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Effect of Lead and Salicylic Acid on Some Plant Growth Parameters in *Pisum sativum* L.

[1]Andrey Yu. Ratushnyak, [1]Anna A. Ratushnyak, [1]Marina G. Andreeva,
[2,3]Airat R. Kayumov and [3,4]Maxim V. Trushin

[1]State Budgetary Establishment Research Institute for Problems of Ecology and
Mineral Wealth Use of Tatarstan Academy of Sciences, Daurskaya 28, 420089 Kazan, Russia
[2]Department of Water Supply and Drainage,
Kazan State University of Architecture and Engineering, Zelenaya Str 1, 420043 Kazan, Russia
[3]Kazan Federal University, Institute of Fundamental Medicine and Biology,
Kremlyovskaya 18, 420008 Kazan, Russia
[4]Kazan Institute of Biochemistry and Biophysics, Rusian Academy of Sciences,
Lobachevsky St. 2/31, 420111 Kazan, Russia

Abstract: Lead is a ubiquitous pollutant in the environment widely distributed in soil and waters. Lead-polluted soils may be the major reason for reduction of agricultural products. Therefore, search of compounds with antitoxic properties seems a very actual task. This study was performed to investigate the possible antitoxic effect of salicylic acid using plants of pea (*Pisum sativum* L.) as experimental objects. It was detected that salicylic acid displayed selective action on plant growth parameters in pea. The possible explanations for the observed phenomena were presented.

Key words: Pea · Lead · Toxicity · Salicylic acid · Growth · Plants

INTRODUCTION

Lead is a ubiquitous pollutant in the environment widely distributed in soil and waters [1-3]. In plants, the toxicant may provoke growth alterations like production reduction, yellowing of leaves and disturbing photosynthesis [4]. Besides, it may present serious problems for human health [5]. Many methods of environmental monitoring of lead pollution were suggested [6] and a lot of approaches for lead detoxication were discussed [7, 8]. Among other detoxicants, salicylic acid was stated as potential agent in regulation of plant stress response [9-12]. Moreover, this compound was showed to be able to alleviate cadmium toxicity in plants [13]. Thus, the aim of the present study was to investigate lead action on some plant growth characteristics of *Pisum sativum* and the potential antitoxic effects of salicylic acid that was chosen as antitoxicant to lead.

MATERIALS AND METHODS

Agricultural property (55°47' N, 49°10' E) was provided by Ecological-Biological Center of Kazan, Republic of Tatarstan, Russia. The land plot had loamy soil and was open to sun. Pea seeds (*Pisum sativum*, breed Venetz) was provided by Tatar Scientific Research Institute of Agriculture, Russian Academy of Agricultural Sciences. In the control variant, plants were not treated. There were 3 experimental variants – with lead acetate ($Pb(CH_3COO)_2$ - 0.25 mg/L, lead acetate plus salicylic acid ($C_6H_4(OH)COOH$) 10^{-4}M and with salicylic acid alone. All variants received the same amount of irrigation. During 5 weeks, the following parameters were monitored - plant height, a number of tendrils, a number of leaves, leaf length and leaf width. For each variant, 50 individual plants were analyzed. Experimental data were presented as mean ± standard error.

Corresponding Author: Dr. Maxim V. Trushin, Department of Genetics, Kazan Federal University, Kremlyovskaya 18, 420008 Kazan, Russia.

RESULTS AND DISCUSSION

Effect of lead on plant height. Our results showed that lead treatment may stimulate plant height. This was especially noted for variant with lead alone (Table 1). At the initial stages of observation, there were no changes between control and variant with salicylic acid alone. But since 35th day of observation, salicylic acid also stimulated plant height. The analogous results were obtained for variant with lead and salicylic acid. This was unusual finding since the opposite data were presented for other plants [14]. One of the possible explanations for this phenomenon is that this concentration of lead was too small to inhibit plant height and low concentrations may stimulate production of gibberellic acid with growth promoting effects. The similar data were reported for cadmium and *Vigna* plants [15].

Effect of lead on number of tendrils. In all variants (lead alone, salicylic acid alone and their combination), we did not detect any statistically significant changes regarding this phenotypic sign. It is possible to suggest that the absence of changes was connected with insufficient concentration of lead and salicylic acid to induce some changes in enzymatic apparatus of pea plants as it was presented in other study [16].

Effect of lead on number of leaves. There were increases in number of leaves in all variants (lead alone, salicylic acid alone and their combination). In one variant (combination of lead and salicylic acid) we did not detect difference by the end of experiment (49th day of observation). Thus, this increase in number of leaves may be considered as stress-response reaction to the action of heavy metal. This effect may be considered as adaptive reaction to lead stress [17-19].

Effect of lead on leaf length and width. In our experimental study, we did not detect any statistically significant changes in leaf length and width. Therefore, changes in leaf area were also absent in variants with lead, salicylic acid or their combination.

Table 1: Effects of lead ans salicylic acid on plant growth parameters. Note: SA - salicylic acid. Results are presented as mean ± SE

Parameter	Day of observation	Control	Lead	SA	Lead+SA
Plant height, cm	21	4.57±0.35	7.12±0.45	5.41±0.33	8.08±0.38
	28	12.91±0.73	15.5±0.860	11.28±0890	16.62±0.86
	35	18.18±0.98	25.99±1.13	21.48±1.08	24.08±1.23
	42	31.06±1.59	37.21±1.06	39.93±1.47	37.53±1.19
	49	47.34±2.31	65.78±0.65	62.38±1.53	59.4±1.700
Number of tendrils	21	1.52±0.16	1.81±0.15	2.57±0.13	2.33±0.18
	28	4.34±0.24	3.96±0.28	3.81±0.12	4.08±0.28
	35	6.3±0.380	7.96±0.51	7.78±0.53	8.1±0.650
	42	17.3±1.100	19.11±0.59	19.25±1.12	17.45±0.80
	49	33.15±1.98	28.54±0.76	29.45±1.20	28.25±1.07
Number of leaves	21	2.76±0.26	9.15±0.58	10.47±0.67	12.48±0.64
	28	8.0±0.420	20.13±0.54	19.2±0.550	18.03±0.71
	35	12.56±0.56	26.54±0.61	24.48±0.74	23.5±0.700
	42	25.36±1.27	33.96±0.96	40.02±1.27	34.4±1.110
	49	44.19±2.29	55.74±0.74	50.73±1.28	44.4±1.460
Leaf length, cm	21	1.82±0.10	1.44±0.09	1.55±0.17	1.83±0.13
	28	2.23±0.07	2.06±0.05	2.47±0.10	2.2±0.090
	35	2.41±0.08	3.12±0.04	3.04±0.11	3.71±0.05
	42	3.71±0.16	3.88±0.12	4.21±0.13	4.42±0.07
	49	4.21±019	4.84±0.04	5.38±0.16	4.95±0.05
Leaf width, cm	21	1.63±0.09	0.94±0.06	1.41±0.19	1.34±0.15
	28	1.93±0.06	1.47±0.05	2.17±0.12	1.41±0.05
	35	2.04±0.06	2.46±0.04	2.44±0.08	2.57±0.07
	42	3.07±0.11	3.09±0.01	3.08±0.08	3.05±0.06
	49	3.18±0.17	3.46±0.03	3.87±0.10	3.97±0.07

CONCLUSION

In this study, the principle effects of lead on plant height and number of leaves were revealed. These changes may be considered as adaptive reaction to abiotic stress condition (lead pollution). To clarify the role of salicylic acid in toxicant-alleviating effect, it is necessary to use a broader spectrum of lead and salicylic acid concentrations.

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