Factors Contributing to and Limiting Vegetable Crop Productivity Across an Urban to Rural Transect in Greater Chicago, Illinois

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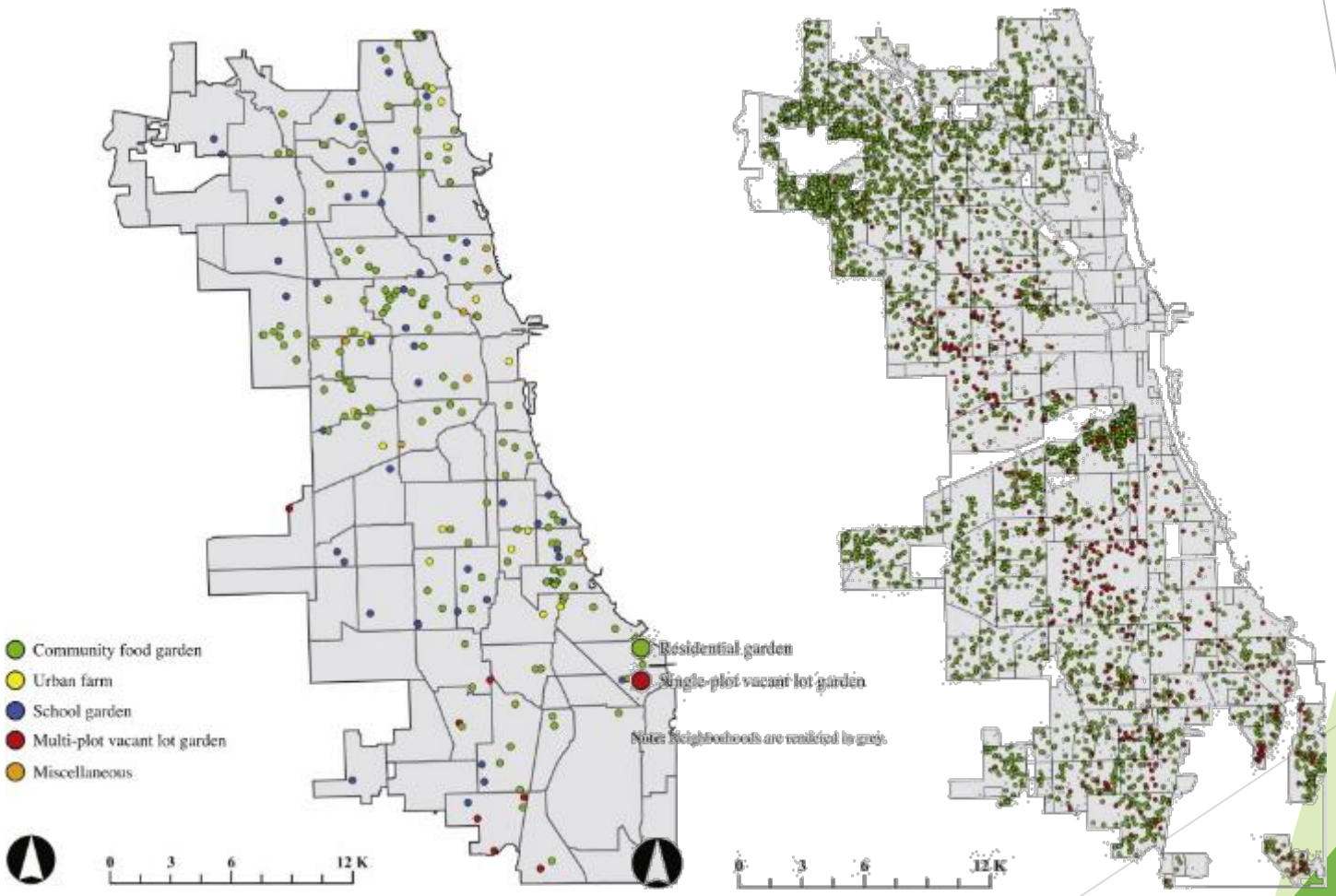
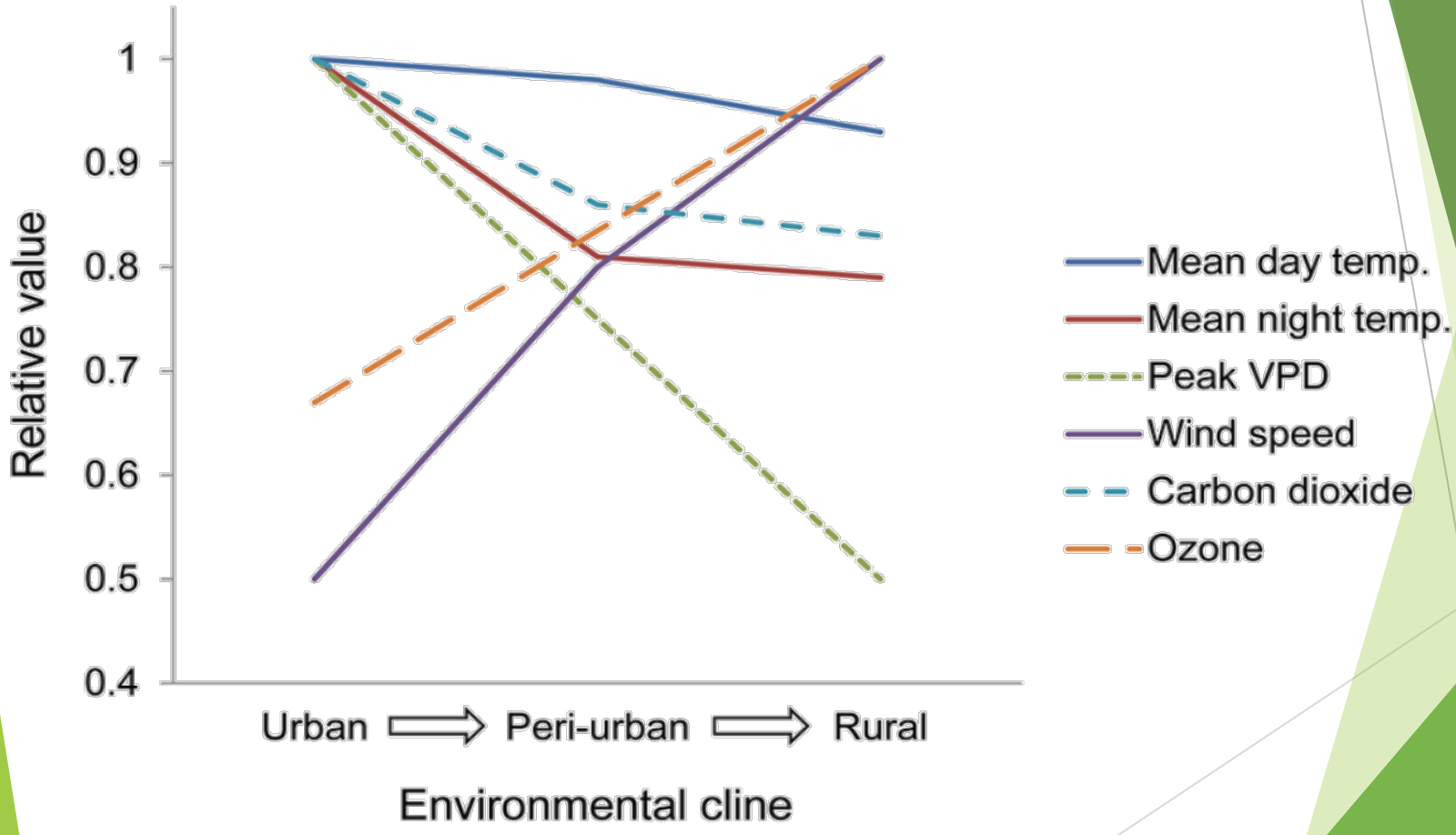
Introduction

Urban Agriculture: Growing Food in City



Mapping public and private spaces of urban agriculture in Chicago through the analysis of high-resolution aerial images in Google Earth, Taylor and Lovell 2012

