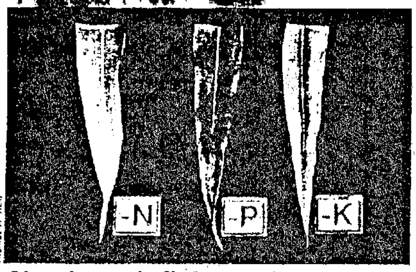
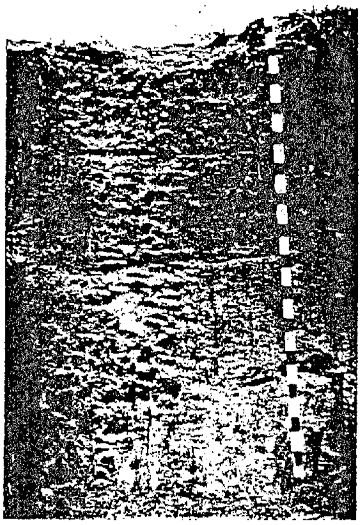
SOIL DETERIORATION: CAUSES AND CONTROL TECHNOLOGIES

- IMPACT OF SEVERAL MANAGEMENT SYSTEMS ON SOIL MESOFAUNA
- SOIL COMPACTION EVALUATION UNDER VARIOUS CROPPING SYSTEMS USING THE PENETROGRAPH
- AVALIAÇÃO DO DESEMPENHO DE UM SUBSOLADOR VIBRATÓRIO
- NITROGEN TRANSFORMATION IN CROPPING SYSTEMS USING DIFFERENT COVER CROPS AND THEIR EFFECTS ON N AVAILABILITY TO THE SUCCEEDING MAIZE CROP
- EFFECT OF SILICON APPLICATION IN THE YIELD OF ANNUAL CROPS ON CERRADO SOILS



Nutrient deficiency in corn


Green manure production


Latossol in Cerrado

Embrapa
Cerrados

IMPACT OF SEVERAL MANAGEMENT SYSTEMS ON SOIL MESOFAUNA

[1]Hiroyoshi Shiraishi, [2]Lourival Vilela

[1]*Agência de Cooperação Internacional do Japão - JICA*
[2]*Embrapa Cerrados*, cx. postal 08223, CEP 73301-970, Planaltina-DF, Brasil

INTRODUCTION

The soil fauna in agriculture has been ignored or considered insignificant for many years. Currently, the role of soil fauna on the processes of organic matter humification and mineralization, on the aggregation and structuration of soil and plants nutrition receives much more attention.

These effects are of particular importance on the increase of the efficiency of the fertilizers. In the present study it was done a prelintinary evaluation of different soil use systems on the soil mesofauna population density and diversity.

MATERIALS AND METHODS

Density (individuals/m^2) and diversity of soil mesofauna was monitored in several soil use systems in experiments carried out in Oxisols of Uberlândia (MG) and Campo Grande (MS). The soil fauna was obtained by extraction using a Berlese-Tullgren funnel (Foto 1).

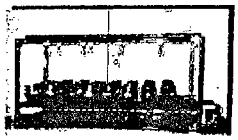


Foto 1. Berlese-Tullgren funnel

RESULTS

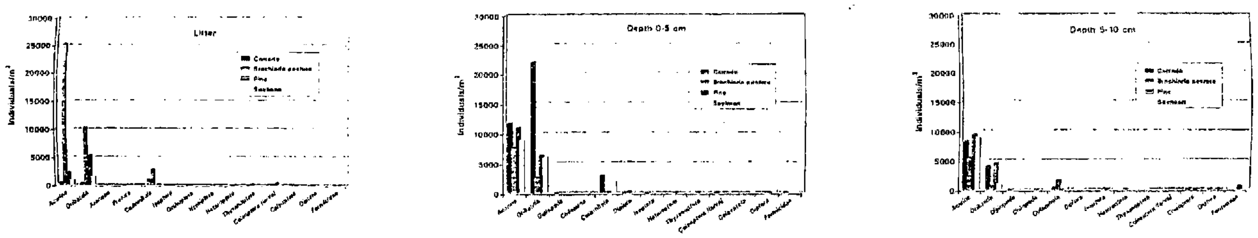


Figure 1. Impact of several soil use systems on soil mesofauna in Oxisol of Uberlândia, MG.

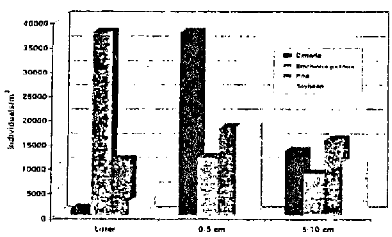


Figure 2. Impact of several management systems on total mesofauna density. Uberlândia, MG, 1997.

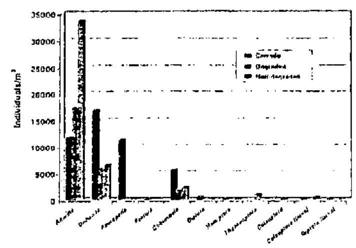


Figure 3. Impact of Brachiaria pasture degradation on soil mesofauna in a latosol of Campo Grande, MS.

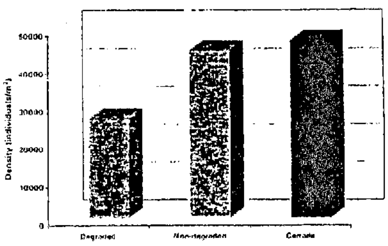


Figure 4. Effect of Brachiaria pasture degradation on total mesofauna density. Campo Grande, MS, 1997.

CONCLUSIONS

The mesofauna population under native cerrado was larger than the other systems studied.

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Prostigmata (Acari) was the main component of soil mesofauna and it's population was higher under pastures. This phenomenon is related to the presence of cattle excrement.

●●●●●

Cattle excrement increased fungae and nematoda diversity in soil. Consequently, the role of Prostigmata as a predator was favoured.

The process of pasture degradation reduced soil mesofauna population.

Embrapa
Cerrados

SOIL COMPACTION EVALUATION UNDER VARIOUS CROPPING SYSTEMS USING THE PENTROGRAPH

[1]Hideo Kubotera , [2]Lourival Vilela

[1]*Agência de Cooperação Internacional do Japão - JICA*

[2]*Embrapa Cerrados*, cx. postal 08223, CEP 73301-970, Planaltina-DF, Brasil

INTRODUCTION

Highly weathered Latosols (Oxisols in the USDA soil taxonomy) are widely distributed in the Cerrado region. These soils have the problems of chemical properties such as low nutrients content, low CEC and high phosphate retention. Therefore the productivity will decrease if the adequate soil management are not implemented.

The degree of subsoil compaction influences root elongation. nutrients dynamics. soil erosion and it is an important check point among the soil properties under various cropping systems. However, the determination of subsoil compaction using Yamanaka penetrometer is time and labor demanding and, the need of a pit, brings disturbance to the plots.

Penetrograph records the resistance to the penetration of a cone which is vertically pushed into the soil. It is an effective tool to measure soil compaction using less time and labor.

OBJECTIVES

1 to compare the data of penetrograph (cone penetrometer Dik-5520) with the Yamanaka penetrometer;

2 to evaluate the soil compaction under the various cropping systems and tillage methods.

MATERIALS AND METHODS

The soil compaction was monitored in distinct soil use systems evaluated in a long-term experiment carried out in a dark red latosol of Embrapa Cerrados. Planaltina (DF). The soil use systems studied are as follows:

1) Native cerrado;
2) Andropogon gayanus pasture under grazing;
3) Soybean/corn rotation, heavy disk harrow;
4) Soybean/corn rotation, moldboard plow;
5) Pasture/crop rotation (four years pasture/four years crop);
6) Crop/pasture rotation four years crop/four years grass.

The soil compaction (penetration resistance) was measured at the surface and 60cm depth on five or six points at intervals of ten to fifteen meters on a diagonal line in each plot. Soil compaction was also measured in the tracks of tractors in treatments 3 and 4. The data, which was recorded in the form of continuous line on the chart paper was read and digitized in order to calculate the average and standard deviation.

Soil compaction was also measured with the Yamanaka penetrometer in the cerrado, pasture, and soybean/corn rotation plots.

RESULTS

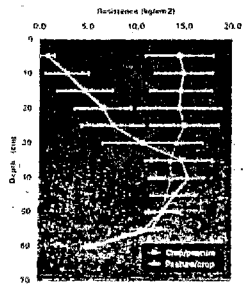

Figure 2. Effect of crop/pasture rotation on soil compacretion. Bars indicate standard deviation.

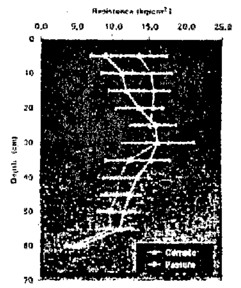

Figure 1. Effect of pasture on soil comoactation. Bars indicate standard deviation.

