



Irrigation and Crop Load Interactions



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The rationale behind the interactions of irrigation and crop load

- The higher the crop load the higher the demand for the production of dry matter/assimilates.
 - Higher assimilation rate requires higher stomatal conductance and therefore higher transpiration rate.
 - There is a possibility that in low crop load trees the amount of required assimilates can be supplied even at a certain stress (lower stomatal conductance).
 - Fruit development involves expansive growth which is turgor dependent.
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The combined effect of irrigation rate and crop load on the **yield**



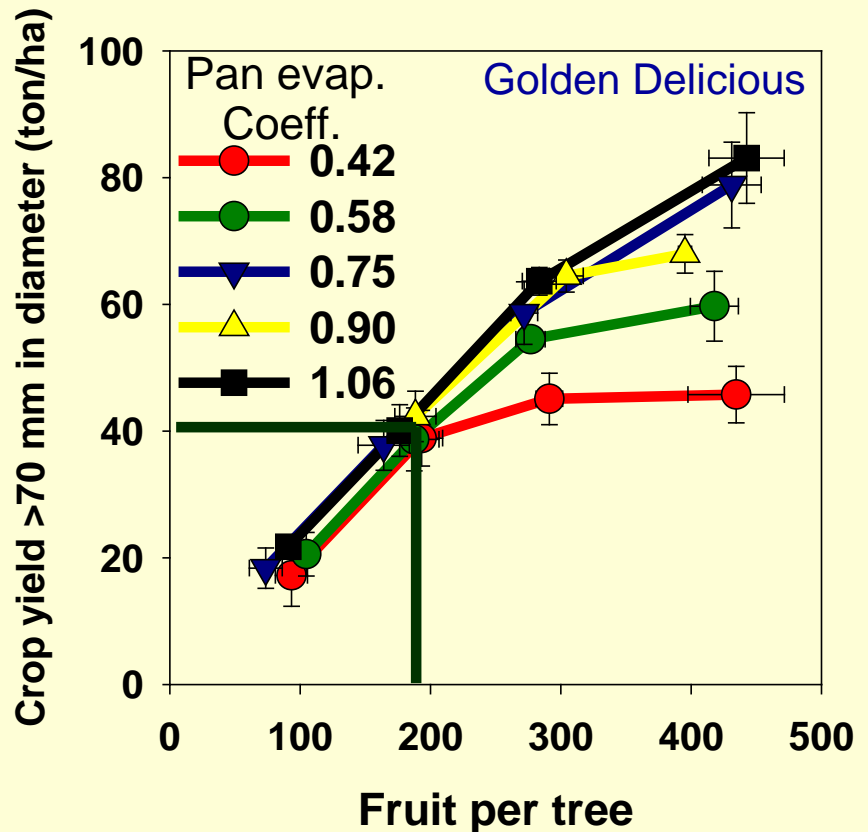
The response of apple crop yield (>70 mm) to irrigation rate and crop load (Naor et al, 1997)

Five irrigation rates were applied in the main fruit growth stage - (0.42 – 1.06).

Each irrigation treatment had four crop loads.

Irrigation above the lowest rate does not affect crop yield at low crop levels.

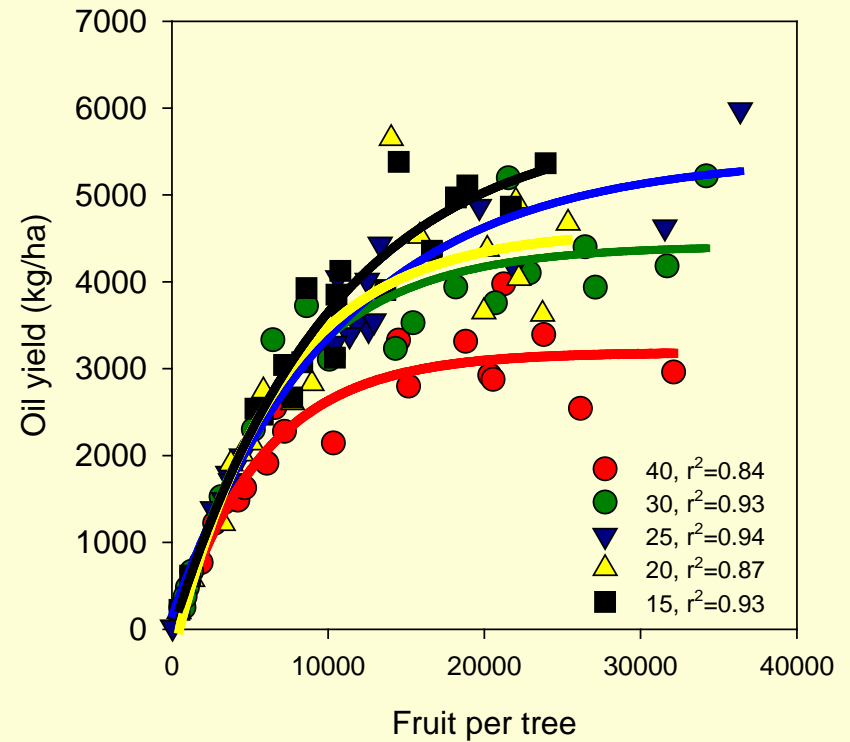
The higher the crop level the higher the dependence of crop yield on irrigation.



The response of olive oil yield to irrigation rate and crop load (Naor et al, 2013)

Irrigation does not affect oil yield at low crop level.

The higher the crop level the higher the dependence of oil yield on irrigation.



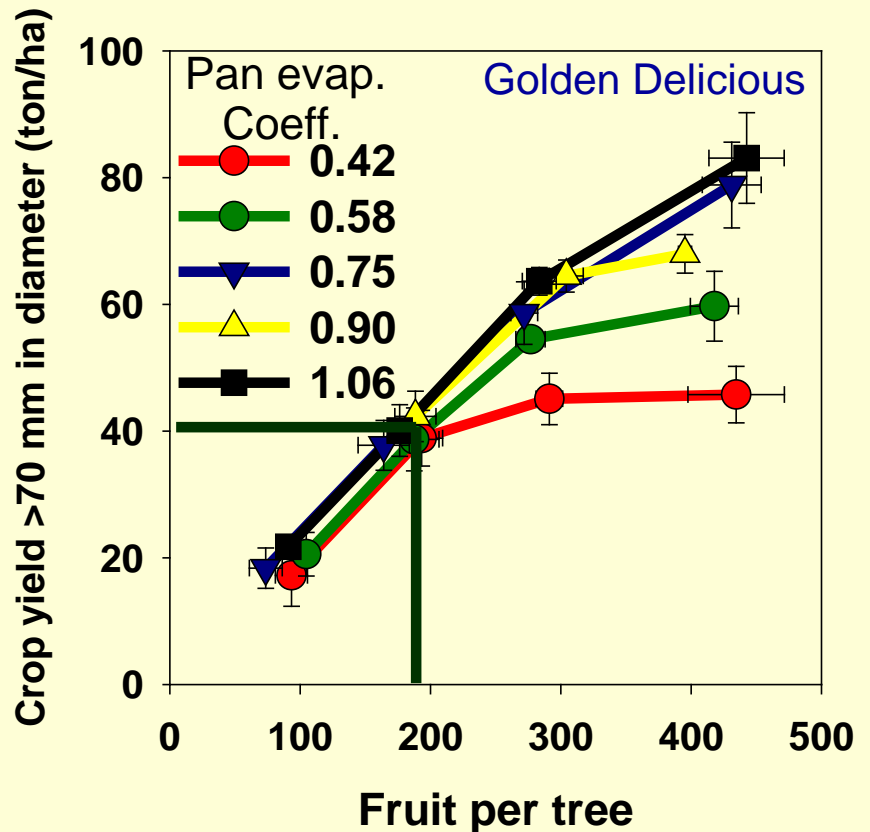
Fruit size depends on the balance between the source and the sink of assimilates


Source capacity - Irrigation affects the availability of assimilates by changing stomatal conductance.

Sink capacity - Crop level affects the availability of assimilates as it determines the whole tree demand for assimilates.

Source capacity can be decreased at low crop load (**less water, lower stomatal conductance**).

Sink capacity can be decreased by fruit thinning to allow the remaining fruit to reach final size.



