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Effects of Super Absorbent Polymer on the Quantity, Quality, Physiological and Biochemical Wheat (*Triticum aestivum* L.) in soils infected with Lead

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ABSTRACT: Soil pollution with heavy metals result of human activities such as mining, metallurgical and application of fertilizers, pesticides and fungicides in agriculture etc. which threaten human health and the ecosystem. Patterns modern industrial activities leading to environmental pollution, especially pollution with heavy metals out. So for evaluation of effects of super absorbance and lead nitrate on wheat a factorial experiment in completely randomized design with 12 treatment and 3 replication in varamin city at 2014 is done. The results of this experiment showed that increasing the concentration of the plant in order to increase the lead, and superabsorbent And decrease in antioxidant enzymes such as superoxide dismutase, catalase, glutathione peroxidase was. Thus it can be concluded that, given that the country is arid and semiarid region And also due to the pollution of soils with heavy metals using it as superabsorbent are effective treatments that can enhance the water holding capacity of the plant And also the effect of reducing the toxicity of these elements seem essential.

Keywords: Super absorbent polymer, nitrate, lead, wheat.

INTRODUCTION

Soil contamination with heavy metals result of human activities such as mining, metallurgical and application of fertilizers, pesticides and fungicides in agriculture and human health and ecosystems so that it endangers. Patterns modern industrial activities leading to environmental pollution, especially pollution with heavy metals out. Many acidic soils and arable land, about half of which have the potential to produce food as a source of heavy metals to plant roots is limited (Shyam, 2001). Lead is a dangerous heavy metal pollutants in the environment, impact on metabolic and physiological organisms, so in recent years, researchers have become more concerned (Badot, 2003). Lead toxicity in plants prevents the elongation of roots, inhibition of photosynthesis, and so fitted. The sensitivity of plants to lead and their responses varies and depends on the physiological and genetic structure them. So study the effect of heavy metals on the one hand to identify the plants tolerant plants and using them in clearing soils contaminated and the other side seems necessary to develop a tolerant genotypes. Therefore, in this study the effect of different concentrations lead on some physiological and biochemical parameters of wheat plants was studied (Eak *et al.,* 1999). To remove metal from acrylic and acrylamide polymer used was significant. The advantages of removing soil contaminants by polymers can be easily understood and relatively economical process (Sri Ranjan, 2005). Super absorbent polymer for plant available water capacity in the face of loss of water and nutrients due to leaching, surface runoff increases evaporation. Swollen super absorbent polymer in soil and water and dissolved nutrients in the store. So like a miniature store water and nutrients available to plants, acts (Pesek, 1999). Water and nutrients directly to the root hairs that grow inside the super absorbent gel, absorbed. Super absorbent and water-based liberalization of moisture gradients, capillary flow of water to the root zone of protection (Pawlowski *et al.,* 2009). Impair respiration and photosynthesis are (Shaw *et al.,* 2004). For example, it has been reported as a result of exposure to aluminum in soybean increased levels of superoxide dismutase and malondialdehyde and similar reports about beans, barley and tomato are influenced by copper (Shaw *et al,* 2004). Superoxide dismutase (SOD) is an enzyme mismatch between metal and oxygen free radical superoxide to hydrogen peroxide catalyzed by the And seems to play an important role in protecting cells against the detrimental effects of free radicals play an indirect (Luis *et al.,* 1983). Application of super absorbent polymer treatments was observed that the lowest activity of superoxide dismutase and malondialdehyde relative to the control at the highest level of lead toxicity. This result probably reflects the fact that the superabsorbent stress Flzsngyn by another defense mechanism reduces Antioxidant enzymes SOD activity is higher because of the plant's defense mechanism to reduce oxidative damage and proline can also be a factor in mitigation of oxidative tasks.

