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OPPORTUNITIES FOR PRODUCING EARLY, HEALTHY TOBACCO SEEDLINGS USING MICROIRRIGATION

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ABSTRACT

For successful tobacco production, the most important prerequisite is to first obtain healthy, high-quality, and timely produced tobacco seedlings. In our country, the traditional method is still used, involving seedling production in cold beds covered with polyethylene fabric in the form of a tunnel. Proper care during seedling cultivation is essential and includes several timely and thoroughly performed agrotechnical practices, among which irrigation is a key factor. With this in mind, our goal was to investigate whether different irrigation methods influence the possibility of obtaining early-produced, healthy tobacco seedlings. For this purpose, three different irrigation methods were tested: variant one - watering with a watering can, variant two - watering with sprinklers and variant three - micro-sprinkler irrigation. Based on the two-year research, the results confirmed that the third variant - micro-sprinkler irrigation - enabled the production of healthy tobacco seedlings 5-10 days earlier compared to the control. Additionally, the number of seedlings suitable for transplanting was higher in this variant, reaching 2122/m², compared to 1862/m² in the control.

Keywords: irrigation, tobacco seedlings, micro-sprinkler irrigation, sprinkler, watering can.

1. Introduction

The Prilep region, renowned for producing the finest aromatic, fine-leaf tobacco of the Prilep type, relies heavily on water for producing healthy, high-quality, and timely-grown tobacco seedlings. This process is complex and requires considerable skill in performing agrotechnical measures and ensuring plant protection.

Research indicates that tobacco seedling production technology in this region has remained conservative, with no significant innovations observed over a long period. According to Mickoski (2004), the water requirements of tobacco vary depending on the type of tobacco and its developmental stage.

Tobacco production technology is carried out in two main phases:

- production of tobacco seedlings
- field production of tobacco

To achieve stable and high-quality production, it is essential that the first phase yields healthy and high-quality seedlings. Among individual producers of fine-leaf aromatic tobacco, traditional methods of seedling production are still the most common. These methods involve watering the seedlings using watering cans with grids, irrigation hoses, or sprinklers connected to a pipe network. All of these watering methods simulate artificial rainfall by dispersing water as fine droplets.

Traditional irrigation methods are considered to have several limitations. Modern agricultural production aims to introduce more efficient techniques that reduce labor, conserve the environment and optimize water use. Contemporary tobacco seedling production focuses on improving water management through the implementation of alternative irrigation methods. Techniques such as micro-sprinkler irrigation are particularly important in seedling production because they contribute to producing healthy, early-grown seedlings, which ultimately ensures stable and high-quality tobacco production.

In addition to other essential agrotechnical practices, proper irrigation of tobacco seedling beds is crucial for achieving high-quality seedlings. Recognizing the critical importance of irrigation methods, a field experiment was conducted in 2022 and 2023 to evaluate whether different irrigation approaches affect the production of early, healthy and transplant-ready tobacco seedlings.

Figure 1. Scientific Tobacco Institute - Prilep

The Scientific Tobacco Institute - Prilep (Figure 1), as the oldest and only authorized scientific institution of its kind in the Balkans, specializes in the production of certified tobacco seeds. Each year, seed plantations are established to meet the needs of tobacco farms, with the majority of the area planted with fine-leaf oriental aromatic tobacco of the Prilep

type. Producing healthy tobacco seedlings, from which robust plants and high-quality seeds can be obtained, is both a significant responsibility and a major challenge.
The Scientific Tobacco Institute - Prilep continually strives to introduce and adopt modern agricultural practices that minimize negative environmental impacts. One key area of improvement is the modernization of irrigation methods, with particular emphasis on watering tobacco seedling beds during seedling production.
During the two-year research, we identified both positive aspects and certain limitations of this irrigation method. For this reason, further research is necessary to overcome the limitations and refine the advantages of this approach. The ultimate goal is for this irrigation method to find practical application among individual tobacco growers in the production of tobacco seedlings.

2. Materials and methods

Field experiments were conducted at the Scientific Tobacco Institute – Prilep on a plot suitable for tobacco seedling production over a two-year period (2022–2023). Seedlings of the Prilep P 66 variety were sown in previously prepared cold beds at a seeding rate of 4.5 g/m².

Three irrigation variants were included, each with four replications: Variant 1 – Traditional method using a watering can (also serving as the control), Variant 2 – Sprinkler irrigation, Variant 3 – Micro-sprinkler irrigation. Each micro-sprinkler had a spray capacity of 60 L/h, providing a 360° circular coverage with a 20% overlap between sprinklers. The micro-sprinklers were mounted on a drip irrigation hose at 80 cm intervals, with five micro-sprinklers per replication. The hose was fixed to metal supports 60 cm above the bed surface, ensuring even water distribution across the entire bed area.

