ISSN: 2586-7342 © 2020 KFHCA. http://www.kjfhc.or.kr
doi: http://dx.doi.org/10.13106/kjfhc.2020.vol6.no1.17.

Influence of Infrared Radiationon Sowing Quality and Growth Indicators of Winter Wheat Plants

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Received: November 15, 2019. Revised: January 22, 2020. Accepted: February 05, 2020.

Abstract

Wheat is the most abundant crop in the world, accounting for one third of the world's population diet. In Ukraine, wheat is in fact, in addition to its nutritional value, a national symbol of the state. Therefore, the main thesis on the development of modern plant growing in Ukraine is the reduction of costs and the introduction of innovative technologies. The quality of grain and seed depends on many factors, namely: agro-climatic conditions, sowing condition of the seed material, quality characteristics of the soil, yielding properties of seeds, pre-sowing seed treatment. etc. For this purpose, the photosynthesis and intensity of photosynthesis need to be limited to the width of the leaf and the height of the leaves by a smaller cut of the stem. It is extremely important to ensure that the head and side pagons of wheat are in good condition. All parameters are often secured by the technology of grain preparation before delivery. Prior to this technology, it is possible to introduce processing of the material in the form for the development of the material. This article presents the effectiveness of the use of infrared irradiation for the pre-sowing treatment of winter wheat seeds in Sekobra Research, Germany.

Keywords: Infrared Irradiation, Decontamination, Growth Parameters, Vitality, Thermostat.

Major classification: Health Science (Environmental Safety and Engineering,. Bioenergy).

1. Introduction

Increasing crop yields is a major issue in agricultural development in Ukraine. To improve the sowing qualities of seeds and increase the germination energy, various methods of removing their biological system from rest, including optical methods (Cherenkov & Kosulin, 2005), are used. In particular, stimulation of seeds with laser irradiation allows to increase germination and growth energy within 20% and, as a consequence, to obtain a yield increase of 11–12% at low energy costs (Velsky, 1996). Infrared irradiation can be attributed to both photovoltaic and thermal methods because the rays of this range have a high permeability and cause the seeds to heat up. The positive effect of this treatment is to increase the germination and growth energy at the initial stages of plant development within 11% (Altukhov & Fedotov, 2011). Ultraviolet irradiation of seeds and plants has also become widespread, especially in closed soil conditions. The method is used for decontamination of seed material, air, soil, control of plant diseases, continuation of daylight (Chervinsky & Pashkovska. 2018).

2. Methods

Effects of pre-sowing treatment of winter wheat seed by infrared irradiation on its germination and germination energy were studied in biosensor laboratories and electrical laboratories of illumination and irradiation of NUBAN

("NUBIP") of Ukraine. Seeds of winter wheat produced by Sekobra Research were treated with infrared irradiation by IKZK -250 lamp at a distance of 2 cm from the lamp for a time from 30 sec to 2 min. Then the energy of germination, seed germination and growth parameters of seedlings were studied. To determine the similarity of wheat seeds the existing method according to DSTU (GOST) 4138 – 2002 was used.

