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THE EFFECT OF DIFFERENT METHODS OF PREVENTING REPLANTING DISEASE AND DIFFERENT LEVELS OF IRRIGATION ON SOIL AND LEAF MINERAL CONTENT

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A B S T R A C T

The aim of this study was to determine the effect of different methods of preventing replanting disease on the content of available nutrients in the soil, and total nutrient content in the leaves of apples of the variety "Elstar" at the peak of the fruiting period. Three levels of irrigation and six methods of replanting were examined and were found to have varying effects on soil nutrient content. Irrigation increased magnesium content and increased pH. Ammonium phosphate significantly increased in soil phosphorus. The different methods of preventing replanting disease and the different levels of irrigation also affected leaf nutrient content. Weather conditions during the vegetation period also had a large effect on soil nutrient content.

Key words: soil exhaustion, irrigation, prevention methods, mineral components, soil, leaves

INTRODUCTION

When the same plant species is repeatedly grown on the same site, replanting disease can reduce growth and yield. Many factors contribute to replanting disease, including nutrient exhaustion, the build-up of toxic substances, and increasing pest and pathogen populations specifically associated with the plant species in question (Sewell and White, 1979; Pacholak et al., 1997; Sobiczewski, 2000).

Because replanting disease has numerous causes, there is no one single effective method that can be universally applied to control. One of the most effective methods of preventing replanting disease is chemical disinfection of the soil with

nematodicides, fungicides, actinomycetes, or biocides with various spectrums of activity. Chemical agents often eliminate replanting disease, but they can also reduce the biological activity of the soil, which in turn reduces growth and yield (Gur et al., 1998). For this reason, agrotechnical measures, such as fertilization or tilling, can also play a role in controlling replanting disease. Mineral fertilization, especially with specific nutrients, also directly effects plant growth and pathogen development in exhausted soils (Gullino and Mezzalama, 1993). Phosphorus, especially in the form of mono-ammonium phosphate, plays an important role (Slykhuis, 1988; Utkhede and Smith, 1994; Nicolic et al., 1998). Organic fertilizers, such as biohumus, peat or farmyard manure, are also useful (Engel, 1988; Tagliavini et al., 1993; Szczygieł and Zepp, 1998). Irrigation sometimes helps by leaching toxic substances from the rhizosphere (Szczygieł, 1993; Pacholak et al., 1995).

The aim of this study was to determine the effect of different methods of preventing replanting disease on the content of available nutrients in the soil, and total nutrient content in the leaves of apples of the variety 'Elstar' at the peak of the fruiting period.

MATERIAL AND METHODS

The study was carried out from 1996 to 2003 at the orchard of the Agricultural and Pomiculture Experimental Station at Przybroda, which belongs to the Pomology Department of the Agricultural University in Poznań.

In the spring of 1998, one-year-old apple trees of the cultivar 'Elstar' on M.9 EMLA rootstock were planted 3.5 x 1.0 meter apart in pits (0.6 x 0.6 x 0.6 m = 0.216 m^3) lined with sheet plastic. After the old apple trees had been removed from the site, the soil was not tilled.

Immediately after planting, the trees were cut back to a height of 90 cm above ground level and fastened to stakes for support. In the spring of 1999 and 2000, the trees were pruned to form fusiform crowns. In the spring, nitrogen fertilizer was applied to each tree at the rate of 5 g/m^2. All other agrotechnical procedures, such as pruning, irrigation, protection, and fruit set thinning, were performed as recommended for commercial apple orchards.

Three levels of irrigation were used in the experiment:

W_0 – No irrigation. Soil water content depended solely on natural precipitation.
W_1 – Irrigation to keep soil water content at –0.03 MPa.
W_2 – Irrigation to keep soil water content at –0.01 MPa.

