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Environmental Assessment of the Tree Plant Leaves According to their Physiological State and Fluctuating Asymmetry Indices of Morphological Features, Which Widely Spread in Baku

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Abstract: Slowed down fluorescence and pattern changes of FA(fluctuating asymmetry) parameters of plant tree leaves of tree-shaped bushes as: *Olea europea L., Quercus ilex L., Populus nigra L., Eucalyptus cameldulensis Dehn., Platanus orientalis L., Ligustrum japonica Thund.* as well *Pinus eldarica L.* tree plants widely spread in Baku (The Azerbaijan Republic) in the research areas that ecologically called risky where technogenic pollution is considered the most polluted area of the city. The results of the research showed change at FA and slowed down fluorescence parameters of chlorophyll of ingestigated plant leaves collected from urbanized environment that more loaded by harmful components; morphometric structural changes at tree leaves developed in the polluted condition of environment possible to correspond changes of intra - organism physiological state. The results of the research provide new opportunities to use in environmental assessment at ecological monitoring of Baku.

Keywords: Ecological assessment, fluctuating asymmetry, phenotypic characters, morphological features.

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1 Introduction

Effect of anthropogenic factors onto environment are being increased nowadays. These effects result serious ecological problems expressing in a wider aspect in city environment.The solution of ecological problems is carried out by providing stable protection of the environment that is a priority field of of the XXI Century. In order to provide improvement (progress) of environment, before environmental management of it a quality assessment of the environment is required.The using of new methods which are economically favourable, more informative, easy and maintaining bioethics principls is prespective for the assesment of the environmental quality in the pollution condition. It is possible to solve successfully all these questions by using biomonitoring ways [7]. Plant organisms are used to be under harmfull and negative stress factors during growth in the period of onthogenesis in an unfavorable environment. From this point of view use of plant objects in biomonitoring is important. Tree plants are more sensitive to pollution of urboecosystems. They result intraspecies changes of an organism by adapting to pollution environment. The change of biomorphological features of plant organisms growing in diverse environment, from the ecological point of view it is related with violation stability of individual growth [12,13].

The purpose of tresearch was to study of FA(fluctuating asymmetry) indices and chlorophyll fluorescence at leaves of certain tree plant species inhabited and developed in polluted areas of different grade from the ecological point of view widely spread in Baku. A leaf is a main vital organ of a plant and it is a reliable diagnostics at assessment of relation between environment and plant. That is why slowed down fluorescence and pattern changes of FA parameters at plant tree leaves of tree-shaped bushes as: *Olea europea L., Quercus İlex L., Populus nigra L., Eucalyptus cameldulensis Dehn., Platanus orientalis L., Ligustrum japonica Thund. as well Pinus eldarica L.* tree plants widely spread in Baku in the reserch areas that we call ecologically risky where technogenic pollution is higher considered more polluted area of the city and ecological optimum called ecologically pure monitoring to provide ecological assessment of the environment and definition of slowed down fluorescence and pattern changes of FA indices have been appointed.

2 Material and Methods

Tree-shaped bushes as: *Olea europea L., Quercus İlex* L.,*Populus nigra L., Eucalyptus cameldulensis Dehn., Platanus orientalis L., Ligustrum japonica Thund.* as well a tree plantlike *Pinus eldarica L.*of approximately at the same age which are widely applied in greenery planting of Baku of the Absheron Peninsula have been used in the research work. The Mardakan Arboretum (suburb) and Baku Botany Garden (city) strictly protected territories were chosen as ecological optimum area as these are technogenic loaded and

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Table 1: Indicators of FA in leaves of the investigated samples.

Species	Zone	X±x	FA	D	V	R	Mod	Eb
Quercus İlex L.	ecological optimum	0,85±0,02	0,12	0,003	20	2	0	100
	ecological risk	1,53±0,02	0,83	0,011	22	4	0,1	90
OleaeuropeaL.	ecological optimum	0,51±0,03	0,07	0,09	40	2	0,4	100
	ecological risk	1,15±0,04	0,3	0,36	62	3	0,9	85
Ligustrum japonica Thund.	ecological optimum	0,72±0,05	0,09	0,03	24	2	0,5	100
	ecological risk	1,32±0,07	0,41	0,13	27	4	1.0	88
Eucalyptus cameldulensis Dehn.	ecological optimum	0,92±0,06	0,05	0,03	20	2	0,5	100
	ecological risk	1,31±0,03	0,29	0,08	21	3	1,0	91
Pinus eldarica L.	ecological optimum	0,03±0,001	0,001	0,01	33	1,0	00	100
	ecological risk	0,09±0,002	0,004	0,11	36	1,5	0,1	84
Populus nigra L.	ecological optimum	0,78±0,03	0,11	0,03	21	2	0,5	100
	ecological risk	1,47±0,04	0,38	0,13	24	4	1,0	90
Platanus orientalis L.	ecological optimum	0,160±0,004	0,054	0,02	18	1	0,1	100
	ecological risk	0,996±0,001	0,095	0,82	90	5	1,1	69

Table 2. Chang in the intensity:millisecond-delayed light emission (ms-DLE)chlorophyll a of leaves of the investigated tree plants and phases intensity ratio of the - ms-DLEto the intensity of SL.*PP –Prompt Phase, SP – Slow down Phase, SL – Stasionary Level*

