2022 8th International Conference
on Energy Efficiency and Agricultural Engineering
EE&AE 2022

30th June - 2nd July 2022, Ruse, Bulgaria

Influence of Pre-Sowing Electromagnetic and Chemical Treatment on Sowing Qualities of Maize Seeds

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GOAL OF THE STUDY

One of the established methods for increasing yields is the use of artificial fertilizers [1,2]. In many cases it leads to the contamination [3] of soil and produce.

It is known that the pre-sowing treatment of seeds with fungicides is carried out in order to protect them from economically significant pests.

Since the world of animate and inanimate nature exists in the Earth's electromagnetic field, it is only natural to look for approaches to increase yields through preliminary electrical stimulation of the seeds [4].

The analysis of the non-traditional ways to increase crop yields (such as for triticale [5,6], cotton [7,8], rape seeds [9] and vegetable crops [10,11]) shows that treatment in magnetic fields [12,13], electrical and electromagnetic fields [14] is used.

Considering the fact that the pre-sowing electromagnetic, electrical and other types of treatment alter the electrical state [15] of the seeds, it is reasonable to expect that wetting the seeds by treating them with fungicide will affect this state.

The purpose of this study was to determine the results of the pre-sowing fungicidal and electromagnetic treatment of maize seeds at different fill levels of the electromagnetic exposure device.

METHODOLOGY OF THE INVESTIGATION

In this study, maize seeds from the French hybrid MAS 47.P were used. It is a mid-late hybrid of FAO group 440.

The pre-sowing electromagnetic treatment was performed in a specially designed device for pre-sowing electrical treatment of seed material [16].

The adopted electromagnetic impact control factors were: [17] applied voltage U, kV between the device electrodes (electromagnetic field parameters), and duration of treatment τ, s. The control factor values were based on the results obtained in other studies [14,17].

The adopted practice for establishing the impact of the fill level in the screw conveyor for electromagnetic treatment [16] was to fill the device to 50%, with the maize seeds reaching the middle of the screw shaft, or the seeds reaching "only the tip" of the screw thread, i.e. the fill level of the screw conveyor was 10%.

The type of fungicide used was "Picador 35ST." This is a systemic insecticide for pre-sowing treatment of seeds. It has a guaranteed effect against wireworms, grey worms and different types of weevils (e.g. grey maize weevil).

The experiment planning matrix is shown in Table 1.

From Table 1 it can be concluded that in options No.1, No.3 and No.5 the electromagnetic treatment was done on seeds that had been previously disinfected with fungicide. For them, the abbreviated designation (d) was used. In the options with numbers 2, 4 and 6, the seeds were not disinfected at the time of applying the electromagnetic treatment – they were marked with the abbreviation designation (n). These seeds were subjected to treatment with fungicide after the electromagnetic treatment.

The seeds were treated in an electromagnetic field on March 25th. In accordance with the established methodology [17], they were sown in the field on April 17th (i.e. 23 days after the electromagnetic treatment) in the land of the company „Safari" near the village of Borisovo, Ruse district. On the same day, experiments were also performed in laboratory conditions.

MAIN RESULTS FROM THE STUDY

From the laboratory experiments, the length of the germs and roots, the number of roots and the mass of the sprouting plants were determined, as well as their germination power and germination capacity. The described data, expressed as a percentage of the reference specimen (%/rs) are shown in Fig. 1 (for seeds pre-treated with fungicide and for seeds untreated with fungicide).

From Fig. 1 it can be concluded that the pre-sowing electromagnetic treatment of seeds pre-treated with fungicide had a favourable effect on all monitored laboratory parameters – Fig. 1. The explanation for the higher values seen in option No. 1d is that a significantly smaller quantity of seeds (only on the "tip of the screw thread") was exposed to the effect of the same electromagnetic field.

The results in Fig. 1 show that when fungicidal treatment was applied to the seeds after the pre-sowing electromagnetic treatment, the effect of the latter was suppressed. This can be explained by the fact that the treatment ("wetting") with moist fungicide increased the electrical conductivity of the electromagnetically pre-treated seeds, and presumably some equalization of the electrical potentials [19], natural and acquired, occurred as a result of the pre-sowing electromagnetic treatment.

In the case shown in Fig. 1, the number of roots grown was the only parameter with values greater than those of the reference specimen - by 20.8%, 8.3% and 21.3% for the options with numbers 2n,4n and 6n, respectively.

During the vegetation of the plants in the field, the characteristics of the maize plant stalks were established. For this purpose, measurements of the plant height reached **Hp**, cm, the number of leaves **B**, the heights of the first cob $\mathbf{H_{c1}}$, cm and the second cob $\mathbf{H_{c2}}$, cm, were taken.

After harvest was done, the number of cobs harvested and their length (Fig. 2), the number of rows on the cob and the number of kernels in a row (Fig. 3) were studied, together with the total mass of the cobs with the kernels (Fig. 4).

