

Physiological Growth of Sunflower with Treatment of Zinc

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Abstract

Metal ion contamination in the environment causes hazardous effects on plant growth, yield production, and also led to physical and chemical changes. Sunflower (*Helianthus annuus* L.) plant is added to be one of the most edible seed crop growing in harsh climatic regions. It also has good water use efficiency. The study remains unclear about the physiological growth of sunflower with treatment of Zinc. A pot experiment was conducted in the old Botanical Garden at University of Agriculture, Faisalabad to analyze and check the impact of heavy metal zinc sulphate stress on sunflower (*Helianthus annuus*) two hybrids FH687 and FH674. After three weeks varying concentration of zinc sulphate (0mM, 20mM and 40mM) along with 250ml tap water was applied in rooting medium. Every day 250ml water was applied to each pot. The crop was harvested after 45 days and morphological parameters were studied such as root length, shoot length, root weight, shoot weight and number of leaves. Zn stress significantly reduced the growth attributes. A marked drop in all morphophysiological attributes such as root length, leaf number and shoot length was recorded. Maximum reduction of growth, biochemical and physiological parameters was noted at 40mM concentration of zinc. Zinc toxicity involves inhibition of cytoplasmic enzymes and damage to cell structures due to oxidative stress. It alters the catalytic function of enzymes which damage the cellular membranes and inhibit root growth. Zinc stress causes maximum effect on hybrid FH674 as compared to other hybrid FH687.

Keywords: Root length; Shoot length, Zinc, Sunflower, Biochemical parameters.

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INTRODUCTION

Plants can endure high concentration of heavy metals. In minute concentration some heavy metals are vital for plants but their higher amount cause stunt growth in plants. Under stress condition reactive oxygen species (ROS) are produced. Heavy metals are injurious for membrane lipids. Plant cells contain protection mechanisms to reduce the effects of ROS. Agricultural soils are affected by toxicity of heavy metals due to prolonged use of phosphate fertilizers & industrial waste. In plants lipid peroxidation is the most toxic effect of heavy metals that causes deterioration of membrane [1].

The activeness of several enzymes, proteins and carbohydrates especially in oil crops is basically regulated by Zn. Fertilization, manufacturing of chlorophyll, pollen task need Zn for maintenance. Decreased yield, flawed pollens are result of Zn deficiency. Restricted root growth and reduce potency of Zn occurs in moisture deficit conditions [2]. To lessen the tensions of drought, regulation of stomata and ion balance is maintained by fertilizer zinc sulfate

which is balanced during water deficit. Chloroplast structure is substantially affected by S deficit circumstance. Under water deficit conditions the quantity and quality of sunflower is raised by micronutrient application. Zn finger family of transcription factors and crucial part of enzymes [3].

Metal ion contamination in the environment causes hazardous effects on plant growth, yield production, and also led to physical and chemical changes. Metal toxicity can inhibit Protein activity or disrupt their structures. 30% of the world's rearing land is Zn-deficient. Foliar applications is competent and notable for nutrient engrossment. Foliar application of minerals is realistic. The desire for advanced living poses major threat to ecosystem as it is increased with the industrial improvement. Mainly after 1950s, populated urban environment affect the health and quality of living organisms by causing serious damages to the ecosystem. Natural and human activities are contaminating the environment, they are discharging more than what the environment can handle and affect the standard of farming products. Heavy metals scathe biomolecules that results in increase of (ROS), (OH),

(H₂O₂), (O₂⁻) that leads to oxidative stress treating organisms with some chemical, biological and physical agents results in toxicity[4].

Zinc deficiency decreases the activity of the immune system in human beings. Zn⁺² also affects animal and plant activity. Zinc deficiency also decreases the next-generation growth. Also due to the low amount of the plants that cause damages to the plant size and cause chlorosis [5].

