

Research Article

Role of hydroxyl benzoic acid foliar spray on amelioration of lead tolerance on *Triticum aestivum* L.

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Abstract

Heavy metal pollution of water and soil has become a global issue, which extensively effect the major cereal crops and human health in the world. Current study aimed to conduct the role of exogenously applied Hydroxyl Benzoic Acid (HBA) foliar spray on agronomic and physicochemical parameters of two varieties of *Triticum aestivum* L. i.e. Jhanbaz and Galaxy 2013 under the lead (heavy metal) stress. Leaves of the above plants were treated (after 7, 14, 21 days) with distilled water (control), 2ppm Pb²⁺ (T1), 2ppm Pb²⁺ +HBA (T2), 4 ppm Pb²⁺ (T3), and 2ppm Pb²⁺ +HBA (T4) and response of plants was observed at first, second and third week of the germination. Results of the lead (Pb²⁺) treatment of 4ppm and 2ppm showed high adverse effect on physiochemical and growth performance. Whereas HBA foliar spray revealed better performance by improving seedling vigorous index, agronomic parameters and percent field capacity under application of lead at 4ppm and 2ppm. This indicated that the toxic effects generated by heavy metal stress were relatively overcome by the application of HBA. However, results exhibited the better growth and physicochemical performance were recorded in Jhanbaz as compared to Galaxy 2013 and recommended variety under induced lead stress (lead).

Keywords: Growth performance; Heavy metal; HBA; Lead; *Triticum aestivum* L.

Introduction

Heavy metal pollution of water and soil supplies has become a major problem in the modern world. Due to a direct interaction between these sources and the food chain, the excessive concentration of heavy metals is a serious threat to human life [1]. More heavy metal presentation to ground water through polluted soil plays a vital role in health and environmental aspects. Pb²⁺ is one of the most toxic heavy metals without biological function, which is quickly absorbed by plants and it is toxic to living organisms even at low concentrations [2].

Inevitably, the use of industrial wastewater for agricultural land irrigation has skyrocketed due to water shortage crises and fertility benefits. Lead (Pb²⁺) is a heavy metal of anthropogenic origin [3]. Pb²⁺ is a pollutant that accumulates in soils, sediments and water and is extremely persistent in the environment [4]. Pb²⁺ has no biological function and is toxic to living organisms, even at low concentrations. Although Pb²⁺ is not an essential element, some plant species multiply in an area contaminated with Pb²⁺ and accumulate it

in different parts. The roots are the first organ in contact with various components of the rhizosphere [5]. Lead is absorbed by the plants through roots and caused disturbance of ions with in plants [6]. It has been speculated that lead toxic drugs may cause physiological and biochemical changes in the *Oryza sativa* L. [7]. Lead is not essential for a relatively high reactions of plant cells but it will remove this metal if it is present in their environment, especially in rural area where it is polluted by automobiles exhausts and in farms, contaminated with fertilizers containing heavy metals as impurities [8]. Plants take Pb^{2+} from the solution in the soil at the roots, and then the largest amount of Pb^{2+} accumulates in the roots in insoluble form [9]. Accumulation of lead in plants increases with an increase in plant lead levels. Lead can cause a wide range of physical and biochemical dysfunctions in seed germination, plant growth, water conditions and nitrate uptake [10-12].

Lead is one of the most widely used heavy metals and is highly toxic to plants [13]. Throughout the plant, Pb^{2+} can affect photosynthesis at stoma levels, mesophyll cells, pigment content, and light and dark reactions. Heavy metal pollution of soil and water is a global environmental problem [14]. The objective of this study is to conduct the role of exogenously applied Hydroxyl Benzoic Acid (HBA) foliar spray on agronomic, and physicochemical parameters two varieties of *Triticum aestivum* L. such as Jhanbaz and Galaxy 2013 under the induced stress of heavy metal (lead).

Materials and Methods

Peshawar Industrial City Peshawar is a major producer of industrial wastewater in KPK Province. Due to their significant wastewater production, local farmers can use these alternative water resources for irrigation. Three samples of wastewater were taken from an industrial area of Peshawar city. The average concentration of Pb^{2+} in industrial wastewater was determined by a nuclear absorption

spectrophotometer (AAS) and ranged from 2 ppm to 4 ppm. To perform this measurement, a lab specialist pumped 100 ml of dirty water directly into the laboratory [15]. However, the presence of metallurgical fluids in wastewater prevents plants from growing due to its complex biocides and chemicals [16]. Treating mineral fluids was not reasonable or cost-effective, so the wastewater was prepared with the infamous Pb^{2+} solution (100 mg / 1) developed by Merck Millipour of Germany.