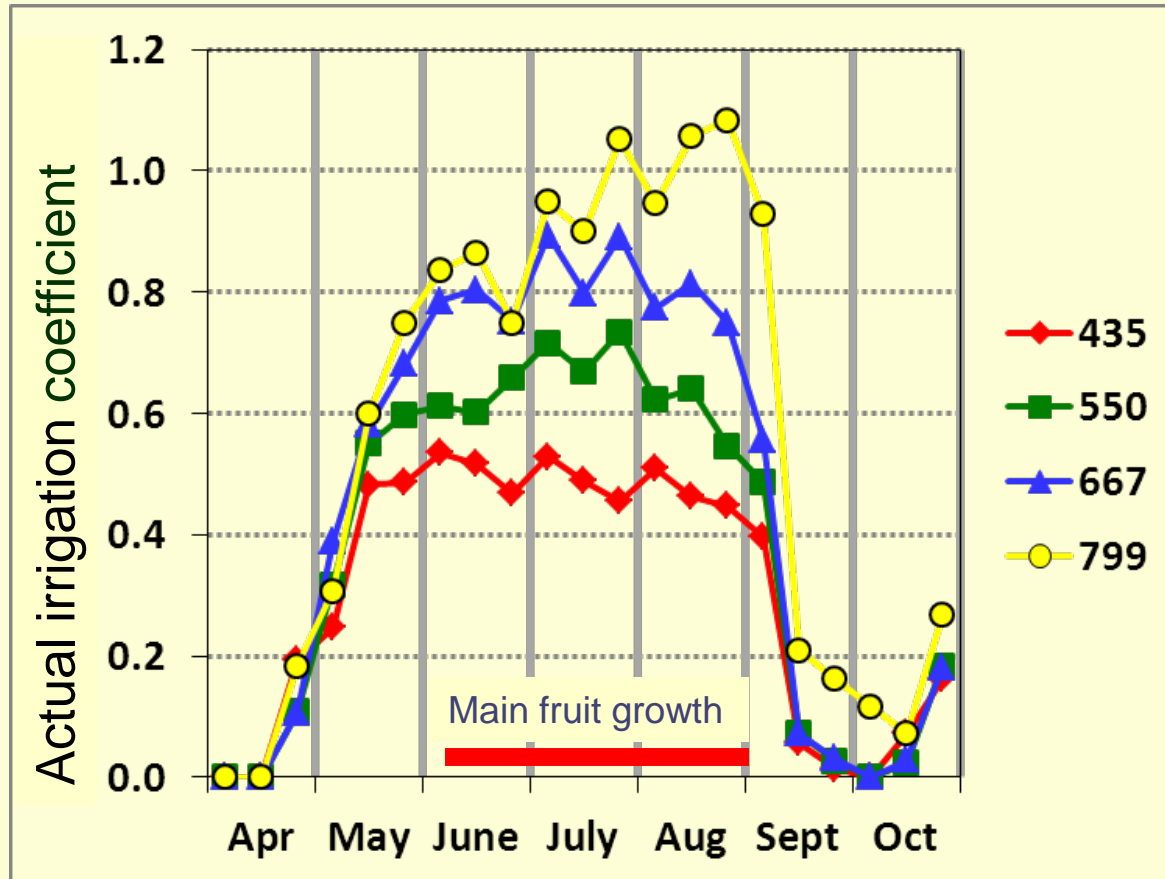


The effects of crop load and irrigation on apple crop yield

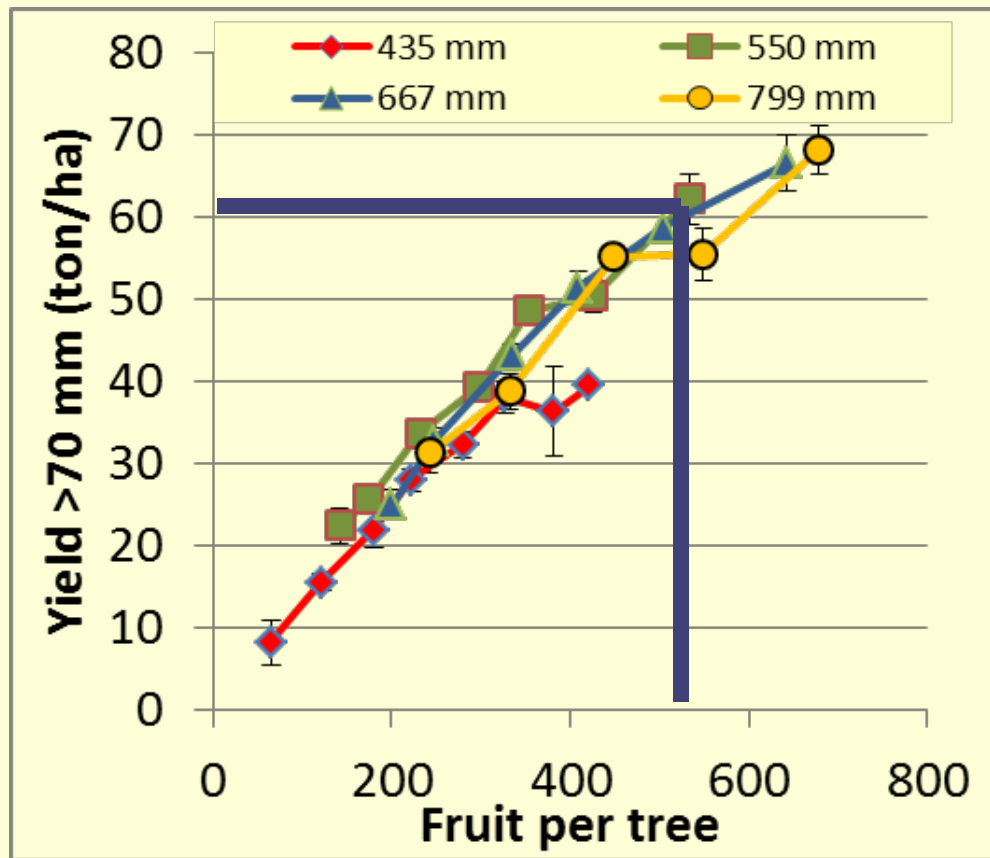
- Four seasonal irrigation levels and four crop loads were examined in a factorial design.
- The results of the first six years are presented (2009-2014).



The seasonal distribution of the irrigation water

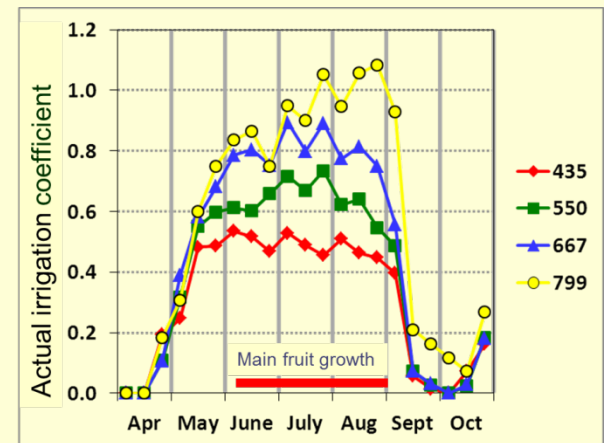
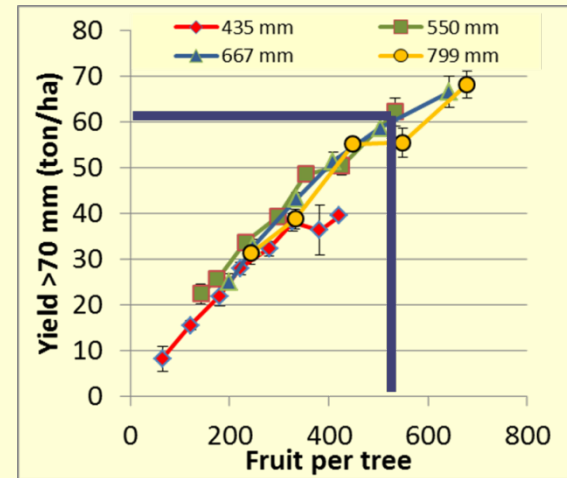


Effect of irrigation and crop load on crop yield of apple >70 mm (2009-2014 data)



~25% of the water can be saved and still have 60 t/ha >70 mm.