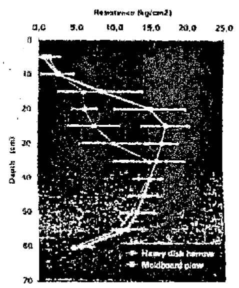

Figure 3. Impact of tillage systems on soil compactation. Bars indicate standard deviation.

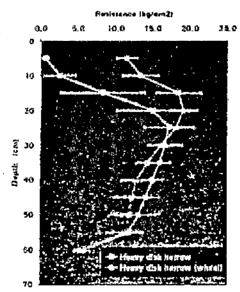

Figure 4. Impact of tractor traffic on soil compactation. Bars indicate standard deviation.

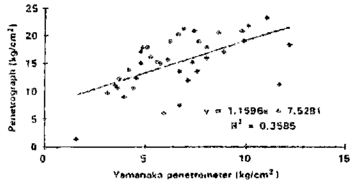

Figure 5. Relationship between the value of penetrograph and Yamanaka penetrometer.

CONCLUSIONS

Soil compaction was variable under different cropping systems or tillage methods.

Compared to Yamanaka penetromenter, the penetrograph was an efficient equipment to measure soil compaction.

Embrapa

Cerrados

AVALIAÇÃO DO DESEMPENHO DE UM SUBSOLADOR VIBRATÓRIO

[1]Claudio A. B. FRANZ, [1]Sergio M. FOLLE, [2]Keiich INOUE, [1]Francisco E. C. ROCHA

[1]Embrapa Cerrados, cx. postal 08223, cep 73301-970, Planaltina, DF.

e.mail: franz@cpac.embrapa.br

[2]Consultor do Convênio Embrapa Cerrados/JICA

RESUMO

Este trabalho teve como objetivo avaliar o desempenho de um subsolador com mecanismo vibratório acionado pela tomada de potência de tratores agrícolas. As avaliações foram realizadas em um Latossolo vermelho escuro, argiloso, tendo como parâmetros avaliados a força de tração e potência exigidas pelo implemento, nas condições com vibração e sem vibração, e em três velocidades de deslocamento. Os resultados permitiram concluir que a utilização do equipamento com vibração diminuiu em 20 % a exigência de força e potência, bem como estes parâmetros foram menores na velocidade mais baixa.

ABSTRACT

The objective of this work was to evaluate the performance of a subsoiler equiped with vibration mechanism acionated by PTO shaft of agricultural tractors. Evaluation of traction force and power absorved by the implement with and without vibration were carried out on Clayey Red Dark Latossol for three operating speeds. Results obtained show that when vibration mechanism is swich on traction force and power demanded by the implement decresced up to 20% for the higher operating speed.

INTRODUÇÃO

O desenvolvimento da agricultura na região dos Cerrados, tem sido possível com o uso intensivo de máquinas agrícolas. Este fator, aliado as características pluviométricas da região e ao dimensionamento de parques e seleção inadequada das máquinas tem levado a resultados não desejáveis, com degradação dos solos e alto consumo energético. (FOLLE et al., 1994; FRANZ et al., 1994; VOORHEES, 1985).

As condições do solo durante as operações de preparo e plantio são normalmente executadas com umidade não adequada o que tem sido um dos principais fatores para o aparecimento de camadas compactadas, tornando inevitável o uso de subsoladores de forma intensiva, na tentativa de corrigir o problema (ISHIDA et al., 1995).

LANÇAS et al., 1993, encontraram resultados operacionais melhores na operação de subsolagem, em menores teores de água no solo, no entanto com maiores consumo de combustível e esforços de tração.

OGAWA et al., também encontraram melhores resultados na destruição de camadas compactadas, em condições de solo seco do que em solo úmido. Dentre estes parâmetros pode-se incluir também, a forma das hastes do subsolador, espaçamento entre estas, velocidade de trabalho e profundidade, no entanto a grande maioria dos estudos realizados nesta área, são unanimes em afirmar que o alto consumo energético constitui-se problema na operação de subsolagem.

NAGASAKI et al., 1996, estudando este problema, avaliaram um subsolador com sistema de vibração, denominado vibrosubsolador, encontrando decréscimos na energia requerida para descompactar o solo a medida que aumentaram a vibração do equipamento. Utilizando o mesmo modelo de vibrosubsolador, foi desenvolvido o presente trabalho, e os resultados aqui apresentados constituem-se parte dos estudos em andamento na Embrapa Cerrados em projeto de cooperação técnica entre a EMBRAPA/CPAC e JICA (Japan International Cooperation Agency) nesta área de pesquisa.

MATERIAL E MÉTODOS

Este trabalho foi desenvolvido na Embrapa Cerrados, em um Latossolo Vermelho Escuro, argiloso, com 49 % de argila, 8 % de silte, 7 % de areia grossa e 36 % de areia fina. Foi avaliado o desempenho de um subsolador vibratório (vibrosubsolador), marca KAWABE, apresentado na Figura 1, com espaçamento entre hastes de 0,75 m.

Foram utilizados como parâmetros para sua avaliação, os efeitos da vibração (com 540 rpm na TDP do trator e sem vibração) e velocidade de deslocamento (2,4, 3,5 e 4,2 km/h), na exigência de força de tração e potência. Para coleta de dados foi utilizado um Sistema Modular de Aquisição de Dados, constituído por um dinamômetro de três pontos e torciômetro, desenvolvido pelo Departamento de Máquinas Agrícolas da UNICAMP (Universidade Estadual de Campinas). O solo no momento da coleta de dados encontrava-se com 18,5% de umidade.

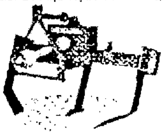

FIGURA 1

RESULTADOS E DISCUSSÃO

Na Tabela 1, são apresentados os resultados de força e potência encontrados nos diferentes tratamentos. Como pode ser observado, na velocidade mais baixa de trabalho não houve diferença nos resultados com e sem vibração, mas com diferenças significativas para as velocidades de 3,5 e 4,2 km/h. Pode ser observado também que os acréscimos de velocidades causaram acréscimos no esforço de tração exigido e consequentemente na potência, como já comprovado em outros estudos. Ao comparar-se as velocidades de 3,5 km/h sem vibração e 4,2 km/h com vibração também não houve diferença, mas em relação aos outros tratamentos esta diferença ocorreu, fato este que vem a comprovar ainda mais o efeito tanto da velocidade e da vibração na força de tração, isto é, acréscimos de velocidade causaram acréscimos de força de tração e, o subsolador com vibração apresentou decréscimos na força e potência exigidas. Os resultados aqui apresentados, fazem parte de um trabalho em andamento, em que estão incluidos também os efeitos do equipamento e do tratamentos apresentados, na descompactação do solo

Tabela 1 - Efeito dos diferentes tratamentos (velocidade e vibração) na demanda de força de tração (kN) e potência (kW) do vibrosubsolador.

Tratamentos			
Velocidade (km/h)	Vibração	Força de Tração (kN)	Potência (kW)
2,4	Com	18,40 a*	12,27
2,4	Sem	20,04 a	13,37
3,5	Com	24,62 b	23,94
3,8	Sem	29,54 d	28,74
4,2	Com	30,48 d	35,56
4,2	Sem	35,85 f	41,89

* as médias seguidas pela mesma letra não apresentaram diferença significativa a nível de 5%.

CONCLUSÕES E RECOMENDAÇÕES

Os resultados permitiram concluir que o equipamento estudado apresentou vantagens(menor força e potência exigidas) ao ser utilizado com o sistema de vibração acionado, para as velocidades de 3,5 e 4,2 km/h, fato não encontrado na velocidade mais baixa de trabalho 2,4 km/h.

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TECHNICAL COOPERATION BY THE GOVERNMENT OF JAPAN

NITROGEN TRANSFORMATION IN CROPPING SYSTEMS USING DIFFERENT COVER CROPS AND THEIR EFFECTS ON N AVAILABILITY TO THE SUCCEEDING MAIZE CROP

[1]Seishiro Nakashima, [2]Arminda M. de Carvalho, [2]Leide R. M. de Andrade & [2]Cláudio Sanzonowicz
[1]*Japan International Cooperation Agency - JICA*
[2]*Embrapa Cerrados*, P.O. BOX 08223, ZIP CODE 73301-970, Planaltina-DF, Brazil

INTRODUCTION

The soil fertility and physical and biological conditions in intensive cropping systems in Cerrado soils usually decrease with time, and improving these properties by fertilisers or tillage is difficult. One way to improve soil properties is to use appropriate copping systems, as those using cover crops as green-manure or mulch.

The introduction of those plants leads to the accumulation of biomass, enhancing the soil biochemical and biological characteristics. Also, cover crops have been considered important means of increasing nutrient availability of soils, mainly N. However, for the correct evaluation of these effects it is necessary to understand the processes of N-biomass transformation (mineralization and N availability).

The Cerrados' region climate is characterised for its well-defined wet and dry seasons. This results in a large variation of soil temperature and moisture, that are very important in the mineralization of soil organic matter. To evaluate the rate of biomass nitrogen mineralization it is necessary to consider all those conditions. In this study, it was evaluated the rate of N-biomass mineralization method with the objective to determine the N availability to the succeeding maize crop.

