



Foliar application of nano-iron, nano-zinc and nano-titanium on the growth of barley

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Abstract— Nano fertilizers are new generation of the synthetic fertilizers which contain readily available nutrients in nano scale range. To evaluate the effects of foliar spray of nano-iron and nano-zinc as well as nano titanium dioxide on grain yield and its components in barley under supplemental irrigation conditions, a field experiment was carried out in the semi-arid highland region of Maragheh, Iran. The treatments included micronutrients (Cont: control Nano-Fe: press nano chelate, NanoZn: zinc nano chelate,) and foliar application of nano-titanium, Cont: (without application), and Nano-Ti: 2000 ppm. PH (plant tallness), SD (stem breadth), NGS (number of grains per spike), PL (peduncle length), SL (spike length), TGW (thousand grain weight), DA (day to anthesis) and GY (grain abdiccate) were measured. The primary principal component clarified 73% of total variation whereas the second principal component clarified 15% of observed variability. We found positive association between TGW (thousand grain weight) and DA (day to anthesis), between SD (stem distance across) and NGS (number of grains per spike), and between NGS (number of grains per spike) and GY (grain yield). Although foliar fertilization with nano-fertilizer is more effective, it may be due to their high mobility in the vascular transport system of plants, the properties of nanoparticles are highly dependent on the size, shape and surface functionalization, so further studies in the vascular transport system. of plants is needed. induced cellular and molecular changes after foliar application of micronutrient nano-fertilizer.

Keywords- exogenous application, nano ferric oxide, nanoparticles

1. introduction

Within the final few a long time, a few analysts attempted to look at the potential of nanobiotechnology to move forward micronutrients utilize proficiency and strategies that result within the plan and improvement of effective unused nano-fertilizer conveyance stages for utilize at the cultivate level [1]. Micronutrients fertilizers determined from nanotechnology cab be presented as typified interior nanomaterials, coated with a lean defensive polymer film, or conveyed as particles or emulsions of nanoscale measurements. Moreover, Nano defined fertilizer can discharge supplements more gradually in participation with routine fertilizers which may lead to upgrade of supplement utilize proficiency and avoidance of natural contamination. Application of nano-fertilizer s may progress solvency and scattering of insoluble supplements in soil, decrease supplement immobilization and increment the bio-availability. Nano defined fertilizers can effectively be ingested by plants and they may display delayed successful term of

supplement supply in soil or on plant compared with customary fertilizers. Zhang et al. [2] explored the impacts of slow/controlled-release fertilizers cemented and coated by nanomaterials on trim. It was found that these nanocomposites were secure for wheat seed germination, rise and development of seedlings and these nano-fertilizer s give an effective implies for directed, responsive and opportune conveyance of supplements to plants. Application of zinc nano-fertilizer on pearl millet essentially progressed shoot length, root length, root region, chlorophyll substance, add up to solvent leaf protein, plant dry biomass, and chemical exercises of corrosive phosphatase, soluble phosphatase, phytase, and dehydrogenase over to control. In this ponder the grain surrender at edit development was made strides by due to application of zinc nano-fertilizer. A few thinks about appear that exogenous application of a few nanoparticles can essentially made strides plant development. Titanium dioxide nanoparticles are promising as effective supplement source for plants to move forward biomass generation due to improve the nitrogen digestion, photoreduction exercises of photosystem II and electron transport chain, ensuring the chloroplast film structure from responsive oxygen species, and utilization of local supplements by advancing microbial exercises. Within the northwestern portion of Iran zinc and press insufficiencies are dietary disarranges in most of the plants developed in dryland condition. Since these two supplements are definitively included in grain abdicate generation and their lack may happen as often as possible in semiarid districts; the display examination was embraced to make strides understanding approximately the foliar application of nano chelated press and zinc fertilizers as well as nano-TiO₂ on abdicate and surrender components of winter grain.

2. Materials and Methods

The grain cultivar Sahand was hand planted within the try. Plants were developed beneath rain-fed condition that gotten normal precipitation and as it were two supplemental irrigations were connected amid jointing and heading stages. Medications were connected agreeing to randomization total squares plan beneath factorial format with three imitates. The medications included micronutrients (Cont: control Nano-Fe: press nano chelate, NanoZn: zinc nano chelate,) and foliar application of nano-titanium, Cont: (without application), and Nano-Ti: 2000 ppm. Micronutrients connected three times amid start of tillering arrange, booting and smooth arrange. Nano-titanium was showered on the plants clears out at conclusion of vegetative development and amid the inflorescence rise. Plants showered with refined water served as the control. Nano- titanium (nTiO₂) was obtained from the Pishgaman Nano, Iran. Nano chelate fertilizers were gotten from the Sepeher Parmis Company, Iran, which contained zinc oxide or press oxide nanoparticles. A few characteristics comprise on PH (plant tallness), SD (stem breadth), NGS (number of grains per spike), PL (peduncle length), SL (spike length), TGW (thousand grain weight), DA (day to anthesis) and GY (grain abdicate) were measured. Vital component examination, based on the relationship lattice was performed by Minitab.

