eCoCulture
Stress Specialists

How the product works

What is plant stress?

- Stress naturally occurs during poor growing conditions (abiotic stress) and during attack by insects and diseases (biotic stress).
- Stress always leads to depression of plant health, crop yield and food quality.
- During stress plant cells produce increased levels of peroxides / reactive oxygen species (ROS). ROS are highly destructive to cell structures.
- In response to increased ROS the plant produces more ethylene, closes stomata and starts to shut down photosynthesis, reducing nutrient uptake essential for plant health (hyper-sensitive reaction).
- Use of **XStress** reverses the effects of this stress response.

XStress

eCoCulture
Stress Specialists

XStress - background information

- **XStress** is a specifically designed foliar fertiliser to help combat stress
- **XStress** contains the essential micro-elements required for enhanced plant health, including the correct proportions of iron, zinc, manganese and copper, combined with additional magnesium and glycine
- Applications of **XStress** allow the plant to maintain photosynthesis and increase the level of anti-stress compounds (jasmonates, glycine), anti-oxidants (anthocyanin, glutathione, linoleic acid) and other proteins (SAM) controlling the levels of ROS, hydroxides, ammonia and ethylene.
- Reduced levels of ethylene lead to visibly better fruit, more yield and longer shelf life.
- Apply **XStress** prior to cold weather, during conditions of high UV light, use regularly to prevent damage from saline irrigation water, high temperatures or when water is not freely available to the plants.

XStress

eCoCulture
Stress Specialists

1. Control of cellular reactive oxygen species (ROS)

Control of cellular ROS

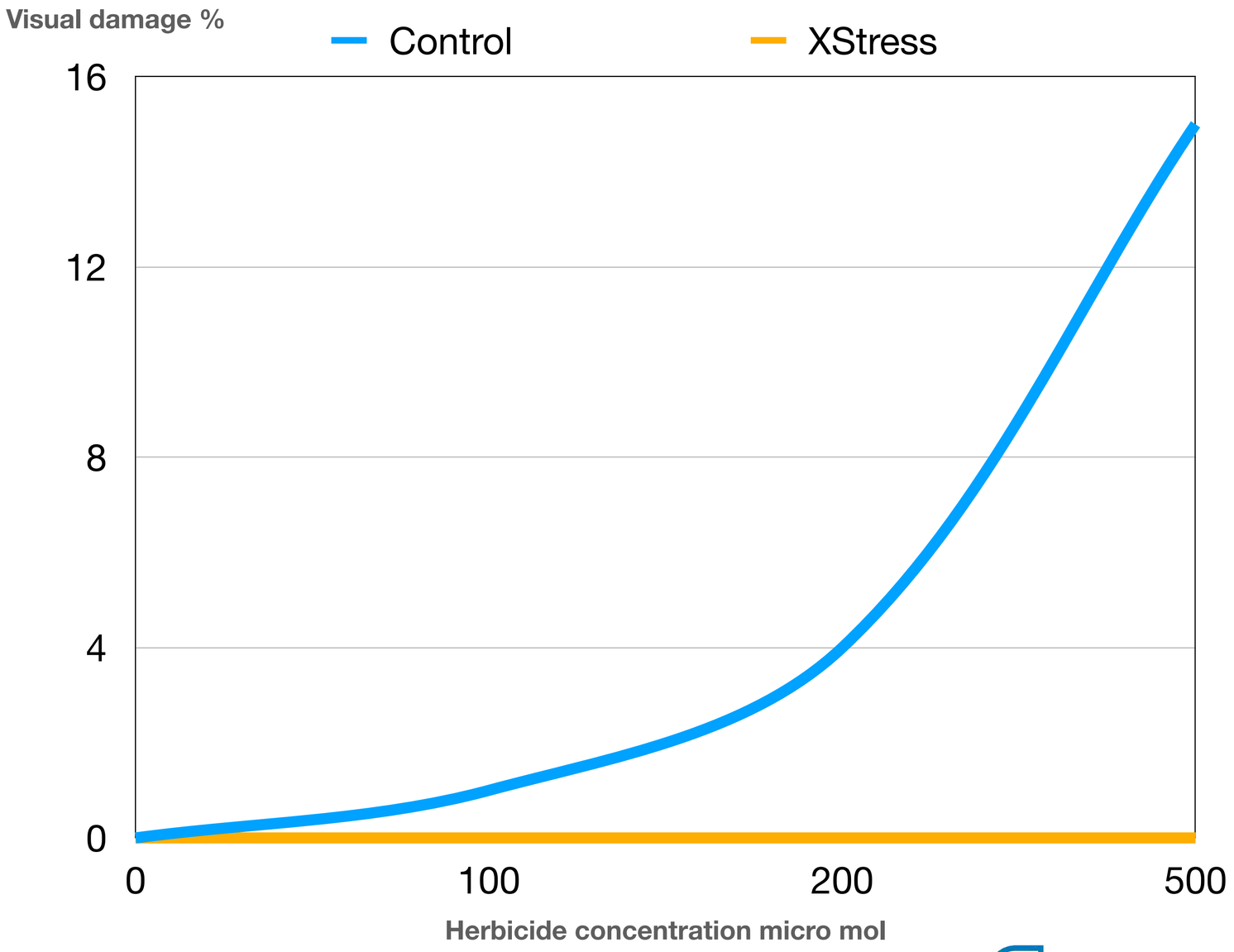
- Study looked at the protection **XStress** gave against cellular level stress
- Plant stress is often associated with an increase in reactive oxygen species (ROS), causing cell death, leading to leaf damage, reduced photosynthesis and impaired plant growth
- Laboratory studies were set up using tomato plants comparing **XStress** treated plants to control
- Oxidative stress was induced by using methyl viologen (*Paraquat)* herbicide

XStress

eCoCulture
Stress Specialists

Leaf damage

- As concentration of the herbicide increases to 500 micro mol, leaf damage in the control increases to 15%
- **XStress** prevented any leaf damage, showing it protected the plant against ROS

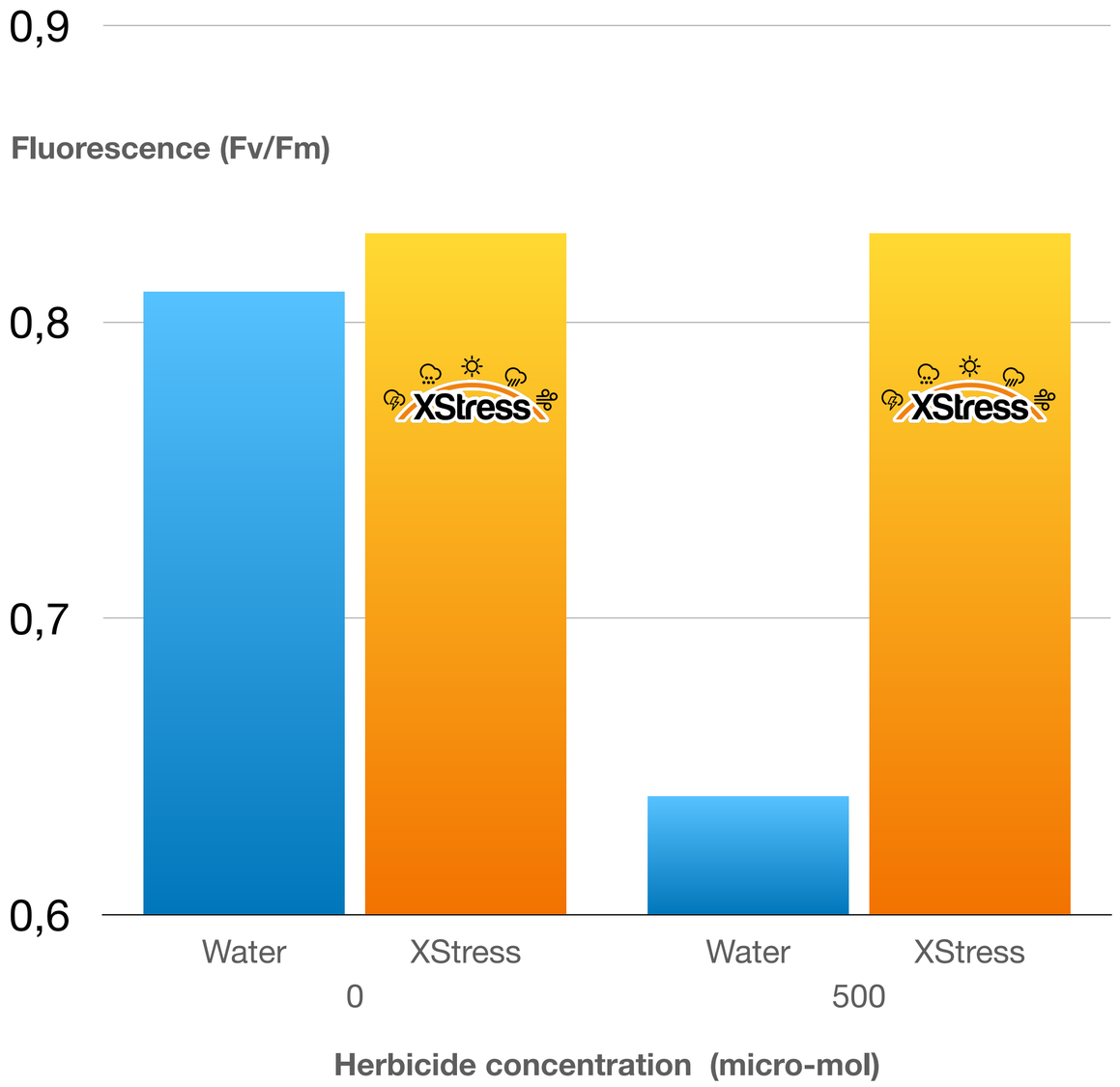


XStress

eCoCulture
Stress Specialists

Chlorophyll fluorescence

- As herbicide damage increases, chlorophyl fluorescence decreases by 21% in control
- Reduced florescence indicates less photosynthesis
- **XStress** prevents any damage or loss in photosynthesis



