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Cytotoxic effects of Reynoutria × bohémica extract in the Allium test model

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Introduction

Invasive species pose a significant threat to biodiversity. One such species is Reynoutria bohémica (Fig. 1) — a perennial herbaceous plant from the Polygonaceae family, first described in 1983. It is a hybrid of Reynoutria japonica and Reynoutria sachalinensis, it quickly spread, displacing local species. To study the allelopathic and cytotoxic properties of this plant, the Allium test was used — it is a standard plant test system based on onion.

Aim of the research: to evaluate the mutagenic and cytotoxic effects of the aqueous extract of Reynoutria bohémica on onion roots using the Allium test method and to compare them with effects of potassium dichromate ($K_2Cr_2O_7$).

Fig 1



Materials and methods

The alcoholic (96%) extract of Reynoutria in a 1:20 ratio was evaporated to a dry residue and dissolved with distilled water to the original volume. Bulbs of Stuttgart Riesen onion were germinated in various media: distilled water (negative control), distilled water with potassium dichromate (0.4 mg/L, positive control), as well as in similar media with bulbs pre-soaked in the Reynoutria extract. For each experimental variant 9 bulbs were taken. Then, squashed preparations of root tips were made, microphotographs of them were obtained using a Leica microscope. Cells in various mitotic phases and also chromosomal aberrations were counted.

Results

The results are presented in Diagram 1. Analysis of the results showed that mitotic indices in media with only distilled water and with soaking were close — 2.24% and 2.18% respectively, indicating no significant influence of the Reynoutria extract on cell proliferation.

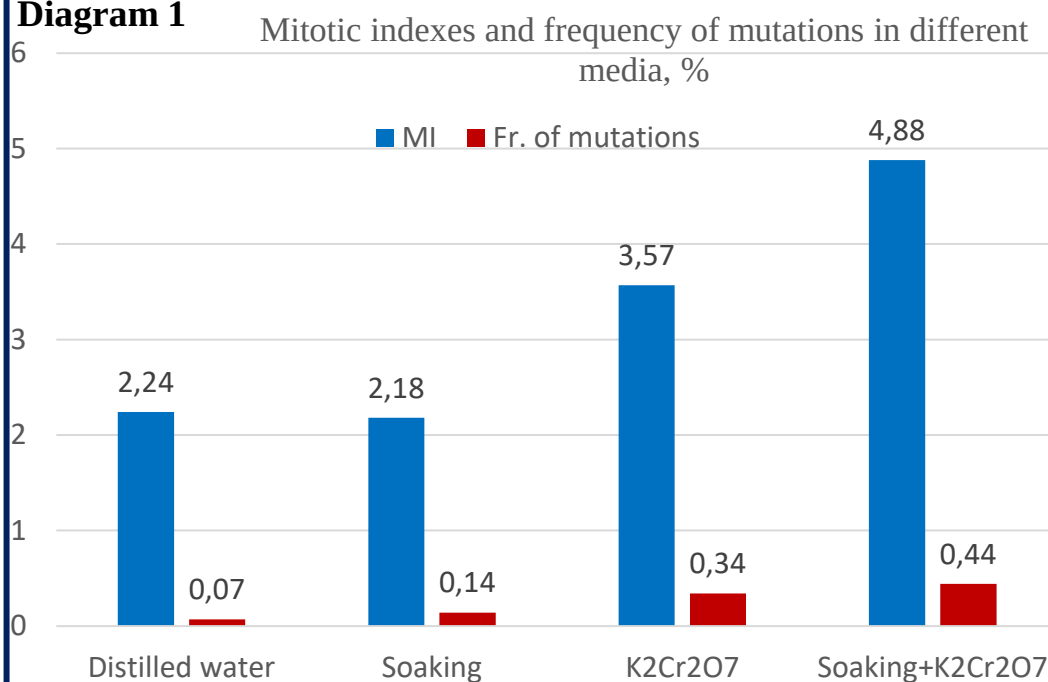
The frequency of chromosomal aberrations with soaking was twice as high as without it — 0.14% versus 0.07%.

