

## DETERMINATION OF THE AGROTECHNICAL EFFICIENCY OF ELECTROTECHNOLOGY ENABLING SEQUENTIAL CULTIVATION OF WHEAT AND COTTON IN A SINGLE SEASON (WHEAT PHASE)

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**Mukhammadiev Ashiraf., Ziyadullayev Zoxidjon Fayzullayevich.,  
Nazirov Sardor Jamoliddin o'g'li**

### **Abstract**

The article presents the results of scientific research conducted in 2024-2025 under production conditions at the "J. Nazirov" farm in the Yukori Chirchik district of the Tashkent region. The study aims to determine the agrotechnical efficiency of electrotechnology enabling sequential wheat and cotton cultivation in a single season (specifically the wheat phase). Comparative determinations were made regarding the root and stem length and weight, number of plants, number of grain spikes per plant, grain weight per spike, and the weight of one and one thousand grains of wheat planted in the field with and without the application of electrotechnology.

### **Keywords**

Electrotechnology, wheat, cotton, stem, spike, grain, ultraviolet radiation, grain weight, seed, soil, plant.

### **Introduction**

In regions where arable land and irrigation water are limited, increasing cropping intensity through sequential (double) cropping is a practical way to raise overall agricultural output without expanding cultivated areas. In Uzbekistan, wheat-cotton systems are among the most important production chains, and improving the biological potential of wheat during the first (wheat) phase can directly influence the feasibility and productivity of the subsequent cotton crop within the same season.

Alongside conventional agronomic measures (optimal sowing time, seeding rates, fertilization, and crop protection), interest has been growing in environmentally friendly physical methods that can stimulate seed and plant development without increasing chemical load. Electrotechnological approaches – particularly the controlled use of ultraviolet radiation (UVR) as a treatment of seeds, soil, and plants – are considered promising because they can activate physiological and biochemical processes linked to germination, early vigor, and stress tolerance. In theory, such stimulation may improve key yield-forming traits

(plant density, tillering, spike parameters, and grain weight) that ultimately determine field performance [1, p. 3-5].

However, the practical value of these approaches must be demonstrated under real production conditions and quantified using measurable agrotechnical indicators. In addition, for sequential wheat-cotton cultivation, it is important to understand how stepwise exposure of the “seed-soil-plant” system influences wheat growth and yield components during the wheat phase, which serves as the foundation for the whole single-season sequence.

Therefore, this study was designed to determine the agrotechnical efficiency of UVR-based electrotechnology for wheat grown under production conditions in 2024–2025 at the “J. Nazirov” farm (Yukori Chirchik district, Tashkent region) [2, p. 1-7].

The research compares biometric and yield-structure parameters – such as root and stem length and weight, number of plants, number of spikes per plant, grain weight per spike, and the mass of one grain and 1,000 grains – between plots managed with and without electrotechnological treatment, including different UVR exposure variants.

## **MATERIALS AND METHODS**

Field activities under production conditions to determine the agrotechnical efficiency of electrotechnology enabling sequential wheat and cotton cultivation in a single season were carried out regarding wheat from October 2024 to June 2025 at the "J. Nazirov" farm in the Yukori Chirchik district of the Tashkent region.

Experiments regarding the agrotechnical efficiency of cotton planted after wheat were conducted in 2025 at the experimental field of the Scientific Research Institute of Cotton Breeding, Seed Production, and Cultivation Agrotechnologies in the Kibray district of Tashkent region. This article presents the results obtained regarding wheat in the conducted field experiments.

A one-hectare area where corn was cultivated in 2024 was selected for the experiment at the farm. Before planting wheat seeds, the field area was cleared of residues from the predecessor crop (corn) and leveled using a harrow (leveler). The allocated land area was divided into two equal parts: one part was designated as experimental, and the other as control (without electrical treatment). The experimental part of the land was divided into three equal sections, and the soil in all sections was irradiated using UV radiation (UVR) with wavelengths of P253.7+P300 and a power of 90+90W. The distance from the soil surface to the light source was 20 cm, and the soil irradiation speed was 0.5 m/s [3, p. 4-8].

## **Results and discussion**

The first section of the experimental field was designated as the first variant, the second section as the second variant, and the third section as the third variant.

First Variant: The wheat seeds planted were irradiated with UVR (P253.7+P300, W=30+30, H=20 cm, t=22 sec).

Second Variant: The seeds planted were irradiated with UVR (P253.7+P300, W=60+60, H=20 cm, t=22 sec).

Third Variant: The wheat seeds planted were irradiated with UVR (P253.7+P300, W=90+90, H=20 cm, t=22 sec).

The seeds planted in the field were irradiated on October 17th by placing 2.5 kg of seeds in 60x30x20 cm plastic cassettes at a thickness of 1.0 cm. Wheat seeds were planted on October 20th at a rate of 100 kg on the 0.5 ha experimental area and 100 kg on the 0.5 ha control area. Seeds were planted simultaneously in the experimental and control plots using a seeder aggregated with tractors.

