



Effect of two growing system on cucumber crop cycle, yield, water and electricity use efficiency.

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Background

Cucumber is a very fast-growing plant. The downside of this fast-growing is that if the plant is trained to grow along a vertical wire (the training-wire), it quickly reaches the fixing point of the wire. This fixing point of the training-wire is called the crop-wire.

Traditionally, when this point is reached, growers simply bend the top of the crop over the crop-wire. Due to gravity, the top of the crop is then growing downward. When this downward growing top of the crop gets some length (say 1,5 meter), the top is picked up and bent over the crop-wire again. This can be repeated a third time, but after that, the bunch of leaves and stems becomes that messy that the crop must be removed. After the removal of the old crop, a new crop must be planted.

Due to this practice, cucumber cultivation has traditionally three cycles a year and therefore also three times some weeks without production.

When using a high wire system, the training-wire can be elongated and shifted aside to cope with the continuously growing stem (up to 60 cm a week). This is called the High Wire system. Of course, the continuously growing stems will just as well create a large bunch of stems, but in the high wire system, the bunches are from de-leaved stems and are at the bottom side of the crop. Therefore, the bunch of stems will be much less messy. This makes that one crop cycle can stay productive for a longer period. Per kg of product this reduces the initial costs for seeds, propagation and planting and it reduces the number of weeks without production.

