SUPPLEMENTAL MATERIAL #1

ASINAGRO
AGRONOMIC ADVICE AND RESEARCH

TEST WITH ADDITIVE FOR FERTILIZERS HUMUS - RICE

Second section – Thirty-Three - Uruguay

2023-2024 HARVEST

Agricultural Engineer Hernán Zorrilla   *Agricultural Engineer Emiliano Ferreira*

INTRODUCTION

The essay is based on a little-known topic for rice cultivation in our country: the use of the fertilizer additive Humus from the Paraguayan company Tiróleo .
The bioactivation of fertilizers, with additives such as humus, aims to optimize their assimilation in order to reduce their consumption, maximizing the use of nutrients and minimizing losses that affect the environment and the producers' economy.

Agricultural activities today face challenges in finding ways to ensure the preservation of natural resources for future generations, minimize environmental impacts, help mitigate climate change, and produce food of proven safety and quality.

In this context, there are various strategies and visions regarding the paths to be taken. In our case, we see a priority in advancing paths that promote gradual changes in inputs, management, and processes, reducing the environmental footprint and maintaining or improving the productivity and quality of the rice produced.

The incorporation of bioinputs , such as the additive Humus de Tyróleo , is a key tool to generate valid alternatives to a traditional sustainable and high-productivity management system.

In response to this challenge, an exact basal fertilization trial using the Humus additive from the company Tiróleo was installed in the second section of the Treinta y Tres department, on a farm with a long history of cultivation.

Starting with the NPK fertilizer dosage recommended by a technical expert based on soil analysis, two doses of humus were tested, both in addition to and in place of the fertilizer, and compared with a commercial control (fertilizer alone). Furthermore, all treatments were applied in duplicate, incorporated into the row or broadcast as a cover crop, to compare the effectiveness of both localization methods.

This report presents data on the test setup, materials and methods, results, statistical analysis of performance, and final comments. Illustrative photographs are also included.

GOALS

- To evaluate the effectiveness of the fertilizer additive Humus in rice cultivation.
- Contrast between online application and random coverage.
- Adjust the application of Humus in relation to replacement or addition with NPK fertilizer.
- Quantify its impact on crop yield.

MATERIALS AND METHODS

Product evaluated: fertilizer additive

Humus
Bioactivating additive with the same physical characteristics as a granulated fertilizer, making it suitable for mixing prior to application.
It is obtained from plant remains that go through a fermentation process where a set of microorganisms – Microbiome – are incorporated, which interact with each other , in balance and conditioned by the soil and the chemical processes that direct them.
Nutrient release depends on the existing microbiology in the soil, but the use of the additive increases this dynamic because the incorporated microbiome favors the processes that make nutrients available to plants.

Treatments: (Dose kg/ha)

TRT	Humus	NPK (1)	Location	Relationship Humus: NPK
1-	0	150	Line	Control
2-	0	150	Broadcast seeding	Control
3-	50	150	Line	Additive
4-	50	150	Broadcast seeding	Additive
5-	50	100	Line	Replacement (2)
6-	50	100	Broadcast seeding	Replacement (2)
7-	20	150	Line	Additive
8-	20	150	Broadcast seeding	Additive
9-	20	100	Line	Replacement (3)
10-	20	100	Broadcast seeding	Replacement (3)

(1) NPK base fertilizer: 0 – 20/20 – 30
(2) Complete 1:1 replacement with a 33% reduction in NPK dosage
(3) Partial replacement 0.4:1 with 33% reduction in NPK dosage

Design

Random blocks with three repetitions
Plots of 20 m^2 (4 m wide by 5 m long).

Distribution of treatments:

5	6	4	7	3
10	1	9	2	8
1	3	5	7	9
2	4	6	8	10
10	9	8	7	6
1	2	3	4	5

Test facility

Locality	Producer	Planting date	Cultivate
The Charqueada	Hernán Zorrilla	October 16	INIA Merín

Representative location of the traditional rice-growing basin of Laguna Merín. The area near the town of La Charqueada in the department of Treinta y Tres corresponds to the unit of the same name on the Uruguayan Soil Survey Chart, scale 1:1,000,000, and the dominant soil where the trial was conducted is a Planosol. Subeutric Ocher with silty loam texture , with Solods Associated ochrics .

Soil analysis -

Predecessor: legume meadow
Management: Spring glyphosate – pre-tillage (disk and leveling)

pH (H2O)	5.9
MO (%)	2.1
P – citric acid (ppm)	5
K (meq /100 gr soil)	0.17
Mg (meq /100 gr soil)	2.1
Mg/K ratio	12.3

Recommended Dose

The recommendation for fertilizing rice with phosphorus and potassium is determined by the information contained in INIA Technical Sheet No. 46, based on chemical analysis of the soil.

For phosphorus adjustment, the soil analysis data was considered (range between 3 - 5 ppm), in a medium soil (30 - 50% clay) and taking as a fertilization strategy the criterion of "sufficiency", which consists of adding nutrients up to a critical level, above which the probability of finding a yield response is low.

For the potassium adjustment, the soil analysis data (0.14 – 0.17 meq / 100 gr soil) was considered with ammonium acetate extraction, with a Mg / K ratio (< 15) and taking the "sufficiency" criterion as a fertilization strategy.

According to the tables, the fertilization recommendation would be:

- P_2O_5 = 42 units / ha
- K_2O = 50 units / ha

For the commercial Control NPK (0 - 20/20 - 30) it is adjusted to 150 kg/ ha (treatment 1).

Description of the environment

The trial was installed in a rice crop, planted on a Planosol Subeutric Ocher with a silty loam texture , associated with a Solods Ocrico belonging to the La Charqueada unit.

The sowing date of the farm corresponds to mid-October with the INIA Merín cultivar of Indica genotype, long cycle and resistant to *Pyricularia oryzae* . When planted at the recommended time, this high-yield variety, with adequate P and K adjustments, has shown a strong response to nitrogen fertilization. Since its release in 2015, its area has been increasing, currently positioning itself as the one with the largest planted area, reaching 50% of the rice area in the last harvest.

Crop management:
Sowing:
Date: 16-10-23
Sowing conditions: Good sowing preparation
Soil with low humidity
Sowing type: row – seeder: John Deere pneumatic Cultivar: INIA Merín / Sowing density: 140 kg/ ha

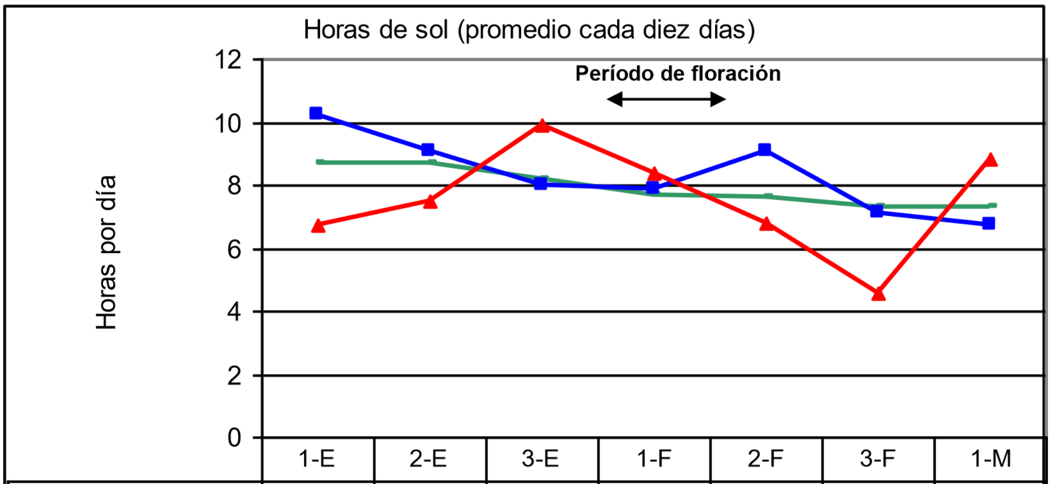
Basal fertilization:
Date: 5-11-23 with the crop emerged (rice 1 leaf)
Dosage: according to treatments

Photo 1 – State of the trial at the time of installation, marking the lines for manual fertilization in the furrow.

Photo 2 – Left: Fertilization treatments in the row. Right: Fertilization treatment at Broadcast seeding in coverage.

30 - 11 - 2023: first coverage with urea (46-0/0-0): 150 kg/ ha at the beginning of tillering
03 - 12 - 2023: start of permanent flooding
26 - 12 - 2023: second coverage with urea (46-0/0-0): 50 kg/ha at primordium

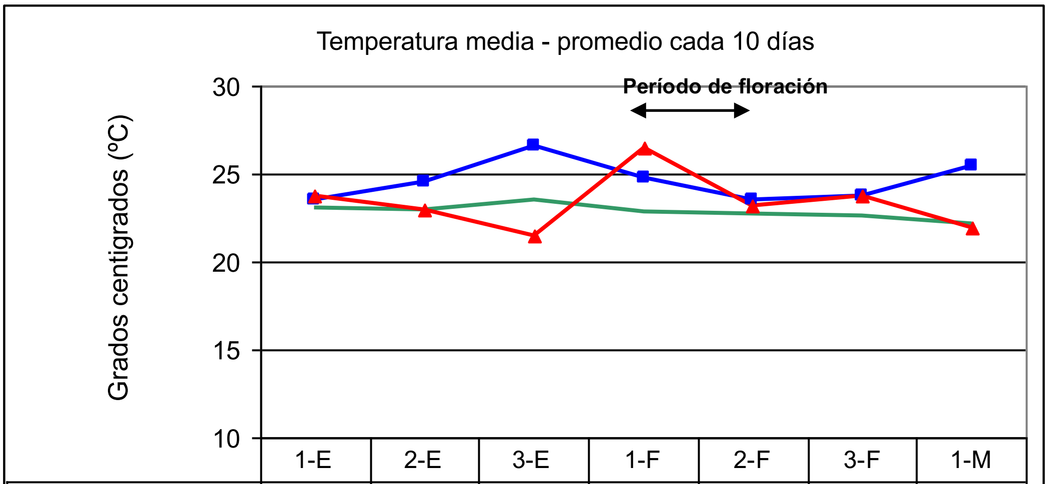
Climatic characterization of the harvest determining the yield potential



	1-E	2-E	3-E	1-F	2-F	3-F	1-M
SH (1973-2022)	8,7	8,7	8,2	7,7	7,6	7,3	7,3
2023	10,2	9,1	8	7,9	9,1	7,1	6,7
2024	6,7	7,5	9,9	8,4	6,8	4,6	8,8

Chart I – Average sunshine hours per decade

Source: Agroclimatology Bulletin – Inia Treinta y Tres Laguna Pass Station



	1-E	2-E	3-E	1-F	2-F	3-F	1-M
SH (1971-2022)	23,1	22,9	23,5	22,8	22,7	22,6	22,2
2023	23,5	24,5	26,6	24,8	23,5	23,7	25,5
2024	23,8	23,0	21,5	26,5	23,2	23,8	21,9

Graph II – Average temperature per decade

Source: Agroclimatology Bulletin – Inia Treinta y Tres Laguna Pass Station

This harvest showed lower luminosity, 3.6% lower than the historical series and 7.5% below the previous one, in the critical period defined by Stansel , J (1975), which covers the 21 days before and 21 days after flowering, where sunlight hours have the greatest impact on yields. On the other hand, the average temperature, except in the last decade of January, was higher than the historical series during the reproductive stage, which is the most sensitive time to determine grain sterility due to the incidence of low temperatures. This factor is identified as one of the main causes that explain the instability of yields in the eastern part of our country.

For the October planting season, climatic factors showed similar results to the historical series, but with strong fluctuations, mainly in sunlight hours. Therefore, yields with high variability between fields could be expected, in response to the technological management employed by the producer.

PERFORMANCES

Kg/ ha corrected to 13% humidity

Treatments	Yo	II	III	*Average*
1	9851	9403	9537	*9597*
2	10299	9627	10030	*9985*
3	10612	10746	10254	*10537*
4	10164	9851	10791	*10269*
5	10701	10881	11060	*10881*
6	10567	10343	10030	*10313*
7	10254	10612	10746	*10537*
8	11194	10030	10343	*10522*
9	10075	10522	10299	*10299*
10	10254	9896	9627	*9925*

- Overall average of the test: 10287 kg/ ha (206 dry bags/ ha)

TRT	Humus	NPK	Location
1-	0	150	Line
2-	0	150	Broadcast seeding
3-	50	150	Line
4-	50	150	Broadcast seeding
5-	50	100	Line
6-	50	100	Broadcast seeding
7-	20	150	Line

8-	20	150	Broadcast seeding
9-	20	100	Line
10-	20	100	Broadcast seeding

STATISTICAL ANALYSIS

FV	gl	SC	CM	F
Blocks	2	215460	107730	
Treatments	9	3696770	410752	3.57 *
Mistake	18	2070127	115007	
Total	29	5982357		

CV: 3.30%

With a general average of the test of 10287 kg/ ha , statistically significant differences were found at 5%, due to the treatments.

Treatments	Average Yield (kg/ ha)	
5	10881	to
3	10537	ab
7	10537	ab
8	10522	ab
6	10313	bc
9	10299	bc
4	10269	bc
2	9985	CD
10	9925	CD
1	9597	d

DMS = 411 kg/ ha

Means with a common letter are not significantly different ($p > 0.05$)

TRT	Humus	NPK	Location
1-	0	150	Line
2-	0	150	Broadcast seeding
3-	50	150	Line
4-	50	150	Broadcast seeding
5-	50	100	Line

6-	50	100	Broadcast seeding
7-	20	150	Line
8-	20	150	Broadcast seeding
9-	20	100	Line
10-	20	100	Broadcast seeding

Average yield per treatment

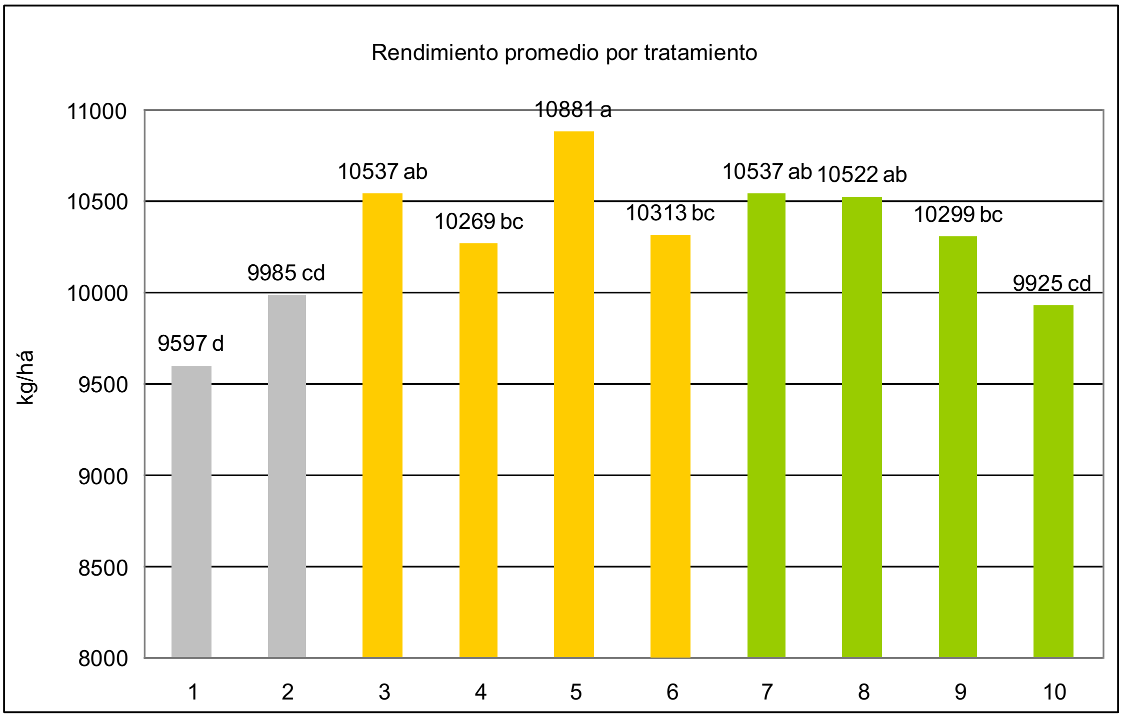


Chart No. 1 - Average yield (kg/ ha) per treatment. With separation of averages.

Means with a common letter are not significantly different (p > 0.05)

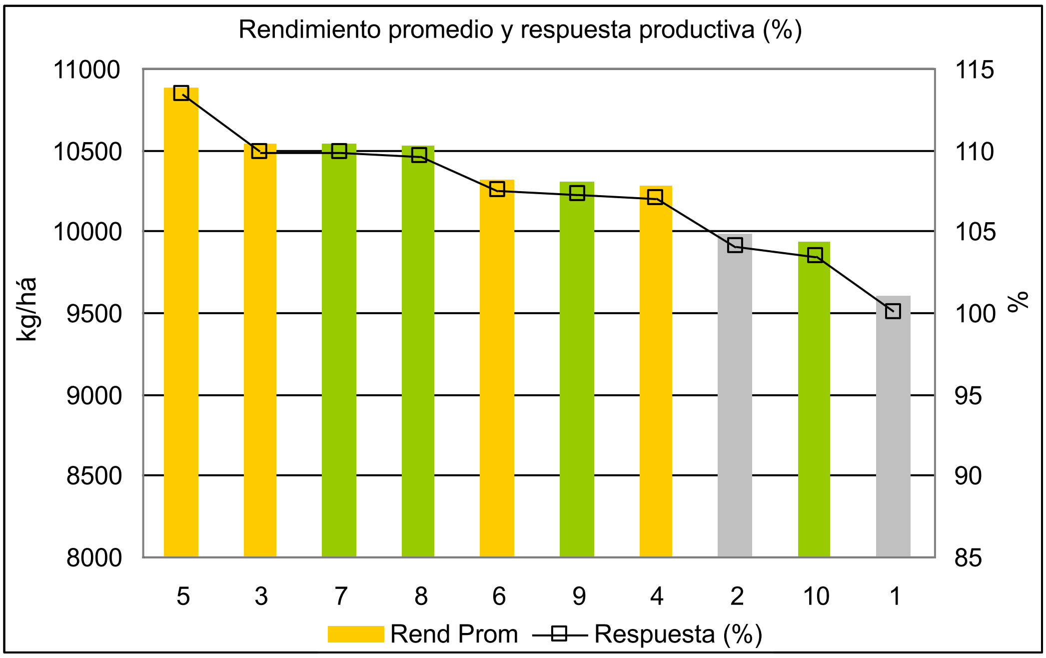
Controls without Humus
Humus 50 kg/ ha
Humus 20 kg/ ha

TRT	Humus	NPK	Location
1-	0	150	Line
2-	0	150	Broadcast seeding
3-	50	150	Line
4-	50	150	Broadcast seeding
5-	50	100	Line
6-	50	100	Broadcast seeding
7-	20	150	Line
8-	20	150	Broadcast seeding
9-	20	100	Line
10-	20	100	Broadcast seeding

Ordered decreasing average yield and productive response

Treatments	Rend Average (kg/ ha)	Rend Prom (bls / ha) (1)	Productive response (%) (2)
5	10881	218	113
3	10537	211	110
7	10537	211	110
8	10522	210	110
6	10313	206	107
9	10299	206	107
4	10269	205	107
2	9985	200	104
10	9925	199	103
1	9597	192	100

(1) Average yield: in dry bags of 50 kg/ ha
(2) Productive response on the commercial Control (treatment 1)_ Base = 100%



Graph No. 2 - Average yield ordered decreasing (kg/ ha) and productive response (%)

Controls without Humus
50 kg/ ha

Humus 20 kg/ ha Humus

TRT	Humus	NPK	Location
1-	0	150	Line
2-	0	150	Broadcast seeding
3-	50	150	Line
4-	50	150	Broadcast seeding
5-	50	100	Line
6-	50	100	Broadcast seeding
7-	20	150	Line
8-	20	150	Broadcast seeding
9-	20	100	Line
10-	20	100	Broadcast seeding

Average yields (kg/ ha) grouped by:

1- Dose of Humus and NPK fertilizer 2- Location method

Dose (kg/ ha) (1)	Line	Broadcast seeding	*Average*
0 + 150	9597	9985	*9791*
20 + 100	10299	9925	*10112*
50 + 100	10881	10313	*10597*
20 + 150	10537	10522	*10530*

50 + 150	10537	10269	*10403*
Average	*10370*	*10203*	

(1): Humus + Fertilizer

Grouping yields by location method, the overall average for in-line applications showed a 1.6% increase compared to the average for broadcast treatments applied to the cover crop.

The doses of 50 + 100 and 20 + 150, of Humus + NPK fertilizer, recorded the highest average yield, considering all the dose combinations evaluated.

Yields (kg/ha) depending on the response to doses of Humus + NPK fertilizer

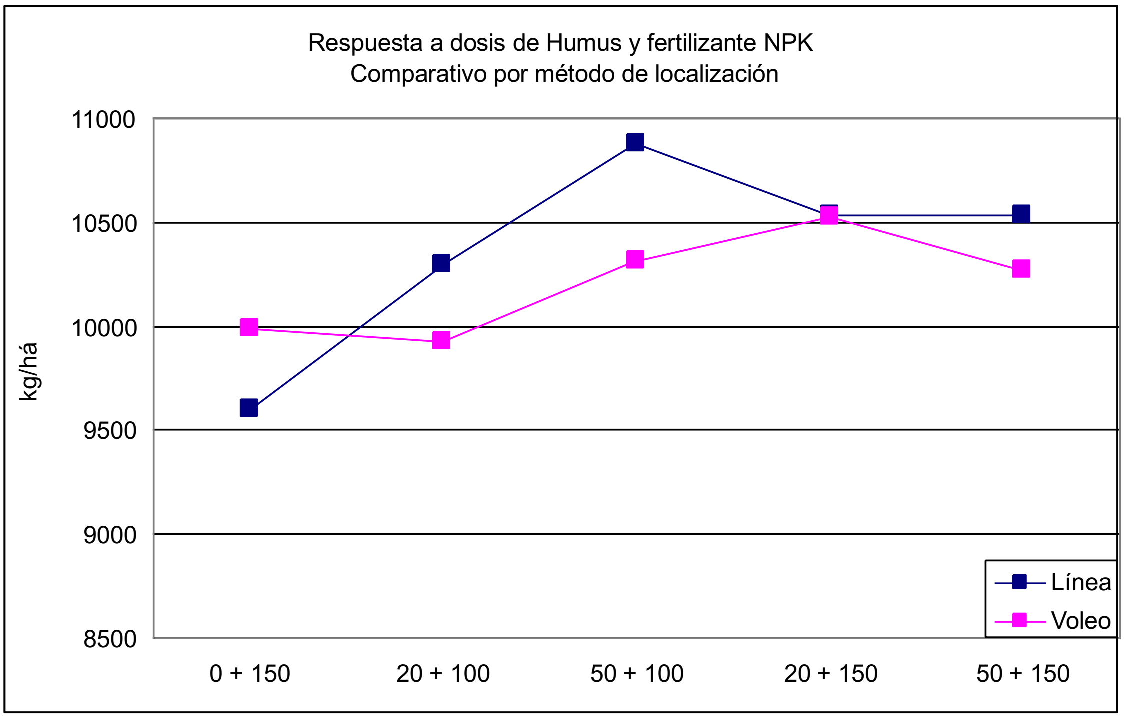


Chart 3 - Response to doses of humus + NPK fertilizer. Comparison of different localization methods.

