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ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ
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Содержание

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A NEW APPROACH IN THE PRODUCTION OF ORIENTAL TOBACCO IN NORTH MACEDONIA

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Abstract. Macedonian tobacco is far recognized for its quality and its participation in the blend of American cigarettes is irreplaceable. The oriental type of tobacco in this area has been grown for a long time,dates back centuries. Tobacco production in the country began a long time ago (XVI century, during the Ottoman Empire), but it was greatest in the second half of the XX century, since when tobacco production is treated from an economic, commercial, fiscal, social and demographic aspect. In addition to the primary production of tobacco, there are a large number of tobacco companies in the country for the purchase and processing of tobacco. In the past there were even several tobacco factories for the production of cigarettes. Tobacco is the most profitable crop in the country, if we take into account the subsidies and the regulated market. Tobacco processors pay a good price, but they are looking for unified quantity and quality. When it comes to the quality of Macedonian tobacco, today the biggest problem is the modernization of production, harvesting and drying of tobacco, before being bought by companies. Therefore, in this paper we will give an overview of the new approach for improving and increasing the efficiency of the production of oriental type tobacco in the country, It should not be denied here that the new approach is directly related to the new generations of tobacco farmers, the retention of young people in rural areas (this period, the country has is especially mass migrations in many European, and overseas countries), the outflow of people for economic reasons (unemployment and low wages for subsistence). It may sound strange, but Macedonian farmers do not have the opportunity to improve production, and there are more reasons. We are talking about the wide implementation of new technologies for the production of tobacco seedlings, modernization of the process of harvesting and drying of tobacco, operations that are inseparable to obtain high yields and quality tobacco raw material. It is indisputable that people want to learn, and they want to make their job easier with the help of new agronomic techniques and the implementation of advanced production technologies.

Keywords. Oriental tobacco production, technology, solar process of drying.

Introduction

The territory of the country occupies a small area; it is continental country on the Balkans and it is a "hot spot" in the production of high quality oriental tobacco, with relatively stable traditional production compared to the other tobacco producer's countries. It is well-known country where the best oriental tobaccos are grown. With a share of 3%, the country is positioned among the eight major oriental tobacco producing countries in the world. Also, tobacco occupies about 3% of the total arable land in the country. The average tobacco planted area in the country in the period 2010-2019 was less than 16 000 ha (Graph.1). Due to differences in relief, altitude and the effect of other climates, the conditions for tobacco production cannot be the same on the whole territory, due to which the country is divided into tobacco-producing regions. In general, the whole territory is characterized by very suitable and diverse conditions for the production of oriental tobacco.

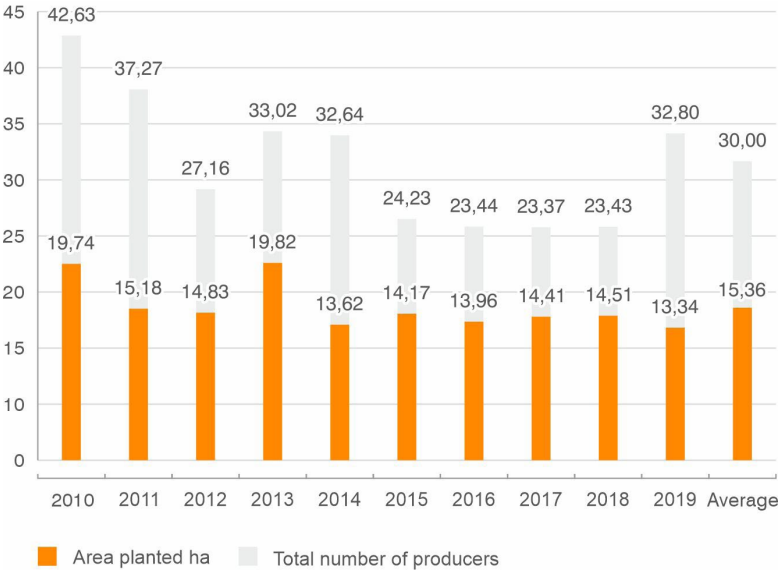
A common feature of all regions is aridity, especially in the summer months, high temperatures and insolation in vegetation period. Such conditions are a guarantee for the production of small-leaf, aromatic tobacco, which are recognizable all over the world in their own way outstanding quality. Climatic and soil conditions determine the distribution of a certain type / variety of tobacco. Climate and soil are inseparable. Soil fertility, relief and climate determine the structure of certain types of tobacco in the country. Most of the tobacco production takes place in the Pelagonija and Southeast region or a total of 87% of the total production in the Republic of Northern Macedonia.