Sunflower (*Helianthus annuus* L.) plant is added to be one of the most edible seed crop growing in harsh climatic regions. It also has good water use efficiency. It also led to enhance the economy of the country. Moreover, sunflower has nutritional properties, and their seeds contain high oil content 35%-48% [6].

Sunflower (*Helianthus annuus* L.) has economic importance in terms of agriculture worldwide. The high level of its fatty acid (69%) easily explains the importance of the sunflower plant. Oilseed crops play a vital role in broiler food [7,8]. They are rich in proteins and carbohydrates. During the flowering and seed filling stage at high temperature and in drought, conditions decrease the yield production. Water stress is one of the most reducing factors on sunflower range from 200-900mm. The high temperature increases water consumption at flowering and low while vegetative. Sunflower is drought. Soil with prominent heavy metal engrossment hinders its growth. Different mechanisms of living entity are regulated by aliphatic amines. In Turkey, major oil seed crop is sunflower due to poor climatic condition no crop rotation is done. To overcome low moisture content seeds are sown in seedbeds that results in irregular germination [9,10].

MATERIALS AND METHODS

Experimentation was led to assess the consequence of zinc on sunflower (*Helianthus annuus*) genotype FH-687 and FH-674 in University of Agriculture Faisalabad Botanical garden through the year 2019. Zinc sulphate (ZnSO₄) utilized as a source of zinc element. Three (0mM, 20mM and 40mM) levels of Zn were applied in research area.

Seed source

Hybrids of two sunflower varieties FH 687 and FH 674 were utilized for the research work and attained by Ayub agriculture research institute.

Sowing

18 plastic pots were occupied with 8 kg soil. The pots used for sowing contain an underneath hole which was covered by a piece of fine cotton cloth. Before sowing, pots were irrigated with tap water. Approximately 8 seeds were sown in each pot at the depth of 2cm. Healthy seeds of similar size were selected for sowing. The experiment strategy was factorial completely randomized strategy with three

repetitions. Afterward propagation, plants were moistened with tap water whenever required. After germination, seedlings were thinned to maintain 4 plants per pot of equal size and then applied zinc to the plants to start my experiment [12].

Treatments and Source

Simple water used to treat plants present in the University of Agriculture, Faisalabad. The salt that we want to apply to plants are taken from our Botany Department in a specific amount and make the solution in 1.5L of water and apply to specific plants [13].

- 1- Normal water or 0mM zinc solution
- 2- 20mM zinc solution
- 3- 40mM zinc solution

Germination

8 seeds were sown in each pot on 11/3/2019 date. After 5 days seeds were germinated all pots were totally germinated first 20 days simple water was applied after 20 days they were applied ZnSO₄. Just one time metal applied in whole research [15]

DATA COLLECTION

Two plants from each pot were collected after applying treatment. Plants were pulled up cautiously and washed with tap water. Data for growth, physiological and bio-chemical parameters were recorded. Fresh weight noted immediately in lab then they were left in oven to study their dry weight and for further studies.

Growth parameters

Shoot length was measured by using a measuring tape and their mean values were calculated.

Root length (cm)

Root length was measured by using a measuring tape and their mean values were calculated.

Shoot fresh weight (g)

Fresh weight of shoot was determined immediately after uprooting the plants with the help of systemic weight machine and mean values were calculated.

Root fresh weight (g)

Fresh weight of root was determined immediately after uprooting the plants with the help of systemic weight machine and mean values were calculated.

Shoot dry weight (g)

Dry weight of shoot were determined after keeping the fresh samples in oven at 65°C for 1 week to get constant dry weight and mean values were calculated [16].

Root dry weight (g)

Dry weight of root were determined after keeping the fresh samples in oven at 65C° for 1 week to get constant dry weight and mean values were calculated[17].

