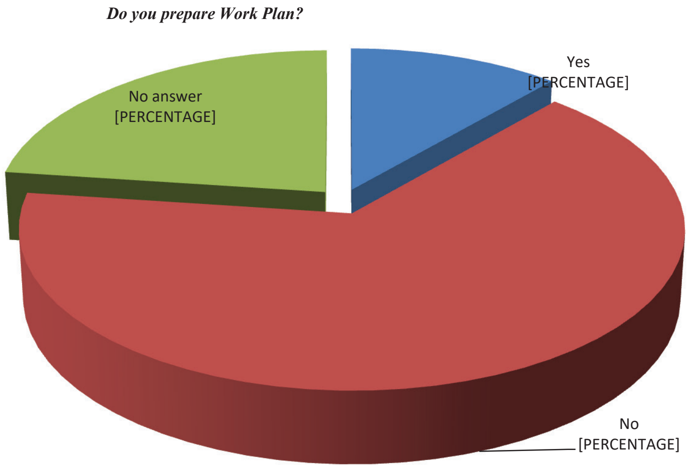


Chart 3. Answers to the third question

According to the second auxiliary hypothesis, the fourth question was:

Do you think that you need training to make a work plan?

In fact, this question is not important only for obtaining information, but it is also an auxiliary question for comparison with the previous (third) question.

The processed answers to the survey questions are given in the chart below.

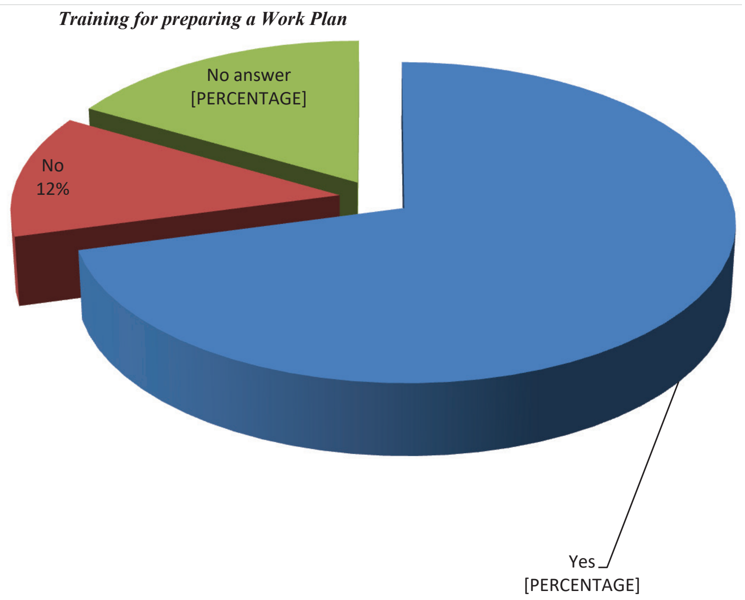


Chart 4. Answers to the fourth question

The third question was: *Do you think that you need training for making a work plan* and is related to the second auxiliary hypothesis. The following answers have been received: 68 respondents (71% of all respondents) answered yes, which means that they need training for making good work plan, 12 respondents (12% of all respondents) answered no, 16 respondents (17% of all respondents) answered **no answer (indefinite).**

It is obvious that there is necessity of training for preparation of a business plan. However, the calculated value of the X^2- test is greater than the tabular (theoretical) value with a probability of 95%. The X^2- test and the contingency coefficient were calculated, with the following values:

Calculated value for the X^2- test and the contingency coefficient are:

$$X^2_{0,05\ (calculated\ value)} = 79,952 < X^2_{0,05\ (tabular\ value)} = 5,991$$

$$C= 0,534$$

The calculated value of the X^2- test and the contingency coefficient show that the answers of the examined tobacco producers on the two questions (the third and the fourth) differ drastically. This can be seen from the previous two graphic displays. That's why the calculated value of the X^2 - test is quite high - 79,952. The contingency coefficient is 0.534, which shows that there is a dependence on the answers of the respondents, i.e. they correspond according to the questions asked.

After processing empirical data, through analysis, modeling, tabular and graphical presentation, as well as calculation of the value of the x^2-test, a general conclusion can be drawn that most tobacco producers do not prepare a work plan for the harvested tobacco production.

This does not fully confirm the general hypothesis that the work plan plays a major role in the proper, timely, qualitative, quantitative, economical and effective production of tobacco, and therefore the work plan is necessity for tobacco producers, especially for those who practise tobacco production as basic occupation.

From the processing and calculation of the received answers of the tobacco producers, it is shown that tobacco production is not main activity for the majority of the surveyed tobacco producers. Hence, it is not easy for them to fully focus on tobacco production, and thus achieve economical and effective - profitable business results without complete preparation of the work plan for tobacco production and other additional activities.

