TRANSLATION

CIICA International Center for Research and Training in Agriculture

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December 17, 1997

Lic. Pablo Martinez del Rio
Agricola Genetica, S.A. de C.V.
Mexico, D.F

Dear Mr. Martinez:

Based in the Agreement that was signed between CIICA and Agricola Genetica, you will find the results of the research that was developed in our program of plant nutrition in this Institution.

The title of the work that was developed is:

Study of the application of microorganisms (MICROSOIL) in the soil, for the production of tobacco Virginia in Chiapas.

We hope to have accomplished the objective that was intended and stay at your service to solve any doubt.

Without any other thing for the moment, receive our best wishes.

Sincerely,

Illegible Signature

Dr. Velitchka B. Nikolaeva
Director of Research, CIiCA

Centro Internacional de Investigación y Capacitación Agropecuaria, A.C.
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Diciembre 17,1997.
Lic. Pablo Martínez del Río P.
Agrícola Genética S.A. CV.
México, D.F.
Estimado: Lic. Martínez

En base al convenio establecido entre el CIICA y Agrícola Genética, se anexan resultados de Investigación desarrollados en programa de nutrición vegetal de esta institución .

El trabajo desarrollado se titula:.

Estudio de la aplicación de microoorganismos (MICIROSOIL) en el suelo para la producción del tabaco virginia en Chiapas.

En espera de haber cumplido con el objetivo planteado y cualquier duda a la presente, quedamos de usted.

Sin otro particular por el momento, reciba un cordial saludo.

Atentamente

P.A.
Dra. Velitchka B. Nikolaeva
Director de Investigación, CIICA.

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PLANT NUTRITION

Study of the application of microorganisms (MICROSOIL) in the soil.

For the production of tobacco Virginia in Chiapas.

AGRICULTURE CYCLE 1995/1996

AGREEMENT: AGRICOLA GENETICA, S.A. DE C.V.
Lic. Pablo Martinez del Rio Petricioll
Representative

DEVELOPED BY: Illegible Signature
Q.A. Jorge Luis Lopez
Plant Nutrition

Tapachula Chiapas, August of 1996.

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NUTRICION VEGTAL

ESTUDIO DE LA APLICACION DE MICROORGANISMOS EN EL SUELO PARA LA PRODUCCION DEL TABACO VIRGINIA

CICLO AGRICOLA 1995 /96

CONVENIO: AGRICOLA GENETICA SA CV.

Lic. Pablo Martínez del Río Petricioli Representante

Q.A. Jorge Luis López
Nutrición Vegetal

Tapachula, Chris. , Agosto de 1996.

Vo.Bo.Dra. Velitchica B. Nikoiaeva
Director del CHCA.

Introduction

The growing of Virginia Tobacco has a limitation in the production and quality, when in the soil you find or apply excessive quantities of nitrogen, under their different forms (NO_3 or $NH+_4$).

In coastal Chiapas, it is very hard to find soils with low (<1.0) percentage of organic matter; the organic matter, in considerable quantities (3 - 4 %) can set free the nutrients that should be available for the crop and that in a certain time should allow the no-application of fertilizers; the fertilizers could cause an imbalance in the quantity and quality of the crop.

In this particular way, this work studied the effects of MICROSOIL, when applied to a soil with an average of 4.8% of organic matter in which tobacco Virginia K - 326 was planted.

Objective

To establish the influence of MICROSOIL, alone or in combination with inorganic solid fertilizers, over the production and industrial quality of tobacco Virginia K - 236, dried in stoves.

Method and Materials

3.1 Finding and deciding the place for the experimental site.
The work was developed in a tobacco production module, in the ejido Alvaro Obregon, Mpio. de Tapachula, Chiapas, Mexico.

3.2 Getting the soil sample.
In order to get to know the fertility index of the soil that was under study, a zigzag sampling was prepared and a physics analysis was made, the results can be seen in Chart 1.

3.3 General description of the crop

The tobacco transplanted was a Virginia K - 236 kind, dated December 7, 1996. The set out separation between lines was of 1.10 m (3'7") and the interval between plants was of 0.45 m (1'6"), with a total of 19,980 plants per hectare.