RESULTS AND DISCUSSION

Shoot length (cm)

Data for shoots length of sunflower hybrids FH 687 and FH674 grown under control (T0=Water)

condition and zinc sulphate (ZnSO₄) stress condition is presented below in graph. Application of zinc sulphate stress caused a significant reduction in shoot length. With increasing concentration of zinc in soil solution shoot length reduced. Maximum reduction at 40mM (Water+ZnSO₄ 40mM) zinc sulphate was applied in rooting medium was observed as compared to control series.FH 687 show better growth than the hybrid FH 674[16].

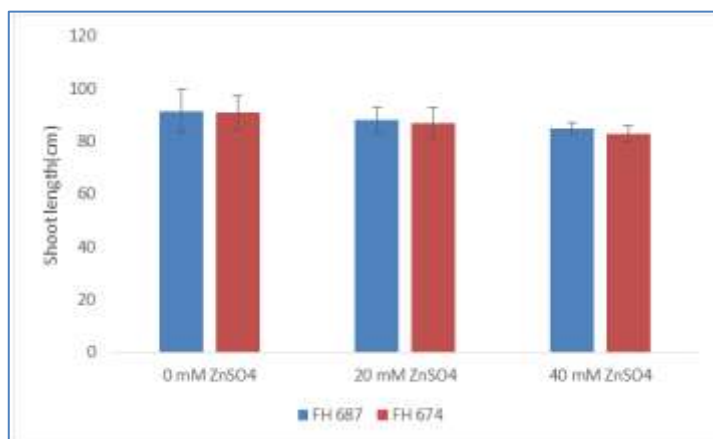


Fig-1: Shoot length of two sunflower hybrids grown under zinc stress

Root length (cm)

Data for root length of sunflower hybrids FH 687 and FH674 grown under control (T0=Water) condition and zinc sulphate (ZnSO₄) stress condition is presented below in graph. Application of zinc sulphate stress caused a significant reduction in root length. With

increasing concentration of zinc in soil solution root length reduced. Maximum reduction at 40mM (Water+ZnSO₄ 40mM) zinc sulphate was applied in rooting medium was observed as compared to control series [17]. FH 687 show better growth than the hybrid FH 674.

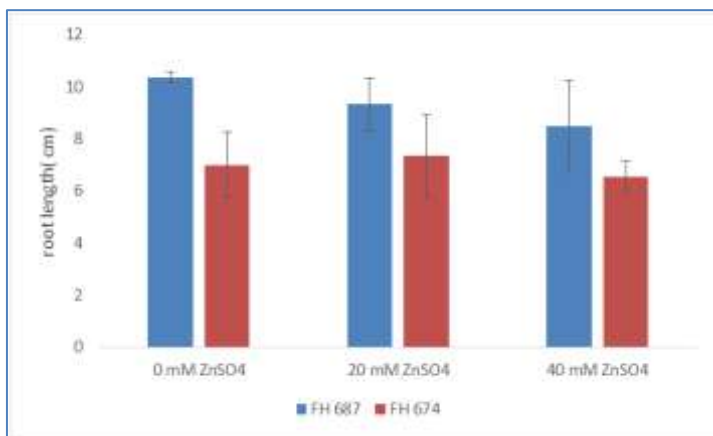


Fig-2: Root length of two sunflower hybrids grown under zinc stress

Number of leaves (per plant)

Data for number of leaves of sunflower hybrids FH 687 and FH674 grown under control (T0=Water) condition and zinc sulphate (ZnSO₄) stress condition is presented below in graph. Application of zinc sulphate stress caused a significant reduction in

number of leaves. With increasing concentration of zinc in soil solution number of leaves reduced. Maximum reduction at 40mM (Water+ZnSO₄ 40mM) zinc sulphate was applied in rooting medium was observed as compared to control series. FH 687 show better growth than the hybrid FH 674[18].

