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# THE EFFECT OF SOME MIXED TETRAOXANES ON GERMINATION AND ANTIOXIDANTS IN MAIZE SEEDLINGS

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## ABSTRACT
Application of natural or synthetic substances could increase maize vigor. In this study we examined the influence of four mixed tetraoxanes on germination and seedlings growth of maize inbred line with low germination ability. Tetraoxanes expressed positive influence on germination rate and maize seedlings growth through increased DPPH-scavenging activity, improve water and antioxidative status by increase of phytic acid and phenoles concentration.

## INTRODUCTION
Germination is one of the most sensitive phases in growth of agricultural plants, where optimal conditions in temperature and water accessibility are required. Seedlings are particularly sensitive to environmental stressors, especially when maize lines are considered. They tend to germinate and grow slower, have poorer adaptability to stress and seeds could lose germination ability relative fast. Application of natural or synthetic substances could increases maize vigor, particularly of seeds with poor viability. It is proven that some stimulators positively affect growth, water absorption and antioxidative response of plants [1-4]. The aim of experiment was to examine the influence of four mixed tetraoxanes on germination and early growth (seven-day old seedlings) of maize inbred line with low germination ability (<50%).

## EXPERIMENTAL
Seeds of maize line with lower germination ability (about 40%) were soaked into distilled water (control) and mixed tetraoxanes solution ($10^{-6}$ M; T1-T4).

The seeds were germinated under controlled laboratory conditions on filter paper (BP, 20⇔30°C, ISTA Rules [5]). After 7 days, germination rate was determined and length of roots and shoots were measured. After drying at 60°C roots and shoots fresh and dry weight were determined. Free energy (ΔG) of free water was calculated using sorption isotherm [6]:

$$\Delta G = -RT \ln(a_w)$$

From root and shoot samples DPPH reduction capacity was determined by the method of Abe [7], phytic acid (Pphy), phenoles (Phen) and soluble thiolic groups (PSH) were determined from the same extract [8-10]. Results are present with standard deviation (SD) and the dependences between examined parameters were obtained by correlation (Pearson's coefficients).

## RESULTS AND DISCUSSION

It was observed that all applied treatments induced increasing in germination rate (Figure 1), but the highest impact expressed T1 and T2, with increase for 11.3% correspond to control. From this point, dual role of peroxide (toxic and signalling) was surpassed [1], indicating greater safety with tetraoxanes usage.

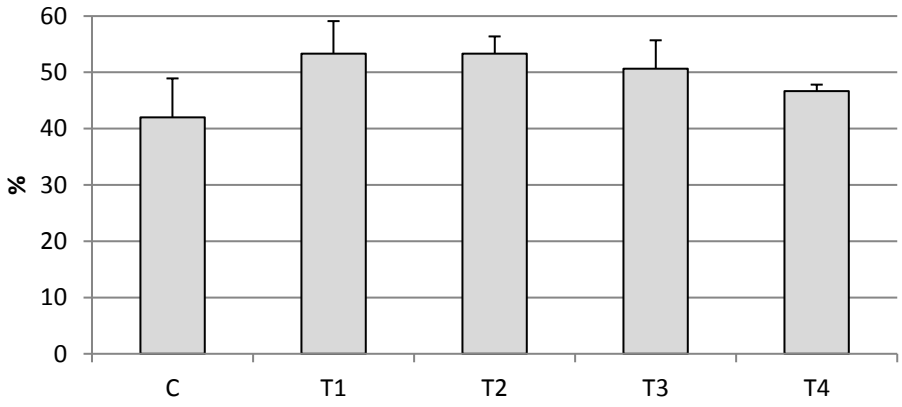


**Figure 1.** The influence of mixed tetraoxanes (T1-T4) and control (C) on germination rate

It was shown that maize seedlings react variously to applied treatments. Root and shoot length were increased by all treatments. For root the highest length increase was with T2 and T4 treatments and with T4 for shoot. High impact on the antioxidant parameters (DPPH, Pphy, Pphe and PSH) was observed in the root after treatment with all compounds, in comparison to control, indicating potentially increased stress tolerance [3]. Treatments with

T1 and T4 resulted with the highest values for DPPH, which is also tied with the highest values in Phen and lowest values in Pphy, indicating crucial Phen role as protective compounds abainst oxidative stress [2,9]. In addition, although treatments with T2 and T3 results with smallest change in DPPH, Phen and PSH, they exhibited the highest increase of Pphy, which had at the same time the highest variability among antioxidants. It is also important to underline that increase of DPPH-scavenging activity was positive connected to increase of phenolics and negative with increase of phytic acid, outlining them as a main antioxidants on the root level [2,4]. On the shoot level, treatment with T4 showed the highest impact on length, Pphy and Phen values. While the increase of shoot length coincidence with the highest Phen value, it is reversely related with Pphy.

**Table 1.** The influence of mixed tetraoxanes (T1-T4) on root and shoot length, free energy of free water (ΔG), DPPH-scavenging activity, phytic acid (Pphy), phenolics (Phen) and soluble thiol groups (PSH)

| | Length (cm) | ΔG (J $mol^{-1}$) | DPPH (%) | Pphy (mg P $g^{-1}$) | Phen (μg $g^{-1}$) | PSH (nmol $g^{-1}$) |
|---|---|---|---|---|---|---|
| | Root | | | | | |
| C# | 8.86 | 0.21 | 71.90 | 0.62 | 208.18 | 125.38 |
| T1 | 11.26 | 0.20 | 95.59 | 0.30 | 421.70 | 122.99 |
| T2 | 13.37 | 0.21 | 75.56 | 2.43 | 220.63 | 67.08 |
| T3 | 11.58 | 0.21 | 78.89 | 1.49 | 202.84 | 78.26 |
| T4 | 13.12 | 0.24 | 99.58 | 0.63 | 330.06 | 78.26 |
| Mean | 11.64±1.81 | 0.21±0.01 | 84.31±12.45 | 1.09±0.87 | 276.68±96.39 | 94.40±27.59 |
| | Shoot | | | | | |
| C | 4.84 | 0.22 | 90.85 | 1.48 | 572.05 | 214.83 |
| T1 | 7.33 | 0.22 | 94.14 | 1.58 | 492.87 | 239.58 |
| T2 | 7.33 | 0.20 | 99.25 | 1.93 | 548.92 | 190.07 |
| T3 | 6.20 | 0.21 | 75.14 | 1.30 | 653.90 | 224.41 |
| T4 | 8.16 | 0.22 | 99.20 | 0.69 | 701.05 | 223.61 |
| Mean | 6.77±1.29 | 0.21±0.01 | 91.72±9.93 | 1.40±0.46 | 593.76±83.35 | 218.50±18.22 |
| C# Control, distilled water. | | | | | | |

## CONCLUSION

Applied mixed tetraoxanes expressed various effects on maize germination and seedlings growth. Generally positive influence on germination rate and maize seedlings growth was achieved, through increase in DPPH-scavenging

activity, improve of water and antioxidative status by increasing of phytic acid and phenolics concentration.

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