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THE EFFECTS OF USING DIFFERENT SYSTEMS OF PRODUCTION OF TOBACCO SEEDLINGS

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Abstract
Tobacco is an economically important crop in Macedonia. To improve tobacco production is necessary good agricultural practice, which also involves the implementation of new technologies for production of tobacco seedlings. The Floating Trays System (FTS) is an advanced plant growing technology, which is particularly important when it comes to the resistance of tobacco plants and adaptation to a new environment (unavoidable physiological stress after transplantation). It represents an environmentally acceptable technology that allows respectively management chemicals and decreasing the risks of pollution on the humans and environmental management, as well as the establishment of sustainable development at the global level. FTS also provides a high yield and high quality of tobacco. Allows maximum use of dissolved nutrients, so plants form a strong root system and have a rapid development after transplantation. Further development of strong stems enables the formation of an adequate number of leaves even in unfavorable climatic conditions for tobacco, and synthesizes and accumulates more dry mass per plant. The experiment was set in a randomized block system in four repetitions on two oriental tobacco cultivars (*prilep NS 72* and *yaka YV 125/3*), each in three variants: variant 1-control (conventional system of production); variant 2-N and variant 3-P (the soilless system using Floating Trays). Among the systems evaluated, the soilless system is technically the most successful and innovative which represents a technological progress for producing uniform seedlings for their quick formation in the field and to establish more homogeneous plantations. The results obtained in this trial showed significant differences among the tested variants.

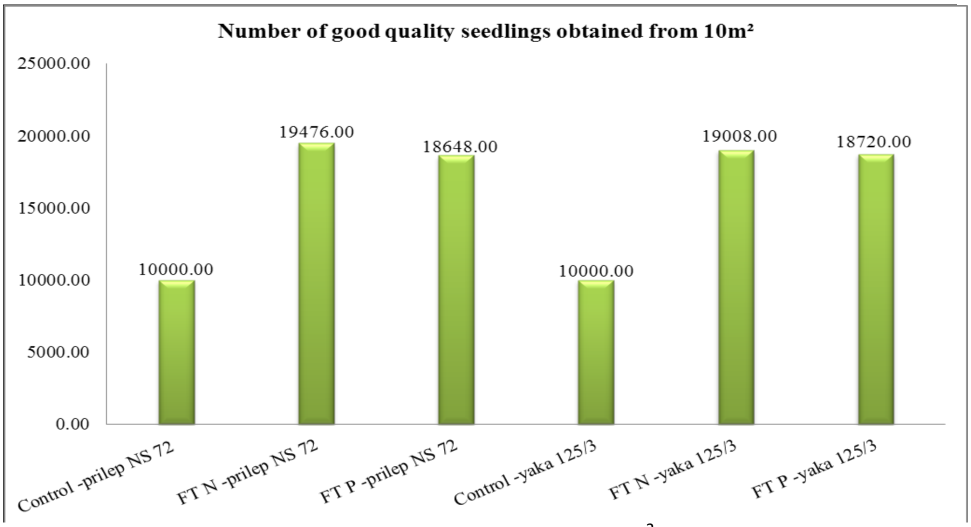
Keywords: Tobacco seedlings quality, floating system versus conventional.

Introduction

The production of oriental tobacco in Macedonia has a very long tradition. Tobacco is one of the most economically important agricultural crops in the country. To produce high-quality tobacco, growers must begin with healthy seedlings. The ideal seedling is disease free, hardy enough to survive transplanting shock, and available for transplanting on time. In general, earlier transplanted seedlings give better yield than late-transplanted tobacco (*Smith et al., 2003*). 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. Each type of tobacco, variety, requires separate intervention depending on the intensity of biotic agents, soil and climatic conditions, as well as cultural, traditional practices in one area. Macedonian production is traditionally the production of oriental type of tobacco. The production of oriental tobacco in Macedonia is located almost in all regions, soils with weaker productivity. For successful production, there must be a good quality of tobacco seedlings, to obtain uniformity according to morphological and biological characteristics of tobacco at field. After transplanting in the field tobacco plants for a few days survives a so-called transplantation shock because of unfavorable external conditions. This change is very insignificant in terms of seedlings produced by the classical mode of production, where there is an extremely large imbalance between the root system and the new conditions that often result in extended periods of stress, poor reception and slow plant growth (post transplanted shock). This shock is caused by the loss of most of the root system in the process of uprooting the seedlings from the beds (*Hoyert, 1979*). The production of healthy seedlings is the first step in the production of high quality tobacco. Use of FTS technology, means having more resistant and rapidly recovering plants after transplanting. The percentage of accepted plants is significantly higher in comparison to conventional seedlings. This directly affects crop yield per unit area and reduces labor costs. Improving tobacco production requires good agricultural practice which among other things involves implementation of new production technologies. The aim of this study was to show the differences that are very important between conventional production and the FTS technology that relate to their quantitative properties, and after transplantation to the qualitative properties of tobacco raw material. With the exposed results, we wanted to give contribution to the farmers education improvement of and wide implementation of the FTS production of seedling in Macedonia.