MATERIAL AND METHODS

a) Soil type: Red-Yellow Latossol (Typic Acrustox)

Table 1. Chemical characteristics of the soil used in the experiments with soil incubation

pH		EC (1:5)	Exchangeable meq/100g			Available ppm	Exchangeable ppm	
H2O	KCl	MS/cm	Ca	Mg	K	SI	Mn	Fe
4.8	4.2	0.14	0.13	0.07	0.08	20.3	0.3	0.8

b) Plant material: pigeonpea (*Cajanus cajan*), mucuna (*Mucuna pruriens*), pear millet (*Penisetum americanum*)

Table 2. Composition of the cover crop plants used

Species	Organic matter	Carbon (C)	Nitrogen (N)	C/N	Phosphorus (P)	Ash
pigeonpea	88.79%	51.50%	1.53%	34	0.11%	3.92%
mucuna	89.88%	52.13%	1.47%	35	0.09%	2.27%
pearl millet	85.48%	49.58%	1.22%	41	0.12	5.97%

Carbon (C) = organic matter / 1,724

RESULTS

RATE OF BIOMASS MINERALIZATION (LABORATORY AND GREEN HOUSE CONDITIONS)

Experiment 1

- Objective: To evaluate the effect of temperature on the biomass mineralization rate.
- Method of soil incubation
- Temperature: 20, 30, and 40°C
- Soil moisture: 30 % (constant)

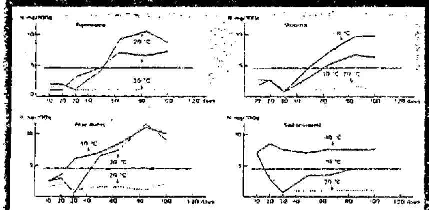


Fig. 1 - Effect of incubation temperature on soil biomass-N mineralization

Table 3. Rate of biomass mineralization

Treatment		Amount applied (g/10 kg soil)	Remained (g/10 kg soil)	Organic matter Mineralization (%)
Pigeonpea	wet soil	100	11.2	89
	dry soil	100	88.8	11
Mucuna	wet soil	100	14.3	86
	dry soil	100	86.8	14
Pearl millet	wet soil	100	19.7	80
	dry soil	100	94.7	5

CONCLUSIONS

- The time necessary for nitrogen mineralization was about 60, 80 and 80 days to pigeonpea, mucuna and pearl millet, respectively and was affected by soil moisture;
- The rate of nitrogen mineralization was 20, 10 and 20 % to piongeonpea, mucuna and pearl millet, respectively.

Experiment 2

- Objective: To evaluate the effect of soil moisture on the biomass mineralization rate.
- Method of soil incubation
- Temperature: 30°C (constant)
- Soil moisture: dry soil (< 3%) and wet soil(~30 %)

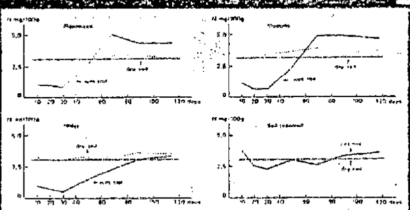


Fig. 2 - Effect of soil moisture in soil biomass-N mineralization

CONCLUSIONS

- The rate of biomass mineralization was lower in dry soil (moisture < 3%) than in wet soil (moisture ~ 30 %). At first, there was a decrease in the inorganic N (microbiological immobilisation) in wet soil. Further, it was necessary approximately 50, 60 and 90 days to have net biomass-N mineralization, from pigeonpea, mucuna and pearl millet, respectively. That suggests that nitrogen availability, due to micro-organisms activity, is affected during dry season in Carrado Region.

NITROGEN AVAILABILITY (FIELD CONDITION)

Experiment 1

- Objective: To evaluate the rate of biomass mineralization and N availability in a maize cropping system using different species as green-manure (tillage system) or mulch (no tillage system).
- Method of soil sampling
- Cropping system: a) tillage, and b) no tillage systems
- Plant material: pigeonpea (*Cajanus cajan*), mucuna (*Mucuna pruriens*), pear millet (*Penisetum americanum*)
- Succeeding crop: maize

Plant species and tillage system	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pigeonpea					
tillage	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
no tillage	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mucuna					
tillage	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
no tillage	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pearl millet					
tillage	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
no tillage	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Control					
tillage	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
no tillage	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CONCLUSIONS

- There were no effects of the plant specie and method of plant incorporation (green-manure or mulch) on the amount of inorganic N in the soil;

Experiment 2

- Objective: To evaluate the effect of soil moisture conditions, during the dry and wet seasons, on soil biomass mineralization rate.
- Method of soil sampling
- Cropping system: a) no tillage system
- Plant specie: pear millet (*Penisetum americanum*)
- Succeeding crop: maize

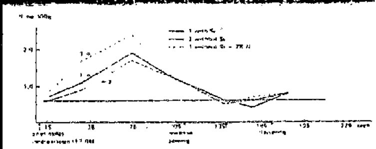


Fig. 3 - Changes in soil total inorganic N after pear millet incorporation

CONCLUSIONS

- Mineralization of biomass-N from pearl millet lasts approximately 3 months during the dry season. This result suggests that N availability for the succeeding crop is not high.

Embrapa Cerrados

TECHNICAL COOPERATION JICA BY THE GOVERNMENT OF JAPAN

EFFECT OF SILICON APPLICATION IN THE YIELD OF ANNUAL CROPS ON CERRADO SOILS

[1]Seishiro Nakashima, [2]Enéas Zaborowsky Galrão, [2]Leide R. M. de Andrade

[1]Japan International Cooperation Agency - JICA

[2]Embrapa Cerrados, P.O. BOX 08223, ZIP CODE 73301-970, Planaltina-DF, Brazil

INTRODUCTION

Silicon may increase crop yields by it's indirect effects, that means, reduction on P sorption by soil, decrease Al solubility, improvement of plant resistance to fungus disease, to insect attack, to Mn and Fe toxicity and reduction on plant water transpiration coefficient.

However, there are few works relating the effect of Si application in Cerrado soils on the annual crops yield. These project was carried out, at Embrapa Cerrados, Planaltina-DF, in 1997 and 1998, with the following objectives:

1. Green house experiment: the objective was to compare four Si sources on plant dry matter yield.

2. Field experiment: the objective was to evaluate the effect of Si on the grain yields of corn and dry matter production of pearl millet.

RESULTS

Even though the application of Si increased the dry matter production of rice, corn and soybean in relation to the control treatment, there was no significant difference among them (Table 1).

The application of Si had low effect in the grain yields of corn and dry matter production of pearl millet (Table 2).

Table 2. Corn grains (Hibrid BR 201) production, Si content in corn leaf and dry matter production of pearl millet (cv. Americano), in a Dark Red Latossol, clay, from Cerrado, Planaltina, DF.

Treatment	Corn (wet season, 97/98) Grains, kg/ha (13% moisture)	Corn (wet season, 97/98) Si content of the leaf (%)	Pearl millet (dry season/98) D.M.[2] (kg/ha)
1. With silicate[1] (3.000 kg/ha)	7.470	5.0	5.675
2. Without silicate	7.200	3,6	5.090

[1]Kasil (58% of total SiO2) Brazilian, [illegible] from the natural thermophosphate of Yoorin; [2]sprinkling irrigated and D.M. = dry matter yield of the aerial part collected at flowering.

Table 1. Effect of Si on dry matter production of rice, corn, and soybean grown in a Red-Yellow Latossol (Typic Acrustox) of the Cerrado Region, Planaltina, DF.

SiO2 g/kg soil	Silicate: Korosai(1)	Tenrosei(1)	Kosail(2)	Keisodo(2)
	Rice — Dry matter, g/pot			
0	2.5	2.8	2.2	2.7
0.3	2.9	3.2	2.6	2,9
0.6	5.0	3.8	2.6	3.3
1.2	4.4	4.0	3.7	4,1
Average	3.7	3.4	2.9	3,2
	Corn			
0	5.7	4.2	4.6	5.2
0.3	7.0	8.8	7.1	5.2
0.6	9.0	7.4	9.1	8.5
1.2	8.0	7.0	12.5	9.6
Média	7.4	6.8	8.3	7.1
	Soybean			
0	4.8	5.0	3.7	4.1
0.3	5.7	6.3	5.1	4.3
0.6	6.6	5.4	5.1	4.3
1.2	6.6	6.1	4.8	4.5
Média	5.9	5.7	4.7	4.3

1japanese origin; 2 national

CONCLUSIONS

1. There was no significant difference among the four Si sources applied to the Red Yellow Latossol in the dry matter production of rice, corn and soybean.

2. There was no significant effect of the application of Si in the clay Dark Red Latossol, in the grains yield of corn and in the dry matter production of pearl millet.

