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Syed Mohmad Afrayeem
Research scholar in Seed Science and Technology, Dept. of Genetics and plant Breeding SHUATS, Allahabad UP, India

AK Chaurasia
Associate Professor, Dept. of Genetics and plant Breeding SHUATS, Allahabad UP, India

Correspondence
Syed Mohmad Afrayeem
Research scholar in Seed Science and Technology, Dept. of Genetics and plant Breeding SHUATS, Allahabad UP, India

Effect of zinc oxide nanoparticles on seed germination and seed vigour in chilli (*Capsicum annuum* L.)

Syed Mohmad Afrayeem and AK Chaurasia

Abstract
In order to determine the effect of zinc oxide nanoparticles on seed germination and seed vigour in chilli, an experiment was conducted at the Seed Testing Laboratory (STL) of Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Deemed to be university, Allahabad in CRD (Completely Randomized Block Design) having three replications. In present investigation, different concentration (0.0, 0.25,0.50 and 0.75g) of ZnO Nps were prepared in distilled water and used for the treatment in chilli seeds to study the effect on seed germination, root length, shoot length and seedling growth. The results showed that the effect of ZnO nanopaticle was significant on germination percentage, root length, shoot length and seedling length. Seed germination increased in higher concentrations, however showed decrease in values at lower concentrations. The root, shoot and seedling length was also maximum in higher concentration and in lower concentrations it showed decreased values.

Keywords: Nanoparticles, germination, vigour, chilli, treatment.

Introduction
Chilli (*Capsicum annuum*) belongs to the genus Capsicum under Solanaceae family widely grown in almost all areas and seasons in India (Asaduzzaman *et al.*, 2010) [6]. Chilli is widely grown as spice, vegetable or cash crop in the tropics. (Hemannavar, 2008) [7]. Globally chili is grown over an area of 1.7 million ha with production of 7.18 million tons (Anon., 2014) [5]. The average yield of chilli in India is 1.878 metric t ha -1 which is very low compared to the yield of other chilli growing countries of the world. Delayed and erratic germination of chilli seeds is one of the reasons of low yield of chilli. There are many factors responsible for the delayed and erratic germination of chilli seeds. Among the various factors, diseases are predominant. Chilli suffers from many diseases caused by fungi, bacteria, viruses, nematodes and also abiotic stresses. Fungal diseases play a vital role in reducing the germination of chilli. Among the fungal diseases damping off, anthracnose or fruit rot, powdery mildew and leaf spots are the most prevalent ones. It is a wide year spread problem limiting the profitable cultivation and seed production throughout the major chilli growing regions of India. The disease has been observed to occur in three phases viz., (i) seedling blight or damping off stage, prevalent in the nursery, (ii) leaf spotting and die back stage which is initiated at different stages of growth and (iii) fruit rot stage in which especially the ripe fruits are infected. The disease is both seed borne and air borne and affects seed germination and vigour to a greater extent (Ahmed, 1982; Perane and Joi, 1988; Mesta, 1996 and Asalmol *et al.*, 2001) [1-4]. Seed treatment is a process of treating seeds by any physical, chemical, biological or other agent(s) to destroy harmful seed-borne organisms or to protect the seeds against infection. It is done to prevent germination failure and seedling infection, to destroy external and internal seed borne pathogens and to develop a protective zone around the seed in the soil which protects the germinating seed and seedling from the attack of certain soil borne pathogens. To increase the production of chilli qualitatively and quantitatively; farmer requires healthy and quality seeds with high percentage of germination and purity. Hence, it is imperative that seeds must be tested before they are sown in the field.

The biocidal properties of the NPs have significant practical relevance. Antibacterial and antifungal properties of metal NPs can be tapped to control bacterial and fungal organisms responsible for crop losses. However, it must be very clear that these NPs should not have any adverse effect in plant systems. Hence, in present investigation it was planned to study the influence of ZnO NPs on seed germination and seed vigour in chilli.