Hypothesized environmental challenges of UA

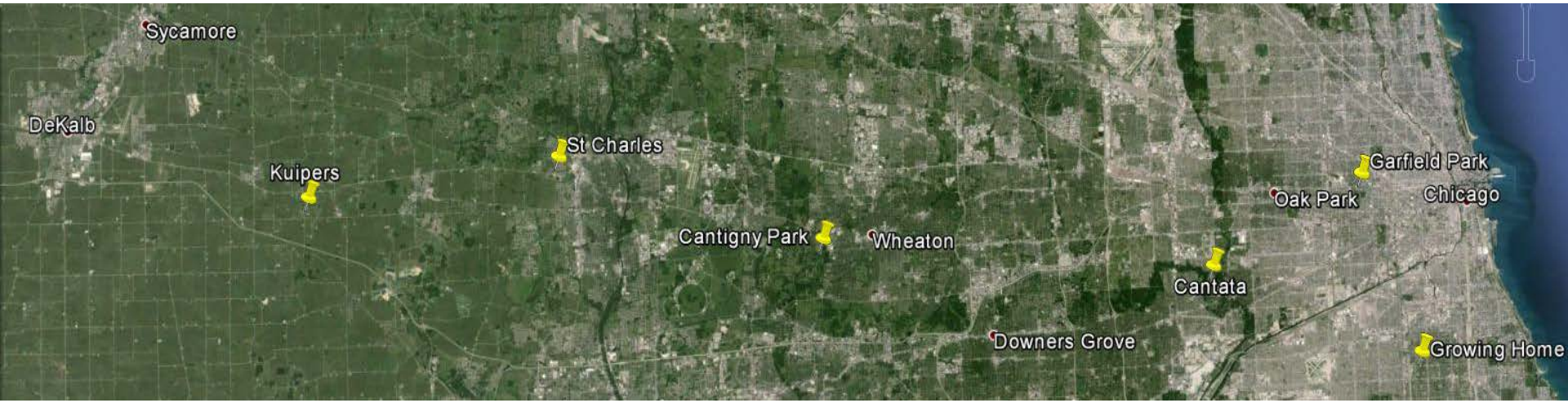


Environmental Challenges Threatening the Growth of Urban Agriculture in the United States. Wortman and Lovell 2013.

Objectives

- Quantify urban, peri-urban, and rural microclimate
  - Relevant to plant production
- Quantify vegetable crop response in raised bed production system
- Determine variety differences across the urban to rural transect
- Model effects of urban environmental measures on vegetable responses
- Make empirical recommendations for urban farmers and policy makers

Garden Site Selection



Experiment Materials and Methods

Approach: Garden Setup

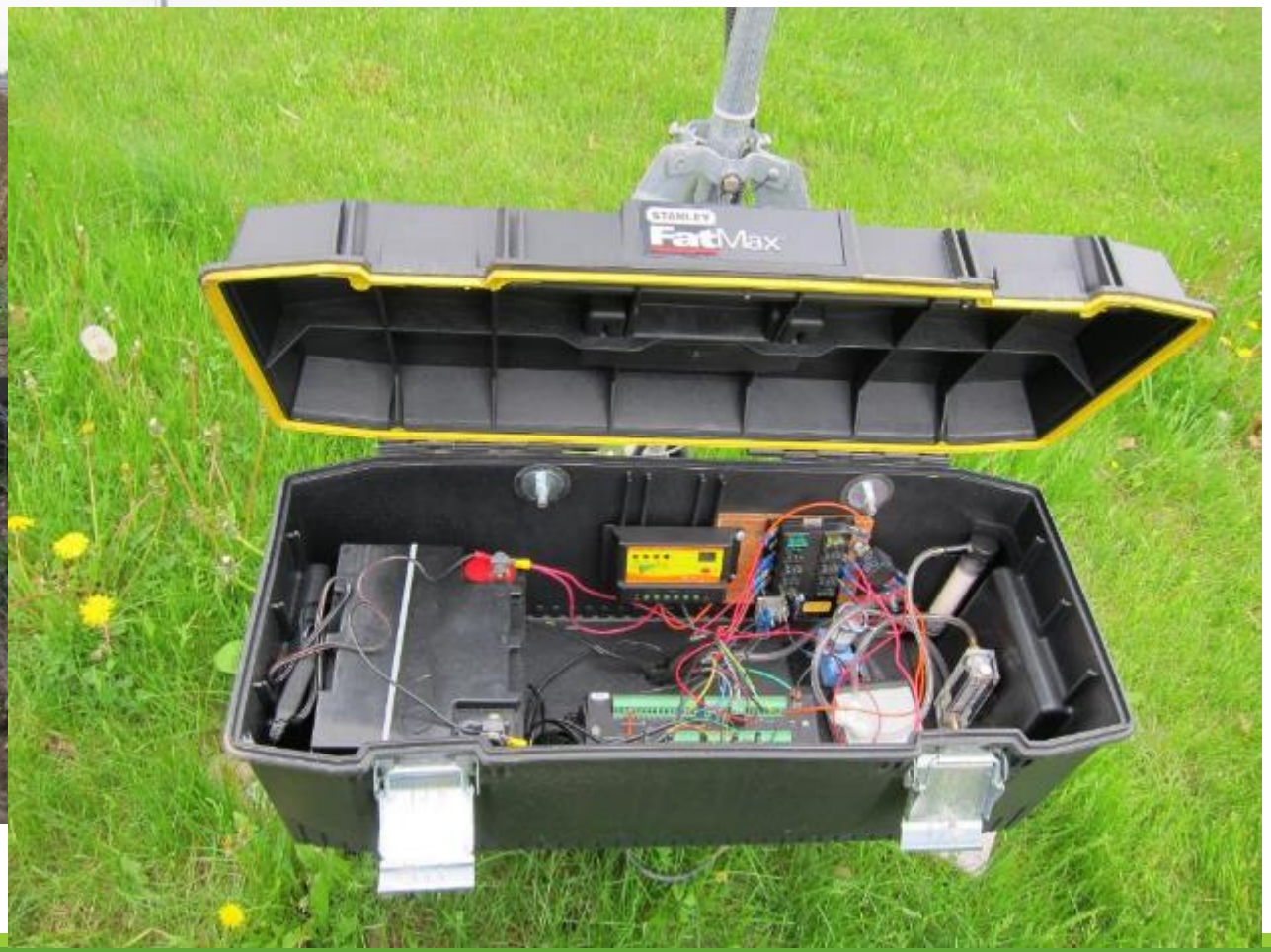
Approach: Vegetable production

Material and Methods

Approach: Crops

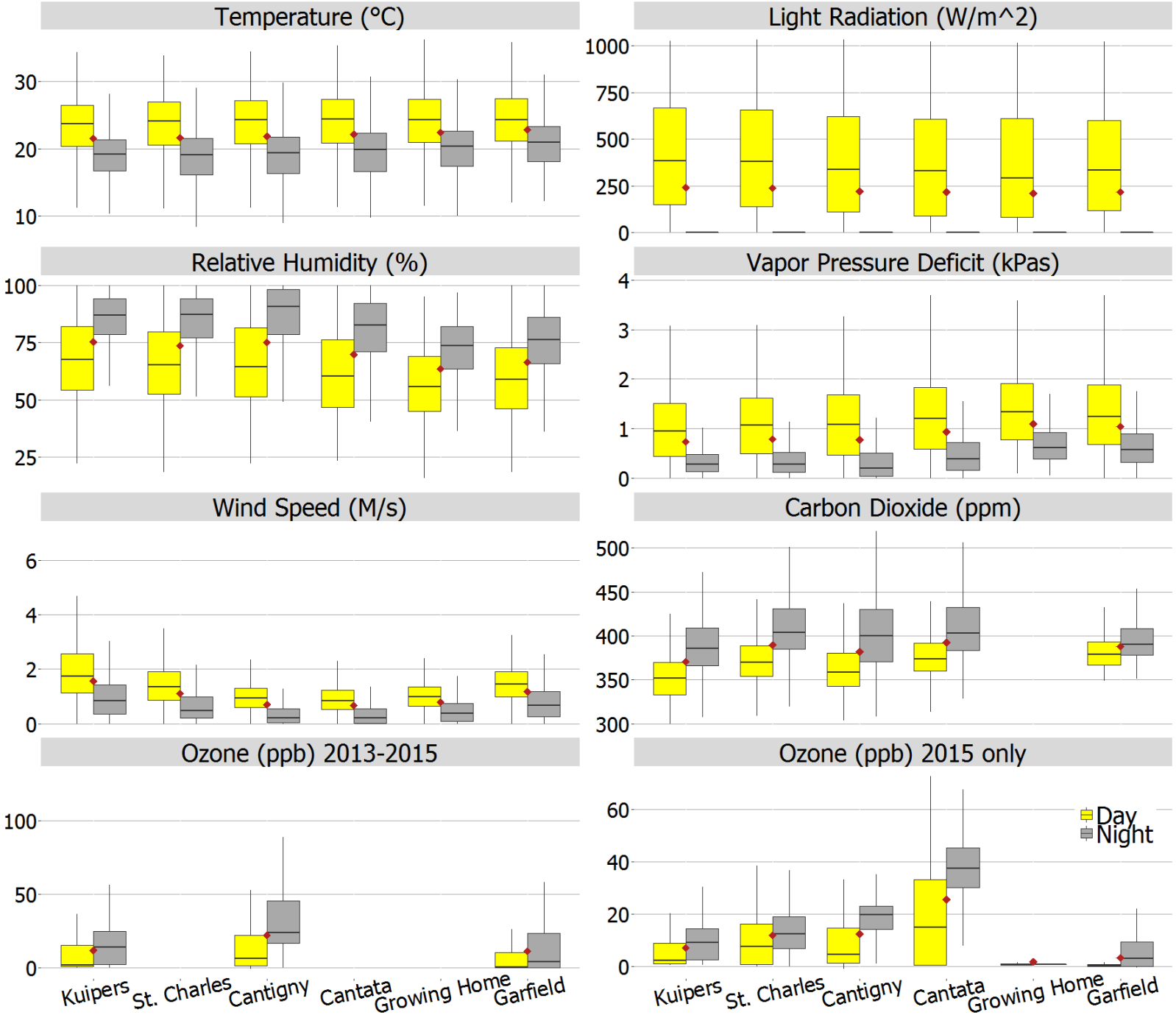
- Three sowing dates per year
  - Spring (kale and onion)
  - Summer (tomato, pepper, and snap bean)
  - Fall (table beet and Brussel sprout)
- Two varieties as sub-plot within each bed