At each level of irrigation, four replicates of one tree each were treated according to one of the following methods of preventing replanting disease:

1. Control.
2. Soil replacement.
3. Temik 10 G 10g/m^2.
4. Aliette 80 WP 0.4 g/l soil.

5. Ammonium phosphate 1g/l soil.
6. Peat – one part peat to two parts soil.

Every year in mid-July, soil samples were collected from the soil layer up to 40 cm deep (arable and sub-arable) in four replicates. Samples were dried at room temperature. Available phosphorus and potassium were measured by the Egner-Riehm method. Magnesium was measured by the Schachtschabel method. Soil pH was measured in KCl. Leaf samples were collected at the same time as the soil samples. After the leaves were dried, nitrogen, phosphorus, potassium, magnesium and calcium were measured by the method described by Ostrowska et al. (1991).

Data were statistically elaborated with the help of the STAT software package. The significance of differentces between treatments was determined by Duncan's multiple-range t-test at $P = 0.05$.

RESULTS AND DISCUSSION

The relative change in soil phosphorus content compared to the baseline varied widely depending on which method of preventing replanting disease was used. By far the greatest relative increase was observed with ammonium phosphate. A moderate relative increase was observed with soil replacement. A slight relative increase was observed with peat. A slight relative decrease was observed with Aliette 80 WP and Temik 10 G. The level of irrigation had no significant effect on soil phosphorus content. Soil phosphorus content was high at all levels of irrigation (Tab. 1).

The relative change in soil potassium content compared to the baseline varied moderately depending on which method of preventing replanting disease was used. By far the greatest relative increase was observed with ammonium phosphate. The greatest relative decrease was observed with soil replacement and with Aliette 80 WP. Smaller relative changes were observed with the other treatments. The level of irrigation had no significant effect on soil potassium content. Soil potassium content was moderate at all levels of irrigation (Tab. 1).

The relative change in soil magnesium content compared to the baseline varied slightly depending on which method of preventing replanting disease was used. The greatest relative increase was observed with Temik 10 G, and the greatest relative decrease with peat. The level of irrigation had a significant effect on soil magnesium content. Soil magnesium content was significantly higher at a water potential of –0.01 MPa. However, soil magnesium content was high at all levels of irrigation (Tab. 1).

The potassium to magnesium ratio was optimal regardless of which method of preventing replanting disease was used.

The relative change in soil pH compared to the baseline varied slightly depending on which method of preventing replanting disease was used. The greatest relative increase was observed with ammonium phosphate, and the greatest relative decrease with soil replacement. The level of

Table 1. Soil mineral content and pH at the beginning and the end of the study period versus method of preventing replanting disease and level of irrigation

Irrigation level	Preventing method	Phosphorus [mg/100 g]		Potassium [mg/100 g]		Magnesium [mg/100 g]		pH	
		1999	2003	1999	2003	1999	2003	1999	2003
W_0	control	3.6 a*	3.9 a	6.1 a	8.8 ab	3.2 a	8.1 b	4.0 a	5.0 a
	soil replacement	5.3 ab	6.8 b	10.1 b	6.9 ab	3.4 a	8.5 b	6.8 b	5.3 a
	Temik 10 G	3.1 a	2.4 a	5.0 a	4.2 a	3.6 a	5.4 ab	4.0 a	4.1 a
	Aliette 80 WP	3.0 a	3.2 a	6.7 a	3.4 a	4.2 a	3.5 a	4.1 a	4.4 a
	ammonium phosphate	11.3 b	53.6 d	6.1 a	11.2 b	3.5 a	6.2 ab	3.6 a	7.3 b
	peat	2.1 a	3.5 a	5.7 a	5.5 a	4.6 a	3.7 a	4.0 a	4.4 a
W_1	control	3.3 a	3.8 a	5.0 a	5.8 a	5.1 ab	4.4 a	5.0 a	5.0 a
	soil replacement	5.2 ab	8.4 b	9.7 b	5.1 a	4.6 ab	4.7 a	6.9 b	4.5 a
	Temik 10 G	2.4 a	3.1 a	4.4 a	5.0 a	4.8 ab	8.0 b	4.4 a	4.2 a
	Aliette 80 WP	4.1 a	3.0 a	6.4 a	3.8 a	6.7 b	3.8 a	5.0 a	4.5 a
	ammonium phosphate	11.2 b	56.7 d	5.1 a	10.4 b	5.1 ab	6.1 ab	4.1 a	7.3 b
	peat	2.3 a	3.3 a	4.8 a	4.8 a	7.4 b	5.0 a	4.3 a	4.7 a
W_2	control	3.1 a	4.7 a	5.5 a	6.4 ab	6.9 b	8.3 b	5.9 ab	5.3 a
	soil replacement	5.5 ab	7.7 b	9.6 b	5.5 a	6.5 b	7.9 b	7.1 b	4.8 a
	Temik 10 G	4.1 a	3.3 a	7.7 ab	6.6 ab	6.9 b	10.8 bc	5.9 ab	5.3 a
	Aliette 80 WP	3.6 a	2.3 a	5.3 a	5.2 a	8.3 b	8.7 b	5.4 ab	4.8 a
	ammonium phosphate	10.9 b	35.5 c	4.2 a	8.3 b	7.1 b	6.4 ab	4.7 a	7.4 b
	peat	2.8 a	2.7 a	6.1 a	6.0 ab	8.6 b	7.2 b	5.0 a	6.0 ab

