

The effect of the cropping systems with direct seeding on permanent soil cover (systems SCV) on the phosphate ions in the solution of soil in the grounds cultivate and on the yield in the highland of Madagascar

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Introduction

The potentiality of phosphorus in crop fertilization can be estimated from its effect on the performance of the plant that can be manifested by the development of plant organs. In the operation of soil-solution-plant system, the phosphate ions, which are dissolved in the soil solution, are important because the level of concentration of these ions in the soil solution after collecting roots regulates the transfer of diffusible ion phosphate lodged in the soil solid phase to the solution (Morel, 2002).

Currently, with the goal of increasing in order to the agricultural production while respecting the environment for sustainable development, alternative solutions to the habits of farmers should be found.

Researchers at CIRAD and its partners have proposed and studied for several years cropping systems with direct seeding mulch-based cropping systems (SCV) (Séguy and al., 2006).

Thus, this study is devoted to the analysis of the effect of agricultural practices on these phosphate ions in the soil solution and crop yields.

Materials and methods

1. Device studied

In this article, the device Andranomanelatra farm, which is located in the heart of Madagascar highlands of Vakinankaratra, at an altitude of about 1600 m, was chosen to study the effect of cropping systems on crop yields and concentrations of phosphate ions in the soil solution. The climate there is humid high altitude tropical climate (Michellon and al., 2004).

2. Treatments

Four cropping systems, which mainly differ on soil preparations, or direct seeding mulch-based cropping systems (SCV) or soil tillage (Lb), and fertilization performed were taken into consideration:

- Soil tillage (Lb) is done with a spade (angady), a plow a tractor according to the surface to a depth of 20-25 cm. Before the labor, the soil is cleared and crop residues are exported out of the plot. Weeding after planting or during the cycle is done manually.
- The SCV system that we chose is with litters which are kept permanently on the soil. This dead vegetation cover consists of crop residues that are returned on the plot.
- Treatment, designated F1 practice of applying 5 t ha⁻¹ of cattle manure each year and is a common and recommended practice at farm level.
- Treatment designated F2 is to spread each year 5 t ha⁻¹ of cattle manure with mineral NPK fertilization and liming provide as dolomite at 500 kg ha⁻¹.

Table 1 : Amounts (kg ha⁻¹) provided of phosphorus (P) for the fertilization levels F1 and F2 in the device Andranomanelatra farm

Culture	Fertilization level	Manure	Fertilizer	Total
kg ha ⁻¹				
Corn/Soybean	F1	6,1	-	6,1
Corn/Soybean	F2	6,1	29,5	35,6

3. Analytical Method: Colorimetric dosage of ions phosphate

The method of ammonium molybdate complex described by Murphy and Riley (1962) was used to dose the ion phosphates in the soil solution.

4. Statistical analysis of data

The comparison of the effect of cropping system performance and the concentration of phosphate ions in the soil solution can be done with a statistical analysis (ANOVA). This analysis uses two factors (SCV and Lb) and two modes of fertilization (F1 and F2).

Results and Discussions

1. Ion Phosphates in the soil solution

In order to understand the origins of variations in the concentration of ion phosphates in the soil solution, we determined the concentrations according to cultural practices (fertilization and culture system), which are assumed as elements playing important roles in this variation.

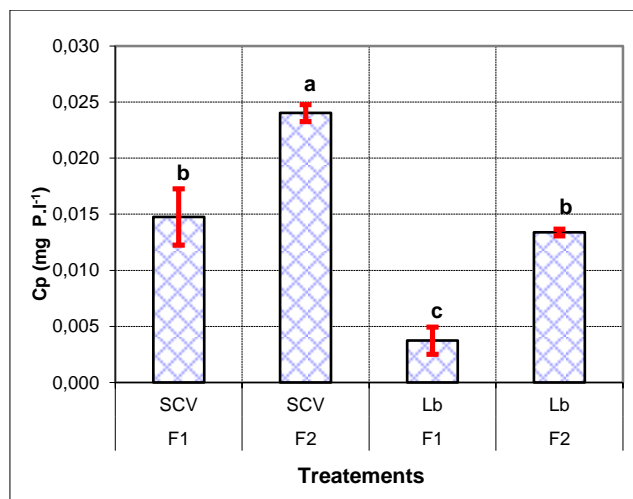


Figure 1: Ion phosphates in the soil treatment according

At the end of the results of laboratory analysis and statistical test, it was found that the direct-seeded systems with permanent soil cover has a positive effect on the amount of ion phosphates in the soil solution to Andranomanelatra.

In the two compared systems, apart from the non-tillage in no-till system, it is the plant cover that could be causing the difference through the organic matter brought by these plants covers. It is obvious that the plant covers which are dead or alive bring organic material on the ground.

Summaries of test comparing organic matter stocks under different soil tillage systems, mainly in the United States, show that the organic matter stocks are higher than on average no-till but this increase is relatively limited.

The study conducted by Randriantsoa (2001) on a Malagasy Oxisol showed that compared to plowing, SCV brings 80% C.

Compared to studies done by Razafimbelo in 2005 on the Andranomanelatra farm, Carbon stocks under SCV and soil tillage are significantly different for 0-20cm layers.

2. Crop Yields

The results presented are the yields obtained during the period 1996-2003 which represents 8 campaigns.

To limit the annual effect, we calculated the cumulative yield for each plot by adding the performance of each year over the period of experimentation. Then, the average, standard deviations were calculated as well as ANOVA and the comparison of treatments. The results are shown in Table 2.

Table 2: Averages and standard deviations (n = 3) of the cumulative grain (t ha⁻¹) for the different treatments yield. The values were obtained by adding the harvest obtained from 1996 to 2003.

Treatments	Cumulative yield t ha ⁻¹	Change in yield compared to SCV_F1
SCV_F1	14,7 (±1,0) b	0%
SCV_F2	24,7 (±1,9) a	+68%
Lb_F1	7,2 (±2,2) c	-51%
Lb_F2	13,1 (±0,7) b	-11%

As regarding the ranking of treatments (a: SCV_F2, b: SCV_F1 and Lb_F2 c: Lb_F1) on the concentration of phosphate ions in the soil solution and on the crop yields, a positive correlation with a coefficient r^2 correlation = 0.9734 has been noticed.

The explanation of the yield improvement of direct-seeded system or SCV may be based on the increase of the concentration of ion phosphates in the soil solution under the effect of this system.

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