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## GROUND-COVER SYSTEMS IN NON-IRRIGATED OLIVE ORCHARDS

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### Introduction

Currently, in NE Portugal, we are advising farmers to adopt ground-cover systems in olive orchards instead of tillage. Most of soils are on steep slopes and have very low organic matter content (Arrobas and Rodrigues, 2002). This consequently creates huge problems for soil conservation. However, we need strong arguments to convince the farmers. Tillage is a very old and ingrained practice; it is easy, pleasant and in some ways it works. Alternative management systems, such as the use of herbicides or cover crops, need a high degree of technical expertise. Ground-cover systems affect crop growth and yields by influencing weed competition, water use efficiency, nutrient uptake, soil fertility and soil conservation. In order to evaluate the multiple aspects of soil management systems in olive groves two field experiments have been conducted since October 2001 in NE Portugal. In this abstract olive yields and the increase in trunk circumference are presented.

### Materials and methods

One of the experiments was carried out in Mirandela in an olive orchard previously tilled and the other in Bragança in an orchard that had been grown under a sheep-walk pasture in the preceding years. The Mirandela trial started in a young (13 years) olive grove where soil tillage (two annual scarifications in spring) was kept as control, and two herbicide treatments were implemented: an herbicide with a residual component (terbutylazine + diuron) plus a non-selective component (glyphosate), applied in February; and a glyphosate content herbicide, applied in April. In the Bragança trial, three treatments were also established: the control (pasture); soil tillage; and a non-selective herbicide (glyphosate) applied in April. The trees were selected in October 2001, two months before the first harvest, based on the homogeneity of their canopies, in order to reduce the variability associated of each individual tree. The olive yields were recorded annually from 12 and 10 previously selected trees per treatment in Mirandela and Bragança trials, respectively. In the Mirandela trees the trunk circumference at 50 cm above ground level was also recorded.

### Results

In the first year (2001), before the different soil management treatments were implemented, the mean values of olive yield were similar in Mirandela (table 1) and Bragança (table 2) trial. In the course of the years, despite the variability among trees, huge differences in olive yields and trunk circumference increases occurred in both localities.

Table 1 – Olive yields and annual trunk circumference increase in Mirandela trial.

Year	Tillage		Glyphosate		Res. herbicide	
	Olive yield kg/tree	Trunk circ. ( $\Delta$ cm)	Olive yield kg/tree	Trunk circ. ( $\Delta$ cm)	Olive yield kg/tree	Trunk circ. ( $\Delta$ cm)
Dec. 01	7.2 (1.8) <sup>s</sup>	---	6.9 (2.9)	---	6.2 (1.6)	---
Dec. 02	2.3 (1.9)	1.6 <sup>t</sup> (0.9)	2.7 (1.8)	2.1 (0.7)	3.3 (1.9)	1.7 (0.7)
Dec. 03	6.2 (1.2)	0.6 (0.7)	8.8 (2.1)	1.7 (0.7)	7.0 (2.4)	1.1 (0.8)
Dec. 04	0.5 (0.4)	1.1 (0.6)	3.5 (2.6)	2.2 (0.8)	2.4 (2.3)	1.9 (0.8)
Dec. 05	3.0 (2.1)	0.5 (0.3)	5.5 (2.4)	1.1 (0.6)	5.2 (2.2)	0.6 (0.5)
Total	19.1	3.8	27.5	7.1	24.1	5.3

<sup>s</sup>in parentheses, mean standard deviation, <sup>t</sup>difference from the preceding year.

Table 2 – Olive yields in Bragança trial

	Pasture	Tillage	Glyphosate
Year	Olive yield (kg/tree)		
Dec. 01	10.6 (3.5) <sup>§</sup>	9.4 (3.2)	11.3 (4.0)
Dec. 02	2.3 (2.1)	3.8 (3.7)	6.3 (2.9)
Dec. 03	1.7 (1.4)	3.1 (2.7)	7.1 (2.7)
Dec. 04	19.1 (6.3)	27.9 (14.8)	37.1 (6.1)
Dec. 05	4.1 (1.8)	6.1 (4.2)	6.4 (5.2)
Total	37.9	50.3	68.3

### Discussion

Glyphosate treatment was the best soil management system in the Mirandela experiment when both olive yield and trunk circumference were compared. Residual herbicide gave a poor result in comparison with glyphosate. The residual herbicide kept the soil without vegetation throughout the whole year. The use of glyphosate allows for the presence of green weeds in the winter and a mulching of dead material in the summer which promotes the infiltration of water and improves the soil physical and chemical properties, as reported by Gómez et al. (1999). Tillage kills weeds but limits nutrient uptake by ripping the most active surface roots of the trees. Thus, glyphosate proved to be the best soil management system in Mirandela trial. In the Bragança trial, the presence of natural vegetation caused a huge decrease in olive yields. The 'sheep-walk' control of natural vegetation was not effective in reducing the competition for water. Available water is the most limiting resource in non-irrigated orchards (Pastor et al., 2001). Thus, olive yield in the pasture plot was the lowest when compared to the other treatments. Unequivocally, ground-cover systems influenced crop yield. Non-tillage allows roots to exploit soil surface layers. These aerated layers are the richest in nutrients, regularly applied as fertiliser and recycled from senescent leaves. Tillage damages the roots in spring and early summer when there is a high demand for nutrients. Even in a nutrient-rich soil, minerals would not be physically available because tillage limits its uptake. However, in non-irrigated orchard, if one excludes tillage, one needs to reduce weed competition for water, by using herbicides or other methods, because the summer is long and water stress limits crop growth and yield.

### Conclusions

The best soil surface management system in these non-irrigated olive orchards was to keep the soil covered with green weeds in the winter and covered with dead vegetation in the summer, using a glyphosate based herbicide in early spring. The farmers need to understand this to promote both the short-term olive yield, for their own profit, and the sustainability of the cropping system.

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