EFFECTS OF SELENIUM AND COPPER SUPPLY ON GROWTH PARAMETERS OF *LEPIDIUM SATIVUM* AND *BRASSICA OLERACEA* SEEDLINGS

Tocai Mariana*, Laslo Vasile*, Vicas Simona Ioana*,

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048, Oradea, Romania, e-mail: tc_mariana@yahoo.com

Abstract

This study investigates the effect of different concentrations of nanoparticles (Se and Cu) uptake, on growth parameters in broccoli (Brassica oleracea var. cymosa) and cress (Lepidium sativum) sprouts,. Broccoli and cress seed were treated with nanoselenium and nanocopper solutions in different concentrations (10, 50,100 ppm) for 9 days. The treatment of Broccoli and cress sprouts with different concentration of nanoselenium and nanocopper showed no inhibitory effect on germination.The procent of germination of the samples treated with various concentrations of nanoSe ranged between 85-87% compared to the 89% of control. Application of nanoSe to broccoli sprouts shown no significant changes in terms of biomass, shoots length or root weight. With respect to the weight of the cress sprouts, significant differences were obtained with experimental variants treated with 50 ppm and 100 ppm of nanoCu compared to the control.

Key words: nano selenium, broccoli sprouts, germination, polyphenolic compounds, antioxidant activity

INTRODUCTION

The importance of selenium and cooper for human health has been suggested in a number of studies, altough because this minerals has narrow safety margin, the controversies surrouding supplementation still remain and epidemiologic data is far from being conclusive (Piekarska et al., 2014). Proper intake of selenium was shown to be associated with the reduced risk of prostate, skin, colorectal, liver, mamary, and lung cancers (Clark, 1998; Lener et al, 2013; Reid et al, 2002; Yoon et al., 2001; Zen & Combs, 2008; Zlowcka-Perlowska et al, 2012).

Cooper (Cu) a redox active metal is an essential nutrient for all species. Deficits of this nutrient during pregnancy can result in gross structural malformations in the conceptus, and persistent neurological and imunological abnormalities. Excessive amounts of Cu in the body can also pose a risk. Acute Cu toxicity can result in a number of pathologies and in severe cases , death. (Uriu- Adams et al., 2005).

The aim of this experimental work was to tested different concentration of nanoparticles (selenium and copper) on germination and growth parameters of broccoli and cress seeds and sprouts, respectively.

MATERIAL AND METHODS

The research was conducted in Biotechnological and Chemical and Biochemistry laboratories from Environmental Protection Faculty of University of Oradea.

Plant Material and Experimental Design

Broccoli and cress seeds (*Brassica oleracea* L. *botrytis* subvar. *Cymosa, Lepidium sativum,* respectively) were purchased from Agrosel company, certified as professional products. Seeds were sowed in plastic pots, 50 seeds/pot (in triplicate – 12 pots for each nanoparticle). The substrate used for growing the seedling was filter paper. The seeds were sprinkled twice a day with different concentration nanoselenium and nanocopper solution (10, 50 and 100 ppm). For each treatment, a control was used that was sprinkled with pure water. The experiments continued for 9 days.

Nanoselenium and nanocopper particles were purchased from Biotechnology Laboratory from Environmental Protection Faculty of University of Oradea.

Determination of germination capacity and biometrics measurements

The germination was carried out in the phytothron with controlled temperature (25 ^{0}C) and photoperiod (16 h of light, 8 h in the dark). The germination capacity was determined at 48 hours from starting the experiments, when the radicle was approximately 2 mm long or more. To determined the procent of germination (%) the following formula (Eq.1) was used:

Germination (%) =number of germinated seeds x 100 /total number seeds (Eq.1)

At the final of experiment (9 days), shoots and roots were separated, and their lenght or weight was measured immediately after harvest. Values were calculated in gram per 20 seedlings.

Statistical Data

All the data were processed by one-way analysis of variance (ANOVA) ($P = 0.05$). Mean value differences were analyzed with Tukey's test ($P = 0.05$).

RESULTS AND DISCUSSION

Germination samples was calculated at 48 hours after the start experiment; it was determined by counting the seeds do not germinate seeds in relation to the total number of seeds . The procent of germination (%) of broccoli and cress seeds grown under diferent concentrations of nano selenium (10, 50 and 100 ppm) are presented in Fig. 1 and Fig. 2.