After, the rapid structural change in cigarette consumption anywhere in the world (accepting the type American blend), 90% of the production of total amount of tobacco in the country is export oriented, there is also support (financial and legal framework) from the state. Periodic oscillations, in tobacco production, depend on the weather conditions that affect the quantity as well as quality. While in the world, the trend of production goes upward with the increase in the yield of unit area, in Macedonia there are frequent oscillations, which in some years are the result of climate change, but often also of the non-existent purchase prices for kg of tobacco. The production varies both by number of producers, and by the production quantity of tobacco by region (Kabranova & Arsov, 2017). The average production per hectare is about 1.500 kg/ha, but there are a many producers who produce 3.000 kg/ha.

Tobacco is one of the field crops that have a long tradition in the country. Therefore, it has its sociological, economic and cultural impact. The tradition of production is passed down from generation to generation, so every year more than 25 thousand households in the country are engaged in tobacco production, especially in the countryside (also those who have tobacco as a supplementary income). Tobacco production is quite mechanical in the phases of pre-harvest (production of tobacco seedlings, transplanting, harvesting) and postharvest (drying, sorting tobacco leaves). Improving these production processes to a great extent will compensate for the lack of labor force, which is quite reduced among farmers due to the demographic situation, attract young people to start tobacco production, because this is the only crop that provides a stable income (tobacco production is regulated by the Law on Tobacco, Tobacco Products and Related Products (Official Gazette of the Republic of North Macedonia / No. 98/2019 and Amendments to the Official Gazette No. 27/2020), and there is also a stable demand in the world market. (Miceska & Dimitrievski, 2016).

The most represented varieties of tobacco grown in the country are of oriental origin, mainly the species Prilep, Yaka and Basmak. According to the latest data from the State Statistical Office of the Republic of North Macedonia the production and trade of tobacco and tobacco products in Gross Domestic Product (GDP) in 2017, participated with 3.2%, and the tobacco industry in the total industry of the country participates with 4%. Tobacco is one of the most important export products; The Republic of Northern Macedonia participates in the production of tobacco worldwide with 0,3%, while the oriental tobacco with 3%. The convenience of natural con-

ditions provides production of over 20,000 tons per year, which is much above the need for domestic consumption, so 90% of production is intended for export. In the last fifteen years, in the period from 2005 to 2019, an average of 26 thousand tons of tobacco and tobacco products were exported annually with an average annual worth about 107 million euros. Thus, tobacco participates with about 25% in the total agro-food export and with about 3% in the value of the total export of the country, which significantly affects the trade balance (MakStat, 2020).

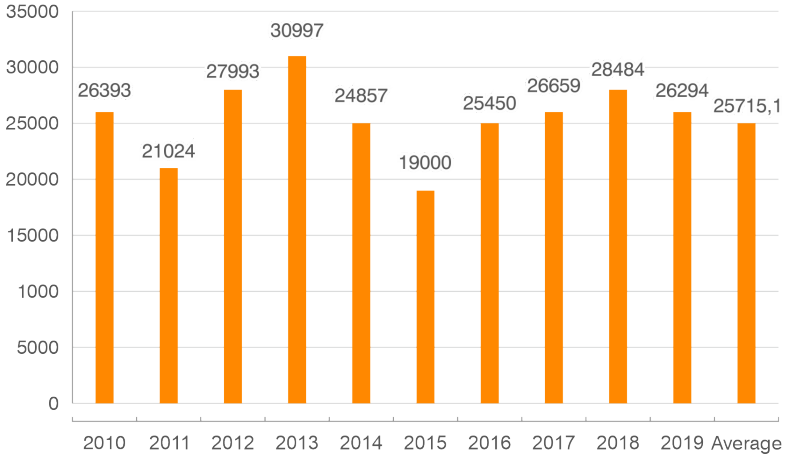


Graph. 1 Areas under tobacco (ha) and number of growers, average (2010-2019)

All activities and processes related to production of this crop are regulated by law on Tobacco, Tobacco Products and Related Products ("Official Gazette of the Republic of North Macedonia" No. 98/2019 and 27/2020). According to the provisions of this Act, tobacco producer's use only certified seed material from the authorized institution. The country is ranked as a second-largest oriental producer at 47% of Turkish total output, and quality Prilep AB has been fetching prices above EUR 3.00/kg, equivalent to the green leaf price of Turkish Izmir (Source: Star Agritech International; published October 2018; with additional editing by TOBACCO ASIA).