*Results followed by the same letter do not differ significantly at P = 0.05 according to Duncan's t-test

irrigation had a significant effect on soil pH. There was only a slight relative increase in the pH in the irrigated soils, and a much larger increase in the non-irrigated soil (Tab. 1). This conflicts with the results reported earlier by Pacholak and Przybyła (1996), which showed that there was a significant increase in soil pH in irrigated soils.

Leaf nitrogen content varied depending on which method of preventing replanting disease was used. The highest leaf nitrogen content (2.30% d.m.) was found with peat at a moisture content of –0.03 MPa, and with Temik 10 G at a moisture content of –0.03 MPa. The lowest leaf nitrogen content (1.87% d.m.) was found with soil replacement at a moisture content of –0.03 MPa. Leaf nitrogen content was lower than the baseline values only in the control soil and in the soil treated with soil replacement. Leaf nitrogen content was optimal with all the other methods of preventing planting disease used. The level of irrigation did not have any significant effect on leaf nitrogen content (Tab. 2)

Leaf phosphorus content also varied depending on which method of preventing replanting disease was used. The highest leaf phosphorus content (0.14% d.m.) was found with Temik 10 G at a moisture content of –0.03 MPa and –0.01 MPa. The lowest leaf nitrogen content (0.10% d.m.) was found with soil replacement at a moisture content of –0.03 MPa. Leaf phosphorus content was lower than baseline values regardless of which method of preventing replanting disease was used. In the soil treated with ammonium phosphate, leaf phosphorus content was low even though the soil phosphorus content was very high. The level of irrigation did not have any significant effect on leaf phosphorus content (Tab. 3).

Leaf potassium content also varied depending on which method of preventing replanting disease was used. The highest leaf potassium content (1.44% d.m.) was found with the control soil and with at a moisture content of –0.01 MPa. The lowest leaf potassium content (0.94% d.m.) was found with Aliette 80 WP at a moisture content of –0.03 MPa. Leaf potassium content increased with increasing soil moisture content. Leaf potassium content was optimal and higher than the baseline with all treatments and at all levels of irrigation (Tab. 4).

Leaf magnesium content also varied depending on which method of preventing replanting disease was used. The highest leaf magnesium content (0.43% d.m.) was found with peat at a moisture content of –0.01 MPa. The lowest leaf magnesium content (0.25% d.m.) was found with ammonium phosphate at a moisture content of –0.01 MPa. (Tab. 5). Leaf magnesium content ranged from moderate to high compared to the baseline. The level of irrigation did not have any significant effect on leaf magnesium content (Tab. 5).

The highest leaf calcium content (1.96% d.m.) was found with ammonium phosphate without irrigation. Irrigation significantly lowered leaf calcium content (Tab. 6).