**Table 1**

|                       |                       |                       |
|-----------------------|-----------------------|-----------------------|
| Control area 0.5 ha   |                       |                       |
| Variant 1<br>0.166 ha | Variant 2<br>0.166 ha | Variant 3<br>0.166 ha |

Table 1 presents the layout of the control and experimental plots.

The plant growth cycle is typically divided into two phases: germination-to-heading and heading-to-ripening. The duration of the germination-to-heading phase depends primarily on the biological characteristics of the variety, while external climatic conditions are of secondary or minor importance [2].

The duration of the heading-to-ripening phase is mainly dependent on air temperature and humidity conditions. The germination-to-heading phase is crucial in determining early maturity. The treatment of wheat plants with UVR (Ultraviolet Radiation) during the vegetation period was implemented taking into account the occurrence of energy deficiency at the cellular level when the plant enters the aforementioned physiological processes [3].

During the germination-to-heading phase, the plants were treated twice with UVR. Consequently, stimulation of plant growth was achieved under the influence of UVR. This can be observed in the examples of wheat plants excavated from the experimental and control plots, as shown in Figure 1. A third irradiation treatment is conducted just prior to the plant entering the heading stage.

As noted above, on January 16, 2025, the shoot and root sections of wheat plants germinated in the experimental and control variants were excavated. Their length and weight were analyzed across the experimental variants and control plots in 10 replications[4, p. 3-5].

Table 2 presents the average indicators of the experimental and control results based on 10 replications. It details the biometric indicators (as of January 16, 2025) of plants grown from wheat seeds planted on October 20, 2024, across the different variants and the control group.

**Table 2**  
**The effect of UV irradiation on winter wheat**

| No | Number of seeds per plant germinated from a single seed, pcs | Stem height, cm | Root height, cm | Wet            |                |                 | Dry             |
|----|--|-----------------|-----------------|----------------|----------------|-----------------|-----------------|
|    |  |                 |                 | Stem height, g | Root height, g | Total height, g | Total height, g |
| 1  | First variant  |                 |                 |                |                |                 |                 |
| 2  | 13,0   | 28,9            | 9,3             | 9,0            | 1,7            | 10,7            | 2,7             |
| 3  | Second variant   |                 |                 |                |                |                 |                 |
| 4  | 11,8   | 29,7            | 10,8            | 8,4            | 1,8            | 10,2            | 1,7             |
| 5  | Third variant  |                 |                 |                |                |                 |                 |
| 6  | 11,1   | 28,1            | 11,3            | 7,8            | 2,4            | 10,2            | 2,6             |
| 7  | Average indicator across variants                            |                 |                 |                |                |                 |                 |
| 8  | 11,96  | 28,9            | 10,46           | 8,4            | 1,63           | 10,36           | 2,33            |
| 9  | Control  |                 |                 |                |                |                 |                 |
| 10 | 9,2  | 23,3            | 9,6             | 6,0            | 1,6            | 8,1             | 2,0             |
| 11 | Difference of average variant indicator relative to control  |                 |                 |                |                |                 |                 |
| 12 | +1,08  | +5,60           | +0,86           | +2,4           | +0,03          | +2,26           | +0,33           |

Based on the experimental results presented in the table, the average indicators for the variants were higher across all parameters compared to the control group [5, p. 3-7].

This indicates that the UVR (Ultraviolet Radiation) treatment stimulated the development of the seeds, as well as the stem and root sections of the plants that germinated from them.



**Figure 1.** The process of determining the biometric characteristics of wheat grown with UVR treatment under production conditions.



**Figure 2.** The process of treating wheat plants and soil with UVR during the vegetation period.



**Figure 3.** Comparative condition of wheat plants cultivated with UVR treatment versus control wheat samples (March 19, 2025).



**Figure 4.** Condition of UVR-treated wheat as of May 5, 2025.



**Figure 5.** Condition of UVR-treated wheat as of June 11, 2025.

During the vegetation period, the wheat plants and the soil were treated with UVR three times in the manner illustrated in Figure 2.

The first UVR treatment was carried out on March 19, 2025; the control wheat plants were not irradiated[6, p. 3-4].