In Variant 1, seedlings were watered using a 12 L plastic watering can with a grid, which also served as the control. Irrigation for all three variants was performed once daily, with the water volume adjusted according to the seedling growth stage and prevailing environmental conditions. All other agrotechnical and protection measures were applied equally across all variants, with the only difference being the irrigation method.
Seedling sampling was carried out using a randomized method, where seedlings from each variant were uprooted and counted to determine the number of plants suitable for transplanting per 1 m². Two samplings were performed for each variant.

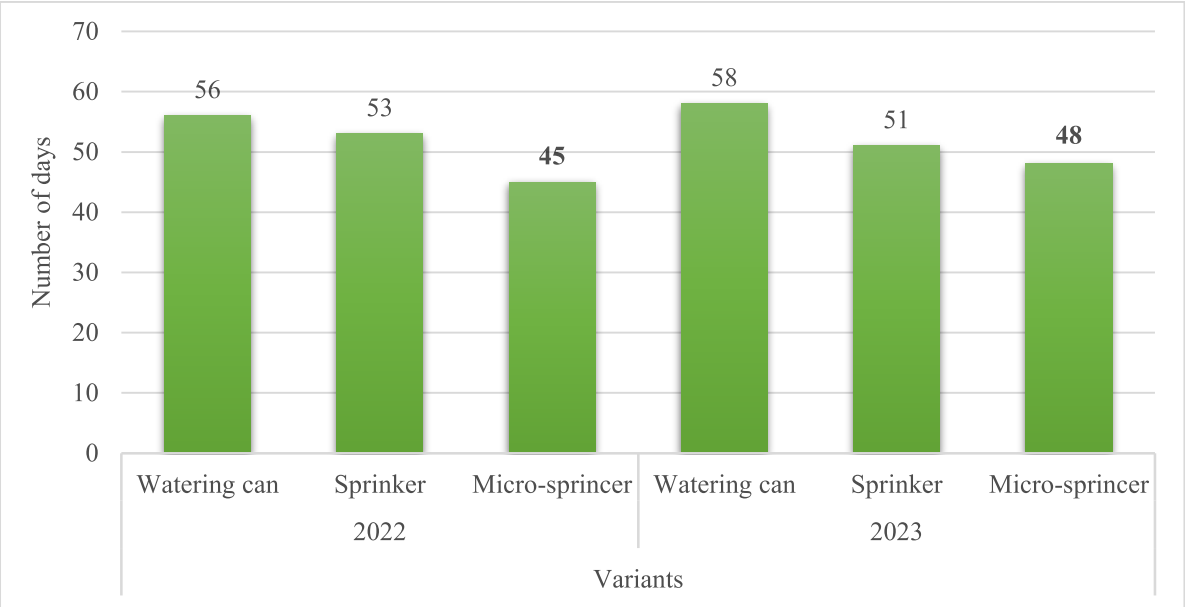
3. Results and discussion

The sowing rate was determined according to the literature. According to Korubin-Aleksoska (2004), the recommended sowing rate is 3-5 g per 10 m² of bed. During the study, observations made throughout the development period of the tobacco seedlings allowed us to conclude that the micro-sprinkler variant (Figure 2) had the shortest period from sowing to first sampling, with 45 days in the first year and 48 days in the second year. In the sprinkler variant (Figure 3), seedlings were ready for the first sampling after 53 days in the first year and 51 days in the second year. For the watering can variant (Figure 4), seedlings required 56 days in the first year and 58 days in the second year to reach the same stage, as illustrated in Graph 1. These results indicate that micro-sprinkler irrigation accelerates early seedling development, allowing for earlier transplanting compared to traditional irrigation methods.

Figure 2. Micro-sprinkler irrigation

Figure 3. Sprinkler irrigation

Figure 4. Watering with a watering can



Graph 1. Duration of the vegetative period of tobacco seedlings (in days)

Based on the data presented in Table 1, the total number of healthy uprooted tobacco plants per 1 m² was highest in the third variant (2986 plants), of which 2121 were suitable for transplanting (Table 2). In the second variant, the number of seedlings suitable for

transplanting was 1966 (Table 2), while in the first variant this number was the lowest, amounting to 1862 plants out of a total of 2660 (Table 1).