Material and methods

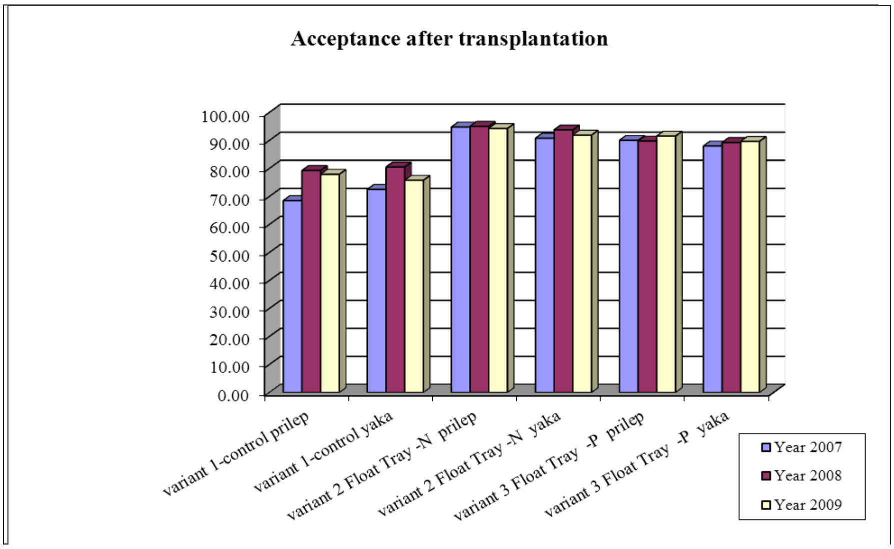
The experiment was conducted in cooperation with the tobacco company Veles Tabak, in Veles, in random block system, four replications on two varieties of oriental tobacco *prilep NS 72* and *yaka JV 125:* Variant 1-control ø (conventional production); Variant 2 - Float Tray (TERRA STAR 22:11:22+2Mg with 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). The total quantity of fertilizer was added in water beds (0,001 % solution). In the period from 2007 to 2009, the following materials were necessary: the required quantity of certificated tobacco seed (granulated tobacco seed for FT variant), peat with following characteristics: pH ($CaCl_2$) 5,0-6,0; mean structure of particles, organic content: 250-400 mg / L N, 280-450 mg / L P_2O_5 and 320-500 mg / L K_2O % (polystyrene trays with 589 alveolus per tray were filled with peat 50% and perlite 50%); polyethylene for covering water beds; agril (as a protector towards condensation) and protection (10 ppm Ridomil MZ 72 -am. Metalaksil+Mankozeb –against *Pernospora tabacina* Adam, and 10 ppm Fundazol-50 WP -am. Benomyl 50 %), against diseases which damage the seedlings, such as: *Pythium sp*. and *Rhizoctonia solani*. As a prevention, Decis EC 25 (am. Deltametrin) was added in concentration 0.05 % against *Trips tabaci* Lind, *Myzus persicae* Sulz., and other insects. Water conductivity into the pool on FTS was followed regularly (EC is a commonly used indicator of fertilizer salts levels in media and water) for keeping the concentration of fertilizer. Measuring was with conduct meter (DIST WP 4 Conductivity/TDS meter, HANNA instruments, range 0,01-19,99 mS/cm (mmho/cm) with ATC), with reading the conductivity of clean water first, and then conductivity of the solution. Thermoregulation above the pool was conducted with uncovering of the tunnel. Traditional technology of seedlings production needs additional fertilizers to the plants (1 % solution), which follows with application of fungicides and insecticides, and 7 days before transplanting to make vigorous seedlings. 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 (Graph.1). In this period, suitable agrotechnical measures (watering, nutrition and protection) were applied in order to obtain healthy and well developed seedlings. Before transplanting, the number of usable seedlings was determinate. After transplanting, the number of accepted plants (%) was determinate. Common agro-technical measures for successful production experiment were conducted. The soil preparation for cultivation consisted of basic processing to improve soil structure and to create favorable conditions for normal microbial processes to enhance disposal of water-air-heat regime in the soil, to reduce weeds and etc. Transplantation of tobacco was done manually. Transplanting time was different, applicable for the Veles area and in close connection with the meteorological conditions during the test period. In the three studied years the standard agro–technical measures were conducted. Special attention was given to the choice of surface of the land, the crop rotation where the predecessor was barley (*Hordeum sativum L.*). After transplantation of tobacco seedlings, the number of accepted plants (%), and the crisis period (from transplanting to acceptance) were analyzed, as well as dry mass of tobacco (kg/ha) obtained after harvesting. The results were processed by SPSS for Windows, procedure Sum of squares, Model III.