Approach: Climate Monitoring

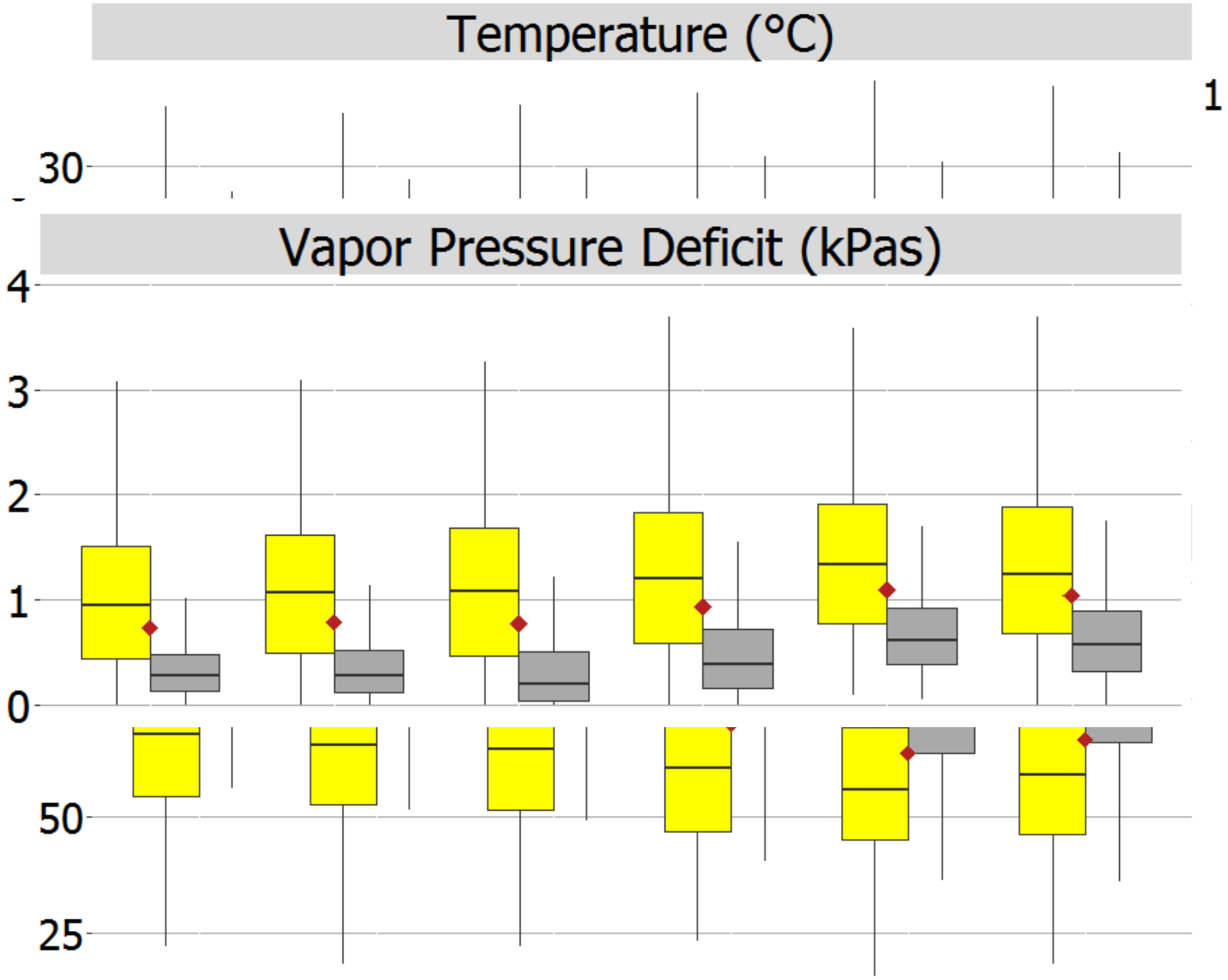


Material and Methods

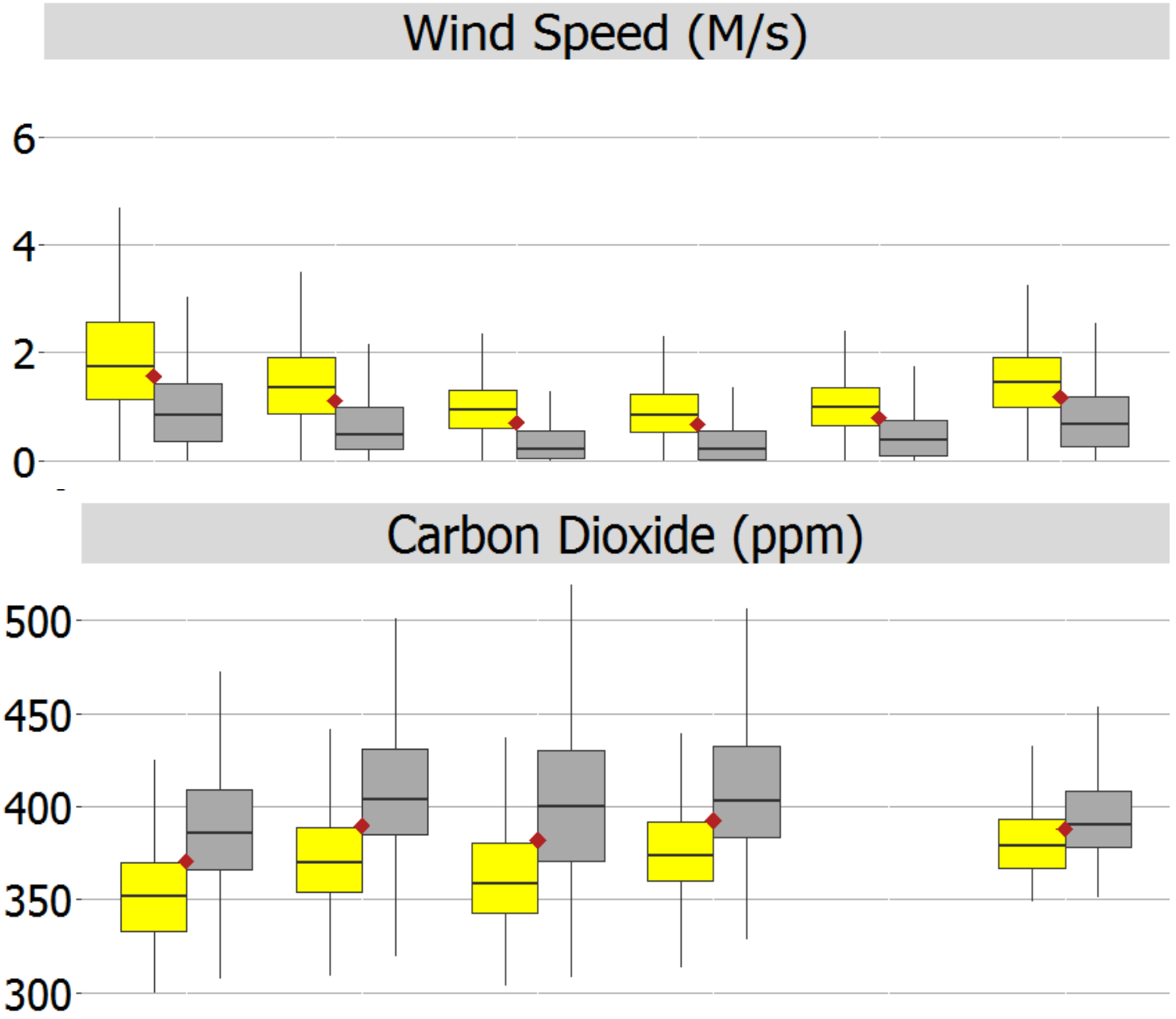
Microclimate Monitoring Results



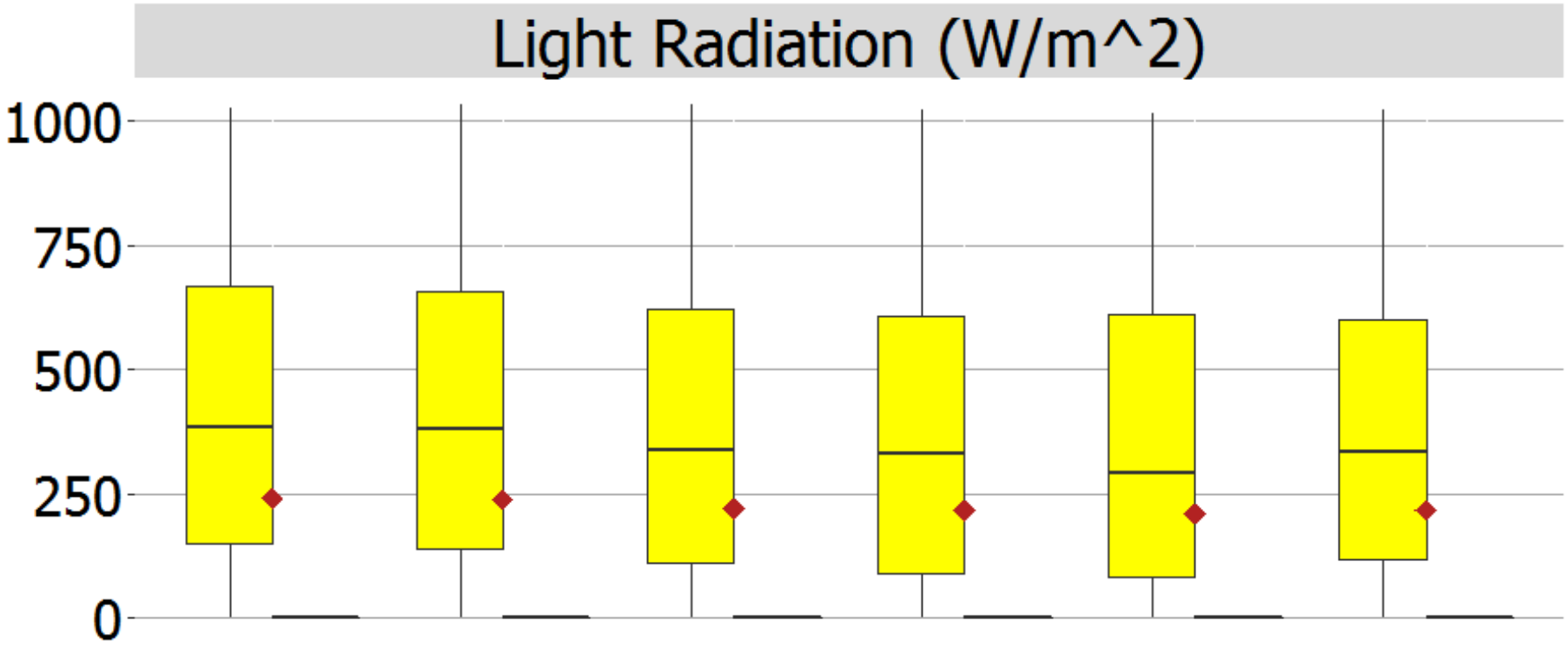
Test Gardens: Rural to Urban



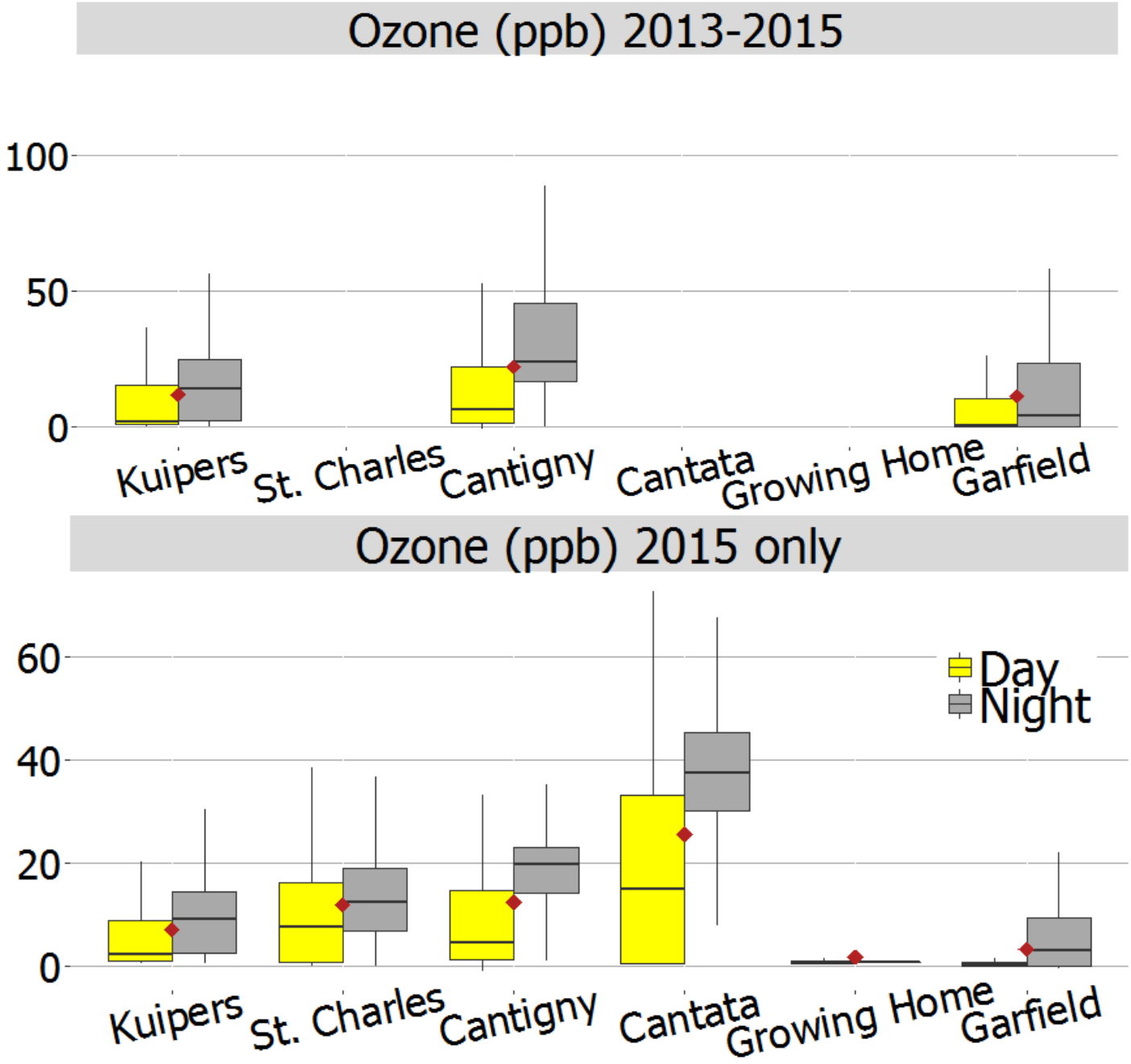
Results: Microclimate



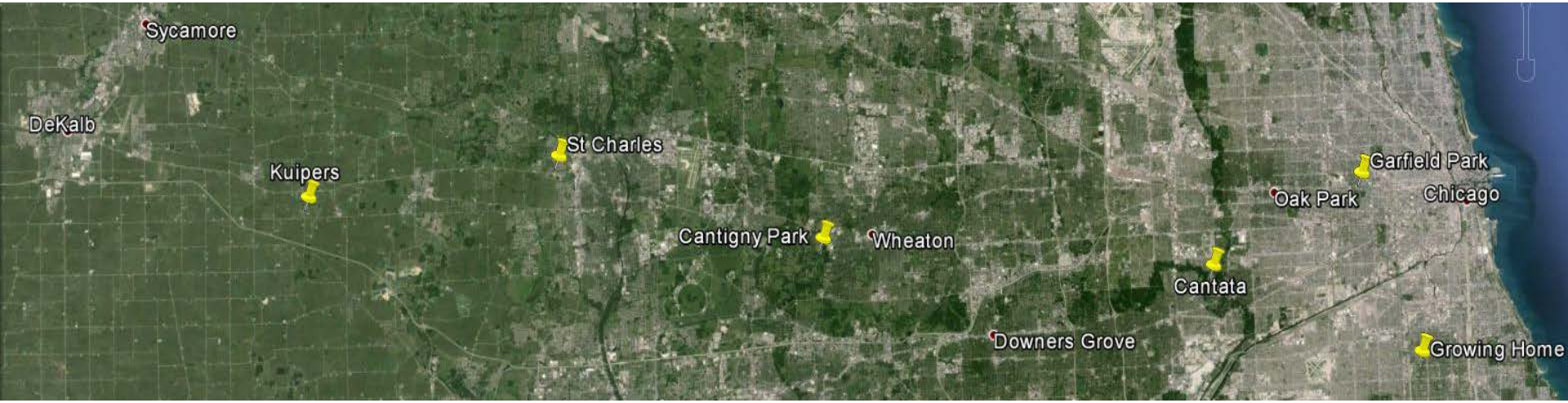
Results: Microclimate



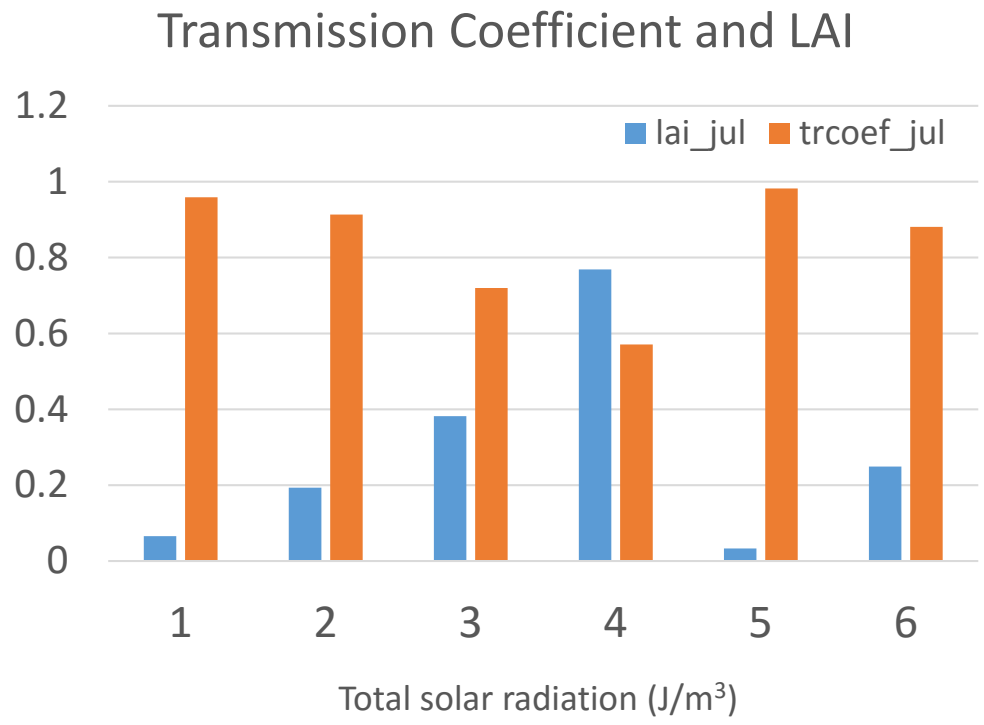
Results: Microclimate

