THE EFFECT OF SUPPLEMENTAL LIGHTING WITH LEDs ON PHYSIOLOGICAL PERFORMANCE ,GROWTH AND FRUIT YIELD OF STRAWBERRY PLANTS

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Introduction

- Energy is one of the major expenses for greenhouse producers.
- Most energy used in greenhouse production today is derived from fossil fuels (negative impacts on the environment).
- New lighting technology that reduces consumption of electricity should be of interest to growers.

LED lighting systems have advantages over existing horticultural lighting:

- Ability to control spectral composition.
- Ability to produce high light levels with low heat output.
- Long operational lamp life.
- Flexible design options for horizontal or vertical lighting (intra-canopy lighting).

Many studies have shown that supplemental lighting during low light periods can increase growth and yield of greenhouse vegetable plants.

Objective

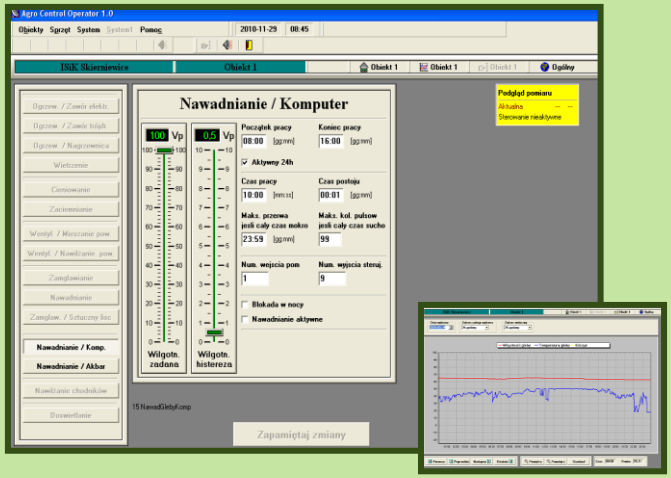
Evaluation the effect of supplemental lighting with LED light source on growth, physiological response and yielding of strawberry plants.

Materials and Methods

Two cultivars: ‘Elsanta’, ‘Grandarosa’

Cultivation period: late winter/early spring (planting date in 2013: 30 January).

Growing conditions: plants were grown in containers filled with peat/coco peat mixture. Plants were irrigated with drip system according to substrate moisture status.



Materials and Methods

TREATMENT:

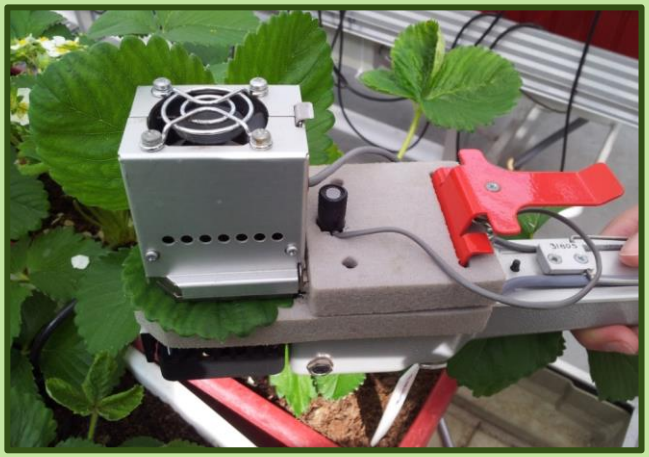
- Without supplemental lighting (control).
- Supplemental lighting with standard HPS lamps (400 W).
- Supplemental lighting with LED lamps (110 W). The spectral composition of the light emitted by the LED lamp was: 68,5% red (~665/640 nm), 28,4% blue (~445 nm) and 3,1% far red (~730 nm).

Two LED lamps were used to obtain similar level of PAR as from one HPS lamp. Lighting was turned on (6 am – 6 pm) when the incoming solar radiation was lower than 100 W m^{-2}.

Materials and Methods

PHYSIOLOGICAL EVALUATION:

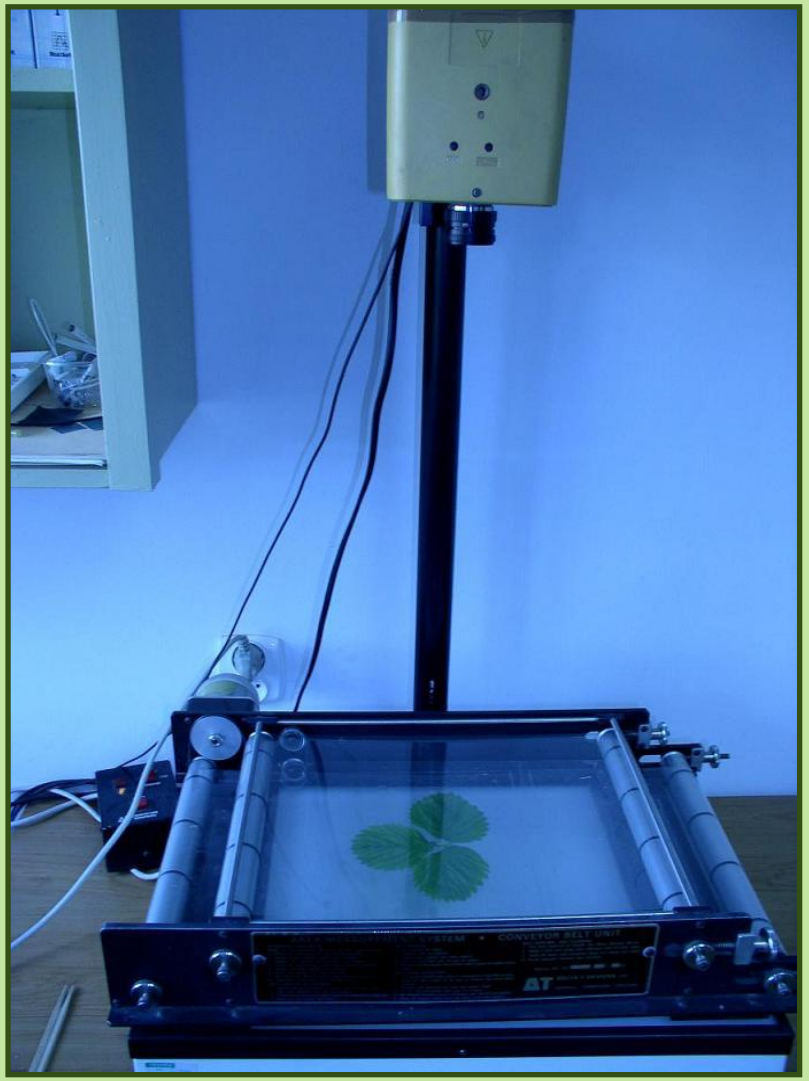
- Photosynthetic rate (gas exchange method).
- Photosynthetic activity (chlorophyll fluorescsence method).
- Relative chlorophyll content (leaf greenness).



