HEAT WAVE IMPACT ON PHYSIOLOGICAL STATUS AND GREEN MASS YIELD OF RED CLOVER

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INTRODUCTION

Heat wave, as a result of climate change, is an increasingly common phenomenon in eastern Croatia. During the early summer of 2021, eastern Slavonia experienced a severe heat wave with maximal daily temperature peak at 38.9 °C. Here, we report impact of heatwave on plant antioxidative status after unfavorable conditions and consequently on green mass yield (GMY) of 12 red clover cultivars/breeding populations of different origin and therefore, different tolerance to heat.

MATERIAL AND METHODS

Experiment was performed on 12 red clover cultivars/breeding populations of different origin sown in March 2021 at the experimental field of Agricultural Institute Osijek. Heat wave occurred in the middle of June and lasted until end of the month. Tissue samples (leaflets) were collected 28th of June. Leaflets were homogenated in liquid nitrogen and several analyses were performed: determination of water content (WC) [1]; lipid peroxidation (MDA) [2]; proline content [3]; guaiacol peroxidase activity (GPOD) [4]; polyphenol oxidase activity (PPO) [5]; proteins content [6] and polyphenols content [7]. Green mass yield (GMY) were taken after last cutting in October 2021.

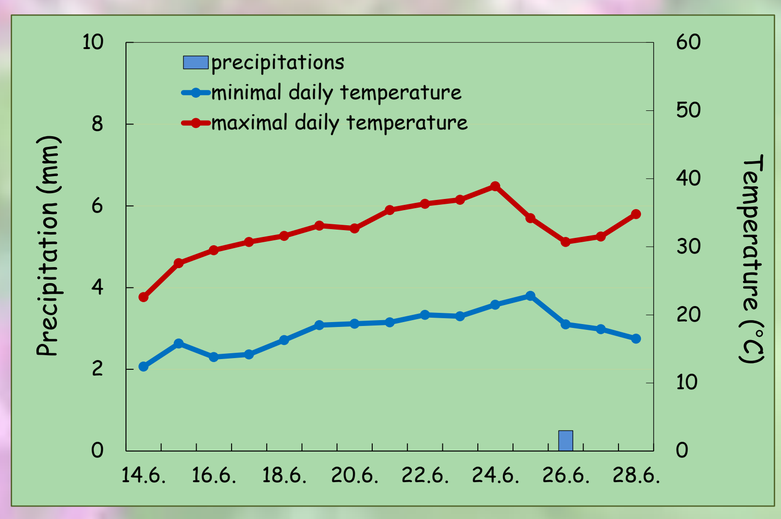

Figure 1. Precipitations (mm), minimal and maximal air temperatures (°C) in Osijek (June 2021).

Table 1. Water content (WC), lipid peroxidation (MDA), proline content, guaiacol peroxidase (GPOD) and polyphenol oxidase (PPO) activity, protein and polyphenol content, and green mass yield (GMY) in 12 red clover cultivars/breeding populations after heat wave. Different letters indicate significant difference among cultivars/breeding populations at $p < 0.05$ according to the LSD test.

Cultivar/breeding population	Origin	WC (%)	MDA (nmol/g FW)	Proline (µmol/g FW)	GPOD (nkatal/mg_{pr})	PPO (nkatal/mg_{pr})	Proteins (mg/g FW)	Polyphenols (mg_{GAE}/g FW)	GMY (t/ha)
OPCD* 1	Croatia, PIO	69.97a	12.98ab	2.22b	11.49d	18.23cde	29.85ab	4.47ef	10.98b
OPCD 2	Croatia, PIO	68.43de	12.90ab	2.79a	14.43bc	15.94efg	30.90a	4.87cd	12.01ab
OPCD 3	Croatia, PIO	68.10ef	12.97ab	2.16bc	11.68d	14.18g	31.24a	4.72cde	14.53a
OS VIVA	Croatia, PIO	69.47bc	13.21a	2.10bcd	14.32bc	20.26abc	27.81bc	4.61def	11.83ab
OS MARIS	Croatia, PIO	67.90f	10.78d	2.01cd	16.94a	22.62a	21.50f	4.68cdef	11.66ab
Scarlett II	USA	68.44de	12.81ab	1.72f	13.65c	21.76ab	25.43cd	5.00c	10.43b
Ottawa	Canada	66.30h	10.32d	1.93de	13.83c	17.61def	24.75de	6.09a	9.71b
RAM	Canada	67.31g	9.65e	1.72f	15.94ab	19.97bcd	22.01ef	5.41b	9.64b
Start	Czech	69.42bc	11.63c	1.99cd	11.18d	14.04g	29.69ab	4.46ef	9.04b
PRIMUS	Belgium	68.67d	11.86c	1.80ef	16.69a	16.35efg	26.60cd	4.59def	11.48ab
Grasslands Sensation	New Zealand	69.79ab	12.60b	2.28b	10.88d	15.80fg	31.02a	4.37f	9.63b
Relish	New Zealand	69.23c	13.08ab	2.13bc	15.76ab	21.56ab	25.08cd	4.74cde	11.87ab
	CV (%)	1.58	10.10	14.12	15.70	16.49	12.73	9.25	13.65
	MIN	66.30	9.65	1.72	10.88	14.04	21.50	4.37	9.04
	MAX	69.97	13.21	2.79	16.94	22.62	31.24	5.98	14.53