- The distribution of water
 - Reduce dramatically post harvest irrigation.
 - Some water can be saved early in the season.
 - Prefer the early stage of the main fruit growth stage in terms of irrigation level.
- Fruit thinning should be done very early in the season.

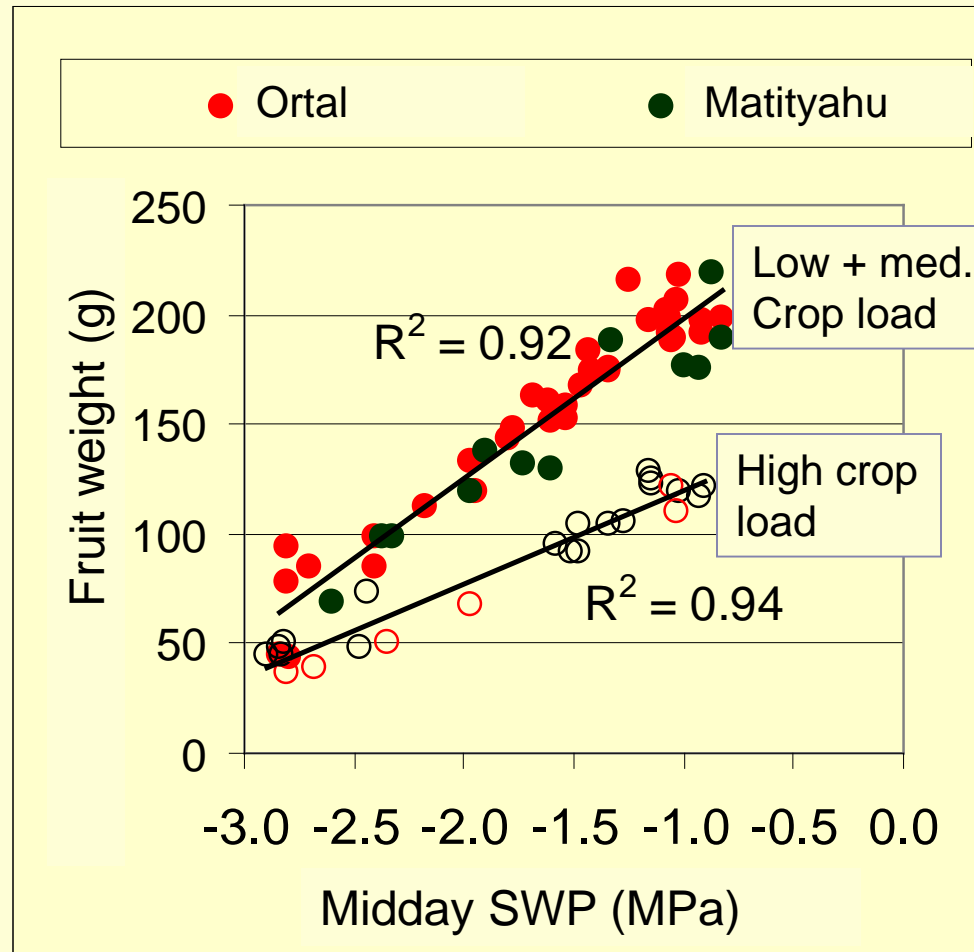




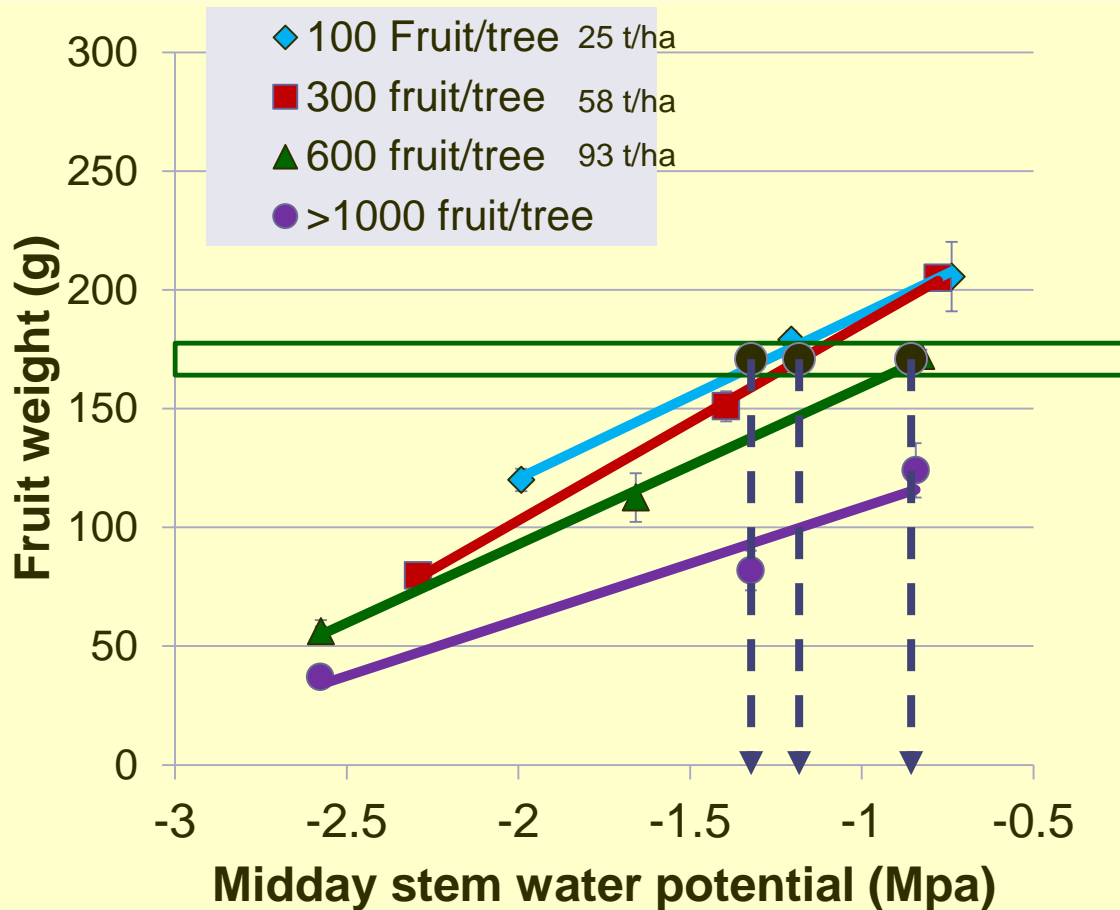
The effect of crop load on the relationships
between **stem water potential and apple fruit size**



The response of fruit weight to tree water status (Naor et al, 2008)



Effect of crop loads on thresholds for irrigation scheduling in apple (Naschitz et al, unpub.)