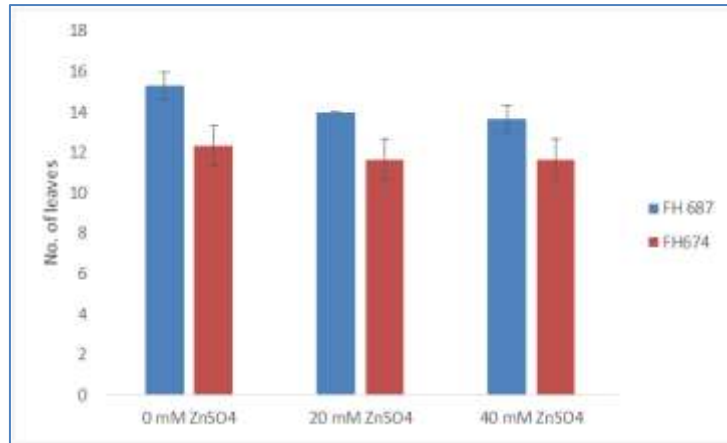


Fig-3: Number of leaves of two sunflower hybrids grown under zinc stress

Root fresh weight (g)

Data for root fresh weight of sunflower hybrids FH 687 and FH674 grown under control (T0=Water) condition and zinc sulphate (ZnSO₄) stress condition is presented below in graph. Application of zinc sulphate stress caused a significant reduction in

root fresh weight. With increasing concentration of zinc in soil solution root fresh weight reduced. Maximum reduction at 40mM (Water+ZnSO₄ 40mM) zinc sulphate was applied in rooting medium was observed as compared to control series. FH 687 show better growth than the hybrid FH 674.

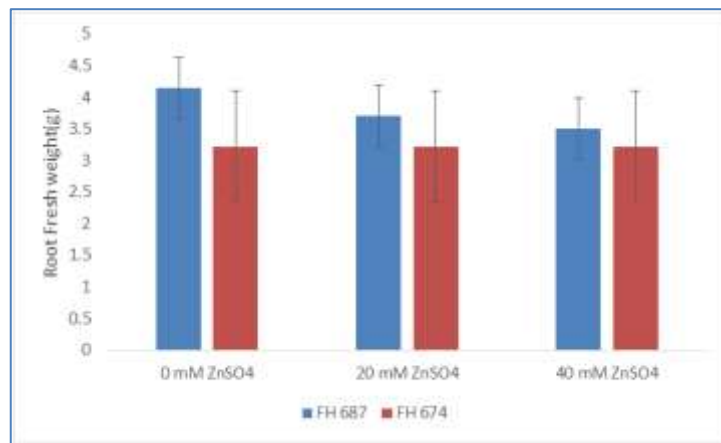


Fig-4: Root fresh weight of two sunflower hybrids grown under zinc stress

Shoot fresh weight (g)

Data for shoot fresh weight of sunflower hybrids FH 687 and FH674 grown under control (T0=Water) condition and zinc sulphate (ZnSO₄) stress condition is presented below in graph. Application of zinc sulphate stress caused a significant reduction in

shoot fresh weight [18]. With increasing concentration of zinc in soil solution shoot fresh weight reduced. Maximum reduction at 40mM (Water+ZnSO₄ 40mM) zinc sulphate was applied in rooting medium was observed as compared to control series. FH 687 show better growth than the hybrid FH 674[19].

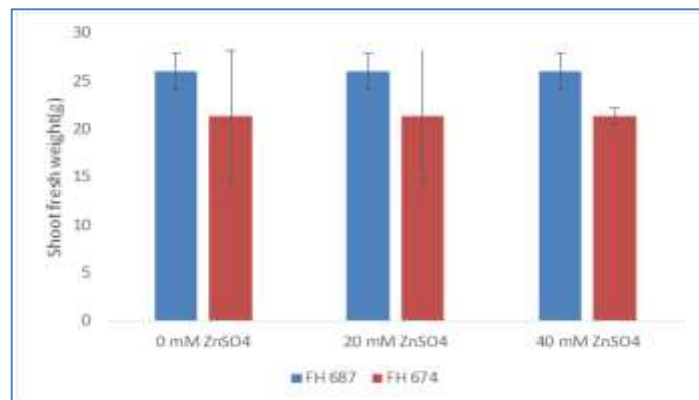


Fig-5: Shoot fresh weight of two sunflower hybrids grown under zinc stress

Root dry weight (g)

Data for root dry weight of sunflower hybrids FH 687 and FH674 grown under control (T0=Water) condition and zinc sulphate ($ZnSO_4$) stress condition is presented below in graph. Application of zinc sulphate stress caused a significant reduction in root dry weight.