Materials and Methods

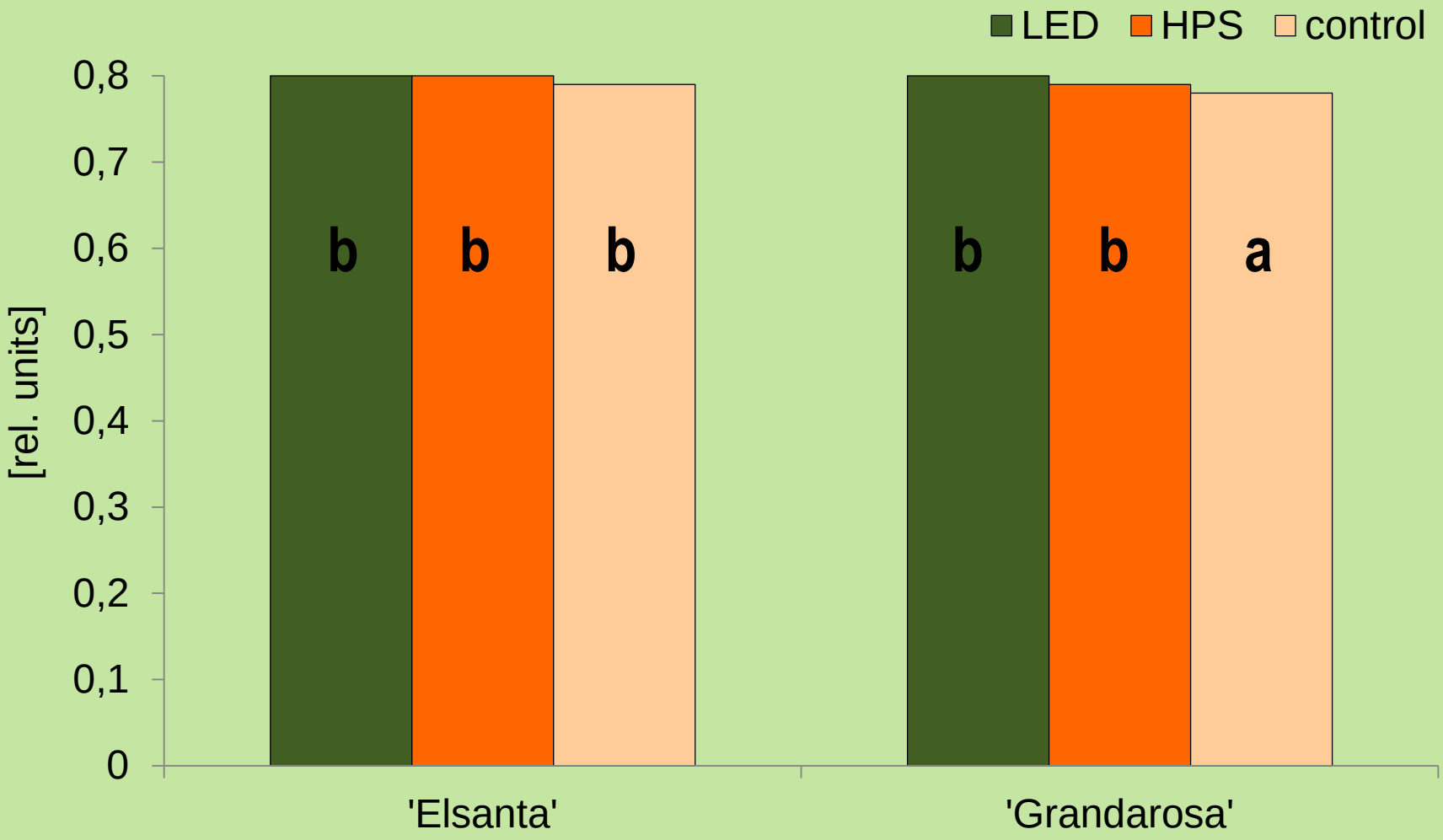
PLANT GROWTH ASSESSMENT:

- Fresh weight of leaves.
- Fresh weight of roots.
- Laf surface area.
- Crown diameter.