Yields grouped by dose of Humus and NPK fertilizer

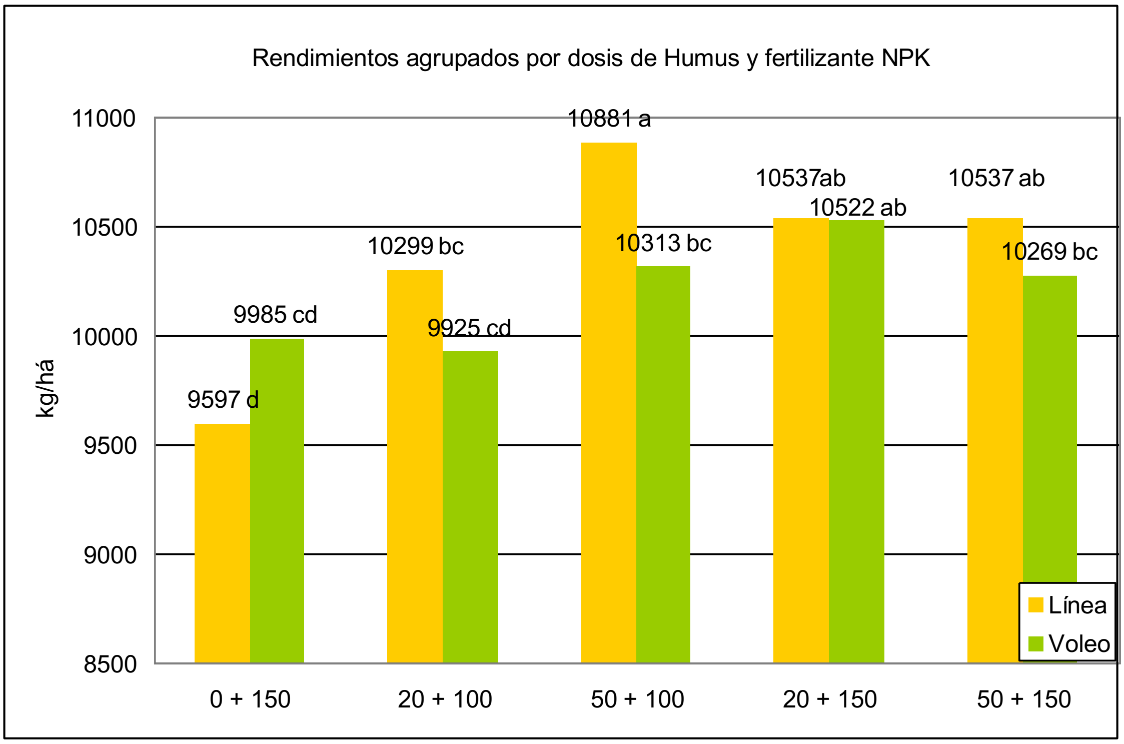


Chart 4 - Yields grouped by dose of humus and NPK fertilizer. With separation of averages.

Means with a common letter are not significantly different ($p > 0.05$)

- With the dose of Humus 50 + NPK 100, the localization treatment on the line significantly exceeded that of broadcast application on the cover.
- In the remaining dose combinations, no statistically significant differences were found by location method.
- In most cases, a trend of higher yield was observed for treatments applied in the line compared to broadcast treatments, except in the case of fertilization with NPK alone, where the trend was the opposite.

Yields grouped by location method

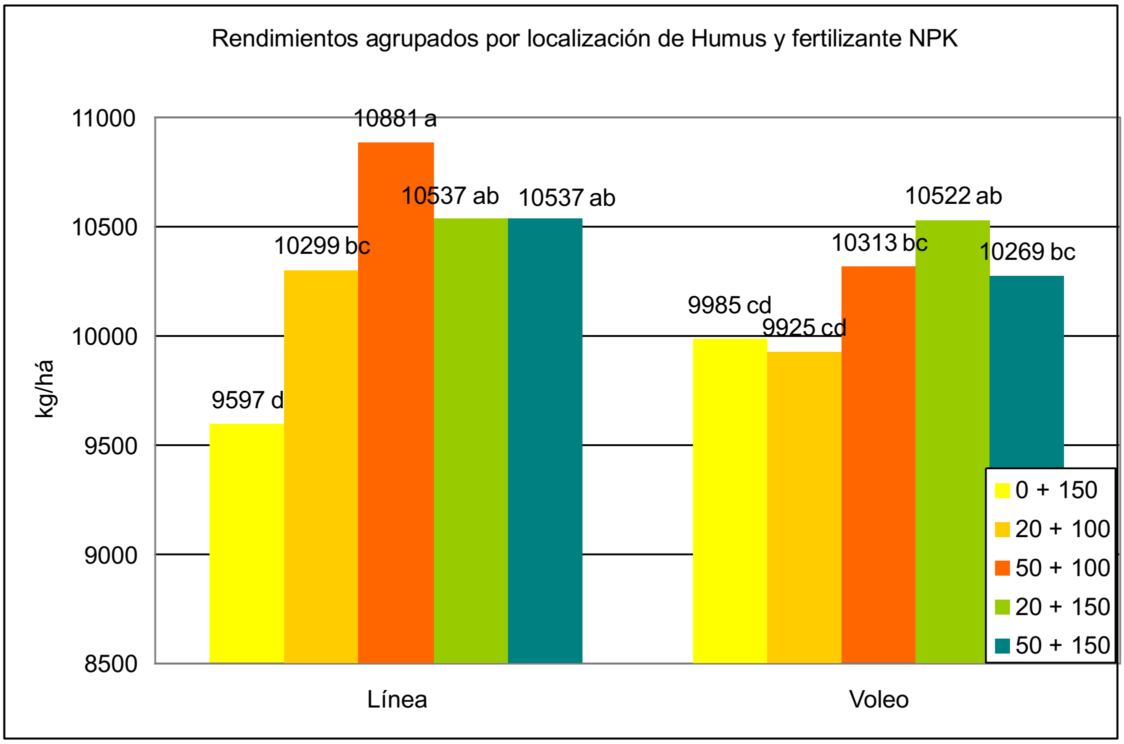


Chart 5 - Yields grouped by location method. With mean separation.

Means with a common letter are not significantly different (p > 0.05)

- By applying Humus and NPK fertilizer to the line, all treatments with the bioactivator significantly outperformed the commercial control (NPK fertilizer only).
- With this application method, the treatment with Humus 50 + NPK 100 stood out, being positioned in a first step of performance, but did not differ statistically from the treatments of 20 + 150 and 50 + 150, of Humus and NPK respectively.
- When applying humus and NPK fertilizer broadcast on the cover crop, only the treatment with Humus 20 + NPK 150 significantly outperformed the commercial control (NPK fertilizer only). The other combinations did not differ statistically from the control.
- In general terms, four combinations of Humus and NPK fertilizer achieved significant productive response over the best commercial control (only NPK fertilizer broadcast), three of them were applied in line and one broadcast.
- The responses were variable, in one case the addition of Humus replacing the NPK fertilizer dose 1:1 caused a significant increase in yield and in the three remaining cases the response was achieved by adding the bioactivator to the NPK control dose.

Photo 3: In the foreground, the commercial NPK 150 control applied in-line. It presented the lowest test performance, not differing statistically from only two treatments and being significantly outperformed by the rest.

Photo 4: The commercial Control NPK 150 applied by broadcasting was significantly surpassed by four combinations of Humus + fertilizer, three of them in line and one broadcast.

Photo 5: Treatment 3 (Humus 50 + NPK 150 applied in line) was the best in terms of yields step and significantly outperformed the best commercial Control (fertilizer NPK lone).

Photo 6: Treatment 4 (Humus 50 + NPK 150 applied by broadcasting) did not differ statistically from best commercial Control (only fertilizer) and NPK by Broadcast seeding).

FINAL COMMENTS

The essay is based on a little-known topic for rice cultivation in our country: the use of the fertilizer additive Humus from the Paraguayan company Tiróleo .

Starting with the NPK fertilizer dosage recommended by a technical expert based on soil analysis, two doses of humus were tested, both in addition to and in place of the fertilizer, and compared with a commercial control (fertilizer alone). Furthermore, all treatments were applied in duplicate, incorporated into the row or broadcast as a cover crop, to compare the effectiveness of both localization methods.

The trial was installed in a commercial farm of the INIA Merín variety, which occupies 50% of the rice area, in the second section of the department of Treinta y Tres, on Planosol soils . Subeutrics Ocricos with a silty loam texture , associated with Solods Ocricos belonging to the La Charqueada unit.

CONCLUSIONS

Performance

With a general average of the test of 10287 kg/ ha , statistically significant differences were found at 5%, due to the treatments.

Treatment 5 (Humus 50 + NPK 100 applied to the line) was at the top of the yields, not differing statistically from three treatments, but significantly surpassing the rest (see graph No. 1).

The other treatments that were positioned in that first performance step were 3 (Humus 50 + NPK 150 applied in line) and 7 and 8 (Humus 20 + NPK 150 applied in line and broadcast respectively).

These four top-performing treatments achieved significant productive response over the best commercial control (only broadcast NPK fertilizer), highlighting that three of them were applied in line and one broadcast.

Grouping yields by location method, the overall average for application in the row showed a 1.6% increase compared to the average for broadcast topdressing treatments. Furthermore, the 50 + 100 and 20 + 150 doses of humus + NPK fertilizer recorded the highest average yields among all dose combinations evaluated.

Observing the different productive responses by grouping treatments by additive and fertilizer dose allows us to compare the effectiveness achieved based on the application method. The most eloquent result was recorded with the Humus 50 + NPK 100 dose, where the in-row application significantly outperformed the broadcast application. On the other hand, with the remaining dose combinations, no statistically significant differences were found based on the application method. However, in most cases, a trend of higher yield was observed for the in-row treatments compared to the broadcast treatments, except in the case of NPK fertilization alone, where the trend was the opposite (see graph 4).

Grouping the results by the location method (see graph No. 5) allows us to highlight the main conclusions drawn from this test:

I) By applying Humus and NPK fertilizer to the line, all treatments with the bioactivator significantly outperformed the commercial control (only NPK fertilizer), with the treatment with Humus 50 + NPK 100 standing out, which was positioned at the first level of performance, but did not differ statistically from the treatments of 20 + 150 and 50 + 150, of Humus and NPK respectively.

II) When applying humus and NPK fertilizer broadcast on the cover crop, only the treatment with Humus 20 + NPK 150 significantly outperformed the commercial control (NPK fertilizer only). The other combinations did not differ statistically from the control.

In summary, four combinations of humus and NPK fertilizer achieved significant yield responses compared to the best commercial control (only broadcast NPK fertilizer). Three of these were applied in-row and one broadcast. The responses varied; in one case, the addition of humus, replacing the NPK fertilizer dose 1:1, led to a significant increase in yield, and in the remaining three cases, the response was achieved by adding the bioactivator to the NPK control dose.

The results with the Humus fertilizer additive are promising and generate good prospects for commercial adoption. However, the technological changes it entails in terms of adjusting the base fertilizer dosage and the location method require further research and validation to generate solidly supported technical recommendations.

SUPPLEMENTAL MATERIAL #2

ASINAGRO
AGRONOMIC ADVICE AND RESEARCH

TEST WITH ADDITIVE FOR FERTILIZERS HUMUS - SOYBEANS

Third section – Thirty-Three - Uruguay

2023-2024 HARVEST

Agricultural Engineer Hernán Zorrilla *Agricultural Engineer Emiliano Ferreira*

INTRODUCTION

The essay is based on a little-known topic for soybean cultivation in our country: the use of the fertilizer additive Humus from the Paraguayan company Tiróleo .
The bioactivation of fertilizers, with additives such as humus, aims to optimize their assimilation in order to reduce their consumption, maximizing the use of nutrients and minimizing losses that affect the environment and the producers' economy.

Agricultural activities today face challenges in finding ways to ensure the preservation of natural resources for future generations, minimize environmental impacts, help mitigate climate change, and produce food of proven safety and quality.

In this context, there are various strategies and visions regarding the paths to be taken. In our case, we see a priority in advancing paths that promote gradual changes in inputs, management, and processes, reducing the environmental footprint and maintaining or improving the productivity and quality of the rice produced.

The incorporation of bioinputs , such as the additive Humus de Tyróleo , is a key tool to generate valid alternatives to a traditional sustainable and high-productivity management system.

In response to this challenge, an exact basal fertilization test using the Humus additive from the company Tiróleo was installed in the third section of the department of Treinta y Tres, on a farm where the rice-soybean rotation is carried out.

Starting with the NPK fertilizer dosage recommended by a technical expert based on soil analysis, two doses of humus were tested, both in addition to and in place of the fertilizer, and compared with a commercial control (fertilizer alone). Furthermore, all treatments were applied in duplicate, incorporated into the row or broadcast as a cover crop, to compare the effectiveness of both localization methods.

This report presents data on the test setup, materials and methods, results, statistical analysis of performance, and final comments. Illustrative photographs are also included.

GOALS

- To evaluate the effectiveness of the fertilizer additive Humus in soybean cultivation.
- Contrast between online application and random coverage.
- Adjust the application of Humus in relation to replacement or addition with NPK fertilizer.
- Quantify its impact on crop yield.

MATERIALS AND METHODS

Product evaluated: fertilizer additive

Humus
Bioactivating additive with the same physical characteristics as a granulated fertilizer, making it suitable for mixing prior to application.
It is obtained from plant remains that go through a fermentation process where a set of microorganisms – Microbiome – are incorporated, which interact with each other , in balance and conditioned by the soil and the chemical processes that direct them.
Nutrient release depends on the existing microbiology in the soil, but the use of the additive increases this dynamic because the incorporated microbiome favors the processes that make nutrients available to plants.
Treatments: (Dose kg/ ha)

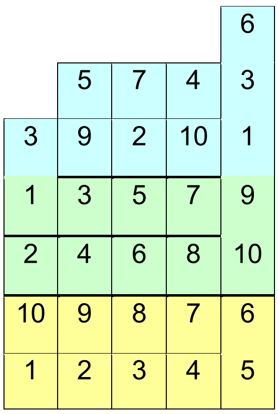
TRT	Humus	NPK (1)	Location	Relationship Humus: NPK
1-	0	200	Line	Control
2-	0	200	Broadcast seeding	Control
3-	50	200	Line	Additive
4-	50	200	Broadcast seeding	Additive
5-	50	150	Line	Replacement (2)
6-	50	150	Broadcast seeding	Replacement (2)
7-	20	200	Line	Additive
8-	20	200	Broadcast seeding	Additive
9-	20	150	Line	Replacement (3)
10-	20	150	Broadcast seeding	Replacement (3)

(1) NPK base fertilizer: 0 – 20/20 – 30
(2) Complete 1:1 replacement with 25% reduction in NPK dosage
(3) Partial replacement 0.4:1 with 25% reduction in NPK dosage

Design

Random blocks with three repetitions
Plots of 20 m ^{2} (4 m wide by 5 m long).

Distribution of treatments:



Test facility

Locality	Producer	Planting date	Cultivate
Vergara	Hernán Zorrilla	December 1st	DM 60i62

Representative location of the traditional rice-growing basin of Laguna Merín, the area included in the third section of the department of Treinta y Tres corresponds to the "Rincón de Ramírez" unit of the Soil Recognition Chart of Uruguay, scale 1:1,000,000, and the soil where the test was installed is a Planosol Distric Ocher with a silty loam texture.

Soil analysis -

Predecessor: rice stubble
Management: Spring glyphosate – pre-tillage (disk and leveling)

pH (H2O)	5.5
MO (%)	1.8
P – citric acid (ppm)	6
K (meq /100 gr soil)	0.21

Recommended Dose

The recommendation for phosphorus and potassium fertilization for soybeans is determined based on soil chemical analysis and the production system that alternates soybeans with rice in a 1:1 rotation.

- P_2O_5 = 40 units / ha
- K_2O = 60 units / ha

For the commercial Control NPK (0 - 20/20 - 30) it is adjusted to 200 kg/ ha (treatment 1).

Description of the environment

The trial was installed in a rice crop, planted on a Planosol Distric Ochric with a silty loam texture belonging to the Rincón de Ramírez unit.

The planting date for the farm is early December, with the Don Mario genetic variety, DM 60i62 IPRO , with a short sixth cycle and indeterminate growth habit. Its main characteristics include its excellent adaptation to medium-yield environments and rice plain soils.

Crop management:
Sowing:
Date: 1st-12-2023
Sowing conditions: Good sowing preparation
Soil with good humidity
Planting type: row – seeder: John Deere planter
Variety: DM 60i62 IPRO / Sowing density: 13 seeds/m linear

Basal fertilization:
Date: 6-12-23 with the germinated culture
Dosage: according to treatments

Photo 1 – Sowing the test.

Photo 2 – Installation of the test with location of Humus and NPK fertilizer in the furrow for treatments

Climatic characterization of the harvest determining the yield potential

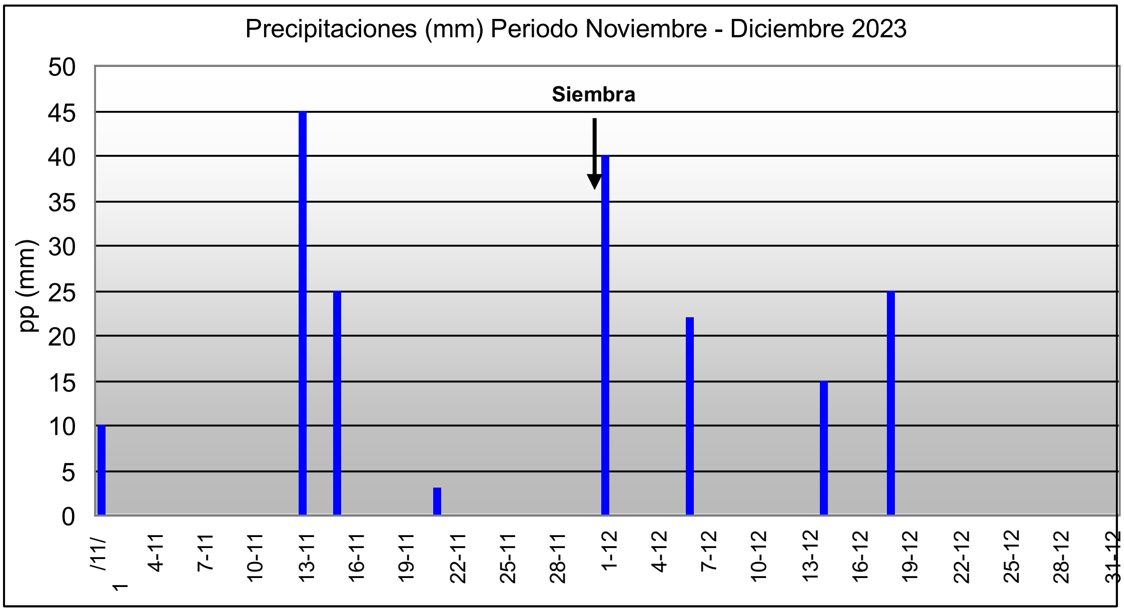
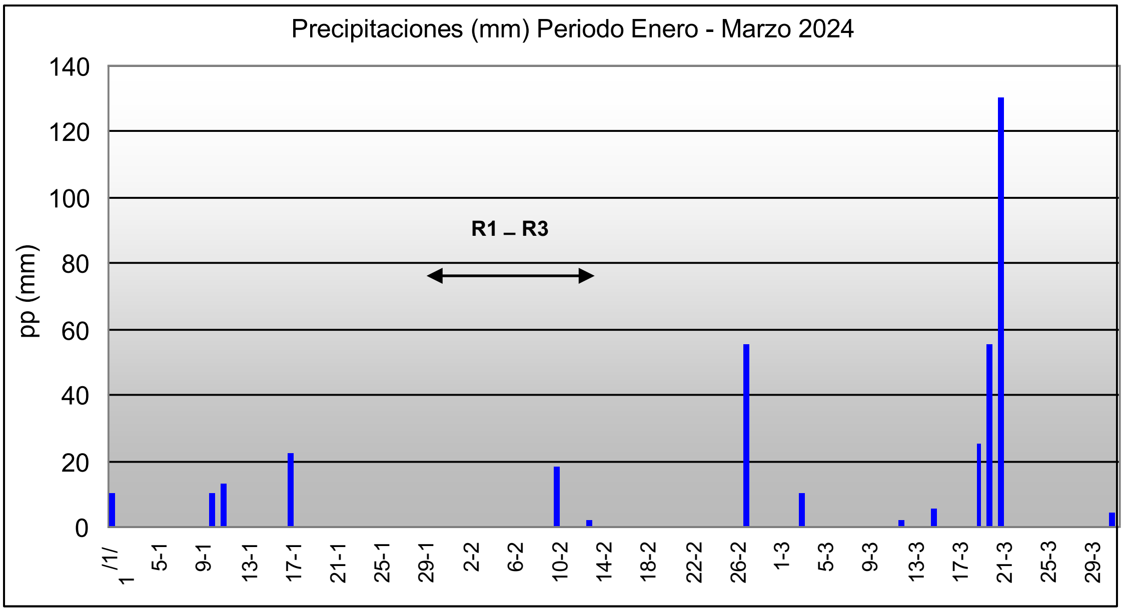


Chart I – Daily rainfall (mm) – Period November – December 2023 Source: Producer's own data.

Immediately after sowing, rainfall occurred which, due to its volume, could affect the establishment of the crop on soils with flat topography and poor drainage. However, in the trial, a good recovery of plants was achieved, achieving a population of 280,000 plants/ ha .



Graph II – Daily rainfall (mm) – Period January – March 2024 Source: Producer's own data.

Prior to and during the critical yield-generating stage, between R1 and R3, there was no significant rainfall, but the crop nevertheless showed acceptable development and realized very good yield potential, favored by timely rainfall during grain filling.

EVALUATIONS

Plant development – 35 days after emergence –

Photo 3: In the foreground, treatment 10 (Humus 20 + NPK 150 applied broadcast). In the background, treatment 9 (same dose but placed in a row) was seen to have developed more than the treatment mentioned above, 35 days after emergence.

Photo 4: On the left, treatment 5 (Humus 50 + NPK 150 applied in the row). On the right

Treatment 7 (20 + 200). They presented similar plant development in the first evaluation.

Photo 5: Treatment 5 in the foreground (Humus 50 + NPK 150 located on the line). In the background Treatment 6 (same dose but applied randomly). They showed a similar development of plants, 35 days after emergence.

Plant development – 55 days after emergence –

Photo 6: In the foreground is the commercial control (NPK 200 applied in line). In the background is located the treatment 3 (Humus 50 + NPK 200 in line) with greater plant development and inter-row coverage than the Control, 55 days after the emergency.

Photo 7: In the foreground, treatment 10 (Humus 20 + NPK 150 applied broadcast). In the background, treatment 9 (same dose but placed in a row) was seen to have developed more than the treatment mentioned above, 55 days after emergence.

Photos 8 and 9: In the foreground, the commercial control (NPK 200 applied broadcast). In the background, treatment 7 (Humus 20 + NPK 200 applied in the row) with a notable response in plant development and inter-row coverage, 55 days after emergence.

Root development – 65 days after emergence –

TRT. 3 (50 + 200 line) / TRT. 4 (50 + 200 broadcast seeding) / TRT. 7 (20 + 200 line) / TRT. 8 (20 + 200 broadcast seeding)

Small differences in root size were observed in favor of treatments with higher doses of humus, regardless of the location method. The superior root development was reflected in the aerial parts of the crop, with greater plant development.

Plant development – 85 days after emergence –

Photo 11: in the foreground the commercial Control (NPK 200 applied broadcast) and in the background the Control commercial applied in the line. The first mentioned showed a slightly higher development of plants , 85 days after emergence.

Photo 12: in the foreground treatment 4 (Humus 20 + NPK 150 applied by broadcasting) and in the background the Treatment 3 (same dose but located online), did not record significant differences in the **plant** development , 85 days after emergence.

Photo 13: in the foreground treatment 6 (Humus 20 + NPK 150 applied by broadcasting) and in the background the Treatment 5 (same dose but located online). The first one was highlighted by a superior plant development, 85 days after emergence.

Photo 14: in the foreground treatment 10 (Humus 20 + NPK 150 applied by broadcasting) and in the background Treatment 9 (same dose but located online). As in the evaluations Previously , the latter was observed with greater plant development than the former.

