Potential for using dendrometers for irrigation management of vegetable crops

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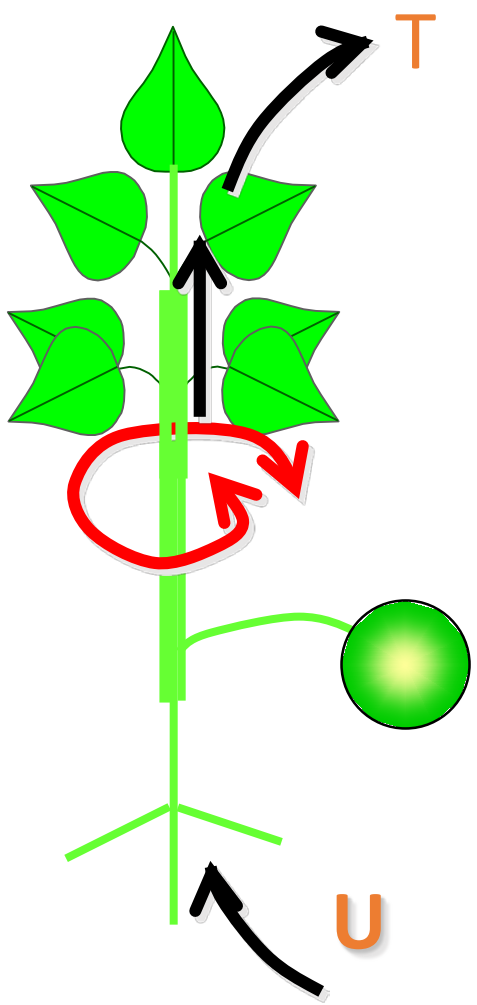
Dendrometers or LVDT sensors

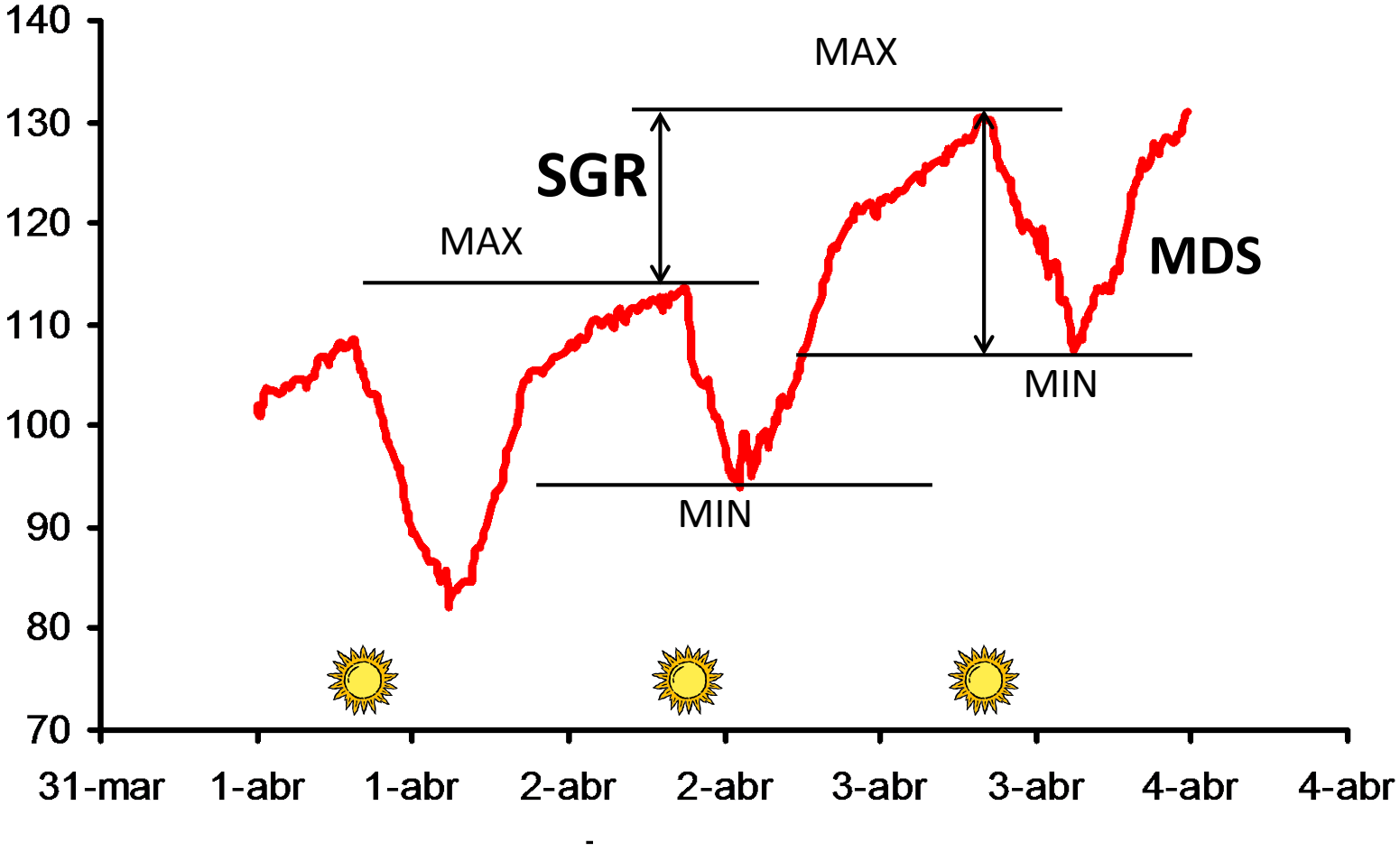
- High sensitivity to assess plant water status
- Continuous data recording ➡ Automatic irrigation
- Direct assessment of plant water status compared to traditional indirect measurements (climate or soil water status)

