International Journal of Microbiology Research
ISSN: 0975-5276 & E-ISSN: 0975-9174, Volume 9, Issue 5, 2017, pp.-897-898.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000234

Research Article

EFFECTS OF NANO ZINC OXIDE PARTICLES ON SEEDLING GROWTH OF MAIZE (*Zea mays* L.) IN GERMINATING PAPER TEST

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Received: April 23, 2016; Revised: May 10, 2017; Accepted: May 11, 2017; Published: May 28, 2017

Abstract- The Lab experiments was conducted during *kharif* season of 2016-17 in laboratory of Department of Agronomy, Gandhi Krishi Vigyana Kendra (G.K.V.K), University of Agricultural Sciences (UAS), Bengaluru with different concentration of nano zinc oxide (800 ppm, 1000 ppm, 1200 ppm 1400 ppm and 1600 ppm) to assess the performance of maize seedling. Among the different concentration of nano zinc oxide 1200 ppm recorded higher root length (13.43 cm), shoot length (10.43 cm) and seed vigour index (2186.25) and lowest under De ionised distil water (6.53 cm, 5.79 and 1129.33 cm).

Keywords- Nano ZnO, Maize, Germination, SVI.

Citation: Meena Dharam Singh, et al, (2017) Effects of Nano Zinc Oxide Particles on Seedling Growth of Maize (*Zea mays* L.) in Germinating Paper Test. International Journal of Microbiology Research, ISSN: 0975-5276 & E-ISSN: 0975-9174, Volume 9, Issue 5, pp.-897-898.

Introduction

Maize (*Zea mays L.*) is the third most important cereal crop in the world after wheat and rice with an area of 182 million ha, production of 987 million tonnes and productivity of 5423 kg per ha (Anon, 2015) [1]. Maize is considered as "Queen of Cereals" because of its high production potential and wider adaptability. In India, it is cultivated on an area of 8.55 million ha with a production of 22. 23 million tonnes and the productivity of 2600 kg per ha (Anon., 2015) [1]. In Karnataka, it is cultivated on an area of 1.36 million ha with a production of 4.09 million tonnes with an average productivity of 3018 kg per ha (Anon., 2015) [2]. In addition it is having several important uses such as quality food for human, quality feed for animals and also use for production of alcohol, starch protein and oil and more recently it considered as potential bio-fuel crop in India. Maize occupies important place as food (25%), animal feed (12%) poultry feed (49%), industrial products mainly starch (12%) and one per cent each in brewery and seed. Maize has attained a commercial crop status due to easiness in cultivation, tolerance towards pest and diseases, high yield and better market price. It comes up well under a wide range of soil and climatic conditions. There is a lot of scope to increase the present maize yield.

Nano technology is a field of convergence among life sciences, material science and information technology. It is an emerging field of science capable of resolving issues and problems that are impossible to tackle in engineering and biological sciences. Among the advancement in sciences, nanotechnology is being visualized as a rapidly evolving field that has potential to revolutionize agriculture and food systems and improve the condition of the poor.

Khodakovskaya *et al.* 2012 [3] suggested that nanoparticles interact with plants causing many morphological and physiological changes, depending on the properties of nano aprticles. Surface area, solubility and penetrability of nano particles decides the efficacy of applied nano zinc oxide on the crops. Ma *et al.* 2010 reported effects of nano on crop plants particles depends on size, chemical and physical properties of nano particles. [4].

The present study was taken up to investigate the promontory or inhibitory effects of various concentrations of ZnO nanoparticles on seedling growth of maize (*Zea Mays* L.). Nanoparticles with small size and large surface area are expected to be the ideal forms for use as a Zn fertilizer in plants. Farmers are using both sulphates and chelated Zn (with ethylene di ammine tetra acetic acid, EDTA) for soil and foliar applications; however, the efficacy is low.