PERFORMANCES

Kg/ ha corrected to 12% humidity

Treatments	Yo	II	III	*Average*
1	3400	3225	3550	*3392*
2	3250	3400	3600	*3417*
3	4000	3700	3800	*3833*
4	3450	3675	3775	*3633*
5	3875	3975	4025	*3958*
6	4075	4350	4300	*4242*
7	4200	4125	3925	*4083*
8	3775	4000	3525	*3767*
9	3375	3650	3500	*3508*
10	3325	3675	3275	*3425*

- Overall average of the test: 3726 kg/ ha

TRT	Humus	NPK	Location
1-	0	200	Line
2-	0	200	Broadcast seeding
3-	50	200	Line
4-	50	200	Broadcast seeding
5-	50	150	Line
6-	50	150	Broadcast seeding
7-	20	200	Line
8-	20	200	Broadcast seeding
9-	20	150	Line
10-	20	150	Broadcast seeding

STATISTICAL ANALYSIS

FV	gl	SC	CM	F
Blocks	2	55167	27583	
Treatments	9	2444354	271595	9.73 *
Mistake	18	502333	27907	
Total	29	3001854		

CV: 4.48%

With a general average of the test of 3726 kg/ ha , statistically significant differences were found at 5%, due to the treatments.

Treatments	Average Yield (kg/ ha)	
6	4242	to
7	4083	ab
5	3958	bc
3	3833	CD
8	3767	CD
4	3633	of
9	3508	ef
10	3425	F
2	3417	F
1	3392	F

DMS = 203 kg/ ha

Means with a common letter are not significantly different ($p > 0.05$)

TRT	Humus	NPK	Location
1-	0	200	Line
2-	0	200	Broadcast seeding
3-	50	200	Line
4-	50	200	Broadcast seeding
5-	50	150	Line
6-	50	150	Broadcast seeding
7-	20	200	Line
8-	20	200	Broadcast seeding
9-	20	150	Line
10-	20	150	Broadcast seeding

Average yield per treatment

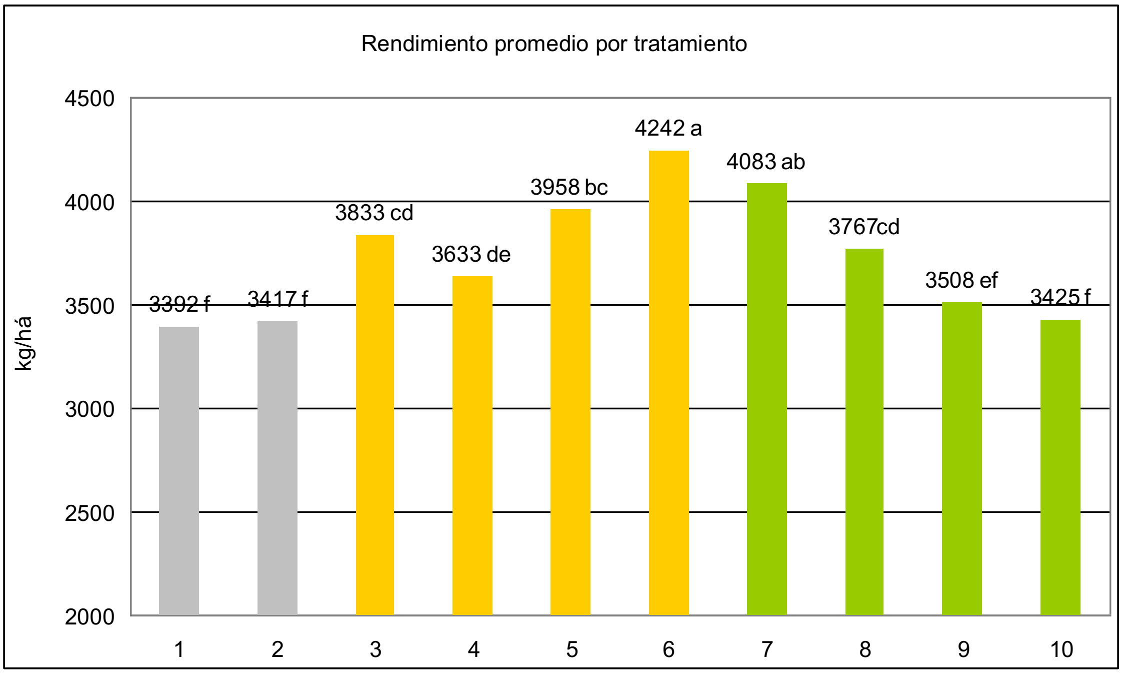


Chart No. 1 - Average yield (kg/ ha) per treatment. With separation of averages.

Means with a common letter are not significantly different ($p > 0.05$)

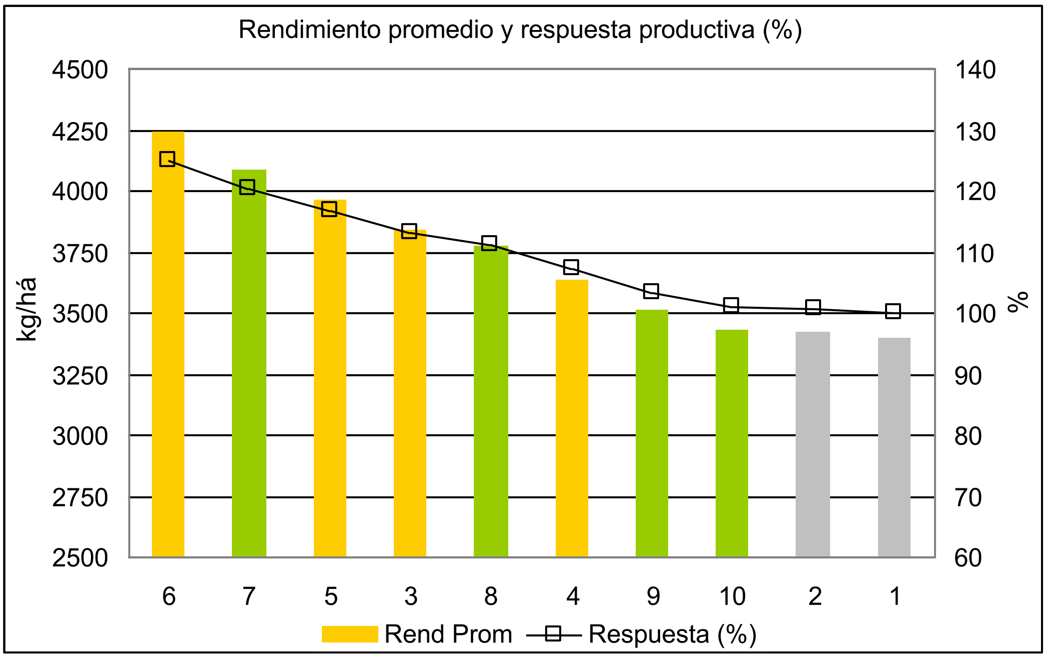
Controls without Humus
Humus 50 kg/ ha
Humus 20 kg/ ha

TRT	Humus	NPK	Location
1-	0	200	Line
2-	0	200	Broadcast seeding
3-	50	200	Line
4-	50	200	Broadcast seeding
5-	50	150	Line
6-	50	150	Broadcast seeding
7-	20	200	Line
8-	20	200	Broadcast seeding
9-	20	150	Line
10-	20	150	Broadcast seeding

Ordered decreasing average yield and productive response

Treatments	Rend Average (kg/ ha)	Productive response (%) (1)
6	4242	125
7	4083	120
5	3958	117
3	3833	113
8	3767	111
4	3633	107
9	3508	103
10	3425	101
2	3417	101
1	3392	100

(1) Productive response on the commercial Control (treatment 1)_ Base = 100%



Graph No. 2 - Average yield ordered decreasing (kg/ ha) and productive response (%)

Controls without Humus
50 kg/ ha
Humus 20 kg/ ha Humus

TRT	Humus	NPK	Location
1-	0	200	Line
2-	0	200	Broadcast seeding
3-	50	200	Line
4-	50	200	Broadcast seeding
5-	50	150	Line
6-	50	150	Broadcast seeding

7-	20	200	Line
8-	20	200	Broadcast seeding
9-	20	150	Line
10-	20	150	Broadcast seeding

Average yields (kg/ ha) grouped by:

1- **Humus and NPK fertilizer dosage**
2- **Localization method**

Dose (kg/ ha) (1)	Line	Broadcast seeding	*Average*
0 + 200	3392	3417	*3405*
20 + 150	3508	3425	*3467*
50 + 150	3958	4242	*4100*
20 + 200	4083	3767	*3925*
50 + 200	3833	3633	*3733*
Average	*3755*	*3697*	

(1): Humus + Fertilizer

Grouping yields by location method, the overall average for in-line applications showed a 1.6% increase compared to the average for broadcast treatments applied to the cover crop.

The doses of 50 + 150 and 20 + 200, of Humus + NPK fertilizer, recorded the highest average yield, considering all the dose combinations evaluated.

Yields (kg/ ha) depending on the response to doses of Humus + NPK fertilizer

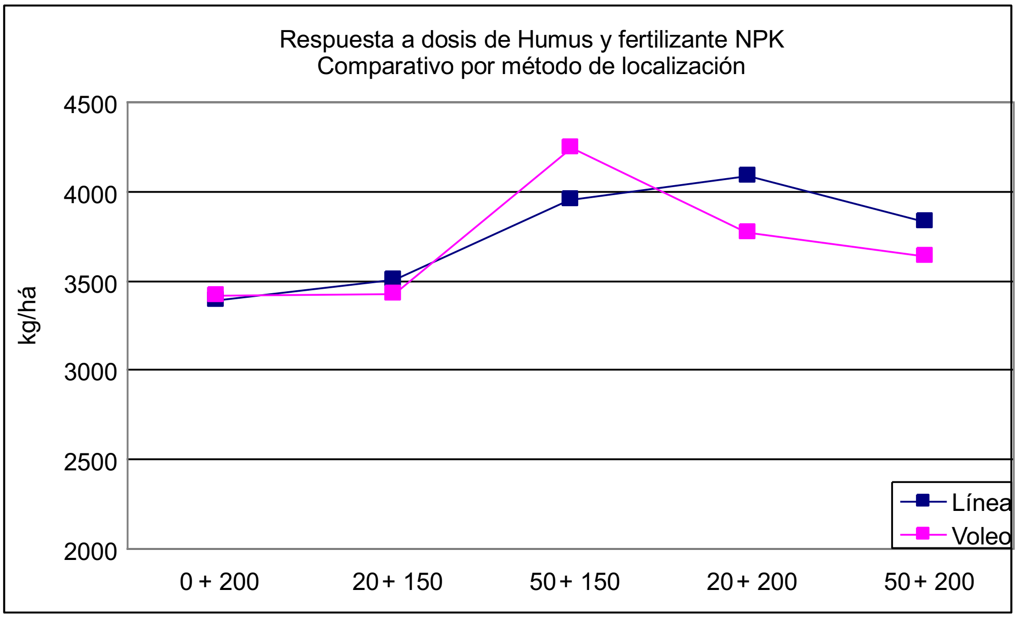


Chart 3 - Response to doses of humus + NPK fertilizer. Comparison of different localization methods.

Yields grouped by dose of Humus and NPK fertilizer

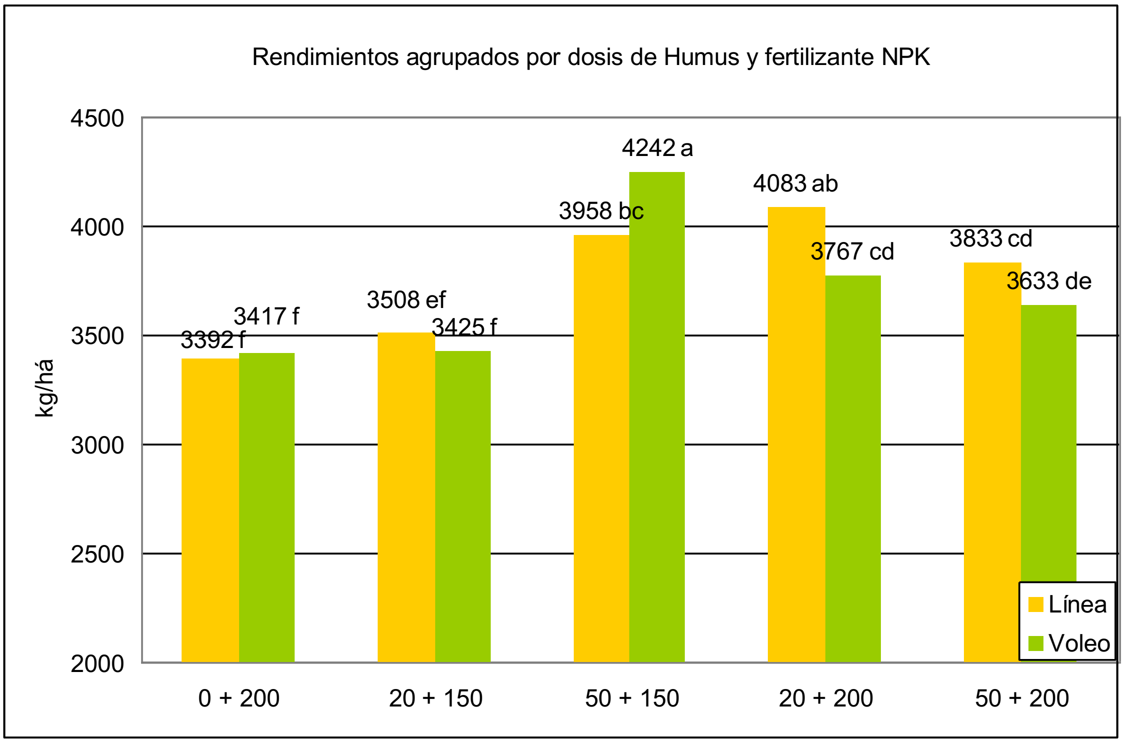


Chart 4 - Yields grouped by dose of humus and NPK fertilizer. With separation of averages.

Means with a common letter are not significantly different ($p > 0.05$)

- With the Humus 50 + NPK 150 dose, broadcast application significantly outperformed the on-row application. On the other hand, with the Humus 20 + NPK 200 dose, the result was the opposite, with the on-row application significantly more effective.

- In the remaining dose combinations, including commercial controls, no statistically significant differences were found by location method.

Yields grouped by location method

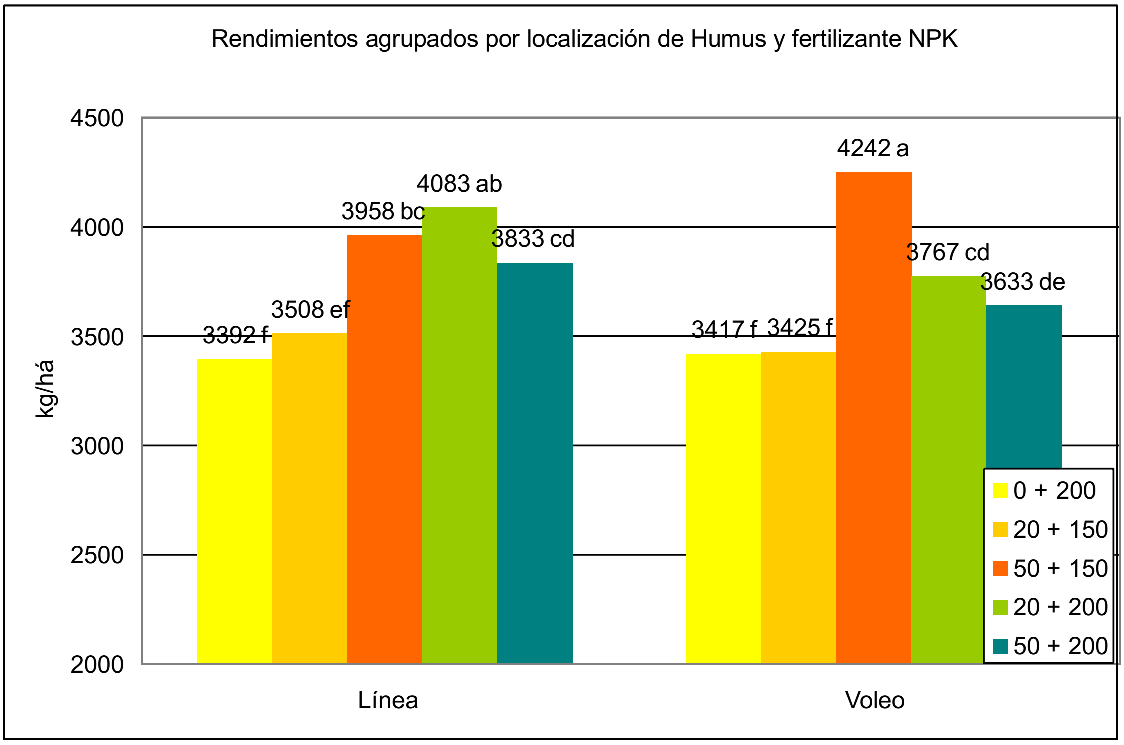


Chart 5 - Yields grouped by location method. With mean separation.

Means with a common letter are not significantly different ($p > 0.05$)

- For both online and broadcast location, all treatments with Humus + NPK fertilizer, except those with the lowest dose (20 + 150), significantly outperformed the commercial controls (only NPK fertilizer).
- With the application in the line, the treatment with Humus 20 + NPK 200 stood out, positioning itself in a first step of performance, but did not differ statistically from the treatment of 50 + 150.
- Broadcast application of the Humus 50 + NPK 150 treatment resulted in the highest yield, significantly surpassing the rest.
- In general terms, six combinations of Humus and NPK fertilizer achieved significant productive response over commercial controls (only NPK fertilizer), three of them were applied in line and the other three broadcast.
- The responses were variable, but in the line the most notable treatment was adding Humus to the NPK fertilizer and in the case of broadcast application the addition of Humus replacing the NPK fertilizer dose 1:1 caused a significant increase in yield.

Photo of the same dose but located on line 15: in the foreground the commercial Control. They were located at the last performance step, NPK 200 applied by broadcasting and in the background the Control with

being significantly surpassed by most treatments applied with Humus + NPK fertilizer.

Photo 16: in the foreground treatment 4 (Humus 50 + NPK 200 applied by broadcasting), in the background the Treatment 3 (same dose but located on the line). They did not differ statistically from each other , but significantly outperformed commercial controls (NPK fertilizer only).

FINAL COMMENTS

The essay is based on a little-known topic for soybean cultivation in our country: the use of the fertilizer additive Humus from the Paraguayan company Tiróleo .

Starting with the NPK fertilizer dosage recommended by a technical expert based on soil analysis, two doses of humus were tested, both in addition to and in place of the fertilizer, and compared with a commercial control (fertilizer alone). Furthermore, all treatments were applied in duplicate, incorporated into the row or broadcast as a cover crop, to compare the effectiveness of both localization methods.

The trial was installed in a commercial field of the DM 60i62 IPRO variety, which reached a population of 280,000 plants/ ha and was located in the third section of the Treinta y Tres department, on Planosol soils. Dystrics Ochrics with a silty loam texture belonging to the Rincón de Ramírez unit.

CONCLUSIONS

Performance

With a general average of the test of 3726 kg/ ha , statistically significant differences were found at 5%, due to the treatments.

Treatment 6 (Humus 50 + NPK 150 applied broadcast) was at the top of the yields, not differing statistically from treatment 7 (Humus 20 + NPK 200 applied in the line), but significantly surpassing the rest (see graph No. 1).

These higher performance treatments achieved significant productive response between 20 and 25% over commercial controls (NPK fertilizer only) (see graph No. 2).

Grouping yields by location method, the overall average for application in the row showed a 1.6% increase compared to the average for broadcast topdressing treatments. Furthermore, the 50 + 150 and 20 + 200 doses of humus + NPK fertilizer recorded the highest average yields among all dose combinations evaluated.

Observing the different productive responses grouping treatments by additive and fertilizer dose allows us to compare the effectiveness achieved based on the location method. The most eloquent results were recorded with the Humus 50 + NPK 150 dose, where the broadcast application treatment significantly exceeded the in-row location treatment. With the Humus 20 + NPK 200 dose, the result was the opposite, with the in-row location being significantly more prominent. On the other hand, with the remaining dose combinations, including the commercial controls, no statistically significant differences were found based on the location method (see graph 4).

Grouping the results by the location method (see graph No. 5) allows us to highlight the main conclusions drawn from this test:

I) For both in-line and broadcast application, all treatments with Humus + NPK fertilizer, except those with the lowest dose (20 + 150), significantly outperformed the commercial controls (only NPK fertilizer).

II) With the application in the line, the treatment with Humus 20 + NPK 200 stood out, positioning itself in a first step of performance, but did not differ statistically from the treatment of 50 + 150. Applying broadcast in coverage, the treatment with Humus 50 + NPK 150 was placed at the top of the yields, significantly surpassing the rest.

In summary, six combinations of humus and NPK fertilizer achieved significant yield responses compared to commercial controls (NPK fertilizer alone). Three of these were applied in rows and the other three were broadcast. Responses varied, but in rows, the most notable treatment was adding humus to the NPK fertilizer. In the case of broadcast application, the addition of humus, replacing the NPK fertilizer dose 1:1, led to a significant increase in yield.

The results with the Humus fertilizer additive are promising and generate good prospects for commercial adoption. However, the technological changes it entails in terms of adjusting the base fertilizer dosage and the location method require further research and validation to generate solidly supported technical recommendations.

SUPPLEMENTAL MATERIAL #3

ASINAGRO
AGRONOMIC ADVICE AND RESEARCH

TEST WITH ADDITIVE FOR FERTILIZERS HUMUS - SOYBEANS

Third section – Thirty-Three - Uruguay

2024-2025 HARVEST

Agricultural Engineer Hernán Zorrilla

Agricultural Engineer Emiliano Ferreira

INTRODUCTION

The trial is based on a little-known topic for soybean cultivation in our country: the use of the fertilizer additive MO Humus from the Paraguayan company Tiróleo. The bioactivation of fertilizers, with additives such as MO Humus, aims to optimize their assimilation in order to reduce consumption, maximizing nutrient utilization, and minimizing losses that affect the environment and the producers' finances.

Agricultural activities today face challenges in finding ways to ensure the preservation of natural resources for future generations, minimize environmental impacts, help mitigate climate change, and produce food of proven safety and quality.

In this context, there are various strategies and visions regarding the paths to be taken. In our case, we see a priority in advancing paths that promote gradual changes in inputs, management, and processes, reducing the environmental footprint and maintaining or improving the productivity and quality of the rice produced.

The incorporation of bioinputs, such as the MO Humus additive from Tyróleo, is a key tool for generating valid alternatives to a traditional, sustainable, and highly productive management system.

In response to this challenge, for the second consecutive year, an accurate basal fertilization trial using the MO Humus additive from the company Tiróleo was installed in the third section of the Treinta y Tres department, on a farm where the rice-soybean rotation is carried out.

Starting with the NPK fertilizer dosage recommended by a technical expert based on soil analysis, two doses of OM humus were tested, both in addition to and in place of the fertilizer, and compared with a commercial control (fertilizer alone). Furthermore, all treatments were applied in duplicate, incorporated into the row or broadcast as a cover crop, to compare the effectiveness of both localization methods.

This report presents data on the test setup, materials and methods, results, statistical analysis of performance, and final comments. Illustrative photographs are also included.

GOALS

- To evaluate the effectiveness of the fertilizer additive MO Humus in soybean cultivation.
- Contrast between online application and random coverage.
- Adjust the application of MO Humus in relation to replacement or addition with NPK fertilizer.
- Quantify its impact on crop yield.

MATERIALS AND METHODS

Product evaluated: fertilizer additive MO Humus

Bioactivating additive with the same physical characteristics as a granulated fertilizer, making it suitable for mixing prior to application.
It is obtained from plant materials, subjected to the microaerophilic batch fermentation process under physicochemical and biological conditions that promote and enrich the natural microbiome of plant extracts.

