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Original Research Article

The Effect of Foliar Application of Benzoic Acid on Growth and Production of Wheat

Hakim Zamir[1], Altaf Hussain[1*], Muzamil Shabir[1], Aftab Aslam[1], Muhammad Hassan[2], Shahab U Din Waqas[1], Muhammad Zubair Akhtar[3], Sajid Hussain[4]

[1]Department of Botany, University of Agriculture Faisalabad, Pakistan
[2]Department of Agronomy, College of Agriculture, University of Sargodha, Pakistan
[3]Department of Botany, Government College University Faisalabad, Layyah Campus, Pakistan
[4]Institute of Pure and Applied Biology, Bahauddin Zakariya University, Multan, Pakistan

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***Corresponding author:** Altaf Hussain
Department of Botany, University of Agriculture Faisalabad, Pakistan

Abstract

Wheat is one of the most important crop. Which is cultivated in whole world. It belongs to Poaceae family. An experiment was performed to check the effect of foliar application of benzoic acid on growth and production of wheat. This experiment was conducted according to complete randomized design. Three treatments of benzoic acid (100 ml/L, 200 ml/L and 400 ml/L) were used. Data was recorded for plant height, number of tillers/m^2, flag leaf area, spike length, number of grains/spike and plant dry weight/m^2. Then data was analyzed by ANOVA and mean values of each treatment were compared by using Fisher's LSD. The results showed that foliar use of benzoic acid at 200 ml/L provided the best results for all traits (number of tillers/m^2, flag leaf area, spike length, number of grains/spike and plant dry weight/m^2) except plant height. Foliar application of benzoic acid at 200 ml/L greatly enhance the growth and yield in wheat. This was because of increase in auxin production or increase in cell division. While height was the only trait which was gradually decreased with the increase of benzoic acid level.

Keywords: Wheat, Benzoic acid, Foliar application, Growth and Yield.

INTRODUCTION

Wheat belongs to Poaceae family. This family also includes some other major crops such as rice, maize etc. Wheat is used as a staple food in Asian countries. It is grown about all over the world. It is cultivated in Asia, Africa, America and Europe. Wheat is a rich source of carbohydrates for humans [1]. It is also one of the best source of energy for world population. To live healthy life, wheat is the best diet, because it reduces the cholesterol level and chances of heart diseases. In year 2019-20 wheat production of world was recorded 758.3 million tonnes, which showed a decline of 0.5% as compared to the previous year yield. China was the country which provided the highest yield of wheat about 134 million tonnes [2].

It is necessary to find some methods to increase the yield of wheat. As human population is growing gradually, wheat consumption is also increasing, so it is necessary to fill the gap between production and consumption. This target can be achieved only by developing some new techniques. One of such methods is application of benzoic acid. Benzoic acid is part of natural compounds which are synthesized in plant body to enhance metabolism. These compounds not only help in metabolism but also assist in antiseptics and flavor enhancement [3]. Benzoic acid can be produced by plants. They release it to the soil for the assimilation of nutrients. While some plants produce Benzoic acid in large amount to compete with their competitors [4]. The foliar application of Benzoic acid is recognized as a potential method to mitigate the salinity stress [5]. Benzoic acid can also provide tolerance to biotic and abiotic stress. When foliar application of benzoic acid is applied during stress, then enzyme benzoic acid-2-hydroxylase converts benzoic acid into salicylic acid [6]. BA is a functional group of SA, which is responsible for increasing stress tolerance.

BA can be helpful to plants for heat tolerance. Foliar application of benzoic acid can help to increase the growth and yield parameters. Benzoic acid showed positive effects on productivity of several crops. Benzoic acid also increased the growth and yield in Soybean [7]. So on the basis of these results it can be expected that benzoic acid will provide beneficial results on wheat.

Review of literature:

A research experiment was carried out by [7] to check the effect of benzoic acid on soybean plants. Major aim of this experiment was to induce the drought tolerance by applying benzoic acid. Benzoic acid was applied at 0.5 mM level. Drought stress caused the decline in WUE, chlorophyll content and photosynthetic rate. When benzoic acid was applied exogenously the results showed an enhancement of WUE, chlorophyll content and photosynthetic rate. Which shows that benzoic acid can be helpful in inducing drought tolerance in various crops.

An experiment was carried out by [8] to check the effect of benzoic acid and thiourea. This experiment was conducted in Egypt. In this experiment three levels of benzoic acid and three levels of thiourea were used. Purpose of this experiment was to check the effect of these treatments on growth and yield. The results showed that benzoic acid 200 ml/L and thiourea 1000 ml/L greatly affected the growth and yield on wheat crop.