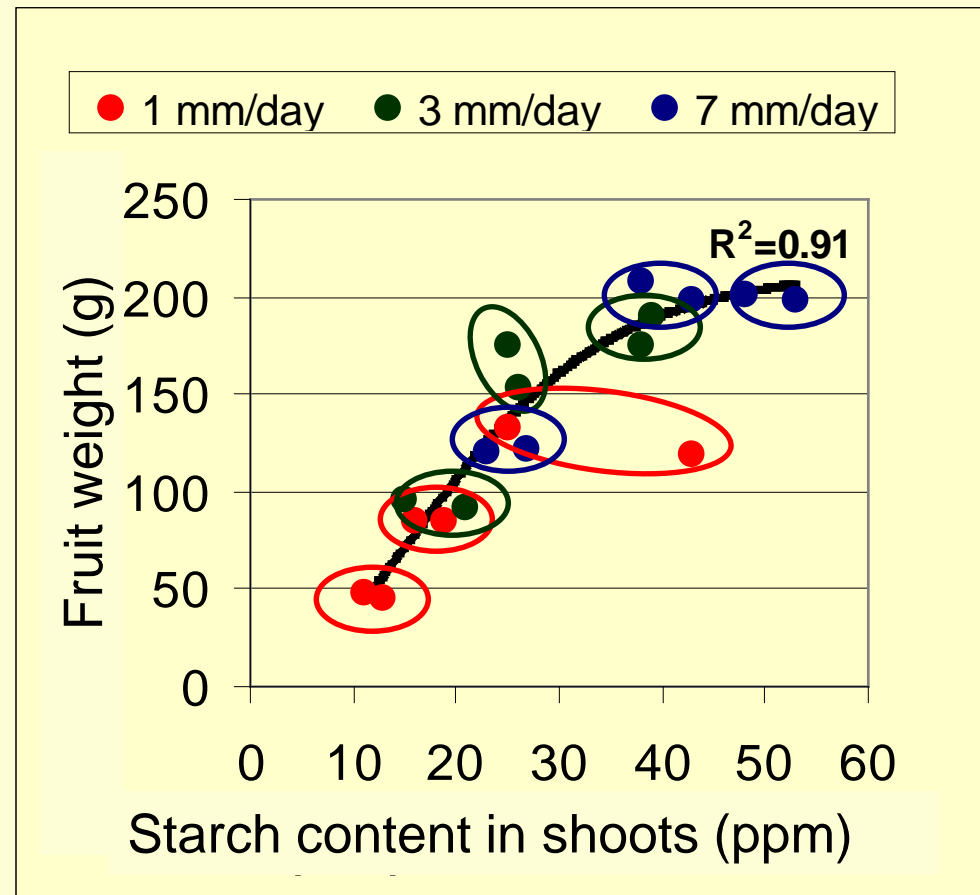


The combined effect of irrigation rate and crop load on the **availability of assimilates**



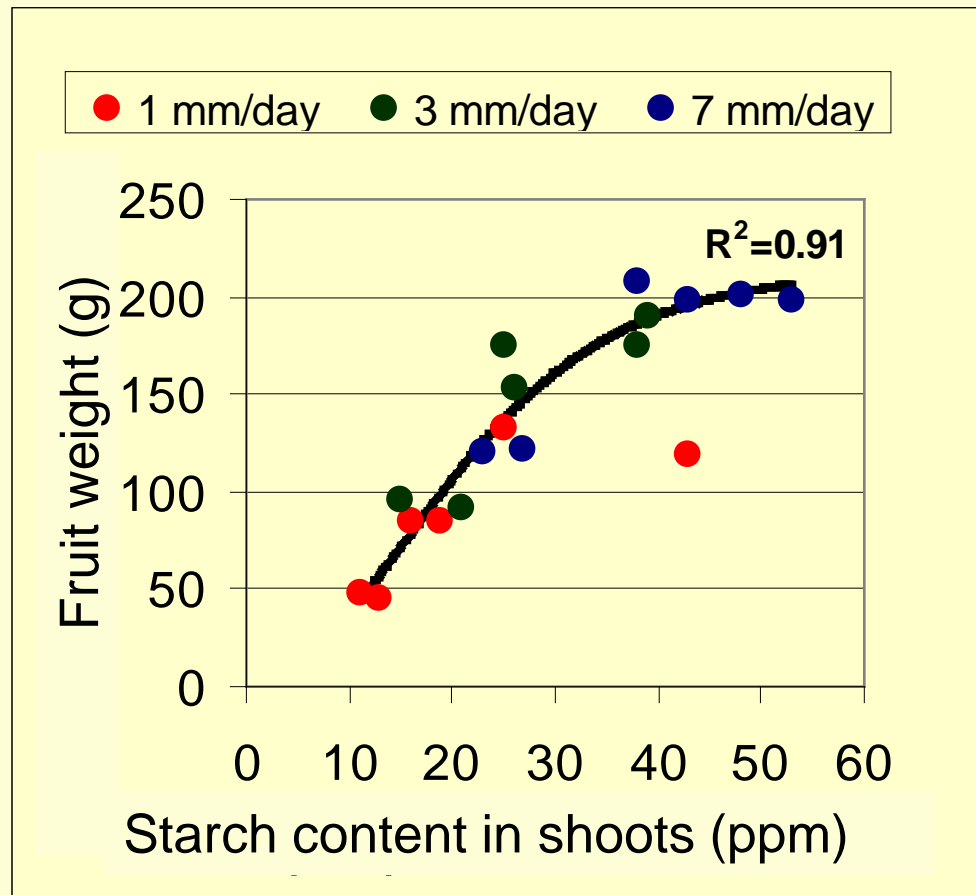
Starch content in shoots as an indicator of assimilates availability in apple (Naschitz et al., 2010)

- Two factors were examined in a Golden Delicious orchard:
 - Irrigation rate – 3 levels
 - Crop load – 3 levels
- Starch content and final fruit size were measured.

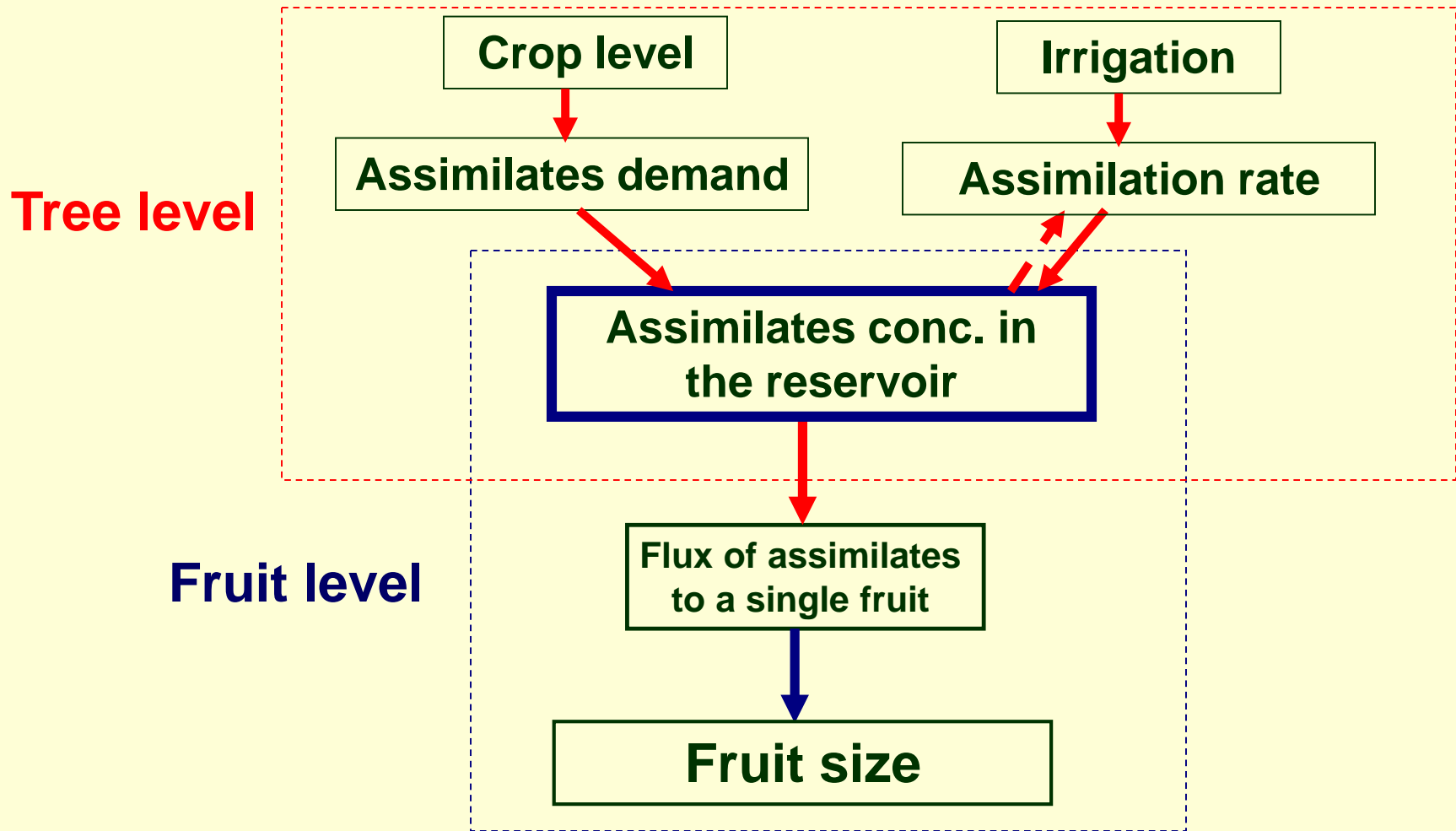


Starch content in shoots as an indicator of assimilates availability in apple (Naschitz et al., 2010)

- Fruit weight had the same response to starch content weather the variability was due to irrigation or crop load.
- Starch content in the shoots integrates the effect of irrigation and crop load on the availability of assimilates.



