RESULTADOS

TECNOLOGIA EM

Bioativação

penergetic

POR UMA AGRICULTURA INTELIGENTE

penergetic

SUMMARY

PRESENTATION

SCIENTIFIC ARTICLES

penergetic

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SCIENTIFIC ARTICLES

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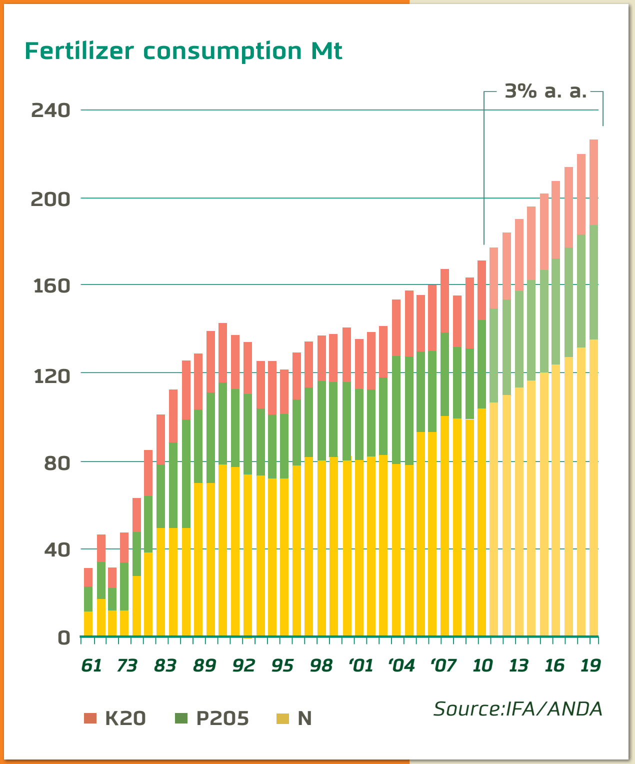
What are we **looking for?**

We live in a constantly changing environment that creates challenges in social, political and environmental issues. The adjustment of these issues is a basic premise for the formation of a healthy, balanced and prosperous society, capable of respecting and preserving the scarce resources of our planet, without compromising future generations.

Today, one of the greatest challenges of global agriculture is to ***develop agricultural systems*** that are at the ***same time sustainable and financially viable***, that can produce food, fiber and energy in sufficient quantity and quality, with a reduced impact on natural resources. In this sense, the adoption of alternative and innovative technologies and production models, that result in the optimization of the use of inputs of high economic cost and environmental impact, can represent a viable strategy for producers who are seeking to adopt more productive and sustainable systems.

The use of ***technologies that increase the water use efficiency, light and nutrients available*** to plants, constitutes a quantum leap in the search for more productive, balanced and less polluting processes.

In this issue you will find valuable information **that is revolutionizing Brazilian and World Agriculture.**



Whats is **Penergetic®?**

Penergetic® is a natural bioactivation technology, unique in the world, developed and produced in Switzerland by the company Penergetic® International AG, which allows the copying and transfer of specific information on original substances (IC's - Information Carriers) for a carrier substance through the energization process of electromagnetic waves in narrow spectrum.

This information is transferred through this energetic charge and contains specific properties, harmless to any living organism, capable of promoting the increase of the biological activity of the soils and plants, revitalizing disturbed ecological processes (such as our current agriculture, intensive monoculture), by treating the cause and not the consequence of such disturbances, bringing the standards of quality and biological balance closer to nature. We call this action promoted by Penergetic®, of **BIOACTIVATION.**

How does the **Penergetic**® Technology Work?

The mode of action of the Penergetic® technology is based on practical principles of quantum physics, biophysics and chemistry.

Scientists Albert Einstein and Nikola Tesla (1943)

Through technology, every atom, compound, molecule or substance with proven effect in agriculture, whether in the improvement of biological activity in the soil, absorption and utilization of nutrients, decrease of biotic and abiotic stress, promotion of plant growth or protection of plants; has a specific electromagnetic oscillation (specific wave) measured in the Tesla scale, that under controlled conditions of electromagnetic induction, a certain electromagnetic frequency is exerted on a receiving mineral.

This energy will change the electron excitation state of the receiving material and this state of excitement will cause the clay mineral pass to vibrate in an electromagnetic frequency identical to the particular wave found in these original natural substances (IC's), such as organic compounds, nutrients, enzymes, etc, which results in improved soil / microorganism / plant / atmosphere interactions. That is, through continuous wave modulation, the Penergetic® technology is able to reproduce any wavelength emitted in nature and imprint this energy on a clay-mineral capable of retaining and emitting such energy (IC's) in nature.

The theoretical contextualization used in Penergetic® technology can be easily recognized through the published works of Nikola Tesla. In the Penergetic® products, the process of energizing (electromagnetic energy) comes from theories proposed by ***Michael Faraday*** in 1846 and by ***James Clerk Maxwell*** in 1864, both physicists who worked on the matter of energizing materials. Based on the results obtained by the two researchers, ***Nikola Tesla,*** in the middle of 1900, developed the first methodology of energizing materials without the use of cables and connectors. Such methodology yielded to Tesla the first registered patent in the world regarding the transference of wireless energy. Based on this information, Penergetic® reproduced the information described by Tesla, based on the equation below:

$$\sum_{i=1}^{m} W_P^{IC} = f\left(W_{Pi}^{OS}, E, H_{1,2}, \varnothing_{1,2}, t_E, t_{H_{1,2}}, OS_{A,d}^{n}, \overline{OS^n\ IC^o}, f_{H_{1,2}}, f_{H_{1,2}}^{Profil}\right)$$

Whereas: 1 is the original material from which the spin is copied and 2 is the material to be energized.

In short: ***The Penergetic® technology is capable of activating biochemical processes and modulating physiological activities of microorganisms and plants, organizing the biochemical matter of each system.***

Why **Penergetic®**?

Several studies on the activation of the edaphic microbiota and the photosynthetic process in plants, through the use of electromagnetic energy, attest that this science is not theoretical, but practical and real. Current literature presents a large number of works demonstrating the effect of the use of electromagnetic energy on microbial activity, insect orientation and feeding, as well as on crop productivity.

The use of Penergetic® technology and other bioactivation tools should not be seen only as an innovation, but as an immediate need for promotion of a more economical agriculture, viable and environmentally friendly.

As always say friends and excellent farmers, Piero and Fábio, from the Poggio di Camporbiano Farm, in the Tuscany region, Italy: *"In the struggle against nature, one always loses. It is up to each one to choose which side to support."*

Penergetic® Technology for the Bioactivation of Agroecosystems

Antônio Nascimento Teixeira - Master of Science in Soil, Agronomic Consultant.

The realization, in practice, of the need to maintain a high biological activity within the agricultural soils, was the result of a natural maturation of the sector. The dissatisfaction with the current chemical model stimulated agronomists, technicians, researchers, companies and producers, to seek answers to the following questions, among others:

1. Why are crops increasingly fragile from pest and disease attacks, as well as from climatic variations, despite so many technological and genetic advances?

2. Why is the lack of correlation between increasing the amount of fertilizer and the increase in productivity increasingly common?

3. Why the results of soil and leaf analysis often do not seem to explain what we are actually seeing in the clinical examination of the crops?

The reductionist and Cartesian approaches have failed to meet these demands of the agricultural sector and society as a whole. The best answers found to these questions so far, go through the biological pathway of systemic understanding of the natural processes involved in agricultural production.

A great deal of serious scientific work, conducted in agricultural systems around the world, points in the same direction: **the dominant agricultural model drastically reduces the life of the system. In quantity, diversity and activity. This reduction makes the system more and more hostage to external inputs, since they reduce the natural forces that worked to keep it sustainable and productive.**

penergetic

On the other hand, the agro-ecological concepts serve very well to demonstrate that, by preserving and increasing the life and diversity of the soil-plant system, we achieve better results for all involved, because:

1. Improve Producer Profits;

2. Improves food quality;

3. Decrease environmental impacts.

Therefore, the current challenge is launched: how to preserve, increase and harmonize organisms in this living and multispecies system called agriculture?

Currently, the sector of manufacturers of agricultural inputs, in the world, looks for solutions to this issue. All of them are betting on products. There are countless products launched on the market in recent years, in order to meet this urgent need. By analyzing the modes of action and the effects produced by them, we can perceive different strategies, for example:

1. To provide the system with live microorganisms in the hope that they will be established and reproduced more than the existing ones;

2. Replace mineral fertilizers with organic or organomineral, to provide nutrients to plants in a less aggressive way;

3. Provide organic substances such as acids, enzymes, amino acids, seaweed extracts, etc., in order to stimulate the life of the system.

The research, in turn, works by testing different managements as a way to achieve the same goal: to increase the life of the system. We highlight two:

1. The managements that combine crops, livestock and forests;

2. Those who combine different successions of cultures, handling cocktails of hedge plants.

Within this context of management and products that seek to increase the life of the soil-plant system, we highlight the use of Penergetic® technology, associated with the management of cover plants, as the most promising alternative to date.

Tropical farming systems are, much more than cold-climate systems, highly dependent on microorganisms and phytomass production. The great difference between Penergetic® and other technologies is that it promotes a natural and lasting increase in life.

Penergetic® actually activates biological systems, harmonizing the environment with its electromagnetic field, rather than playing external organisms in a system without conditions to maintain them. After all, trying to increase life, without understanding the motives that led to its decrease, doesn't seem to be the best strategy.

Penergetic® technology is therefore a coherent strategy to bioactivate the soil-plant systems. The best effects have been observed when associated with other actions consistent with the proposed objective.

Decrease what is destroying the life of the system, increase what is favoring it: it seems, this is the key to better days in food production.

What **challenges** us?

Always grounded in agronomic principles, but clearly understanding the fertility of soils far beyond chemistry, what challenges us is the awareness that it is possible to make agriculture more intelligent and rational, more economical and sustainable.
What challenges us is to have a deep understanding of the farming systems of production that we work, and that they are composed of a great natural and fragile structure, that needs balance and moderation in all the processes of production.

Penergetic® technology brings to the market the unique opportunity to produce more at lower costs in a sustainable and safe way. We invite you to check out some of the official results obtained from the use of this technology in its various aspects.

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Penergetic® Technology Validation for the cultivation of peanuts in sugarcane fields reform

Denizart Bolonhezi - Agronomist, PhD in Agronomy, Researcher APTA/IAC
Supported by : **Jairo Aparecido Lima** - Agronomist and
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INTRODUCTION

21 fields were installed with Penergetic®, cultivated with IAC-886 (01), IAC-503 (06), IAC-OL3 (01), IAC-505 (01) and Ready (01), in the crops of 2013/14, 2014/15 and 2015/16. The results showed average gains of 13.17% in pod productivity (+30 sc ha^{-1}) for the main peanut cultivars, considering 21 sites in three consecutive harvests. The magnitude of the response of these commercial validations suggests the need for research, for scientific confirmation and explanation of the verified effects' causes. The objective of the present work was to validate in commercial conditions the use of Penergetic® technology on peanut yield, under conditions of sugarcane reform in three consecutive harvests.

MATERIAL AND METHODS

The characteristics of the installation sites, as well as the dates of sowing and harvest, are given in table 1.

The applications of Penergetic® Pflanzen (250g ha^{-1}) were carried out on the occasion of the first applications with fungicides, divided in 100 + 150 g ha^{-1}. It was considered the ideal maturation point for each cultivares evaluated for harvest. After mechanical pull-off during the process of "healing" the field, sampling survey for the final plant population were held. The productivity evaluation was performed by harvesting in 4 lines of 800 meters, on the plots with Penergetic® treatment and in the Control. After mechanical harvesting, pod production was transferred to overflow, for mass quantification, using a load cell scale. After discounting the impurities and humidity, the values were extrapolated to kg ha^{-1}.

Table 1. Installation locations and dates of sowing and harvesting of the trials.

Safra	Município	Área (ha)		Cultivar	Data	
2013/14		Penergetic®	Controle		Semeadura	Colheita
L1	Sertãozinho/SP	**120**	----	IAC 886	Nov/13	Feb/14
L2	Guarantã/SP	**120**	390	IAC 503	Oct/13	Mar/14
2014/15	**Município**	**Penergetic®**	**Controle**	**Cultivar**	**Semeadura**	**Colheita**
L3	Sertãozinho/SP	**13.71**	15.73	IAC 886	Nov/14	Apr/15
L4	Sertãozinho/SP	**14**	10	IAC 886	Oct/14	Apr/15
L5	Planalto/SP	**16**	40	IAC 503	Oct/14	Apr/15
L6	Bocaina/SP	**3.1**	1.8	IAC 886	Nov/14	Mar/15
L7	Bocaina/SP	**0.97**	0.876	IAC 886	Nov/14	Mar/15
L8	Dumont/SP	**1.11**	1.38	Pronto	Oct/14	Mar/15
L9	Zacarias/SP	**0.201**	0.358	IAC 886	Oct/14	Mar/15
L10	Pompéia/SP	**48**	10	IAC 886	Nov/14	Mar/15
L11	Garça/SP	**24**	100	IAC 886	Nov/14	Mar/15
L12	Pompéia/SP	**24**	24	IAC 886	Nov/14	Apr/15
2015/16	**Município**	**Penergetic®**	**Controle**	**Cultivar**	**Semeadura**	**Colheita**
L13	B. Paulista/SP	----	----	IAC 503	Nov/15	Apr/16
L14	Planalto/SP	----	----	IAC 886	Nov/15	Apr/16
L15	Zacarias/SP	----	----	IAC 886	Nov/15	Mar/16
L16	Araraquara/SP	----	----	IAC 505	Oct/15	Apr/16
L17	S. R.P. Quatro/SP	----	----	IAC 886	Oct/15	May/16
L18	Colômbia/SP	----	----	IAC 503	Oct/15	Mar/16
L19	Ícem/SP	----	----	IAC 503	Dec/15	May/16
L20	G. Peixoto/SP	----	----	IAC 503	Nov/15	Apr/16
L21	Sertãozinho/SP	----	----	OL3	Oct/15	Mar/16

*L = Place

INCREASED PRODUCTIVITY (%)

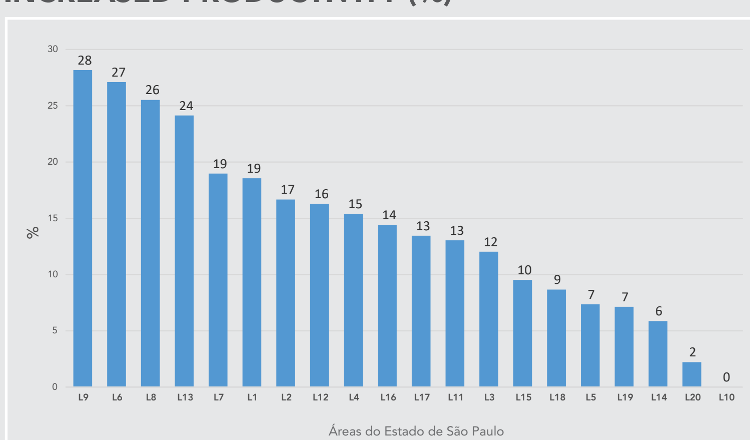

Figure 1. Percentage gains in pod productivity at 20 evaluation sites and four peanut cultivars in the crops of 2013/2014, 2014/2015 and 2015/2016.

RESULTS

AVERAGE POD YIELD (sc/ha)

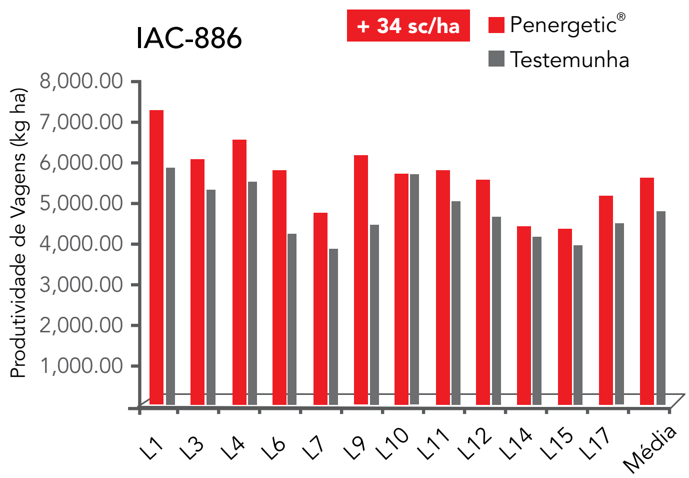

Figure 2. Average yield of pods at 12 sites for the cultivar IAC-886 in reform of sugarcane field, with and without Penergetic® technology, in the crops of 2013/2014, 2014/2015 and 2015/2016.

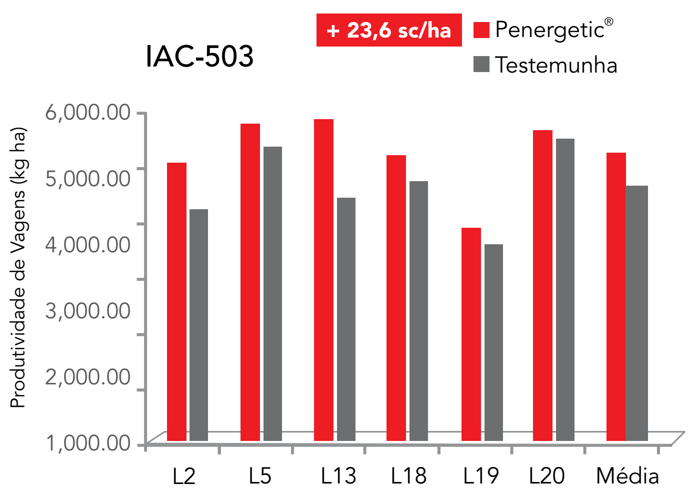

Figure 3. Average yield of peanuts at six sites for the cultivar IAC-503 in reform of sugarcane field, with and without Penergetic® technology, in the crops of 2013/2014, 2014/2015 and 2015/2016.

CONCLUSIONS

The results generated on a commercial scale showed **average gains of 13.17% in pod productivity (+30 sc ha^{-1}) for the main peanut cultivars,** considering 21 sites in three consecutive harvests. The magnitude of the response of these commercial validations suggests the need for research, for scientific confirmation and explanation of the verified effects' causes.

Productivity and quality of peanut seeds due to the application of Penergetic®

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Rodrigo Valochi - Agronomist
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INTRODUCTION

The peanut crop is concentrated in the State of São Paulo, with more than 80% of the cultivated areas under cane field reform. The use of residues from the agricultural industry, the rusticity and the strong interaction with the soil biota, make the peanut crop poorly responsive to the use of mineral fertilizers. However, the excessive use of inputs during the cycle can interfere in the soil microbiota, requiring the adoption of bioactivation strategies, which favor the maximum exploitation of the genetic potential of the cultivars.

OBJECTIVES

The objective of the experiment was to evaluate the effects of soil and crop bioactivation through the use of Penergetic® Technology in peanut crops.

MATERIAL AND METHODS

The experiment was installed in Planalto, SP, in the crop of 2015/16. The soil used was classified as Yellow Red Latosoil, clay-sandy texture, the chemical characteristics of which were: pH = 5,6; Ca = 28,0 cmolc dm-3; Mg = 7,0 cmolc dm-3; CTC = 61,0 cmolc dm-3; P (Resin) = 44,7 mg dm-3; K = 6,6 cmolc dm-3; B (hot water) = 0,20 mg dm-3; Cu = 0,73 mg dm-3; Fe = 109,7 mg dm-3; Mn = 6,1 mg dm-3; Zn = 1,33 mg dm-3; V =68,4 %; M.O.= 21,3g dm-3. Runner type peanuts were used (Arachis hypogea L.) the commercial cultivar IAC-886, in a randomized block designing, with four treatments and six repetitions (3 in conventional tillage and 3 on raw cane straw). The treatments were: (1) Control - without Penergetic®; (2) Penergetic® Kompost (250g ha^{-1}) with application after sowing, together with the application of the pre-emergent herbicide; (3) Penergetic® Pflanzen (250 g ha^{-1}) with split applications (100 + 150 g ha-1) on the occasion of the first applications with fungicides; (4) Penergetic® Kompost (250g ha^{-1}) + Penergetic® Pflanzen (250g ha^{-1}). Each experimental plot consisted of 12 rows of peanuts, each 30 meters long. The following characteristics were evaluated: pod yield, grain, yield, weight of 100 grains and physiological seed quality. The data were submitted to analysis of variance and the averages were compared by Turkey (p<0,05).

RESULTS

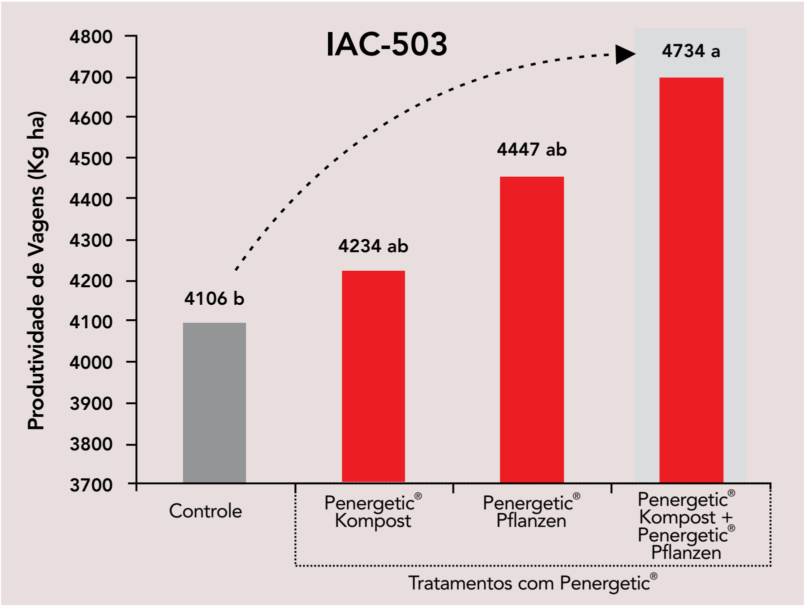

Figure 1. Productivity of peanuts, variety IAC-503, Planalto/SP, 2016.

Averages followed by the same letter do not differ from each other by the Tukey test at 5% probability.

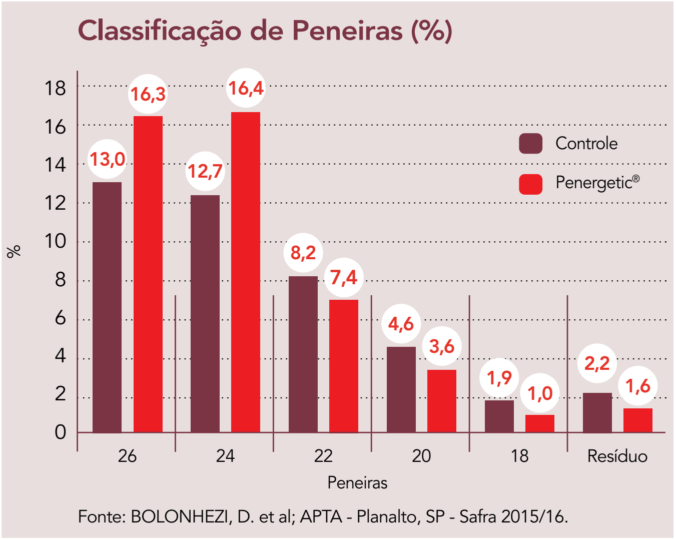

Figure 2.

Figure 3. Root System Bioactivated, Planalto/SP, 2016

CONCLUSIONS

According to analysis of variance, it was verified that the treatment with Penergetic® Technology (Penergetic® Kompost + Penergetic® Pflanzen) showed an increase of 628 kg ha^{-1} in pod productivity and a 3% increase in sieves 26 and 24.

Phosphate fertilization and Penergetic® application on common bean yield

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Adriano Stephan Nascente - Agronomist, PhD in Agronomy

INTRODUCTION

The common bean crop has great economic importance to Brazil, being produced in three seazons, called the rainy season, droughts and winter; which have different environmental conditions, considering the season, soil, crops and technological level employed (Wander, 2007). In the 2013 crop of the South-Central region (Central-West and Southeast), the winter common bean was cultivated in 187,700 ha, with a production of 465,5 thousand tons of grains, corresponding to an average yield of 2,480 kg ha^{-1} and 15.6% of all national production (CONAB, 2013). However, this average productivity is still considered low, since there are productivity reports around 4.000 kg ha^{-1} (NASCENTE et al., 2012).

Among the factors that may contribute to increase crop productivity, there is fertilization, since an adequate and balanced nutrient supply provides the full development of the crop with a positive impact on grain yield (PAGANI & MALLARINO, 2012; CRUSCIOL et al., 2013). In this sense, we have phosphorus (P), an essential element in plant metabolism, that contributes significantly to the increase of root development, besides favoring the increase of the number of pods and the mass of grains which results in positive increases in grain yield (PELÁ et al., 2009; ZUCARELLI et al., 2010).

The phosphorus requirement needed by the bean plants is lower than that of potassium (K) and nitrogen (N), however, the amount applied is usually higher (VIEIRA et al., 2006). This is due to the high P fixation rate in tropical soils, caused mainly by precipitation with Fe and Al, reaction with hydrated oxides of the same metals and reactions with silicate clays, because of this the use by the crop varies from 5% to 25% of total applied (Malavolta, 1980). In this way, it may be occurring an elevation of levels of phosphorus in the soil, without increasing the availability to plants. In this way, the development of technologies that provide greater availability of phosphorus to plants could provide a reduction in the amount of phosphate fertilizers applied to the soil, generating economic and environmental gains, since these fertilizers are produced from mineral reserves of non-renewable character (PELÁ et al., 2009).

In order to increase the availability of nutrients in the soil, the most advanced producers have used Penergetic® technology, which consists of the application of Penergetic® Kompost and Pflanzen products, which, according to the manufacturer, come from bentonite clay submitted to the application of electric and magnetic fields (BRITO et al., 2012). Also according to the manufacturer these products are used as a bioactivator of soils (Penergetic® Kompost, applied to soil) which increases and balances microbiological activities in the soil and as a plant bioactivator (Penergetic® Pflanzen), providing more energy to the photosynthetic process and facilitating the interaction of plant + beneficial microorganism (PENERGETIC, 2013).

The objective of this work was to determine the grain yield and production components of common bean affected by phosphate fertilization and by the application of Penergetic® Kompost and Penergetic® Pflanzen.

Table 1. P values for the variables of number of pods, number of grains pod^{-1} (GRAO), weight of 100 grains (MASSA) and grain yield (PROD) of common bean due to the harvest and phosphate fertilization (P), application of Penergetic® (Pen) and interaction. Unaí/MG, crops of 2012 and 2013.

Fatores	VAGENS	GRÃO	MASSA	PROD
	número	número	gramas	kg ha^{-1}
Safra agrícola (ano)				
2012	256 b[1]	4,52 a	25,4 b	2911 b
2013	305 a	4,69 a	28,1 a	4061 a
	Valor de *p* (probabilidade de teste F)			
Ano	<0,001	0,1186	<0,001	<0,001
CV (%)	10,0	8,7	5,3	8,4
	Ano 2012			
Doses de Fósforo (P)				
0	250	4,71	24,3	2799
40	207	4,29	25,2	2889
80	253	4,73	26,0	3123
120	254	4,34	25,7	2831
Aplicação Penergetic®				
Sem	252 a	4,59 a	24,6 b	2815 b
Com	260 a	4,45 a	26,1 a	3006 a
	Valor de *p* (probabilidade de teste F)			
P	0,7117	0,5849	0,5547	<0,001
Penergetic®	0,2879	0,3587	<0,001	<0,001
P x Penergetic®	<0,001	<0,001	0,8421	0,7002
CV (%)	7,0	10,4	4,8	4,5
	Ano 2013			
Doses de Fósforo (P)				
0	246	4,71	26,9	3120
40	322	4,68	28,9	4368
80	318	4,73	28,0	4247
120	336	4,66	28,7	4510
Aplicação Penergetic®				
Sem	283 b	4,61 b	27,3 b	3579 b
Com	328 a	4,76 a	28,9 a	4543 a
	Valor de *p* (probabilidade de teste F)			
P	<0,001	0,4493	<0,001	<0,001
Penergetic®	<0,001	<0,001	<0,001	<0,001
P x Penergetic®	0,1254	0,2591	0,2752	<0,001
CV (%)	12,2	5,0	3,9	12,0

[1]Mesma letra na vertical não diferem entre si pelo teste Tukey para p< 0,05.

MATERIAL AND METHODS

The experiment was carried out in different places on Fazenda Guaribas, in the municipality of Unaí, MG in the years of 2012 and 2013. The soils of the experimental areas were classified as Red-Yellow Latosoil (2012) and Red Latosoil (2013), dystrophic with open clay texture. Before the installation of the experiments, soil samples were collected and chemical and physical analyzes were performed, according to Claessen's recommendations (1997).

The experimental design was in randomized blocks in the 4 x 2 factorial scheme, with eight repetitions. The plots had the dimensions of 7.0m long x 2.0m wide, and is considered as a useful portion of the two central lines, disregarding 0.50 m from each end. The treatments consisted of the combination of three doses of phosphorus applied to the soil (40, 80 and 120 kg ha^{-1} of P_2O_5) plus the control (0 kg ha^{-1} of P_2O_5), using as source the monoammonium phosphate, with the presence and absence of Penergetic® application. Phosphorus doses were calculated based on soil analysis and correspond to 0, 1/3, 2/3 and the recommended dose for the crop. The application of Penergetic® was done in two steps: 1st application of 250 g ha^{-1} of the Penergetic® Kompost applied to the soil, soon after the management desiccation of the cover plants, one day before the common bean sowing; and a 2nd application of 250 g ha^{-1} of the Penergetic® Pflanzen via leaf, in the V4 stage of common bean plants. The application was performed with bar sprayer with syrup volume of 200 L ha^{-1}.

The spacing between the lines was 0.50 m and the seeding density was 8 seeds m-1. After sowing, it was carried out the broadcasting application of 65 kg ha^{-1} of K2O (KCl) and 90 kg ha^{-1} of N (Urea) (without incorporation). The cultural treatments were carried out according to the needs of the crop, using the recommended products. During the two agricultural years, the central pivot irrigation system was used.

For the evaluation of the production components (number of plant pods-1, number of pod grains-1 and mass of 100 grains), 10 random plants were collected in each plot. The grain yield (130g kg^{-1} of moisture) was evaluated by performing the harvest of the useful plot. As additional information, the agronomic efficiency of the application of P was calculated, in which the productivity of a given treatment was subtracted by the productivity of the control treatment (without P) and the result divided by the amount of P applied.

The data were submitted to variance analysis, and when the F test was significant, we proceeded to the Tukey test ($p < 0.05$). For the quantitative data (phosphorus doses), the regression analysis was performed.

RESULTS AND DISCUSSION

In 2012 it was found that there was no significant effect of m-2 pods number, number of pod-1 grain and weight of 100 grains for the factor levels of phosphorus, taking effect on the variable of greatest interest to producers, grain yield (Table 1). Regarding the application of Penergetic®, there was an effect on the mass of 100 grains and on the productivity.

The highest doses of phosphorus applied (80 and 120 kg ha^{-1}) did not provide positive increases in grain yield of the crop. Thus, the supply of P in the sowing furrow, up to the dose of 40 kg ha^{-1} of P_2O_5 was sufficient to produce productivity similar to that of the higher doses of P. This result may have occurred due to the high levels of P in the soil, being considered average, common fact in areas under no-tillage.

Regarding the use of Penergetic® in the year 2012, it was verified that its application provided significant increases in the mass of 100 grains (from 24,6 to 26,1 g) e also on grain yield of the crop (from 2815 to 3006 kg ha^{-1}) (Table 1). Brito et al. (2012) also verified that the application of Penergetic® provided significant increases in grain yield of common bean, when compared to the control treatment (without the use of Penergetic®). According to the authors, the Penergetic® technology provides better conditions for the development of plants, mainly due to the better absorption of nutrients such as phosphorus. In this sense, the results of the present study allow us to infer that the use of these products provided better conditions for the development of the crop resulting in higher grain yield. Further research should be done to better clarify the effects of these products on the plant that cause this better development.

In 2013 it was found that there was significant effect of phosphorus doses for the m-2 pods number, weight of 100 grains and productivity (Table 1). Regarding the use of Penergetic®, there was an effect in all evaluated variables, where the application of Penergetic® provided higher values in relation to non-application of the product. There was also interaction between these two factors (phosphorus doses and Penergetic® use) in the grain yield variable.

Regarding productivity, interaction with the Penergetic® application was observed, with linear adjustment, in the absence of product application, and quadratic adjustment of the data when Penergetic® was applied (Figure 1). However, regardless of the application of the product, it is verified that fertilization with phosphorus provided significant increases in grain yield of the crop.

The application of Penergetic®, regardless of the combination with the phosphorus dose, resulted in

Table 2. Agronomic efficiency in the productivity of common bean grains, depending on phosphate fertilizing (P) and the application of Penergetic®.

Doses de Fósforo	Ano 2012		Ano 2013	
	Com Penergetic®	Sem Penergetic®	Com Penergetic®	Sem Penergetic®
	Eficiência agronômica de P (kg de grão kg de P^{-1})			
0	-	-	-	-
40	7,4 a* A	5,9 a B	53,4 a A	16,2 a B
80	6,5 a A	5,9 a A	23,0 b A	8,8 b B
120	2,9 b A	0,5 b B	16,7 b A	8,9 b B

* Equal letters, lowercase in the column or uppercase in the row (within the same year), do not differ from each other by the Tukey test for p <0,05.

higher values of grain yield of the bean in the 2013 crop, in relation to the treatments without the product (Table 2). It was verified that, when Penergetic® was applied, the agronomic efficiency of the application of phosphorus was much higher than that of the absence of application of the product, especially in the year 2013, being the efficiency much higher in the lower doses of phosphorus.

For the treatments with Penergetic® a significant increase of the productivity until the dose of 82.2 kg de P_2O_5 ha^{-1}, reaching 5,313 kg ha^{-1} of grains (Figure 1). On the other hand, without the application of Penergetic® the response to the application of phosphorus in the soil was linear, and the maximum yield was 3,903 kg ha^{-1} of grains. Based on the results, it can be inferred that the application of Penergetic®, provided a higher grain yield with lower dose of applied phosphorus. This result may indicate that there was greater availability of phosphorus to the plants when Penergetic® was applied, possibly from soil and/or organic colloids due to the higher soil microbial activity.

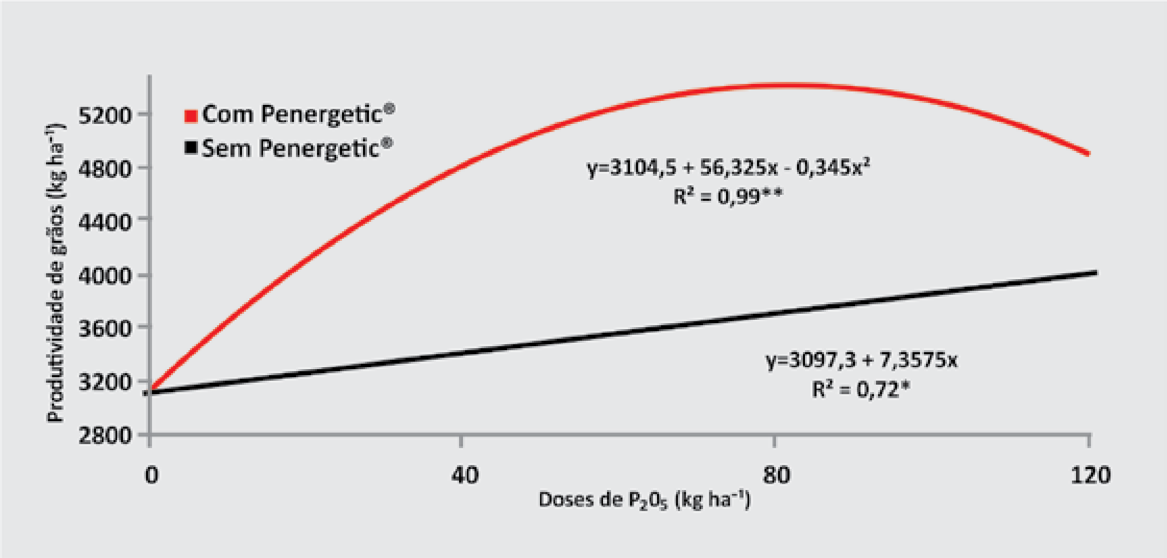

Figure 1. Productivity of common bean grains as a function of P_2O_5 doses applied to the soil in 2013 in Unaí/MG.

CONCLUSIONS

The phosphorus fertilization provided significant increases in grain yield and the common bean production components in the two years of cultivation. The use of Penergetic®, independent of the dose of phosphorus used, provided higher grain yield than the treatments without application of the product during the two years of cultivation. In the year 2013, the application of Penergetic® provided higher grain yield (5313 kg ha^{-1}) in a lower dose of phosphorus (82,2 kg of P_2O_5 ha^{-1}) than in the absence of the product (3903 kg ha^{-1}) in the highest dose of phosphorus (120 kg of P_2O_5 ha^{-1}).

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Performance of the Penergetic® Kompost and Pflanzen in cotton crop

Fabiano Andrei Bender da Cruz - Agronomist, PhD in Agronomy, Researcher and Consultant of the Fundação Bahia

INTRODUCTION

The Penergetic® is a bioactivator of soil (Penergetic® Kompost) and plants (Penergetic® Pflanzen), with the potential to promote increased positive effects on plant vigor, with balance between soil / plant, by optimizing the use of fertilizers added or existing fertility in the soil. It acts on the release of the fixed phosphorus not available to the plants, and promotes the rebalancing of microorganisms, providing more energy in the photosynthetic process.

PURPOSE

Evaluate the performance of Penergetic® Kompost and Pflanzen technology on production components, cotton productivity and technological characteristics of the fiber.

Table 1. Chemical and physical soil characterization in depth from 0 to 20cm (Luís Eduardo Magalhães/Bahia. 2015/16).

MO	pH	P	Ca	Mg	K	Al	H+Al	SB	CTCe	CTC
g dm^{-3}		mg dm^{-3}	-------------			$mmol_c$ dm^{-3} -------------				
13	4,8	28	23	6	1,9	0	16	30,9	30,9	46,9
V	**m**	**S**	**B**	**Cu**	**Fe**	**Mn**	**Zn**	**Argila**	**Silte**	**Areia**
------ %	------	----------------	----------------	mg dm^{-3}	-------------			------------ g kg^{-1}	------------	
66	0	6	0,8	0,5	52	2,4	1,5	230	70	700

MO: K2Cr2O7; pH: CaCl2; P, Ca, Mg, K, Cu, Fe, Mn and Zn: Mehlich 1; Al: KCl; H+Al: SMP; S: Ca(H2PO4)2; B: hot water.

Table 2. Description of treatments used in cotton crops (Luís Eduardo Magalhães/Bahia. 2016).

Trat.	Descrição	05-34-00	Penergetic Kompost	Penergetic Pflanzen
1	Adubação Padrão	320 kg ha^{-1}	-	-
2	Adubação Padrão + Penergetic	320 kg ha^{-1}	0,6 kg ha^{-1} (Dessecação)	0,2 kg ha^{-1} (V5-8) 0,2 kg ha^{-1} (B3-B5) 0,2 kg ha^{-1} (F3-F5)
3	Adubação Ajustada	200 kg ha^{-1}	-	-
4	Adubação Ajustada + Penergetic	200 kg ha^{-1}	0,6 kg ha^{-1} (Dessecação)	0,2 kg ha^{-1} (V5-8) 0,2 kg ha^{-1} (B3-B5) 0,2 kg ha^{-1} (F3-F5)

MATERIAL AND METHODS

The experiment was conducted in the crop of 2015/16 In the Centro de Pesquisa e Tecnologia do Oeste Baiano, Fundação Bahia, at Luís Eduardo Magalhães, Bahia, whose geographic coordinates are 12°05'26'' S and 45°42'42'' W, with altitude of 760 m. In soil classified as typical Distrophic YELLOW LATOSOIL (SANTOS et al., 2013), sample drawn at depth of 0 to 20 cm was submitted to chemical and granulometric analysis (RAIJ et al., 2001; CAMARGO et al., 1986) and the results are shown in Table 1.

The area is characterized by a system of minimum cultivation, cultivated with soybean (crop of 14/15), corn in the off season (15/15) and cotton (15/16), located in the Pivot 1. It was used the type DP 1536 BGII RRFlex®, treated with Avicta® (0.36 mL kg-1 stes), Standak Top® (3.0 mL kg-1 stes) and Priori® (2.5 mL kg-1 stes), they were mechanically sown in 01/26/16 (emergence in 02/01/16), with fertilization between 200 and 320 kg ha^{-1} of 05-34-00 (7% Ca, 14% S, 0.05% B, 0.05% Cu, 0.1% Mn and 0.1% Zn) in the sowing groove, according to Table 2, beyond the superficial application of 190 kg ha^{-1} of Ammonium Sulphate and 250 kg ha^{-1} of KCl, to the 15 DAE, 160 kg ha^{-1} of Urea to the 30 DAE and 160 kg ha^{-1} of Urea to the 45 DAE. Phytosanitary management followed the pattern of the Fundação Bahia. The experiment, which was a randomized block design with 5 replicates, consisted of 4 treatments (Table 2), with each experimental plot being composed of 4 sowing rows spaced in 0.76m with 8m length, maintaining a distance of 15m between plots. We evaluated at harvest (07/12/16), the plant population, plant height, the average weight of boll, seed cotton productivity, lint yield and technological characteristics of fiber, and the data submitted to the analysis of variance and the means compared by the Tukey test (P<0.05).

RESULTS AND DISCUSSION

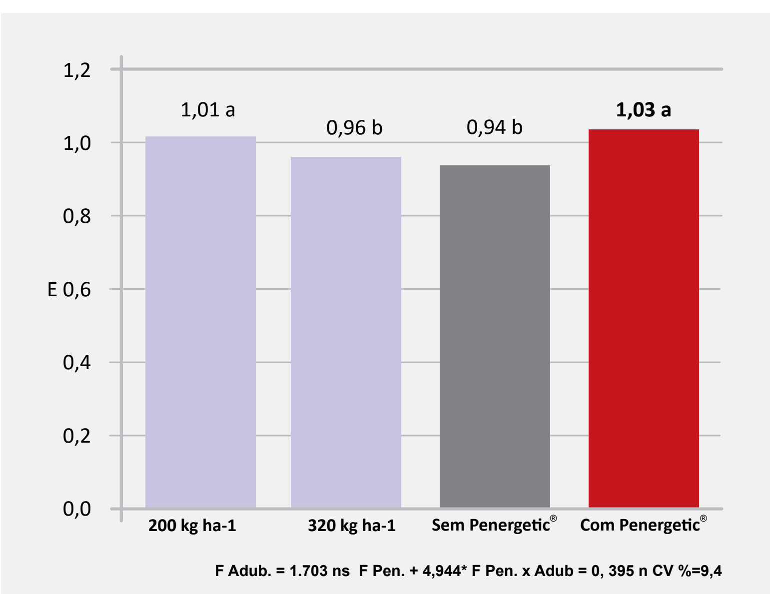
Average for plant population, the average weight of bolls and lint yield were not significantly influenced by treatments (Table 3). The productivity of cotton seed was significantly (p<0.01) was influenced by the interaction Fertilization x Penergetic® Technology (Table 3), obtaining an average of 2,154 kg ha^{-1} (144 @ ha^{-1}). When the standard fertilization of 320 kg ha^{-1} of the formula 05-34-00 is maintained in the sowing furrow, the use of Penergetic® Technology caused a reduction of 210 kg ha^{-1} (14 @ ha^{-1}) in the production of cotton seed. However, when setting the fertilizer to 200 kg ha^{-1} of 05-34-00 in the sowing groove, Penergetic® Technology resulted in an increase of 398 kg ha^{-1} (26.5 @ ha^{-1} ou 17%) in the production of cotton seed. Penergetic® technology promoted higher plant growth, regardless of the fertilizer used (Figure 1).

Table 3. Plant population (POP), average boll weight (PC), lint yield (REND.), Seed cotton yield (PROD.) and relative production (PR) for different treatments (Luís Eduardo Magalhães/Bahia. 2016).