Omar (2009), the decrease in enzyme activity in barley seedlings by using super absorbent, the report said. Super absorbent and can absorb up to 95% water and release it so that potential soil moisture available to plants for a longer time, the upper limit of kept (Kiatkamjornwong, 2007). Scientific name English name is Wheat *Triticum* L. and Wheat (Khodaande, 1384) from the family of grasses (Poaceae), Category monocots, the tribe Triticeae, the tribe and the genus *Triticum* is *Triticinea* (Khodabande, 1384). According to his introduction to the objectives of this study can be envisaged: 1. The use of superabsorbent polymers by measuring the amount of lead concentration in wheat grain and shoot and without application of these polymers. 2 Responses antioxidant enzyme activities of superoxide dismutase, catalase and glutathione peroxidase in wheat effect against metal contamination 3. The morphological and physiological characteristics of plants under conditions of heavy metal contamination of lead in comparison with the use of super absorbent polymer.

MATERIAL AND METHODS

For evaluation of effects of super absorbance and lead nitrate on wheat a factorial experiment in completely randomized design with 12 treatment and 3 replication in varamin city at 2014 that lead in three levels (0, 200 and 400 mg per kg of soil) and second superabsorbent (S) at four levels (0, 2, 4 and 6 g per kg of soil) is completed. In order to determine the parameters studied, 5 plants from each treatment were randomly selected for various traits such as seed number, seed weight and seed weight and attributes such as:

Superoxide dismutase

To calculate the number of leaves per shoot sub 3 in the morning before the warm weather gets picked up from the farm. The amount of the enzyme was determined by the method of Misra. The Tris buffer solution (containing phosphate, di-sodic, 7.2 = pH) with 3/1 mM EDTA, The menu is prepared sodic carbonate and 0.1 mM and the concentration of epinephrine with 0/25 mM as substrate is used, then it is added to the prepared solution, the changes in absorbance resulting from the oxidation of epinephrine, Enzyme activity is measured as the standard and pure enzyme was used to standardize the results The unit is capable of oxidation of 5.0 mM epinephrine in a minute (Khashuei, 1389).

Malondialdehyde

Enzyme assays of malondialdehyde using Ohkaw and Ohishi, (1979) have done. For this purpose 2/0 gram of plant tissue (leaves), divided into small pieces and Hmvznayzr in 2 ml of 5% acetic acid in the presence of tri-chloroethyl ice is homogeneous. Then centrifuged at 12,000 rpm for 15 min and the supernatant harvested. Half ml of thiobarbituric acid solution with a half ml of thiosulfate solution and 20% acetic chloroethyl more mixed and incubated at 96 ° C for 25 minutes in. In cold conditions, then centrifuge at 10,000 rpm for 5 min is. Absorption of the supernatant at 532 nm was measured. Thiosulfate solution of thiobarbituric acid and acetic chloroethyl more than 20 percent is used as a control. MDA content was determined using a standard curve.

Chlorophyll content

Chlorophyll a chlorophyll meter to measure the amount of chlorophyll a, b, ab is used. In the absence of the methods used. The experimental material consisted of crushed leaves 1 g, 1 g of calcium carbonate, pure acetone, to measure the factor of ((Sestak and Catasky., 1966 is used. That leaves chopped 1 g plus 1 g of calcium carbonate in a porcelain mortar mixed And 10 ml of 100% acetone was gradually added, The resulting mixture was filtered and poured into a test tube, test tube and placed in a container of water and ice to the laboratory was dark to minimize the biochemical interactions of acetone is evaporated. Then the tubes into the centrifuge 2500 rpm for 2 min to extract data uniformity and homogeneity is obtained, Then remove the tubes with 9 ml acetone cc of a 80% mixture in the cell was placed in a spectrophotometer at wavelengths of 663 nm and for chlorophyll a 647 nm for the considered chlorophyll b, It was, ultimately, the absorbance was read the notes. The numbers of each sample was replaced in the following formula to measure chlorophyll a, b, respectively.

