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Pot trial with acid soil ameliorants on avocados under glasshouse conditions

R O Barnard and Wilma H Mentz

Department of Soil Science and Plant Nutrition, University of Pretoria, Pretoria 0002

INTRODUCTION

Several aspects of the inorganic nutrition of avocados, and factors affecting this, have been undertaken and reported on (Barnard, 1988; Barnard & Slabbert, 1988; Barnard, 1989, 1990; Barnard, Cillié & Kotzé, 1991).

As Ca appears to be of paramount importance in avocado nutrition, and many soils are relatively acid and leached prior to establishment, the importance of ensuring adequate background conditions is generally recognized. Du Plessis and Koen (1987) found, in a field trial with avocados over several years, that "moderate" amounts of different Ca sources had a beneficial effect on growth.

The objective of the present pot trial was to compare different Ca sources, at high levels of application as acid soil ameliorants, with avocados as test plants.

METHOD

A glasshouse pot trial on two acid soils was conducted with very young avocado trees (Hass on Duke 7) as test plants, with three replicates of each treatment. The soils were taken from avocado estates in Everdon, Natal (sandy loam) and from Westfalia, Tzaneen (sandy loam).

The treatments were:

Control:	Soil only
Sulphur:	1t/ha 300 mm
Alum:	S equivalent of 1t/ha 300 mm
Calcite:	5t/ha 300 mm calcite (AR) 10t/ha 300 mm calcite (AR) 20t/ha 300 mm calcite (AR) 40t/ha 300 mm calcite (AR)
Gypsum:	equivalent of 5t/ha calcite equivalent of 10t/ha calcite equivalent of 20t/ha calcite
Ca-acetate:	equivalent of 20t/ha calcite
Ca-fulvate:	equivalent of 5t/ha calcite equivalent of 20t/ha calcite equivalent of 40t/ha calcite
Ca-oxiproduct: (Ca-OP)	equivalent of 5t/ha calcite equivalent of 20t/ha calcite equivalent of 40t/ha calcite

The air-dried sifted soil (7 kg of Everdon and 6 kg of Westfalia soil per pot – plastic pots were used) was thoroughly mixed with the relevant amounts of the products, except for the Ca-acetate and Ca-fulvate which was applied on the surface and watered in with deionised water. The trees were planted in April 1991 and the growth observations reported here were done 10 months later, in February 1992; a number died because of being initially weak and were replaced where possible.

Sampling procedure: the second and fourth leaf from the apex, and two older leaves were cut at the stem of each plant and rinsed twice in deionised water. The leaves of the three replicates of each treatment were pooled, dried at 65°C, milled, wetashed and the Ca determined by atomic absorption spectroscopy.

RESULTS

Growth observations

Everdon soil

Control:	Medium/weak growth. Light green leaves.
Sulphur:	Growth weaker than control.
Alum:	Much weaker than control.
Calcite:	5t/ha treatment produced slightly better growth than the control; 10t/ha calcite produced the best growth and leaf colour of the calcite treatments; 20t/ha showed serious chlorosis, weak growth; 40t/ha showed very weak growth; very yellow and necrotic.
Gypsum:	The 5t/ha calcite equivalent produced the best growth of the gypsum treatments, much better than the control, although the 10t/ha showed only slightly less growth that 5t/ha. 20t/ha produced weak growth.
Ca-acetate:	The growth produced appeared slightly better than the "best" Ca-oxiproduct treatment (40 t CaOP/ha calcite equivalent), and also better than the "best" Ca-fulvate treatment (5t/ha calcite equivalent). The Ca-acetate treatment produced much better growth than the control.
Ca-fulvate:	The 5t/ha and 20t/ha calcite equivalent treatments produced better growth than the 40t/ha, with 5t/ha slightly better than 20t/ha, but there did not seem much difference in growth from the control.
Ca-oxiproduct:	There was not much difference in the growth produced by 5, 20 and 40t/ha treatments, but the best was 40t/ha, with 20t/ha second. The growth produced by these treatments did not differ much from those of the control.