Trat.	Penergetic	POP Plantas m^{-1}	PC g	REND. %	PROD. kg ha^{-1}	PROD. @ ha^{-1}	PR %
320 kg ha^{-1}	Sem	10,0	5,1	45,6	2210 a	147 ± 4,1	100
320 kg ha^{-1}	Com	8,9	5,2	45,7	2000 b	133 ± 2,8	90
200 kg ha^{-1}	Sem	8,9	5,2	46,9	2004 b	134 ± 6,1	91
200 kg ha^{-1}	Com	8,7	5,3	45,6	2402 a	160 ± 5,1	109
		9,14	5,2	45,9	2154	144	-
CV (%)		18,9	8,3	3,3	5,3	5,3	-
F Adubação		0,818 ns	0,330 ns	0,736 ns	3,681 ns		-
F PEnergetic		0,641 ns	0,488 ns	0,839 ns	3,401 ns		-
F Adubação x Penergetic		0,384 ns	0,006 ns	1,153 ns	35,49 7 **		-

[1]Test F: * and ** significant to 5% and 1% of probability, respectively, and ns not significant. Averages followed by the same letter within fertilization levels do not differ among themselves by the Tukey test at the 1% probability level.: overall average. CV: coefficient of variation.

Figure 1. Effect of the level of fertilization and use of Penergetic® technology on the height of cotton plants (Luís Eduardo Magalhães/Bahia. 2016).



Averages followed by the same letter do not differ from each other by the Tukey test at 5% probability.

CONCLUSIONS

Penergetic® Technology promoted a significant increase in plant height, regardless of the level of fertilization used;

Penergetic® Technology increased seed cotton yield by 17% when adjusted the level of fertilizer applied in the sowing groove, but decreased yield when the fertilizer doses were maintained in the sowing groove.

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Effect of Penergetic® Pflanzen e Kompost and Kompost in cotton crop

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INTRODUCTION

The cotton plant (*Gossypium hirsutum L.r. latifolium Hutch*), is a species with a short annual cycle, is considered a crop of great socioeconomic importance for the Country, especially for the Northeast, Midwest and Southeast regions.

The Penergetic® is a bioactivator of soil (Penergetic® Kompost) and plants (Penergetic® Pflanzen), with the potential to promote increased positive effects on plant vigor, with balance between soil / plant, by optimizing the use of fertilizers added or existing fertility in the soil. It acts on the release of the fixed phosphorus not available to the plants and promotes the rebalancing and increase of microorganisms providing greater energy in the photosynthetic process.

PURPOSE

The goal of this work is to evaluate the effect of Penergetic® Pflanzen and Penergetic® Kompost on cotton productivity components.

MATERIAL AND METHODS

The work was conducted in the crop of 2014/15 in the Centro de Pesquisa e Tecnologia do Oeste Baiano, Fundação Bahia, at Luís Eduardo Magalhães, Bahia, whose geographic coordinates are 12º05'12" S and 45º42'30" W, with an altitude of 768 m in relation to the average sea level.

The variety used in this test was BRS 368RF®, mechanically sown in the 2014/15 harvest in the month of December with fertilization of 100 kg ha^{-1} and 500 kg ha^{-1} 05-34-00 (8% Ca, 5% S, 0,08% B, 0,05% Cu, 0,2% Mn and 0,15% Zn) in the sowing furrow, according to pre-established treatments (Table 1), besides the superficial application for all the treatments of 220 kg ha^{-1} of 00-00-60 and 130 kg ha^{-1} of 45-00-00, at 33 DAE, 120 kg ha^{-1} of 21-00-00+24% of S at 46 DAE, 150 kg ha^{-1} of 00-00-60 and 130 kg ha^{-1} of 45-00-00 at 48 DAE. The cultural treatments carried out in the culture were those recommended for commercial cultivation (insecticides, fungicides and micronutrients).

The experiment, which was a randomized block design with five repetitions, consisted of four treatments (Table 1), with each experimental plot being composed of four sowing rows spaced in 0.76m with length of 10m, being the useful area composed by the two central lines, excluding two meters of each end.

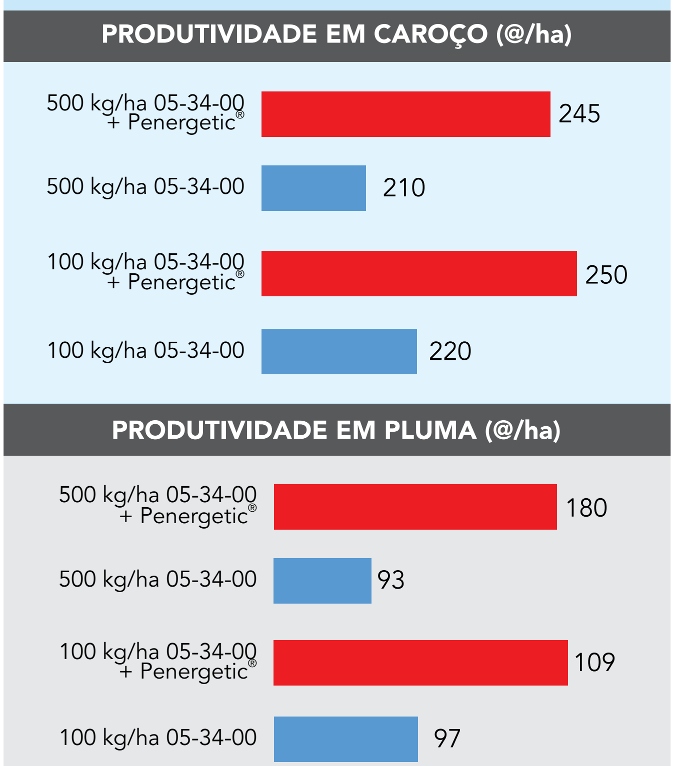
The treatments were performed by spraying Penergetic® Kompost prior to planting and Penergetic® Pflanzen at 11, 21, 45 and 66 days after the emergence, using a pressurized backpack sprayer at a constant pressure (CO_2) of 2.9 kgf cm^{-2}, equipped with an aluminum bar with 6 flat jet nozzles spaced at 0.5 m, with a volume of equivalent syrup of 150 L ha^{-1}.

In the cotton harvest, held to 195 DAE were evaluated cotton productivity in seed and lint, and the data were submitted to analysis of variance and the effects of fertilizer levels and applications of Penergetic®.

Table 1. Description of treatments used in cotton crops Fundação Bahia. Luís Eduardo Magalhães/BA. Crop of 2014/15.

Adubação de semeadura 05-34-00 (kg ha^{-1})	Tratamento Penergetic®	(11 DAE) Penergetic® Kompost (g ha^{-1})	(21 DAE) Penergetic® Pflanzen (g ha^{-1})	(45 DAE)	(65 DAE)
500 kg ha^{-1}	Controle	–	–		
500 kg ha^{-1}	Penergetic®	500 g ha^{-1}	167 g ha^{-1}	167 g ha^{-1}	167 g ha^{-1}
100 kg ha^{-1}	Controle	–	–		
100 kg ha^{-1}	Penergetic®	500 g ha^{-1}	167 g ha^{-1}	167 g ha^{-1}	167 g ha^{-1}

Figure 1. PCotton and lint Cotton Productivity (@/ha) under different doses of fertilizer 05-34-00 in the presence of Penergetic® (Luís Eduardo Magalhães/Bahia. 2015).



RESULTS AND DISCUSSIONS

In Figure 1, it can be observed seed cotton productivity in @/ ha when used at doses of 100 and 500 kg ha^{-1} of fertilizer 05-34-00, whose variable was not significantly influenced ($p<0,05$) by the treatments, that is, the supply of 170 kg ha^{-1} of P_2O_5 provided equivalent yields to those obtained with the use of 34 kg ha^{-1} of P_2O_5.

When we analyze the effect of applying or not Penergetic® on the seed cotton yield, regardless of the applied dose of fertilizer (Figure 1), there was a significant increase (30 and 35 @/ha), whereas the application of Penergetic® associated to the different doses of P_2O_5 yielded similar productivities, evidencing its effect independent of the dose of P_2O_5 adopted.

The productivity of the cotton in lint was increased (87 and 12% ha), influenced by the application of Penergetic® (Figure 1).

CONCLUSION

The application of Penergetic® provided higher productivities of cotton seed and lint in the different treatments.

Testing using Penergetic® Technology in forests

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INTRODUCTION

The objective of these works was to verify the effects of the application of the Penergetic® Kompost and Penergetic® Pflanzen technology in forests, since they have already been widely used in other agricultural crops. However, in the harvest of commercial forests, there's still no substantial analysis of the results of the action of the mentioned products, making the present study one of the pioneers.

The experiments were carried out in forest nurseries, producers of eucalyptus seedlings - and in areas of commercial forest planting, both in forest stands and in silvopastoral production systems, being carried out in different regions of Paraná.

TEST 1

PURPOSE

The objective of the experiment was to evaluate the effect of Penergetic® on seedlings of Eucalyptus urograndis Clonal, in relation to the promotion of the production substrate microbiota, in order to calibrate the ideal doses of Penergetic® Pflanzen and Penergetic® Kompost.

METHODOLOGY

This experiment was conducted under the shelter of the greenhouse, which enabled certain conditions were controlled, such as availability of water, light, temperature, relative air humidity, among others. The propagation - via cuttings - the seedlings occurred on 02/11/2016, and that the subsequent management of the seedlings consists in irrigation with duration of 10 seconds at every 15 minutes, being that they remained 20 days in the greenhouse, 7 days in the shade house and 5 days in trays in full sun. Thus the following treatments were performed:

T1: Control (without application);
T2: Penergetic® Pflanzen (1g L^{-1}) 45 days after staking;
T3: Penergetic® Pflanzen (1,5g L^{-1}) 45 days after staking;
T4: Penergetic® Pflanzen (2g L^{-1}) 45 days after staking;
T5: Penergetic® Pflanzen (4g L^{-1}) 45 days after staking;
T6: Penergetic® Kompost (1g L^{-1}) on the day of staking + Penergetic® Pflanzen (3g L^{-1}) divided into 3 applications, ie at 20 days, 40 and 60 days after application of Penergetic® Kompost.

A completely randomized experimental design was used, with a 6x4 factorial scheme, corresponding to 6 treatments and 4 repetitions, each repetition composed of 20 sample units (seedlings) totaling 80 seedlings per treatment. The experiment consisted of a total of 480 seedlings.

The evaluations were carried out in may 2016, at 90 days after propagation of E. urograndis and the parameters evaluated were: plant height (cm), neck diameter (mm), root length (cm), fresh mass (g) and dry mass (g).

For the evaluation of the plant height a millimeter rule was used and for the diameter of the neck a pachymeter. After this process, the roots of the seedlings were unearthed and washed in running water in order to remove all the commercial substrate rooting for later perform the measurement of the size of the main root of each change and the quantification of dry mass and green mass, basically it is constituted in the weighing of the green mass in analytical balance, subsequent drying of the samples in greenhouse, and new weighing of the dry mass. The data were tabulated in a Excel spreadsheet and submitted to the statistical analysis with software ASSISTAT 7.7.

Table 1. Results of statistical analysis relating Height, root collar diameter (D.C.) and root length. Londrina/PR, 2016.

Tratamento	Altura total (cm)	D.C (mm)	Comprimento de Raiz (cm)
T1	19,62 c	3,14 a	13,96 b
T2	22,18 ab	2,66 b	14,73 b
T3	22,39 ab	2,78 b	17,74 ab
T4	21,35 b	2,58 b	16,59 ab
T5	23,58 a	2,61 b	19,15 a
T6	21, 30 b	2,70 b	16,48 ab

The averages followed by the same letter are not statistically different from each other. The Tukey test was applied at a 5% probability level ($p < 0.05$). Whereas: D.C = Root collar diameter.

Table 2. Results of the dry and green leaf and root mass of the evaluated individuals. Londrina/PR, 2016.

Tratamento	Massa Verde Folha (g)	Massa Seca Folha (g)	Massa Verde Raiz (g)	Massa Seca Raiz (g)
T1	61,49	22,12	65,05	13,71
T2	63,28	22,82	62,87	11,93
T3	66,53	22,45	49,60	10,25
T4	48,98	17,37	55,23	10,23
T5	66,49	22,48	68,38	11,62
T6	65,3	22,84	54,06	11,44

RESULTS AND DISCUSSION

The results obtained, through the statistical analysis, are expressed in Table 01.

As for the variable height, it was observed that the treatments T2, T3, T4 and T6, did not differ statistically. The T5 treatment (Penergetic® Pflanzen (4g L^{-1}) 45 days after staking) was the one that presented the best results (23.58 cm) for this variable, standing out significantly from the other treatments, however not statistically differing from treatments T2 and T3. The T1 (Control) treatment had the lowest rates of development for the variable under analysis. From the results it is possible to identify that the application of 4g L^{-1} Penergetic® Pflanzen 45 days after staking It contributes to the height development of seedlings of E. urograndis farmed.

Regarding the root collar diameter variable (D.C.), a statistical difference between the T1 (Control) treatment and the other treatments was reported, and the best indexes were presented for T1 (3.14 mm). Analyzing the height and diameter variable of the root collar, the height/diameter ratio can be clearly seen since in the T1 treatment the seedlings spent more developing energy in the root collar diameter and consequently lower energy in height development. Technically, the lower the value of this ratio, the better the ability of seedlings to survive and become established in the field.

Another factor taken into consideration is the length of the roots, wherein the T5 treatment (19.15 cm) was statistically different from treatments T1 (13.96 cm) and T2 (14.73 cm). In this way it is possible to perceive the relationship between root length and height, since in both variables the T5 treatment (Penergetic® Pflanzen (4g L^{-1}), 45 days after staking) it was more effective in the development of these indices.

Observing the Table 2 for the variable green and dry mass of the leaf, it is noted that only the T4 treatment (Penergetic® Pflanzen (2 g L^{-1}) 45 days after staking), it differed significantly from the other treatments, presenting the lowest indices, the other treatments did not present significant differences. As for the dry and green mass of the root, the treatment that presented the lowest indices was the treatment T3 (Penergetic® Pflanzen (1.5 g L^{-1}) 45 days after staking), but the other treatments did not present expressive differences in the values.

CONCLUSIONS

The application of 4g L^{-1} Penergetic® Pflanzen 45 days after staking it contributes to the root development and the height of seedlings of *E. urograndis* farmed. This is one of the important criteria to determine the good initial establishment of the seedlings in the field, however, there was no greater increment in diameter, and with that, the height-to-diameter ratio was higher than that of the control. According to specialists in the production of eucalyptus seedlings, the lower this relationship is, the greater is the adaptation of the plant in the field, and it is necessary to follow the development of these seedlings in the field to analyze how it will be its consequent development, in order to generate a more accurate conclusion regarding the application of Penergetic®.

penergetic®

unisafe Consultoria

TEST 2

PURPOSE

On this occasion the experiment was implemented with the purpose of testing the effects of Penergetic® Pflanzen and Kompost on components of afforestation of silvopastoral systems of integration, at more advanced stages of development.

METHODOLOGY

The experiment was conducted in a silvopastoral system, in which it is intercropped the afforestation component Eucalyptus - clone I144 - with the cultivar Panicum maximum (Guinea grass). The tree component was systematically implanted with a spacing of 15 meters between simple rows and 4 meters between plants. These commercial production areas under study were implemented in the month of October, 2012.

Because the forest is already established and at an advanced stage of vegetative development, the application of Penergetic® was carried out with the use of agricultural aircraft, and the applied doses of 500 grams per hectare of Penergetic® Kompost, in addition to 250 grams per hectare of Penergetic® Pflanzen – one month after the first application, in all the blocks, except for the controls. This experiment was conducted in a total area equivalent to 105.00 hectares, and in 82.49 hectares there was application of Penergetic®, and in 22.51 hectares there was no application of these products. In this way the design consisted of two treatments which are described below:

Treatment 1: Control (Without Penergetic®);
Treatment 2: Penergetic® Pflanzen (forest with 2 years and 4 months) and Penergetic® Kompost (forest with 2 years and 5 months).

The difference between the treatments was measured in July 2016, that is, 3 years and 9 months after planting and 1 year and 4 months after the application of Penergetic®. For that, a forest inventory was carried out, delimiting two parcels of 3,120m² (52 x 60 meters) in each treatment, amounting 12,480m² of sample area in the two treatments of the experiment, where the following parameters were measured: diameter at breast height (1.3 meters from the floor), total height and volume of wood. The equipment used in this stage was a forest bevel gauge (caliper rule), forest electronic clinometer and field clipboard.

RESULTS AND CONSIDERATIONS

The Table 3 shows that there was a difference in productivity in volume among the evaluated treatments. The carrying out of the assessments at 1 year and 4 months, after the application of Penergetic® in the area, they validated the use of Penergetic®, showing advantages in the use of this product.

Table 3. E. urograndis productivity (I144) Productivity of treatments performed in the experiment at Fazenda Matão. Loanda/PR, 2016.

Tratamento	I (anos)	H (m)	DAP (cm)	N (árv./ha)	V (m³/ha)	IMA (m³/ha/ANO)
Controle	3	18,15	20,50	147	44,29	11,36
Penergetic®	3	19,12	21,84	147	53,19	13,64

Considering that: I= age; H= average height; DAP= average diameter; N= number of trees per hectare; V= volume by hectare; IMA= average annual increment.

The area of silvopastoral system with spacing applied to systematic afforestation of 15 x 4 meters without the application of Penergetic® presented 44.29 m³ ha^{-1}, while the area with the application of Penergetic® presented 53.19 m³ ha^{-1}, showing that with the application of Penergetic® and its bioactivation capacity, there was an increase in the forest biomass increase, corroborating with gains in productivity of 9 cubic meters per hectare (17%), at 3 years and 6 months of age.

In addition, the average annual increase of woody biomass in the area with the application of Penergetic® was approximately 2.3 m³ ha^{-1} $year^{1}$ higher, and demonstrated that even Eucalyptus being a long--cycle perennial crop, the 3.5-year-old forest was able to respond to the application of Penergetic® in only one year and four months.

Since the present study is pioneer in the evaluation of results from the application of Penergetic® in commercial forests, it is advisable to carry out new experiments for forests, in other stages of development and soil and climatic conditions.

CONCLUSION

The application of Penergetic® demonstrated increased productivity of eucalyptus biomass in silvopastoral integration system. Even though Eucalyptus is a perennial and long cycle crop, the 3.5 year old forest component has already shown a response to the application of Penergetic®, one year and four months after application.

It can be concluded that in a silvopastoral system, with spacing of 15 x 4 meters applied to the tree component, the application of Penergetic® led to increased productivity of a E. urograndis forest (I144), in approximately 9 cubic meters per hectare - **17% higher** than the area where there was no positioning of this product.

TEST 3

PURPOSE

The objective of this experiment was to evaluate the results of the application of Penergetic® in a commercial forest of Eucalyptus urograndis (I144), in a forest massif, conducted for multiple uses.

METHODOLOGY

For this experiment were initially demarcated four (4) areas of approximately 2,000 m² along the forest massif E. urograndis with different ages and areas of silvicultural managements. The demarcation of an area of 2,000 m² was designed to provide a safety and insulation area for the application of Penergetic®.

These areas were identified, in loco, with the demarcation in white paint of the marginal trees. Subsequently, the application of Penergetic® Pflanzen and Kompost was carried out in these already delimited areas.

After 10 months of application of the Penergetic®, this settlement was evaluated, via forest inventory. In the area 1 (L2Q1) the E. urograndis forest was 5.9 years old at the time of the dendrometric survey, area 2 (L2Q1) presented with 6.2 years, the area 3 (L3Q3) with 5.3 years and the area 4 (L4Q3) was 4.2 years. In areas 1, 3 and 4, it was carried out the allocation of two tranches of 400 m² and adjacent to these areas also allocated to two installments in the same proportions, ie, areas that had not received the Penergetic® called controls.

In area 2, *E. urograndis* was 6.2 years old, that is, more advanced age, and there was already intensive thinning and there was a spacing between trees much higher than the other areas evaluated. Thus, it was necessary to allocate larger plots (484 m²) to obtain greater accuracy of the parameters evaluated in the dendrometric survey.

With this, it was possible to measure the height and diameter variables at the chest height (1.30 m from the ground), besides quantifying the number of trees and conducting qualitative assessments of the forest.

RESULTS AND DISCUSSIONS

The following are the values obtained from the forest inventory (Table 1). Among the values presented, the main index to be evaluated that indicates the productivity of the forest is Average Annual Increase (IMA). Thus, by analyzing the following table we can see the difference between the areas with Penergetic® application and the areas without Penergetic application®.

It can be seen that all areas with Penergetic® application had superior IMA results when compared to controls. This demonstrates that the application of Penergetic® between 5.3 and 6.2 years old for forests of E. urograndis, providing greater increases in volume. This result can also be observed by the mean values of diameter and height of the dendrometric survey.

In the area 1, in which *E. urograndis* was 5.9 years old, where Penergetic® was applied, the increase in height and diameter was 5.3% and 9.43% higher than the area without application, respectively. Consequently, the average annual increase in volume obtained was 37.4% higher with Penergetic® application, demonstrating gains in productivity and advantages in the positioning of this product. In the area 2 with *E. urograndis*, of 6.2 years of age, the average height and average diameter of the trees obtained were 8.45% and 14.96% higher than in the area without application of Penergetic®, respectively.

This area presented lower IMA than the other areas due to being an area that has already undergone an intensive thinning, however if only within this zone of management the IMA was 19.45% higher with the application of Penergetic®, ie, not applying Penergetic® has 23.6 m³ ha^{-1} year-1 and applying Penergetic® this value rises to 29.3 m³ ha^{-1} year-1.

In the area 3, with *E. urograndis* of 5.3 years, it was observed that the average height and the average diameter of the trees were 0.21% and 5.85% larger than the area without applying Penergetic®, respectively.

The IMA of this area was higher than those found in areas 1 and 2, and the incremental result was positive and the IMA showed 16.53% greater with the application of Penergetic®, ie, not applying Penergetic® has 62.31 m³ ha^{-1} year-1 and applying Penergetic® this value jumps to 74.65 m³ ha^{-1} year-1.

In area 4, with *E. urograndis* of 4.2 years of age it was possible to observe that the average height and the average diameter of the trees were 2.04% and 2.43% higher than in the zone without application, respectively.

However, even though it is a younger area than the others, there was no significant effect on the IMA of this area.

Table 1 - Specifications of results obtained in the dendrometric survey (Source: Unisafe Consulting, 2016).

AMOSTRA	ALTURA (m)	DIAMET. (cm)	NUM. ÁRV. (400 m²)	VOL. 10.000 m² (m³)	ÁREA AMOSTRADA (ha)	VOL. TOTAL (m³)	IDADE PLANTIO	IMA MÉDIO (m³/ha/ANO)	IMA REAL (m³/ha/ANO)
A1 (P1-PE)	27,04	16,21	54	376,80	1,92	771,90	5,90	63,87	68,00
A1 (P2-PE)	26,23	15,48	69	425,54				72,13	
A1 (P1-TE)	25,46	13,87	44	211,67	2,00	251,26	5,90	35,88	42,59
A1 (P2-TE)	24,96	14,83	54	290,85				49,30	

AMOSTRA	ALTURA	DIAMET. (cm)	NUM. ÁRV. (484 m²)	VOL. 10.000 m² (m³)	ÁREA AMOSTRADA (ha)	VOL. TOTAL (m³)	IDADE PLANTIO	IMA MÉDIO (m³/ha/ANO)	IMA REAL (m³/ha/ANO)
A2 (P1-PE)	28.18	21.16	21	214,89	2,46	447,73	6,20	34.66	29,30
A2 (P2-PE)	28,00	22,42	13	148,44				23,94	
A2 (P1-TE)	24,90	17,44	22	135,16	2,00	146,30	6,20	21,80	23,60
A2 (P2-TE)	26,53	19,62	19	157,44				25.39	

AMOSTRA	ALTURA (m)	DIAMET. (cm)	NUM. ÁRV. (400 m²)	VOL. 10.000 m² (m³)	ÁREA AMOSTRADA (ha)	VOL. TOTAL (m³)	IDADE PLANTIO	IMA MÉDIO (m³/ha/ANO)	IMA REAL (m³/ha/ANO)
A3 (P1-PE)	27,42	15.39	68	433,58	1,89	749,00	5,30	81.81	74,65
A3 (P2-PE)	26,05	17,07	48	357,72				67,49	
A3 (P1-TE)	27,69	15,03	59	362,47	2,00	330,25	5,30	68.39	62,31
A3 (P2-TE)	25,67	15,53	49	298,03				56,23	

AMOSTRA	ALTURA (m)	DIAMET. (cm)	NUM. ÁRV. (400 m²)	VOL. 10.000 m² (m³)	ÁREA AMOSTRADA (ha)	VOL. TOTAL (m³)	IDADE PLANTIO	IMA MÉDIO (m³/ha/ANO)	IMA REAL (m³/ha/ANO)
A4 (P1-PE)	22,54	16,20	43	249,68	1,65	354,10	4,20	59,45	51,12
A4 (P2-PE)	22,06	16,36	31	179,72				42,79	
A4 (P1-TE)	21,39	14,82	38	175,18	2,00	216,48	4,20	41,71	51,54
A4 (P2-TE)	22,30	16,95	41	257,78				61,38	

Whereas: A= area; P= plot; PE= Penergetic®; TE= control.

CONCLUSIONS

The experiments demonstrated differences between the areas with application of Penergetic® and the areas without application of Penergetic®.

The E. urograndis with 5.9 years, showed a percentage increase, on the average annual increase of 37.4% with Penergetic application®.

The E. urograndis with 6.2 years and intensive thinning, also showed an increase in productivity, with an IMA obtained 19.45% higher than the control area, (the product was not applied). The same can be said for the E. urograndis of 5.3 years, where it was obtained IMA of 62.31 m³ ha^{-1} year-1 without applying Penergetic®, and 74.65 m³ ha^{-1} year-1 applying Penergetic®, that is, 16.53% higher.

Performance of the Penergetic® technology in soybean production

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INTRODUCTION

The Penergetic® technology operates in soil and plant bioactivation with the potential to promote positive effects on plant vigor, increase optimization of supplied or existing nutrients in the soil as well as to improve the soil microbiota. With the use of Penergetic®, some authors found positive results in the reduction of inputs, indicating a better use of existing fertility, better release and utilization of nutrients to plants and existing natural resources, consequently the increase in crop productivity. In this sense, the purpose of the work was to evaluate the performance of Penergetic® Technology in soybean production in the crop of 2015/16.

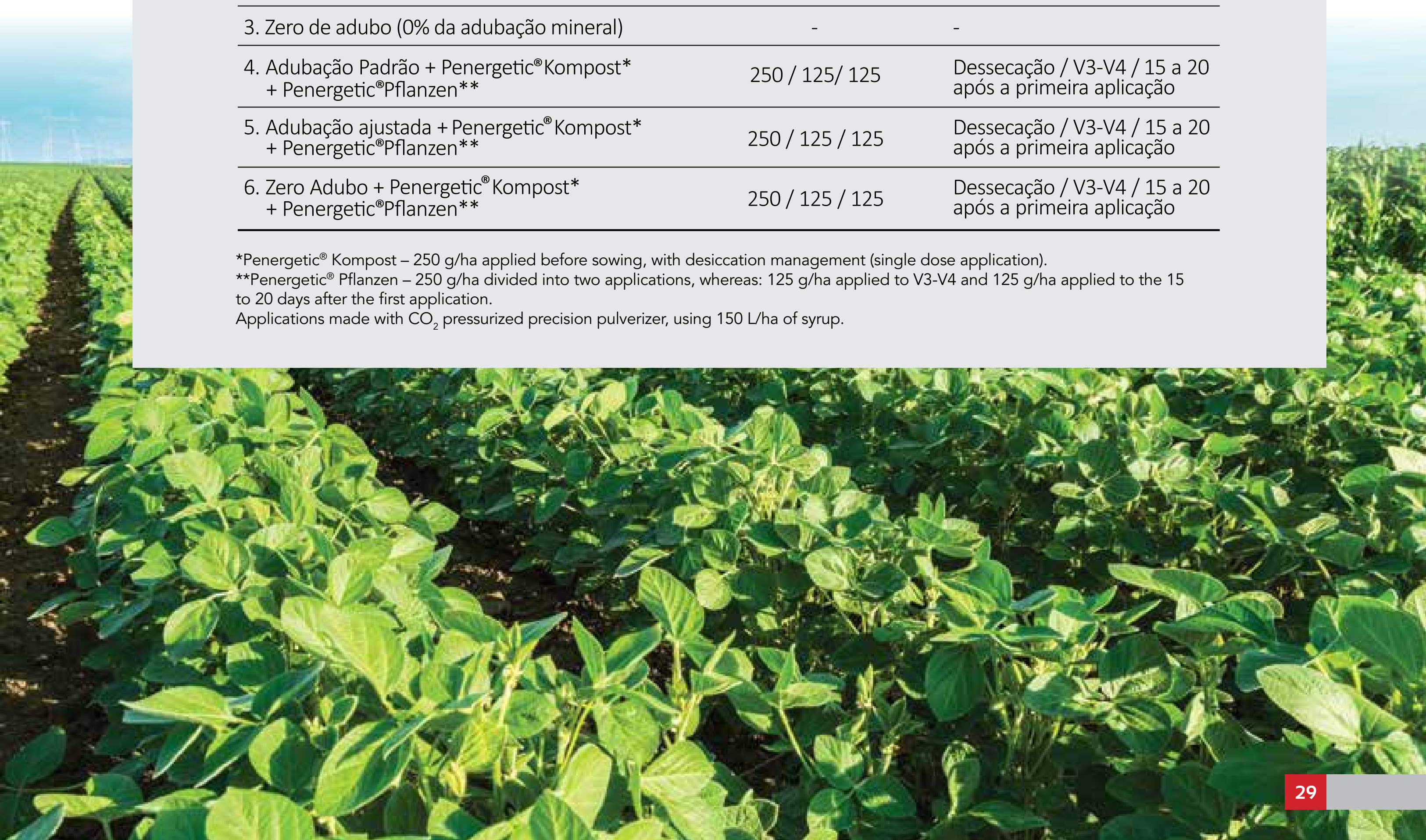
MATERIAL AND METHODS

For the performance of the test, the following treatments were evaluated:

Table 1. Description of the treatments used in the test (Rio Verde/GO, crop of 2015/16)

Tratamentos	Dose de PE (g/ha)	Épocas de Aplicação
1. Adubação Padrão (100% adubação mineral)	-	-
2. Adubação ajustada (50% da adubação mineral)	-	-
3. Zero de adubo (0% da adubação mineral)	-	-
4. Adubação Padrão + Penergetic® Kompost* + Penergetic® Pflanzen**	250 / 125/ 125	Dessecação / V3-V4 / 15 a 20 após a primeira aplicação
5. Adubação ajustada + Penergetic® Kompost* + Penergetic® Pflanzen**	250 / 125 / 125	Dessecação / V3-V4 / 15 a 20 após a primeira aplicação
6. Zero Adubo + Penergetic® Kompost* + Penergetic® Pflanzen**	250 / 125 / 125	Dessecação / V3-V4 / 15 a 20 após a primeira aplicação

*Penergetic® Kompost – 250 g/ha applied before sowing, with desiccation management (single dose application).
**Penergetic® Pflanzen – 250 g/ha divided into two applications, whereas: 125 g/ha applied to V3-V4 and 125 g/ha applied to the 15 to 20 days after the first application.
Applications made with CO_2 pressurized precision pulverizer, using 150 L/ha of syrup.



All cultural treatments were carried out according to the technical indication for the crop, and according to the schedule of the Farm, except for the fertilization that followed the treatments. To perform the test, it was used to cultivate soybean the Nidera 7000, in the commercial area of central pivot, the Fontes do Saber farm, belonging to the University of Rio Verde (UniRV). The evaluations were carried out in plots of 22.5m², representing 9 planting lines by 5 meters in length. For the harvest, 4 central lines were used for 4 meters in length, in a completely randomized design with four repetitions. In order to avoid influence among the treatments, a distance of 20 meters was used between the plots.

During the crop cycle, the following evaluations were carried out: soil analysis, performed before planting, at depths of 0-10cm, 10-20cm and 20-40cm; Root volume by water displacement in full flowering; Dry mass of the area and root in the R1 / R2 stage; average rate of chlorophyll in stage R1 / R2; Number of nodules at 30 days after emergence; average height of the plants in the stage R1 / R2 and at harvest and grain yield. The grain yield was adjusted to 13% moisture and calculated at sc/ha^{-1}. All data of the analyzed variables were submitted to analysis of variance and average test (Tukey to 5% of probability) to obtain the final results.

RESULTS AND DISCUSSION

The average height of plants in R1 / R2 was higher in plots that received the Penergetic technology®, with 72.62 cm. The height of plants in the plots without Penergetic® application were similar regardless of fertilization. The plots that did not receive mineral fertilization (0% fertilization) showed higher plant height, both in the general average and with the application of Penergetic®, with 79.05 cm (Table 2).

The plots fertilized with Penergetic® presented higher chlorophyll index, in relation to plots without Penergetic® (Table 2). Possibly, the higher the chlorophyll index, the higher the N and Mg content in the leaf.

The dry mass of the soybean root in R1 / R2 didn't show any difference between treatments and the application or not of Penergetic® (Table 2). Results similar to those obtained from the root volume (Table 2).

The dry mass of the aerial part of the plants at R1 / R2 days, after sowing was higher in the plots without application of Penergetic® and the fertilization that presented the highest dry mass of the aerial part was with 50% of the mineral fertilization (Table 2).

Table 2. Evaluation Parameters

Tratamentos	Altura das plantas (cm)			Índice de clorofila		
	Sem Penergetic®	Com Penegetic®	Média	Sem Penergetic®	Com Penegetic®	Média
100% Adubação	69,05	68,15 B	68,60 AB	43,2	44,42	43,81
50% Adubação	63,15	70,65 B	66,90 B	43,67	44,97	44,32
0% Adubação	64,25	79,05 A	71,65 A	43,02	45,1	44,06
Média	65,48 b	72,62 a	69,05	43,30 b	44,83 a	44,07
CV (%)	4,65			3,9		
Tratamentos	**Massa seca de raíz (g/planta)**			**Massa seca da parte aérea (g/planta)**		
	Sem Penergetic®	Com Penegetic®	Média	Sem Penergetic®	Com Penegetic®	Média
100% Adubação	16,4	14,4	15,3	23,2 B	23,46 B	23,4 B
50% Adubação	17,8	15,8	16,8	30,6 A	24,5 A	27,5 A
0% Adubação	14	14,1	14,2	23,9 B	19,7 AB	21,8 B
Média	16,1a	14,8a	15,5	25,9 a	22,6 b	24,2
CV (%)	13,85			10,07		
Tratamentos	**Volume de raíz (ml/planta)**			**Número de nódulos por planta**		
	Sem Penergetic®	Com Penegetic®	Média	Sem Penergetic®	Com Penegetic®	Média
100% Adubação	5,37	6,19	5,78	28,7 B	19,4	24,0 b
50% Adubação	7,25	6,5	6,87	26,8 B	21,9	24,3 b
0% Adubação	6,62	5,82	6,12	39,6 A	23,8	31,7 a
Média	6,42 a	6,1 a	6,26	31,7 a	21,7 b	26,7
CV (%)	21,34			13,21		

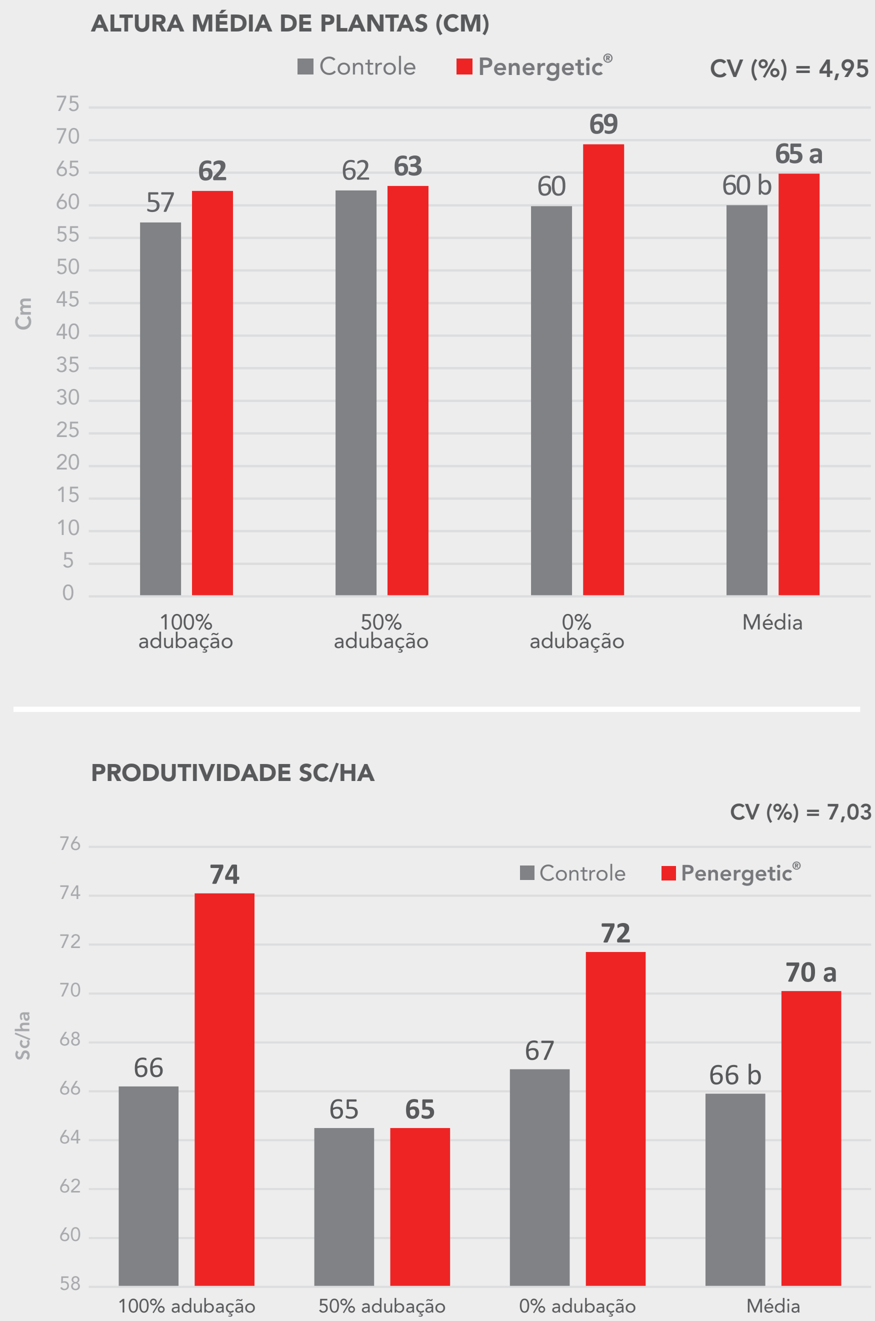
Averages followed by the same capital letter in the column and lowercase in the row do not differ statistically from each other to 5% by the Tukey test.

The number of nodes in the R1 / R2 stage was similar in all plots where there was application of Penergetic®. However, in plots that did not receive Penergetic®, the number of nodules was higher, and the soybean of the part that was not fertilized had the highest number of nodules per plant, 39.6 (Table 2).

The plant height at the harvest (116 days after sowing) was higher in plots that received the Penergetic technology®, with 64.85 cm. The height of plants in the plots without Penergetic® application were similar regardless of fertilization. Inferring that the Penergetic® interfered positively in the final height of plants (Figure 1). The plots that did not receive mineral fertilization (0% A.M.) presented higher plant height, regardless of whether they received Penergetic® or not (Figure 1). The height results of plants at the time of harvest were similar to the evaluation of the height of plants in R1 / R2 in the first evaluation of the test (Table 2).

The treatment with 100% of mineral fertilizer and Penergetic® presented the highest grain yield (74 sc/ha), 11% more in relation to the treatment that did not receive Penergetic® (66 sc/ha), as can be seen in Figure 1.

Figure 1. Height average of plants and productivity.



Averages followed by the same capital letter do not differ statistically from each other to 5% by the Tukey test.

CONCLUSION

The use of bioactivator of soils (Penergetic® Kompost) and plants (Penergetic® Pflanzen) in the soybean crop promoted greater homogeneity in the plant stand; largest population of plants per hectare; higher plant height; higher chlorophyll content and higher grain yield.

Evaluation of the agronomic efficiency of the use of Penergetic® in soybean crop. Tangará da Serra/MT

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INTRODUCTION

The soybean crop (Glycine max (L.) Merrill) is one of the most important for Brazilian agriculture, occupying an area of approximately 33 million hectares, with a production of over 95 million tons (CONAB, 2016). It is also one of the crops that receive the largest investments in terms of technology, in order to increase their productive potential. Among these technologies we can mention the genetic improvement of plants, products for the protection of plants against insects and diseases, precision agriculture, agricultural machinery and implements, etc. However, one of the factors that impede productivity increase in most crops and significantly affects the productive process in tropical soils is the phosphate fertilization. Phosphorus (P) is the most limiting nutrient of biomass productivity in tropical soils. Brazilian soils are deficient in P, as a consequence of the source material and the strong interaction of P with the ground, wherein less than 0.1% is found in solution (RAIJ, 2001).

The application of P in high doses in weathered soils is justified by the intense fixation of this element, causing low P content available, mainly in soils where there is a predominance of sesquioxides. This way, the adoption of management techniques or the use of products or technologies that make it possible to provide the fixed P becomes essential for agriculture in tropical regions to become more feasible both economically and environmentally. In view of the need to incorporate new technologies for nutrient utilization, the present work aimed to evaluate the agronomic efficiency of Penergetic® Kompost and Penergetic® Pflanzen combined with different doses of phosphorus in soybean.

MATERIALS AND METHOD:

The research was conducted in the crop of 2015/16 in the area of Experimental Station ASSOBASE, Located along the highway MT 480 KM 15 (toward Deciolândia). The geographical location of this area is defined by the following coordinates: latitude 14°33'47"S, longitude 57°32'18" W and altitude of 314 meters.

The sowing was carried out on December 11, 2015, with the help of the fertilizer seeder of 5 lines, of the Jumil brand, with a vacuum system of distribution of seeds. 17 Seeds were arranged in the sowing line by linear meter at an average depth of 4 cm in spaced rows 0.45 m.

The soil of the experimental site is classified as Red-Eutrophic Latosoil, with slightly undulating relief and with good drainage. The area has been cultivated in recent years with soybean-corn succession, with soybean being grown in the main crop (October-January) and maize in the second crop (February-June).

Soil sampling was performed, for the chemical and physical characterization of the area where the experiment was conducted. The samples were analyzed in the laboratory Plante Certo, with head office in the city of Várzea Grande - MT.

TREATMENTS USED IN THE EXPERIMENT:

1. 0 kg/ha of P_2O_5
2. Recommended fertilization of 45 kg/ha of P_2O_5
3. Standard fertilizer of the producer of 100 kg/ha of P_2O_5
4. 0 kg/ha of P_2O_5 + Penergetic®
5. Recommended fertilization of 45 kg/ha of P_2O_5 + Penergetic®
6. Standard fertilizer of the producer of 100 kg/ha of P_2O_5 + Penergetic®

The Penergetic® Kompost was applied at the dosage of 250g/ha before the soybeans planting. Both applications of the Penergetic® Pflanzen occurred in V3-V4 and R1, with a dosage of 125 g/ha in each application.

Table 1. Chemical characterization of Soil of the experimental area ASSOBASE, before the implementation of the experiment, Tangará da Serra/MT.

pH	P	K	Ca	Mg	H	Al	H+Al	SB	CTC	M.O	V
H2O	--mg/dm^{-3}--		----------------------cmolc/dm^3----------------------							(g/kg)	%
5,6	2,2	114	1,99	0,77	4,03	0,00	4,03	3,45	9,3	19,0	55

The seeds used in the experiment received industrial treatment with the Avicta Completo set of products, which is the union of the Avicta 500 FS, Cruiser 350 FS and Maxin Advanced 195 FS. In addition to the industrial treatment, the seeds were inoculated with the Optimize Power product, in the dose of 300 ml p.c. / 100 kg of seeds moments before sowing.

The control of weeds and pests in the crop were carried out as needed. The weeds and pests control in the crop were carried out as needed.

Table 2. Application of pesticides during the period of tests.