Methods

Schematic drawing of both systems

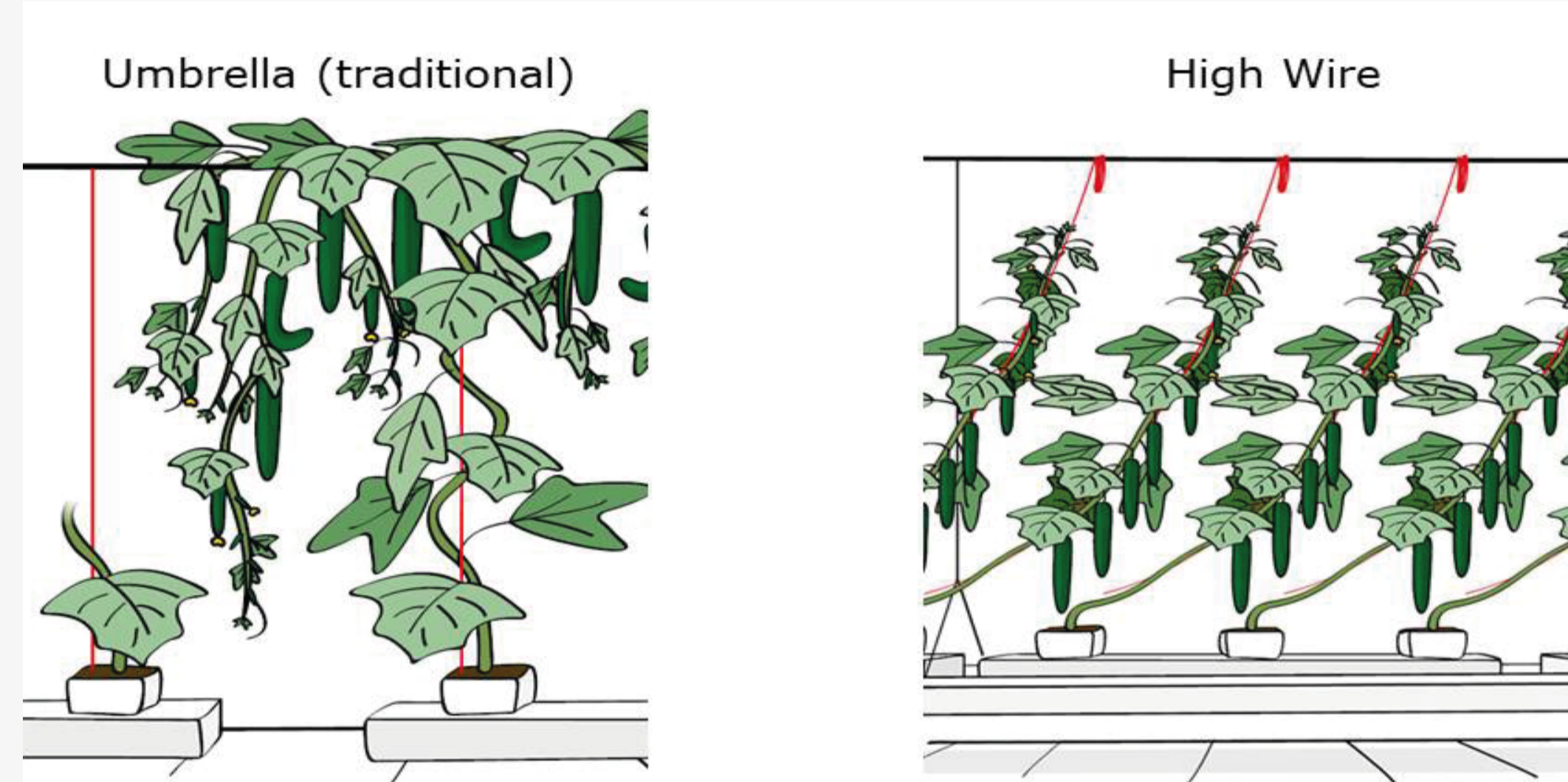


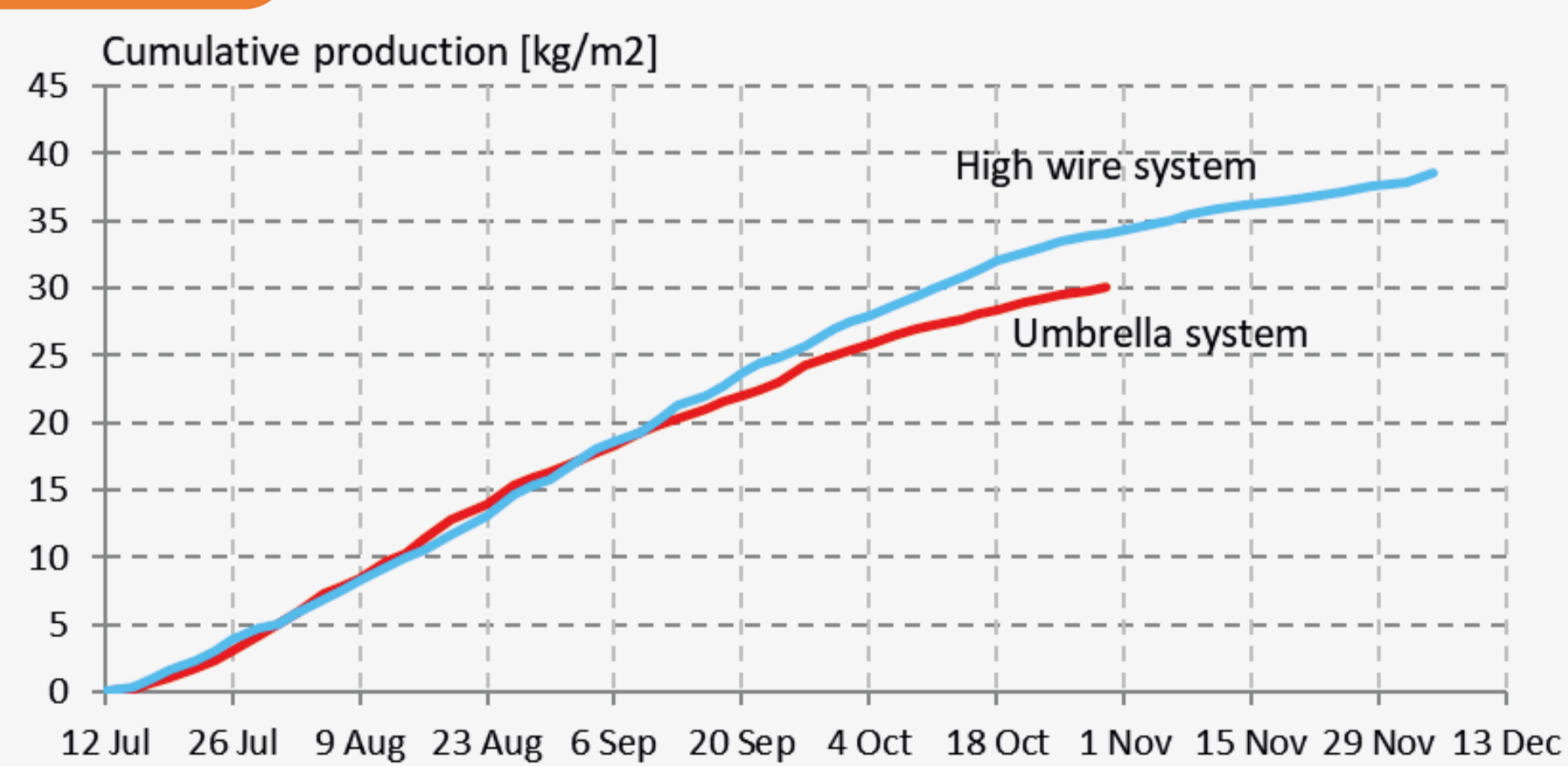
Photo of the high wire production and the trolley used



