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SOIL MANAGEMENT OF AVOCADOS. EFFECTS ON GROWTH AND CROPPING

J.N. Hermoso, J.T. Soria and J.N. Farré
Estación Experimental La Mayora
Algarrobo Costa. Malaga 29750
Spain

Abstract

A long-term experiment on avocado soil management was established with recently planted Hass/Topa-Topa trees at 8 x 8 m. The treatments were clean soil with shallow cultivation (cultivation), clean soil with herbicides (herbicide), regularly sowed natural weed cover (sward) and sugar cane bagasse (mulch). Mulching was discontinued in 1983 allowing sward to grow.

A shorter term experiment, lasting four seasons, included mulched or unmulched soil, with or without preemergence herbicides from planting. Also transparent polyethylene and expanded polystyrene board.

Mulched trees grew significantly better than unmulched trees, in both experiments, for the first four growing seasons. Synthetic mulches performed as well or better than bagasse. Preemergence herbicides did not affect growth.

In the long term experiment, mean yield far the first 8 years (6 crops) was in the order Mulch > Cultivation > Herbicide = Sward. The order for tree efficiency (yield per unit trunk sectional area) was Cultivation = Sward = Mulch > Herbicide. At the adult stage, two trees out of sixteen under sward were killed by Rosellinia necatrix.

From 11 to 18 years of age (8 crops) yield was in order Herbicide > Cultivation > Sward. There was no difference in yield between trees with sward from planting and trees, previously under mulch, with sward from 8 years of age. The order for tree efficiency was Cultivation = Herbicide = Sward) Sward (following Mulch).

Fruit size was similar far all treatments.

1. Introduction

In the early 70's clean soil with frequent shallow cultivation was the most common soil management method for fruit trees in the Mediterranean coast of Spain. In contrast, under similar climatic conditions, in California and Israel herbicides were widely used. Before the start of the experiments several preemergence herbicides had been screened by means of field and pat studies for low tree toxicity and good weed control under dry winter conditions (Farré y Hermoso, 1984).

Maintenance of the natural wood cover as a out sward is a common way of soil management for deciduous fruit trees along a wide range of climatic conditions (Farré, 1979). It does not involve the use of potentially polluting chemicals and its energy requirements are slightly lower than cultivation. Additionally it may increase soil organic matter and improve soil surface physical conditions.

Mulches usually improve soil physical conditions without the competition for nutrients and water of the sward.

2. Materials and Methods

2.1. Treatments

The long term experiment on avocado soil management was established in December 1974 with recently planted Hass/Topa-Topa trees at 8 x 8 m. The treatments were clean soil with shallow cultivation (cultivation), clean soil with herbicides (herbicide), regularly mowed natural wood cover (sward) and sugar cane bagasse (mulch). For the first two seasons the tram under sward were kept weed free in a 1 m radius with herbicides. Bagasse, with approximately 50 % dry matter, was applied at the rate of 10 kg m-2 over the whole surface and reapplied as needed to maintain good soil cover. Mulching was discontinued in 1983 allowing sward to grow.

A short term experiment was started in May 1979 with recently planted trees at 7 x 4 m. It included bagasse mulch, over 2 a wide strip along the row and unmulched soil, both with or without preemergence herbicide from planting. Also transparent polyethylene and expanded polystyrene board (Porexpan).

2.2. Experimental design

Treatments were applied an a randomized complete block design of 4 tree plots, with 9 replicates in the short term experiment and 4 replicates in the long term experiment. From year 7, two trees under sward showed reduced growth. A new plot of four trees from a guard row had their 5 cm topsoil changed for virgin soil. From year 12 the records of the plot with missing trees was calculated adding the new four trees to the two old trees still alive. Trunk cross-sectional area was measured at 25 cm above ground in the short and 20cm in the long term experiment.

2.3. Herbicides

Caragard (CIBA-GEIGY), a mixture of the triazines terbumetone and terbutilazine, was used bemuse of its good performance in preliminary experiments in the short term experiment and all but the last two seasons of the long term experiment.

Roundup (glyphosate) was used as postemergence herbicide. Paraquat was occasionally used in the short term experiment.

2.4. Irrigation,-soil and fertilization

All trees were originally drip irrigated. In the long term experiment they were changed to microsprinklers at 12 years of age.

Except for the first 2 years of the long term experiment soil matric potential measured with tensiometers was maintained above -15 kPa in summer and -30 kPa in winter.

The soils have been described by Farré (1979). N, P, K and Zn were applied according to leaf content, uniformly to all treatments.

3. Results

3.1. Growth- of-young trees

In both experiments (table 1) young mulched trees grew consistently better than unmulched trees.

Table 1 – Growth of young trees

	Trunk area (cm^2) at 4 years of age		% Increase trunk area years 1 to 4
	short exp.	long exp.	short exp.
Postemergence (PH)	110		1750
Pre + Postemergence (PPH)	106	132	1670
PH + Bagasse	132		1740
PPH + Bagasse	128	160	1780
Polystyrene			1950
Polyethylene			2230
Cultivation		103	
Sward		114	
LSD 99 %	19.9	31.5	
95 %	14.6	21.9	329

Sinthetic mulches were as good or better than sugar cane bagasse.

Under clear polyethylene trees grew slightly but not significantly better than under expanded polystyrene.

Under the experimental conditions, the preemergence herbicide did not reduce growth of very young trees.

3.2. Cropping

Cropping in the long term experiment is summarized in table 2. For the first six crops mean yield and tree size were largest under mulch. Tree efficiency was similar under all treatments except clean roil with herbicide that had slightly lower values.

For the last eight crops here reported, tree efficiency was similar for all treatments except for the sward trees previously under mulch that had the lowest values. Mean tree size and yield were highest under the clean soil with herbicide. Mean fruit size was within the range 200 - 210 g. similar for all treatments.

Table 2 - Yield and efficiency

	Years 3 to 8 yield kg tree^{-1} year^{-1}	efficiency g cm^{-2}	Years 11 to 18 yield kg tree^{-1} year^{-1}	efficiency g cm^{-2}
Cultivation	48	245	69	129
Herbicide	43	196	75	118
Herbicide + Mulch (up to year 9) Later sward	53	228	60	96
Sward	40	230	61	123
LSD 95 %	12	N.S.	15	28

4. Discussion

The improved growth of young trees with mulches recorded here has been frequently reported (Farré, 1979). The present results show that some pre-emergence herbicides can be safely used from planting on light roils in low rainfall areas. This is probably safer nowadays with the availability of low solubility herbicides.

The trees under sward had, some years, reduced leaf nitrogen levels that may have reduced their growth. Summer soil matric potentials were similar for all treatments. Under drip irrigation the wetted area is less than 1.5 % of the surface soil. Cut sward transpiration from this reduced area is therefore negligible. Adult avocado trees completely shaded the ground which was further covered with a thick layer of leaves. This reduced the density and growth of the sward even when microsprinklers were used.

The root system of the avocado under the conditions of the experiments is extremely shallow. Munoz (1988) showed that 49 per cent of the avocado root length under drip and 59 per cent under microsprinklers were in the top 15 cm of soil. The improved exploration of this fertile and well aerated top soil by the mulched and, to a lesser extent, the clean with herbicide trees may have been the main cause for their improved growth and cropping. The increased susceptibility of the avocado root system to Rosellinia necatrix under sward is a further drawback of this method.

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