Two different concentrations of solution were prepared, 4ppm and 2ppm, medium and strong wastewater was used in this study, respectively. The experiment was conducted during the 2015 wheat growing season at the Department of Botany, Bacha Khan University, Charsadda (latitude, 348°43.080'N, longitude, 7143'50.880'E) and altitude 282 m. Selected Local Blend Jhanbaz and Galaxy 2013 *Triticum aestivum* L. from Nowshera Cereal Crops Research Institute (CCRI). The seeds were sterilized in a solution of 10 ml of Clorox and 200 ml of water for 3 minutes and then washed with 50% ethanol for 3 minutes. After that, the seeds were rinsed with distilled water and planted in plastic pots (14 cm bottom inside diameter, 18.5 cm top inside diameter, 15.6 cm height and 0.5 cm depth). Thick) filled with air-dried soil and sand (3: 1) in triplicate pots. They were protected from the rain and 3 pots were submitted to each treatment. The total number of pots was 30. Plants were watered as needed. Sampling was performed 15 days after the start of treatment with heavy metals. For each treatment, 3 repetitions were taken. After the agronomic study, the samples were dried at room temperature for analysis of the heavy metal Pb^{2+} . (20) Grams of soil of a uniform depth were taken 6 inches from the surfaces of the pots. Dry weight was determined after drying the soil in an oven for 72 hours at 70 °C until constant weight.

Soil moisture content

The %age moisture content of soil is

calculated by following formula:

$$\% \text{age moisture content} = \frac{\text{Soil Fresh weight} - \text{Soil Dry weight} \times 100}{\text{Soil Fresh weight}}$$

Field capacity of rhizospheric soil

The field capacity of rhizospheric soil was

calculated following the method:

$$\text{Field Capacity (\%)} = \frac{\text{Wet soil weight (g)} - \text{Dry soil weight (g)} \times 100}{\text{Dry soil weight (g)}}$$

Analysis of heavy metal lead for Rhizospheric soil and plant powder

Distilled water of 1 mL and 9 mL of rhizospheric clay extracts was taken into a test tube and lead was analyzed on an

atomic absorption spectrophotometer. Micronutrients, micronutrients and heavy metals rhizome soil were measured by the formula:

$$\text{Nutrients (ppm)} = (\text{Extract in ppm} - \text{blank}) \times \frac{A}{W} \times \text{dilution factor}$$

Whereas

A = Total extract volume (ml)

W = Rhizospheric soil dry weight

Procedure

Take the oven dried sample (0.25 g) in a 50 ml flask and add 6.5 ml of mixed acid solution, i.e. nitric acid, sulfuric acid, per chloric acid (5: 1: 0.1) and boil on a hot plate with extractor hood.

Then a few drops of contaminated water were added and allowed to cool. The

digested samples were then transferred to a 100 ml volumetric flask and the volume was increased to 100 ml by adding contaminated water. The extract was then filtered through whatman # 42 filter paper and stored in plastic bottles labeled filtrate. The concentration of these elements throughout the sample was determined by the Shamadzo AA-670 nuclear absorption spectrophotometer.

$$\text{Plant Cation of Nutrient} = (\text{Extract in ppm} - \text{blank}) \times \frac{A}{W} \times \text{dilution factor}$$

Whereas

A=Total volume of extract (mL)

W=Dry Plant Weight

Results and Discussion

Germination percentage

When applied Pb^{2+} stress *Triticum aestivum* L. showed reduction in germination but under HBA showed promotion. The maximum germination has been indicated after 7 day(d) and 14d treatment in T3 (V1) and T4 (V2), followed by T4 (V1) and T3 (V2), while the minimum was found in T1 (V1) and T5 (V2) while day after of 21 treatments the maximum germination has been found in

T2 (V1) 5.618% and T4 (V2) with 16% (Table 1) while the lowest has been reported in T1 (V1) and T5 (V2) our result is also linked with [17, 18]. Who demonstrated that this metal exerts plant growth, seed germination, shoot growth, root growth, evaporation, chlorophyll production, laminar organization in the cytoplasm and cell division. Sprouts are sensitive to environmental influences in the germination and germination stages [19]. Toxicity of Lead significantly affects the processes of biological in various plants like in maize, barley, wheat, Citrullus, cauliflower and in vegetables. lead

decreases the seedling growth, shoot length, root length; number of leaves [20].

