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Research Article

Seed Health Status during Storage in Chilli (*Capsicum annuum* L.) under the Influence of Chemically Synthesized Nanoparticles

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Abstract

Seed treatment with fungicide is a common practice for controlling seed-borne diseases which cause pollution to environment; while nanoparticles may be the alternative agent to treat the seed without any hazard to mammal and beneficial microbes. Thus, the effect of nanoparticles (Zinc oxide and Almonium oxide) at different dilutions on the seed health status of chilli seed was evaluated. Three concentations of both zinc and almonium nanoparticls as 25µg, 50 µg, and 75 µg including a control (untreated) were tested. Seeds were kept in the different concentrations of nanoparticles for eight hours, air-dried and then sun dried to 12-13% moisture content. The treated seeds were preserved in polythene bags. Health was assayed following blotter test for detection of fungal infection at different intervals of storage period (tri-monthly) up to 12 months. The treatment T_3 (ZnO @ 0.75µg/ltr) showed lowest fungal seed infection (*Fusarium mondiforme*) as compared to control (untreated) which showed highest seed infection percentage at every interval of storage period. With the increase of storage period seed infection with *Fusarium mondiforme* increases gradually. The lowest seed-borne infection was observed in seeds treated with Zinc oxide nanoparticls followed by concentrations of almonium oxide nanoparticles. Hence it was seen that zinc oxide nanoparticles at higher concentrations has positive effects and aluminium oxide showed negative effects on seed health status in chilli.

Keywords: *Treatments, nanoparticles, chilli, storage, infection.*

Introduction

Chilli suffers from many diseases caused by fungi, bacteria and viruses. Among the fungal diseases, powdery mildew, cercospora leaf spot and anthracnose are the most prevalent ones Akpomedaye, *et al.*, (1998). The powdery mildew caused by *Leveillula taurica* (Lev.) and is a major constraint in Chilli production in India causing heavy yield loss ranging from 14 to 20 per cent, due to severe defoliation and reduction in size and number of fruits per plant (Mathur, *et al.*, 1972, Sivaprakasam, *et al.*, 1976 and Gohokar and Peshney, 1981). Scientists are working on nano-engineered enzymes that will allow simple and cost-effective conversion of cellulose from waste plant parts into ethanol. 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. (Liou and Wu, 2010). Hence the present investigation was carried out to study the effect of nanoparticles on seed health status in Chilli during storage.

Materials and Methods

The present investigation entitled "Effect of nanoparticles on seed health status during storage in chilli was conducted during the year 2017-2018 at the Seed Technology Laboratory of Department of Genetics and

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Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj in CRD (Complete Randomized Block Design) having four replications.

The experimental material comprising of a variety "Pant-C1" was collected from Directorate of Seed and Farm, G. B. Pant University of Agriculture Sciences and Technology, Uttarakhand.

The nanoparticles (Zinc oxide and Aluminum oxide) were synthesized at Seed Testing Laboratory SHUATS, Prayagraj and laboratory of chemistry, University of Allahabad and National Botanical Research Institute, Lucknow. The seeds were treated before kept in storage with three concentrations of nanoparticles (zinc and aluminium oxide) each 25µg, 50 µg, and 75 µg having 6 treatments with control (untreated). The observation on seed health was recorded through blotter test for fungal infection after the completing of different intervals of storage period (tri-monthly) till the end of whole storage period of 12 months. The experimental data recorded were subjected to suitable statistical analysis for the parameters, viz. mean, standard deviation and standard error of mean.

