



Effect of temperature on yield of tomato

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Background

Greenhouse crops have quite some flexibility in growing at different temperatures, but the marketable yield will be higher when optimal temperatures are applied. It needs a long experience with a particular crop to find the ultimate optimal values, but as a general guideline a tomato crop grows well at an average diurnal temperature around 17 °C in poor light conditions (DLI smaller than 10 mol PAR/(m² day)) and at an average temperature around 22 °C in abundant light conditions (DLI above 25 mol PAR/(m² day)).

As light is abundant in Saudi Arabia, the general guideline suggests to grow tomatoes with preferably a diurnal mean temperature between 20 and 22°C. Experience from past years shows that the crops indeed perform well under these conditions, but there was often still a notable loss of marketable yield due to Blossom End Rot (BER). The plant physiological background of the occurrence of BER is still not clear, but it is related to stress and climate conditions do have an effect. As lower temperatures are likely to result in a decreased stress level, lowering the temperatures might reduce the occurrence of BER. As this will increase the marketable yield, the additional costs of lowering the temperature might be outweighed by better benefits. To test this hypothesis the performance of a number of tomato varieties was observed in a one year tomato cultivation cycle in two temperature regimes.

Objective

Comparison of the performance of various tomato types in a lowered temperature regime with respect to harvestable yield and the occurrence of blossom end rot (BER).

Methods

Several different tomato types were selected and seeds from different breeders were used. The varieties differed in shape, color and average fruit weight.

	Variety	Breeder	Type	Color	
1	Midelyce (DRTH1032)	DeRuiter	Round	Red	Large tomatoes
2	DRTC9515	DeRuiter	Cocktail	Red	
3	Juanita	DeRuiter	Cherry truss	Red	Cocktail type
4	Yelorita	DeRuiter	Cherry cluster	Yellow	
5	DRTC8634	DeRuiter	Cherry cluster	Red	Cherry type
6	Garincha F1	ENZA ZADEN	Cherry elongated	Red	
7	Ayaori F1	ENZA ZADEN	Cherry round	Red	
8	Freshtom F1	ENZA ZADEN	Fruit weight 30-70 gm	Red	Cocktail type
9	Marvellance	DeRuiter	Cluster (120 gm)	Red	
10	Roenza F1	ENZA ZADEN	Round	Red	Medium size tomatoes
11	Profance	DeRuiter	120 - 140 grams	Red	

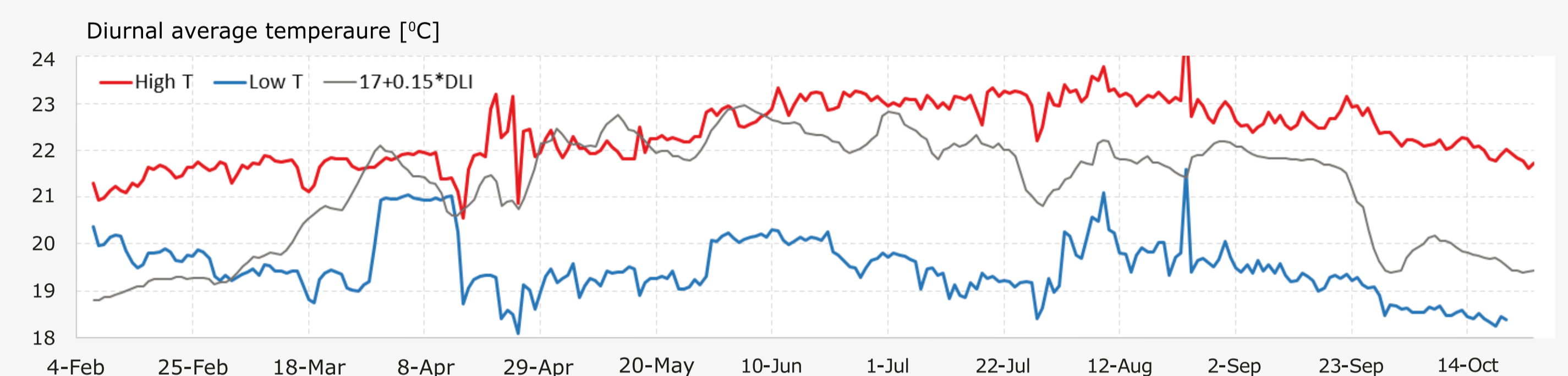
Seeds were sown in rockwool planting cubes and raised in the special nursery compartment (M1). One month after sowing, the young plants were transplanted to the greenhouse compartment. Each variety was attributed to a 20 meter long gutter. With a gutter-to-gutter distance of 1.6 m, each variety occupied 32 m² of the compartment. Plants were grown on rockwool slabs with the customary stem density of 5 stems per m², which come from 2.5 plants per m² with a double stem. The crops were grown in two air conditioned compartments (H2 and H4) in Estidamah.