Nutrient release depends on the existing microbiology in the soil, but the use of the MO Humus additive increases this dynamic because the product's natural microbiome favors the processes that make nutrients available to plants.
Treatments: (Dose kg/ha)

TRT	Humus	NPK (1)	Location	Relationship Humus: NPK
1-	0	200	Line	Control
2-	0	200	Broadcast seeind	Control
3-	50	200	Line	Additive
4-	50	200	Broadcast seeind	Additive
5-	50	150	Line	Replacement (2)
6-	50	150	Broadcast seeind	Replacement (2)
7-	20	200	Line	Additive
8-	20	200	Broadcast seeind	Additive
9-	20	150	Line	Replacement (3)
10-	20	150	Broadcast seeind	Replacement (3)

(1) NPK base fertilizer: 0 – 20/20 – 30
(2) Complete 1:1 replacement with 25% reduction in NPK dosage
(3) Partial replacement 0.4:1 with 25% reduction in NPK dosage

Design

Random blocks with three repetitions
Plots of 20 m ^{2} (4 m wide by 5 m long).

Distribution of treatments:

6	5	4	7	3
10	1	9	2	8
1	3	5	7	9
2	4	6	8	10
10	9	8	6	7
1	2	3	4	5

Test facility

Locality	Producer	Planting date	Cultivate
Vergara	Hernán Zorrilla	November 13	DM Garra IPRO STS

Representative location of the traditional rice-growing basin of Laguna Merín, the area included in the third section of the department of Treinta y Tres corresponds to the “Rincón de Ramírez” unit of the Soil Recognition Chart of Uruguay, scale 1:1,000,000, and the soil where the test was installed is an Ochric Dystric Planosol with a silty loam texture.

Soil analysis -

Predecessor: rice stubble
Management: Spring glyphosate – pre-tillage (disk and leveling)

pH (H2O)	5.3
MO (%)	1.9
P – citric acid (ppm)	8
K (meq/100 gr soil)	0.19

Recommended Dose

The recommendation for phosphorus and potassium fertilization for soybeans is determined based on soil chemical analysis and the production system that alternates soybeans with rice in a 1:1 rotation.

- P_2O_5 = 40 units / ha
- K_2O = 60 units / ha

For the commercial Control NPK (0 - 20/20 - 30) it is adjusted to 200 kg/ha (treatment 1).

Description of the environment

The trial was installed in a soybean crop, planted on a Dystric Ochric Planosol with a silty loam texture belonging to the Rincón de Ramírez unit.

The planting date for the farm is mid-November, with the Don Mario genetic variety, Garra IPRO STS , a long-cycle VI crop with an indeterminate growth habit. Its main characteristics include its excellent adaptation to medium-to-low productivity environments and rice plain soils.

Crop management:
Sowing:
Date: 13-11-24
Sowing conditions: Good sowing preparation
Soil with low humidity
Planting type: row – seeder: John Deere planter
Variety: DM Garra IPRO STS / Sowing density: 17 seeds/m linear

Basal fertilization:
Date: 20-11-24 with the germinated culture
Dosage: according to treatments

Photo 1 – Sowing the test.

Climatic characterization of the harvest determining the yield potential

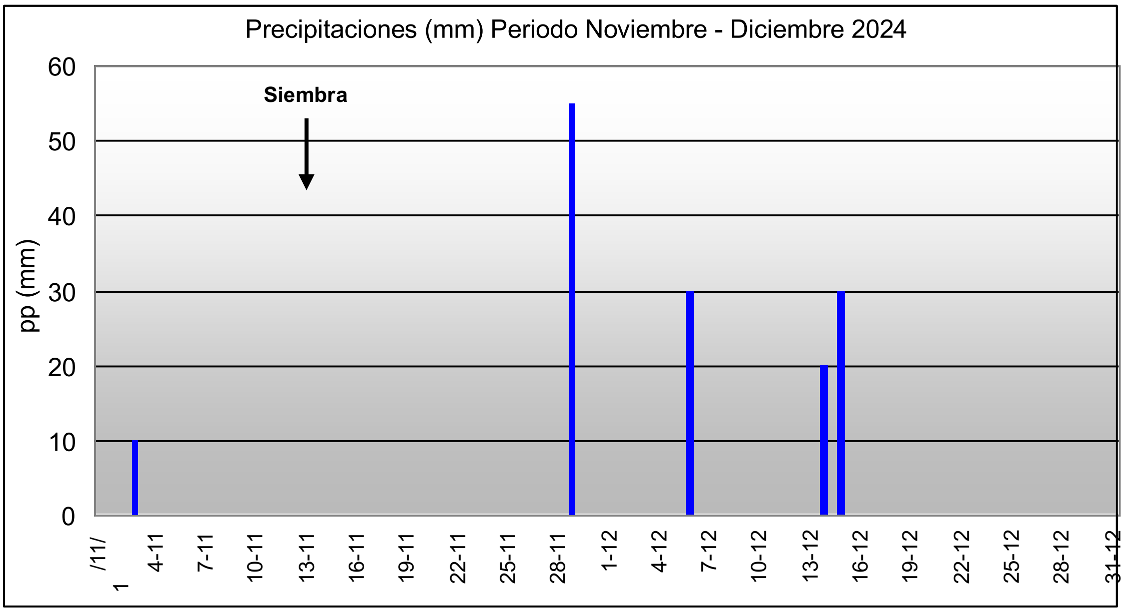
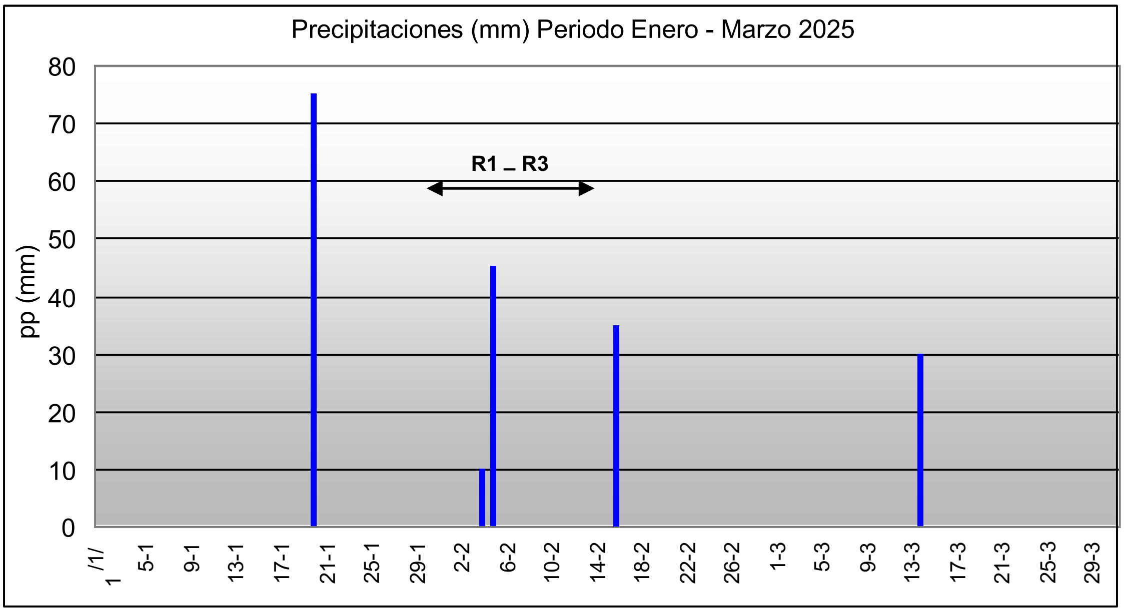


Chart I – Daily rainfall (mm) – Period November – December 2024 Source: Producer's own data.

Planting was carried out immediately after a low rainfall event, but due to the quality of the rainfall, determined by a good seeder, excellent plant recovery was achieved, achieving a population of 320,000 plants/ha.



Graph II – Daily rainfall (mm) – Period January – March 2025 Source: Producer's own data.

Prior to and during the critical stage for yield generation, between R1 and R3, significant rainfall occurred that favored the generation of very good yield potential, finally materialized by timely rainfall during grain filling.

EVALUATIONS

Plant development – 37 days after emergence –

Photo 2: Treatment 7 (Humus 20 + NPK 200 located in the row) in the foreground, and Treatment 8 (same dose but applied broadcast) in the background. They showed similar plant development in the initial evaluation.

Photo 3: on the left, treatment 6 (Humus 50 + NPK 150 applied by broadcasting) and on the right, treatment 7 (20 + 200). The treatment mentioned in the previous section was observed to have greater plant development. First term, 37 days after the emergency.

Photo 4: in the foreground treatment 10 (Humus 20 + NPK 150) and in the background treatment 6 (50 + 150) both applied broadcast. They showed similar plant development 37 days later. of the emergency.

Photo 5: in the foreground treatment 10 (Humus 20 + NPK 150) and in the background the commercial control (NPK 200) both applied by broadcasting. The first mentioned showed a greater development of plants than the Control, at the time of the first evaluation.

Plant development – 85 days after emergence –

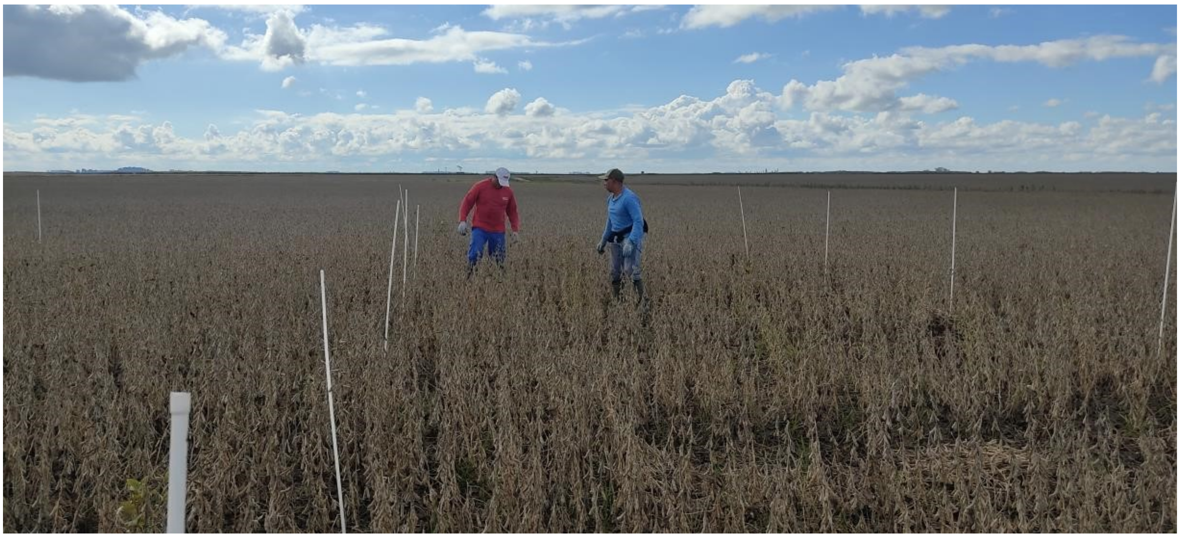
Photo 6: on the left, treatment 5 (Humus 50 + NPK 150 located on the line) and on the right treatment 4 (50 + 200 applied by broadcasting) showed similar plant development, 85 days after the emergency.

Photo 7: Treatment 3 (Humus 50 + NPK 200) in the foreground, and the commercial control (NPK 200) in the background, both located in a row. The former showed greater plant development at the time of the second evaluation.

Photo 8: Treatment 4 (Humus 50 + NPK 200 applied broadcast on the cover) in the foreground, and Treatment 3 (50 + NPK 200 applied on the row) in the background. The latter showed greater plant development 85 days after emergence.

Photo 9: on the left, treatment 6 (Humus 50 + NPK 150 applied by broadcasting in coverage) On the right, treatment 7 (20 + 200 located on the line). The first one presented a noticeable greater development of plants at the time of the second evaluation.

PERFORMANCES
Kg/ha corrected to 12% humidity



Treatments	Yo	II	III	*Average*
1-	3450	3675	3750	*3625*
2-	3775	3525	3400	*3567*
3-	4225	4350	4125	*4233*
4-	3800	4000	3950	*3917*
5-	3575	3675	3925	*3725*
6-	3900	3825	4050	*3925*
7-	3700	3525	3450	*3558*
8-	4025	3775	3700	*3833*
9-	3875	3725	3950	*3850*
10-	3850	4125	4000	*3992*

- Overall average of the test: 3823 kg/ha

TRT	Humus	NPK	Location
1-	0	200	Line
2-	0	200	Broadcast seeind
3-	50	200	Line
4-	50	200	Broadcast seeind
5-	50	150	Line
6-	50	150	Broadcast seeind
7-	20	200	Line
8-	20	200	Broadcast seeind
9-	20	150	Line
10-	20	150	Broadcast seeind

STATISTICAL ANALYSIS

Test: Tukey; Alpha = 0.05

FV	gl	SC	CM	F
Blocks	2	875	438	
Treatments	9	1204188	133799	5.82 *
Mistake	18	414125	23007	
Total	29	1619188		

CV: 3.97%
With an overall trial average of 3823 kg/ha, statistically significant differences were found at 5%, due to the treatments.

Treatments	Average Yield (kg/ha)	
3-	4233	to
10-	3992	b
6-	3925	b
4-	3917	b
9-	3850	bc
8-	3833	bc
5-	3725	CD
1-	3625	d
2-	3567	d
7-	3558	d

DMS = 184 kg/ha

Means with a common letter are not significantly different (p > 0.05)

TRT	Humus	NPK	Location
1-	0	200	Line
2-	0	200	Broadcast seeind
3-	50	200	Line
4-	50	200	Broadcast seeind
5-	50	150	Line
6-	50	150	Broadcast seeind
7-	20	200	Line
8-	20	200	Broadcast seeind
9-	20	150	Line
10-	20	150	Broadcast seeind

Average yield per treatment

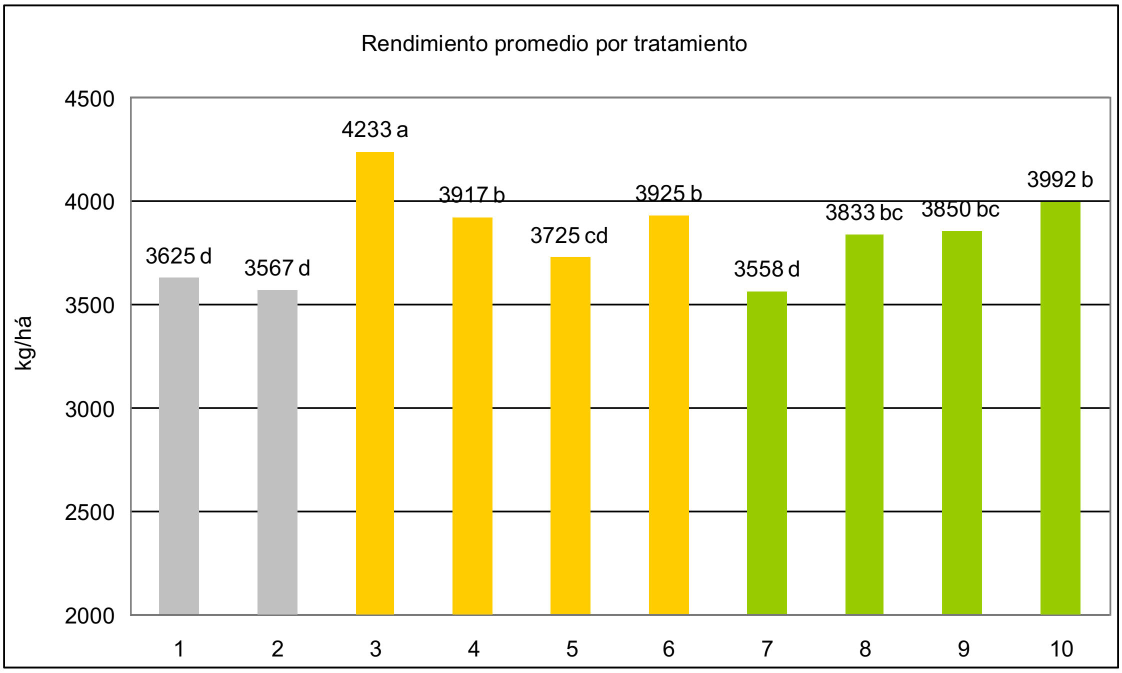
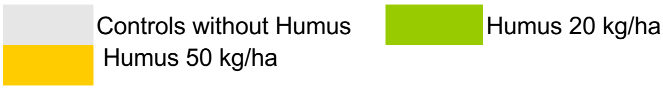


Chart No. 1 - Average yield (kg/ha) per treatment. With separation of averages.

Means with a common letter are not significantly different (p > 0.05)



Treatment 3 (Humus 50 + NPK 200 located in the line) was positioned at the top of the yields, significantly surpassing the rest.

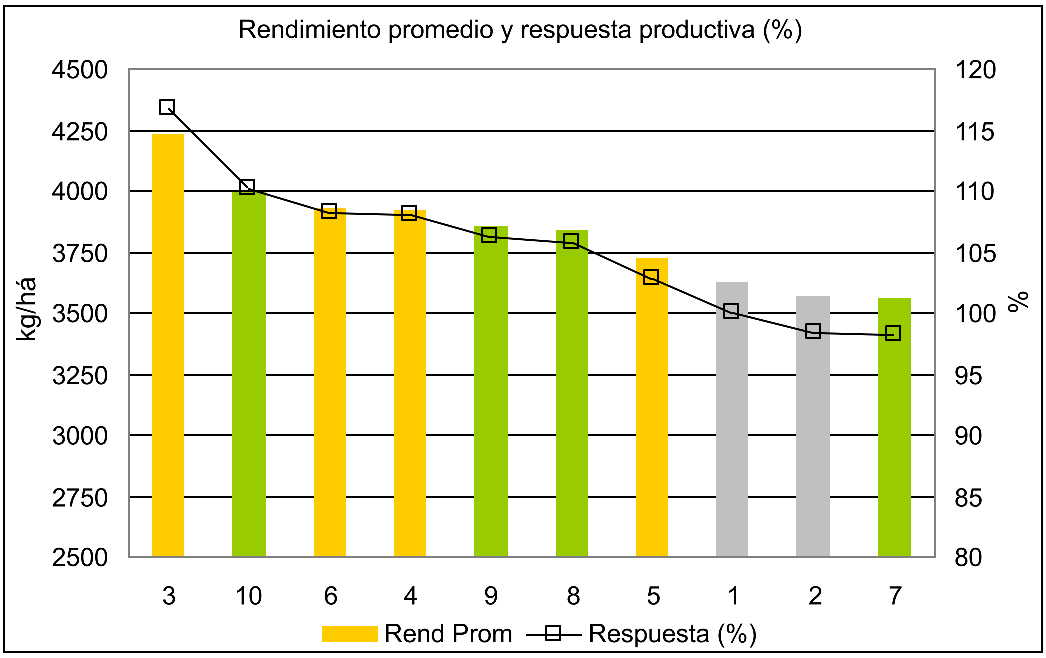
In a second step, a group of treatments with different combinations of MO Humus plus NPK fertilizer and both localization methods were positioned, which significantly outperformed the commercial controls.

TRT	Humus	NPK	Location
1-	0	200	Line
2-	0	200	Broadcast seeind
3-	50	200	Line
4-	50	200	Broadcast seeind
5-	50	150	Line
6-	50	150	Broadcast seeind
7-	20	200	Line
8-	20	200	Broadcast seeind
9-	20	150	Line
10-	20	150	Broadcast seeind

Ordered decreasing average yield and productive response

Treatments	Average Yield (kg/ha)	Productive response (%) (1)
3-	4233	117
10-	3992	110
6-	3925	108
4-	3917	108
9-	3850	106
8-	3833	106
5-	3725	103
1-	3625	100
2-	3567	98
7-	3558	98

(1) Productive response on the commercial Control (treatment 1)_ Base = 100%



Graph No. 2 - Average yield ordered decreasing (kg/ha) and productive response (%)

Controls without Humus
50 kg/ha
Humus 20 kg/ha Humus

TRT	Humus	NPK	Location
1-	0	200	Line
2-	0	200	Broadcast seeind
3-	50	200	Line
4-	50	200	Broadcast seeind
5-	50	150	Line

6-	50	150	Broadcast seeind
7-	20	200	Line
8-	20	200	Broadcast seeind
9-	20	150	Line
10-	20	150	Broadcast seeind

Average yields (kg/ha) grouped by:

1- **Dosage of MO Humus and NPK fertilizer**
2- **Localization method**

Dose (kg/ha) (1)	Line	Broadcast seeind	*Average*
0 + 200	3625	3567	3596
20 + 150	3850	3992	3921
50 + 150	3725	3925	3825
20 + 200	3558	3833	3696
50 + 200	4233	3917	4075
Average	*3798*	*3847*	

(1): MO Humus + Fertilizer

Grouping yields by location method, the overall average for broadcast coverage showed a 1.3% increase compared to the average for treatments applied in the line.

The dose of 50 + 200 MO Humus + NPK fertilizer recorded the highest average yield, considering all the dose combinations evaluated.

Yields (kg/ha) depending on the response to doses of MO Humus + NPK fertilizer

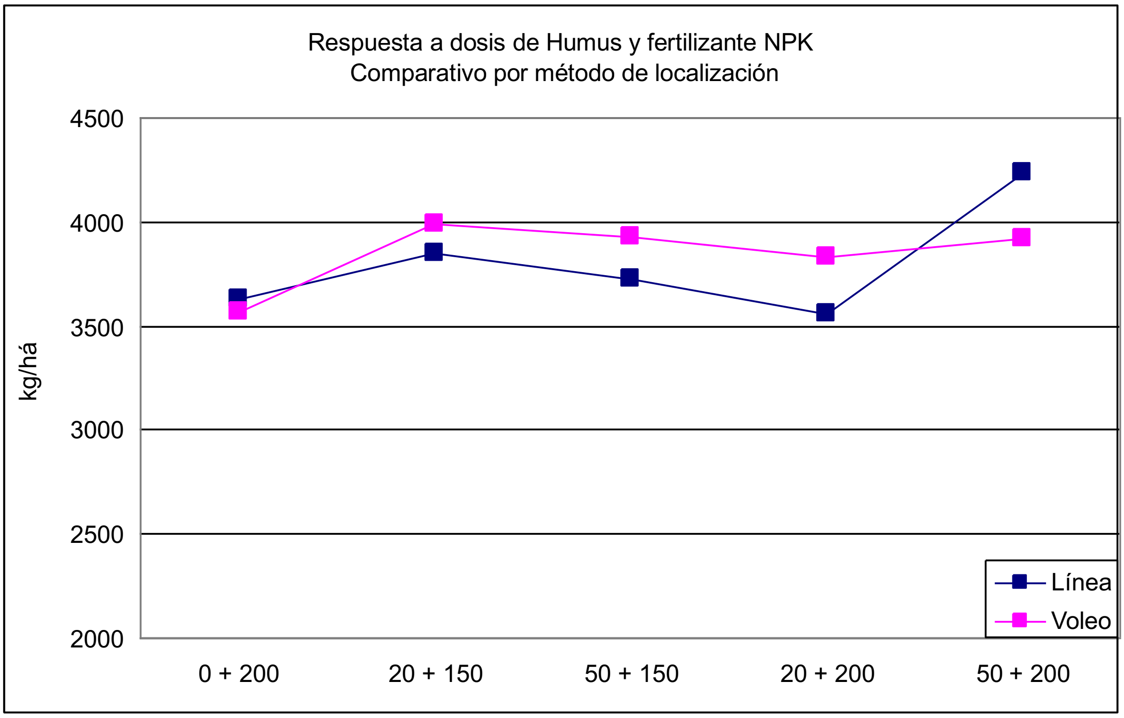


Chart 3 - Response to doses of OM humus + NPK fertilizer. Comparison of different localization methods.

