

# Increased germination of barley and wheat using cold plasma

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**Abstract.** An innovative installation for pre-sowing treatment of seeds of various crops with cold plasma, it allows to increase their germination, resistance of plants to external stresses, productivity and ecological value of the product were proposed in this paper.

## 1 Introduction

Currently, the main task of agricultural production is to improve the sowing quality of different crops seeds using new modern technologies. The seeds quality affects the quantity of manufactured product. The better seeds are processed, the better a production.

An effective solution to this problem is to improve the seeds quality using the influence of physical factors on seeds. In practice, various types of seeds treatment are used, such as heating, exposure to high frequency currents, etc. [1-5].

All methods of presowing seeds treatment are classified into three classes: mechanical, physical and chemical. Mechanical methods of seeds preparation are used in all systems without exception, preceding physical and chemical influence methods.

One of the most significant methods to increase productivity is the chemical treatment. By means of chemical treatment, bacteria can be destroyed up to 100% during seed sterilization, but this method is not so ideal. The using of chemical treatment can lead to the accumulation of toxic substances which can get into human body.

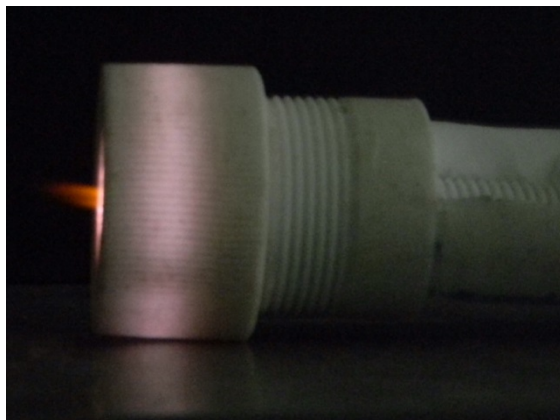
Current trends in the field of seeds disinfection before the sowing directed at finding new highly rational and environmentally friendly technologies. The promising solving to achieve the above-stated objects is a method of treating seeds with a cold plasma, it combines the electrical and thermal processes of exposure to seeds and it allows them to be regulated.

## 2 Experimental studies

To conduct experimental studies, the cold plasma generator was developed, shown in Figure 1 [6-10].

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**Fig. 1.** Cold plasma generator.

Seeds of various crops, including wheat and barley, were exposed to the cold plasma. To conduct experimental studies of the effects of the cold plasma on the seeds germination, seeds samples were prepared in equal amounts. Some of the seeds were exposed to the cold plasma under various treatment conditions, some were left without treatment. Next, the seeds were planted in prepared containers and were grown under the same conditions. At the end of the experiment, the number of seeds sprouted and the mass of greenery were determined.

## 2.1 Barley

For research, 2 samples containing 50 seeds each were prepared. This samples were subjected to various processing modes:

1. Cold plasma argon gas, processing time 1 min.
2. Control without processing.

Figure 2 shows the sprouts of barley after 7 days after planting.



**Fig. 2.** Seed emergence 7 days.

After 14 days, the mass of sprouts was determined for each regimen (table 1).

**Table 1.** The mass of boring.

1 mode	2 mode
36	29
36,28g	27,32g

This variety of barley has 58% germination, as a result of processing of cold plasma, germination increases to 72%.

**2.2 Spring wheat Ekado-70**

For research, 7 samples containing 40 seeds each were prepared. The samples were subjected to various processing modes, including ozone and high-voltage discharge:

- 1. Ozone 1 min.
- 2. High voltage direct current discharge voltage 6 kV, current 10 mA, argon plasma gas, distance 0.5 cm, processing time 1 min.
- 3. High-voltage direct current discharge voltage 6 kV, current 30 mA, plasma-forming gas air, distance 0.5 cm, processing time 1 min.
- 4. High voltage discharge 20 kHz, 12 kV, without plasma-forming gas, distance 1 cm, processing time 1 min.
- 5. Cold plasma (argon) distance 1cm, processing time 1 min.
- 6. Cold plasma (air) distance 1cm, processing time 1 min.
- 7. Control, without processing.

Figure 3 shows wheat germ after 7 days after planting.



**Fig. 3.** Seeds germination 7 days after planting

After 12 days, the mass of sprouts was determined for each regimen (table 2).

**Table 2.** The mass of boring.

1 mode	2 mode	3 mode	4 mode	5 mode	6 mode	7 mode
38	35	39	40	39	40	36
7,36g	7,48g	8,80g	8,52g	8,24g	8,02g	7,30g

This wheat variety has 90% germination, as a result of cultivation in various ways, the germination will increase to 100%. For the cold plasma and a high-frequency discharge, the germination is 10% higher than that of the control samples, with other processing methods the efficiency is less, and when using a direct current discharge with argon, the germination is reduced by 2% compared to the control sample.

### 3 Conclusions

The using of the cold plasma has a beneficial effect on the germination of various seeds. Moreover, the worse the germination of untreated seeds, the greater the effect of the use of the cold plasma. In processing with the cold plasma, the germination can increase up to 4 times.

When there was a good germination of untreated seeds, the treatment with the cold plasma does not negatively affect germination, also these seeds grow faster and give a greater yield of greenery.

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