- Many studies and applications in fruit trees
- Very few studies in vegetables, and only under controlled conditions (growth chambers, pots)

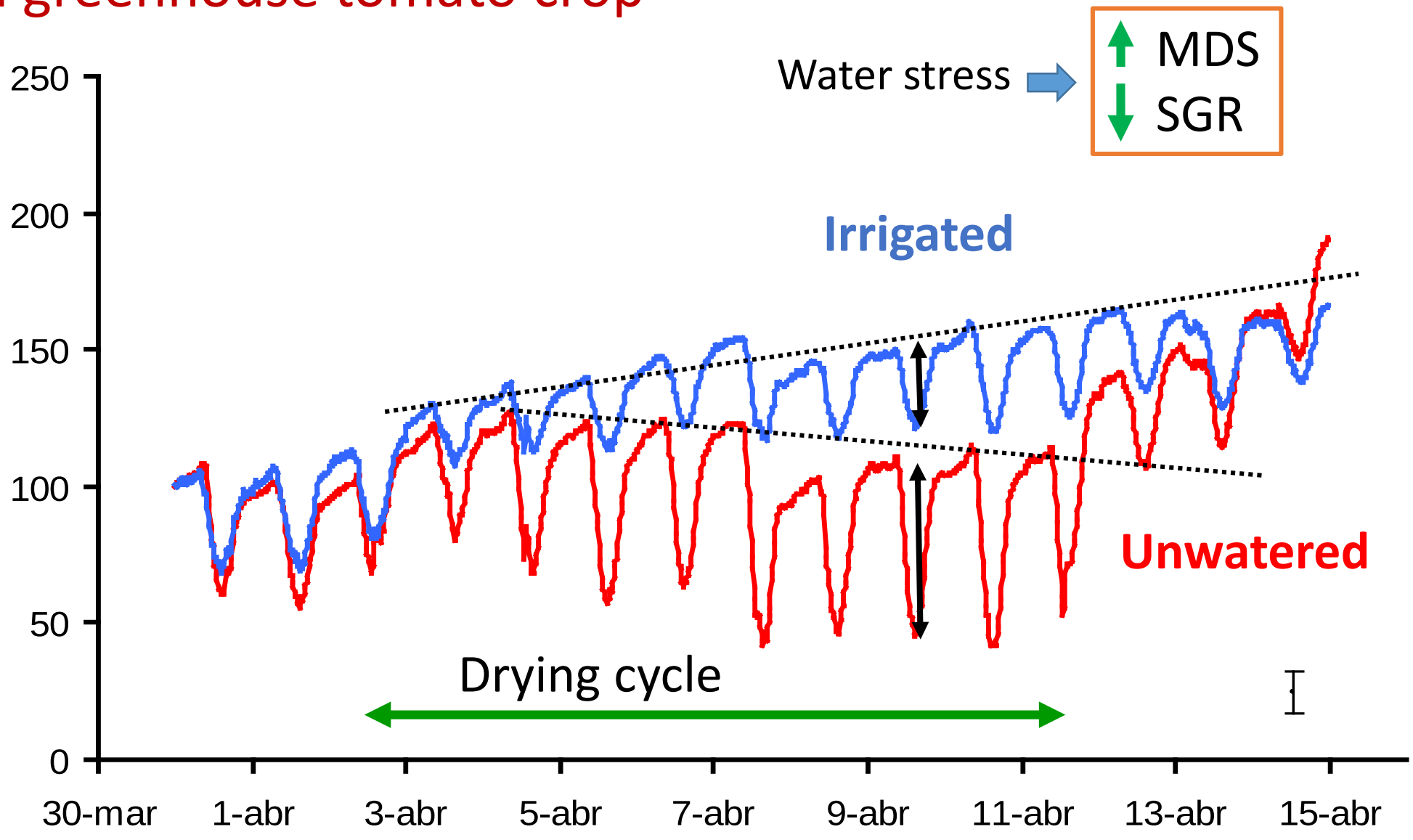
Daily stem diameter variations (µm)- Tomato crop