Yields grouped by dose of MO Humus and NPK fertilizer

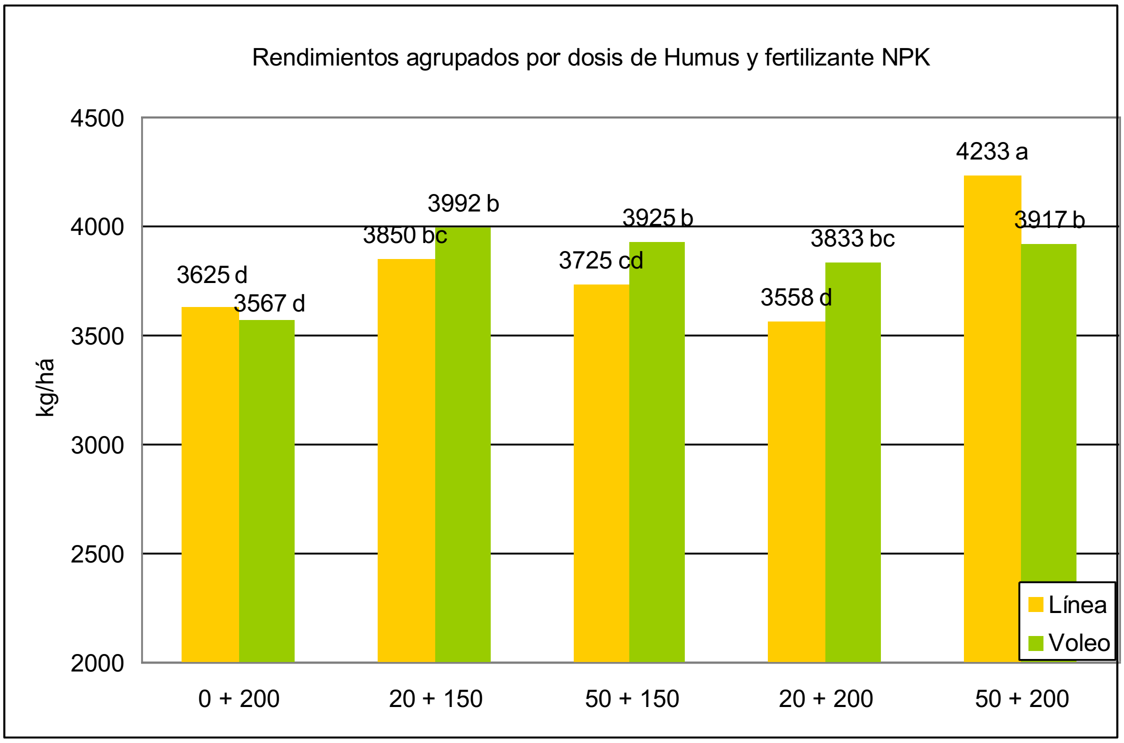


Chart 4 - Yields grouped by dose of humus and NPK fertilizer. With separation of averages.

Means with a common letter are not significantly different (p > 0.05)

- With the 50 + 150 and 20 + 200 doses of OM humus + NPK, the broadcast topdressing treatments significantly outperformed the line-based treatments. On the other hand, the 50 + 200 dose resulted in the opposite, with the line-based treatment significantly outperforming the other treatments.

- In the commercial Control and in the combination of MO Humus + NPK of 20 + 150, no statistically significant differences were found by the location method.

Yields grouped by location method

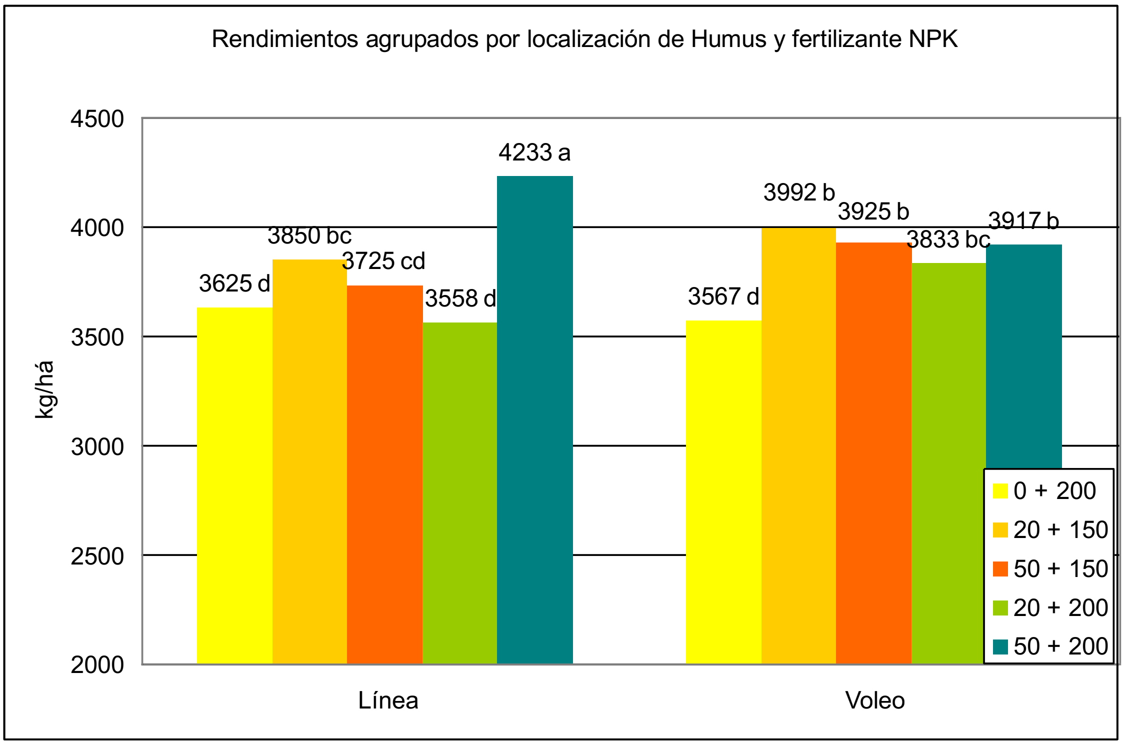


Chart 5 - Yields grouped by location method. With mean separation.

Means with a common letter are not significantly different (p > 0.05)

- When applied broadcast as a cover crop, all treatments with MO Humus + NPK fertilizer significantly outperformed the commercial control (NPK fertilizer only) and did not differ statistically from each other.

- With the application of the line, the treatment with OM Humus 50 + NPK 200 stood out, positioning itself at the top of the yields, significantly surpassing the others. In second place was the 20 + 150 treatment, which statistically outperformed the commercial control, while the remaining combinations were no different.

- In general terms, six combinations of MO Humus and NPK fertilizer achieved significant productive response over commercial controls (only NPK fertilizer), two of them were applied in line and the other four were broadcast in coverage.

Photo 10: In the foreground, the commercial control NPK 200 applied in-line, and in the background, treatment 10 (Humus 20 + NPK 150 broadcast on the surface). The latter significantly outperformed the control, achieving a 10% increase in yield over it.

Photo 11: On the left, treatment 3 (Humus 50 + NPK 200 applied in-line), and on the right, treatment 4 (same dosage but broadcast on the surface). The former significantly outperformed the latter in the final yield obtained.

Photo 12: In the foreground, treatment 4 (Humus 50 + NPK 200) and in the background, treatment 6 (50 + 150), both broadcast on the surface. They did not differ statistically from each other in the final yield obtained.

Photo 13: On the left, treatment 6 (Humus 50 + NPK 150 broadcast on the surface), and on the right, treatment 7 (20 + 200 applied in-line). The former significantly outperformed the latter.

Photo 14: In the foreground, treatment 7 (Humus 20 + NPK 200 applied in the row), and in the background, the commercial control (NPK broadcast as top-dressing). They did not differ statistically from each other in the final yield obtained.

FINAL COMMENTS

The essay is based on a little-known topic for soybean cultivation in our country: the use of the fertilizer additive MO Humus from the Paraguayan company Tiróleo.

Starting with the NPK fertilizer dosage recommended by a technical expert based on soil analysis, two doses of OM humus were tested, both in addition to and in place of the fertilizer, and compared with a commercial control (fertilizer alone). Furthermore, all treatments were applied in duplicate, incorporated into the row or broadcast as a cover crop, to compare the effectiveness of both localization methods.

The trial was installed in a commercial field of the DM Garra IPRO STS variety, which reached a population of 320,000 plants/ha and was located in the Third Section of the Treinta y Tres department, on Ochric Distric Planosols soils with a silty loam texture, belonging to the Rincón de Ramírez unit.

CONCLUSIONS

Performance

With an overall trial average of 3823 kg/ha, statistically significant differences were found at 5%, due to the treatments.

Treatment 3 (Humus 50 + NPK 200 located in the line) was positioned at the top of the yields, significantly surpassing the rest (see graph No. 1).

This superior performance treatment achieved a productive response of 17% over the commercial control (only NPK fertilizer located in the line) (see graph No. 2).

In a second performance tier, a group of treatments with different combinations of OM Humus plus NPK fertilizer and with both localization methods were positioned, which significantly outperformed the commercial controls.

Grouping yields by location method, the overall average for broadcast topdressing showed a 1.3% increase compared to the average for all treatments applied in the line. Furthermore, the 50 + 200 OM humus + NPK fertilizer dose recorded the highest average yield among all dose combinations tested.

Observing the different productive responses by grouping treatments by additive and fertilizer dose allows us to compare the effectiveness achieved based on the application method. The most eloquent results were recorded with the OM Humus + NPK doses of 50 + 150 and 20 + 200, where the broadcast topdressing treatments significantly outperformed the row-based spotting treatments. On the other hand, the opposite result was found with the 50 + 200 dose.
In the commercial Control and in the combination of MO Humus + NPK of 20 + 150, no statistically significant differences were found by the location method (see graph No. 4).

Grouping the results by the location method (see graph No. 5) allows us to highlight other relevant conclusions drawn from this essay.
When applied broadcast as a cover crop, all treatments with MO Humus + NPK fertilizer significantly outperformed the commercial control (NPK fertilizer only) and did not differ statistically from each other.

With the application of the line, the treatment with OM Humus 50 + NPK 200 stood out, positioning itself at the top of the yields, significantly surpassing the others. In second place was the 20 + 150 treatment, which statistically outperformed the commercial control, while the remaining combinations were no different.

In general terms, six combinations of MO Humus and NPK fertilizer achieved significant productive response over commercial controls (only NPK fertilizer), two of them were applied in line and the other four were broadcast in coverage. The responses were variable, but in three cases the highest production was achieved by adding MO Humus to the NPK fertilizer and in the remaining three by replacing part of the dose of NPK fertilizer with the bioactivator.

The results with the fertilizer additive MO Humus are encouraging, as significant yield responses were found with its use in soybean crops. However, the most effective combination to maximize this response could not be determined, as several options were highlighted. However, the variable location method is providing certainty that both in-line application and broadcast coverage would not generate differences in the expected response.

SUPPLEMENTAL MATERIAL #4

ASINAGRO

AGRONOMIC ADVICE AND RESEARCH

TEST WITH ADDITIVE FOR FERTILIZERS HUMUS - RICE

Seventh section – Thirty-Three - Uruguay

2024-2025 HARVEST

Agricultural Engineer Hernán Zorrilla

Agricultural Engineer Emiliano Ferreira

INTRODUCTION

The trial is based on a little-known topic for rice cultivation in our country: the use of the fertilizer additive MO Humus from the Paraguayan company Tiróleo . The bioactivation of fertilizers, with additives such as MO Humus, aims to optimize their assimilation in order to reduce consumption, maximizing nutrient utilization, and minimizing losses that affect the environment and the producers' economies.

Agricultural activities today face challenges in finding ways to ensure the preservation of natural resources for future generations, minimize environmental impacts, help mitigate climate change, and produce food of proven safety and quality.

In this context, there are various strategies and visions regarding the paths to be taken. In our case, we see a priority in advancing paths that promote gradual changes in inputs, management, and processes, reducing the environmental footprint and maintaining or improving the productivity and quality of the rice produced.

The incorporation of bioinputs , such as the MO Humus additive from Tyróleo , is a key tool for generating valid alternatives to a traditional sustainable and highly productive management system.

Responding to this challenge, an exact basal fertilization trial was installed in the seventh section of the department of Treinta y Tres for the second consecutive year, using the MO Humus additive from the company Tiróleo , on a farm with a long history of cultivation.

Starting with the NPK fertilizer dosage recommended by a technical expert based on soil analysis, two doses of OM humus were tested, both in addition to and in place of the fertilizer, and compared with a commercial control (fertilizer alone). Furthermore, all treatments were applied in duplicate, incorporated into the row or broadcast as a cover crop, to compare the effectiveness of both localization methods.

This report presents data on the test setup, materials and methods, results, statistical analysis of performance, and final comments. Illustrative photographs are also included.

GOALS

- To evaluate the effectiveness of the fertilizer additive MO Humus in rice cultivation.
- Contrast between online application and random coverage.
- Adjust the application of MO Humus in relation to replacement or addition with NPK fertilizer.
- Quantify its impact on crop yield.

MATERIALS AND METHODS

Product evaluated: MO Humus fertilizer additive

Bioactivating additive with the same physical characteristics as a granulated fertilizer, making it suitable for mixing prior to application.
It is obtained from plant materials, subjected to the batch fermentation process. microaerophilic under physicochemical and biological conditions that promote and enrich the natural microbiome of plant extracts.
Nutrient release depends on the existing microbiology in the soil, but the use of the MO Humus additive increases this dynamic because the product's natural microbiome favors the processes that make nutrients available to plants.

Treatments: (Dose kg/ha)

TRT	Humus	NPK (1)	Location	Relationship Humus: NPK
1-	0	150	Line	Control
2-	0	150	Broadcast seeind	Control
3-	50	150	Line	Additive
4-	50	150	Broadcast seeind	Additive
5-	50	100	Line	Replacement (2)
6-	50	100	Broadcast seeind	Replacement (2)
7-	20	150	Line	Additive
8-	20	150	Broadcast seeind	Additive
9-	20	100	Line	Replacement (3)
10-	20	100	Broadcast seeind	Replacement (3)

(1) NPK base fertilizer: 0 – 20/20 – 30
(2) Complete 1:1 replacement with a 33% reduction in NPK dosage
(3) Partial replacement 0.4:1 with 33% reduction in NPK dosage

Design

Random blocks with three repetitions
Plots of 20 m^2 (4 m wide by 5 m long).

Distribution of treatments:

		6	5	7	
		3	8	4	
9	2	1	10	9	7
6	8	10	1	3	5
4	2	10	9	8	7
1	2	3	4	5	6

Test facility

Locality	Producer	Planting date	Cultivate
Seventh section	Gustavo Ferrari	October 20	CL 19231

Representative location of the traditional rice-growing basin of Laguna Merín. The area comprised in the seventh section of the department of Treinta y Tres corresponds to the La Charqueada unit of the Soil Recognition Chart of Uruguay, scale 1:1,000,000, and the dominant soil where the trial was carried out is a Planosol. Subeutric Ocher with a silty loam texture .

Soil analysis -

Predecessor: legume meadow
Management: Spring glyphosate – pre-tillage (disk and leveling)

pH (H2O)	5.4
P – citric acid (ppm)	7
P – Bray I (ppm)	3
Zn – DTPA (ppm)	0.8
Ca (meq /100 gr soil)	6.4
Mg (meq /100 gr soil)	3.1
K (meq /100 gr soil)	0.25
Na (meq /100 gr soil)	0.4
Mg/K ratio	12.4

Recommended Dose

The recommendation for fertilizing rice with phosphorus and potassium is determined by the information contained in INIA Technical Sheet No. 46, based on chemical analysis of the soil.

For phosphorus adjustment, soil analysis data was used (range between 5 - 7 ppm), in a medium soil (30 - 50% clay) and two fertilization strategies were considered: 1) taking the "sufficiency" criterion, which consists of adding nutrients up to a critical level, above which the probability of finding a yield response is low and 2) the replacement criterion, which involves replacing part of the quantities that the grain extracts from the system above the sufficiency level, with the aim that the nutrient content in the soil remains around the critical level.

For the potassium adjustment, the soil analysis data was considered (> 0.20 meq /100 gr soil) with ammonium acetate extraction, with a Mg / K ratio (< 15) and taking both fertilization strategies.

According to the tables, the fertilization recommendation would be:

By criterion of “sufficiency”.

- P_2O_5 = 14 units / ha
- K_2O = 0 units / ha

By “replacement” criterion.

- P_2O_5 = 45 units / ha
- K_2O = 20 units / ha

The commercial control NPK (0 - 20/20 - 30) was adjusted to 150 kg/ ha (treatment 1), correcting the nutrients considering the replacement, since it is the management most adopted by the producer who owns the establishment.

Description of the environment

The trial was installed in a rice crop, planted on a Planosol Subeutric Ochric with a silty loam texture , belonging to the La Charqueada unit.

The sowing date of the farm corresponds to the end of October with the INIA CL 19231 cultivar with high yield potential, intermediate-short cycle and resistant to *Pyricularia oryzae* . This is a promising material with good potential for area expansion due to its outstanding attributes, such as productivity, cycle, grain quality, and the possibility of use in fields with weed problems, due to its tolerance to imidazolinones .

Crop management:

Sowing:
Date: 20-10-24
Sowing conditions: Good sowing preparation
Soil with good humidity
Type of sowing: line – seeder: Stara – Model: Guapa Supra pneumatic Cultivar: CL 19231 / Planting density: 130 kg/ ha

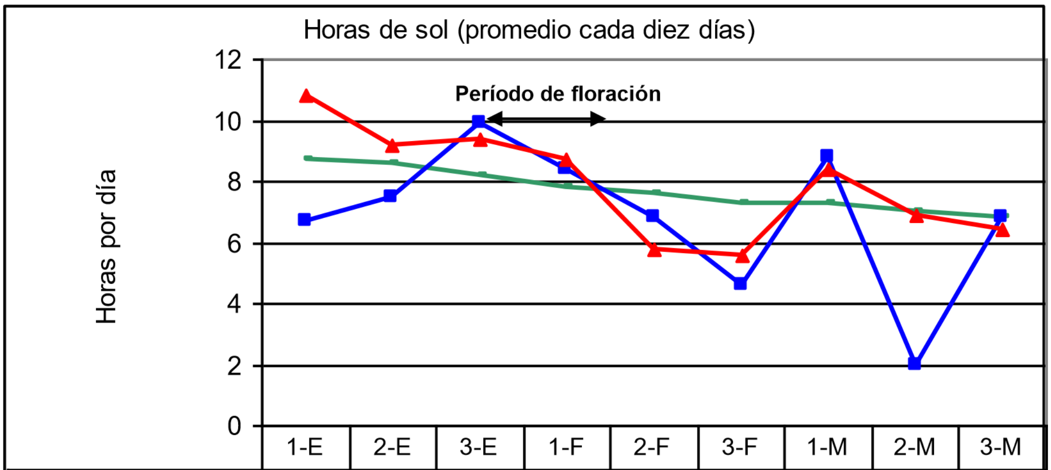
Basal fertilization:
Date: 10/29/2024; crop emerged
Dosage: according to treatments

Photos 1 and 2 – State of the test at the time of installation, marking the lines for the manual fertilization in the furrow.

15 - 11 - 2024: first coverage with urea (46-0/0-0): 150 kg/ ha at the beginning of tillering

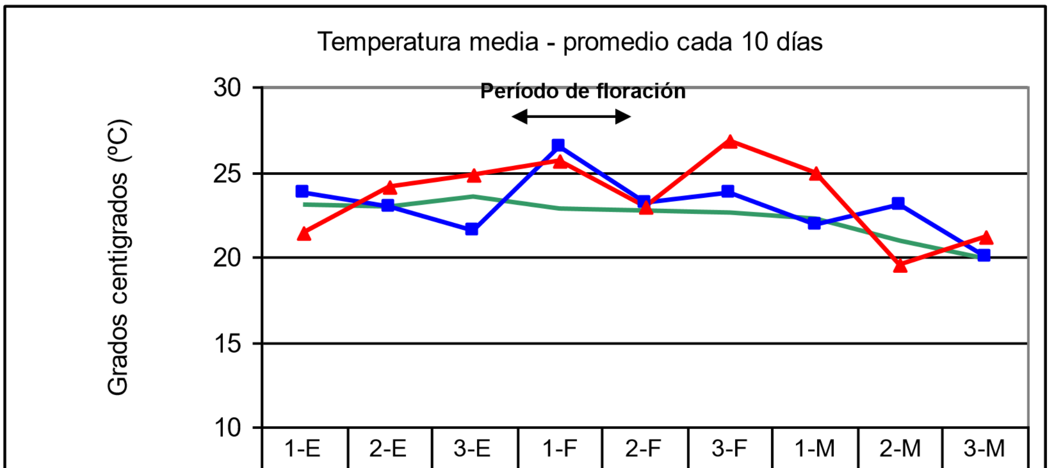
20 - 11 - 2024: start of permanent flooding
12 - 12 - 2024: second coverage with urea (46-0/0-0): 50 kg/ha at primordium

Climatic characterization of the harvest determining the yield potential



	1-E	2-E	3-E	1-F	2-F	3-F	1-M	2-M	3-M
SH (1972-2023)	8,7	8,6	8,2	7,8	7,6	7,3	7,3	7,0	6,8
2023/2024	6,7	7,5	9,9	8,4	6,8	4,6	8,8	2	6,8
2024/2025	10,8	9,2	9,4	8,7	5,8	5,6	8,4	6,9	6,4

Chart I – Average sunshine hours per decade
Source: Agroclimatology Bulletin – Inia Treinta y Tres Laguna Pass Station



	1-E	2-E	3-E	1-F	2-F	3-F	1-M	2-M	3-M
SH (1972-2023)	23,1	22,9	23,5	22,8	22,7	22,6	22,2	21	19,9
2023/2024	23,8	23	21,5	26,5	23,2	23,8	21,9	23,1	20
2024/2025	21,4	24,1	24,8	25,7	22,9	26,8	24,9	19,5	21,2

Graph II – Average temperature per decade
Source: Agroclimatology Bulletin – Inia Treinta y Tres Laguna Pass Station

This harvest showed a luminosity 2.8 % higher than the historical series and 1.5 % above the previous one, in the critical period defined by Stansel , J (1975), which covers the 21 days before and 21 days after flowering, where the hours of sunshine have the greatest impact on yields. On the other hand, the average temperature was higher than the historical series practically throughout the entire reproductive stage, which is the most sensitive time to determine grain sterility due to the incidence of low temperatures. This factor is identified as one of the main causes that explain the instability of yields in the eastern part of our country.

For the October planting season farms, climatic factors had higher records than the historical series and the previous harvest, mainly in incident radiation, so exceptionally high yields could be expected, in response to the technological management used by the producer.

PERFORMANCES

Kg/ ha corrected to 13% humidity

Treatments	Yo	II	III	*Average*
1-	11821	11690	12215	*11908*
2-	11952	12302	12872	*12375*
3-	12697	12828	12259	*12594*
4-	12609	12259	11777	*12215*
5-	13791	13572	13003	*13455*
6-	13703	13003	13922	*13543*
7-	13835	13309	13528	*13558*
8-	13703	13134	13485	*13441*
9-	11646	13178	12390	*12405*
10-	13003	12346	12697	*12682*

- Overall average of the test: 12818 kg/ ha (256 dry bags/ ha)

TRT	Humus	NPK	Location
1-	0	150	Line
2-	0	150	Broadcast seeind
3-	50	150	Line
4-	50	150	Broadcast seeind
5-	50	100	Line
6-	50	100	Broadcast seeind

7-	20	150	Line
8-	20	150	Broadcast seeind
9-	20	100	Line
10-	20	100	Broadcast seeind

STATISTICAL ANALYSIS

Test: Tukey, Alpha = 0.05

FV	gl	SC	CM	F
Blocks	2	64915	32458	
Treatments	9	10478484	1164276	5.94 *
Mistake	18	3528416	196023	
Total	29	14071816		

CV: 3.45%
With a general average of the test of 12818 kg/ ha , statistically significant differences were found at 5%, due to the treatments.