Effect of irrigation and crop load on assimilates availability (Naschitz et al, unpub.)

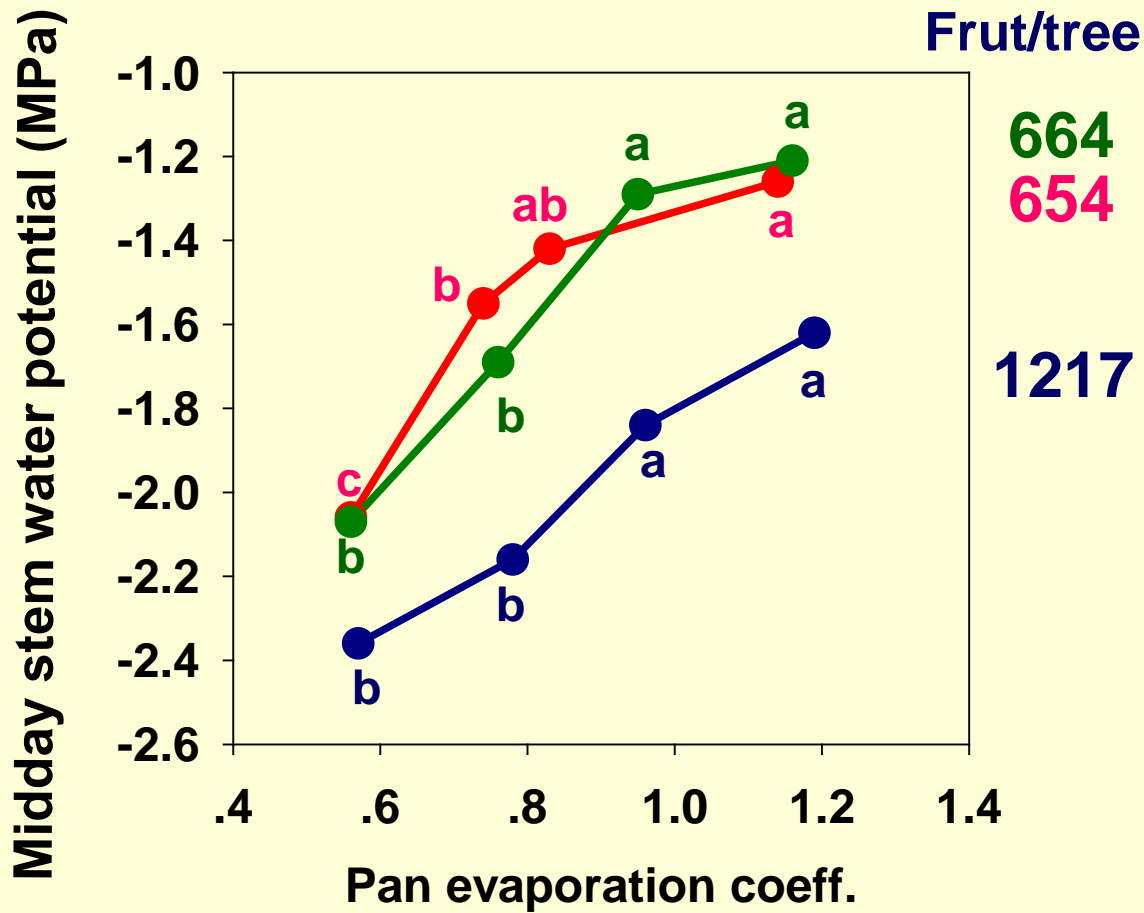




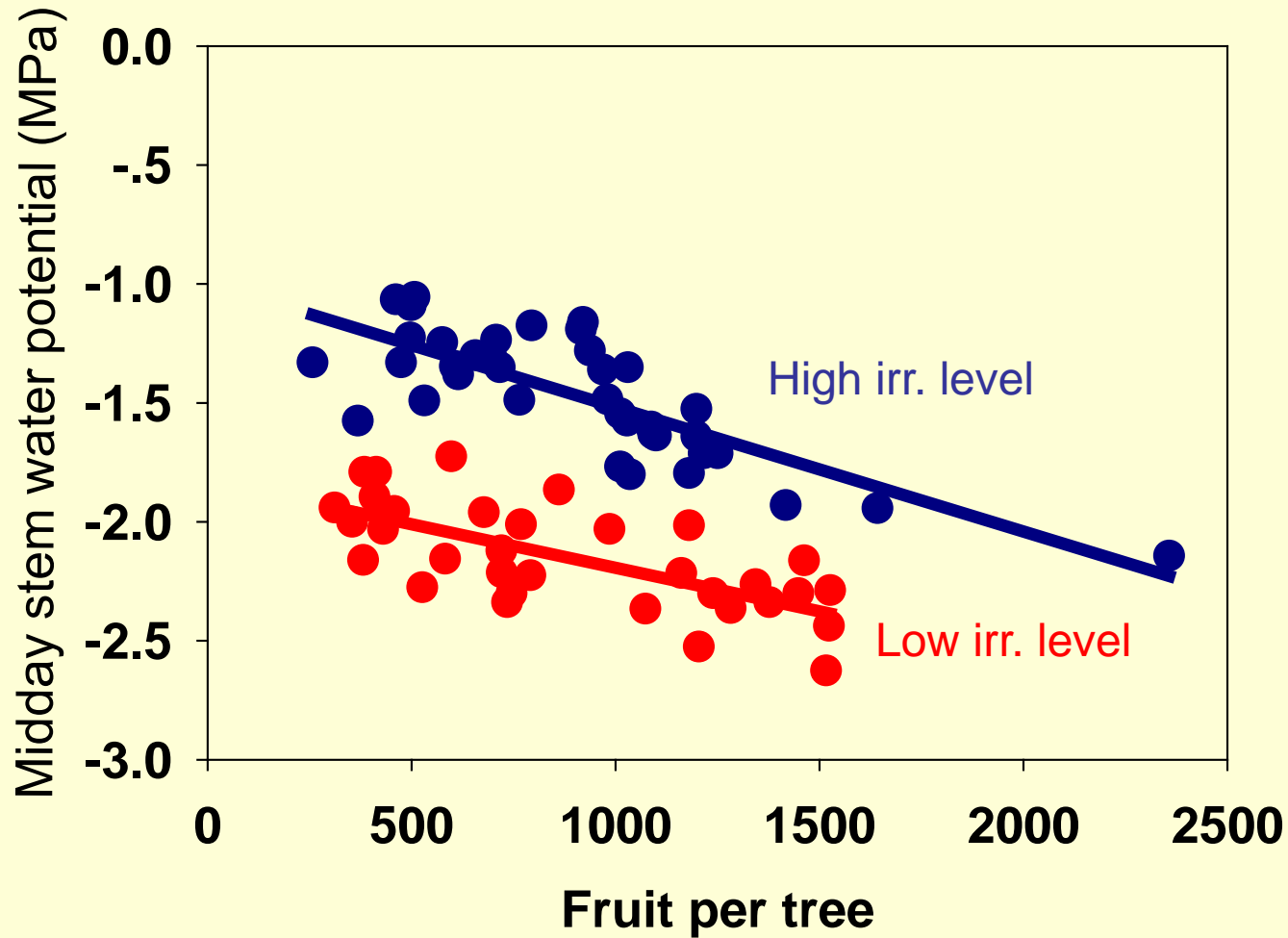
The combined effect of irrigation and crop load on stem water potential