SGR: Stem growth rate **MDS: Maximum daily shrinkage**



SDV in a greenhouse tomato crop



Objectives of the research line

Evaluate suitability of SDV to detect water deficit in greenhouse vegetables, considering:

- Growing season (cool vs. warm)
- Growing media (soil vs. pots)
- Plant age (young vs. adult plants)

Experiments in plastic greenhouses

- Tomato soil
  - Autumn-winter
  - Spring-summer

  Growing season
  - Young plants
  - Mature plants

  Plant age
- Pepper autumn-winter
  - Soil
  - pots

  Root volume/density

Treatments

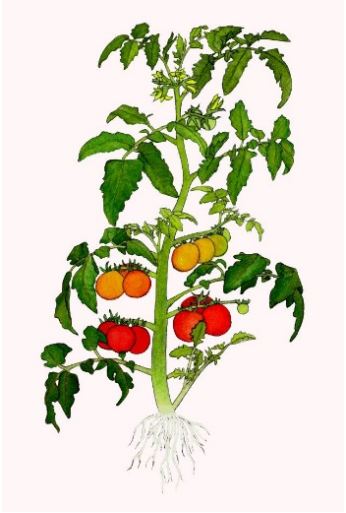
- Well-watered
- Unwatered (drying period)

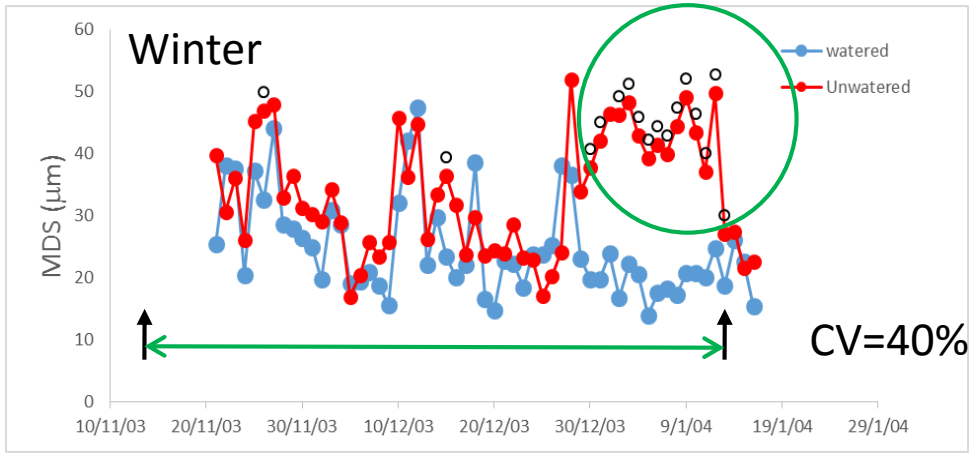
Measurements

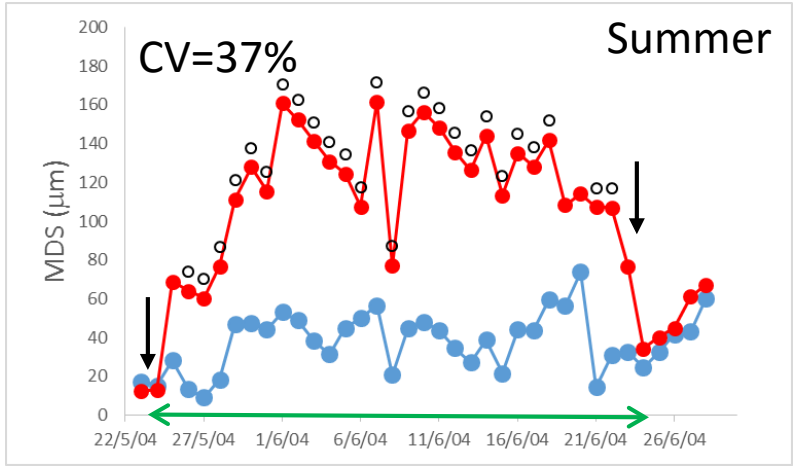
- Stem diameter variation (LVDT sensors, Solartron Metrology) every 30 minutes
- Leaf and Stem water potential (daily)

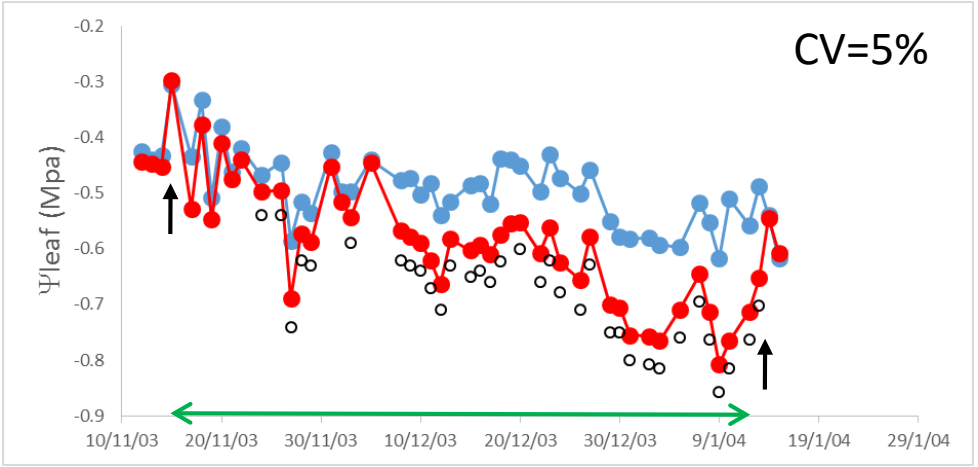
The response of SDV (stem diameter variations) indices to water deficit dependent on:

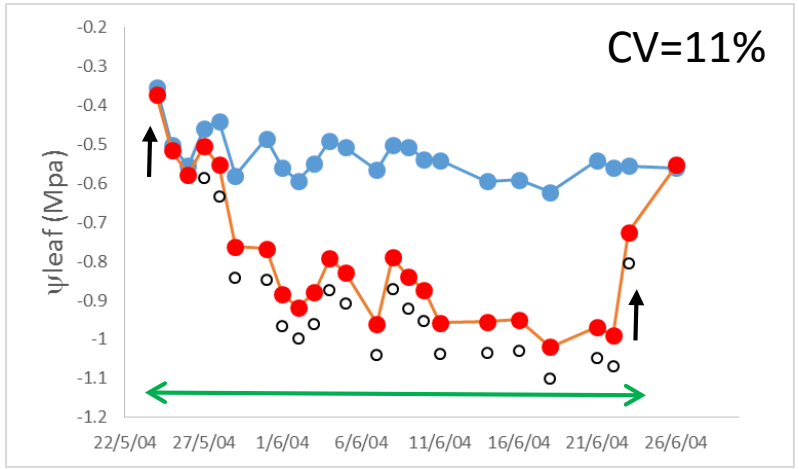
1) Climatic conditions/growing season- tomato