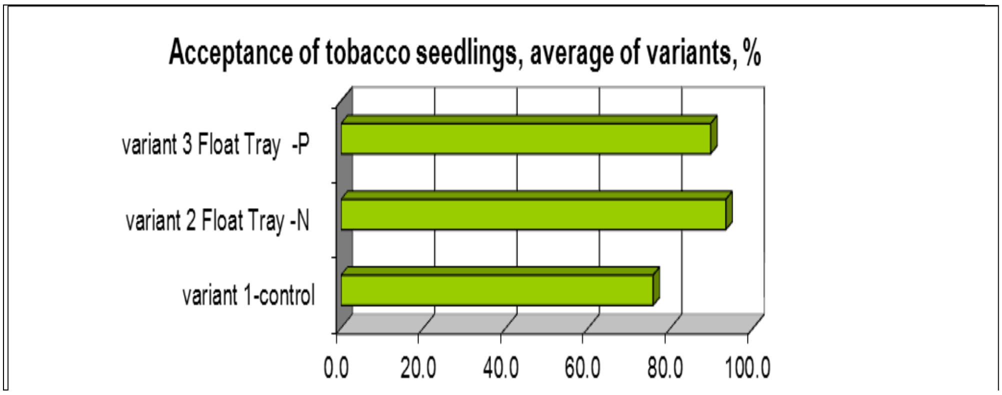
Graph 1. Difference between numbers of seedlings obtained from 10m^2 from different production technologies, by variants

Results and discussion

Time of transplanting, as an important point of fields stage, primarily depends on the time when the seedlings are ready for transplanting and weather conditions at the time of the year. The period after transplanting is considered crucial for the overall production at the end of vegetation. Therefore, after transplanting, the plants should have enough available moisture well to develop the first leaves. The level of acceptance of tobacco seedlings depends on agro-environmental features at the time of transplanting, agro-technical measures, but mostly from the quality of seedlings. After successful acceptance, the plant develops quickly and steadily by forming leaves from the bottom to the top (*Uzunovski,* 1989). The seedlings derived from the conventional production (variant 1-control ø), have longer critical period after transplantation in both examined varieties, compared with plants from FTS technology. The percentage of acceptance depends very much on the climatic conditions in the year of production in all examined variants Graph 2 shows the acceptance between variants after transplanting. Graph 3 shows that the seedlings produced in a conventional way are less resistant to new conditions and are hardly accepted. The lowest acceptance shows variant 1-control (75.7 %), which proves that accepting tobacco in the field depends on its quality, expressed above all with a well-developed root system and morphological uniformity in terms of its dimensions (*Pearce & Palmer, 2005*). With the conventional production of seedlings it is not possible. Rates of tested nitrogen fertilizer show difference in tobacco seedlings quality, so greater acceptance due to the quality produced seedlings (93.4% acceptance for variant 2-FT, N, and 89.73 % for variant 3-FT, P). This is very important when it comes to the quality of the fertilizer used and recommended in the production of transplants (Graph 3). Because of existence of proper ingredients (food, water, air, etc.) and not existence of mutual competition, seedlings from FTS technology are equal, with balanced growth and development (strong roots, well-developed stem and number of leaves). Plants are morphologically identical during growth and development in terms of height, number of leaves, the size of the leaves that are almost identical (*Turshic, 2000*). After the technological maturity, the tobacco is harvested and dried. Measured dry mass of tobacco (kg/ha) after harvesting show the following results (Table 1).