Performed a research to study the effect of spray of benzoic acid on wheat to mitigate the chromium toxicity. Data was recorded for various growth and physiological traits. Results showed that Benzoic acid mitigated the effect of chromium toxicity and showed significant results for all traits [9].

A research experiment was performed by [10] to check the effect of Hydroxyl Benzoic Acid (HBA) on wheat to mitigate the effect of Lead toxicity. In this experiment various levels of lead were applied on seedlings leaves. Then various treatments of HBA were applied and data was recorded for various growth and physiological parameters. Results showed that HBA foliar application increases the seedlings growth and dry weight. This study showed that HBA caused significant decrease in Lead toxicity.

MATERIALS AND METHODS

A field experiment was conducted to check the effect of foliar application of benzoic acid on wheat. Wheat was sown in November. This experiment was performed according to CRD by using three replications. Three treatments of benzoic acid (100 ml/L, 200 ml/L and 400 ml/L) was used in this experiment, which was applied as foliar spray at various stages of crop. Social and agronomical practices were performed consistently.

Calculation of Data for dependent variables:

A. Plant height:

Data for this variable was measured with the help pf measuring tape. Height of five plants from each replication was measured and then their mean value was calculated.

B. Flag leaf area:

Leaf area was measured with the help of Quarrie and Jones equation. Which is as follows:

Leaf area = Length x Breadth x 0.75

C. Number of tillers/m^2:

Number of tillers in one-meter square area of each replication was counted and then their mean value was calculated.

D. Spike length:

Spike length was measured with the help pf measuring tape. Spike length of five plants from each replication was measured and then their mean value was calculated.

E. Number of grains/tiller:

Number of grains per tiller of five plants in each replication was counted and then their mean value was calculated.

F. Plant dry weight/m^2:

Plant dry weight in one-meter square area of each replication was calculated with the help of an electrical adjust "Display Fx-300" and D organization constrained Japan and then their mean value was calculated.

External variable:

External variables were those pests which effect on wheat growth and yield. These pests were controlled by applying some pesticides on crop. So that our results could not be effected by these pests.

Analysis of Data:

Data were analyzed by ANOVA and treatment means were compared by using Fisher's LSD at 0.05.

RESULTS

Analysis of Variance:

Analysis of variance for all traits (plant height, number of tillers/m^2, flag leaf area, spike length, number of grains per spike and plant dry weight/m^2) showed significant results as shown in tables.

Analysis of Variance for Plant Height:

Source	DF	SS	MS	F	P
Trt	3	386.653	128.884	850	0.0000
Error	8	1.213	0.152		
Total	11	387.866			

Analysis of Variance for Flag Leaf Area:

Source	DF	SS	MS	F	P
Trt	3	30.7142	10.2381	179	0.0000
Error	8	0.4587	0.0573		
Total	11	31.1729			

Analysis of Variance for Number of Tillers/m^2:

Source	DF	SS	MS	F	P
Trt	3	6083.26	2027.75	1331	0.0000
Error	8	12.19	1.52		
Total	11	6095.45			

Analysis of Variance for Spike Length:

Source	DF	SS	MS	F	P
Trt	3	21.2339	7.07796	504	0.0000
Error	8	0.1124	0.01405		
Total	11	21.3463			

Analysis of Variance for Number of Grains/Tiller:

Source	DF	SS	MS	F	P
Trt	3	395.505	131.835	1820	0.0000
Error	8	0.579	0.072		
Total	11	396.085			

Analysis of Variance for PDW/m^2:

Source	DF	SS	MS	F	P
Trt	3	138852	46283.9	18025	0.0000
Error	8	21	2.6		
Total	11	138872			

Mean Comparison:

Mean comparison for all traits was performed. The results showed significant differences for all traits at various treatments as shown in figure. The results showed that optimum amount of benzoic acid is required to increase significant growth and yield in wheat. Foliar application of benzoic acid at 200 ml/L provided the highest results for all traits (number of tillers/m^2, flag leaf area, spike length, number of grains/spike and plant dry weight/m^2) except plant height. Foliar application of benzoic acid at 200 ml/L greatly enhance the growth and yield in wheat. This is because of increase in auxin production or increase in cell division. At 400 ml/L level of benzoic acid, plant height was the highest. The results for all traits are as follows:

1- Plant height:

Plant height is an important trait in wheat, as plant height increases there are greater chances of lodging of crop by wind. So it is necessary to develop some methods to reduce the height of wheat plants. The results showed that with the foliar application of benzoic acid height of plants decreases. As level of benzoic acid was increased, height of plants was gradually decreased. The shortest plant height was measured at 400 ml/L as shown in figure. Which shows that higher level of benzoic acid is required to reduce the plant height.