Shoot and root length

Heavy metal stress directly affects the plant shoot and root length, the current study indicated that the maximum shoot length was documented in T2 (V1) and T1 (V2) whereas the lowest has been found in T1 (V1) and T5 (V2). After 14d treatment the maximum shoot length has been indicated in T5 (V1) with 28.6cm and T2 (V2), while the minimum has been found in T4 (V1) and T5 (V2). The maximum shoot length after 21d treatment was noted in T3 (V1) and T1 (V2), whereas the lowest has been reported in T4 (V1) and T2 (V2) (Table 2). While after 7d treatment the maximum root length has been found in T1 (V1, V2) followed by T3 (V1, V2), while the lowest has been noted in T5 (V1, V2). After 14d treatment the maximum root length has been reported in T2 (V1) with 17.25cm and T4 (V2) with 11.05cm, whereas the lowest has been indicated in T5 (V1) and T3 (V2). The maximum root length has been found after 21d treatment in T3 (V1) and T4 (V2), while the lowest has been noted in T1 (V1) and T5 (V2).

Soils contaminated with Pb^{2+} cause sharp decreases in crop productivity there by poisoning a serious problem for agriculture (21) (Table 3). Similarly, result was also found that Retarded or no root and shoot formation was observed in the *Triticum aestivum* L. plant when expose to higher concentration of Cr [21]. Enlarge in heavy metals uptake reduces growth of plant and development for the reason that they start interacting with the micronutrient and limits their availability to the plant. Lead adversely affects plant growth which depends upon its concentration and plant species. Reduction in plant tallness due to Pb^{2+} is reported in many plants, 11%, 22% and 41% decrease in height of oats [22], in *Lactuca sativa*, *Curcumas sativus* and *Panicum miliaceum* [23] and *Triticum aestivum* L. [24].

Fresh and dry biomass

The higher fresh shoot weight was found in T1 (V1,V2) after 7d treatment and was noted lowest in T4 (V1) with 0.207g and T5 (V2) with 0.721g. The shoot fresh weight after 14d treatment has been indicated in T2 (V1) and T3 (V2), while the lowest was indicated in T4 (V1) and T2 (V2). After 21d treatment the maximum shoot fresh weight has been indicated in T4(V1) and T3 (V2), whereas the lowest has been reported in T4 (V1) and T2 (V2) while After 7d treatment the highest shoot dry weight was found in T4(V1) and T2 (V2), while the lowest was noted in T3 (V1, V2). The upper limit shoot dry weight has been reported in T2 (V1) with 0.14g and T1 (V2) with 0.145g after 14d treatment, whereas the smallest has been reported in T4 (V1) and T2 (V2). The higher dry weight of shoot was noted after 21d treatment in T4 (V1) and T3 (V2), while the lowest was noted in T3 (V1) and T4 (V2) (Table 2) while root maximum fresh weight has been reported after 7d,14d,and 21d in T2 (V1), and in T3 (V2), whereas the lowest has been reported after in T3 (V1) and T5 (V2), T4 (V1) and T2(V2), and T1 (V1) and T2 (V2) respectively whereas dry weight has been found maximum 7d and 14d treatment in T2, T4 (V1) and T3 (V2), but the lowest has been noticed after 7d in T5 (V1, V2), after 14d in T4 (V1), T2 (V2) and after 21d treatment in T1 (V1) and T2 (V2) (Table 3). Similarly, benzoic acid at 100-400 mg L⁻¹ increased seedling growth, biomass, flavonoid protein, carbohydrate and phenolic content of *physiolas vulgaris* plant [25] and considerably increased totals insoluble and soluble carbohydrates in *Ammi visnaga* L. In previous studies it has also been reported that dry weight of root and their length of the *Caesalpinia pulcherrima* was repressed by 100ppm Pb^{2+} [26], total root weight and root length of *Triticum aestivum* L. was also affected by 20 mg Pb^{2+} (VI) kg⁻¹ [27].