XStress

eCoCulture
Stress Specialists

Control of ROS

Conclusions

- **XStress** protects tomato plants from oxidative stress (induced via paraquat)
- **XStress** prevents physical damage to the leaf
- Consequently chlorophyll fluorescence remains high under stress giving greater plant growth under stress conditions
- In absence of any stress plant growth is improved by **XStress** micro-nutrient formula

XStress

eCoCulture
Stress Specialists

2. Control of salt stress

Control of salt stress

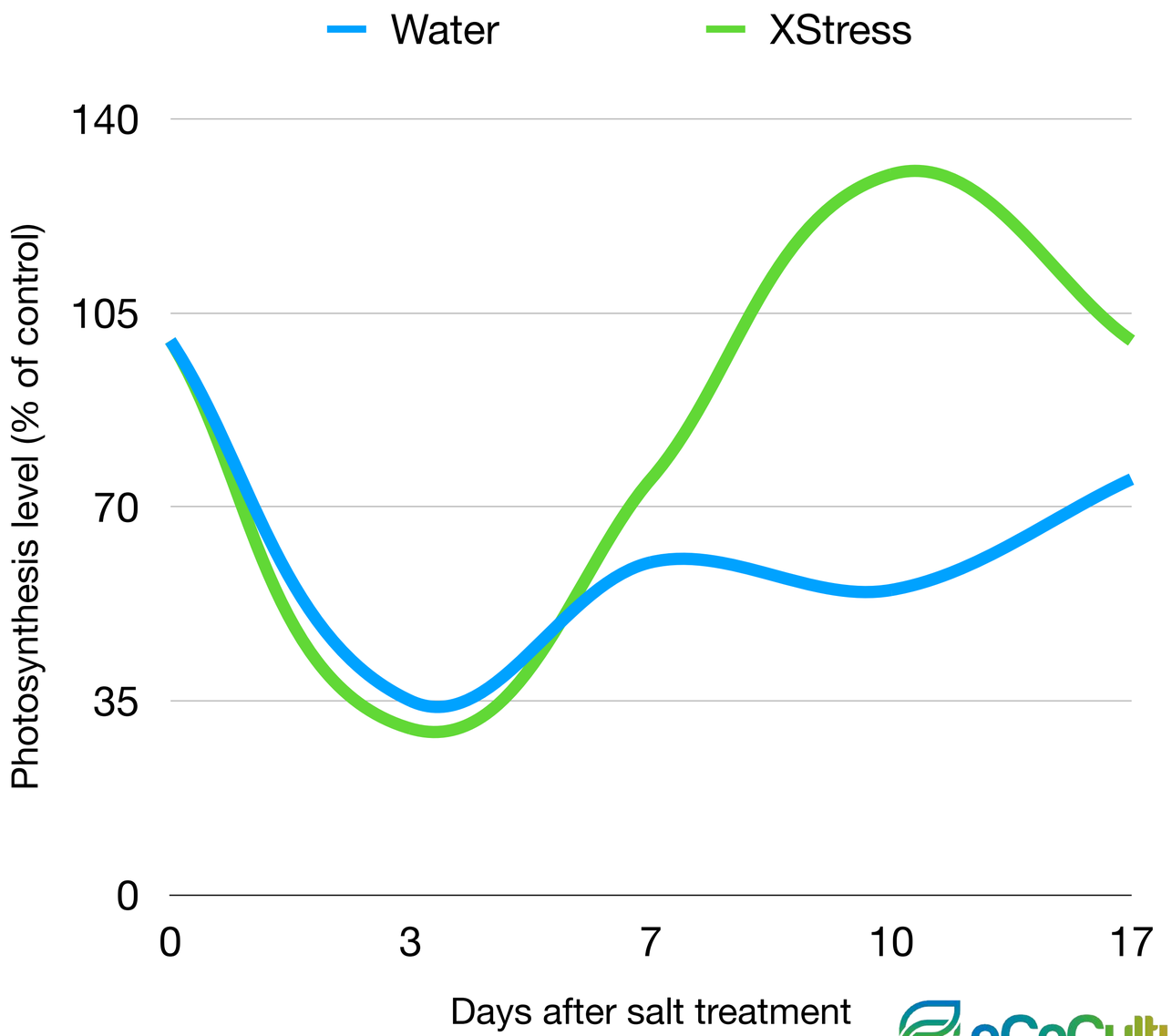
- Saline water is a major cause of plant stress and reduced yield
- A trial was set up to see if **XStress** could prevent the effects of saline water reducing growth by measuring photosynthesis
- **XStress** was compared to a control of plain water
- Tomato plants were treated with **XStress** and two days later the tomato plants were irrigated with saline water twice (equivalent to 1/5th seawater)
- Measurements were made of photosynthesis and anti-oxidant levels

XStress

eCoCulture
Stress Specialists

Effect on photosynthesis

- Plants treated with **XStress** recover rapidly after initial shock to 100% photosynthesis by day 10
- Control plants never recover remaining at 75% of pre-treatment photosynthesis levels at day 17
- Main driver of recovery is improved stomal conductance