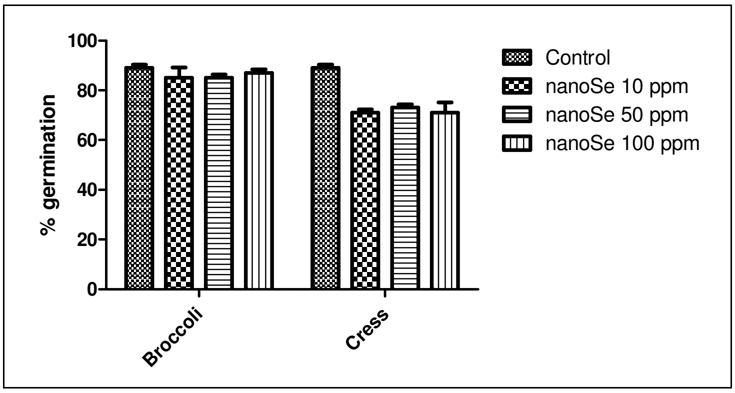


Fig. 1. The procent of germination (%) of broccoli and cress seeds grown under diferent concentrations of nano selenium (10, 50 and 100 ppm). Control means seed grown only with distilled water

Under nanoselenium treatment, the broccoli germination was not affected when the different concentrations of nanoselenium were used compared with control sample (Fig.1). However, in the case of treatment of cress with nanoselenium, the germination was lower compared with control, but not significantly difference between the different concentration of nanoselenium was noticed (Fig.1).

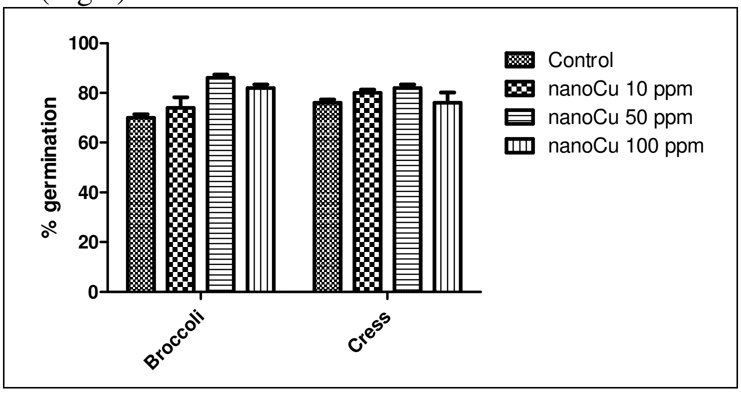
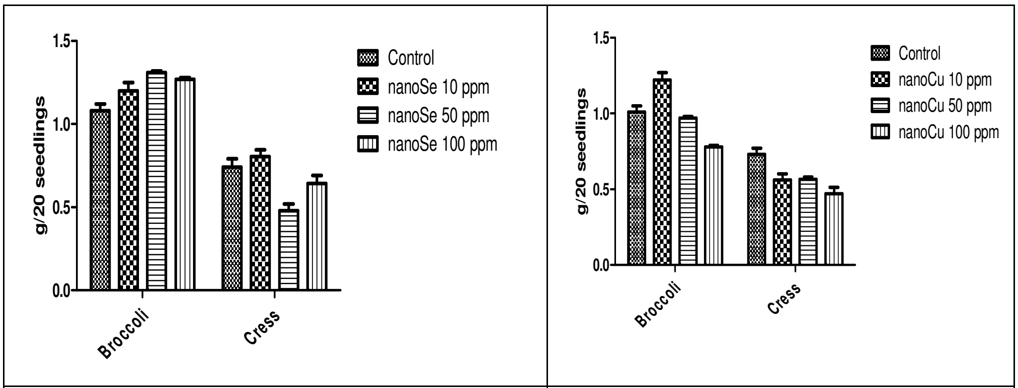


Fig. 2. The procent of germination (%) of broccoli and cress seeds grown under diferent concentrations of nano copper (10, 50 and 100 ppm). Control means seed grown only with distilled water