CROP PROTECTION: CONTROL METHODS

- BIOLOGICAL CONTROL OF SOYBEAN CYST NEMATODE *Heterodera glycines* WITH A BACTERIAL HYPERPARASITE, *Pasteuria nishizawae*

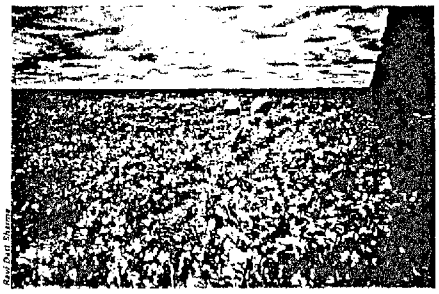
- PRINCIPAIS PRAGAS DA GRAVIOLEIRA NO CERRADO

- PRODUÇÃO MASSAL DE BIOINSETICIDA PARA A LAGARTA DA SOJA, *Anticarsia gemmatalis*

- A STUDY OF BIOLOGICAL CONTROL OF INSECT IN THE CERRADOS REGION: SCALE INSECTS AND A MEALYBUG (*Homoptera: coccoidea*) INFESTING MANGO TREES AND THEIR PARASITOIDS (*Hymenoptera: chalcidoidea*) IN BRASILIA AND PERNAMBUCO

- DOENÇAS RADICULARES DE PLÂNTULAS DE SOJA E FEIJÃO NOS CERRADOS

Graviola damaged by pests



Soybean field infested with the soybean cyst nematode, Heterodera glycines

Artificial diet for A. gemmatalis

Embrapa
Cerrados

BIOLOGICAL CONTROL OF SOYBEAN CYST NEMATODE *Heterodera glycines* WITH A BACTERIAL HYPERPARASITE, *Pasteuria nishizawae*.

[1]Tsutomu Nishizawa & [2]Ravi Datt Sharma
[1]Japan International Cooperation Agency - JICA
[2]Embrapa Cerrados, P.O. BOX 08223, ZIP CODE 73301-970, Planaltina-DF, Brazil

INTRODUCTION

Soybean cyst nematode (SCN), *Heterodera glycines*, a most economically damaging pathogen of soybean has been spreading rapidly in recent years in soybean growing areas since its first discovery in 1991/92 cropping season from four states of Brazil, occupying about 10.000 hectares. In 1997/98, the area infested with this nematode has touched 1,700.000 hectares in seven states (Fig.1).

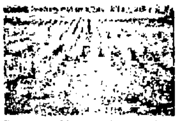


Fig. 1 Soybean field infested with Soybean Cyst Nematode [illegible] Minas, MG. March, 1998.

Crop rotation have been used most often to manage this nematode. However, persistent crop losses indicate that additional management strategies are needed. *Pasteuria nishizawae*, a gram-positive, mycelial, and endospore-forming bacterium, a promosing candidate for the biological control of SCN and endemic in Japan was introduced in Brazil under JICA project in 1997.

OBJECTIVES

The main objectives of this project were :

- to develop propagation methods in vivo;
- to assess its potential as a biological control agent; and
- to study the methods of its application under field conditions in future.

MATERIALS & METHODS

The propagation of *Pasteuria nishizawae* was tried *in vivo* condition because *genus Pasteuria* has not yet been cultivated axenically. As nothing is known about *P. nishizawae* multiplication methods, basic studies were made under laboratory and greenhouse conditions.

Spore attachment studies: Five cadavers (white to pale coloured small cysts) were crushed in 5 *ml* water in a watchglass and homogenised by dissecting needle. The spore suspensions were air-dried for 24 hr and 168 hr at 26-28oC to improve efficiency of spore attachment to body surface of second stage juveniles (J_2) of SCN. Spore attachment to J_2 of SCN is the prerequisite for multiplying this bacterium (Figs. 2 and 3).

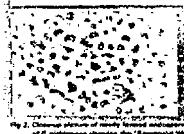


Fig 2. Closeup picture of newly formed endospores of P. nishizawae showing the "Sporangial Wall" [illegible]

Fig. 3. Second stage juvenile of SCN showing P. nishizawae spores attachment before inoculation to soybean plant for in vivo multiplication.

Propagation of *P. penetrans in vivo:* Nematode *host: Heterodera glycines* race 3 with 4 to 18 endospores of *P. nishizawae* (J_2 were inoculated: nematode numbers used varied from 500 to 2500/pot. About 415 000 J_2 of SCN encumbered with bacterial spores were inoculated in 220 pots grown with soybean cv. Cristalina and cv. Doko RC (14-21 days old) to study the multiplication of this bacterium. The inoculated plants were grown in the glasshouse and evaluated after 2,5 t0 3-months (Fig. 4).

Fig. 4 In vivo multiplication trial of P. nishizawae in soybean in the glasshouse conditions after 2.5 months

Application trial of P. nishizawae in pots by drenching of spore suspension: Ninety cadavers were macerated in 3 ml of distilled water and the spores were counted using Haemocytometer. The total spore counts were $18x10^6$. On an average each cadaver contained $2x10^5$ spores.

A total of 24 pots of 1 kg capacity were filled with autoclaved LVE soil of which 12 were drenched with 50 *ml* of spore suspension containing $1x10^7$ spores/pot with *P. nishizawae* and the remaining 12 pots were inoculated with 2300 J_2 of SCN/pot kept as check.

All the pots were sown with three soybean cv. Doko RC seeds/pot and maintained on glasshouse tables with temperature ranging from 15 to 32 0C. The pots were evaluated after 95 days (Table 2).

RESULTS

In vivo propagation trials, the spore attachment studies revealed that spores dried during 168 hr was significantly higher than 24 hr drying or no drying (Table 1).

Tabel 1. Effect of air-drying treatment of spores on the attachment of spores to J_2 body surface of soybean cyst nematode at 28°C after 24 hours under laboratory conditions.

Treatment	N°. of juveniles observed	N°. of spores attached/ J_2
Not air-dried	100	0.03 ± 0.17
Air-dried for 24 hr	100	4.30 ± 3.1
Air -dried for 168 hr	100	18.20 ± 6.9

The healthy cysts took 25 to 30 days to mature wharas cadavers with mature bacterial spores took 75 to 85 days or more thus confusing an unexperienced resercher about its life cycle(Fig. 5).

Fig. 5 Soybean roots showing developing SCN females after 2.5 months of inoculation.

The data obtained from multiplication trial *in vivo* revealed that 1,15% of the cysts counted were white cadavers which contained *P. nishizawae* spores.

Although, the spores attached to each juvenile was more than 15, even than the multiplication rate was very low. It is possible that the spore attachment method used, migt have seriously affected the spore germination resulting in poor multiplication of this bacterium. Further studies are needed to clarify this fact.

The data obtained from the drenching application trial had similar results to that of the multiplication trial (Table 2).

Table 2. Application trial of *P. nishizawae* in pots by drenching of the spore suspension. Initial inoculum: 2300 J_2 of *H. glycines*/kg of soil/pot ; Initial spore population: $1x10^7$ spores/pot. Average of 12 pots/treatment.

Treatment	Cysts	Juveniles (J2)	Eggs	Total
Check	95	156	190	441
Inoculated	162	202	116	480

CONCLUSIONS

As a part of the basic studies about the multiplication of *P. nishizawae in vivo* the following conclusions can be made:

- Further studies are needed about the spore attachment to juveniles of SCN i.e. spores should be sonnicated before use.
- Multiplication of *P. nishizawae* in vivo was extremely low and extremely slow than *P. penetrans* a hyperparasite of *Meloidogyne* spp. The life cycle of *P. nishizawae* is completed after 85 to 90 days and the average number of spores produced per female was $2x10^5$.
- Supressiveness was observed in few pots after 3 months and number of spores per juvenile increased after nine months.

Embrapa
Cerrados

PRINCIPAIS PRAGAS DA GRAVIOLEIRA NO CERRADO

Tetsu Asayama[1], Maria Alice Santos Oliveira[2] e Ivone Midori Icuma[3]

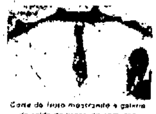
[1]Agência de Cooperação Internacional do Japão - JICA
[2]Embrapa Cerrados, cx. postal 08223, CEP 73301-970, Planaltina-DF, Brasil
[3]CNPq / Embrapa Cerrados


Gravíolas com frutos atacados por brocas


Frutos sadios da graviola

BROCA-DA-SEMENTE
Bephratelloides pomorum


Dano causado pela broca-da-semente


Cone do fruto mostrando a galeria de saída da broca-da-semente


Orifícios de saída da broca-da-semente


Macho e fêmea da broca-da-semente *Bephratelloides pomorum*

O inseto adulto é uma pequena vespa que deposita os ovos nas sementes dos frutos ainda pequenos, e à medida que o fruto e a semente crescem, a larva também se desenvolve e empupa completando o seu ciclo. Quando adulta, a vespa faz um orifício (galeria) na polpa e na casca, para atingir o exterior. Esses orifícios são sinais de saída das vespas adultas. Além de danos nas sementes, o fruto é potencialmente prejudicado pelas perfurações na casca, e esses orifícios possibilitam a entrada de microrganismos que causam o apodrecimento do fruto. Ocorre principalmente na época da seca (maio a setembro).

