

The Implementation of Float Tray System Technology for Production of Tobacco

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Abstract: Macedonia is characterized by a highly variable climate that has already experienced an increase in mean temperature and moisture deficits, as well as an increase in the severity of extreme events like drought, heat waves and forest fires. As for climate change, tobacco is one of the most stable crops in which the changes will not have such a drastic impact on further production, primarily because of the high adaptability of tobacco as a plant. To improve tobacco production is necessary good agricultural practice, which involves the implementation of new technologies for production of tobacco seedlings. The aim of study was to represent the current situation of tobacco production in Macedonia, and to give further directions using the advanced technology, in order to improve production, and facilitate the work of people whose existence depends on this crop. Research was conducted on oriental tobacco varieties: prilep NS 72 and yaka YV 125/3. This paper provides a primary information for obtaining high-quality tobacco seedlings, based on the benefits that ensure new Float Tray System technology.

Keywords: Float Tray System, tobacco production

Introduction

Tobacco (*Nicotiana tabacum* L.) is one of the most important agricultural export crops in Macedonia. Botanically, tobacco belongs to the genus *Nicotiana*, which is one of the five major genera of the family Solanaceae, *Nicotiana tabacum* L. and *Nicotiana rustica* L. being the two commercially cultivated species (Sarala et al. 2013). The natural resources in Macedonia (soils with modest fertility, dry climate) provide convenient conditions for growing oriental type of tobacco, mostly for export. Macedonia is a unique country in the Balkan in which 100% is oriental tobacco production (Kabranova and Arsov, 2009). According to data from the Ministry of Agriculture Forestry and Water Economy

(MAFWE, 2017) small-scale farming is the dominant type of tobacco production.

The production of oriental tobacco in Macedonia is located almost in all regions, even on soils with weaker productivity, where rarely other culture would be cost-effective. Still, approximately 98 percent from total production of tobacco in the country is produced in two biggest production regions: Pelagonia region - 55% and South-eastern region - 33% (Nomenclature of Territorial Units for Statistics is consists of 5 levels, based on the territorial organization of the local self-government in the Republic of Macedonia. The NTES-level 3 consists of 8 non-administrative units – Statistical regions (Official Gazette of the Republic of Macedonia No. 158/2007).

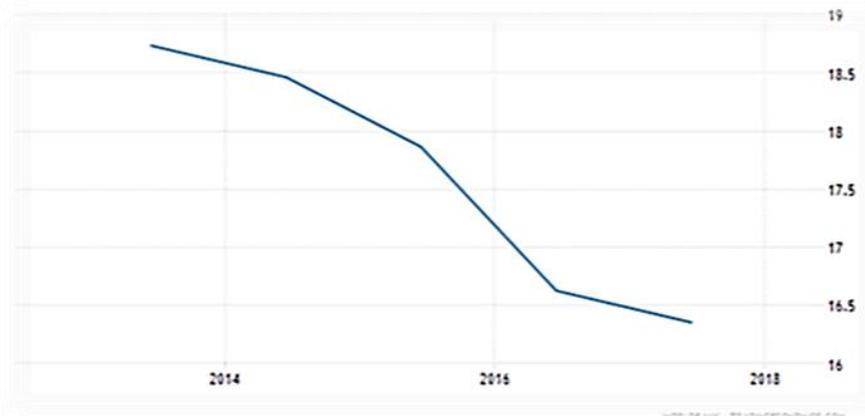


Picture 1. Statistical regions in the Republic of Macedonia
 Source: State Statistical Office of Republic of Macedonia, 2016

The high significance of tobacco for the Macedonian economy goes back to the ottoman period of time, when it was one of the most important agricultural crops such as poppy, sesame, cotton. The sector was heavily affected by the separation of Ex-Yu countries and long transitional period after which contributed to fluctuations in production and yield. New trends in tobacco production and processing, as well as liberalization of the market have also led to a change in the mental structure of farmers who cultivate tobacco. Tobacco industry continues to play an important role in the Macedonian economy, mostly depends on foreign tobacco companies and their demand for certain types of tobacco.

New foreign direct investments (Socotab, Alliance One, Phillip Morris) have appeared on a free market, which is why the tobacco sub-sector continues to play an important role as a main source of income for more than 40 000 families. Although Macedonia is considered to be an agricultural country, today data on employment in agriculture show something different (Chart 1). Thus, the percentage of employment of people in agriculture in Macedonia (according to the World Bank data on the collection of development indicators compiled from officially recognized sources) is 16.36% in 2017.