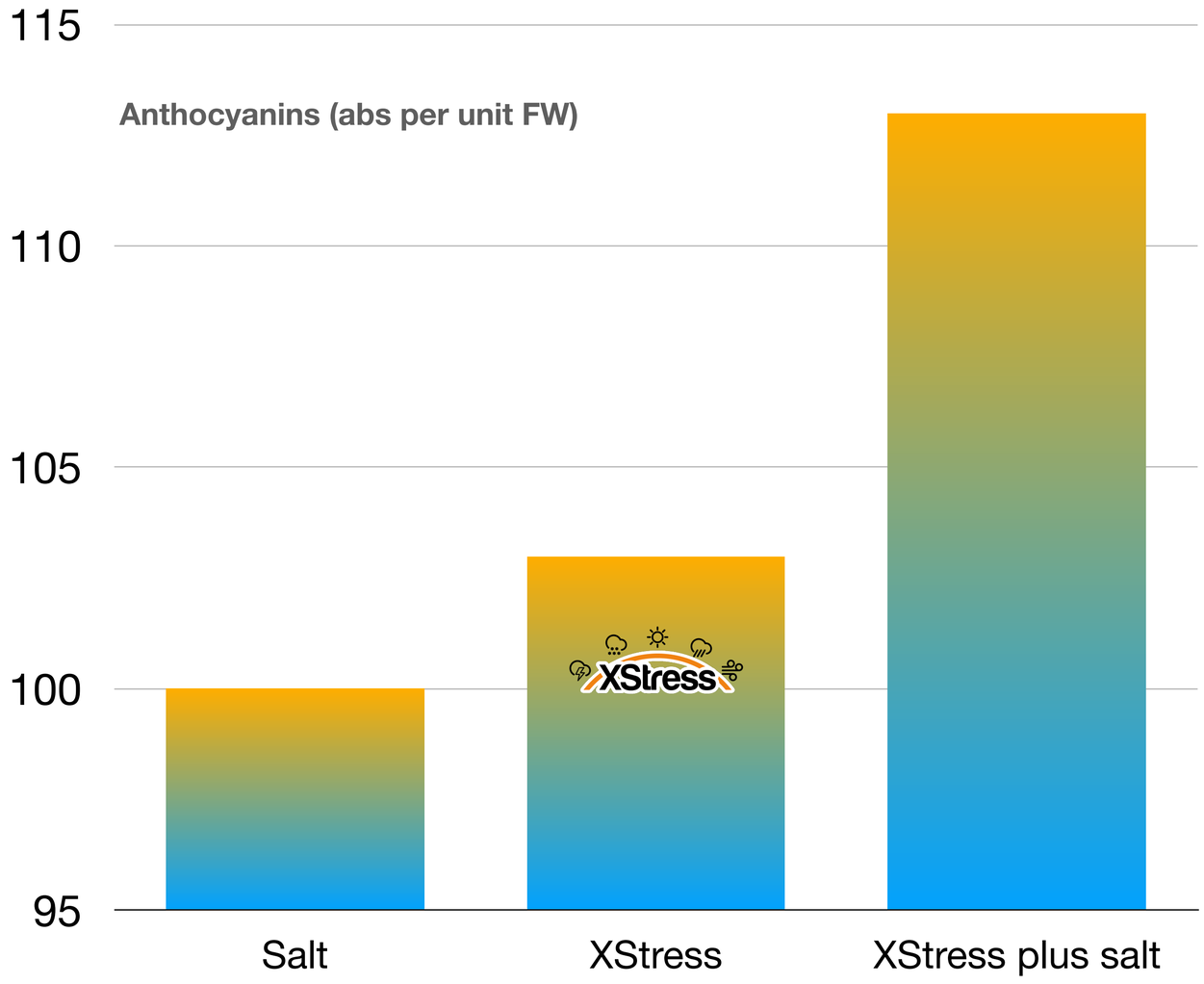


XStress

eCoCulture
Stress Specialists

Increased production of anthocyanin

- **XStress** increased the level of anti-oxidant production by 13% compared to untreated
- In absence of stress **XStress** maintains extra anti-oxidant levels
- Anthocyanin controls damaging ROS (reactive oxygen species) produced in the cell during stress



XStress

eCoCulture
Stress Specialists

Salt Stress

Conclusions

- Saline water can have a dramatic effect on plant photosynthesis, **XStress** allows plants to recover to 100% of pre-treatment levels
- Under salt stress **XStress** induces production of anthocyanin (flavonoid) to protect plant cells against damaging Reactive Oxygen Species (ROS)
- Increased levels of anti-oxidants stimulated by **XStress** help reduce infection of diseases such as powdery mildew by 50%

XStress

eCoCulture
Stress Specialists

3. Cold stress

Control of cold stress

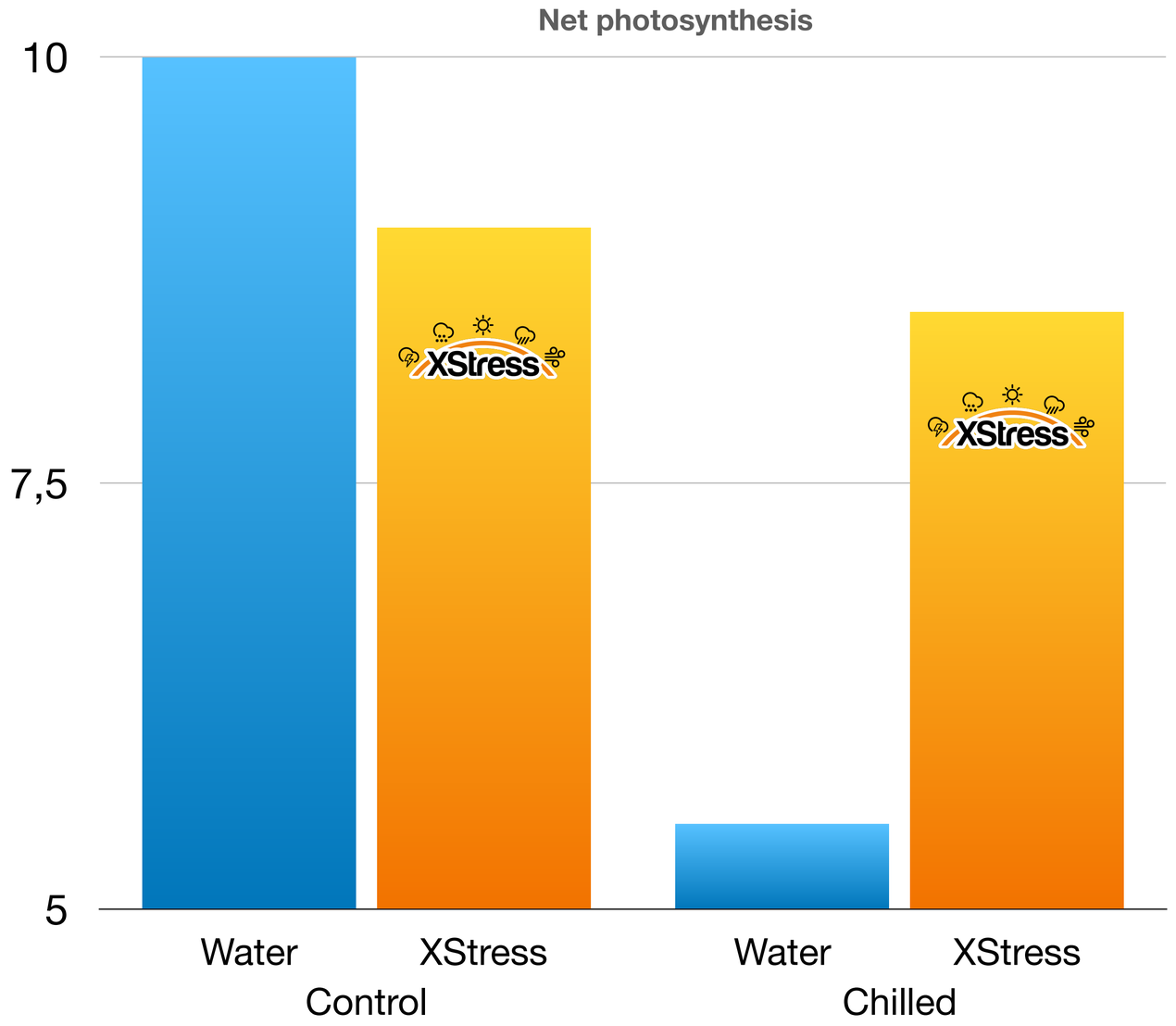
- Cold temperatures induce stress response, decrease in photosynthesis and increase in ethylene
- Leaf damage often seen as scorch
- Flowers and fruit often aborted because of cold stress
- Pre-treatment with **XStress** prevents plant stress response

XStress

eCoCulture
Stress Specialists

Cold stress

- Plants pre-treated with **XStress**
- Tomato plants chilled at 4°C for 1 night
- Photosynthesis measured after 3 days
- **XStress** treated plants were 35% less stressed than control



4. UV light

XStress

eCoCulture
Stress Specialists

Control of stress caused by UV light

- High UV light can be physically damaging to plant tissues, causing scorch
- Plant response to high UV is to shut down photosynthesis
- Grape vines are known to be prone to UV damage due to climactic conditions
- Trials set up to look at effect of UV on grape vines and response to **XStress**

XStress

eCoCulture
Stress Specialists

Grape vines

- Viticulture industry of great global (and local) importance
- Excess stress reduces yield
- Scorch to berries reduces quality
- High stressed fruit can lead to poor flavours in viticulture

High UV damage

Low UV

Laboratory tests

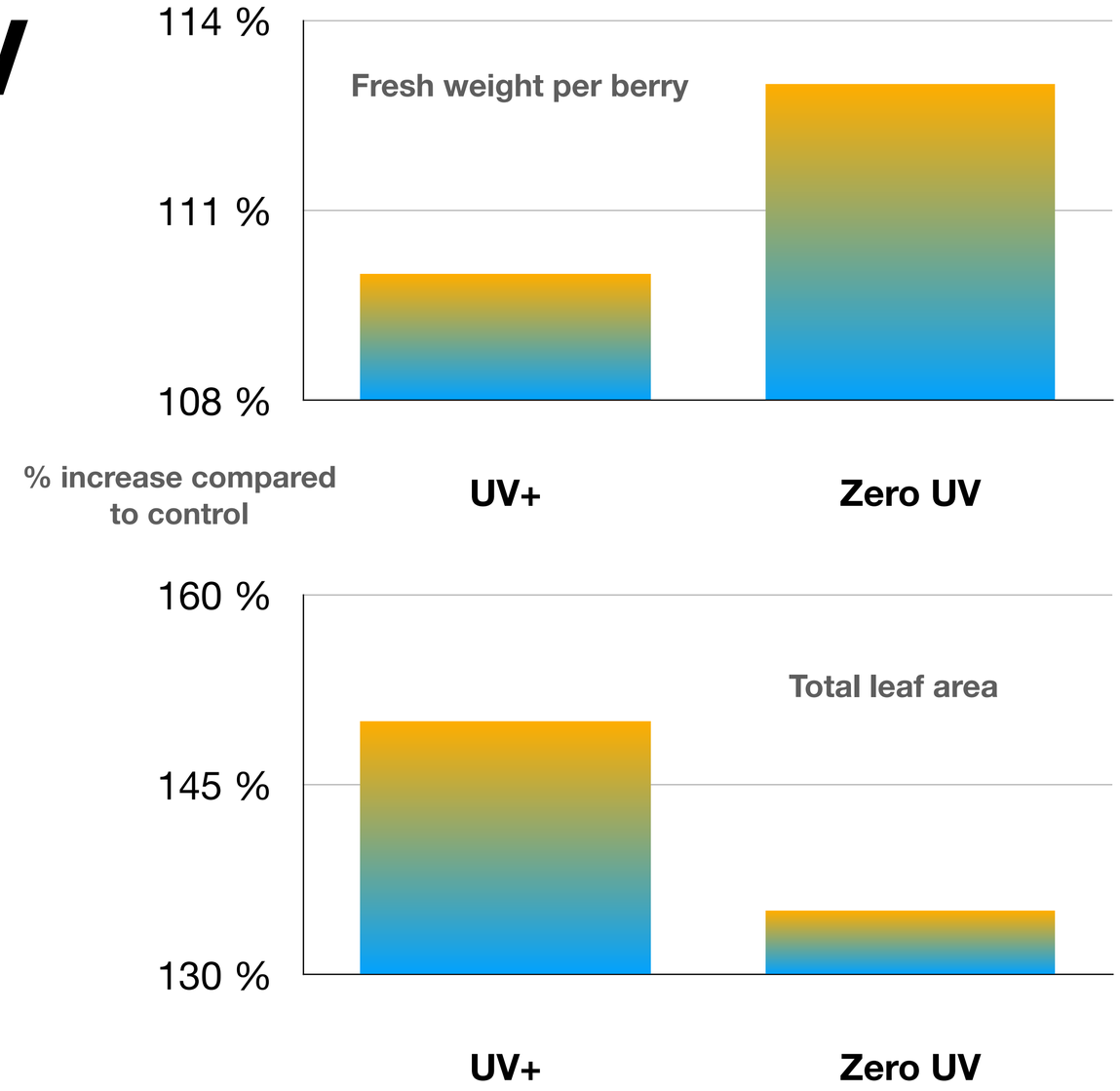
- Dwarf Sauvignon Blanc plants were pre-treated with **XStress** or water (control)
- Plants were subjected to a defined UV exposure for two weeks
- Comparison of how plants responded to UV+ and UV- was measured