BROCA-DO-COLETO
Heilipus catagraphus


Sintomas de ataque da broca-do-coleto

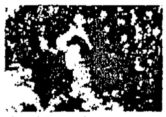

Adulto da broca-do-coleto *Heilipus catagraphus*

As larvas fazem galerias na casca e câmbio, chegando a bloquear totalmente a circulação da seiva. Em seguida, os ferimentos são invadidos por microrganismos oportunistas que causam total escurecimento dos tecidos, seguido da podridão-das-raízes. Como conseqüência desse ataque, as plantas, inicialmente, tornam-se amarelecidas, tombam e, posteriormente, secam e morrem. Os sintomas do ataque dessa praga têm sido confundido com os causados pela broca-do-tronco. No entanto, os danos desta estão limitados à região do coleto, ao passo que a broca-do-tronco ataca mais os ramos e troncos finos. Ocorrem principalmente na época das chuvas.

BROCA-DO-FRUTO - *Cerconota anonella*

A broca-do-fruto é considerada a praga que mais prejudica a gravioleira. Sua forma adulta é uma mariposa que põe os ovos sobre as flores e pequenos frutos. A larva tem coloração que varia de rosada a verde-pardo a qual ataca e destrói o interior da polpa inclusive as sementes. As larvas podem empupar no próprio fruto ainda na planta, ou no solo. No fruto, para empupar, abrem uma galeria até a casca, perfurando-a. Com fragmentos dos frutos e fios de seda, é construída uma câmara saliente no interior da qual se transforma em crisálida. Por ser uma praga que ataca o fruto, conseqüentemente, afeta o valor comercial dele, tornando-o impróprio para a comercialização ou dificultando o trabalho de extração da polpa. Além de depreciar a qualidade do fruto, a praga abre portas para a entrada de vários organismos oportunistas que predispõem ou causam a podridão da polpa. Os sinais de ataque dessa praga são caracterizados por frutos retorcidos, com manchas escuras, irregulares, quase sempre perfurados. Sobre essas manchas escuras, às vezes, observa-se um tipo de serragem que são os excrementos da larva. Ocorrem principalmente na época das chuvas.


Sintomas de ataque da broca-do-fruto


Larva da broca-do-fruto e seus danos


Pupa da broca-do-fruto


Adulto da broca-do-fruto *Cerconota anonella*


Danos causados pela broca-do-tronco no fruto


Larvas da broca-do-tronco encontrada no fruto

BROCAS-DO-TRONCO
Cratosomus bombina bombina e Eurypages pennatus


Larva da broca-do-tronco e seus danos


Adulto da broca-do-tronco *Cratosomus bombina*


Adulto da broca-do-tronco *Eurypages pennatus*

A broca-do-tronco é uma broca cuja fêmea abre pequenos orifícios abaixo da epiderme do tronco e aí deposita seus ovos. As larvas além de fazerem perfurações e galerias no interior dos troncos e galhos, predispõem a planta ao ataque de organismos oportunistas como fungos que reduzem sua produtividade ou aceleram sua morte. Ocorrem principalmente na época da seca.

Época de Ocorrência das Pragas da Gravioleira nos Cerrados CPAC-1998/99

PRAGA	ÉPOCA DE OCORRÊNCIA	ESTAÇÃO DO ANO	OBS.
Broca-do-coleto *Heilipus catagraphus*	Novembro-Fevereiro (adulto)	Chuvosa	Queda planta
Brocas-do-tronco *Cratosomus bombina* *Eurypages pennatus*	Junho-Outubro (larva)	Seca	Orifícios no tronco
Broca-do-fruto *Cerconota anonella*	Setembro-Junho (larva)	Chuvosa	Danifica o fruto
Broca-da-semente *Bephratelloides pomorum*	Abril-Julho (adulto)	Seca	Danifica a semente

INIMIGOS NATURAIS DA BROCA-DO-FRUTO

Tipo de inimigo natural	Espécie
Parasitóide de larva	*Apanteles* sp.
Parasitóide de larva	*Xiphosomella* sp.
Parasitóide de pupa	*Brachimeria annulata*
Parasitóide de pupa	*Trichospilus diatraeae*

MEDIDAS DE CONTROLE

1. Poda de limpeza
2. Pincelamento do tronco e ramos com uma calda a base de: cal extinta (4Kg), sulfato de cobre (1Kg), enxofre (100g), diazinon (200g), sal de cozinha (100g), óleo de soja (600ml) e água (12 l)
3. Manter as plantas bem adubadas e com tratos culturais adequados.
4. Injeção de querosene ou inseticida nas perfurações feitas pelas brocas-do-tronco
5. Uso de variedades mais tolerantes como o tipo Morada
6. Fazer inspeções periódicas no pomar para verificar a ocorrência de pragas.
7. Eliminar os frutos atacados na própria planta e os caidos, queimando os ou enterrando-os a 50 cm de profundidade.
8. Fazer pulverizações a cada 15-20 dias, com inseticidas à base de deltametrina mais óleo mineral, iniciando-as quando os frutos estiverem pequenos. As pulverizações devem ser feitas diretamente nos frutos. Devem-se adicionar às soluções destes produtos fungicidas à base de benomil (60 g do p.a /100 l de água).
9. Plantio consorciados com outras fruteiras.

Embrapa
Cerrados

PRODUÇÃO MASSAL DE BIOINSETICIDA PARA A LAGARTA DA SOJA, *Anticarsia gemmatalis*

[1]Tetsu Asayama, [2]Maria Alice Santos Oliveira and [3]Ivone Midori Icuma

[1]*Agência de Cooperação Internacional do Japão - JICA*

[2]*Embrapa Cerrados*, cx. postal 08223, CEP 73301-970, Planaltina-DF, Brasil

[3]*CNPq / Embrapa Cerrados*

INTRODUÇÃO

A cooperação JICA/EMBRAPA-Cerrados tem o objetivo de melhorar a qualidade do *Baculovírus* adaptando às condições climáticas do Cerrado e difundir o uso deste *Baculovírus* para o controle da lagarta *A. gemmatalis*, visando a conservação do ambiente e aumento da produtividade na cultura da soja.

OBJETIVO

Dois planos foram elaborados e apresentados pelo consultor da JICA, Tetsu Asayama, para serem desenvolvidos no Laboratório de Entomologia do CPAC. Um com o objetivo de difusão de tecnologia, sendo objeto principal do trabalho do consultor e outro como cooperação de pesquisa, conforme descrito a seguir:

1 - Difusão de tecnologia: Produção massal de bioinseticida para o controle da lagarta da soja *Anticarsia gemmatalis*

a) Melhoria da dieta artificial para a criação massal de *A. gemmatalis*

b) Uso de folhas de soja seca e maceradas para melhoria da dieta artificial

c) Recuperação de material desperdiçado

d) Melhorar a qualidade do agente do vírus

e) Aplicação da tecnologia

2 - Cooperação no estudo das pragas de gravioleira

PROCESSOS NA PRODUÇÃO DO *Baculovirus*

a) Criação massal de *Anticarsia* para a produção do *Baculovirus*
- Desenvolvimento tecnológico de criação da lagarta
- Desenvolvimento e produção de dieta artificial

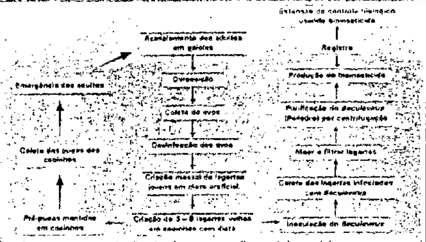
b) Produção massal do *Baculovirus Anticarsia*
- Restabelecimento tecnológico e multiplicação do vírus
- Produção do bioinseticida

c) Avaliação em campo experimental
- Testes e avaliações em campo experimental
- Ajustes de metodologia

d) Validação em áreas de produtores
- Transferencia de tecnologia e extensão aos rodutores ao uso do *Baculovirus*

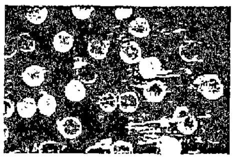
e) Registro

Observação: as etapas a) e b) estão em andamento, as etapas c), d) e e) ainda levarão mais ou menos 2 anos para sua conclusão



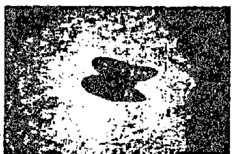
Passos para a criação de *A. gemmatalis* em laboratório e produção do *Baculovirus*

Danos causados pela lagarta da soja *Anticarsia gemmatalis* em lavoura no Cerrado



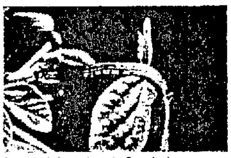
Ovos

Lagartas



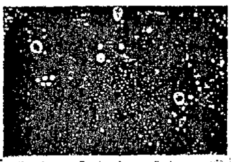
Pupas

Adulto



Lagarta infectada pelo Baculovirus no campo

Lagartas infectadas pelo Baculovirus em dieta artificial



Microfotografia do vírus poliedrose nuclear

Poliedro purificado

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A STUDY OF BIOLOGICAL CONTROL OF INSECT PESTS IN THE CERRADOS REGION: SCALE INSECTS AND A MEALYBUG (*Homoptera: coccoidea*) INFESTING MANGO TREES AND THEIR PARASITOIDS (*Hymenoptera: chalcidoidea*) IN BRASILIA AND PERNAMBUCO.

