

# Effects of light intensity on soluble sugars and organic acids in tobacco leaf (*Nicotiana tabacum* L.)

**Bin Cai**

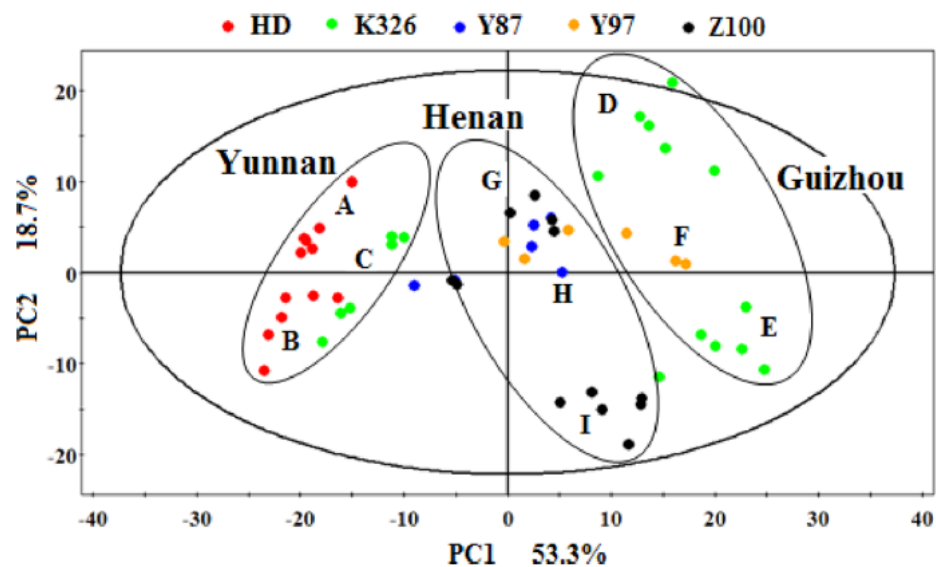
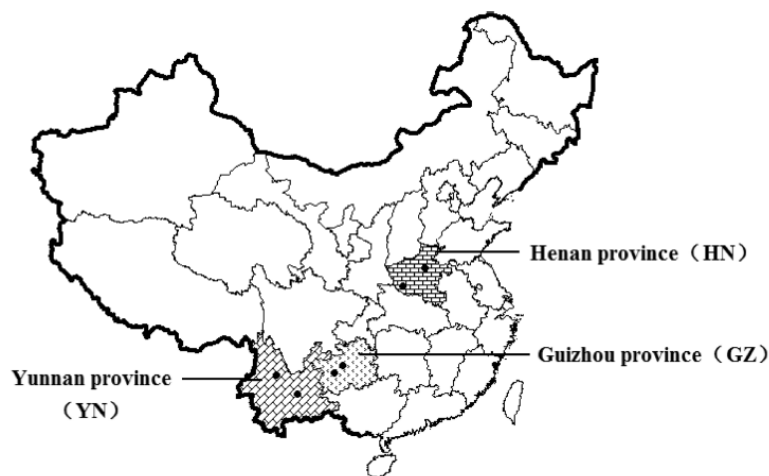


**Nashville, TN**

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# Background

- Ecological conditions play a larger role in the formation of the regional characteristics of tobacco than varieties.



Zhang, L. *et al.* *J. Agric. Food Chem.* **2013**, *61* (11), 2597–2605.

# Background

- Sunlight, as an important ecological factor, has been shown to be significantly associated with tobacco regional characteristics and chemical constituent accumulation.
- This study is designed to dissect the effects of sunlight on tobacco chemicals.