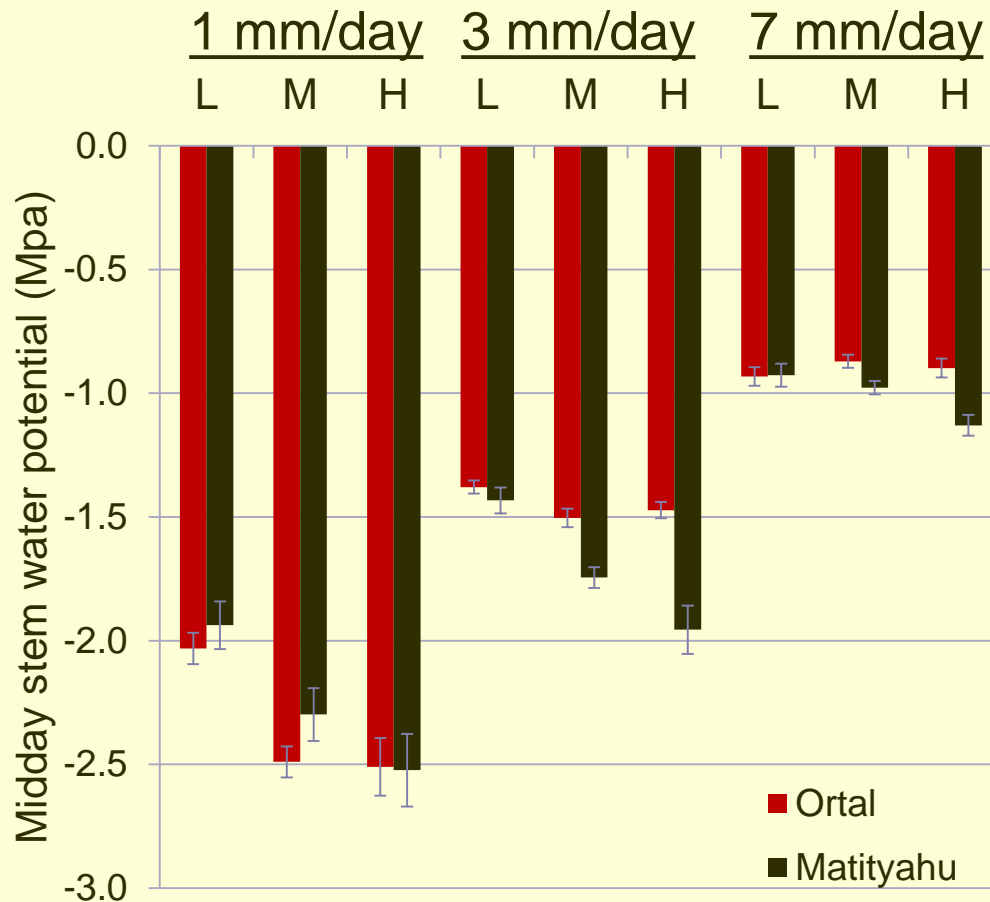
Effect of the irrigation rate on midday stem water potential in nectarine (Naor et al, 2001)



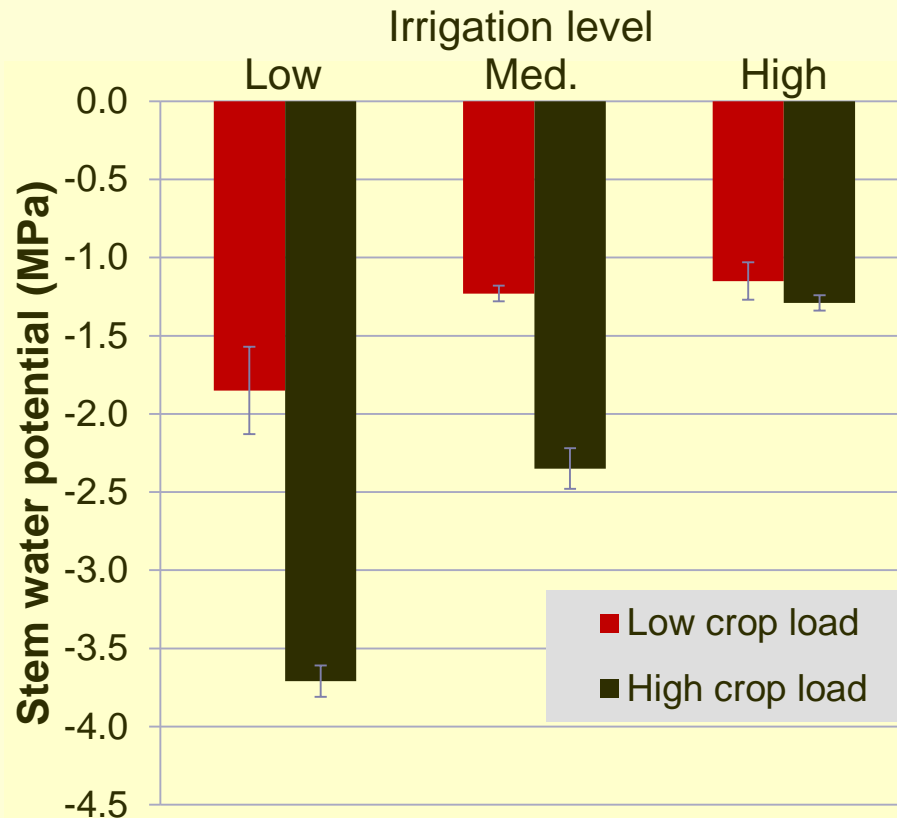
Effect of the number of fruit per tree on midday stem water potential in nectarine



Effect of crop load on midday stem water potential in apple (Naor et al, 2008)



Effect of crop load on stem water potential and stomatal conductance in olive (Naor et al, unpub.)