Treatments	Average Yield (kg/ ha)	
7-	13558	to
6-	13543	to
5-	13455	to
8-	13441	to
10-	12682	b
3-	12594	b
9-	12405	bc
2-	12375	bc
4-	12215	bc
1-	11908	c

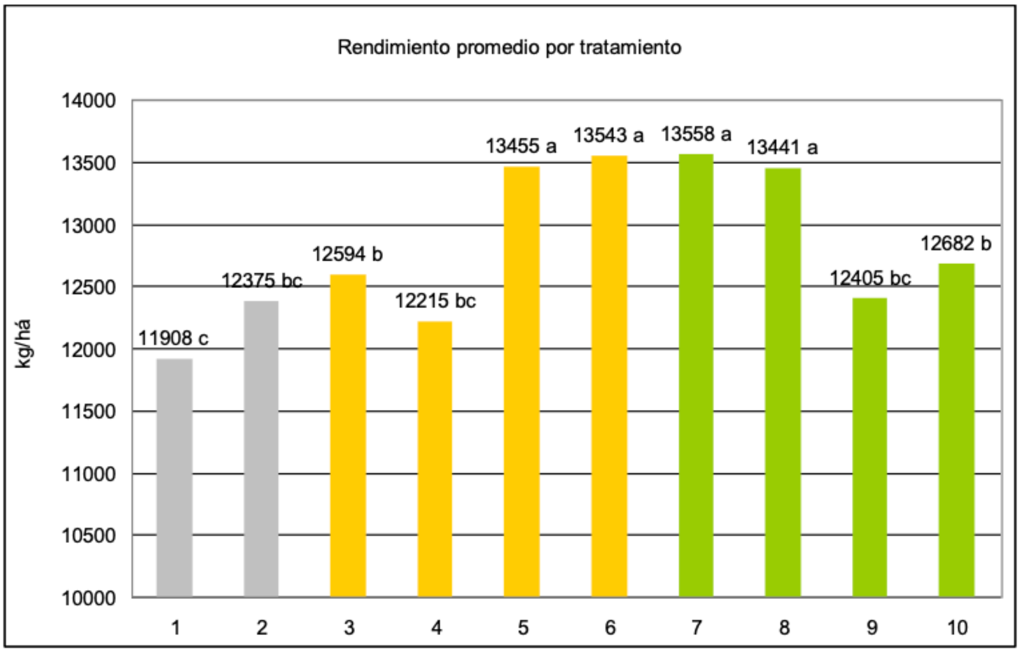
DMS = 537 kg/ ha

Means with a common letter are not significantly different (p > 0.05)

TRT	Humus	NPK	Location
1-	0	150	Line
2-	0	150	Broadcast seeind
3-	50	150	Line
4-	50	150	Broadcast seeind
5-	50	100	Line
6-	50	100	Broadcast seeind

7-	20	150	Line
8-	20	150	Broadcast seeind
9-	20	100	Line
10-	20	100	Broadcast seeind

Average yield per treatment



Gráfica N° 1 - Rendimiento promedio (kg/há) por tratamiento. Con separación de medias.

Means with a common letter are not significantly different (p > 0.05)

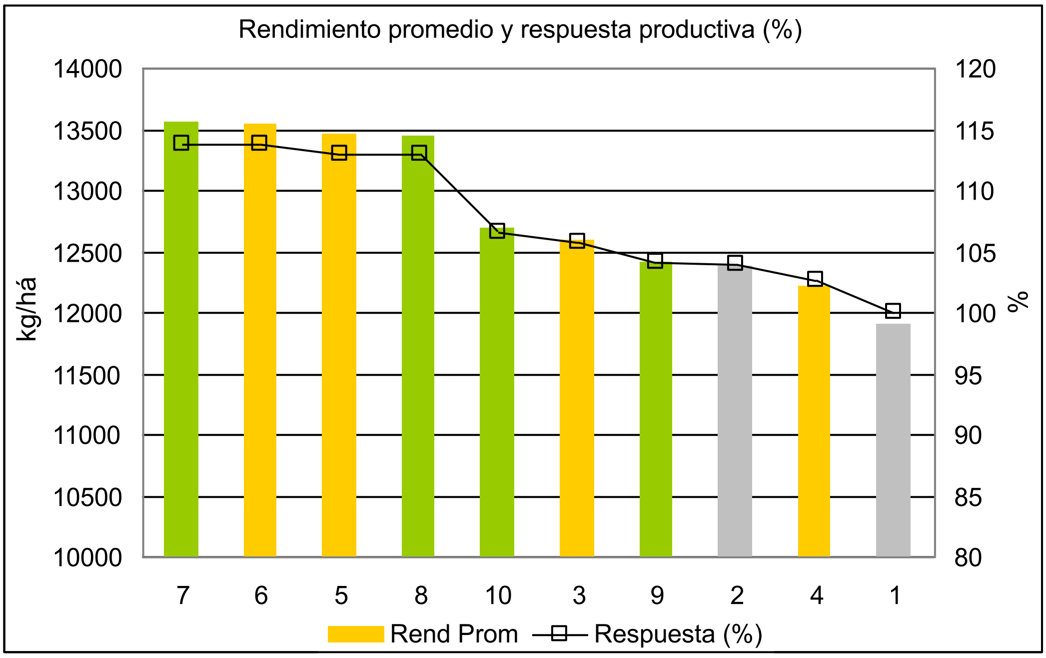
Controls without Humus
Humus 50 kg/ ha
Humus 20 kg/ ha

TRT	Humus	NPK	Location
1-	0	150	Line
2-	0	150	Broadcast seeind
3-	50	150	Line
4-	50	150	Broadcast seeind
5-	50	100	Line
6-	50	100	Broadcast seeind
7-	20	150	Line
8-	20	150	Broadcast seeind
9-	20	100	Line
10-	20	100	Broadcast seeind

Ordered decreasing average yield and productive response

Treatments	Rend Average (kg/ ha)	Rend Prom (bls / ha) (1)	Productive response (%) (2)
7-	13558	271	114
6-	13543	271	114
5-	13455	269	113
8-	13441	269	113
10-	12682	254	106
3-	12594	252	106
9-	12405	248	104
2-	12375	248	104
4-	12215	244	103
1-	11908	238	100

(1) Average yield: in dry bags of 50 kg/ ha
(2) Productive response on the commercial control (treatment 1)_ Base = 100%



Graph No. 2 - Average yield ordered decreasing (kg/ ha) and productive response (%)

Controls without Humus
50 kg/ ha
Humus 20 kg/ ha Humus

TRT	Humus	NPK	Location
1-	0	150	Line
2-	0	150	Broadcast seeind
3-	50	150	Line
4-	50	150	Broadcast seeind
5-	50	100	Line
6-	50	100	Broadcast seeind
7-	20	150	Line

8-	20	150	Broadcast seeind
9-	20	100	Line
10-	20	100	Broadcast seeind

Average yields (kg/ ha) grouped by:

1- Dose of MO Humus and NPK fertilizer 2- Location method

Dose (kg/ ha) (1)	Line	Broadcast seeind	*Average*
0 + 150	11908	12375	*12142*
20 + 100	12405	12682	*12543*
50 + 100	13455	13543	*13499*
20 + 150	13558	13441	*13499*
50 + 150	12594	12215	*12405*
Average	*12784*	*12851*	

(1): Humus + Fertilizer

Grouping the yields according to the location method, no differences were found between the two in the overall average.
The doses of 50 + 100 and 20 + 150, of Humus + NPK fertilizer, recorded the highest average yield, considering all the dose combinations evaluated.

Yields (kg/ha) depending on the response to doses of Humus + NPK fertilizer

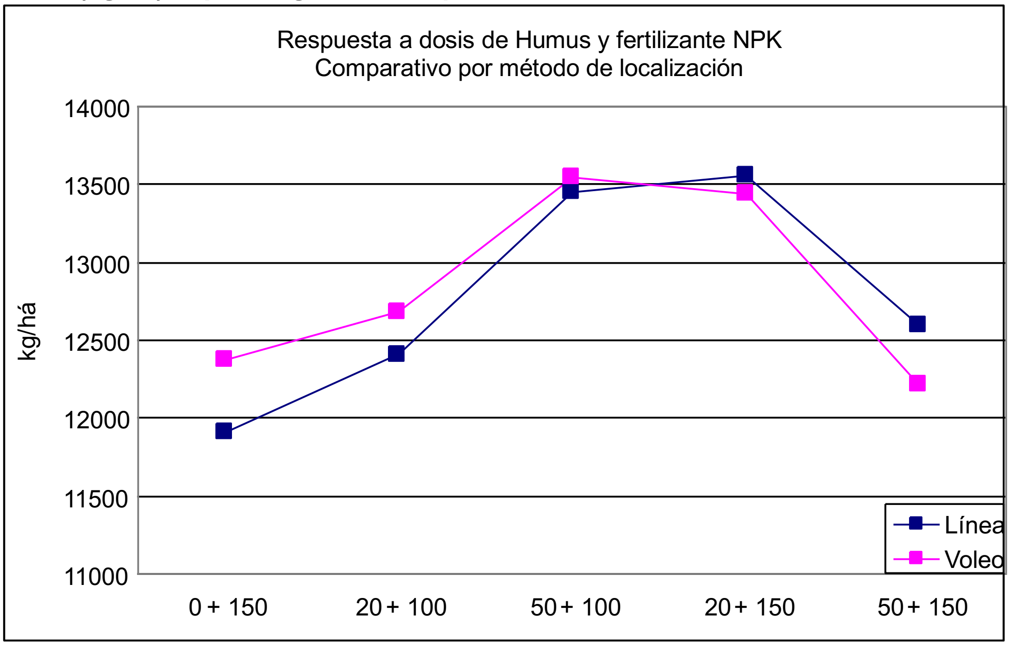


Chart 3 - Response to doses of humus + NPK fertilizer. Comparison of different localization methods.

Yields grouped by dose of MO Humus and NPK fertilizer

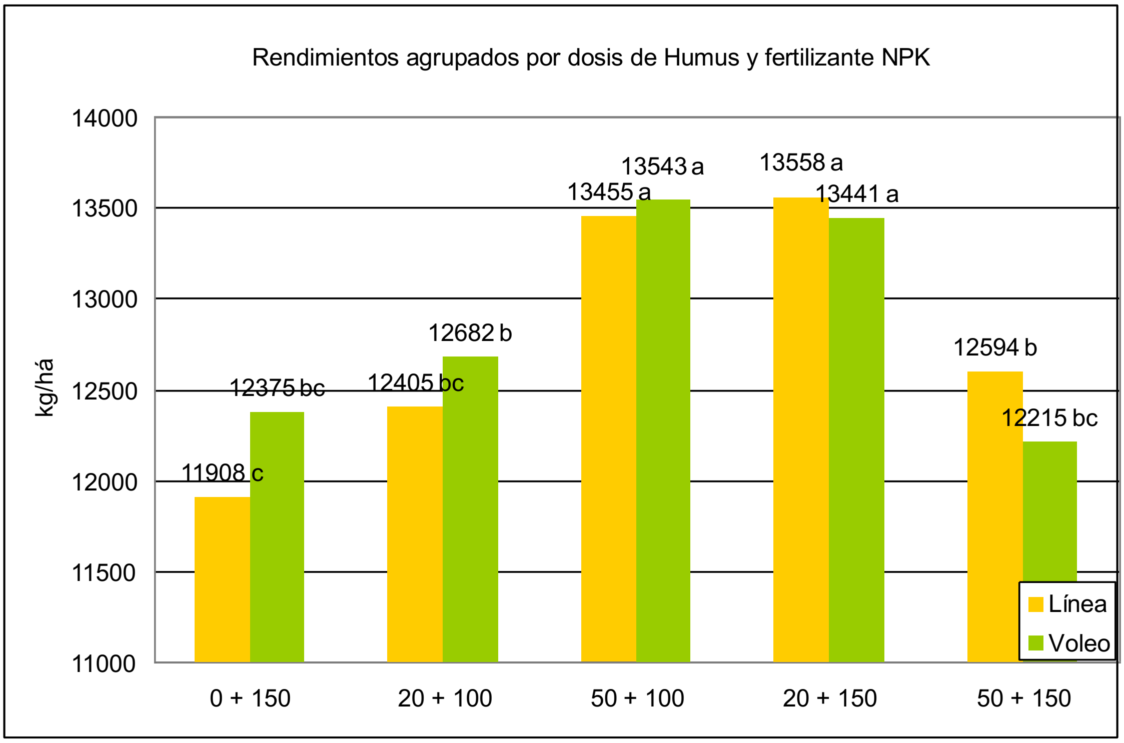


Chart 4 - Yields grouped by dose of humus and NPK fertilizer. With separation of averages.

Means with a common letter are not significantly different ($p > 0.05$)

- In none of the dose combinations of MO Humus and NPK fertilizer were statistically significant differences found by the location method.
- With the highest dose of MO Humus and NPK, a trend of higher performance was observed for the treatment applied in the line compared to broadcasting, on the contrary , with the lowest dose of both and with fertilization only with NPK, the trend was favorable to broadcast application in coverage.

Yields grouped by location method

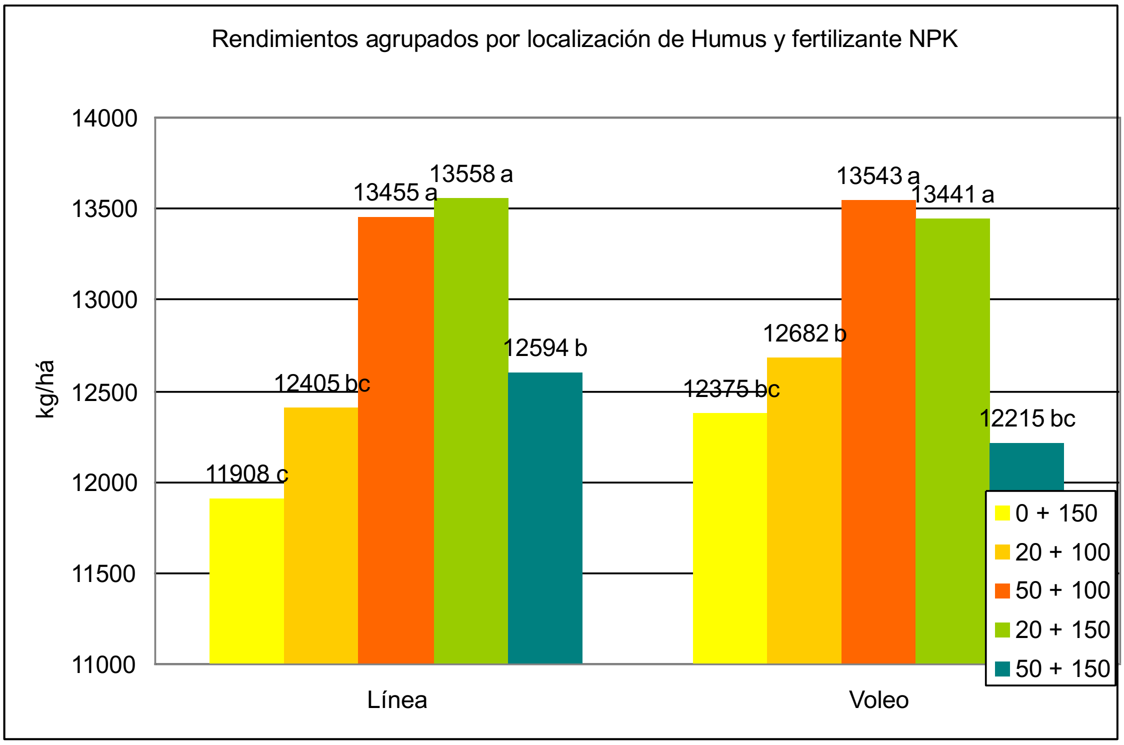


Chart 5 - Yields grouped by location method. With mean separation.

Means with a common letter are not significantly different ($p > 0.05$)

- By applying MO Humus and NPK fertilizer in the line, all treatments with the bioactivator significantly outperformed the commercial control (only NPK fertilizer), with the exception of the combination with the lowest dose of both, from which it did not differ statistically.
- With this application method, the combinations of 50 + 100 and 20 + 150 of MO Humus and NPK fertilizer respectively stood out, which were positioned in a first step of performance.
- When applying OM humus and NPK fertilizer broadcast as a top dressing, only the 50 + 100 and 20 + 150 combinations significantly outperformed the commercial control (NPK fertilizer only). The remaining combinations did not differ statistically from the control.
- In general terms, two of the combinations of MO Humus and NPK fertilizer achieved significant productive response over the best commercial control (only NPK fertilizer broadcast), with no differences due to the location method.
- The responses were variable, in one case the addition of MO Humus replacing 1:1 the dose of NPK fertilizer caused a significant increase in yield and in the other the response was achieved by adding the lowest dose of the bioactivator to the dose of the NPK control.
- In summary, the addition of MO Humus achieved the best performance at a higher dose as a substitute for NPK and at a lower dose as a fertilizer additive.

Photo 3: The commercial controls can be seen, with NPK 150 applied in the row on the left and broadcast on the right. They did not differ statistically from each other, but the broadcast treatment tended to show a higher yield than the one applied in the row.

Photo 4: Treatments with Humus 50 + NPK 150, applied in the row on the left and broadcast on the right. They did not differ statistically from each other, but the treatment applied in the row tended to show a higher yield than the one broadcast.

Photo 5: Treatments with Humus 50 + NPK 100, applied in the row on the left and broadcast on the right. They did not differ statistically from each other but ranked among the highest-yielding treatments in the trial.

6 Photo 6: Treatments with Humus 20 + NPK 150, broadcast on the left and applied in the row on the right. They did not differ statistically from each other but ranked among the highest-yielding treatments in the trial.

Photo 7: Treatments with Humus 20 + NPK 100, broadcast on the left and applied in the row on the right. They did not differ statistically from each other, but the broadcast treatment tended to show a higher yield than the one applied in the row.

Photo 8: On the left, the control NPK 150 applied in the row, and on the right, treatment 9 (Humus 20 + NPK 100 applied in the row). They did not differ statistically from each other, but the Humus + NPK treatment showed a 4% higher yield compared to the control.

FINAL COMMENTS
The essay is based on a little-known topic for rice cultivation in our country: the use of the fertilizer additive MO Humus from the Paraguayan company Tiróleo .

Starting with the NPK fertilizer dosage recommended by a technical expert based on soil analysis, two doses of OM humus were tested, both in addition to and in place of the fertilizer, and compared with a commercial control (fertilizer alone). Furthermore, all treatments were applied in duplicate, incorporated into the row or broadcast as a cover crop, to compare the effectiveness of both localization methods.

The trial was installed in a commercial field of the INIA CL 19231 variety, a new material with high expansion potential, in the third section of the Treinta y Tres department, on Planosol soils. Subeutrics Ochrics with a silty loam texture , belonging to the La Charqueada unit.

CONCLUSIONS

Performance

With a general average of the test of 12818 kg/ ha , statistically significant differences were found at 5%, due to the treatments.

Treatments with the combinations of MO Humus + NPK of 50 + 100 and 20 + 150, regardless of the location method, were positioned at the top of the yields, significantly surpassing the rest and not differing statistically from each other (see graph No. 1).

These four higher-performing treatments achieved significant productive response between 13 and 14% over the commercial control (only NPK 150 fertilizer online) (see graph No. 2).

When grouping yields by location method, no differences were found between the two methods. On the other hand, the 50 + 100 and 20 + 150 doses of OM humus + NPK fertilizer recorded the highest average yields, considering all the dose combinations evaluated.

Observing the different productive responses by grouping treatments by the dose of the additive and the fertilizer allows us to compare the effectiveness achieved based on the location method and from here arises one of the most important conclusions of the test: in none of the combinations of doses of MO Humus and NPK fertilizer were statistically significant differences found by the location method (see graph No. 4).

The most eloquent trends were observed with the highest dose of MO Humus and NPK where the treatment applied in the line stood out over the broadcast treatment and on the contrary with the lowest dose of both and with fertilization only with NPK the trend was favorable to the broadcast application in coverage.

Grouping the results by the location method (see graph No. 5) allows us to highlight the main conclusions drawn from this test:

I) By applying MO Humus and NPK fertilizer in the line, all treatments with the bioactivator significantly outperformed the commercial control (only NPK fertilizer), with the exception of the combination with the lowest dose of both, from which it did not differ statistically.

II) When applying OM humus and NPK fertilizer broadcast on the mulch, only the 50 + 100 and 20 + 150 combinations significantly outperformed the commercial control (NPK fertilizer only). The remaining combinations did not differ statistically from the control.

In summary:

- Two of the combinations of MO Humus and NPK fertilizer achieved significant productive response over the best commercial control (only NPK fertilizer broadcast), with no differences due to the location method.

- The type of response was variable, in one case the addition of MO Humus replacing 1:1 the dose of NPK fertilizer caused a significant increase in yield and in the other the response was achieved by adding the lowest dose of the bioactivator to the dose of the NPK control.

- The addition of MO Humus achieved the best performance at a higher dose, being a substitute for NPK, and at a lower dose, being a fertilizer additive.