In media with potassium dichromate, mitotic index was higher in the soaking variant — 4.88% versus 3.57% without it.

The frequency of chromosomal aberrations in media with potassium dichromate exceeded that in media without it; soaking increased mutagenicity in both cases. The highest frequency of aberrations was observed in the medium with soaking and potassium dichromate, that confirms the mutagenic properties of Reynoutria bohémica extract.

The distribution of cells by mitotic phases is presented in Diagram 2. The examples of chromosomal aberrations are showed in the Fig.2

Diagram 1



Conclusions

1. The extract of Reynoutria bohémica shows more pronounced mutagenic properties compared to potassium dichromate.
2. The combined action of the Reynoutria bohémica extract and potassium dichromate leads to an increase in mitotic disturbances.
3. The combined action of Reynoutria bohémica extract and potassium dichromate promotes an increasing of mitotic activity, while only the Reynoutria extract alone does not have such effect.

Diagram 2

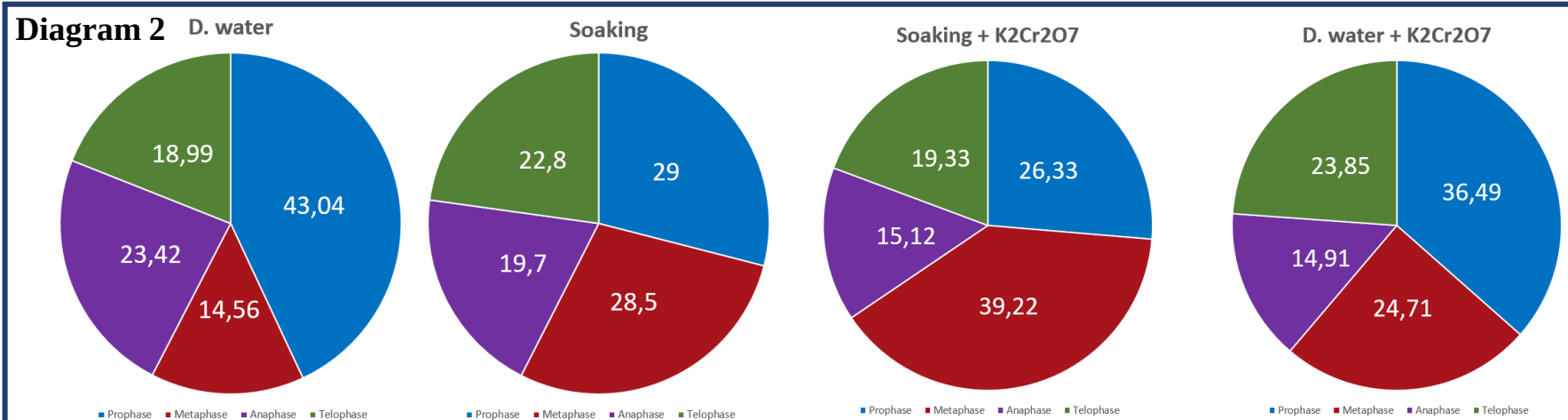
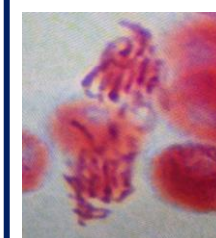
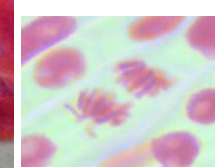
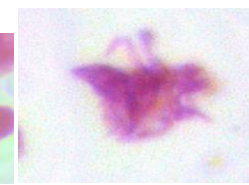
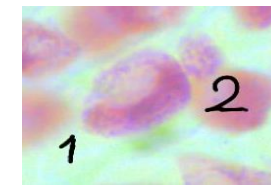


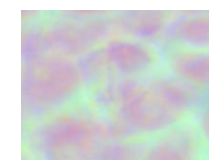
Fig.2 Chromosomal aberrations



Acentric fragments in anaphase (d. water, soaking),
prophase (d. water)



Additional nucleus – 2,
main nucleus – 1
(soaking+K2Cr2O7)



Anaphase bridge
(soaking+K2Cr2O7)