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RESEARCHES CONCERNING THE INFLUENCE OF *LAURUS NOBILIS* ESSENTIAL OIL ON *ZEA MAYS* KERNELS GERMINATION

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Abstract: In Romania, during the last few years, maize crop (*Zea mays*) faced new climatic conditions that lead to lower yields. The main cause of grain mass decrease per Ha is the low rainfall in June and July months, leading to the installation of pedological drought. To improve this situation, it was studied the possibility of corn seed germination at sub-optimal temperature, in order to soil water conservation for a longer period. In this study there were performed two experiments involving the use of *Laurus nobilis* essential oil as product for seed treatment. In the first experiment it was determined the optimal dose of *L. nobilis* essential oil, and in the second experiment it was tested the germination of treated seeds with optimal dose of essential oil at different temperatures. Data analysis showed that after 3 days, at 30ºC, *L. nobilis* essential oil in 1000 ppm concentration inhibited seed germination with 11% and radicle growth with 7%. At 15ºC, after 7 days from treatment, treated seeds with 1000 ppm *L. nobilis* essential oil had a 61.86% higher germination and 71.06% increased root growth compared to the untreated control.

Key words: *Zea mays, essential oil, sub-optimal, germination*

INTRODUCTION

Between 2007 and 2015, maize crop occupied about 2.5 million hectares in Romania with an average production of 3.5 tons/ha (NIS, 2015; NIS, 2016), which represents almost 70% of the nutritional potential of agricultural land in Romania. Regarding the hydric regime (Figure 1), annual precipitation ensures a sufficient amount of water for most land, but because of low thermal favorability (Figure 2) in the early stages of vegetation, maize overshadows not enough soil resulting in significant loss of water through evaporation. Due to lower levels of rainfall in June and July, as a result of climate change in recent years, farmers are forced to advance the time of sowing in the first decade of April, risking achieving an incomplete germination in the absence of average soil temperatures over 10ºC. In order to ensure a normal germination of the corn kernels in sub-optimal temperature conditions, a seed treatment prior to sowing based on *Laurus nobilis* L. essential oil was tested. In this study two experiments were performed. The first experiment consisted in finding the optimal dose of *L. nobilis* essential oil for stimulation of seed germination and in the second one, the rate of germination of oil treated seeds at different temperatures.

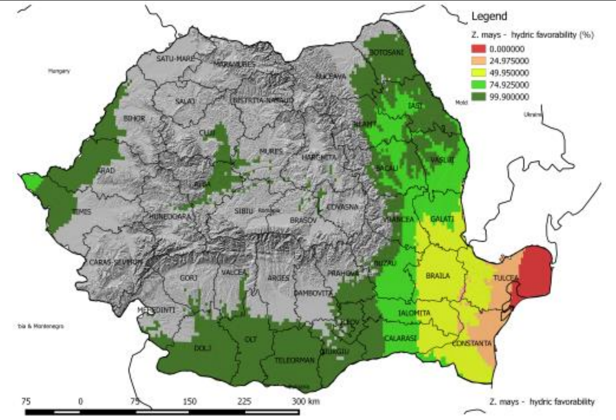

Figure 1. *Z. mays* – hydric favorability (%), 1950-2000 (diva-gis; ecocrop)

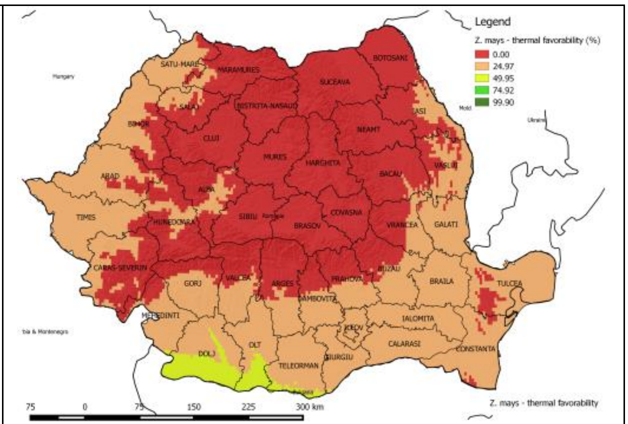

Figure 2. *Z. mays* - thermal favorability (%), 1950-2000 (diva-gis; ecocrop)