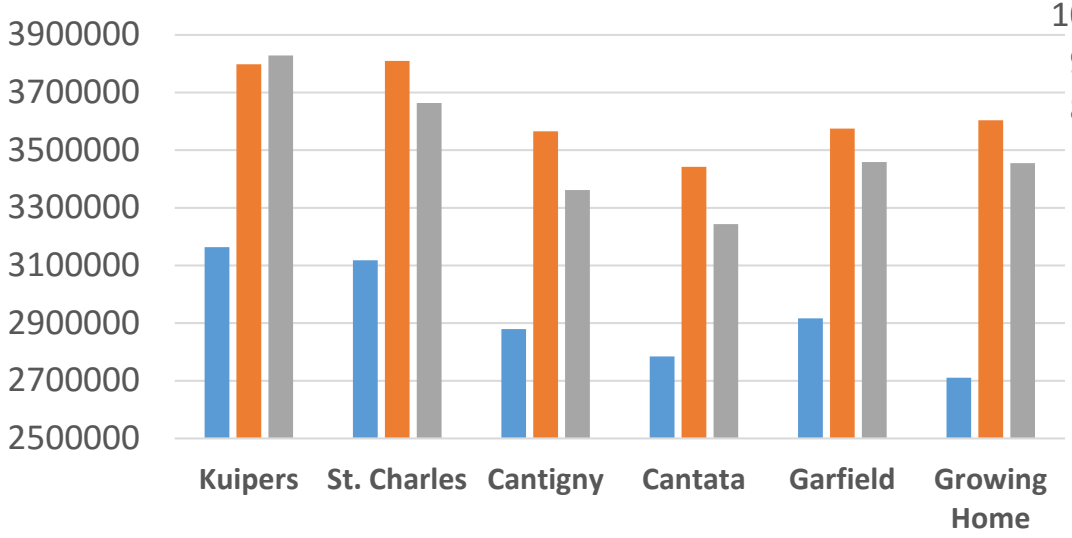


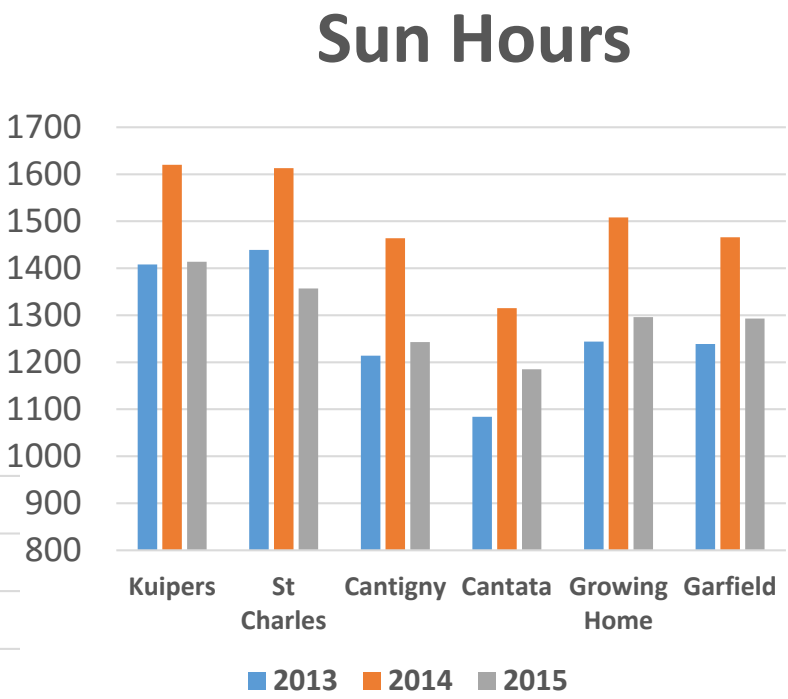
Results: Microclimate



Micrometeorological Modelling



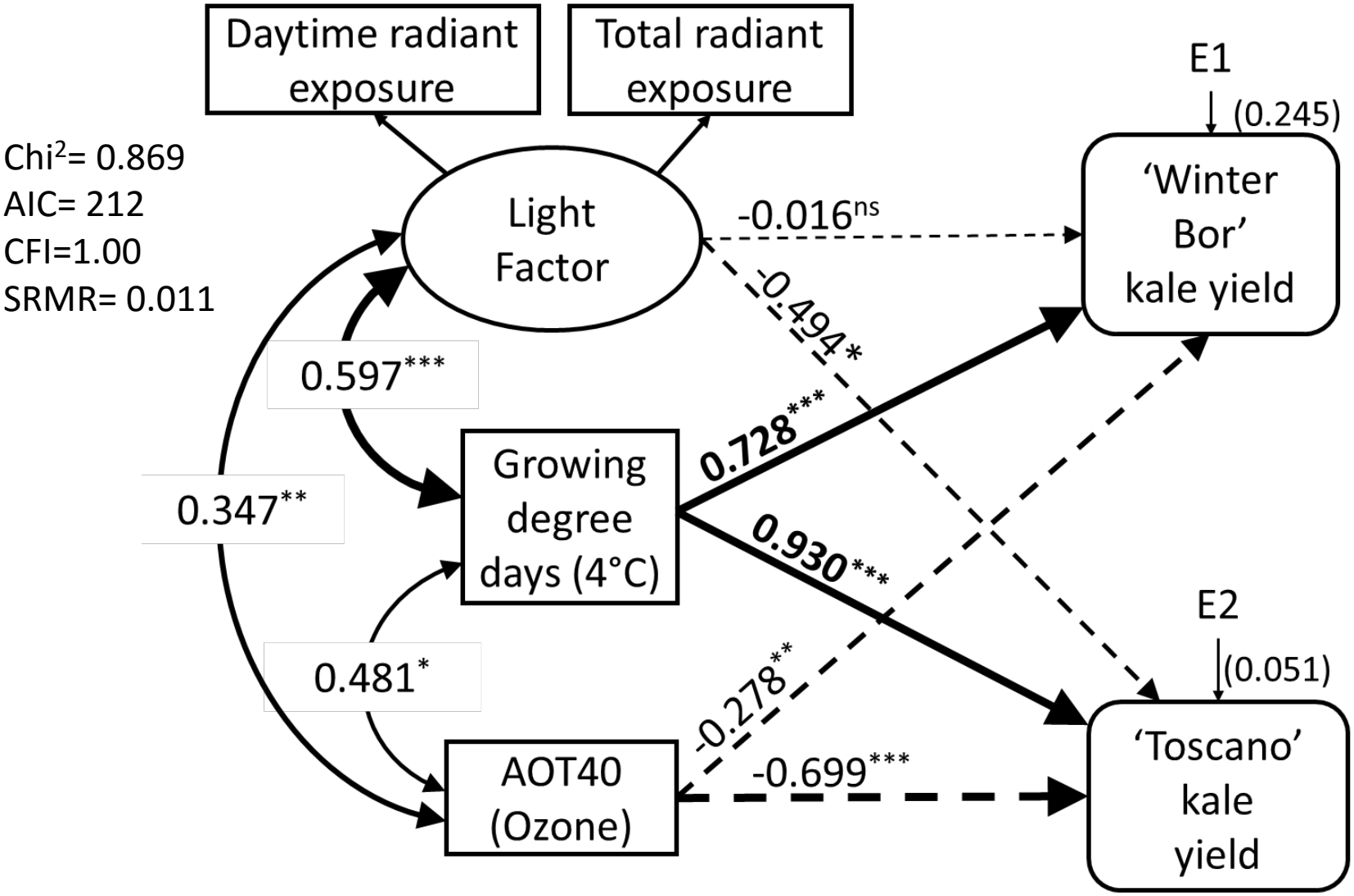




Micrometeorological Modelling

Vegetable response to environment

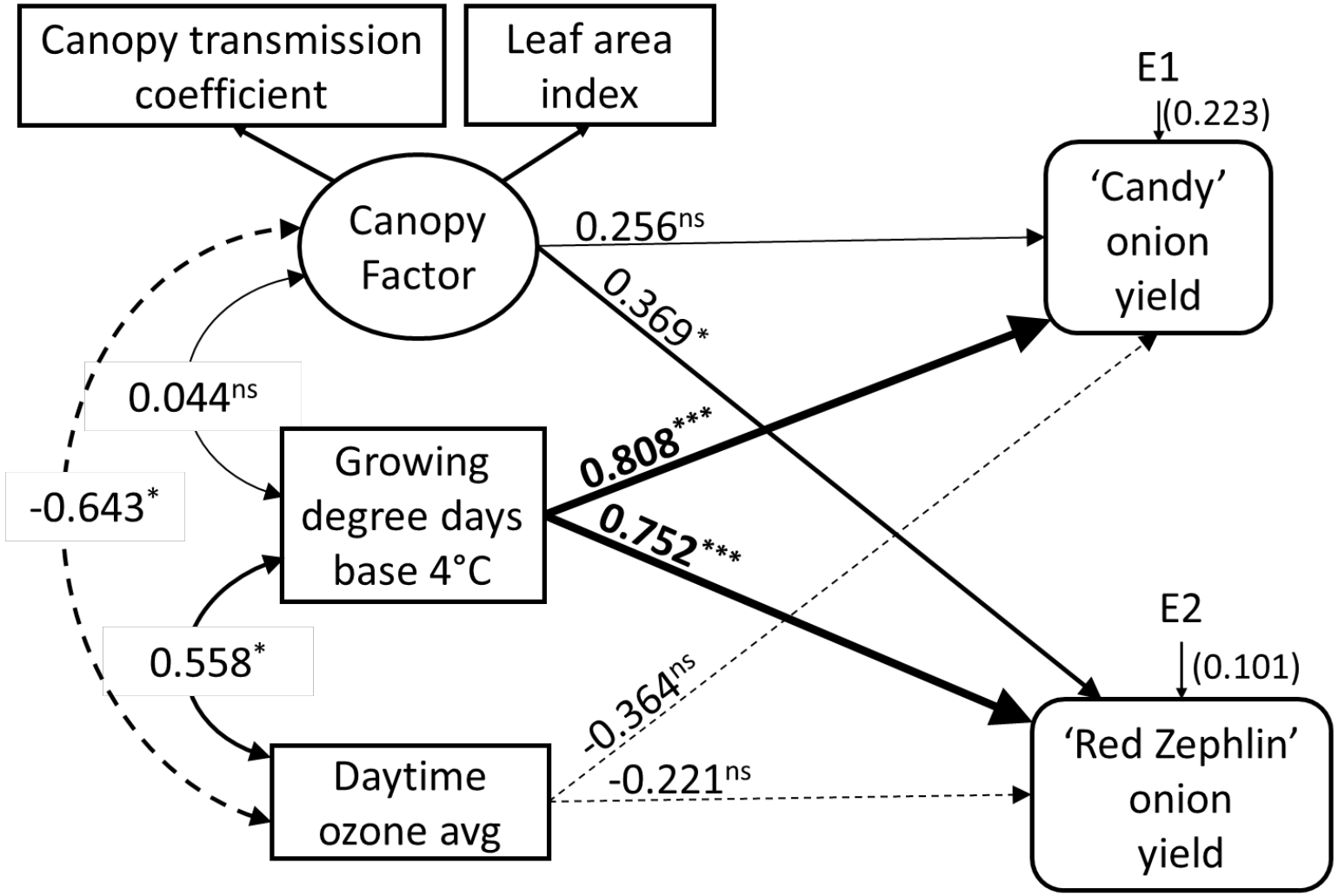
Spring Crops: Kale



Structural Equation Modelling

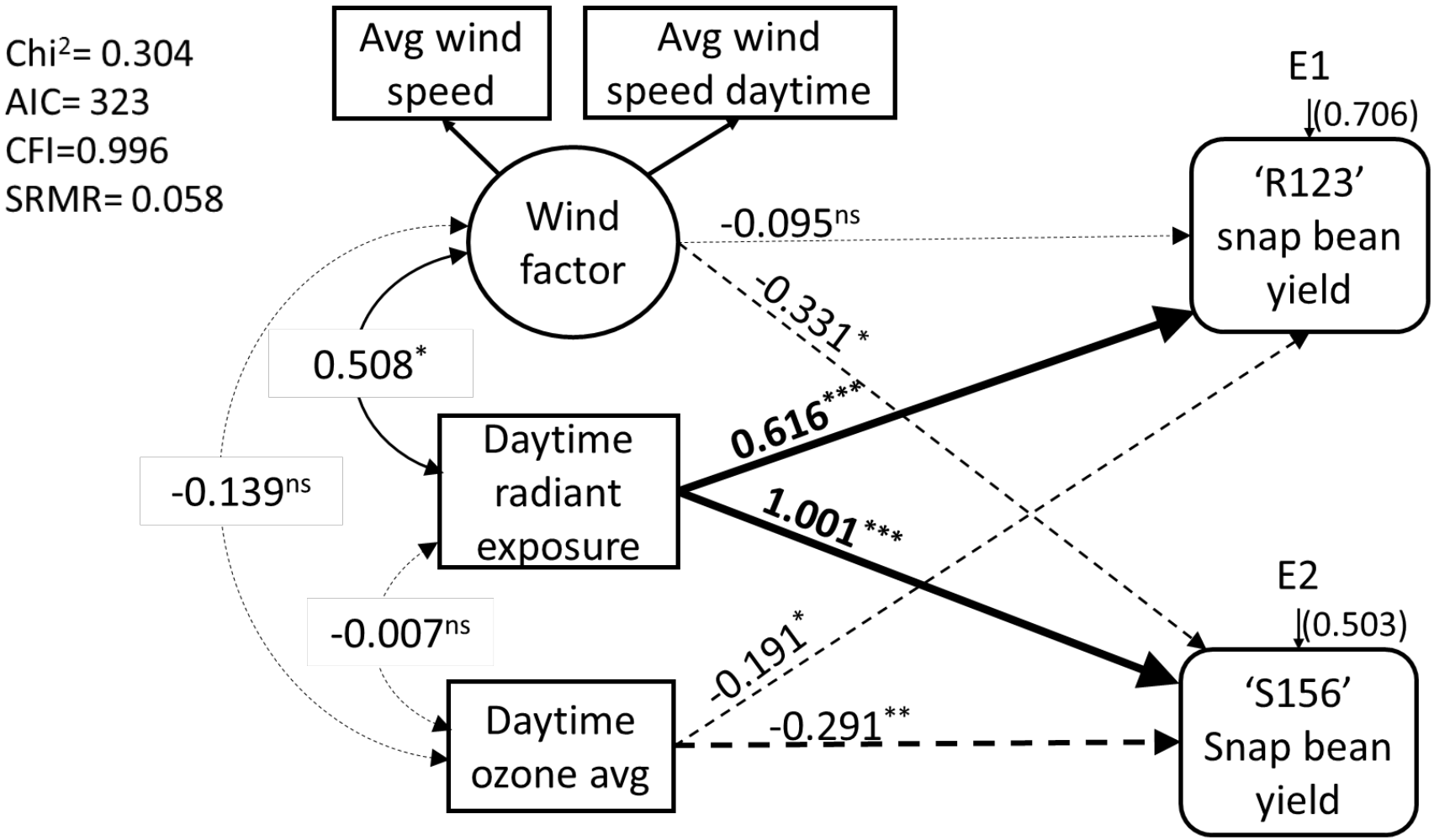
Spring Crops: Onions

Chi^2= 0.852
AIC= 310