The new approach in tobacco production refers to modern production techniques, advanced technologies in tobacco seedlings production, improved production practices & climate-smart practices, which will allow to the farmers to be more competitive in the market.

50% larger than the world's number three producer, Greece. Nowadays, the top Over the years (period 2010-2019), an average annual production of unprocessed raw tobacco amounting to around 25,000 tonnes (Graph. 2).



Graph.2 Purchase of unprocessed (raw) tobacco, tons (2010-2019 years)

According to the data from ISET-Information System for Tobacco Records maintained by the Ministry of Agriculture, Forestry and Water Economy, in the period from 2010 to 2019 the following areas and number of tobacco producers were recorded (Table 1).

Table 1. Total area and number of tobacco producers

Crop	Area /ha in 000	Producers in 000
2010	19.74	42.63
2011	15.18	37.27
2012	14.83	27.16
2013	19.82	33.02
2014	13.62	32.64
2015	14.17	24.23
2016	13.96	23.44
2017	14.41	23.37
2018	14.51	23.43
2019	13.34	32.80
Average	15.36	30.00

Source: Ministry of Agriculture, Forestry and Water Management, 2020 year

Material and Method

In this paper, original data from several years experiments and research of the Faculty with certain individual producers and companies are used. Also, official data from the Reports of the Statistical Office of the Republic of Macedonia, data from the Ministry of Agriculture, Forestry and Water Management of the Republic of Macedonia were used.

In the analysis of the data a comparison was made (the average values in relation to the areas under tobacco, production, yield).

The main varieties of oriental tobacco were used form April to May 2019, with traditional production of seedlings and Float Tray System Technology of tobacco seedlings production. Necessary materials for both types of production were used as standard in the production of seedlings. After the tobacco harvest, drying was done in two ways (in the traditional dryer and in the modern advanced dryer). The tobacco (tobacco leaves) subject of drying trial, was planted on the farmer's fields during the end of May 2019. The field trial with tobacco was carried out in area of 0.2 ha, or the surface from which the tobacco leaves were provided 0.1 ha for tobacco leaves or in quantity, about 900-1000 kg of green tobacco, which was dried in a way as a farmer practiced, and 0.1 ha with same with quantity in a new type of dryer (curing barn). 0.04 ha surface area was needed for new type of dryer and existing ones. Also, farmer provides premises for placement and storage of dried tobacco as was needed. All activities related to the production and drying of tobacco were carried out by the farmer and his family.

Field trials with drying were set at 5 producers (farmers) of tobacco in different regions of Macedonia.

The cultivated variety was Prilep 66 9 (oriental type, intended for sun curing). No interventions were carried out on the area where the tobacco was grown, by our side. The aim was farmer to produce tobacco with the agro-technology that he usually used. The subject of the research was only harvested tobacco leaves.

Harvesting was through picking belts (5 belts), manually. Then, the harvested leaves were stringed and dried in both dryers (curing barns), traditional and new one.

Design of trial:

- first variant in the manner and in the dryers that the farmer has control (Metal scaffolding covered with polyethylene canvas);
- second variant in the polycarbonate dryer (experiment).

In the first variant the dryers are set as the farmer knew, or as he works, while in the second variant, the dryer is set in a specific direction. The upper side of the roof must be facing north, lower to south. Also the slope of the roof is 20°. It is designed to make solar energy more efficiently utilized.

Drying in both types of dryers was carried out as time ripened in the field. From the second, up to fifth hand (picking belt), or from the end of June until the end of October.

Drying into the barns was done in arrays, horizontally placed in two rows in both variant.

The new type of dryer, according to our designs, is made by metal company KOD engineering from Skopje. The order for the dryer was made at the end of May 2019 and the firm successfully completed it at the end of June 2019.

Before the tobacco was sold, samples were taken from our side, for chemical analysis. Chemical composition of tobacco is determined in the accredited chemical laboratory (ISO 17025) of the Scientific Institute of Tobacco in Prilep, by picking belt (insertions) for both variants (Farmer dryers-old type and New type dryer).

