

USING FRUIT FLY AS THE TEST-SYSTEM TO DETECT SOIL POLLUTION BY HEAVY METALS.

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Abstract

The mutagenic effect of the soil aqueous extracts containing the different concentrations of the lead salt with *Drosophila melanogaster* test-system was found. For lead salts concentration that is 200 times higher than the natural background concentration observed a certain decrease in the frequency of recombination.

Introduction

Drosophila melanogaster is a classic genetic object, which is widely used for the monitoring of the environmental pollution [1]. Usually it would be ideal to deal with a direct effect of a factor, the influence of which is investigated [2,3]. However, in reality the living organism is never influenced by a single factor. In this study we investigate an influence of soil aqueous extracts on *Drosophila* genetic mechanisms. Such extracts are exactly the source of mineral elements for the living organisms [4].

Methods

The soil aqueous extracts containing the different concentrations of the lead salt were prepared in Ukrainian Agriculture Institute (Table 1). The lead concentration was determined by the atomic absorption method at the ASS-3 apparatus (Germany). The lead concentrations in soil varied from 1 to 500 times of the natural background level, while lead salt content in the water-soluble fractions were at the level of the resolution limit of the apparatus for all the samples studied. These water-soluble fractions were used in the *Drosophila* test-system.

Table 1 Lead amounts in different fractions of the gray soil as a function of lead salts input*

Lead salts input relative to the natural background level (Pb, mg/kg of soil)	Lead concentration (mg/kg)		
	Acid-soluble fraction (1 N HCl)	Fraction soluble in acetic ammonium buffer (pH 4.8)	Water-soluble fraction
1	8.68	2.57	About 0.01
5	9.38	4.4	About 0.01
20	16.6	13.3	About 0.01
50	35.3	25.4	About 0.01
100	67.2	59.1	About 0.01
200	158.7	11.3	About 0.01
500	397.1	203.3	About 0.01

*The lead nitrate was used as the input salt.

We have applied the test of sex-linked lethal mutations [5]. The wild type males were drunk the soil aqueous extracts, then they were mated with virgin females of the C(1)DX stock. The sex chromosomes of the females of the C(1)DX stock are physically linked, that is why the male X-chromosome is always transmitted from father to son. Using the C(1)DX stock allows us to detect for the first progeny the frequency of all lethal modifications appearing in the sex chromosomes.

We have applied also the recombination test [6]. The soil aqueous extracts were introduced directly into the milieu for the heterozygous females. The recombination frequency is detected for the second generation.

Results and discussion

The water extracts obtained from the soil samples of different amounts of lead salts (5 to 500 times of the natural background level) produced a certain increasing in the frequency of the sex-linked lethal mutations in comparison with the ordinary water as a control (table 2). Thus the applied test-system appeared more sensitive to the changes of the lead salt amount in the soil than the atomic absorption method. However we did not observe a linear dependence of the effect *versus* dose. It is interesting that a mutagenic effect of the lead inorganic compounds has not been demonstrated for *Drosophila melanogaster* in several studies of other authors [7].

Table 2 The frequency of *Drosophila melanogaster* sex-linked lethal mutations

Lead salts input relative to the natural background level	Male number	Female number	Pirson's criterion ($\chi^2=3.84$ corresponds to $P=0,05$, $\kappa=1$)
0 (ordinary wather)	194	109	$\chi^2=2.0$
1 (water extracts of soil)	117	80	$\chi^2=1.6$
5	184	148	$\chi^2=76.7$
20	147	102	$\chi^2=21.19$
200	128	125	$\chi^2=193.28$
500	181	125	$\chi^2=22.63$

For lead salts concentration that is 200 times higher than the natural background concentration we observe a certain decrease in the frequency of recombination between the genes *white* and *cut*, which are located in the first chromosome (Table 3). We did not observe any reliable decrease in the recombination frequency in all other cases.

Table 3. The results of the test of the recombination frequency between the genes *white* (*w*) and *cut*(*ct*)

Lead salts input relative to the natural background level	The crossing over frequency between the genes <i>w</i> and <i>ct</i> (%)
0 (ordinary wather)	18.50±1.9
1 (water extracts of soil)	21.84±2.2
5	18.66±1.9
20	18.59±1.9
50	23.06±2.3
100	16.78±1.7
200	11.84±1.2
500	20.28±2.0

Further researches are necessary to understand the mechanisms of the effects observed.

Conclusions

1. It has been demonstrated a mutagenic effect of the aqueous extracts of soils containing 5 to 500 times of the natural background level of lead salts.
2. An influence of the water-soluble fractions obtained from the lead salts-containing soils on the frequency of recombination between the genes *white* and *cut* has been observed.
3. In all our tests we did not observe a linear dependence of the effect *versus* dose.

References

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