With increasing concentration of zinc in soil solution root dry weight reduced. Maximum reduction at 40mM ($Water+ZnSO_4$ 40mM) zinc sulphate was applied in rooting medium was observed as compared to control series. FH 687 show better growth than the hybrid FH 674.

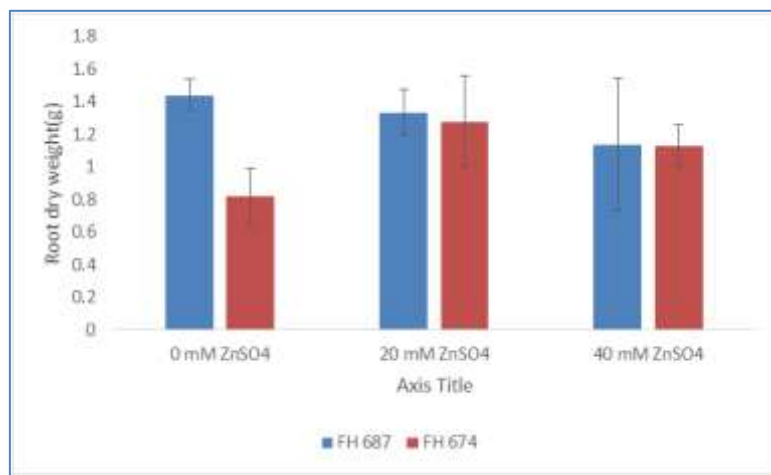


Fig-6: Root dry weight of two sunflower hybrids grown under zinc stress

Shoot dry weight (g)

Data for shoot dry weight of sunflower hybrids FH 687 and FH674 grown under control (T0=Water) condition and zinc sulphate ($ZnSO_4$) stress condition is presented below in graph. Application of zinc sulphate stress caused a significant reduction in shoot dry

weight. With increasing concentration of zinc in soil solution shoot dry weight reduced. Maximum reduction at 40mM ($Water+ZnSO_4$ 40mM) zinc sulphate was applied in rooting medium was observed as compared to control series. FH 687 show better growth than the hybrid FH 674.

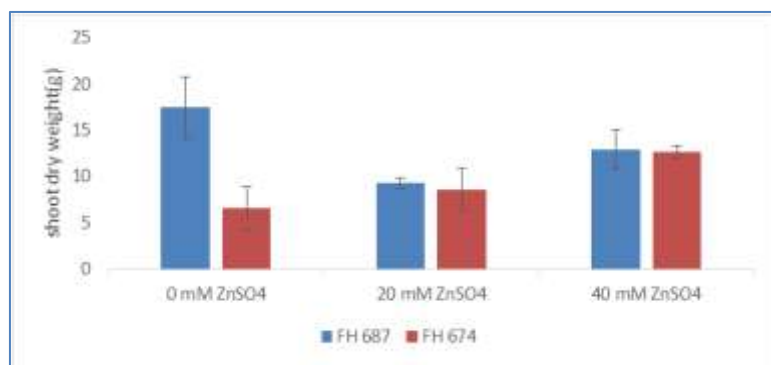


Fig-7: Shoot dry weight of two sunflower hybrids grown under zinc stress

CONCLUSION

This study helpful investigating the growth of the sunflower under the different treatments of the zinc as the metal ion contamination in the environment causes hazardous effects on plant growth, yield production, and also led to physical and chemical changes. Zinc deficiency also decreases the next-generation growth. Also due to the low amount of the plants that cause damages to the plant size and cause chlorosis.

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