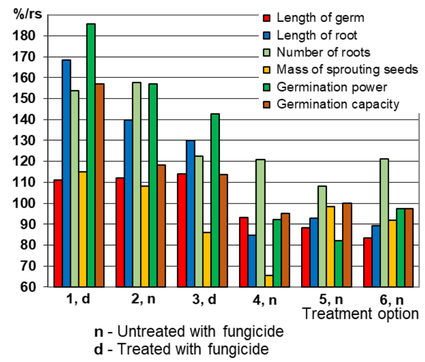

Fig.1. Results of the laboratory study of pre-sowing electromagnetic treatment of seeds of the maize hybrid MAS 47.P (as a percentage of the reference specimen -%/rs)

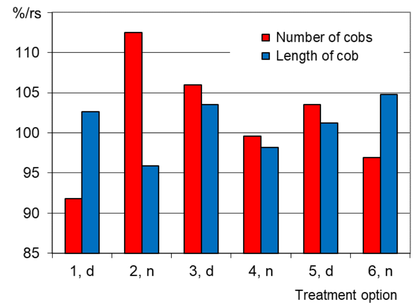

Fig.2. Results of the study of the number and length of maize cobs (expressed in % of the reference specimen) after pre-sowing electromagnetic treatment of the seeds (d – disinfected with fungicide before the electromagnetic treatment, n – non-disinfected with fungicide)

From the results presented in Fig. 2 it is also evident that the pre-sowing electromagnetic treatment had a different impact on the pre-disinfected seeds (options 1d, 3d, 5d) compared to the non-disinfected seed (options 2n, 4n, 6n). It is worth noting that for treatment option No. 3n, both monitored parameters had greater values than those of the reference specimen – the number of cobs was 6.0% higher, and their length – 3.5% higher than those of the reference specimen. The impact factors for treatment option No. 3n were voltage U=1.65 kV, duration of treatment τ =10s, and screw conveyor fill level – up to the middle of the shaft (50%).

The increased voltage of U=2.5 kV between the electrodes produced better results in option No. 5d, where the number of cobs was 3.5% higher, and the length – 1.2% higher in comparison with the reference specimen. This shows that the effect of the electric discharge was weaker than the impact of the pre-sowing electromagnetic treatment at a higher voltage.

The increased number of harvested cobs in treatment options 2n, 3d and 5d can be considered to be the result of the performed pre-sowing electromagnetic treatment.

The different effects of the control factors during pre-sowing electromagnetic treatment, namely voltage, duration of electromagnetic exposure, screw conveyor fill level, and time of seed disinfection (before or after the electromagnetic treatment), are evident also from Fig. 3.

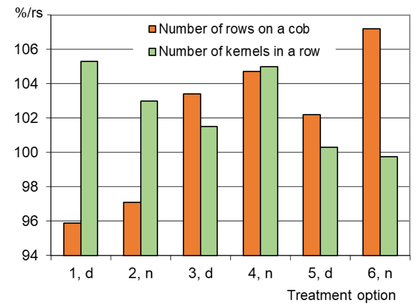

Fig.3. Results of the study of the number of rows on a maize cob and the number of kernels in a row (expressed in % of the reference specimen) after pre-sowing electromagnetic treatment of the seeds: d – disinfected with fungicide before the electromagnetic treatment, n – non-disinfected with fungicide before the electromagnetic treatment

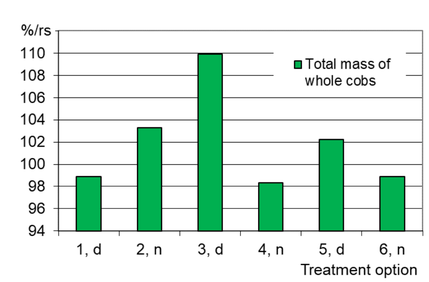

Fig.4. Results of the study of the total mass of maize cobs (expressed as % of the reference specimen) after pre-sowing electromagnetic treatment of the seeds

It can be concluded from Fig. 4 that the total mass of the cobs in treatment option 3d (pre-disinfected seeds treated at U=1.65 kV and τ=10 s) was 9.9% more than in the reference specimen. This was due to the higher number of harvested cobs, their length, and the number of kernel rows in each. Under equal other conditions, the assumption could be made that the pre-sowing electromagnetic treatment was responsible for the above results. It produced a positive effect in option 3d (Fig. 1) with 57.6% more plant roots grown compared to the reference specimen, which in turn favourably influenced fructification. The increased number of harvested cobs indicated that, under equal other conditions, also some of the lateral buds on the maize stalk developed after the pre-sowing electromagnetic treatment. The increase in the processing voltage from U=1.6 kV to U=2.5 kV contributed to a 2.2% increase in the yield from the pre-disinfected seeds in treatment option 5d. This is consistent with the results for the number and length of the maize cobs, given in Fig. 2.

CONCLUSIONS

1. The results of the preliminary study indicated that the pre-sowing electromagnetic treatment of maize seeds should be carried out after disinfection of the seeds with fungicide. Then, by applying voltage of 1.65 kV between the electrodes for a treatment duration of 10s (treatment option No.3d), an increase of 6.0% and 9.9% in the number and mass of the harvested cobs, respectively, was achieved as compared to the reference specimen.

2. It was established that, for the values of the control factors used, and at a 50% fill level of the pre-sowing electromagnetic treatment device, better results of the monitored parameters were achieved than with a 10% fill level.