RESULTS OF EXPERIMENTS WITH SOILLESS OPEN FIELD TOMATO CULTURE IN GERMANY AND POLAND

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INTRODUCTION

Pressure from the water protecting legislation and the commonly expressed need for environment friendly growing methods, as well as for healtly food products, free from chemical plant protection residues, resulted in research being undertaken on using soilless culture for growing some vegetable crops in field conditions. Tomato, a crop of high cultural requirements and great economical importance was choosen for detailed investigations with this new growing technique. The paper summarizes and discusses results with the soilless open field tomato culture in Grossbeeren, Germany, where the research started (Vogel and Flögel, 1994) and in Skierniewice, Poland, where the research is continued.

MATERIAL AND METHODS

The experiments with tomatoes in soilless culture in the open field and in traditional soil culture were carried out in 1992-1993 at the Institute of Vegetable and Ornamental Crops in Grossbeeren and in 1994-1995 at the Research Institute of Vegetable Cropss in Skierniewice, Poland. A short geographic and climatic characteristic of both places is given in Table 1.

In both places indeterminate tomato cultivars were grown. In Grossbeeren in 1992: 1. Counter (de Ruiter), 2. Dario (Sluis & Groot), 3. Diplom (Hild), 4. Hildares (Hild), 5. Isnova (Mauser), 6. Tresor (Clause) and in 1993 Hildares and Isnova; in Skierniewice in 1993:

1. Hildares, 2. Isnova, 3. Ibis, 4. Slonka (3-d and 4-th PNOS Ozarów) and in 1995 1. Delfine (Sluis & Groot), 2. Fa-177 (Hazera), 3. Hartboy (Bejo), 4. Selfesta (Mauser), 5. Terra (Royal Sluis).

Table 1. Selected geographic and climatic data for Skierniewice and Grossbeeren

		Skierniewice	Grossbeeren
Altitude	m	128.5	38
Latitude	o	51.58	52.52
Mean annual air temp.	oC	7.9	8.8
Mean monthly air temp.	oC		
May		13.2	12.9
June		16.4	16.7
July		18.2	18.0
August		17.3	17.4
September		13.4	13.9
Mean annual precipitation	mm	531	520
Mean annual sunshine	h	1706	1818

Tomato transplants were produced in heated greenhouse (from sowing end of March) in mineral wool cubes or in regular pots, for the soilless and soil culture respectively. Planting on field beds was made between 15 and 20 May at spacing of 65 x 50 cm (Grossbeeren) or 60 x 50 cm (Skierniewice). Plot size varied from 3.6 to 5.4 m^2. Plants grown on soilless beds were fastened with string to a wire construction about 2 m above the ground whereas these of the soil culture were fastened to stakes.

The soilless culture was based on the Plant Plane Hydroponic system (Schröder and Broneske, 1990; Vogel et al. 1991 and 1996). An outline of the soilless culture arrangement is shown in Fig. 1 and 2. Plants grown in soilless culture were irrigated with a complex, hydroponic, nutrient solution. The irrigation, depending on plant growth stage and weather conditions was executed 4 - 8 times per day in cycles lasting 10 - 15 minutes.

Fig. 1. Experiment site with soilless culture of tomato in open air in RIVC Skierniewice