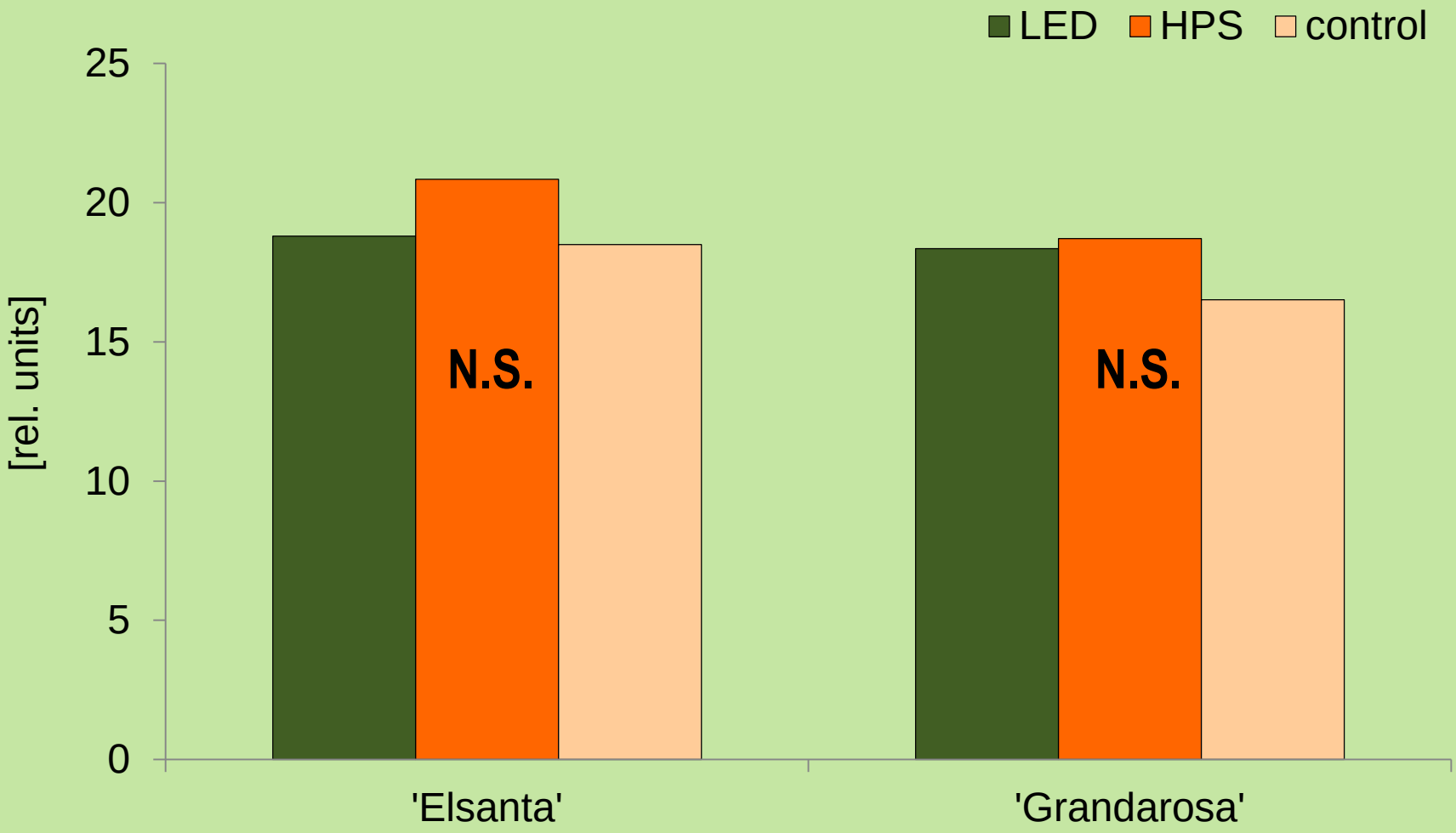
Results

Maximum photochemical efficiency (Fv/Fm)