Chl.a (mg.L-1) = (12.25 * A663 - 2.79 * A647)*D
Ch.b (mg.L-1) = (21. 5 * A647 - 5.1 * A663)*D
Chla + b (mg.L-1) = (7.15 *A663 - 18.71 * A647)*D

Proline

Preparation of dimenhydrinate Nin: Nin dimenhydrinate 1.25 g in 30 mL of acetic acid were of analytical grade and were dissolved in the medium heat. Then 20 mL of 6 M phosphoric acid was added and stirred completely. This solution is stable at 4°C for 24 hours. 5.0 g of tissue for sensing proline content of leaves and roots Svlfvsalysylyk acid in 10 ml of 3% in Chinese mortar was worn and perfectly homogeneous. Extract with Whatman No. 2 paper flat and volume were recorded. 2 ml of the filtered extract with 2 ml and 2 ml of acetic acid were of analytical grade dimenhydrinate Nin mixed and heated for one hour in a water bath (100°C) were used. After placing the test tubes in an ice bath, the reaction was ended. Then 4 mL of toluene was added and the contents of each tube were stirred vigorously for 15 to 20 seconds.

The top phase containing toluene and the aqueous phase was separated from proline uptake by a spectrophotometer (Model UV-160, Schimadzu, Tokyo, Japan) at a wavelength of 520 nm was determined. The measurement of toluene were used as controls. Proline concentration in each sample was determined based on the absorption and concentration in the standard curve was calculated on the basis of milligrams per gram of fresh weight.

Lead levels in shoots

To determine the lead concentration in shoots and roots of the plant, a plant grams of the powder in an electric furnace at 550°C for four hours, the ash. The ash obtained by 10 ml of hydrochloric acid in the molar extraction. The element concentrations in the extracts, measured by atomic absorption AAS Vario 6 model will be. To analyze data using SAS statistical software. The means by Duncan's multiple range test at the five percent level were compared statistically. Corresponding graphs were plotted using Excel software.

RESULTS AND DISCUSSION

A. Grains

Analysis of variance showed that the number of grains of wheat plants The main effect of lead nitrate consumption, super absorbent, and their interactions on the plant height was significant at the 1% level (Table 1). Application factors were mutually according to the results of the comparisons of the mean (Table 2) showed Superabsorbent using 6 kg of soil with lead nitrate consumption are discussed in comparison with other treatments, most grains in the stressed treatments (number 37/67) showed And the lowest number of grains of superabsorbent taking control with use of 400 mg per kg of lead nitrate (number 67/13), respectively. In normal conditions, plant development environment sufficient to exploit all vegetative organs and the proper production of assimilates.

The spike is produced, and thus the maximum number of seeds produced at this level, But with the tension and reduce the production and storage of assimilates and thus the number of seeds per plant, reduced number of spikes. You can increase the number of seeds per plant, by increasing the amount of superabsorbent polymers, attributed to an increase in the number of ears per plant. It seems, superabsorbent polymer is able to improve the physical and chemical properties of the soil and increase nutrient availability, capacity and increase the number of data sources to produce kernels are Smale. Application of super absorbent element also has a damaging effect on the adsorption of lead in the soil and prevent its absorption by plants, reduced And thereby provide environmental conditions favorable for plant growth (Roustaei *et al.*, 2012).

Table 1: Analysis of variance of the effect of lead nitrate on the traits and super absorbent.

S.O.V	df	Mean of squares (MS)							
		Number of Grain	Grain weight	TCW	Superoxide dismutase	Malon dialdehyde	Chlorophyll	Proline content	Lead levels in shoots
Lead nitrate (a)	2	50.194**	0.227**	1.278 ns	736905.424**	111.23**	72.6**	0.002**	0.017**
Super absorbance (b)	3	572.472**	0.844**	264.839**	7384.9 **	1.777**	2.84**	0.000**	0.006**
(a×b)	6	10.306**	0.023*	22.675 *	1312.187 **	0.313**	0.369**	0.000ns	0.001ns
Error	24	2.25	0.008	6.621	128.385	0.032	0.079	0.000	0.000
C.V%	-	6.3	5.28	5.61	2.26	1.67	1.17	5.99	29.55

ns, **, * respectively indicates the lack of significant differences, and significant at the 1% and 5% is significant.