For experimental purpose lots of 10 m (32'3") were designed.

The agricultural practices that were used are in accordance with the

production norms for commercial use of Agroindustrias Moderna (a Company of Grupo Pulsar, Mexico).

3.4 Process.

For this study the four processes that were applied are the following:

(1) 000 - 00 - 000 (A)
(2) {A) + MICROSOIL 0.5% {B)
(3) {B) + 20 - 46 - 55
(4) 40-46-110

The #(1) process is the equivalent to the natural fertility of the soil; the #(2) process includes the #(1) process plus an application of liquid MICROSOIL at 0.5% to the soil and around the root system of the plants; the #(3) process is the, application of #(2) plus 20 kg/ha of N, 46 kg/ha of P_20_5 and 55 kg/ha of K_20, and the #(4) process is the application on (1) of the formula 40 - 46 -110 kg/ha as N P_20_5 - K_20.

3.4.1. Execution of the different processes

With the exception of the process #(1), in the processes #(2) and #(3) were done one week before transplanting the tobacco plants. The process #(4) was developed in two stages: the first, one week after transplanting, and the second thirty (30) days after transplanting.

3.4.2. Fertilizers used in the processes.

Besides MICROSOIL, the fertilizers used were 14 - 00 - 40 and 00 - 46 - 00.

3.5 Experimental design

This work was executed under an experimental design of random blocks with four processes and seven repetitions. Each experimental unit consisted of six trenches, in which four of them belonged to the useful plot and two to the edges or borders, as it is shown in the chart 2.

3.6 Analyzed variables.
Following you can find the variables that were evaluated in this experiment.

A) Agronomic:

1. Weight in green
2. Weight in dry
3. Green: dry ratio
4. Foliar index
5. Height

B) Industrial quality:

1. Nicotine
2. Total nitrogen
3. Sugars reducers
4. Potassium
5. Chlorides
6. Ashes

CHART 1. SOIL ANALYSIS OF THE EXPERIMENTAL PLOT.

Parameter	Concentration	Level
N - NO3	64.0 ppm	High
P	35.0 ppm	High
K	625.0 ppm	High
Ca	1500.0 ppm	Medium
Mg	441.9 ppm	High
Cl	9.9 ppm	Appropriate
pH	6.7	Neutral
C.E.	0. ms/cm	Low
M.O.	4.8%	Very rich
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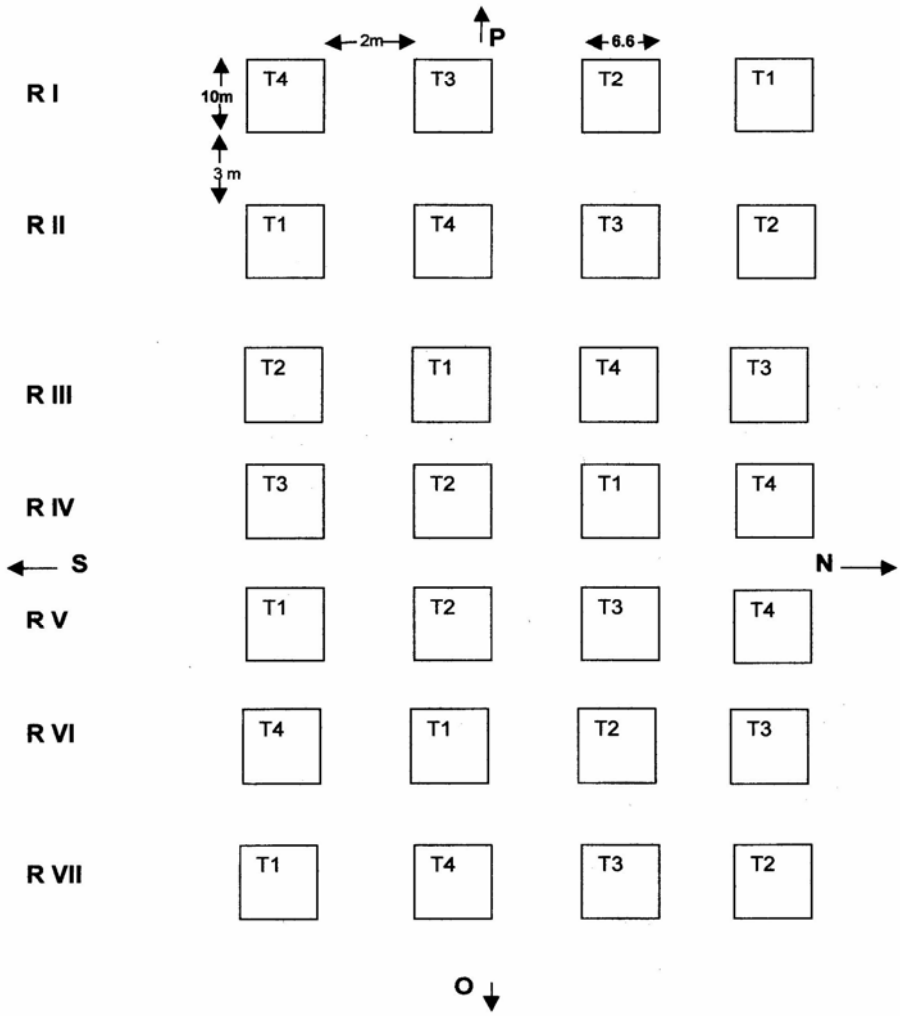
CHART 2. DISTRIBUTION OF THE PROCESSES APPLIED.