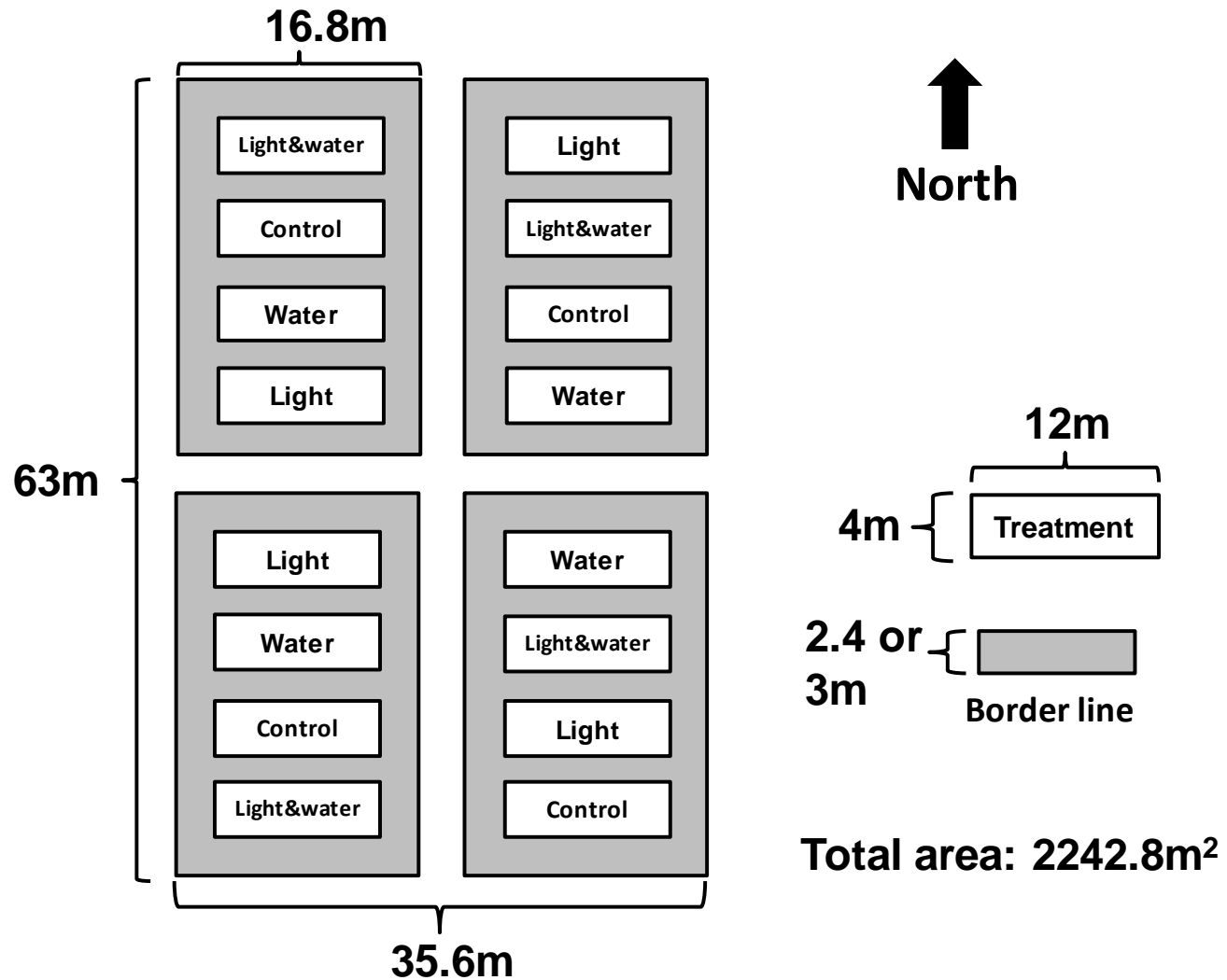
# Experimental designs

- **Plant materials:** K326
- **Field plot:** randomized block design, four treatments and four replications
- **Treatments:** Control, light reduction, soil water reduction and combination of light and soil water reduction. Treatment time: topping to harvest.
- **Sampling:** 12<sup>th</sup> leaf from bottom, transportation using liquid nitrogen, freeze-dry before grinding; sampling at harvest and after curing.

# Experimental designs

- **Field microcondition:** Recorded by Onset Hobo every 30min
- **Chemical analysis of leaf:**
  - GC/MS metabolimics
  - Soluble sugars
  - Organic acids