Synthesis of Nanoparticles

Alumina nanoparticles were prepared by sol gel method using aluminum nitrate precursor and ammonium carbonate **(Ruihong, *et al.*, 2006 and Hochepied, *et al.*, 2003).** 50ml aluminum nitrate 3M solution was taken at temperature 65-85 degree. Then add 50 ml 3M solution drop by drop ammonium carbonate and stair continuously to obtain white milky suspension. Suspension was filtered and calcinated silica crucible at 300 to 400 degree in mufalfurnace and white crystals were obtained. ZnO nanoparticles was prepared as reported by **(Beek, *et al.*, 2005)** through the hydrolysis. 50ml zinc nitrate 3M solution was taken at temperature 65-85 degree. Then add 50 ml 3M solution drop by drop sodium hydroxide and stair continuously to obtain white milky suspension. Suspension was filtered and calcinated silica crucible at 300 to 400 degree in mufalfurnace and white crystals were obtained. Once the samples were obtained via the synthesis route, they were characterized using, in the first instance, transmission electron microscopy (TEM), and X-ray diffraction (XRD).

Results and Discussion

The data on seed infection (*Fusarium*) as influenced by seed treatment with nanoparticles during storage are presented in Table. With the advancement of storage period, seed infection (*Fusarium*) has increased irrespective of treatments. The mean seed infection increased from (5.11) percent at the initial month storage period to (10.85) percent by the end of storage period. The seeds treated with higher concentrations of aluminum oxide nanoparticles showed high fungal infection (*Fusarium*), whereas seed infection percent decreased gradually at lower concentrations of Al_2O_3 nanoparticles. This shows there was not much effect on seed health when seeds were treated with Al_2O_3 nanoparticles. The seeds treated with zinc oxide nanoparticles showed minimum seed infection. The seed infection (*Fusarium*) varied significantly among treatments throughout the storage period. From third month onwards seed infection varied significantly and lowest seed infection (*Fusarium*) was recorded in seeds treated with T_3 (ZnO @ 0.75µg/ltr) (4.75%) followed by T_2 (ZnO @ 0.50µg /ltr) (5.25 %) which was on par with T_4 (Al_2O_3 @ 0.25µg/ltr) (5.35%), and T_1 (ZnO @ 0.25µg/ltr) (5.88%), While significantly highest seed infection was recorded in T_0 (8.53%) control. Similar trend was noticed through the storage period. At the end of storage period significantly lowest seed infection (*Fusarium*) was recorded in T_3 (ZnO @ 0.75µg/ltr) (9.76 %) followed by T_2 (ZnO @ 0.50µg /ltr) (9.90%) which was at par with T_1 (ZnO @ 0.25µg/ltr) (10.53 %) and T_5 (Al_2O_3@ 0.50µg/ltr) (11.03 %), While significantly highest seed infection was recorded in control T_0 (12.25 %) control.

Overall, we found through our study that Al_2O_3 nanoparticles have a negative impact on the growth and yield on chilli and Zinc oxide nanoparticles had positive effect. Researchers like **Camp and Fudge (1945), Chapman (1966), Viets (1966), Anderson (1972), Mengel and Kirkby (1978), Marschner (1993), Brown, *et al.* (1993) and Fageria, *et al.* (2002)** have reported essential and important role of zinc in plant growth, reproduction and yield. It has been indicated that the retention time of Zn in the plant system is low and hence, the bioavailability of Zn for long period is not sure with the use of ZnSO4 fertilizer. Farmers are using both zinc sulfate for soil and foliar applications; however, the efficacy is low.

Table: effect of nanoparticles on seed health status during different intervals of storage period in chilli

Treatments		0 Months	3 Months	6 Months	9 Months	12 Months
T_0	Untreated (Control)	7.43	8.53	9.33	10.29	12.25
T_1	ZnO_3 @ 0.25µg/ltr	4.78	5.88	6.68	7.70	10.53
T_2	ZnO_3 @ 0.50µg/ltr	5.05	5.25	6.95	7.68	9.90
T_3	ZnO_3 @ 0.75µg/ltr	3.65	4.75	5.55	6.58	9.76
T_4	Al_2O_3 @ 0.25µg/ltr	4.15	5.35	6.05	7.10	10.30
T_5	Al_2O_3@ 0.50µg/ltr	4.25	6.15	6.15	7.23	11.03
T_6	Al_2O_3@ 0.75µg/ltr	6.49	7.67	8.89	9.92	12.18
MEAN		**5.11**	**6.22**	**7.08**	**8.07**	**10.85**
SE(m)		0.47	0.50	0.49	0.58	0.78
SE(d)		0.51	0.36	0.59	0.34	0.76

