PERFORMANCE EVALUATION OF THE PHONOLITE VIA MINERAL IN ADULT ORANGE TREES

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Abstract

The present study's goal was to analyze the performance of the Phonolite as a source of potassium in the fertilization management of the orchard of the adult orange trees. The study was conducted under field conditions in a commercial orchard of 'Pera' sweet orange trees on 5-year old mandarin lime trees. The randomized block experimental design was used, in a factorial scheme with 3 factors (3 doses of Phonolite (60 kg $K_2O.ha^{-1}$; 120 kg $K_2O.ha^{-1}$; 180 kg $K_2O.ha^{-1}$); 2 doses of Plaster (without Gypsum and with 1 $t.ha^{-1}$); 2 doses of Limestone (without Limestone and with 1,5 $t.ha^{-1}$), plus 1 additional treatment with the farmer's traditional fertilization (120 kg $K_2O.ha^{-1}$ via 20- 00-20), totaling 13 treatments, with 4 repetitions and 5 plants per plot. The treatments were applied on 02/02/2012 with a superficial application by tractor on the soil under the plant canopies, using a Vicon fertilizer spreader, without incorporation.

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Soil samples were evaluated at 5 depths (0-5, 5-10, 10-15, 15-20 e 20- 40 cm) previously removed, 27, 78 and 118 days after the application, and the fruit production of the plants was evaluated at the end of the crop. However, the fruits that were already on the plants when the Phonolite was applied were harvested. It was concluded that the Phonolite was shown to be as effective as the traditional fertilization to elevate the percentage of potassium in the soil and in the leaf. It also contributed significantly to the increase in the orchard's productivity.

Introduction

The citrus are, in general, demanding in K. The deficiency is more perceptible in the fruits that become small, with a thin and smooth peel, having an early maturation. (QUAGGIO, 1991).

Brazil is very dependent on potassium exports to meet its agricultural demand. By 2008, only 7% of the national demand was produced in Brazilian territory (ALVES, 2012).

New sources of potassium fertilization are fundamental to decreasing the import dependency. In this context, Phonolite, which is a natural silicate from the volcanic rock of the Plateau of Poços de Caldas, has the potential as an alternative source of potassium.

Therefore, this study had as an aim to evaluate the Phonolite's performance as a potassium source in the fertilization management of the orchard of the adult orange trees.

Materials and Methods

The study was conducted under field conditions in a commercial orchard of 'Pera' sweet orange trees on 5-year old mandarin lime trees, in the district of Taquaral, State of São Paulo.

The soil of the plantation is a dystrophic red-yellow latosol of a medium texture.

The randomized block experimental design was used, in a factorial scheme with 3 factors (3 doses of Phonolite 2 doses of gympsum, 2 doses of limestone), plus 1 additional treatment with the farmer's traditional fertilization (120 kg $K_2O.ha^{-1}$ via 20-00-20), totaling 13 treatments, with 4 repetitions and 5 plants per plot.

The three doses of Phonolite were: 60 kg $K_2O.ha^{-1}$; 120 kg $K_2O.ha^{-1}$; 180 kg $K_2O.ha^{-1}$. The two doses of limestone were: without limestone and with 1.5 $t.ha^{-1}$. The two doses of Plaster were: 1 without Gypsum and with 1 $t.ha^{-1}$. All the treatments received 120 kg $N.ha^{-1}$, through the ammonium nitrate and phosphorus wasn't applied in this crop.

The treatments were applied on 02/02/2012 with a superficial application by tractor on the soil under the plant canopies, using a Vicon fertilizer spreader, without any kind of incorporation. To evaluate and compare the results soil samples were taken at 5 depths (0-5, 5-10, 10-15, 15-20 e 20-40 cm). Those samples occurred at 27, 78 and 118 days after the application. Besides the first one that was before the application.

At the end of the crop, the fruit production of the plants was also evaluated. However, the fruits that were already on the plants when the Phonolite was applied were harvested. The data were analyzed using an F-test and the averages compared via test t (LSD) to 5% of the error probability.

Results

Soil Analyses

In the soil analysis the collection dates and collection depths were considered as also being variable factors and were considered separately in the statistical analysis.