MATERIALS AND METHODS

Corn kernels from Prahova County, Păulești granary and commercial *Laurus nobilis* essential oil (INCI-name: *Laurus nobilis* leaf oil; CAS-number 8002-41-3 / 8007-48-5) were used. In both experiments the corn kernels were used with its own unaltered microbial load. Germination experiments were conducted in vented Petri dishes (92 x16 mm), to which has been added 15 layers of cellulose paper (Blue tris) moistened with 10 ml water in order to maintain constant moisture (Figure 3). The *L. nobilis* essential oil was conditioned as an emulsion of 5% essential oil and 0.2% agar (Remme et al., 1993).

Figure 3. First experimental design

The protocol for essential oil optimal dose determination consisted in germination of 1200 of corn kernels (seeds 50 x 6 doses x 4 repetitions, Figure 4) at 24°C, for three days. The tested concentrations of essential oil were 0 ppm, 500 ppm, 1000 ppm, 2000 ppm, 3000 ppm and 5000 ppm, reported to the corn kernels weight with 12% humidity. For uniform distribution of volatile oil emulsion in the 50 seeds mass, 4 ml of water were added.

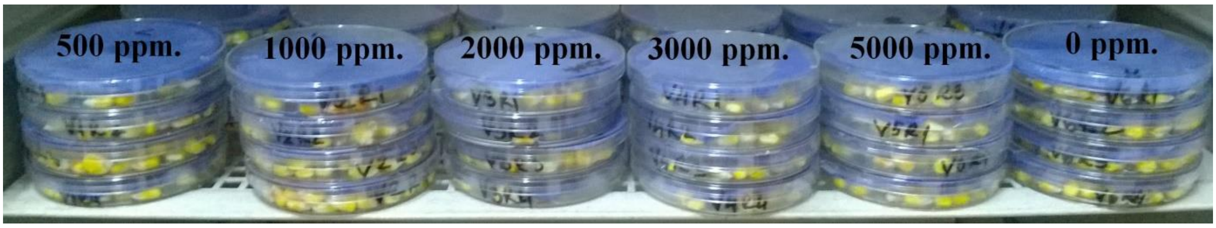

Figure 4. Different concentrations of *Laurus nobilis* essential oil

After four days of incubation, the average germination rate and radicle length were measured with a digital micrometer (Figure 5).

Figure 5. Radicle length measurement

The protocol for corn seed germination assessment in the presence of *L. nobilis* essential oil consisted in 2400 seeds germination (50 seeds x 2 doses x 6 end-point temperatures x 4 repetitions). *L. nobilis* essential oil concentrations used was 1000 ppm and 0 ppm (untreated control). Testing temperature in the germination experiment included six levels: 5°C, 10°C, 15°C, 20°C, 25°C and 30°C (Figure 6).

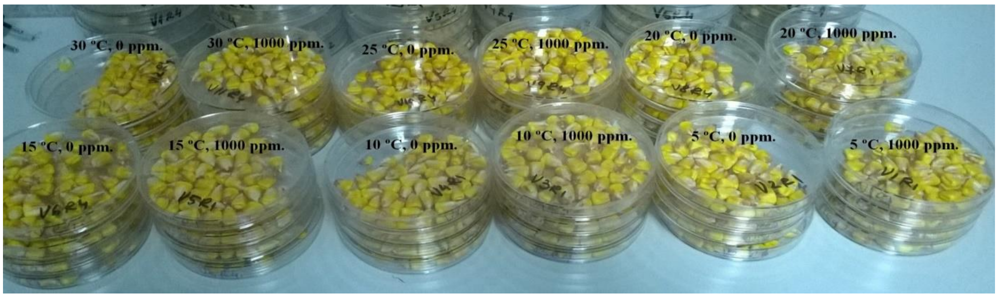

Figure 6. Second experimental design

RESULTS AND DISCUSSION

In the experiment for *L. nobilis* essential oil optimal dose determination, the concentration of 1000 ppm essential oil induced a higher germination with 11% compared to untreated variant (Figure 7), a higher average radicular growth of 6 mm compared to 20 mm untreated variant (Figure 8) and a total radicular growth (radicle length x germinated seeds) higher with 42.63% (Figure 9, paired test: P=0.0177, R^2= 0.8827).