2- Flag leaf area:

Flag leaf area is another important trait in wheat crop. It is necessary for plants to develop leaves with higher leaf area to accumulate more chlorophyll and can absorb more sunlight which can result in higher photosynthesis rate ultimately resulting in higher growth and higher yield. In this experiment foliar application of benzoic acid at 200 ml/L showed the highest flag leaf area as shown in figure. But when 400 ml/L level of benzoic acid was applied, flag leaf area was decreased as compared to flag leaf area at 200 ml/L [10].

3- Number of tillers/m^2:

Number of tillers/m^2 area is one of the most important traits related to yield. Numbers of tillers/m^2 were the highest at 200 ml/L as shown in figure. While at 400 ml/L numbers of tillers/m^2 were the lowest than the controlled one also. Which showed that optimum foliar application of benzoic acid increases the tolerance to various stresses and helps in survival of plants.

4- Spike length:

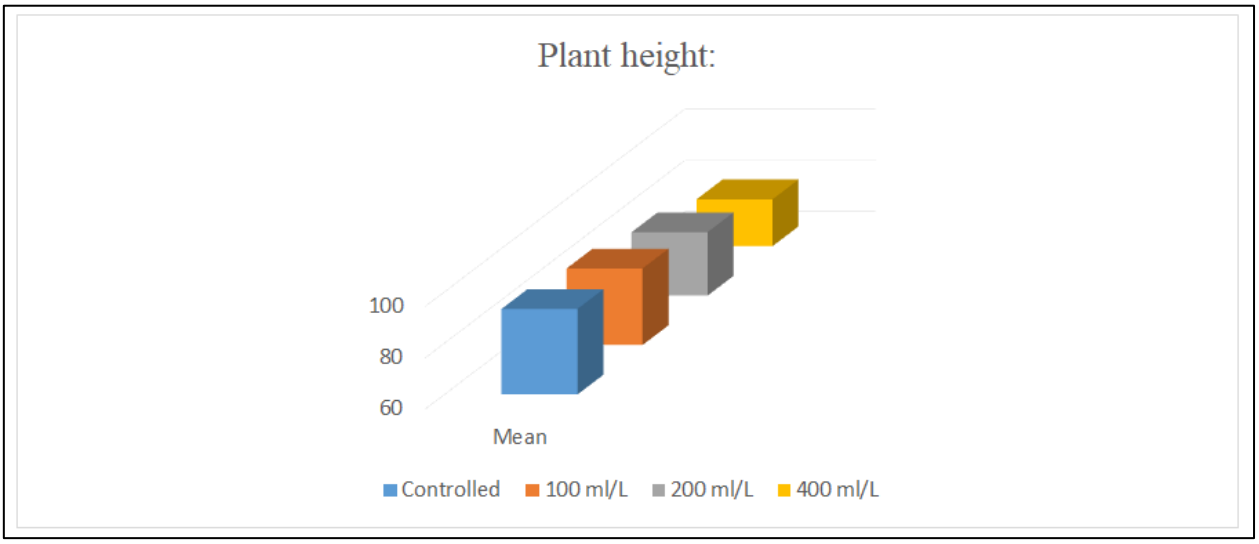
Spike length is also an important trait in wheat crop. This trait is directly associated with yield. Greater the length of spike there will be the greater number of grains. Results showed that spray of benzoic acid at 100 ml/L provided a certain increase in spike length while spray of benzoic acid at 200 ml/L provided the highest spike length and benzoic acid at 400 ml/L showed a significant decrease in spike length as shown in figure. Which showed that optimum foliar application of benzoic acid increases the spike length [8].