High UV (UV+) Standard UV (UV-)

Physical response to UV

- With normal (UV-) light levels **XStress** increased berry weight by 13% and leaf area by 40% compared to control; this is due to the micro-nutrients in the **XStress** formula

- When stressed by high (UV+) light levels **XStress** increased berry weight by 10% and total leaf area by 50% by preventing leaf damage

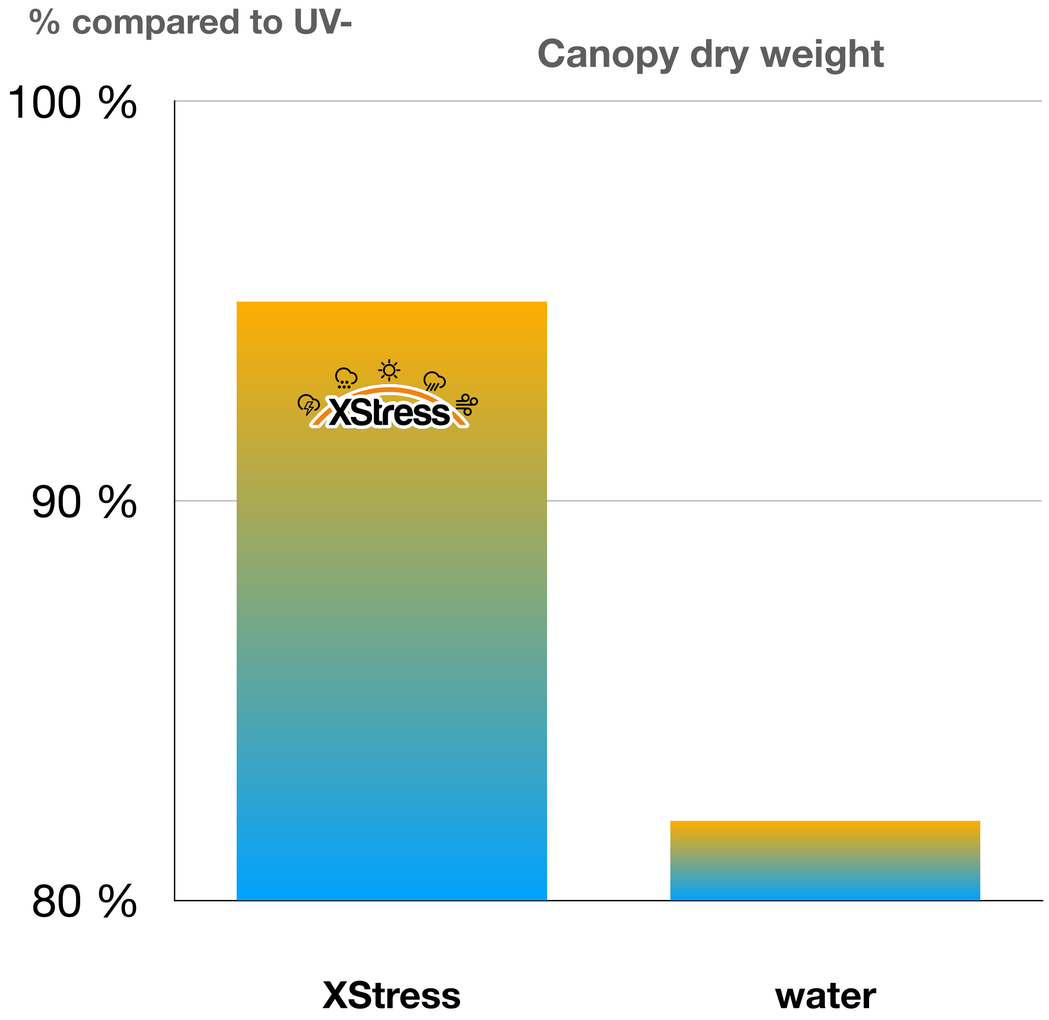


XStress

eCoCulture
Stress Specialists

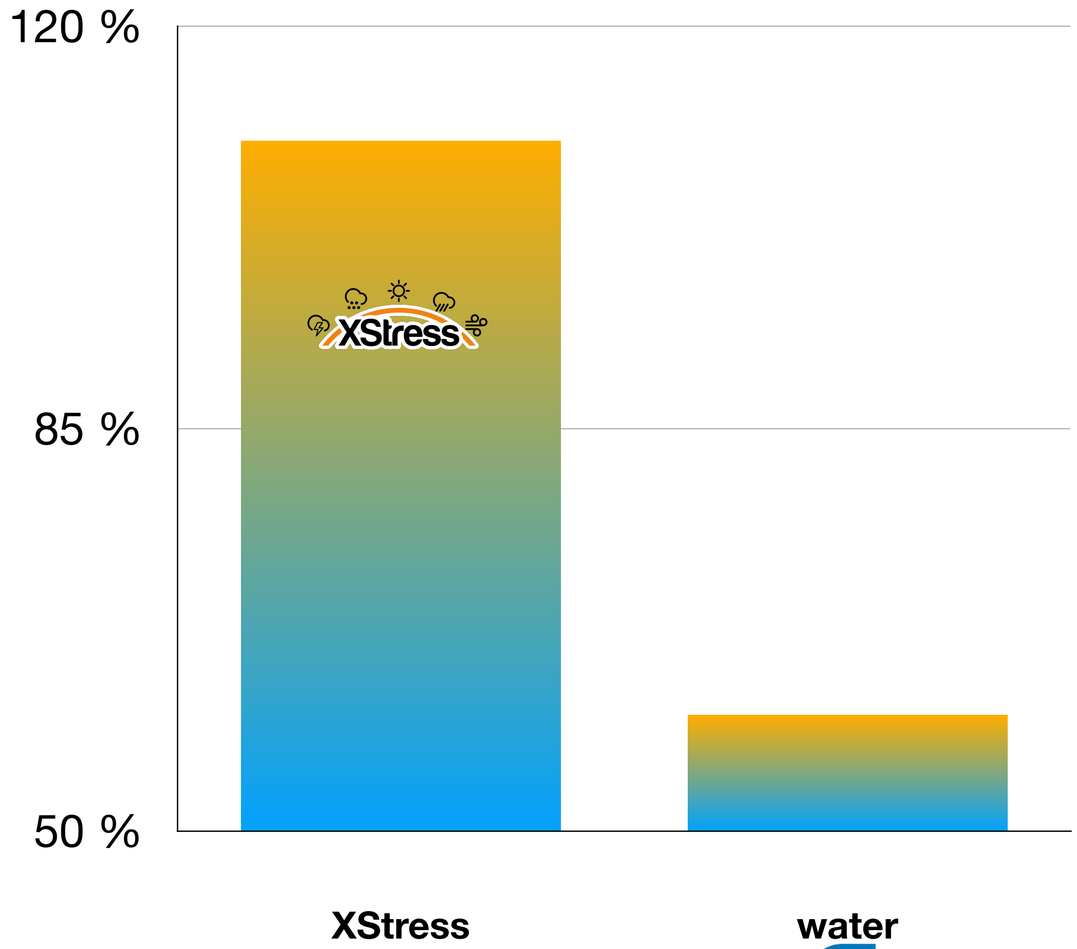
Plant weight

- Control plants exposed to UV+ lost 20% of their total biomass
- Plants treated with **XStress** lost only 5% of biomass when exposed to UV+
- **XStress** reduced the effect of UV+ stress by 19%



