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METHODS AND RESULTS FOR DETERMINING THE PARAMETERS AND OPERATING MODES OF IRRADIATING WATERMELON SEEDS WITH ULTRAVIOLET RAYS

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Abstract: This research paper presents an experimental study on the pre-sowing treatment of watermelon seeds ("Dilnoz" variety) using ultraviolet (UV) radiation to enhance germination rates. The experiments were conducted using a custom laboratory setup with bactericidal lamps emitting at wavelengths of 253.7 nm and 300 nm, with a total power of 150 W. The study systematically varied key parameters, including the height from the irradiator to the seeds (3, 6, 9, 12 cm), exposure time (1, 3, 5, 7 minutes), and the combination ratio of the two UV wavelengths. The results demonstrated that the specific combination of two 253.7 nm lamps and three 300 nm lamps, with an irradiation distance of 9 cm and an exposure time of 5 minutes, yielded the optimal germination rate of 98.3%. This was significantly higher than the control sample (74.1%) and all other tested parameter combinations. The study concludes that this optimized UV treatment regimen is a highly effective and rational method for stimulating watermelon seed germination, offering a promising technique for agricultural enhancement.

Keywords: ultraviolet radiation, watermelon seeds, germination capacity, irradiation parameters, wavelength, bactericidal lamp, laboratory setup, optimization, seed treatment, agriculture, growth stimulation, experimental research.

Introduction. It is well known that ultraviolet radiation is a part of the natural solar spectrum. Due to its diverse effects, it has long attracted the attention of doctors, biologists, and scientists from other fields[1–2].

In Uzbekistan, increasing crop yields is one of the key factors in enhancing agricultural production. At present, in addition to improving traditional agrotechnical measures, it is necessary to make rational use of new resources to boost crop productivity. Among such methods are the application of ultraviolet (UV) radiation to plants and the use of growth stimulants, which allow regulation of physiological processes occurring within plants[3-5].

For many agricultural crops, the technological process includes pre-sowing treatment of seeds with low-frequency electromagnetic waves (LFEMW) and ultraviolet radiation (UVR), seed moistening (when necessary), and exposure of plants to UV radiation during the growing season — specifically at the stages of 2–3 true leaves, budding, and full flowering. The electrification of plants is carried out either independently or in combination with necessary agrotechnical operations (such as cultivation, etc.)[6-12].

At Kokand State University, operational modes of electrotechnologies for seed disinfection and stimulation using ultraviolet radiation (UVR) have been developed.

Methodology. First, the germination rate of "Dilnoz" variety watermelon seeds in the control variant was tested under laboratory conditions in four replications. The germination rate of the watermelon seeds under laboratory conditions in the control variant was 74.1%. The germination of the watermelon seeds was determined visually and by calculation. Seedlings began to emerge within the first two days. After six days, the germination process stabilized, and on the ninth day, the test was stopped and all viable seeds were recorded.

The seeds were placed on moist filter paper and put into laboratory glass containers. They were kept in a dark place at a temperature of 22–25°C. Experiments to determine the germination and energy of the seeds were carried out under laboratory conditions according to GOST 12039-82.

For each variant, 30 watermelon seeds were selected. The selected seeds were irradiated using a controlled stand (Figure 1).

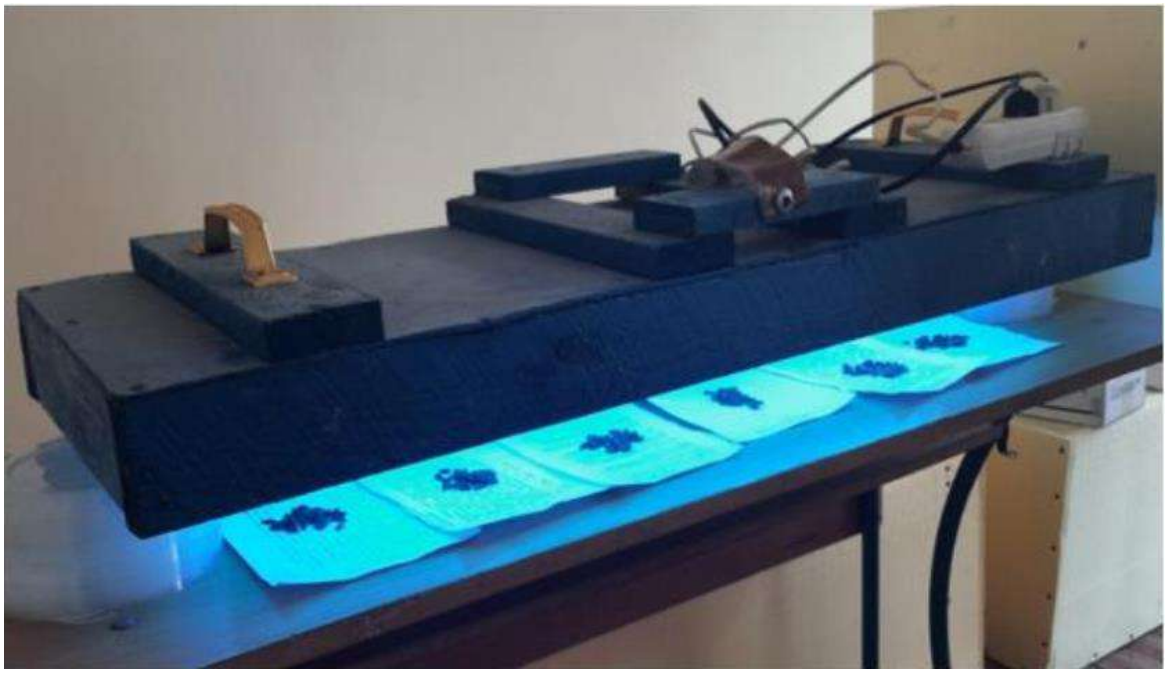

Figure 1. Laboratory stand for ultraviolet irradiation of watermelon seeds

Experimental studies on the irradiation of watermelon seeds were conducted in four replications using a laboratory prototype of the developed irradiation device.