Also, it was confirmed that the tobacco producers need training to prepare a work plan, which in addition to the answers received was confirmed by the calculated value of the X^2-test (79, 952), which is greater than the tabular (theoretical) value (5,991) with probability of 0.95, i.e. with 95% probability.

All this confirms that work plans are necessary for every business entity and also for the entity whose main activity is the production of tobacco. The work plan is used to direct the proper performance of business activities and proper use of available resources.

CONCLUSIONS

This scientific work indicates that the work plan is a kind of conceptual document and instrument that serves as a reminder and initiative for making decisions regarding the proper and timely performance of all tobacco activities in all phases, and thus their continuous improvement.

The business plan is also a document that serves as a standard to which the current results of operations can be compared. It is also used to monitor key performance. Regular comparison of the planned with the current activities allows to identify the problems before they become irreparable. Regular comparison and corrective measures help to keep the work on the desired path, towards achieving the goal.

This research points out the role of the work plan as an instrument that ensures successful planning and operation of the organizational entity, which is actually the subject of the research. Its quality interpretation and use gives the entity the opportunity to provide significant activities and resources for the planned tobacco production harvest, to reconsider decisions such as opportunities to expand tobacco production with additional activities (e.g. construction of new production facilities intended for those activities), entering open markets, associating with repurchasing business partners, etc.

REFERENCE LIST

1. Barac S. 2007. “BankingPraktikum", University Singidunum, Beograd
2. Barjaktarović L., Jović Z., Milojević M. 2021. "Business Finance", Singidunum University, Faculty of Business. 4. Updated edition. Belgrade
3. Grozdanic R. 2007. “Business plan for beginners”, Technical Faculty - Cacak
4. Miceski T. 2009. "Business Planning ", UGD, Faculty of Economics, - Stip, working material
5. Miceski T. 2014. "Business and business plan", University GoceDelchev - Stip, Faculty of Economics - Stip
6. Miceski T., 2009. "Management", UGD, Faculty of Economics - Stip, Abbreviated edition
7. Muler P.M. 1991. “Organisation des Approvisionnementdans l”industrie, Les editions dorganisation5, rue Rousselet Paris
8. Todorovic J. Duricin D, Janosevic S., 2010. “Strategic Management”, 3rd Edition, Institute for Market Research
9. Miceski T. 1998-2000. Project:"Some economic organizational aspects for the development of farm tobacco production in order to increase employment, social security and the efficiency of tobacco production”, Ministry of Science-Skopje, PSI Tobacco Institute - Prilep
10. Miceski T. 2001-2003. Project: "Management, motivation and entrepreneurship - basic factors for improving the efficiency of the management of tobacco production organizational entities" (2001-2003), PSI Tobacco Institute - Prilep

Table 1 - Summary of responses of active tobacco producers

Questions		Offered answers	Active tobacco producers Value	%
1. Is tobacco production your main family activity?		Yes	43	45 %
		No	46	48 %
		Yes and No (indefinite)	7%	7 %
Total			96	100 %
2. Besides tobacco production, do you also deal with additional activity?	Yes		48	50 %
	No		43	45%
	No answer		5%	5%
Total			96	100%
3. Do you prepare a written Work Plan for the annual production of tobacco?		**Yes**	11	11 %
		No	63%	66 %
		I note (plan) only the basic things (investments, expenses, expected income, loans)	22%	23%
Total			96%	100 %
4. Do you think that you need training for making a good work plan?		Yes	68%	71%
		No	12	12 %
		No answer	16%	17 %
Total			96	100 %

Survey Questionnaire - Work Plan

Dear Sir/Madam, this survey questionnaire has been prepared for scientific research activities.

First of all, **thank you** for your cooperation. We inform you that your answers to the survey questionnaire remain anonymous.

Please **circle only one of the offered answers** in each question.

1. **Is tobacco production your main family activity?**

   А) **Yes**
   Б) **No**
   В) **Yes and No (indefinite)**

2. **Besides tobacco production, do you also deal with additional activity?**

   А) **Yes**
   Б) **No**
   В) **No answer**

3. **Do you prepare a written Work Plan for the annual production of tobacco?**

   А) **Yes**
   Б) **No**
   В) **I note (plan) only the basic things (investments, expenses, expected income, loans)**

4. Do you think that you need training for making a good work plan?

   А) **Yes**
   Б) **No**
   В) **No answer**

Thank you for your cooperation

INSTRUCTIONS TO AUTHORS

"Tutun/Tobacco" is published biannually (double issues).

Since the publication is of an international character, all manuscripts should be submitted in English. Authors whose native language is not English should have their papers checked by research workers from the related fields who have good proficiency in the English language. All manuscripts must be proofread prior to submission. Language and style of the manuscripts are responsibility of the author.

The publication presents: original scientific papers, review articles, short reports, professional papers and other works related to tobacco science and practice.

Original scientific papers - should contain original scientific research results, previously unpublished. It must be presented in a manner enabling the experiment, i.e. research method, to be repeated and accuracy of the analysis, results and conclusions confirmed.

