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EFFECT OF FOLIAR APPLICATION OF LEAD ON THE GROWTH AND YIELD PARAMETERS OF WHEAT

PARVEEN RASHID* AND S. MUKHERJI

Department of Botany, University of Calcutta, 35 Ballygunge Circular Road, Calcutta 700 019, India

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Foliar application of lead nitrate solution in four different concentrations resulted in decrease in various growth indices and yield parameters of wheat over the control. The rate of decrease was gradually higher with increasing concentrations of lead nitrate and the maximum effect was noticed under highest dose.

Key Words: Foliar spray, Lead nitrate, Wheat.

Introduction

Lead (Pb) is available to plants from soil and air [1]. Environmental concentrations of Pb have increased recently because of several Pb based industrial operations [2] and automobile traffic [3]. Plants growing near highways contain more Pb than plants growing in most other locations [4]. The source of this Pb as Pb halogen particulates is from automobile exhaust [5].

The ubiquitous presence of Pb in soil and air, complicated and accentuated now by anthropogenic additions, makes questions of lead effect on plants of critical importance in formulating both short and long term environmental policy. The importance of this is amplified by two possibly conflicting observations. The first is that Pb is highly toxic to many organisms. Secondly, even though large concentrations of Pb are present in localized plant environments and even associated in or on plants [6], there are few reports of Pb induced toxic effects on plants grown in natural ecosystems that have been severely contaminated with Pb [6]. The present investigation was undertaken to study the effect of Pb as foliar spray on the growth and yield parameters of wheat.

Materials and Methods

Wheat (*Triticum aestivum* L. cv. Sonalika) plants were grown in earthenware pots filled with garden soil together with farmyard manure. The pots were arranged in randomized block design and the experiment was replicated four times. There were five pots in each treatment per replication and ten plants were raised in each pot. The first foliar spray was done at 30 days after sowing (DAS). There were five more foliar sprays at weekly intervals. About 100 ml solution containing $PbNO_3$ at a concentrations of 0,1,4,7 and 10 mM was sprayed to the foliar parts of the plant by means of a hand sprayer. Tween-20 (0.05%) was added as wetting agent. Plant height, dry weight of leaf, dry weight of stem, flag leaf length, dry weight of 5 entire plants, leaf area/plant were recorded at the post flowering stage. Panicle length, filled grains/panicle, unfilled grains/panicle and 1000 grain weight were recorded after harvest. Data were analysed statistically and mean values of different treatments were adjudged by LSD values. Regression (linear) analysis was used to show the relationship of growth and yield paramters with different concentrations of lead treatment.

* Department of Botany, University of Dhaka, Dhaka 1000, Bangladesh.

Results and Discussion

Lead treatments gradually decreased various growth and yield parameters except unfilled grains/panicle and the rate of decrease was proportional to the increasing concentrations of Pb (Fig.1).

Results of various growth and yield parameters are graphically depicted in Figs. 2 and 3 respectively. Plant height decreased as the concentration of Pb in the solution increased (Fig. 2.**1**). Plant height was decreased by 19% at the 10 mM foliar spray. Flag leaf showed a gradual reduction in length with a maximum of about 18% at 10 mM Pb spray (Fig. 2.**2**). There was also gradual decrease in the dry matter of leaves and stem (Figs. 2.**3** and 2.**4**). Spraying solution of 10 mM effected 26% and 14% reduction in the dry matter of leaves and stem respectively. A gradual reduction was also noted in the average dry weight of 5 entire plants with a maximum of 59% at the highest Pb concentration (Fig. 2.**5**). Leaf area/plant showed remarkable responses at all concentrations and the per cent decrease was about 23, 27, 30 and 55 respectively for 1,4,7 and 10 mM Pb spray from the control (Fig 2.**6**).

Pb sprays decreased the panicle length (Fig. 3(**7**). The gradual decrease noted was 8,14, 16 and 28 % respectively from the control with 1,4,7 and 10 mM Pb spray. All the Pb treatments reduced the number of filled grains/panicle (Fig. 3(**8**). An appreciable reduction of 30 and 39 % was brought about by 7 and 10 mM Pb spray respectively. Number of unfilled grains was found to be increased with increasing Pb

concentrations (Fig. 3(9). The percentage increase over the control were 131,232, 360 and 447 for the 1,4,7 and 10 mM Pb spray, respectively. The 1000-grain weight decreased with the increase in Pb concentrations Fig 3(O). Seven and 10 mM spray decreased the weight by 42 and 47 % respecctively from control whereas the decrease under 1 and 4 mM was of the order of about 36 and 40 %. The lowest concentration (1mM) decrease the grain weight from 30 mg to 19 mg/seed which accounted 40% decrease in grain weight.

