Phenotyping of potato genotypes in terms of their tolerance to soil drought and high temperature

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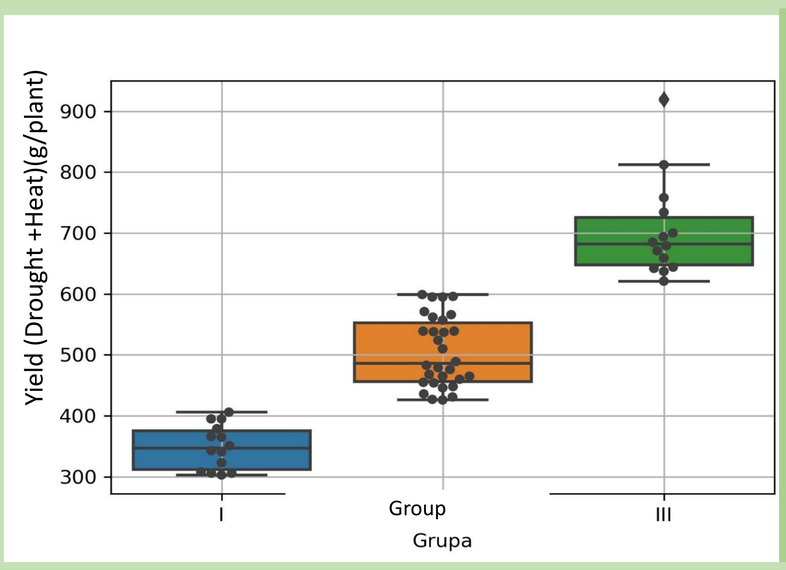
Introduction

Global climate change in the form of extreme heat and drought poses a major challenge to sustainable crop production by negatively affecting plant performance and crop yield. Potatoes require a cool growing season with an average daily temperature of 15–18◦C temperatures above 21◦C have adverse effects on growth. The optimal tuber yield for most commercial potato varieties is produced when potato plants are grown at average day temperatures between 14 and 22 ◦C. The susceptibility of potato crops to high temperatures largely depends on the genotype, development stage, and stress duration; tuber initiation and bulking are the most critical stages. In potato plants, the minimum night temperature plays a crucial role during tuberization, which is reduced at the night temperatures above 20◦C with complete inhibition above 25◦C.

Material and methods

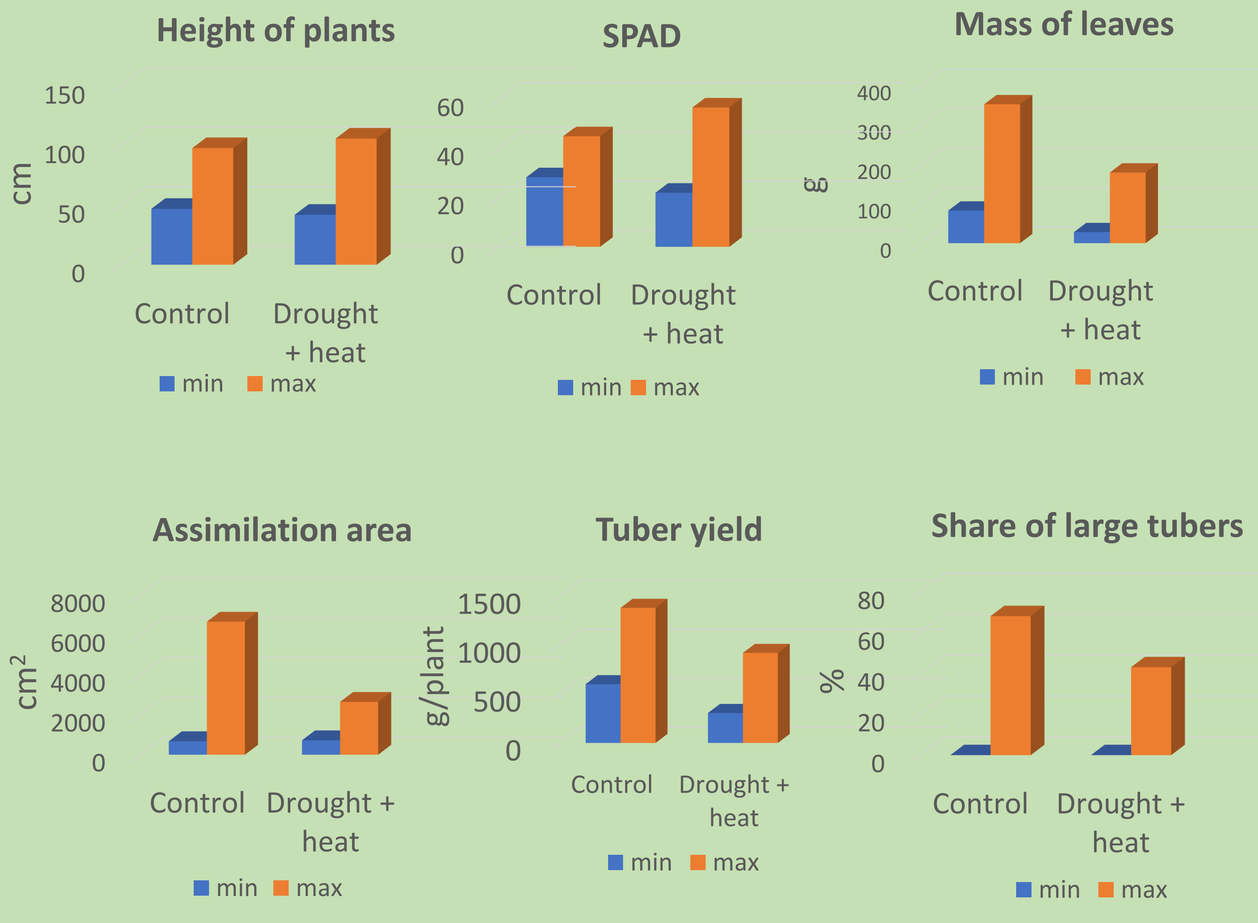
The research was carried out on 50 genotypes of potatoes grown in pots. Half of the plants were grown in natural conditions (the weather conditions in the place of cultivation), and the other half was subjected to abiotic stresses, i.e. drought and elevated temperature during the tuberization period. The following plant parameters were assessed: plant height, leaves mass, assimilation area, leaf greenness (SPAD). At the end of the growing season, the yield was assessed, its structure and the share of tuber defects.

