



THE EVALUATION OF ADAPTIVE CAPABILITY FOR SOME CEREALS CULTIVATED IN THEIR NATURAL ENVIRONMENT

NATIGA NABIYEVA

Genetic Resources Institute of Azerbaijan National Academy
of Sciences, Baku, Azerbaijan
Email: gen_eht@yahoo.com

Abstract

The biennial monitoring of growing *T.aestivum* L. and *H. vulgare* L. in the area of E-field radiation was carried out. During the period, the annual increase of spontaneous mutation level in the anaphase root cells and lipid peroxidation intensity in the leaves has been registered. It was revealed that the adaptive capability of barley in the E-field environment is relatively high.

Key words: *cereals, E-field radiation, adaptive capability, lipid peroxidation, chromosome aberration*

Introduction

Living organisms and their medium are constantly affected by various factors of environment. Plants fixed to their substratum are especially subject and most sensitive not only to constantly varying ecological conditions, but also the strong anthropogenic pressure [7,8]. One of the factors negatively influencing plant populations and biocoenosis as a whole is the electromagnetic pollution of environmental. As a rule, a weak and short-term influence of electromagnetic radiation does not cause the essential mutation of genetic and physiological functions of plants because, in the course of evolution, living organisms have adapted to a certain level of E-field. However, the sharp and long influence of this factor leads to the disturbance of many physiological functions of plants and, in particular, their genetic status that, finally, puts them under the threat of an exhaustion and disappearance [2,3].

Thereupon, an actual problem is the studying and evaluating of degree of ecological risk and adaptable possibilities of plant biodiversity, i.e. the obtaining and accumulation of information on the current condition of plants, as well as the

forecast of their development and change in the territories subjected to the influence of electromagnetic radiation.

In territory of the Azerbaijan Republic there are areas affected with the impact of electromagnetic radiation of a radar station located in the Gabala area. This ecological situation is quite serious and needed in the regular monitoring of plants in the specified territory. With that end, we have been carried out the biennial ecologic-genetic monitoring of main cereals cultivated near to the radar station that are, accordingly, subjected to the influence of electromagnetic radiation.

Materials and Methods

Objects of the study were *T.aestivum L.* and *H.vulgare L.* Within two years, samples of the seeds of both the species have been collected from farms that are in the zone of direct exposure of the station - from 2 various cultivated fields (Jyrdibi and the Amirvan plain) in the Amirvan village, and from the Dashmir cultivated field in the Vandam village which is situated rather further from the radar station. Experiments were carried out in laboratory conditions on seedlings of wheat and barley with using cytogenetic and biochemical methods.

One of the approaches to estimate genetic damages in plants resulting from negative anthropogenous factors is based on the cytogenetic study of chromosomes [1,7,9]. Therefore, the frequency of chromosomal aberrations in the root meristem of the seedlings was taken as a basis in the researches [1].

Considering that the condition of cell metabolic system influences on the mutability of genome, the intensity of lipid peroxidation (LP) in leaves of the plants has been investigated. It is known that peroxide reactions are very sensitive to any, even very small negative effects of environment impact. Products of peroxidation are highly active dialdehydes among which malonic dialdehyde (MDA) is found out in the highest concentrations [4,5,10]. The amount of MDA in leaves was defined with using the color reaction of tyobarbituric acid [6].

Results and Discussions

Monitoring of the first year study has shown that in samples of *T.aestivum L.* and *H.vulgare L.* collected in each of 3 farms the level of spontaneous chromosomal mutability is in the limits of evolutionally developed values and varies from 2 to 4 % (Table 1).

Table 1

Level of spontaneous mutability in *T.aestivum* L. and *H.vulgare* L. for two years of the study

Areas studied		Years of observation	<i>T.aestivum</i> L.			<i>H.vulgare</i> L.		
Villages	Cultivated fields		Total amount of anaphases, (N)	Amount of aberrated anaphases, (n)	Frequency of chromosomal aberrations, (M±m)	Total amount of anaphases, (N)	Amount of aberrated anaphases, (n)	Frequency of chromosomal aberrations, (M±m)
Aminvan	Jyrdibi	I	1055	47	4.45±0.64	891	39	4.38±0.69
		II	1036	80	7.72±0.83	907	59	6.51±0.82
Vandam	Dashmir	I	916	34	3.71±0.63	881	22	2.50±0.53
		II	888	54	6.08±0.80	884	42	4.75±0.72
		I	883	27	3.06±0.58	878	30	3.42±0.62
		II	918	53	5.78±0.77	923	51	5.53±0.73

However, by results of the monitoring carried out in the 2nd year, the increase of frequency of structural changes of chromosomes in root meristem cells of the seedlings of the plant seeds collected from all experimental fields was observed. So, the researches carried out in the 2nd year have shown that in comparison with the 1st year the level of cytogenetic damages in the plants of wheat collected from both the fields in the Amirvan village was 1.5 times as many, and in the Vandam village this indicator increased 2 times as high. The relatively high frequency of aberration in cells of wheat collected from the Jyrdibi field in the Amirvan village, in comparison with the aberration frequency of the same species taken from 2 other fields, has been established. These data indicate the high level of mutational process in *T.aestivum L.* cultivated in the zone directly exposed to the impact of electromagnetic radiation.