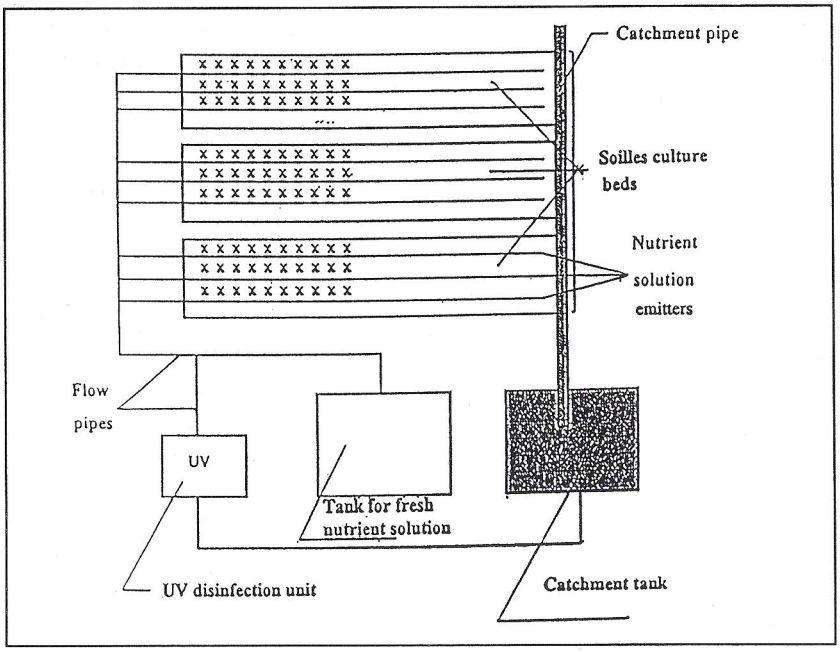
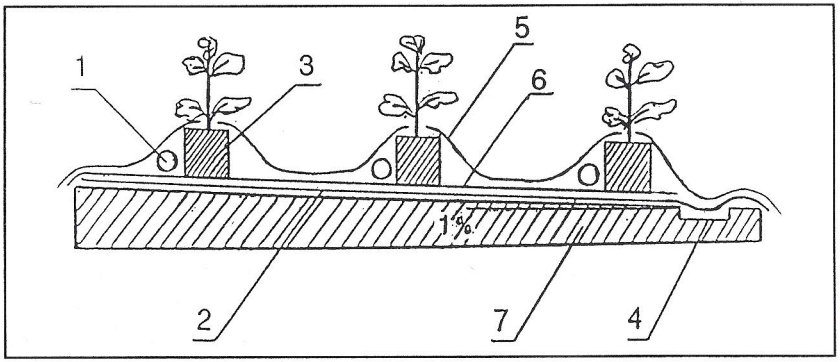


Fig. 2. Cross section of cuture bed



1. nutrient solution emitter
2. and 5. polyester film
3. mineral wool cub
4. catchment pipe
6. non-woven polyester
7. Ground

Tomatoes in soil culture were grown according to actual recommendations. The soil moisture was kept at 70 - 80 percent of water holding capacity by means of drip irrigation. Data on early, marketable and total yield presented in the paper, derive from the experiments carried out in Grossbeeren and in Skierniewice. Other data on yield and plant growth are from the experiments in Skierniewice only.

RESULTS

Yield

In both locations i.e. in Grossbeeren and in Skierniewice yields of tomato fruits from soilless culture were considerably higher compared to the soil culture (Table 2). The differences in favour of soilless culture, for the early, marketable and total yield accounted for 71, 56 and 52 %, respectively in Grossbeeren and 520, 73 and 44 %, respectively in Skierniewice. The differences in the mentioned yield categories were in the trial in Skierniewice highly significant (Fig. 3). Considerable differences among the studied cultures appeared also in the non-marketable yield fractions. This can be observed in Fig. 4 showing the results of the 1995 trial in Skierniewice, where the share of cracked, diseased and green fruits was in soilless culture much lower than in soil.

Fruit weight

Weight of marketable fruit was in soilles culture higher as compared to soil culture (Table 3). The differences for the cultivars in trial averaged 34 % and 22 % for the years 1994 and 1995, respectively.