Table 2. Leaf nitrogen content versus method of preventing replanting disease and level of irrigation

Treatment		Leaf nitrogen [% of dry matter]					
		mean for 1999-2000	2001	2002	2003	mean for 2001-2003	mean for irrigation level
W_0	control	2.38 h*	2.03 b-h	2.35 c-h	1.87 a-f	2.08 ab	2.14 a
	soil replacement	2.33 gh	2.15 b-h	2.16 b-h	1.74 ab	2.02 ab	
	Temik 10G	2.28 g	2.08 b-h	2.42 d-h	1.84 a-f	2.12 ab	
	Aliette 80WP	2.14 e	2.20 b-h	2.41 d-h	1.99 b-h	2.20 ab	
	ammonium phosphate	2.38 h	2.28 b-h	2.33 b-h	1.99 b-h	2.20 ab	
	peat	2.22 f	2.34 b-h	2.24 b-h	2.16 b-h	2.24 b	
Mean for all methods			2.18 bc	2.06 ab	2.06 ab		
W_1	control	2.09 de	1.82 a-d	2.21 b-h	2.00 b-h	2.01 ab	2.14 a
	soil replacement	2.36 h	1.78 a-c	2.44 e-h	1.38 a	1.87 a	
	Temik 10G	2.28 g	2.39 c-h	2.19 b-h	2.34 b-h	2.30 b	
	Aliette 80WP	2.07 cd	2.08 b-h	2.45 e-h	2.10 b-h	2.21 b	
	ammonium phosphate	2.47 i	1.92 a-g	2.55 h	2.00 b-h	2.15 ab	
	peat	1.95 a	2.36 c-h	2.48 f-h	2.10 b-h	2.30 b	
Mean for all methods			2.32 c	2.38 c	2.39 c		
W_2	control	2.02 bc	2.00 b-h	2.19 b-h	2.23 b-h	2.14 ab	2.15 a
	soil replacement	2.29 g	1.74 a-e	2.48 f-h	2.11 b-h	2.14 ab	
	Temik 10G	1.98 ab	2.20 b-h	2.36 c-h	1.86 a-e	2.14 ab	
	Aliette 80WP	1.92 a	1.98 b-h	2.48 f-h	1.84 a-e	2.10 ab	
	ammonium phosphate	2.30 g	1.82 a-d	2.44 e-h	2.00 b-h	2.09 ab	
	peat	1.95 a	2.51 gh	2.43 d-h	1.96 a-h	2.30 b	
Mean for all methods			1.93 a	1.99 ab	1.99 ab		
Mean for all methods and all levels of irrigation			2.10 b	2.36 c	1.97 a		

*For explanation, see Table 1

Table 3. Leaf phosphorus content versus method of preventing replanting disease and level of irrigation

Treatment		Leaf phosphorus [% of dry matter]					
		mean for 1999-2000	2001	2002	2003	mean for 2001-2003	mean for irriga-tion level
W_0	control	0.15b-d*	0.11 a-f	0.13 d-g	0.12 b-g	0.12 a-d	0.12 a
	soil replacement	0.16 cd	0.12 b-g	0.11 a-f	0.10 a-d	0.11 ab	
	Temik 10 G	0.16 cd	0.13 d-g	0.11 a-f	0.11 a-f	0.12 a-d	
	Aliette 80 WP	0.14 ab	0.15 gh	0.12 b-g	0.12 b-g	0.13 cd	
	ammonium phosphate	0.15 bc	0.15 gh	0.12 b-g	0.13 d-g	0.12 a-d	
	peat	0.15 bc	0.15 gh	0.11 a-f	0.12 b-g	0.13 cd	
Mean for all methods			0.14 b	0.11 a	0.12 a		
W_1	control	0.14 a	0.11 a-e	0.12 b-g	0.12 b-g	0.11 ab	0.12 a
	soil replacement	0.16 d	0.08 a	0.13 d-g	0.10 a-d	0.10 a	
	Temik 10G	0.18 f	0.14 e-h	0.13 d-g	0.14 f-h	0.14 d	
	Aliette 80 WP	0.14 a	0.11 a-f	0.13 d-g	0.13 d-g	0.12 ad	
	ammonium phosphate	0.15 b-d	0.12 b-g	0.12 b-g	0.13 d-g	0.12 a-d	
	peat	0.17 e	0.12 b-g	0.12 b-g	0.09 ab	0.11 ab	
Mean for all methods			0.11 a	0.13 ab	0.12 a		
W_2	control	0.14 ab	0.10 a-d	0.11 a-f	0.12 b-g	0.11 ab	0.12 a
	soil replacement	0.14 ab	0.11 a-f	0.13 d-g	0.17 h	0.14 d	
	Temik 10 G	0.23 h	0.13 d-g	0.13 d-g	0.12 b-g	0.12 a-d	
	Aliette 80 WP	0.14 ab	0.12 b-g	0.13 dg	0.10 a-d	0.11 ab	
	ammonium phosphate	0.16 d	0.11 a-f	0.13 d-g	0.12 b-g	0.12 a-d	
	peat	0.19 g	0.11 a-f	0.12 b-g	0.11 a-f	0.11 ab	
Mean for all methods			0.11 a	0.13 ab	0.13 ab		
Mean for all methods and all levels of irrigation			0.12 a	0.12 a	0.12 a		