Photosynthetic response to UV

- Plants taken from normal UV- and exposed to UV+
- Photosynthesis measured before and 1 day after exposure to UV+
- **XStress** increased photosynthesis by 10%
- In control plants photosynthesis decreased by 25%

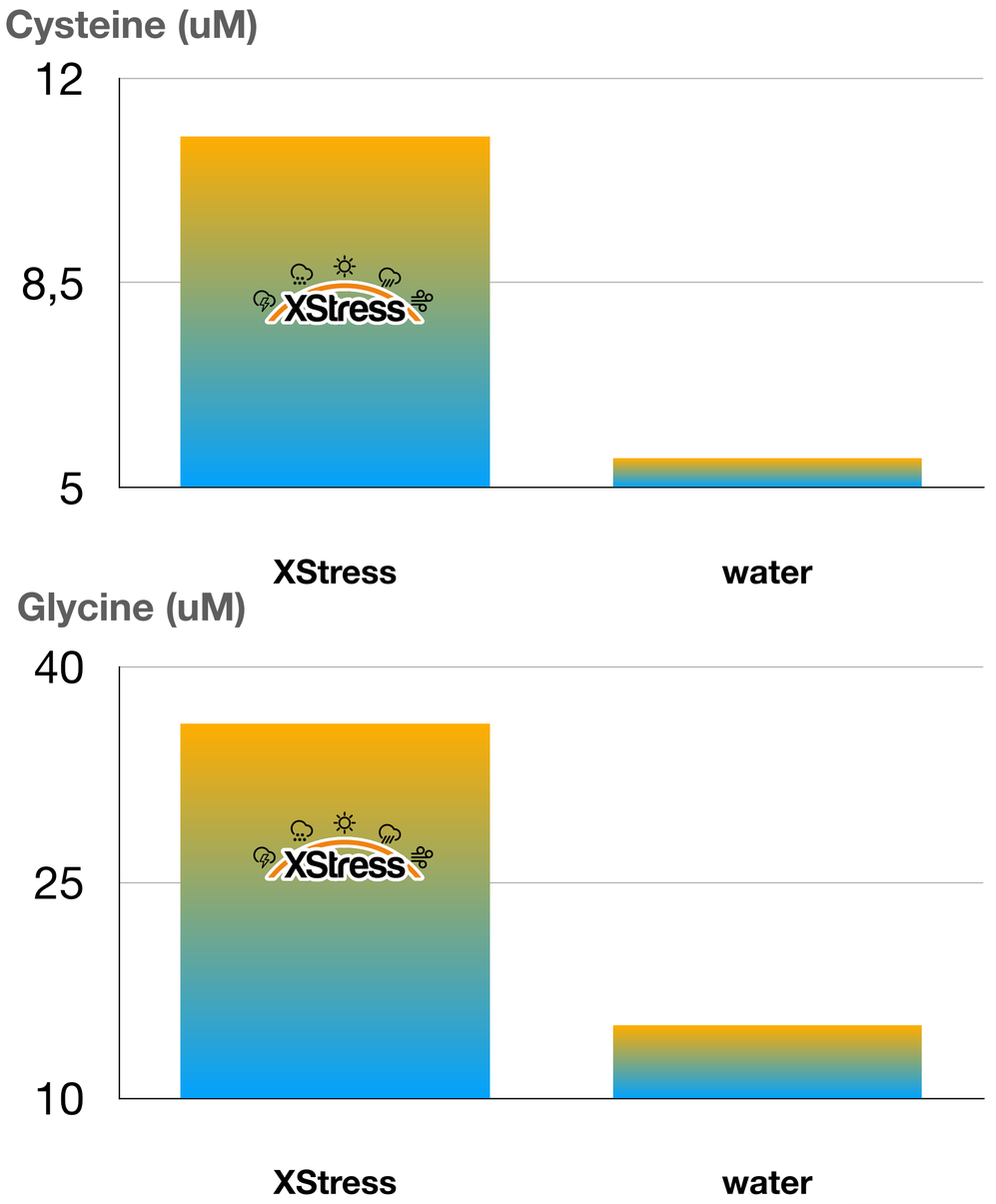


XStress

eCoCulture
Stress Specialists

Anti-oxidant response

- Both cysteine and glycine are important in antioxidant / anti-stress metabolism, e.g. glutathione production
- **XStress** increased levels of anti-oxidants significantly



UV light

Conclusions

- Use of **XStress** can help prevent physical damage to leaves caused by UV stress
- **XStress** reduces the loss in plant biomass caused by UV stress
- Because of better plant health berry weight increases when using **XStress** with or without UV stress
- Plants treated with **XStress** maintain over 100% photosynthesis even in presence of UV stress
- Increased levels of anti-oxidants induced by **XStress** protect plant from UV damage