Data	Produto	Dose (kg ha^{-1} ou L ha^{-1})	Classe
11/01/2016	Zapp QI 620	1,80	Herbicida
11/01/2016	Glytrel	1,00	Nutriente foliar
10/01/2016	Mustang	0,20	Inseticida
20/01/2016	Mancozin	1,00	Nutriente foliar
20/01/2016	Fox	0,40	Fungicida
20/01/2016	Aureo	0,30	Adjuvante
28/01/2016	Prêmio	0,05	Inseticida
07/02/2016	Fox	0,40	Fungicida
07/02/2016	Aureo	0,30	Adjuvante
07/02/2016	Mustang	0,20	Inseticida
07/02/2016	Bazuka	1,00	Inseticida

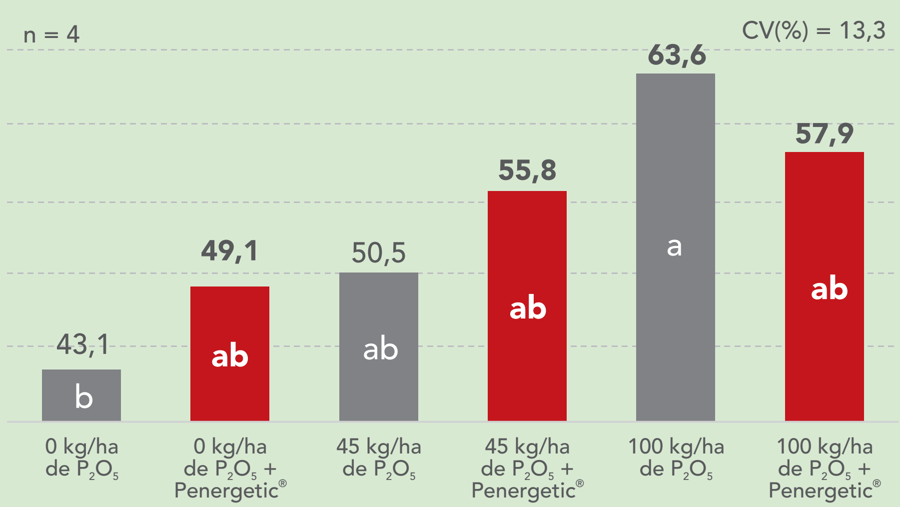
The material was harvested on March 17, 2016. Plants within the floor area of each plot were harvested (4 lines x 2 m), each plot was identified and threshed in a stationary threshing, the grains were weighed and the data transformed into sacks of 60.0 kg/ha^{-1}, with moisture corrected for 13.0%.

RESULTS AND DISCUSSION:

Statistical analyzes and multiple comparisons of productivity averages showed significant statistically differences, only for standard mineral fertilization compared to the control treatment (without Penergetic®).

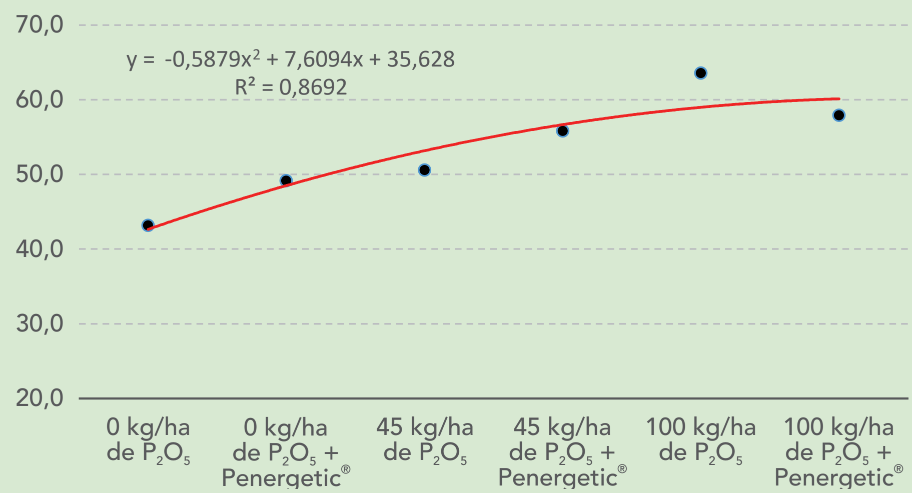
Graphic 1. Soil productivity in the mineral fertilization and Penergetic® interaction in the experimental field of Assobase at Tangará da Serra/MT.

Averages followed by the same letter do not differ from each other by the Tukey test at 5% probability.



All treatments showed an increase in productivity, when applied with Penergetic®, except for the treatment with 100% phosphate fertilization. This may be associated with the luxury consumption that the plants perform when the supply of nutrients exceeds the physiological and metabolic needs of the crop. According to MALAVOLTA (1996), initially the plants tend to increase the nutrient content in the tissues, until reaching the critical level, from that there is no more economic response in the production of dry mass. The increase in nutrient accumulation is proportional to the accumulation of dry matter; thereafter, there is an increase in the nutrient absorption rate.

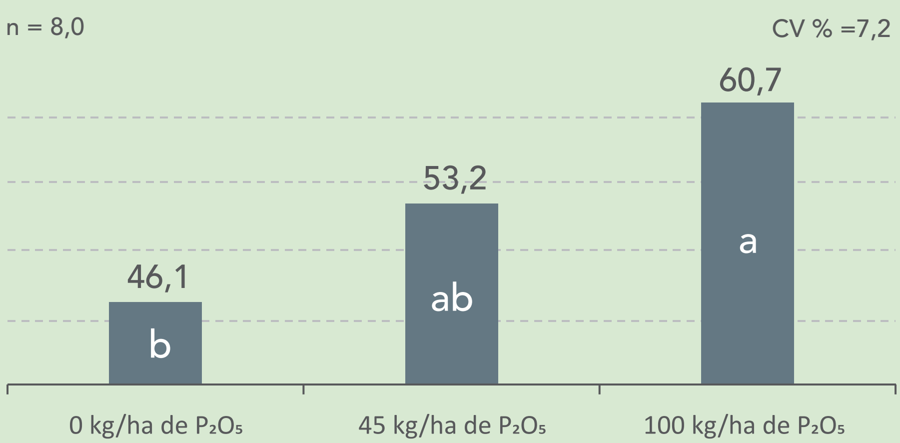
Graphic 2. Quadratic model for soybean yield in mineral fertilization and the use of Penergetic®.



Graphic 2 shows how the production levels obtained for each treatment achieve the best fit to the quadratic model when the coefficient of determination (R2) shows that the increments in grain production are represented by 87% of the cases that were related among the assessed variables. These results allow to assure that the phosphate fertilizer associated to the use of the Penergetic® technology, provides an increase of grain production.

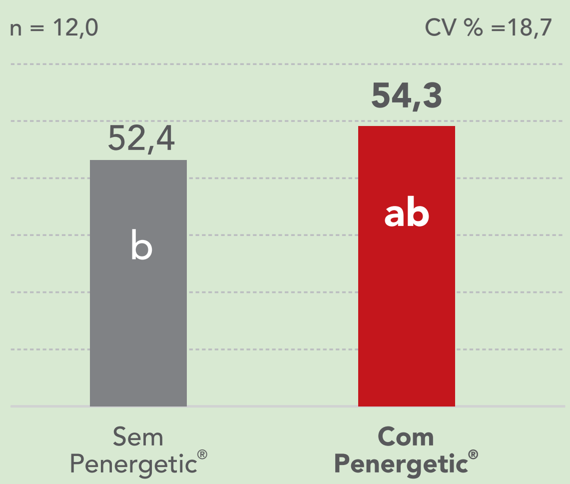
Graphic 3. Isolated effect of levels of phosphate fertilization under soybean productivity (sc / ha) in the experimental field of the Assobase Consultoria.

Averages followed by the same letter do not differ from each other by the Tukey test at 5% probability.



The effect of increasing doses of mineral fertilizer was analyzed by anova and post-hoc tests, showing highly significant statistical differences, with emphasis on the standard fertilization (100 kg/ha of phosphorus) that reached 60.7 sc/ha of soybean, followed by the indicated fertilization (45 kg/ha of phosphorus) with 53.2 sc/ha (Graphic 3).

Graphic 4. Effect of Penergetic® applications in the soybean yield



Averages followed by the same letter do not differ from each other by the Tukey test at 5% probability.

Although it didn't show significant differences (graphic 4), when the treatments with and without Penergetic® were compared for n = 12 observations, the plots that received applications of Penergetic® showed an average increase of 1.9 sacks/ha, which corroborates the direct influence of technology on productivity.

Similar results were published by COBUCCI et al, (2016), concluding that Penergetic® applications independent of the combination with the phosphorus doses, provided higher values of grain yield of the bean in relation to the treatments without the bioactivator. It turns out that when Penergetic® was applied, the agronomic efficiency in the management of phosphorus was much higher than the absence of application of Penergetic® Technology, being the efficiency and cost-benefit much higher in the adjusted doses of phosphorus.

Considering the results exposed so far, it can be inferred that the application of the Penergetic® Technology provided a higher productivity of grains, with less amount of applied phosphorus. The results indicate that there is a greater availability of phosphorus to the plants, when combining Penergetic® spraying with low P levels in the soil, a situation that can occur, if the organic and mineral phosphorus are bio-available, by the action of microorganisms specialized in solubilization and mineralization of the element.

It is important to note that tests are currently conducted in testal plots and production fields, in order to confirm the hypotheses previously exposed, since the Mato Grosso grain producers report positive increases in soybean and cotton productivity, when incorporating the principles of bioactivation in their commercial crops.

CONCLUSIONS:

The applications of Penergetic® in interaction with indicated and zero fertilization provided productivity increases in soybean of 5.3 and 6.0 sc/ha, respectively.

It was verified the effect of luxury consumption of the nutrient by the plant, when high doses of phosphorus were applied followed by the Penergetic® spraying.

Student's T test did not present statistical differences, when comparing the treatments with and without Penergetic, however, the plots that received Penergetic® applications provided mean increments of 1.9 sacks/ha.

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penergetic

Mycorrhization of corn in **bioactivated soils**

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INTRODUCTION

Brazilian soils have low natural availability of phosphorus due, mainly, to the high retention capacity of this nutrient. In this sense, it is becoming increasingly necessary to understand the microbial symbioses with the cultivated plants, aiming at the bioavailability of nutrients via fungal and/or bacterial activity.

Among the biological interrelations established in the soil ecosystem, the symbioses between plants and heterotrophic microorganisms, such as the case of mycorrhiza, stand out due to the benefits provided to plant production. According to BRADY and WEIL (2002), mycorrhiza are considered the symbiosis of greater ecological and economic expression between soil fungi and roots of vascular plants.

In the last decades, the interest in the use of mycorrhizal fungi inoculated of agricultural interest has intensified, due to the benefits that these provide to the plants, making possible the establishment of crops in soils that have sub optimal conditions of availability of water, nutrients or even in with presence of pollutants. Arbuscular mycorrhiza and the ectomycorrhizas promote a significant increase in the area of root absorption of colonized plants, maximizing the use of water and nutrients, such as phosphorus, nitrogen and potassium and some non-fungistatic micronutrients (SMITH and READ, 2008).

In the mutualistic relationship established between the roots of the plant and the fungus, a micotrophy occurs, where the fungus provides the plant with a greater area of water and mineral nutrients absorption due to the extension of its hyphae in the soil, and in contrast, the plant releases in the form of root exudates, some photosynthates, organic compounds and amino acids, benefiting the mycelial development (ZEPPA et al., 2005).

According to DUPONNOIS et al. (2008), in the mycorrhizosphere, a term used to describe the region where the associations between fungi and the root system of plants occur, several processes occur that influence not only the fungus-plant interaction but also the nutritional balance and the stabilization of microbial ecosystems.

In addition to the benefits that mycorrhizal fungi provide to the plants, which have been described previously, when in symbiosis with the vegetable, fungi produce phytormons (Indole acetic acid - AIA, and some compounds derived from auxins) in response to the production of phenolic compounds released by the roots of the plant at the time of colonization. These are excreted in the mycorrhizosphere, becoming bioavailable to plants and have an important indirect effect on plant growth (SMITH and READ, 2008).

In recent years, knowledge about the symbiosis between mycorrhizal fungi and grain crops has encouraged the management of biological soil fertility, resulting in increases in quality and productivity, with the possibility of adjusting the dosage of phosphate fertilizer to be added to the crop.

PURPOSE

The present work had the objective of evaluating the efficiency of the bioactivation, in the increment of mycorrhizal symbiosis, in the corn crop under field conditions.

METHODOLOGY

The tests were carried out in four cultivated areas in the state of Rio Grande do Sul. We evaluated the percentage of mycorrhizal colonization and the number of mycorrhizal vesicles in treatments: 1) Fertilization according to the recommendation for the crop (Control); 2) Reduction of phosphate fertilization, based on the results of soil chemical analysis, and; 3) without the use of phosphate fertilization. The three treatments were carried out with and without the application of the soil and plant bioactivator (Penergetic® Technology), a total of six treatments with four repetitions. The planting of the crop followed the climatic zoning for the study regions, and the phytosanitary management was carried out according to the technical recommendations.

The Penergetic® Kompost was applied in the pre sowing, with a dosage of 250g per hectare, and the Penergetic® Pflanzen was applied in two seasons, 125g per hectare in V3 (third sheet) and 125g per hectare 20 days after the first application. During the flowering of corn, the plants were collected to evaluate the percentage of mycorrhizal colonization and number of mycorrhizal vesicles by grass root. At the end of the cycle, the crop yield was evaluated in relation to the treatments. The data were submitted to analysis of variance and the averages were compared by the Tukey test ($p<0,05$).

RESULTS

The application of Penergetic® Technology resulted in an increase in the percentage of mycorrhization of the corn roots. The adjustment of fertilization, the exclusion of phosphorus fertilization and standard fertilization resulted in an increase of 26, 23 and 28% of mycorrhization, respectively, compared to the control treatment without bioactivation.

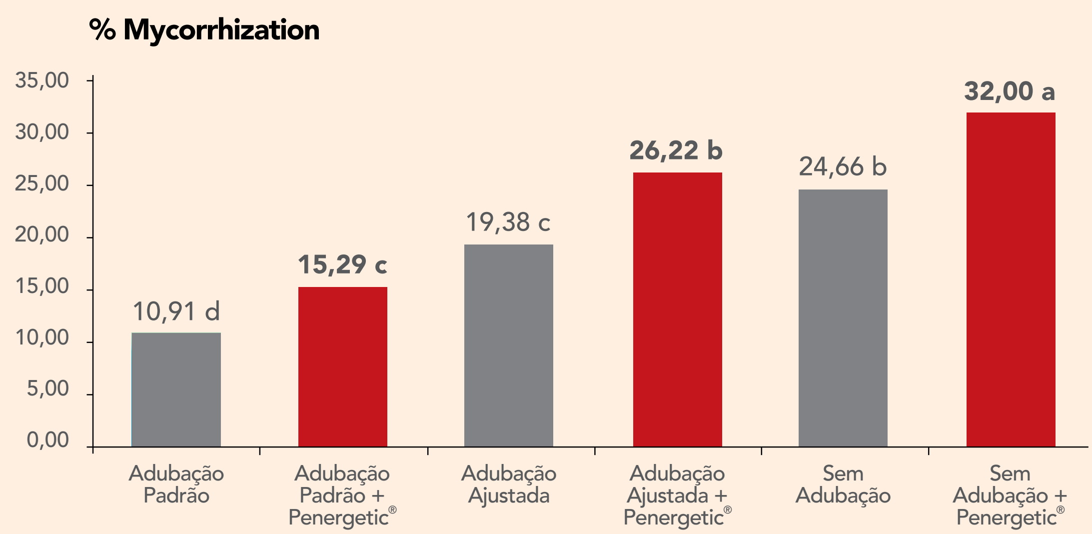
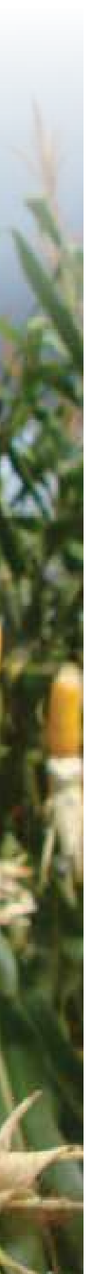


Figure 1. Percentage of mycorrhizal colonization.

Averages followed by the same letter do not differ among themselves, by the Tukey test at a 5% probability.



CONCLUSION

The Penergetic® bioactivator proved to be efficient in increasing the mycorrhizal symbiosis in corn.

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Influence of soil bioactivation on microbial activity of the soybean

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INTRODUCTION

The microbial biomass plays a fundamental role in the plant production, acting directly in the biogeochemical cycles of the elements, in the degradation of the organic material and, consequently, in the maintenance of the bioavailability of nutrients, establishing symbiotic interactions that are beneficial to crop productivity. In the case of soybean, it is estimated that up to 94% of the nitrogen required by the most productive cultivars is supplied via biological fixation. Microbiological parameters analysis in cultivated soils are increasingly important, in order to understand and preserve microbial communities and symbioses of agronomic interest. Among these parameters, the basal respiration represents an indicator that is sensitive to changes in the microbial community, caused by management and / or products applied in the soil ecosystem.

PURPOSE

The objective of this work was to evaluate the effect of Penergetic® technology, as a soil and plant bioactivator in soybean crops.

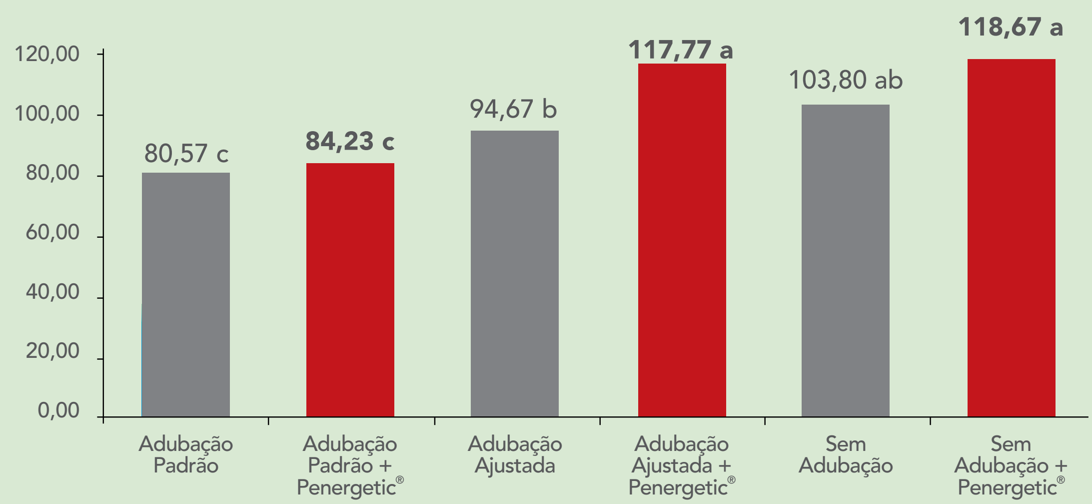
METHODOLOGY

To prove the effects, field tests were carried out in four areas of cultivation, in the state of Rio Grande do Sul, evaluating the basal respiration and nodulation of soybean roots in treatments: 1) Fertilization according to the recommendation for the crop (Control); 2) Adjustment of phosphate fertilization, based on the results of soil chemical analysis, and; 3) Without the use of phosphate fertilization. The three treatments were carried out with and without the application of the soil and plant bioactivator (Penergetic® Technology), a total of six treatments with four repetitions. There was no supply of nitrogen during the crop cycle. In the soybean flowering stage, the soil and root system of the plants were collected to evaluate the basal respiration. At the end of the crop cycle, the productivity in each treatment was evaluated. The data were submitted to analysis of variance and the averages were compared by the Tukey test ($p<0{,}05$).

RESULTS

The basal respiration showed a direct relationship with both the rationalization of fertilization and the use of the Penergetic® technology. Soil bioactivation increased the flow of CO_2, going from 80.7 mg of C-CO_2 per kg of dry soil per day in the control treatment, to 117.7 and 118.6 mg of C-CO_2 per kg of dry soil per day in the treatments where the application of Penergetic®, together with the practice of adjusting the fertilizer dosage and withdrawal of the fertilization, respectively.

Figure 1. **RESPIRAÇÃO BASAL** (mg de C-CO_2/por kg de solo seco por dia)



Averages followed by the same letter do not differ from each other by the Tukey test at 5% probability.

CONCLUSION

The Penergetic® technology proved to be an efficient tool for microbial activation, in favor of symbiosis with nitrogen-fixing bacteria in soybean crops.

Effect of Penergetic® Technology on soybean crop management

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INTRODUCTION

Soybean is considered one of the ten most economically important crops in the world, being one of the main sources of protein concentrates and vegetable oil (DÍAZ et al., 1992). The first records of world production in the soybean crop come from the United States, leading the world market. In Brazil, for the 2015/2016 crops, soybeans occupied an area of approximately 33 million hectares, with a total production of approximately 95 million tons. At the national level, the major soybean producing states are Mato Grosso, Paraná and Rio Grande do Sul (CONAB, 2016).

Due to the great relevance of the crop, increasing the productivity is increasingly sought. Therefore, the balanced nutritional management is fundamental so that the crop can express its maximum productive potential. Most Brazilian soils where soybeans are grown have nutrient deficiencies or imbalances between them (SFREDO, 2007).

However, the increasing expansion of the agricultural activity has led to questions about the quality of the soil management systems in use (SALTON et al., 2008). Therefore, if the soil represents a basic component to the agricultural activity, the conservation of its agronomic quality is essential for the maintenance of the long-term production.

Soybean is a very demanding crop in all essential macro nutrients. In order for nutrients to be efficiently used by the crop, they must be present in the soil in sufficient quantities and in balanced relationships. Insufficiency or imbalance between nutrients can result in poor absorption of some and excessive intake of other (SFREDO, 2008).

Phosphorus is very important for the development of soybean crops, being responsible for significant responses in the grain yield. But the use of potassium, according SFREDO (2008), besides favoring the functioning of several enzymes, can dramatically reduce the percentage of incidence of fungal and bacterial diseases, when combined with climatic factors, harvest management, among others. For this reason, the deficiency of this nutrient may cause a decrease in the photosynthetic rate, increasing the respiration rate of the plant.

Faced with the need to incorporate new technologies for nutrient utilization, this study aimed to evaluate the effect of Penergetic® Kompost and ® Pflanzen on the establishment, development and productivity of soybean crop.

MATERIAL AND METHODS

The trial was conducted in the crop of 2015/16 in the research station of PA Consultoria Agronômica, Research & Precision Agriculture, based in Fazenda São Paulo, district of Deciolândia, in the city of Diamantino, MT, whose geographical coordinates are: latitude 14°03'59,9" S, longitude 57°17'13,1" W and altitude of 592 meters.

Seeding was carried out on 11/19/2015 And the cultivar used was M 8372 IPRO. The experiment was carried out in clay soil (60% clay) with high natural fertility. In the treatment of seeds, it was used the Pyraclostrobin (2.5%) + Thiophanate Methyl (22.5%) + Fipronil (71.3%) of trade name Standak TOP + Co (0.6%) + Mo (6%) + Amino acids (13%) by trade name EXION DA.

For the control of weeds, the mixtures of Diclosulan + S-Metolachlor (30 g ha^{-1} + 1.0 L ha^{-1}), of trade name DUAL GOLD + SPIDER and a post-emergence application of glyphosate + mineral oil (3.0 L ha^{-1} + 0.5 L ha^{-1}) of trade name ZAP QI + NIMBUS.

Three applications of fungicides were carried out, as follows: Trifloxtrobina + Protconazole, of trade name FOX, Benzovindiflupir + Azoxtrobina of trade name ELATUS and Trifloxtrobina + Protconazole.

For the control of caterpillars, bedbugs, and other pests, insecticide applications were performed, when the area reached the level of economic damage.

Some environmental factors capable of influencing the quality of the applications were monitored, and data collected using the portable Anemometer (VA 8021) are shown in Table 1.

penergetic

Table 1. Dates, Relative Air Humidity (U.R.), Temperatures (T.), Application time and Wind speed (V.V.) in the application of Penergetic® treatments in different phenological stages. Diamantino/MT, 2016.

Aplicações	U.R. (%)	T. (°C)	Horário de Aplicação	V.V. (Km h-¹)*
1ª - 19/11/15	72,30	28,8	9h - 10h	2,4
2ª - 12/12/15	64,70	29,2	10h - 11h	2,1
3ª - 28/12/15	67,30	31,5	10h - 11h	2,8

Six treatments were used to evaluate the effect of Penergetic® Kompost and Penergetic® Pflanzen in the establishment and development of soybean crops (Table 2).

Table 2. Different fertilizer managements used in the soybean crop, conducted at the Estação Experimental PA Consultoria Agronômica, Pesquisa & Agricultura de Precisão. Diamantino/MT, 2016.

N° Tratamentos	Doses (gha-¹) Penergetic®	Época de Aplicação Penergetic®
1. Adubação Padrão* + Penergetic® Kompost + Penergetic® Pflanzen + Penergetic® Pflanzen	250 + 125 + 125	Dessecação / V3-V4 15 a 20 após a primeira aplicação
2. Adubação Padrão*	-	-
3. Adubação Indicada** + Penergetic® Kompost + Penergetic® Pflanzen + Penergetic® Pflanzen	250 + 125 + 125	Dessecação / V3-V4 15 a 20 após a primeira aplicação
4. Adubação Indicada**	-	-
5. 0 kg P_2O_5 + Penergetic® Kompost + Penergetic® Pflanzen + Penergetic® Pflanzen	250 + 125 + 125	Dessecação / V3-V4 15 a 20 após a primeira aplicação
6. 0 kg P_2O_5	-	-

**Standard fertilization: Formula 02-28-00, in the dosage of 262 kg ha^{-1}*
***Indicated fertilization: Formula 02-28-00, in the dosage of 110 kg ha^{-1}).*
Potassium fertilization of 150 kg ha^{-1} of Potassium Chloride was used in all treatments.

The experimental design adopted was the factorial for three amounts of phosphate fertilizer with and without applications of the Penergetic technology, six treatments were distributed in five repetitions. The plots contained 4 rows of 3 meters each. Corrected productivity for 13% of moisture.

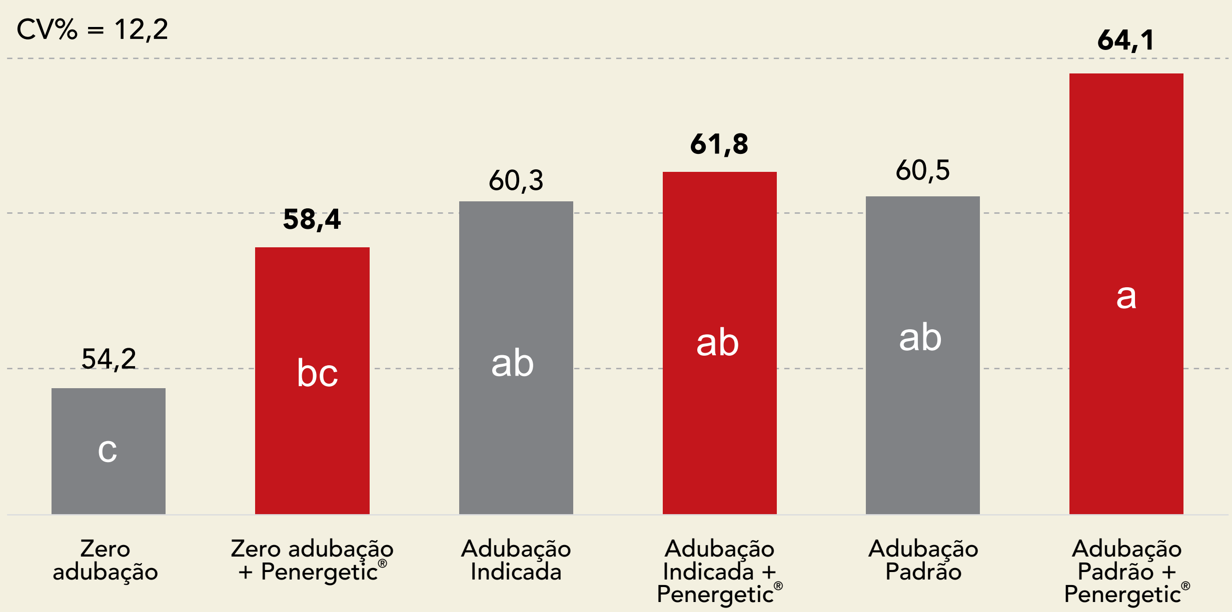
The obtained data were submitted to analysis of the variance and the averages compared by the Tukey test, at 5% of significance, using the SISVAR software (FERREIRA, 2000).

RESULTS AND DISCUSSION:

In the agricultural year 2015/2016 climatic factors were instrumental in that there were unforeseen in the crops of the Mato Grosso state. The high temperatures, rainfall delays, along with the water stress periods (Indian Summer), made it difficult to follow the orientations of the sowing season, which had a direct impact on the average yield of soybean crops. This also reflected the average low productivity of the present test.

Under these test conditions, the applications of Penergetic provided higher productivity results, when compared to treatments in which they were not applied.

Graphic 1. Productivity (sc/ha) of soybean in the test field of PA Consultoria 2016, Diamantino/MT.



Averages followed by the same letter do not differ from each other by the Tukey test at 5% probability.

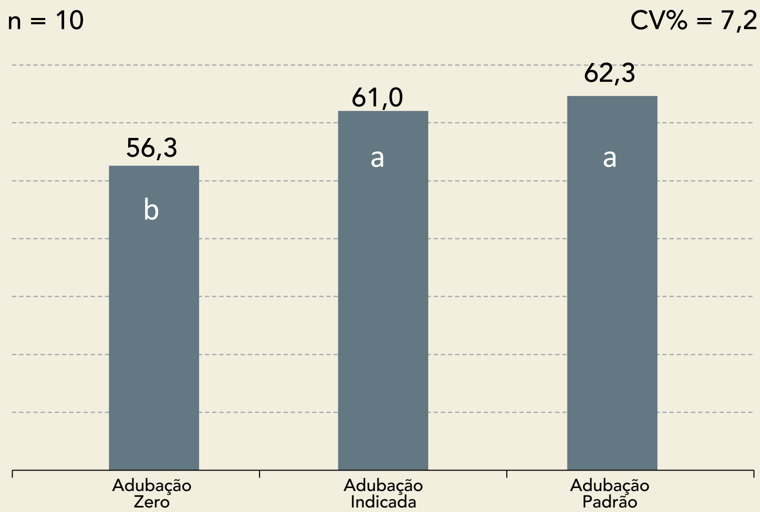
According to the graphic 1, the increase of productivity in the three levels of phosphate fertilization was verified, when using the Penergetic® Technology. It is worth mentioning that the highest grain yield achieved corresponded to the standard fertilization of the producer and the indicated fertilization, both combined with the spraying of Penergetic® Technology. Regardless of the level of fertilization used, there was an increase in productivity due to the Penergetic® Technology. The increase in productivity due to the use of Penergetic® Technology ranged from 1.5 to 4.2 sacks/ha.

There was a statistically significant difference for standard fertilization with Penergetic® when compared to zero fertilization, with and without Penergetic®. The data presented in the graphic 1, show a tendency of increases of productivity, in response to a possible relation between the quantities of phosphate fertilizers and the applications of Penergetic®. However, this effect cannot be analyzed from the data recorded during the performance of the experiment, due to the complex relationships that occur with phosphorus in the soil solution, from the fertilization that, depending on the soil buffering power, may have equilibrium with the immobilized P--inorganic in the clay-humus, and the P-organic contained in the organic matter and the soil biota.

There was a statistically significant difference, with emphasis on standard fertilization (73 Kg/ha of P_2O_5) which reached 64.1 sacks/ha of soybeans, followed by the indicated fertilization (31,0 Kg/ha of P_2O_5) with 61.8 sacks/ha (Graphic 1).

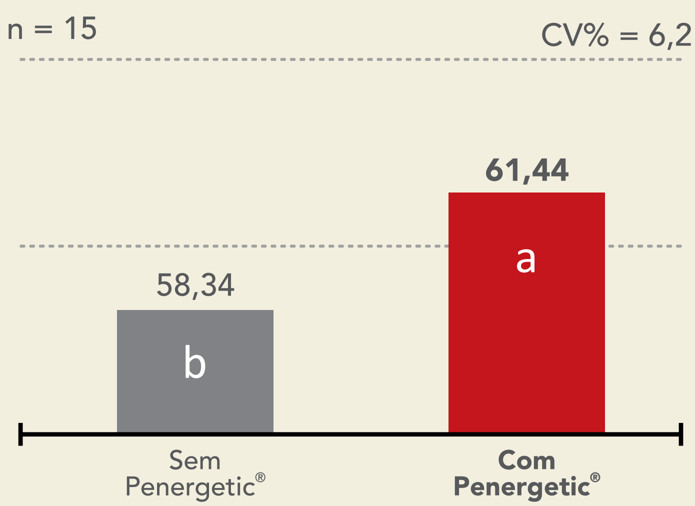
The results show that the productivity increases were higher, when the phosphate fertilizers were applied, which corroborates the need of the plant for the nutrient, however, the production levels obtained in the indicated and standard fertilizations were similar, this fact may be associated to the low levels of phosphorus available in the soil, which at times may be lower than the critical level required for the crop (Graphic 2).

Graphic 2. Effect of phosphate fertilization levels on soybean yield at the experimental station of PA Consultoria.



Averages followed by the same letter do not differ from each other by the Tukey test at 5% probability.

Graphic 3. Effect of Penergetic® applications in the soybean yield in the experimental station of PA Consultoria.



Averages followed by the same letter do not differ from each other by the Tukey test at 5% probability.

There was a statistically significant difference, when compared with treatments with and without the Penergetic® Technology (graphic 3). The average of the plots that received applications of Penergetic®, presented average increments of productivity of 3.1 sc/ha.

The results obtained in this study coincide with the data published by BRITO et al. (2012) also verified that the application of Penergetic® provided significant increases in grain yield of common bean, when compared to the control treatment (without the use of Penergetic®). According to the authors, the Penergetic® technology provides better conditions for the development of plants, mainly due to the better absorption of nutrients such as phosphorus.

CONCLUSION:

The use of the Penergetic® technology associated with the Standard fertilization, indicated fertilization and zero fertilizer provided productivity increases in soybean of 4.1; 1.5 and 4.2 sc/ha, respectively.

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Penergetic® Kompost as a Bioactivator of Growth of microorganisms under in vitro conditions

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Cléber Witt Saldanha - Forestry Engineer, PhD in Physiology

INTRODUCTION

When the soil is in balance, it is inhabited by several microorganisms that influence its fertility (STAMFORD et al., 2005) for providing diverse chemical, physical and biological transformations, beneficial to the sustainability of agriculture (SOTTERO, 2003). Among the naturally occurring microorganisms, in the most diverse types of soil, are the fungi of the genus Trichoderma sp., which are considered as biostimulators of root growth, furthermore, facilitate the solubilization and absorption of nutrients by plants (HARMAN, 2000; HARMAN et al., 2004). According to Delgado et al. (2010), some species of this genus also have the potential to provide nutrients in the rhizosphere, to the point of reducing the need for fertilization in crops. The GL culture medium was developed to identify microorganisms capable of increasing the phosphorus arrangement to the plants, through the mineralization and solubilization processes of this element.

PURPOSE

The objective of this test was to evaluate the effect of the addition of Penergetic® Kompost on the development of three isolates of Trichoderma sp. in GL culture medium containing an insoluble form of phosphorus (inorganic phosphate precipitate).

METHODOLOGY

Mycelial discs (9 mm diameter) of three isolates of Trichoderma sp. grown in PDA culture medium (potato dextrose agar) for 15 days were transferred to the center of Petri dishes (90mm diameter), on GL culture medium, containing inorganic phosphate precipitate, with or without addition of Penergetic® Kompost. This culture medium is used to select phosphorus solubilizing microorganisms, as it consists of an insoluble form of phosphorus, phosphate-tricalcium ($CaHPO_4$) (BRADLEY-SYLVESTER et al., 1982). The treatments evaluated were: GL medium containing $CaHPO_4$ with and without addition of Penergetic® Kompost (2,08g.L^{-1}). Three fungal isolates of the genus Trichoderma were identified, identified as: 04, 21 and 30. None of these isolates showed phosphate solubilization capacity, according to previously performed tests. After autoclaving the GL medium were added 50 mL of K_2HPO_4 (10%) and 100 mL of $CaCl_2$ (10%). Thus, there is the formation of an inorganic phosphate precipitate ($CaHPO_4$). The constituents of each solution are reported in the **table 1.**

Table 1. Solutions used for the preparation of GL medium containing $CaHPO_4$ (BRADLEY-SYLVESTER et al., 1982).

Solução	Reagente	Qtde. (g)	Volume total da solução
Meio GL	Glicose	10	850 mL
	Extrato de levedura	2	
	Ágar	15	
Solução 1	K_2HPO_4	5	50 mL
Solução 2	$CaCl_2$	10	100 mL

After the homogenization of the three constituent solutions of GL medium, containing $CaHPO_4$, the Penergetic® Kompost was added to the culture medium in a completely aseptic environment. The experimental units were randomly distributed within the climate chamber (temperature of 25±2 °C and 12-hour photoperiod). After 72 and 120 hours of incubation, the plates were analyzed for growth of fungal isolates.

RESULTS

Significant visual differences were observed in relation to the growth of the three fungal isolates grown in culture medium with Penergetic® Kompost, compared to those that grew without the presence of the product. **After a period of 72 hours incubation, the isolates n°. 4 and 21 showed noticeably higher growth rate when grown in culture medium with Penergetic® Kompost addition (Figure 1).**

With Penergetic®

Without Penergetic®

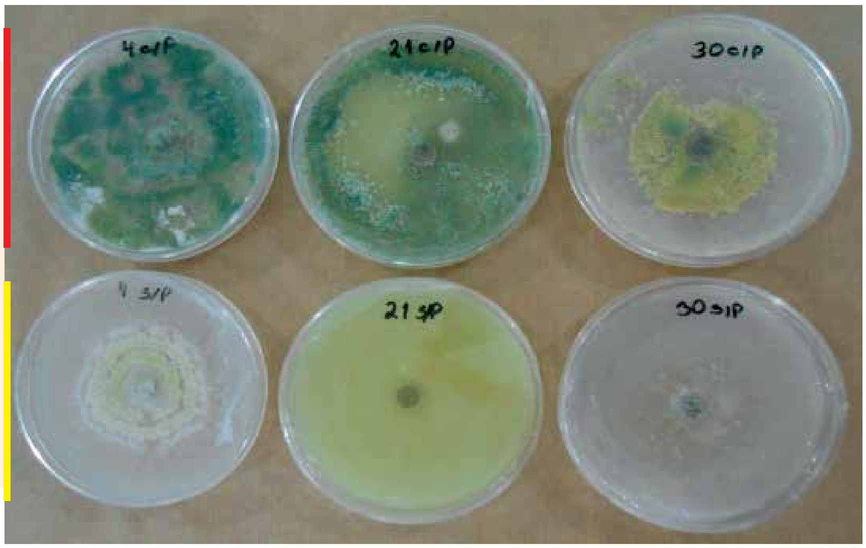
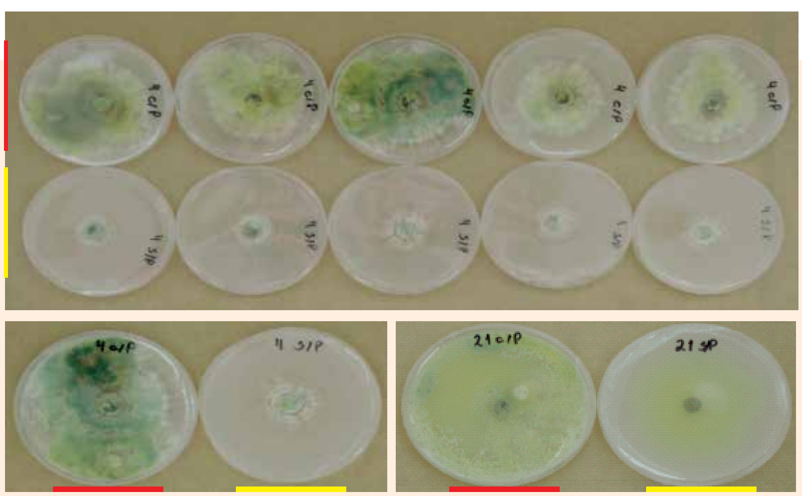


Figure 1. In vitro growth of the fungal isolates of Trichoderma sp. (isolates n° 4 and 21) in GL culture medium containing $CaHPO_4$ with and without addition of Penergetic® Kompost, after a period of 72 hours incubation.

From 120 hours of incubation, it was observed that the no. 30 isolate also showed differences in relation to growth and sporulation due to the addition of Penergetic® Kompost to the culture medium **(Figure2)**.

With Penergetic®

Without Penergetic®



With Penergetic® Without Penergetic® **With Penergetic®** Without Penergetic®

Figure 2. In vitro growth of three fungal isolates of Trichoderma sp. (isolates n° 4, 21 and 30) in GL culture medium containing $CaHPO_4$ with and without addition of Penergetic® Kompost, after a period of 120 hours incubation.

In this way, analyzing the growth pattern of the Trichoderma sp. isolates from 72 hours of incubation, It was observed that both mycelial growth and sporulation of the isolates grown in culture medium enriched with Penergetic® Kompost were significantly higher than the growth and sporulation of the isolates grown in the absence of the product (Figures 1 and 2). It is also noted that increases in growth and sporulation of the isolates grown in medium with Penergetic® Kompost were maintained over time, because even after 120 hours of incubation, the isolates grown in the absence of Penergetic® Kompost presented evidently lower growth and sporulation, probably due to the reduced supply of the nutrients essential for their development, being, in this case, the nutrient phosphorus.

CONCLUSION

The addition of Penergetic® Kompost to the GL culture medium containing phosphate-tricalcium favored the growth and sporulation of fungal isolates of the genus Trichoderma sp. under in vitro conditions.

Effects of the application of Penergetic® Pflanzen on leaf chlorophyll content in soybean and tomato plants

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Cléber Witt Saldanha - Forestry Engineer, PhD in Physiology

INTRODUCTION

The most studied parameter of the plant in order to indicate the level of nitrogen (N) on the leaf to predict the need for cover fertilization is the relative chlorophyll content in the leaf. This method is based on the positive correlation between the chlorophyll content and the N content in the plant (SORATTO et al., 2006; BARBOSA FILHO et al., 2008, 2009). Chlorophyll content occupies a prominent position, since it determines the photosynthetic potential of the plant through its control over the amount of solar radiation that a leaf absorbs (BLACKBURN, 2007; HATFIELD et al., 2008). A possibility for quantitative determination of chlorophyll content, in a fast and non-destructive manner, based on their spectral signatures is the use of chlorophyll meters, which are active sensors of green color intensity in leaf tissues, and operate by combining transmittance and absorbance properties of chlorophylls (SHADCHINA and DMITRIEVA, 1995; BLACKBURN, 2007). The indirect readings performed by the portable chlorophyll meter correspond to the relative chlorophyll content present in the plant leaf (TAKEBE and YONEYAMA, 1989; CHAPMAN and BARRETO 1997). The chlorophyll content can be altered by different factors, such as stressful conditions, nitrogen fertilization or even the application of alternative bio-inducers.

PURPOSE

The purpose was to verify if the foliar application of the product Penergetic® Pflanzen changes the chlorophyll content in the leaves of soybean plants and tomato plants in a greenhouse.

METHODOLOGY

The test was conducted in a greenhouse using soybean and tomato plants grown in plastic cups containing the commercial substrate Carolina Soil (Figure 1). Twenty-seven days after sowing, five plants of each crop received application of Penergetic® Pflanzen solution in the aerial part through manual spraying. It was used a dose of 1.9 g of product Penergetic® Pflanzen per liter of water, and each plant received 2.5 mL of the solution. The solution was applied using a hand spray.

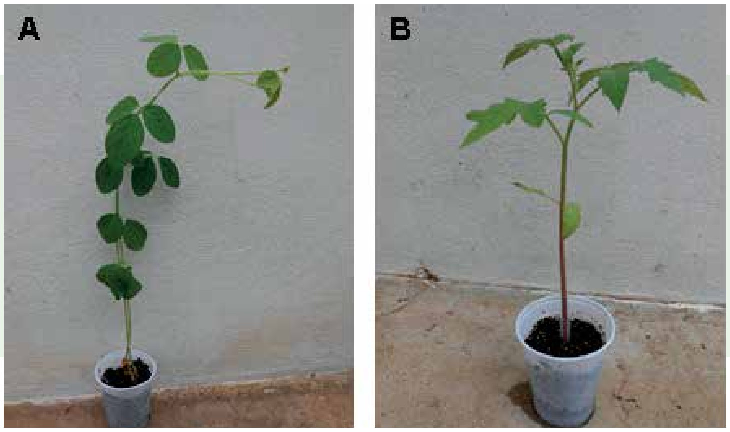


Figure 1. Plants of soybean (A) and tomato (B) with 27 days after sowing, grown in plastic cups containing the commercial substrate Carolina Soil.