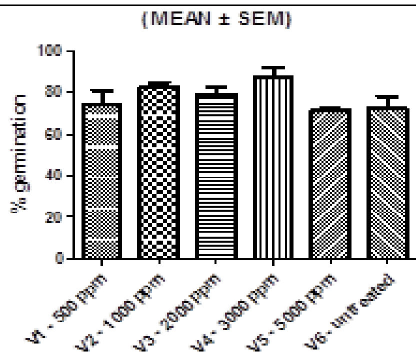

Figure 7. *Zea mays* germination with *Laurus nobilis* essential oil

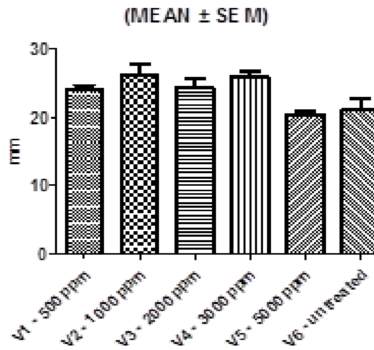

Figure 8. *Zea mays* radicle length growth in the presence *Laurus nobilis* essential oil

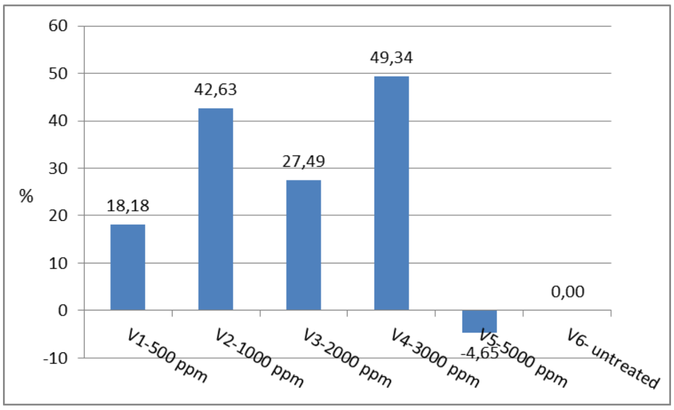

Figure 9. *Zea mays* total radicular growth stimulation

In the germination and root growth experiment at different temperatures in the presence of 1000 ppm *L. nobilis* essential oil, the seeds showed no germination at 5°C and 10°C, not even after seven days of incubation. At 30ºC, the number of germinated seeds and radicular length was decreased in treated variant compared with control. At temperature of 15°C, *L. nobilis* essential oil in 1000 ppm concentration induced an increase of 61.8% on germination and 71.06% root growth stimulation on repetition (Figure 10).