XStress

eCoCulture
Stress Specialists

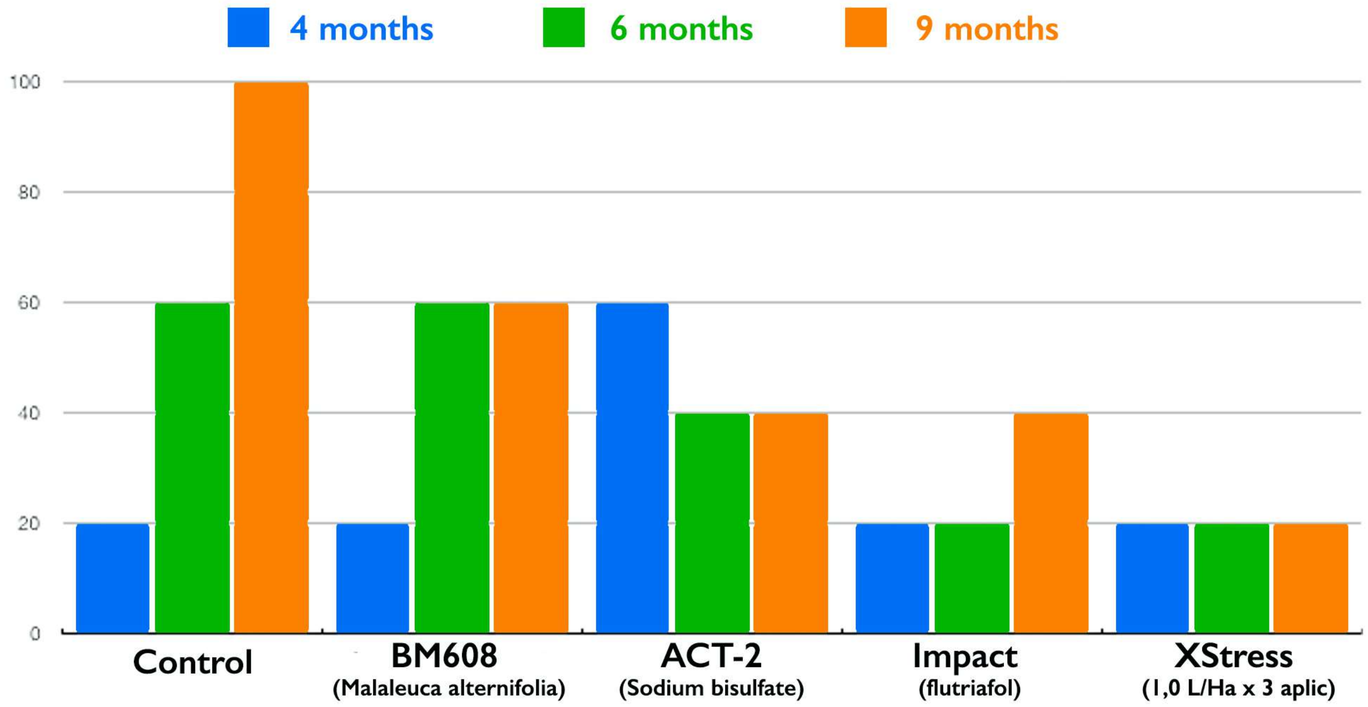
5. Disease stress

XStress

eCoCulture
Stress Specialists

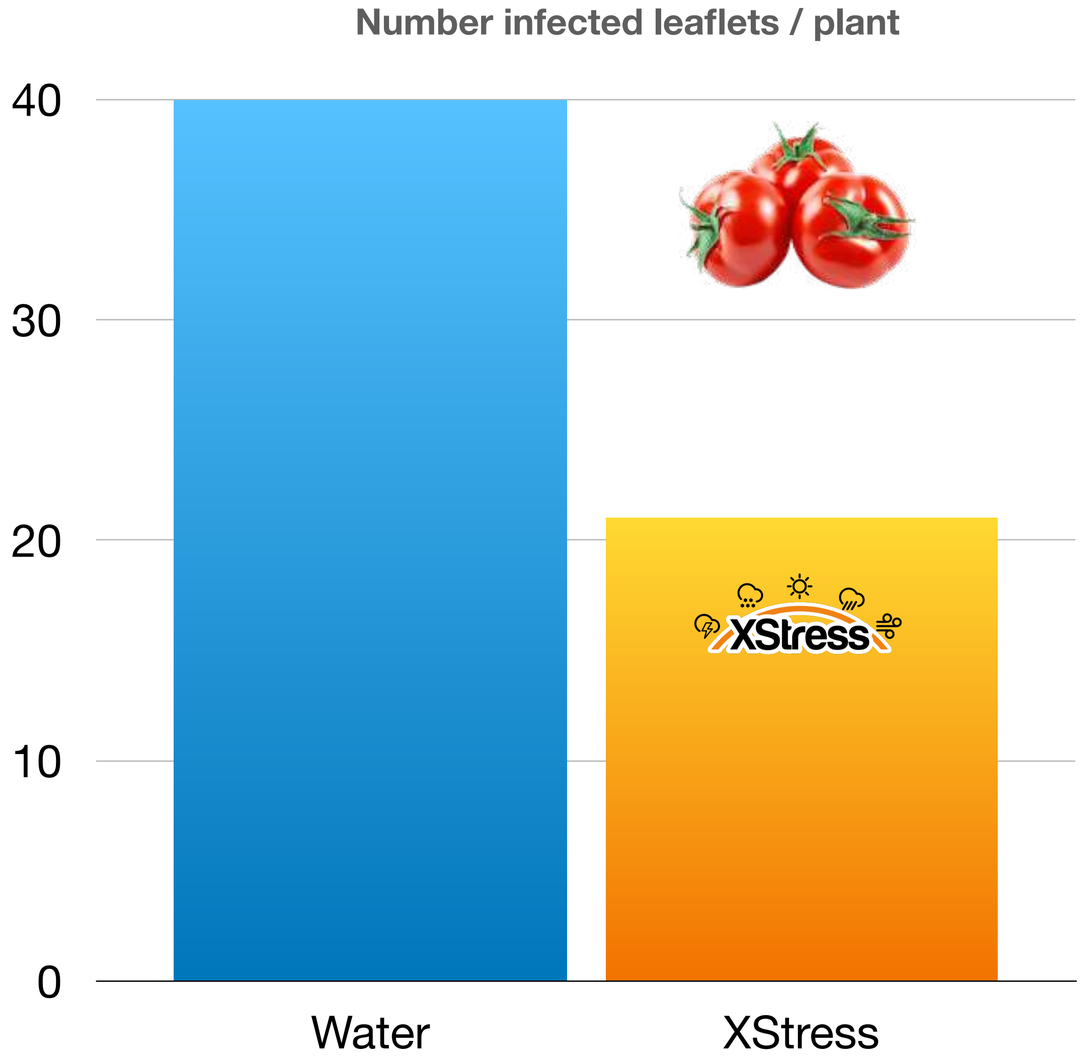
Panama disease bananas

- Plants growing under stressful conditions are more prone to fungal disease.
- Where **XStress** was used as an anti-stress product, it prevented Panama disease from establishing in the crop.
- By maintaining cell wall integrity and plant health, the fungi was prevented from infecting cells
- Reducing stress worked as efficiently as the standard fungicide flutriafol
- Reference also slide 12



Tomatoes - powdery mildew

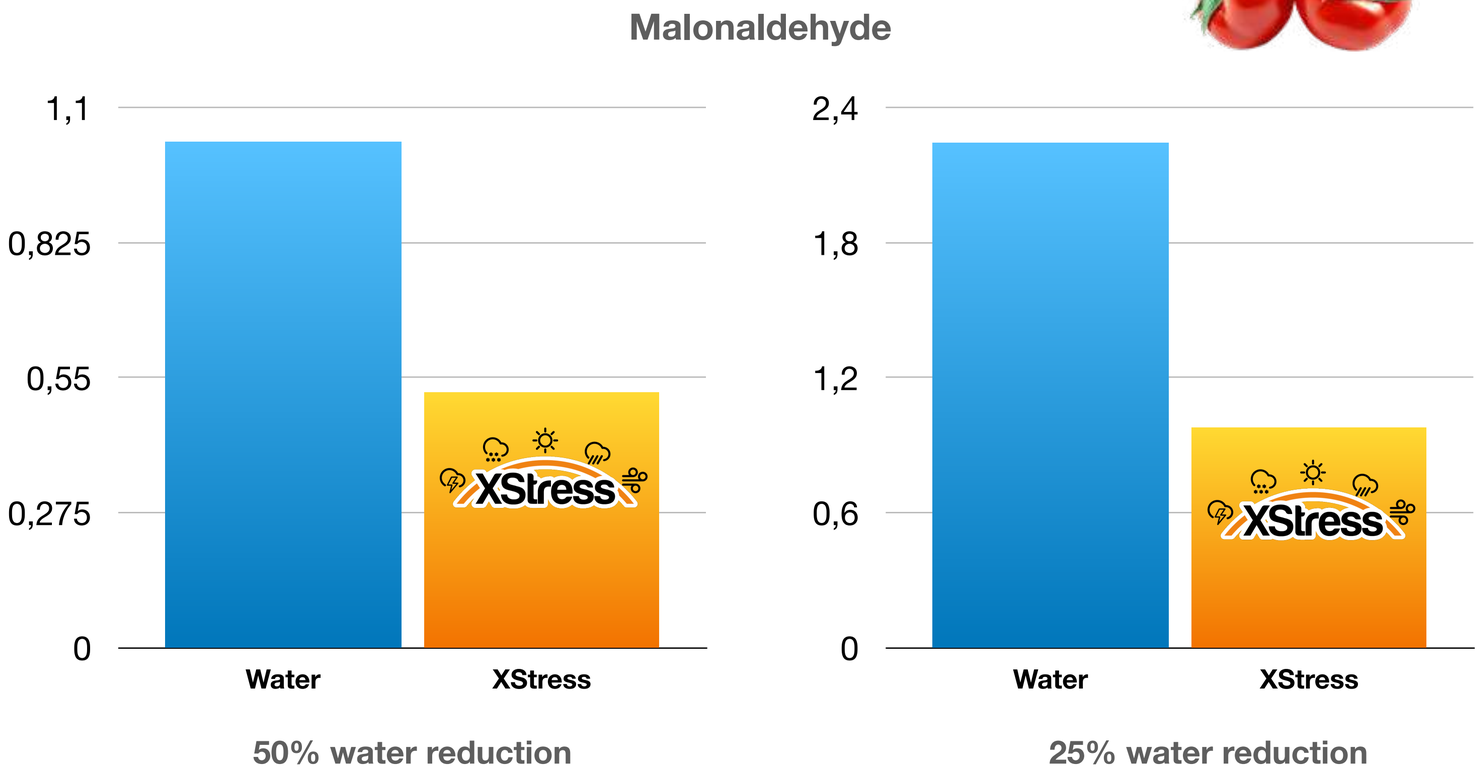
- Increased anti-oxidant levels help combat effects of diseases
- By using **XStress** disease levels are reduced by 50%
- Lowering plant stress increases plant's ability to defend against infection (plant health)