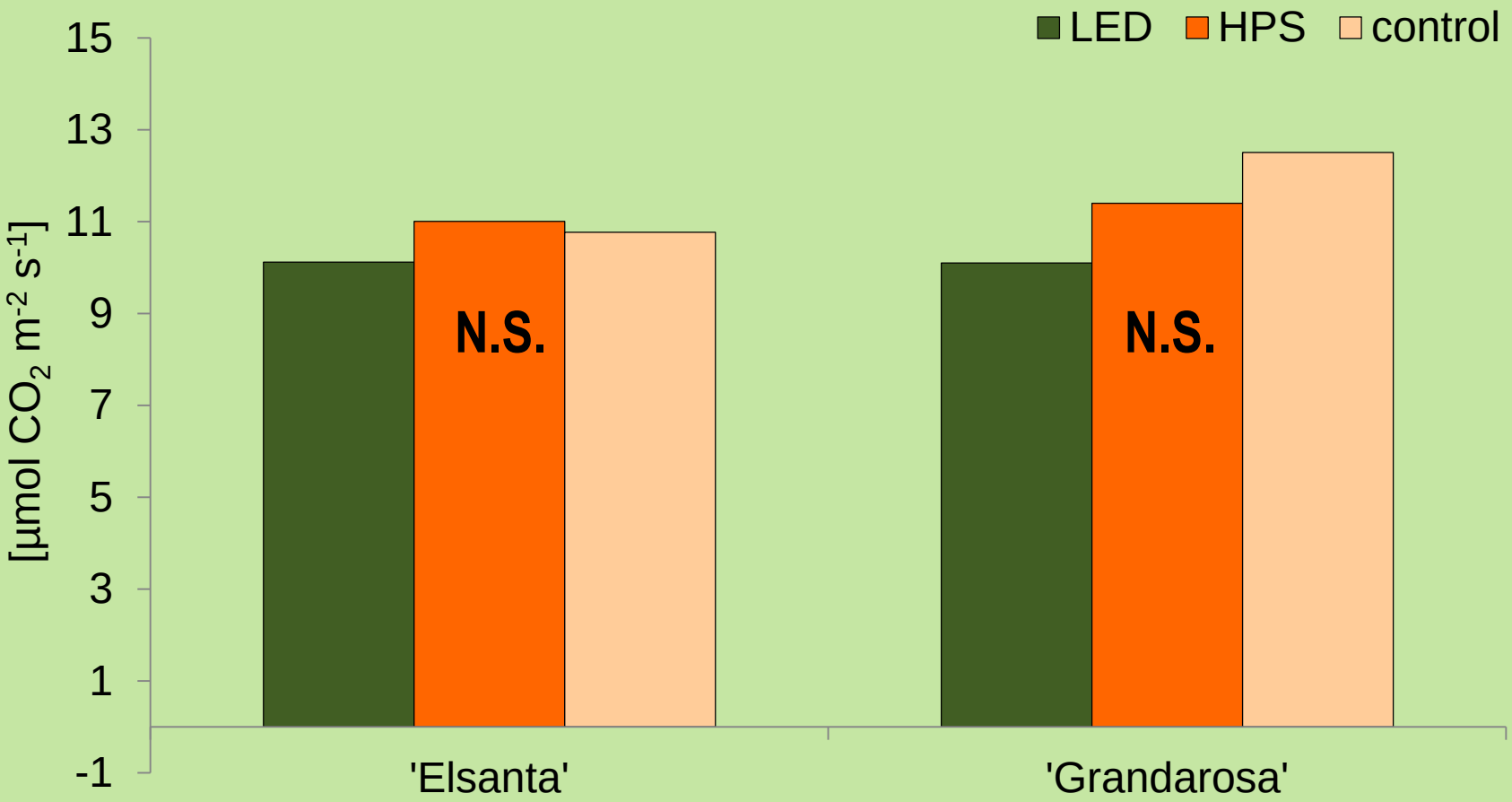
Results

Relative chlorophyll content



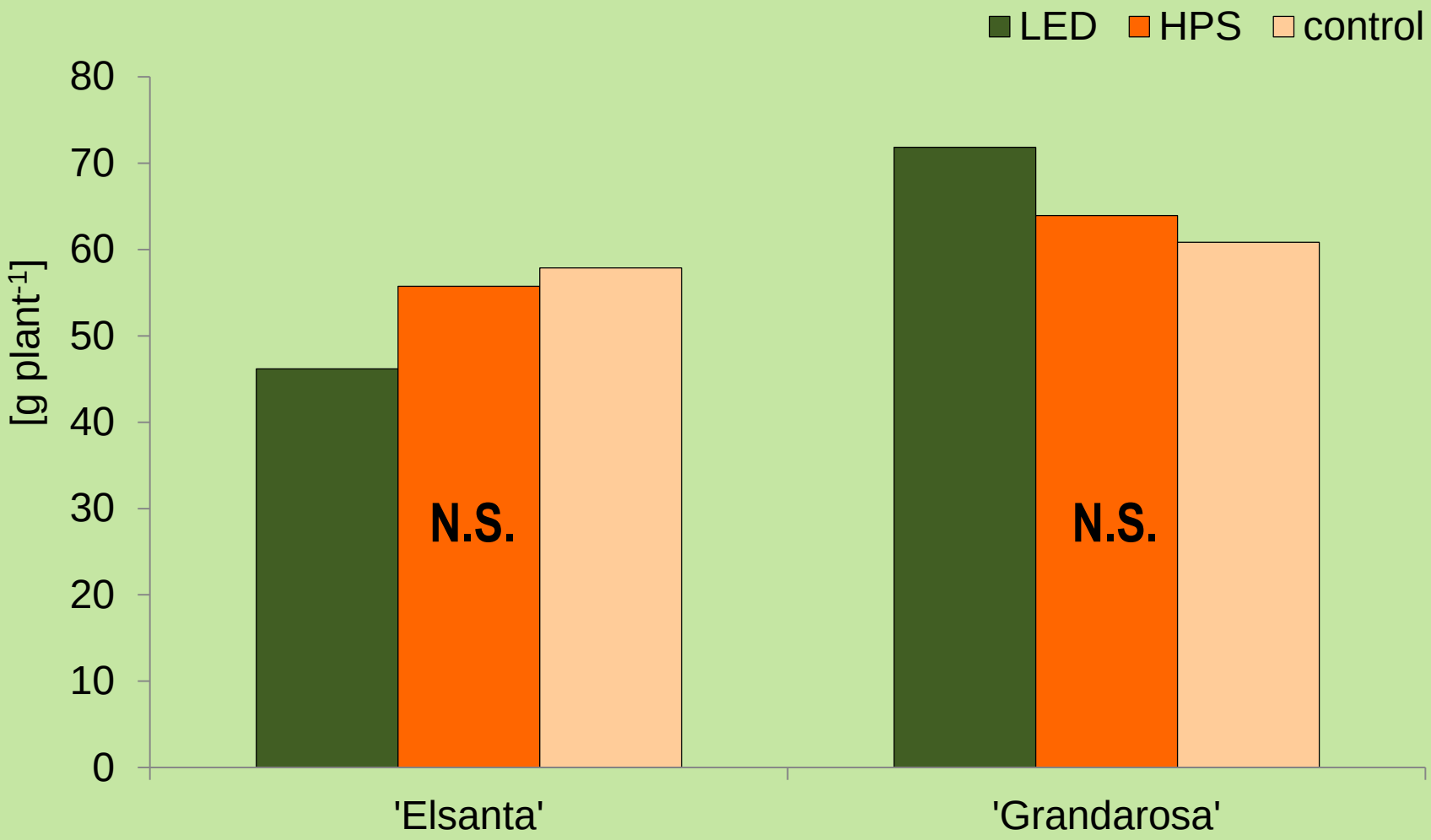
Results

