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# RESULTS OF DEVELOPING A DEVICE FOR IRRADIATING WATERMELON SEEDS WITH ULTRAVIOLET LIGHT

***Usmonov Inomjon Isroilovich,*** *PhD, Associate Professor,*
*Head of the Department of Electrical Technologies,*
***Abdullajonov Sirojiddin Sadirdin o‘g‘li,*** *doctoral student,*
***Abdusattorov Axadjon Ortiqali o‘g‘li****, independent researcher,*
*E-mail: abdullajonovsirojiddin699@gmail.com,*
*Kokand State University*

***Abstract.*** *Improving the laboratory and field germination of seeds sown for melon crops, particularly watermelon, and disinfecting them against various diseases, is of considerable practical importance in agriculture for increasing yield. In this connection, developing a special device that irradiates watermelon seeds with ultraviolet (UV) light and improving the efficiency of its use is a pressing issue. The aim of the study is to conduct experimental research on a laboratory model of a device for irradiating watermelon seeds with ultraviolet light and to determine the most rational irradiation regimes. The experiments were carried out on the laboratory model of the ultraviolet irradiation device with four replications, using bactericidal lamps with a wavelength of 253.7 nm (P = 60 W) and 300 nm (P = 90 W), for a total power of P = 150 W. Different regimes were compared with respect to the distance between the seeds and the irradiator and the treatment time. A two-stage conveyor system turned the seeds over during their movement, ensuring uniform, high-quality irradiation of both sides. The proposed ultraviolet device makes it possible to effectively disinfect watermelon seeds before sowing and to stimulate their growth.*

***Annotatsiya.*** *Poliz ekinlari, xususan, tarvuz urug‘larining laboratoriya hamda dala unuvchanligini oshirish va ularni turli kasalliklarga qarshi zararsizlantirish (dezinfeksiya qilish) qishloq xo‘jaligida hosildorlikni ko‘tarish uchun muhim amaliy ahamiyatga ega. Shu munosabat bilan, tarvuz urug‘larini ultrabinafsha (UB) nurlar bilan nurlantiruvchi maxsus qurilmani ishlab chiqish va undan foydalanish samaradorligini oshirish dolzarb vazifa hisoblanadi. Tadqiqotning maqsadi – tarvuz urug‘larini ultrabinafsha nurlar bilan nurlantirish qurilmasining laboratoriya modelida eksperimental tadqiqotlar o‘tkazish hamda eng maqbul nurlantirish rejimlarini aniqlashdan iborat. Tajribalar ultrabinafsha nurlantirish qurilmasining laboratoriya modelida to‘rt takroriylikda, to‘lqin uzunligi 253,7 nm ($P = 60$ Vt) va 300 nm ($P = 90$ Vt) bo‘lgan, umumiy quvvati $P = 150$ Vt ga teng bakteritsid lampalar yordamida o‘tkazildi. Turli rejimlar urug‘lar va nurlatgich orasidagi masofa hamda ishlov berish vaqti bo‘yicha o‘zaro taqqoslandi. Ikki bosqichli konveyer tizimi urug‘larni harakat davomida ag‘darib, ularning har ikki tomoni bir tekis va sifatli nurlanishini ta’minladi. Taklif etilayotgan ultrabinafsha qurilma ekishdan oldin tarvuz urug‘larini samarali zararsizlantirish va ularning o‘sishini rag‘batlantirish imkonini beradi.*

***Аннотация.*** *Повышение лабораторной и полевой всхожести семян бахчевых культур, в частности арбуза, а также их обеззараживание от различных заболеваний имеют важное практическое значение в сельском хозяйстве для повышения урожайности. В связи с этим разработка специального устройства для облучения семян арбуза ультрафиолетовым (УФ) светом и повышение эффективности его использования являются актуальной задачей. Цель исследования – проведение экспериментальных исследований на лабораторной модели устройства для ультрафиолетового облучения семян арбуза и определение наиболее рациональных режимов облучения. Эксперименты проводились на лабораторной модели ультрафиолетовой облучательной установки в четырёхкратной повторности с использованием бактерицидных ламп с длиной волны 253,7 нм ($P = 60$ Вт) и 300 нм ($P = 90$ Вт) общей мощностью $P = 150$ Вт. Различные*

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*режимы сравнивались по расстоянию между семенами и облучателем, а также по времени обработки. Двухъярусная (двухступенчатая) конвейерная система переворачивала семена во время их движения, обеспечивая равномерное и качественное облучение с обеих сторон. Предлагаемое ультрафиолетовое устройство позволяет эффективно обеззараживать семена арбуза перед посевом и стимулировать их рост.*