Results and discussion

1. Comparative technologies for the production of tobacco seedlings

Each production of tobacco begins with the production of tobacco seedlings, followed by transplantation of tobacco in the open field. In our country, oriental tobacco is still traditionally grown in the classical way in open-field beds. Production of tobacco seedlings has important role as regular measure of the tobacco production technology (Uzunovski, 1989). To produce high-quality tobacco, growers must begin with healthy seedlings. In the production of tobacco seedlings, the main problem is labour-intensive work on the farm (children, elderly family members). The implementation of Float Tray System (FTS) technology is the best solution to improve all working process. All tobacco seedling production operations are shortened, strictly controlled, the procedure is very simple, fast and safe. The operation of weed cleaning is omitted, which is necessary and difficult in traditional seedling production. The ideal seedling is disease free, hardy enough to survive transplanting stress, and available for transplanting on time. In general, earlier transplanted seedlings give better yield than late-transplanted tobacco (Smith et al., 2003).

For successful production, there must be good quality tobacco seedlings in order to achieve uniformity according to the morphological and biological characteristics of tobacco in the field. And this is exactly the success of the advanced seedling production technology in Floating Trays.

In the world, this technology is already even more progressive when it comes to Virginia and Burley tobacco. But when it comes to oriental tobacco, this is not the case. Our many years of experience have shown that it is inevitable to have a romantic attitude towards the introduction of new achievements in the production process. For successful production there must be good quality. But when it comes to oriental tobacco, this is not the case. Implementation in practice is very difficult when it comes to our country. It is not only about financial implications (production with FTS contributes to the savings of certified seed material), but also about the resources provided by the so-called hardened or traditional farmers who are ready to invest their sweat, but do not change their habits (although classic production is a very hard and risky business). Visible and outstanding results are also shown by the data obtained from our experimental trials from oriental tobacco (Table 2).

Table 2. Average number of usable transplants per unit area, index (%)

	Variant	Number of Transplants: from m² / Traditional Bed From 0,25 m² -Tray / FTS	Number of Transplants from 10 m²	Index
Variety	Prilep – traditional production	1000	10000	100
	Yaka - traditional production	1000	10000	100
	Prilep - FTS technology	535	19255	193
	Yaka – FTS technology	520	18708	187
Ave	Traditional	1000	10000	100
	FTS	528	18982	190

Since the success of the entire tobacco production in the field primarily depends on the quality of seedlings produced, it is obvious that the more healthy and vital seedlings are obtained in less space, the farmer has higher production efficiency, tobacco uniformity and adequate composition per hectare. Experience with the use of the Float Tray system technology of seedling production has shown that production of quality seedlings is also combination of several factors: quality seed material (certified seed), optimal microclimatic conditions, optimal vegetation space / plant (Picture 1), good quality of substrate, regular control and proper care of the seedlings and well-trained-experienced tobacco producer. As a result, we get seedlings with a well-developed main root system, well-developed and upright stem well-developed 6-8 leaves (absence of chlorosis or necrosis), absence of diseases and injuries from pests (no weeds) and such seedlings have a great ability to adapt and quickly accept seedlings in the field (>95%). When using this technology, it is necessary to conduct proper care and monitoring during the vegetation, namely: fertilizer selection and use, temperature management, & humidity management (passive ventilation - with the use of side and cover openings and/or forced ventilation - with fans). Shading (nets, light cloths) is recommended to avoid daily drastic changes in T / insolation, thus reducing the light intensity - in the hottest hours of the day. Adequate hygienic-technical precautions are necessary (Disease and pest control). FTS technology can increase the efficiency of tobacco production by introducing smarter, safer and easier seedlings production.

Picture 1. Traditional, in cold beds (left) FTS technology (right)

For wider implementation, it is very important that it is necessary for farmers to gain practical experience. Then they could use the support of various funds for agricultural development, if they want to improve their production on the farm, increase the quality and yield per unit area. Farmer training, and the presentation of the results of field experiments are also necessary to achieve the best results (in order to improve the efficiency of farmers).

Picture 2. Tobacco seedlings traditionally produced (left) FTS advanced technology (right)

Picture 2, shows the difference in the obtained tobacco seedlings is obvious depending on the chosen method of production.

2. Improving the Drying of Oriental Tobacco

The green leaves of oriental tobacco after harvesting must go to sun-drying. This method is used for drying oriental and semi-oriental tobacco in all countries producing these types of tobacco. In Macedonia this drying method is the most used one (Boceski, 2003).

The Macedonian oriental tobacco is dried on the sun, in dryers made of different materials (wood, metal or combination of both) covered with polyethylene canvas. The shape and dimensions of the dryers are not standardized. Every farmer makes them according to their possibilities and knowledge.