6. Water (osmotic) stress

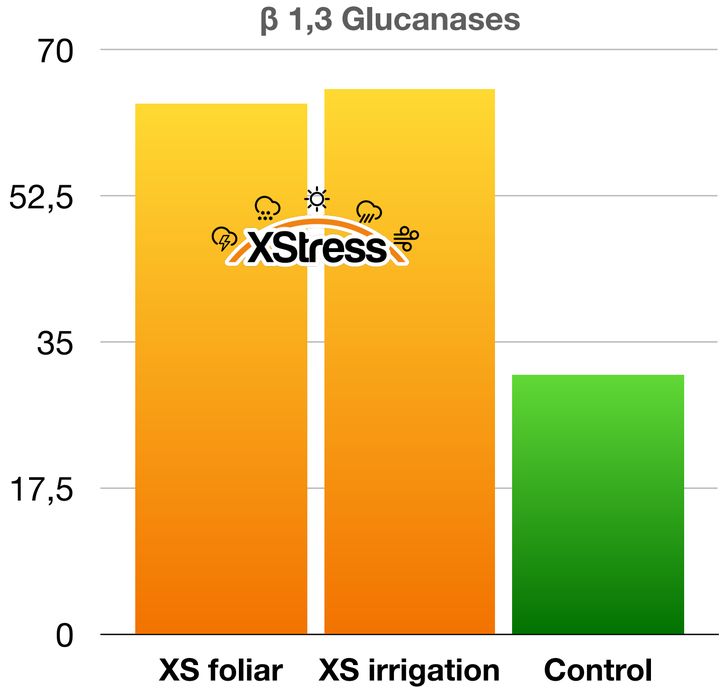
Tomatoes - Spain

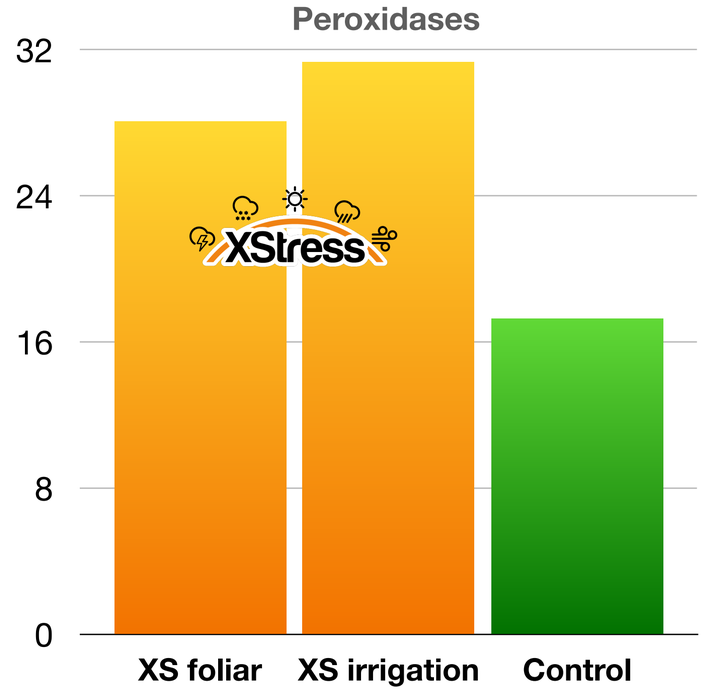
- Tomato plants were put under water stress, reducing irrigation by 25% and 50% of normal
- Malonaldehyde is the main breakdown product of linoleic acid which is manufactured in response to stress
- The lower the level of malonaldehyde (as a marker of oxidative stress), the lower the level of plant stress
- In both cases levels of stress decreased by around 50%

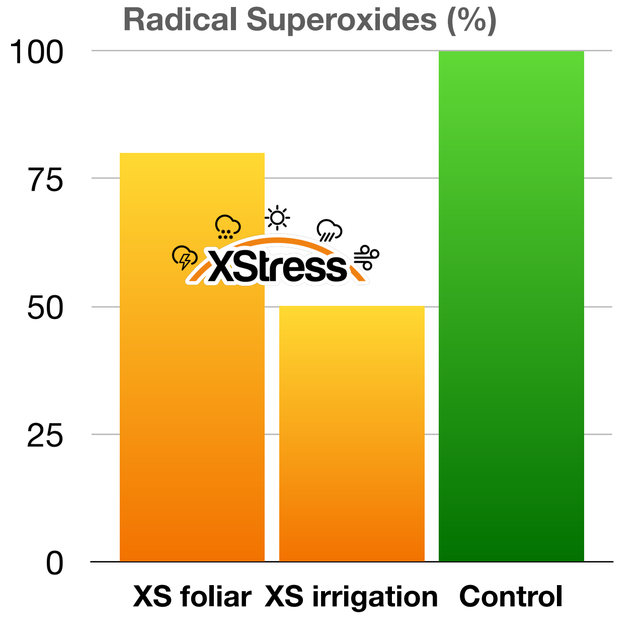


Grapes - Brasil

- Severe stress was caused by high temperatures and reduced water
- The up-regulation of glucanase and peroxidase anti-oxidants help to counteract the effects of stress at a cellular level
- Reduction of damaging radical superoxides (ROS) in the cell is the beneficial outcome, leading to better growth and yield. (Reference slide 4)
- Rate of applications:
  Foliar: 4 applications @ 1.0 l/ha
  Irrigation: 4 applications @ 1.5 l/ha







XStress

eCoCulture
Stress Specialists

Osmotic stress

Conclusions

- Water stress through reduced irrigation or high temperatures has a major impact on plant stress
- Levels of ROS increase in cells causing damage, reducing yield, quality and plant health
- Use of **XStress** unregulated linoleic acid, glucanase and peroxidase to counteract stress
- Levels of ROS decreased by up to 50% in treated plants

XStress

eCoCulture
Stress Specialists

7. Ethylene control

Ethylene control

- During periods of stress excess ethylene is produced
- This is primarily to liberate calcium from cell walls to combat ROS
- Excess early ethylene release (not for ripening) leads to weakened cell walls, poor fruit quality, increased disease levels.
- By using **XStress** prior to harvest anti-oxidant levels are increased and ethylene levels decreased. This leads to increased shelf life of fruit post-harvest

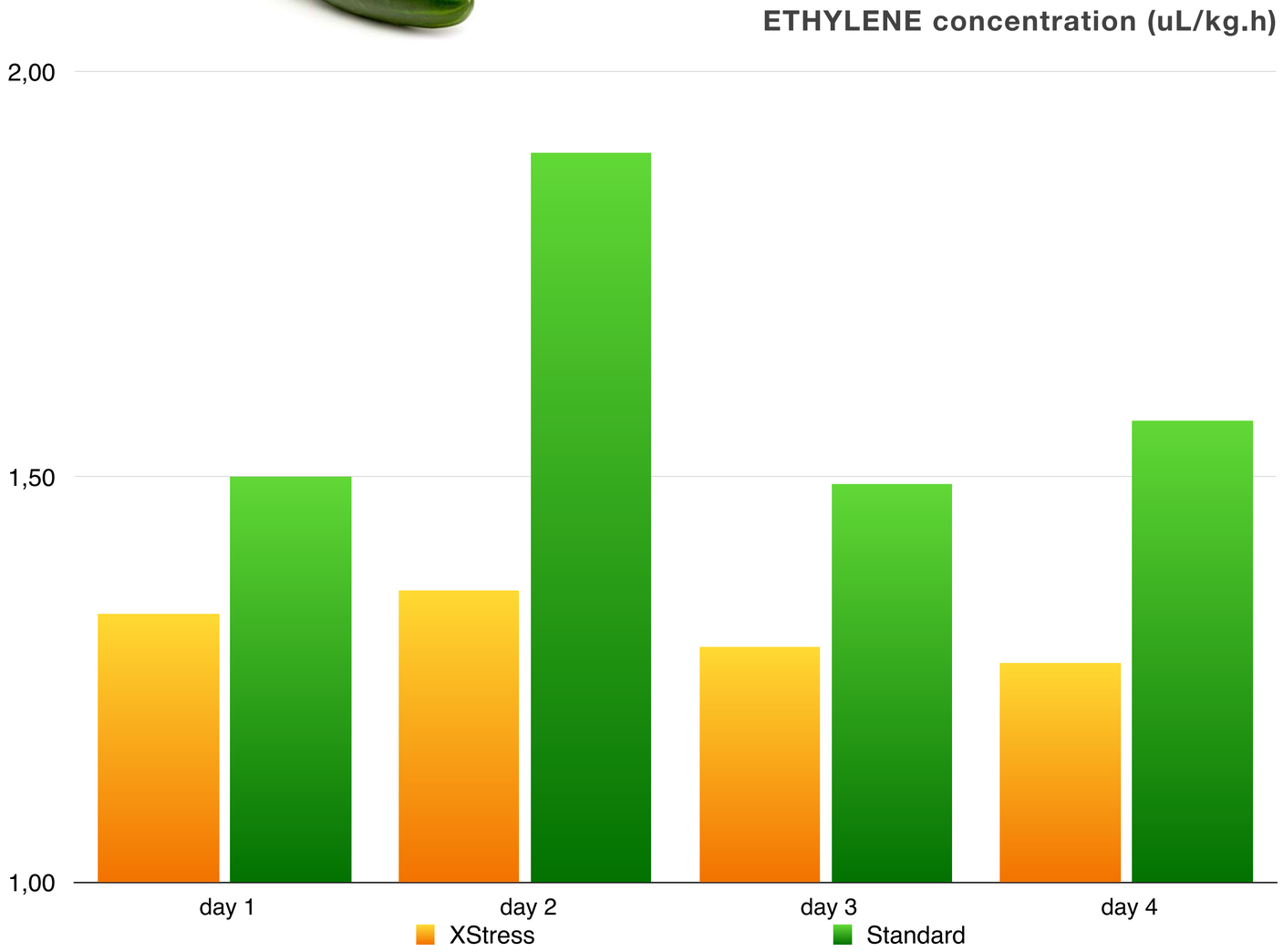
XStress

eCoCulture
Stress Specialists

Cucumber - Spain

tecnova
CENTRO TECNOLÓGICO

- 3 applications (10 day interval) pre-harvest
- **XStress** applied at 1cc/l
- At day 4 post-harvest **XStress** reduced ethylene production by 20%



