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EFFECT OF FUNGICIDE TREATMENTS ON THE BIOCHEMICAL AND MORPHOLOGICAL RESPONSES OF WHEAT (*TRITICUM AESTIVUM* L.)

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Abstract

Fungicides are commonly applied to protect crops from fungal infections; however, their influence on plant biochemical processes can be significant. This study investigated the effects of the fungicide azoxystrobin on the biochemical and morphological parameters of wheat (Triticum aestivum L.). The experiment was conducted at the Institute of Biological Sciences (IBS), Gomal University, Dera Ismail Khan, Pakistan. Thirty days after germination, wheat seedlings were treated with different concentrations of azoxystrobin (500 mg/L, 1000 mg/L, and 1500 mg/L), along with a control group (no fungicide). Biochemical parameters, including total carbohydrate and protein contents, were analyzed. Results revealed that both carbohydrates and proteins increased with rising fungicide concentration, with the maximum enhancement observed at 1000 mg/L—showing a 14% and 3.2% increase in carbohydrates and proteins, respectively. Additionally, the highest concentration (1500 mg/L) resulted in the greatest leaf length (18.4 cm) compared to the control (16.8 cm). These findings suggest that optimal levels of azoxystrobin can positively influence the biochemical composition and vegetative growth of wheat seedlings.

Introduction

Wheat (*Triticum aestivum* L.) is the most important cereal crop and grown all over the world. With increased global population and changes consumption preferences, there has been substantial increase in demand for wheat during the past 50 years. According to world estimates, an average of 50% yield losses in agricultural crops are due to abiotic factors like high temperature (20%), low temperature (7%), salinity (10%), drought (9%) and other forms of stresses (4%). Among Southeast Asian countries, India and Pakistan are more challenged with multitude combinations of several abiotic stresses (Ziyaev et al. 2011; Sharma and Ravi, 2013). Wheat production is affected mainly by biotic and abiotic stresses all over the world. Of these, pathological diseases are the most important limiting factor of wheat production as different pathogens infect wheat plants, causing severe losses in yield and quality. Wheat crop is attacked by biotrophic fungi, necrophytic species and nematodes, as well as viruses and bacteria (Absattarova et al. 2002; Juroszek and von Tiedemann, 2011).

Chemical control by the application of fungicides remains the main way to reduce the incidence of fungal and nematode diseases on major crops. The most common interventions consist of spraying aerial parts of plants with fungicides. Fungicides are used in fields to increase the production of crops like wheat. Fungicides are used in agriculture to prevent the crops from different types of diseases that arise from the fungus. But fungicide can negatively affect the biochemical parameters of wheat like proteins, proteins, chlorophyll contents, alkaline protease activity and phenols contents (Slawecki et al, 2002).

Carbendazim which is benziimidazole group fungicide affects biochemical parameters of wheat. It can decrease the chlorophyll contents but increase concentration of alkaline protease activity and phenol contents in wheat. Azoxystrobin (AZ) is a group of strobiliurin class of fungicide. Strobiliurin is the class of chemicals that are used as a fungicides and the mostly used strobiliurin is Azoxystrobin (Giuliani et al., 2011). Azoxystrobin act as bio-regulators with novel biochemical mode of action. It is used in wheat crop to control different diseases but beside, it can help the wheat crop against heat stresses (Rademacher, 2004; Zhao et al., 2007). This study was designed to investigate the effects of fungicide (azoxystrobin) on biochemical parameters of wheat.

Material And Method Material

The experiment was conducted Institute of Biological Sciences, Gomal University, Dera Ismail Khan, Pakistan. The experiment was performed to demonstrate harmful effects of fungicide (azoxystrobin) on the biochemical parameters of wheat (*Triticum aestivum* L.). Wheat variety used in this study was local wheat cultivar namely AZRC Dera.