# Field plot



# Treatments



**Light reduction**



**Soil water reduction**



**Light&water reduction**



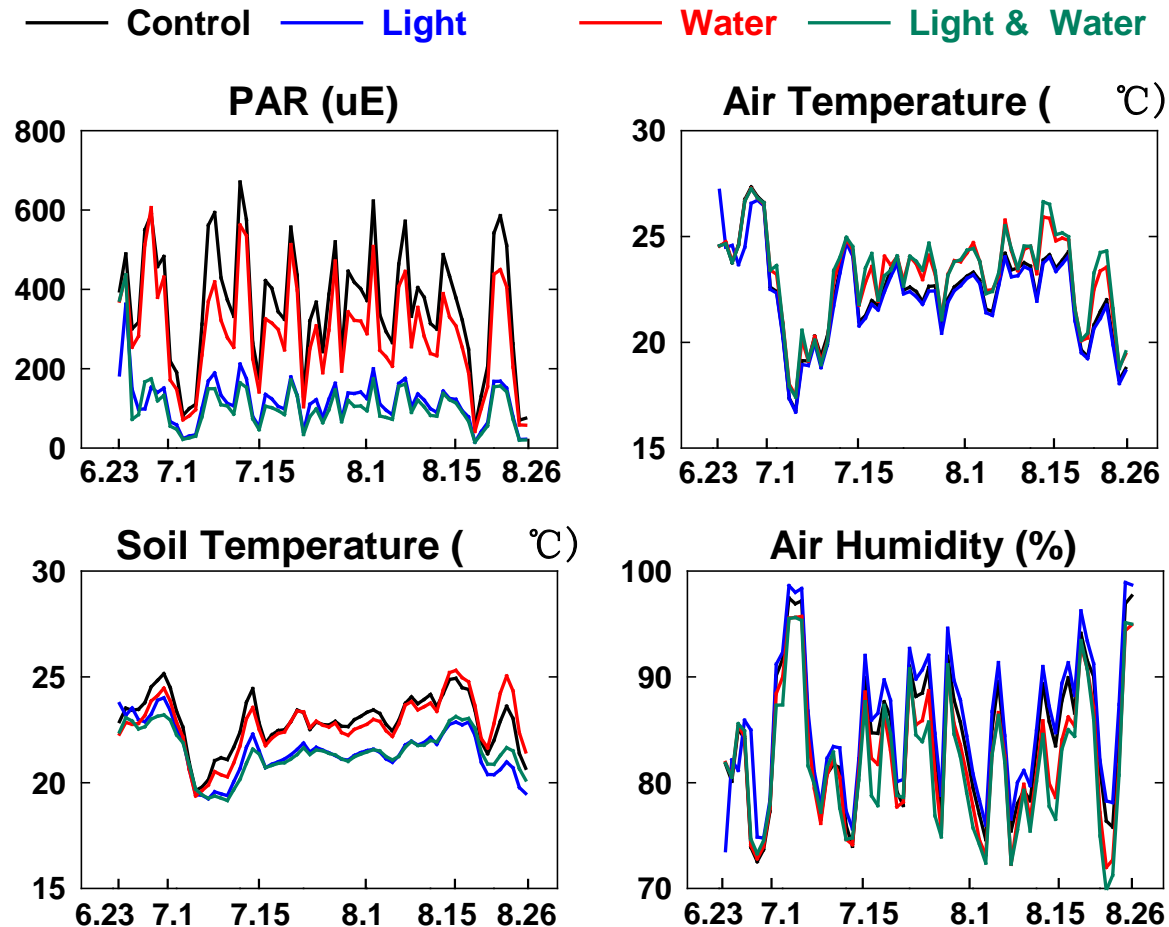
**Discontinue the exchange of soil water**