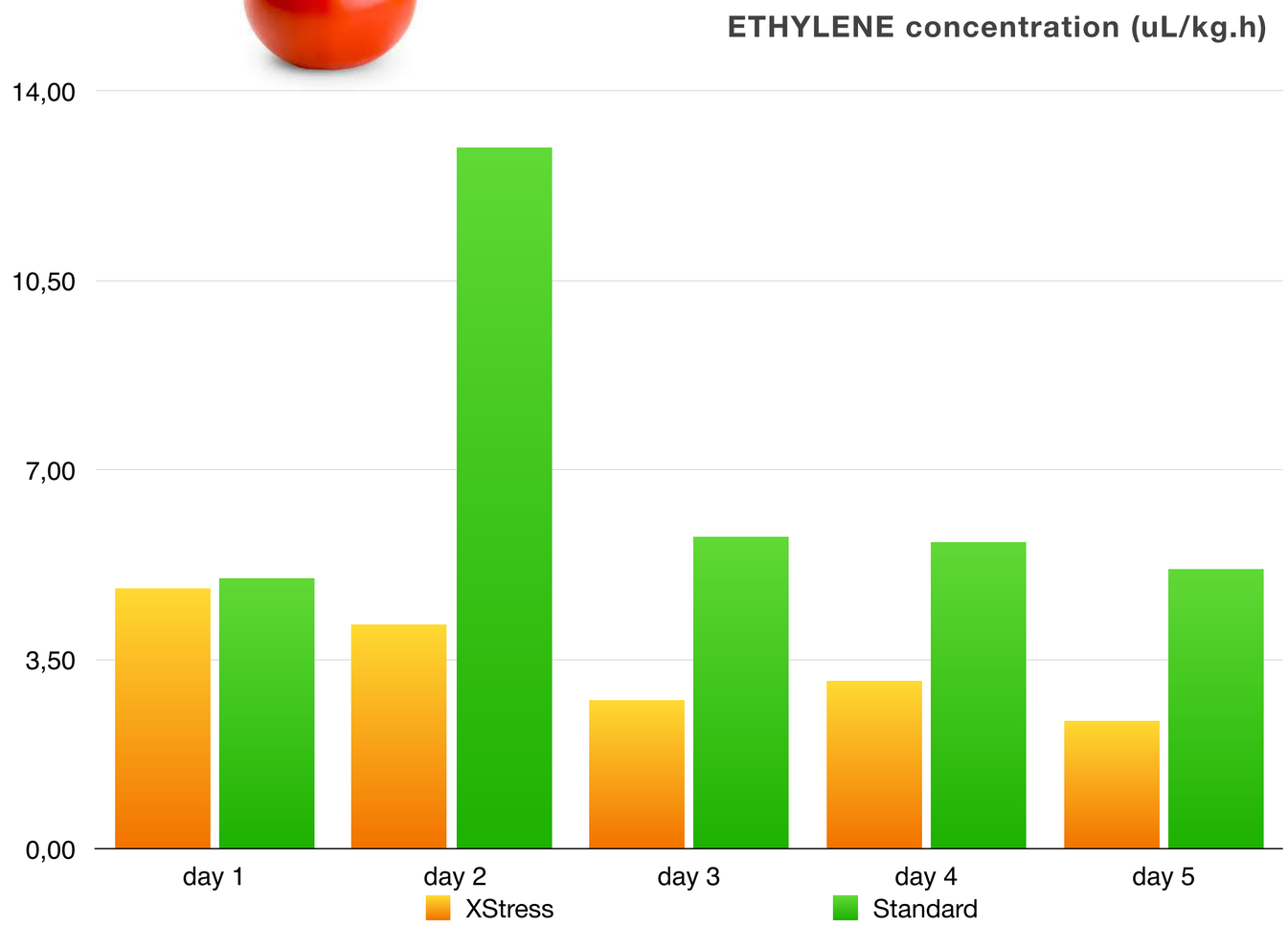
XStress

eCoCulture
Stress Specialists

Tomato - Spain

tecnova
CENTRO TECNOLÓGICO

- 3 applications pre-harvest
- **XStress** applied at 1l /1,000l water
- After 5 days post-harvest **XStress** reduced ethylene production by a total of 50%



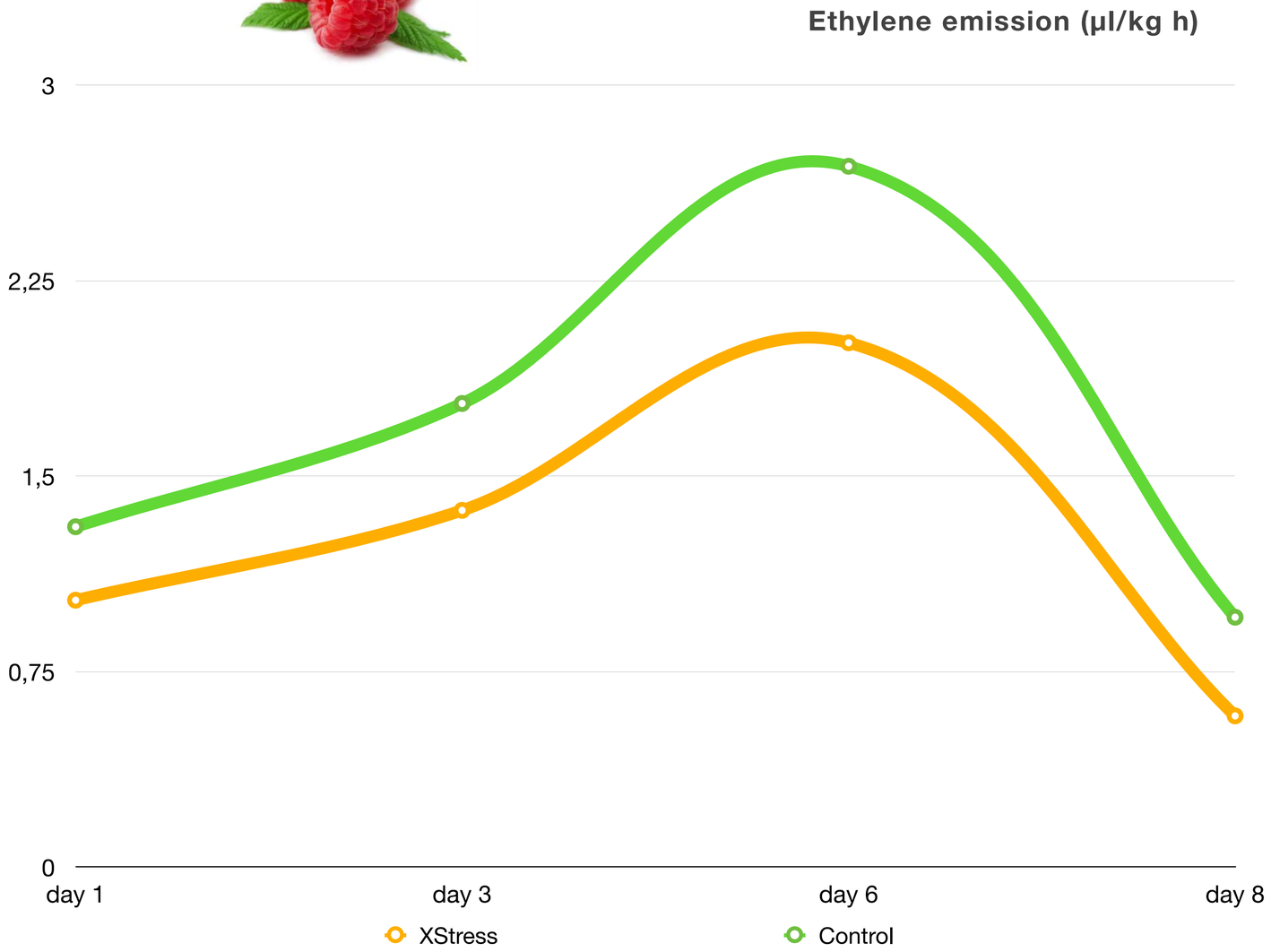
XStress

eCoCulture
Stress Specialists

Rasberries - Spain

tecnova
CENTRO TECNOLÓGICO

- 2 applications 10 and 4 days pre-harvest
- **XStress** applied at 1.5cc /l water
- After 8 days post-harvest **XStress** reduced ethylene production by a total of 25%



XStress

eCoCulture
Stress Specialists

Ethylene control

Conclusions

- In all fruit pre-harvest applications of **XStress** reduced ethylene levels in all situations by preventing stress
- Reduced ethylene levels prevent premature maturation in fruit
- Shelf life increases, fruit firmness increases, secondary disease decreases (botrytis), waste decreases

XStress

eCoCulture
Stress Specialists

Summary

- Designed specifically for control of plant stress.
- Improves plant health and nutrition in all circumstances.
- Controls all types of stress from salinity, UV, high temperatures, osmotic and disease.
- Acts at a cellular level by increasing anti-stress proteins, reducing ROS and stopping excess ethylene production.
- Improves quality and yield of fruit as well as increasing shelf life