A special trolley was developed for the low tech greenhouse high wire system so the workers can reach the top wire and can lower the crop.

Results

Production in both compartments



Results

Table 1. Effect of growing system on cucumber crop cycle, yield, water and electricity use efficiency.

	Umbrella	High Wire		
Crop cycle duration	124	153	days	
Sowing date	10-Jun	10-Jun		
Transplant date	28-Jun	28-Jun		
First harvest	12-Jul	12-Jul		
Last harvest	30-oct	28-Nov		
Production	30	38	kg/m ²	26% improvement
Irrigation water	630	720	liter/m ²	
Padwall evaporation	1950	2325	liter/m ²	
Total water use	2580	3045	liter/m ²	
Water use efficiency	86	80	liter/kg	7% improvement
Electricity Padwall fans	10.9	13.7	kWh/m ²	
Electricity Padwall pump	1.8	2.1	kWh/m ²	
Electricity RO-machine	1.4	1.6	kWh/m ²	
Electricity irrigation supply	0.2	0.2	kWh/m ²	
Total electricity	14.3	17.6	kWh/m ²	
Electricity efficiency	0.48	0.46	kWh/kg	3% improvement
Macro Nutrients	1.52	1.76	kg/m ²	
Fertilizer efficiency	51	46	gr/kg	9% improvement

It is clear that although for the High Wire system the absolute consumption of water, electricity, and fertilizers per m² is higher than for the Umbrella system, the efficiency of the use of the consumables is better for the High Wire system. This is, of course, caused by the higher production that could be achieved.

The %26 improvement of production holds when looking at this crop cycle, but as the cropping period of the High Wire cucumber system is longer, it does not reflect the yearly increment of production.

A grower will have more cultivation cycles per year with the Umbrella System than with the High Wire cultivation system. Assuming that preparing the greenhouse for a next cycle takes 2 weeks, a grower can have $2.64 = (14+124)/365$ Umbrella cycles per year and $2.18 = (14+153)/365$ High Wire cycles per year. When just linearly extrapolated, the yearly production in the Umbrella system is expected to be $30 \times 2.64 = 79.2$ kg/(m² year) and in the High Wire system $38 \times 2.18 = 82.8$ kg/(m² year).

The estimated increment of yearly production by using the High Wire system is therefore %5.



Cucumber plants after 4 months of transplanting the seedlings using two growing systems in field trial

Conclusion

The experiment on high wire cucumber production in a tunnel greenhouse showed that production water use efficiency and energy efficiency can be improved by modernizing the crop-training system toward a High wire system.

- Water use efficiency improved by %7
- Electricity use efficiency improved by %3
- Fertilizer use efficiency improved by %9
- Crop production per cycle improved by %26, but because a High Wire production system will have fewer cycles per year (as one cycle lasts longer), the yearly production increment is estimated on %5. It is called estimated, because for this computation, the figures obtained from the experiment were just linearly extrapolated to obtain a yearly production figure.
- At an average cucumber price of 2 SAR/kg, this %5 increment of production represents an additional turnover of 8 SAR/(m² year). This is supposed to be worth the additional costs for the High Wire cropping system



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