

## Effect of no-tillage and mulching with cover crops on yield of parsley

*Marzena Błażewicz-Woźniak*

Department of Soil Cultivation and Fertilization of Horticultural Plants  
Agricultural University in Lublin  
Leszczyńskiego 58, 20-068 Lublin, Poland  
e-mail: marzena.wozniak@ar.lublin.pl

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### ABSTRACT

In field experiments with parsley 'Berlińska', following factors were compared: 1) cultivation system (no-tillage and conventional tillage with spring ploughing), 2) usage of cover crop mulches: white mustard (*Sinapis alba* L.), spring vetch (*Vicia sativa* L.), tansy phacelia (*Phacelia tanacetifolia* B.), oat (*Avena sativa* L.). Total and marketable yields of parsley roots were affected in large extent by weather conditions. Significantly higher total yield of parsley roots was obtained from plots cultivated in a conventional way, comparing to no-tillage method. Reduced soil cultivation system (no-tillage) had no negative influence on marketable yield of parsley roots. Oat and phacelia mulches created the best conditions, whereas mustard mulch created the worst environment for parsley yielding.

## INTRODUCTION

Traditional soil tillage is the most energy-absorptive and labor-consuming process in plants cultivation (Dzienia and Sosnowski 1990). For many years modifications were aimed to simplify this stage of production (Droese et al. 1986, Roszak et al. 1991, Dzienia 1995, Radomska and Radomska 1995, Walters and Kindhart 2002). One of alternatives is introducing of so-called “no-tillage” system. This way of cultivation is often connected with using mulches and therefore it performs a function of conservation tillage (Hoyt et al. 1994, Bradley 1995, Zimny 1999, Smith et al. 2001, Reiter et al. 2002). Intercrop cover plants, being left on the surface of a field as mulch, positively affect properties of soil. Consequently, its structures and water-air relations improve. Furthermore, soil compaction and water-air erosion are reduced (Merkes 1989, Iwuafor and Kang 1994, Dzienia 1995, Nyakatava et al. 2001). All these changes, taking place in soil environment, positively influenced growth of roots, which is particularly important in cultivation of root vegetables (Błażewicz-Woźniak 2003).

The main objective of research was to determine the influence of no-tillage method and a process of mulching with cover crops on total and marketable yield of parsley roots.

## MATERIAL AND METHODS

Field experiments were carried out in years 1997, 1999 and 2000 in Felin Experimental Station on grey-brown podzolic soil. The experimental plant was ‘Berlińska’ parsley. The following factors were considered in experiment scheme: 1) the way of performance of pre-sowing soil tillage (conventional tillage with middle ploughing and no-tillage), 2) intercrop cover plants: white mustard (*Sinapis alba* L.), spring vetch (*Vicia sativa* L.), tansy phacelia (*Phacelia tanacetifolia* B.) and oat (*Avena sativa* L.). The experiment was established using split-plots method in four replications. Cover plants were sown in the third decade of August in a year preceding parsley cultivation. They were left on fields for a winter-time and in the spring next year plots were covered with a natural mulch. Before parsley was sown, one half of a field had been cultivated in a traditional way using middle-deep ploughing, whereas the second half of a field had been left without tillage. Mineral fertilization was applied during a spring-time in following doses: 150 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>, 200 kg K<sub>2</sub>O ha<sup>-1</sup>, 75 kg N ha<sup>-1</sup> pre-sowing and 75 kg N ha<sup>-1</sup> top-dressing. Parsley seeds were sown on April 26 in two rows spacing 35 cm at the amount of 8 kg ha<sup>-1</sup>. Harvest was performed on the 6<sup>th</sup> of October and total as well as marketable yields of parsley roots were determined, according to PN-R-75370. Obtained results were analyzed with a variance method. Differences were tested at significance level of  $p = 0.05$ .

## RESULTS AND DISCUSSION

Weather conditions in respective years notably affected parsley yield (Table 1). The most favorable weather conditions were observed in 2000, when the largest total yield of parsley roots was obtained (mean 40.1 t ha<sup>-1</sup>), comparing to 1999 (24.9 t ha<sup>-1</sup>) and 1997 (20.0 t ha<sup>-1</sup>) – Table 2. In 1999, after sowing, there occurred gusty rains and snowing that caused a notable deterioration of physical soil properties and also conditions of plants (Konopiński et al. 2001). The average total yield of parsley roots during three years of research was 28.3 t ha<sup>-1</sup>.