Photosynthetic rate



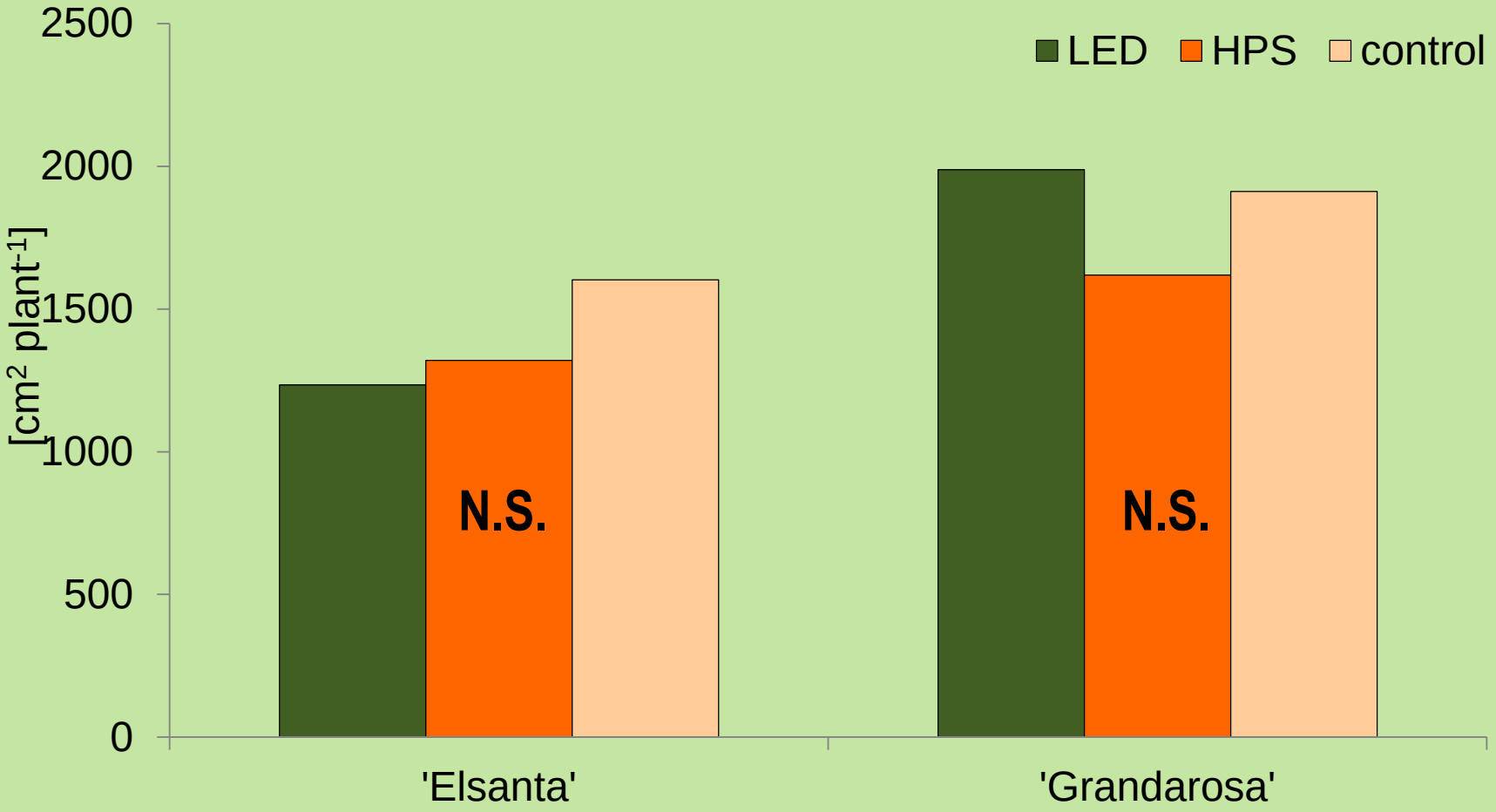
Results

Fresh weight of leaves



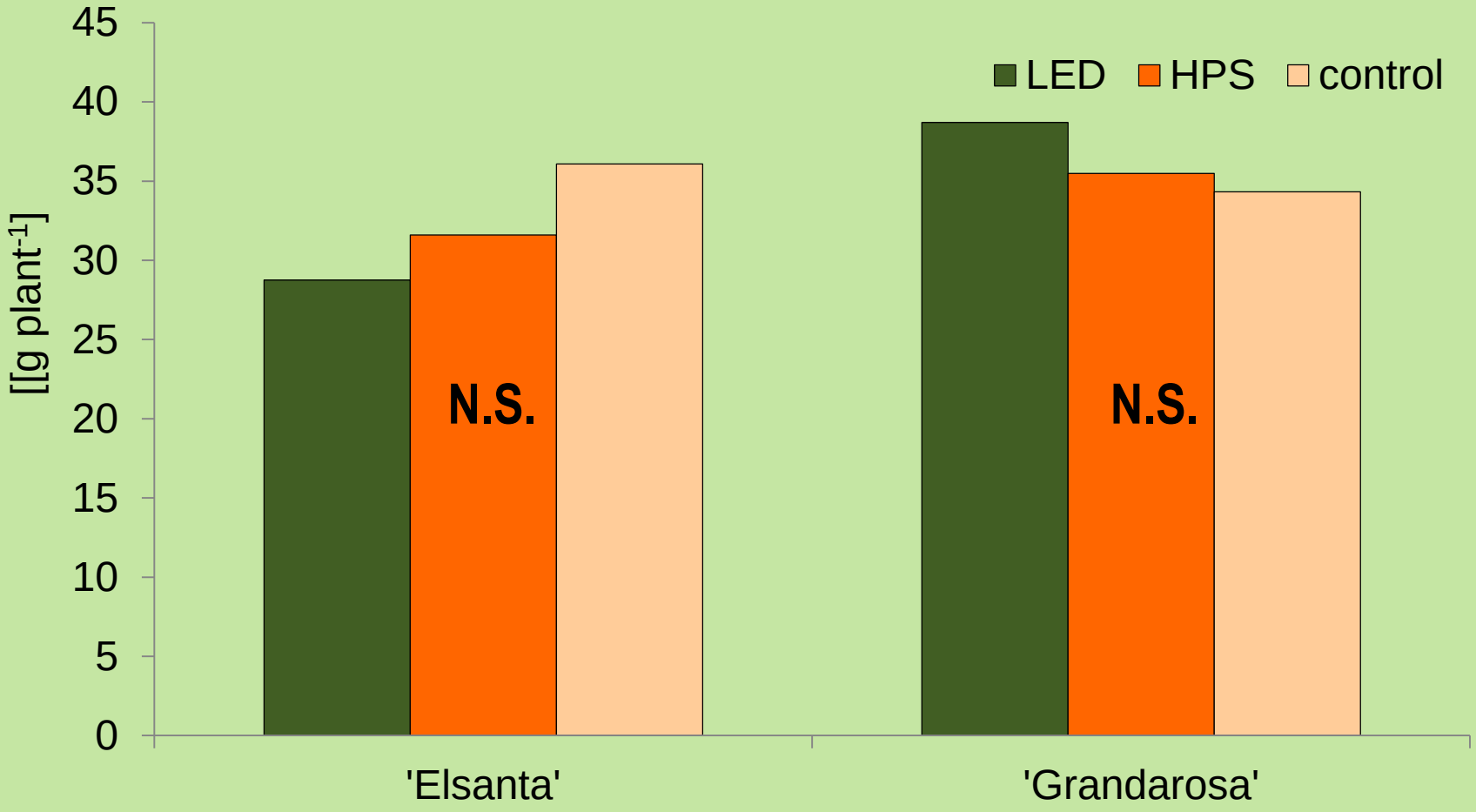
