Enhancing the performance of chrysanthemum synthetic seeds through iron oxide nanoparticles supplementation

Dariusz Kulus[1], Alicja Tymoszuk[1], Magdalena Osiał[2], Daria Groń[1]

[1]Bydgoszcz University of Science and Technology, Faculty of Agriculture and Biotechnology, Laboratory of Ornamental Plants and Vegetable Crops, Bernardyńska 6, 85-029 Bydgoszcz, Poland, dkulus@gmail.com

[2]Polish Academy of Sciences, Institute of Fundamental Technological Research, Pawińskiego 5B Street, 02-106 Warsaw, Poland

Chrysanthemum holds significant economic importance as a popular ornamental plant globally, contributing to the horticultural and floricultural industries. To meet the growing demand for chrysanthemum plants, the development of synthetic seeds may become necessary, ensuring efficient propagation and genetic preservation of elite cultivars. Nanoparticles can be a valuable additive in the production of manufactured seeds as carriers of growth regulators. The aim of this study was to investigate the effect of iron oxide nanoparticles (Fe_3O_4NPs) in combination with auxin indole-3-acetic acid (IAA) on the growth and development of chrysanthemum synthetic seeds. Shoot tips of *Chrysanthemum* × *morifolium* (Ramat.) Hemsl. 'Richmond' were encapsulated in MS-based calcium alginate beads either with an addition of Fe_3O_4NPs alone or IAA or both the auxin and NPs. A control without Fe_2O_3NPs or IAA was included. Next, the synthetic seeds were inoculated on a water agar medium for six weeks and, then, sown in a greenhouse in a mixture of peat and perlite (2:1). It was found that the supplementation of alginate beads with Fe_3O_4NPs or IAA (alone or in combination) increased the germination efficiency (80 – 92%) compared with the control (60%). Even though the addition of nanoparticles did not enhance rhizogensis, synthetic seeds supplemented with Fe_3O_4NPs produced longer shoots that survived acclimatization better (75%) than the plant from the other treatments (11 – 33%). The reason for these results is that nanoparticles can ensure better nutrient and moisture retention. The utilization of nanoparticles in the production of synthetic seeds for chrysanthemum is a cutting-edge technique that can improve their viability and performance.

Keywords: artificial seeds; horticulture; IAA; *in vitro* tissue culture; manufactured seeds, ornamental plants; plant biotechnology; synseeds