Wheat germination and application of fungicide

Seeds were germinated by following standard method (Rangwala et al, 2013). Uniform size seeds were selected, sterilized their surface with 0.1% solution of hydrogen peroxide (H_2SO_4) for 5 minutes to prevent from any fungal attack, washed with distilled water 3-4 times. Seeds were then placed in Petri-plates that lined up with filter paper which were moistened with distilled water. After that Petri-plates were seal with tape to avoid fungal growth and placed in dark for 2 days for germination. After 2 days, the seeds were shifted into cups for further growth. At day 30 post germination, the fungicide (azoxystrobin) concentrations (500mg/l,1000mg/l and concentration of protein, proteins and 1500mg/l) was sprayed on the wheat. Each fungicide treatment was applied with three biological replicates. Total protein contents, total protein contents and leaf length were measured 7 days-post application of the fungicide.

Determination of biochemical parameters

Estimation of carbohydrates

The carbohydrate contents were estimated by the phenol-sulfuric acid method (Nielsen, 2010). The total protein content was calculated by the formula;

100 mg/l of sample=

$$\frac{\textit{Concentration of glucose}}{\textit{Absorbance}} \times 100$$

For Control group; $TA = \frac{0.020}{0.208} \times 100$

TA0=9%

For 500mg/l fungicide spray; $TA1=\frac{0.040}{0.355}\times 100$

TA1=11%

For 1000mg/l fungicide spray; $TA2=\frac{0.060}{0.418}\times 100$

TA2=14%

For 1500mg/l fungicide spray; $TA3=\frac{0.080}{0.563}\times 100$

TA3=14%

Estimation of proteins

The proteinswere estimated by bi-uret method (Parvin et al., 1965). Total protein content was calculated by the following formula;

$$X = \frac{\textit{Concentration of protein} \times \textit{amount of protein sample}}{1}$$

For Control group; $TA0=\frac{1\times 0.2}{1}$

TA0= 0.2%

For 500mg/l fungicide spray; $TA1=\frac{2\times 0.4}{1}$

TA1= 0.8%

For 1000mg/l fungicide spray; $TA2=\frac{3\times 0.6}{1}$

TA2= 1.8%

For 1500mg/l fungicide spray; $TA3=\frac{4\times 0.8}{1}$

TA3=3.2%

Statistical analysis
The data was subjected to Satistix v.8.0 for estimating LSD and mean values, and graphs were made using MS Excel.

Results And Discussion

Effect of azoxystrobin on total carbohydrate contents
Results showed that different concentrations of azoxystrobin have varying effects on total carbohydrate contents in wheat 7 days after exposure to fungicide. Carbohydrate contents in the wheat increased with increasing concentrations of azoxystrobin as compared to control. The minimum increase in carbohydrate contents (11%) was observed at highest dose of 1500mg/l while the highest carbohydrate contents were noticed at optimal concentration of 1000 mg/l (14%) as compared to control group (9%) (Fig. 1). Chiu-Yueh et al., (2019) reported the effects of fungicide Azoxystrobin on physiology and biochemical profile of wheat seedling under extreme heat. They treated the wheat with different concentrations of azoxystrobin such as 6.4, 4, 20, 40 and 80 mg/l along with control plants and were placed in heat for 1 hours. The result showed that azoxystrobin could not protected wheat against heat stress. However, the total carbohydrate contents and photosynthetic pigments were increased at optimal concentration of 40 mg/l. These results support our findings.

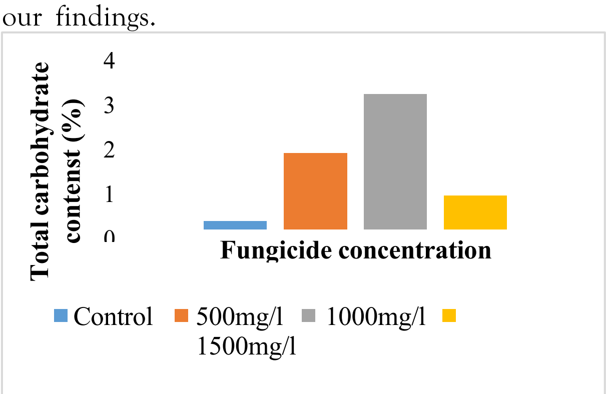

Fig. 1 Response of wheat total carbohydrate contents to varying concentrations of azoxystrobin.

