Histological Characteristics of Sugar Beet Petiole Through an Evaluation of Drought Tolerance

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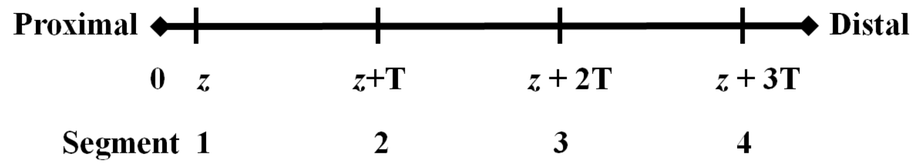
Generally, the structural characteristics of the plant that are associated with its ability to survive under dry conditions are referred to as xeromorphic characteristics. Assessment of the variability degree of morphological, micromorphological and anatomical characteristics of breeding material with respect to water use efficiency and drought can be used for selection of sugar beet genotypes with better tolerance to water deficiency. In order to provide it, there is a need to assess the degree of genetic variability of various plant part characteristics with respect to water management in plants, under optimal water supply.

In this research we quantified histological characters of petiole of ten sugar beet genotypes, using morphometric, classic anatomical and stereological method. The aim was to determine histological bases of the genotypic differences for drouht toletance, to calculate volume densities of diferent tissues in petiole, to examine the variability of anatomical characters and to assess the proportion of different tissues in proximal end distal petiole segments.

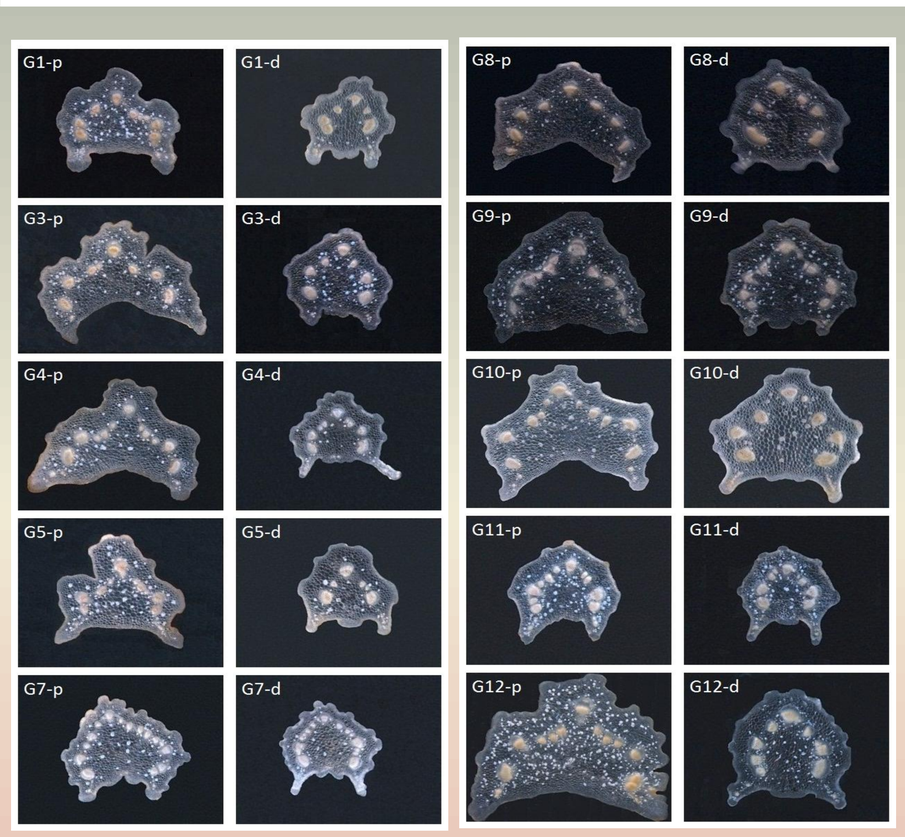
Petiole tissue blocks were sampled for stereological analysis according to systematic uniform random sampling model for elongated plant organs.



