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

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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.

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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±0.86	11.28±089	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±1.7
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±0.38	7.96±0.51	7.78±0.53	8.1±0.65
	42	17.3±1.1	19.11±0.59	19.25±1.12	17.45±0.8
	49	33.15±1.98	28.54±0.76	29.45±1.2	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±0.42	20.13±0.54	19.2±0.55	18.03±0.71
	35	12.56±0.56	26.54±0.61	24.48±0.74	23.5±0.7
	42	25.36±1.27	33.96±0.96	40.02±1.27	34.4±1.11
	49	44.19±2.29	55.74±0.74	50.73±1.28	44.4±1.46
Leaf length, cm	21	1.82±0.1	1.44±0.09	1.55±0.17	1.83±0.13
	28	2.23±0.07	2.06±0.05	2.47±0.1	2.2±0.09
	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±0.1	3.97±0.07

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.

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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