SDV indices

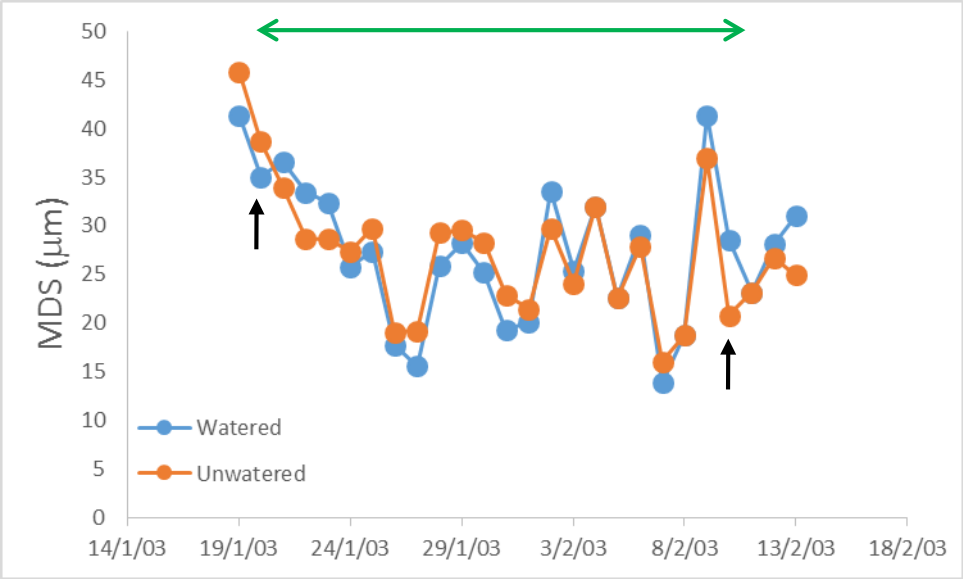
- Winter response
  - Slow
- Summer response
  - Rapid
  - Large
- More variability than Ψleaf

- **Very sensitive in summer,**
- **Insensitive in winter**

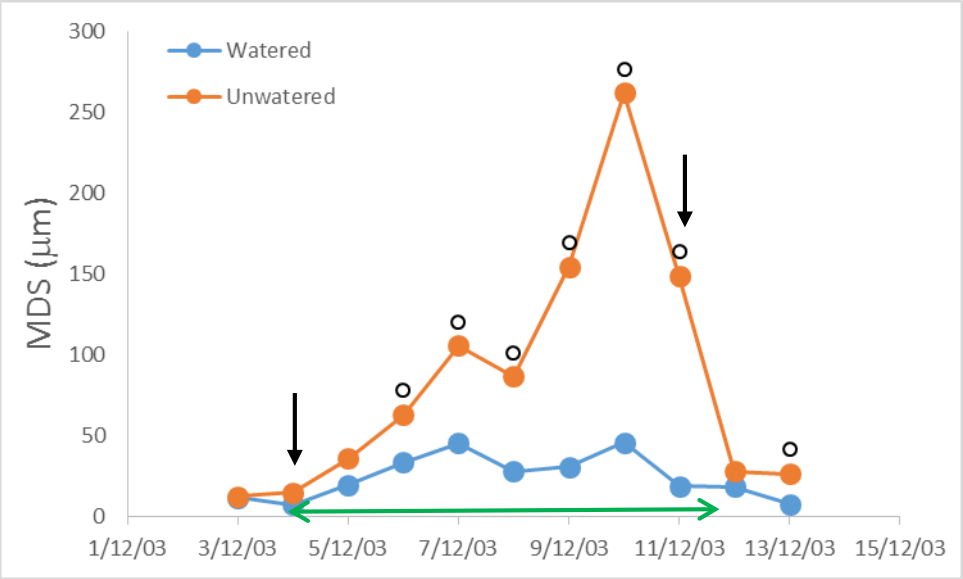
The response of SDV indices to water deficit dependent on:

2) Growing media- pepper (winter growth)

Plants in soil



Plants in pots



- MDS unaffected by drying
- But, Ψstem affected

- MDS large and rapid responses to drying
- Larger and more rapid than Ψstem

- **Much more sensitive in pots, in winter**
- **Careful with results from pot studies, e.g. the previous studies**

The response of SDV indices to water deficit dependent on:

3) Plant age- tomato

- Young plants, SGR (Stem growth rate) the most sensitive SDV index to water stress
    - Rapid growth hides MDS
- Mature plants, MDS (maximum daily shrinkage) the most sensitive index to water stress
- Therefore, no single index suitable for entire crop cycle

- **Practical limitation with fast growing species (vegetable crops)**
- **Two sequential indices would be required**

Issues regarding SDV in greenhouse vegetables to detect water stress

Issue	Implications
Higher variability than Ψleaf	Large number of sensors
Most suitable index depends on plant age	Potential limitation for irrigation protocols
Low sensitivity under low evaporative demand	Not suitable for GH crops grown under cool conditions
Under high evaporative demand more sensitive than Ψleaf	Potential for use in open air crops and GH crops under warm conditions
Suitable for plants grown in containers (even in winter)	Potential for use in substrate

Thanks !!