The crops stayed in the greenhouse for 10 months, so almost a full year. Starting in the begin of April, the greenhouse was harvested twice a week.

Results

The graph below shows the realized diurnal average temperatures in the high temperature and in the low temperature greenhouse. The high temperature was a little warmer than generally applied and the low temperature greenhouse was kept considerably colder.



The black line in the graph shows the target temperature that is often used as a guideline for tomato growing, namely a temperature dependent on the amount of radiation to which the crop is exposed. With the formula $T_{target} = 17 + 0.15 * DLI$, with DLI expressed in mol/(m² day), a standard tomato growing would use a temperature quite in between the two regimes applied.

The table below shows the production results of the 11 different varieties.

	Variety	Good [kg/m ²]		BER [kg/m ²]		Fruit size [g]	
		High T	Low T	High T	Low T	High T	Low T
1	Midelyce (DRTH1032)	75.2	70.2	0.00	0.00	166	158
2	DRTC9515	49.6	47.5	0.00	0.00	70	71
3	Juanita	32.4	29.9	0.00	0.00	18	29
4	Yelorita	42.1	34.3	0.00	0.00	21	34
5	DRTC8634	33.7	31.1	0.00	0.00	18	29
6	Garincha F1	34.9	32.2	0.08	0.00	20	34
7	Ayaori F1	39.6	32.1	0.03	0.02	20	34
8	Freshtom F1	45.3	45.3	0.00	0.01	35	61
9	Marvellance	57.4	60.5	0.00	0.00	136	143
10	Roenza F1	68.8	71.4	0.36	0.00	148	154
11	Profance	59.4	68.6	0.00	0.00	137	139

Due to the very different types of tomatoes, there is a wide range of production levels. Blossom end rot was hardly observed. Only one variety encountered some BER (only %0.5). However, this amount is so small that it cannot be considered conclusive.

A summary of the production levels per type of tomato is shown below.

	Type	Marketable yield		Delta %
		higher temps [kg/m ²]	lower temps [kg/m ²]	
1	Large tomato	75.2	70.2	93%
2,8	Coctail type tomatoes	47.4	46.4	98%
3 - 7	Cherry tomatoes	36.5	31.9	87%
9 - 11	Medium size tomatoes	61.9	66.8	108%

The experiment confirmed climates, like in KSA, this is a nice asset, but of course the market should be willing to pathe general trend that the cherry tomatoes benefit from growing at higher temperatures. In hot y more per kg of product as the harvest per m² is notably lower. Also, growing cherry tomatoes requires more labor.

Conclusion

- The yield was clearly affected by the temperature differences.
- The majority of the observed crops performed better under the 'standard' temperature regime than under the lowered temperature regime. Three out of 11 varieties performed better in the lowered temperature regime, but probably not enough to outweigh the additional costs associated with lower temperatures in an arid climate.
- Blossom end rot did not appear in this crop. It cannot be concluded therefore that a higher temperature regime was more detrimental or that a lower temperature regime was better to prevent BER.
- All varieties performed well under the cropping conditions, but Midelyce of the coarse varieties and Yelorita of the cherries performed best.



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