# 70d after transplant



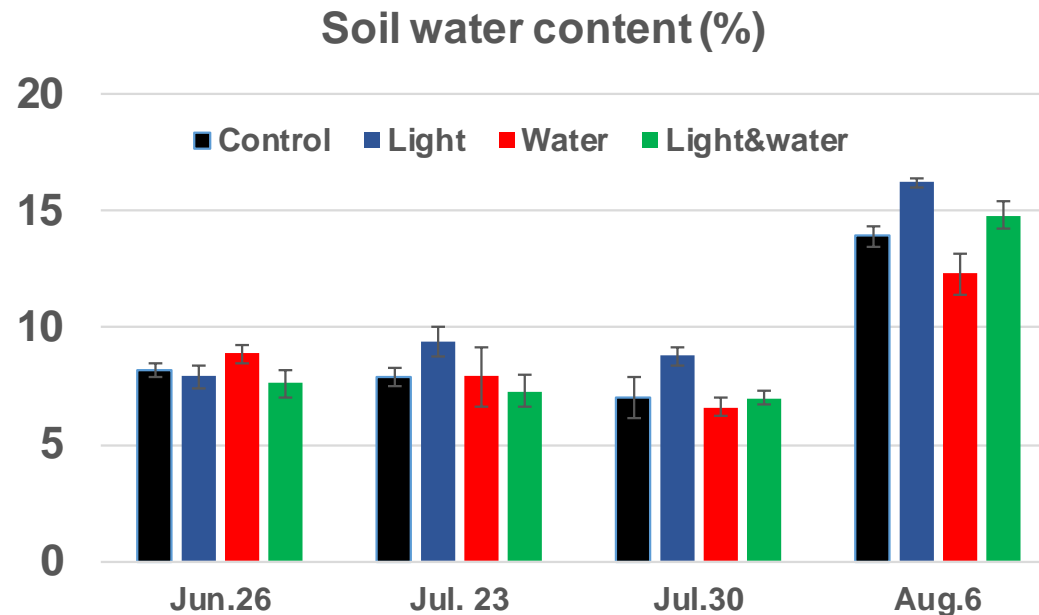


# Field micro-condition during treatments



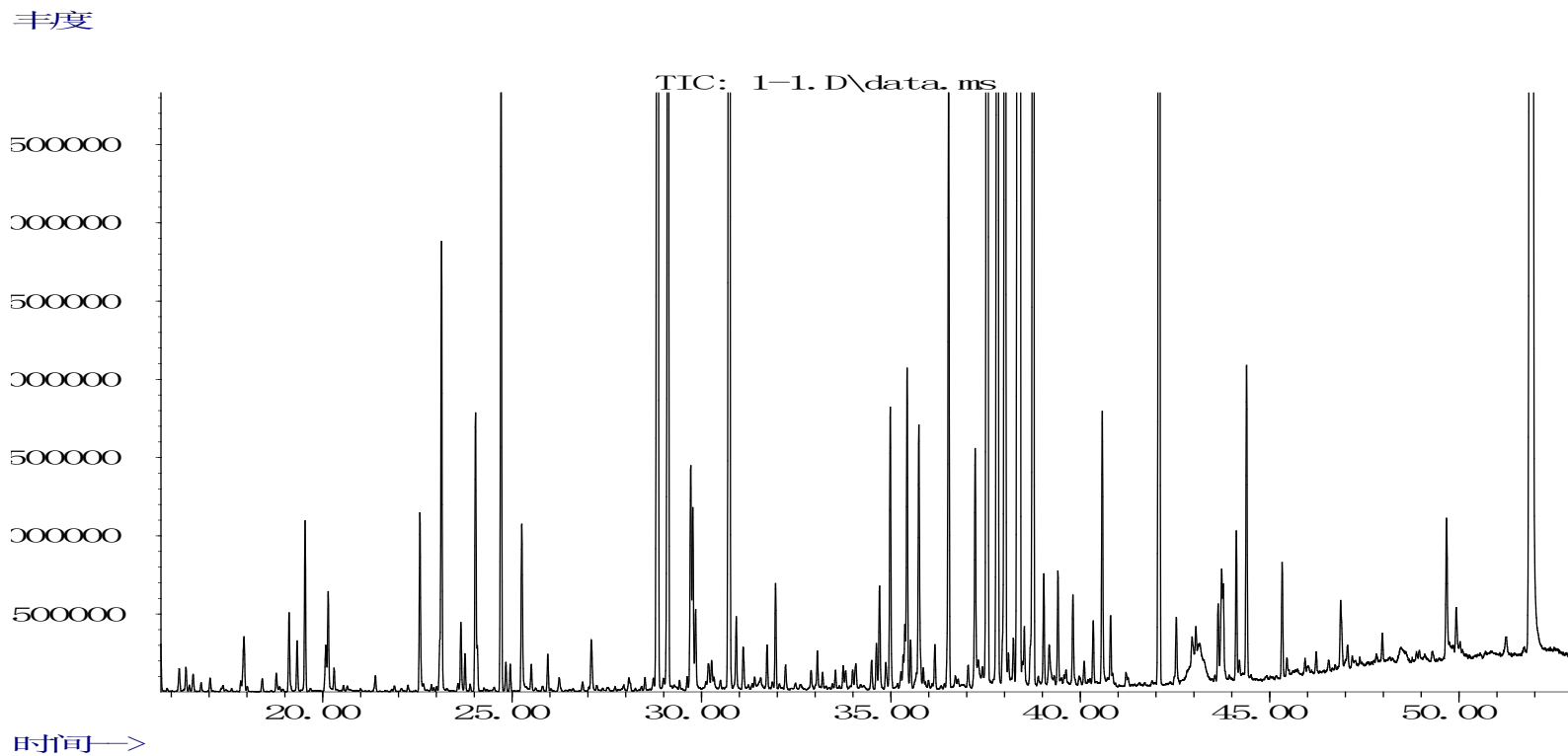
Light reduction treatment reduces PAR and Soil temp. Water reduction treatment increases air temperature. No difference was found for air humidity.