The treatments were with and without the Penergetic® Pflanzen application, being used five replicates per treatment for each plant species (soybean and tomato). The plants were kept in a greenhouse for seven days, and a daily reading was performed at the same time, on the chlorophyll content with the chlorophyll meter ClorofiLOG CFL 1030 (FALKER, 2008). The readings were performed at one point of the leaf limb of the first pair of fully expanded leaves from the apical meristem, sampling one plant at each repetititon.

RESULTS

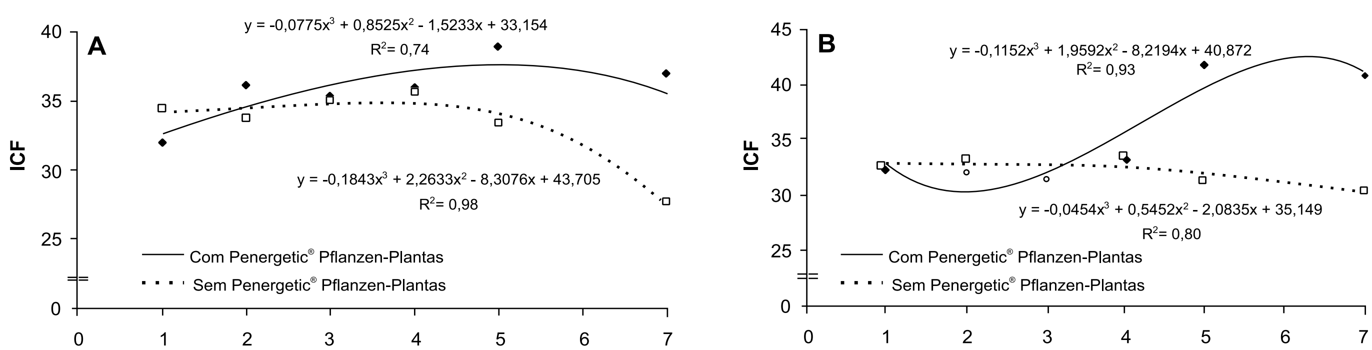
Different behaviors were observed between the soybean and tomato plants that received and those that did not receive the application of Penergetic® Pflanzen.

For the soybean plants, from the second day after the application of the product, the leaf chlorophyll index (ICF) presented increases in relation to the control plants (without application of the product). From the fifth day of the application, this difference became significantly higher (Table 1, Figure 2A).

Table 1. Averages of leaf chlorophyll content (ICF) determined in soybean and tomato plants with or without the addition of Penergetic® Pflanzen in the aerial part. Averages of five repetitions. (n = 5).

Avaliações / Dias	Índice de clorofila nas folhas (ICF)			
	Soja		Tomateiro	
	Com Penergetic®	Sem Penergetic®	Com Penergetic®	Sem Penergetic®
1	32,02	34,44	32,04	32,56
2	36,10	33,68	31,52	33,16
3	35,36	35,02	31,40	31,74
4	35,88	35,64	33,04	33,36
5	38,88	33,40	41,60	31,42
7	35,32	27,66	40,68	30,24

Figure 2. Chlorophyll Falker Index (ICF) observed in soybean (A) and tomato (B) plants after application of Penergetic® Pflanzen.



It was observed that, from the fifth to the seventh day of evaluations, there was a reduction in the production of chlorophyll by soybean plants (Figure 2A), which probably occurred due to the increase in the temperature inside the greenhouse during the period of conduction of the experiment. For tomato plants, a slight decrease in chlorophyll content was observed in the plants that received the product in the first two days after application. However, 72 hours after application, these plants showed significantly higher foliar chlorophyll indices than those observed in the control plants. **On the seventh day after the application, the increase in chlorophyll content in plants that received the application of Penergetic® Pflanzen reached 25.88% in relation to the control plants. In these plants, the effect of temperature was also observed, but with lower intensity. However, in plants that received Penergetic® Pflanzen this effect was not observed (Figure 2B).** Possibly, the high temperatures registered in the 5th to 7th day (higher than 37° C) caused reduction of chlorophyll indices in both plant species. However, it is important to highlight the difference observed between the plants that received and those that did not receive Penergetic® Pflanzen application. The first group showed a milder reduction than those that were not treated with the product. These results suggest an important application of this product as a protector of the pigment systems, although the acting mechanism still has to be studied. The results presented in Figure 2 can be inferred that, as regards the increase in chlorophyll content, the product **Penergetic® Pflanzen promoted a higher photosynthetic rate.**

CONCLUSION

Application effects of Penergetic® Pflanzen (solution of 1,9 $g.L^{-1}$) on leaf chlorophyll content in soybean and tomato plants promoted increases in leaf chlorophyll content.

Bioactivator effect of Penergetic® Pflanzen and Penergetic® Kompost in the vegetative development of coffee in bare and cultivated soil, associated with phosphate fertilizers and cattle manure

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Felipe Santinato - Agronomist, Master in Plant Production
André Luís Teixeira Fernandes - Agronomist, Doctor of Water and Soil Engineering

INTRODUCTION

The commercial product Penergetic® is a bioactivator of soil and plants, with the potential to promote increased positive effects on plant vigor, with balance between soil / plant, by optimizing the use of fertilizers added or existing fertility in the soil. It acts on the release of the fixed phosphorus not available to the plants, and promotes the rebalancing of microorganisms, providing more energy in the photosynthetic process. Some works in the coffee crop have been published with positive results in reducing the amount of inputs applied in soils from medium to high fertility, indicating that Penergetic® technology promotes better utilization of existing fertility and existing natural resources.

METHODOLOGY

The study was conducted from December 2013 to July 2014 (6 months), in the municipality of Araguari – MG, in the experimental field Izidoro Bronzi, belonging to the Association of Coffee Growers of Araguari. They were used pots, arranged in a greenhouse nursery with polypropylene mesh, with 50% of shading and irrigation by sprinkling with flow rate of 70.0 Lh -1 (MATIELLO et al., 2010). The treatments studied were:

T1 - Virgin cerrado soil (SVC);

T2 - Virgin cerrado soil with Penergetic® Pflanzen and Kompost (SVCP);

T3 - Virgin cerrado soil with simple superphosphate (SVCSS);

T4 - Virgin cerrado soil with simple superphosphate and with Penergetic® Pflanzen and Kompost (SVCSSP);

T5 - Virgin cerrado soil with phosphate from Araxá (SVCFA);

T6 - Virgin cerrado soil with phosphate from Araxá and with Penergetic® Pflanzen and Kompost (SVCFAP);

T7 - Virgin cerrado soil with cattle manure (SVCEC);

T8 - Virgin cerrado soil with cattle manure and with Penergetic® Pflanzen and Kompost (SVCECP);

T9 - Virgin cerrado soil with cattle manure and with simple superphosphate (SVCSSE);

T10 - Virgin cerrado soil with cattle manure and with simple superphosphate and with Penergetic® Pflanzen and Kompost (SVCSSECP);

T11 - Virgin cerrado soil with cattle manure and with phosphate from Araxá (SVCFAEC);

T12 - Virgin cerrado soil with cattle manure and with phosphate from Araxá and with Penergetic® Pflanzen and Kompost (SVCFAECP);

T13 - Tillage soil cultivated for 10 years (SLC);

T14 - Tillage soil cultivated for 10 years with Penergetic® Pflanzen and Kompost (SLCP);

T15 - Tillage soil cultivated for 10 years (SLCEC);

T16 - Tillage soil cultivated for 10 years with cattle manure and with Penergetic® Pflanzen and Kompost (SLCECP);

The treatments were arranged in a completely randomized design, with four repetitions, totaling 64 plots. Each plot included a vase containing three plants. They were used vases with 20 liter capacity (perforated plastic buckets) filled with a substrate, according to the treatments in study. Three plants of the cultivar Catuaí Vermelho IAC 144 were planted in each vase, with three pairs of leaves, in bare root, to avoid interference of the original substrate of the seedlings. In all vases, 25 g of potassium chloride was applied. The coverage of nitrogenous fertilizations were carried out with ammonium sulfate and urea as recommendations of MAPA Procafé, in force to the region, as well as all the cultural and phytosanitary treatments.

The water management was performed according to SANTINATO & FERNANDES 2012, maintaining the field capacity in the vases with 80%. The Penergetic® Kompost was applied via soil, at the dose of 600g ha-1, and the Penergetic® Pflanzen was applied via foliar, divided into three applications, using the dose of 200 g ha^{-1} in the 1°, 3° and 5° months of carrying. The superphosphate and Araxá phosphate were applied in 300g doses in the $vase^{-1}$ (1.5t ha^{-1}) and 500g $vase^{-1}$ (2.5 t ha^{-1}). The cattle manure was applied at the dosage of 2.0 L in each pot, corresponding to 5.0 t ha^{-1}. At six

months after planting the seedlings, proceeded to the experiment assessements. The plant biometry was carried out, dry matter, plant nutrition parameters and soil fertility parameters. The data were submitted to analysis of variance and when proceeding to the Tukey test, both at 5% probability. The results are expressed in graphs for better understanding and visualization.

RESULTS

The biometric and dry matter variables presented significant differences in the analysis of variance and the Tukey test, as can be visualized in the graphs 1.1 to 1.8. **The superiority of all the treatments that used the Penergetic® product, in relation to the control and the other treatments that was verified,** independently of the substrate in which the seedlings were planted. The highest values obtained in the biometric parameters happened in the treatments 4, 8, 12, 14 and 16. In the average of the treatments, with the application of Penergetic®, yielded increases of 18, 17, 10, 21, 8 and 49% at plant height, crown and stem diameter, root length, number of branches and number of leaves, respectively. It is important to point out that even with the low natural fertility of the cerrado soils, in the absence of any phosphate fertilization, the application of Penergetic® promoted an increase in all evaluated biometric parameters. The results were higher in soils that received phosphate and organic fertilization. Regarding soil fertility parameters, it was observed that treatments that did not use Penergetic® obtained higher levels of Al+3 and m%. This was due to the fact that Penergetic® acts in the release of Ca^{+2} and Mg^{+2} Present in the soil, notably in the soil fertilized with manure, which releases them gradually, the Ca^{+2} and Mg^{+2} form compounds with aluminum, neutralizing it. This fact also influences in the m% and V%, with increase of the saturation index of bases in the treatments fertilized with Penergetic®. **The application of Penergetic® resulted in an increase in the content and availability of phosphorus for the plants, as illustrated in the graphic 2.1.** The P is the main nutrient for coffee in the crop formation stage, mainly because of its role in the formation and expansion of the root system. Probably the greatest supply of this nutrient was responsible for the increase in the biometric parameters of the plants. The greatest difference between the absence factor and the presence of Penergetic® was obtained in virgin cerrado soil, fertilized with phosphate of Araxá. This source provides about 28% of P_2O_5 soluble in citric acid, and low efficiency in the supply of this nutrient to the plants when compared to other sources (MALAVOLTA et al., 2006). The application of Penergetic®, along with Araxá phosphate, enhanced its efficiency, releasing a greater amount of P_2O_5.

CONCLUSION

It can be concluded that Penergetic® acts on the release of nutrients contained in soils, organic fertilizers or minerals, providing a greater amount of these to the plants, especially Ca, Mg and P. And that the increased use of nutrients obtained by the use of biometric Penergetic® promotes greater plant growth.

GRAPHICS OF THE BIOMETRIC PARAMETERS

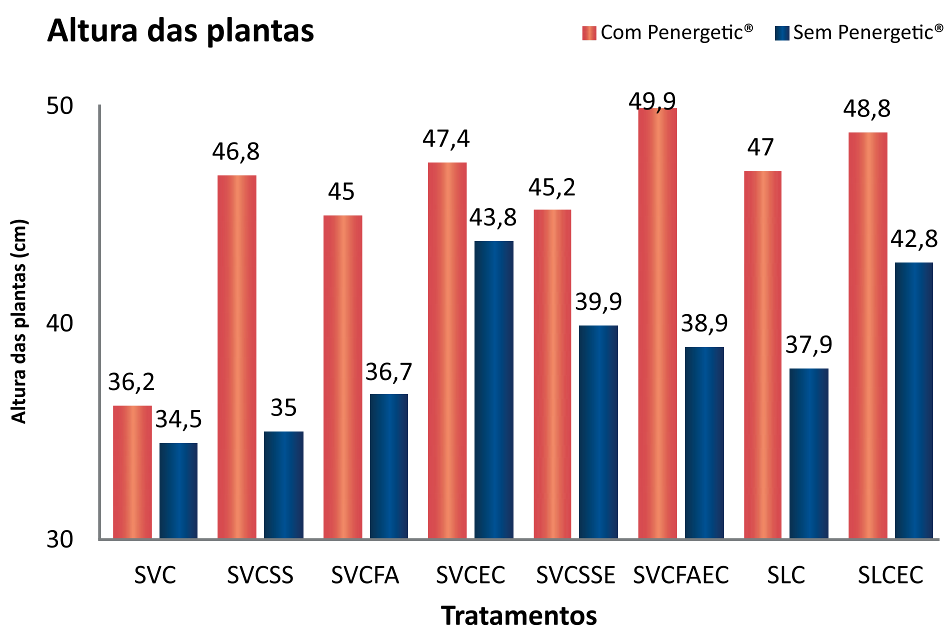

Gráfico 1.1. Altura em cm das plantas de café, Araguari, 2014.

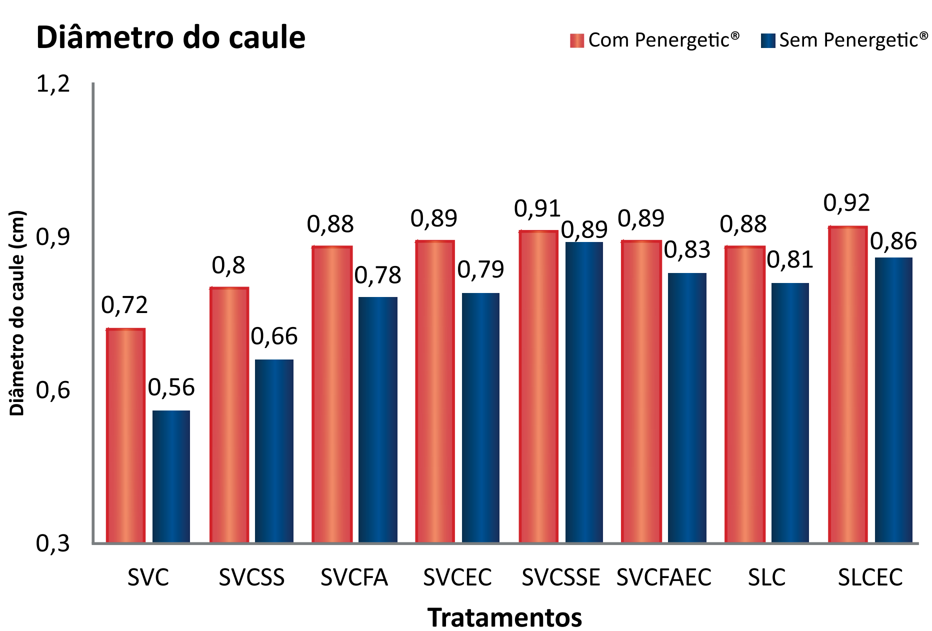

Gráfico 1.2. Diâmetro do caule em cm das plantas de café, Araguari, 2014.

LEGEND OF THE GRAPHICS

SVC = T1 and T2: Virgin cerrado soil
SVCSS = T3 and T4: Virgin cerrado soil + simple superphosphate
SVCFA = T5 and T6: Virgin cerrado soil + phosphate from araxá
SVCEC = T7 and T8: Virgin cerrado soil + cattle manure
SVCSSE = T9 and T10: Virgin cerrado soil + simple superphosphate + cattle manure
SVCFAEC = T11 and T12: Virgin cerrado soil + simple superphosphate + phosphate from araxá
SLC = T13 and T14: Tillage soil cultivated for 10 years
SLCEC = T15 and T16: Tillage soil cultivated for 10 years + cattle manure

GRAPHICS OF THE BIOMETRIC PARAMETERS

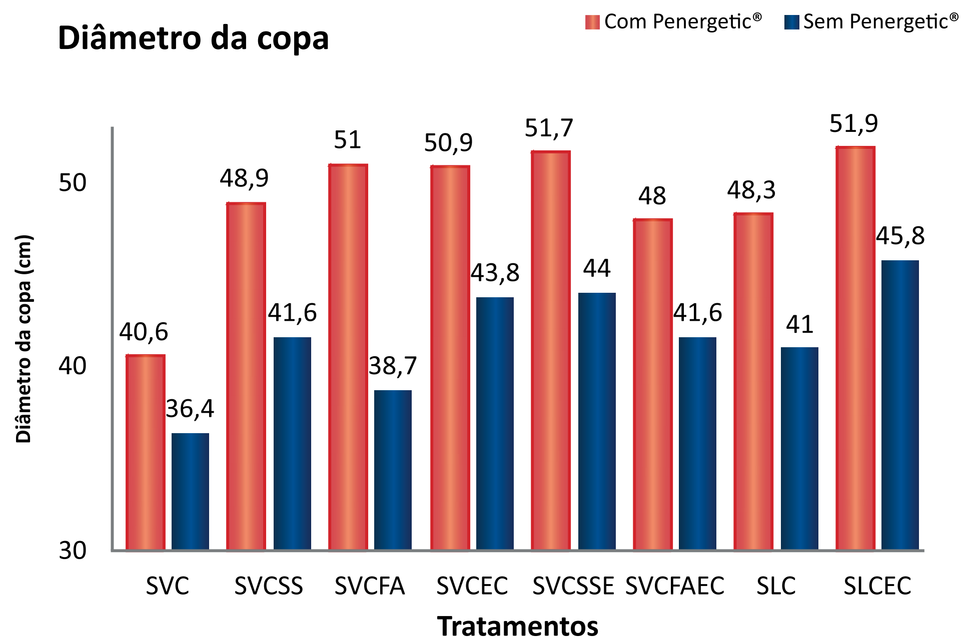

Gráfico 1.3. Diâmetro da copa em cm das plantas de café, Araguari, 2014.

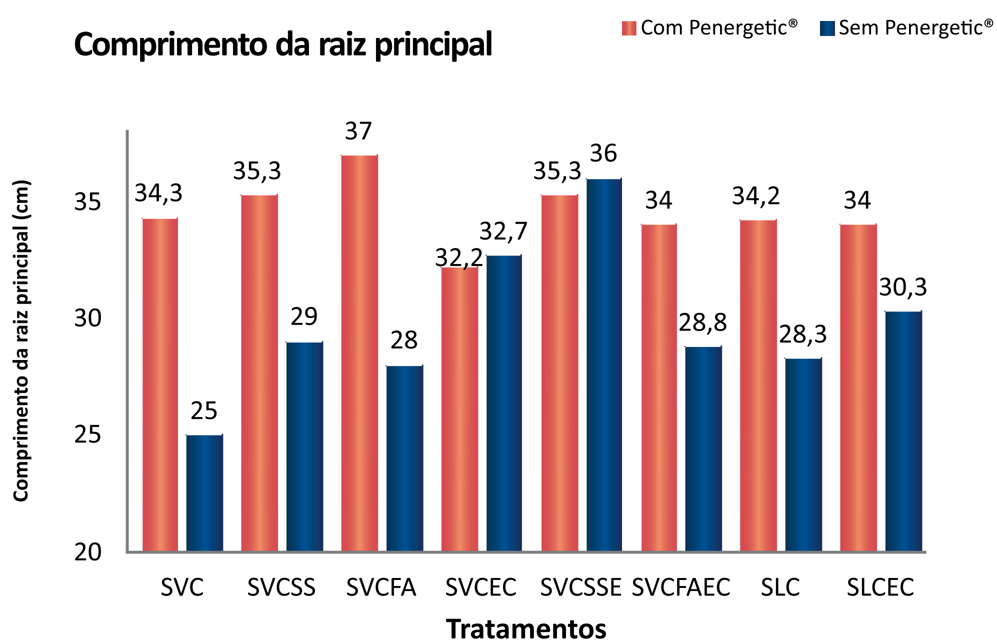

Gráfico 1.4. Comprimento da raiz principal em cm das plantas de café, Araguari, 2014.

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GRAPHICS OF THE BIOMETRIC PARAMETERS

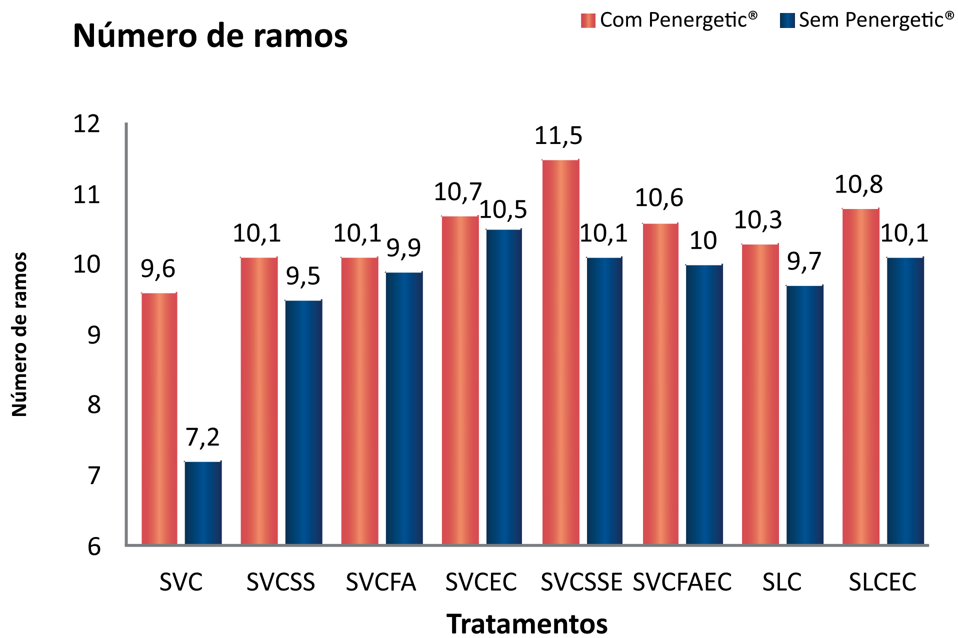

Gráfico 1.5. Número de ramos das plantas de café, Araguari, 2014.

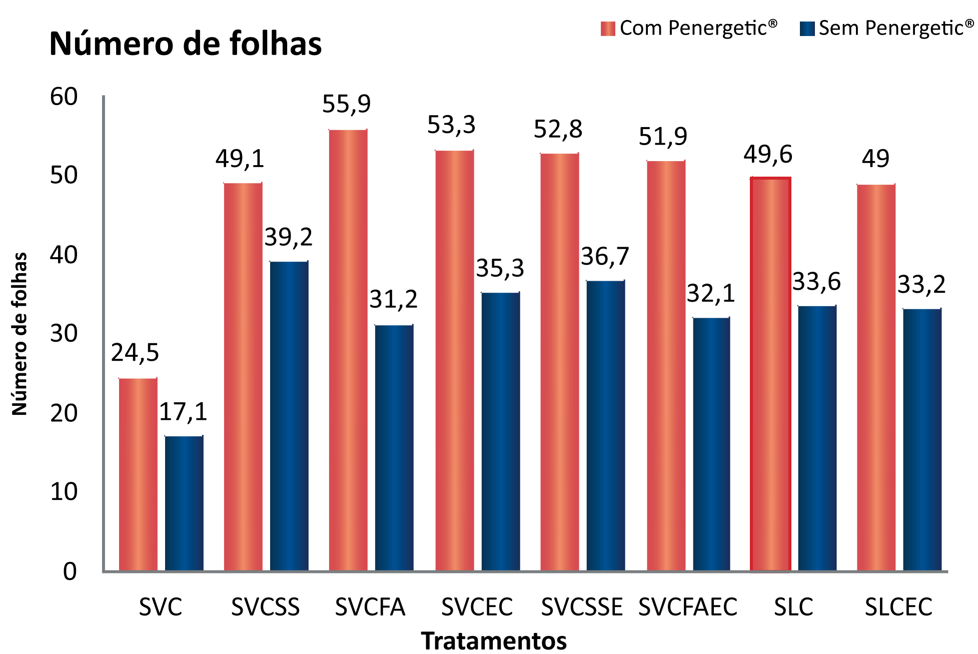

Gráfico 1.6. Gráfico 1.6. Número de folhas das plantas de café, Araguari, 2014.

GRAPHICS OF THE BIOMETRIC PARAMETERS

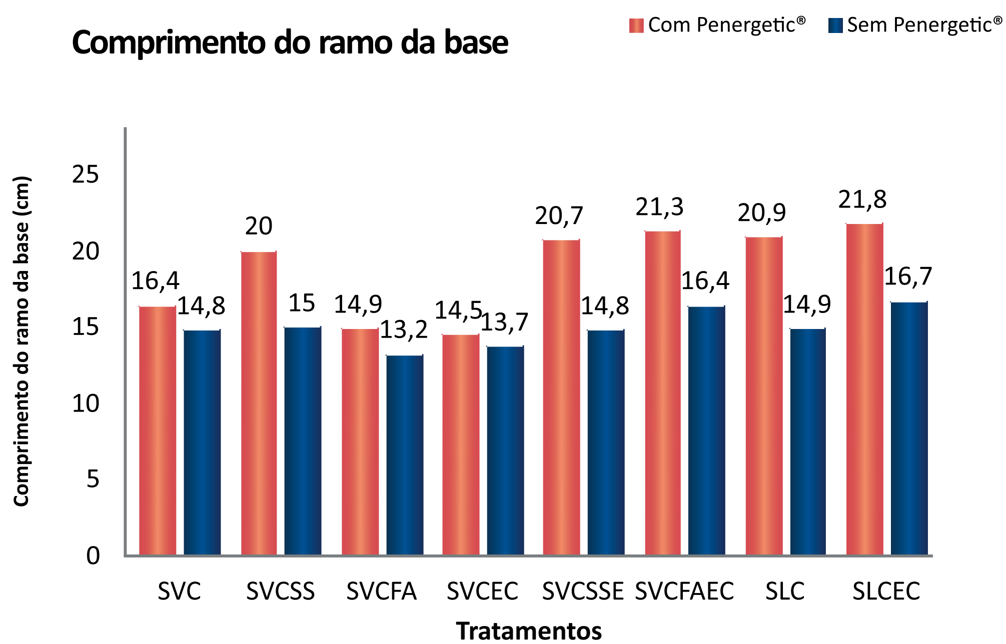

Gráfico 1.7. Comprimento do ramo da base em cm das plantas de café, Araguari, 2014.

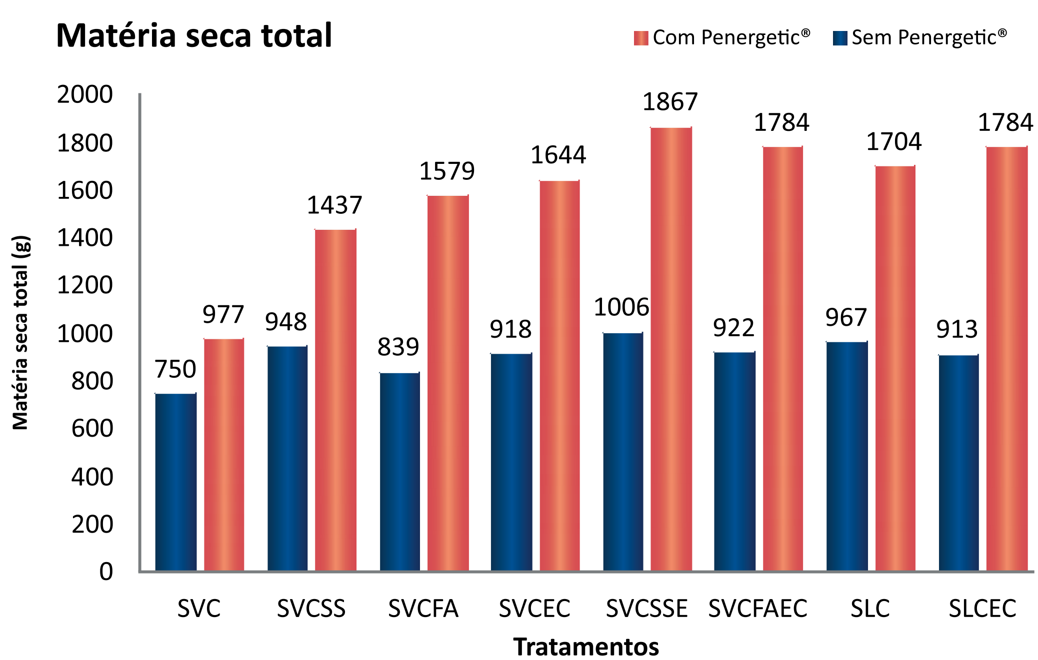

Gráfico 1.8. Matéria seca total em gramas das plantas de café, Araguari, 2014.

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GRAPHICS OF THE SOIL FERTILITY PARAMETERS

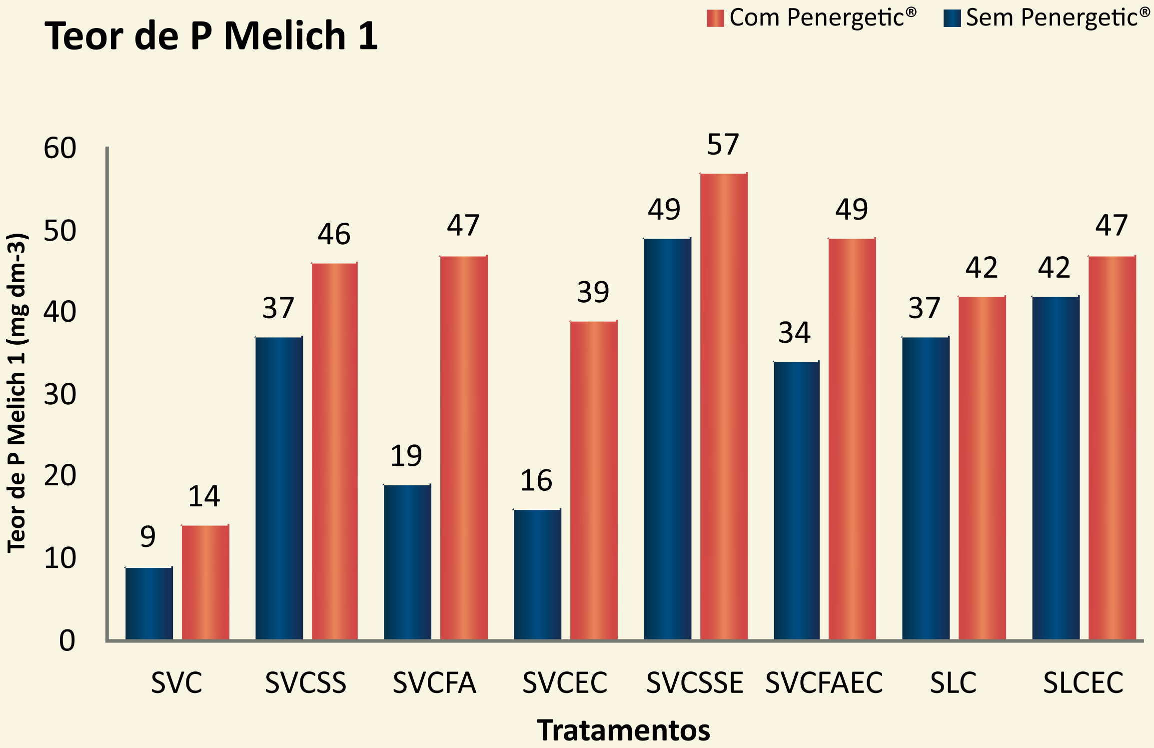

Gráfico 2.1. Teor de Pmelich 1 (mg dm-3) no solo, Araguari, 2014.

LEGEND OF THE GRAPHICS

SVC = T1 AND T2: VIRGIN CERRADO SOIL
SVCSS = T3 AND T4: VIRGIN CERRADO SOIL + SIMPLE SUPERPHOSPHATE
SVCFA = T5 AND T6: VIRGIN CERRADO SOIL + PHOSPHATE FROM ARAXÁ
SVCEC = T7 AND T8: VIRGIN CERRADO SOIL + CATTLE MANURE
SVCSSE = T9 AND T10: VIRGIN CERRADO SOIL + SIMPLE SUPERPHOSPHATE + CATTLE MANURE
SVCFAEC = T11 AND T12: VIRGIN CERRADO SOIL + SIMPLE SUPERPHOSPHATE + PHOSPHATE FROM ARAXÁ
SLC = T13 AND T14: TILLAGE SOIL CULTIVATED FOR 10 YEARS
SLCEC = T15 AND T16: TILLAGE SOIL CULTIVATED FOR 10 YEARS + CATTLE MANURE

Study the feasibility of providing potassium and phosphorus in Cerrado soils using the Penergetic®

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Roberto Santinato - Agronomist Researcher for MAPA Procafé
Reginaldo O. Silva - Experimental Field Manager at Izidoro Bronzi, Araguari/MG
Antônio Nascimento Teixeira - Master of Science in Soil, Agronomic Consultant

INTRODUCTION

The communities of micro and macroscopic organisms that inhabit the soil perform essential activities for the maintenance and survival of plant and animal communities. In the soil, the main activities of the organisms are: mineralization of organic matter; humus production; Nutrient and energy cycling; fixation of atmospheric nitrogen; production of complex compounds that cause soil aggregation; xenobiotics decomposition and biological control of pests and diseases, thus providing ideal conditions for an extremely high biodiversity.

Specifically in coffee cultivation, Penergetic® technology has been used in practice to promote the balance and intensification of microbiological activities in the soil, in order to improve the supply of potassium and phosphorus nutrients, mainly in the percentages of these elements that are in non-labile forms in the soil.

OBJECTIVES

Within this context, an experiment was set up with the following objectives: **1)** Evaluate the effect of applying **Penergetic® Kompost and Penergetic® Pflanzen**, of the biological balance of the soil, mineral nutrition, growth, yield and quality of coffee irrigated and cultivated in savanna conditions, and **2)** to evaluate the possibility of reducing the P and K fertilization of the coffee, with the use of Penergetic technology®.

METHODOLOGY

The experiment is being conducted at the Izidoro Bronzi Experimental Field, agreement with Universidade de Uberaba, Association of Coffee Growers of Araguari (ACA) and Fundação Procafé, in coffee crop with the cultivar Catuaí Vermelho IAC 15, with 07 years old, spacing of 3.70 x 0.70 m, located at Fazenda Chaparral, On the banks of the Rodovia do Café, Km 09, city of Araguari (MG). The irrigation system is drip type, with self-compensating emitters, flow of 2.3 liters / hour, spacing of 3.70 m between rows and 0.70 m between drippers. Five treatments were applied, according to table 1.

Fertilizer applications were carried out in October, November, December, January, February and March (divided into 2 applications per month), the **Penergetic® Kompost** was performed in October and the **Penergetic® Pflanzen -** 3 applications along with spraying of pesticides. Culture, phytosanitary and nutritional treatments were carried out as recommended by SANTINATO, FERNANDES (2012).

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Table 1. Description of the treatments installed in the Experimental field of Izidoro Bronzi.

TRATAMENTO	DESCRIÇÃO
T1	Testemunha Padrão (gotejo normal, sem adubação PK, adubação nitrogenada normal)
T2	Adubação de cobertura convencional via fertirrigação (100% de NPK recomendada)
T3	Adubação de cobertura convencional via fertirrigação (100% de NPK recomendada) + Penergetic® Pflanzen e Penergetic® Kompost.
T4	Adubação de cobertura convencional via fertirrigação (75% de NPK recomendada) + Penergetic® Pflanzen e Penergetic® Kompost.
T5	Adubação de cobertura convencional via fertirrigação (50% de NPK recomendada) + Penergetic® Pflanzen e Penergetic® Kompost.

TRAT	PRODUTIVIDADE (sacas beneficiadas / ha)							
	2009 2010	2010 2011	2011 2012	2012 2013	2013 2014	2014 2015	MÉDIA	PR %
T 1	44,7	49,3	43,2	32,7	23,6	26,9	36,8	-16
T 2	38,6	50,1	47,1	38,2	42,86	46,6	43,9	100
T 3	48,4	57,1	33,2	54,6	50,7	50,0	49,0	11,6
T 4	52,5	49,8	55,1	48,7	50,1	52,5	51,5	17,3
T 5	40,7	75,6	41,9	54,4	53,5	57,0	53,9	22,8

Table 2. Harvest of the different treatments, in benefited sacks per hectare, five harvests, Experimental Field of Izidoro Bronzi, Araguari/MG

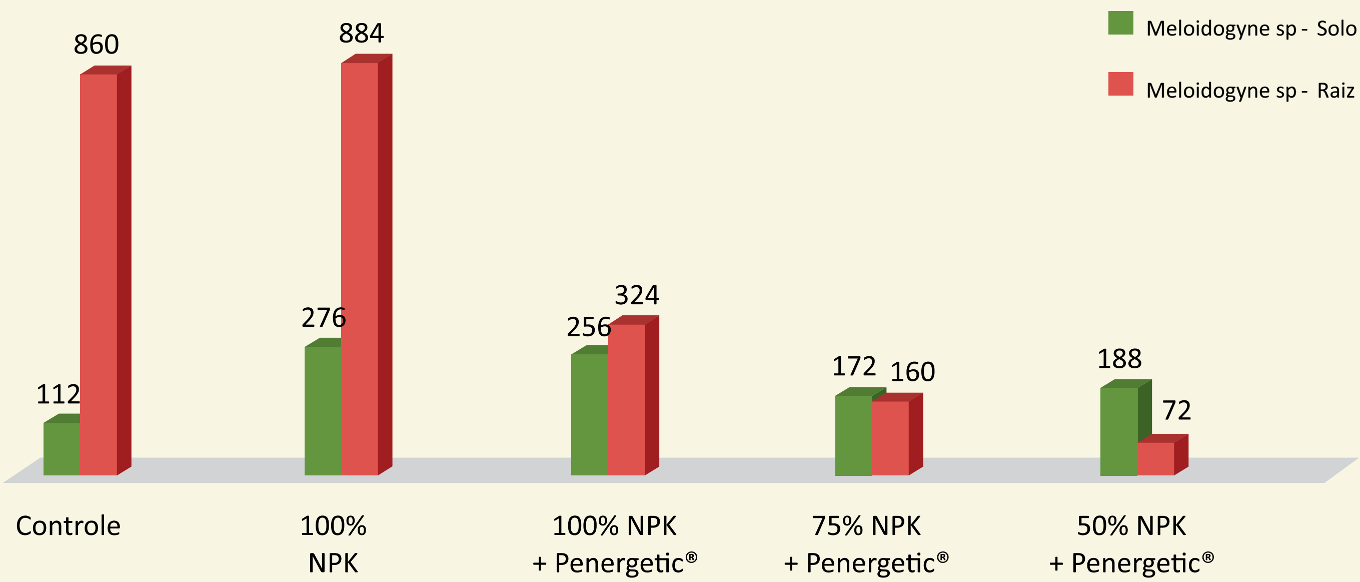
Quantidade Nematoides		Tratamentos				
		T 1	T 2	T 3	T 4	T 5
Meloidogine sp.	Solo	112	276	256	172	188
	Raiz	860	884	326	160	72
Pratylenchus sp.	Solo	-	-	-	-	-
	Raiz	-	-	-	04	-
Rotylenchulus reniformis	Solo	-	04	-	-	04
	Raiz	-	-	-	-	-

Table 3. Count of nematodes in the soil and roots of the coffee plant. Laboratory of Nematology - EPAMIG - Analysis 81/2013

CONCLUSION

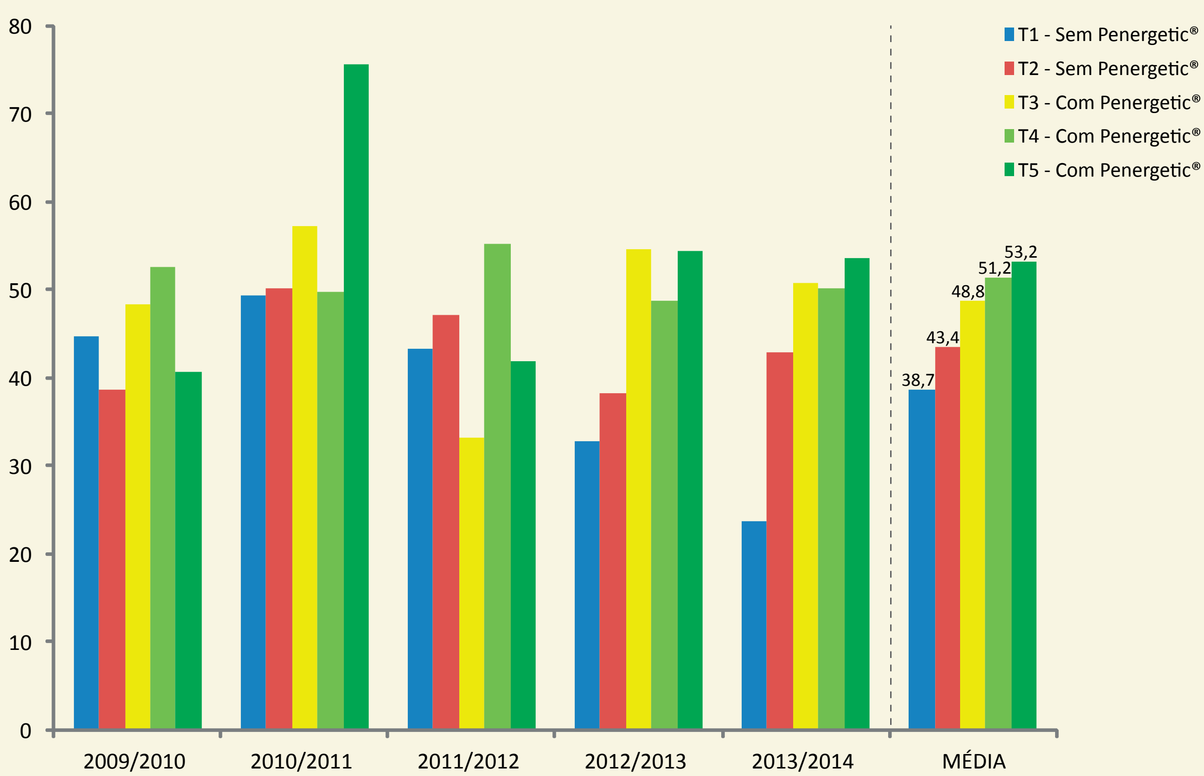
It can be concluded after 5 crops, the use of technology Penergetic® is feasible for the coffee plant nutrition, since it allows reducing the required fertilization with increased productivity. On the average of five harvests, the superiority of production compared to conventional nutrition was 10 benefited sacks/ha/year, with 50% reduction in the amount of NPK recommended. Regarding the biological indicators, compared with the control and conventional fertigation treatments with Penergetic® promoted increases of 16-36% in microbial biomass, there was a higher colonization of mycorrhiza in the roots of coffee, with values of 10.6 to 22% and superiority of number of mycorrhizal spores with values of 10 to 19/50 mL of soil. And lower incidence of nematodes in the coffee roots of the treatments that used the technology.

NEMATOLOGICAL ANALYSIS - COFFEE | ACA – ARAGUARI-MG/2013



Graphic 1 - Count of nematodes in the soil and roots of the coffee plant

PRODUCTIVITY (BENEFITED SACKS/HA)



Graphic 2 - Productivity (benefited sacks/ha), five coffee crops

Effect of using Penergetic® Technology in the suppression of damage caused by phytonematodes

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Zaida Inês Antoniolli - PhD in Ecology Of Mycorrhizal Molecular Aspects, Professor of the Department of Soils/UFSM

INTRODUCTION

Nematodes represent the largest number of multicellular organisms in the soil. These organisms are distributed in about 15,000 known species, but there are estimates that the total number may reach 50.0000 species in the soil. These organisms represent the trophic level of the system, due to its rapid reproductive cycle, morphology, food specificity and short-term response to environmental changes and soil management actions. These organisms occupy a central position in the food chain of debris, participating in fundamental ecological processes, such as decomposition and nutrient cycling.

