

Planting Time and Sunlight Protection of Avocado Maiden Trees in Orchard Installation

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Abstract. Avocado maiden trees in Brazil are produced in black plastic bags under semi-shade conditions. These plants, after being transferred to the orchard, usually suffer from full sunlight and water deficit stress, which may cause losses (death) of 10 to 30%.

Aiming to minimize these losses, a field experiment was carried out in 1989 at the Estacao Experimental Agronômica of the Universidade Federal do Rio Grande do Sul (Agronomical Experimental Station of the Federal University of Rio Grande do Sul) situated in Eldorado do Sul, Southern Brazil (30°06' S; 51°39' W), comparing two planting times and four sunlight protection systems.

Planting times were: May (5 months after grafting) and October (10 months after grafting). Sunlight protection systems were: SP_j = no protection; S_{fy} = mulching around the tree to a depth of 10 cm; SP₃ = covering trees with *Eucalyptus* branches; and SP₄ = combination of SP₂ and SR_j.

Results showed that planting in May with no sunlight protection diminished plant losses and produced a better initial growth.

The production of avocado (*Persea americana*) in the State of Rio Grande do Sul is still small, comprising about 17,752,000 fruit of the 489,165,000 fruit produced by Brazil (IBGE, 1988). Most of this production comes from home orchards, whose trees are usually propagated by seeds and are grown without technical care.

From planting time up to six months after planting, many orchard problems occur resulting in a great number of plant deaths. These plant deaths are mainly due to the weakness of the young avocado trees, which suffer from water and wind stress, and excess sunlight. These factors, alone or in combination, may delay young plant growth or cause orchard failure (Koller, 1984).

According to Malo (1978), young avocado trees grow very fast and are very fragile, needing an abundance of protection from both excess water and wind. Strong winds are harmful to young trees, causing defoliation, fruit fall, breakage of branches and an increase in transpiration which intensifies damage by drought, hence delaying plant growth and fruiting.

According to Montenegro (undated) and Koller (1984), it is useful to set up vegetative windbreaks before planting in order to avoid the damage of young avocado trees caused by winds.

Koller (1984) stated that young avocado trees, whose roots do not grow deep into the soil, may suffer from water stress, in spite of not showing any symptoms on the leaves.

According to Montenegro (undated) avocado, as well as citrus, need an adequate level of soil humidity. Long periods of drought may cause total leaf fall, which is a natural defense mechanism which avoids greater losses of tissue water.

When irrigation is available, planting of young maiden trees may be done in any season. If not, it is preferable to plant during a rainfall period (Montenegro, undated; Campos, 1984).

After planting, it is advisable to build a basin of soil around the tree and to mulch it with the aim of retaining water for a longer period (Campos, 1984; Medina, 1978).

A study done by Slowik *et al.* (1979) with avocado cv. Hass planted in a soil with low humidity, showed a significant decrease in the dry weight of leaves, branches and total dry weight of plants. The levels of Na, Mg, and Cu of leaves of plants grown under low soil humidity conditions was significantly greater than those of plants grown in the soils with higher soil humidity. Under the same conditions, the levels of N, P, K, Ca, Mg, Zn, and Mn per plant were significantly smaller, independent of nutrient contents of leaves, branches and roots.

According to Gregoriou and Kumar (1984), a mulch of 8 cm in depth significantly increased the growth of young maiden trees of avocado cv. Pollock cultivated in hot humid conditions. Mulching diminished weed growth and the daily oscillation of temperature of soil, maintaining higher levels of soil humidity, improving physical features of soil and promoting strong rooting below the mulch.

According to Camargo *et al.* (1961), mulching considerably affects the soil microclimate and decreases temperature variation. On dry and sunny days, the maximum temperature of strip soils are greater than on vegetated soils and at night temperatures fall to very low values.

Balerdi (1977) compared straw and black plastic film mulch vs manual hoeing using recently planted avocado maiden trees. Results showed good plant growth and

excellent weed control with plastic mulch and unsatisfactory results from straw mulch and manual hoeing.

In places or time of high temperature, direct solar radiation may burn the stem bark and branches of young trees. In order to avoid these problems, avocado maiden trees must be produced under semi-shade conditions and be protected against solar radiation after planting in the orchard (Koller, 1984).

Franco (1961) observed that soils exposed to high temperature and direct sunlight radiation may get very hot on the surface and burn young trees at the crown. Young trees of coffee affected by this kind of injury languished very quickly. Carnauba and Ortoloni (1966) also observed great losses of citrus maiden trees by burn initially at the grafting point and later throughout the periphery of the stem.

Aiming to protect avocado maiden trees from burns by solar radiation, Koller (1984) suggested partial shading of the young avocado trees immediately after planting in the orchard. This can be done using 70 to 80 cm *Eucalyptus* branches stacked in the soil around the young trees, which produces gradual acclimation of the young avocado tree as a result of progressive leaf fall from the *Eucalyptus* branches.

Seeking alternatives to minimize these problems, time of planting and protection systems of maiden trees after planting in the orchard were tested.