In the variance analysis it is observed that only the doses of potassium, the depth of the collected sample and the days after the application (AAD) had a significant effect on the levels of K (Chart 1).

Chart 1. Variance Analysis with f-test of the potassium level in the soil.

VF	LG	QS	MQ	F	
Potassium	3	590,1337	196,7112	3,455	*
Plaster	1	84,24563	84,24563	1,480	ns
Limestone	1	50,20075	50,20075	0,882	ns
Depth	4	357,1842	89,29605	1,568	**
AAD	2	544,6673	272,3336	4,783	**
Error	573	32627,07	56,94078		
VC (%)=	30.82				

There is a direct correlation between the doses applied of the Phonolite with the levels measured in the soil. Whereas the doses of 100 and 150% did not differ from the traditional fertilization, showing that it is a potential source of potassium to use with orange trees (Chart 2).

Chart 2. Comparison of average potassium level in the soil in relation to the potassium dosage applied.

Sources	K in the soil (mg/dm^3)	
Conventional	4,24	ab
Phonolite 50%	4,16	b
Phonolite 100%	4,52	a
Phonolite 150%	4,71	a

In relation with the depth, there also exists a linearity in the reduction of the potassium level in the soil with the increase in the depth (Chart 3).

The interaction between the potassium doses and depth was not significant, showing that the potassium contained in the Phonolite shows exactly the same mobility as the traditional fertilization (Chart 4).

Chart 3. The mean comparison of the potassium level in the soil in relation to the depth at which the sample was collected.

Depth of the collection	K in the soil (mg/dm^3)	
0-5 cm	5.68 a	a
5-10 cm	5.14 a	a
10-15 cm	4.41 ab	ab
15-20 cm	3.84 ab	ab
20-40 cm	3.14 b	b

Chart 4. The expansion of the interaction between the doses and depth

	Depth of the collection (cm)				
Treatments	**5**	**10**	**15**	**20**	**40**
Conventional	5,53	5,08	4,38	3,45	2,80
Phonolite 50%	5,43	4,96	3,85	3,62	2,96
Phonolite 100%	5,87	5,30	4,28	3,86	3,29
Phonolite 150%	5,78	5,19	5,11	4,18	3,29

Days after the application, and due to being exposed to weather such as strong summer rains and the extraction of the orange tree plants, it can be noticed that the maximum potassium level was reached 78 days after the application and it begun to decrease after that (Charts 5 and 6).

Chart 5. The mean comparison of the potassium level in the soil in relation to days after the application (AAD).

Days After the Application	Level
0	3,88*
27	3,76 b
78	5,03 a
118	4,58 ab

Chart 6. The expansion of the Treatments Interaction and days after the application.

	Days after the application		
Treatment	**27**	**78**	**118**
Conventional	3,88	5,08	4,14
Phonolite 50%	3,62	4,57	4,29
Phonolite 100%	4,31	4,68	4,56
Phonolite 150%	3,31	5,81	5,00

Fruits Harvest

Even with the application being made when the fruits already were in development, there was a significant difference to the productivity of the plants (Chart 7). This can be explained by the fact that the potassium is a big factor in the increase in the size of the plant's fruits.

Chart 7. Variance analysis with f-test for the levels of potassium in the leaf.

VF	LG	QS	MQ	F	
Potassium	3	512.5982	170.8661	2.061	*
Limestone	1	290.6277	290.6277	3.506	*
Plaster	1	2.679602	2.679602	0.032	ns
error	6	3812.989	82.89106		
VC (%)		20,95			

There was a significant difference between the Phonolite treatments (100% of the K_2O recommended) with the traditional fertilization (Chart 8).

Chart 8. The mean comparison of the treatments for fruit production (kg/plant).

Treatment	Boxes/hectare	Kg/Plant	Kg/hectare
Conventional	37.675000 b	31.383,28	769,2
Phonolite 50%	41.400000 ab	34.486,20	845,3
Phonolite 100%	42.656250 ab	35.532,66	870,9
Phonolite 150%	47.793750 a	39.812,19	975,8

Conclusions

The Phonolite proved to be as effective as the traditional fertilization in increasing the potassium level in the soil and in the leaf. The Phonolite also contributed significantly to the increase in the productivity of the orchard.

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