Information disclosed by the Brazilian Agricultural Research Corporation (Embrapa), show that there are in Brazil approximately 25 pathogens of economic importance for grain crops, especially the soybean crop. Among these, the phytonematoids have been growing in importance in the productive system, and gaining space in the Brazilian scenario, and may even render some areas of cultivation unviable.

Nematodes in agricultural crops are associated with at least a dozen phytonutrient genera, where of which the genera *Meloidogyne spp., Heterodera spp., Pratylenchus spp., Rotylenchulus spp., Helicotylenchus spp. and Xiphinema spp.* are the most important.

The large number of existing host plant species, easy dissemination and interaction with other phytopathogenic organisms place these phytonematoids among the major pathogens responsible for crop damage, reducing crop yields and resulting in losses of about $ 125 billion annually.

Each growing season is evident the increase of concern and consequent demand for the control measures and sustainable management of these phytopathogens, as the areas with symptoms of the action of these organisms, especially those causing galls and root lesions, has been growing year by year. This dissemination is associated, among other factors, with the lack of disclosure of the problems inherent in the presence of these plant phytopathogens in the crops, the lack of knowledge of the distribution of these organisms in the field, as well as the mismanagement that has been adopted in infested areas.

Although the biology and behavior of phytonematoids that causes galls and root lesions are well known by the research, the control of these organisms in the field still presents great limitations, both due to the lack of efficient products and the lack of information by the technical assistance, since frequently the low productivity observed in areas infested by plant parasitic phytonematode is initially attributed to soil fertility problems, phytotoxicity or chemical action of fungi or bacteria of agricultural importance.

For the productivity to be compatible with the profitability expected by the producer and with the potential of the crop, a constant search is needed for the solutions and the adoption of measures related to nutrition, management and phytosanitary conditions of the crop. The control of these organisms is not only based on the attempt to eradicate them, but on the reduction of the population present in the soil to levels not harmful to the production.

In this context, the objective of this material is to present information that helps in the sustainable control of phytonematoids that cause damage to agricultural crops.

METHODOLOGY

The nematofauna existing in field and greenhouse tests were evaluated to determine the efficiency of Penergetic® Technology in suppressing damage caused to soy, wheat and corn crops.

For the evaluation of nematodes, soil and root samples were collected, which were conditioned in plastic bags, properly identified and kept in a polystyrene box, until the moment of their use. The soil nematode extraction was performed by the combined methods of flotation, sedimentation, sieving and separation by centrifuge in sucrose solution (Jenkins, 1964). After the collection and extraction of the phytonematoids, the nematodes were counted, using a stereoscope microscope, with a 40x magnification.

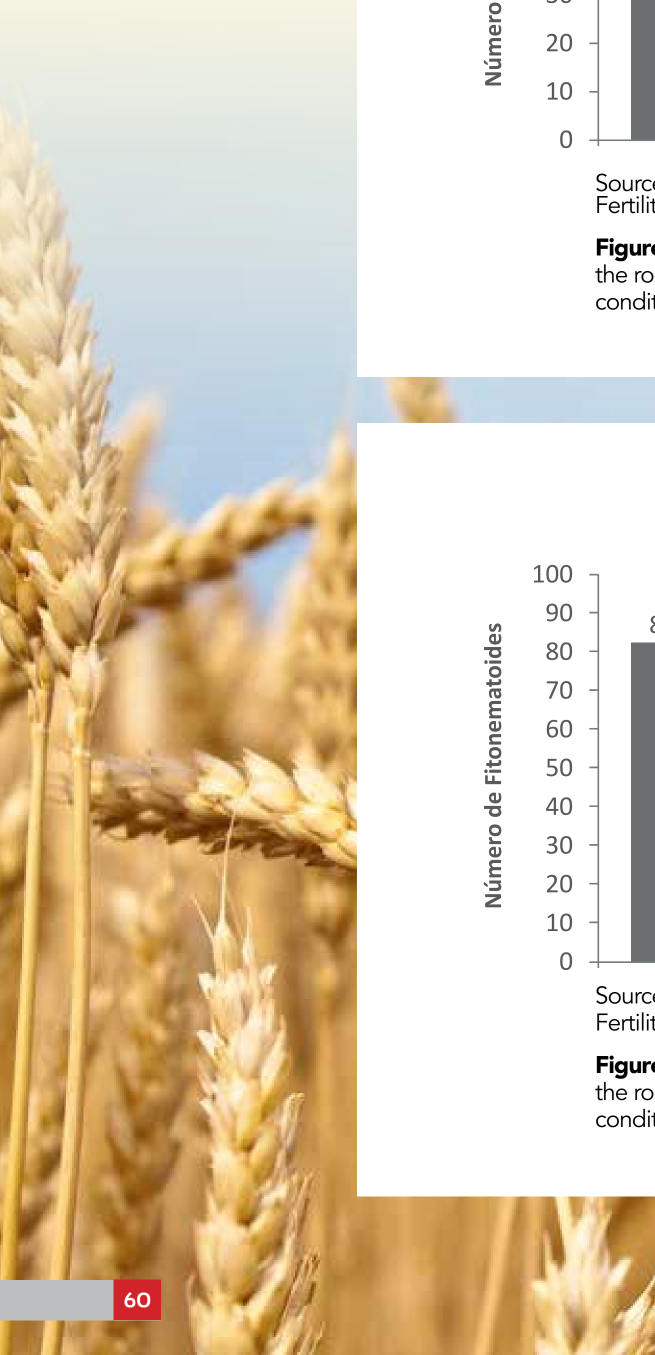
The identification of the phytonematoids was performed through the morphological characteristics according to Jairajpuri and Ahmad (1992), Heyns (1971), Siddiqui (1985) and Mai and Mullin (1996).

In order to evaluate the phytonematoid population within the roots, the number of organisms was counted in the flowering period, using the described methodology by Byrd et al. (1983) for staining of roots. After the staining step, the roots were arranged between two glass slides, under a microscope with a magnification of 40x, to count the number of phytonematoids penetrated.

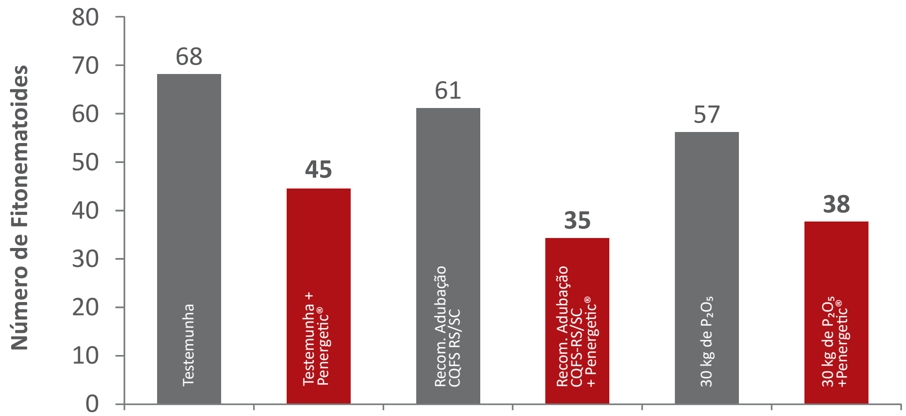
Subsequently, the efficiency of commercial (chemical and biological) assets was evaluated at 36, 45 and 60 days after nematoid inoculation, used in the control of phytonematodes with and without the presence of Penergetic® Technology.

The data obtained were submitted to analysis of variance and test of means according to Tukey by software SISVAR (Ferreira, 2000).

WHEAT



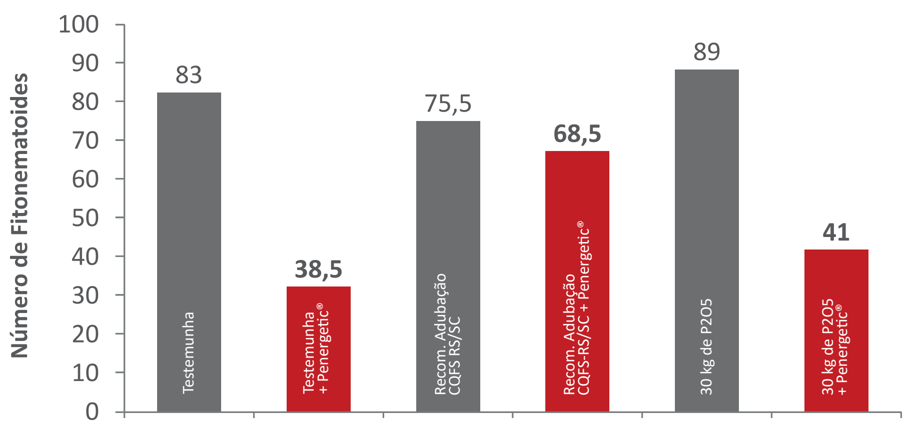
NUMBER OF PENETRATED NEMATODES
Meloidogyne javanica



Source: UFSM/RS. (CQFS RS/SC – Committee on Soil Chemistry and Soil Fertility of Rio Grande do Sul and Santa Catarina).

Figure 1. Number of phytonematoids *(Meloidogyne javanica)* penetrated into the roots of cultivar Quartz wheat, in the flowering stage, under greenhouse conditions. Average of 5 repetitions.

NUMBER OF PENETRATED NEMATODES
Pratylenchus brachyurus

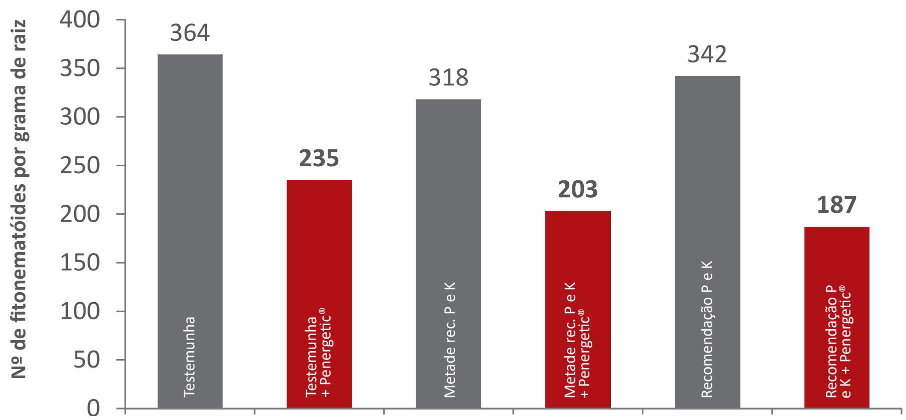


Source: UFSM/RS. (CQFS RS/SC – Committee on Soil Chemistry and Soil Fertility of Rio Grande do Sul and Santa Catarina).

Figure 2. Number of nematoids *(Pratylenchus brachyurus)* penetrated into the roots of cultivar Quartz wheat, in the flowering stage, under greenhouse conditions. Average of 5 repetitions.

SOYBEAN

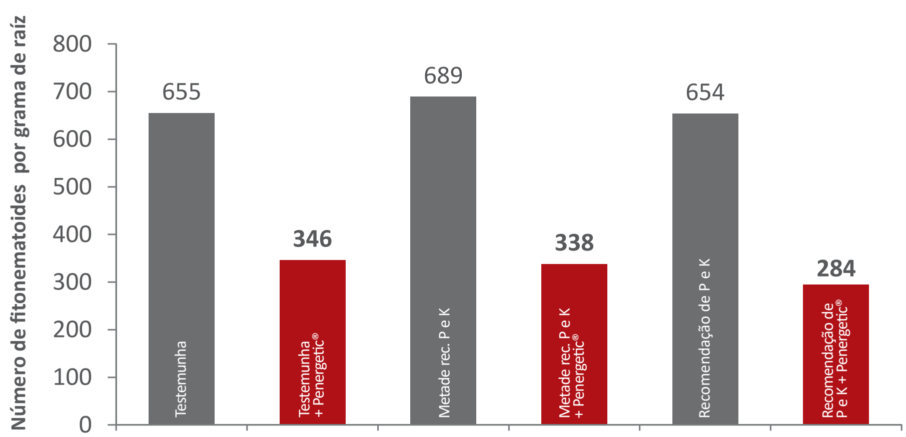
NUMBER OF PENETRATED NEMATODES IN THE FLOWERING
Pratylenchus brachyurus



Source: UFSM/RS. (Rec, Penergetic® Pflanzen and Kompost - recommendation of phosphorus and potassium according to the Committee on Soil Chemistry and Soil Fertility of Rio Grande do Sul and Santa Catarina).

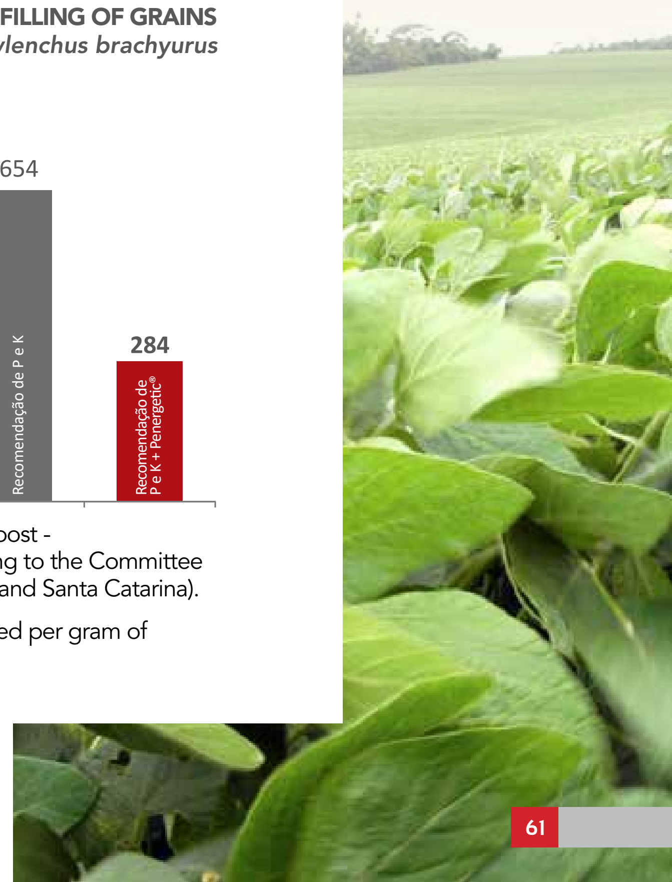
Figure 3. Number of *Pratylenchus bvrachyurus* penetrated per gram of soybean root cv Fepagro 36RR subjected to different treatments (CV% 13.24).

NUMBER OF PENETRATED NEMATODES IN THE FILLING OF GRAINS
Pratylenchus brachyurus



Source: UFSM/RS. (Rec, Penergetic® Pflanzen and Kompost - recommendation of phosphorus and potassium according to the Committee on Soil Chemistry and Soil Fertility of Rio Grande do Sul and Santa Catarina).

Figure 4. Number of *Pratylenchus bvrachyurus* penetrated per gram of soybean root cv Fepagro 36RR in a greenhouse.



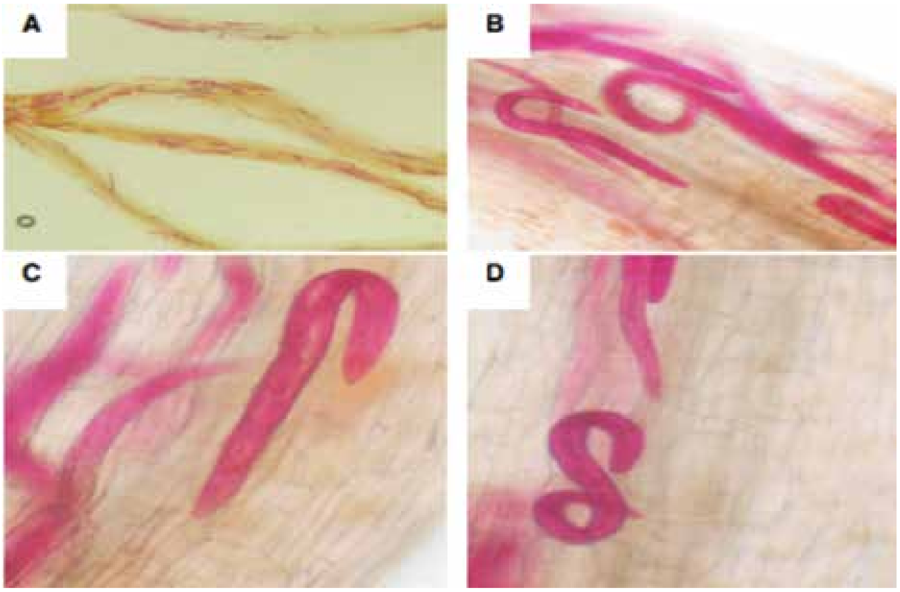


Figure 5. Nematoide of the root lesions *Pratylenchus brachyurus* penetrated the roots of soybean of cultivar Fepagro 36RR, in the stage R8. (A) Increase of 20x and (B,C,D) Increase of 100x.

Source: UFSM/RS.

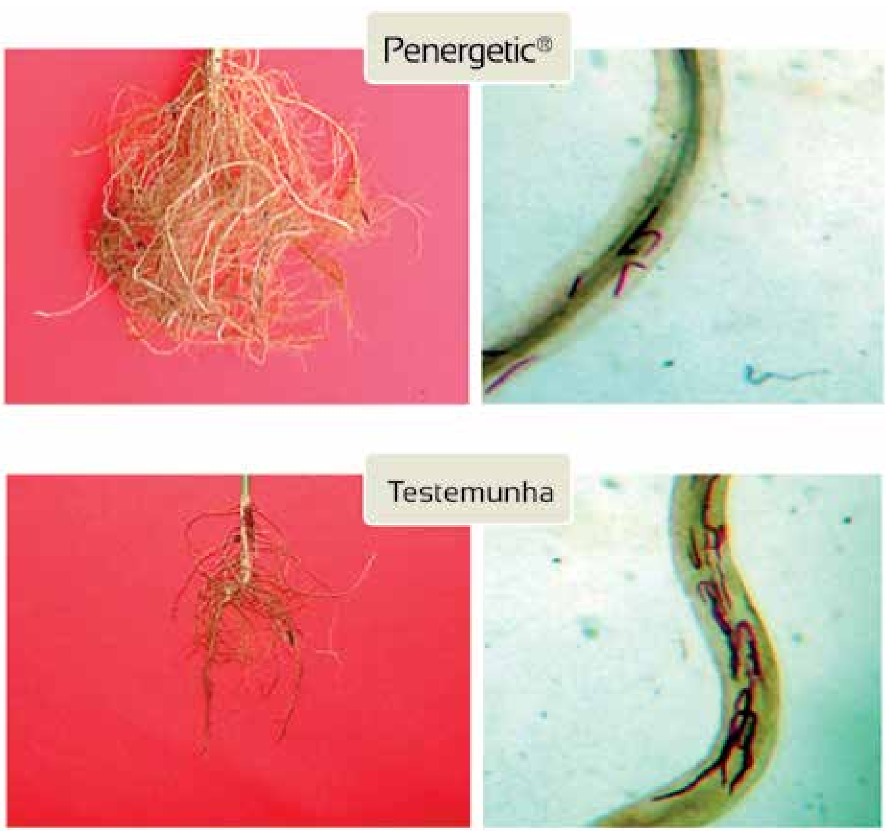


Figure 6. Nematoids *(Pratylenchus brachyurus)* penetrated into the roots of soybean of cultivar Nidera 5909 at 60 days after the emergence under greenhouse conditions. Average of 6 repetitions.

Source: UFSM/RS.

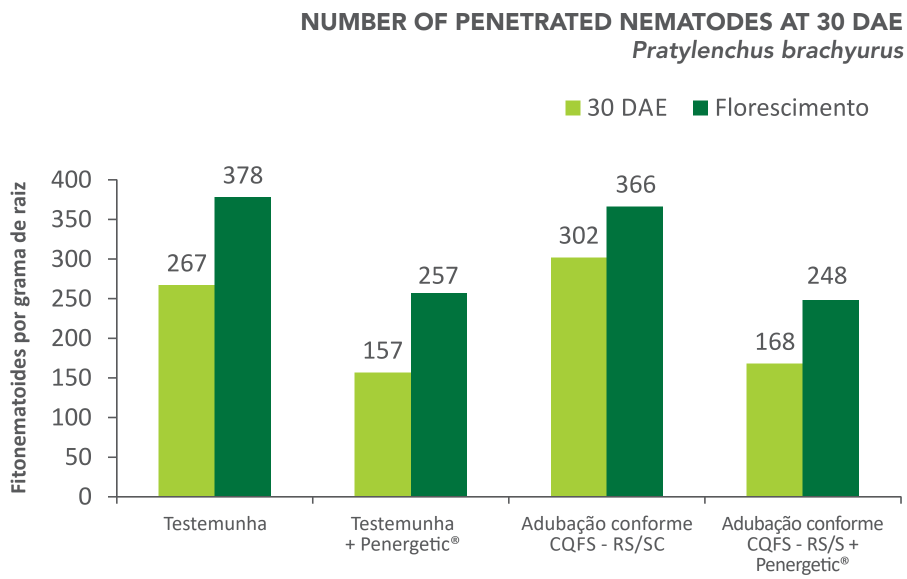


Figure 7. Number of nematodes of the *Pratylenchus brachyurus* species, penetrated into soybean roots at 30 days after the emergence (DAE) and flowering of the crop.

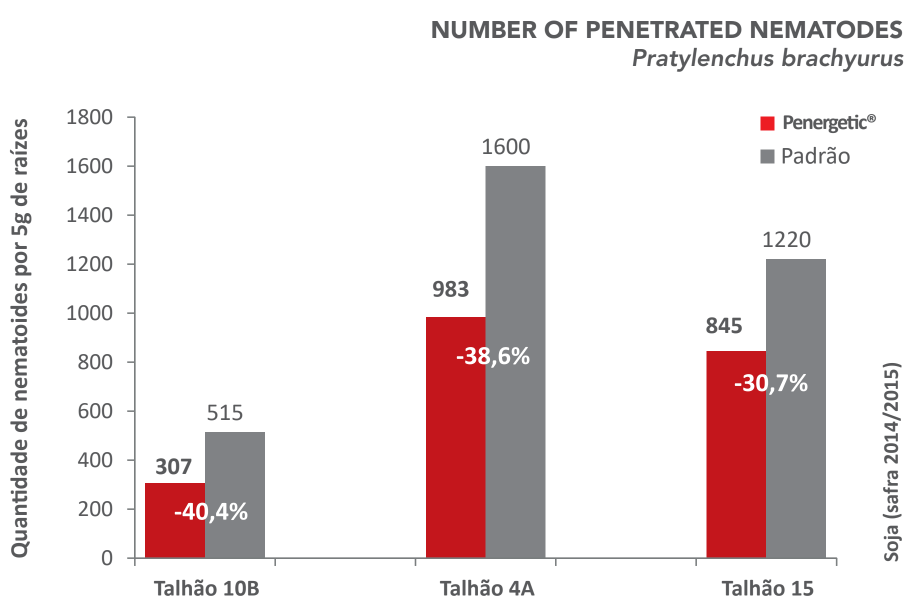


Figure 8. Number of *Pratylenchus brachyurus* em raízes de soybean.
Fazenda Reunidas do Papagaio, Sapezal/MT - Average of 3 plots: Crop of 2014/15.

Figure 9. Phytonematoids *(Pratylenchus brachyurus)* penetrated into the roots of corn of cultivar TLTG Vipter at 60 days after the emergence under greenhouse conditions. Average of 6 repetitions.

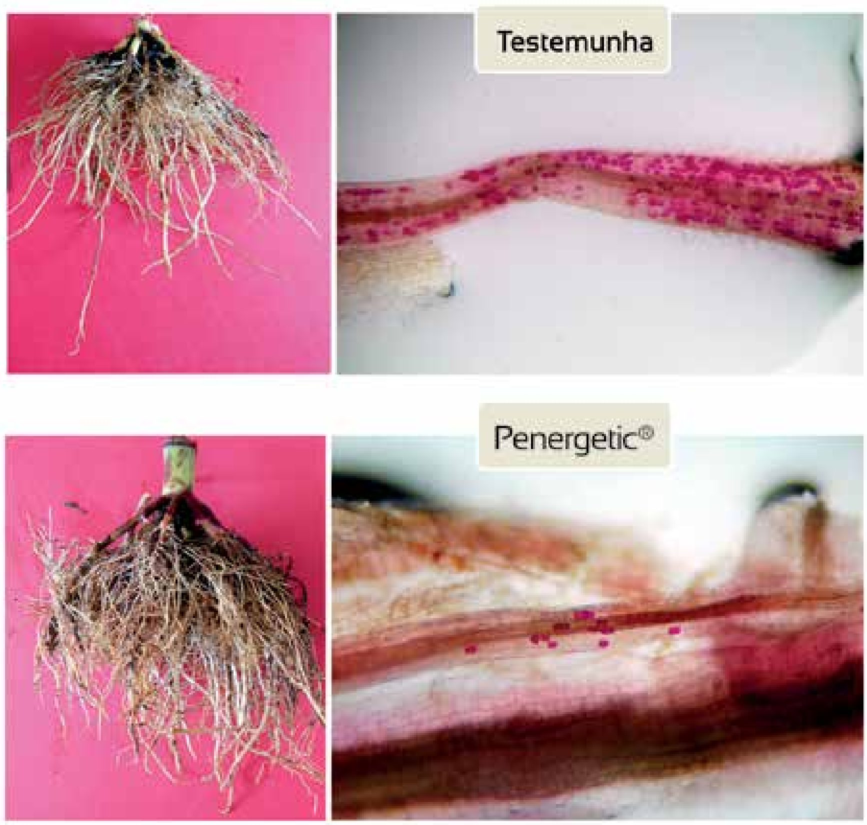
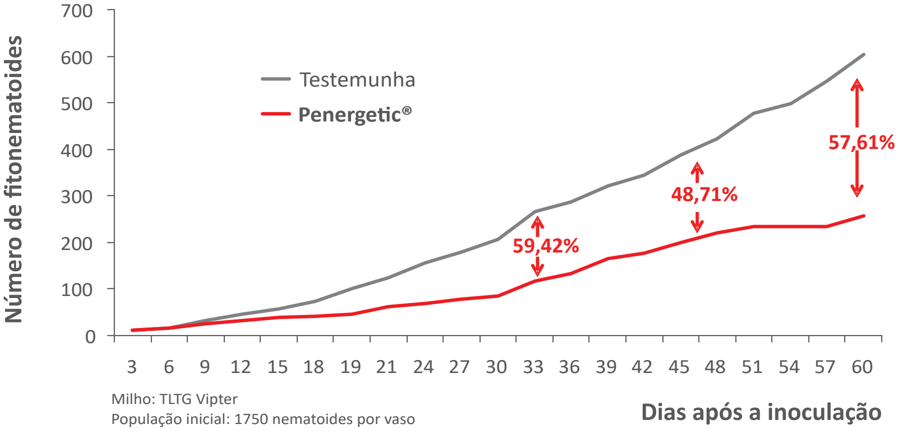


Figure 10. Number of phytonematoids *(Pratylenchus brachyurus)* penetrated into the roots of hybrid corn of cultivar TLTG Vipter during the first 60 days after the emergence under greenhouse conditions.



SOYBEAN

NUMBER OF PENETRATED NEMATODES IN THE SOYBEAN ROOTS
(Pratylenchus brachyurus)

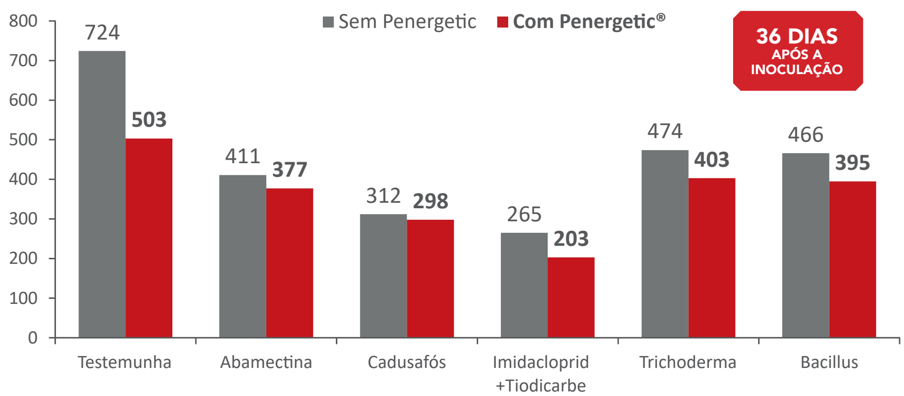


Figure 11.

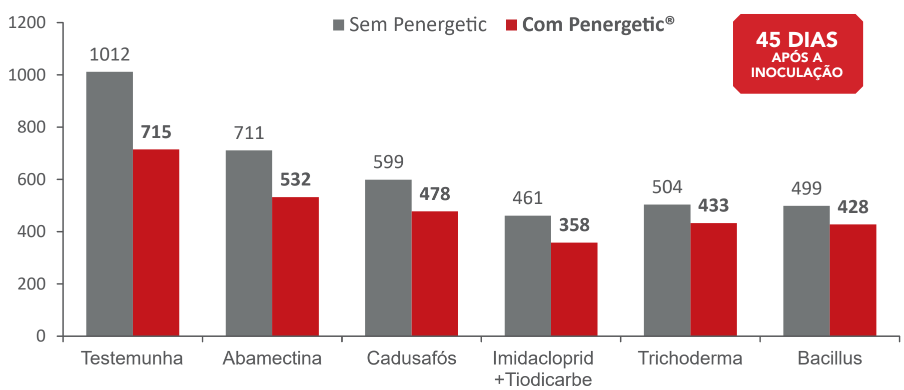


Figure 12.

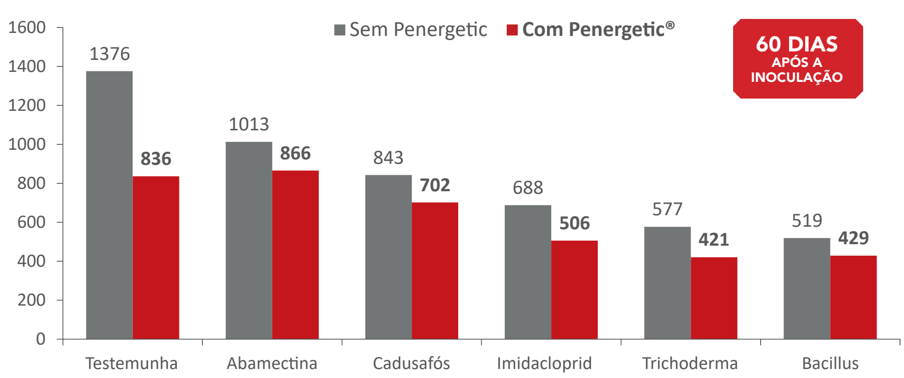


Figure 13.

CONCLUSIONS

Assuming that the phytonematoids parasitism cycle begins with the penetration and/or injury caused by the infective larvae in the roots of the plant, it could be observed that the treatments that used the Penergetic® Technology resulted in a lower number of penetrated nematodes and/or root lesions, consequently resulting in greater plant development.

Effect of Penergetic® Pflanzen and Penergetic® Kompost on the stimulation to mycorrhization in soybean roots

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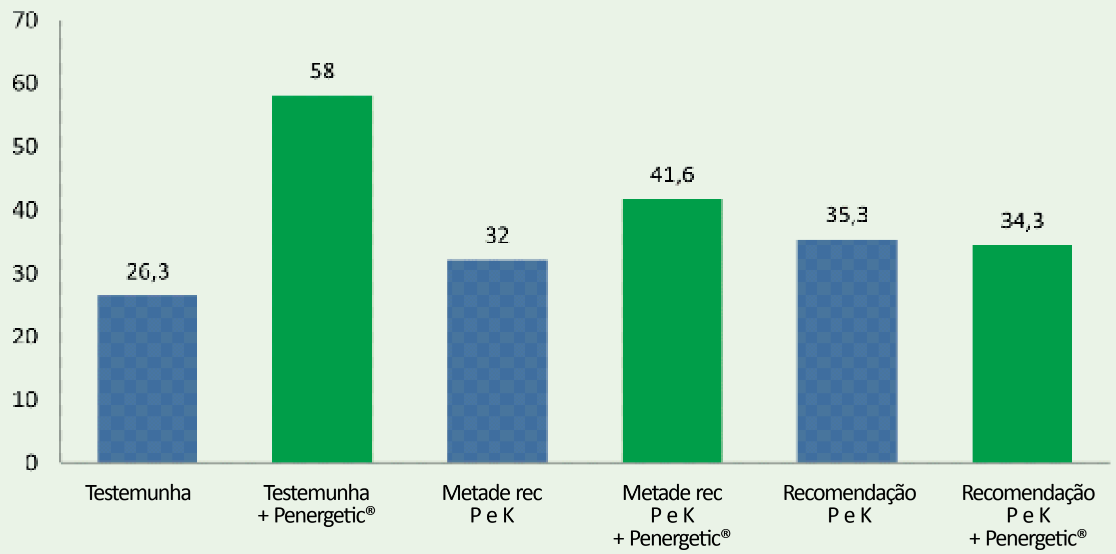
Among the biological relations established in the soil ecosystem, the symbiose between plants and heterotrophic microorganisms, such as the establishment of mycorrhiza, stand out due to the benefits provided to plant production. The Mycorrhizae are considered the symbiosis of greater ecological and economic expression between fungi of the soil and roots of superior plants, representing a mutualistic relationship between the roots of the plant and the fungus, where the fungus provides the plant with a greater area of water and nutrients absorption, such as phosphorus, nitrogen and potassium and some non-fungistatic micronutrients, due to the extent of its hyphae in the soil. The objective of this work was to evaluate the effect of Penergetic® Pflanzene and Penergetic® Kompost on the rate of mycorrhization of soybean plants under greenhouse conditions. For the assessements, pots with a capacity of 5L were filled with 4 kg of soil, in which the following treatments were used: **1)** control; **2)** control with the application of Penergetic®; **3)** application of half the recommended dose of P_2O_5 and K_2O; **4)** application of half the recommended dose of P_2O_5 and K_2O with the application of Penergetic®; **5)** application the recommended dose of P_2O_5 e K_2O; **6)** application the recommended dose of P_2O_5 e K_2O with the application of Penergetic®. The Penergetic® Kompost was applied on the ground seven days before the sowing of soybeans and the Penergetic® Pflanzen applied via foliar phases V3 and R1. During the period of flowering of the crop, a counting and identification of mycorrhizal spores in the soil of each treatment was carried out through the wet sieving method (GERDEMANN and NICHOLSON, 1963) and centrifugation in sucrose solution (JENKINS, 1964). The spores obtained were arranged on slides and visualized under an optical microscope, to identify the species according to their morphological characteristics (INVAM, 2001). In the grain filling stage, the percentage of mycorrhizal colonization was evaluated, where the roots were clarified according to the proposed methodology by KOSKE and GEMMA (1989) and evaluated according to the intersection method proposed by GIOVANETTI and MOSSE (1980). It was observed a greater number of spores in the soil and diversity of genera in the treatments where the application of Penergetic®, except in treatments where we used the recommended dose of P_2O_5 and K_2O, where the content of P may have helped to reduce the presence of spores in the soil. As for mycorrhization, the application of Penergetic® resulted in an increase of 29.41%, 27.86% and 7.84%, in the percentage of root colonization, when compared to the control treatments, half dose and recommended dose of P_2O_5 and K_2O, respectively. Based on the results obtained, it was concluded that the Penergetic® technology provided an increase in the number of mycorrhizal spores, in the soil, and in the percentage of mycorrhizal colonization, in soybean roots.

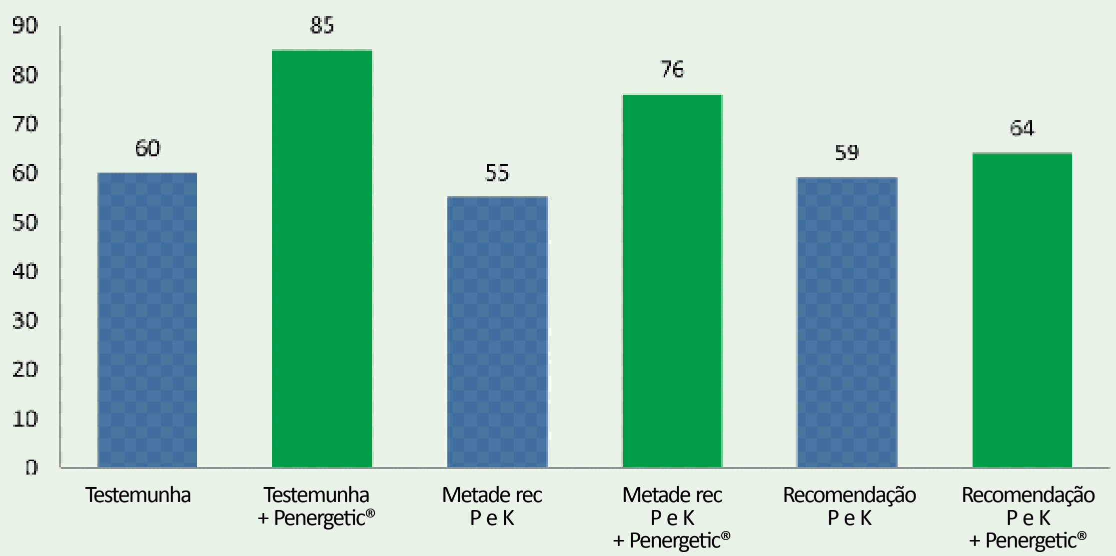
Number of mycorrhizal spores in soil and mycorrhization of roots of soybean plants cv Fepagro 36RR subjected to different treatments

Nº esporos micorrízicos por 100 gramas de solo



Results on soybean flowering - (CV 21.6%)

Micorrização nas raízes (%)



Results on soybean grain filling - (CV 18.66%)

UFSM

Effect of the Penergetic® Pflanzen and Penergetic® Kompost in suppressing of damage caused by nematodes in soybean crops

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Edicarla Trentin - Agronomist, PPG Master's Degree in Soil Science/UFSM
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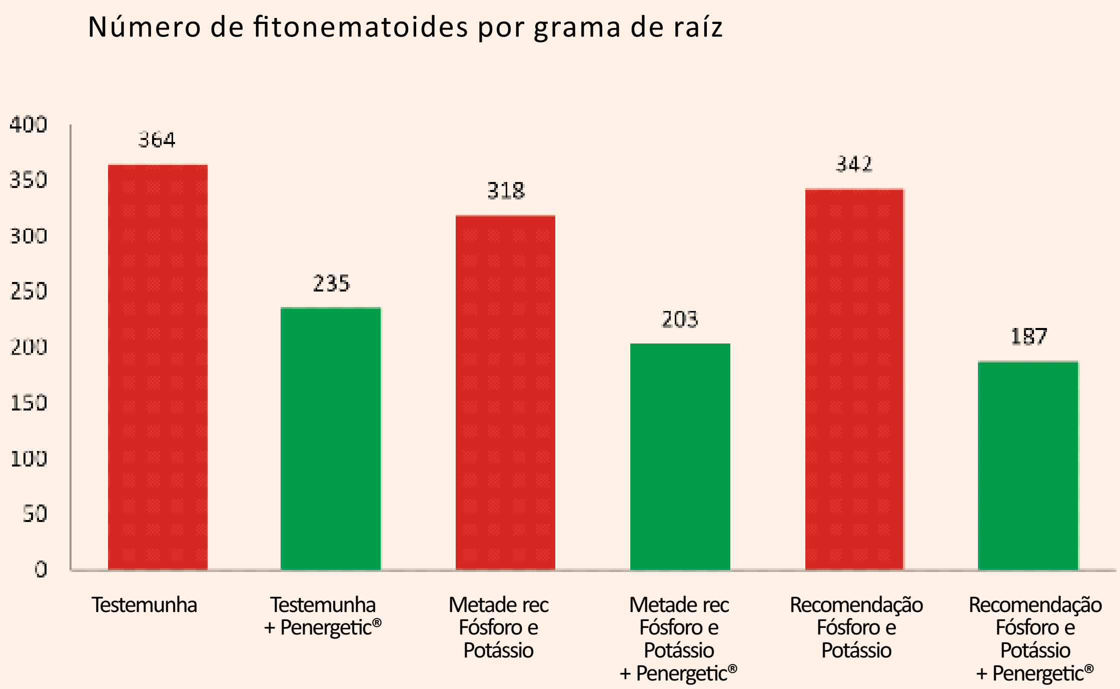
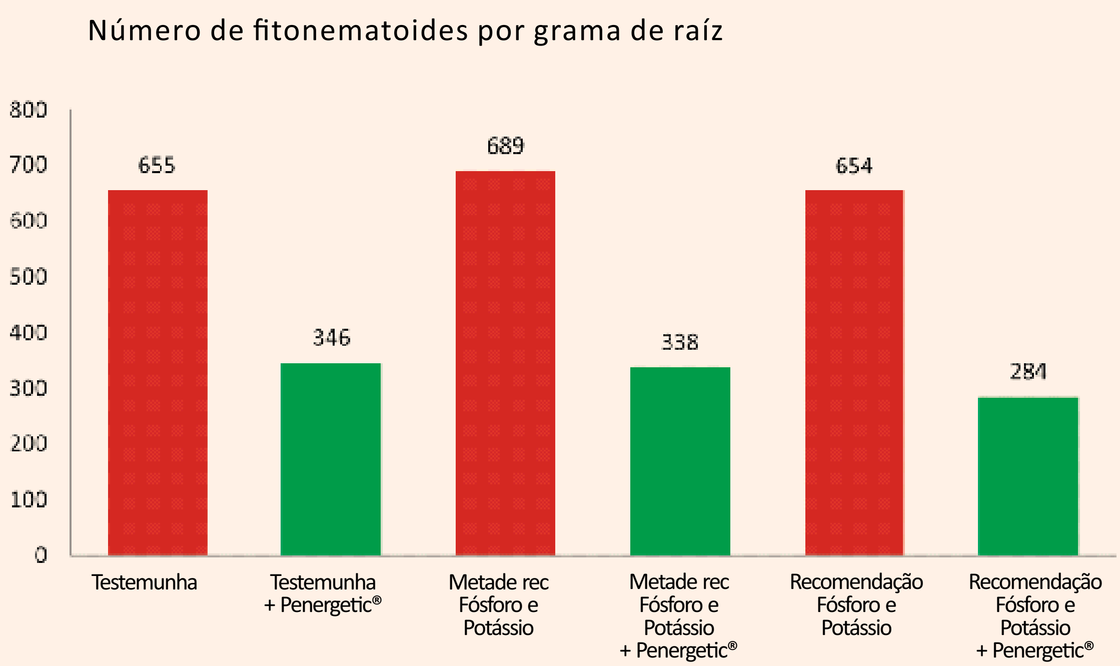
Andressa de Oliveira Silveira - Post-Doctorate in Soil Science, Department of Sanitary and Environmental Engineering/UFSM

The wide geographical distribution, the easy dissemination and interaction with other phytopathogenic organisms place these nematoids among the major pathogens responsible for crop damage. **Currently, the nematode of the species Pratylenchus brachiurus (Godfrey), that causes root lesions, represents one of the main threats to soybean productivity in the southeastern and central-western regions of Brazil.** Due to the presence of complex control, practices or treatments that stimulate the soil microbiota should be included in the phytoematoid management, promoting competition among organisms in the rhizosphere. Among the alternatives, the Penergetic® Pflanzen and the Penergetic® Kompost, constituted of energized bentonite clay, aims at the activation of the soil microbiota, optimizing the interactions between the edaphic organisms. The objective of this study was to evaluate the effects of the Penergetic® Pflanzen and Penergetic® Kompost in the damages caused by P. *brachiurus* in the soy. For this, in greenhouse, plastic vases with capacity of five liters were sown with soybeans cultivar Fepagro 36RR, inoculated with 1750 eggs and juveniles of P. *brachyurus*. Nine treatments were evaluated: **1)** control without the inoculation of the nematode; **2)** control with inoculation of the nematode and without the application of Penergetic®; **3)** Control with inoculation of the nematode and with the application of Penergetic®; **4)** application of the recommended dose of P_2O_5 and K_2O without inoculation of the nematode; **5)** application of the recommended dose of P_2O_5 and K_2O with inoculation of the nematode and without the application of Penergetic®; **6)** application of the recommended dose of P_2O_5 and K_2O with inoculation of the nematode and with the application of Penergetic®; **7)** application of half the recommended dose of P_2O_5 and K2O without the inoculation of the nematode; **8)** application of half the recommended dose of P_2O_5 and K_2O with inoculation of the nematode and without the application of Penergetic®; and **9)** application of half the recommended dose of P_2O_5 and K_2O with inoculation of the nematode and with the application of Penergetic®. The Penergetic® Kompost was applied on the ground seven days before the sowing of soybeans and the Penergetic® Pflanzen applied via foliar phases V3 and R1. During the crop cycle, **it was observed that the use of Penergetic® reduced the typical symptoms of the damage caused by *P. brachyurus* in soybean.** At the end of the crop cycle, it was observed that in the control treatment, the phytonematoid presence resulted in a 13% decrease in the number of pods and a 15% decrease in grain weight per plant, regardless of the application of Penergetic®. When applying the fertilization (half the dose or recommended dose), the use of Penergetic® reduced the damage caused by P. *Brachiurus*, proving to be an efficient tool in the management of phytonematoids in soybean.

