

THE EFFECT OF SOIL MULCHING AND IRRIGATION ON YIELDING OF APPLE TREES IN RIDGE PLANTING

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A B S T R A C T

The aim of the study was to examine how irrigation, tree planting method, and soil mulching affect yield of apple trees in the first three years after planting. In the spring of 2000, two-year-old 'Jonagored' apple trees on M.9 rootstocks were planted either traditionally or in ridges. Trees were planted 3.5 x 0.5 m apart (5714 trees per ha) and were trained as a slender spindles. Both traditionally planted and ridge planted trees were subjected to the following four soil management treatments: 1) Herbicide without irrigation; 2) Herbicide with irrigation; 3) Mulching with pine bark; and 4) Mulching with black plastic (non-woven polypropylene). The experiment was carried out in a randomised block design with four replications. Each experimental plot consisted of five trees. Irrigation, soil mulching and ridge planting increased yield during the three years of this study. Trees treated with herbicide and irrigation had the highest yields. Traditionally planted trees which had been treated with herbicide alone had the lowest yield. Irrigation increased mean fruit weight and tree vigour.

Key words: apple, mulching, irrigation, planting in ridge, yield, growth

INTRODUCTION

In ridge planting, trees are set on the top of ground and hilled with soil with a lister. Ridge planting can be used in orchards in which the water table is high (Perry, 1996). There have been conflicting reports on the benefits of

ridge planting. Bootsma (1995) reported that ridge planting is a good method for replanting trees. Sosna and Szewczuk (1998) reported that ridge planting reduces tree vigour. Treder and Mika (2001) found that ridge planted trees grew weaker in the third year after planting. Sako and Laurinen (1986) reported that ridge planted apple trees grew more vigorously than traditionally planted trees. When trees were replanted using ridge planting, growth was initially stronger, but after a few years, growth was weaker than in traditionally planted trees (Bootsma, 1995). Treder and Mika (2001) found that ridge planting had no influence on yield or fruit quality in apples. Similar results were obtained by Perry (1996), though he did find that ridge planting improved yield in peaches and sour cherries. Wagenmakers and Tazelaar (1998) conclude that the effects of ridge planting depended on the apple cultivar under study. With ridge planting, the soil dries out easily, which can seriously impair growth during periods of drought (Perry, 1996; Treder and Mika, 2001). Sako and Laurinen (1986) suggest that mulching ridge planted trees with black plastic can improve growth by maintaining water availability and increasing soil temperature.

The aim of this study was to examine the effects of irrigation, tree planting method, and soil management on yield of apple trees in the first three years after planting.

MATERIAL AND METHODS

The experiment was conducted from 2000 to 2003. In the spring of 2000, two-year-old 'Jonagored' apple trees on M.9 rootstocks were planted either traditionally or in ridges. Trees were planted 3.5 x 0.5 m apart (5714 trees per ha) and were trained as slender spindles. Both traditionally planted and ridge planted trees were subjected to the following four soil management treatments: 1) Herbicide without irrigation; 2) Herbicide with irrigation; 3) Mulching with pine bark; and 4) Mulching with black plastic (non-woven polypropylene). The experiment was carried out in a randomised block design with four replications. Each experimental plot consisted of 5 trees.

In the first year after planting, Roundup 360 SL (5 l ha⁻¹) plus Chwastox Extra 300 SL (2 l ha⁻¹) was applied twice, at the end of May and at the beginning of July. In 2002-2003, Casoron GR (dichlobenil, 70 kg ha⁻¹) was applied to the moist soil at the beginning of March. During the summers, some weeds grew on the pine bark, so Glifogan 360 SL (5 l ha⁻¹) plus Chwastox Extra 300 SL (2 l ha⁻¹) was applied to pine bark mulched rows once a season. Black plastic effectively stopped weed growth for the whole course of this study. Irrigation was applied when soil potential dropped to 0.03 MPa. Fertilizer (50 kg N ha⁻¹) was applied once a year.

Yield and mean weight were recorded for each tree. Blossoms were counted on six randomly selected trees for each treatment. Tree vigour was estimated using trunk cross sectional area (TCSA).

Weather conditions from 2000 to 2003 are presented in Figure 1, according to the method proposed by Walter and Lieth (1967). In 2003, periods of drought occurred in April, June and August. During the course of this study, winter temperatures did not damage the trees.