B. Grain weight

Analysis of variance for grain weight of wheat plants showed that the main effects of lead nitrate consumption, super absorbent at the 1% level and their interactions on seed weight was significant at the 5% level (Table 1). Both applications are reviewed each factor according to the results of the comparisons of means showed that Superabsorbent using 6 kg of soil with lead nitrate consumption are discussed in comparison with other treatments, The highest grain yield in the stressed treatments (2/343 g) showed as well as the lowest seed weight of 4 milligrams per kilogram of superabsorbent soil with 400 kg of soil nitrate ingestion of lead (1/197 g) (Table 2). In experiments conducted by Yazdani and colleagues (1386) also found that the use of superabsorbent materials can improve plant growth and yield. Highland *et al* (1388) also stated that the use of hydrogels for water storage capacity at the plant reduced the stress on the corn plant. Significant increase in grain yield with the use of superabsorbent. The trial is likely to increase the water holding capacity of the soil by the gradual release of superabsorbent and water uptake by the roots. In experiments conducted by Yazdani and colleagues (1386) also found that the use of superabsorbent materials can improve plant growth and yield. Highland *et al* (1388) also stated that the use of hydrogels for water storage capacity at the plant reduced the stress on the corn plant.

C. TCW

Analysis of variance showed that grain weight of wheat plants was not significant main effect of lead nitrate consumption, But the main effect of superabsorbent and their interactions on seed weight were significant at 1% and 5%, respectively (Table 1). Application factors were mutually according to the results of the comparisons of the mean (Table 2) showed that Superabsorbent using 6 kg of soil with lead nitrate consumption are discussed in comparison with other treatments, the highest grain weight in stress treatments (45/57 mg) showed As well as the lowest seed weight of superabsorbent consumption with consumption of 400 g per kg of soil nitrate, Pb (25/40 mg), respectively. The results of a survey conducted by Abedini and Sajedi (1390) on dryland wheat cultivars indicated that application of superabsorbent decreases the amount of water required by and seed weight increased by 25% relative to the control was. This material whilst providing water and nutrients necessary for the plant to prevent leaching of soil nitrogen and other nutrients play a key role. Grain weight per plant, the plant's ability to assimilate supply reservoir and the environment Such as moisture and nutrient availability during grain filling is. In the absence of stress, nutrients, temperatures are much lower and so the number of tanks, each tank of assimilate availability increases and thus coarser grains and increases seed weight. Application of super absorbent reducing the negative effects of heavy metal stress increased grain weight per plant (Khadem *et al.*, 1386).

D. Superoxide dismutase (SOD)

Analysis of variance showed that the main effect of superoxide dismutase wheat consumption of lead nitrate, super absorbent, and their interactions on the level of superoxide dismutase was significant at the 1% level (Table 1). Both applications are reviewed each factor according to the results of the comparisons of the mean (Table 2) showed the lack of superabsorbent with 400 kg of soil nitrate ingestion of lead are discussed in comparison with other treatments, most treatments of stress on superoxide dismutase (6/787 A / mg pro.min-1Δ) showed. The effects of stress, increases oxygen in the plant's growing conditions are different mechanisms to remove and destroy oxygen species uses. Superoxide dismutase is the first enzyme in the detoxification process (Garnczarska & Ratajczak, 2000). In this study, the concentration of heavy metals in the environment lead to growth in SOD activity, superoxide (O_2) is converted to H_2O_2 increased It appears that activation of superoxide dismutase (SOD) in response to the damaging effects of oxygen produced from cassava in the lead. The activity of this enzyme was found in the highest concentrations of these elements in the soil. The overall increase in soil lead concentration in wheat increased activity of antioxidative enzymes superoxide dismutase the corresponding enzyme induction and increased activity that has caused excessive lead. Use of superabsorbent polymer with low levels of superoxide dismutase activity compared to the control at the highest level lead toxicity. This result probably reflects the fact that superabsorbent Flzsngyn effects of stress by reducing other defense mechanism, Antioxidant enzymes SOD activity is higher because of the plant's defense mechanism is the reduction of oxidative damage can also be a factor in mitigation of oxidative tasks. Omar (2009), the decrease in enzyme activity in barley seedlings by using super absorbent, the report said. Sharma and Dubai (2005) in their research increased SOD activity levels of lead toxicity have been reported. So it seems that the production and activity of this enzyme may be an important defense mechanism against the elements Plants and plant resistance is attributed to the strategy, So that the enzyme is superoxide radicals can possibly digest.