Materials and Methods

The experiment was carried out at the Estacao Experimental Agronômica of the Universidade Federal do Rio Grande do Sul situated in Eldorado do Sul, Southern Brazil (30°06' S; 51°39' W),

This region has a subtropical climate without drought. The soil where the experiment was conducted belongs to the Sao Jerônimo series, classified as a Red-Brown Lateritic Dystrophic Soil.

The statistical design used a split-plot in randomized blocks with four replicates. Blocks were made by cultivars: 'Yon', 'Impala', 'Baronesa', and 'Ouro Verde'; plots were made by times of planting (5 and 10 months after grafting), and sub-plots by methods of protection against solar radiation. Each sub-plot holds four plants spaced 2 x 2 m.

Treatments were: (i) Time of planting: 5M = 5 months after grafting; 10M = 10 months after grafting; and (ii) Protection methods against solar radiation: SP₁ = No protection; SP₂ = Straw mulch around the young tree; SP₃ = Shading with branches of *Eucalyptus*; and SP₄ = combination of SP₂ and SP₃.

Maiden trees used in this experiment were grafted in December 1987, and up to planting time were grown in black polyethylene bags 30 cm high and 15 cm in diameter and kept under semi-shade (approximately 50% of full sun) conditions.

Planting dates were: May and October for the first and second planting time, respectively.

Before planting, the soil of the orchard was plowed, harrowed, and fertilized with 150 g of potassium chloride, 500 g of ordinary superphosphate, 1 kg of lime, and about 10 L of cattle manure per plant. After planting a basin of soil was made around the young trees. The branches of *Eucalyptus* were kept around the trees for two months, by which time they lost all leaves.

The variables evaluated in this experiment were (i) trunk girth at a height of 20 cm from the soil; (ii) average diameter of tree crown; and (iii) height of the trees.

Results reported here are based on data evaluated 13 months and 9 months after first and second time planting. Data were analyzed by analysis of variance and means of variables which showed significance at $P < 0.05$ were submitted to the Tukey test.

Results and Discussion

The statistical analysis showed significant effects for planting time and for the interaction of planting time x protection system employed.

Table 1 shows that planting time 5 months after grafting was more beneficial to plant growth than planting 10 months after grafting. This was so for all three plant growth variables evaluated (i.e., height, crown diameter, and trunk girth).

Better growth of young trees planted earlier (March) may be caused by the fact that keeping maiden trees in plastic bags for a longer time obviously slows root growth and may also slow the uptake of water and nutrients. Slowed down by the plastic bags, the roots grew less and became root-bound. Because of this, Montenegro (undated), Koller (1984), and other researchers advise to plant earlier.

On the other hand, mild temperature and greater availability of water in the soil should also favor plant growth of maiden trees planted in May. This supposition is strengthened by the fact that after October in Rio Grande do Sul, high temperature and drought may occur, which according to Montenegro (undated), and Campos (1984) are unfavorable to plant growth.

Plant protection systems had significant effect only on crown diameter and plant height of the trees planted 5 months after grafting. Table 1 also shows that less plant growth occurred in *SP-1* system where plants were not protected. There were no significant differences between the effects of mulching and *Eucalyptus* branches; best effects were obtained by the combination of these two treatments.

Planting time corresponding to 10 months after grafting did not show any statistically significant differences between protection systems; nevertheless, results suggest a

similarity to the results obtained for 5 months after grafting. This was not apparent possibly due to the lesser amount of time these plants had from planting time to the date of evaluation.

The poorer growth of plants which did not receive mulching, nor the protection of *Eucalyptus*, may be caused by many factors, among which sunburn and frost injury were observed. Because of this, the number of plant deaths was greater in unprotected maiden trees. Besides, trees which had mulching and protection against solar radiation may have had available water and less competition from weeds, as observed by Camargo *et al.* (1961), Balerdi (1977), and Gregoriou and Kumar (1984).

Conclusions

1. The best initial growth occurred when the avocado maiden trees were planted in May, five months after grafting;
2. The three sunlight protection systems diminished plant losses and enhanced initial growth of the avocado maiden trees, only when planted in May; and
3. Up to eight months after planting time, there was no effect of sunlight protection systems on plant growth of avocado maiden trees planted in October.

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Table 1. Effect of two planting times and three sunlight protection systems on plant height, plant crown diameter, and trunk girth of avocado maiden trees. Planting times indicate months after grafting.

Sunlight Protection Systems	Height (cm)		Diameter (cm)		Trunk Girth (cm)	
	Planting Times					
	May (5m)	October (10m)	May (5m)	October (10m)	May (5m)	October (10m)
SP ₁ - Control	81.1 b	67.4 a	59.3 b	44.4 a	6.4 a	5.4 a
SP ₂ - Mulching	102.7 ab	84.6 a	81.9 a	55.5 a	8.9 a	6.7 a
SP ₃ - Shading	102.0 ab	73.5 a	80.0 a	53.3 a	7.9 a	5.7 a
SP ₄ - (SP ₂ + SP ₃)	113.2 a	85.1 a	89.9 a	57.6 a	8.4 a	6.9 a
Means	99.8 A	77.8 B	77.8 A	52.7 B	7.9 A	6.1 B

All means in columns with the same letter are not statistically different at P<0.05.