*For explanation, see Table 1

Table 4. Leaf potassium content versus method of preventing replanting disease and level of irrigation

Treatment		Leaf potassium [% of dry matter]					
		mean for 1999-2000	2001	2002	2003	mean for 2001-2003	mean for irrigation level
W_0	control	1.14 a-d*	1.33 b-j	1.77 jk	1.22 a-j	1.44 c	1.30 b
	soil replacement	1.43 de	1.06 a-h	1.27 a-j	0.99 a-g	1.10 a-c	
	Temik 10 G	1.07 a-c	1.09 a-h	1.34 b-k	1.03 a-h	1.15 a-c	
	Aliette 80 WP	0.90 a	1.21 a-j	1.48 e-k	1.10 a-h	1.26 a-c	
	ammonium phosphate	1.03 a-c	1.30 b-j	1.72 i-k	1.14 a-i	1.38 bc	
	peat	1.22 a-e	1.19 a-j	1.94 k	1.20 a-j	1.44 c	
Mean for all methods			1.20 b	1.58 c	1.11 ab		
W_1	control	1.31 c-e	1.10 a-h	1.59 g-k	1.46d-k	1.38 bc	1.16 a
	soil replacement	1.12 a-d	1.05 a-h	1.58 g-k	0.86 a-d	1.16 a-c	
	Temik 10 G	0.94 ab	0.90 a-f	1.60 h-k	1.15 a-i	1.22 a-c	
	Aliette 80 WP	1.23 b-e	0.88 a-e	1.29 b-j	0.66 a	0.94 a	
	ammonium phosphate	1.23 b-e	0.93 a-f	1.40 c-k	0.93 a-f	1.09 ab	
	peat	1.18 a-e	1.07 a-h	1.59 g-k	0.78 ab	1.15 a-c	
Mean for all methods			0.99 ab	1.51 c	0.97 ab		
W_2	control	1.24 b-e	1.16 a-j	1.41 d-k	1.01 a-h	1.19 a-c	1.16 a
	soil replacement	1.09 a-c	1.05 a-h	1.60 g-k	1.13 a-i	1.26 a-c	
	Temik 10 G	1.49 e	1.15 a-i	1.51 f-k	0.91 a-f	1.19 a-c	
	Aliette 80 WP	1.23 b-e	1.03 a-h	1.60 h-k	0.80 a-c	1.14 a-c	
	ammonium phosphate	1.09 a-e	0.94 a-f	1.37 b-k	0.95 a-f	1.09 ab	
	peat	1.34 c-e	0.99 a-h	1.40 c-k	0.96 a-f	1.12 a-c	
Mean for all methods			1.05 ab	1.48 c	0.96 a		

*For explanation, see Table 1

Table 5. Leaf magnesium content versus method of preventing replanting disease and level of irrigation