Results

Total leaf surface area



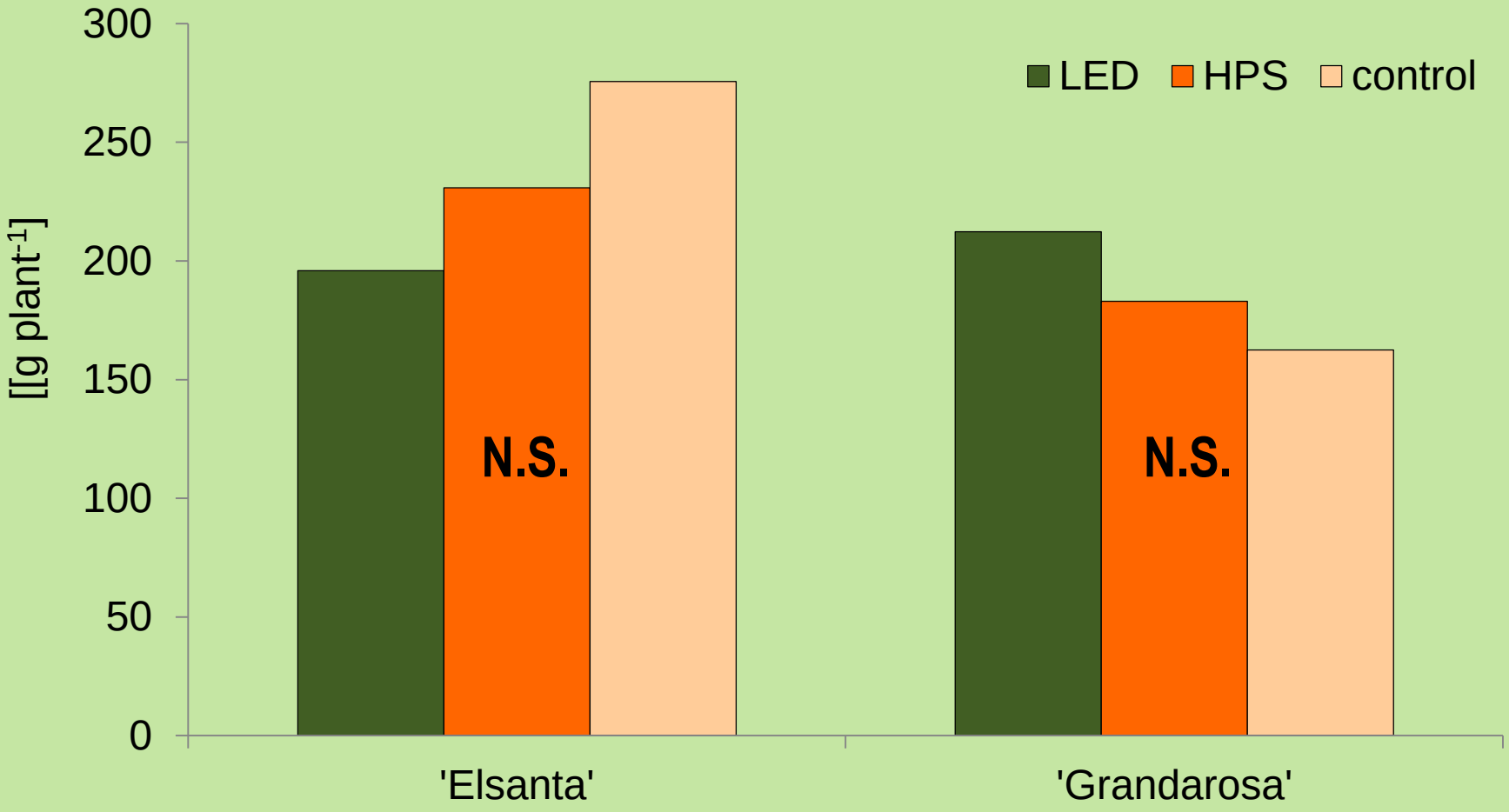
Results

Weigh of roots



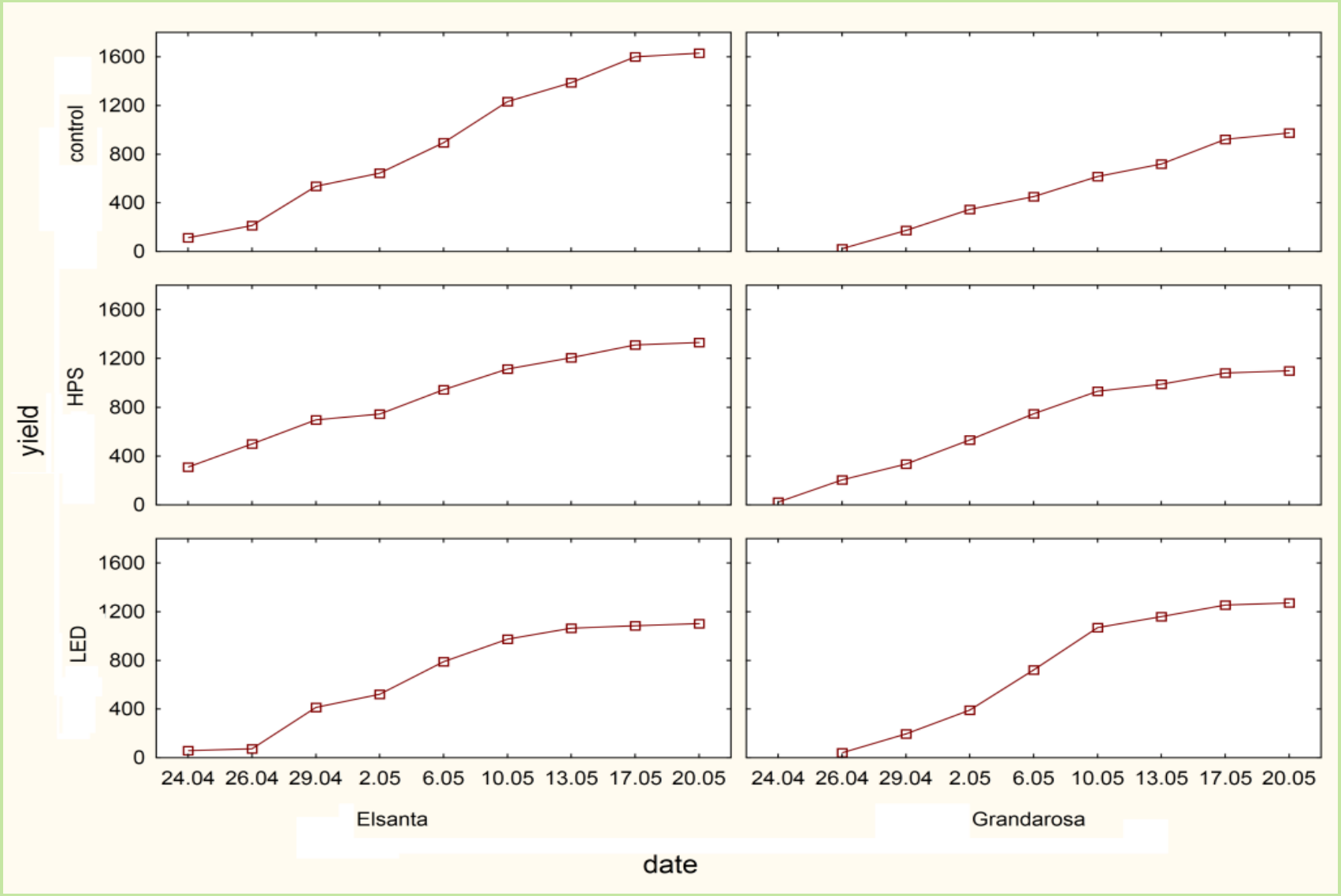
