# Influence of ultraviolet radiation on sowing qualities of the cucumber family of the "Murashka" varieties

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**Abstract.** Increasing the productivity of crops, preliminary stimulation of seeds. One of the effective physical methods of pre-sowing stimulation is the treatment of seeds with solar ultraviolet radiation A and B. The article examines the results of research studies measuring the density of germination energy and the similarity of the "Murashka" variety cucumber seeds. The analysis of dependences, and incomes according to the research results, allows the maximum values of germination energy and germination of cucumber seeds are 190 – 210 J/m$^2$.

## 1 Introduction

The effectiveness of pre-sowing seed treatment of cultural results of such authors as Kondratieva N.P., Gazalov V.S., Karpov V.N., Belyakov M.V., Krasnolutskaya M.G., Chervinsky L.S., Romanenko A. I., and several others [2;4-10]. In particular, Kondratiev N.P., Chervinsky L.S., and Romanenko A.I. study the influence of the distant sun on the change of cucumbers. So, the obtained dependence of N.P. Kondratieva established the relationship between the germination of cucumber seeds and the dose of ultraviolet radiation (figure 1). But this dependence is contradictory and does not allow studying the nature of this parameter for penetration.

Chervinsky L.S. and Romanenko A.I. conducted an experiment as treatment parameters chose the voltage of the DRT lamp, the temperature of seed treatment, and exposure [11]. The effect of exposure dose during this experiment was considered indirectly through the level of voltage at the source and exposure (duration of exposure) and was not explicitly determined. For this flock, the presented analysis of the work performed in the field of studying the effect of ultraviolet radiation on the sowing qualities of vegetable seeds, in particular on the sowing qualities of cucumber seeds, is important. Based on this analysis, it can be argued that the issue of determining the radiation dose at which the maximum stimulating effect is achieved remains unresolved.

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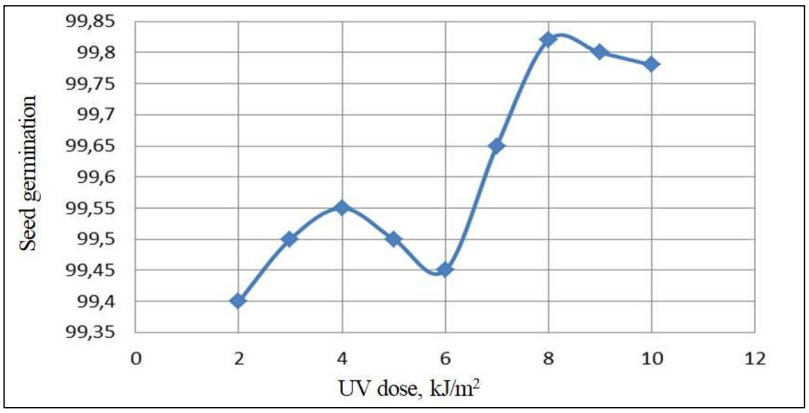


**Fig. 1.** Changes in the germination of cucumber seeds depending on the dose of UV irradiation [10].

## 2 Materials and methods

We studied the effect of the dose of ultraviolet radiation in the range of UV-A and UV-B on the sowing qualities of cucumber seeds. For this task, an experiment was carried out in which a LE-30 lamp was used as a radiation source. The choice of the radiation source was due to its spectral characteristics. The maximum radiation density of LE-type lamps is in the wavelength range that has the maximum stimulating effect – 320–380 nm [1;3].

The radiation source was located at a height of 0.2 m above the irradiated surface, on which the seeds were placed in one layer. To measure ultraviolet irradiance, the "UV-Radiometer TKA-AVS" was used.

Seeds of cucumber varieties "Murashka" were exposed to ultraviolet radiation at the following doses: 50; 100; 150; 200; 250; 300; 350 J/m2. The number of seeds in the sample was 100 pcs. Seed germination took place in germinating beds between layers of moistened filter paper following the requirements of the GOST-12038-84 standard [12].

Table 1 presents the results of these experiments.

**Table 1.** The results of the study of the influence of the dose of ultraviolet radiation on the sowing qualities of seeds of cucumbers of the "Murashka" variety.

| Exposure dose, J/m$^2$ | Germination energy, % | Seed germination, % |
|---|---|---|
| Control | 82 | 92 |
| 50 | 87 | 93 |
| 100 | 93 | 95 |
| 150 | 95 | 96 |
| 200 | 97 | 97 |
| 250 | 93 | 95 |
| 300 | 93 | 94 |

## 3 Results

In the course of the regression analysis, the general form of the functions and the values of the coefficients of the regression equation was determined, the significance of the

coefficients of the regression equation was assessed by the Student's criterion and the resulting models were evaluated for adequacy.

Figures 2 and 3 show the results of the regression analysis of the dependence of the energy of germination of cucumber seeds of the "Murashka" variety on the exposure dose and the plot of the objective function.

The coefficients of the regression equation have the following values $b_0 = 82,42857$, $b_1 = 0,12524$, $b_2 = -0,0003$. Tabular value of Student's criterion $t_{05}(4) = 2,776$. Thus, for all coefficients of the regression equation, the condition $|t_{b_i}| > t_{05}(4)$ is satisfied and the equation has the following form:

$$EP = 82,42857 + 0,12524 \cdot DV - 0,0003 \cdot DV^2, \quad (1)$$

Where $EP$ is the germination energy, %, $DV$ is the exposure dose, J/m$^2$.

Regression Summary for Dependent Variable: EN

Continue...