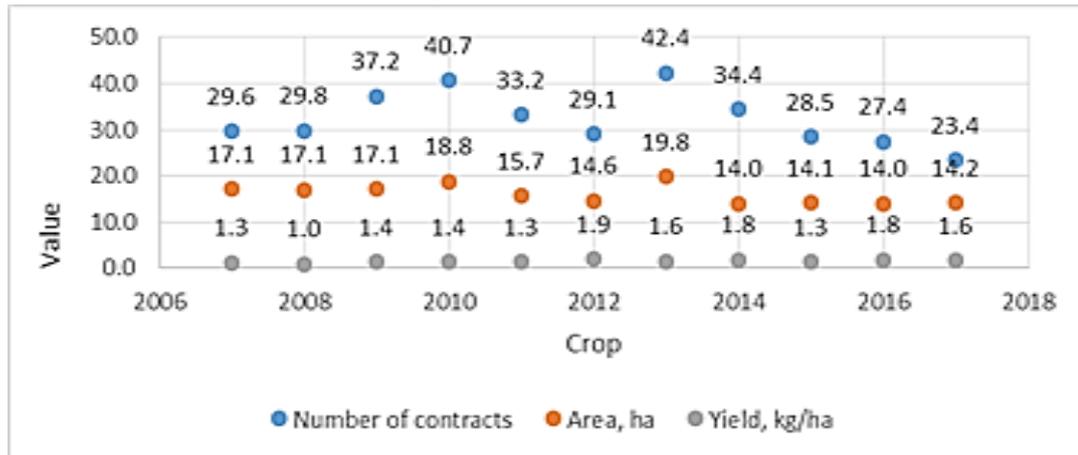
Chart 1: Macedonia - Employment in agriculture (% of total employment)



The data show that there is a trend of declining employment in agriculture, which is certainly result of difficult rural conditions, more pronounced emigration, especially of young people, abandonment of agriculture and activation in other sectors. Still, a large part of the total active agricultural population is engaged in tobacco

production. Tobacco production is entirely dependent on smallholder farming, based on intercrop and crop rotation systems which include essential crops (such as maize, wheat and alfalfa). Graph 2 shows data on the number of contracts, the area under tobacco and the average yield (kg/ha).

Chart 2. Number of contracts, area, yield (2007-2017)



Source: MAFWE, 2017 Sector Field Crops - Annual reports

The socioeconomic importance of tobacco in the country requires a continuous update of technical improvements to rationalize the cultural practices in order to obtain a product of higher quality, but respecting the environment.

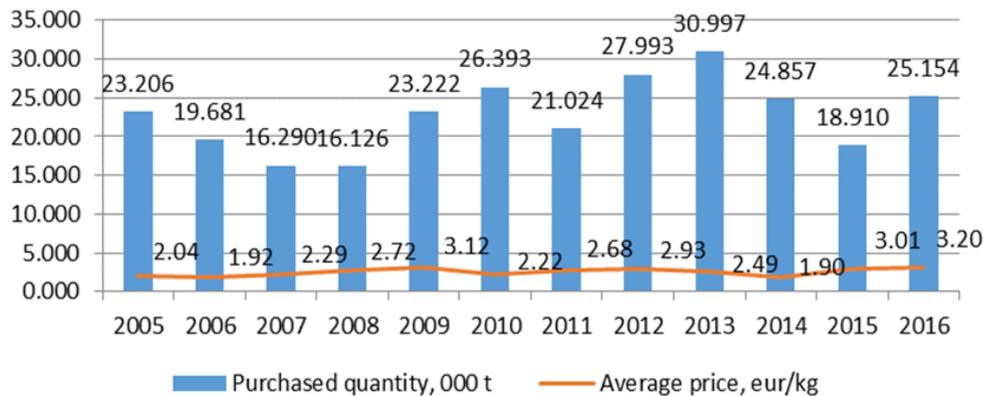
Why to grow tobacco? Despite a massive campaign against the use of tobacco and its harmful effects on human health, tobacco is still present on a farm. According to Tehwei Hu The Public Health Institute University of California, Berkeley (2018), tobacco is interesting because tobacco farming earns cash income, it is often more profitable than other crops, the Government encourages tobacco farming as a major source of tax revenue and foreign exchanges, tobacco industry needs a steady supply of tobacco leaf. These reasons are a good basis to consider how to improve working conditions, increase income, while taking care of the health of people, their families and the entire environment.

Tobacco companies distribute free inputs (seed, fertilizer, and technical assistance) during each cropping season to farmers during the critical period in the tobacco growing cycle (it is more cost effective to provide support to the farmers and guarantee good quality of production, and concentrate their efforts in processing). This is part of the contractual arrangements between farmers and processors. Macedonia begin in applying measures to encourage the production of tobacco by the state.