Results

Fruit yield



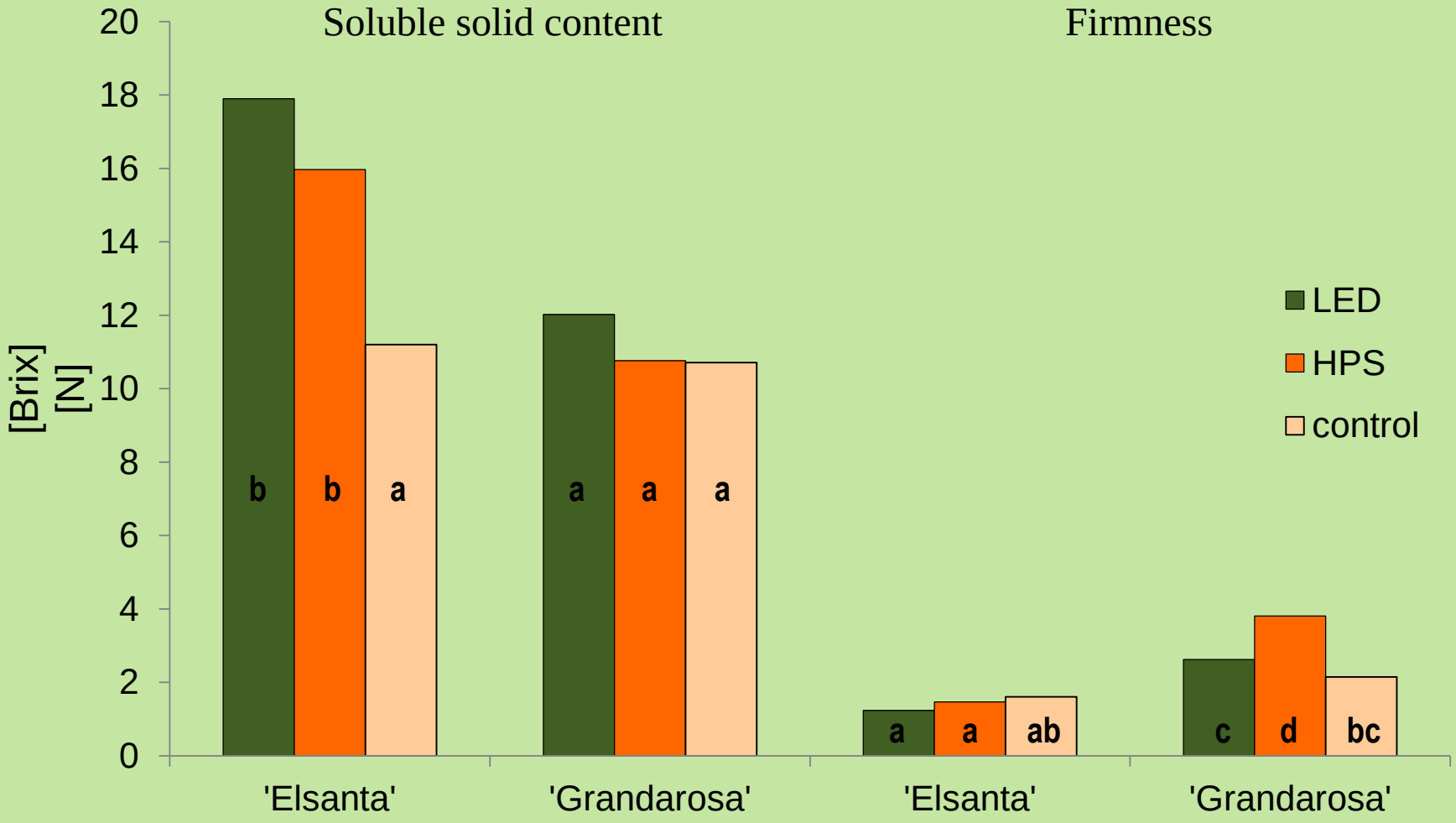
Results

Fruit harvest period (cumulative values)