3. Results

The seed germination energy is an important indicator of the quality of the seed. It characterizes the degree of viability of the seeds, the ability to give quick and large-scale harvest, which is of great importance for obtaining a high yield. Laboratory seed germination is a quantitative indicator of its quality, which is a measure of viability. Seeds with low germination sharply deteriorate the yielding properties and quite often, even with increasing seeding rates, it is impossible to reach a high yield. To determine the germination and germination energy from a batch of seeds, samples were taken in four replicates of 100 seeds each. Each seed sample was spread on moistened filter paper placed on the bottom of the grow box. The grow box was covered with a glass plate, signed and placed in a thermostat for seed germination. The thermostat maintained a constant humidity of the filter paper and a temperature of about 20 ° C. Seed germination of different cultures will be determined after a certain period of stay in the thermostat, wheat seeds are determined after 7 days. Germinated is considered to be a seed in which the seedlings and roots are normally developed, and the main root is not shorter than the length of the seed. The sprouted seeds have underdeveloped roots or they do not have or they have decayed, and the seedlings have the form of a single stalk or it's absent at all. The number of sprouted seeds in a 100-seed sample determines the germination of seeds in percentage. Out of the four replicates, the average percentage is obtained, which will characterize a particular variant (batch) of seeds (Kindruk, Slyusarenko, & Getch, 2003). Simultaneously with the laboratory similarity, the energy of seed germination - its ability of quick and large-scale germination (DSTU (GOST) 2949-94, p.15) is also under determination. Naturally, the seeds that germinate first have a higher vitality and form a more productive offspring than those that sprout later, precisely by measuring the top and bottom of the seedlings with a millimeter ruler (Gritsaenko, Gritsaenko, & Karpenko, 2003).

The results of the study are summarized in Table 1.

Table 1: Effect of pre-sowing infrared irradiation of seeds on sowing qualities of winter wheat

Options	Germination energy,%	Seed germination,%
Seeds chemically treated (standard)	90,0	96,7
Raw seeds	88,0	96,0
The seeds were treated with infrared radiation		
30 sec	92,0	94,7
45 sec	97,3	100,0
60 sec	94,7	99,3
2 minutes	93,3	97,3

According to Table 1 it is visible that pre-sowing treatment of winter wheat seeds by infrared irradiation improves sowing quality of seeds. In particular, it was noted that the energy index of germination of wheat seeds treated with infrared radiation for 30, 45, 60 seconds exceeded the seeds treated with chemicals (standard) by 2, 7.3 and 4.7%, respectively. By increasing the processing time to two minutes, the indicator decreased, but remained higher than the standard by 3.3%.

The germination of wheat seeds treated with chemical agents was 96.7%, while that of untreated 96%. When exposed to infrared radiation for 45 and 60 seconds, this indicator increased to 100 and 99.3%, respectively, which confirms the high stimulating effect of pre-sowing in this period of time. Pre-treatment with infrared irradiation for 45 and 60 sec results the best stimulation of the germination energy and germination of wheat seeds.

The effect of infrared radiation on the biometric parameters of winter wheat seedlings was studied for 7 days. From the Table 2 and Fig. 1 shows that the treatment of seeds with infrared radiation for 30 to 60 seconds stimulated growth processes in plants.

Thus, according to Table 2 we can conclude that in the laboratory the highest stimulating effect was observed during seed treatment with infrared radiation for 45 and 60 sec. The lengths of the underground parts of the seedlings increased by 6.5 and 6.6 cm, respectively, compared to the standard.

Table 2: Effect of pre-sowing infrared irradiation on winter wheat growth rates

Option	Length of the underground part of the seedling, cm	Length of the aboveground part of the seedling, cm
The seeds are chemical processing (standard)	7,2	7,5
Raw seeds	4,1	4,3
The seeds were treated with infrared radiation		
30 sec	7,4	8,2
45 sec	13,7	10,1
60 sec	13,8	10,3
2 minutes	7,1	6,1

Stand. Raw seeds 30 sec 45 sec 60 sec 120 sec
Figure 1: Undergroundparts of seedlings

4. Conclusions

Thus, according to the experimental studies, it can be concluded that pre-sowing treatment of winter wheat seeds with infrared radiation lamp IKZK-250 improves sowing qualities and stimulates the growth of seedlings. The highest rates of germination energy and germination of seeds were observed by treating the seeds with IR radiation for 45 sec. These figures were 97.3 and 100% respectively. The highest growth parameters were observed in the case of 60 seconds treatment, the aboveground part of the seedling increased by 37.3% compared to the standard, and the underground part - 91.7%. The results obtained indicate the prospect of pre-sowing winter wheat seed infrared radiation.

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