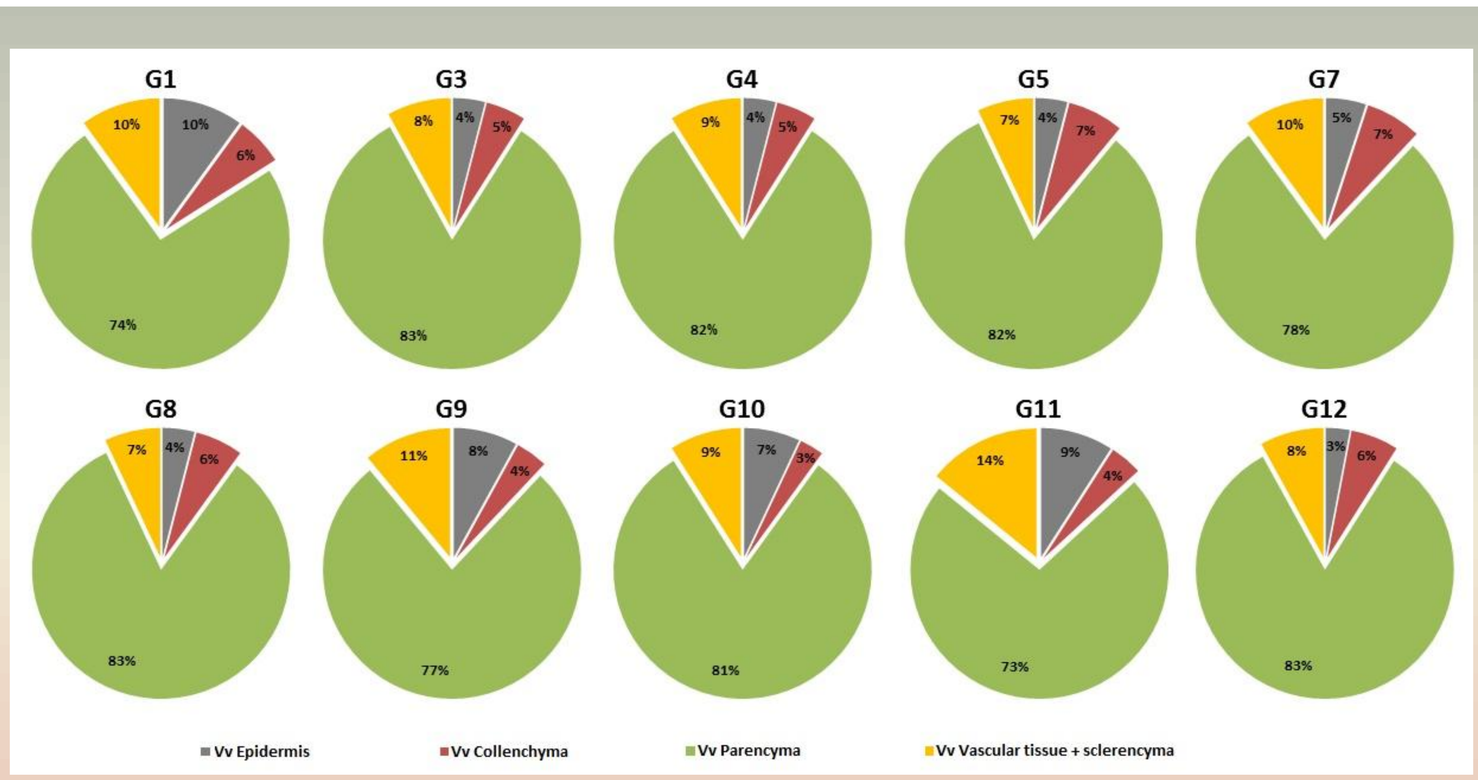
The proportion of tissues was estimated by point-counting method. Point grid test system of 192 test points was superimposed over cross-sections, and each intersection on the grid represented one sampling point. Approximately 3000 points per petiole were counted. Based on the data obtained by stereological analysis, volume densities of tissues were calculated using the formula.

$$Vv(x) = \frac{\sum_{j=1}^{n} Pj(x)}{\sum_{j=1}^{n} Pj(y)}$$

n - the number of examined sections
Pj (x) (j=1, …, n) – the number of test points hitting the specific tissue of interest on j-number of sections
Pj (y) (j=1, …, n) - the total number of test points hitting the entire petiole cross section on j-number of sections



A significant petiole cross-section shape variability was found in both the proximal and distal segments.

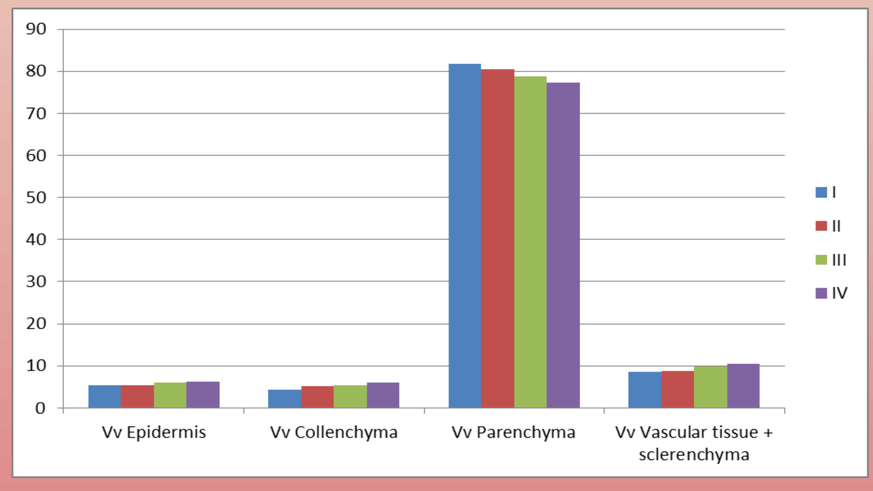


The general variability of the sample, and the contribution of individual character on variability were analyzed as well. A genotype specificity and significance of differences of volume densities (*Vv*) of various issues were obtained for each petiole segment.