Number of phytonematoids penetrated in the roots of soybean plants cv Fepagro 36RR subjected to different treatments



Results on **soybean flowering** - with inoculation of ***Pratylenchus brachyurus***



Results on **soybean grain filling** - with inoculation of ***Pratylenchus brachyurus***

UFSM

Bioenergetic effect of Penergetic® on microbial activity and soil quality

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Rodrigo Josemar Seminoti Jacques - PhD in Soil Science, Professor of the Department of Soils/UFSM
Ricardo Bemfica Steffen - Agronomist, PhD in Soil Science, Post-Doctorate in Soil Science/UFSM
Gerusa Pauli Kist Steffen - Agronomist, PhD in Soil Science, Researcher at Fepagro Florestas, Santa Maria/RS
Antônio Carlos Bassaco - Master in Agrobiology, Technician of the Laboratory of Soil Biology/UFSM

Currently, with the growing demand for food and the rise of the sustainable agriculture model, the great challenge is to meet the need for food production in concomitance with the preservation of natural resources. The use of biostimulating products of the microbial population in the soil and vegetal photosynthetic activity corroborates with the reduction of production costs, environmental degradation, increase of soil quality and crop yield. Thus, the objective of this study was to evaluate the quality of the soil through biological indicators, determination of microbial activity through the basal respiration and activity of several enzymes in the soil, directly related to nutrient cycling. The experiment was conducted during the soybean crop cycle *(Glycine max L.)* the Research Center for Seeds of Fepagro, at Júlio de Castilhos. It was performed four treatments, with three repetitions each: **T1**: control; **T2**: only Penergetic®; **T3**: recommendation of the Rolas for K and P; **T4**: recommendation of the Rolas for K and P + Penergetic®.

Soil sampling was performed at four different times (12/03/2013; 01/13/2014; 03/07/2014 and 04/11/2014) at a depth of 10 cm. The samples were sieved in a 2mm sieve and stored at -4° C. Were determined microbial basal respiration and the activities of enzymes β – Glycosidase, acid phosphatase, urease and FDA hydrolysis, according to the procedures described in Dick et al. (1996) for the first three and second methodology of Adam & Duncan (2001) for the hydrolysis of FDA. The results found for microbial respiration were higher in the third collection, but there was no statistical difference between treatments with and without Penergetic® and chemical fertilization, representing a peak activity of the population of soil microorganisms. Already for the enzymatic activity, the hydrolysis of the FDA and β - Glycosidase didn't present statistical differences between the treatments and the collections, being insensitive to detect variations between the different fertility treatments used. However, **for acid phosphatase there was greater activity in the treatment with Penergetic®** in the second collection, although it didn't have differed from the chemical treatments, with and without addition of Penergetic® (Table 1).

Table 1. The acid phosphatase enzyme activity (µg p-nitrofenol g^{-1} dry soil h^{-1}) in samples collected before sowing and at 30, 90 and 120 days after the emergence of soybean.

Tratamentos	Antes da semeadura	30 dias	90 dias	120 dias
Testemunha	334,06 ^{ns}	369,16 b	406,76 ^{ns}	423,36 ^{ns}
Penergetic®	415,40 ^{ns}	468,06 a	449,83 ^{ns}	365,80 ^{ns}
Recomendação de P	413,80 ^{ns}	429,03 ab	457,36 ^{ns}	373,30 ^{ns}
Recomendação de P + Penergetic®	409,83 ^{ns}	407,07 ab	425,60 ^{ns}	428,43 ^{ns}
CV %	5,96	3,86	3,06	4,09

^{ns} diferença não significativa.

On the other hand, the enzyme urease showed a tendency of greater activity in the treatment with Penergetic® in the third collection, not differing from the chemical treatment (Table 2).

Table 2. The urease enzyme activity (µg $N\text{-}NH_4$ g^{-1} dry soil $2h^{-1}$) in samples collected before sowing and at 30, 90 and 120 days after the emergence of soybean.

Tratamentos	Antes da semeadura	30 dias	90 dias	120 dias
Testemunha	57,35 ^{ns}	75,54 ^{ns}	100,86 b	79,46 ^{ns}
Penergetic®	63,27 ^{ns}	75,79 ^{ns}	128,96 a	70,90 ^{ns}
Recomendação de P	71,91 ^{ns}	74,71 ^{ns}	123,33 a	87,40 ^{ns}
Recomendação de P + Penergetic®	70,98 ^{ns}	75,09 ^{ns}	101,03 b	78,90 ^{ns}
CV %	6,28	3,12	2,11	10,41

^{ns} diferença não significativa.

Thus, the phosphatase and urease enzymes tended to be more sensitive to the effects of the application of soil fertilization treatment. **The Penergetic® presented itself as an efficient bioactivation tool for microbial activity.** However, in order to prove the results, it is necessary to continue the tests in the same soil, to observe the behavior of the microbial population of the same, including in other agricultural crops.

Biological activity and persistence of cultural residues deposited on the soil surface, submitted to the application of Penergetic®

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Edicarla Trentin - Agronomist, PPG Master's Degree in Soil Science/UFSM
Zaida Inês Antoniolli - PhD in Ecology Of Mycorrhizal Molecular Aspects, Professor of the Department of Soils/UFSM
Rodrigo Josemar Seminoti Jacques - PhD in Soil Science, Professor of the Department of Soils/UFSM

The food activity of the edaphic community, and the speed of decomposition of cultural residues deposited on the soil, are factors that directly interfere in the dynamics of nutrient cycling and in the management of agricultural crops. The work had as objectives: **1)** To determine the persistence of different cultural residues and residue size in soybean cultivation that received application of Penergetic® during the crop cycle and **2)** evaluate the effects of the application of Penergetic® on the food activity of the edaphic community. The tests were conducted at Júlio de Castilhos (RS) during the cultivation of soybean cultivar Fepagro 36 submitted to different forms of fertilization and doses of Penergetic®. The treatments applied in the field were: **1)** Control (without application of Penergetic® and mineral fertilization); **2)** Application of Penergetic® as recommended by the manufacturer; **3)** Phosphorus (P) and potassium (K) application as recommended in the Manual of Fertilization and Liming for the States of RS and SC, and **4)** application of Penergetic® and mineral fertilization (P and K). To evaluate the persistence of the residues, the ***litter bags*** or decomposition sacks were used. The residues of wheat crops were manually cut with scissors and the ryegrass were mechanically crushed in a grinder. Changes in the feeding activity of the fauna were evaluated through the use of ***bait-slides.*** After 21 days, the slides were removed from the soil and evaluated for the state of perforations, the holes being classified as empty, partially empty or filled. Differences were observed in the persistence and rate of degradation of both residues, in the different treatments, over the 120 days.

Table 1. Persistence of wheat straw and ryegrass residues at 30, 60, 90 and 120 days after the emergence of soybean, using the methodology of the decomposition bags *(litter bags)*. Averages of five repetitions

Tratamentos	Persistência da palhada (%)			
	Palha de azevém[1]			
	30	60	90	120
Testemunha	95,23 a[3]	84,27 b	69,34 ab	72,08 a
Penergetic®	95,62 a	86,02 a	67,69 b	66,75 c
Recomendação de P	94,43 ab	84,58 b	71,14 a	70,16 b
Rec. de P + Penergetic®	92,91 b	85,61 a	71,00 a	72,17 a
CV (%)	26,14	24,54	18,21	17,45
	Palha de trigo[2]			
Testemunha	97,76 ^{ns}	87,58 a	73,49 a	74,15 a
Penergetic®	97,56 ^{ns}	84,58 b	68,56 b	69,74 b
Recomendação de P	97,15 ^{ns}	83,84 b	70,30 b	65,34 c
Rec. de P + Penergetic®	98,88 ^{ns}	84,56 b	73,89 a	69,96 b
CV (%)	21,13	16,70	20,05	18,32

[1]Ground straw. [2]Cut straw.

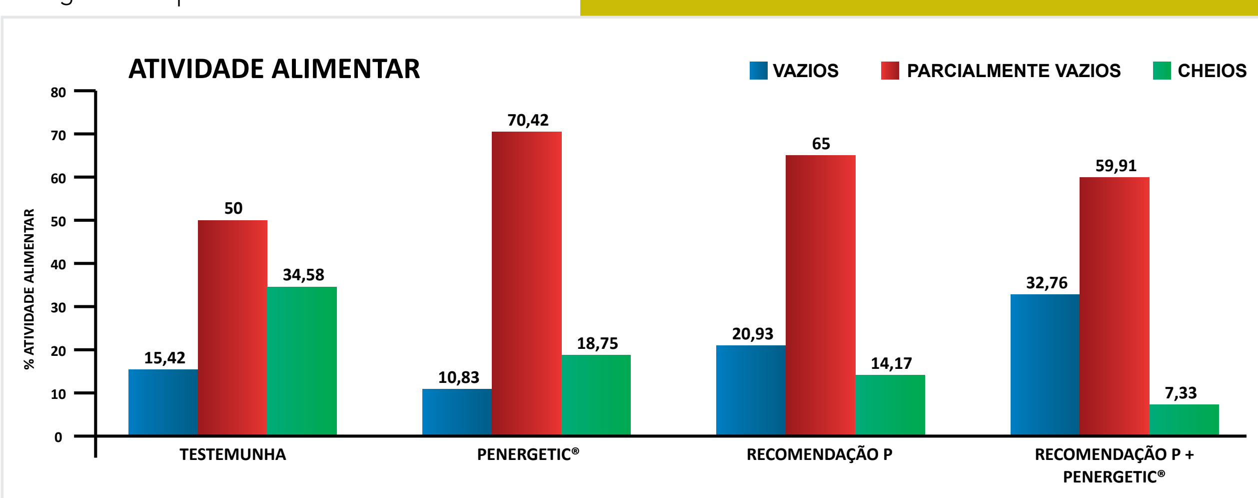
[3]Averages followed by the same letter in the columns do not differ from each other by the Tukey test at 10% probability.

^{ns} no significant difference.

Higher rate of degradation was observed up to 90 days. The size of the residue interfered with the persistence rate in the field. The shredded ryegrass straw persisted less, indicating a higher rate of degradation. At 120 days, the highest degradation rate of ryegrass residues occurred in the treatment 2, corresponding to the addition of only Penergetic®, whereas for wheat residues, the highest rates occurred in treatments 2 and 3. Significant differences were observed between treatments in the activity of organisms inhabiting the topsoil at 0-8cm (Figure 1).

The control plots presented higher percentage of filled holes (34.58%), indicating less biological activity. The plots in which was added only Penergetic® presented a higher percentage of partially empty holes (70.42%). **The corresponding treatment to the application of fertilizers (P and K) with the Penergetic® resulted in increased biological activity in the soil, a result evidenced by the lower percentage of filled holes (7.33%) and a higher percentage of empty holes (32.76%) compared to the other treatments. The application of Penergetic® together with soil fertility correction favored biological and microbiological activity, reducing the rate of persistence of residues on the surface.**

Figure 1. Feeding activity of soil organisms cultivated with soybean, evaluated using the *bait-slide* methodology in the 0-8 cm soil layer. Average of 30 repetitions.



Effect of Penergetic® Pflanzen and Penergetic® Kompost in the mycorrhization and the penetration of phytonematoids in wheat roots

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Rodrigo Josemar Seminoti Jacques - PhD in Soil Sciencem, Professor of the Department of Soils/UFSM.
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Juliane Schmitt - Biologist, PPG Master's Degree in Soil Science/UFSM.
Antônio Carlos Bassaco - Master in Agrobiology, Technician of the Laboratory of Soil Biology/UFSM.

INTRODUCTION

Mycorrhizae are mutualistic associations between some soil fungi and a wide variety of plants. In addition to the greater absorption of nutrients, the mycorrhizal symbiosis gives the plants other benefits such as: greater efficiency in nodulation and biological nitrogen fixation; immobilization of heavy metals; optimization in water use; improvements in soil structure, reduction of biotic and abiotic stresses, etc.

PURPOSE

The objective of the present work was to determine the effect of Penergetic® technology, associated or not with chemical fertilization, on mycorrhization and on the penetration of phytonematoids in the roots of wheat plants.

METHODOLOGY

The experiment was conducted in the greenhouse in the Department of Soils of UFSM, Santa Maria, RS. For the cultivation of wheat, a Red Dystrophic Latosoil, collected in the municipality of Catuípe/RS. The soil was packed in polyethylene pots with a capacity of 5,000 mL, containing 4,000 g of soil. The Penergetic® was applied at the doses and times recommended by the manufacturer. The fertilization of the crop followed the indications of the Manual of Fertilization and Liming and wheat sowing of cultivar Quartz was carried out on the 07/23/2014, placing 15 seeds per pot, and 10 days after the emergence the thinning was done, leaving 10 plants per pot. The experiment consisted of six treatments with four repetitions, arranged in a completely randomized design:

T1 = Testemunha

T2 = Penergetic®

T3 = Half of NPK recommendation

T4 = Half of NPK recommendation + Penergetic®.

T5 = NPK recommendation according to the Manual of Fertilization

T6 = NPK recommendation + Penergetic®

The treatments were conducted in the presence and absence of nematodes, which were inoculated in the soybean crop predecessor. In the period of flowering of the crop, five plants per repetition were collected, and the samples of roots used to determine the percentage of mycorrhizal colonization and penetration of nematodes. The averages were compared by the Tukey test, at 5% probability, using the SISVAR statistical program.

RESULTS

Mycorrhizal colonization

The percentage of mycorrhization of wheat roots was influenced by the addition of phosphorus in the soil, and by the use of Penergetic®, although statistical differences were not observed (Table 1).

Table 1. Percentage of mycorrhizal colonization in the roots of flowering wheat plants, submitted to different treatments and grown in a greenhouse in the presence and absence of the phytonematode *Pratylenchus brachyurus.*

Tratamentos	Sem	Com
T1 - Testemunha	80,00 aA	70,00 ^{ns}B
T2 - Penergetic®	73,75 abB	86,25 ^{ns}A
T3 - Metade Rec. NPK	62,50 abA	61,25 ^{ns}A
T4 - Metade Rec. NPK + Penergetic®	76,25 aA	76,25 ^{ns}A
T5 - Recomendação NPK	41,25 bB	60,00 ^{ns}A
T6 - Recomendação NPK + Penergetic®	55,00 abB	66,25 ^{ns}A
CV%	**12,27**	**9,52**

^{ns} no significant difference.

Averages followed by the same letter, lowercase in the columns and upper case in the lines, do not differ from one another, by the Turkey test at 5% probability.

However, the presence of nematodes in the soil proved not to influence the mycorrhization roots. The average of treatments, mycorrhizal colonization was 78%, 69% and 56%, respectively, in treatments without addition of phosphorus, with half the dose and at the recommended dose. In the comparisons of the averages between pairs of treatments, it is observed that **this technology increased the percentage of colonization by 13%, except for the treatments of control and Penergetic®, in the absence of nematodes.**

Penetration of phytonematodes

The Penergetic® technology has been shown to reduce the penetration of the Pratylenchus brachyurus nematodes in wheat roots, except for the treatment with NPK Recommendation (Figure 1). **In the comparison between the treatments of control and Penergetic®, there was a 54% reduction in nematode penetration and in the comparison between treatments with half of the NPK recommendation, the reduction was 43% due to the application of Penergetic®. According to the observed results, it is possible that the Penergetic® technology results in greater activity of the rhizosphere microorganisms, which, in turn, form a biological barrier around the root, protecting it from the attack of pathogens.**

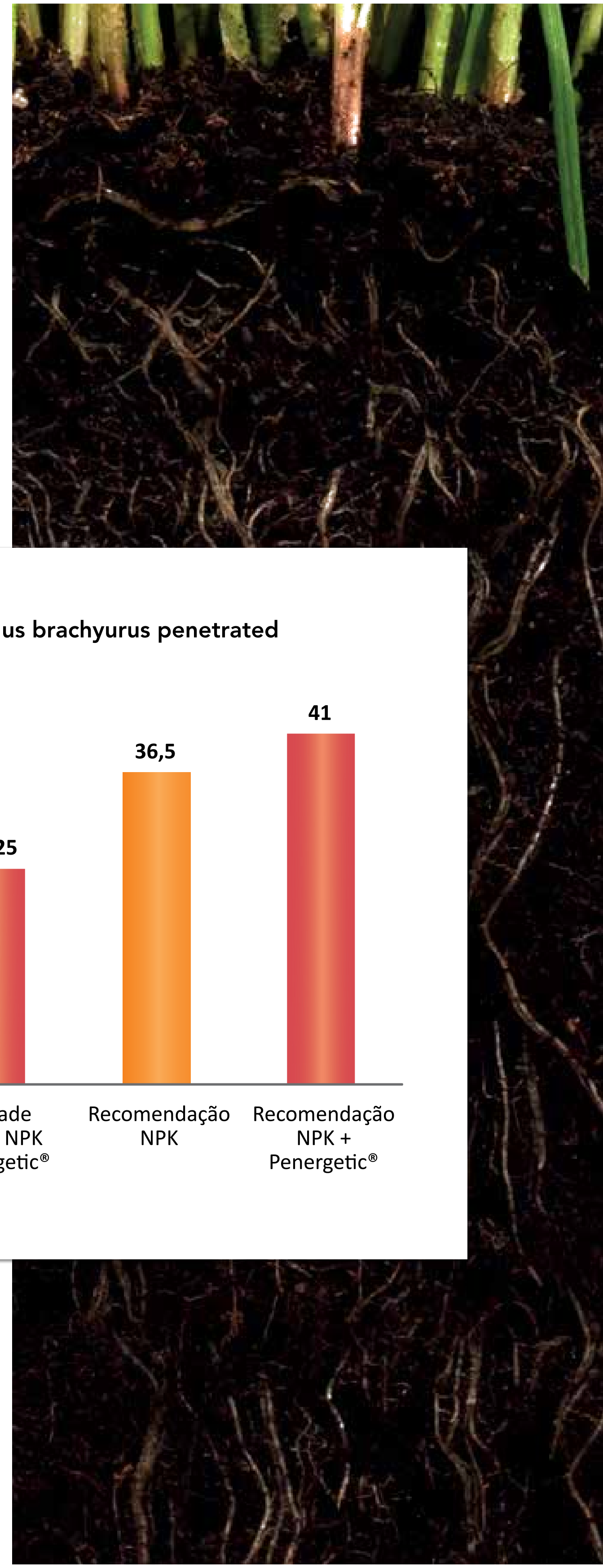
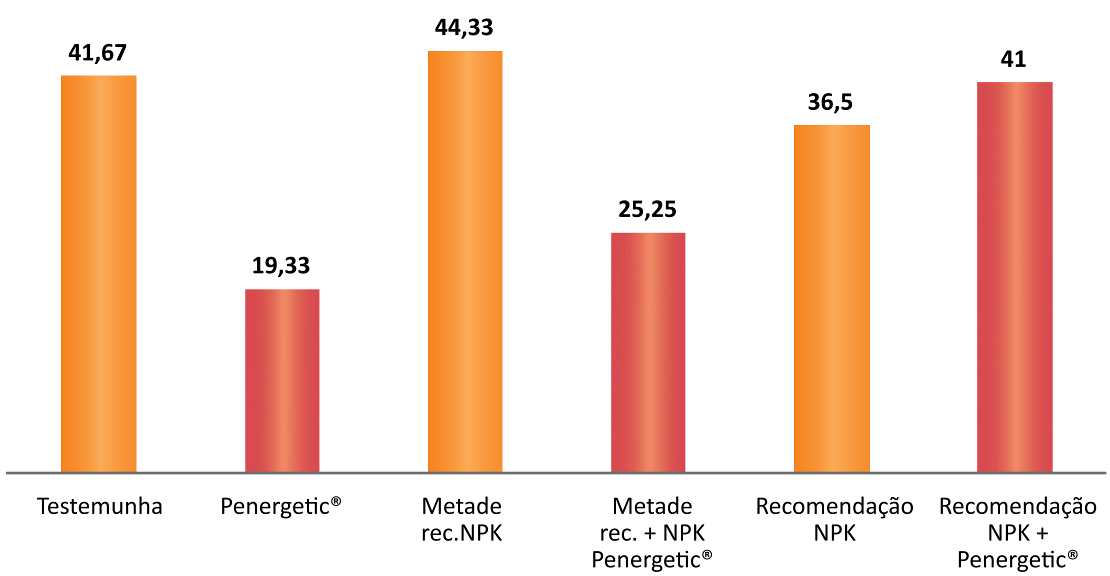


Figure 1 – Number of nematode Pratylenchus brachyurus penetrated



CONCLUSIONS

The application of Penergetic® increased mycorrhizal colonization by wheat plants by 13%, even when the soil was fertilized with phosphorus at the recommended dose or with half of it, although statistical differences were not observed. For most treatments, **Penergetic® technology reduced the penetration of *Pratylenchus brachyurus* nematodes in wheat roots, by approximately 50%.** The results indicate that the use of Penergetic® Pflanzen and Penergetic® Kompost can stimulate mycorrhization and reduce the penetration of the phytonematode in wheat roots.

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Effect of Penergetic® Pflanzen and Penergetic® Kompost in the activity of the soil microorganisms in a wheat crop

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INTRODUCTION

Conventional agriculture is characterized by the massive adoption of chemical inputs, without concern for the environmental impacts. The impacts caused by the agriculture due to the inappropriate and continuous use of fertilizers and pesticides are not restricted to the pedosphere, being able to reach the whole ecosystem of the planet. In this sense, a significant innovation effort has been made to replace the expensive and environmentally degrading inputs with inputs that are efficient, low cost and less aggressive to the environment and to man. Among these, it stands out the Penergetic®, which is recommended to increase the photosynthetic efficiency of plants (Penergetic® Pflanzen) and to optimize the decomposition of organic matter by the activation of soil microorganisms (Penergetic® Kompost). In the evaluation of this input in the crops, it is fundamental to use microbiological indicators of soil quality, since the Penergetic® is a product that seeks to activate the microorganisms.

PURPOSE

The objective of this work was to determine the effect of the Penergetic® application, associated or not with chemical fertilization, in the microorganism activity of the soil of a wheat crop, through the evaluation of microbiological indicators basal respiration, content of C, N and P in microbial biomass, and activity of β-glicosidase, acid phosphatase and urease enzymes.

METHODOLOGY

The cultivation of wheat, cultivar Quartz (average cycle), It was conducted from June 2014 to November 2014, the Research Center for Seeds of the Agricultural Research State Foundation (FEPAGRO), in the city of Júlio de Castilhos/RS, under the responsibility of Dr. Madalena Boeni. The cultivation was followed by the official recommendations of the Technical Information for Wheat and Triticale, with a seed density of 170 kg of seeds ha^{-1}, in a direct seeding system. The experiment was carried out in a Dystrophic Red Latosoil, with plots of 7 x 50 meters, in a scheme of three randomized blocks, in which the six treatments were allocated:

T1 = Control;

T2 = Penergetic®;

T3 = NPK recommendation according to the Manual of Fertilization;

T4 = NPK recommendation according to the Manual of Fertilization + Penergetic®;

T5 = 30Kg of P_2O_5;

T6 = 30Kg of P_2O_5 + Penergetic®.

The fertilization recommendation was performed according to the assessement of soil fertility and recommended an average productivity of 4 t ha^{-1} of wheat, was composed of 60 Kg ha^{-1} of P_2O_5 and 40 Kg ha^{-1} of K_2O. All treatments received 20 kg ha^{-1} of N at sowing and 80 kg ha^{-1} of nitrogen in the form of urea: 60% Of the dose in the stages V3 - V4, beginning of the crop tillering (07/18/2014); and 40% of the dose in V7, beginning of the stretching (08/07/2014)

During the course of the experiment were performed 4 soil samplings for microbiological analyzes at approximately 30 (07/22/2014), 60 (08/29/2014), 90 (09/25/2014) and 120 (10/23/2014) days after wheat sowing. All the results were submitted to analysis of variance (ANOVA), through software Sisvar, and the averages of the treatments were compared to each other by the Tukey test, at 5% probability ($P<0,05$).

RESULTS

Basal soil respiration

The basal respiration is proportional to the activity of aerobic microorganisms in the soil, which, in most cases, degrade organic matter, using O_2 as the final electron acceptor and releasing CO_2. Thus, it is assumed that, the greater the CO_2 production of a soil, the greater the activity of microorganisms. **The highest rate of respiration of soil microorganisms occurred in samples collected at 60 days after wheat sowing, at which time the Penergetic® stimulated the microbial activity of the soil, proven in the comparison of treatments of control and Penergetic®.** This trend was maintained until the end of the experiment, but no statistical differences were observed. **It is noteworthy that the 60-day Penergetic® treatment presented the highest C-CO_2 production among all the evaluations performed.** At 90 and 120 days after sowing the plants, all treatments with Penergetic® showed higher basal respiration levels than its equal without Penergetic®, but these differences were not statistically significant but **showed a tendency to stimulate microbial activity in the soil when using this technology.**

Soil Microbial Biomass

The microbial biomass is an indicative of the stock of C, N and P, that is in fast cycling in the soil. **The values of C of the microbial biomass of the soil were higher in the 60 days collection, and in the treatment with the application of 30 kg of P_2O_5 + Penergetic®, in all collection seasons.** Without showing statistical differences, the comparison of the treatments of control and Penergetic®, shows that there was little incentive to increase the C content in microbial biomass of the soil by the application of this product at 30 and 60 days after sowing wheat. Treatment with the NPK Recommendation showed no significant differences in any of the periods evaluated. **The treatment of 30kg of P_2O_5 + Penergetic® this was higher in all times sampled to the treatment of 30kg of P_2O_5, with statistical differences in collections of 30 and 90 days.** The N content in microbial biomass of the soil was followed the same trend as the C of the biomass, and the treatment of 30kg of P_2O_5 + Penergetic® was superior to the others, from the beginning of the analysis until the end of the experiment. **Even without showing the statistical differences in most comparisons between treatments, it is observed that the application of Penergetic® resulted in increases of the P content in microbial biomass of the soil.**

Enzyme Activity in the Soil

The greater the activity of β-glycosidase, the greater the degradation activity of soil residues by the microorganisms. The major activities of the β-glycosidase enzyme were observed again in the collection performed at 60 days. The phosphatases catalyze the hydrolysis of organic phosphorus to inorganic phosphorus (PO4-2), making it available to plants. The quantification of the activity of this enzyme can provide a potential index of phosphorus mineralization in a given soil. **In the collection at the 30 days after sowing the wheat crop, all treatments with Penergetic® showed higher activity of the enzyme phosphatase in relation to treatments without Penergetic®, which are statistically significant differences** (Table 1).

Table 1. The acid phosphatase enzyme activity (µg p-nitrofenol g^{-1} dry soil h^{-1}) in samples collected at 60, 90 and 120 days after the wheat sowing.

Tratamentos	30 dias	60 dias	90 dias	120 dias
Testemunha	595,91 b	618,04 ns	635,02 ns	574,50 ab
Penergetic®	637,76 a	678,23 ns	678,60 ns	643,77 a
Recomendação NPK	566,32 c	707,17 ns	593,09 ns	547,89 b
Rec. NPK + Penergetic®	624,75 ab	693,64 ns	666,77 ns	546,48 b
30 kg de P_2O_5	545,24 c	609,26 ns	616,24 ns	543,48 b
30 kg de P_2O_5 + Penergetic®	643,39 a	634,79 ns	552,84 ns	631,65 ab
CV %	1,72	8,48	9,30	5,59

ns não significativo

The ureases enzymes act on the N cycle, contributing to the release of inorganic N for absorption by plants. In the collection of 60 and 90 days, we observe higher urease activity in all treatments with Penergetic® when compared to treatments without Penergetic®, although there were no statistical differences. In the last collection, it was observed that the Penergetic® stimulated the activity of the urease enzyme in the three comparisons between treatments with and without this product, these differences being statistically significant (Table 2).

Table 2. The acid urease enzyme activity (µg N-NH4 g^{-1} dry soil $2h^{-1}$) in samples collected at 60, 90 and 120 days after the wheat sowing.

Tratamentos	30 dias	60 dias	90 dias	120 dias
Testemunha	101,52 a	99,83 ^{ns}	95,78 ^{ns}	33,56 cd
Penergetic®	86,49 b	102,17 ^{ns}	99,48 ^{ns}	41,67 b
Recomendação NPK	103,04 a	98,66 ^{ns}	83,47 ^{ns}	31,12 d
Rec. NPK + Penergetic®	96,35 ab	110,53 ^{ns}	84,58 ^{ns}	44,93 b
30 kg de P_2O_5	107,22 a	105,63 ^{ns}	101,15 ^{ns}	38,25 bc
30 kg de P_2O_5 + Penergetic®	107,52 a	110,26 ^{ns}	103,89 ^{ns}	53,50 a
CV %	**4,82**	**9,58**	**8,41**	**5,89**

ns não significativo

CONCLUSION

The use of the Penergetic®, associated or not with mineral fertilization, stimulated the activity of the phosphatase enzyme 30 days after wheat sowing. Basal respiration of the soil was stimulated by Penergetic®, without the application of mineral fertilization, at 60 days after wheat sowing. The Penergetic®, stimulated the activity of the urease enzyme 120 days after wheat sowing when associated or not with mineral fertilization. **For all the microbiological indicators analyzed, it was observed that in the great majority of the comparisons between the treatments, with and without the application of Penergetic®, there was a stimulus to the activity of the soil microorganisms by this product.** In many cases, there were no statistical differences, because these numerical differences were not high or because the coefficient of variation (CV%) was high, intrinsic characteristic of the microbiological analyzes of samples collected in field experiments, where the natural heterogeneity of the soil becomes evident.

Effect of Penergetic® Pflanzen and Penergetic® Kompost in the production components of wheat grown in the presence and absence of nematodes

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INTRODUCTION

Wheat is the second most produced cereal in the world, after maize, with a production of 712.7 million tons in the crop of 2013/2014. The wheat crop has great potential for expansion, given the enormous domestic market for the commercialization of this production. The Penergetic® is a product recommended to optimize the decomposition of organic matter in the soil by the activation of microorganisms (Penergetic® Kompost) and increasing the photosynthetic efficiency of plants (Penergetic® Pflanzen), which can bring improvements to wheat yield, since it can make the plant better nourished and less susceptible to attack by phytopathogens.

PURPOSE

Evaluate the effect of Penergetic® Pflanzen and Penergetic® Kompost on the production components of wheat grown in the presence and absence of Phytonematodes that cause root lesions, of the genus *Pratylenchus spp.*

METHODOLOGY

The experiment was conducted in the greenhouse in the Department of Soils of UFSM, Santa Maria/RS. For the cultivation of wheat, the Red Dystrophic Latosoil, collected in the municipality of Catuípe/RS, which in the crop of 2013/2014 was used in a soybean cultivation experiment with Penergetic®. The Penergetic® was applied at the doses and times recommended by the manufacturer. The fertilization of the crop followed the indications of the Manual of Fertilization and Liming. The wheat sowing of cultivar Quartz was carried out on the 07/23/2014, placing 15 seeds per pot, and 10 days after the emergence the thinning was done, leaving 10 plants per pot. The experiment consisted of six treatments with four repetitions, arranged in a completely randomized design.

T1 = Control

T2 = Penergetic®

T3 = Half of NPK recommendation

T4 = Half of NPK recommendation + Penergetic®.

T5 = NPK recommendation according to the Manual of Fertilization

T6 = NPK recommendation + Penergetic®

The inoculum was composed of pure populations of *Pratylenchus brachyurus* obtained from the species-specific isolation, carried out by Agrolab/GO. During the flowering and ripening period of the wheat, five plants were collected in each of these periods, for the evaluation of yield components; Diameter of stem, height of plants (from the stem to the spike disregarding the edges), dry shoot biomass, number of grains and dry mass of grains. The obtained data were submitted to analysis of variance and test of averages, according to Tukey at the level of significance of 5%, by SISVAR software.

RESULTS

In the flowering period, the use of Penergetic® tended to reduce the stem diameter of the plants cultivated in the absence of nematodes, with statistical differences between the treatments of Control and Penergetic®. In the presence of nematodes, the use of Penergetic® resulted in a higher stem diameter, in all comparisons between treatments with and without this product, with statistical difference only in the comparison between treatments of Control and Penergetic®. The use of Penergetic® tended to increase the phytomass of the aerial part of the wheat plants in the flowering, when cultivated in the presence and absence of the phytonematodes. It is worth noting that Penergetic® was able to prevent the effects of nematodes in the reduction of the phytomass, although without presenting statistical differences, because statistically significant reductions in the accumulation of phytomass were only observed in the treatments without Penergetic®. In all comparisons between the treatments, with and without Penergetic®, there was a tendency of increasing the number and the mass of grains in the plants cultivated in the presence of this technology, both in the presence and absence of nematodes, except for the comparison between treatments control and Penergetic® without the presence of nematodes. It is noteworthy that in all treatments without Penergetic®, with the exception of the half of rec. NPK in the grain mass, the presence of the nematodes statistically reduced the number and mass of grains per plant, but in the presence of this technology these components were statistically increased or reduced in a small degree, so as not to present statistical differences between plants grown with and without nematodes. This demonstrates again the protective effect of Penergetic®, reducing the malefic effects of phytonematodes in wheat plants.

CONCLUSIONS

The use of Penergetic® technology, associated or not with mineral fertilization, tended to increase the height and phytomass of wheat plants in flowering and the number and mass of grains, both in the presence and the absence of phytonematodes, but these increases were not statistically significant. The phytonematodes caused statistically significant reductions in height, phytomass, number and mass of grains only in wheat plants grown without Penergetic® technology, the Penergetic® acted in a way to minimize the evil effects of the nematodes of the genus Pratylenchus on the components of wheat production.

Effect of Tecnologia Penergetic® Technology on the rate of decomposition of ryegrass crop residues *(Lolium multiflorum Lam.)*

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INTRODUCTION

The organisms and microorganisms present in the soil are the main agents of the biochemical activity that occurs in the agricultural systems, being directly involved in all the biological processes that provide the cycling and the availability of the nutrients, contained in organic residues, for the plants (González et al., 2001). In this sense, practices able to provide biostimulation of these agents on the soil, promote direct benefits of the nutrient cycling and productivity of agricultural crops. The objective of this work was to determine the effect of the Penergetic® technology, associated to different levels of fertilization in wheat, on the rate of decomposition of ryegrass crop residues.

MATERIAL AND METHODS

The rate of degradation of ryegrass crop residues was determined during the cultivation of wheat cultivar Quartzo, using the methodology of "decomposition bags" (Thomas & Asakawa, 1993) or "litter bags" (Rezende et al., 1999; Amado et al., 2002). The test was conducted at Fepagro Sementes, at Júlio de Castilhos (RS). Six field treatments were used and one natural control: **T1** = control without fertilizer; **T2** = control + Penergetic®; **T3** = phosphorus and potassium recommendation by CQFS-RS/SC; **T4** = phosphorus and potassium recommendation by CQFS-RS/SC + Penergetic®; **T5** = 30 Kg of P_2O_5; **T6** = 30 Kg of P_2O_5 + Penergetic®; **T7** = native bush (natural control). The dosage of Penergetic® Kompost and Penergetic® Pflanzen, applied in wheat was 250g ha^{-1}.

The decomposition bags were made of voile fabric (20x10 cm) and filled with approximately 25g of ryegrass crop residues. These residues were collected in the field, dried at room temperature and ground in a silage mill. The decomposition bags were randomly distributed over the soil in experimental plots. In the 110-day period, five bags of decomposition were removed from each field treatment, and three bags were removed from the native forest, at each collection in the interval of 0, 30, 60, 90 and 110 days. The material was taken to the laboratory to evaluate the mass loss, where it was submitted to external washing in running water, for the removal of impurities (soil particles) and drying in a greenhouse with forced aeration at 65° C until reaching constant weight. Afterwards, the bags were weighed on analytical balance to determine the progressive loss of mass of the residues.

RESULTS AND DISCUSSION

The percentage of persistence of the cultural residues of ryegrass decreased during the 110 days of evaluation, with the highest rates of decomposition occurring up to 60 days, evidenced by the greater loss of mass of the residues inside the decomposition bags. Higher values of persistence of straw in the field indicate a lower rate of decomposition (Table 1).

Table 1. Persistence of ryegrass crop residues at 30, 60, 90 and 110 days after the emergence of wheat (cultivar Quartzo), using the methodology of the decomposition bags *(litter bags)*. Average of repetitions.

Tratamentos	Persistência da palhada (%)			
	30	60	90	**110**
Testemunha	93,63 a	69,29 ab	68,86 ab	**68,97 a**
Testemunha + Penergetic®	77,04 c	73,09 ab	68,67 ab	**63,60 a**
Recom. adubação CQFS-RS/SC	87,01 b	66,69 b	67,54 ab	**64,21 a**
Recom. adubação CQFS-RS/SC + Penergetic®	86,44 b	72,43 ab	74,53 a	**70,08 a**
30 kg P_2O_5	86,53 b	71,56 ab	70,84 ab	**65,60 a**
30 kg P_2O_5 + Penergetic®	85,33 b	75,59 a	67,00 ab	**66,21 a**
Mato nativo	82,86 b	72,47 ab	66,00 b	**63,00 a**
CV (%)	**3,60**	**6,49**	**6,44**	**9,83**

[1]*Averages followed by the same letter in the columns do not differ from each other by the Tukey test at 10% probability..*

During the first 30 days of evaluation, the highest value of persistence of straw was observed in the control treatment, indicating lower rate of decomposition. **The treatment that provided the lowest residue persistence was the control + Penergetic®, which differed statistically from the other treatments.** After 90 days of evaluation, no treatment effect was observed on the persistence of ryegrass residues, in the plots cultivated with wheat and in the native forest area (Table 1).

The straw decomposition coefficient expresses the number of grams of residue that has been degraded daily, for each gram of straw present inside the decomposition bag. At 30 days, the data of the decomposition coefficient (Table 2) confirmed the results of persistence of ryegrass residues (Table 1), indicating a higher rate of degradation in the control treatment + Penergetic® and lower rate of degradation in the control treatment (Table 2).

Table 2. Decomposition coefficient of ryegrass crop residues at 30, 60, 90 and 110 days after the emergence of wheat (cultivar Quartzo), using the methodology of the decomposition bags *(litter bags)*. Average of repetitions.

Tratamentos	K (g dia^{-1})			
	30	60	90	**110**
Testemunha	0,053 c	0,251 ab	0,267 a	**0,273 a**
Testemunha + Penergetic®	0,190 a	0,230 ab	0,271 a	**0,309 a**
Recom. adubação CQFS-RS/SC	0,113 b	0,291 a	0,284 a	**0,310 a**
Recom. adubação CQFS-RS/SC + Penergetic®	0,117 b	0,238 ab	0,224 a	**0,257 a**
30 kg P_2O_5	0,114 b	0,243 ab	0,254 a	**0,295 a**
30 kg P_2O_5 + Penergetic®	0,124 b	0,206 b	0,280 a	**0,286 a**
Mato nativo	0,145 b	0,224 ab	0,288 a	**0,315 a**
CV (%)	**21,19**	**16,98**	**15,47**	**20,61**

[1]*Averages followed by the same letter in the columns do not differ from each other by the Tukey test at 10% probability.*

In the same period, no significant differences were observed between the treatments that received fertilization, according to the recommendation of the CQFS-RS/SC with and without application of Penergetic®, treatments with the addition of 30 kg P_2O_5 with and without addition of Penergetic® and native bush area (Table 2). Another way to evaluate the effect of the application of Penergetic® and phosphate and potassium fertilization on the decomposition dynamics of the different cultural residues is through the calculation of accumulated decomposition over time. The values expressed in Table 3 indicate, for each evaluated period, the average value of grams of straw decomposed in each treatment, considering the initial number of grams added in each experimental unit.

Table 3. Cumulative Decomposition of ryegrass crop residues at 30, 60, 90 and 110 days after the emergence of wheat (cultivar Quartzo), using the methodology of the decomposition bags *(litter bags)*. Average of repetitions.

Tratamentos	Decomposição (g)			
	30	60	90	**110**
Testemunha	1,59 c	7,52 ab	8,01 a	**8,20 a**
Testemunha + Penergetic®	5,69 a	6,90 ab	8,13 a	**9,27 a**
Recom. adubação CQFS-RS/SC	3,38 b	8,72 a	8,51 a	**9,29 a**
Recom. adubação CQFS-RS/SC + Penergetic®	3,50 b	7,15 ab	6,71 a	**7,71 a**
30 kg P_2O_5	3,42 b	7,30 ab	7,63 a	**8,84 a**
30 kg P_2O_5 + Penergetic®	3,73 b	6,18 b	8,40 a	**8,58 a**
Mato nativo	4,34 ab	6,73 ab	8,63 a	**9,46 a**
CV (%)	**21,13**	**17,37**	**16,58**	**20,54**

[1]*Averages followed by the same letter in the columns do not differ from each other by the Tukey test at 10% probability.*

At the end of the 30 day evaluation, it was observed that the addition of Penergetic® in the soil increased the rate of decomposition of the crop residues of ryegrass in the surface. Although numerically higher, the average cumulative decomposition value of the treatment control + Penergetic® did not differ statistically from the average value observed in the native bush area, a treatment used as a reference environment for edaphoclimatic and biological conditions that were not altered by anthropic interference, where it was expected to find the highest rates of decomposition of residues (Table 3).

The control treatment had the lowest average value of accumulated decomposition of the residues at 30 days, indicating less biological activity of the organisms and microorganisms involved in the activity of vegetal decomposition at the soil surface. The treatments that received addition of mineral fertilizers, with or without addition of Penergetic® presented intermediate values of accumulated decomposition of the residues of ryegrass, ie, statistically average values lower than the treatment control + Penergetic® and higher than the control treatment (Table 3).

These results suggest that there was an isolated effect of the application of Penergetic® on the superficial biological activity of the agricultural ecosystem, directly influencing the nutrient cycling dynamics, being able to reflect positively on the quality of the soil. Although less significant, it was possible to observe a positive effect of the isolated addition of mineral fertilizers (phosphorus and potassium) or combined with Penergetic® technology on the activity of biota and microbiota involved in the process of surface residues decomposition, in relation to the control treatment (Table 3).

As for the coefficient of degradation of residues, no significant differences were observed between the treatments, in relation to the values of accumulated decomposition of the ryegrass straw, from the 90 days of evaluation (Table 3).

CONCLUSION

The application of Penergetic® in wheat crop increased the rate of decomposition of ryegrass residues deposited on the soil, reducing the percentage of persistence of the straw on the surface, in the first 30 days.

Feed activity of microorganisms and soil fauna in agricultural crops submitted to different managements

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ABSTRACT

The biological activity of the soil represents a key element for the maintenance of the sustainability of the production in agricultural environments. The objective of this work was to evaluate the effects of mineral fertilization (phosphorus and potassium) and Penergetic® technology on the bioactivation of soil in agricultural crops through the evaluation of food consumption of fauna and edaphic micro-organisms. The trials were conducted in soybean (summer) and wheat (winter) crops submitted to different forms of fertilization and application of Penergetic® technology. Four treatments were evaluated: **T1** = Control without Fertilizers; **T2** = Control + Penergetic®; **T3** = mineral fertilization of phosphorus and potassium and **T4** = fertilization of phosphorus and potassium + Penergetic®. The dosage of Penergetic® Kompost and Penergetic® Pflanzen, applied in both crops was 250g ha^{-1}. For the evaluation of the food consumption in the experimental plots, the methodology was used *bait-slide*. The slides remained in the soil for 21 days. The percentages of empty, partially empty and filled holes for two soil layers: 0 to 8 and 8 to 16 cm deep, besides the assignment of notes to the standard of food consumption. Principal component analyzes (PCA) were also performed of the results of feeding activity, notes the feeding activity, crop productivity and soil respiration. The use of Penergetic® technology combined with phosphate and potassium mineral fertilization promoted a significant effect on the food activity of the fauna and microorganisms present in the 0 to 8 cm soil layer in soybean cultivation.

