

## EARLY GROWTH CONTROL OF HYBRID CORN PLANTS BY SEED TREATMENT WITH NUTRIENTS SOLUTION

### CONTROLUL TIMPURIU AL CREȘTERII PLANTELOR HIBRIZILOR DE PORUMB PRIN TRATAREA SEMINȚELOR CU SOLUȚIE DE NUTRIENȚI

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**Abstract.** Experiments were performed under laboratory controlled conditions at 25°C in the dark, air humidity of 60-70% with four maizes (*Zea mays* L.) hybrids, including Porumbeni 180 (Por. 180), Bemo 203 Porumbeni 374 MRf (Por. 374), Porumbeni 427 (Por. 427) to test the influence of seed treatment with water (control) or ½ Hoagland nutrients solution (½ NS) on germination parameters. Seeds treated with ½ NS showed the tendency to decrease the final percentage of germination for studied hybrids. At the same time, seed treated with ½ NS promoted the growth of 5-day-old seedlings, increasing the height of epicotyls, radicle length, and accumulation of fresh biomass of plantlets.

**Key words:** Seeds, maize, hybrids, Hoagland nutrient solution, growth parameters

**Rezumat.** Experimentele au fost efectuate în condiții controlate de laborator la 25°C la întineric, umiditatea aerului de 60-70% cu patru hibridi de porumb (*Zea mays* L.), inclusiv Porumbeni 180 (Por. 180), Bemo 203, Porumbeni 374 MRf (Por. 374), Porumbeni 427 (Por. 427) pentru a testa influența tratării semințelor cu apă (control) sau ½ soluție nutritivă Hoagland (½ SN) asupra parametrilor germinativi. Semințele tratate cu ½ SN au manifestat tendința de a scădea procentul final de germinație pentru hibridii studiați. În același timp, amorsarea semințelor cu ½ SN a favorizat creșterea răsadurilor de 5 zile, majorând înălțimea epicotilelor, lungimea radicelelor și acumularea biomasei proaspete a plantulelor.

**Cuvinte cheie:** Semințe, porumb, hibridi, soluție nutritivă Hoagland, parametrii de creștere

## INTRODUCTION

Maize (*Zea mays* L.) is an important crop worldwide, being a valuable source in the diet of the population and animals, as well as in various industries. In modern agriculture the cultivation of corn is very widespread, occupying the third place in the world production, after wheat and rice.

Factors associated with increased global food security and climate change lead to the implementation of various changes in agricultural technologies. In this

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context, various approaches are used to better manage, maintain and improve crop production resources.

In order to stimulate and improve the cultivation of maize plants, especially in the early stages of ontogenesis, different strategies and types of treatments are applied (Dezfuli *et al.*, 2008; Imran *et al.*, 2013; Tian *et al.*, 2014). One of the effective methods used to improve germination process is to prime the seeds before sowing with different nutrient solutions (Imran *et al.*, 2013; Tian *et al.*, 2014). Literature data (Dezfuli *et al.*, 2008; Guan *et al.*, 2014; Tian *et al.*, 2014; Harender *et al.*, 2018; Shrestha *et al.*, 2019; Nciizah *et al.*, 2020) have previously demonstrated a positive effect of treatment seeds by individual or some combinations of micro- and macroelements on the process of seed germination, plant growth and productivity in various environmental conditions.

The aim of this study was to evaluate the effects of seed treatment with water or ½ Hoagland nutrients solution on seed germination and seedling growth of different maize hybrids in the early stages of ontogenesis.

## MATERIAL AND METHOD

The seeds of different maize hybrids were used as object of study, including Porumbeni 180 (Por. 180), Bemo 203, Porumbeni 374 MRf (Por. 374), Porumbeni 427 (Por. 427), offered by the Public Institution “**Porumbeni**” **Institute of Phytotechnics**. Experiments were performed under laboratory controlled conditions at 25°C, in the dark and air humidity of 60-70%. Before germination maize seeds were treated with distilled water (control) or ½ Hoagland nutrients solution (½ NS) (Hoagland and Arnon, 1950). Subsequent germination of control and experimental seeds was carried out on respective solutions - distilled water or ½ NS. Seedlings were collected after 5 days for biometric assessments, including measurement of epicotyls height and radicle length. These seedlings were later used to determine the fresh biomass. The results were statistically analyzed using the “Statistics 7” software package for computers. The obtained results are means of 3 measurements of samples resulting from 3 different experiments.

