Study on cultivation of environmentally friendly seed potatoes based on electrical technology

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Abstract. This article highlights the results of scientific research conducted by scientists from the Institute of Energy Problems of the Academy of Sciences of the Republic of Uzbekistan and the Tashkent Institute of Irrigation and Agricultural Mechanization Engineers of the National Research University in 2022 on the basis of justification and step-by-step electrical effects on the cultivation of environmentally friendly fast potatoes, including environmentally friendly agricultural.

1. Introduction

There has been a shortage of potatoes in Uzbekistan in recent years. But in the conditions of our republic there are enough opportunities to fully provide the population with local products. In 2022, the sown area allocated for potatoes was increased to 86 thousand hectares, which can give the republic an additional 850 thousand.

Department for the development of horticulture, viticulture, horticulture and potato growing (according to the information) The Ministry of Agriculture reported that the period of partial potato shortage in Uzbekistan fell mainly in January-May of this year. To compensate for this, potatoes were purchased from neighboring countries with our Republic (Russia, Kazakhstan). According to the medical standards of our republic, the annual demand of the population for potatoes, based on the consumption level of 52.6 kg, is a total of 1.9 million tons, while according to the WHO standard, the annual consumption of 96.7 kg is 3.4 million tons, respectively.

In 2021, the gross potato harvest in the republic amounted to 3.3 million tons, of which 650 thousand tons were stored as seeds for next year's harvest. And in 2022, a total of 3.3 million tons of potatoes were grown in our republic [1]. Currently, 131 types of potatoes recommended for planting in Uzbekistan are included in the State Register of Agricultural Crops [2]. At the same time, 19 varieties were created by local research institutes. Most of the species belong to Dutch-bred potatoes. The most famous are "Arizona", "Arnova", "Arinda", "Zafira", "Condor", "Constance", "Marfona", "Marquis", "Picasso", "Rodeo", "Roco", "Romano", "Sinora", "Evolution", which planted in vast areas across the country.

The high electrostatic fields, particularly the pulse shaped ones, might damage the biological systems, either directly or indirectly, through numerous processes [3]. When electric charges and dipoles are subject to complicated limit conditions, the field causes them to travel in both directions. Modifications can also be made to protein molecule form and structure, molecular binding forces, and chemical reaction rates. By changing cellular metabolism through interaction with hydraulic, chemical (Ca2+, ROS), and hormone signals (ABA and JA) in plants, electrical stimulation is an effective and environmentally benign technology that controls plant growth and development [4, 5]. Electrical stimulation has been found to have both beneficial and detrimental impacts on fruit quality, crop output, and seed germination in numerous plant species [6, 7]. More intriguingly, electrical stimulation can also increase a plant's resiliency to salt and cold stress [8]. It is unclear, however, whether electrical stimulation can promote potato seed germination, seedling growth, and the development of thermotolerance. As a result, this study looked at how electrical stimulation affected potato seed germination, seedling growth, and the development of thermotolerance.

2. Methods

According to the results obtained in the second half of the year in this direction, electrotechnological impact support, environmentally friendly, disease-resistant and pest-resistant electrical equipment for potato cultivation was developed.

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According to this technology, potatoes dug up in autumn and divided into seeds are infused until spring, emitting ultraviolet light (λ = 254 nm). In the spring season, potatoes are treated with ultraviolet (UV) light with a wavelength of 254÷300 nm

The plot of land on which potatoes are planted is leveled with a seed drill before planting seed potatoes. This agricultural operation is carried out together with the irradiation of the soil with ultraviolet radiation with a wavelength of 254÷300 nm. Seed potatoes irradiated with UV are planted in soil treated with UV. The planted seed potato plant is gradually treated with UBL during the growing season. This event is carried out during the processing of row spacing before watering.

In summer, the excavated potatoes are sorted out, from which small sprouts are separated into seeds. For consumption, large and medium-sized begonias are isolated. Feathers separated from seeds are treated with UV at a wavelength of 254 ÷300 nm and preserved for a month. In the summer season, the area of land for planting potatoes is leveled for planting potatoes. Simultaneously with this event, the soil is treated with UV with a wavelength of 254÷300 nm.

Potato feathers obtained in this experiment are irradiated according to the variants and preserved until spring. Control feathers are also preserved without irradiation. In the spring of 2023, these tubers are processed by UV light according to the options according to the technology and planted as seeds as shown in Figure 1.

