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The effect of nanoparticles on development parameters in a plant species: durum wheat *(Triticumdurum* Desf*)*

Nadia Chiahi*[1], Manel Boulouedenine[2] and Louhichi Brinis[2]

[1]Laboratory of plant breeding- Faculty Natural Sciences and Life University BADJI Mokhtar-UBM-Annaba-Algeria
[2]Faculty of Engineering Sciences, University Mohamed Cherif MESSAADIA-Department of Physics-SoukAhras-Algeria

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ABSTRACT

In this study we were interested in assessing the impact of ZnO nanoparticles and their effects on durum wheat (Triticum durum Desf). The effect of ZnO is evaluated in three varieties of wheat (Boussallem, Gtadur and Ouarsenis), the three varieties are represented by ***V1, V2 V3*** *and through a range of development settings, made in the laboratory. The selected varieties were exposed to increasing concentrations of NPs ZnO* ***(0.01mg / ml, 0.05mg / ml, 0.1mg / ml, and 0.5mg / ml).*** *The results show that the presence of ZnO based NPs can exert a stimulating effect according to the effect inhibitor concentration and the parameter under study, it is concluded that, except for a decrease in root elongation: strong effect concentration. We can advance the development of wheat seedlings was not much affected by the presence of ZnO NPs in their experimental medium sometimes it provoked a stimulating effect (increasing the percentage of germination).*

Keywords: Nanoparticles, ZnO, germination; vegetable species, concentrations.

INTRODUCTION

The particles are a search field rich in potential for new applications in the most diverse fields such as materials, health, energy, food, transportation to name a few.

The nanoparticles can be found in all environmental compartments (water, soil, air). Therefore, all of the food chain species may be exposed to nanoparticles**.[1]**

More current knowledge of the effects on manufactured NPs on plants is relatively limited. These recent studies include those of us **[2]**, studied the impact of NPs ZnO on the germination of radish seeds. a study on garlic (*Allium sativum*) has been carried out by **[3] and[4].**Who determined the effects of (ZnO) on mesquite velvet (Prosopis juliflora-velutina) **[5]** that investigated the effects of ZnO nanoparticles of titanium dioxide (TiO2) on rice (*Oryza sativa L.*), more **[6]**;who has studied the impact of TiO2 nanoparticles and carbon nanotubes on soft wheat and rapeseed? It is within this framework that our contribution fits is to highlight the impact of engineered nanoparticles (ZnO) on durum wheat (*Triticum durum*Desf).

MATERIALS AND METHODS

2.1. physical hardware

Figure 01 : Poudre du ZnO pur

The characterization of nanoscale powder was carried out in the University Mohamed KhidherBiskra, Algeria and has delivered us by the care of Dr. BOULOUEDNINE.

1.2. Biological material

The biological material used for the realization of the experimental section are three varieties of durum wheat: Boussallem ;Gtadur and Ouarsenis (V1, V2 , V3) and grown under the same culture conditions the pilot farm Yousfi Tayeb (Souk Ahras-Algeria) North East of Algeria -36˚14 North latitude and 7˚10 East longitude, during the 2012 companion.

1.3. Experimental protocol

2.3.1. Getting Suspension of ZnO Nanoparticles.

In view of their use in bioassays, the ZnO nanoparticles are suspended in ultra pure water (pH 5.5). Mother's suspensions are always prepared in the same conditions. For the realization of the test we chose four increasing concentrations of ZnO "**C1 = 0.01mg / ml, C2 = 0.05 mg / ml, C3 = 0.1 mg / ml, C4 = 0.5 mg / ml** ". The dispersion of nanoparticles in water is achieved by a magnetic stirrer; the use of the latter is used to break the weak bonds between the particles.

2.3.2. Protocol of exposure to nanoparticles.

This protocol aims to analyze the effect of ZnO NPs on the development parameters of the varieties of durum wheat. Seed germination and development in hydroponics has exposure wheat seeds and seedlings with different concentrations of NPs in ultrapure water for determination of germination and root elongation; Then in the Hoagland nutrient medium for measuring evapotranspiration and calculation of dry biomass.

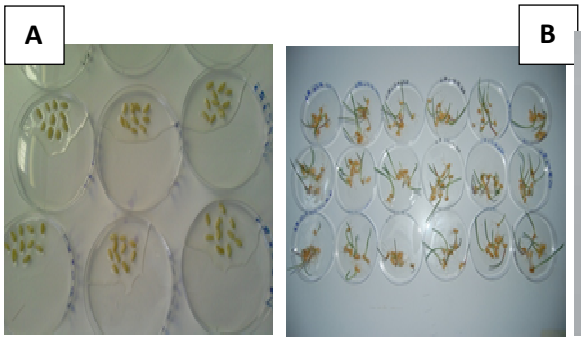

Figure 02: Getting wheat germination in Hydroponics A: 1st day of germination, B: 7emday germination.