Leaf numbers, area, fresh and dry biomass

Results of our study conform that Pb^{2+} stress is not only harmful for germination, shoot, root length and biomass but also harmful for leaf too. The maximum fresh leaf weight has been showed by T1 (V1, V2) after 7d treatment with 0.093g and 0.154g, while the lowest was found in T4 (V1) and T2 (V2). After 14d treatment the maximum leaf dry weight has been noted in T2 (V1) and T3 (V2) while the lowest has been reported in T4 (V1) and T2 (V2). After 21d treatment the maximum leaf dry weight has been found in T5 (V1) and T3 (V2), whereas the minimum has been showed by T4 (V1, V2) respectively (Table 4). The maximum leaf dry weight has been noticed after 7d treatment in T1 (V1) and T2 (V2), whereas the minimum has been reported in T3 (V1) and T2 (V2). After 17d treatment the maximum leaf dry weight has been indicated in T2 (V1) and T3 (V2), while the minimum was reported in T3 (V1) and T2 (V2). The maximum leaf dry weight has been found after 21d treatment in T5 (V1) with 0.022g and T3 (V2) with 0.038g, whereas the lowest has been reported in T2 (V1) and T4 (V2) (Table 4). No. of leaves has been found maximum in T1 (V1) and T3 (V2) after 7d treatment and the lowest has been noticed in T3 (V1) and T2 (V2). After 17d treatment the maximum No. of leaves has been reported by T5 (V1) and T4(V2), while the minimum has been showed by T4 (V1) and T5 (V2). After 21d treatment the maximum No. of leaves has been indicated in T4(V1) and T5(V2) whereas the lowest has been reported in T2 (V1, V2) respectively (Table 4). Consequences of leaf area has been noticed maximum after 7d treatment in T2 (V1) and T4 (V2), followed by T5 (V1) with 5.35cm and T4 (V2) with 43.55cm, while the lowest was noticed in T4 (V1) and T5 (V2) respectively. After 14d treatment the maximum leaf area has been reported in T5 (V1) and T3 (V2), while the lowest was indicated by T4 (V1) and T2 (V2). After 21d treatment the maximum leaf area has

been showed by T4 (V1) 5.61cm and T3 (V2) with 12.69cm, while the lowest has been found in T1 (V1) and T2 (V2) respectively (Table 5). Along with number of leaves in plant, heavy metals also affect the other aspects of leaves of different plants such as Pb^{2+} effect leaf biomass and area of *Albizia lebbek* [28], decrease in leaf area of primary and trifoliate leaves of bush bean plant [29], dry leaf yield of bush bean plants was also decreased [30], decrease in leaf dry weight and leaf area of *Oryza sativa*, *Acacia holosericea*, *Leucaena leucocephala* [31], and *P. vulgaris* [32], reduced leaf size of spinach [33], pretentious young leaves in tomato plants [34].

Moisture contents, Field capacity, vigorous index

Table 1 showed that maximum % moisture content has been reported in T5 (untreated control) in V1 (Jhanbaz) and T1 (2ppm Pb^{2+}) in V2 (Galaxy 2013) after 7d treatment, followed by T3 (4ppm Pb^{2+}), whereas the lowest has been reported in T1 (2ppm Pb^{2+}) in V1 with 0.033% and T5 (untreated control) in V2. The maximum % moisture content after 14d treatment was noted in T1 (2ppm Pb^{2+}), followed by T3 (4ppm Pb^{2+}), while lowest was found in T4 (2ppm Pb^{2+} +HBA) in V1 and T5 (untreated control) in V2. After 21d treatment the maximum % moisture content was noted maximum in T5 (untreated control) in V1 with 5.925% and T2 (2ppm Pb^{2+} +HBA) in V2, followed by T1 (2ppm Pb^{2+}) in V1 and T4 (2ppm Pb^{2+} +HBA) in V2, whereas the lowest has been reported in T2 (2ppm Pb^{2+} +HBA) in V1 and T1 (2ppm Pb^{2+}) in V2 respectively. The maximum F.C (field capacity) has been indicated in T3 (V1) and T1 (V2), followed by T1 (V1) and T3 (V2), while the lowest was found in T1 (V1) and T5 (V2) after 7d treatment. After 14 days' treatment the maximum F.C has been indicated in T1 (V1, V2) with 5.397-6.276%, followed by T3, whereas the lowest was noted in T4 (V1) and T5 (V2). The maximum F.C has been reported after 21d treatment in T5 (V1) and T3 (V2),

