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THE CORRELATION BETWEEN MITOTIC ACTIVITY AND YIELD TO *HELIANTHUS ANNUUS* L.

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Abstract

The purpose of this study was to establish the existence of a correlation between mitotic activity in Helianthus annuus (sunflower) and seed production, taking into research five genotypes (G1-G5). The mitotic index had variable values (19.5%-39.4%). It was found a direct correlation between high mitotic activity (39.4%) and high production (2,105 kg/ha); the G3 genotype was the one that stood out from this point of view. Also, the G4 genotype, which recorded the lowest value of the mitotic index (19.5%), was noted with the lowest value of yield (1,758 kg/ha). The results suggest that genotype is one of the most dynamic indicators for sunflower cytogenetic research. This comes in support of genetic research for sustainable management of the agricultural system in general and sunflower crops in special. An intense mitotic activity is directly correlated with plant growth, development and fructification at optimal parameters. However, in addition to intense mitotic activity, environmental factors also play a decisive role.

Key words**:** *mitosis, sunflower, genotype, production, correlations*

INTRODUCTION

Sunflower is one of the most widespread oleic plants in Romania. From its seeds, quality oil is obtained, highly appreciated both in Romania and abroad. The high demand for sunflower oil, but also the multiple importance of this plant is why it is cultivated on very large areas. In our country it occupies significant areas especially in Dobrogea, Romanian Plain and Western Plain.

The importance of sunflower culture is given by its wide use in human nutrition, but also in animal feed, including industrial and energy uses.

Sunflower oil is especially used in people's nutrition because it has a high quality, a superior colour, taste and smell. It is considered one of the best vegetable oils, having a high content of unsaturated fatty acids. It has a low content of saturated fat and cholesterol and a high content of vitamins [22].

Genetics is one of the most current sciences, due to the importance of knowing the mechanisms of transmission of the characters to plants and of the manifestation of these characters as a result of the interaction of the hereditary base with the factors of the natural and anthropic environment [20, 21].

As integral part of genetics, the cytogenetics of crop plants, including sunflower, uses their own means of investigation and interpretation, through which they study the morphology, structure and behavior of chromosomes in mitosis and meiosis, together with the consequences of chromosomal and nuclear anomalies, from numerically and structurally point of view.

The high and constant production potential of the sunflower crop is maintained if the chosen genotype is genetically superior but also if the crop technology and recommended density are respected. The study of mitosis in different sunflower genotypes, cultivated under different environmental conditions and the

correlation of mitotic activity with production could complement the results related to genetic variability and its importance in modern sunflower breeding. Mitosis is the totality of the processes by which a cell grows, duplicates its chromosomes and divides, resulting in two cells identical to the cell from which they were arose [20].
Plant cells reproduction provide the growth, proliferation, differentiation, tissue regeneration and all of which is based on the intense mitotic activity [8, 21]. Also, the decrease in mitosis intensity may be due to the action of some chemicals substances, like herbicides, insecticides and fungicides [3]. The clastogenic effects of a test substance must be researched by in test systems such as chromosomal abnormalities [11, 17, 18]. Heterosis, also called hybrid vigour, is directly involved in obtaining a high sunflower and other crops production [9, 10].

MATERIALS AND METHODS

The genotypes investigated were grown at non irrigated conditions, following the method of multi-stage blocks, in the didactic field of the faculty. After recording the production, a number of 100 seeds from each genotype were brought to the Genetics laboratory of the Faculty of Agronomy for cytogenetic determinations. To this end, the seed samples were placed in Petri dishes, distributing 20 seeds in each recipient. For germination, the filter paper of the Petri dishes was maintained wet with distilled water.
To study the sunflower chromosomes, the meristematic roots were processed according to the staining protocol using the Feulgen method [3, 20]. The microscopic preparations were studied by counting 1,000 cells in each slide, in 3 repetitions.
It was necessary to calculate the mitotic index (Im%) or the frequency of the cells in the division for each genotype, in order to be able to appreciate the correlation between the mitotic activity and the proliferation of the cells.

RESULTS AND DISCUSSIONS

The results of the cytogenetic study to sunflower and their correlation with yield are illustrated in Table 1. The uniqueness of each tested genotype can be observed, expressed by the variable values of the mitotic index, which suggests a different level of adaptability at the cellular level. This cellular adaptability is the result of the interaction between the genetic factor and the environmental conditions [22]. The highest value was 39.4% (G3) and G4 registering the lowest mitotic activity, namely 19.5% (Fig.1).