[1] Yozo Murakami, [2] Ivone Midori Icuma and [3] Maria Alice Santos Oliveira
[1] *Agência de Cooperação Internacional do Japão - JICA*
[2] *CNPq / Embrapa Cerrados*
[3] *Embrapa Cerrados*, cx. postal 08223, CEP 73301-970, Planaltina-DF, Brasil

INTRODUCTION

Biological control is one of the most important methods to control pests in a sustainable agricultural system with low adverse effects on agro-environments and natural ecosystems around the crops fields. In Brazil several species of Coccoidea are found on mango trees. Among them *Aulacaspis tubercularis* (Family Diaspididae), *Pseudaonidia tribitiformis* (Family Diaspididae), *Pseudococcus adonidum* (Family Pseudococcidae) and *Saissetia coffeae* (Family Coccidae) are most important. Two predacious coccinellids Azya *luteipes* and *Pentilia egena* and a fungus disease have been recorded as natural enemies. However, parasitoids have never been recorded. In this report we noted the results of investigations which we made from January to February of 1998 in Brasilia-DF and Pernambuco State.

MATERIALS AND METHODS

We surveyed the scale insects and mealybugs on mango trees and collected them from the following sites as shown in Table 1. From these plots, we sampled about 60 to 200 leaves on which scale insects were found, and investigated female and male scales under stereoscopic microscope. Scale insects were classified into those parasitized and unparasitized. The parasitized ones were defined as those eggs, larvae or pupa of parasitoids were found in (for endoparasitoids) or on (for ectoparasitoids) the scale insects and those parasitoid meconia were found in or on the hosts with emerging holes. For mealybugs, the adult females and mummies in which parasitoid larvae or pupae were observed were counted. The mummies were placed in a test tube (20cm length x 2.5 cm diameter) with cotton plug to obtain adult specimens of the parasitoid.

Table 1. Name of plots and dates on which scale insects and a mealybug were collected.

Names of plots	Details of plots	Date of collection
CPAC-A	A well-managed orchard in CPAC, Brasilia-DF	Jan. 15
CPAC-B	A weeds-growing orchard in CPAC	Jan. 15
Proflora-A	Well-managed commercial orchards in the Proflora Farm, Brasilia-DF	Jan. 21
Proflora-B	Non-sprayed trees in the Proflora Farm	Jan. 21
Bebedouro	A commercial orchard in a farm in Bebedouro, Petrolina, Pernambuco State	Feb. 10
Fruit-fort	A commercial orchard in a farm of the Fruit fort Co. Ltd., Petrolina	Feb. 11
Boa esperance	A commercial orchard in a farm in Boa esperance, Petrolina	Feb. 11

RESULTS AND DISCUSSION

We found three species from mango trees in the present study, i. e., *Aulacaspis tubercularis* and *Pseudococcus adonidum* from Brasilia-DF and *Pseudaonidia tribitiformis* from Petrolina, Pernambuco State (Fig.1).

Density of *A. tubercularis* was lower in the well-managed orchards than in the weeds- growing orchard and on the non-sprayed trees (Table 2). An aphelinid solitary endoparasitoid *Aspidiotiphagus lounsburyi* was the dominant parasitoid, but the parasitization rate was very low and did not show any density-dependent tendency (Table 3 and Fig. 2).

Table 2. Density of Aulacaspis tubercularis per infested leaf of mango trees sampled in orchards in Brasilia-DF

Plot	No leaves examined	Female		Male		Total	
		Mean	Range	Mean	Range	Mean	Range
CPAC-A	193	3.7	0 – 33	121.3	0 – 781	125.0	1 – 770
CPAC-B	100	13.1	0 – 51	274.0	25 – 1,356	287.1	27 – 1,97[illegible]
Proflora-A	37	6.6	0 – 44	139.7	15 – 581	146.3	17 – 595
Proflora-B	75	23.0	1 – 82	366.5	16 – 1,630	389.5	20 – 1,69[illegible]

Aulacaspis tubercularis *Pseudococcus adonidum* *Pseudoanidia tribitiformis*

Table 3. Parasitization rate of *A. tubercularis* on mango trees in Brasilia-DF

Plot	Female			Male		
	No hosts examined	% parasitism by endoparasitoid	% parasitism by ectoparasitoid	No hosts examined	% parasitism by endoparasitoid	% parasitism by ectoparasitoid
CPAC-A	707	5.1	0	18,446	10.4	0
CPAC-B	1,312	1.0	0	26,895	0.2	0
Proflora-A	642	2.5	0.2	13,548	2.9	0
Proflora-B	1,725	0.2	0	14,250	0.3	0

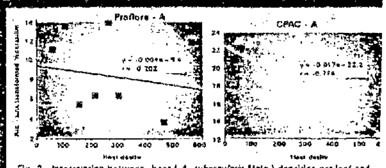

Fig. 2 - Interrelation between host (*A. tubercularis* Male) densities per leaf and arc-sine transformed parasitization rates of male scale insects.

As for another diaspine scale, *P. tribitiformis* found in Pernambuco, it was sometimes at high density on leaves (Table 4). The dominant parasitoid was an aphelinid ectoparasitoid *Aphytis* sp.

The rate of parasitization, however, was very low in orchards at low density as well as at high density (Table 5).

The interrelation between host densities and rates of parasitism showed that the parasitism would be rather inverse density-dependent (Fig. 3).

Table 4. Density of Pseudaonidia tribitiformis per infested leaf of mango trees sampled in orchards in Petrolina, Pernambuco

Plot	No leaves examined	Female		Male		Total	
		Mean	Range	Mean	Range	Mean	Range
Bebedouro	62	6.0	1 – 29	2.0	0 – 33	8.0	1 – 50
Fruit-fort	63	48.6	8 – 162	27.1	1 – 86	75.7	18 – 259
Boa esperance	65	35.2	2 – 128	31.1	2 – 84	66.3	9 – 190

Table 5. Parasitization rate of *P. tribitiformis* on mango trees in Petrolina, Pernambuco

Plot	Female			Male		
	No hosts examined	% parasitism by endoparasitoid	% parasitism by ectoparasitoid	No hosts examined	% parasitism by endoparasitoid	% parasitism by ectoparasitoid
Bebedouro	372	0.3	2.7	124	0	0
Fruit-fort	2,703	0	5.3	1,249	0	3.0
Boa esperance	2,396	0	1.7	2,114	0	12.6

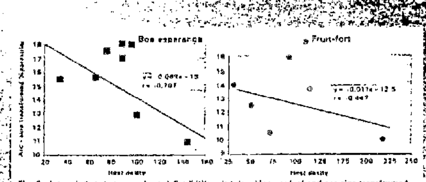

Fig. 3 - Interrelation between host (*P. tribitiformis*) densities per leaf and arc-sine transformed parasitization rates by the ectoparasitoid.

The third species, *Pseudococcus adonidum* was rarel[y] found in mango orchards in Brasilia. An encyrtid solitar[y] endoparasitoid *Leptomastix* sp. attacks the mealybug at relatively high parasitism (Table 6). But the observation about thi[s] mealybug was extremely limited in our present study.

Table 6. Parasitism of Pseudococcus adonidum on a mango fruit collected in the Proflora Farm in Brasilia-DF

No hosts examined	No hosts parasitized	% parasitism
147	30	20.4

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DOENÇAS RADICULARES DE PLÂNTULAS DE SOJA E FEIJÃO NOS CERRADOS

Shigeo Naito[1] (Período do consultor no CPAC 11/11/96 a 20/12/96)
Maria José d'Avila Charchar[2], Kazuo Matsumoto[1]
[1]*Agência de Cooperação Internacional do Japão - JICA*
[2]*Embrapa Cerrados*, cx. postal 08223, CEP 73301-970, Planaltina-DF, Brasil

RESUMO

Muitas plântulas de soja apresentaram, podridão radicular em lavouras no município de Formosa e Unaí, bem como no CPAC. Em área experimental do CPAC, foi observada a presença do fungo *Rhizoctonia* spp. no caule próximo ao solo de plantas de feijão.

Na fase inicial do desenvolvimento da soja, os fungos mais freqüentemente isolados do sistema radicular, em ordem decrescente foram: *Rhizoctonia* spp., *Fusarium* spp. e *Sclerotium rolfsii*.