The height of the wheat plant decreased with increasing concentrations of lead. Similar reduction in plant height was obtained by using heavy metals like zinc [7] and nickel [8]. High lead level also reduced plant height in rye grass and white clover [9]. Carlson and Bazzaz [10] found that lead and cadmium caused a reduction in root growth, woody stem diameter increment and foliage growth of American sycamore (*Platanus occidentalis* L.). Increased lead treatment also resulted in an appreciable reduction in dry matter content of whole plant. It seems that the rate of photosynthesis of the lead treated plant declines due to the toxic effect [11] and because of this effecct leaf growth continues at a low rate and such decline in photosynthesis has led to a substantial reduction in the rate of production in dry matter in the plant. In all concentrations, the Pb treatments decreased the area of leaves and the effect is more pronounced towards the maturity of the plant. Dutta [12] mentioned that forage sorghum treated with $PbCl_2$ showed reduction in leaf area. General decrease in growth parameters have been found after Pb treatment in hydroponic culture of red maple [13], corn [14] and rice [15].

Panicle length, filled grains/panicle and 1000-grain weight decreased to variable extents under different Pb treatments. The decrease of grain yield of wheat can be attributed to deccreases in these parameters. Opinions differ as to the importance of the conditions which determine floral induction. According to Thorne *et al.* [16] spikelet number is determined by conditions prior to inflorescence initiation but Rawson [17] clearly establish the importance of post initiation condition also. Here in fact exposure of plants to Pb spray established a negative correlatlion between length of panicle and number of florets differentiated within each panicle.

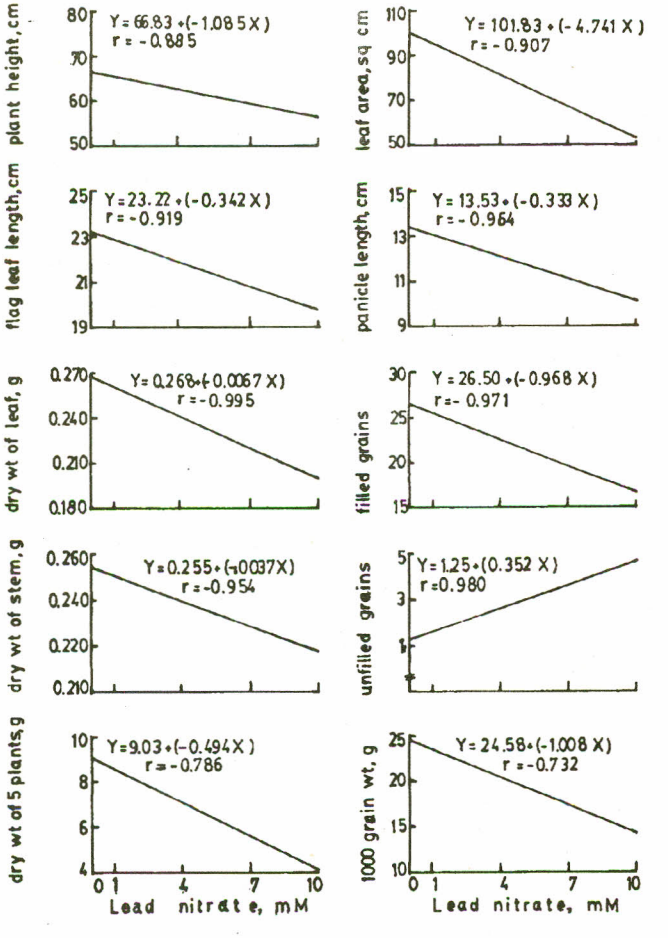

Fig. 1. Regression of means of various growth and yield parameters of wheat on five different concentrations of lead nitrate treatments.