Table 1. The results of the cytogenetic study to sunflower

G	I_m %	The mitosis index phases				The seed production (kg/ha)
		Mitotic index of prophase %	Mitotic index of metaphase %	Mitotic index of anaphase %	Mitotic index of telophase %	
G1	31.8	46.2	20.7	14.9	18.2	1,962
G2	24.1	44.1	21.3	14.8	19.8	1,845
G3	39.4	47.5	22.3	15.8	14.4	2,105
G4	19.5	45.2	19.8	13.8	21.2	1,758
G5	20.6	41.2	19.2	14.1	25.5	1,810

Source: Own calculation.

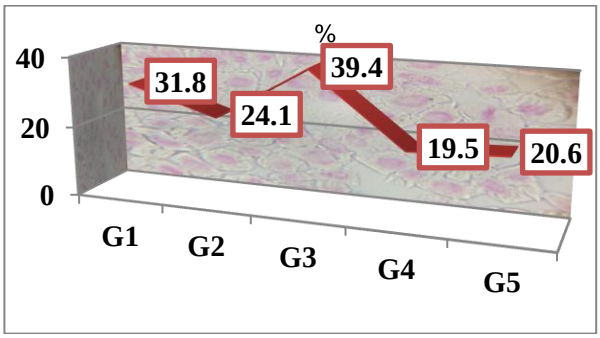

Fig. 1. Graphical representation of the mitotic index (Im%) to sunflower
Source: Own calculation.

The vegetal cell is an open thermodynamic system, in which the intense mitotic activity correlates with the intensity of the other processes that take place in the cells, namely the transformation of assimilated substances and energy into the growth process.
The variability of the mitotic index was noticed in the case of the mitosis stages, where the recorded values had values from minimum to maximum as follows: 41.2%-47.5% for the prophase stage; 19.2%-22.2% for metaphase; 13.8%-15.8% for anaphase and 14.4%-25.5% for telophase.
Plants growth, development and fructification are physiological phenomena characterized by

increasing of the weight and volume of the plant. At the basis of these phenomena is the process of cell proliferation and growth by extension, i.e. mitotic activity. Therefore, an intense mitotic activity is directly correlated with plant growth, development and fructification at optimal parameters. However, in addition to intense mitotic activity, environmental factors also play a decisive role [16, 23]. As shown in Figure 2, there is a direct correlation between intensity of mitotic activity and sunflower seed production.

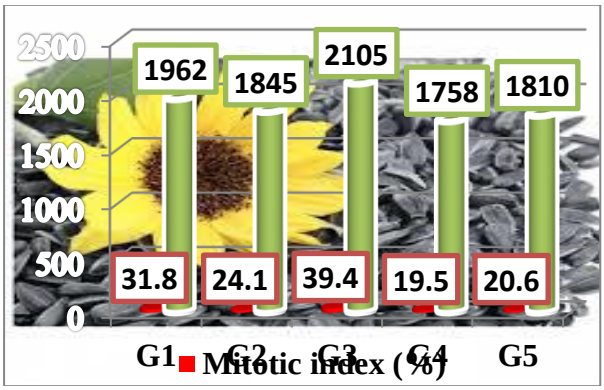

Fig. 2. The correlation between mitotic activity and seed production to some sunflower genotypes
Source: Own calculation.

Thus, G3 genotype was noted by the highest values, both in terms of mitotic index and production (2,105 kg per hectare), thus suggesting the direct correlation between these two characters. Also, the G1 genotype, which recorded a high mitotic index, achieved a good seed production (1,962 kg). The G2 genotype which had a slightly lower mitotic activity, obtained 1,845 kg per hectare seed production. The lowest mitotic activity was found to G4 sunflower genotype and thus he obtained the lowest seed production (1,758 kg per hectare).

We mention that all sunflower genotypes were grown under the same environmental conditions. So, the results suggest that genotype is one of the most dynamic indicators for sunflower cytogenetic research. This comes in support of genetic research for sustainable management of the agricultural system in general and sunflower crops in special.

Application of plant protection measures and an optimal management of agricultural culture establishment create favourable conditions for the photosynthetic process and improving the physiological status of the plants [12-15, 5-7, 19].

The genetic potential of fruiting is variable for each sunflower genotype, but mitotic activity, along with a proper nutrition and other technological elements in optimally ensured can result in high and quality yields, both in seeds and of oil [1, 2, 4, 9].

CONCLUSIONS

The intensity of the mitotic activity to sunflower is directly correlated with plant growth and development. The genetic uniqueness of each tested genotype was expressed by the variable values of the mitotic index and yield, which suggests a positive correlation between the two characters. However, the seed production is a complex hereditary character, determined by genes with various individual effects.

Mitotic activity in sunflower is correlated with seed production, but an intense mitotic activity does not exclude other vegetation factors that must be ensured for optimal growth, development and fructification. The increase of the production indices to sunflower can be achieved through improvement processes that mainly focus on the dominance effects of the genes.

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