followed by T1 (V1) and T3 (V2), whereas the lowest was noted in T2 (V1) and T1 (V2). Maximum vigorous index has been reported in T3 (V1) and T5 (V2) after 7d treatment, while the minimum has been evaluated in T2 (V1, V2). After 17d treatment the maximum vigorous index has been found in T1 (V1) with 768.6 and T5 (V2) with 929.90, while the lowest has been reported by T4. The maximum vigorous index has been noticed in T3 (V1) and T5 (V2), while the minimum has been showed by T2 (V1) and T4 (V2) respectively (Table 5). Similarly, result is also found by [35], the treatment T2 (2ppm+HBA) in both varieties showed the maximum values for the majority of agronomic characters among all the treatments. Treatment T2 (2ppm+HBA) showed the maximum vigor index in both varieties and was the best treatment of our research work. Maximum Vigor index was recorded in treatment T2 of Galaxy 2013 (2546.2 ± 992.778), followed by treatment T4 of the same variety [36] whereas, treatment T3 (4ppm) of both varieties was the worst treatment with the lowest vigor index in all samples.

Rhizospheric soil and whole plant

Table 6 exhibited the maximum concentration of lead in rhizospheric soil has been found maximum after 7d treatment in T5 (V1) with 1.156, followed by T4 (V2), while the lowest concentration

has been found in T1 (V1,V2). After 14d treatment the maximum concentration after 14d treatment has been recorded in T3 (V1,V2), whereas the lowest has been noticed in T1 (V1,V2). The maximum concentration of lead in rhizospheric soil has been showed after 21d treatment in T5 (V1) with 1.399 and T3 (V2) with 1.569, while the lowest has been reported in T1 (V1) and T5 (V2) respectively. The maximum concentration of lead in whole plant has been found maximum in T5 (V1) and T4 (V1) after 7d treatment, while the lowest has been noticed in T1 (V1) and T2 (V2). After 14d treatment the maximum concentration has been found in T5 (V1) with 1.484 and T3 (V2) with 1.429, whereas the minimum concentration has been reported in T1 (V1) and T2 (V2) respectively. The maximum concentration of lead in whole plant after 21d treatment has been found in T4 (V1) and T5 (V2), whereas the lowest has been reported in T1 (V1) and T4 (V2) respectively. Result is similar with the work of [37, 38] that showed Plants' responses to lead exposure are used as tools (biomarkers) in the context of environmental quality assessment. To develop tools for ecological study, understanding the mechanisms involved in plant absorption, transfer and toxicity is essential.

Table 1. Influence of foliar spray of Hydroxyl benzoic acid on percent field capacity, soil moisture, and germination percentage of *Triticum aestivum* L. under inoculation of Pb²⁺ at 2ppm and 4ppm

Treatment	Jhanbaz								
	% moisture			Field capacity			Germination		
	7d	14d	21d	7d	14d	21d	7d	14d	21d
T1	0.03±0.00	5.21±0.01	5.23±1.17	3.47±0.04	5.40±0.10	5.42±1.27	11.00±1.41	11.0±1.41	1.39±0.03
T2	0.04±0.02	1.98±0.84	2.65±1.44	4.70±1.56	2.00±0.87	2.71±1.48	12.50±1.41	12.5±1.42	5.62±1.84
T3	0.05±0.01	4.33±1.12	4.40±0.61	5.49±0.72	4.47±1.19	4.54±0.64	15.00±2.12	15.0±2.12	3.31±0.64
T4	0.04±0.00	1.88±0.76	4.66±1.23	3.89±0.13	1.90±0.79	4.83±1.39	13.50±2.12	13.5±2.12	5.31±1.19
T5	0.05±0.01	3.66±0.61	5.93±3.63	5.55±0.51	3.76±0.64	6.26±3.86	12.50±1.41	12.5±1.41	2.62±0.87
Treatment	Galaxy 2013								
	% moisture			Field capacity			Germination		
	7d	14d	21d	7d	14d	21d	7d	14d	21d
T1	0.13±0.05	6.01±1.14	1.38±0.35	14.05±6.66	6.27±1.25	11.0±1.41	12.5±2.828	12.5±2.828	12.5±2.828
T2	0.07±0.00	3.36±3.62	5.39±1.72	7.82±0.15	3.53±3.86	12.5±1.41	12.5±1.414	12.5±1.414	12.5±1.414
T3	0.09±0.05	5.53±1.23	3.23±0.06	9.92±6.50	5.75±1.31	15.0±2.12	12.5±1.414	12.5±1.414	12.5±1.414
T4	0.07±0.02	5.22±1.17	5.12±1.12	8.04±3.36	5.42±1.26	13.5±2.12	16±0.707	16±0.707	16±0.707
T5	0.05±0.00	2.65±1.44	2.57±0.84	4.99±0.29	2.71±1.48	12.5±1.41	11±1.414	11.00±1.414	11±1.414