# Field micro-condition during treatments



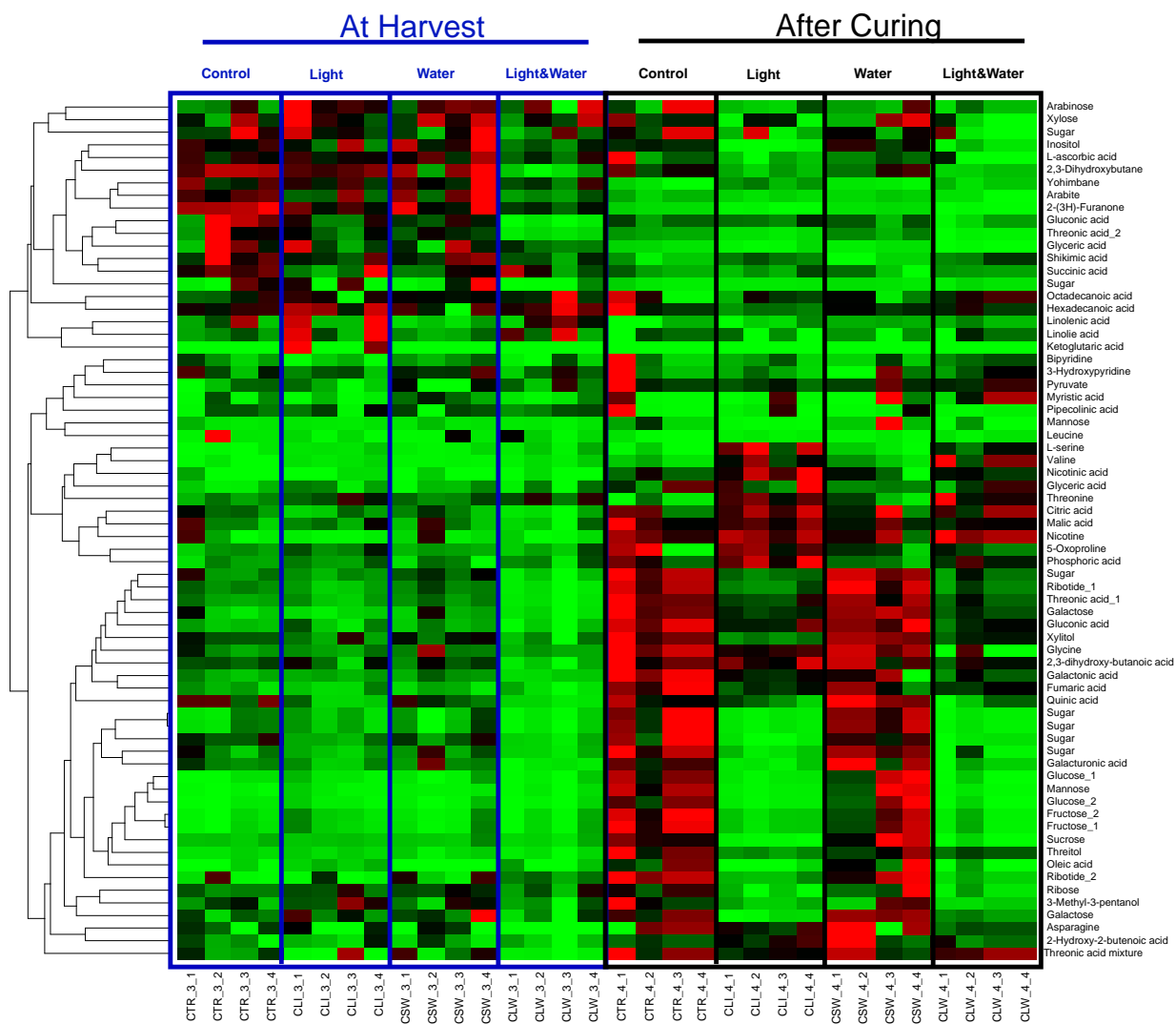
Due to the rainfall at early growth stage, soil water reduction treatment fail to work till at harvest. Light intensity reduction treatment increases soil water content.