Materials and Methods
Department of Genetics and Plant Breeding, Sam Higginbotom University of Agriculture,

Technology & Sciences (SHUATS), Allahabad during November 2016 to February 2017. Seeds of chilli were used in the experiment collected from GBPUA&T, Pantnagar University. Collected seed samples were stored at temperature (20°C). There were four treatment combinations used in this study which are as follows: T0=Control (untreated), T1=Seed treatment with ZnO (0.25g), T2 = Seed treatment with ZnO (0.5g) and T3 = Seed treatment with ZnO (0.75g). Seeds were treated in different concentrations of zinc oxide nanoparticle for six hours as well as control. After six hours seeds were dried for some time and placed on moistened blotter paper at the rate of 100 seeds per plate. Data were recorded on percent seed germination, root length, shoot length and total length at 14 days. Completely Randomized Design (CRD) was followed to carry out the experiment. Each treatment was replicated thrice. The collected data on different parameters were analyzed statistically.

Results and Discussion

Results pertaining to seed germination and early seedling growth clearly indicate that ZnO NPs at lower concentration reduce seed germination and seedling growth, but at higher concentration promote seed germination and seedling growth. Highest concentration (0.75g) of ZnO NPs showed significantly high germination percentages i.e. 65.7% whereas untreated seeds showed 62 % seed germination (Table. 1). Lower concentrations of ZnO NPs (0.25 and 0.50g) showed significant decrease in shoot and root lengths, however higher concentrations (0.75g) of ZnO NPs showed increased root length, shoot length and total seedlings height. There was no major difference in root shoot ratio in all treatments however an increasing trend was seen from lower to higher concentrations. Lee *et al.*, (2008) [8] studied the effect of copper nanoparticles on bean (*Phaseolus radiatus*) and wheat (*T. aestivum*) plants. They observed decrease in growth parameters in the seedlings due to copper nanoparticles. However Zheng *et al*., (2005) [10] observed significant enhancement in the growth of spinach in lower concentrations of nano TiO2 as compared to higher concentrations. Lin and Xing (2007) [9] evaluated phytotoxicity of five types of metallic nanoparticles in six higher plant species and indicated that seed germination was not affected except for the inhibition of nano ZnO in *Lolium multiflorum* and *Zea mays*.

Table 1: Mean performance of chilli seed for germination and vigour parameters

Treatments	Germination Percentage (%)	Root Length (cm)	Shoot Length(cm)	Total Seedling Length(cm)
T_0	61.00	0.90	2.31	3.22
T_1	62.00	1.20	2.10	3.30
T_2	63.66	1.21	2.38	3.59
T_3	65.00	1.35	2.40	3.75
Grand Mean	62.91	1.16	2.30	3.46
CD 5%	2.17	0.28	0.19	0.27
CV	1.83	12.89	4.59	4.23
Max	65	1.35	2.40	3.75
Min	61	0.90	2.10	3.22

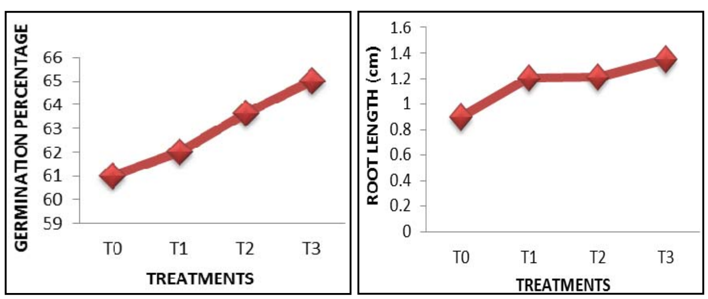

Fig 1: Effect of zinc oxide nanoparticle on seed germination and root length

They indicated that inhibition of root growth varied significantly among nanoparticles and plants, and it is partially correlated to nanoparticle concentration. It was earlier reported that 2000 mg/l (among the concentrations of 20, 200, 2000 mg/l) of the nano-Al_2O_3 suspensions shows inhibitions of root growth on five different plant species [13]. The concentrations of 2000 mg/l were, initially used to see the effect of silver nanoparticles on seed germination, root and shoot growth. Germination of seeds and application of nanoparticles during germination will be carried out following the method described by Lin and Xing (2007) [9].