Os isolados de *Rhizoctonia* spp. obtidos de podridão radicular da soja e do feijão foram divididos em dois grupos:

1. *Rhizoctonia solani* que foi predominantemente isolada e

2. *Rhizoctonia* spp. binucleada que apresentou menor diâmetro da hifa que *Rhizoctonia solani*.

A maioria dos isolados de *Rhizoctonia solani* recuperados de plântulas de soja e feijão pertenceram ao grupo de anastomose AG - 4 e foram encontrados no mesmo campo, sugerindo que a densidade do inóculo pode aumentar com a falta de rotação de cultura.

OBJETIVO

Verificar a ocorrência da podridão radicular e seus agentes causais, especialmente na fase inicial do desenvolvimento da soja e do feijão nos Cerrados.

RESULTADOS

Podridão radicular da soja e do feijão na fase inicial de seu desenvolvimento nos Cerrados

Local		Cultura	Idade da planta	Nº de plantas	Raízes doentes (%)
Formosa (MG)	A	Soja	2 Semanas	115	27.5
	B	Soja	2 Semanas	127	5.5
	B	Feijão *	2 Semanas	29	17.2
Unaí (MG)	A	Soja	3-4 Semanas	148	15.5
	B	Soja	2-3 Semanas	130	30.8
	B	Feijão *	2-3 Semanas	63	71.4
CPAC (DF)	A	Soja	2 Semanas	182	13.5
	B	Soja	1 Semana	148	14.2

Tipos de isolados de Rhizoctonia spp. recuperados de plântulas de soja e feijão nos Cerrados

Local		Espécie de Planta	Nº de Isolados	AG-4	Outros *	BI - Rhizoctonia spp. *
Formosa	A	Soja	15	14	0	1
Unaí	A	Soja	8	8	0	0
	B	Feijão	17	17	0	0
	B	Feijão	19	18	0	1
CPAC	C	Feijão	19	18	0	1
	D	Soja	13	12	0	1
	E	Feijão	15	14	0	1
	C	Feijão	1*	1	0	0
	C	Amaranthus	1*	1	0	0
	C	Common purslane purslane	1*	1	0	0

Fungos isolados de plântulas de soja e feijão com podridão radicular

Local		Cultura	Nº de raízes infectadas	Rhiz	Fus	Scl	Pyth	Others
				Freqüência do isolamento (%)				
Formosa (MG)	A	Soja	40	85.5	12.5	0.0	0.0	32.5
	B	Soja	8	12.5	50.0	0.0	0.0	37.5
	B	Feijão	7	28.6	57.1	0.0	0.0	14.3
Unaí (MG)	A	Soja	26	16.4	61.5	0.0	0.0	23.1
	B	Soja	40	45.0	20.0	7.5	0.0	27.5
	B	Feijão	37	62.3	28.7	0.0	0.0	8.1
CPAC (DF)	A	Soja	26	30.8	3.8	30.8	0.0	34.6
	B	Soja	15	46.7	13.3	0.0	0.0	30.8
	C	Feijão	39	80.0	-	-	-	-
	D	Soja	3	50.6	18.4	0.0	0.0	27.3
	E	Feijão	35	87.5	0.0	0.0	0.0	12.5

Foto 1- Podridão radicular no feijoeiro.

Foto 2- *Tanatephorus cucumeris* (forma perfeita e *Rhizoctonia solani* AG-4) em plantas de feijão.

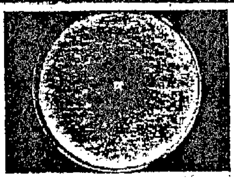


Foto 3- *Rhizoctonia solani* AG-4 (uma semana em BDA) isolada de plântulas de soja com podridão radicular.

CONCLUSÕES

Na fase inicial do desenvolvimento da soja, o fungo mais freqüentemente isolado da podridão radicular foi *Rhizoctonia* spp. e *Fusarium* spp., seguido de *Sclerotium rolfsii*.

Os isolados de *Rhizoctonia* spp foram divididos em dois grupos:

1. *Rhizoctonia solani* predominantemente isolado.

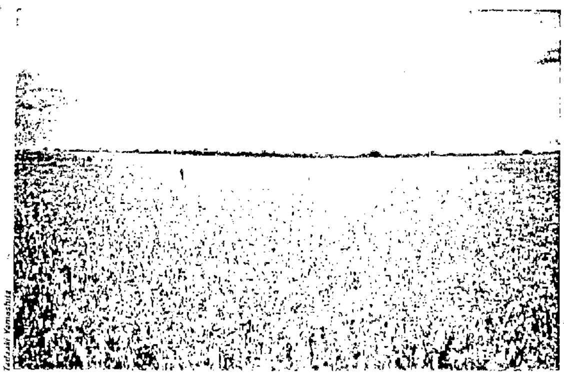
2. *Rhizoctonia* spp. binucleada. Muitos isolados de *Rhizoctonia* solani obtidos de plântulas de soja e feijão pertenceram os grupos de anastomose AG-4.

CROP PRODUCTION SYSTEM: SELECTION AND DEVELOPMENT

- EFFECT OF PEARL MILLET ON SOYBEAN YIELD INCREASE
- EVALUATION OF PEARL MILLET IN BRAZILIAN SAVANNAS
- PEARL MILLET AS A COVER CROP FOR NO-TILL SOYBEAN PRODUCTION IN BRAZIL

Pearl millet as an optional crop

Sunflower production



Soybean production

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EFFECT OF PEARL MILLET ON SOYBEAN YIELD INCREASE

[1]Hideo Gocho and [2]Renato Fernando Amabile

[1]*Japan International Cooperation Agency - JICA*

[2]*Embrapa Cerrados*, P.O. BOX 08223, ZIP CODE 73301-970, Planaltina-DF, Brazil

This experiment is carried out to clarify the cause of pearl millet's effect on yield increase of soybean.

Continuous cultivation of pearl millet as optional crop of soybean for 4 years, comparing with other optional crops (oat, sunflower and bean (feijão-bravo-do-Ceará) - *Canavalia brasiliensis*, gave following information.

RESULTS

1. Soybean yield increased about 4 to 10% than that of control (without optional crop). (Fig. 1)
2. In surveying on nematodes which attack soybean, it was confirmed that pearl millet is resistant to *Meloidegyne javanica* but is not resistant to *Pratylenchus brachurus* and is moderate resistant to *Helicotylenchus dihystera*. Therefore, a combination of soybean and pearl millet as a optional crop, in future, indicates the possibility of suffering some damages of the latter two species of nematodes. (Fig. 2)
3. It is not seemed to be bad effect on contents of major and minor elements in the soil. (Fig. 3, Fig. 4)
4. Organic matter of pearl millet, which was mowed down and covered field, was decomposed only the level of 10% during 3.5 months (from August to middle of November).
5. From result of survey of soil hardness in soybean cultivating field using self-registered soil hardness meter (DIK-5520), pearl millet and feijão-bravo-do-Ceará plots showed lowest soil hardness in the proceeding optional crops plots. (Fig. 5)
6. From the result of trial estimation of manure amount of pearl millet by using the data of chemical analysis of optional crops' plant in heading stage, manure amount of dry matter in pearl millet was highest compared with other optional crops (oats, sunflower, bean "feijão-bravo-do-Ceará"). (Fig. 6, Fig. 7)

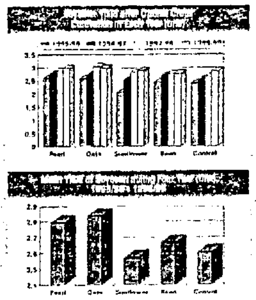

Fig. 1. Soybean Yield after Cultivating Optional Crops.

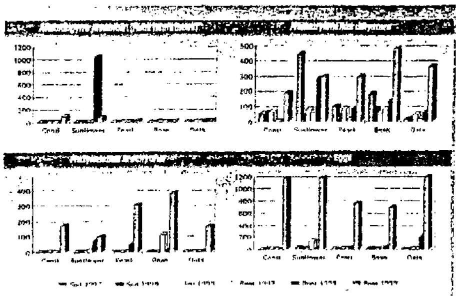

Fig. 2. Density of Nematodes in Soil and Root in the field after Cultivating Optional Crops.

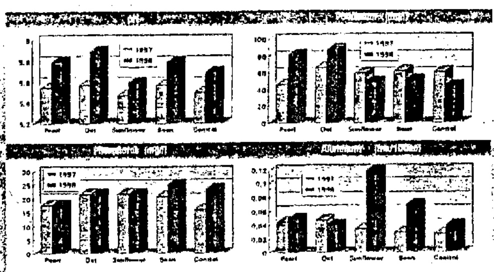

Fig. 3. Chemical analysis of soil in the field after optional crops cultivation in 1997 and 1998.

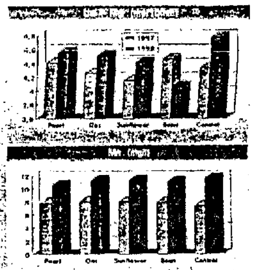

Fig. 4. Chemical analysis of soil in the field after optional crops cultivation in 1997 and 1998.