Plant growth

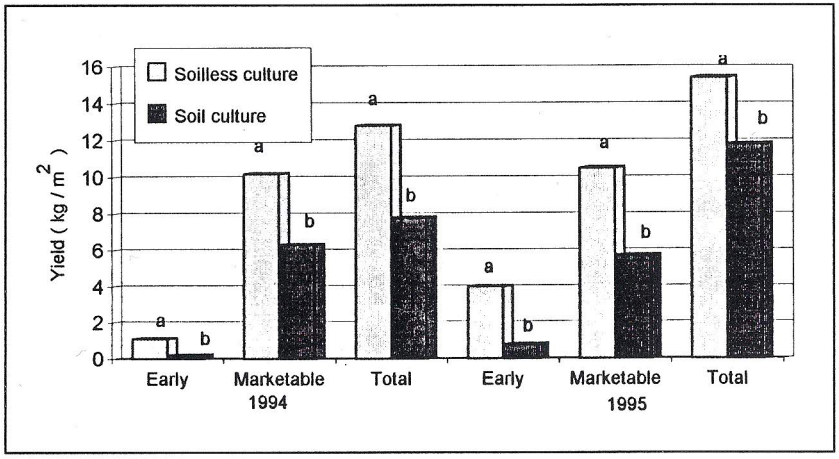
Plant growth as indicated by plant height, plant stem diameter and number of leaves per plant, was in soilless culture higher than in soil (Table 4, 5 and 6). This was most evident for plant height which in all three measurement dates showed significantly greater values. Advanced plant growth was observed already few days after transplanting of the

tomato seedlings. Seedlings in the mineral wool cubes, irrigated with nutrient solution grew faster than these in conventional plant substrate, irrigated with water.

Table 2. Tomato yield in soilless culture (PPH) and soil culture (SC) in open air

Object	Yield (kg/m^2)			
	Grossbeeren 1992-1993		Skierniewice 1994-1995	
	PPH	SC	PPH	SC
Early yield	3.6	2.1	2.6	0.5
Marketable yield	13.4	8.6	10.4	6.0
Total yield	16.1	10.6	14.1	9.8

Fig. 3. Tomato yield in soilless culture and soil culture in open air



CONCLUSIONS

Obtained results confirm the suitability of soilless culture with the Plant Plane Hydroponic technique for open field production of tomatoes.

However, further work is necessary on evaluating the economic aspects of this new method, especially in comparison to conventional production. This will provide information whether the soilless culture is feasible for application in commercial production in the open field.

Fig. 4. Non-marketable tomato yield in open air in soilless culture and soil

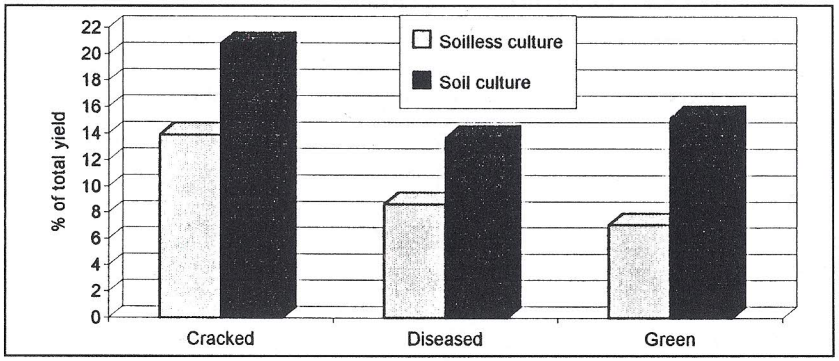


Table 3. Average marketable tomato fruits in open field in soilless culture (PPH) and soil (SC)

1994			1995		
Cultivar	Fruit weight (g)		Cultivar	Fruit weight (g)	
	PPH	SC		PPH	SC
Hildares F_1 (Hild)	61.7 a	42.5 b	Delfine F_1 (S&G)	111.6 a	92.4 b
Isnova F_1 (Mauser)	48.0 a	42.3 a	FA - 177 (Hazera)	102.9 a	83.0 b
Ibis F_1(PNOS Ożarów)	73.6 a	51.3 b	Hartboy F_1 (Brjo)	96.7 a	81.4 b
Słonka F_1(PNOS Ożarów)	72.1 a	52.5 b	Terra F_1 (RS)	126.2 a	117.2 b
			Selfesta (Mauser)	112.1 a	75.6 b
Average	63.8 a	47.6 b	Average	109.9 a	89.9 b