SUPPLEMENTAL MATERIAL #5

SM5

pathway	13	14	4	5	6
PWY-3781	147816.26	89228.887	108146.193	131609.691	84475.2878
PWY-5101	81267.1096	49228.8628	54131.3733	64681.0301	30363.7755
ILEUSYN-PWY	78744.8733	47703.5285	50824.9266	65032.3199	29417.4454
VALSYN-PWY	78744.8733	47703.5285	50824.9266	65032.3199	29417.4454
PWY-7663	80545.1055	47236.5197	48041.3129	63568.5044	20376.5504
PWY-5973	79161.7998	47184.1586	48265.7793	60638.6945	21750.0688
PWY-7111	77713.474	45378.7018	50781.0802	64388.5686	34111.6097
BRANCHED-CHAIN-AA-SYN-PWY	70329.9256	42273.712	49055.7334	52906.1907	26600.9043
FASYN-ELONG-PWY	69130.3606	38948.4063	42017.7684	61456.1084	20376.5504
NONOXIPENT-PWY	64031.4887	38619.0731	45412.1757	50839.587	26035.9345
TCA	62402.7803	37308.0334	45007.8115	49463.1298	25869.25
PWY-5103	62150.4849	37272.1936	43938.5988	46086.5236	23470.0835
PWY-3001	60639.1054	36801.1805	41588.5579	48663.1579	23689.5484
PWYG-321	58291.7522	36764.1589	28125.0032	61817.6323	3815.11717
PWY-5667	61700.1486	36743.7145	45255.6138	37918.6807	22087.7291
PWY0-1319	61700.1486	36743.7145	45255.6138	37918.6807	22087.7291
PWY-6969	61135.7783	35970.6834	45226.2258	49370.4442	27451.8284
PWY-7208	59080.1621	35547.7248	40943.1719	42519.1602	23539.6705
PWY-7664	55822.2526	35300.5149	26875.379	57857.1358	3655.98895
PWY-7229	59354.1967	34950.9998	43894.0937	38896.5205	22326.9253
THRESYN-PWY	57197.5741	34720.9303	38450.2788	47901.8931	23183.7144
PWY-5989	54173.5414	34204.6756	25596.6535	59850.6573	3277.24065
PWY-6282	53505.0885	34182.8796	25145.442	58586.6201	3228.85802
PWY-7219	58185.9767	34007.8186	44742.5487	36093.0074	20865.7927
REDCITCYC	53687.3552	33852.0178	20849.1062	51826.6297	25972.4566
PWY-7220	56056.5626	33675.13	40326.9027	40035.4593	23332.5105
PWY-7222	56056.5626	33675.13	40326.9027	40035.4593	23332.5105
PWY-6126	57066.2715	33625.1229	42496.9968	37601.3482	21651.5809
DTDPRHAMSYN-PWY	53639.8653	33289.8468	34997.8588	35731.0057	15678.7307
PWY-2942	56213.2933	33189.6777	37897.9202	42578.3698	23518.4457
PWY0-862	51927.1322	32979.731	24574.0826	53835.2005	3178.57891
PWY-5686	55887.3754	32943.1778	41628.9328	37126.4408	20023.8752
PWY0-162	55788.1091	32903.3422	41999.9239	37221.6908	20430.9198
PHOSLIPSYN-PWY	57437.9429	32616.1855	44037.3037	37974.5471	22177.7984
PWY-5659	54300.9275	32058.7196	41532.0438	39283.3505	25708.2883
PWY-7228	53438.7408	31918.789	39408.0765	39788.2783	23778.6958
ANAGLYCOLYSIS-PWY	53421.707	31777.2948	39816.313	39845.2285	24298.3268
PWY-5097	53611.5313	31691.8775	35535.1056	41138.2148	23399.1545
PWY-6121	53522.0629	31567.5744	38297.5601	36491.8066	20944.8787
PWY-841	53244.7472	31430.0833	39075.9971	36495.9416	21048.747
PWY-6122	53678.2112	31369.4705	38669.1178	37639.7815	20768.0723
PWY-6277	53678.2112	31369.4705	38669.1178	37639.7815	20768.0723
PWY-6125	52295.6109	31149.1554	38828.9358	38312.8602	22809.1107
CALVIN-PWY	51515.1763	31121.3276	37678.4114	36065.4266	21601.7545
PWY4FS-8	54999.6352	30979.6141	41769.0455	36615.9805	21183.4988
PWY4FS-7	54999.6352	30979.6141	41769.0455	36615.9805	21183.4988
FAO-PWY	50727.3713	30944.8062	29142.4229	41756.5804	27066.488
FASYN-INITIAL-PWY	47139.6633	30696.394	22353.9554	47432.1568	2810.65195
PWY-7094	51671.5575	30667.9966	30881.053	40233.9949	25153.2629
PENTOSE-P-PWY	49062.1551	30164.9458	33209.636	45568.3038	22638.4176

TRPSYN-PWY	51056.1981	30139.485	38670.5596	34943.6247	20800.9486
COMPLETE-ARO-PWY	51777.9114	29790.0252	40092.2616	34432.9546	19899.9861
PWY-7221	49826.7114	29542.2482	37814.4215	37777.9003	22483.6322
P108-PWY	51147.1568	29362.8771	37877.0862	39061.6351	16569.784
PWY-5188	48879.9152	28851.9644	36141.1236	35563.5515	20946.6084
PWY-7211	47904.3287	28800.8908	28791.8246	33762.2792	17098.9151
SER-GLYSYN-PWY	53749.4364	28687.6477	33713.5105	34379.2631	24462.8373
COA-PWY	49229.3471	28649.6626	37242.6563	32671.322	19945.1915
GLYCOLYSIS	46992.6641	28483.7459	36599.1268	39843.0415	22431.0368
PWY-6163	48151.6708	28293.806	36982.323	32511.3735	17664.4568
POLYISOPRENSYN-PWY	47942.9074	28145.3911	36608.5264	32911.0889	20879.1221
TRNA-CHARGING-PWY	47123.536	28012.5748	32556.6925	30842.5693	17943.794
RIBOSYN2-PWY	47833.0413	28011.5448	34984.171	31923.5241	17700.0754
GLUCONEO-PWY	45264.0428	27986.2765	31400.1721	39212.4447	19624.5286
ARO-PWY	48697.7984	27979.2413	37749.1203	33222.8011	18503.5855
PWY0-1586	38623.3439	27826.3466	22588.4321	69906.1471	43341.2296
SULFATE-CYS-PWY	47055.8768	27765.9446	24812.9222	29775.1867	17943.6195
PWY-5189	46165.8597	27747.7946	33974.2036	36081.6684	20643.1664
PWY-6897	44049.6033	27666.9639	30935.9023	34165.0389	15586.9742
PWY-6387	46148.1715	27590.6044	36480.7577	34824.3754	19962.977
PEPTIDOGLYCANSYN-PWY	46266.0207	27571.502	36333.5013	34142.9417	19419.1956
HISTSYN-PWY	45052.0806	27544.4962	33321.826	32960.9448	18956.4663
PWY-6123	46808.9064	27396.0322	34689.8044	31118.9184	17377.4628
PWY-5345	45774.07	27349.4285	25225.4745	25535.6604	15558.3652
PWY-7197	46031.1972	27348.2795	36156.8713	32132.7487	19401.9313
HEMESYN2-PWY	43227.7862	27231.3453	31701.673	34161.9552	19042.4782
1CMET2-PWY	43695.0172	26920.2779	26636.4688	27813.1521	12291.8006
P105-PWY	46070.9305	26648.7958	33834.6015	38733.5314	20356.7479
PWY-7184	45138.0513	26611.8705	29949.2088	31220.0862	15226.4439
PWY-6385	43824.549	26490.2883	32712.703	34140.8888	20220.6192
PWY-7539	42247.2666	26351.1222	28805.5286	30812.4251	18498.319
PWY-6386	43320.2634	26347.2146	32479.176	35177.9544	20129.9079
PANTO-PWY	44228.2964	26324.8492	31984.7014	33349.6347	20497.8911
PWY-6147	41693.5245	25973.0447	28626.9636	29847.5185	17297.0547
GLUTORN-PWY	45431.8671	25838.4698	33804.772	29694.8257	19356.9577
PWY-7323	46151.7201	25677.6208	34555.907	35785.5332	6976.0269
SO4ASSIM-PWY	42151.6142	25656.0678	19569.4824	39879.6458	19544.7892
PWY-5484	41167.9401	25536.1903	32615.0349	37786.9644	20494.2852
PANTOSYN-PWY	41596.657	25511.8162	29960.5788	32580.4979	19685.8252
PWY-7234	42122.011	25379.0815	27072.636	25249.5692	16390.2816
DAPLYSINESYN-PWY	43380.7804	25255.1835	28752.3975	32456.9092	18721.3804
PWY0-1261	39243.3706	25247.2535	23697.7105	37989.6944	24753.9964
FOLSYN-PWY	40556.721	25083.5187	26748.7184	27709.8413	14852.3766
PWY-5918	39469.8782	24885.5653	26581.9454	33138.1838	18271.3066
PWY-5913	39615.868	24875.8735	25702.5344	34980.3092	18992.064
ARGSYN-PWY	41533.1536	24819.7273	32506.3471	27355.8487	19308.5621
PWY-6700	44267.9797	24818.9798	29410.789	19237.5604	11977.4852
PWY-7400	41478.9347	24813.0844	32444.5494	27400.3145	19207.8372
PWY-5695	49713.6328	24615.1115	29601.7805	51030.6722	21258.1708
PWY-5154	40852.0919	24570.9423	27554.8592	23792.4461	11392.6595
PWY-5121	41046.1175	24306.5669	25622.2132	35398.9818	21098.6162
PYRIDNUCSYN-PWY	42753.8819	24272.2644	31440.5198	29935.6108	15079.2658

P23-PWY	46631.4271	24217.162	39245.5127	34243.3584	20427.1068
PWY0-166	41070.5825	23972.673	29163.8958	29547.8465	14844.436
NONMEVIPP-PWY	39953.7104	23808.3259	23815.0767	32803.6999	19169.2704
PWY-7560	39953.7104	23808.3259	23815.0767	32803.6999	19169.2704
GLYCOLYSIS-E-D	39912.2773	23528.5575	25600.5364	35742.1615	17864.2828
THISYN-PWY	35931.3993	23499.7996	17537.9655	31370.4371	7098.33839
OANTIGEN-PWY	41767.9013	23335.2535	33479.6037	25779.0257	17258.8187
ARGSYNBSUB-PWY	43399.5791	23301.4304	34640.9771	28438.6107	21139.9415
HSERMETANA-PWY	40647.4875	23242.2917	25123.4606	30527.0089	11455.8025
PWY-6612	36902.817	23106.4538	23556.4129	25826.7508	12894.4485
NAGLIPASYN-PWY	39512.2887	22961.282	24374.6137	14644.8091	1078.85914
COLANSYN-PWY	40659.1182	22622.2432	24309.2242	30811.6784	4902.8059
GLYCOLYSIS-TCA-GLYOX-BYPASS	34001.3316	22458.0667	25843.5336	33819.8602	17199.6093
PWY-6608	38120.9148	21939.7858	24183.3039	47922.1345	8342.7227
PWY-6467	38578.33	21887.35	24649.34	13716	968.75
P4-PWY	37684.8506	21820.825	25013.8372	32497.8376	16477.809
PWY0-781	36954.6745	21704.1166	24615.1092	23864.7242	16136.9636
PWY-1269	38249.1759	21629.9082	24872.8656	13722.4969	1044.35135
ANAEROFRUCAT-PWY	38157.9027	21468.3524	28671.309	32492.0926	18124.7518
UDPNAGSYN-PWY	39831.0448	21403.1555	38656.9964	24338.8306	20592.2351
SALVADEHYPOX-PWY	39214.7114	21288.3632	23990.311	49615.7504	9710.73924
HEME-BIOSYNTHESIS-II	31315.5996	21015.7663	19248.4886	30317.2221	15691.4494
PWY-7254	22868.7813	20987.8242	3606.92741	29538.6366	13925.2119
PWY-5971	38284.3215	20965.9562	17025.9696	4457.85584	4582.76098
PWY-7200	35333.1417	20940.9526	21827.7495	30386.1207	16772.5421
GLYCOGENSYNTH-PWY	34509.0162	20915.753	26483.0392	25784.1919	17191.6454
PWY-7392	32367.321	20854.5994	20198.2657	32312.6626	19784.1193
PWY-5347	35172.7259	20116.7706	22608.774	38199.4056	16061.2833
PWY-7196	36661.106	20115.4713	25843.5885	23327.4541	18369.9679
PWY-6609	32144.0708	20073.819	22186.3555	39794.1717	23551.5153
P42-PWY	37643.1251	19654.7255	37012.3585	26502.9477	22878.0262
PWY-6703	36712.8752	19507.3223	29094.7874	9172.91741	9707.69728
HISDEG-PWY	30045.4975	18931.0339	14589.5789	30700.023	11860.4409
FERMENTATION-PWY	26748.6485	18862.7261	15052.1874	12747.8447	15855.275
MET-SAM-PWY	32903.2428	18840.7116	21134.5649	34441.4083	15941.5481
TCA-GLYOX-BYPASS	26637.3241	18536.6711	19973.7379	29378.6148	15026.4317
BIOTIN-BIOSYNTHESIS-PWY	28219.9574	18048.3387	20384.889	14935.2618	4117.24515
LEU-DEG2-PWY	30292.2083	17785.8265	10749.0673	16531.025	1965.05429
PWY-6519	27457.586	17713.4384	21001.9448	13338.7004	3498.81487
PWY-5855	28266.3914	17423.4984	21039.6008	13714.721	3414.13738
PWY-5856	28266.3914	17423.4984	21039.6008	13714.721	3414.13738
PWY-5857	28266.3914	17423.4984	21039.6008	13714.721	3414.13738
PWY-6708	28266.3914	17423.4984	21039.6008	13714.721	3414.13738
PWY-7199	28872.4671	17230.889	15273.1621	28877.4427	15066.6751
PWY-6353	32269.8792	17195.6061	19838.7166	45800.6523	11733.4012
UBISYN-PWY	27731.4303	17050.2936	20778.5244	12642.0778	2638.46268
GLYCOCAT-PWY	30990.3459	16935.0288	23251.8467	11368.5263	11620.4574
PWY-6628	27548.923	16321.1762	16841.018	4375.57073	4422.91767
PWY-6630	27321.6722	16210.8175	16832.215	4375.25017	4421.7925
PWY-6737	29432.5465	16105.6102	16439.8022	11782.7839	11368.4054
PWY-6317	26284.0885	15881.9874	14919.9834	36820.8591	20305.9775
PWY-7242	23238.7638	15863.5691	5867.06892	31459.0506	7738.15653

PWY-5104	33866.9696	15744.3236	33116.9782	22940.895	19873.0448
PYRIDNUCSAL-PWY	26542.0619	15213.6212	21766.059	22092.4164	11493.6946
PWY-4984	22220.2658	14509.3589	12441.576	26371.5781	13585.402
PWY-6892	19132.4355	14043.5253	6482.85108	22063.7776	2230.27462
PWY-5920	23079.3834	14036.3279	17720.4377	23930.5174	3812.57175
PWY-5505	22026.1155	13874.4973	12871.4769	12716.7222	7679.16923
GALACTUROCAT-PWY	18720.6758	13850.379	3788.82978	29549.0504	7008.68366
GLYOXYLATE-BYPASS	23572.7336	13226.7231	16797.3586	24895.413	15870.5059
HOMOSER-METSYN-PWY	23019.1736	12545.1318	14854.1642	31477.5531	13113.0608
PWY0-1241	23289.4652	12353.1103	13588.0864	12593.2773	208.558178
PWY0-1415	20222.5395	12312.0775	15660.1106	21717.5686	2999.98037
PWY-7431	19926.187	12311.0912	3820.59762	33502.5881	4309.20084
PWY-6507	15688.2087	12284.4369	1785.44317	19485.8455	7251.73482
P164-PWY	25894.458	12242.6683	16317.5971	0	136.203346
PWY0-1061	14995.429	11870.8261	6641.15584	12556.6789	14515.5104
ARG+POLYAMINE-SYN	18402.533	11324.8987	13083.1124	19143.2901	14912.8809
PWY-6263	18413.5657	11240.7344	15103.3886	23600.9563	5385.96723
PWY-5838	19037.6795	11099.4419	10614.4436	7934.09098	2923.15557
PWY-6901	18018.686	10935.0542	12331.6622	15569.8082	10692.4922
PWY-7328	16676.6072	10923.9032	3696.16549	2788.86608	1304.25092
PWY0-1479	18450.9601	10781.0904	10976.1367	2709.06786	534.598449
DENOVOPURINE2-PWY	21070.1572	10624.3982	10920.5142	12287.9874	16179.1217
PWY-181	18045.6276	10583.1236	12128.2299	3417.27886	3198.14123
PWY-5897	17943.5688	10484.2174	9820.2592	7674.94052	2981.18436
PWY-5898	17943.5688	10484.2174	9820.2592	7674.94052	2981.18436
PWY-5899	17943.5688	10484.2174	9820.2592	7674.94052	2981.18436
PWY-6478	17632.6217	10318.8761	10944.7902	12866.4162	15.6689135
COBALSYN-PWY	15741.8965	10108.2276	9851.52776	25529.4424	18905.8565
PWY-6151	17862.9654	10078.2455	4914.09202	10033.6305	9300.98719
PWY-5840	16868.6128	10026.8475	10310.3905	7993.88412	3224.96424
PRPP-PWY	19367.2933	9827.61393	10260.3927	11558.001	15750.0742
PWY-6269	13797.2431	9407.84265	8725.3817	21330.3691	10004.5568
PWY-5509	13709.3925	9347.0757	8649.76791	21323.7937	10062.348
PWY-7371	14975.9462	9266.05805	8214.5135	24813.6055	13290.1424
PWY-7187	17024.9563	8661.13275	9051.02911	10313.7552	10783.807
ASPASN-PWY	8274.86068	8511.09541	3629.03956	4141.80712	5925.80625
PWY-5861	14544.3662	8491.9274	7803.86234	5781.7628	2064.57553
ALL-CHORISMATE-PWY	14280.5297	8420.87013	5268.68402	2877.47235	1767.19456
P124-PWY	16934.3097	8307.39209	7296.42022	36190.5519	14455.4913
PWY-5022	15457.8672	8304.6313	14236.9212	20993.335	19969.8155
PWY-6545	15191.1889	8303.59205	22657.3345	25508.3572	17027.6599
NADSYN-PWY	10571.6829	8028.30488	2881.43721	617.717761	1799.82155
PWY-7374	9041.32396	7661.21849	3188.42705	24310.7271	12476.852
POLYAMSYN-PWY	11912.6169	7622.47492	8225.39402	14816.4691	12917.1593
POLYAMINSYN3-PWY	11929.6198	7594.84542	5962.28168	6221.5676	1450.49927
GALACT-GLUCUROCAT-PWY	12109.8554	7402.5651	1279.28701	18338.1174	1829.32802
PROTOCATECHUATE-ORTHO-CLEAVAG	12245.3037	7348.41665	6178.26105	14984.7864	4295.87353
PWY0-1296	13779.1046	7174.31781	7776.78802	12884.7185	16453.8444
PWY-5845	13288.3128	7003.17326	3333.1788	1543.61799	1090.95633
PWY-5850	13288.3128	7003.17326	3333.1788	1543.61799	1090.95633
PWY-5896	13288.3128	7003.17326	3333.1788	1543.61799	1090.95633
PWY-1861	2515.68486	6932.68031	3605.54311	6167.72236	13403.9256

PWY490-3	10603.9965	6762.81783	568.251268	10777.5081	1029.50437
PWY-5100	16917.6705	6631.94477	10960.4819	14675.2789	14386.2878
TYRFUMCAT-PWY	10630.4208	6629.72718	4675.35869	1206.92072	1275.49653
PWY-7332	11251.0488	6626.23196	3321.51476	7315.79315	4248.30461
PWY-5863	11012.3717	6613.90566	5220.81129	6427.33323	1746.20113
PWY-5028	9791.91727	6526.59911	2813.58262	1130.27927	1539.64266
PWY0-1297	12647.1245	6425.94652	8226.68878	15932.5893	18744.447
PYRIDOXSYN-PWY	8265.92226	6399.89756	9378.32976	397.697298	363.988487
GLUCUROCAT-PWY	12183.6751	6397.1027	1883.3375	15732.1902	2835.54023
PPGPPMET-PWY	9985.95368	6360.80269	4959.66506	1650.05083	630.183095
PWY-5837	10003.2238	6015.42347	4679.47896	5724.36018	1539.07951
PWY0-1298	11496.8005	5777.37605	7618.67372	12304.8874	13986.4365
PWY-5651	7280.24364	5719.33398	1864.06319	389.132745	1181.94566
SUCSYN-PWY	4773.13478	5379.99943	996.223525	0	73.0112127
NAD-BIOSYNTHESIS-II	8555.50013	5377.55064	1336.10834	19168.116	301.089104
P161-PWY	8863.15436	5328.95957	7949.00431	13111.1416	22197.4068
RUMP-PWY	1890.20619	5259.46961	2709.99391	4692.24979	10638.3941
PWY-5860	9723.3534	5081.15663	2289.13798	1046.41579	742.855162
PWY-5862	9723.3534	5081.15663	2289.13798	1046.41579	742.855162
P122-PWY	8914.76931	5021.13894	5887.83319	11061.326	6232.46921
PWY0-845	8012.39633	4964.45565	6124.52955	864.476028	798.672589
PWY-5747	6277.04895	4937.66519	3209.03914	2195.2527	390.903346
PWY0-42	5729.96141	4776.64472	2000.64299	2571.7336	472.632693
GLUCOSE1PMETAB-PWY	4693.40733	4775.463	544.773221	428.822348	599.179098
PWY-621	4522.07477	4482.81981	1179.10028	2394.50457	6024.87673
PWY-5384	4522.07477	4482.81981	539.98487	797.054189	1562.07753
RHAMCAT-PWY	8292.34983	4453.04224	3048.90955	19162.0249	7728.32365
PWY-6749	6533.07072	4420.25243	2436.1123	16378.9616	179.298397
PWY-7376	7701.79687	4297.65017	4005.01959	9704.84902	2906.97016
PWY0-1533	8291.3177	4121.86079	3985.15199	1646.9172	551.046209
PWY-5419	6344.32048	4046.917	1537.83719	1856.58576	810.204
ARGORNPROST-PWY	7613.98134	3940.23919	4367.18977	3408.3444	1576.03758
ENTBACSYN-PWY	6034.49974	3913.63687	4909.2665	4637.2103	4801.74257
PWY-7237	5121.08	3822.2	5193.66	22388.89	23677.78
PWY-5304	3804.96	3816.65	2880.61	27965.05	15571.61
PWY-5676	8161.43739	3481.95728	4162.86901	1497.41949	2819.3639
P125-PWY	2678.21048	3352.96137	437.638613	3242.33527	3401.32149
PWY-7007	5080.29622	3326.74618	1855.75214	6973.56605	1221.88589
PWY-5180	5741.52417	3317.84482	2896.89723	5526.64468	8396.83234
PWY-5182	5741.52417	3317.84482	2896.89723	5526.64468	8396.83234
DENITRIFICATION-PWY	4740.80932	3309.97459	1033.72291	438.875882	558.010544
PWY-5655	4763.11207	3284.99721	1275.31713	442.798094	868.700921
PWY-7315	5727.20022	3240.21942	339.511575	0	179.103964
PWY-5741	6641.92666	3192.89577	2285.636	0	63.8825822
PWY-1622	4650.71673	3191.64795	3767.27772	0	155.081205
PWY-5420	5027.36701	3152.89783	1823.57743	2623.47455	1332.49415
PWY0-321	4816.88558	3137.65913	1719.97799	806.730162	276.259929
PWY-6396	2877.34859	3061.95405	779.380657	1754.1375	342.266589
PWY-5647	3748.44472	2993.06814	769.892612	267.45872	470.230777
PWY-6383	3938.61591	2870.96362	3659.40903	22969.503	10170.1109
PWY-5415	4641.20017	2847.35905	2597.46079	4928.18422	7058.02479
PWY-5654	3620.99376	2801.06377	803.826004	356.213731	454.819048

PWY-6588	4548.53532	2774.37925	484.820102	1465.76005	4451.66347
PWY-6876	4548.53532	2774.37925	484.820102	1465.76005	593.348195
PWY-5910	2878.316	2737.75684	1134.084	33.0339514	419.349797
P441-PWY	3413.75966	2679.18918	2281.76253	1627.82161	2490.96103
PWY-6071	4294.65021	2608.80754	1367.54801	871.621322	307.109862
CODH-PWY	4924.31418	2533.78424	8302.38988	107.394488	1006.59966
P281-PWY	3599.2084	2484.7429	1505.14493	1890.24345	464.326036
HEXITOLDEGSUPER-PWY	3465.84671	2473.32032	6754.54359	9516.10074	8675.74562
PWY-7456	4824.21713	2403.60649	400.847338	190.958661	376.278956
PWY-3801	67.3941727	2398.62378	267.733923	0	0
P562-PWY	3921.83435	2388.61615	3273.51135	8988.79626	12637.6113
PWY-6895	3535.59742	2356.35361	2958.4341	18167.8502	13500.7353
PWY-7255	4003.97032	2332.67062	2337.88076	8184.1234	7126.08167
PWY-7347	1818.88393	2248.23816	421.822305	0	22.3552373
KDO-NAGLIPASYN-PWY	418.37392	2225.02089	1107.27529	0	0
TEICHOICACID-PWY	2729.38521	2186.63874	1275.26902	5339.71699	1195.30192
PWY-5941	5119.04876	2147.56916	738.704596	0	0
PWY-5181	3379.53764	2118.9447	1478.02765	770.315347	317.635533
PWY-5705	3202.3612	2026.80185	792.223055	15189.5516	376.882992
PWY-922	2053.90233	1977.40955	801.783586	23.1287153	294.757641
P101-PWY	3091.02719	1959.6576	494.022015	18307.602	13087.1462
P381-PWY	3000.18493	1937.98787	333.438543	814.806756	1322.24619
PWY-7616	2549.76767	1933.08434	1107.52661	7145.80389	8740.83044
PWY-6505	3132.90505	1900.35555	1085.22083	442.798094	654.294449
P221-PWY	5093.74942	1875.56855	261.3447	3406.31917	258.320608
ORNDEG-PWY	3047.13195	1825.98503	0	0	0
PWY-6562	2224.71335	1811.68342	746.991081	62.9452946	940.007483
PWY-5392	3209.69361	1804.95504	229.702195	3337.12839	0
PWY-7090	3558.66475	1790.41388	898.554454	0	195.062687
PWY1G-0	3012.33299	1767.79841	3659.0342	14761.6867	7674.40294
CATECHOL-ORTHO-CLEAVAGE-PWY	2106.94439	1747.74189	1917.11083	1723.48058	275.624389
PWY-6182	2270.83174	1721.14215	1783.55782	1804.35827	252.449543
PWY-7377	2719.81399	1719.66674	1641.64636	6.99643956	494.928889
PWY-5417	2079.52552	1627.1786	1760.93791	1625.6773	217.773909
PWY-5431	2079.52552	1627.1786	1760.93791	1625.6773	217.773909
PWY-5507	2210.70913	1449.23968	336.261683	0	600.199124
PWY-6185	2052.69071	1439.39076	991.240614	462.802463	162.780493
PWY-6728	2290.18243	1392.90541	1260.91001	189.149413	137.769348
PWY-5430	1985.95174	1388.31996	660.489433	744.505107	131.667901
CRNFORCAT-PWY	1283.665	1385.98405	155.09829	0	0
KETOGLUCONMET-PWY	1500.47852	1333.00192	357.043741	691.131078	68.4571788
PWY-6590	3526.16481	1323.17962	2097.33107	661.656135	1884.58601
PWY-5178	1635.40059	1288.75687	593.235069	2356.89072	130.723965
GLCMANNANAUT-PWY	1321.86807	1283.0824	951.064173	521.514536	818.385627
PWY-6339	2497.86435	1253.85784	0	0	0
PWY0-1277	2230.9773	1194.96867	1082.84691	3644.37075	136.118905
PWY-6167	1738.87661	1150.17222	1348.66518	0	71.3133181
P461-PWY	940.84038	1106.85753	1835.73629	5105.98173	9786.99749
PWY-5183	1518.24764	1090.4103	225.624941	321.391748	76.3938969
GLUCARDEG-PWY	2384.34678	1081.86059	1671.49859	204.267734	135.872765
PWY-6174	1502.83032	1075.10723	258.283757	0	73.2004177
CENTFERM-PWY	2865.48121	1073.99501	1704.28404	518.396846	1504.59227