E. Malondialdehyde (MDA)

Analysis of variance showed that the main effect of malondialdehyde wheat consumption of lead nitrate, super absorbent, and their interactions on the level of malondialdehyde was significant at the 1% level (Table 1). Both applications are reviewed each factor according to the results of the comparisons of the mean (Table 2) showed The lack of superabsorbent with 400 kg of soil nitrate ingestion of lead are discussed in comparison with other treatments, most treatments of stress on malondialdehyde (nmol g FW 15/14) showed and the lowest intake of 6 mg per kilogram of malondialdehyde superabsorbent soil with lead nitrate consumption (307/7 nanomoles per gram fresh weight), respectively. It can be concluded that the lack of superabsorbent with the use of 400 kg of lead nitrate in soil could be due to an increase in malondialdehyde. Application of super absorbent polymer also has the lowest levels of biomarkers of malondialdehyde compared to the control at the highest level lead toxicity. This result probably reflects the fact that superabsorbent Flzsngyn effects of stress by reducing other defense mechanism, Antioxidant enzymes SOD activity is higher because of the plant's defense mechanism is the reduction of oxidative damage can also be a factor in mitigation of oxidative tasks. Omar (2009), the decrease in enzyme activity in barley seedlings by using super absorbent, the report said. With high concentrations of heavy metals and stress, malondialdehyde increased capacity. When antioxidant defenses are decreased or increased free radical formation, in such a situation known as oxidative stress occurs. Oxidative stress can lead to tissue damage. Oxidative stress occurs when the peroxidation of unsaturated fatty acids, lipids increased, and the effect of free radical attack on lipids, and Ldhydhay occur, including malondialdehyde (Pouresmaeili, 1385).

F. Total chlorophyll

Analysis of variance showed that the chlorophyll content of wheat plant main effect of lead nitrate consumption, super absorbent, and their interactions were significant at 1 per cent (Table 1).

Application factors were mutually according to the results of the comparisons of the mean (Table 2) showed that Superabsorbent using 6 kg of soil with lead nitrate consumption are discussed in comparison with other treatments, The total chlorophyll under stress treatments (79/26 mg g wet weight) showed the lowest chlorophyll and total consumption of 400 g per kg of soil super absorbent with use of lead nitrate (72/20 mg g wet weight), respectively. Abbas Zadeh *et al* (1386) reported no stress conditions, the amount of chlorophyll a, b and total chlorophyll levels are at the highest stress levels and chlorophyll a, b and total reduced. Led by inhibiting the absorption of essential elements such as Mg, Fe prevents the synthesis of chlorophyll, the photosynthetic apparatus due to protein-ligand SN - Chlorophyllase activity also increases damage and chlorophyll degradation in lead toxicity (Sharma and dubey, 2005). So one of the reasons for the increase in reactive oxygen species-induced chlorophyll loss was heavy metal, heavy metal stress in plants seems to be capable of inhibiting chlorophyll biosynthesis and degradation of the species under study.