Barrena, *et al.* (2009), Arora, *et al.* (2012), Savithramma, *et al.* (2012) and Gopinath, (2014) reported that AuNPs improve seed germination in lettuce, cucumber, mustard; Boswellia ovalifoliolata reported that AuNPs improve seed germination. Currently Prasad, *et al.,* (2012) studied the effect of nanoscale zinc oxide on the germination, growth and yield of peanut and observed significantly more growth and yield. Maintenance of seed vigor and viability during storage is a matter of prime concern in India. Owing to the prevailing sub-tropical climate in the major parts of the country, seeds of most crop species show rapid deterioration In general, there are differences among species (Agrawal, 1976) and also among varieties within a species (Agrawal, 1978) with respect to loss of viability during storage. Seed senescence or deterioration is irreversible and inexorable process. The highest (12.25%) fungal infection (*Fusarium*) was found in case of untreated seeds at different intervals of storage, whereas less fungal infection (*Fusarium*) was found when the seeds treated zinc oxide nanoparticles. Similar results were found by D'Souza, *et al.* (2001), Chidanandaswamy (2001), and Xiao-Fang, *et al*. (2012)

Conclusion

It is concluded that nanoparticles showed significant effect on seed health of chilli during storage. Higher concentrations of ZnO NPs reduce seed infection when compared to control till the end of storage period. But Al_2O_3 NPs at higher concentrations deteriorates seed during storage due to high toxicity; they are needed to apply at lower concentrations optimum for storage of seed. Further research and biochemical analysis is required to understand that how nanoparticles potentially cause various morphological and physiological changes in plant.

Declaration

This submitted work has not been published previously (except in the form of an abstract, and an academic thesis), and is not under consideration for publication elsewhere, it's publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright holder.