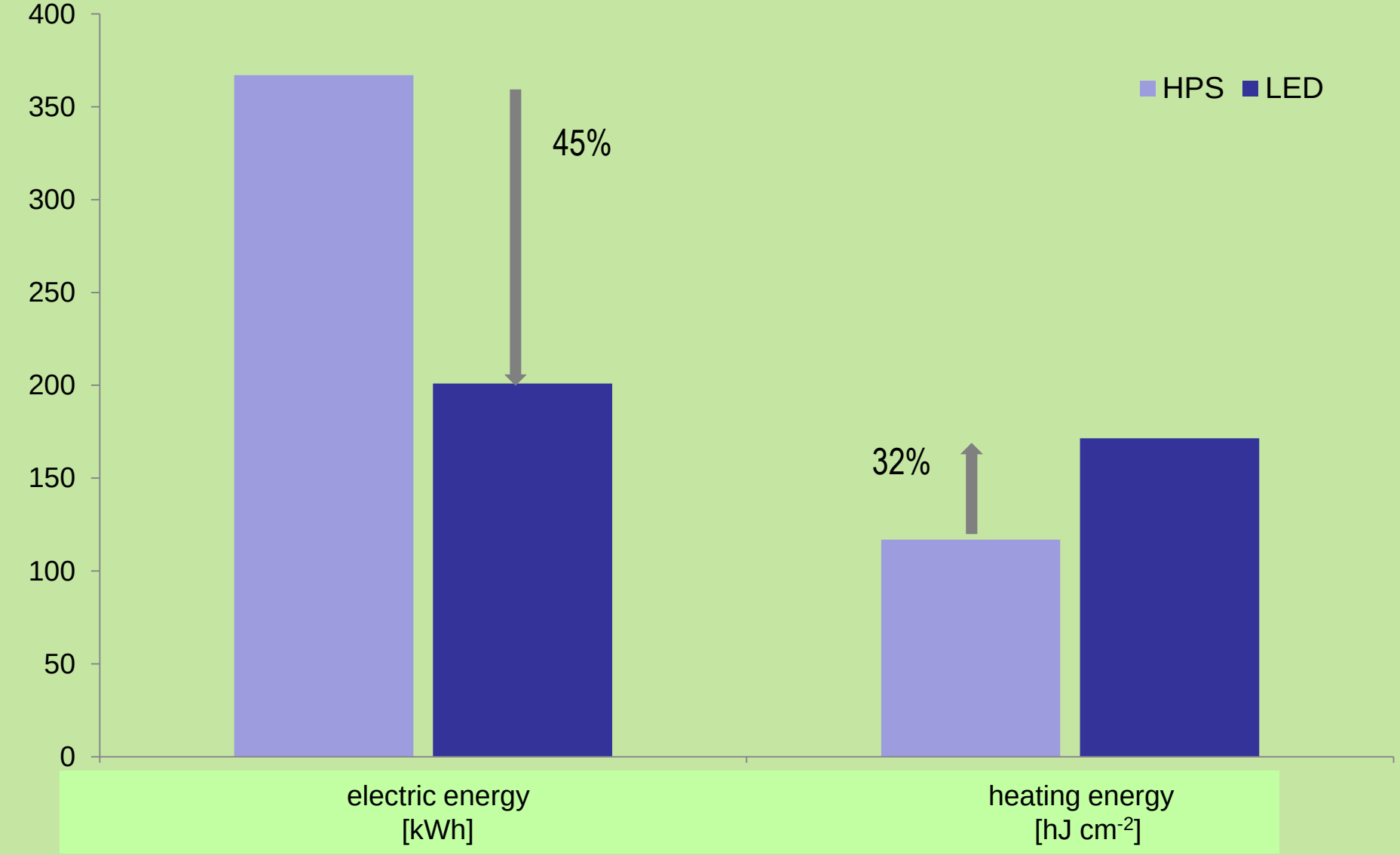


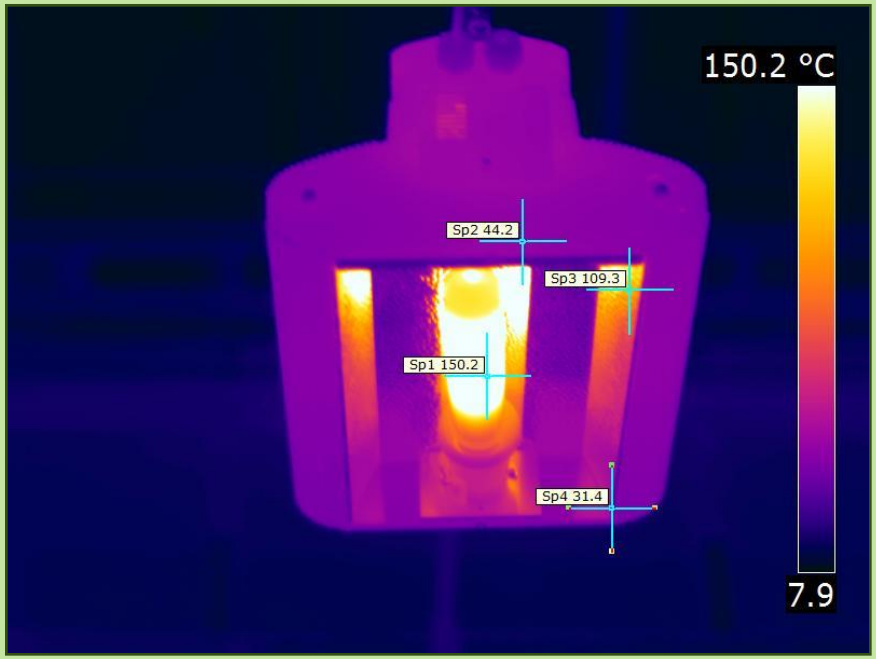
Results

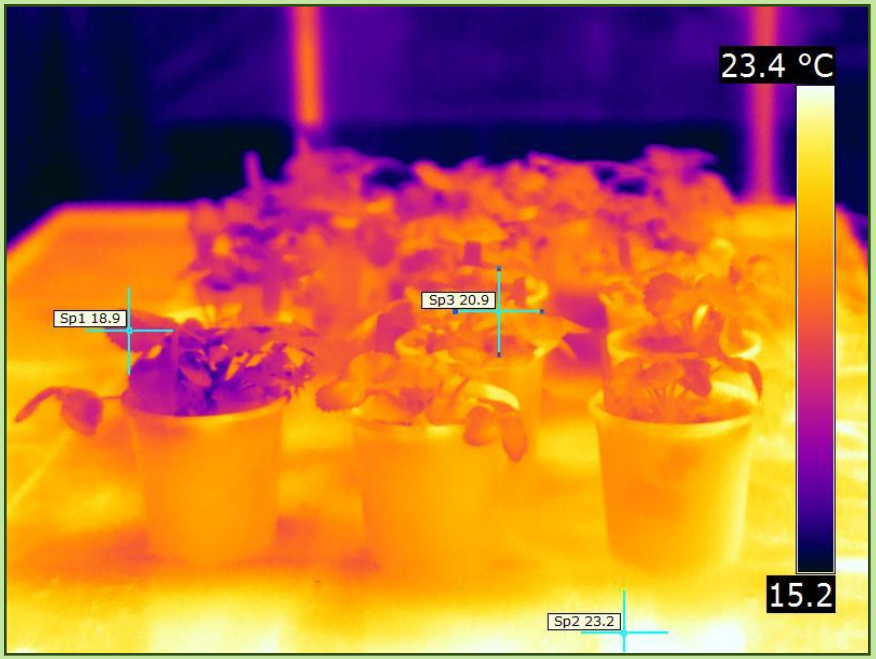
Fruit quality



Results


400
350
300
250
200
150
100
50
0
HPS
LED
45%
32%
electric energy
[kWh]
heating energy
[hJ cm-2]


150.2 °C
Sp2 44.2
Sp3 109.3
Sp1 150.2
Sp4 31.4
7.9


23.4 °C
Sp3 20.9
Sp1 18.9
Sp2 23.2
15.2


28.8 °C
Sp3 33.4
Sp1 17.0
Sp2 29.5
Sp4 22.6
Sp5 25.4
10.6


23.7 °C
Sp2 16.7
Sp3 16.1
Sp1 18.5
15.6

Conclusions

Replacement of the HPS with the LED lamps resulted in energy savings approaching 45 percent.

No significant influence of supplemental lighting on efficiency of photosynthetic apparatus was recorded.

Cultivars varied in plant vigor, but no differences in plant growth between lighting regimes were observed.

Cultivar ‘Elsanta’ gave higher yield (on average) than ‘Grandarosa’. However no significant effect of additional lighting with LED on plant productivity was found.


Thank you

The sustainable improvement of European berry production, quality and nutrition value in a changing environment: Strawberries, Currants, Blackberries and Raspberries.

Acronym: EUBerry

http://www.euberry.univpm.it/

2011 – 2014