Keywords: Soil biology, bioactivation, food consumption.

INTRODUCTION

The organisms and microorganisms that live in the soil interfere directly and indirectly in the biogeochemical cycles of the elements and in the nutrition of the plants. Although the nutrient mineralization process is dependent on the action of microorganisms, soil fauna plays an important role in this process by regulating the microbial populations (Trogello et al., 2008; Socorrás & Izquierdo, 2014). In addition, the diverse groups that make up the fauna of the soil perform important systemic services, such as the initial fragmentation of the debris, the stimulation, digestion and dissemination of microorganisms, the selective predation of fungi and bacteria, these actions directly interfere in the decomposition of organic matter and alter the availability of nutrients for plants (Cragg & Bardgett, 2001).

The soil fauna influences the nutrient cycling processes through two main routes: directly, through the physical modification of the litter and the soil environment, and indirectly through interactions with the microbial community. Its direct effects on biogeochemical cycling occur through fragmentation and incorporation into the soil of plant residues, promoting an increase in the availability of nutritional resources for the microorganisms and mediating the transfer of solutes and particulates deep into the soil profile (Decaëns et al., 2003; Trogello et al., 2008). They also affect the biogeochemical cycling the physical rearrangement of the soil particles, changing the pore size distribution and, as a result, infiltration patterns and gas emission (Beare et al., 1995).

With the modifications imposed by the use of the soil and, in particular by agriculture, the fauna and the microorganisms, in different degrees of intensity, are affected by the impacts caused by the agricultural practices (Alvarez et al., 2001), both due to changes in soil properties, and by the direct action of these practices on the organisms.

Measures of food consumption of soil biota are indicators of decomposition rates (Reinecke et al., 2008) and functional integrity of ecosystems (Filzek et al., 2004). Originally developed by von Törne (1990), as a method capable of measuring the food activity of soil organisms in situ, the test of bait-slide represents a tool capable of detecting changes in the food consumption pattern of the soil fauna in environments submitted to different products or managements, whether deleterious or beneficial.

The Penergetic® technology has been used in agriculture to bioactivate existing microorganisms and fauna in the soil system. The effect of the technology is due to the addition of energized particles, which are introduced in the agricultural systems via spraying in the soil and on the plants. When coming into contact with the soil, the energy coming from the technology acts in a beneficial way in the agricultural system, interfering in the biological activity of the biota and microbiota of the soil, as well as on the availability of the nutrients for the plants. The energization process used by Penergetic® technology comes from the theories proposed by Michael Faraday, in 1846, and by James Clerk Maxwell in 1864, Both physicists who worked on the issue of energizing materials (Pauli, 1927; Dirac, 1928; Noack, 1985). In the 1960s, it was observed that some bacterial genera exhibited the surprising behavior of persistently migrating toward the geomagnetic north, even when the orientation of the sample on a slide was altered by the rotation of the microscope stage (Bellini, 1963). Since then, research has been carried out in order to understand the mechanism that involves this behavior. Bellini (2009) described the electromagnetic movement, demonstrating that the movement of protons and electrons occurs in a different way and, added to the force of gravity, this movement generates a sense of frequency, which guides the movement of certain microorganisms.

Currently, the literature presents a large number of works demonstrating the effect of the use of electromagnetic energy on microbial activity (Siannah et al., 2003; Siannah et al., 2012), orientation and alimentary activity of edaphic organisms (Esquivel et al., 2004; Hsu et al., 2007; Wajnberg et al., 2010) and crop productivity (Pieturszewski, 1993; Barbosa-Cánovas et al., 1998; Hajnorouzia et al., 2001; Novitsky et al., 2001; Zapata et al., 2002; Souza-Torres et al., 2006; Pekarskas et al., 2011; Ladino et al., 2012; Padrino et al.; 2013). In this sense, the present study aimed to evaluate the effects of mineral fertilization (phosphorus and potassium) and Penergetic® technology on the bioactivation of soil in agricultural crops through the evaluation of food consumption of fauna and edaphic microfauna.

MATERIAL AND METHODS

The trials were conducted in soybean (January) and wheat (October) crops submitted to different forms of fertilization and application of Penergetic® technology in the agricultural year of 2014, in the municipality of Júlio de Castilhos, RS, Brazil.

The treatments evaluated were: **T1** = Control without Fertilization; **T2** = Control + Penergetic®; **T3** = recommendation of phosphorus and potassium by CQFS-RS/SC and **T4** = recommendation of phosphorus and potassium by CQFS-RS/SC + Penergetic®. The Penergetic® technology consisted in the application of 250g ha^{-1} of each of the products: Penergetic® Pflanzen (applied on the aerial part of the plants) and Penergetic® Kompost (applied on the soil). Based on phosphorus and potassium contents in the soil initially present, were added 50 kg of P_2O_5 and 80 of K2O ha^{-1} in the plots corresponding to treatments T3 and T4.

The slides used in the test were made according to the description of the bait-slides marketed by the German company Terra Protecta (1999). The holes were filled with substrate composed of a homogeneous mixture of cellulose, wheat flour and activated carbon in the mass proportions of 70:27:3. Thirty slides per experimental plot were used, which were vertically inserted in the soil with the aid of a metal blade, through the opening of a slit in the soil. The slides were arranged between the lines of the crops, in two groups of 15 slides, distant from each other at approximately 5 meters. The test was carried out over a period of 21 days, with the removal of all slides deposited at each testal plot, at the end of the corresponding period.

The slides were stored in individual paper bags, for further processing in the laboratory. The results were expressed as percentage of empty, partially empty and filled holes for two soil layers: For the layer of 0 to 8 cm, the first eight holes were considered and for the layer of 8 to 16 cm the holes 9 through 16 were considered. Also notes were assigned for each of the 16 holes of the blades, according to the observed drilling pattern: empty holes (note 3), partially empty (note 2) and filled holes (note 1). Based on the scores attributed to the consumption pattern of the holes of each of the slides exposed in the field, an average consumption index was calculated for each treatment. This way, the higher the average value attributed to the slides, as a function of the substrate consumption, the greater the food activity of the organisms and microorganisms present in the experimental plot.

The results were submitted to analysis of variance between treatments, using the Sisvar software (Ferreira, 2000). The averages of the each treatment were compared to each other by the Tukey test, at 5% probability ($P<0,05$).

RESULTS

The highest average percentage of completely filled holes was observed in the slides deposited in the soil of the control plot, in relation to other treatments, for both depths analyzed in the soybean crop (Figures 1 and 2). The presence of substrate not accessed by the fauna and the microorganisms in the holes of the slides, indicates less biological activity in the soil, allowing comparisons between the patterns of substrate consumption intensity in each of the treatments applied in the field.

Regarding the percentages of the completely empty holes in the soybean crop, in the 0 to 8 cm layer, there were also significant differences between treatments, with the highest average percentage (32.1%) was observed in the plot that received the application of Penergetic® technology, together with phosphate and potassium fertilization, differing from the control treatment (Figure 1). **These results indicate that the isolated or combined addition of mineral fertilizers and Penergetic® positively influenced the activity of the edaphic community present in the soil, resulting in greater food activity in the 0 to 16 cm layer in summer cultivation (Figures 1 and 2).**

In all treatments evaluated in soybean crops, in the most superficial layer of the soil, average percentages of partially empty holes were observed, above 50%, with emphasis on the treatment of the isolated application of Penergetic® technology, which presented 70.4% of holes partially consumed by the soil biological community, differing significantly from the control treatment (Figure 1).

Comparing the food consumption pattern of the 0 to 8 cm layer organisms in wheat cultivation, it was observed that there was no differentiation of the treatments (Figure 1). Similar results were observed in layer of 8 to 16 cm (Figure 2).

Feeding activity of soil organisms in the 0-8 cm soil layer.

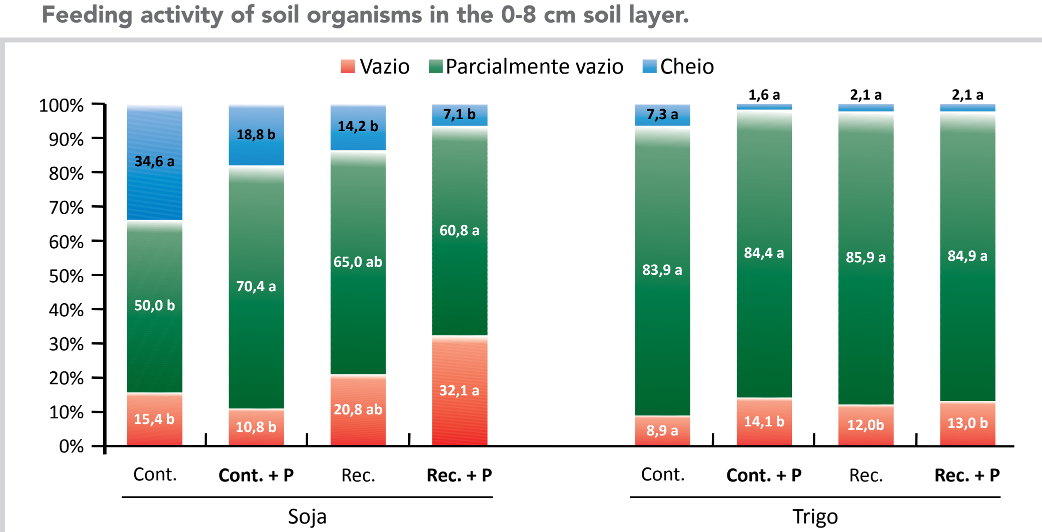


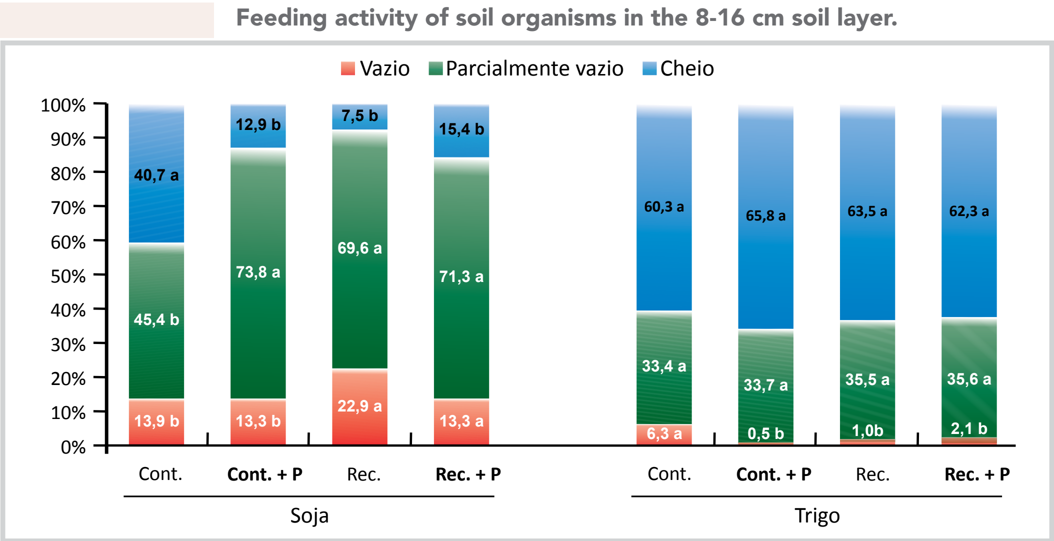
Figure 1. Percentage of empty holes, partially empty and filled holes in the 0 - 8 cm soil layer, indicating the food activity of the organisms in soybean and wheat crops submitted to different treatments. Average of 30 repetitions. Averages with the same letter at each degree of consumption in the orifices of the slides do not differ from each other at 5% probability.

When assigning notes to the consumption pattern of the substrate present inside the holes of the slides, the effect of mineral fertilization combined or not with the Penergetic® technology, on the bioactivation of the biota and microbiota of the soil is even more evident. For both layers of soil evaluated in soybean crop, the slides deposited in the control plots (without application of Penergetic® and mineral fertilizers) presented significantly lower marks, indicating less biological activity in relation to the other treatments (Figures 3 and 4).

In soybean cultivation, comparing only the food activity of the fauna and microfauna in the most superficial layer of the soil (0-8 cm), where there is greater species diversity and abundance of organisms, it was observed that the combination of soil fertility correction and application of Penergetic® resulted in a significant increase of the biological activity of the soil, through the increase of the food consumption.

It was observed a positive effect of the

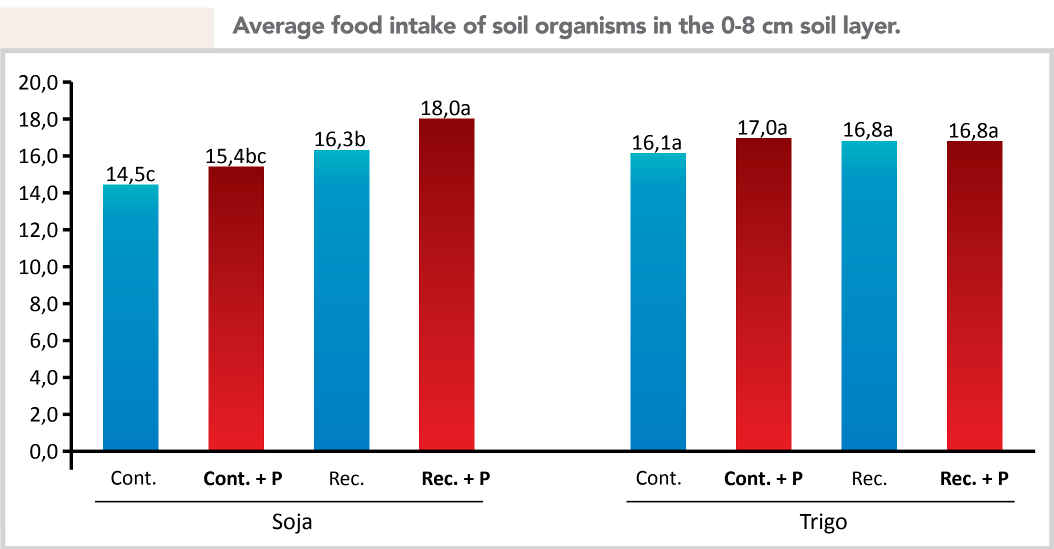
Figure 2. Percentage of empty holes, partially empty and filled holes in the 8-16 cm soil layer, indicating the food activity of the organisms in soybean and wheat crops submitted to different treatments. Average of 30 repetitions. Averages with the same letter at each degree of consumption in the orifices of the slides do not differ from each other at 5% probability.



correction of phosphorus and potassium levels present in the soil, as well as the isolated or combined application of the Penergetic® technology on the food activity of the fauna and microfauna inhabitant in the soil in soybean crop. In the most superficial layer of the soil (0 to 8 cm), the correction of the levels of these nutrients, allied to the use of Penergetic®, resulted in effects of bioactivation and/or stimulating the biological activity of the soil, being observed higher percentage of totally empty holes (32.1%) and lower percentage of completely filled holes (7.1%) in this treatment (Figure 3).

According to Silva Filho et al. (2002), are found populations of solubilizing microorganisms between 104 and 107 g^{-1} of soil, and may vary according to the location and method of evaluation, and on the order of 106 g^{-1} of rhizosphere soil of various legumes. The interaction between microorganisms and between these and the environment is known. However, the vast majority of the information is available regarding the use of biochemical signals between the microorganisms. A few years ago, research results are showing that in addition to biochemical signals, fungi and bacteria can "communicate" with the environment by electromagnetic signals (Cifra et al., 2011; Dotta et al., 2011; Dotta & Rouleau, 2014).

Figure 3. Average food intake index of the soil organisms in the 0-8 cm layer, calculated by assigning grades according to the substrate consumption pattern in slide-bite distributed in soybean and wheat crops. Notes: 1 (filled holes), 2 (partially empty) and 3 (empty holes). Averages of 30 repetitions.



Average food intake of soil organisms in the 8-16 cm soil layer.

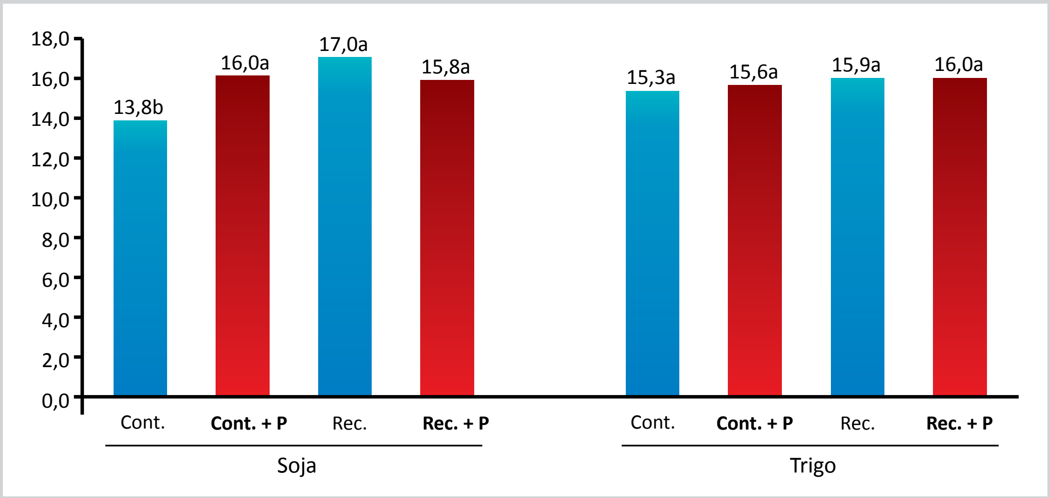


Figure 4. Average food intake index of the soil organisms in the 8-16 cm layer, calculated by assigning grades according to the substrate consumption pattern in slide-bite distributed in soybean and wheat crops. Notes: 1 (filled holes), 2 (partially empty) and 3 (empty holes). Averages of 30 repetitions."

The fact that there was no significant effect of the use of Penergetic® technology and phosphate and potassium fertilization on wheat crop (Figures 1, 2, 3 and 4) may be related to the climatic conditions of the region where the study was carried out, characterized by the occurrence of temperatures below 10° C in winter (Lima et al., 2013). This way, it is possible that the low temperatures have inhibited the biological activity of the soil.

It is important to emphasize that the society is looking for a new model of agriculture that is capable of generating quality food with reduction of the application of chemical inputs, aiming at reducing production costs and preserving the environment. Issues regarding the need and the excessive use of mineral fertilizers in agricultural crops have been discussed for decades in the search for alternatives, to guarantee the sustainability of agriculture (Costa, 2002). The cost of mineral fertilizers, especially phosphates, has steadily increased. Allied to this, the phosphate reserves of the planet are being consumed at a fast pace, compromising this practice in the near future.

Therefore, it is necessary that new technologies be proposed to improve the quality of agricultural systems, benefiting crop productivity and the survival of organisms and microbiota present in the system. The biostimulus to the presence and activity of the existing life in the soil, contributes to the sustainability of the agriculture, besides acting directly in the cycling of the organic matter and contribute to the reduction of the necessity of external contribution of nutrients in the agricultural crops.

CONCLUSION

The food activity of the fauna and microorganisms in the layers of 0 to 8 and 8 to 16 cm of the soil, was intensified by the use of Penergetic® technology alone or combined with phosphate and potassium fertilization in soybean crop. In the winter crop, due to climatic conditions, soil food activity was similar in all evaluated treatments.

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Soil bioactivation in the suppression of the damage caused by *Pratylenchus brachyurus* in the soybean crop

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Brazil is the largest exporter and the second largest producer of soybeans worldwide. Currently, the production of soybeans in Brazil is led by the states of Mato Grosso, Paraná, Rio Grande do Sul and Goiás, which correspond to 82.0% of soybeans produced in the country. According to a survey carried out by MAPA, estimates for soybeans indicate a Brazilian production of 86.5 million tons in 2020/2021 (MAPA, 2011). Approximately 25 pathogens present economic importance for this crop in Brazil. The phytonematodes have been growing in importance in the productive system, and gaining space in the Brazilian scenario, and may even render some areas of soybean cultivation unviable (GRIGOLLI; ASMUS, 2014).

Currently, the control of phytopathogens is based on the use of active principles, which guarantee the maintenance of productivity by reducing the damage caused by these organisms in the roots. However, this practice poses risks of environmental contamination l. In this sense, there are pressures from society to make the use of chemicals increasingly restricted by farmers. According to Sediyama et al. (2014), there is currently a setback in pest management programs, resulting in increased intensity and rates of application of agrochemicals in crops, with undesirable consequences from an economic and environmental point of view. With the selection of agrotoxic resistant individuals, active ingredients that are increasingly aggressive are used, and the undesirable consequences increase in the same proportion. In the soybean crop, with each crop new pests arise and control becomes increasingly inefficient.

Among the phytopathogens responsible for damage in grain crops, especially for soybeans, the phytonematodes that cause root lesions of the genus *Pratylenchus spp.* In general, the nematodes of this genus cause serious problems, due to the great capacity of adaptation to the diverse agrosystems. For these reasons, coupled with the speed and ease of dissemination of plant phytonematodes, it is essential that new control alternatives be tested to be allied to farmers in the control of these phytoparasites. In view of the above, the objective of the study was to evaluate the effect of Penergetic® Pflanzen and Penergetic® Kompost for the mycorrhization and the penetration of phytonematoids in soybean roots

The penetration of Pratylenchus brachyurus was evaluated in soybean cultivar Nidera 5909. The plants were grown in plastic containers with 3L capacity containing soil, kept in a greenhouse.

The treatments evaluated were: **1)** Control (without application of the Penergetic® technology and without mineral fertilization); **2)** Application of the Penergetic® technology and without mineral fertilization; **3)** Phosphorus (P) and potassium (K) application CQFS-RS/SC (2004), and **4)** application of the Penergetic® technology and application of phosphorus (P) and potassium (K), according to CQFS-RS / SC (2004). The application of the Penergetic® technology (Penergetic® Pflanzen and Penergetic® Kompost) was performed according to technical recommendations: Penergetic® Kompost (250 g ha^{-1}) applied to the soil before soybean sowing and Penergetic® Pflanzen (250 g ha^{-1}) in aerial applications at the stage V3 (125 g ha^{-1}) and 15 days after the first application (125 g ha^{-1}).

The inoculum consisted of pure populations obtained from the species-specific isolation. The preparation of the inoculum was carried out by grinding the roots, according to the technique described by Hussey and Barker (1973) Modified by Boneti and Ferraz (1981). 5 ml of a suspension containing 1750 juveniles P. brachyurus were inoculated, which was distributed in three orifices of approximately 2cm of depth, located in the surroundings of each plant.

After 30 days and during the flowering period of the crop, the number of phytonematodes inside the roots was counted, using the methodology described by Byrd et al. (1983) for staining of roots. After the staining step, the roots were arranged between two glass slides, under a microscope with a magnification of 40x, to count the number of phytonematoids penetrated.

The data obtained were submitted to analysis of variance and test of means according to Tukey by software SISVAR (FERREIRA, 2000).

The use of Penergetic® Pflanzen and Penergetic® Kompost this resulted in a decrease in the number of phytonematodes penetrated in soybean roots, both at 30 days after emergence and the flowering of the crop. Considering that the soybean plants were cultivated in a greenhouse, being less exposed to biotic and abiotic stresses, the results demonstrate the susceptibility of the soybeans to the attack of this phytonematode and that the different products have an efficient management of these organisms. This result

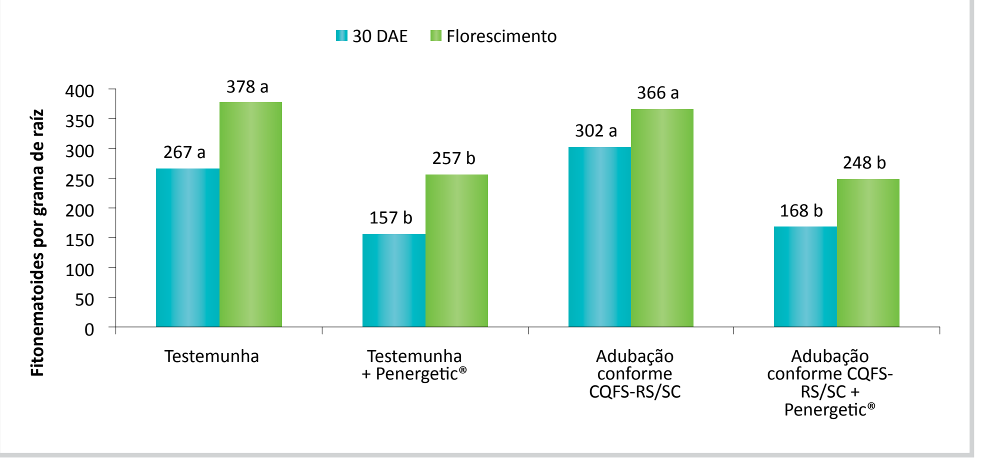
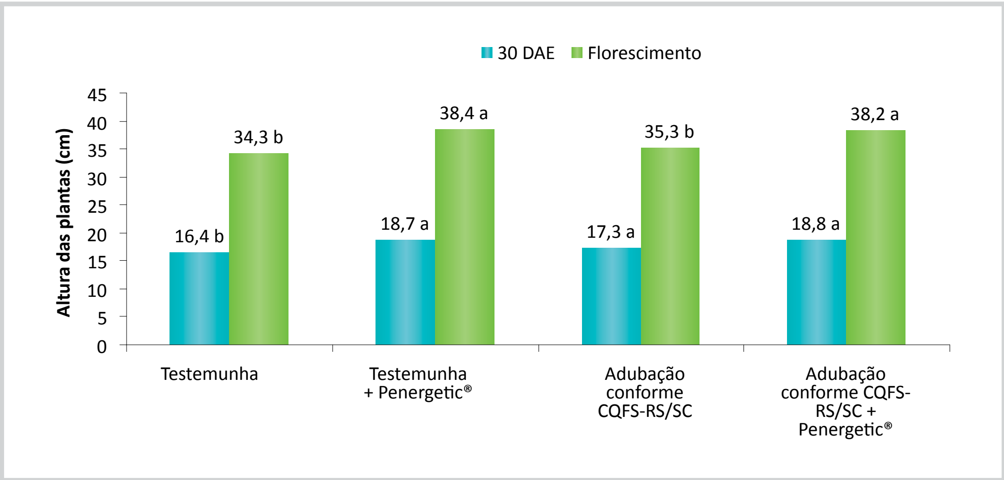


Figure 1. Number of phytonematodes of the *Pratylenchus brachyurus* species, penetrated into soybean roots at 30 days after the emergence (DAE) and flowering of the crop.

is related to the factors: (a) lower number of phytonematodes penetrated in the root system and (B) reduction of the multiplication of these organisms in the soil, thus demonstrating the delay effect of the nematode cycle inside the root and smaller source of inoculum in the soil.

As for the damages caused to the root system of the plants, from the stages V4-5, period in which the phytonematode cycle is already established inside the roots, where the number of neoplastic deformations, necrosis and root failure begin to correspond directly to the degree of parasitism and the probable damage inherent to the action of phytonematodes, it was observed that the damage caused to soybean roots was significantly lower in the plants that received Penergetic® technology.

Figure 2. Height of soybean plants kept in soil inoculated with the phytonematode of the Pratylenchus brachyurus species, at 30 days after the emergence (DAE) and flowering of the crop.



In view of the reduced effectiveness of chemical nematicides available in the market, the management of infested areas should be accomplished through the integration of several control techniques, such as the use of non-host crops and cultivars, the use of antagonistic plants and the use of technologies capable of limiting the damage inherent to the attack of these organisms. In this context, the results of this work demonstrate that the use of the Penergetic® technology is an auxiliary tool in the control of phytonematodes in the field, by the effects on the reduction of the intensity of infection of the phytoparasites in the root system of the soybean crop.

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Effects of Penergetic® in the seed germination and chlorophyll content in soybean plants

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Brazil is currently the second largest producer of soybeans, worldwide. The growth of production and the increase of the productive capacity of the Brazilian soybean are allied with the scientific advances and the availability of technologies in the productive sector. Over the past 40 years, the world soybean production has increased by more than 500%. In addition, changes in the living standard of countries such as China, and the growing demand for raw materials for biodiesel production, indicate that the world soybean production will continue to grow. Vencato et al. (2010), projects a 40% increase in soybean production in Brazil by 2020, surpassing the United States in production, and becoming the world's largest producer of this oilseed. However, for projections such as this can be realized, it is urgent that the producer is made available the technologies that sustain this production level. According to a balance of the US Department of Agriculture, Brazil currently participates with 26.5 and 31.3%, respectively, in the production and export of soybeans in the world.

According to Freitas, (2011), the growth of soybean harvest in Brazil has always been associated with scientific advances and the availability of technologies to the producer. Among these advances, emphasis is given to mechanization, the creation of highly productive cultivars adapted to the different regions and the development of technologies related to both crop management as the management of pests and diseases, which are responsible for a significant portion of annual losses.

In this context, the adoption of innovative products that result in the reduction of the use of inputs of high economic and environmental cost, can represent a viable strategy for producers who are seeking to adopt more productive systems, without reducing crop yields. Among these products, we highlight Penergetic®, which uses electromagnetic energy in the optimization of photosynthetic efficiency of plants (Penergetic® Pflanzen). PEKARSKAS et al. (2011) evaluating the effect of the application of Penergetic® on winter crops, observed an increase in the wheat yield and quality. Jankauskiene and Surviliene (2009) evaluating the effect of different products in stimulating the germination of vegetables, observed that the use of Penergetic® Pflanzen resulted in increases in the vigor of tomato, radish, cucumber and beet seeds. The same authors, in assessing the effect of spraying the Penergetic® Pflanzen on beet seedlings, observed a higher absorption of the photosynthetically active radiation, a higher rate of electron transmission and an increase in the accumulation of dry matter.

According to MOTTA et al. (2000) the guarantee of the best performance of a given crop depends, fundamentally, on seed quality, characterized by germination and vigor, which is characterized by the ability of a given seed lot to establish normal seedlings under field conditions.

The most studied parameter of the plant in order to indicate the level of nitrogen (N) on the leaf to predict the need for cover fertilization is the relative chlorophyll content in the leaf. Chlorophyll content occupies a prominent position, since it determines the photosynthetic potential of the plant through its control over the amount of solar radiation that a leaf absorbs (HATFIELD et al., 2008).

In view of the above, the objective of this study was to evaluate the use of Penergetic® Pflanzen in the germination of soybean seeds and its effect on the photosynthetic process in the vegetative phase of the crop.

For the germination test, soybean seeds cultivar Nidera 5909 were submitted to the treatments 0.2, 2.5 and 3 grams of Penergetic® Pflanzen per kilogram of seed used in the form of seed treatment. The germination test was carried out with four repetitions of 25 seeds each. Germitest paper, in the form of a roller, was used, moistened with distilled water, in the proportion of two and a half times the weight of the paper and the material was kept at a temperature of 25ºC. The counting of percentage germination occurred on the fifth day after the test installation.

Assessments of chlorophyll index (ICF) were carried out under field conditions, using the cultivar Nidera 5909. For the evaluations, the control treatments were used (without the use of the Penergetic® technology) and the Penergetic® Pflanzen treatment, in the dosage of 250 g ha^{-1}. Before the application of the Penergetic® Pflanzen (stage V3) and in the stages V4, V6 and R1, the chlorophyll index was evaluated in 12 plants per treatment.

The data of germination and chlorophyll index were submitted to analysis of variance and test of averages according to Tukey at 5% of probability.

The use of Penergetic® Pflanzen in the treatment of soybean seeds resulted in a significant increase in both germination and root growth (Figure 1). Concentrations of 2.5 and 3 grams per kilogram of seed provided germination significantly higher than the other treatments. As for the rootlet length, 3 grams of Penergetic® Pflanzen per kilogram of seed resulted in a longer rootlet length. Treatments 2 and 2.5 grams of Penergetic® Pflanzen per kilogram of seed were higher than the control treatment (absence of Penergetic®).

Regarding the chlorophyll index, determined through the use of the chlorophyll meter, it was observed that the use of the Penergetic® technology this resulted in an increase in the index from the application of the product to the measurement performed

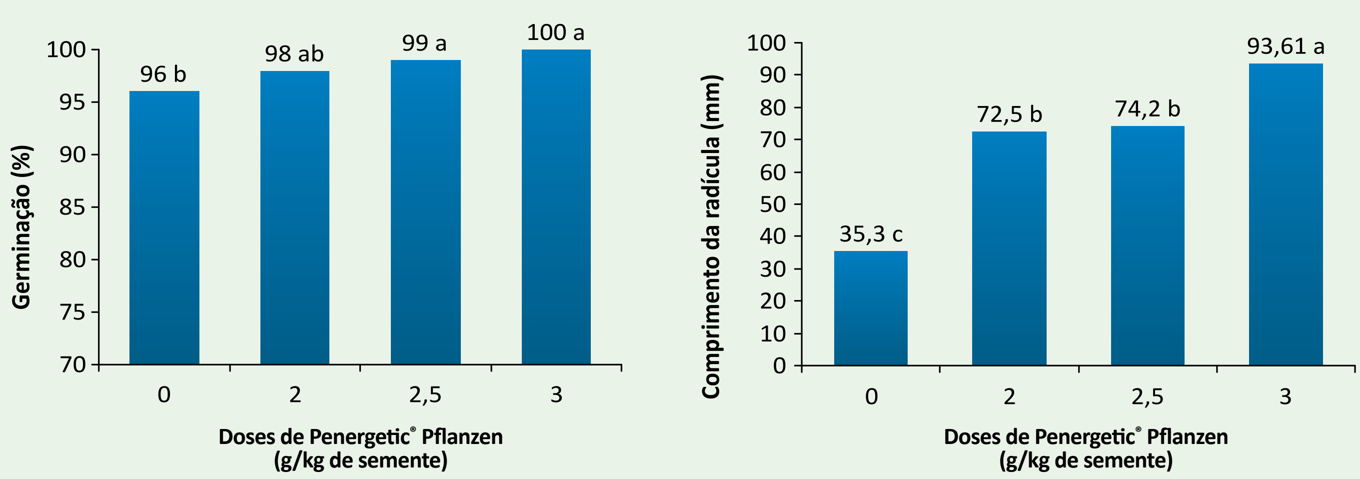

Figure 1. Percentage of germination and length of **soybean rootlet**, submitted to different dosages of Penergetic® Pflanzen via seed treatment.

in stage R1 of the crop, presenting a quadratic response for this variable (Figure 2). The importance of this information is based on the positive correlation between the chlorophyll content and the N content in the plant. The N is an inducer of metabolic processes, with effects on the absorption of macro and micronutrients and on the allocation of matter and energy by plants (SILVA et al., 2011).

The results presented here allow, in addition to rationalizing the nitrogen fertilization of the crop (CARVALHO et al., 2012), inferred as to the gains in productivity conferred by the

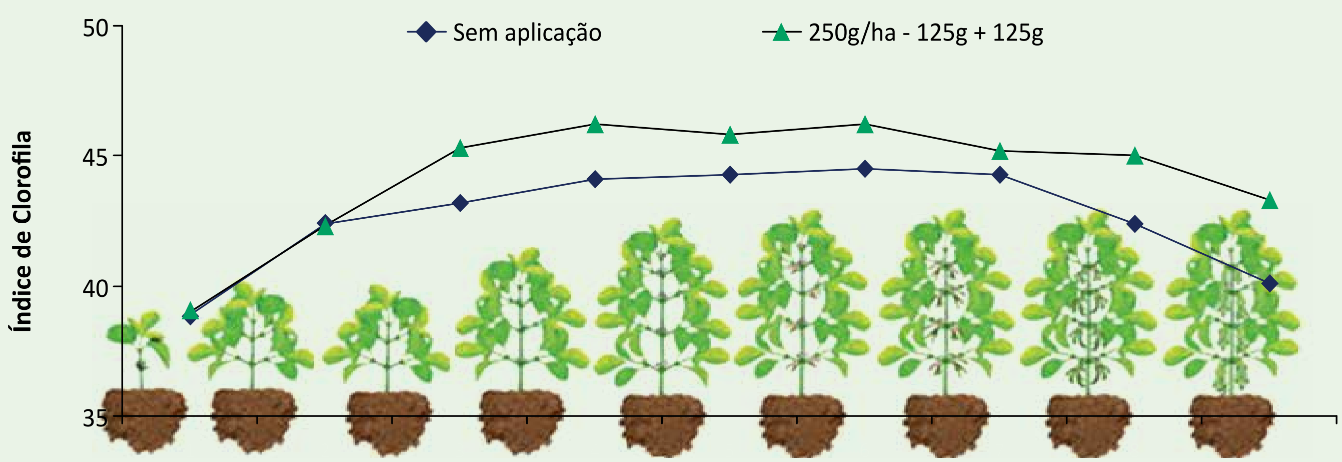

Figure 2. Falker chlorophyll index (ICF) measured in soybean plants submitted to different treatments

application of the Penergetic® P product, due to photosynthetic promotion by increasing its action machinery.

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Evaluation of the use of Penergetic® Pflanzen and Penergetic® Kompost in temperate climate fruit trees

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INTRODUCTION

The productivity and quality of fruits of an orchard are a result of the interaction of several factors, highlighting the genetic potential and the environment (soil, nutrient and water balance management). Maximum yield and optimal fruit quality are achieved when the nutritional status of the plant is ideal. Under many agricultural situations, this condition is satisfied by the annual supply of fertilizers and the correction of soil acidity. The nutritional aspect is particularly important for the fruits, knowing the influence that minerals have on their quality. Fruit plants are highly responsive to the addition of fertilizers. In many cases fertilization and consequently the nutritional status of crops, can affect not only the productivity, but the size and weight of the fruit, color, appearance, flavor, aroma, post-harvest conservation, resistance to pests and diseases, among others. The bioactivation, or biological activation, of the plants is a positive interference that gives subsidy so that they show their productive potential, making it possible to enhance their ability to convert light, water and nutrients into grains, fibers, cellulose, etc., facilitating its association with soil and its microorganisms. This will result in a healthier, stronger and more vigorous plant.

PURPOSE

The objective of this study is to evaluate the performance of the Penergetic® Kompost and Penergetic® Pflanzen products in the bioactivation of soil and the cv Kampai Peach plants.

METHODOLOGY

The experiment is being conducted on the property of Mr. Alberto Nascimento no Distrito of Campos de Holambra, Paranapanema-SP, in crop cv Kampai Peach, of 4 years old. Two treatments were applied, and the fertilization performed consisted of 100 kg/ha of potassium nitrate, 100kg/ha of urea and 150kg/ha of KCl divided into two applications. Follows treatments:

Control: Producer Standard.

Treatment 1: 600 g/ha Penergetic® Kompost and 600 g/ha Penergetic® Pflanzen.

The application of Penergetic® Kompost it was done in a single dose on the day 06/26/2014, and the applications of Penergetic® Pflanzen were divided in three times, and applied in the days 06/18/2014; 07/02/2014 and 07/20/2014, respectively. The fruit shelflife assessments were held, firmness assessment (lbs) of fruits, evaluation of Brix (soluble solids), chemical analysis of fruits and yield.

RESULTS

The first soil analysis was performed before the test installation, on the 06/04/2014. At the end of the experiment a new analysis will be done to measure the total P level, before and after the application of Penergetic®. To evaluate the shelf life, the fruits were visually observed (Figures 1 and 2) and the firmness was evaluated with the aid of the penetrometer. In addition, it assessed the brix and size of the fruits. Evaluations were made on the day of harvest at 3, 5, 7 and 10 days after harvest. For the chemical analysis of fruits, 15 fruits were collected from each treatment and sent to the laboratory. The analysis of the treated area presented levels of elements, such as, potassium, calcium, manganese, among others, superior to the control. For the evaluation of the crop yield, it was carried out a count of fruits of 3 plants and calculated the average for each treatment. Thus, an average of 30 fruits were collected from each treatment and weighed to obtain an average yield per plant. The results presented had 238 fruits per plant of the control, and of 306 fruits per plant of the Treatment with Penergetic® Pflanzen and Penergetic® Kompost. What expresses an average yield superiority of 68 fruits of plants treated with Penergetic®. The average weight per fruit in grams also presented differences, being of the control of 85 grams, and that of the treatment with Penergetic® of 88 grams, even the treated area with the highest number of fruits per plant, their average weight was also higher. The productivity parameters of the treated area with Penergetic® presented a 33% increase in relation to the control.

CONCLUSIONS

It was concluded that the fruits in the treated area presented a greater diameter than the fruits of the control, and that the yield of the treated area was significantly higher than that of the control area, wherein the average weight per fruit was 33% more than the fruits of the control.

FIGURE 1. SHELFLIFE OF THE PEACHES OF THE 1ST HARVEST

FIGURE 2. SHELFLIFE OF THE PEACHES OF THE 2ND HARVEST

Use of soil and plant bioactivator, with and without mineral fertilizer in soybean, and the relation with nutritional phytoavailability and production components

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Eloir Paulo Gris - Agronomist

The soybean (Glycine max L.) is of great importance for the Brazilian agricultural activity, occupying the second place among the main field products worldwide, both in area and value of production. The soils in which soybeans are grown usually exhibit high phosphorus (P) fixation capacity and this makes the efficient use of fertilizer, and this makes the efficient use of fertilizer a primordial thing (MOTOMIYA et al., 2004). As the rate of absorption and transport of inorganic P (Pi) by roots is greater than its diffusion rate in the soil, a depletion zone is formed, resulting in an area of depletion for this element still in the rhizospheric environment. In this way the plant developed mechanisms to capture this element beyond this zone, through mutualistic associations or symbioses between fungi and roots, called mycorrhiza (MOREIRA & SIQUEIRA, 2002).

The so-called modern techniques of soil management have greatly diminished the diversity and importance of mycorrhiza in the field, this implies a fall in the resilience and stability of agroecosystems (JEFFRIES et al., 2003). In this aspect, commercial products have been promoting the survival of these organisms, at least that is what its manufacturers indicate, which is aimed at stabilizing mycorrhiza in the soil and reducing the use of phosphate fertilizers; currently called soil and

plant bioactivators.

Considering the importance of fertilization of soybeans for yield gains and the complexity of the application and availability of P in the soil--plant system in tillage, this work has the objective of evaluating the use of the bioactivator of soil and commercial plant, in the presence and absence of fertilizer in the base, as well as the nutritional phytoavailability and yield of the soybean production components.

The experiment was conducted in the field for no tillage in the straw in the city of Palotina-PR; during the period from October 2014 to February 2015. The soil was classified as Red Latosoil Type 3 and particle size and chemical analyzes are presented in Table 01. Four treatments were implemented that took into account the need for P for soybean (EMBRAPA SOJA, 2010) and the application of the Penergetic® Technology as a commercial bioactivator, varying between presence and absence of both, being arranged in the following way:

T1 (+F+BI): 100% of phosphorus + 100% of the bioactivator; **T2** (+F-BI): 100% of phosphorus + 0% of the bioactivator; **T3** (-F+BI): 0% of phosphorus + 100% of the bioactivator; **T4** (-F-BI): 0% of phosphorus + 0% of the bioactivator.

It was used to cultivar TMG 7363® resistant to Glyphosate, depositing 14 Seeds per linear meter and applied fertilizer formulated 07-36-10 (N_2; P_2O_5; K_2O) In the amount of 400 kg ha^{-1}, in the plots that received fertilization. Each treatment had an area of 36 m^2. The application of the bioactivator consisted of the Penergetic® Kompost product, performed in pre-sowing at the dosage of 300g ha^{-1}, and of the Penergetic Pflanzen performed twice at 28 days after the emergence (DAE) in the phenological stage V5 (150 g ha^{-1}) and at the 39 DAE in the R1 (150 g ha^{-1}). At the 86 DAE, it was collected leaves, for analysis of the leaf tissue, being 25 leaves of the middle third of the plant, at the phenological stage R5.3. It was determined macronutrients: Phosphorus (P), nitrogen (N), potassium (K), calcium (Ca), Magnesium (Mg) and sulfur (S) and the micronutrients Copper (Cu), zinc (Zn), manganese (Mn), boron (B) and Iron (Fe).

At the 115 DAE it occurred a harvest, which were determined yield components: number of pods per plant (NLP); number of grains per legume (NGL) and mass of 100 grains (M100); corrected the grain moisture to 13%. The experimental design was completely randomized (DIC), with four treatments and three repetitions. The obtained data were submitted to the F test (Fisher) with analysis of variance (ANOVA) at 1% and 5% of significance, the averages were compared using the Tukey test at 5% of probability.