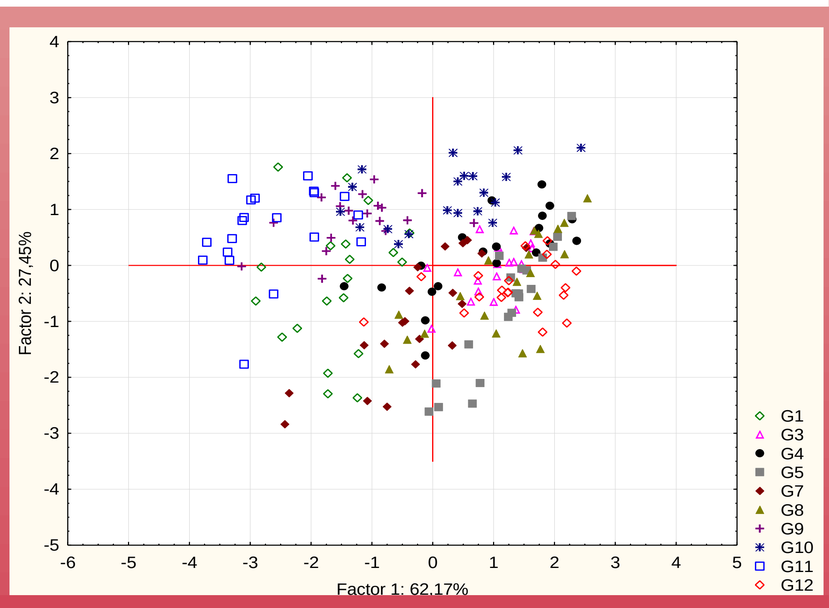
Principal Component Analysis of volume densities of petiole tissues of sugar beet genotypes. Marked loadings are >0.7000 and significant for the axis.

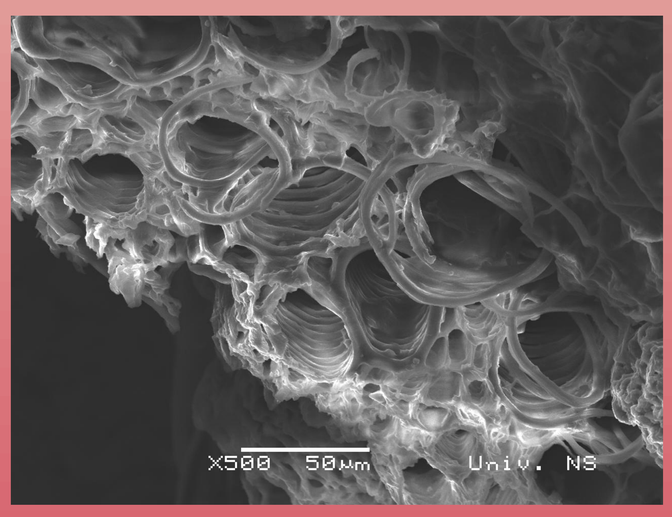
Characters	Factor 1	Factor 2
Vv epidermis	**-0.861**	0.237
Vv collenchyma	-0.051	**-0.996**
Vv parenchyma	**0.997**	0.215
Vv vascular bundles+sclerenchyma	**-0.888**	0.064
Eigenvalue	2.489	1.098
Total variance explained (%)	62.2	27.5

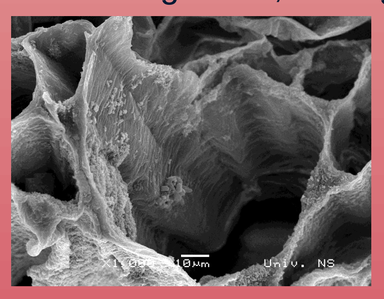
The results of PCA analysis showed that the percentage of parenchyma surface area and petiole index were characteristics that mostly contributed to the overall variability.

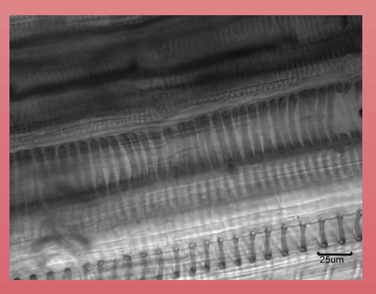


Volume densities (*Vv*) of petiole tissues on different segments, averaged for all cultivars









SEM and light micrographs of vascular tissue

Acknowledgements

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