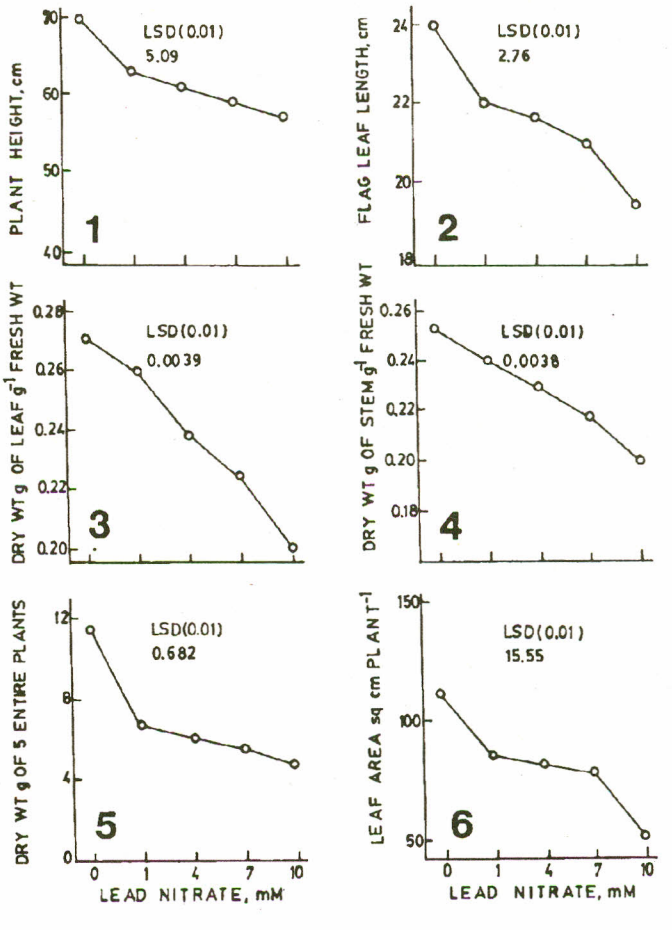

Fig. 2. Effect of various concentrations of lead nitrate solution on (1) Plant height, (2) Flag leaf length, (3) Dry wt of leaf, (4) Dry wt of stem, (5) Dry wt of 5 entire plants and, (6) Leaf area in wheat.

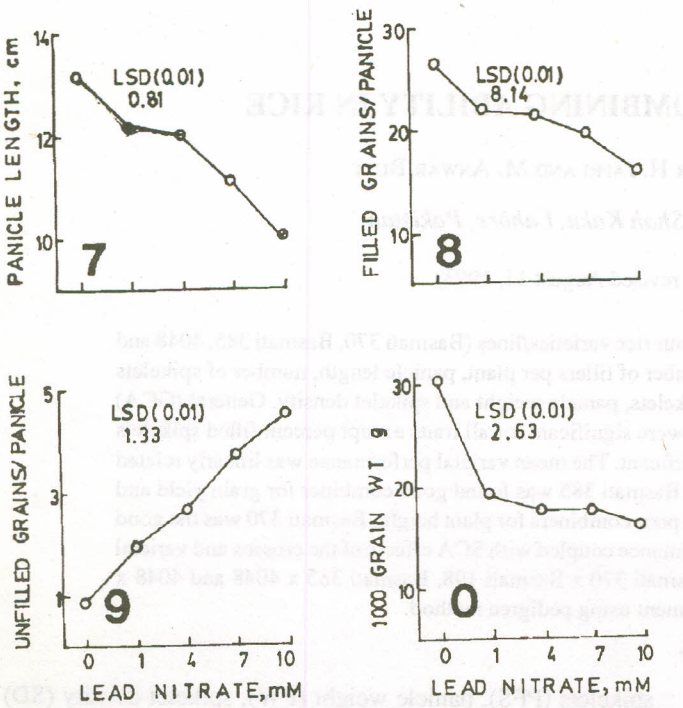

Fig. 3. Effect of various concentrations of lead nitrate solution on (7)Panicle length, (8) Filled grains/panicle, (9) Unfilled grains/panicle, and (O) 1000-Grain wt.

Number of filled grains per panicle are essential yield determinants of wheat. This character as well as other major yield components tegether with grain size are determined by conditons after anthesis. The data presented here indicates that number of grains per panicle and final grain size (1000 grain weight) are decreased by lead treatment. Thus maturation of the grains seems to be influenced by lead coupled with the supply of assimilates principally from the smaller flag leaves as a result of lead treatment. Better grain filling is a compromise between the need to develop sufficient storage capacity in the form of grains as sink and the the need to fill it from the source with sufficient photosynthetic activity, a fact which has been found shown to be inhibited by lead spray [11]. Juwarker and Shiende [18]] observed that length of earhead and grain yield of barley were reduced due to combine treatment of cadmium and lead.

In the present investigation the growth and yield paramentes of wheat were reduced by the foliar spray of lead. This experiment indicates that lead could affect plant growth and yield in agricultural areas near highways and industrial sources and that continued increase in their use in industries could signifcantly affect plant growth over wider areas of agricultural lands.

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