T1 stands for 2ppm + Pb²⁺, T2=2ppm Pb²⁺ +HBA, T3=4ppm Pb²⁺, T4= 2ppm Pb²⁺ +HBA, T5= Untreated/control

Table 2. Effect of foliar spray of Hydroxyl benzoic acid on shoot length, fresh and dry biomass of *Triticum aestivum* L. under inoculation of Pb²⁺ at 2ppm and 4ppm

Treatment	Jhanbaz								
	Shoot length			Shoot fresh weight			Shoot dry weight		
	7d	14d	21d	7d	14d	21d	7d	14d	21d
T1	2.26±3.96	26.0±0.35	26.4±0.84	0.56±0.14	0.48±0.01	0.34±0.011	0.12±0.03	0.13±0.01	0.09±0.02
T2	24.75±0.00	28.35±0.21	29.8±6.08	0.456±0.09	0.59±0.13	0.34±0.05	0.11±0.03	0.14±0.04	0.09±0.00
T3	22.15±0.07	24.1±4.38	30.5±0.35	0.22±0.00	0.26±0.09	0.267±0.022	0.04±0.00	0.05±0.01	0.06±0.00
T4	19.55±0.07	18.65±0.91	24.65±0.98	0.20±0.01	0.16±0.32	0.36±0.021	0.12±0.05	0.04±0.00	0.134±0.00
T5	18.75±0.00	28.6±5.16	27.5±0.35	0.34±0.13	0.56±0.31	0.32±0.09	0.06±0.05	0.14±0.07	0.09±0.02
Treatment	Galaxy 2013								
	Shoot length			Shoot fresh weight			Shoot dry weight		
	7d	14d	21d	7d	14d	21d	7d	14d	21d
T1	9.85±2.05	0.08±0.03	43.45±7.99	0.72±0.15	0.76±0.51	0.77±0.49	0.08±0.03	0.15±0.046	0.20±0.10
T2	7.7±0.77	0.09±0.04	24.85±10.53	0.49±0.29	0.24±0.20	0.37±0.37	0.09±0.04	0.06±0.03	0.09±0.08

T3	8.7±1.90	0.07±0.02	42±11.68	0.32±0.17	0.97±0.47	1.09±0.52	0.07±0.02	0.24±0.16	0.26±0.10
T4	7.05±1.27	0.08±0.00	37.00±0.35	0.44±0.02	0.54±0.00	0.38±0.00	0.08±0.00	0.12±0.00	0.09±0.00
T5	6.05±0.28	0.07±0.00	39.25±4.95	0.38±0.02	0.40±0.03	0.76±0.28	0.07±0.00	0.10±0.001	0.19±0.07

T1 stands for 2ppm-Pb²⁺, T2=2ppm Pb²⁺ +HBA, T3=4ppm Pb²⁺, T4= 2ppm Pb²⁺ +HBA, T5= Untreated/control

Table 3. Influence of foliar spray Hydroxyl benzoic acid on root length, dry and fresh biomass of *triticum aestivum* L. under inoculation of Pb²⁺ at 2ppm and 4 ppm

Treatment	Jhanbaz								
	Root length			Root fresh weight			Root dry weight		
	7d	14d	21d	7d	14d	21d	7d	14d	21d
T1	11.25±0.21	10.5±0.00	12.00±2.13	0.103±0.00	0.13±0.06	0.04±0.01	0.06±0.00	0.09±0.03	0.04±0.01
T2	10.88±4.56	17.25±5.30	13.75±1.41	0.33±0.11	0.28±0.15	0.11±0.32	0.21±0.10	0.18±0.10	0.08±0.02
T3	10.3±0.49	10.45±1.62	14.50±1.41	0.09±0.13	0.12±0.02	0.05±0.01	0.06±0.01	0.07±0.00	0.04±0.01
T4	10.8±4.66	14.6±7.70	14.00±1.41	0.17±0.08	0.09±0.01	0.13±0.02	0.05±0.02	0.07±0.00	0.12±0.02
T5	08.35±1.20	05.55±0.42	12.4±0.56	0.11±0.05	0.12±0.02	0.06±0.01	0.03±0.02	0.05±0.00	0.04±0.01
Treatment	Galaxy 2013								
	Root length			Root fresh weight			Root dry weight		
	7d	14d	21d	7d	14d	21d	7d	14d	21d
T1	09.85±2.05	07.50±1.06	12.45±03.39	0.093±0.03	0.14±0.06	0.06±0.01	0.06±0.02	0.06±0.00	0.04±0.011
T2	07.7±0.77	09.40±0.56	11.06±01.13	0.07±0.038	0.02±0.00	0.05±0.00	0.04±0.08	0.07±0.00	0.03±0.00
T3	08.70±1.90	5.85±1.06	12.70±05.30	0.11±0.091	0.19±0.10	0.11±0.07	0.09±0.04	0.09±0.07	0.08±0.06
T4	07.05±1.27	11.05±0.35	21.09±06.15	0.08±0.01	0.173±0.00	0.07±0.02	0.04±0.01	0.09±0.00	0.03±0.00
T5	06.05±0.28	07.85±1.34	10.25±0.35	0.03±0.00	0.17±0.04	0.05±0.00	0.01±0.00	0.06±0.07	0.03±0.00