CFI=1.00
SRMR= 0.032



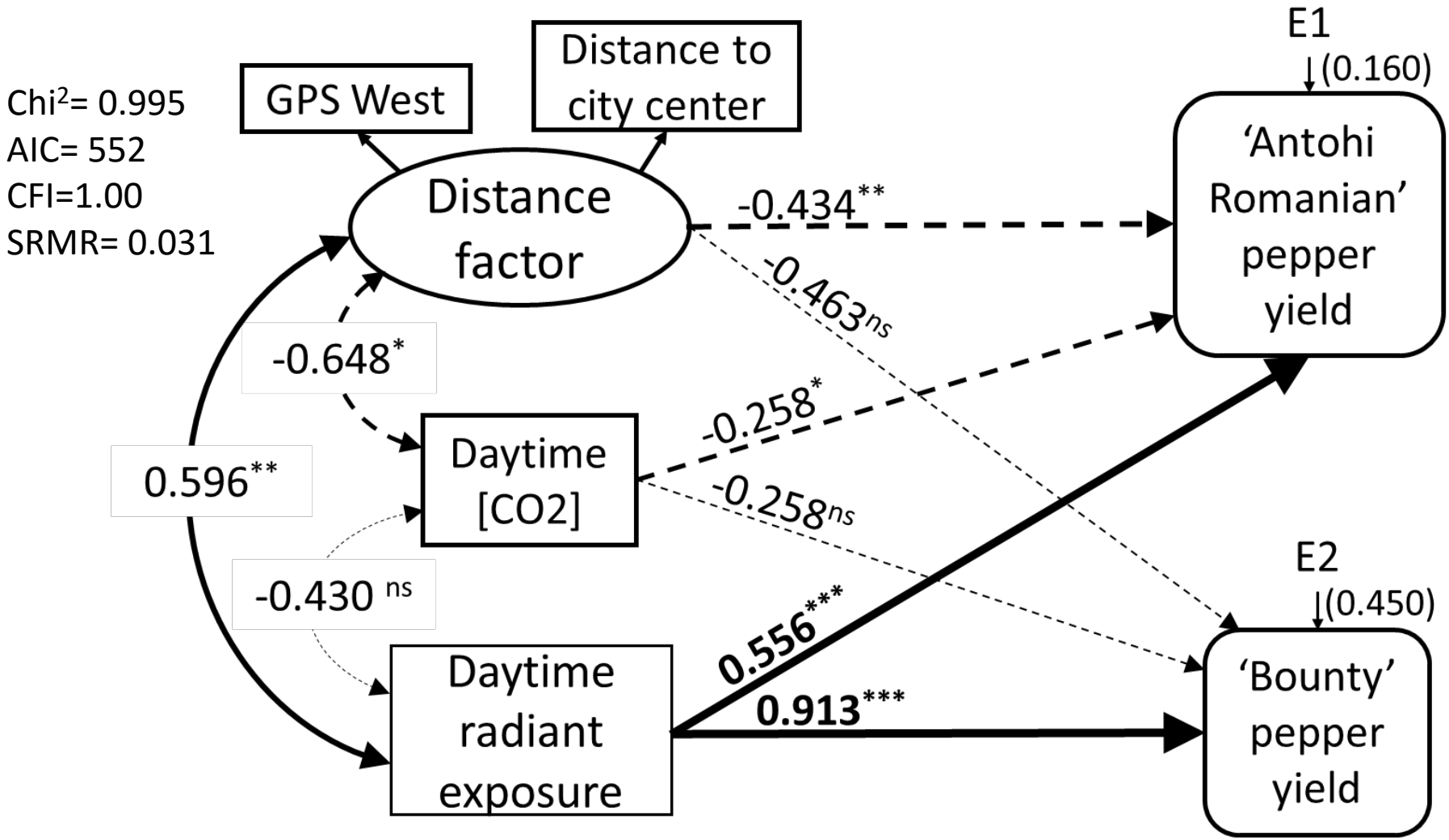
Structural Equation Modelling

Summer Crops: Beans



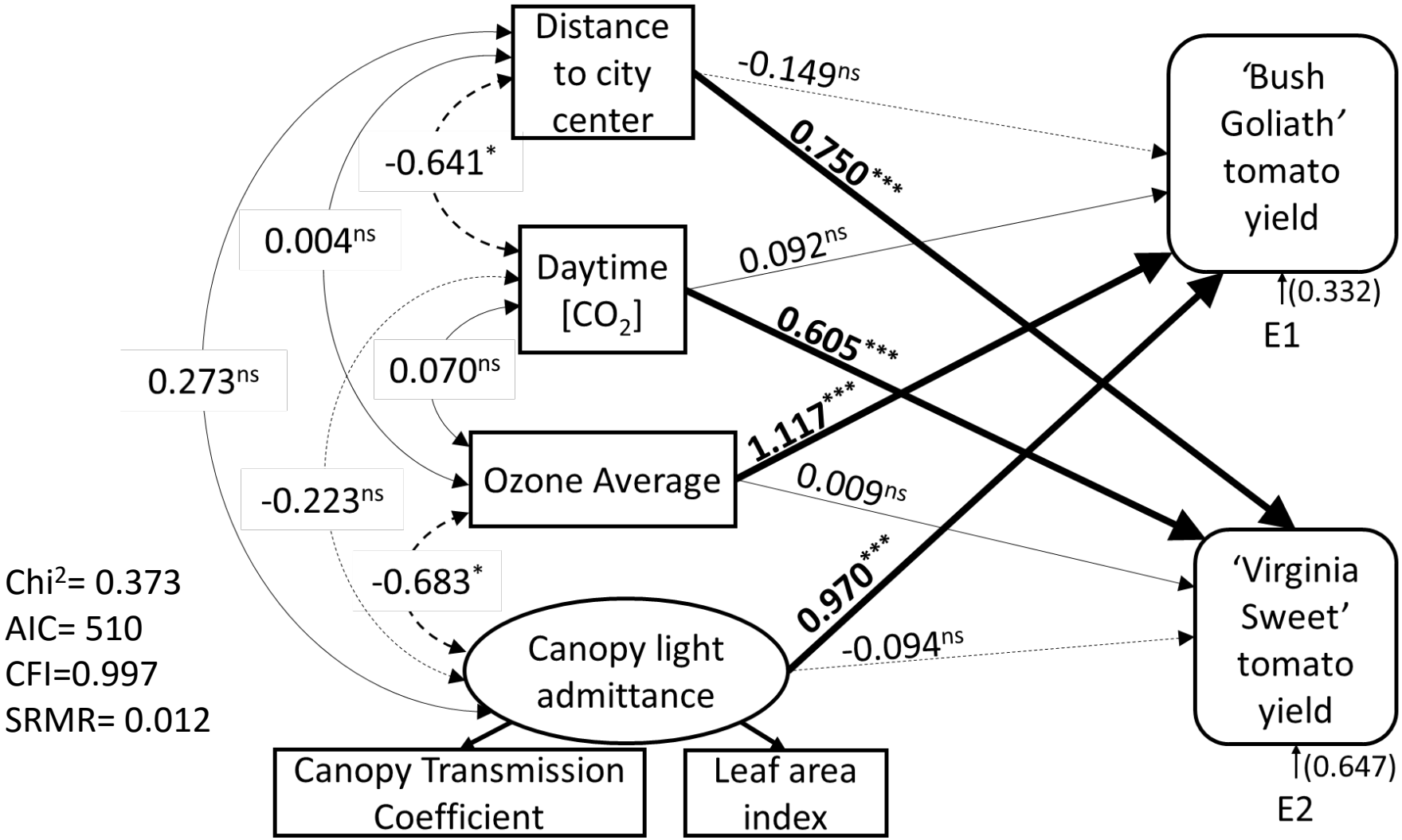
Structural Equation Modelling

Summer Crops: Peppers



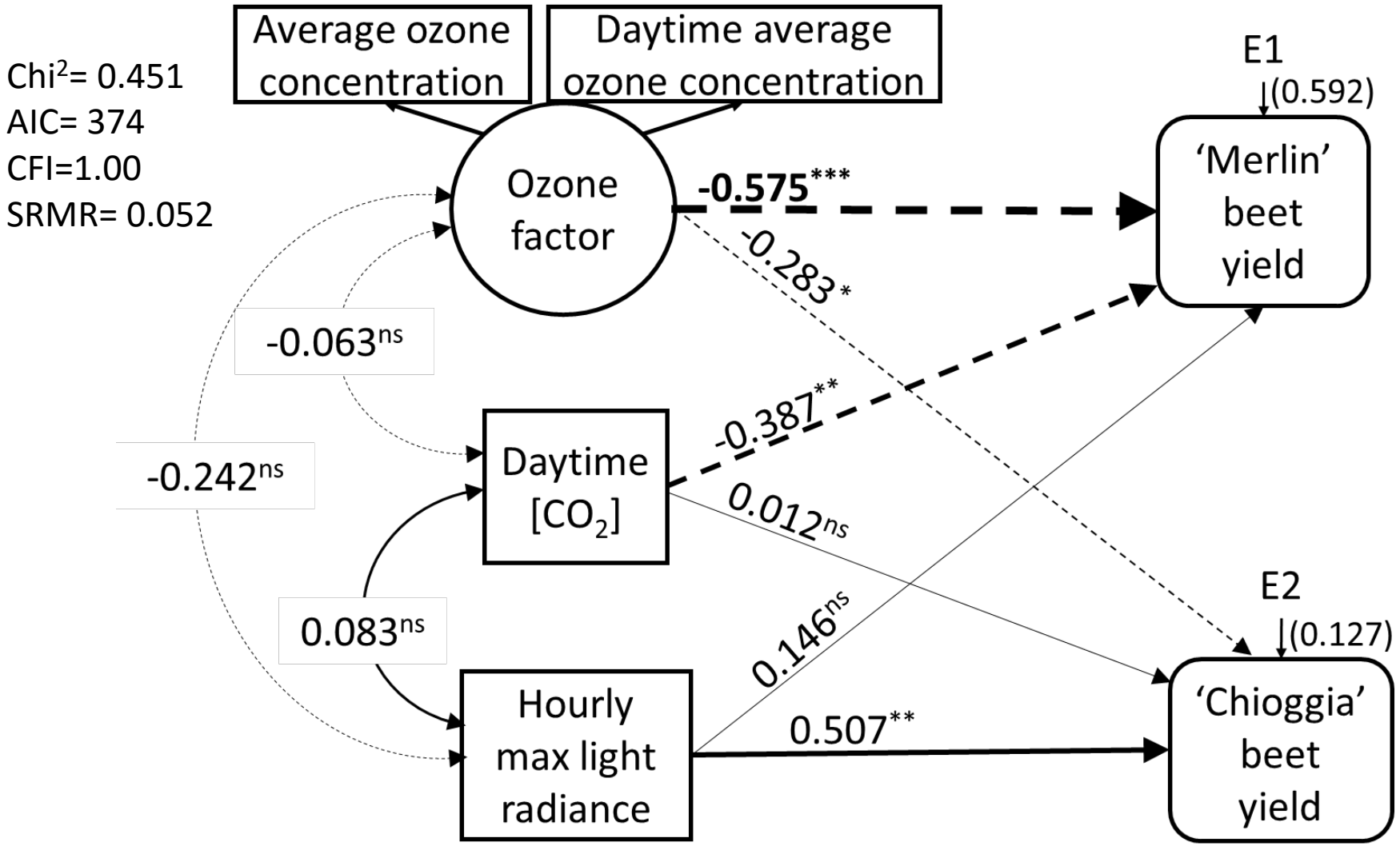
Structural Equation Modelling

Summer Crops: Tomatoes



Structural Equation Modelling

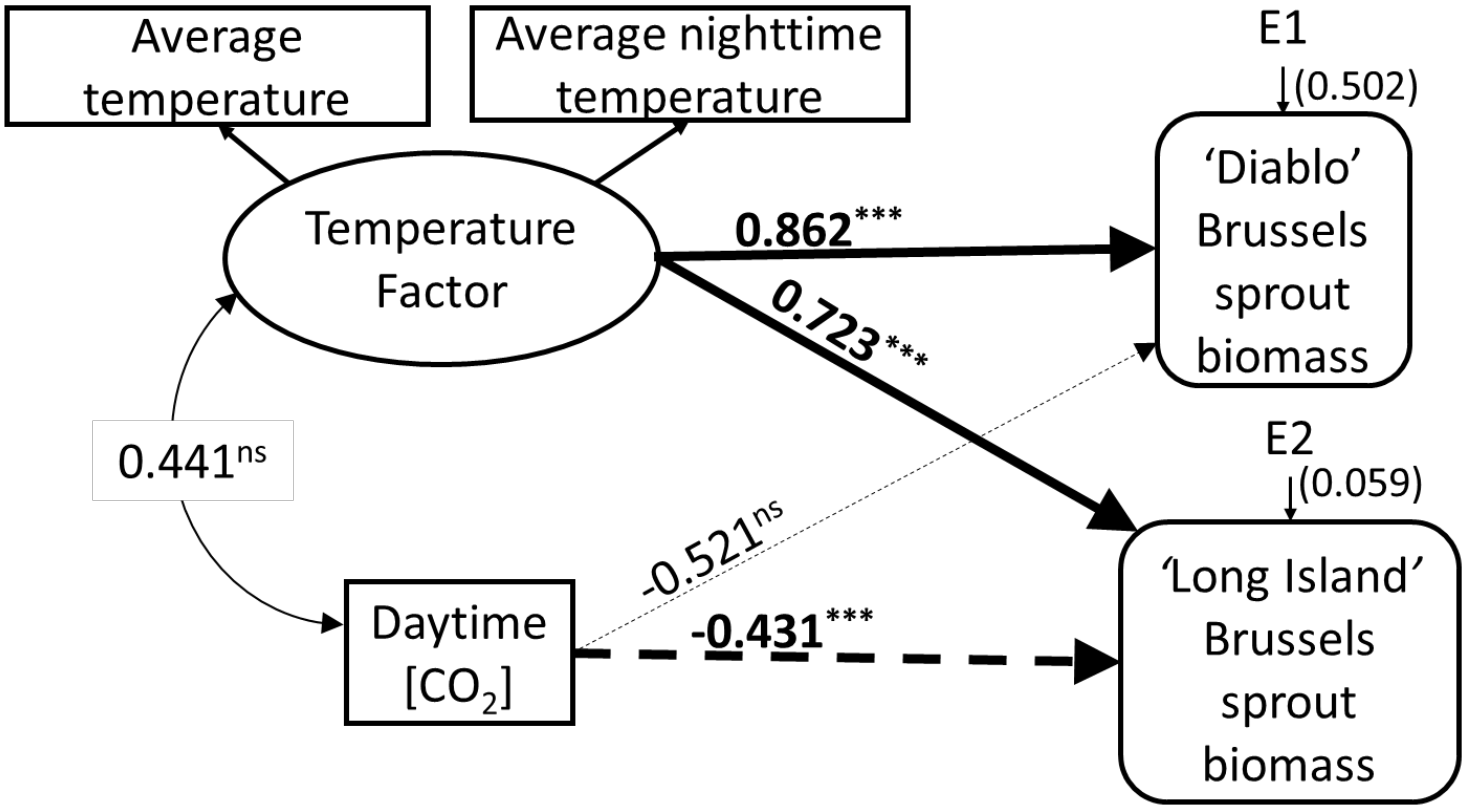
Fall Crops: Beets



Structural Equation Modelling

Fall Crops: Brussels sprouts

Chi^2= 0.738
AIC= 309
CFI=1.00
SRMR= 0.014



Structural Equation Modelling

Conclusions

Conclusions

- Peri-urban sites (Cantata and Cantigny) had the highest ozone concentrations and most light impedance
- Temperature and CO_2 were greater closer to the city center, RH was lower in the city
- Temperature, light, ozone, and CO_2 were the largest drivers of plant response
- Early and late season crops (cool season) can gain advantage from extra heat in urban environments, but were negatively affected by ozone

Conclusions

- Summer (warm-season) crops responded to light and CO_2 and unexplained variance
- Summer crops did not respond to temperature differences
- Light had reduced effect in spring crops, likely because tree canopy had not closed during growing period
- Peri-urban gardens had lowest yields in many crops and years
- SEM models showed different variety responses to environment in kale, tomato, beet, and Brussel sprout

Acknowledgments

- **Advisory Committee**
  - Sam Wortman
  - Jack Juvik
  - Carl Bernacchi
  - Adam Davis
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  - Growing Home
  - Garfield Park
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  - Cantigny Park
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Questions?