Effect of azoxystrobin on total protein contents
Results showed that different concentrations of azoxystrobin have varying effects on total protein contents in wheat 7 days after exposure to fungicide. Protein contents in the wheat increased with increasing concentrations of azoxystrobin as compared to control. The minimum increase in protein contents (0.8%) was observed at highest concentration of 1500 mg/l while the highest protein contents were noticed at optimal concentration of 1000 mg/l (3.2%) as compared to control group (0.2%) (Fig. 2).

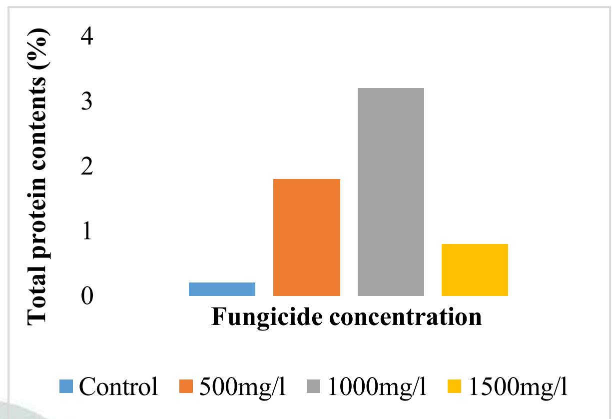

Fig.2 Response of wheat total protein contents to varying concentrations of azoxystrobin.

Effect of azoxystrobin on leaf length
Results showed that different concentrations of azoxystrobin have varying effects on leaf length in wheat 7 days after exposure to fungicide. Leaf length in the wheat increased with increasing concentrations of azoxystrobin as compared to control. However, there was no obvious increase in leaf length at 500 mg/l and 1000 mg/l concentrations of azoxystrobin. The highest increase in leaf length was noticed at azoxystrobin levels of 1500 mg/l (18.5cm) as compared to control group (16.8cm) (Fig. 3). Rangwala et al., (2013) reported the effect of different concentrations of fungicide on growth parameters of wheat (*Triticum aestivum* L.) seedlings, such as germination percentage, root length, shoot length, vigor index, fresh weight, dry weight and viability percentage. The result showed that in all fungicide doses, the germination percentage, root length, shoot length, vigor index, fresh weight and viability percentage increased but decrease the dry weight. The germination percentage, root length and shoot length rate

increased at 1500 mg/l dose of fungicide. These results support the findings of our study.

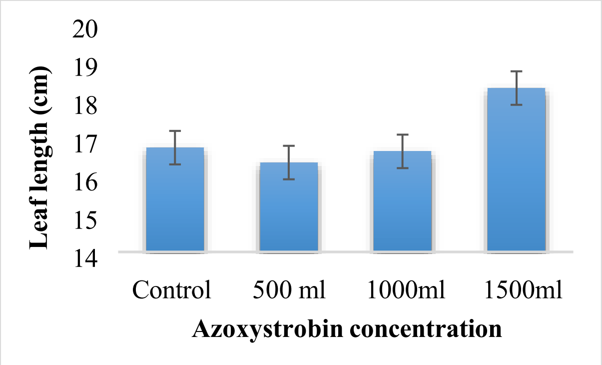

Fig. 3 Response of wheat leaf length to varying concentrations of azoxystrobin.

Conclusion

Although the use of fungicide exerts the harmful effect on wheat but fungicide can also increase crop production. The use of fungicide is considered good for the crop production. In this study, the fungicide (azoxystrobin) increased the biochemical parameters of wheat. The optimal concentration (1000mg/l) of fungicide increased the wheat total carbohydrate and protein contents while the highest concentration of 1500mg/l caused maximum increase in wheat seedling leaf length. It is concluded from study that the optimal concentration of fungicide application can exert the positive effects on the biochemical parameters and leaf length of the wheat seedling.

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