The Macedonian farmers association is very strong one, which is visible by the relatively stable prices (Chart 3) through the years. Agricultural policy for tobacco has been based on determination of guarantee price and production support by the state.

Subsidies for producers are paid directly to the producer's account. In the last 10 years, the value is 0,98 euro per kilogram of purchased tobacco, for all purchased classes. The year 2017 the average price for 1 kg of tobacco reached 3.56 euro.

Chart 3. Comparison of prices and yields on an annual basis



Source: Analyzed data

The aim of this paper is to improve tobacco production in the country in order to increase the overall efficiency of production. The study was conducted to evaluate the effect of usage of Float Tray system technology of tobacco seedlings production, as one of the key prerequisites for quality production. During the vegetation, a large number of factors have an impact on the tobacco that allow or interfere on the tobacco plant to express its biological and production potentials. Except the biological potential of the varieties, the largest influences have taken scientific farming methods and agro ecological conditions during the growing season.

Tobacco growers must begin with production of healthy seedlings, in order to achieve a good quality and yield per unit area. The high quality seedlings are produced with Float Tray System technology, production which presents hydroponic system of growing tobacco seedlings on sterile substrate in medium with fertilizers and protection. The tobacco seedlings are quite uniform according to their morphological and biological characteristics, especially when tobacco has been transplanted on the field. Tobacco in the field depends on its well-developed root system and morphological uniformity in terms of its dimensions (Pearce & Palmer, 2005).

The difference between plants (root length, length of stem, stem diameter, number of leaves) depends on the chosen

technology for production, the weather conditions, the varieties of tobacco, as well as chosen float trays with specific dimensions for each of seedling (Karajankov et al., 2001). Therefore, management practices that improve standards and promote uniform growth are very important (Smith et al., 2003). Strong root system will ensure proper plant development, with adequate number of leaves on it, the accumulation of dry mass, high yield and quality of tobacco. The most critical period in the development of tobacco occurs immediately after transplanting in the field. The quality of tobacco comes to light when after planting the field, with the high number of plants accepted and their rapid development, well-developed root systems and trees (Hensley, 2003).

The post transplanted shock is caused by the loss of most of the root system in the process of uprooting the seedlings (Hoyert, 1979).

Materials and Method

In early spring the trial started with preparation of seed beds for planting. For traditional technology, seedlings production was in cold beds, covered with polyethylene. For Float Tray System technology, sowing was done with pelleted seed. The total quantity of fertilizer was added in water beds (0,001 % solution). All agro technical measures for proper development of the plants were made for both technologies of

seedlings production, in order to obtain maximum healthy, usable seedlings per unit area.

The experiment was conducted in random block system, in four replications on two varieties of oriental tobacco (prilep NS 72 and yaka JV 125/3) in three variants: Variant 1-control (traditional production); Variant 2 - Float Tray (TERRA STAR 22:11:22+2Mg with microelements: Fe-0,0335 %, Cu-0,017 %, Mg-0,1 %, B-0,01 %, Mn-0,017 %, Mo in traces, Zn-0,01 %, Co in traces, +EDTA and Auxin) and Variant 3-Float Tray (CHELAN 11:49:12+2Mg with microelements: Fe-0,0335 %, Cu-0,017 %, Mg-0,1 %, B-0,01 %, Mn-0,017 %, Mo in traces, Zn-0,01 %, Co in traces). Quality of tobacco seedlings was exposed through the development of root and dimensions of the plant: stem length (cm), stem diameter (mm); and total mass of the plant (g). Special attention was given to the choice of surface of the land, the crop rotation where the predecessor was barley (*Hordeum sativum* L.). After transplanting, the number of accepted plants (%) was determinate. The results were processed by SPSS for Windows, procedure Sum of squares, Model III.

Results and Discussion

The analysis of the data according to the conducted technologies in the production of seedlings shows following: control, average acceptance - 75.7 %, while acceptance is superior - 91.5 % at Float Tray system production of tobacco seedlings. Such a high acceptance of the seedlings is a result of the short period of adaptation. Observing the varieties, the results even show a higher percentage of acceptance in variety *prilep* than *yaka* (94.7% vs 92.1%). In terms of technology conducted, there is a statistically significant difference between percentage of accepted plants in Variant 1- control and Variant 2 FT -N, Variant 1- control and Variant 3 FT -P (P=0,001), as well as Variant 2 FT -N and Variant 3 FT P (P=0,01). From the obtained data on the morphological characteristics of tobacco plants, it is concluded that the average root length in plants obtained from the conventional production of seedling is less (14.6 cm -15.1 cm) than the average root length of variant 2, FT-N (16.7 cm-16.9 cm) and variant 3 FT-P (16.0 cm-16.4 cm). Statistical processing of root length values, height and thickness of the seedling and total mass of the plant for factors and interaction between factors tested with the F-test shown in Table 1.

