CHANGES IN THE ROOT SYSTEM SIZE OF THE POTATO VARIETIES IN RESPONSE TO DROUGHT AND HEAT STRESS

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Introduction

Potato plants (Solanum tuberosum) have relatively shallow root systems and, consequently, potato growth and yield depend on regular rainfall and are sensitive to water shortages. Varieties with larger and more expansive root systems are more likely to be able to retrieve water and nutrients from the soil. Therefore, these varieties should be less susceptible to periodic droughts and high temperature. Measurement of the size and extent of the root system of different varieties gives key information for breeding varieties adapted to regions with frequent shortages of rainfall and high temperature. Measurement of root system parameters requires difficult and time-consuming labor. Therefore, most studies examine only a small part of the total plant material and comprehensive studies await improved methods for phenotyping.

Material and methods

The study was conducted in the year 2016 in specially constructed cylindrical pots with open bottoms. They were 50 cm tall and 12 cm wide, allowing for proper development of the above-ground and below-ground parts of the in vitro plants. These pots can be opened along the seam of the cylinder, allowing the extraction of the entire root system, without damage. Seven potato varieties were planted. Half of pots were subjected to high temperature (38/25°C) for 2 weeks during tuberization period and the rest stayed in optimal temperature. The same seven cultivars were subjected to drought stress in the same phase. After the stresses the following measurements of root system were made: the depth range (cm), the total length of roots (cm), the total area of roots (cm^2), the average diameter of roots (mm) and the total dry weight of the root system (g). The measurements were done on all combinations.

Results

Under the influence of the applied stresses the changes in the size and architecture of the root system have occurred. These changes were different for both stresses. Under the applied high temperature all the root system parameters, i.e. the length, area, diameter, dry weight of roots declined. Under the drought stress however there was an increase in the length and area of the roots but decrease in their diameter. Applied soil drought caused the roots lengthened, reaching to the deeper layers. The level of changes was different and depended on variety.

Tab. 1. Changes in root system size in response to high temperature (mean for 7 varieties)

Combination	Parameters of root system			
	Length (cm)	Area (cm^2)	Diameter (mm)	Dry mass (g)
Control	5494	700	0,406	0,75
High temperature	3486	398	0,360	0,36