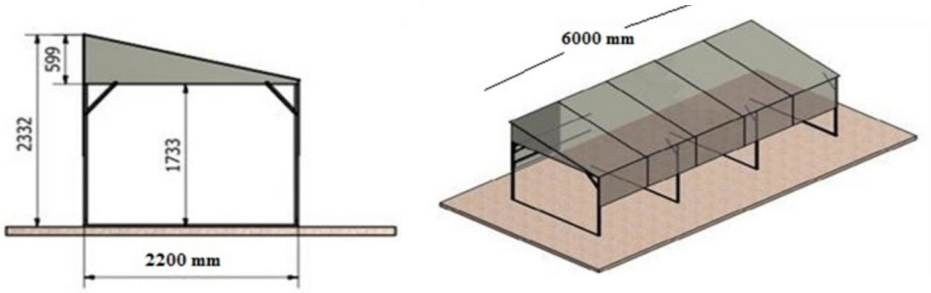
Our country is with long sunny periods from May till the end of September, in some years, due to the prolonged vegetation of the tobacco in the field, the drying process ends in mid-October. The green leaves of oriental tobacco after harvesting must go to sun-drying.

From the current field information it is clear that the efficiency in the utilization of solar energy is not taken into account. The exposure of the dryers as well as the roof of the dryer is not taken into consideration.

Improving the method of Oriental tobacco drying by introducing a new type of solar dryer (Picture 3).

With the new type of dryer and the way of its setting, the inconsistencies will be eliminated. The dryer is provided for sun-dried oriental tobacco types. Its purpose is to establish:

- Standardization of Curing Condition
- Time Saving
- Cost of Production
- Quality Impact



Picture 3. New type of dryer
(sketch, metal construction and polycarbonate panels)

New type of dryer is with a sloping roof, made of metal construction and partially covered with polycarbonate panels (UV Stabilized Polycarbonate with a thickness of 1-1,5 mm). The construction is joined by screws and can be dismantled and reassembled as needed. The dimensions of this dryer are: 6000 length x 2000 width x 1733 mm height in the middle part (Picture 3).

Picture 4. Farmers dryer left, New type of dryer right

Picture 5. Tobacco in: Farmers dryer (left)

New type of dryer (right)

**Photos are made by authors - Location: vilige Edinakovci, municipality Demir Hisar 598 m.a.s.; 41°15'41"N 21°14'48"E*

The capacity of dryer is 120 arrays horizontally placed in two rows. If a one dried string weighs 0,4 kg in that case we will have 48 kg of dry tobacco for a one circle of drying. Tobacco is harvested in five belts; therefore there will be five cycles of drying. Assuming that 0,1 ha of tobacco permits 220 kg of dry tobacco, in that case it is enough for 0,1 ha area

The chemical composition of both variants is within the range typical for oriental tobacco (Table 3 and 4).

Table 3. Chemical analysis Farmer dryers, %

Picking belt	1-st picking	2-nd picking	3-th picking	4-th picking	**Average**
Nicotine	1,50	2,21	1,77	2,17	**1,91**
Reducing sugars	17,79	14,87	15,73	14,62	**15,75**
Total reduction	23,61	15,95	18,25	16,94	**18,69**
Polyphenols	5,82	1,08	2,52	2,32	**2,94**

Total nitrogen	1,88	2,47	2,15	3,17	**2,42**
Protein	7,40	6,38	7,36	10,00	**7,79**
Ash	15,34	14,70	10,29	12,97	**13,33**

Table 4. Chemical analysis New type dryer, %

Picking belt	1-st picking	2-nd picking	3-th picking	4-th picking	**Average**	**Index Old/ New**
Nicotine	1,51	2,73	1,41	1,91	**1,89**	**98,82**
Reducing sugars	11,16	11,46	20,20	17,16	**15,00**	**95,19**
Total reduction	12,73	14,72	26,40	21,88	**18,93**	**101,31**
Polyphenols	1,57	3,26	6,20	4,72	**3,94**	**134,16**
Total nitrogen	2,21	2,46	1,76	3,11	**2,39**	**98,66**
Protein	7,81	5,53	6,11	11,08	**7,63**	**98,04**
Ash	16,59	13,80	8,59	12,41	**12,85**	**96,42**

From the data (through Index Old / New dryer) presented in Table 4, it can be seen:

- Tobacco dried in the new type of solar dryer has lower average nicotine content;
- Reducing sugars is lower;
- Polyphenols are higher in the new type dryer;
- Total reduction, are higher in the new type dryer;
- Total nitrogen, Protein and Ash are lower.