Table I. LSD Test

Dependent	Technology / Variant	Difference Mean values	Standard deviation	Significance
<u>Root length</u>	Ø1 FT2	7,5317***	0,3748	0,000
	Ø 1 FT 3	3,6817***	0,3748	0,000
	FT 3 FT 2	3,8500***	0,3748	0,000
<u>Stem length</u>	Ø 1 FT 2	0,03833	0,3539	0,914
	Ø 1 FT 3	1,1367**	0,3539	0,002
	FT 3 FT 2	1,1750***	0,3539	0,001
<u>Stem thickness</u>	Ø 1 FT 2	0,9775***	0,09441	0,000
	Ø 1 FT 3	0,0716	0,09441	0,449
	FT 3 FT 2	0,9058***	0,09441	0,000
<u>Total mass</u>	Ø 1 FT 2	4,7008***	0,3310	0,000
	Ø 1 FT 3	0,9958**	0,3310	0,003
	FT 3 FT 2	3,7050***	0,3310	0,000

*** The difference between the mean values is significant for the level of 0.001

** The difference between the mean values is significant for the level of 0,01

The results show that the developed plants originating from the seedlings obtained by Float Tray System production

have a significantly developed root. The same, as the main transporters of water and nutrients from the soil in the tobacco leaves,

ensure proper nutrition of the tobacco plant during the entire vegetative period. In this way, the growth in the plants is balanced, with the appearance of their biological features. With regard to the applied technology, the highest average height is characterized by tobacco plants of variant 2 FT-N (116.2 cm), and with the smallest average height are the tobacco plants of variant 1-class, control (107.0 cm). The method of production of the seedling affects to a certain extent the formation of plant leaves in tobacco planted on the field, although the number of leaves is actually a varietal characteristic and depends to a great extent on the agro-ecological conditions (soil type, meteorological conditions) and the implemented agrotechnical measures during tobacco vegetation. The thickness of the stem in the seedlings of the control variant is 4.55 mm for the variety prilep NS 72 and 4.07 mm in the variety yaka 125/3. In the FTS technology of seedling production, the thickness of the stem is 5.21 mm in the variety prilep NS 72 and 4.62 mm in the variety yaka 125/3. The results show that FTS technology of production of tobacco seedling allows for obtaining early, healthy and quality seedling. The number of plants resulting from FTS technology is maximally used. The harvest of tobacco produced by the FTS technology is carried out faster, it is more economical, which increases productivity and improves the humanization of labor. The reason is uniformity of seedlings, and proper and uniform growth and development of the plant after transplantation.

Conclusion

The production of oriental type tobacco is labor intensive for these two stages: the production of tobacco seedlings and the harvesting tobacco leaves. Significant efforts have been made to improve the efficiency of these two operations over the years, some of which are successful but have not yet been implemented. Practical experience and scientific research in conventional production of tobacco seedlings indicate that production technology is quite conservative and very difficult for all family members.

Accepting the FTS technology means educating workforce and costs as well as increasing labor productivity. It must be emphasized that FTS technology reduced the number of manual operations that are absolutely necessary for conventional seedling production. FTS technology provides a reduction in human factor at all stages of seedling production, and as for input costs, they are only higher at the beginning of implementation of this mode of production as an initial investment in material. Also, the frequent weather changes point to the need for the development of various techniques for the management of biotic and abiotic stresses especially after transplanting in the open field. Implementation of Float system tray technology can help to escape these risks. The results show a statistically significant difference between the percentages of accepted plants. The results show that with the Float Tray System technology the accepted percentage of plants after transplantation is significant (> 90%).

For the successful production of tobacco, production of a quality tobacco seedling is of special importance, which will further provide some uniformity in relation to the morphological and biological characteristics of the tobacco plant, which on the other hand will provide a raw material with certain technological characteristics for further processing and final processing into products for consumption.

Recommendation

The socioeconomic importance of tobacco production in Macedonia requires a continuous technical improvements and good agricultural practices in order to obtain a product of high quality, but at the same time production with respect to the environment. The quality of tobacco, the yield, improvement and motivation, management and control should be expressed. The use of scientific and expert consulting services is a basic factor for the development of a modern family business of tobacco growers. Improving the quality of the tobacco to the European and world standards by continuous collaboration with

the science, using experts through the growing season in order to find the opportunity how to get healthy plants, good yield, how to adopt new technologies for making easier and more productive tobacco production. As the ultimate goal is to increase competitiveness and efficiency in the production of tobacco.

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