*OPCD-breeding population

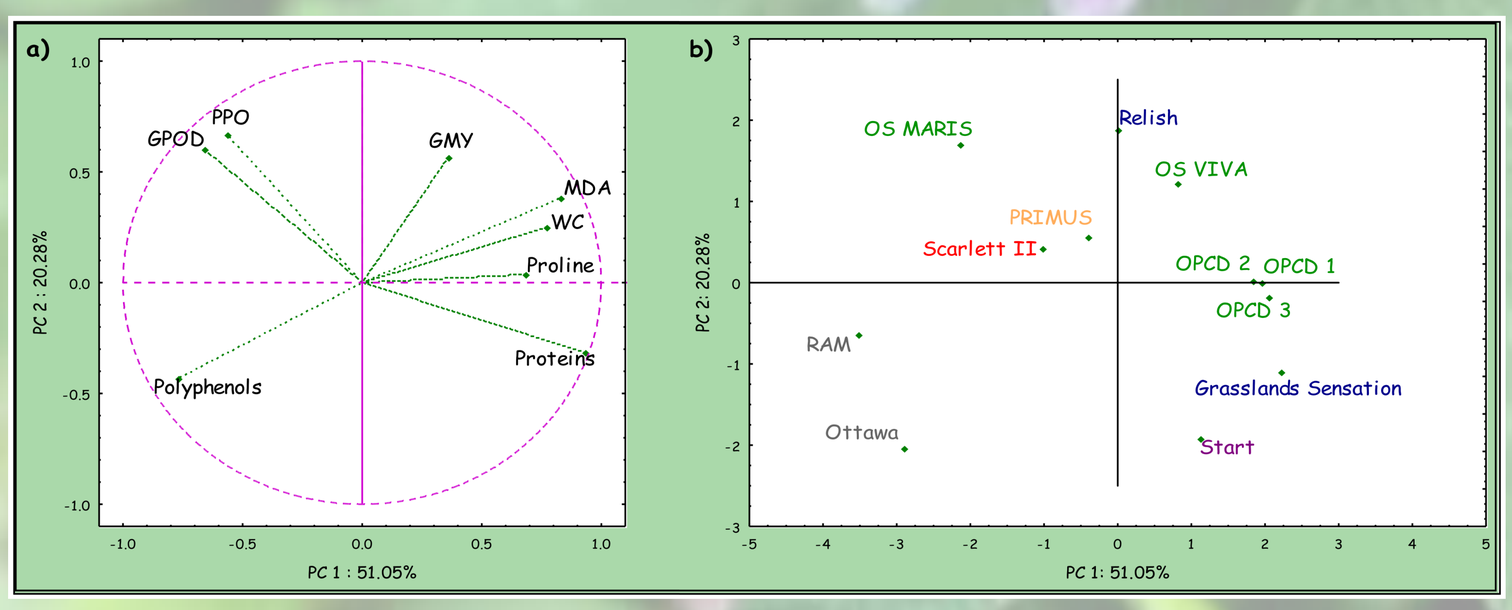

Figure 2. Principal component analysis (PCA) of analyzed traits in 12 red clover cultivars/breeding populations after heat wave exposure.

CONCLUSIONS

Canadian cultivars Ottawa and RAM converged with the lowest water content (WC) and the highest polyphenols which indicates that polyphenols played a leading role in the stress response of those cultivars. Heat wave response of cultivar OS MARIS was arranged by activation of enzymes guaiacol peroxidase (GPOD) and polyphenol oxidase (PPO). Heat wave activated both enzymatic and non-enzymatic response mechanisms and ultimately influenced GMY. Principal component analysis (PCA) grouped Croatian cultivar OS VIVA and OPCDs in the same quadrant with GMY indicating that heat the least influenced GMY in those cultivars and therefore sort out them as potential source of tolerance to stressful conditions.

References
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