Graph 2. Acceptance of tobacco seedlings, %



Graph 3. Acceptance after transplanting (average of variants)

Table 1. Average dry mass of tobacco (kg/ha)

PNS 72			*Y V 125/3*		
Harvest	Dry mass, kg/ha	Index	Harvest	Dry mass, kg/ha	Index
Control ø			Control ø		
2007	2139.2	100	2007	1893.0	100
2008	2359.8	100	2008	2548.0	100
2009	2582.1	100	2009	2120.4	100
Average	2360.4	100	Average	2187.1	100
FTS N			FTS N		
2007	2600.9	122	2007	2231.6	118
2008	3060.9	130	2008	2941.2	115
2009	3095.1	120	2009	2599.2	123
Average	2919.0	124	Average	2590.7	118
FTS P			FTS P		
2007	2354.7	110	2007	1923.9	101
2008	2598.9	110	2008	2582.1	101
2009	2889.9	112	2009	2428.2	115
Average	2614.5	111	Average	2311.4	106

The production technology also influences the yield of the dry mass tobacco. The yield is higher for 24 % and 18 % respectively for variants of 2 FTS -N or 11 % and respectively by 6 % for variants of 3 FTS – P, compared with control variant for both varieties. Differences in yield between variants 2 and 3 are result of increased ratios of macro elements in the fertilizer combination. In all tested variants (control, FTS -N and FTS -P), the average yield per dry weight per unit area is lower in the variety *yaka JV 125/3* in comparison to variety *prilep NS 72*, which is a result of the characteristics of the certain variety.

Table 2 Dry mass yield (kg/ha), interaction Harvest/Technology

Harvest	Technology			Average
	Control	FT N	FT P	
2007	2016.1	2416.2	2139.3	2190.5
2008	2453.9	3001.1	2590.5	2681.8
2009	2351.3	2847.2	2659.1	2619.2
Average – technology	2273.7	2754.8	2462.9	

LSD Test

DV	Harvest		Mean value difference	SD	Significance
Yield kg/ha	2007	2008	-491,2667**	143,04326	0,007
	2007	2009	-428,6167*	143,04326	0,015
	2009	2008	-62,6500	143,04326	0,672
DV	**Technology**		**Mean value difference**	**SD**	**Significance**
Yield kg/ha	1	2	-481,0833**	143,04326	0,008
	1	3	-189,2000	143,04326	0,219
	3	2	-291,8833	143,04326	0,072

The average yield values for dry mass show that variant 2 FTS -N contributed with 2754.8 kg/ha or 21% higher yield of variant 1-control. Regarding the harvest, the highest yield was obtained in 2008. From the data presented in the Table 2/LSD, it can be noticed that there is a statistically significant difference between the yield per unit area (kg/ha) in the 2007 harvest compared to the 2008 harvest, with the 2007 harvest relative to the harvest 2009. In terms of production technology, it is noted that there is a statistically significant difference between the yield per unit area (kg/ha) of variant 1 (conventional production) and variant 2 FTS -N. Among the other variants, there is no high statistical difference in relation to the yield per unit area.

Conclusions

FTS technology represents modern and cost-effective tobacco seedling production technology that achieves greater efficiency in work processes and higher results. The used seedlings production area (which will provide an adequate number of plants /area) is almost 2 times smaller than that in conventional way of production. The conditions provided by this technology have a strong impact on the growth and development of the seedlings (more suitable plants for transplantation, on average 90 %), in relation to the classical way of producing tobacco seedlings. Among the systems evaluated, the soilless system (FTS technology) is technically the most successful and innovative which represents a technological progress for producing uniform seedlings. Due to the same dimensions of the plants - the transplant effect is increased, and the basic needs of the labor force is minimal; there is a quick formation in the field with more homogeneous plantations. With high acceptance of the seedlings (variant 2 FTS N - 93.4% was emphasized) plants rapidly continue their growth and development. The effects of using advanced technology versus conventional are multiple. Variant 2 – FTS N, showed higher results in terms of yield and quality. The average yield per dry mass per unit area is the highest in variant 2 of the container N, for example: in the variety *prilep NS 72* – 2919.0 kg ha. FTS is ecologically acceptable technology that enables appropriate chemical management and reduction of risks from human and environmental pollution. It also ensure establishment of sustainable development on a global scale.

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