T1 stands for 2ppm-Pb²⁺, T2=2ppm Pb²⁺ +HBA, T3=4ppm Pb²⁺, T4= 2ppm Pb²⁺ +HBA, T5= Untreated/control

Table 4. Effect of foliar spray Hydroxyl benzoic acid on leaf numbers, leaf day and fresh biomass of *Triticum aestivum* L. under inoculation of Pb²⁺ at 2ppm and 4ppm

Treatment	Jhanbaz								
	Leaf fresh weight			Leaf dry weight			No of leaves		
	7d	14d	21d	7d	14d	21d	7d	14d	21d
T1	0.093±0.026	0.0815±0.001	0.052±0.011	0.025±0.007	0.0225±0.00	0.0175±0.004	11±0.707	8.5±1.414	10±1.414
T2	0.091±0.008	0.094±0.013	0.057±0.012	0.022±0.002	0.024±0.004	0.017±0.004	8±0.707	11.5±0.707	8.5±0.707
T3	0.057±0.00	0.058±0.012	0.061±0.004	0.013±0.000	0.02±0.0007	0.019±0.0007	6.5±0.707	8.5±1.414	8±0.707
T4	0.037±0.007	0.0375±0.004	0.0495±0.006	0.009±0.003	0.016±0.0007	0.019±0.0007	7.5±0.00	4.5±2.121	10.5±0.00
T5	0.079±0.023	0.084±0.048	0.071±0.020	0.01±0.014	0.02±0.014	0.0225±0.002	8±0.707	12.00±2.121	8.5±0.707
Treatment	Galaxy 2013								
	Leaf fresh weight			Leaf dry weight			No of leaves		
	7d	14d	21d	7d	14d	21d	7d	14d	21d

Treatment	Leaf fresh weight			Leaf dry weight			No of leaves		
	7d	14d	21d	7d	14d	21d	7d	14d	21d
T1	0.154±0.037	0.1535±0.083	0.122±0.011	0.015±0.010	0.044±0.015	0.027±0.008	7±1.414	9.5±0.707	11.5±3.535
T2	0.091±0.053	0.048±0.029	0.067±0.048	0.032±0.013	0.0185±0.004	0.023±0.011	6.00±0.00	8.00±0.707	9.5±2.828
T3	0.07±0.039	0.162±0.076	0.122±0.048	0.021±0.006	0.0525±0.016	0.0385±0.013	7.5±0.00	9.5±1.414	11±1.414
T4	0.105±0.016	0.104±0.009	0.065±0.141	0.021±0.005	0.035±0.009	0.0225±0.004	7.5±0.00	10.00±0.707	9.5±0.707
T5	0.107±0.007	0.094±0.015	0.084±0.006	0.023±0.003	0.0245±0.002	0.024±0.002	7.5±0.00	9.00±0.00	12±2.121

T1 stands for 2ppm-Pb²⁺, T2=2ppm Pb²⁺ +HBA, T3=4ppm Pb²⁺, T4= 2ppm Pb²⁺ +HBA, T5= Untreated/control

Table 5. Effect of foliar spray Hydroxyl benzoic acid on vigorous index and leaf area of *Triticum aestivum* L. under inoculation of Pb²⁺ 2ppm and 4ppm