# GC/MS Chromatogram

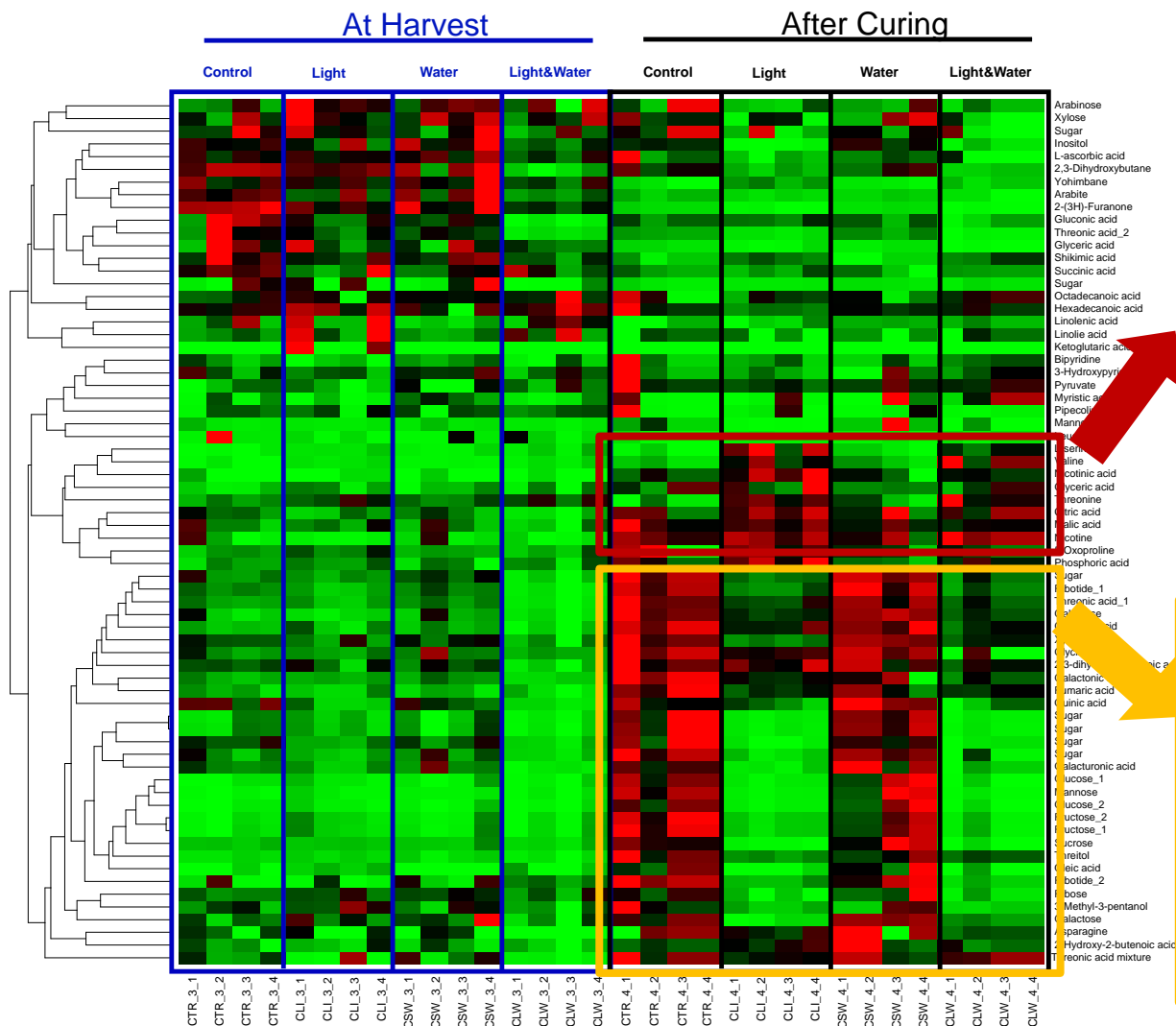


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# Primary metabolites changes



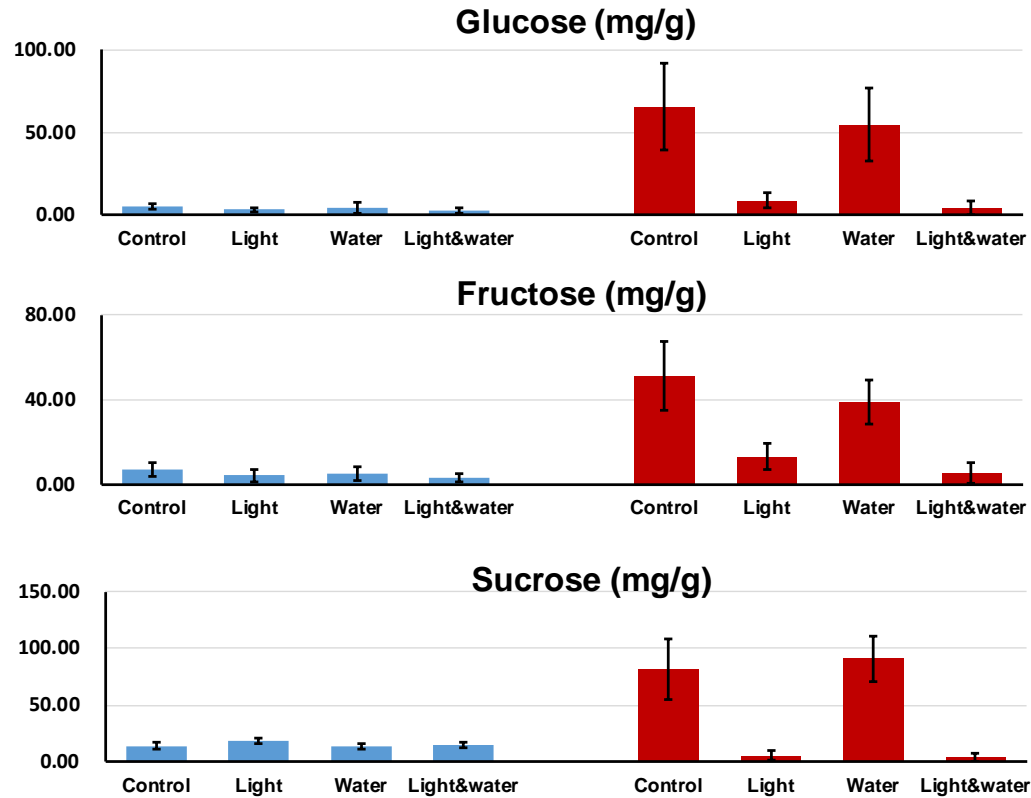
# Primary metabolites changes



Increase: citric acid, L-serine, valine, nicotinic acid, Glyceric acid, threonine, nicotine, phosphoric acid