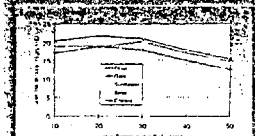

Fig. 5. Relation between species of optional crops and soil hardness.

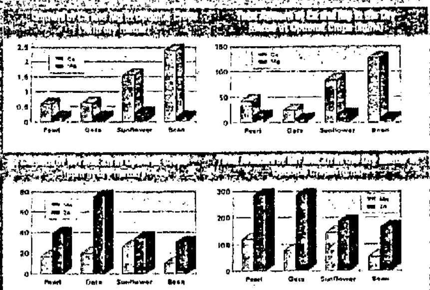

Fig. 6. Content of Minor Element and its Total Asmount in Optional Crops.

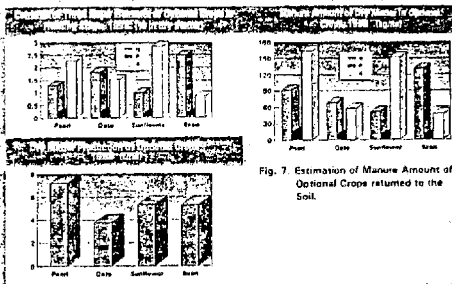

Fig. 7. Estimation of Manure Amount of Optional Crops returned to the Soil.

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EVALUATION OF PEARL MILLET IN BRAZILIAN SAVANNAS

[1]Hideo Gocho, [2]Austeclínio L. de Farias Neto
[1]Japan International Cooperation Agency - JICA
[2]Embrapa Cerrados, P.O. BOX 08223, ZIP CODE 73301-970, Planaltina-DF, Brazil

INTRODUCTION

Pearl millet (*Pennisatum Glaucum* (L.) R. Br.) is an important cereal crop worldwide grown on about 26 million hectares in the warm tropics, particulary in Africa and Indian subcontinent. In these areas pearl millet is used as human food. In developing countries pearl millet cropping systems tend to be extensive, with limited application of improved technologies, except in some of the more commercialized farming regions in India.

In Brazil pearl millet has been rapdly adopted by farmers as the ideal crop for no-till soybean production. It is stimated that over 1 million hectares were sown in 1998, and the area is expanding rapdly. Thus in terms of area sown to the crop, Brazil is already one of the top ten pearl millet production countries. The use of pearl millet as a cover crop-mulch in no-till soybean production in the brazilian savannas, or cerrados, exploits the crop's rapid vegetative growt rate, adaptation to soils of low inherent fertility, and hability to draw on nutrients and water lying deep below the soil surface. These factors combine to increase productivity and economics of no-till soybeans, reducing cash crop in the cerrados (ICRISAT, 1996).

Pearl millet is the most drought tolerant of all domesticated cereals and soon after its domestication It became widely distributed across the semi-arid tropics of africa and Asia. Is a highly tillering, cross-polination diploid tropical C4 cereal. Results from feed experiments involving pearl millet with maize or sorghum from literature indicate that pearl millet is at least equivalent to maize and generally superior to sorghum in protein content and quality, protein efficiency ratio (PER) values, and metabolizable energy (MEn) levels (Andrews et all, 1993).

To study the peformance of Pearl millet genotypes by contributing breeding programs in Brazil, 33 genotypes were evaluated at Embrapa Cerrados.

MATERIAL AND METHODS

One experiment was planted in march, 1998 and another was planted in november, 1998. The experimental design was a randomized complete block design with six replications.

The analysed variable were: green matter (ton/ha), dry matter (ton/ha), flowering time, plant height, and disease ratings.



Table 1- Growt characteristics and yield of pearl millet. Embrapa CPAC, 1998.

Genotype	Green matter (ton/ha)	Dry matter (ton/ha)	Plant height (cm)	Flowering (days)	Rust (1-5)	Grain yield (Kg/ha)
BN-2	38,13	4,77	150	59	1,5	1620
AFPOP 88	37,73	4,73	160	62	2	1926
IVC C8	35,72	5,14	145	58	2	2943
SENPOP	35,25	4,86	140	59	2	2793
SADC-WGC	34,70	5,08	155	56	2	2816
SDMV 91018	34,60	5,10	140	58	2	3520
ICMV 155	33,75	4,90	145	56	2	3290
P 1449	33,11	4,80	140	59	2	1443
SDMV 93032	33,05	4,41	145	56	2,5	2780
NC 02	32,90	4,33	145	61	2	1650
Mean	29,03	4,20	140	58	2,18	2630

DISCUSSION

The analysis of variance indicated there were significant differences among genotypes for all variable studied. Mean green matter yields of pearl millet ranged from 38,1 to 32,9. The table 1 show that BN -2 yielded 38,17 (ton/ha) followed by AFPOP 88, IVC - C8 and SENPOP. Low significant diferences were observed among acessions for rust severity.

For flowering time the date ranged from 55 to 62 days to flowering. As show on table 1 two genotypes (SDMV 91018 and ICMV 155) exceeded 3,0 tons per hectare. These preliminary results are encouraging and in conclusion ten genotypes were identified with high level of green matter production and three for green yield production.

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PEARL MILLET AS A COVER CROP FOR NO-TILL SOYBEAN PRODUCTION IN BRAZIL

[1]Y. Uemura, [2]G. Urben Filho and D.A.M. Netto
[1]Japan International Cooperation Agency - JICA
[2]Embrapa Cerrados, P.O. BOX 08223, ZIP CODE 73301-970, Planaltina-DF, Brazil

INTRODUCTION

Continuous cultivation of soybean in the Cerrados region of Brazil, results in decreased productivity due damaged soil structure, reduced soil organic matter content, and increased occurrence of weeds, pests and diseases.

To make soybean production more sustainable in this region, it is necessary to identify suitable mulch crops to cover the soil surface in a no-till production system.

OBJECTIVE

Evaluate alternative cover crops in soybean-based production systems.

MATERIALS AND METHODS

Three groups of experiments were conducted: 1. Cover crops sown following soybean harvest (soybean/cover crop/soybean); 2. Cover crops sown before soybean (cover crop/soybean/cover crop); 3. Different sowing dates of pearl millet.

The cover crops studied were pearl millet (*Pennisetum glaucum* (L.) R. Br.) varieties Nebraska Dwarf Composite and Bonamigo 1 (BN-1), oat (*Avena Strigosa* Shreb, sunflower (*Heliantus annus* L.), and wild bean (*Canavalia brasiliensis* Mart ex Benth).

RESULTS:

EXPERIMENT 1

Pearl millet productivity was maximum when sown after soybean harvest in 1995 and 1996 (Fig 1). It grew quickly and showed good drought tolerance. Soybean grain yields were highest when cultivated following pearl millet cover crop in 1995/96 and 1996/97 (Fig 2).

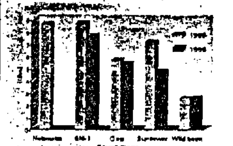

Fig. 1 - Dry matter yields of cover crops sown after harvesting soybean

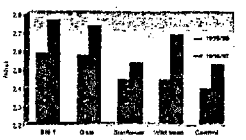

Fig. 2 - Soybean grain yields after cover crops at Planaltina, Brazil

EXPERIMENT 2

The results with cover crops sown before soybean were similar to those described for Experiment 1. The greatest mulch dry matter production was obtained from pearl millet varieties (Fig3).

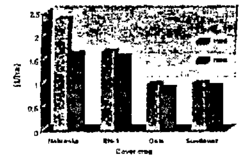

Fig. 3 - Dry matter yields of cover crops from one month's vegetative growth

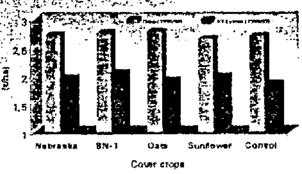

Fig. 4 - Yield of two soybean cultivars sowen after cover crops in 1995/96 and 1996/97

In 1995/96 grain yield of the soybean Doko were greatest following oat, although only marginally greater than those following pearl millet varieties. In 1996/97, the grain production of soybean var.

FT-Estrela sown in a no-till mulch system was better than others cover crops (Fig 4).

EXPERIMENT 3

Dry matter production from pearl millet was influenced by sowing date (Fig 5).

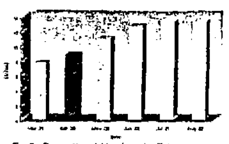

Fig. 5 - Dry matter yields of pearl millet sowen on different dates. Planaltina, Brazil, 1995.

CONCLUSIONS

- Cover crops sown after soybean harvest grew well, especially in the early vegetative phase. Pearl millet that received little rain for two months in this system produced approximately 10 t ha-1 of dry matter.
- The production system where cover crops were sown immediately before soybean grew more rapidly and gave greater soybean yields than the control.
- Among cover crops evaluated pearl millet showed better adaptation to soybean-based production systems. Its fast growth, drought tolerance, and high dry matter production improved growth and grain production of the subsequent soybean crop.