Materials and Methods

The Lab experiments were conducted during *kharif* season of 2016-17 in germination papers. The details of material used and methodology adopted during the course of investigation entitled "Effects of nano zinc oxide (ZnO) particles on seed germination root and shoot length maize (*Zea mays L.*)". The Lab experiment was conducted in the Laboratory of Department of Agronomy, Gandhi Krishi Vigyana Kendra (G.K.V.K), University of Agricultural Sciences (UAS), Bangalore - 560 065. The site is in Region III and agro climatic zone V (Eastern Dry Zone) of Karnataka. Lab experiment was conducted to assess the performance of maize seed treated with different concentrations of nano zinc oxide (800 ppm, 1000 ppm, 1200 ppm 1400 ppm and 1600 ppm).

Preparation of Particle Suspensions and Zinc Ion Solution

The nano particles were suspended directly in double distilled water (DDW) and dispersed by using mechanical stirrer for 30 min. Small magnetic bars were placed in the suspensions for stirring before use to avoid aggregation of the particles. Zinc ion (Zn^{2+}) solution was prepared by dissolving zinc sulfate heptahydrate ($ZnSO_4.7H_2O$) in DDW.

Results and Discussion

A lab experiment was conducted by using different concentrations of nano zinc oxide in the Laboratory of Department of Agronomy, GKVK, UAS, Bengaluru, Karnataka using germinating papers h to assess the effect of nano ZnO on

seedling growth of maize. Among the different concentrations of nano zinc oxide 1200 ppm recorded higher root length (13.43 cm), shoot length (10.43 cm) and seed vigour index (2186.25) and lowest under De ionised distil water(6.53 cm, 5.79 and 1129.33 cm). Several researchers reported that nano zinc oxides increase growth of the plant of different crops like Sedghi *et al.* (2013) [5] in soybean, Raskar and Laware (2014) [6] in onion, Ramesh et al. (2014) [7] in wheat and Prasad *et al*. (2012) [8] in peanut and many studies, increasing evidence suggests that zinc oxide nanoparticles (ZnONPs) increase plant growth and development. However, higher dose of ZnO nano particles inhibit the germination, growth and development of the plants which is depends on the concentration.

Table-1 *Effects of nano zinc oxide on seedling growth of the maize*

Treatments	Germination %	Root length (cm)	Shoot length (cm)	SVI
1. 800 ppm	83.33	13.15	9.59	1895.00
2. 1000 ppm	91.67	13.21	9.88	2116.35
3. 1200 ppm	91.67	13.43	10.43	2186.25
4. 1400 ppm	91.67	11.31	8.70	1834.48
5. 1600 ppm	83.33	11.30	8.58	1656.46
6. ZnSO4(0.5%)	100.00	5.65	12.37	1801.50
7. DI Water	91.67	6.53	5.79	1129.33
CD (0.01)	2.37	2.39	2.38	2.38

Among the different treatments $ZnSO_4$ 0.5 % recorded higher root length and SVI than DI water but it were lower than the nano ZnO oxide concentrations it is mainly because of nano zinc increase the availability of zinc to growing seedling which result in increased the growth of seedling. Similarly positive effects of nano ZnS particles were observed by Meena Dharam Singh and B. N. Aravinda Kumar (2017) [9] and similar results were obtained by Rosa et al. (2013) applied different concentrations of ZnO nano particles on tomato, alfalfa and cucumber and reported that seed germination was enhanced by nano particles of zinc oxide [10].

Conclusion

Nano particles have both positive and negative effects on crop which depends on concentration of solution, size of particles, chemical and physical properties of nano particles. In present experiment nano zinc oxide shown both positive and inhibitory effects on seedling growth of maize. Among the different concentration of nano zinc oxide 1200 ppm recorded higher root length (13.43 cm), shoot length (10.43 cm) and seed vigour index (2186.25) further increase in concentration recorded inhibitory effects on maize sedlings.

Acknowledgement / Funding: Author are thankful to Department of Agronomy, College of Agriculture, University of Agricultural Sciences, Dharwad, Karnataka 580005

Author Contributions: All author equally contributed

Abbreviations:

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of Interest: None declared

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