R= ,91111372 RI= ,83012821 Adjusted RI= ,74519231
F(2,4)=9,7736 p<,02886 Std.Error of estimate: 1,5887

| N=7 | BETA | St. Err. of BETA | B | St. Err. of B | t(4) | p-level |
|---|---|---|---|---|---|---|
| Intercpt | | | 82,42857 | 2,475733 | 33,29462 | ,000005 |
| D | 4,29821 | ,973884 | ,12524 | ,028376 | 4,41347 | ,011569 |
| V1**2 | -4,14697 | ,973884 | -,00030 | ,000069 | -4,25818 | ,013073 |

**Fig. 2.** Table of regression analysis results to determine the coefficients of the regression equation between exposure dose (DV) and germination energy (EP).

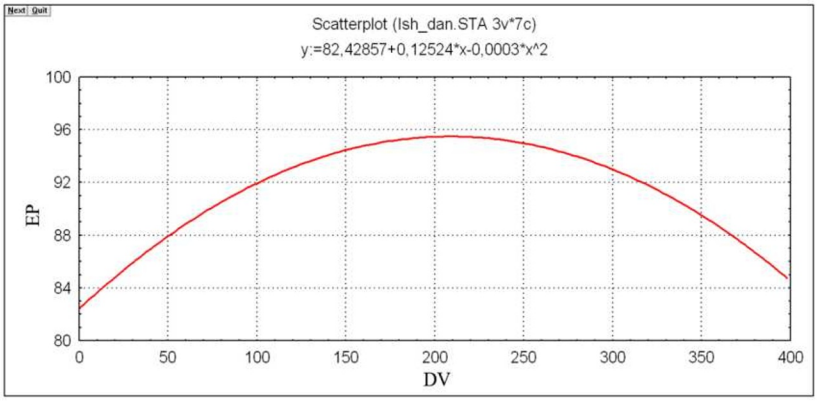


**Fig. 3.** Graph of the objective function of germination energy (EP) from exposure dose (DV) built according to the regression equation.

Similarly, a regression analysis of the dependence of the germination of cucumber seeds on the exposure dose was performed (figures 4 and 5).

$$VS = 90,71429 + 0,0569 \cdot DV - 0,00015 \cdot DV^2, \quad (2)$$

Where $VS$ is seed germination, %.

Regression Summary for Dependent Variable: VSH

Continue...

R= ,93588809 RI= ,87588652 Adjusted RI= ,81382979
F(2,4)=14,114 p<,01540 Std.Error of estimate: ,64550

| N=7 | BETA | St. Err. of BETA | B | St. Err. of B | t(4) | p-level |
|---|---|---|---|---|---|---|
| Intercpt | | | 90,71429 | 1,005935 | 90,17909 | ,000000 |
| D | 4,10849 | ,832446 | ,05690 | ,011530 | 4,93545 | ,007842 |
| V1**2 | -4,36198 | ,832446 | -,00015 | ,000028 | -5,23996 | ,006340 |

**Fig. 4.** Table of regression analysis results to determine the coefficients of the regression equation between exposure dose (DV) and seed germination (VS).

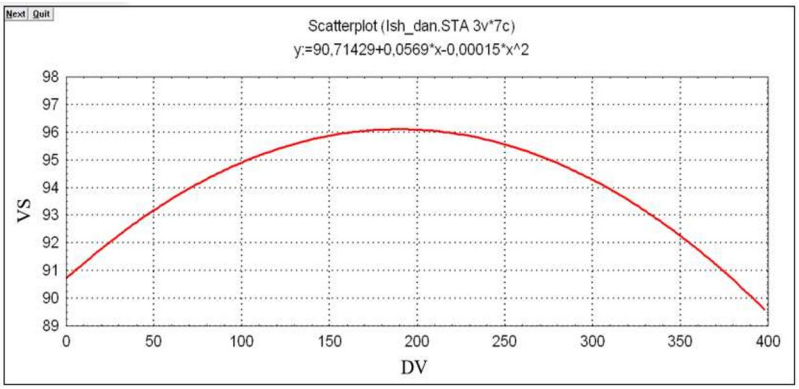


**Fig. 5** Graph of the objective function seed germination (VS) from exposure dose (DV) built according to the regression equation.

The assessment of the adequacy and quality of the obtained models was carried out (1, 2), respectively, according to the Fisher criterion and the coefficient of determination (table 2).

**Table 2.** Significance of indicators of regression analysis.

| Dependency Type | Estimation of the significance of the coefficients of the regression equation by Student's criterion | | Evaluation of the adequacy of the model according to the Fisher criterion | | The value of the coefficient of determination |
|---|---|---|---|---|---|
| | Calculated values of Student's t-test | Theoretical value of the Student's criterion | Calculated values of the criterion | Theoretical value of the criterion | |
| Dependence of the germination energy of cucumber seeds on the exposure dose | $t_{b_0} = 33,29462,$ $t_{b_1} = 4,41347,$ $t_{b_2} = -4,25818$ | 2,776 | 9,773 | 6,94 | 0,83 |
| The dependence of the germination of cucumber seeds on the dose of exposure | $t_{b_0} = 90,17909,$ $t_{b_1} = 4,93545,$ $t_{b_2} = -5,23996$ | 2,776 | 14,114 | 6,94 | 0,88 |

The resulting regression equations adequately describe the dependence of the energy of germination and germination of seeds of cucumber varieties "Murashka" on the dose of exposure to ultraviolet radiation, the values of the coefficients of the regression equations are significant, the response values are in close relationship with the dose of exposure.

## 4 Conclusion

The analysis of objective function graphs (figures 3 and 5) led to the conclusion that pre-sowing stimulation of cucumber seeds with ultraviolet radiation from areas A and B at an exposure dose in the range of 190–210 J/m$^2$ contributes to an increase in germination energy ( *EP* ) and germination ( *VS* ) by 9 and 5% respectively.

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