***Keywords:*** *seed irradiation device, watermelon seed, hopper, conveyor, frame, chain drives, control panel, electric motor, gearbox, cable, drum, germination, ultraviolet light, irradiation, plant.*

***Kalit so‘zlar:*** *urug‘larni nurlantirish qurilmasi, tarvuz urug‘i, bunker, konveyer, rama (stanina), zanjirli uzatmalar, boshqaruv paneli, elektr dvigatel, reduktor, kabel, baraban, unuvchanlik, ultrabinafsha nur, nurlantirish, o‘simlik.*

***Ключевые слова:*** *устройство для облучения семян, семена арбуза, бункер, конвейер, рама, цепные передачи, панель управления (пульт управления), электродвигатель, редуктор, кабель, барабан, всхожесть, ультрафиолетовый свет, облучение, растение.*

**Introduction.** As is well known, ultraviolet radiation is part of the natural solar spectrum. Because of its diverse effects, it has attracted the attention of physicians, biologists, and specialists in other fields. In Uzbekistan, increasing crop yields is one of the key factors in expanding agricultural output. Today, raising crop productivity requires not only improving traditional agrotechnical measures but also the rational use of new resources. Among these is the management of physiological processes in plants through methods of ultraviolet irradiation and the application of growth stimulators [1–2].

For many agricultural crops, the set of technological processes before sowing includes treating seeds with low-frequency electromagnetic waves (LFEMW) and ultraviolet (UV) rays, moistening the seeds (when necessary), and, during the growing period, exposing the plants to ultraviolet rays when 2–3 true leaves appear, and during budding and full flowering. Electrical stimulation of plants is carried out either separately or together with necessary agrotechnical measures (cultivation, etc.).

Pre-sowing seed treatment methods are known that can restore germination capacity lost during storage. Germination, plant growth and development, and yield can be increased through exposure to low doses of ionizing radiation, ultrasound, short-term heat treatment, shock-wave treatment, irradiation in electric and magnetic fields, light of various wavelengths (ultraviolet, red, infrared), laser irradiation, pre-sowing soaking in water activated by various methods or in solutions of biologically active substances, and other techniques.

It is known that in obtaining high yields of agricultural crops - including watermelon, one of the melon-family crops - the quality indicators of seeds prepared for sowing play an important role alongside other agrotechnical measures. This is because using select seeds - seeds that are of high quality, have similar biological properties, and show high laboratory and field germination together with high potential yield - is a guarantee of an abundant harvest. With this in mind, a device for irradiating watermelon seeds with ultraviolet light was developed [3–4].

The degree of exposure to ultraviolet radiation is largely determined by the structure of the seed. The highest transmission in the ultraviolet range occurs through the seed coat of rye and wheat, followed by sorghum and peas. It should be noted that the seed coat of maize almost completely blocks ultraviolet rays, since the limit of its short-wave transmission is set at 370–385 nm.

For long-wave ultraviolet rays, the transmission coefficient in some crops can be 4–10%, whereas ultra-short-wave rays are almost completely absorbed by the seeds. The short-wave transmission limit of the seed coat for ultraviolet radiation ends at approximately 300 nm, which is where the transmission coefficient itself is at its highest.

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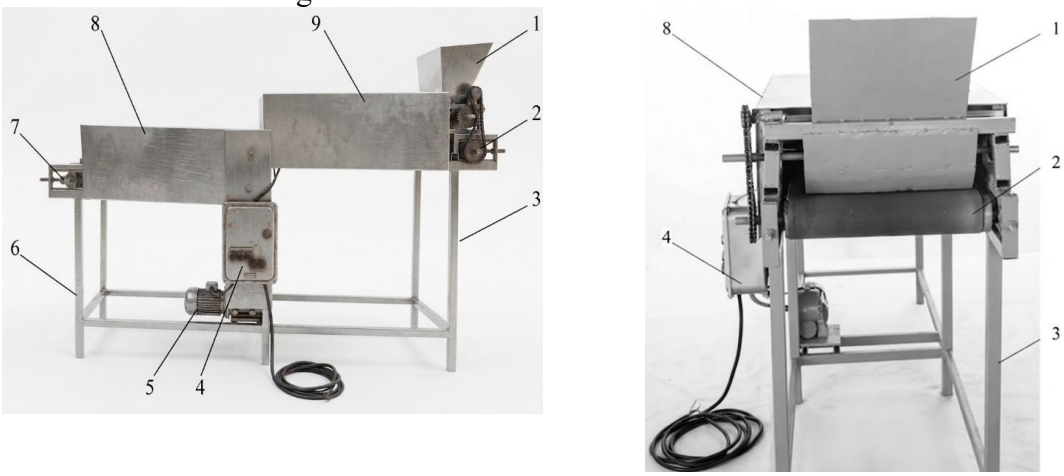
**Methods.** Experimental research on irradiation was carried out using the device for irradiating watermelon seeds with ultraviolet light; the study was conducted on a laboratory model of the irradiation device with four replications [3–5].