Table 4. Plant height of tomato in open field in soilless culture (PPH) and soil (SC)

Year, (No. of cultivars)	Plant height (cm)					
	19 - 20 May		9 - 10 Jun		29 - 30 Jun	
	PPH	SC	PPH	SC	PPH	SC
1994, 4 cvs	31.2 a	22.8 b	46. a	40.3 b	69.1 a	61.3 b
1995, 5 cvs	34.6 a	17.2 b	56.0 a	28.7 b	87.7 a	63.5 b
Average	32.9	20.0	51.3	34.5	78.4	62.4

Table 5. Stem diameter of tomato plants in open field in soilless culture (PPH) and soil (SC)

Year, (No. of cultivars)	Stem diameter (mm)					
	19-20 May		9-10 Jun		29-30 Jun	
	PPH	SC	PPH	SC	PPH	SC
1994, 4 cvs	9.8 a	10.0 a	12.9 a	13.0 a	16.1 a	14.4 a
1995, 5 cvs	8.0 a	8.0 a	11.5 a	9.8 b	15.4 a	12.8 b
Average	8.9	9.0	12.2	11.4	15.8	13.6

Table 6. Mean leaf number of tomato plants in open field in soilless culture (PPH) and soil (SC)

Year, No of cultivars	Mean number of leaves					
	19-20 May		9-10 Jun		29-30 Jun	
	PPH	SC	PPH	SC	PPH	SC
1994, 4 cvs	8.6a	8.5 a	12.3 a	11.4 a	15.6 a	14.5 a
1995, 5 cvs	7.7 a	6.9 b	13.8a	10.7 b	-	-
Average	8.15	7.7	13.1	11.1	-	-

Figures followed by the same letter in Table 3 to 6 are statistiallly insignificant at 5 % level

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SUMMARY

Presented are results of experiments with tomatoes grown in open field soilless culture with the Plant Plane Hydroponic system (PPH) and in soil in Grossbeeren, Germany (1992/1993) and in Skierniewice, Poland (1994/1995). Tomatoes grown in PPH showed stronger plant growth and produced significantly higher and earlier yield with lower share of cracked, diseased as well as green fruits left on plants at the end of the growing season.

DISINFESTATION OF NEMATODE-INFESTED RECIRCULATION WATER BY OZONE AND ACTIVATED HYDROGEN PEROXIDE

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Presented by Willemien Runia

INTRODUCTION

By the year 2000 all crops cultivated in glasshouses in the Netherlands must be grown in closed cultivation systems to prevent leakage of nutrients and pesticides to ground and surface water. This implies re-use of drainwater. Drainwater can be infested wit pathogens, like nematodes, which are easily dispersed by recirculation. Amsing (1990) proved the dispersal of *Pratylenchus vulnus* in an ebb and flow system with roses. Moens and Hendrickx (1990) obtained infected plants in a nutrient film technique (NFT) system after release of *Meloidogyne incognita* in the nutrient solution. According to Benders (1992) almost every *Anthurium andreanum* nursery in the Netherlands is infested with the burrowing nematode *Radopholus similis* (Cobb) Thorne. These plants are all grown as cut flowers in closed cultivation systems on an area of 72 ha (Anonymus, 1995). To prevent the dispersal of *R. similis* to nematode-free parts of the nursery recirculation water has to be disinfested.

Initially, disinfestation methods like heat treatment, ozonation, ultra-violet (UV) radiation and application of activated hydrogen peroxide were tested for efficacy against fungi and viruses by Runia (1995). The same methods were tested for efficacy against nematodes in recirculation water. Amsing and Runia (1995) published information regarding the efficacy of ultra-violet radiation against *R. similis*. In this paper the results of the trials with the oxidizing agents ozone and activated hydrogen peroxide are presented. Two commercial ozone installations were tested for their efficacy against *R. similis* and the efficacy of activated hydrogen peroxide against the same nematode was studied on a laboratory scale.