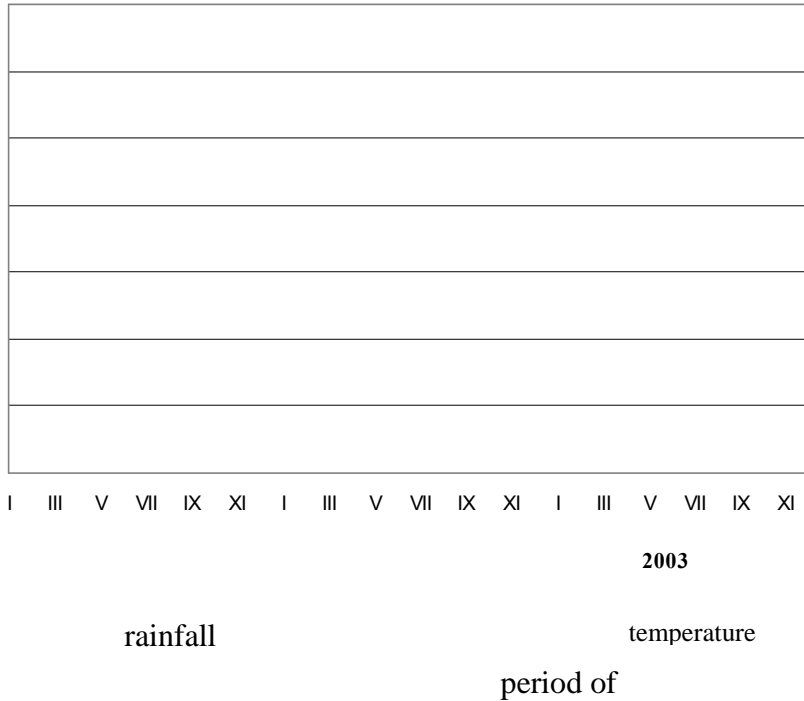


Figure 1. Climatic graph for the years 2001-2003

RESULTS

Irrigation and mulching with pine bark increased yield in both traditionally planted and ridge planted ‘Jonagored’ apple trees (Tab. 1). Mulching with black plastic increased yield in traditionally planted trees, but not in ridge planted trees. Ridge planted trees grew better with herbicide

treatments (Tab. 4). With mulching, there was no significant difference in cumulative yields between traditionally planted trees and ridge planted trees (Tab. 1). In the three years of the study, the highest yield was from trees which were irrigated and ridge planted.

Table 1. Yield of 'Jonagored' and soil management from 2001 to 2003

Soil management treatment		Yield [kg tree ⁻¹]			Total yield 2001- 2003	Productivity index [kg cm ⁻²]
		2001	2002	2003		
Traditional planting	herbicide	3.7 a*	5.9 a	7.2 a	16.7 a	2.8 a
	herbicide+ irrigation	5.2 b	7.4 bc	11.4 d	24.0 d	3.7 d
	pine bark	6.3 d	8.2 cd	8.2 b	22.7 cd	3.5 cd
	black plastic	4.1 a	6.9 b	8.6 bc	19.6 b	3.1 b
	herbicide fallow	5.0 b	6.7 ab	8.0 ab	19.7 b	3.5 cd
Ridge planting	herbicide + irrigation	5.6 bc	9.8 e	13.2 e	28.5 e	4.0 e
	pine bark	6.2 cd	8.9 de	9.0 c	24.2 d	3.6 cd
	black plastic	5.2 b	7.4 bc	8.5 bc	21.1 bc	3.4 c

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

Table 2. Mean fruit weight [g] of 'Jonagored' and soil management from 2001 to 2003

Soil management treatment		2001	2002	2003
Traditional planting	herbicide	168 a*	169 a	106 ab
	herbicide + irrigation	194 bc	204 c	123 c
	pine bark	205 bc	183 b	106 ab
	black plastic	195 bc	182 b	97 a
	herbicide fallow	192 bc	179 ab	108 b
Ridge planting	herbicide + irrigation	194 bc	228 d	150 d
	pine bark	207 c	173 ab	121 c
	black plastic	190 b	180 ab	101 ab

*For explanation, see Table 1

With traditionally planted trees, soil management had a significant effect on fruit weight in 2001 and 2002. With ridge planted trees, mulching with pine bark increased fruit weight only in 2003, which was a dry year. Irrigation increased fruit weight in both traditionally planted and ridge planted trees (Tab. 2).