The tendency of increase of cytogenetic damages during the years of the study was also observed in the barley plants collected from the same populations. The comparative analysis of frequency of chromosomal aberrations in cells of root apical meristem has shown that in comparison with wheat, the barley plants demonstrated rather a lower frequency of chromosomal aberrations.

For 2 years of the observation the increase of spontaneous mutations level in the seedlings of wheat was accompanied by the growth of MDA amount in leaves of the same plants. This fact indicates an intensification of peroxidation processes in the cell membrane (Table 2).

Table 2

The amount of MDA in leaves of *T.aestivum L.* and *H.vulgare L.* for two years of the study

Areas studied		Years of observation	The amount of MDA, mkmol/g	
			<i>T.aestivum L.</i>	<i>H.vulgare L.</i>
Villages	Cultivated fields			
Amirvan	Jyrdibi	I	5.96±0.44	4.90±0.05
		II	9.40±0.22	7.68±0.68
	Amirvan plain	I	7.44±1.14	4.23±0.11
		II	9.20±0.22	7.48±0.66
Vandam	Dashmir	I	3.44±0.11	3.74±0.18
		II	6.98±0.10	7.11±0.12

In plants from the Amirvan village this increase was approximately 1.5 times as many, and in samples from the Vandam village approximately 2 times as

many. Similar results were obtained for investigations carried out in leaves of *H.vulgare* L. collected from the same populations. Rather a higher amount of MDA was observed in plants growing in the Jyrdibi field in the Amirvan village which is directly exposed to the electromagnetic radiation. Compared to the wheat, the MDA amount in barley leaves was lower. The obtained data have shown that the adaptable ability of barley to an existing ecological environment is higher than wheat.

Conclusion

The biennial monitoring of *T.aestivum* L. and *H.vulgare* L. plants in the Amirvan and Vandam villages of the Gabala area of Azerbaijan has revealed the increase of the frequencies of chromosomal aberrations and the level of LP activation during years of the observation. It may be explained with cumulating negative effects of constantly operating radar station in plants of the researched territory. The comparative analysis of the data obtained in the villages where monitoring was carried out has shown that the experimental plants growing in the Jyrdibi cultivated field of the Amirvan village directly exposed to the impact of the electromagnetic radiation were exposed to genetic risk in much higher degree than plants in other investigated areas.

It has been also revealed that the response of the investigated plants to the existing ecological factor has a non-specific character. Thus, *T.aestivum* L. growing in the range of electromagnetic radiation was more susceptible, but *H.vulgare* L. has shown rather a higher adaptive resistance to the ecological situation.

Reference

1. Aliyev A.A., Majidov M.M., et al. Mutagenesis and methods of analyses of mutations. Baku,1992. 162 p.
2. Grigorev O.A., Bicheldey E.P. et al. Definition of approaches to rationing of the influence of anthropogenous electromagnetic field to natural ecosystems. The annual book of the Russian national committee on protection from non-ionizing radiation. Russian University of FN, 2003, p.46-74
3. Grigorev J.G., Nevzgodina L.V. et al. The influence of electromagnetic radiation of a difficult mode on the higher plants with various metabolic activity.// Materials of 1st Russian conference «The problems of electromagnetic safety of human». Fundamental and applied researches, Moscow, 1996, 28-29 November, p. 101-102
4. Kalashnikov U.E. Activation of antioxidizing system and intensity of lipid peroxidation in wheat in connection with high-quality stability to soil rehumidifying. Plant physiology,1999. V.46, №2, p.268-275
5. Kruchkova L.A., Makoveychuk T.I. Activation of oxidative processes in winter wheat under the influence of *Fusarium Graminearum*. Plant physiology and biochemistry.2007, V.39, №6, p.522-530

6. Lukatkin A.S., Golovanova V.S. Intensity of lipid peroxidation in cooled leaves of thermophilic plants. *Plant Physiology*, 1988. V.35, №4, p.773-780
7. Shumniy V.K. The complex interdisciplinary estimation of consequences of anthropogenous influences. *The Siberian ecological journal*. 2000, V.1, p.1-4
8. Shumniy V.K. et al. The genetic effects of anthropogenous factors of environment. 1993, V. 1, p. 91–106
9. Voronkova E.V., Grigorev J.G. et al. Cytogenetic researches of influence of the electromagnetic field on plants in natural conditions. // Materials of 1st Russian conference «The problems of electromagnetic safety of human». Fundamental and applied researches. Moscow, 1996, 28-29 November, p. 110
10. Zaysev V.G. Methodological aspects of researches of free-radical oxidation and antioxidizing system of organism. *The Zakrevsky bulletin of the Volgograd Medical Academy*. Volgograd, 1998. V.4, p.49-53