The result of ANOVA for macronutrients in the leaf tissue revealed a significant effect for P and N at 5% of probability ($0.01 \leq p < 0.05$) and for element K at 1% probability ($p < 0.01$). For the other elements, there were no significant differences (Table 02). Considering the stage of development in which the leaf was collected (R5.3), several elements are transferred to the grains, their contents reduced in the foliar tissue (CÂMARA, 1998). For P, **it was observed that the highest mean was expressed by the treatment T3 (-F+BI), where it indicates that the full use of the bioactivator without basic fertilization favored the increment of the element,** but statistically it was not different of the T2 (+F-BI) and T4 (-F-BI) which consequently did not differ from T1 (+F+BI) which obtained the lowest average.

In the absence of P from the base of fertilization, the commercial bioactivator managed to keep the average of the nutrient, but the soil was able to provide satisfactorily the P, from availability that already was in the field, as determined the soil analysis (Table 01). Soybean has the potential to present high yields, even under low or no phosphate fertilization conditions, especially when there is a residual effect of previous fertilization, provided the availability of P in the soil is at levels above those considered critical (LANTAMANN et al., 1996), this fact occurred in this experiment.

But when plants absorb P in rates which exceed the demand growth, some processes act to prevent the accumulation of toxic concentrations of P (SCHACHTMAN et al., 1998). Taking into account these facts, the treatment T1 (+F+BI), which presented a lower average, could be linked to this regulation of the element in the plant.

The ANOVA revealed that there were no statistical differences by the F test ($p \geq 0.05$) for the micronutrients in the soybean leaf tissue. This fact can be explained when observing the levels of micronutrients found in soil, as indicated by its analysis (Table 01), all the elements are within the ideal parameters, making it possible to supply the plant during its cycle (EMBRAPA SOJA, 2010).

The analysis of the production of components (Table 3) revealed that the NLP and M100 variables showed significant differences by the F test at 5% probability ($0.01 \leq p < 0.05$) and for the NGL variable there were no significant differences by the F test ($p \geq 0.05$). In the evaluation of M100, it was verified that T2 (+F-BI) and T3 (-F+BI) treatments obtained averages higher than the others, but not statistically different from T1 (+F+BI). The T4 treatment (-F-BI) it had the lowest average presented, but no different from T1 (+F+BI). This leads to the conclusion that both the use of mineral P or the use of the bioactivator individually, have been able to raise the mass of grains.

It is noteworthy that the initial P level in the soil was 24.60 mg dm-3 (Table 1), a high level according to Embrapa Soja (2010). Thus, it was concluded that for leaf P, the use of the commercial bioactivator was similar to that of mineral fertilizer. For the micronutrients there were no significant results. The production components showed that the bioactivator achieved results equivalent to mineral fertilization, however, these data refer to a single agricultural crop. However, similar evaluations with other cultivars and fertility conditions are recommended, especially in soil with P limitation, in order to complement the results found in this experiment.

Table 1. Result of soil analysis

pH	P	K^+	Ca^{2+}	Mg^{2+}		Al^{3+}	H^++Al^{3+}	SB	CTC
H_2O	mg dm^{-3}	---------------------------------- $cmol_c$ dm^{-3} ----------------------------------							
5,65	24,6	0,6	6,61	1,11	0		3,83	8,32	12,15
V	Fe	Cu	Zn	Mn	$S(SO_4)^{-2}$		Areia	Silte	Argila
%	----------------------mg dm^{-3}--------------------						---------------- % --------------		
68,51	69,94	10,98	7,24	324,17		19,05	7,68	23,44	68,88

P, K^+, $S(SO_4)^{-2}$ = Mehlich-I. Al^{+3}, Ca^{+2} e Mg^{+2} = KCl 1 N.

Table 2. Results of macronutrients in plant tissue

Tratamentos	P *	N *	K **	Ca ^{ns}	Mg ^{ns}	S ^{ns}
	-------------------------------------- g Kg^{-1} --------------------------------------					
T1(+F+BI)	3,76 b	31,26 b	18,33 a	17,48 a	1,53 a	4,48 a
T2(+F-BI)	4,13 ab	31,56 b	16,96 b	16,68 a	1,28 a	4,94 a
T3(-F+BI)	4,39 a	31,92 b	18,33 a	16,28 a	1,40 a	4,72 a
T4(-F-BI)	4,00 ab	37,24 a	15,98 b	16,29 a	1,62 a	4,82 a
Média	4,07	32,99	17,4	16,68	1,46	4,74
CV (%)	5,28	5,89	2,41	3,81	9,11	8,77

As médias seguidas pela mesma letra na vertical não diferem estatisticamente entre si. Foi aplicado o Teste de Tukey ao nível de 5% de probabilidade; ns - não significativo; ** - significativo a 1 % de probabilidade pelo Teste F (Fischer); * - significativo a 5% de probabilidade pelo Teste F; CV - coeficiente de variação.

Table 3. Result of analysis of production components

Tratamentos	NLP*	NGL^{ns}	M100* (g)
T1(+F+BI)	47,27 a	2,32 a	11,32 ab
T2(+F-BI)	38,30 ab	2,50 a	11,52 a
T3(-F+BI)	47,17 a	2,54 a	11,62 a
T4(-F-BI)	34,15 b	2,25 a	09,94 b
Média	41,72	2,4	11,09
CV (%)	14,51	8,02	6,6

NLP - número de legumes por planta; NGL - número de grãos por legume e M100 - massa de 100 grãos. As médias seguidas pela mesma letra na vertical não diferem estatisticamente entre si. Foi aplicado o Teste de Tukey ao nível de 5% de probabilidade; ns - não significativo; * - significativo a 5% de probabilidade pelo Teste F (Fischer). CV – coeficiente de variação.

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penergetic

Adjustment of phosphate fertilization using Penergetic® technology in soybean crop

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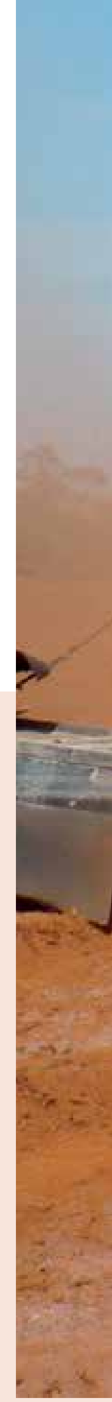

Currently, the world's agricultural production is based on the use of high amounts of inputs related to crops fertilization and the control of pests and diseases, resulting, in addition to environmental pollution, rising production costs. In Brazil, a country with great competitiveness in international agribusiness, this reality is no different.

In a review on sustainable alternatives for the agriculture, Oliveira et al. (2014) described that many of the advances made by Brazilian agribusiness are due to the large-scale use of fertilizers and agrochemicals, which are necessarily imported in large quantities to meet the demand of Brazilian farmers. Still according to the researcher, the safety and sustainability of Brazilian agribusiness are threatened by the availability and susceptibility of these inputs to the prices practiced by the international market. In addition, the global society presents a new concern about the need to achieve higher productivity and a more sustainable way to provide the growing population with food and energy.

Reports published by FAO and UNESCO cite countries such as Brazil, due to soil and climate conditions and due to the area being explored, as potential food exporters in the coming years. However, we must ask ourselves, at what cost? Currently, 53% of phosphorus and 93% of potassium used in Brazilian agriculture, in the most varied crops, are imported mainly from countries like Russia and China, in the case of phosphates and Russia and Canada in the case of potassic fertilizers. According to projections, the dependence on imports of these fertilizers will increase significantly by 2025.

Researches conducted in China, the world's largest producer and consumer of phosphate fertilizers, has shown that only the excess fertilizer used by Chinese farmers in recent years would supply all the demand for phosphate fertilizers in Western Europe and half the demand from African countries (SATTARI et al., 2015). MacDonald et al. (2010) determined that the global phosphorus surplus exceeds 13 kg per hectare per year. Bouwman et al. (2010) in review of nutrient losses and demand for mineral fertilizers in agriculture, showed that between the years 1950-2000, the surplus of phosphorus added to the soils was 11 million tons. The same study points out that by the year 2050, if global agriculture does not adopt mitigation measures, the surplus will increase by approximately 54%.

In 2013, during the 7° International Phosphorus Workshop, carried out in Sweden, lines of research were defined in order to: **1)** Optimize phosphorus management in the changing world; **2)** determine the transport routes of phosphorus from the soil to surface and subsurface waters; **3)** intensify monitoring, modeling and communication regarding the use of phosphorus in agriculture; **4)** determine the importance of organic systems of agricultural production for phosphorus management; **5)** identify appropriate measures to reduce phosphorus losses and **6)** implement mitigation strategies to reduce phosphorus losses and utilization. In this sense, the adoption of alternative and innovative products, that result in the reduction of the use of inputs of high economic and environmental cost, represents a viable strategy for producers who are seeking to adopt more sustainable productive systems without reducing the productivity of the crops. In this sense, the present study had the objective to evaluate the possibility of adjustment of phosphate fertilization using Penergetic® technology in soybean crop

The tests consisted of plantations in the side-by-side design in 28 properties in the southern region of Brazil, 18 properties in the Southeast region and 11 properties in the Center-West region in the agricultural year of 2013/2014, in addition to 100 properties in the South region of Brazil, 17 properties in the Southeast region, 9 properties in the Central-West region in the agricultural year of 2014/2015. The treatments used were: **1)** Producer standard (standard N-P-K fertilizer) and **2)** use of the Penergetic® technology, with phosphate fertilization adjustment according to the soil fertility analysis of each property evaluated, according to the N-P-K formulations of each region. The potassium fertilization was standardized in the areas and in the treatments, being used in cover, in the form of potassium chloride. The Penergetic® Kompost-Soils (250 g ha^{-1}) was applied to the soil during desiccation in pre-sowing and the Penergetic® Pflanzen-Plants (250 g ha^{-1}) applied via leaves in two moments, 125 g in the V3 stage and 125 g 15 days after the first application.

The control of pests, diseases and weeds was carried out, according to the technical indications for the crop, being identical in the plots of side-by-side confrontations. During the harvest, all areas were accompanied by the producer and the work team, determining the crop yield through measurements by area. The results were submitted to analysis of variance (ANOVA) between treatments, using the Sisvar software (Ferreira, 2000). The averages of the each treatment were compared to each other by the Tukey test, at 5% probability (P<0,05).

The use of Penergetic® technology resulted in significant reduction of phosphorus fertilization in all areas of the study, maintain productivity at levels above those seen in areas called "Producer Standard". According to Veneklaas et al. (2012), the reduction in phosphorus availability for crops can directly result in reduced yield.

However, according to the author, the limitation of productivity only occurs if technologies that potentiate the efficiency in the use of nutrients immobilized in the soil are not used.

Owen et al. (2015) in works on the use of efficient microorganisms, demonstrated the importance of microbiota diversity for crop productivity. This study indicates the **current trend of intensification of the use of inputs from "green" technologies, intensifying mineralization of essential nutrients the crops, especially of phosphorus (P), and increasing their availability for plants.** McDaniel et al. (2014), in a meta-analysis of 122 papers published in recent years, on the effects of agriculture on soil microbiota, concluded that the lack of crop rotation and monoculture are selecting microorganisms adapted to certain plants and, thereby, determining the microbiological reactions occurring in these soils and the intensity of these reactions, increasing imbalances with harmful effects agricultural sustainability.

At the cultivation level, the management strategy of the efficiency of phosphorus utilization is linked to the efficiency of microorganisms providing a bioavailability of the nutrient. According to the authors, the introduction of phosphorus in the production system, in an adjusted dosage, represents a fundamental measure in the mitigation of recurrent excesses in Brazilian and world agriculture.

According to Gatiboni et al. (2008), the organic forms of phosphorus (Po) represent the phosphate ions, bound to the organic compounds being its lability directly related to the organic radical decomposition susceptibility, to which the phosphate is attached According to the authors, this storage form of phosphorus in the soil is very susceptible to microbial attack, and composes the "pool" of labile soil phosphorus. **According to the author, soils fertilized with phosphorus in mineral form, the contribution of organic phosphorus to plant nutrition is only 6%. However, to the extent that the soil no longer receives phosphorus fertilization, this contribution is replaced by values close to 45%. According to Stevenson (1994), the organic phosphorus can contribute with up to 80% of the total phosphorus of the soil,** being extremely relevant in the tropical soils, acting in an active way in the availability of this nutrient to the plants. In this way, the biological processes regulate the dynamics and distribution of labile forms of phosphorus in the soil. The social, economic and environmental benefits of the agriculture practiced in a sustainable way represent the most viable path to productive growth trends with social, economic and environmental responsibility.

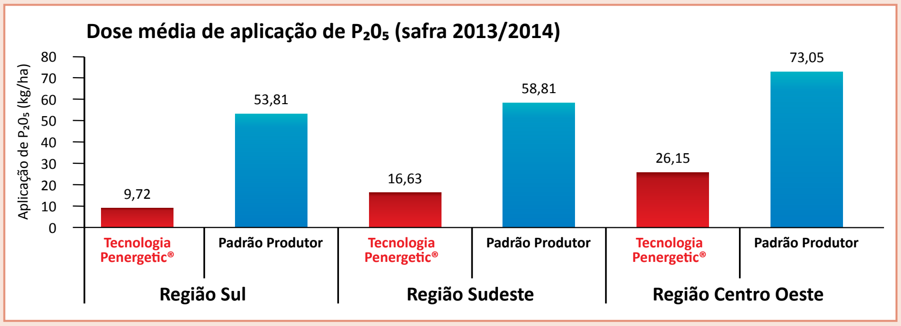

Figure 1. Average dose of P_2O_5 in the South, Southeast and Midwest regions in side-by-side tests comparing Penergetic® technology and standard fertilization of the producer. (Crop of 2013/2014).

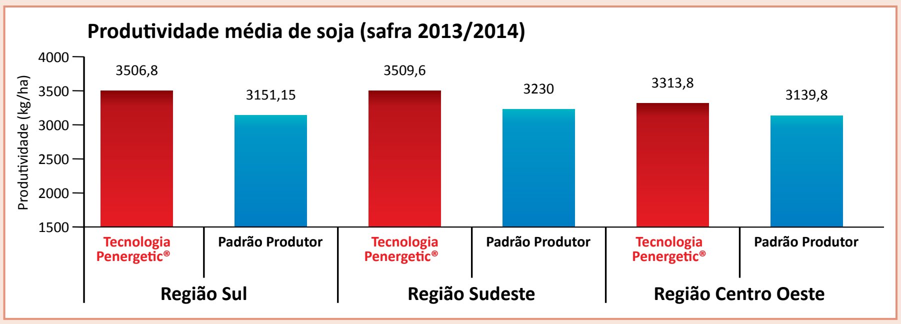

Figure 2. Average dose of P_2O_5 in the South, Southeast and Midwest regions in side-by-side tests comparing Penergetic® technology and standard fertilization of the producer. (Crop of 2013/2014).

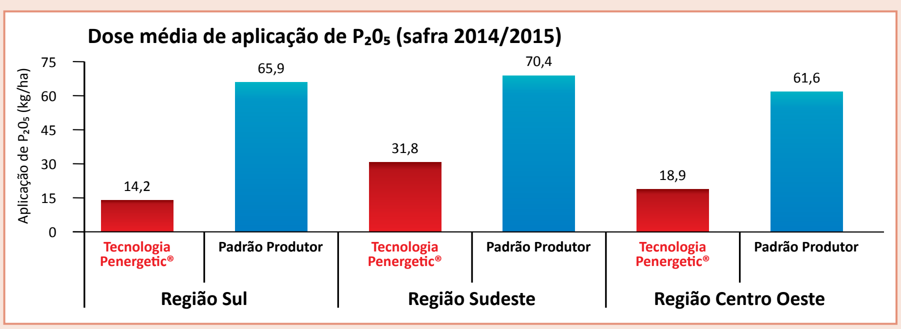

Figure 3. Average dose of P_2O_5 in the South, Southeast and Midwest regions in side-by-side tests comparing Penergetic® technology and standard fertilization of the producer. (Crop of 2014/2015).

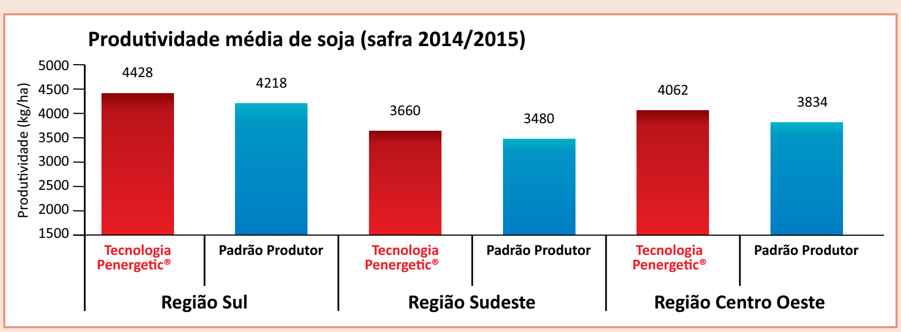

Figure 4. Average dose of P_2O_5 in the South, Southeast and Midwest regions in side-by-side tests comparing Penergetic® technology and standard fertilization of the producer. (Crop of 2014/2015).

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Effect of Penergetic® Pflanzen and Penergetic® Kompost in the soybean production

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INTRODUCTION

The phosphorus requirement needed by the crops generally is lower than that of potassium (K) and nitrogen (N), however, the amount applied is usually higher (Vieira, 2006). This is due to the high P fixation rate in tropical soils, caused mainly by precipitation with Fe and Al, reaction with hydrated oxides of the same metals and reaction with silicate clays, because of this the use by the crop varies from 5% to 25% (Malavolta, 1980). In this sense, it may be experiencing elevated levels of phosphorus in the soil, without increasing the availability to plants. Therefore, the development of technologies that provide greater availability of phosphorus to plants could provide a reduction in the amount of phosphate fertilizers applied to the soil, generating economic and environmental gains, since these fertilizers are produced from mineral reserves of non-renewable character (Pelá et al., 2009).

The Penergetic® technology consists in the application of Penergetic® Kompost and Pflanzen products, using as carriage the bentonite clay and/or Calcium Carbonate, submitted to the application of electric and magnetic fields (Brito et al., 2012). These products, according to the manufacturer, are used as a soil bioactivator (Penergetic® Kompost, applied to the soil), which increases and balances the microbiological activities in the soil and plant bioactivator (Penergetic® Pflanzen), which provides more energy to the photosynthetic process and facilitates beneficial plant-microorganism interaction (Penergetic®, 2013). There are already promising results from the use of these products in wheat (PEKARSKAS, 2012; KADZIULIENE et al., 2005), vegetables (JANKAUSKIENE et al., 2009), Common bean plant (BRITO et al., 2012) and potato (JAKIENE et al., 2008).

PURPOSE

The objective of this study was to evaluate the effects of the Penergetic® Pflanzen and Penergetic® Kompost in the production of soybeans, as well as to validate the recommendations of fertilization of phosphorus and potassium at field level.

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METHODOLOGY

Four field experiments were carried out in cities of Unaí MG; Silvânia-GO; Jataí-GO and Fortaleza do Tabocão-TO. The chemical and physical characteristics of the soils in the experimental areas are described in the Tables 1, 2 ,3 and 4.

Table 1.

Soil analysis of the experimental area of Jataí/GO, 2014/2015.

	pH	M.O.		Ca	Mg	Al	H+Al	V	M
(cm)	(água)	g/dm^3	mmolc/dm^3					%	
0-10		46		3,7	0,7			63	
K	P	B	Cu	Fe	Mn	Zn	Argila	Silte	Areia
mg/dm^3	mg/dm^3	mg/dm^3					g/kg		
210	11	0,28	7	26,8	33,1		370	90	540

Extrator: P-Mehlich; B-Água quente; Cu/Fe/Mn/Zn – DTPA.
-Água quente; Cu/Fe/Mn/Zn – DTPA.

Table 2.

Soil analysis of the experimental area of Silvânia/GO, 2014/2015.

	pH	M.O.		Ca	Mg	Al	H+Al	V	M
(cm)	(água)	g/dm^3	mmolc/dm^3					%	
0-10	5,6	30		3,1	1,3			63	
K	P	B	Cu	Fe	Mn	Zn	Argila	Silte	Areia
mg/dm^3	mg/dm^3	mg/dm^3					g/kg		
170	8,8	0,19	2,9	41	21,5		370	90	540

Extrator: P-Mehlich; B-Água quente; Cu/Fe/Mn/Zn – DTPA.
-Água quente; Cu/Fe/Mn/Zn – DTPA

Table 3.

Soil analysis of the experimental area of Unaí/MG, 2014/2015.

	pH	M.O.		Ca	Mg	Al	H+Al	V	m
(cm)	(água)	g/dm^3	mmolc/dm^3					%	
0-10	5,4	26		3,2	1,1			59	
K	P	B	Cu	Fe	Mn	Zn	Argila	Silte	Areia
mg/dm^3	mg/dm^3	mg/dm^3					g/kg		
162	8,9	0,3	3,8	45	26,3	2,4	360	100	540

Extrator: P-Mehlich; B-Água quente; Cu/Fe/Mn/Zn – DTPA.
-Água quente; Cu/Fe/Mn/Zn – DTPA.

Table 4.

Soil analysis of the experimental area of Fortaleza do Tabocão/TO, 2014/2015.

	pH	M.O.		Ca	Mg	Al	H+Al	V	M
(cm)	(água)	g/dm^3	mmolc/dm^3					%	
0-10	4,5	56		2,5	0,8			47	
K	P	B	Cu	Fe	Mn	Zn	Argila	Silte	Areia
mg/dm^3	mg/dm^3	mg/dm^3					g/kg		
90	8,4	0,32	2,2	37	25,1	2	400	100	500

Extrator: P-Mehlich; B-Água quente; Cu/Fe/Mn/Zn – DTPA.
-Água quente; Cu/Fe/Mn/Zn – DTPA.

The experimental design used in the four experiments was a randomized block design with ten repetitions, where the plots measured 30m long by 40m wide. The treatments were formed by a factorial 3x2, being three doses of fertilizer (Without fertilization; Penergetic® Indication and Standard Fertilization) and two managements (Without Penergetic® and With Penergetic®). The Penergetic® application Kompost--Soils was applied at a dosage of 250 g/ha Immediately applied to the planting and the application of Penergetic® Pflanzen in the dosage of 250 g/ha at 20 days after germination. The treatments were designated as: **T1** - Without fertilization; **T2** - Without fertilization + Penergetic® Technology; **T3** - Penergetic® Indication; **T4** - Penergetic® Indication + Penergetic® Technology; **T5** - Standard Farm Fertilization; **T6** - Standard Farm Fertilization + Penergetic® Technology. In the table to the side are described the sowing data of each region:

Fortaleza do Tabocão -TO Semeadura: Novembro/2014 Cultivar: 8667 Densidade: 13 sementes/m linear	**Silvânia-GO** Semeadura: Outubro/2014 Cultivar: Nidera 7227 Densidade: 20 sementes/m linear
Unaí-MG Semeadura: Outubro/2014 Cultivar: Nidera 7227 Densidade: 20 sementes/m linear	**Jataí-GO** Semeadura: Outubro/2014 Cultivar: Nidera 5904 Densidade: 16 sementes/m linear

In the four experiments, the spacing of 50 cm between the lines was used and held a broadcasting application of 150 kg/ha of KCl before planting. The evaluations were: N° of grains/m², mass of 100 grains (g) and final productivity (Moisture corrected for 13%). The data were submitted to analysis of variance and averages tests (Tukey, 5%).

RESULTS

From the analysis of the Table 5 and of the Graphic 1, it's noted that in Jataí-GO, there was a significant effect of the treatments on the mass of 100 grains, grains/m2 and the final yield of soybean. **It is observed that in the treatments where no fertilization was used, a significant increase of soybean yield occurred with the use of the Penergetic® technology, ranging from 5 to 8%.**

Analyzing the Table 6, it is observed that for the number of grains/m2 there was a tendency of grain growth, with the application of Penergetic®, althought not a meaningful increase. The mass of 100 grains presented an increase of 3 to 5%, with the application of Penergetic® (Table 7).

For the Standard Fertilization treatment (Complete fertilizer), the Penergetic® technology didn't promote a significant increase in legume productivity.

In this experiment it was observed that it was possible to eliminate the basic fertilization with the application of the Penergetic® technology, because the activation effect of the soil microbiota probably confers a greater release of nutrients to the plant.

Table 5. Soybean yield due to the treatments. Jataí/GO, 2014/2015.

Repetições	Sem adubação		Indicação Penergetic® 0 kg/ha 10-54-0		Adubação Padrão 250kg/ha 10-54-0	
	S/ PEN	C/ PEN	S/ PEN	C/ PEN	S/ PEN	C/ PEN
1	53,4	66,6	56,5	56,6	57,3	55,2
2	53	59,2	55,9	59,3	54,6	56,3
3	55,7	60	56,7	55,8	60	59
4	54,7	64,6	54,7	57,4	55,1	58,4
5	53,4	55,6	54	55,5	57,5	57,6
6	55,7	53,5	54	58,9	57,9	59,1
7	55,5	58,6	55,2	58,3	56,2	60,1
8	53,9	53,2	56,6	57,7	57,3	57
9	53,5	58	55	55,4	60	63,2
10	53,4	58,7	55	58,7	57,7	60
Média	**54,2 b**	**58,7 a**	**55,3 ab**	**57,3 ab**	**57,7 ab**	**58,6 a**
%	100	108	102	105	106	108
C.V: 4,9%						

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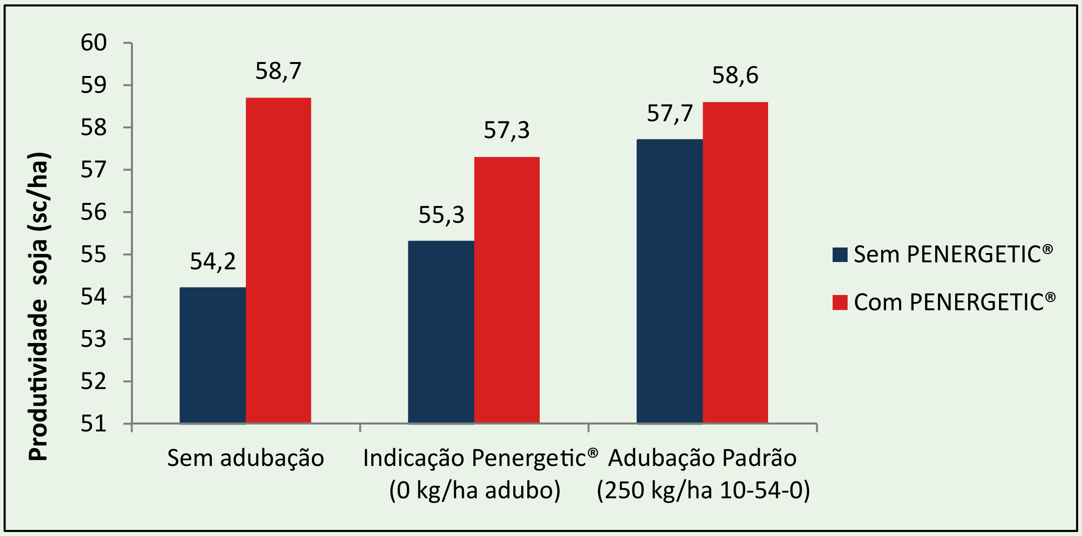
Graphic 1. Average yield of soybeans due to the treatments. Jataí/GO, 2014/2015



*Médias seguidas pela mesma letra não diferem entre si, pelo teste de Tukey, a 5% de probabilidade.

Table 6. Number of grains/m2 of soybeans due to the treatments. Jataí/GO, 2014/2015.

Repetições	Sem Adubação		Indicação Penergetic® 0 kg /ha 10-54-0		Adubação Padrão 250kg /ha 10-54-0	
	S/ PEN	C/ PEN	S/ PEN	C/ PEN	S/ PEN	C/ PEN
1	1982	2452	2125	2114	2219	1950
2	2056	2064	2103	2052	2214	2077
3	2120	2267	2104	2081	2076	2169
4	2001	2382	2092	2138	2391	2194
5	2116	2023	2089	2130	2038	2095
6	2132	2015	2164	2234	2218	2169
7	2137	2150	2113	2277	2189	2157
8	2087	2085	2131	2043	2175	2070
9	2137	2157	1966	2101	2208	2259
10	1965	2145	2181	2188	2348	2146
Média	**2073 b**	**2173 ab**	**2106 ab**	**2135 ab**	**2207 a**	**2128 ab**
%	100	104	101	102	106	102
C.V: 4,7%						

*Médias seguidas pela mesma letra não diferem entre si, pelo teste de Tukey, a 5% de probabilidade.

Table 7. Weight of 100 grains (g) of soybeans due to the treatments. Jataí/GO, 2014/2015.

Repetições	Sem adubação		Indicação Penergetic® 0 kg /ha 10-54-0		Adubação Padrão 250kg /ha 10-54-0	
	S/ PEN	C/ PEN	S/ PEN	C/ PEN	S/ PEN	C/ PEN
1	16,2	16,3	16	16,1	16,4	17
2	15,5	17,2	16	17,4	15,5	16,3
3	15,8	15,9	16,2	16,1	15,8	16,3
4	16,2	16,3	15,7	16,1	15	16
5	15,1	16,5	15,5	15,6	16,2	16,5
6	15,7	15,9	15	15,8	15,6	16,4
7	15,6	16,4	15,7	15,4	15,9	16,7
8	15,5	15,3	15,9	16,9	15,5	16,5
9	15	16,1	16,8	15,8	15,6	16,8
10	16,3	16,4	15,1	16,1	15,3	16,8
Média	**15,6 b**	**16,2 ab**	**15,7 b**	**16,1 ab**	**15,6 b**	**16,5 a**
%	100	103	100	103	100	105
C.V: 3,4%						

*Médias seguidas pela mesma letra não diferem entre si, pelo teste de Tukey, a 5% de probabilidade.

In Silvânia-GO, observed in Table 8 and Graphic 2 that the application de Penergetic® Pflanzen and Penergetic® Kompost in the treatment without fertilization and in the treatment with fertilization made by Penergetic®, generated an increase of 8 to 9% in the soybean yield, reaching the same level of productivity provided by the treatment with standard Farm fertilization.

It is also observed that the treatment without fertilization, the use of the Penergetic® technology provided an increase in the mass of 100 grains (Table 9), as well as the number of grains/m², which obtained superior results in the three treatments (Without fertilization, Penergetic® Indication and Standard fertilization of the farm) with the use of Penergetic® (Table 10).

Again, as noted in Jatai-GO it was possible the

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Table 8. Soybean yield (sc/ha) due to the treatments. Silvânia/GO, 2014/2015.

Repetições	Sem adubação		Indicação Penergetic® 100 kg 5-37-00		Adubação Padrão 300 kg 5-37-00	
	S/ PEN	C/ PEN	S/ PEN	C/ PEN	S/ PEN	C/ PEN
1	56,8	63	59,2	59,8	63,9	62,9
2	52,5	60,7	57,3	59,5	65,3	63,3
3	58,5	59,5	60,2	66,3	63,1	65,6
4	59,3	63,2	56,4	60,4	62,6	59,3
5	58,9	66,7	56,2	60,6	57,3	65,5
6	56	59,5	58,8	59,2	63,9	62,1
7	58,1	61,1	54,1	60,8	61,8	61,4
8	54,6	64,4	59	63	68,1	62,2
9	54,5	56,4	58,4	58,8	64	67,1
10	55,9	60,1	59	62,6	67,9	62,6
Média	**56,5 c**	**61,4 ab**	**57,8 bc**	**61,1 ab**	**63,7 a**	**63,2 ab**
%	**100**	**109**	**102**	**108**	**113**	**112**
C.V: 4,3%						

*Médias seguidas pela mesma letra não diferem entre si, pelo teste de Tukey, a 5% de probabilidade.

Graphic 2. Average yield of soybeans due to the treatments. Silvânia/GO, 2014/2015.

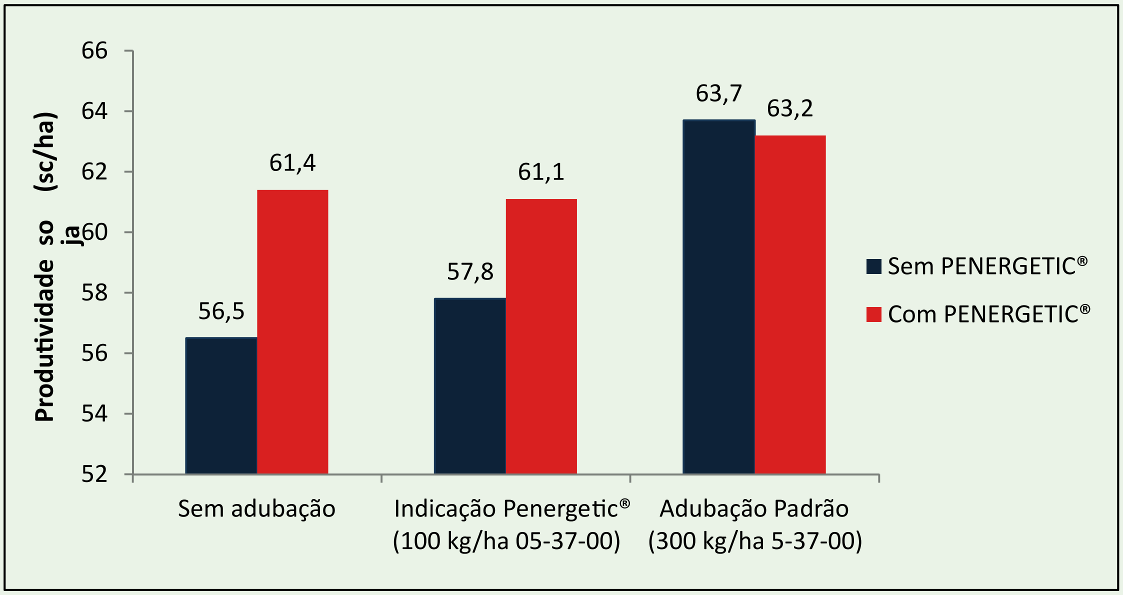


Table 9. Weight of 100 grains of soybeans due to the treatments. Silvânia/GO, 2014/2015.

Repetições	Sem adubação		Indicação Penergetic® 100 kg 5-37-00		Adubação Padrão 300 kg 5-37-00	
	S/ PEN	C/ PEN	S/ PEN	C/ PEN	S/ PEN	C/ PEN
1	17,9	18,7	18,6	17,4	19,2	18
2	17,7	18,6	18,6	18,3	19,6	18,1
3	18,3	18,4	18,6	18,1	19,3	18,7
4	19,1	18,4	17,6	18,4	18,4	18,3
5	17,7	18,4	18,4	17,4	17,9	18,5
6	18,2	17,8	17,9	17,5	18,5	18,7
7	17,6	18,8	19,6	17,8	18,3	18,8
8	17,6	18,5	18,6	17,5	18,9	18,8
9	17,6	18,7	18,4	18,5	19,6	18,8
10	17,1	18,5	18,5	17,9	18,5	19
Média	**17,8 b**	**18,4 ab**	**18,4 ab**	**17,8 b**	**18,8 a**	**18,5 a**
%	100	103	103	100	105	104
C.V: 4,4%						

*Médias seguidas pela mesma letra não diferem entre si, pelo teste de Tukey, a 5% de probabilidade.

Table 10. Number of grains/m2 of soybeans due to the treatments. Silvânia/GO, 2014/2015.

Repetições	Sem adubação		Indicação Penergetic® 100 kg 5-37-00		Adubação Padrão 300 kg 5-37-00	
	S/ PEN	C/ PEN	S/ PEN	C/ PEN	S/ PEN	C/ PEN
1	1906	2015	1906	1998	2002	2099
2	1777	1956	1847	1946	1995	2105
3	1921	1945	1941	2195	1961	2111
4	1863	2063	1925	1971	2043	1950
5	1993	2177	1828	1951	1918	2129
6	1844	2002	1971	2031	2077	1995
7	1978	1947	1654	2046	2026	1959
8	1861	2088	1908	2162	2166	1989
9	1860	1808	1903	1907	1954	2143
10	1966	1954	1919	1994	2208	1972
Média	**1897 b**	**1996 ab**	**1880 b**	**2020 a**	**2035 a**	**2045 a**
%	100	105	99	106	107	108
C.V: 2,5%						

*Médias seguidas pela mesma letra não diferem entre si, pelo teste de Tukey, a 5% de probabilidade.

withdrawal of basic fertilization with the use of Penergetic® technology.

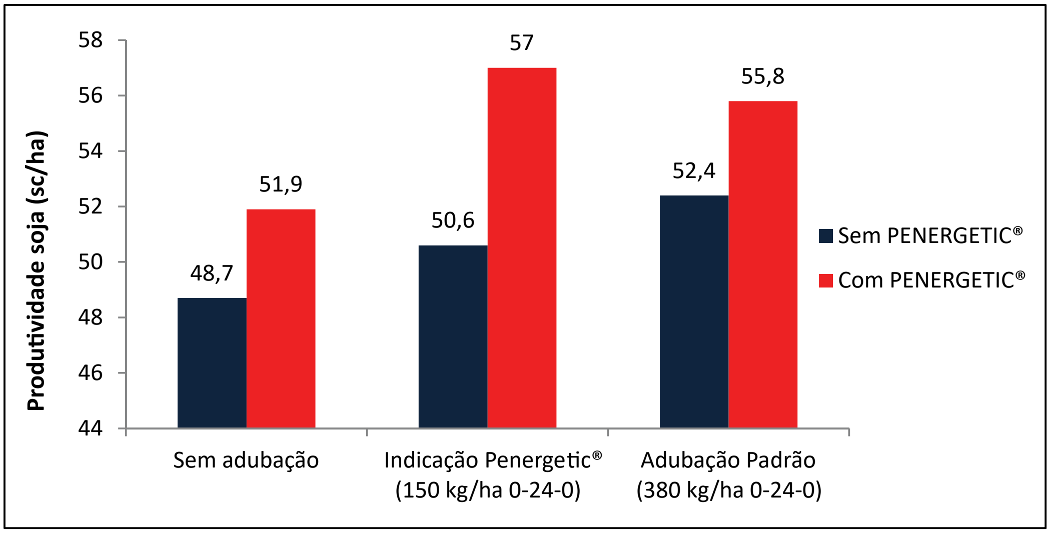
In the experiment conducted in Unaí-MG, is found according to the Table 11 and Graphic 3, that the application of Penergetic® technology promoted a 7% increase in soybean yield in the treatment without fertilization. This result, which was not significantly different from the complete fertilization.

The highest soybean productivity result was obtained in the treatment

Table 11. Soybean yield (sc/ha) due to the treatments. Unaí/MG, 2014/2015

Repetições	Sem adubação		Indicação Penergetic® 150 kg 0-24-0		Adubação Padrão 380 kg 0-24-0	
	S/ PEN	C/ PEN	S/ PEN	C/ PEN	S/ PEN	C/ PEN
1	50,2	54,5	53	58,3	55,2	54,8
2	45,7	51,5	48,4	60,8	49,1	54,5
3	45,1	54,8	47,7	58	51,8	58,3
4	50,4	49,6	51,7	53,2	51,7	63
5	49,3	48,6	47,3	55,2	49,3	51,2
6	51,4	51,6	54,4	55,1	47,4	56,5
7	47,5	54,3	51,1	58,3	55,7	51,3
8	46,7	51,4	52	62	59,7	55,9
9	51,2	52,4	50,7	54	54,4	56,2
10	49,5	51	49,7	55,8	50,2	57,3
Média	**48,7 d**	**51,9 cd**	**50,6 cd**	**57,0 a**	**52,4 bc**	**55,8 ab**
%	100	107	104	117	108	115
C.V: 5,3%						

*Médias seguidas pela mesma letra não diferem entre si, pelo teste de Tukey, a 5% de probabilidade.



Graphic 3. Average yield of soybeans due to the treatments. Unaí/MG, 2014/2015.

where the fertilization was adjusted according to the Penergetic® Indication, linking to the use of Penergetic® Pflanzen and Penergetic® Kompost (Table 11 – Graphic 3).

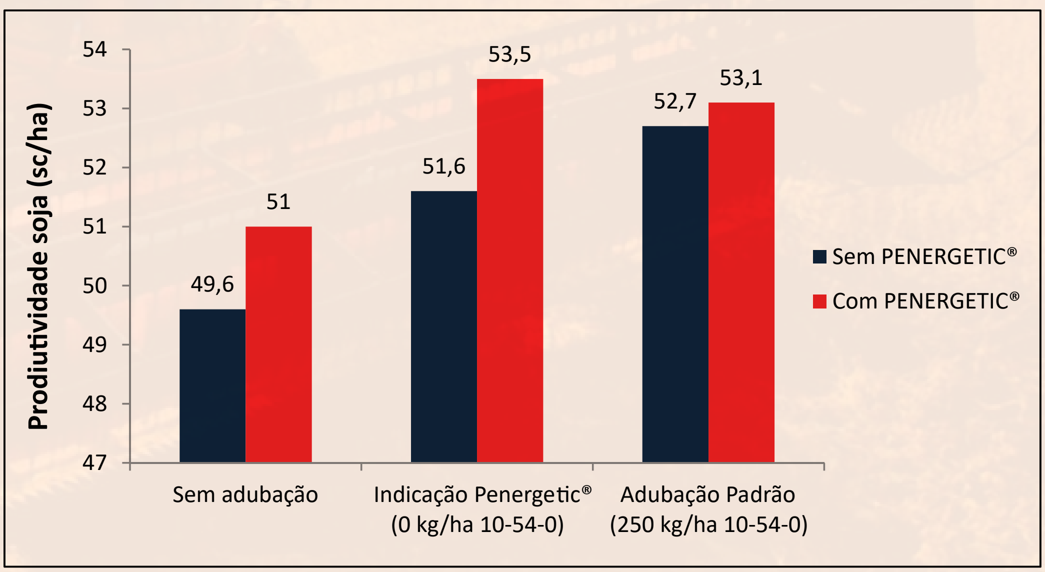
In Fortaleza do Tabocão-TO, according to the Table 12 and Graphic 4, the application of Penergetic® technology promoted a 3% increase in soybean yield in the treatment without fertilization. It should be noted that this result does not differ statistically from the standard fertilization treatment used by the farm.

Table 12. Soybean yield (sc/ha) due to the treatments. Unaí/MG, 2014/2015

Repetições	Sem adubação		Indicação Penergetic® 0 kg /ha 10-54-0		Adubação Padrão 250kg /ha 10-54-0	
	S/ PEN	C/ PEN	S/ PEN	C/ PEN	S/ PEN	C/ PEN
1	45,6	47,8	52,3	54,6	54,3	54,7
2	47,4	48,8	53,2	53,4	50,6	57,4
3	51,4	52,6	50,4	56,4	53,1	52,4
4	50,6	50,7	51,3	48,7	48,5	53,6
5	47,6	53,7	49,7	49,9	53,2	54,8
6	48,7	49,1	48,7	53,5	54,9	55,9
7	51	53,6	52,4	54,3	56,4	52,4
8	52,6	48,6	55,3	50,9	50,3	50,4
9	49,9	53,4	51,4	55,3	52,4	48,9
10	51,2	51,5	50,8	58,3	53,6	50,3
Média	**49,6 b**	**51,0 ab**	**51,6 ab**	**53,5 a**	**52,7 a**	**53,1 a**
%	100	103	104	108	106	107
C.V: 4,5%						

*Médias seguidas pela mesma letra não diferem entre si, pelo teste de Tukey, a 5% de probabilidade.

Graphic 4. Average yield of soybeans due to the treatments. Fortaleza do Tabocão/TO, 2014/2015.



The biggest result of productivity was obtained with the adjustment fertilization and implementation of the Penergetic® technology, yielding 53.5 sc/ha (Table 12 – Graphic 4).

CONCLUSIONS

The use of Penergetic® technology promoted increments of 6 to 8% of soybean yields in the average of the four experiments.

This increase in productivity is directly related to the increase in the number of grains/m^2, as well as the increase in grain mass, also observed with the use of Penergetic® Pflanzen and Penergetic® Kompost.

In all the studied sites, the use of the Penergetic® technology combined with an adjustment in the basic fertilization, promoted a reduction in the use of fertilizer, without significant losses in soybean production, when compared to the levels of productivity obtained with the pattern of fertilization of the farm.


POR UMA AGRICULTURA
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