Treatment		Leaf magnesium [% of dry matter]					
		mean for 1999-2000	2001	2002	2003	mean for 2001-2003	mean for irriga-tion level
W_0	control	0.29 d-f	0.41 d-m	0.30 a-h	0.25 a-d	0.32 ab	0.34 a
	soil replacement	0.26 a-c	0.44 g-m	0.32 a-j	0.24 a-d	0.33 a-d	
	Temik 10 G	0.34 h	0.47 i-m	0.37 b-k	0.27 a-f	0.37 b-d	
	Aliette 80 WP	0.26 a-c	0.48 j-m	0.42 e-m	0.29 a-g	0.39 b-d	
	ammonium phosphate	0.39 I	0.39 c-l	0.33 a-j	0.23 a-c	0.32 ab	
	peat	0.31 fg	0.46 h-m	0.28 a-g	0.29 a-g	0.34 b-d	
Mean for all methods			0.44 d	0.34 c	0.26 a		
W_1	control	0.25 ab	0.44 f-m	0.32 a-j	0.33 a-j	0.36 b-d	0.37 a
	soil replacement	0.26 a-c	0.37 b-k	0.35 b-k	0.21 ab	0.31 ab	
	Temik 10 G	0.34 h	0.57 m	0.39 c-l	0.29 a-g	0.41 cd	
	Aliette 80 WP	0.26 a-c	0.44 g-m	0.43 f-m	0.38 c-l	0.42 cd	
	ammonium phosphate	0.32 gh	0.33 a-j	0.30 a-i	0.30 a-h	0.31 ab	
	peat	0.31 e-g	0.51 k-m	0.32 a-j	0.44 g-m	0.42 d	
Mean for all methods			0.44 d	0.35 c	0.32 bc		
W_2	control	0.29 de	0.40 c-l	0.34 a-j	0.31 a-j	0.35 b-d	0.35 a
	soil replacement	0.28 cd	0.42 e-m	0.29 a-h	0.26 a-e	0.32 a-c	
	Temik 10 G	0.24 a	0.54 lm	032 a-j	0.28 a-g	0.39 b-d	
	Aliette 80 WP	0.28 cd	0.47 i-m	0.32 a-j	0.27 a-f	0.35 b-d	
	ammonium phosphate	0.31 fg	0.28 a-g	0.30 a-i	0.18 a	0.25 a	
	peat	0.27 b-d	0.56 m	0.40 c-l	0.32 a-j	0.43 d	
Mean for all methods			0.44 d	0.33 bc	0.27 ab		

*For explanation, see Table 1

Table 6. Leaf calcium content versus method of preventing replanting disease and level of irrigation

Treatment		Leaf calcium [% of dry matter]					
		mean for 1999-2000	2001	2002	2003	mean for 2001-2003	mean for irrigation level
W_0	control	1.44 c-e	1.09 a-e	1.92 o-q	1.34 a-m	1.45 a-f	1.55 b
	soil replacement	2.02 h	1.03 a-d	1.76 l-q	1.20 a-i	1.33 ab	
	Temik 10 G	1.47 de	1.11 a-f	1.80 m-q	1.33 a-m	1.41 a-c	
	Aliette 80 WP	1.25 a	1.41 b-o	2.14 q	1.44 c-o	1.66 cd	
	ammonium phosphate	1.70 f	1.49 d-o	2.63 r	1.77 l-p	1.96 e	
	peat	1.43 c-e	1.21 a-j	1.88 n-q	1.34 a-m	1.47 b-d	
Mean for all methods			1.22 a-c	2.02 e	1.40 c		
W_1	control	1.39 c-e	1.05 a-d	1.51 d-p	1.58 e-p	1.38 a-c	1.40 a
	soil replacement	2.17 i	0.92 ab	1.65 g-q	0.88 a	1.15 a	
	Temik 10 G	1.35 bc	1.22 a-k	1.73 k-q	1.38 a-n	1.44 bc	
	Aliette 80 WP	1.46 de	0.95 a-c	1.77 l-q	1.36 a-m	1.36 ab	
	ammonium phosphate	1.63 f	1.35 a-m	2.14 g	1.69 h-q	1.73 de	
	peat	1.26 ab	1.17 a-h	1.43 b-o	1.39 a-n	1.33 ab	
Mean for all methods			1.11 a	1.71 d	1.38 c		
W_2	control	1.60 f	1.09 a-e	1.72 j-q	1.24 a-k	1.35 ab	1.40 a
	soil replacement	1.85 g	1.19 a-h	1.71 i-q	1.32 a-m	1.41 a-c	
	Temik 10 G	1.43 c-e	1.40 b-o	1.72 j-q	1.12 a-f	1.41 a-c	
	Aliette 80 WP	1.50 e	1.21 a-j	1.60 e-p	1.02 a-d	1.28 ab	
	ammonium phosphate	1.42 c-e	1.38 a-n	2.00 pq	1.14 a-g	1.50 b-d	
	peat	1.37 cd	1.50 d-p	1.61 f-p	1.26 a-l	1.45 bc	
Mean for all methods			1.29 bc	1.72 d	1.18 ab		
Mean for all methods and all levels of irrigation			1.21 a	1.82 c	1.32 b		