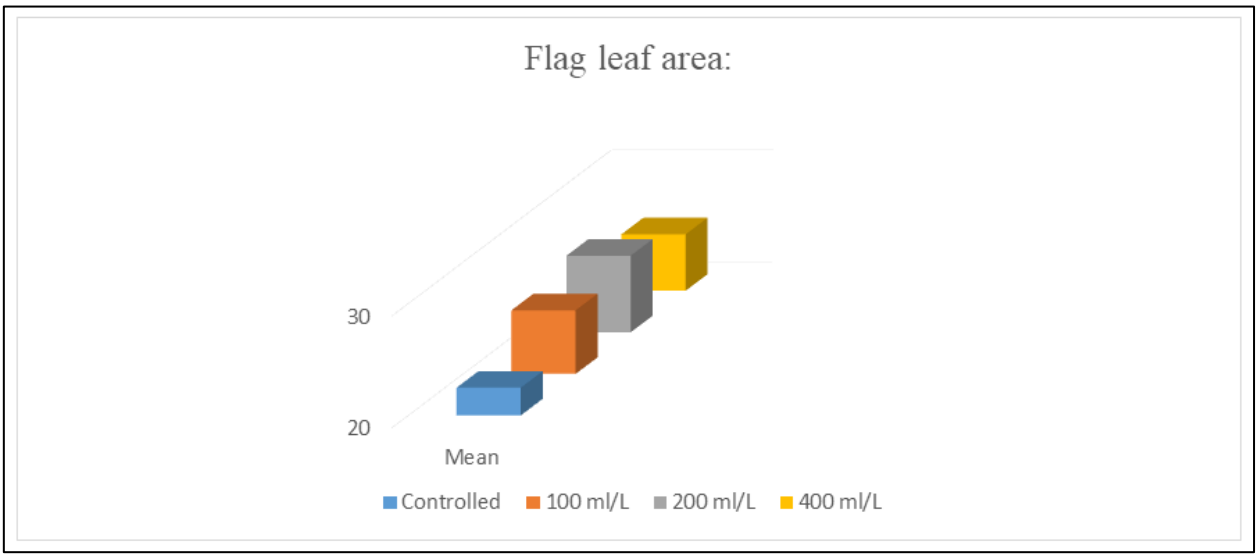
5- Number of grains per spike:

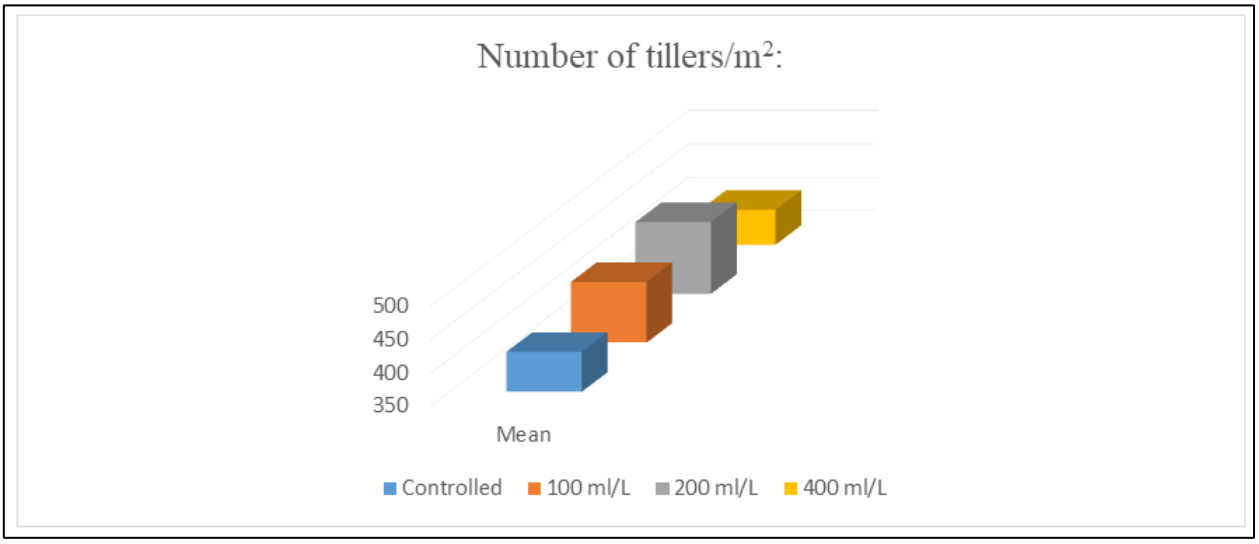
If spike length is too small and there is a great number of grains, then these grains will be of no importance as they have lesser number of carbohydrates and chances of their germination are also too small. So it is necessary that spike length must be higher to develop good quality grains. Results showed that as spike length was the highest at 200 ml/L, number of grains were also the highest at this level and benzoic acid at 400 ml/L showed a significant decrease in spike length so number of grains/spike were also decreased as shown in figure. Which showed that there is a direct relation between spike length and number of grains/spike [8].

6- Plant dry weight/m^2:

Greater the number of tillers/m^2, greater will be the plant dry weight per meter square. As the results showed that, there were greater numbers of tillers/m^2 at 200 ml/L level of benzoic acid so plant dry weight per meter square were also the highest at 200 ml/L as shown in figure. While benzoic acid at 400 ml/L showed a significant decrease in numbers of tillers per meter square so plant dry weight per meter square were also decreased significantly as shown in figure.