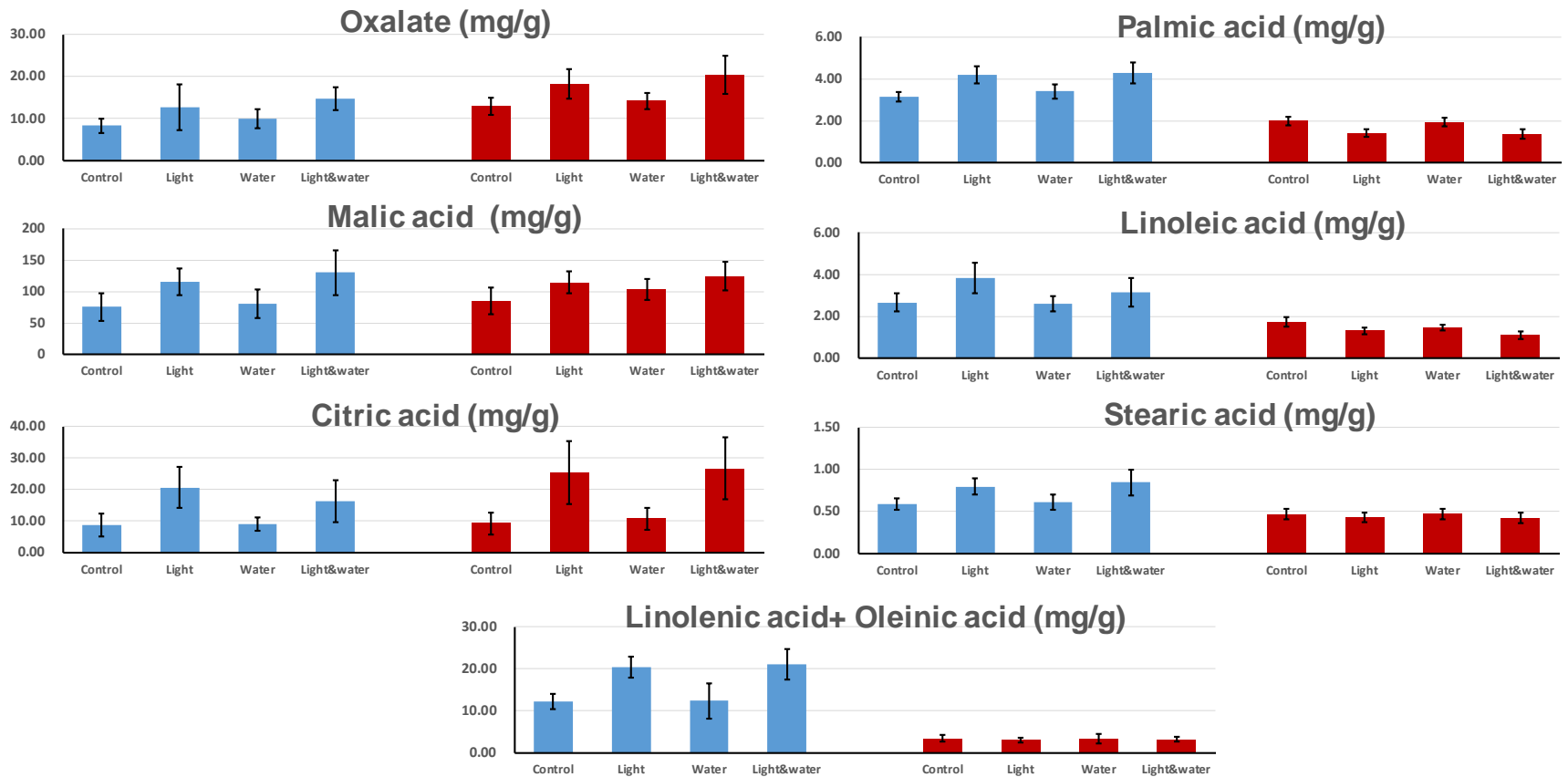
Reduce: glucose, fructose, sucrose, Arabinose, galactose, mannose, gluconic acid, xylitol, glycine, galactonic acid, fumaric acid, quinic acid, galacturonic acid, ribotide, threonic acid, threitol, oleic acid