*For explanation, see Table 1

Chemical disinfection of the soil increases soil nitrogen content and decreases soil microbe populations. This promotes healthy root formation, which in turn promotes the uptake of soil nutrients such as phosphorus and potassium (Wilhelm and Paulus. 1980; Szczygieł. 1993). In our study, chemical disinfection did not increase the availability of soil phosphorus or potassium and had no significant effect on leaf phosphorus or potassium content.

CONCLUSIONS

Soil mineral content varied depending on which method of preventing replanting disease and on which level of irrigation was used. Ammonium phosphate significantly increased soil potassium and phosphorus content. Irrigation at a moisture content of –0.01 MPa significantly increased soil magnesium content and increased soil pH. Irrigation did not affect soil potassium or phosphorus content.

Leaf mineral content also varied depending on which method of preventing replanting disease and on which level of irrigation was used. Peat increased leaf nitrogen and magnesium content. Temik 10 G increased leaf phosphorus and magnesium content. Ammonium phosphate increased leaf calcium content. The control trees had increased leaf potassium content. Non-irrigated trees had increased leaf potassium and calcium contents.

Leaf mineral content varied significantly from year to year, which demonstrates that climatic conditions during the vegetation phase have a significant effect on leaf mineral content in apple trees.

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WPŁYW NAWADNIANIA I SPOSOBÓW PRZECIWDZIAŁANIA ZMĘCZENIU GLEBY NA ZAWARTOŚĆ SKŁADNIKÓW W GLEBIE ORAZ LIŚCIACH

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S T R E S Z C Z E N I E

Podjęte badania miały na celu wyjaśnienie wpływu sposobu przeciwdziałania zmęczeniu gleby na zawartość składników przyswajalnych w glebie oraz ogólnych w liściach jabłoni odmiany ‘Elstar’ w okresie pełnego owocowania. W doświadczeniu zastosowano trzy poziomy nawadniania oraz sześć wariantów przeciwdziałania chorobie replantacyjnej. W trakcie realizacji badań stwierdzono, że zastosowane zabiegi miały wpływ na zawartość składników przyswajalnych w glebie. Nawadnianie wpływało na wzrost zawartości magnezu oraz wzrost pH. Stosowanie fosforanu amonu jako sposobu zapobiegania zmęczeniu gleby powodowało istotny wzrost fosforu w glebie. Zawartość składników w liściach była również modyfikowana przez zastosowanie nawadniania i sposobu zapobiegania zmęczeniu gleby. Jednakże przebieg warunków klimatycznych w okresie wegetacji miał istotny wpływ na zawartość składników w glebie.

Słowa kluczowe: zmęczenie gleby, nawadnianie, sposoby zapobiegania, składniki mineralne, gleba, liście