**Table 3. Biometric indicators of the crop cultivated under production conditions with UV treatment of wheat seeds, plants, and soil during the vegetation period, across variants and control.**

| No.   | Number of plants, pcs | Number of stems in plants, pcs | Stem length, cm | Number of spikes per plant, pcs | Spike length, cm | Number of grains per spike, pcs | Number of grains per plant, pcs | Grain weight per plant, g | Grain weight of all plants, g | Weight of 1000 grains, g | Weight of a single grain, g |
|---|-----------------------|--------------------------------|-----------------|---------------------------------|------------------|---------------------------------|---------------------------------|---------------------------|-------------------------------|--------------------------|-----------------------------|
| First variant UV exposure parameters: P=253.7+P300=30+30W; H=20cm; T=22sek  |                       |                                |                 |                                 |                  |                                 |                                 |                           |                               |                          |                             |
| Average   | 20                    | 8                              | 86.6            | 8                               | 9.6              | 40.1                            | 321.3                           | 13.6                      | 268.6                         | 46.0                     | 0.046                       |
| Second variant UV exposure parameters: P=253.7+P300=60+60W; H=20cm; T=22sek |                       |                                |                 |                                 |                  |                                 |                                 |                           |                               |                          |                             |
| Average   | 21                    | 11                             | 105             | 11                              | 9.7              | 28.9                            | 318                             | 22.6                      | 476.3                         | 51.8                     | 0.050                       |
| Third variant UV exposure parameters: P=253.7+P300=90+90W; H=20cm; T=22sek  |                       |                                |                 |                                 |                  |                                 |                                 |                           |                               |                          |                             |
| Average   | 52                    | 6                              | 100             | 6                               | 7.6              | 33.7                            | 202.6                           | 8.6                       | 450.6                         | 48.4                     | 0.048                       |
| Average indicator across variants   |                       |                                |                 |                                 |                  |                                 |                                 |                           |                               |                          |                             |
| Average   | 31                    | 8.3                            | 97.2            | 8.3                             | 8.9              | 34.2                            | 209.2                           | 14.9                      | 398.3                         | 48.7                     | 0.048                       |
| Control   |                       |                                |                 |                                 |                  |                                 |                                 |                           |                               |                          |                             |
| Average   | 17                    | 6                              | 72              | 6                               | 7.2              | 33.2                            | 188.3                           | 6.6                       | 113.2                         | 28.7                     | 0.028                       |
| Difference of average variant indicator relative to control                 |                       |                                |                 |                                 |                  |                                 |                                 |                           |                               |                          |                             |
| Average   | +14                   | +2.3                           | +25.2           | +2.3                            | +11.7            | +1.0                            | +20.9                           | +8.3                      | +285.1                        | +20                      | +0.020                      |

To determine the biometric indicators of the wheat in the experimental and control plots prior to harvest, a 0.5 x 0.5-meter frame was constructed. Wheat plants within this frame in both the experimental variants and the control group were excavated along with their roots. The following average indicators were determined for the wheat plant samples excavated from within the frame:

- Stem length, cm;
- Number of plants within the frame;

- Number of stems and spikes per plant;
- Length of the spike on each stem;
- Grain weight per spike, g;
- Weight of 1,000 grains, g;
- Weight of a single grain, g.

All the aforementioned biometric indicators were determined in 3 replications. The average values for the plants across the variants and the control group were calculated and are presented in Table 2.

According to the results of the field experiments, the weight of 1,000 grains constituted 51.8 grams when wheat seeds were treated with a power of  $P253.7+P300=60+60W$ , at a distance of  $h=10$  cm, for a duration of 22 seconds. This is 23.1 grams higher than the weight of 1,000 grains in the control group, which was 28.7 grams.

The weight of a single wheat grain was 0.050 g, which is 0.022 g higher than the control weight of 0.028 g. Evaluating this differently, it indicates that the yield obtained using electrotechnology is 1.78 times greater than the control yield.

It was observed that the weight of 1,000 grains of wheat grown using electrotechnology in the first and second experimental variants was also 1.58 and 1.65 times higher than the control, respectively [7, p. 3-5].

### **Conclusion**

In the cultivation of high-yield and high-quality cereal crops, including wheat, the use of non-traditional methods alongside standard planting norms, timing, and other agrotechnical measures – specifically the stepwise influence on the complex biological system consisting of "seed, soil, and plant" – increases the resistance of the wheat seeds planted in these areas to external environmental influences. Specifically:

- It accelerates metabolism in the seed and activates processes occurring within the seed;
- It increases the enzymatic activity, moisture absorption, and osmotic pressure of the cell.

Physiological growth and development in the above-ground and root parts of the plants intensify by 25-30%. Consequently, the productivity of the photosynthesis process increases by 40-45%, and the number of functional genes in the cell nucleus increases. All of this enhances the plant's resistance to radiation (during the germination process), diseases and pests (by 2-3 times), water scarcity (by 25-30%), and other extreme phenomena.

The stepwise irradiation of the complex biological object consisting of seed, soil, and plant with UVR practically confirmed the possibility of solving the energy

problem occurring in physiological processes at the cellular level of the seed and plant using an environmentally pure method. It also demonstrated, using wheat as an example, the potential to unlock physiological capabilities that do not emerge when standard agrotechnical measures are applied.

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