Results. The results are presented in the 6 tables below. According to Table 4, when watermelon seeds were irradiated in UV using 2 lamps with ultraviolet light wavelengths of 253.7 nm and 3 lamps with 300 nm at the same time, the distance from the irradiator to the seeds was 9 cm, the irradiation time of the seeds was 5 minutes, and the germination rate was 98.3% in bactericidal lamps with a power of 150 W, and the best germination was observed when compared with other UV parameters and modes.

The following tables present the germination results of watermelon seeds exposed to ultraviolet radiation (UVR) with wavelengths ranging from 253.7 nm to 300 nm.

1-table

Wave length λ=253,7 nm; 5 lamps used total power P=150 w

Nuv, cm	Nuv, cm	Nuv, cm
3	1	71.6 in
	3	74,1
	5	81.7
	7	75,8
6	1	74,1
	3	77.5
	5	84,1
	7	82.5
9	1	70,8
	3	79,2
	5	84,1
	7	69,2
12	1	67,5
	3	71,7
	5	80,8
	7	65,8

2-table

Wavelength λ = 253.7 nm (4 lamps) and λ = 300 nm (1 lamp); total power P = 150 W

Nuv, cm	Nuv, cm	Nuv, cm
3	1	74,9
	3	78,3
	5	81,6
	7	72,5
6	1	81.6
	3	92,5
	5	87,5
	7	77,4
9	1	70,8
	3	79,9
	5	88,3
	7	78,3
12	1	77,5
	3	84,1
	5	87,4
	7	68,3

3-table

Wavelength λ = 253.7 nm (3 lamps) and λ = 300 nm (2 lamps); total power P = 150 W

Nuv, cm	Nuv, cm	Nuv, cm
3	1	84,1
	3	84,5
	5	87,4
	7	78,3
6	1	75,7
	3	85,8
	5	91,2
	7	74,1
9	1	72.5
	3	85,7
	5	94,9
	7	80.8
12	1	74,2
	3	78,2
	5	84.2
	7	74,9

4-table

Wavelength λ = 253.7 nm (2 lamps) and λ = 300 nm (3 lamps); total power P = 150 W

Nuv, cm	Nuv, cm	Nuv, cm
3	1	78,3
	3	80.8
	5	90.8
	7	77,5
6	1	75,8
	3	87,5
	5	94,1
	7	84.2
9	1	82,4
	3	95,7
	5	98,3
	7	92,4
12	1	77,4
	3	87,5
	5	94,1
	7	84,1

5-table

Wavelength λ = 253.7 nm (1 lamp) and λ = 300 nm (4 lamps); total power P = 150 W

Nuv, cm	Nuv, cm	Nuv, cm
3	1	74,9
	3	81,6
	5	84,9

6-table

Wavelength λ = 300 nm; 5 lamps used; total power P = 150 W

Nuv, cm	Nuv, cm	Nuv, cm
3	1	81,6
	3	84,1
	5	90.8

6	7	74,1	6	7	85,8
	1	78,3		1	85,8
	3	82,4		3	89,1
	5	91.6		5	95,8
	7	76,7		7	82,5
9	1	71.5	9	1	84,1
	3	82,5		3	85,8
	5	90.8		5	92,4
	7	84.2		7	79,2
12	1	71,4	12	1	77,5
	3	74,9		3	83,2
	5	85.7		5	91.6
	7	84,9		7	79,1

Here: P, W – lamp power; N_{uv}, cm – UV irradiation height; t_{uv}, min – UV exposure time; λ = 254 nm, λ = 300 nm – wavelength range of germination, %

Discussion. The experiment was conducted using bactericidal lamps with a total power of 150 W at wavelengths of 253.7 nm and 300 nm, at heights of 3, 6, 9, and 12 cm, and exposure durations of 1, 3, 5, and 7 minutes. Based on the results of the laboratory experiments, it was found that when using two lamps with a wavelength of 253.7 nm and three lamps with a wavelength of 300 nm, with a distance from the irradiator to the seeds of 9 cm, an irradiation time of 5 minutes, and a total power of 150 W, the germination rate reached 100% (Table 4). Compared to other UV radiation parameters and modes, this setup produced the best seedling emergence.

Figure 1. The best average results were obtained when using lamps with wavelengths of 253.7 nm and 300 nm simultaneously. In these studies, aimed at determining the optimal parameters and modes of ultraviolet irradiation for watermelon seeds, the highest germination rate reached 98.3%, once again confirming the rationality of the selected irradiation parameters and methods.

Conclusion

1. As shown in Figure 1, when two lamps with a wavelength of λ = 253.7 nm and three lamps with a wavelength of λ = 300 nm were used simultaneously with a total power of P = 150 W, and the distance from the irradiator to the seeds was 9 cm with an irradiation time of 5 minutes, the watermelon seeds demonstrated the highest germination energy. This once again confirms the rationality of the selected irradiation parameters and methods.

2. In optimizing the irradiation duration regimes and lamp power for seed treatment, it is recommended to use bactericidal lamps with a total power of 150 W, wavelengths of 253.7 nm and 300 nm, a distance of 9 cm from the irradiator to the seeds, and an irradiation time of 5 minutes as the optimal parameters.

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