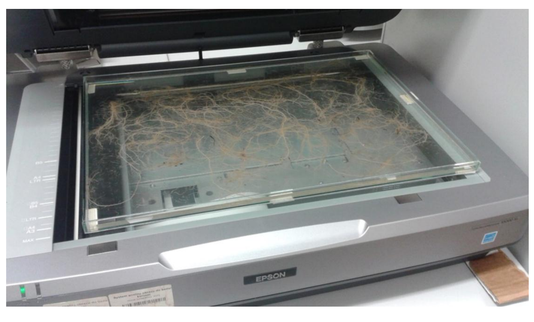


Fig. 1. Decrease of roots length

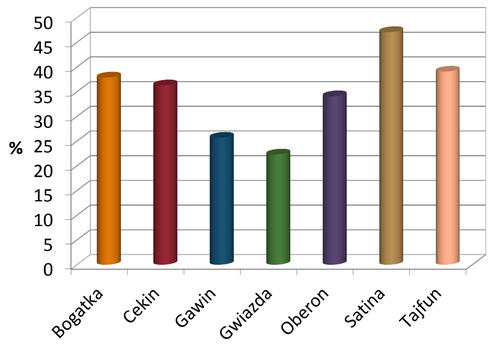


Fig. 2. Decrease of roots area

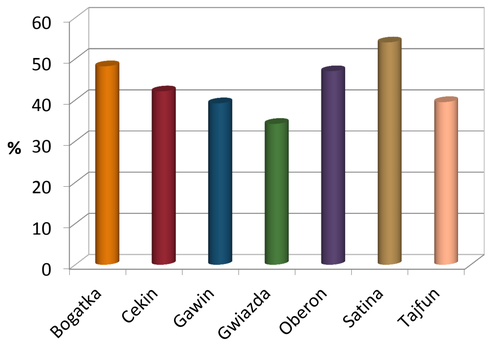


Fig. 3. Decrease of average root s diameter

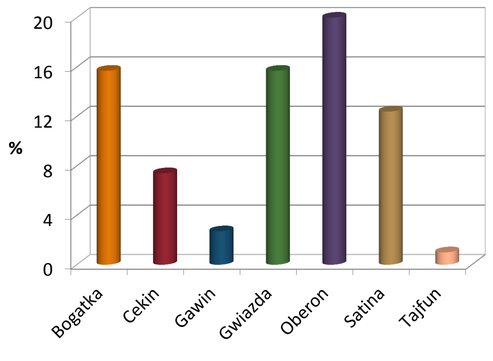
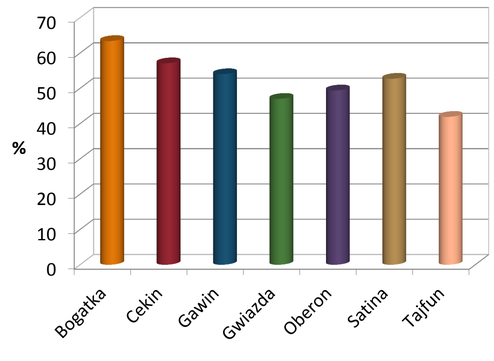


Fig. 4. Decrease of root dry matter



Tab. 2.Changes in root system size in resonse to drought (mean for 7varieties)

Combination	Parameters of root system			
	Length (cm)	Area (cm^2)	Diameter (mm)	Dry mass (g)
Control	5494	700	0,406	0,75
Drought	7233	925	0,308	0,59

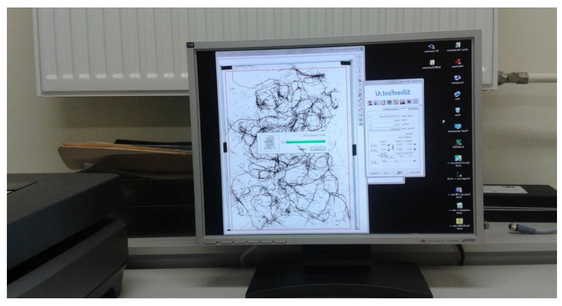


Fig. 5. Increase of root s length

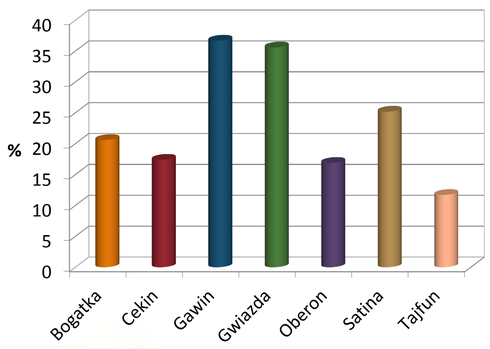


Fig. 6. Increase of roots area

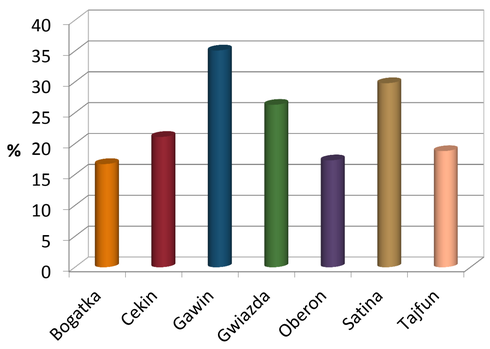


Fig. 7. Decrease of average root s diameter

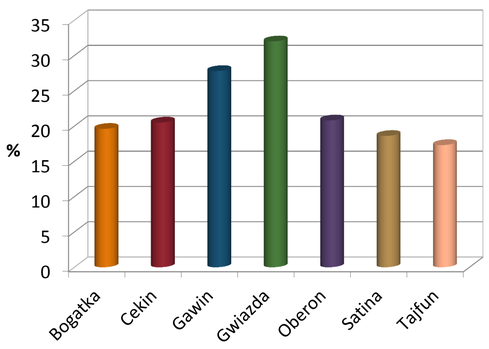
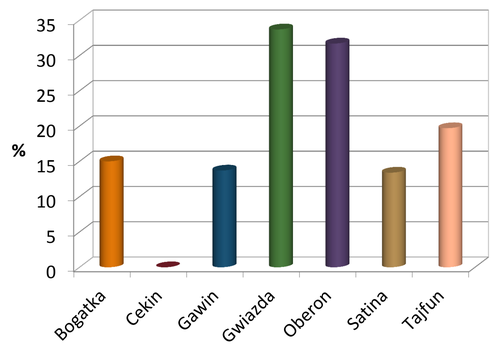


Fig. 8. Decrase of roots dry matter



Conclusion

Varietal differences expressed by changes in the parameters of the root system may be an indicator of their resistance to the abiotic stresses.

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