3. Results and Discussion

Examination of change appeared that all measured characteristics not influenced by foliar application of nano-fertilizers and nano-titanium and the comparable slant was recorded for nano-titanium application (comes about are not appeared). In spite of the fact that, these comes about contrast from a few distributed thinks about [3] who found that the distinctive levels of Zn fertilizer might not altogether influence the plant stature. Agreeing to the demonstrated parts of Fe and Zn on physiological and biochemical forms of improvement and advancement of straw surrender by application of micronutrients, it appears that development of a few other plant organs such as takes off were affected by micronutrients supplements. Within the show think about, the principal component investigation depicted a suitable sum of the overall variation (78%). The primary principal component clarified 73% of total variation whereas the second principal component clarified 15% of observed variability. The relationship coefficient between any two characteristics is approximated by the cosine of the point between their vectors. Within the Figure 1, the foremost unmistakable relations are: a solid positive association between TGW (thousand grain weight) and DA (day to anthesis), between SD (stem distance across) and NGS (number of grains per spike), and between NGS (number of grains per spike) and GY (grain yield) was found as demonstrated by the little harsh points between their vectors ($r = \cos \theta = 1$). Our results are similar to Anjum et al. [4] in wheat.

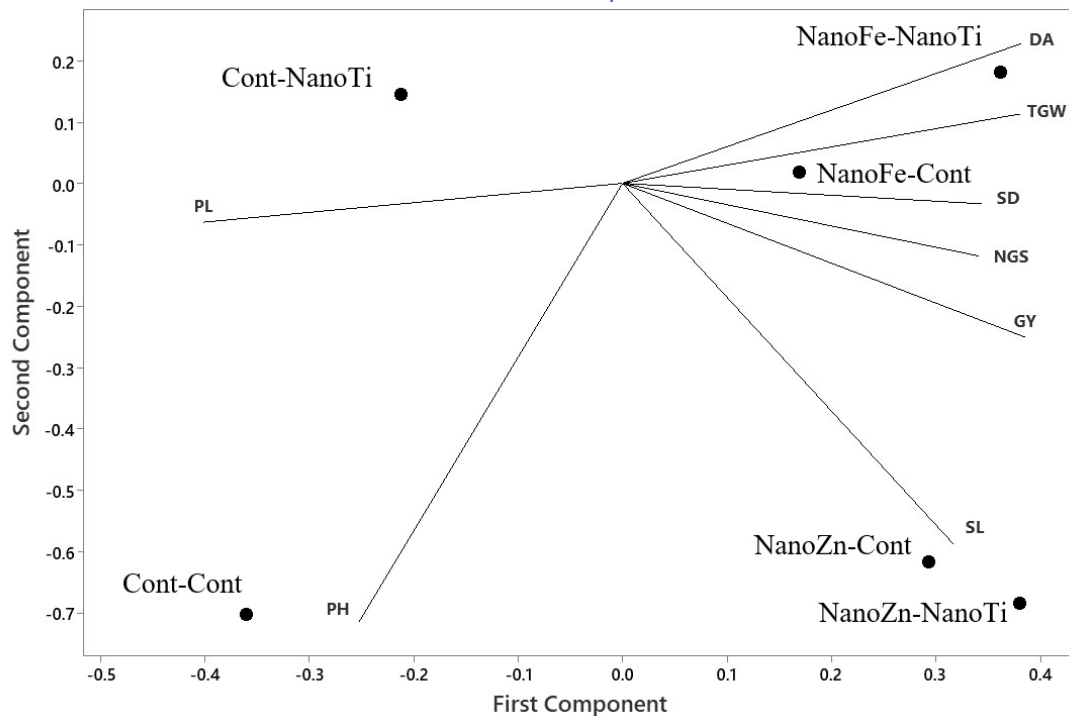


Figure 1. Plot of the first two principal component analysis showing relation among traits of barley and treatments.

There was a negative relationship between peduncle length and plant tallness with most of grain abdicate components (Figure 1) as demonstrated by the close zero-point vectors ($r=\cos 0=1$). We seem not discover any negative or positive relationship between SL (spike length) and DA (day to anthesis), between PH (plant tallness) and SL (spike length), and between PH (plant stature) and PL (peduncle length) as demonstrated by the close opposite vectors ($r=\cos 90=0$). At long last, there was a solid negative affiliation between PL (peduncle length) with both TGW (thousand grain weight) and DA (day to anthesis), and between PL (peduncle length) with both SD (stem distance across) and NGS (number of grains per spike) as demonstrated by the close uncaring angels' vectors ($r=\cos 180=-1$).

Nano micronutrients fertilizers stand out as one of the foremost valuable materials, due to their tall productivity, functionalities, helpful and simple applications. From the show think about, it can be concluded that TiO₂ nano particles and miniaturized scale supplements nano fertilizers at examined concentrations does not show any noteworthy phytotoxicity and may increments the chlorophyll substance, vegetative development and surrender component of grain beneath supplemental water system condition in semi-arid locales with Mediterranean climates. In any case, real development of nano-particles through the fingernail skin depends on the supplement concentration, atomic estimate, chelating structure, time of application and plant species and natural condition.

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