G. Proline content

Analysis of variance showed that the main effect of proline wheat consumption of lead nitrate, super absorbent was Significant at the 1% level, respectively, but their interaction was not significant (Table 1). Comparison of these traits indicated that lead nitrate alone increased proline contents in wheat and The maximum amount of lead nitrate in the treatment of 400 milligrams per kilogram (mg per g wet weight 03958/0) and lowest in the control treatment (01533/0 mg per g wet weight), respectively. The use of superabsorbent alone reduced the wheat plant proline was highest in the control treatment (03344/0 milligrams per gram fresh weight) and lowest in plots treated with 4 g per kg of soil (02367/0 milligrams per gram of fresh leaf), respectively. Contamination of heavy metals such as lead, might have detrimental effects on growth and metabolism of plant leaves. In the present study it was observed that wheat plants, like other plants to defend against the tension of the heavy metal lead, which according to the amount of free proline increased (Ibarra *et al.,* 1988). Proline reduced the damage to membranes and proteins. In addition to proline in osmotic adjustment, cell pH adjustment, oxidation, reduction and regulation, carbon and nitrogen source are regenerated by the elderly. QndHay solution also increases plant stress in addition to maintaining the osmotic potential, will be able to store carbohydrates to maintain optimal cell basal metabolism (Dubey & Singh, 1999). Reduced starch could be due to its decomposition into smaller units, resulting in the accumulation of soluble sugars in the cells (Alaoui *et al.,* 2003). The possible inhibitory effect of lead on the activity of enzymes involved in starch synthesis have. According to Hendry (1992) Heavy metals are likely to produce different forms of active oxygen and free radicals cause oxidative stress. The various forms can react with lipids and cause lipid peroxidation, membrane damage, enzyme inactivation and thus endanger the life of the cell. (Dixi *et al.,* 2001) for the regulation of reactive oxygen species and protection of plants cells under conditions of stress, several enzymes such as catalase and peroxidase are other broom (Nector & Foyer, 1998).

Table 2: Mean comparisons of traits.

Comparison of mean					
Parameters	**Lead nitrate**	**Super absorbance**			
		0	**2**	**4**	**6**
Number of grain	0	15.67 j	20.67 g	29.67 d	37.67 a
	200	16.67 i	20.67 g	24.67 e	32.67 b
	400	13.67 k	19.67 h	22.33 f	31.67 c
Grain weight	0	1.667 d	1.603 f	1.567 g	2.343 a
	200	1.647 e	1.503 h	1.477 i	2.053 b
	400	1.477 i	1.483 i	1.197 j	1.923 c
TCW	0	43.45 g	40.78 j	43.72 f	57.45 a
	200	43.15 h	43.98 e	47.02 d	49.95 c
	400	40.25 k	42.5 i	44.02 e	53.95 b
Superoxide dismutase	0	248.4 g	240.8 gh	224.8 hi	219.3 i
	200	571.6 d	548.9 e	537.4 ef	522.3 f
	400	787.6 a	742.1 b	687.3 c	647.5 c
Malon dialdehyde	0	7.513 g	7.46 g	7.433 g	7.307 g
	200	11.81 d	11.59 d	11.1 e	10.58 f
	400	14.15 a	13.87 a	13.14 b	12.6 c
Chlorophyll	0	26.34 a	26.54 a	26.65 a	26.79 a
	200	23.38 d	23.64 d	24.27 c	24.84 b
	400	20.72 h	21.27 g	21.94 f	22.72 e

H. Lead levels in shoots

Analysis of variance the amount of Pb in the shoots of wheat showed that the main effect of lead nitrate consumption, super absorbent respectively significant at the 1% level, but the interaction was not significant (Table 1). Comparison of these traits indicated that lead nitrate significantly increased the amount of lead in shoots of wheat plants and The maximum amount of lead nitrate in the treatment of 400 milligrams per kilogram (mg g 1017/0) and the lowest in control (02917/0 milligrams per gram), respectively. The use of superabsorbent alone reduced the lead content in wheat shoots and highest in the control treatment (09889/0 mg per kg) and lowest in the group taking 6 grams per kilogram of soil (04/0 mg per kg), respectively. The results also prove the existence of the higher amount of heavy metals in the environment, shows that First of all plant species in environments contaminated with heavy metals that can absorb some of the metals And thereby reduce the extent of environmental pollution And second, the ability to accumulate heavy metals in different plant species can be different (Burken *et al.*, 2011).

This phenomenon is most likely related to physiological traits of species, as some species can greatly superabsorbent as plants absorb heavy metals from the environment Without serious injury to themselves, While some species have lower ability to absorb and may In environments contaminated with heavy metal poisoning caused by damaged and destroyed (Gosh & Singh, 2005; Baycu *et al.*, 2006).

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