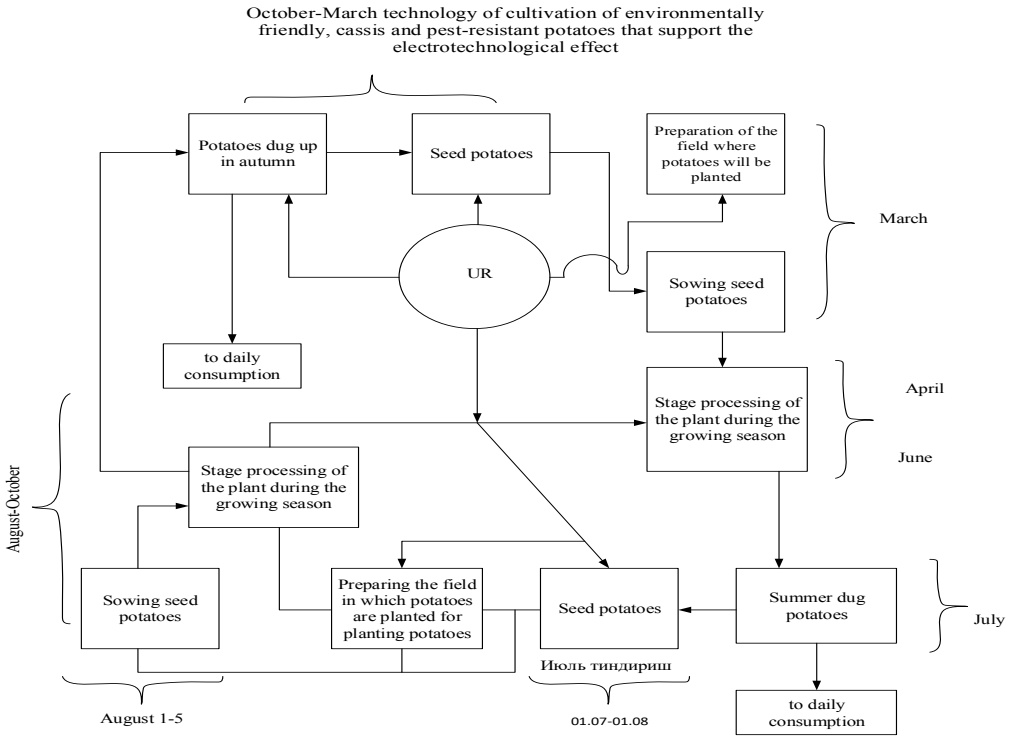

Fig. 1. Technology of growing environmentally friendly, disease-resistant and pest-resistant potatoes, supporting the electrotechnological effect

This agroelectrotechnological method has been tested agrotechnically in production conditions when growing potatoes. Potatoes in the spring with a length of 55 meters in 3rows and 5 rows of 61 meters of experimental variants were planted on another 1 row of 6 meters of control. 220 pieces of potato seeds were planted at the experimental site, which were obtained last autumn. Seeds were irradiated with a power of P = 60 W with a wavelength of λ = 254 nm UV before sowing t = 10 minutes (March 15). The planted rows were irradiated at a rate of τ = 0.5 m/s UBL with a wavelength of P = 30 W λ=254. When the plant sprouts and becomes 10-15 cm.

3. Results

At a wavelength of P = 30 W, UV with λ = 254 nm was irradiated. During the period when the station entered the swamp, electricity was processed again according to these parameters. The last 3 treatments were performed in the

same mode during the transmission period. The number of flowers formed on one stem reached 12-20, which was 2-2.5 times more than in the control.
The rows in which the experiment was conducted had a length of 56 meters, and the yield from 1 meter was: 194.7 /56 = 3.47 kg. If 6 meters of land were sown in the control, the yield per meter was: 7.96/6 =1.33 kg. The distance between rows is 70 cm: if the length of rows on 1 hectare is 142857 meters, and the yield per hectare is: 142857 × 3.47 = 495000 kg or 495 tons. The value of the crop obtained from a potato bush under irradiation with a wavelength of R = 30 W, a wavelength of λ = 254 nm UV is shown in Figure 2 (the average value for five lines).

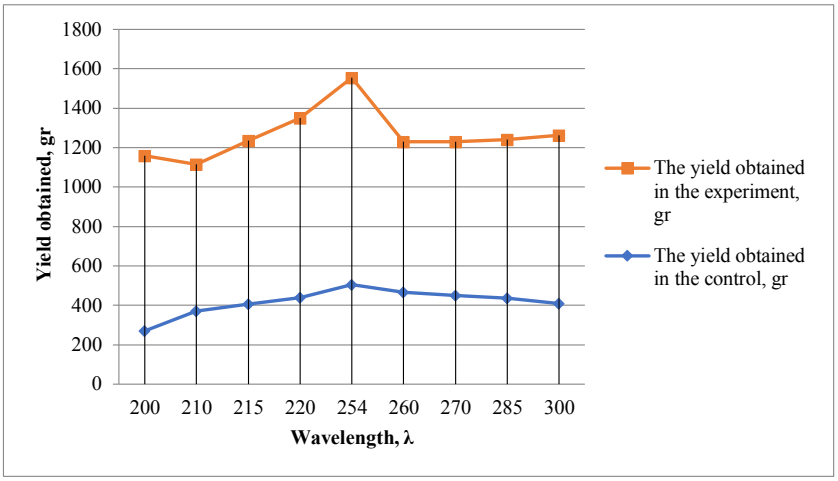

Fig. 2. The value of the crop obtained from a potato

In the experiment, the amount of harvest from one bush relative was 885: 398 = 2.22 times more compared to the control. The total weight of the irradiated potato was 49 g while in the control the total weight of the potato was 39g (Table 1).

Table 1. Irradiated with ultraviolet radiation (experimental) and non-irradiated (controlled) potato harvest

Irrdiated		*Control*	
Large grains, g	22	Large grains	6
Medium grains, g	15	Medium grains	22
Small grains, g	12	Small grains	11
Total, g	49	Total:	39

The appearance of endogenous electric currents entering the growing and exiting parts of the cell that have completed growth is one of the earliest reactions in the process of differentiation of plant cells characterized by a polar type of growth. These electrical currents usually precede morphological changes [9]. Polarization and, first of all, the occurrence of electric currents is of great importance in the growth and development of the embryo. Treatment with a weak electric field increases the mass gain of callus, significantly increases the frequency of formation of roots, buds, and shoots [8], and stimulates somatic embryogenesis in the culture of mesophilic protoplasts [10].

4. Conclusions

Scientific research work in this direction will continue in 2023. The potato feathers obtained in this experiment were irradiated according to the options and tinned until spring. The tugas in control were also tinned without being irradiated. In the spring of 2023, these tubers are treated with UV according to the options according to the above technology and planted as seeds. This agroelectrotechnology is tested agrotechnically in production conditions when growing potatoes.

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