CYTOGENETIC CHARACTERISTICS OF PARENTAL VARIETIES OF SUGAR BEET

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Introduction

Sugar beet (*Beta vulgaris* L.) is one of the leading agricultural crops worldwide, playing a key role in global sugar production. In sugar beet breeding, along with high yield potential, increased sugar content, and resistance to biotic and abiotic stress factors, issues related to genetic and cytogenetic stability are of particular importance. Especially, the condition of the chromosomal apparatus and hereditary characteristics at the cellular level in parental varieties are among the main factors determining the quality and performance of future hybrids.

In modern breeding programs, cytogenetic studies enable an in-depth assessment of the genetic status of varieties, the identification of hidden chromosomal alterations, and the selection of promising genotypes for breeding purposes. Stability in chromosome number and morphology, the regular progression of mitosis, and the intensity of cell division reflect the genetic robustness of plant varieties. Therefore, a comparative investigation of the cytogenetic characteristics of parental sugar beet varieties is of significant scientific and practical relevance.

This thesis presents a comprehensive cytogenetic analysis of four parental sugar beet varieties—Viktoriya, Lara, Oniks, and Novella.

Aim and Objectives of the Study

The main aim of this study was to investigate the condition of the chromosomal apparatus in the parental sugar beet varieties Viktoriya, Lara, Oniks, and Novella using cytogenetic methods and to evaluate their genetic stability.

To achieve this aim, the following objectives were defined:

- to determine the chromosome number in the parental varieties;
- to analyze chromosome morphology and morphometric parameters;
- to assess the activity and stability of the mitotic process;
- to perform a comparative analysis of cytogenetic indicators among the varieties;
- to identify genetically stable varieties suitable for breeding purposes.

Materials and Methods

The study material consisted of the sugar beet varieties Viktoriya, Lara, Oniks, and Novella. Seeds were germinated under laboratory conditions, and root tips were collected for cytogenetic analysis when root length reached 1–1.5 cm. Chromosome preparations were made using classical cytogenetic techniques.

Cells at the metaphase stage of mitosis were analyzed, and at least 25–30 metaphase plates were examined for each variety. Chromosome number, average chromosome length, morphology, and mitotic activity were determined. The obtained data were statistically processed using mean values (X±Sx), standard deviation (σ), and coefficient of variation (Cv%).

Results and Discussion

Cytogenetic Characteristics of the Viktoriya Variety

The Viktoriya variety was distinguished by a high level of cytogenetic stability. Throughout the study, the diploid chromosome complement characteristic of sugar beet (2n = 18) was consistently maintained in all observed cells. The average chromosome length was 24.8 ± 0.10 µm, with a low coefficient of variation, indicating a well-fixed genetic structure and high chromosomal stability.

Cytogenetic Characteristics of the Lara Variety

Although the diploid chromosome number was preserved in the Lara variety, relatively higher variability was observed in certain morphometric parameters. The average chromosome length was 24.5 ± 0.11 µm. Compared to the Viktoriya variety, mitotic activity was slightly lower, suggesting a more diverse genetic structure.

Cytogenetic Characteristics of the Oniks Variety

The Oniks variety was evaluated as one of the most cytogenetically active varieties. The average chromosome length reached 25.1 ± 0.12 µm, representing one of the highest values among the studied varieties. Chromosome morphology was predominantly metacentric, and mitotic division proceeded in a regular and orderly manner.

Cytogenetic Characteristics of the Novella Variety

In the Novella variety, the average chromosome length was 24.3 ± 0.09 µm. Cytogenetic analysis indicated a moderate level of chromosomal stability. Mitotic activity was satisfactory, and cell division occurred in a balanced manner.

General Comparative Analysis

The comparative analysis of the parental varieties demonstrated that Viktoriya and Oniks possess higher cytogenetic stability, whereas Lara and Novella exhibit relatively greater morphometric variability. These differences are

associated with the origin and breeding history of the varieties and are of critical importance when selecting parental forms for breeding programs.

Conclusion

The conducted study provided a comprehensive cytogenetic characterization of the parental sugar beet varieties Viktoriya, Lara, Oniks, and Novella. All varieties maintained a stable diploid chromosome complement. Viktoriya and Oniks were distinguished by higher genetic stability and can be recommended as promising parental forms for sugar beet breeding. The obtained results contribute to the scientific basis for the further improvement of sugar beet breeding programs.

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