



## Comparison of Effect of Sodium Silicate Particle Size in Nutritional Solution on Physiological Growth Trials of Maize Seedlings under Cadmium Stress

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**Introduction:** Although silicon (Si) is the second most abundant element in the earth's crust and its content in plants often reaches values of macronutrients, it is not listed among plant essential elements. However, the beneficial effects of Si in alleviation of various kinds of biotic stresses are well known. Concerning biotic stress, Si enhances, for instance, the resistance of plants to the pathogenic fungi, and it protects plants against and various kinds of insects. Silicon can also mitigate abiotic stresses in plants. Silicon can also reduce the negative effects of some toxic metals in plant species. Cadmium (Cd) is one of the most dangerous toxic metals for living organisms. It is a hazardous contaminant of food and through the food chains enters the human body as a cumulative poison. Contamination of agricultural soils by Cd represents a serious. Environmental problem in many countries and ranks high in food safety issues. Silicon was recently described as an effective substance for alleviation of Cd toxicity in some plants. The use of nano-compound material has given a lot of attention by the agricultural researchers, especially by those investigating seed characteristics, although their exact mechanisms of actions are not well understood. Nanomaterials, because of their tiny size, show unique characteristics. For example, they can change physico-chemical properties compared to bulk materials. They have greater surface area than bulk materials, and due to this larger surface area, their solubility and surface reactivity tend to be higher.

**Materials and Methods:** This experiment was conducted in an environmentally controlled Research greenhouse in Department of Agronomy, Ferdowsi University of Mashhad, Iran. Corn (SC 704) seeds were germinated in a soil less growing system in cocopite. When the seedlings were at the two leaves stage of growth, they were transplanted hydroponic culture. Experiment was carried out as a factorial based using completely randomized design with four replications the. Treatments were included cadmium (CdSO<sub>4</sub>) stress levels (Zero, 50 and 100  $\mu\text{mol l}^{-1}$ ) and sodium silicate treatments (control (Zero), Nano and micro particles with 2 mM concentration).

**Results and Discussion:** The results showed that the effects of sodium silicate, cadmium and their interactions on membrane stability index, specific leaf area, stomatal conductance, Fv/Fm, height, stem diameter, leaf area, shoot dry weight, root dry weight and shoot to root weight ratio was significant. But interaction between cadmium and sodium silicate on relative water content and leaf chlorophyll index was not significant. By increasing of Cd concentration, membrane stability index, chlorophyll index, Fv/Fm, relative water content, specific leaf area, stomatal conductance, height, stem diameter, leaf area, shoot dry weight and root dry weight trials reduced compared to control significantly. In no cadmium condition, sodium silicate nano-particles application reduced height, stem diameter, leaf area and shoot dry weight 12.8, 9, 34.2 and 23.2% compared to control, respectively. In contrast, using of micro particles in non-stress condition, had a positive effect on above mentioned traits. But in 50  $\mu\text{mol l}^{-1}$  Cd, nano-particles increased membrane stability index, specific leaf area, stomatal conductance, stem diameter and shoot dry weight trials, significantly. At highest concentration of cadmium, effect of micro particles on membrane stability index, stomatal conductance and shoot to root was higher than nano-particles. Also, using of nano particles had a positive effect on above mentioned traits in Cd stress condition. In general, application of nano particles in non-cadmium stress conditions had phytotoxicity effects on corn and only in cadmium stress condition, the effect of these particles showed their positive effect.

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**Conclusions:** In general, silicon nanoparticles were only beneficial effect of cadmium stress. Hence, the use of sodium silicate nanoparticles of was possible only in conditions of cadmium stress.

**Keywords:** Chlorophyll fluorescence, Correlation, Hydroponic culture, Nano-particles