AST-PWY	1973.80379	1044.6727	250.253811	68.8888889	76.7046417
GALACTARDEG-PWY	2275.374	983.924738	1254.21007	173.920261	88.2645457
GLUCARGALACTSUPER-PWY	2275.374	983.924738	1254.21007	173.920261	88.2645457
PWY-6210	1664.23468	979.903549	586.089818	202.49265	258.216294
PWY-2941	874.54512	950.913586	1064.45866	10445.1021	14848.0885
PWY-1882	1360.628	932.104932	0	0	0
PWY-7003	1004.80583	911.257956	523.177013	2572.95441	6827.79901
METHYLGALLATE-DEGRADATION-PWY	2267.50828	904.782234	473.695542	1351.72268	1246.53458
PWY-5531	984.983819	903.660127	276.977485	0	0
PWY-7159	984.983819	903.660127	276.977485	0	0
P163-PWY	2105.89164	896.374589	2814.31531	11160.7703	2621.79289
P184-PWY	2122.97114	873.12001	223.431283	527.082106	434.429486
PWY-6944	1394.46467	866.226424	76.2287701	17.854013	0
PWY-3661	750.409598	831.685768	42.4604792	2647.62325	0
PWY-7098	1480.07821	831.03552	207.138966	346.268597	380.239153
PWY-6338	1353.48512	757.034428	186.230794	323.050788	351.828587
PWY-7097	1353.48512	757.034428	186.230794	323.050788	351.828587
3-HYDROXYPHENYLACETATE-DEGRAD/	1761.59419	755.380205	357.059428	1032.27775	352.756199
FUCCAT-PWY	1008.42148	749.911913	703.270183	1360.33082	3857.73237
PWY-6957	1227.18648	742.023149	0	0	0
PWY-5529	247.919732	740.251112	0	0	0
GALLATE-DEGRADATION-I-PWY	1858.45731	736.976176	381.954027	1090.7137	1006.52687
PWY-7295	2468.2413	731.121771	1851.74629	0	0
METHANOGENESIS-PWY	1062.24259	698.02085	1445.3296	0	110.580106
PWY-6654	1042.15516	697.846617	989.306334	0	54.9015837
GALLATE-DEGRADATION-II-PWY	995.574421	668.239524	381.954027	1090.7137	1006.52687
PWY-7391	1021.23862	586.99881	260.241819	16.3810775	174.307443
PWY-5656	851.394416	585.539955	607.538648	0	0
P261-PWY	1031.09392	517.246406	829.723009	17.9928251	884.497348
PWY-6891	753.408403	504.958177	641.337836	6205.44283	8746.20725
DHGLUCONATE-PYR-CAT-PWY	348.217132	494.40446	75.5923788	101.889178	81.8843675
PWY-6641	1057.08295	488.200557	214.574542	7.45067179	0
PWY-5198	923.114594	469.4506	971.640889	0	41.8660947
CHLOROPHYLL-SYN	139.381971	467.552905	0	0	0
HCAMHPDEG-PWY	915.055684	446.363788	407.097618	1712.74407	34.3999683
PWY-6690	915.055684	446.363788	407.097618	1712.74407	34.3999683
PWY-2221	1501.42978	439.207326	0	0	0
ARGDEG-PWY	1.39832796	405.589605	0	0	0
ORNARGDEG-PWY	1.39832796	405.589605	0	0	0
PWY-6349	628.056685	397.341748	632.480724	0	54.2706887
PWY-6572	507.141489	393.696257	51.9922631	0	34.5706133
PWY-722	610.071574	384.31737	84.42161	481.999095	98.0769504
PWY-7210	54.9523643	377.619182	3112.71008	0	136.856296
P621-PWY	874.060342	375.177683	0	0	0
PWY-6350	596.592907	363.211515	613.017375	0	45.4263616
PWY-1501	760.055445	345.705723	0	0	0
METHGLYUT-PWY	0.7489722	344.168271	0	0	0
PWY-7373	361.340653	334.681283	0	0	379.686414
PWY-6992	376.39664	326.746135	819.570193	941.243338	0
PWY-6731	87.4082604	306.141555	306.758288	54.5019813	219.06118
PWY-6471	3172.34925	284.067096	0	14140.4298	0
PWY-7527	275.45003	276.152619	626.862069	5759.38268	8850.3199

PWY-7644	268.912559	271.824513	41.9825073	0	0
LIPASYN-PWY	223.139644	270.496933	59.8874909	0	0
PWY-7198	38.4770303	265.267838	2207.43141	0	95.8358661
PWY-6470	1748.15673	236.86358	0	11032.9909	0
PWY-6107	663.698272	208.830515	0	164.774105	0
VALDEG-PWY	632.627186	202.851464	0	0	0
PWY-5677	802.764845	197.242553	0	0	0
PWY-4361	166.321085	167.502744	383.260209	3900.23823	7165.0923
METH-ACETATE-PWY	579.212183	164.216155	917.222523	2.66649057	593.710675
PWY-3941	472.533324	160.737266	0	0	0
ECASYN-PWY	1.71408255	152.251129	0	0	0
PWY-7013	65.9740155	133.802801	0	1172.54396	0
PWY0-1338	191.883728	126.049063	45.1289983	56.4179104	42.7536232
GOLPDLCAT-PWY	93.6452047	113.893969	100.190387	1086.04154	606.815415
PWY-5532	8.9837595	113.490329	236.965367	0	0
PWY-7385	0	105.000993	0	0	0
PWY-7046	220.930254	101.67188	87.8385487	0	0
PWY-6919	201.315077	96.1076052	0	16.8510638	528.553761
THREOCAT-PWY	1.94552289	90.9856684	0	0	0
PWY-7286	5.9828608	74.4902835	212.366622	0	17.6291093
PWY-6397	240.598463	67.3888825	0	1194.30218	0
PWY-7398	173.294521	61.8456078	120.690411	24.3968949	0
PWY-7528	0	52.8703889	0	0	0
P241-PWY	78.7774887	48.4522725	1059.21615	0	135.674815
AEROBACTINSYN-PWY	79.1189791	39.0933062	0	0	0
PWY-6915	27.9454851	36.6340321	0	10	467.126412
PWY-6165	23.7245335	36.351724	305.834053	0	0
PWY-5005	53.3510147	35.9635496	0	2301.76336	0
PWY-5499	0	33.5	0	0	0
PWY-7084	0	32.3064554	0	0	0
PWY-1422	29.5820184	29.5608759	0	0	0
PWY-7413	0	27.9893136	0	13.9974587	125.560286
PWY-5088	352.213792	23.814845	0	0	0
PWY-5679	114.29	23	0	0	0
PWY-6148	14.3581189	22.9150967	346.097258	0	24.8391803
PWY-3081	0	22.3046885	302.056169	0	0
PWY-7415	0	20.1463415	0	7.8358209	63
PWY-5634	96.1923483	19.6645588	0	0	0
P341-PWY	172.166641	11.6474063	646.833294	0	0
PWY-6830	9.69809557	7.5480866	0	0	0
PWY-6404	795.775109	0	0	385.662498	0
FUC-RHAMCAT-PWY	293.20643	0	293.092646	0	77.8887335
PWY0-41	161.449061	0	0	547.644398	0
PWY-6948	158.361915	0	0	0	0
PWY-622	106.98556	0	101.082487	0	0
GLYCOL-GLYOXDEG-PWY	86.3892206	0	47.9059479	0	19.8346739
PWY-1361	48.7793178	0	320.250157	246.308669	0
PWY5F9-12	46.9561495	0	0	0	0
PWY-7316	45.9826051	0	0	15.9966808	0
LACTOSECAT-PWY	39.5552005	0	0	0	0
LPSSYN-PWY	4.46616398	0	0	0	0
PWY-6629	3.59976338	0	0	0	0

PWY-6713	0.74866277	0	0	0	0
PWY-7446	0.59801359	0	0	0	0
PWY-5266	0	0	2281.10918	5526.64468	0
PWY-5273	0	0	2281.10918	5526.64468	0
PWY-6141	0	0	107.541264	0	0
PWY-6486	0	0	0	248.216128	0
PWY-5519	0	0	0	169.534035	0
PWY-6942	0	0	0	15.6500561	0

SUPPLEMENTAL MATERIAL #6

SM6

baseMean	log2FoldChan	lfcSE	stat	pvalue	padj	Direction	Pathway
18329.262	-1.38655405	0.169718827	-8.16971268	3.09125E-16	6.24432E-14	humus	PWY-6545
33805.771	-0.25471655	0.042043465	-6.05840995	1.37474E-09	7.93419E-08	humus	GLYCOLYSIS
42269.55	-0.19840984	0.033344155	-5.95036341	2.67548E-09	1.35112E-07	humus	PWY-6969
44.469812	-22.4415531	4.408653788	-5.09034145	3.57419E-07	1.3127E-05	humus	PWY-6486
30641.907	-0.30488892	0.060170403	-5.06709128	4.03941E-07	1.35993E-05	humus	PWY-5484
30.483339	-21.9338038	4.40922412	-4.97452686	6.54072E-07	2.03265E-05	humus	PWY-5519
21.251448	-21.2846844	4.410011217	-4.82644678	1.38991E-06	3.90753E-05	humus	PWY-6141
26884.286	-0.29037173	0.069515485	-4.17707975	2.95276E-05	0.000551701	humus	ANAEROFRUCAT-PWY
1439.9056	-13.943519	3.349388439	-4.16300445	3.14087E-05	0.000551701	humus	PWY-5266
1439.9056	-13.943519	3.349388439	-4.16300445	3.14087E-05	0.000551701	humus	PWY-5273
31873.123	-0.21914387	0.054834402	-3.99646695	6.42949E-05	0.001039005	humus	P105-PWY
6848.7303	-2.00846156	0.518262224	-3.8753771	0.00010646	0.001485999	humus	HEXITOLDEGSUPER-PWY
3177.0789	-5.18385784	1.332245204	-3.89106887	9.98036E-05	0.001485999	humus	PWY-4361
30477.427	-0.20040647	0.051719126	-3.87490053	0.000106668	0.001485999	humus	PWY-6386
4147.036	-4.840422	1.257101893	-3.85046115	0.000117896	0.001587661	humus	PWY-7527
31766.09	-0.16311948	0.049417141	-3.30086835	0.000963861	0.010816662	humus	PWY-5189
14260.973	-2.53155502	0.785654929	-3.22222253	0.001272003	0.011978825	humus	PWY-7237
6643.1125	-2.35823581	0.729678837	-3.23188188	0.001229779	0.011978825	humus	PWY1G-0
7257.874	-3.8737751	1.208876976	-3.20444112	0.00135325	0.012425292	humus	PWY-2941
4305.9771	-3.74039945	1.2292207	-3.04290307	0.002343078	0.020578336	humus	PWY-6891
3874.8041	-2.30148749	0.767279947	-2.99954078	0.002703869	0.022757566	humus	P163-PWY
16860.174	-1.21667815	0.412610561	-2.94873245	0.003190801	0.025781671	humus	PWY-5022
110566.91	-0.34610696	0.118434394	-2.92235177	0.003473989	0.027519445	humus	PWY-3781
9216.1672	-2.52379895	0.87608108	-2.8807824	0.003966894	0.030819716	humus	PWY-6895
4837.789	-3.06232678	1.068571971	-2.86581238	0.004159407	0.031705667	humus	P461-PWY
9286.8142	-2.28238953	0.802967389	-2.84244362	0.004476915	0.033493956	humus	PWY-6383
42173.793	-0.12805199	0.045315134	-2.82581062	0.004716114	0.034642	humus	TCA
30462.599	-0.17988288	0.065061065	-2.76483145	0.005695221	0.041086955	humus	PWY-6385
781.24239	13.19766174	1.511899142	8.72919454	2.56493E-18	1.03623E-15	root	ORNDEG-PWY
588.4357	12.78880276	1.585766045	8.064747507	7.33874E-16	9.88283E-14	root	PWY-6339
373.88331	12.13444868	1.714219886	7.078700219	1.45513E-12	1.46968E-10	root	PWY-1882
316.0314	11.89194972	1.768513188	6.72426409	1.76482E-11	1.42598E-09	root	PWY-6957
286.21957	11.74911395	1.912216457	6.144238486	8.0348E-10	5.4101E-08	root	PWY-2221
192.22808	11.17476551	1.998989282	5.590207816	2.26798E-08	1.01807E-06	root	P621-PWY
171.41979	11.00946904	2.043766443	5.386852825	7.17021E-08	2.89676E-06	root	PWY-1501
145.01312	10.76822136	2.235047528	4.817893681	1.45082E-06	3.90753E-05	root	PWY-5677
190.2472	11.15954659	2.326690809	4.796316962	1.61609E-06	4.08064E-05	root	PWY-5529
6129.2748	2.020519721	0.430996128	4.68802291	2.75857E-06	6.19146E-05	root	PWY-7328
124.53058	10.54850891	2.246836603	4.694826894	2.66833E-06	6.19146E-05	root	VALDEG-PWY
2579.8371	1.482981885	0.326738433	4.53874333	5.65905E-06	0.000120329	root	PWY-5419
95.047919	10.15873643	2.367715707	4.29052204	1.78254E-05	0.000360072	root	PWY-3941
118.03377	10.47080059	2.55060783	4.10521777	4.03934E-05	0.000679956	root	CHLOROPHYLL-SYN
2003.8401	2.680293295	0.678568207	3.949924663	7.81758E-05	0.001214732	root	GLUCOSE1PMETAB-PWY
1368.7953	2.847939691	0.750959096	3.792403217	0.000149196	0.001944366	root	PWY-7456
563.34538	3.042205767	0.851622565	3.572246546	0.000353932	0.004468391	root	AST-PWY
554.73221	2.335426911	0.656698759	3.55631388	0.000376095	0.004604311	root	PWY-5183
3214.3842	1.989694932	0.602414317	3.302867936	0.000957014	0.010816662	root	PWY-5860
3214.3842	1.989694932	0.602414317	3.302867936	0.000957014	0.010816662	root	PWY-5862
1780.8101	2.086757515	0.641689126	3.251975807	0.001146058	0.011978825	root	DENITRIFICATION-PWY
1434.5297	2.105011749	0.648842005	3.244259362	0.001177565	0.011978825	root	PWY-5654
4491.1467	1.896425356	0.58866786	3.221554099	0.001274974	0.011978825	root	PWY-5845
4491.1467	1.896425356	0.58866786	3.221554099	0.001274974	0.011978825	root	PWY-5850
4491.1467	1.896425356	0.58866786	3.221554099	0.001274974	0.011978825	root	PWY-5896
26353.477	0.264538509	0.083574897	3.165286694	0.001549302	0.01390929	root	PWY-5345
50.212045	9.238364936	3.052594003	3.02639818	0.002474862	0.021273278	root	PWY-5088

1474.1741	2.251596969	0.753713543	2.987337814	0.002814186	0.023202674	root	PWY-5647

SUPPLEMENTAL MATERIAL #7

					samp_store_dur	samp_store_loc
sample_name	organism	chem_administration	collection_date	env_broad_scale	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
1_	metagenome	NONE	24-Oct	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
1A	metagenome	NONE	24-Oct	Low productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
1B	metagenome	NONE	24-Oct	Low productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
1D	metagenome	NONE	24-Oct	Low productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
1E	metagenome	NONE	24-Oct	Low productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
1F	metagenome	NONE	24-Oct	Low productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
2_	metagenome	NONE	24-Oct	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
3_	metagenome	NONE	24-Oct	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
3A	metagenome	microbiome fertilizer additive	24-Oct	High productivity farm field soil treated with fertilizer additive	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
3B	metagenome	microbiome fertilizer additive	24-Oct	High productivity farm field soil treated with fertilizer additive	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
3C	metagenome	microbiome fertilizer additive	24-Oct	High productivity farm field soil treated with fertilizer additive	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
3D	metagenome	microbiome fertilizer additive	24-Oct	High productivity farm field soil treated with fertilizer additive	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
4_	metagenome	NONE	24-Oct	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
5A	metagenome	NONE	24-Oct	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
5B	metagenome	microbiome fertilizer additive	24-Oct	High productivity farm field soil treated with fertilizer additive	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
FO01GONT	metagenome	NONE	22-Feb	Remanent forest soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
FORESTaITAPUA2AB	metagenome	NONE	22-Feb	Remanent forest soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
KAI01ITAPUAPRODU	metagenome	NONE	23-Sep	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
KAI02PINOSPRODUC	metagenome	NONE	23-Sep	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
KAI03CENTRPRODUC	metagenome	NONE	23-Sep	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
KAI04LICO-PRODUC	metagenome	NONE	23-Sep	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
Productiveaaa1SB	metagenome	NONE	23-Sep	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
SantaRosa-unprod	metagenome	NONE	24-Oct	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
TREATEDFIELDITA1	metagenome	microbiome fertilizer additive	22-Feb	High productivity farm field soil treated with fertilizer additive	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
TREATEDFIELDITA2	metagenome	microbiome fertilizer additive	22-Feb	High productivity farm field soil treated with fertilizer additive	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
UNTREATEDFIELDI1	metagenome	NONE	22-Feb	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
UNTREATEDFIELDI2	metagenome	NONE	22-Feb	High productivity farm field soil	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
4_humus	metagenome	NONE	21-Feb	Fertilizer additive obtained from solid-state fermentation box at surface level	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
5_humus	metagenome	NONE	21-Feb	Fertilizer additive obtained from solid-state fermentation box at mid level	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
6_humus	metagenome	NONE	21-Feb	Fertilizer additive obtained from solid-state fermentation box at bottom level	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
13_root	metagenome	NONE	21-Feb	Root microbiome from well grown succulent plant	3 Days at -80 C	FACEN-UNA, San Lorenzo, Paraguay
14_root	metagenome	NONE	21-Feb	Root microbiome from well grown succulent plant		

sample_name	env_local_scale	env_medium	geo_loc_name	host	lat_lon
1_	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
1A	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
1B	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
1D	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
1E	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
1F	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
2_	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
3_	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
3A	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
3B	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
3C	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
3D	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
4_	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
5A	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
5B	Farm soil	Soil	Paraguay: Itapua	Soil	26.1278 S 55.0442 W
FO01GONT	Forest soil	Soil	Paraguay: Itapua	Soil	26.3708 S 54.9581 W
FORESTaITAPUA2AB	Forest soil	Soil	Paraguay: Itapua	Soil	26.3708 S 54.9581 W
KAI01ITAPUAPRODU	Farm soil	Soil	Paraguay: Itapua	Soil	26.2900 S 55.0264 W
KAI02PINOSPRODUC	Farm soil	Soil	Paraguay: Itapua	Soil	26.2900 S 55.0264 W
KAI03CENTRPRODUC	Farm soil	Soil	Paraguay: Itapua	Soil	26.2900 S 55.0264 W
KAI04LICO-PRODUC	Farm soil	Soil	Paraguay: Itapua	Soil	26.2900 S 55.0264 W
Productiveaaa1SB	Farm soil	Soil	Paraguay: Itapua	Soil	26.2269 S 55.1883 W
SantaRosa-unprod	Farm soil	Soil	Paraguay: Itapua	Soil	26.7933 S 56.7869 W
TREATEDFIELDITA1	Farm soil	Soil	Paraguay: Itapua	Soil	26.3686 S 54.9800 W
TREATEDFIELDITA2	Farm soil	Soil	Paraguay: Itapua	Soil	26.3686 S 54.9800 W
UNTREATEDFIELDI1	Farm soil	Soil	Paraguay: Itapua	Soil	26.3670 S 54.9703 W
UNTREATEDFIELDI2	Farm soil	Soil	Paraguay: Itapua	Soil	26.3670 S 54.9703 W
4_humus	Solid-state fermentation biomass	Solid-state fermentation bioma	Paraguay: Itapua	Fermentation box	26.3733 S 54.9706 W
5_humus	Solid-state fermentation biomass	Solid-state fermentation bioma	Paraguay: Itapua	Fermentation box	26.3733 S 54.9706 W
6_humus	Solid-state fermentation biomass	Solid-state fermentation bioma	Paraguay: Itapua	Fermentation box	26.3733 S 54.9706 W
13_root	Exogenous root samples	Soil	Paraguay: Itapua	Soil	26.3733 S 54.9706 W
14_root	Exogenous root samples	Soil	Paraguay: Itapua	Soil	26.3733 S 54.9706 W

sample_name	sieving	soil_type	soil_type_meth
1_	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
1A	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
1B	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
1D	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
1E	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
1F	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
2_	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
3_	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
3A	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
3B	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
3C	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
3D	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
4_	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
5A	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
5B	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
FO01GONT	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
FORESTaITAPUA2AB	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
KAI01ITAPUAPRODU	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
KAI02PINOSPRODUC	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
KAI03CENTRPRODUC	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
KAI04LICO-PRODUC	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
Productiveaaa1SB	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
SantaRosa-unprod	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
TREATEDFIELDITA1	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
TREATEDFIELDITA2	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
UNTREATEDFIELDI1	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
UNTREATEDFIELDI2	Pooled samples of around 50 g over an area within 20 m from each sampling point. Samples taken within 20 cm from the surface layer.	ultisol	Literature
4_humus	Surface fermentation box, 50 g	NA	NA
5_humus	Mid level fermentation box, 50 g	NA	NA
6_humus	Bottom layer fermentation box, 50	NA	NA
13_root	Samples taken from outside of the root	NA	NA
14_root	Samples taken from outside of the root	NA	NA

sample_name	store_cond	temp	adjacent_environment
1_	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
1A	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
1B	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
1D	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
1E	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
1F	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
2_	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
3_	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
3A	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
3B	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
3C	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
3D	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
4_	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
5A	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
5B	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
FO01GONT	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
FORESTaITAPUA2AB	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
KAI01ITAPUAPRODU	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
KAI02PINOSPRODUC	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
KAI03CENTRPRODUC	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
KAI04LICO-PRODUC	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
Productiveaaa1SB	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
SantaRosa-unprod	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
TREATEDFIELDITA1	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
TREATEDFIELDITA2	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
UNTREATEDFIELDI1	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
UNTREATEDFIELDI2	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	Bosque Atlantico del Alto Parana
4_humus	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	NA
5_humus	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	NA
6_humus	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	NA
13_root	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	NA
14_root	Samples were processed transferred to the lab and processed within 3 days. Samples were stored at -80 C until then.	-80 C	NA