Review articles - should contain critical surveys of the accomplishments in the fields encompassed in the Journal, papers by an individual researcher or a group of researchers with the purpose to undertake, analyze, evaluate or synthesize previously published information. They should present the latest ideas and theories or new scientific achievements.

Preliminary communications - should contain new scientific conclusions whose character suggests quick publishing. They do not have to enable repetition of the experiment and examination of the presented results and can be used as a basis for further research.

This part also contains Letters to the editor or short notes.

Professional papers - should present useful contributions from the field of an applied science whose problematic is not related to the original research. The aim of these papers is not to present new findings but to use already acquired knowledge and implement it into practice.

Other articles published in this journal will not be categorized.

Manuscripts should be submitted to the Editorial Board in typescript and/or electronically, on CD or via E-mail (tobacco_institute_prilep@yahoo.com). Papers must be written in a clear and concise manner using Times New Roman and 12 pt font size, with single spacing. The complete manuscript should be no longer than 10 pages, A4 format, with margins 2.5 cm for all sides. Text must be justified, without hyphenation, avoiding excess white space between words. The Abstract should be translated in Macedonian, using Times New Roman font with Macedonian support.

Manuscripts should follow the format INTRODUCTION, MATERIAL AND METHODS, RESULTS AND DISCUSSION AND CONCLUSION, for experimental research where events are presented in chronological order.

Titles in the text (INTRODUCTION, MATERIAL AND METHODS, RESULTS…) should be centered, boldfaced, written with capital letters, font size 12;

Subtitles should be written with initial capital letter, boldfaced, 12-point font size, aligned to the center;

Arrangement of the paper:

Title - in capital letters, boldfaced, 12-point font size, aligned to the center;

Full name and surname of the authors - capital initial letter, other letters small, font size

12, centered; Name of the institution - for multiple authors from different institutions, each author's surname should be followed by identifying superscript number associated with the appropriate institution.

Address of the institution - full postal address of the institution, as well as the e-mail of the corresponding author; italic, centered.

ABSTRACT - at the beginning of the paper, both in English and Macedonian, should not exceed 150 words. It should mention the techniques used without going into methodological details and should summarize the most important results. Abstracts should not include citations to references. Font size 10, centered.

Key words - up to 7 essential words, in English and Macedonian

For non-Macedonian authors, the Editorial board will provide translation of title, abstract and key words in Macedonian.

INTRODUCTION should provide a brief statement of the subject, comprehensive survey of the relevant lietrature and objectives of the paper;

MATERIAL AND METHODS should be short and concise. Well-known techniques and methods should be indicated by a reference: only new methods or relevant modifications should be described in sufficient detail to allow reproduction of the investigation by others;

RESULTS AND DISCUSSION should be presented in tables, figures, diagrams and photographs, which must accurately describe the findings of the study, ordered sequentially as they appear in the text;

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

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

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

All graphical presentations (including graphs, schemes, drawings, photographs etc) should be submitted on CD together with the text and saved as separate files (graphs should be prepared as Excel files - XLS extension, and schemes, drawings and images should be submitted as .JPG or .TIF files). Minimum resolution for images is 200 - 300 dots per inch.

References in the text should be indicated by Arabic numbers in brackets, to correspond to the Reference list at the end of the paper. When other be presented in a list of references following the text of the manuscript. Cited publications are referred to in the text by giving the author's surname and the year of publication. E.g.: Filiposki (2000), Dimeska et al. (2007), Tso et al. (1990), (Adamu 1989, Campbell 2000).

Nomenclature of genera and species names must agree with the International Code of Zoological Nomenclature (ICZN, latest edition). Taxonomic affiliation, followed by author(s) and year of description, should be presented in complete form at least once in the main text (usually when first mentioned), and in subsequent appearances only the abbreviated form is presented (Metasyrphus corollae Fabricius, 1794 as M. corollae).

Units - measurements should be given in SI units.

CONCLUSIONS should provide a brief and clear summary of the study findings and their contribution in science and practice.

REFERENCE LIST - is arranged alphabetically, in the following order: surname and initial of author(s) first name, year of publication, title of the article, name of publication, volume number and page. For books, author's name, complete title, publisher and date of publishing should be listed.

For journals:

Mickoski J., 1988. Ispituvanje na infektivnata sposobnost na peronosporata i pepelnicata na tutunot. Tutun/Tobacco 1-2, 21-40, Institut za tutun - Prilep.

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

For books:

Russel E. W., 1973. Soil conditions and plant growth. 10th ed., Longman, London.

References are cited on the language of original papers. In literature references, use the International Serials Catalogue for abbreviation of journal names.

NOTE: Manuscripts that are not arranged and submitted according to the above instructions, will not be taken in consideration for reviewing and publishing.

Тутун/Tobacco
Tobacco Institute 7500 Prilep Kicevska bb
Republic of Macedonia
E-mail: tobacco_institute_prilep@yahoo.com