Westfalia soil

Control:	Medium/weak.
Sulphur:	Growth slightly better than the control; slight chlorosis between veins.
Alum:	Growth slightly better than control; slight chlorosis between veins.
Calcite:	The 5t/ha calcite equivalent produced the best growth of the calcite treatments but still with some chlorosis. With the 40t/ha, growth was weakest and trees were dying. The 10 and 20t/ha produced more or less the same amount of growth, the leaves of the 20t/ha being smaller. The 5t/ha treatment produced slightly better growth than the control.
Gypsum:	There was not much difference in the growth produced by the three gypsum treatments. It was noticeable that the leaves of the gypsum treated trees were light yellow/green, although quite large. Generally the growth was more than that of the control.
Acetate:	Much better growth than the control; many leaves; young leaves dark green, older leaves yellowish light-green. The second best growth of all treatments.
Ca-fulvate:	The 20t/ha calcite equivalent was not only the best of the Ca-Fu treatments, but probably the best of all treatments, also slightly better than acetate; dark green leaves. The 5t/ha treatment produced medium growth with dark green leaves; the 40t/ha produced less growth, branches were dying and there was chlorosis in the older leaves. All three treatments however produced better growth than the control.
Ca-oxiproduct:	The 5t/ha calcite equivalent produced the best growth of the three Ca-OP treatments. The growth was beter than the control but weaker than that of acetate. Both the 20 and 40t/ha calcite equivalent produced the weakest growth of all treatments and were dying.

The relative growth of the avocado trees is summarised in Table 1 and the dry mass of the leaf samples in Table 2.

TABLE 1 Growth observations of avocados growing on acid soils treated with ameliorants

Treatments		Growth*	
		Everdon	Westfalia
Control		**	***
Sulphur		**	***
Alum		*	***
Calcite	: 5t/ha	***	***
	10t/ha	****	**
	20t/ha	**	**
	40t/ha	*	*
Gypsum	: equivalent of 5t/ha calcite	****	****
	equivalent of 10t/ha calcite	****	****
	equivalent of 20t/ha calcite	**	****
Ca-acetate	: equivalent of 20t/ha calcite	****	*****
Ca-fulvate	: equivalent of 5t/ha calcite	***	****
	equivalent of 20t/ha calcite	***	*****
	equivalent of 40t/ha calcite	**	***
Ca-oxiproduct	: equivalent of 5t/ha calcite	**	***
	equivalent of 20t/ha calcite	**	*
	equivalent of 40t/ha calcite	***	*

* Very Good ***** Medium *** Very weak *
Good **** Weak **

TABLE 2 Dry mass of leaf samples (g/treatment)

Treatments		Calculated dry mass (g/treatment)*	
		Everdon soil	Westfalia soil
Control		4,02	5,29
Sulphur		3,85	7,63
Alum		2,36	6,78
Calcite	: 5t/ha	4,81	7,00
	10t/ha	5,77	5,13
	20t/ha	4,13	4,46
	40t/ha	2,52	2,57
Gypsum	: equivalent of 5t/ha calcite	6,20	6,60
	equivalent of 10t/ha calcite	6,36	6,76
	equivalent of 20t/ha calcite	5,91	8,31
Ca-acetate	: equivalent of 20t/ha calcite	6,64	5,81
Ca-fulvate	: equivalent of 5t/ha calcite	3,64	6,43
	equivalent of 20t/ha calcite	2,79	7,04
	equivalent of 40t/ha calcite	2,72	4,85
Ca-oxiproduct	: equivalent of 5t/ha calcite	5,22	4,37
	equivalent of 20t/ha calcite	3,15	2,37
	equivalent of 40t/ha calcite	2,35	1,45

* The samples of the three replicates were pooled. Where there were missing pots due to death of plants, the dry mass was calculated.

The Ca-content is given in Table 3 both as a percentage and as the total Ca-content of the complete sample.

TABLE 3 Ca-content of leaves

Treatments		Ca-content			
		Everdon soil		Westfalia soil	
		%	mg/ sample*	%	mg/ sample*
Control		0,47	18,9	0,28	14,8
Sulphur		0,63	24,3	0,27	20,6
Alum		0,40	9,4	0,26	17,6
Calcite	: 5t/ha	0,49	23,6	0,73	51,1
	10t/ha	0,77	44,4	0,74	38,0
	20t/ha	0,83	34,3	0,82	36,6
	40t/ha	1,74	43,9	1,04	26,8
Gypsum	: equivalent of 5t/ha calcite	0,68	42,2	0,54	35,6
	equivalent of 10t/ha calcite	0,91	57,9	0,68	46,0
	equivalent of 20t/ha calcite	0,57	33,7	0,81	67,3
Ca-acetate	: equivalent of 20t/ha calcite	0,84	55,8	0,59	34,3
Ca-fulvate	: equivalent of 5t/ha calcite	0,47	17,1	0,44	28,3
	equivalent of 20t/ha calcite	0,64	17,9	0,67	47,2
	equivalent of 40t/ha calcite	0,62	16,9	0,87	42,2
Ca-oxiproduct	: equivalent of 5t/ha calcite	0,55	28,7	0,58	25,4
	equivalent of 20t/ha calcite	0,86	27,1	0,65	15,4
	equivalent of 40t/ha calcite	0,75	17,6	–	–

* The samples consisted of 4 leaves per replicate, of the 3 replicates pooled (12 leaves in total).