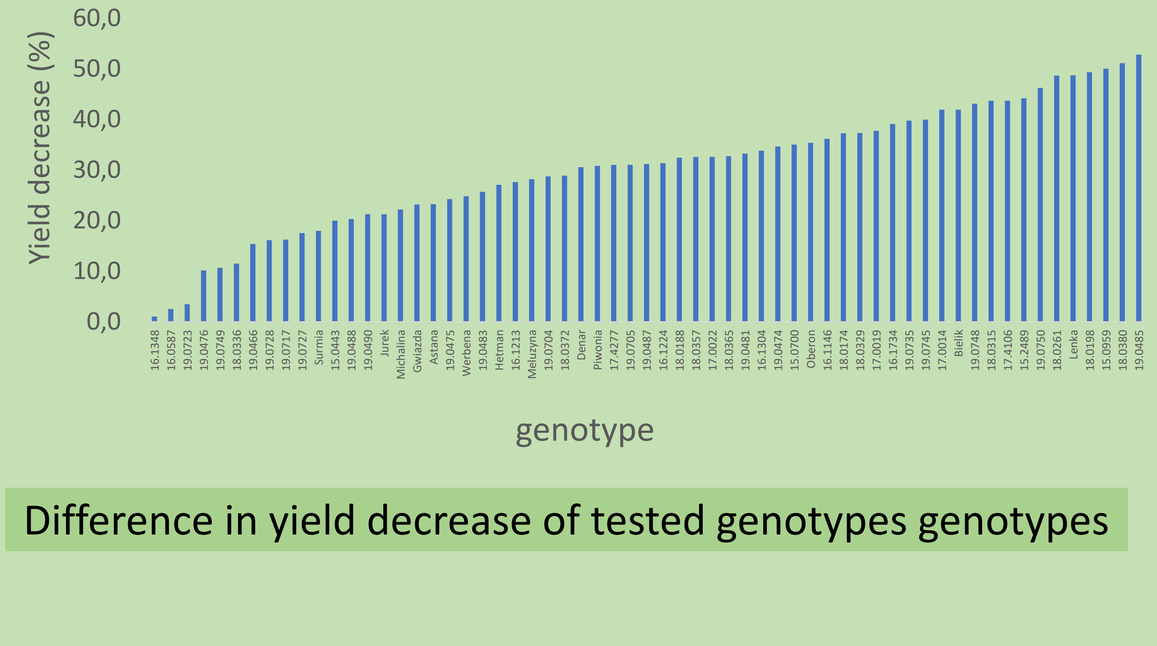
Principal component analysis (PCA) of the tested parameters under control conditions and under conditions of drought and heat stress.



Division of the genotypes into groups of different tolerance to drought and heat stress I - sensitive; II - moderately tolerant; III - tolerant on the basis of the yield obtained in drought and heat stress.

Range of values of examined features for 50 genotypes





Difference in yield decrease of tested genotypes genotypes

S u m m a r y

Using the analysis of the main components of PCA, it was determined that the parameters most determining the distribution of traits in response to the tolerance of plants to drought and high temperature stress: leaves assimilation area, tuber yield and leaves mass. On the basis of the obtained results, all genotypes were divided into groups with different tolerance to drought and high temperature stress.

The following changes in plant morphology took place under the influence of the applied stresses:

- the leaves mass decreased by 59%, the assimilation area decreased by 38.2% (average for all genotypes).
- the height of plants increased by 7,5%, the SPAD index increased by 6,2%
- Final tuber yield decreased by 44.5% and share of large tubers decreased by 10%