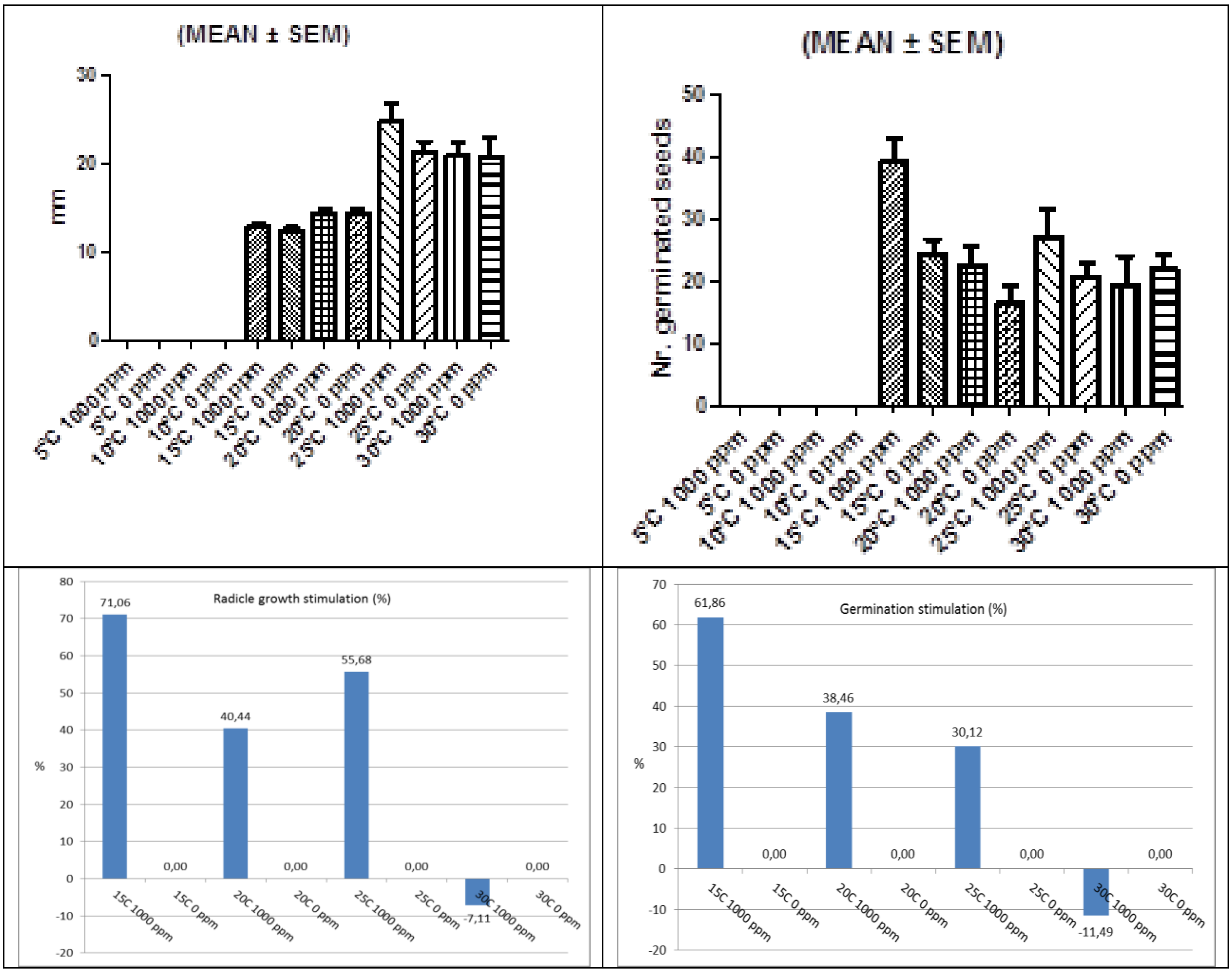

Figure 10. Germination and root growth stimulation

Using paper discs instead of soil to maintain moisture in Petri dishes has the advantage of ensuring a constant evaporation, up to seven days germination period.

Since between the number of germinated seeds, average radicle length and the increasing concentration of *L. nobilis* essential oil cannot be established a correlation (dose / seeds germinated - Spearman correlation r = 0.08571 and dose / average radicle length - Spearman correlation r = -0.02857), it can be concluded that the mechanism of interaction between the *L. nobilis* essential oil and maize seed is more complex than using a single active substance for seed priming. However, it can be observed that there is a significant negative correlation between temperature and percentage of germination stimulation (% germination stimulation / temperature – Pearson correlation r = -0.9638, P= 0.0362).

CONCLUSIONS

Use of *Laurus nobilis* essential oil in corn seed treatment before sowing is a practical approach that could generate optimal use of soil nutrients and seeds genetic resources.

Due to lack of germination at 10°C, although the specialized recommendations indicate sowing in the field when average temperature is 10ºC at least three days, it can be concluded that the seeds germinate only in the range of maximum average temperatures, respectively 12ºC-15ºC. This temperature range within the territory of Romania is reached between the hours 4:00 p.m. and 3:00 a.m. In conclusion, seed priming before sowing and seedbed processing to ensure a high temperature are practical approaches, which can lead to higher yields.

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