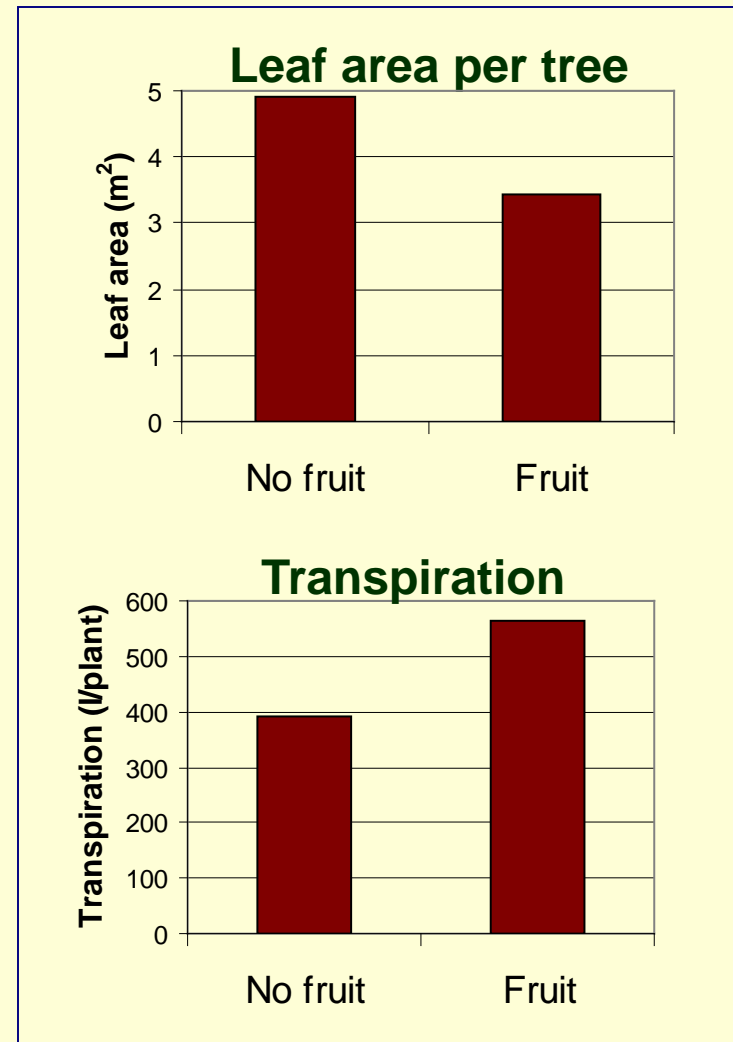


The combined effect of irrigation and crop load on stomatal conductance



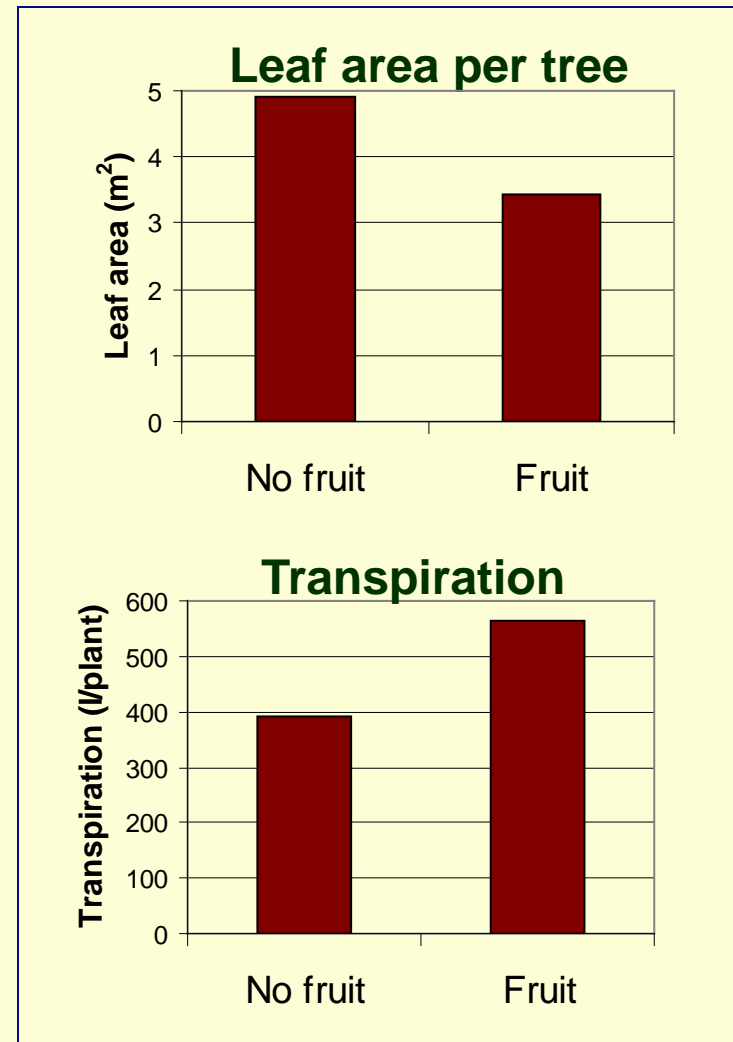
Effect of the presence of crop on water consumption in apple (Lenz, 1986)

- Apple trees were grown in containers.
- Trees with and without fruits were compared.
- Transpiration and leaf area were measured.

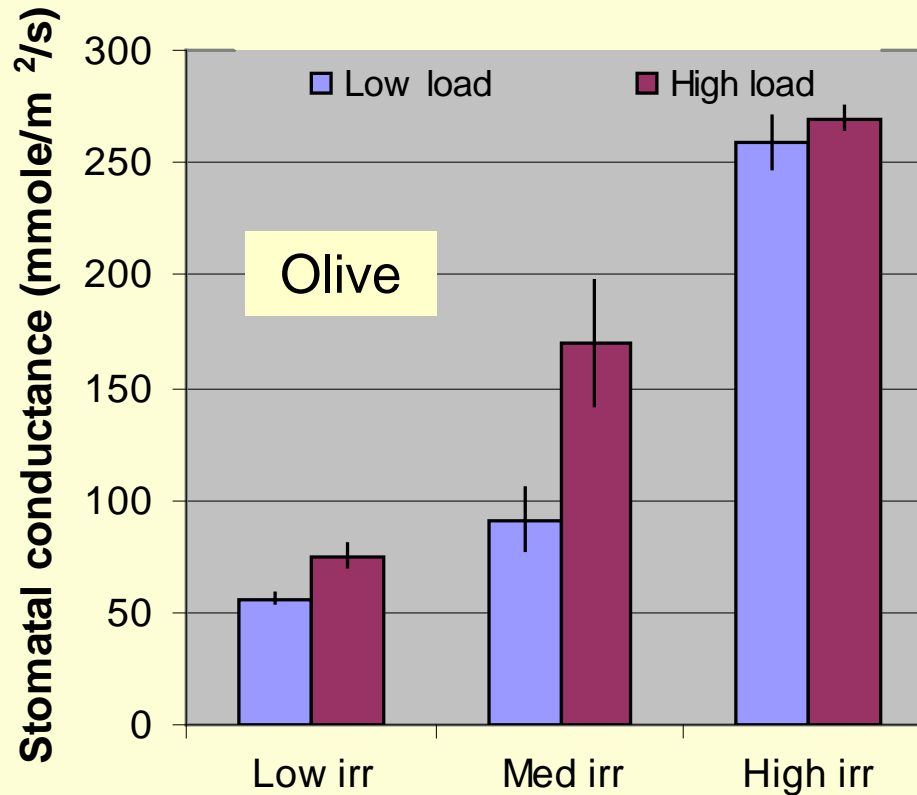


Effect of the presence of crop on water consumption in apple (Lenz, 1986)

- Hansen (1971) and DeJong (1986) reported of higher stomatal aperture in crop bearing trees In non-stressed conditions.