References

1. Agrawal, P.K. "Identification of suitable seed storage places in India on the basis of temperature and relative humidity." *Seed Research*, 7 (1996): 120-127.
2. Agrawal, P.K. "Changes in germination, moisture and carbohydrate of hexapolid triticale and wheat (Triticum aestivum) seed stored under ambient conditions." *Seed science and technology*, 6 (1978): 711-716.
3. Akpomedaye, D.E. and Ejechi, B.O. "The hurdle effect of mild heat and two tropical spices extracts on growth of three fungi in fruit juices." *Food Research International* 31 (1998): 339-341
4. Anderson, W. B. "Zinc in soils and plant nutrition." *Advances in Agronomy*. 24 (1972): 147 186.
5. Arora S., P. Sharma., S. Kumar. and M. Zaidi. "Gold-nanoparticle induced enhancement in growth and seed yield of Brassica juncea." *Plant Growth Regulation* 66 (2012): 3.
6. Barrena, R., Eudald, C., Joan, C., Xavier, F., Antoni, S. and Víctor, P. "Evaluation of the ecotoxicity of model nanoparticles." *Chemosphere* 75.7 (2009): 850-857.
7. Beek, W.J.E., Martijn, M. W., Martijn, K., Xiaoniu, Y. and René, A. J. "Hybrid zinc oxide conjugated polymer bulk heterojunction solar cell." *J. Phys. Chem.B*. 109 (2005): 9505-9516
8. Brown, P. H., Ismael, C. and Qinglong, Z. "Forms and function of zinc in plants." *In: Zinc in Soil and Plants, ed. A. D. Robson, Dordrecht, the Netherlands: Kluwer Academic Publishers* (1993) 93- 106.
9. Camp, A. F. and Fudge B. R. "Zinc as a nutrient in plant growth." *Soil Science*. 60 (1945): 157 164.
10. Chapman, H. D. "Zinc In: Diagnostic Criteria for Plant and Soils." *Riverside, CA: University of California* (1966): 484 499.
11. Chidanandaswamy, B.S. "Studies on *Colletotrichum capsici* (Syd.) Butler and Bisby Causing Leaf Spot of Turmeric (*Curcuma longa* L.)." *M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad* (2001)
12. D'Souza, A., Roy, J.K., B. Mohanty, and B. Dasgupta. "Screening of *Trichoderma harzianum* against Major Fungal Pathogens of Betelvine." *Indian Phytopathology* 54 (2001): 340-345.
13. Fageria, N. K., Baligar, V. C. and Clark, R. B. "Micronutrients in crop production." *Advances in Agronomy*. 77 (2002): 189 272.
14. Gohokar, R.T. and Peshney, N.L. "Chemical control of powdery mildew of Chilli." *Indian Journal of Agricultural Sciences*, 51(1981): 663-665. (1981)
15. Gopinath, V. "Biosynthesis of silver nanoparticles from Tribulus terrestris and its antimicrobial activity: a novel biological approach Colloids and Surfaces, B: Biointerfaces, 96 pp. 69-74 (2012)
16. Hochepied, J.F., O. Ilioukhina. and Berger, M.H. "Effect of the mixing procedure on aluminium (oxide)-hydroxide obtained by precipitation of aluminium nitrate with soda." *Materials Letters* 57.19 (2003): 2817-2822.
17. Liou, .H. and Shao-Jung, W. "Kinetics study and characteristics of silica nanoparticles produced from biomass-based material." *Industrial & engineering chemistry research* 49.18 (2010): 8379-8387.
18. Marschner, H. "Mineral Nutrition of Higher Plants (2nd Ed.)." *Academic Press, London* (1995): 889.
19. Mathur, R. I., G. Singh. and Gupta, R.B.L. "Chemical control of chilli (Capsicum annuum) caused by Leveillula taurica." *Indian J. Mycol. and Plant Pathol* 2 (1972): 182-183.
20. Mengel, L. and Kirkby, E. A. "Principles of Plant Nutrition." *Basel, Switzerland: International Potash Institute* (1978)
21. Prasad, T. N. V. K. V., P. Sudhakar., Y. Sreenivasulu., P. Latha., V. Munaswamy., K. Raja Reddy., Sreeprasad, T. S., Sajanlal, P. R. and T. Pradeep. "Effect of nanoscale zinc oxide particles on the germination, growth and yield of peanut." *Journal of plant nutrition* 35.6 (2012): 905-927.
22. Ruihong, Z., Fen, G., Yongqi, H. and Huanqi, Z. "Self-assembly synthesis of organized mesoporous alumina by precipitation method in aqueous solution." *Mi-*

croporous and Mesoporous Materials 93.1-3 (2006): 212-216.

23. Savithramma, N., M. Linga Rao., S. Ankanna. and P. Venkateswarlu. "Screening of medicinal plants for effective biogenesis of silver nanoparticles and efficient antimicrobial activity." *Int J Pharm Sci Res* 3.4 (2012):1141–1148.
24. Sivaprakasam, K., R. Jaganathan., K. Pillayarsamy. and Anavaradham. "Control of powdery mildew of Chillies." *Madras Agricultural Journal* 63(1976): 52-54.
25. Viets, F. G. "Zinc deficiency in the soil-plant system." *Springfield, IL: Thomas.* (1966): 90–128.
26. Xiao-Fang, L.., Xiao-Qiang, F., Sh, Y., Ting-Pu, W. and Zhong-Xing, S. E"ffects of Molecular Weight and Concentration of Chitosan on Antifungal Activity against *Aspergillus niger*." *Plant Protect. Sci.,* 48.4 (2012): 170–178.

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