For quality oriental tobacco it is important to have: first lover nicotine content, second higher Total reduction, Reducing sugars and Polyphenol and to have less Total nitrogen, Protein and Ash. With the application of the new type of dryer, higher quality of dried tobacco was achieved.

To assess how a better chemical composition will affect economic income, we will refer to the quality coefficients, which represent a mathematical relationship between certain chemical compounds. These are the Polyphenol Number, the Veselinov Number.

The significance of the coefficients is as follows:

Shmuk coefficient (number) is the ratio between soluble sugars (expressed as glucose) and proteins. When the Shmuk coefficient is above 1.3 it is good quality. Applies only to light-colored tobacco dried in the sun or warm air. It can compare tobacco of the same type and origin, grown under similar conditions.

The polyphenol number is also a quality coefficient that is related to the color of the tobacco leaf. It is a relation between total reduction and the content of polyphenols expressed as glucose. If its value is higher the tobacco raw material has a darker color and poorer quality. Applies only to light-colored tobacco, dried in the sun or warm air. The polyphenol number as well as the Shmuk number refer to tobacco of the same type and origin.

Veselinov's coefficient. It is a relationship between soluble sugars (expressed as glucose) and proteins and pure ash. This coefficient is associated with the Shmuk number and the adverse impact on pure ash, i.e. mineral matter, which is in the denominator of the carbohydrate-protein ratio. The number ten is in the numerator in order to obtain approximately integers in the calculation. Higher value (above 1) reflects high quality. The coefficient values are presented in Table 5.

Table 5. Coefficient values

	Shmuk num.	**Polyphenol num.**	**Veselinov's coeff.**	**Average Index**
Farmer Dryer	2,08	14,73	1,59	-
New Dryer	2,09	19,88	1,86	-
Index Farmer / New	**100,3**	**135,0**	**117,3**	**117,5**

From the data presented in Table 5, it can be seen that the dried tobacco in the both dryers has a same Shumk number, a higher polyphenol number and a higher Veselinov number. The average of them, expressed as an index, is 117.5.

In our opinion the increased value in quality of tobacco dried in the new type of dryer is 17.5%.

From the applied activities, based on the data obtained from the field activities, it can be briefly stated:

- The drying time of the tobacco in the polycarbonate dryer observed on the harvest belts is shorter by 2-3 days compared to the tobacco that was dried in the dryers that the farmer had and used.
- The color of dried tobacco in the new type of dryer is lighter than the tobacco dried in the farmer's usual dryers.
- The air temperature inside (in the middle) in the new type of dryer is 3-4 0C higher than the air temperature compared to the farmer's dryers.
- From on-the-spot conversations with the farmer it was found:
- Is pleased with the quality of dried tobacco.
- The drying time is reduced and allows for a greater number of batches tobacco for a certain period of time compared to its dryers.
- The dryer is strong and will have a longer service life.
- The disassembly and assembly option is useful.
- In times when there is no tobacco it could be used for drying e.g. red pepper or some other crops and herbs.

Conclusion

FTS technology is important for improvement of viability of tobacco seedlings (great resistance towards diseases, weeds etc. maximum exploitation of soluble organic material) and all this to form stronger root system that will ensure faster plant development, strong stem with proper number of leaves on it, uniformity, and accumulation of dry mass per plant and higher yield and quality of tobacco. An in-

creasing influence of global climate change on tobacco production, result in a long period of adaptation of the plant after transplantation of seedlings, poor acceptance, the incidence of diseases and so on. FTS technology is a safe way to produce tobacco seedlings that ensure a high rate of acceptance after transplantation, after which the seedlings develop a strong root system that is necessary to provide the desired number of plants per hectare. At the end of the process, it will result in high yield and quality of tobacco.

Benefits of New Solar Dryer are: As a simple construction, the farmer will be able to do it himself. Standardization of Curing Condition (Better Controlled Environment), time saving, about 10%; Better quality Impact, 17,5 % (Existing average purchase price of 217.00 MKD / kg or 3,53 Eur/kg) would increase by 17,5%, if good agro-technical measures are applied, and if there are good climatic conditions during vegetation.

Contributions of New Solar Dryer are: Better use of solar energy, Environmental contribution (do not use polyethylene canvas, use long-lived polycarbonate, use metal instead of timber for drying construction).

Our research is focused on improving the quality of agricultural activities, achieving greater efficiency, a better standard of living for farmers, while maintaining the already recognized quality of Macedonian oriental tobacco on the world market.

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