Crop load and stomatal conductance relationships

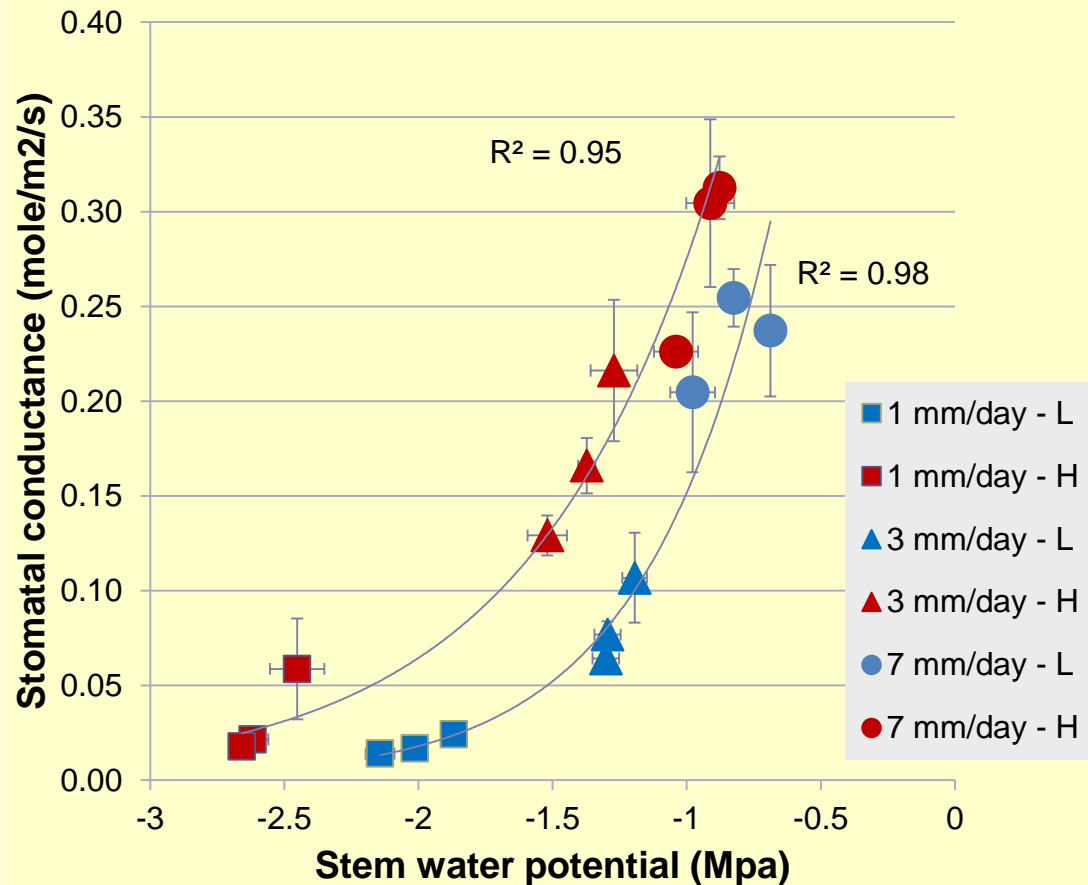




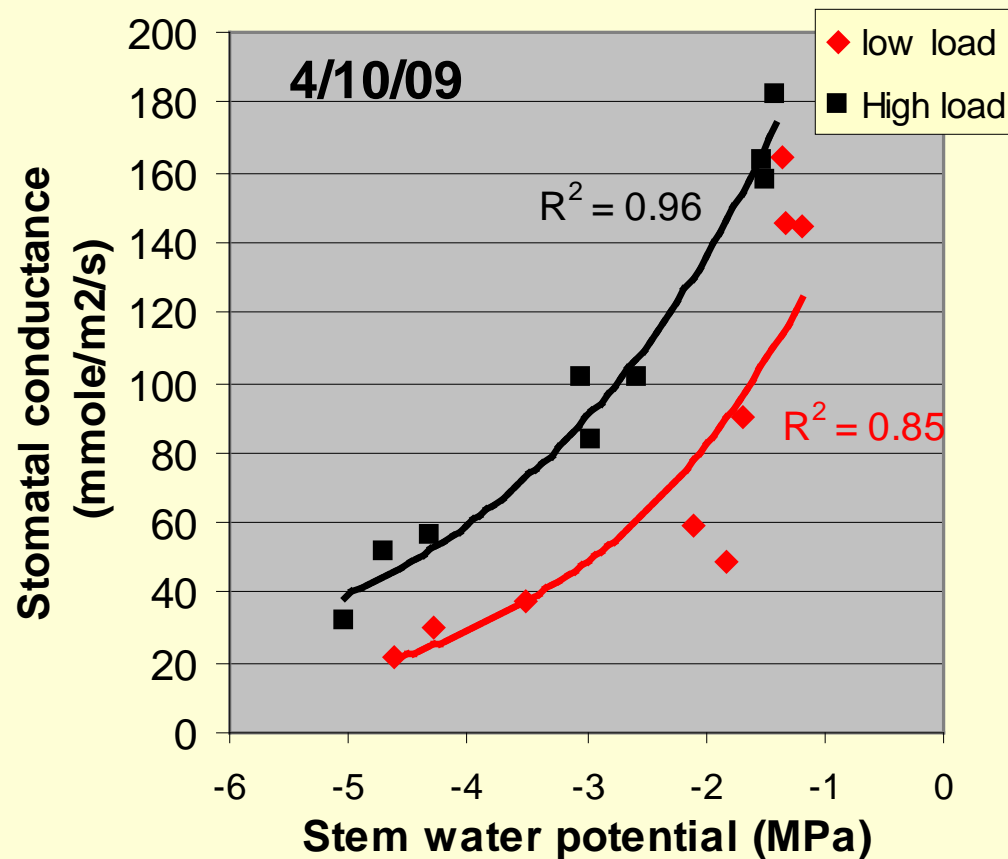
The combined effect of irrigation and crop load on water relations



Effect of crop load on water relations in apple (Naschitz et al, unpub.)

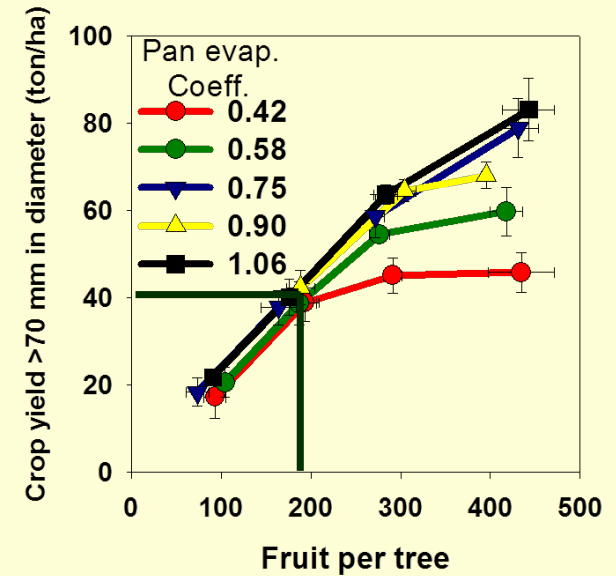


Effect of crop load on water relations in olive (Naor et al, 2012)



Take home messages

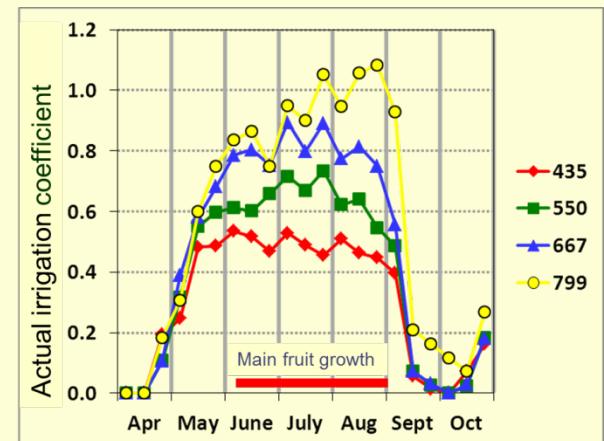
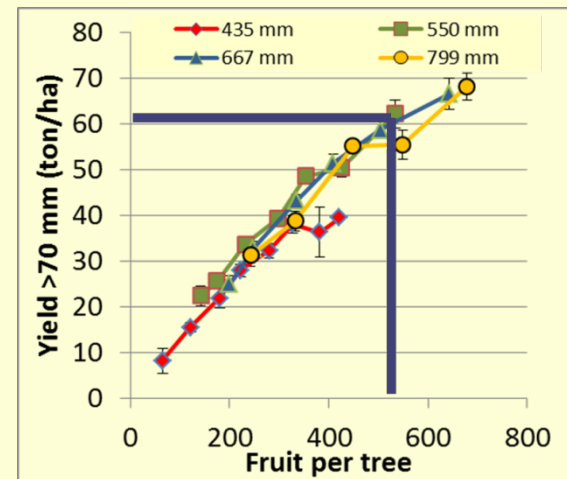
- At low crop loads we can reduce irrigation level.
- Under water shortage we should thin the fruits in order to get commercial fruit size



Take home messages

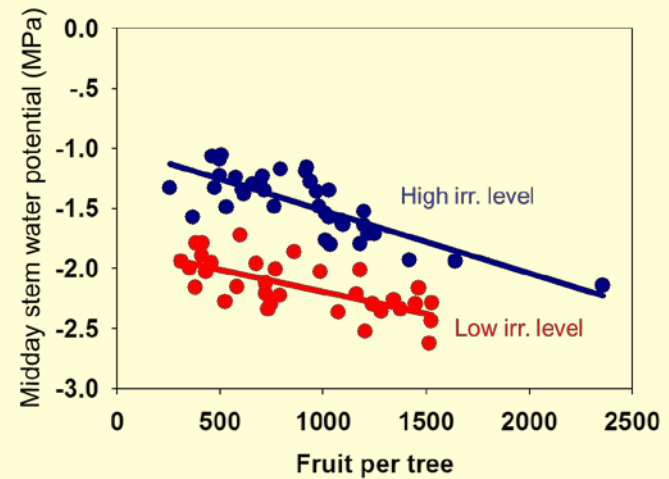
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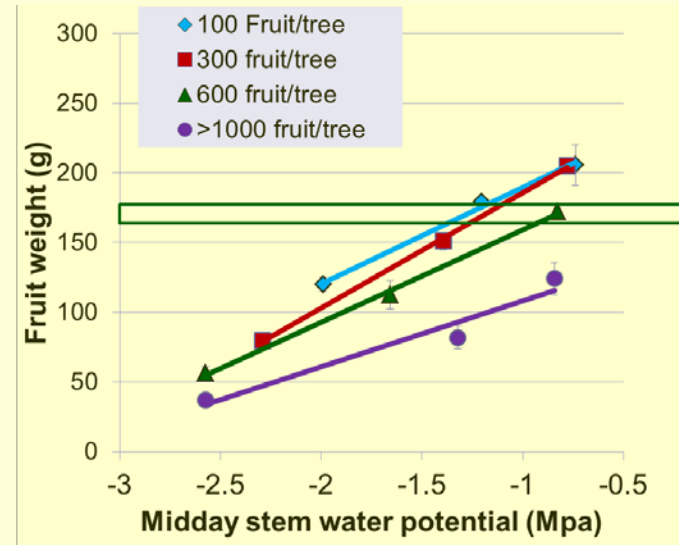
Take home messages

- Crop load affects the midday stem water potential.



Take home messages

- Thresholds of stem water potential change with crop load in apple.
- The higher the crop load the higher the stem water potential threshold.





Take home messages

- The findings in apple should be applicable (in general) to other fruit trees.
- Field studies should be conducted for each crop in order to quantitatively understand the irrigation and crop load interactions.





Thanks

