

The evaluation of light conditions for strawberries grown vertically in open area and greenhouse

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Introduction

Growing strawberries in covered areas can extend the harvest season, reduce risks and increase income. The low intensity of natural light can be the limiting factor for production and yield of strawberries. **The aim of this research** was to evaluate the light conditions for strawberries grown vertically in open area and greenhouse, and their vegetative parameters and chemical composition in response to these conditions.

Materials and Methods

Frigo plants (class HWB) of three strawberry cultivars - 'Honeoye', 'Sonata' and 'Rumba' were planted in April 16, 2019 in double-layer plastic greenhouse and open field conditions. Plants were grown in growing bags (company Rekyva), 10 plants per bag, 6 bags per cultivar in greenhouse and open field. Bags were installed in vertical growing system in three layers – 10 cm, 90 cm, and 155 cm oriented South-North direction with lower levels to East side, and drip irrigation system was used. The light spectral content and intensity were detected by using spectroradiometer Gigahertz-Optic MSC15. Fully mature, but not senescent, leaves were collected for determination of phytochemicals. For absorbance measurements in used detection methods UV spectrometer UV-1800 Shimadzu Corporation was used.

Results

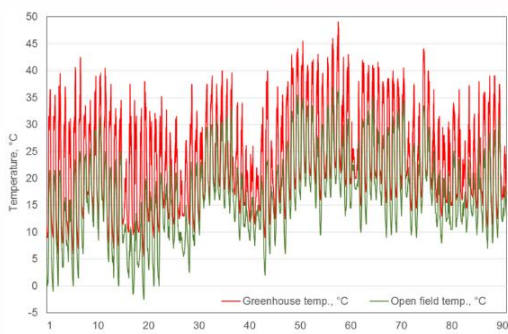


Fig. 1. Temperature conditions in greenhouse and open field.

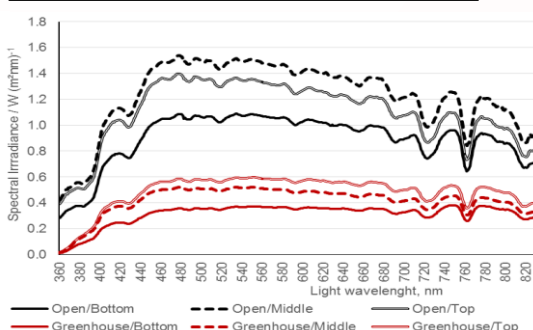


Fig. 2. Spectral irradiance ($W (m^2 \cdot nm)^{-1}$) of strawberry plots in middle of a sunny day on open field and greenhouse in three levels.

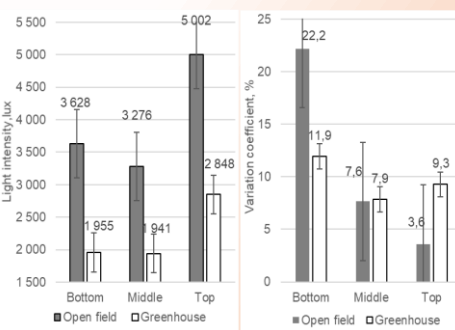


Fig. 3. Light intensity and variation coefficients in strawberry plots on three levels in greenhouse and open area.

Daily temperature fluctuations were notable in both areas, especially in sunny days and in the greenhouse (Fig.1). In total, 56.6% of light intensity was lost in greenhouse (2248 lux in average), compared to open area (3969 lux in average) (Fig. 3), while spectral patterns did not change (Fig.2). In both areas, top layer had significantly higher light intensity, but bottom and middle layers did not differ significantly from each other. In total, bottom layer had 71% of the light intensity at top layer, moreover, light intensity in bottom level also varied more due to shadows (Fig. 3). The influence of cultivar, growing place, and growing positions on biochemical properties was significant and cultivars responded differently to them (Table 1). There were no significant differences between cultivars and growing conditions by count of leaves and by count of inflorescences (Fig. 4).

	'Sonata'				'Honeoye'				'Rumba'			
	Bottom	Middle	Top	LSD _{0,05}	Bottom	Middle	Top	LSD _{0,05}	Bottom	Middle	Top	LSD _{0,05}
Chlorophyll a content, mg g⁻¹												
Open field	0.48	0.51	0.68	0.06	0.61	0.54	0.54	0.02	0.60	0.58	0.31	0.09
Greenhouse	0.64	0.76	1.26	0.19	0.59	0.55	0.62	0.02	1.22	0.67	0.44	0.23
Chlorophyll b content, mg g⁻¹												
Open field	0.35	0.37	0.52	0.05	0.31	0.34	0.32	0.01	0.41	0.30	0.19	0.06
Greenhouse	0.48	0.54	0.75	0.08	0.32	0.34	0.39	0.02	0.99	0.78	0.23	0.23
Carotenoides content, mg g⁻¹												
Open field	0.13	0.11	0.12	0.01	0.14	0.12	0.11	0.01	0.14	0.13	0.07	0.02
Greenhouse	0.14	0.24	0.26	0.04	0.1	0.11	0.15	0.01	0.20	0.18	0.11	0.03
Phenols content, mg g⁻¹												
Open field	1.76	2.5	1.84	0.23	1.39	1.53	1.71	0.09	1.89	1.46	2.4	0.27
Greenhouse	1.81	2.01	1.55	0.13	1.28	1.38	2.30	0.32	2.81	1.86	2.1	0.29
Flavonoids content, mg 100 g⁻¹												
Open field	1.56	1.85	1.76	0.08	1.70	1.58	1.65	0.03	1.87	1.51	1.67	0.10
Greenhouse	1.32	1.31	1.22	0.03	1.28	1.34	1.33	0.02	0.82	1.03	1.07	0.08

Table 1. The effect of light conditions on the biochemical properties of strawberry plants.

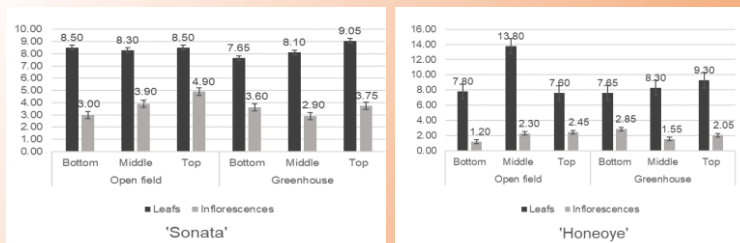


Fig. 4. Count of leaves and inflorescences in strawberry plots on three levels in greenhouse and open area, for cultivars 'Sonata' and 'Rumba'.

Conclusions. Over 50% of light intensity was lost in greenhouse, compared to open area, and bottom levels had just 71% of light intensity in top levels. Some significant differences in leaf biochemical composition were found in tested growing conditions, cultivars responded differently to them.

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