## RESULTS AND DISCUSSIONS

Effect of using ½ Hoagland nutrients solutions (½ NS) on germination and seedling growth.

Treatment of seeds of different maize hybrids before germination for 72 hours with ½ NS demonstrates (tab. 1) that the use of ½ NS influences seed germination, showing the tendency to decrease the final germination rate, compared to the control. It should be mentioned that in the first two days there was a tendency to retain the germination process (data not shown), but in the following days, the nutrient environment significantly increased the germination process, stimulating the growth and further development of seedlings (fig. 1). Photographs of seedlings of different 4-day-old maize hybrids shown in figure 1 demonstrate visual phenological differences between seedlings grown from seeds treated with water (control) or ½ NS. It can be noticed that the seedlings of the

experimental variants, visually, seem to be higher in all the maize hybrids studied, compared to the control seedlings.

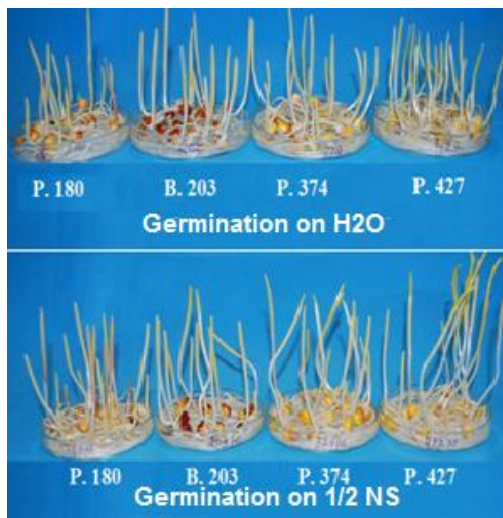


Table 1  
Influence of germination medium on final % germination of seeds of different maize hybrids at 25°C

No.	Hybrids	% of germination	
		H <sub>2</sub> O	½ NS
1	Porumbeni 180	95	95
2	Bemo 203	98	96
3	Porumbeni 374 MRf	88	86
4	Porumbeni 427	90	89

**Fig. 1** Four-day-old seedlings of different maize hybrids obtained from seeds pre-treated with distilled water (H<sub>2</sub>O) or ½ Hoagland nutrient solutions (½ NS), which subsequently germinated on the same medias at 25°C.

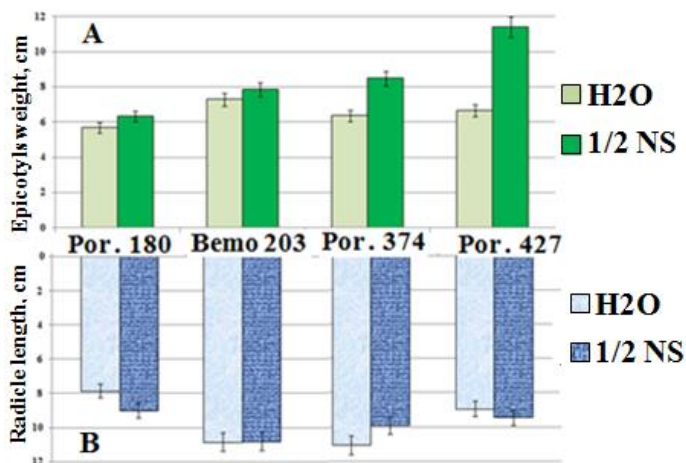
Higher seed germination in the first days in the control variants may be associated with a faster start of hydrolysis processes and mobilization of seed reserves due to the immediate activation of proteolytic enzymes. An important role in the regulation of maize seed germination is played by enzymes related to carbohydrate metabolism, including  $\alpha$ -amylase,  $\beta$ -amylase and starch branching enzymes (Xue *et al.*, 2020).

### Root length and seedling height

The appearance of maize hybrids (*Zea mays* L.) in terms of seedling growth (fig. 1) was confirmed by evaluations of biometric indices. Measurements of root length and seedling height showed that seed treatment with a nutrient solution provided a significant increase in seedling height for all studied maize hybrids (fig. 2A). Height level of maize hybrid seedling Por. 427 and Por. 374 were 72 and 33% higher, respectively, compared to the controls.