Table 1. The air temperatures and amount of precipitation in Felin in the years 1997-2000

	Year	Month					
		IV	V	VI	VII	VIII	IX
Mean monthly temperature (°C)	1997	3.9	13.6	16.8	17.6	18.2	12.5
	1999	8.8	11.6	18.5	20.0	17.3	14.7
	2000	11.2	14.6	17.0	17.0	18.2	11.1
	Mean for 1951-99	7.4	13.1	17.0	18.2	17.2	13.1
Amount of precipitation (mm)	1997	40.8	83.1	36.9	183.8	33.8	47.4
	1999	81.6	45.9	160.9	102.1	33.5	37.6
	2000	68.0	50.4	36.4	138.1	28.3	66.7
	Mean for 1951-99	50.6	58.4	76.2	98.5	63.5	49.8

Regardless of weather conditions and applied plant mulches, the total yield of parsley roots was significantly higher in plots cultivated in a conventional way (average 30.8 t ha<sup>-1</sup>) than in no-tillage fields (average 25.8 t ha<sup>-1</sup>). This relation was noted in years 1997 and 2000. In 1999 parsley reacted differently the way of pre-sowing tillage. The total yield of parsley roots was significantly higher in no-tillage method (average 30.6 t ha<sup>-1</sup>) than after spring ploughing (19.1 t ha<sup>-1</sup>). Kęsik et al. (2000a) stated that yielding of carrot was higher after conventional tillage than after no-tillage method. On the other hand, the same researchers noted higher yielding of onion on no-tillage plots than on those cultivated in a traditional way (Kęsik et al. 2000c). Höppner et al. (1995) did not observe any significant decrease in beets yielding, comparing conventional and no-tillage methods. According to Borowy and Jelonkiewicz (1999), vegetables that reacted favorably to no-tillage system were carrot, beet, cabbage, cucumber, leek and celery, whereas tomato and turnip yields were significantly lower.

Plant mulches, obtained from cover plants and used in this research, significantly affected yields of parsley roots (Table 2). During all years of research and in all objects, the total yield of parsley roots was the lowest in fields where the white mustard was used as a cover plant. In average, regardless of other factors,

the total yield of parsley roots after mulching a ground with white mustard was only 21.5 t ha<sup>-1</sup>. Furthermore, Kęsik et al. (2000b) also determined a negative influence of white mustard mulch on carrot and onion yielding. Significantly the highest yield of parsley roots was obtained from plots mulched with oat (average 33.6 t ha<sup>-1</sup>). Positive influence of mulching with oat was observed in both conventional tillage (36.8 t ha<sup>-1</sup>) and when using no-tillage method (30.4 t ha<sup>-1</sup>). According to Borowy and Jelonkiewicz (2000) carrot, cabbage and celery gave good yields when mulched with rye. In years 1997 and 2000 high yields of parsley roots were obtained from plots mulched with tansy phacelia. The usefulness of tansy phacelia in mulching was emphasized by Zimny (1999). Dzień and Szarek (2000) stated that the conservation tillage positively affected potato yields.

Table 2. Effect of no-tillage and plant mulches on the total yield of parsley roots (t ha<sup>-1</sup>)

Cover plant (mulch)	Total yield of parsley roots (t ha <sup>-1</sup> )			
	1997	1999	2000	Mean
	Conventional tillage (ploughing)			
Control (without mulch)	26.0	15.5	49.5	30.3
<i>Sinapis alba</i>	18.3	11.4	36.9	22.2
<i>Vicia sativa</i>	20.7	25.2	47.4	31.1
<i>Phacelia tanacetifolia</i>	36.8	14.8	49.8	33.8
<i>Avena sativa</i>	32.9	28.6	48.8	36.8
Mean	26.9	19.1	46.5	30.8
	No-tillage			
Control (without mulch)	12.5	32.1	34.5	26.4
<i>Sinapis alba</i>	15.6	21.9	25.0	20.8
<i>Vicia sativa</i>	11.3	27.9	29.5	22.9
<i>Phacelia tanacetifolia</i>	12.4	28.6	44.3	28.4
<i>Avena sativa</i>	13.2	42.6	34.5	30.4
Mean	13.0	30.6	33.8	25.8
	Average			
Control (without mulch)	19.3	23.8	42.0	28.4
<i>Sinapis alba</i>	17.0	16.7	31.0	21.5
<i>Vicia sativa</i>	16.0	26.6	38.5	27.0
<i>Phacelia tanacetifolia</i>	24.6	21.7	47.1	31.1
<i>Avena sativa</i>	23.1	35.6	42.2	33.6
Mean	20.0	24.9	40.1	28.3
LSD <sub>0.05</sub> for:				
tillage	3.0	5.4	4.3	4.2
mulch	6.8	12.4	9.7	10.1
years				6.4

Weather conditions observed throughout years of research had also affected marketable yields of parsley roots (Table 3). Significantly the highest marketable yield was obtained in 2000 (average 12.5 t ha<sup>-1</sup>). In 1999 the marketable yield of

roots was the lowest (7.6 t ha<sup>-1</sup>). Low marketable yield of parsley roots (average 9.5 t ha<sup>-1</sup>) was caused by unfavorable soil conditions – too large compaction and too little soil moisture, particularly in 1999. During that year, the soil density in a layer of 0-20 cm in the full of parsley vegetation was equal to 1.59-1.63 Mg m<sup>-3</sup> and soil moisture from 16.7% up to 17.1% (Konopiński et al. 2001).