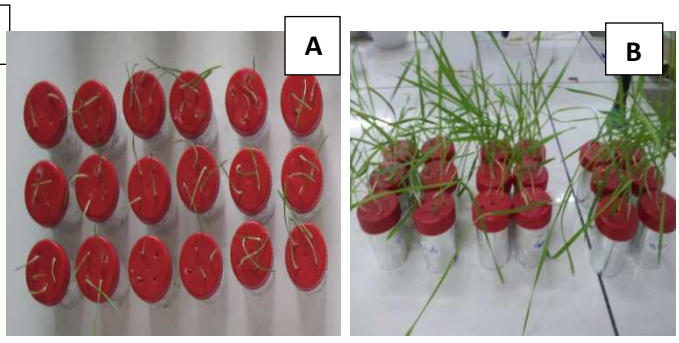

Figure N°03: Wheat farming in hydroponics
A: Establishment of seedling in nutrient medium
B: The appearance of seedlings after 07 days

2.3.3. Parameters Studied.

2.3.3.1. Germination rate (% Ger) .

A seed is considered germinated when its radicle reached 5 mm in length. The germination rate is expressed as a percentage.

2.3.3.2. Root length

To measure the root length of germinated wheat seedlings in different concentrations of ZnO, we used the software Dig Tps.

2.3.3.3. Evapotranspiration (ETP) and Biomass Dryer:

After 7 days of germination of grains in petri dishes, five (5) provided by seedlings are picked and transferred to vials of 60 ml filled and sterilized Hoagland modified [7]. At the end of the experiment, plantlets were dried for 48 h at 60 ° C for measuring, by weighing, the dry biomass. ETP is also assessed by difference in level of the nutrient medium of the vial end of the experiment, and expressed in ml / day. The dry biomassisexpressed in mg.

1.4. Statistical Analysis of Results.

Statistical analysis of the data produced in the experimental section, was performed using Statistica software (version 8; Stat Soft Inc., 2008) with possible involvement $\alpha = 0.05$.

RESULTS AND DISCUSSION

The results of the Kruskal-Wallis concerning the comparison of medians for development parameters clearly indicate that there are not significant differences(P □ 0.05) between the control and treated in three (03) varieties vis-à-vis the evapotranspiration and dry biomass (01.02 paintings and 03).

Significant differences ($p \leq 0.05$) were found between controls and seedlings exposed to nanoparticles inside varieties for the percentage of germination and root length, significant differences between the control and treated, were revealed to within the variety Ouarsenis by improving the percentage of germination in seedlings exposed to NPs. (Table 03). As well as the stimulation of root elongation in the Gtadur variety (Table 02).

Table 02: Comparison development parameters analyzed in the control and the four concentrations of ZnO in V2

parameters of development	$H_{obs.}$	*ddl*	*P*
Germination rate (%) (%)	1,29	4	0,86 NS
Rootlength (cm)	11,33	4	0,023 S
Evapotranspiration (ml)	3,76	4	0,44 NS
BiomassDryer (mg)	3,80	4	0,43 NS

NB **:** s ($p \leq 0,05$) ; ns ($p \geq 0,05$).

Table 01: Comparison of development parameters with the witness and the four concentrations of ZnO in V1

parameters of development	$H_{obs.}$	*ddl*	*p*
Germination rate (%)	4,37	4	0,36 NS
Rootlength (cm)	6,23	4	0,18 NS
Evapotranspiration (ml)	0,60	4	0,96 NS
BiomassDryer (mg)	2,76	4	0,59 NS

NB : s ($p \leq 0,05$) ; ns ($p \geq 0,05$).

Table 03: Comparison development parameters analyzed in the control and the four concentrations of ZnO in V3

parameters of development	$H_{obs.}$	*ddl*	*P*
Germination rate (%) (%)	10,22	4	0,04 S
Rootlength (cm)	7,83	4	0,09 NS
Evapotranspiration (ml)	7,96	4	0,09 NS
BiomassDryer (mg)	4,81	4	0,30 NS

NB : s ($p \leq 0,05$) ; ns ($p \geq 0,05$).

3.1. Impact of ZnO nanoparticles on the Durum.
3.1.1. Effect of ZnO nanoparticles on development parameters.
3.1.1.1. Germination rate (% Ger).