**Results.** Based on an analysis of the working elements of the proposed irradiator device for treating agricultural crop seeds with ultraviolet light, a device was developed at the laboratory of the "Electrical Technologies" Department of Kokand State University to improve the efficiency of irradiating watermelon seeds with ultraviolet light.

Figure 1 shows the general view of the irradiation device developed for treating agricultural crop seeds with ultraviolet light.




*a) side view* *b) front view*

**Figure 1. General view of the laboratory model of the ultraviolet treatment device.**
1 – loading hopper; 2, 7 – belt conveyor; 3, 6 – frame; 4 – control panel; 5 – electric motor; 8, 9 – ultraviolet lamps

The conveyor is driven by a TYPE C712-4 motor with a power of 0.37 kW, voltage of 220/380 V, frequency of 50 Hz, and rotation speed of 1400 rpm, connected via an 80/1 VF62 gearbox. Each conveyor is 110 cm long; the transit time for seeds through both conveyors is 5 minutes, and the conveyor speed is 0.0073 m/s. The concept is relevant for agriculture, since it can be used to treat agricultural crop seeds with ultraviolet rays - specifically, to disinfect and stimulate them. The purpose of the proposed concept is to ensure high-quality, complete ultraviolet irradiation of agricultural crop seeds during the technological process.

The operating principle of the device is as follows: it is connected to the power supply, and voltage is applied to the ultraviolet lamps. The start button is then pressed, and the motor–gearbox (5) drives belt conveyors 2 and 7 into motion via chain transmissions. The watermelon seeds to be irradiated are fed uniformly from loading hopper 1 onto the surface of the belt conveyor. Seeds on the belt-conveyor surface are irradiated by ultraviolet lamps 9. As the seeds move along conveyor 2 and transfer onto conveyor 7, 60–70% of them are turned over and irradiated by ultraviolet lamps 8. As a result, the seeds are irradiated evenly with ultraviolet light on both sides.

The technical result achieved is high-quality, complete treatment of agricultural crop seeds with ultraviolet irradiation during the technological process, which increases the degree of their disinfection and stimulation [6–7].

The proposed device for treating agricultural crop seeds with ultraviolet rays makes it possible to disinfect and stimulate them fully and effectively.

Table 1 presents the results of determining the germination of watermelon seeds irradiated with ultraviolet light.

Table 1

**Results of determining the germination of watermelon seeds**

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| **λ=253.7 nm, P=60 W and λ=300 nm, P=90 W** | | |
|---|---|---|
| **H(UV), cm** | **H(UV), t (min)** | **Germination (%)** |
| 6 | 3 | 86.5 |
| | 5 | 92.6 |
| | 7 | 83.4 |
| 9 | 3 | 94.2 |
| | 5 | 97.1 |
| | 7 | 91.5 |
| 12 | 3 | 86.3 |
| | 5 | 93.4 |
| | 7 | 82.5 |

Table 1 presents the results of experimental trials conducted with lamps of wavelength 253.7 nm and power 60 W, and wavelength 300 nm and power 90 W, at heights of 6, 9, and 12 cm and time intervals of 3, 5, and 7 minutes. According to the results, at a total power of 150 W (combining the 253.7 nm and 300 nm wavelengths), a distance of 12 cm from the irradiator to the seeds, and an irradiation duration of 7 minutes, the lowest germination rate was 82.5%. At the same total power of 150 W, a distance of 9 cm, and an irradiation duration of 5 minutes, the best germination rate – 97.1% – was obtained.

**Discussion.** Analysis of the results presented in the table shows that the effect of ultraviolet (UV) rays on seeds can be either positive (stimulating) or negative (harmful), depending on the irradiation dose, wavelength, and exposure time. In agricultural and laboratory practice, treating seeds with ultraviolet light before sowing is an effective method for increasing yield and seed germination.

Thus, the proposed device for treating seeds with ultraviolet light makes it possible to obtain select seed stock that is disease-resistant, environmentally clean, and has high germination capacity.

**Conclusion.** The proposed device makes it possible to irradiate watermelon seeds and obtain high-quality seed stock. Using lamps with wavelengths of λ=253.7 nm (P=60 W) and λ=300 nm (P=90 W) simultaneously, for a total power of P=150 W, the best germination energy was achieved when watermelon seeds were irradiated with UV light at a distance of 9 cm from the irradiator to the seeds and an irradiation time of 5 minutes, with a germination rate of 97.1%. This once again confirmed the rationality of these irradiation parameters and methods.

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