In 2001 and 2002, blossom counts correlated with yield. Irrigated trees, trees mulched with pine bark, and ridge planted trees had higher blossom counts (Tab. 3). In 2003, these trends were not observed. Trees mulched with pine bark and ridge planted trees had fewer blossoms, but higher yields

because of higher fruit weight. Ridge planted trees grew more vigorously than traditionally planted trees in the first two years, but not in the third and fourth years (Tab. 4). Mulching improved vigour in traditionally planted trees in the first year after planting. Irrigation improved vigour in traditionally planted trees in the second, third and fourth years. Irrigation and mulching with pine bark improved vigour in ridge planted trees in all four years of the study.

Table 3. Blossom count and soil management from 2001 to 2003

Soil management treatment		2001	2002	2003
Traditional planting	herbicide	16.9 a	30.7 a	109.5 bc
	herbicide + irrigation	22.4 bc	32.8 ab	139.8 d
	pine bark	33.2 e	50.8 de	109.9 bc
	black plastic	19.2 ab	40.4 bc	131.7 cd
Ridge planting	herbicide fallow	26.9 cd	41.7 c	105.0 ab
	herbicide + irrigation	33.6 e	56.4 e	121.7 bcd
	pine bark	47.7 f	79.9 f	79.0 a
	black plastic	30.3 de	46.6 cd	130.0 bcd

*For explanation, see Table 1

Table 4. Increase in trunk cross-section area (TCSA) [cm²] and soil management from 2001 to 2003

Soil management treatment		2000	2001	2002	2003
Traditional planting	herbicide	0.58 a	0.90 a	1.09 a	1.51 abc
	herbicide + irrigation	0.67 ab	1.02 bc	1.50 bc	1.78 e
	pine bark	1.14 e	0.99 b	0.98 a	1.54 bcd
	black plastic	0.98 d	1.10 cd	1.40 b	1.53 bcd
Ridge planting	herbicide fallow	0.76 bc	1.06 bcd	0.92 a	1.29 a
	herbicide + irrigation	0.84 c	1.23 e	1.72 c	1.76 de
	pine bark	1.22 e	1.46 f	0.96 a	1.69 cde
	black plastic	1.14 e	1.14 d	1.09 a	1.40 ab

*For explanation, see Table 1

DISCUSSION

Treder and Mika (2001) and Perry (1996) found that ridge planting does not significantly affect yield. However, in our study, the trees which had the highest yield were those which had been ridge planted, irrigated and treated with herbicides. Sako and Laurinen (1986) suggested that back plastic could

be beneficial because of its effect on soil temperature. In our study, black plastic did not have any significant effect on yield. Many studies have shown that mulching improves yield in fruit trees (Bielińska, 2001; Szwedko and Maszczyk, 2000; Engel et al., 2001). Our results confirm that mulching improves yield in traditionally planted and ridge planted apple trees.

Irrigation and mulching with pine bark significantly improve vigour and yield in young ridge planted apple trees. Even though black plastic improves vigour, it did not increasing blossom counts and yields in ridge planted apple trees.

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WPŁYW ŚCIOŁKOWANIA I NAWADNIANIA NA PLONOWANIE DRZEW JABŁONI SADZONYCH W REDLINACH

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

Celem pracy była ocena wpływu sposobu sadzenia drzew, nawadniania i ściółkowania gleby w rzędach na plonowanie drzew jabłoni w pierwszych trzech latach po posadzeniu. Wiosną 2000 roku posadzono dwuletnie drzewka odmiany 'Jonagored' na podkładce M.9 metodą tradycyjną i w redlinach. Drzewa posadzono w rozstawie 3,5 x 0,5 m (5714 drz./ha) i prowadzono w formie wysmukłego wrzeciona. Dla obu metod sadzenia zastosowano cztery sposoby uprawy gleby w rzędach drzew: 1) ugór herbicydowy, 2) ugór herbicydowy i nawadnianie, 3) ściółkowanie korą sosnową, 4) ściółkowanie czarną włókniną. Doświadczenie założono metodą losowanych podbloków w 4 powtórzeniach po 5 drzew na poletku. Nawadnianie, ściółkowanie i sadzenie drzew w redliny wpłynęło na wzrost plonu w pierwszych trzech latach po posadzeniu drzew do sadu. Najwyższe plony uzyskano z drzew nawadnianych. Najniższe plony zanotowano dla drzew sadzonych tradycyjnie i nienawadnianych. Nawadnianie wpłynęło na wzrost średniej masy owoców i silniejszy wzrost badanych drzew.

Słowa kluczowe: jabłoni, nawadnianie, ściółkowanie, redliny, plon, wzrost