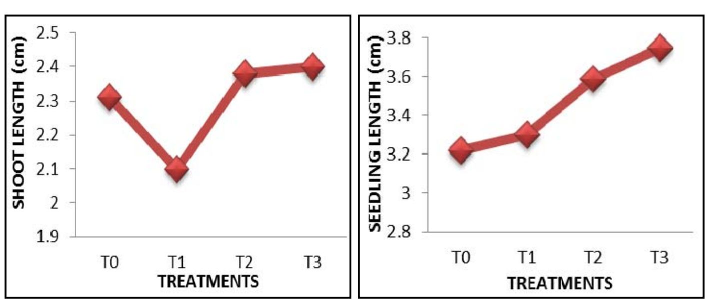

Fig 2: Effect of zinc oxide nanoparticle on shoot length and seedling length

Conclusion

ZnO nanoparticles inhibit root elongations, increased germination rate and early flowering. Zinc oxide NPs have also potential to boost the yield and growth of food crops and release fertilizers which saves fertilizer consumption and minimize environmental pollution. However, due to their unique properties, a number of researches have been done on the toxicological effect of NPs on plants, yet research focusing on the realization of the beneficial effects of NPs on plant remains incomplete. Few studies have shown positive effect of NPs

on plant growth and development The result shows that ZnO at higher concentrations increase the seed germination, root length, shoot length and seedling growth that indicates the higher concentrations is not harmful to the chilli plant.

References

1. Ahmed SS. Studies on Seed Borne Aspects of Anthracnose of Chillies Caused by *Colletotrichum capsici* (Sydow.)Butler and Bisby.M. Sc. (Agri.) Thesis, University of Agricultural Sciences, Bangalore, 1982.
2. Perane RR, Joi MB. Studies on Seed Borne Infection of Fruit Rot and Dieback of Chillies. J. Maharashtra Agric. Univ. 1988; 13:231-232.
3. Mesta RK. Studies on Fruit Rot of Chilli Caused by *Colletotrichum capsici* (Sydow.) Butler and Bisby. M. Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad, 1996.
4. Asalmol MN, Kale VP, Ingle ST. Seed Borne Fungi of Chilli, Incidence and Effect on Seed Germination. Seed Res. 2001; 29(1):76-79.
5. Anonymous. FAO Statistical Year Book, Publishers Food and Agriculture Organization of UN, Rome, 2014, 75-76.
6. Asaduzzaman M, Alam MJ, Islam MM. Effect of *Trichoderma* on Seed Germination and Seedling Parameters of Chilli. Journal of Science Foundation. 2010; 8(1&2):141-150.
7. Hemannavar V. Studies on Seed Borne Aspects of Anthracnose of Chilli and Its Management. MS Thesis, Department of Plant Pathology, College of Agriculture, University of Agricultural Sciences, Dharwad-580005, 2008.
8. Lee WM, An YJ, Yoon H, Kwbon HS. Toxicity and bioavailability of copper nanoparticles to the terrestrial plants mung bean *Phaseolus radiatus* and wheat Triticum aestivum: plant agar test for water-insoluble nanoparticles. Environ Toxic Chem. 2008; 27:1915, 1921.
9. Lin D, Xing B. Phytotoxicity of nanoparticles: inhibition of seed germination and root growth. Environ Pollution. 2007; 150:243, 250.
10. Zheng L, Hong F, Lu S, Liu C. Effect of nano-TiO2 on strength of naturally aged seeds and growth of spinach. Biol Trace Elem Res. 2005; 105:83, 91.