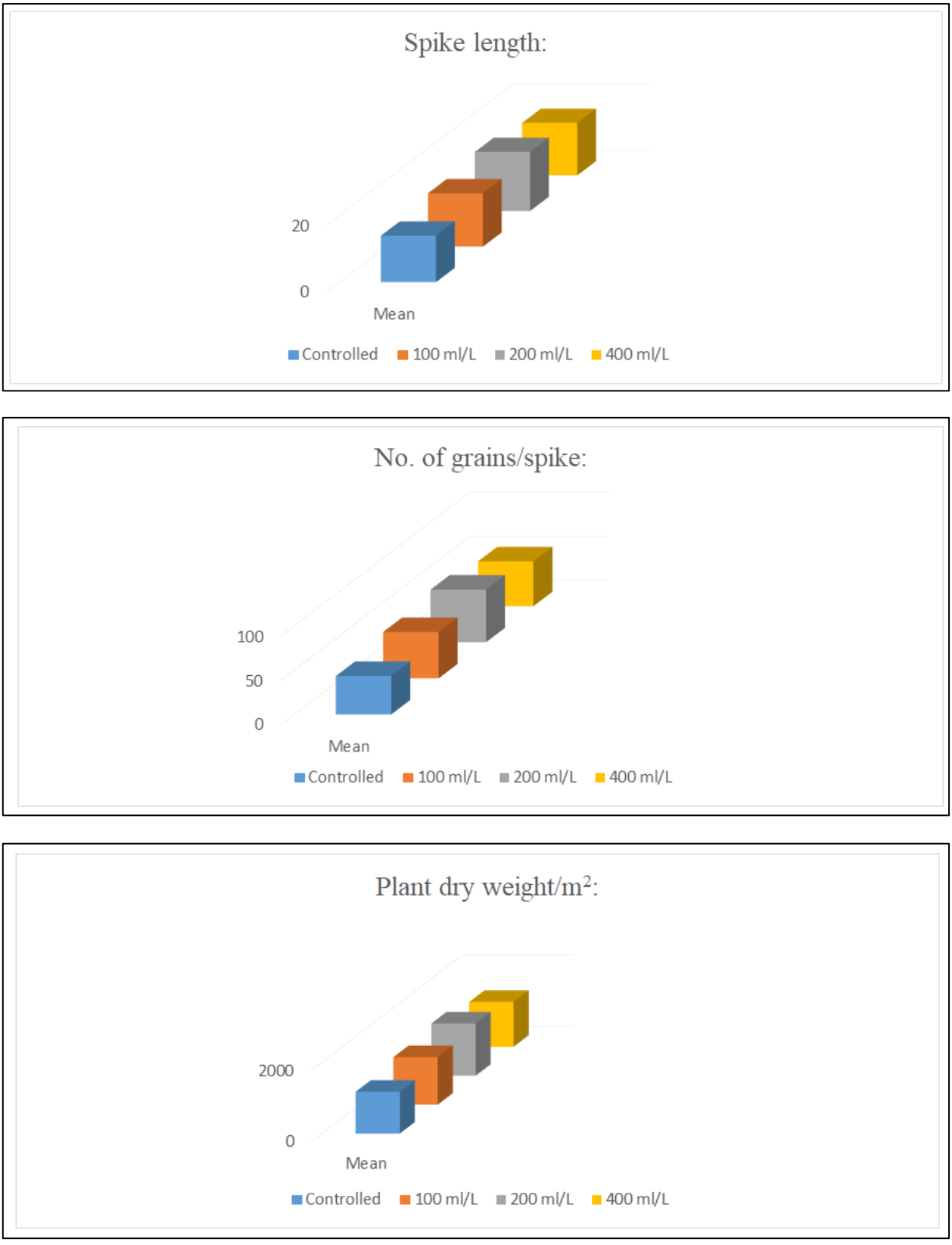


Fig: Mean performance for various traits at different levels of benzoic acid

CONCLUSION

It can be concluded that foliar application of benzoic acid increases the growth and yield in wheat. Foliar application of benzoic acid at 200 ml/L provided the best results for all traits (number of tillers/m^2, flag leaf area, spike length, number of grains/spike and plant dry weight/m^2) except plant height. Foliar application of benzoic acid at 200 ml/L greatly enhance the growth and

yield in wheat. This was because of increase in auxin production or increase in cell division. While height was the only trait which was gradually decreased with the increase of benzoic acid level. The application of benzoic acid as bio regulatory compounds hence opens up new ways for enhancing wheat harvest and improving the quality of wheat grains throughout the globe.

Rain was one of the external variable which may affect our results. Effect of this variable was not much higher on observed results because our results were almost according to experiments written in review of literature.

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