Species	Zone	PP	SP	SL	PP/ SL	SP/ SL
Quercus İlex L.	ecological optimum	10,7	10,0	2,9	3,7	3,5
	ecological risk	7,4	5,8	1,6	4,6	3,6
OleaeuropeaL.	Ecological optimum.	3,9	3,3	0,59	6,6	5,5
	ecological risk	1,9	1,5	0,38	5,4	4,3
Ligustrum japonica Thund.	ecological optimum	8,6	6,2	1,6	5,3	3,8
	ecological risk	5,4	2,9	1,06	5,09	2,7
Eucaliptus cameldu-lensisDehn.	ecological optimum	6,2	5,7	2,3	2,7	2,5
	ecological risk	4,5	3,6	1,4	3,2	2,6
Pinus eldarica L.	ecological optimum	2,8	2,1	0,9	3,1	2,3
	ecological risk	1,6	1,1	0,4	4,0	2,7
Populus nigra L.	ecological optimum	14,1	12,5	3,4	4,1	3,7
	ecological risk	12,8	8,9	2,3	5,6	3,8
Platanus orientalis L.	ecological optimum	15,1	14,4	3,7	4,08	3,9
	ecological risk	13,4	10,5	2,9	4,6	3,6

ecologically polluted areas. Ecologically pollution degree of the areas was determined according to the report of Ministry of Ecology of the Azerbaijan Republic and relevant lab data. 250-300 leaves have been collected from each tree species on each research area. 20-30 leaves have been analysed by collecting them from each tree plant of the same height along with their crowns on the area. FA and fluorescence parameters of morphometric property at the leaves have been studied [2,3,8,9,11]. The investigated FA parameters like bilateral difference, intra-property change frequency, dispersion and change coefficient of morphometric measurements have been determined on the base of program property of leafblade. To study physiological state of the plants fast and stasionary phases of the slowed down chlorophyll fluorescence has been investigated. In order to study thedelayedfluorescence(DF) leaves have been collected in the morning and placed in bags that ismade of black photographic paper before the measurement. A photometric device that allows registering the millisecond component induction picture of the delayed fluorescenceof chlorophyll a in the millisecond interval has been used in the work [1,10]. After preliminary 10 minutes, dark adaptation of each sample proceeded to registration millisecond induction curvedelayed fluorescence (msDF) of chlorophyll a. Assessment of the tree leaves from the test plots differing according to ecological pollution changes have been implemented according to the character of the various phases change of the induction curve of chlorophyll a msDF (4). Induction curve msDF chlorophyll a consists of a fast phase (PP) and a slowdown phase (SP) as well a transition to stationary level (SL). The prompt phase (PP) attracts occurrences on the acceptor side of the PS II and the slow phase (SP) on the donor side of the PS II. The stationary level (SL) of a luminescence reflects the definition of a steady state of the oxidation-reduction process connected with the transfer of electrons within the limits of FS II. That is why rate change between FP and SP to SL prompts about functional state of the RC- reaction centre PSII and its nearest surrounding [1,3]. The results of the research have been worked out by a program package especially prepared with the known mathematic formula (5).

3 Results of the Research and Discussion

The results of the research have been shown in the given tables. The obtained results of the FA indices at leaves of tree plant species in the investigated areas have been shown in Table 1. The level of FA indices at leaves of the researched tree plants which were grown in ecologically optimum and ecologically polluted area are variating as it is seen in the results.The physiological state of the plant has been studied according to change character of the induction curve of the slowed down fluorescence at the leaves of the researched tree plants. In Table 2 it is seen that intensity of both phases (PP,SP) at the leaves of all investigated tree plant species that grow in ecologically polluted areas reduce in comparison with control as well depending on the tree specification (*O.europea*)the reduction occurred 1,1 to 2,2 times; at the leaves of all investigated tree plant species on stationary level (SL) of the slowdown phase (SP) it has been reduced. The reduction has been determined 0,7 (*E.camaldulensis*) to 2,3 times (*P.eldarica*). In the condition of ecological pollution changes in the leaves of all the investigated tree plant species have also been occurred at the prompt phase (PP) and slow down phase (SP) in relation to the stationary level (SL). In the ecologically polluted environment prompt phase (PP) at *O.europea* və *E.camaldulensis*plants in relation to the stationary level (SL) has increased for 1,2 times and at the rest investigated plants this index reduced up to 1,4 (*P.nigra*). Slow down phase (SP) in relation to the stationary level (SL) at *Q.ilex, E.camaldulensis* and *P.nigra* plants has a bit increased (0,96 to 1,2 times); at the rest investigated species (*O.europea*) it reduced up to 1,3 times. These results are connected to both change occurrences at acceptor field and donor field of PS II in the leaves of tree plants. Reduce of the prompt phase (PP) and slow down phase (SP) of chlorophyll slow down fluorescencein relation to the stationary level (SL) in the leaves of the plants researched in the ecologically polluted environment informs that PS II of plant trees are more stable and sustainable in the condition of the stressed environment. It shows more clearly at olive tree plant.According to the results (fundings),it resulted with a brake of PS II activeness under stress factors at tree-shaped bush *L.yaponica*.

4 Conclusions

1. FA indices change at leaves of tree plants in the urbanised environment excessively loaded by harmful components. Accordingly, the increase is observed in the bilateral absolute value of the morphometric property of leaves and depending on bioecological features, ecological tolerance, and sensibility of tree plant species, intra-property changes occur with a non-adequate splash
2. Slowed down illumination emission of the chlorophyll at leaves of the investigated tree plant species under the thorough effect of harmful components of environment changes have been created at PP and SP ratio to SL by rendering sensibility to stress factors effect.
3. Morphometric structure changes at tree plant leaves grown in unfavourable environment can cohere witha change of intra-organism physiological condition.
4. The investigated tree plant species have widely being planted in the greenery of cities and create new opportunities for their use at environmental assessment during the ecological monitoring of Baku of the Azerbaijan Republic.

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