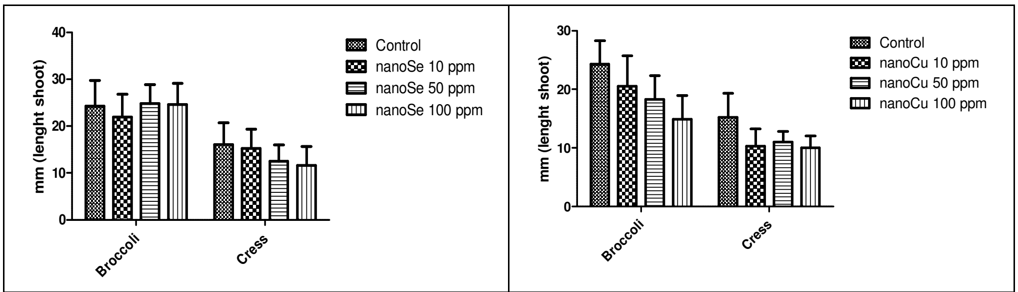
Using nanocopper supply, both samples, broccoli and cress recorder the increasses of procent of germination compared with control. The best results were obtained at 50 ppm nanocopper, in both cases (Fig.2).



a	b

Fig. 3. The biomass (g/20 seedlings) of broccoli and cress growth under different concentration of nano selenium (a); the biomass (g/20 seedlings) of broccoli and cress growth under different concentration of nano copper

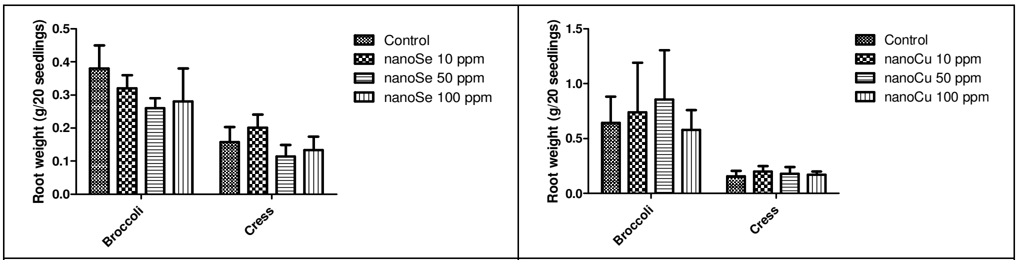
The increase amount biomass was the most at 50 ppm nanoSe in the case of broccoli sprouts, however in the case of cress was at 10 ppm. The effect of appling the nanoCu to broccoli, resulted the increased biomass at 10 ppm, but the biomass of cress was decreased at all concentration tested (Fig.3).



a	b

Fig. 4. The lenght shoot (in mm; average of 20 seedlings) of broccoli and cress growth under different concentration of nano selenium (a); the lenght shoot of broccoli and cress growth under different concentration of nano copper

Compared with the control, the lenght of broccoli shoots grown on nanoSe was not statistically significant. In the case of cress, decreases the lenght of shoots are direct depending of the nanoSe concentration used (Fig.4). Using nanoCu, as treatment of broccoli seeds, resulted in decreasing the lenght of shoots, depending on the concentrations. Also, the lenght of shoots of cress seedlings was decreases comparative with control, but no significantly between the concentration of nanoparticles (Fig.4).



a	b

Fig.5. The root weight (average of 20 seedlings) of broccoli and cress growth under different concentration of nano selenium (a); the root weight of broccoli and cress growth under different concentration of nano copper

Regarding to the root weight, the broccoli sprouts recorded the decrease in it comparative with control. In the cress samples, the highest weight of roots was obtained at 10 pp nanoselenium concentration. When the nano Cu was used in treatment, the weight of broccoli sprouts was higher at 50 ppm. The root weight of cress was not affected by the applying of nano Cu treatment. Appling the nanoSe and nanoCu particles during germination of two kind of seeds (broccoli and cress) did not inhibit the growth of seedlings.

Some *Brassica* vegetables have been designated as selenium acumulators because of their ability to absorb large amounts of inorganic form of selenium (Piekarska et al., 2014). Inorganic form of selenium absorbed may be transformed into varios forms. Because selenium and sulfur share the same uptake and assimilation pathways in plants, selenium can be incorporated into any organo-sulfur compund (Ramos et al., 2011).

The researchs carried out in recent years have shown that the effectiveness of copper-based fungicides can be greatly improved by reducing the particle sizeof nanoparticles. The smaller particle size induce the higher fungicide and bactericide effect. Coverage is better when the particles are smaller because it increases the total area per gram of product that can emit copper ions in humidity conditions. (Chira , 2012).

CONCLUSIONS

In this work, the broccoli seeds watered with nanoSe particles is an efficient way of enriching *Brassica* sprouts with this element without a visible impact on plant physiology. Brassica sprouts and their biological effects in human health suggest that nanoSe-enriched sprouts may be recommanded as a good and safe means for combating selenium deficiencies in the diet.

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