# Soluble sugar changes



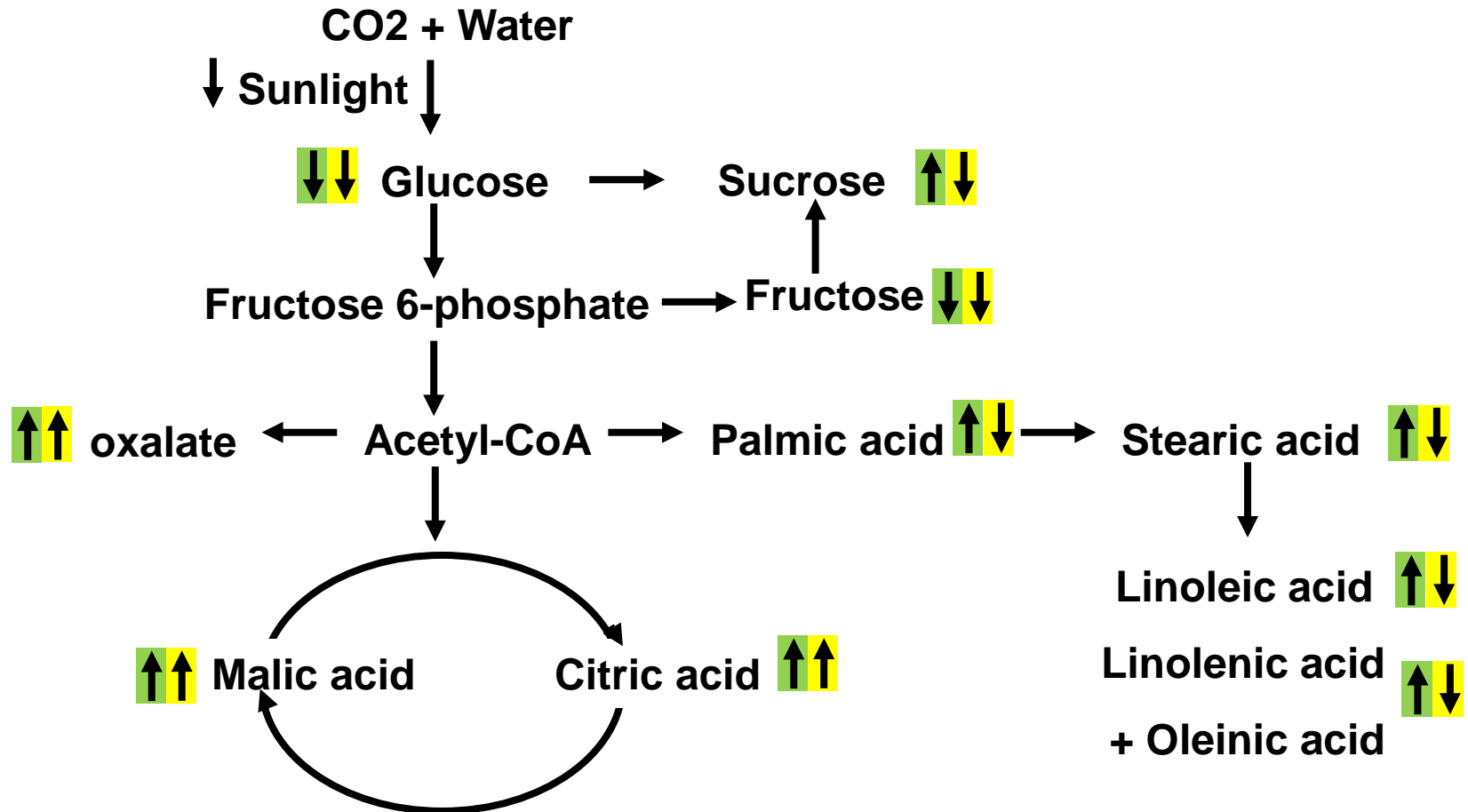
Note: Blue bar represents at harvest, red bar represents after curing. The results are consist of average of 12 replicates and standard deviation.

# Organic acid changes



Note: Blue bar represents at harvest, red bar represents after curing. The results are consist of average of 12 replicates and standard deviation.

# Summary of targeted metabolites results





# Conclusions

- Field study was used to verify the effect of sunlight on tobacco leaf chemical accumulations.
- Comparing with control, shade net reduces the PAR and soil temp, and increases soil water content; while water-proof film increases air temp and fail to reduce the soil water till at harvest.

# Conclusions

- Sunlight reduction decreases the concentration of soluble sugars (glucose, fructose and sucrose), and organic acids (palmitic acid, stearic acid, linoleic acid and mixture of linolenic acid and oleic acid) in cured-leaf; increases oxalate, malic acid and citric acid concentration.
- By combining GC/MS, LC/MS metabolomics and transcriptome results, we have better knowledge of sunlight effects on tobacco leaf chemistry.

A landscape photograph showing a long, straight concrete path that recedes into the distance, flanked by rows of green crops, likely corn. In the background, there are rolling green hills and a small town with several buildings, including a prominent multi-story apartment complex. The sky is a vibrant blue, filled with large, white, fluffy clouds. The overall scene is bright and open.

# Thanks!