The growth (approximate by observation) and the total Ca-content of the whole sample (three replicates together) are given in Figure 1 for the Everdon soil and in Figure 2 for the Westfalia soil.

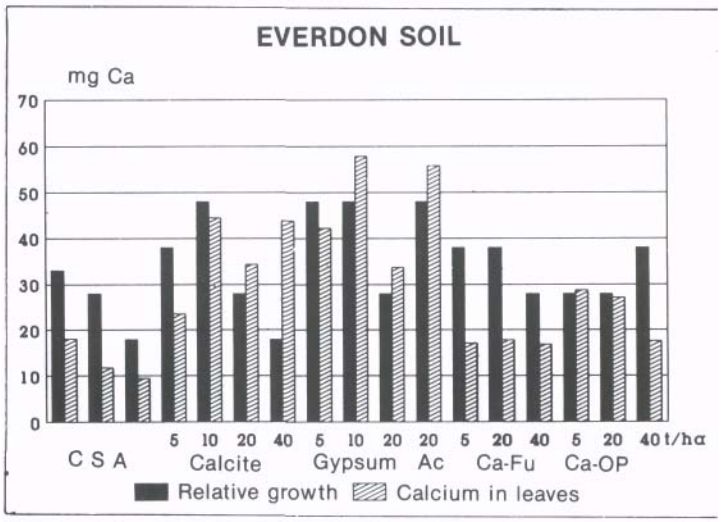

Fig 1 Approximate growth and Ca-content of avocados growing on acid Everdon soil treated with ameliorants.

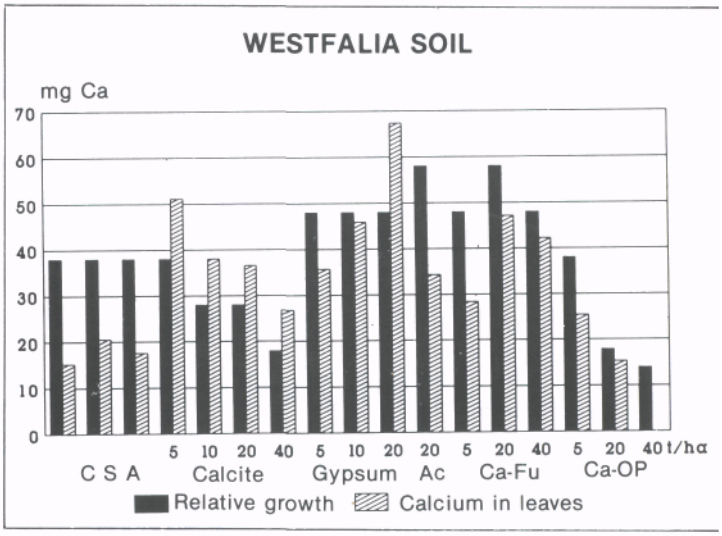

Fig 2 Approximate growth and Ca-content of avocados growing on acid soil treated with ameliorants.

In summary, the following were amongst the best treatments:

Everdon

Gypsum	10t/ha equivalent
Ca-acetate	20t/ha equivalent
Calcite	10t/ha equivalent
Gypsum	5t/ha equivalent

Westfalia

Ca-Fu	20t/ha equivalent
Ca-acetate	20t/ha equivalent
Gypsum	20t/ha equivalent
Ca-Fu	40t/ha equivalent
Gypsum	10t/ha equivalent
Ca-Fu	5t/ha equivalent

CONCLUSIONS

From the above it is clear that there are large differences between the two soils as regards their reaction to different types and levels of calcium ameliorants.

Certain products appear promising as regards both young growth and Ca-content of the

leaves sampled. Others have a somewhat inhibiting effect on either growth or leaf Ca, or both.

What these effects would be in the longer term, and on growth under field conditions, is unclear at this stage. It is obviously of paramount importance to explain them, which will hopefully be done as the trial progresses.

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