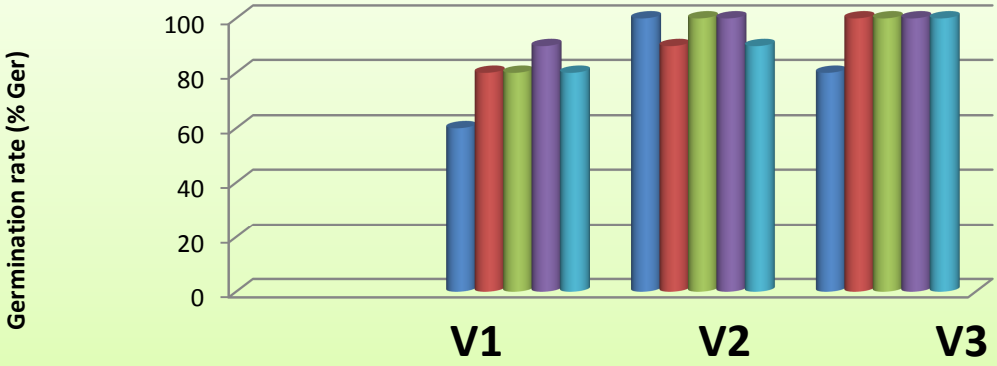

Figure 04: Effect of ZnO NPs of the germination rate in three varieties exposed to different concentrations.

Figure 04: We note that among the variety V3 germination rate was increased in seeds exposed to different concentrations (0.01 mg / mL, 0.05 mg / ml, 0.1mg / ml, 0.5mg / ml)

Indeed the germination rate at V3 from 80% at the 100% control in the presence of nanoparticles.

3.1.1.2. Rootlength (cm)

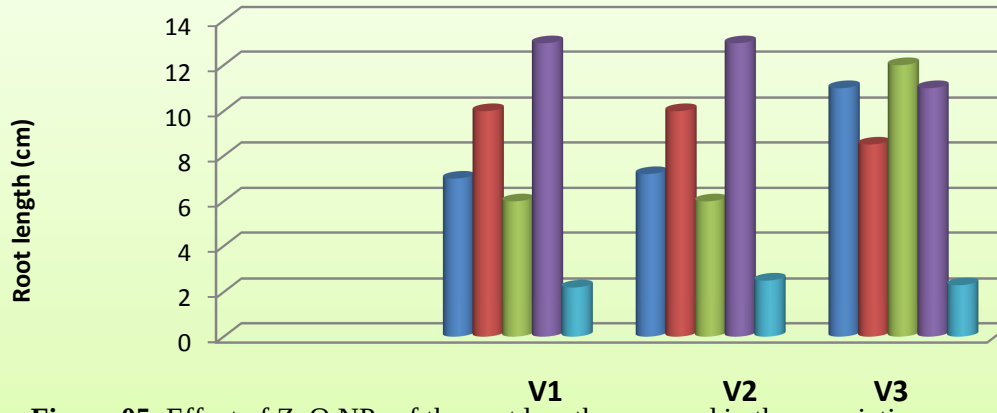

Figure 05: Effect of ZnO NPs of the root length measured in three varieties exposed to different concentrations.

Figure N° 05: We recorded an increase in root length of seedlings at V2 which varies from 8.75 cm to 11.79 cm for the witnesses to a concentration of 0.1 mg / ml of ZnO

Against by exposure to the high concentration of (0.5 mg / ml) causes a decrease in the root elongation which can reach up to 2 cm in length in three varieties.

3.1.1.3.Evapotranspiration (ETP).

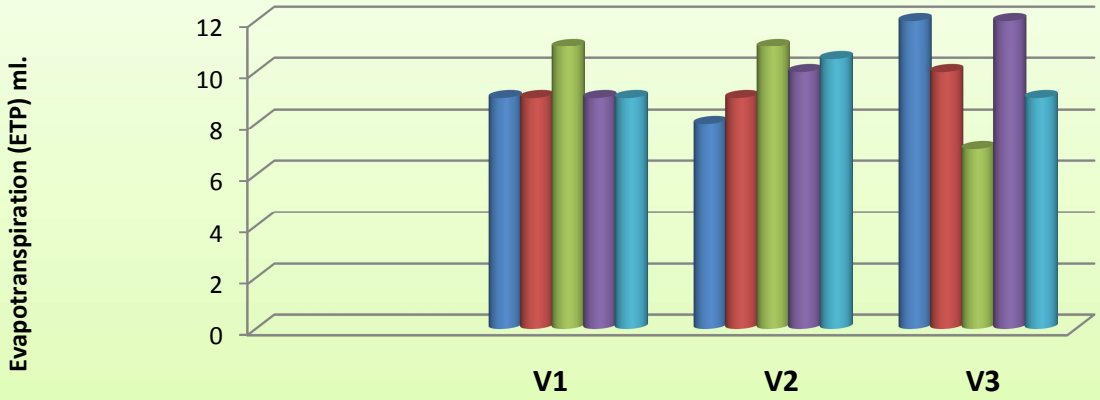

Figure 06: Effect of ZnO NPs of the evapotranspiration rate in three varieties exposed to different concentrations.