Regarding the influence of seed treatment with nutrient solution on the radicle length we can see that the values of this index for studied hybrids are different (fig. 2B). Using of ½ NS significantly increased radicle length of germinated seeds of the Por. 180 and Por. 427 hybrids as compared to water (control). No prominent differences were observed in radicle length of both control and experimental variants of Bemo 203 seedlings (fig. 2B). While the

level of radicle length of Por. 374 was lower in treatments with  $\frac{1}{2}$  NS compared to control.



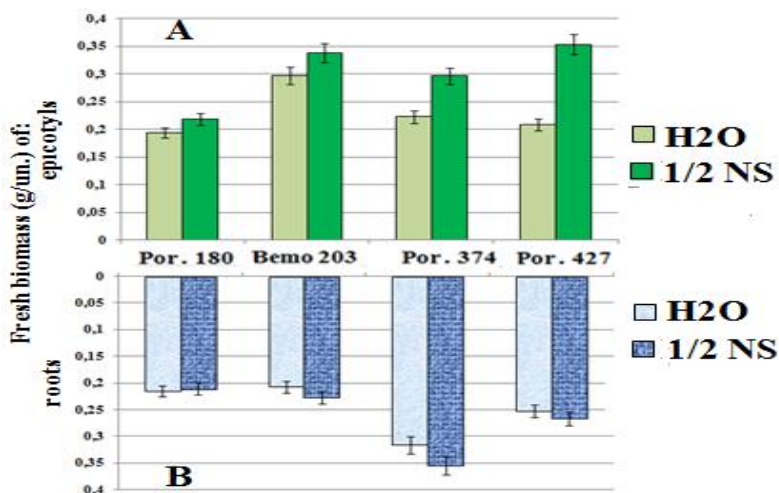
**Fig. 2** Effect of seed treatment of various maize hybrids with H<sub>2</sub>O (control) or  $\frac{1}{2}$  Hoagland nutrient solution ( $\frac{1}{2}$  NS) on epicotyls height (A) and radicle length (B) of five-day-old seedlings

Investigations carried out earlier (Muhammad *et al.*, 2015) showed that the growth rate of maize from seeds soaked in nutrient solution with the addition of + Zn and + Mn was 50 and 100% higher, respectively, compared to control plants.

### Fresh seedling biomass

The phenological differences were also confirmed by comparing the values of fresh biomass of both the aerial part (fig. 3A) and the roots (fig. 3B). Treatments of corn seeds with  $\frac{1}{2}$  Hoagland nutrient solutions significantly increased the fresh biomass of the aerial part (epicotyls), compared to the control. A significant increase in fresh biomass of the aerial part, due to the application of  $\frac{1}{2}$  Hoagland complete nutrients solution, was recorded for the hybrids Por. 427 and Por. 374, which constituted 70 and 30% respectively more than in the control variants. These results are consistent with the data obtained from the study of the effects of seed priming with Zn, Mn, B and P on plant growth and nutritional status of maize (Muhammad *et al.*, 2015).

These researchers showed that the growth of the aerial part of plants obtained from seeds primed with B and P did not reach the biomass level of control plants (complete nutrient solution), but the values of root biomass after priming with P exceeded the values of the respective index. The translocation of Mn and Zn, used preventively for seed priming, in the growth of the aerial part of the seedlings, also contributed to the growth of the seedlings.



**Fig. 3** Effect of seed treatment of various maize hybrids with H<sub>2</sub>O (control) or ½ Hoagland nutrient solution (½ NS) on fresh biomass of epicotyls (A) and radicle (B) of five-day-old seedlings

Thus, our results show that high values of biometric parameters in seedlings of various maize hybrids in the early period of ontogenesis correlated with the use of ½ complete Hoagland nutrients solution (½ NS) for seed treatment and germination evolution.

In order to improve the germination rate of the seeds, it may be necessary to reduce the level of ½ NS. Additional researches should be carried out to determine the best appropriate ratio of complete nutrients solution that could be used for seed treatment.

## CONCLUSION

The results of the study showed that the use of ½ Hoagland nutrients solution for the treatment and germination of the seeds of different maize hybrids led to an increase of the early growth performance of maize plants.

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