Table 3. Effect of no-tillage and plant mulches on the marketable yield of parsley roots (t ha<sup>-1</sup>)

Cover plant (mulch)	Marketable yield of parsley roots (t ha <sup>-1</sup> )			
	1997	1999	2000	Mean
	Conventional tillage (ploughing)			
Control (without mulch)	12.6	3.8	6.7	7.7
<i>Sinapis alba</i>	9.9	3.6	11.4	8.3
<i>Vicia sativa</i>	12.5	7.9	13.8	11.4
<i>Phacelia tanacetifolia</i>	12.1	3.1	11.7	9.0
<i>Avena sativa</i>	17.2	7.1	12.9	12.4
Mean	12.9	5.1	11.3	9.8
	No-tillage			
Control (without mulch)	3.6	5.7	10.0	6.4
<i>Sinapis alba</i>	4.9	4.3	7.6	5.6
<i>Vicia sativa</i>	2.5	13.8	11.9	9.4
<i>Phacelia tanacetifolia</i>	4.0	9.3	21.9	11.7
<i>Avena sativa</i>	4.3	17.1	16.7	12.7
Mean	3.9	10.0	13.6	9.2
	Average			
Control (without mulch)	8.1	4.8	8.4	7.1
<i>Sinapis alba</i>	7.4	4.0	9.5	7.0
<i>Vicia sativa</i>	7.5	10.9	12.9	10.4
<i>Phacelia tanacetifolia</i>	8.1	6.2	16.8	10.4
<i>Avena sativa</i>	10.8	12.1	14.8	12.6
Mean	8.4	7.6	12.5	9.5
LSD <sub>0.05</sub> for:				
tillage	2.6	3.0	n.s.	n.s.
mulch	n.s.	6.9	7.7	n.s.
years				3.9

n.s. – no significant differences

No significant influence of pre-sowing tillage and a usage of mulches on marketable yield of parsley was found. The lowest yield of marketable roots was obtained from plots mulched with white mustard (average 7.0 t ha<sup>-1</sup>) and from no-mulched control (7.1 t ha<sup>-1</sup>), and the highest yield was collected after applying oat mulch (12.6 t ha<sup>-1</sup>). However, those differences were not of statistical significance. Plant mulches improved a marketable yield of parsley roots. In following years of investigation the most positive influence on yielding had mulches obtained from oat, spring vetch and tansy phacelia. The high usefulness of oat and spring vetch was also indicated by Amado et al. (1998). The lowest marketable yield was

observed in control plots. It was due to the fact that on mulched plots soil had a better structure and also was less clodded than on control fields (Błażewicz-Woźniak et al. 2001).

## CONCLUSIONS

1. Desisting from spring-tillage and sowing seeds in non-cultivated soil significantly decreased the total yield of parsley roots comparing to conventional tillage, however it did not affect the yield of marketable roots.
2. Mulching with white mustard notably reduced the total and marketable yield of parsley roots. It was positively affected by mulching with oat, spring vetch and tansy phacelia.
3. The total and marketable yield was significantly influenced by weather conditions.

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#### WPŁYW UPRAWY ZEROWEJ I MULCZOWANIA ROŚLINAMI OKRYWOWYMI NA PLONOWANIE PIETRUSZKI KORZENIOWEJ

Streszczenie: W doświadczeniu polowym z uprawą pietruszki korzeniowej odm. Berlińska uwzględniono następujące czynniki: 1) sposób wykonania przedsięwzięcia uprawy roli (uprawa tradycyjna z orką średnią i uprawa zerowa), 2) międzyplonowe rośliny okrywowe: gorczyca biała (*Sinapis alba* L.), wyka siewna (*Vicia sativa* L.), facelia (*Phacelia tanacetifolia* B.), owies (*Avena sativa* L.). Plon ogólny korzeni pietruszki był w dużym stopniu modyfikowany przebiegiem pogody w kolejnych latach badań. Istotnie wyższy plon ogólny korzeni pietruszki uzyskano po uprawie tradycyjnej niż po zerowej. Zredukowany system uprawy roli nie wpłynął niekorzystnie na plon handlowy korzeni. Najlepsze warunki dla plonowania pietruszki stworzyły mulcze z owsa i facelii. Niekorzystny wpływ na plonowanie pietruszki wywarł mulcz z gorczycy białej.

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