Figure N°06 :The statistical results show no significant differences between controls and treated each variety, which means that different concentrations of nanoparticles used (0.01 mg / mL, 0.05 mg / ml, 0.1mg / ml and 0, 5mg / ml) of ZnO does not disturb such a function in durum wheat

3.1.1.4. Biomass Dryer.

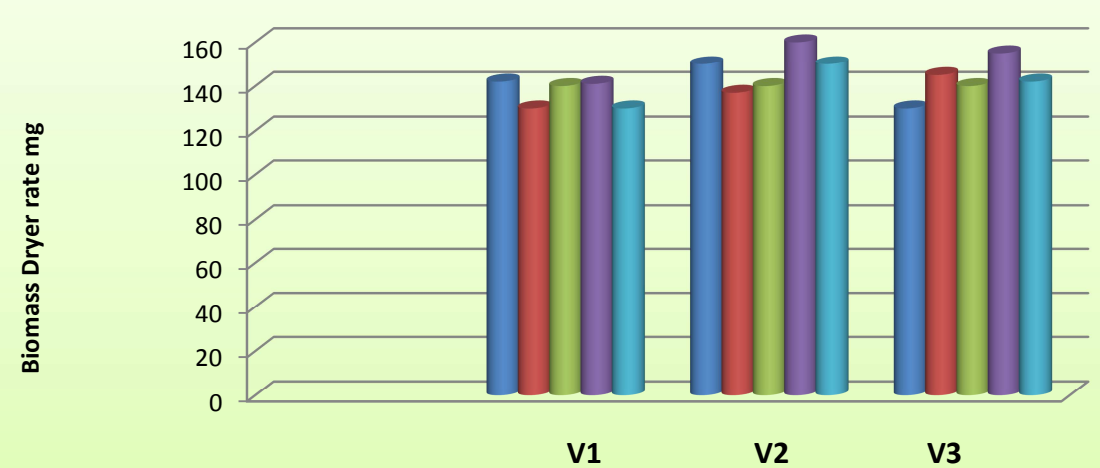

Figure 07: Effect of ZnO NPs of the dry rate of biomass in three varieties exposed to different concentrations.

Figure N°07: Shows the variation of the dry biomass of seedlings of three varieties of durum wheat in the absence of nanoparticles (control) and in the presence of increasing concentrations of the four ZnO

According to statistical results, we recorded no significant differences between the witnesses and the four concentrations of ZnO in each variety. We find that the applied concentrations do not affect the dry biomass.

DISCUSSION

✓The ZnO nanoparticles does not cause a toxic effect on the germination of varieties studied. This result is in agreement with the work [2]**,** who reported that the ZnO nanoparticles have not affected the germination of radish, rapeseed, ryegrass, lettuce and cucumber in the except maize seed

✓Increased seed germination rate among the variety Ouarsenis to different concentrations of ZnO.Stimulation of root elongation in the variety Gtadur concentration 0.1mg / ml.this result is in line with those of [8]**,** which showed a significant increase in rate of germination of tomato seeds exposed to carbon nanotubes
✓One hypothesis justifying the root induction after exposure in ultrapure water or in Hoagland is: In both cases, the NPs are hereby suspended at the origin of new microspores, the microspores (is it plasmodesmes?) In the roots, these pores allowing hydro mineral nutrition more effective. [6]Inhibition of root elongation after exposure to the concentration of 0.5mg /ml.
✓This inhibition of the growth of wheat roots could be due to the toxicity of ZnO causes chromosomal aberrations, these aberrations could lead to a judgment of the mitosis and cell death [9]**.**
✓No effect of ZnO nanoparticles on other development parameters: The evatranspiration and dry biomass.Our results are similar to that of [6]**,** who studied the impact of TiO2 nanoparticles on wheat; the results show that there is no effect on the dry biomass and evapotranspiration measured at different concentrations of TiO2 NPs.

CONCLUSION

Through the preliminary study of the impact of engineered nanoparticles on development parameters durum, we have the following results:

We found an improvement in germination in the seed lot (Ouarsenis V3, the ZnO nanoparticles, while for other seed lots no positive or adverse effects were recorded.

Variety Gradur V2 seed was characterized by a significant root elongation seeds in a range of [0,05-0,1mg / ml] ZnO.

A concentration of 0.5 mg / ml nanoparticles caused an inhibition of root elongation for seeds of three varieties. The ZnO nanoparticles exert no adverse effects on evapotranspiration and dry biomass of seedlings of three batches of treated seed.

It exists:
A concentration effect of nanoparticles and applied seed lots tested responses vis-à-vis the measured parameters. Variability between seed lots shows better tolerance genotype, Exp: The variety Boussallem showed different responses vis-à-vis other varieties.

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