Application of Bioassay Systems to Genetic Risk Evaluation

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Introduction

Tradescantia plant clone 02 which was known as a highly sensitive indicator have been widely used in the experiments and mutagenesis [1,2]. Male gametophyte generation of fruit trees can be applied as bioindicators of genotoxicity. The pollution of the environment with technogenic factors can change the evolutionary formed complexes of adaptive reactions. *In situ* indication of genotoxicity requires well-founded selection of indicator species to estimate genotoxic potential in the examined locality or region [3]. The study area is located in the western part of Ararat valley, near the settlement

Materials and Methods

The study area is located in the western part of Ararat valley, near the settlement Metsamor, approximately 30 km NW of the capital, Yerevan. The climate is strictly continental with strong variations of annual and daily temperature and 271 mm of annual atmospheric fallouts. . In the Ararat Valley the average temperature in July is +25-27℃ while in January - +5-7℃. Weak winds, up to 1m/sec, are dominant. Frequency of pink mutation events (PME), genetic-uncertain (colorless) mutation events (CME), in the test of *Tradescantia* stamen hairs (Trad-SH) and the formation of micronuclei in tetrads (Trad-MN) (revealing the level of non-disjunction or chromosomes damage) were defined. Comparative analysis of radionuclids content and specifically ^{137}Cs, in the study area (around Armenian NPP) and in the control zone were done during the whole period of ANPP operation, in different directions and at various distances from the plant. Reproductive parameters of male gametophyte of some fruit trees were analyzed at plants growing on distances of 3-5 km from the Armenian Nuclear Power Plant (ANPP) - near to settlement Metsamor at their comparison with the control point on the distance more than 30 km from ANPP. Pollens were investigated by the method of the acetocarmine preparations analysis.

Results and Discussions

Depending from soil samples the frequency of PME was 1,7 to 3,2 times higher, than the control level. The high level of PME was marked in soils of Aghavnatun - 1,92±0,33, versus - 0,41±0,16 in the control. The lowest level of PME is detected in soils of Oshakan- 0,92±0,23. The frequency of CME is 1,7 to 3,2 times higher, than the control level. The high level of CME is marked in soils of Oshakan - 12,56±0,85, versus - 3,93±0,48 in control.

The lowest level of CME is detected in soils of Armavir - 6,64±0,62. Analogical relations were detected also for the application of Trad-MN test. The frequency of tetrads with micronuclei exceeded the control level 1,5-3,3 time. The highest mutagenic activity was also detected in of soils of Oshakan and equals 32,0±0,85, versus - 9,8±0,54 in the control. The obtained results demonstrate significant correlation between the levels of ^{137}Cs and the frequency of CME, tetrads with MN and micronuclei in Tradescantia, clone 02 (revealing the level of non-disjunction or chromosomes damage), that equaled r =0,94 until r=0,97.

The results showed a high fertility at the investigated fruit-trees near to settlement Metsamor that was not significantly different from that of the control point. The influence of the ANPP on the male generative system of the investigated taxons of fruit trees for the

investigated year was not revealed.

Table. 1. Mutation changes in Tradescantia grown in different specimens of soils

Variant	PME, 1000± m	CME, 1000± m	Tetrads with MN, %±m	MN in tetrads, %±m	^{137}Cs Bq/kg
Metsamor	1,19±0,26	8,03±0,67	15,87±0,67	26,90±0,81	19,4
Aghavnatun	1,92±0,33	8,13±0,68	15,13±0,65	24,20±0,78	15,3
Armavir	1,44±0,28	6,64±0,62	14,72±0,65	21,80±0,75	15,7
Oshakan	0,92±0,23	12,56±0,85	32,0±0,85	61,0±0,89	65,6
Control	0,41±0,16	3,93±0,48	9,8±0,54	13,40±0,62	12,0

The results do not contradict to results of Ichikawa [2], initiator of *in situ* monitoring with *Tradescantia* around nuclear power plants, that "...various nuclides found in the environment near nuclear power plants might have affected the mutation frequency of *Tradescantia* testers, though the magnitude of the influence might not be large. However, the obtained results do not correlate with the mutations increase with wind direction (Ichikawa , 1981). The point of Oshakan with the rather high revealed levels of ^{137}Cs Bq/kg in investigated soil specimens and maximal revealed mutation events frequency of CME, tetrads with MN and micronuclei was just opposite from the wind direction from Armenia NPP.

Thus, the application of specified highly sensitive tests of *Tradescantia* (clone 02) demonstrates only the differences of investigated specimens of soils, with high correlation of some mutation events with the levels of ^{137}Cs. The reasons of revealed differences are under investigation.

Table 2. Properties of pollen fertility of fruit trees in different points of growth

Investigated taxon	Pollen fertility, %	
	Metsamor	Control point
Pear, sort Malacha	95.44±0.21	94.84±0.22
Pear, sort Dzmernuk	79.71±0.40	86.90±0.34
Peach, folk selection	88.69±0.32	95.61±0.21
Plum, folk selection	96.93±0.17	87.60±0.33

The low percentage (0.5 - 2.0%) of anomalies of meiosis in microsporogenesis, sporades and pollen grains as well as mitosis in root meristematic cells has been revealed in the majority of 94 species of angiosperms (from 28 families) growing in different ecological conditions in the zone with higher radionuclide pollution after the Chernobyl NPP accident. Only in certain species (8-10%) the correlation between an increase of the number of anomalies and an increase of the radiation level was shown. In that research were mostly not presented the species specific for Transcaucasia, and especially fruit trees of local species.

The further monitoring of pollen fertility is necessary at the different plants species, growing around the area of ANPP, for the definitionof their suitability for bioindication of action of environment factors. The formation of gametophyte with the low level of sterility can be important argument for the formation of system of bioindication.

Conclusions

The mentioned approach, allowing to estimate the genotoxic action of environmental factors, is the test for the definition of plants pollen grains fertility. Flowering plants have been used as bioindicators of mutagenicity, phototoxicity and genotoxicity of environmental pollutants. Pant bioassays can be combined with chemical or radiological measurements. The system needs to be expanded by species of interest (human) as there is a difficulty to transfer the revealed dose correlations to humans. Further development of the bioassay system includes various levels: population (epidemiological studies), individual, cellular, molecular (DNA), etc.

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