Table 1. Total number of uprooted plants per m²

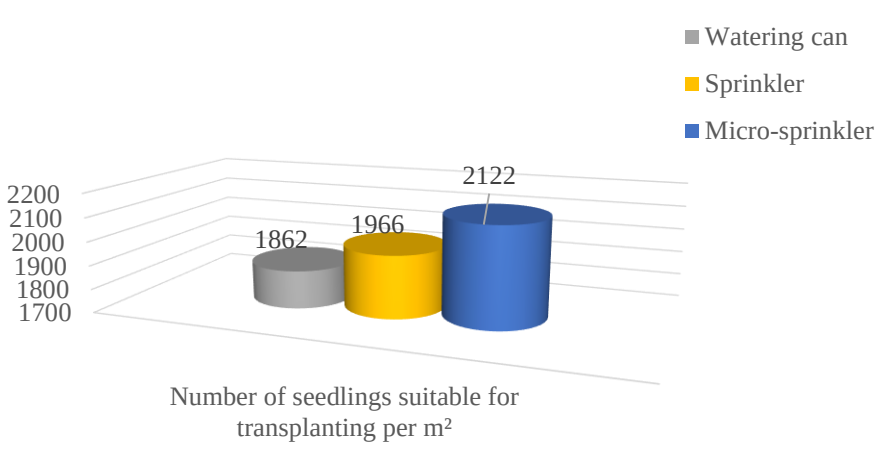
Variant	Total number of uprooted plants per m²			
	2022	**2023**	**%**	**X**
Watering can	2833	2488	100	2660
Sprinkler	2922	2663	105	2792
Micro-sprinkler irrigation	3102	2870	107	2986

Based on the data presented in Table 2, which shows the number of seedlings suitable for transplanting per m² and the total number of days required for them to reach transplanting readiness, it is evident that the seedlings in the third variant reached transplanting maturity the earliest (46 days).

In the remaining variants, the situation differs slightly. The seedlings in the second variant required an additional 6 days to reach transplanting maturity, while the control needed 11 days more compared to the micro-sprinkler variant (Table 2).
These data are also presented in Graph 2.

Table 2. Number of seedlings suitable for transplanting per m² and total number of days to reach transplanting readiness

Variant	2022		2023		X	
	Number of seedlings suitable for transplanting per m²	**Total number of days**	**Number of plants suitable for transplanting per m²**	**Total number of days**	**Number of seedlings suitable for transplanting per m²**	**Total number of days**
Watering can	1981	58	1743	56	**1862**	**57**
Sprinkler	2044	51	1889	53	**1966**	**52**
Micro-sprinkler irrigation	2170	48	2074	45	**2122**	**46**



	Number of seedlings suitable for transplanting per m²
Watering can	1862
Sprinkler	1966
Micro-sprinkler	2122

Graph 2. Number of seedlings suitable for transplanting per m²

Based on the data obtained during the two-year study, we can conclude that micro-sprinkler irrigation, as an alternative method for watering tobacco seedlings, has the potential for practical application among individual tobacco growers. This method fully met our expectations in terms of reducing the time required to produce healthy seedlings suitable for machine transplanting. Pelivanoska et al. (2006) noted that all agrotechnical measures applied during seedling production aim to produce early, environmentally healthy and high-quality tobacco seedlings. Numerous studies worldwide have defined the characteristics of high-quality seedlings. According to Mickovski (2004), seedlings ready for transplanting should be healthy, well-developed, uniform, light green in color, 12–15 cm in height, with 5–6 well-formed leaves. Chukaliev et al. (2003) reported that the efficiency of irrigation using artificial rainfall is approximately 75%, whereas micro-irrigation can achieve efficiencies of up to 90%.

According to Bazukov (2002), the quality and quantity of the tobacco harvest depend directly on the quality of the seedlings.

4. Conclusions

Based on the two-year study on the possibilities of producing healthy, early-grown tobacco seedlings, the following conclusions can be drawn:

- Micro-sprinkler irrigation has practical potential for tobacco growers, as it allows the production of seedlings that fully meet the requirements for machine transplanting. Additionally, the vegetative period is 5–10 days shorter compared to the other two irrigation variants.
- Labor requirements for monitoring the micro-irrigation system are minimal, with only one person needed, unlike the other irrigation methods.
- A drawback observed during the study is the higher initial installation cost, which may impose a financial burden on tobacco growers.
- Another limitation is the dripping from the micro-sprinklers in the beds after the system is disconnected from the water supply.

- To address these limitations and further refine the method, additional research is needed. Expanding this method could enhance its application not only in tobacco seedling production but also in the cultivation of other agricultural crops.

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