Treatment	Jhanbaz						Galaxy 2013					
	Leaf area			Vigorous index			Leaf area			Vigorous index		
	7d	14d	21d	7d	14d	21d	7d	14d	21d	7d	14d	21d
T1	5.72±1.89	7.32±0.035	4.47±0.99	645.57±5.39	1025.48±6.87	645.57±5.39	10.48±2.77	13.95±3.28	9.783±2.81	639.99±5.60	900.11±7.04	1053.0±5.66
T2	6.08±0.05	8.08±1.30	6.12±1.61	509.76±7.29	1501.69±8.01	509.76±7.29	8.58±4.41	4.71±1.88	5.85±3.81	403.2±0.98	802.64±2.74	982.56±2.80
T3	5.35±0.91	5.7±0.84	6.77±0.77	768.6±8.89	2072.7±7.32	768.6±8.89	43.55±55.64	18.66±8.73	12.69±4.62	885.51±4.36	1033.2±4.95	995.89±5.66
T4	4.13±0.43	4.2±0.67	5.61±0.38	526.68±8.26	882±10.35	526.68±8.26	67.64±42.22	10.52±2.30	8.005±2.00	591.5±6.01	696.8±6.02	951.00±4.68
T5	6.02±1.47	8.29±3.16	5.25±0.05	721.59±7.72	1055.68±9.86	721.59±7.72	7.53±0.91	10.01±0.79	9.26±1.03	929.90±5.40	1273.38±8.48	1682.36±5.49

T1 stands for 2ppm-Pb²⁺, T2=2ppm Pb²⁺ +HBA, T3=4ppm Pb²⁺, T4= 2ppm Pb²⁺ +HBA, T5= Untreated/control

Table 6. Influence of foliar spray Hydroxyl benzoic acid on rhizospheric soil and whole plant of *Triticum aestivum* L. under inoculation of Pb²⁺ 2 ppm and 4 ppm

Treatment	Jhanbaz						Galaxy 2013					
	Rhizospheric soil			Whole plant			Rhizospheric soil			Whole plant		
	7d	14d	21d	7d	14d	21d	7d	14d	21d	7d	14d	21d
T1	0.72±0.01	1.36±0.03	1.17±0.01	1.16±0.02	1.31±0.03	1.26±0.06	1.00±0.01	1.29±0.02	1.42±0.01	1.29±0.04	1.40±0.07	1053.0±5.663
T2	1.04±0.04	1.19±0.04	1.26±0.03	1.24±0.02	1.33±0.02	1.31±0.10	1.07±0.02	1.34±0.03	1.50±0.03	1.29±0.06	1.28±0.00	982.56±2.807
T3	1.04±0.04	1.38±0.01	1.30±0.02	1.24±0.05	1.4±0.06	1.37±0.07	1.05±0.01	1.54±0.05	1.56±0.07	1.31±0.02	1.42±0.09	995.89±5.661
T4	1.07±0.03	1.26±0.05	1.35±0.07	1.28±0.03	1.37±0.03	1.55±0.08	1.13±0.07	1.37±0.12	1.52±0.02	1.35±0.06	1.34±0.15	951.00±4.683
T5	1.15±0.05	1.31±0.02	1.39±0.03	1.39±0.04	1.48±0.04	1.42±0.09	1.31±0.05	1.32±0.03	1.38±0.01	1.30±0.01	1.36±0.07	1682.36±5.490

T1 stands for 2ppm-Pb²⁺, T2=2ppm Pb²⁺ +HBA, T3=4ppm Pb²⁺, T4= 2ppm Pb²⁺ +HBA, T5= Untreated/control

Conclusion

The effect of heavy metal (lead) research can be applied to so many current wheat problems including adverse effect on crop productivity. Keeping in views of these problems the present study was aimed to evaluate the effect of heavy metal (lead) on *Triticum aestivum* L. in response to hydro benzoic acid foliar spray. Results postulated that this lead had adverse effect on *Triticum aestivum* L. seedling agronomic characters. The effect of heavy metal (lead) resulted reduction in growth parameters in wheat has been improved by exogenous foliar application of hydro benzoic acid (HBA) thus illustrated that hydro benzoic acid plays a positive role in enhancing plant growth under heavy metal stress.

Authors' contributions

Conceived and designed the experiments: N Dilawar, & F Asad, Performed the experiments: N Dilawar & Samiullah, Analyzed the data: N Dilawar & F Asad, Contributed materials/ analysis/ tools: N Dilawar Wisal & S Shahid. Wrote the paper: N Dilawar & F Asad.

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