TOTAL AREA = 3,207 M^2 (10,378 sq ft)

Results and discussion

The results and discussion for this work has been divided in three aspects: (1) Agronomic, (2) Chemical quality and (3) Cost-Benefit ratio.

4.1 AGRONOMIC

For a farmer to get the productivity in a crop it is essential that it is developed in proper conditions of soil - water - climate, in order to obtain the maximum performance.

For this work there were photos taken of every one of the processes, that when were analyzed they do not show notable differences (See Fig. 1, 2, 3, and 4).

In accordance with the latter, as seen in the Chart 3., it is described each one of the most important agronomic parameters, in addition to the analysis made.

CHART 3. AGRONOMIC EXPRESSIONS OF THE VIRGINIA TOBACCO K - 236; EJIDO ALVARO OBREGON, 1995/1996.

PROCESS	WEIGHT IN GREEN t/ha	DRY WEIGHT kg/ha	RATIO GREEN:DRY	FOLIAR INDEX	HEIGHT cm
1. NO FERTILIZERS (A)	41.9 a*	2594.0 a	16.2	22.4 a	141.1 a
2. (A)+MICROSOIL 0.5 % (B)	42.0 a	2623.2 a	16.0	23.4 a	127.0 a
3. (B)+ 20 - 46 - 55	47.1 a	2749.5 a	17.1	23.7 a	123.3 a
4. 40 - 46 - 10	39.3 a	2413.5 a	16.3	22.0 a	124.7 a

*Means that are united with the same letter are statistically the same (Tukey 5%)

a) In green tobacco the yield results does not have significant differences among the processes; however, the best process was the combination of MICROSOIL at 0.5% with the addition of the formula 20 – 46 – 110 , as $N - P_2O_5 - K_2O$. The process with a bigger index of fertility (40 – 46 – 110), far from increasing the yield shows the contrary, in such way that the absolute witness turn out to be also superior to it.

The dry tobacco yield behave in the same manner as in the green

tobacco yield; meaning that the combination of MICROSOIL at 0.5% plus 20 – 46 – 55 was the best, yet without a significant difference with the other processes. Also, in the conversion from green weight to dry weight, the best process required more green weight to produce a kilogram of a dry one. The foliar index followed the same behavior than the dry and green yield.

b) With respect to the height, the process #(2), #(3) and #(4) had a significant greater influence than the one in the absolute witness.

4.2 INDUSTRIAL QUALITY

CHART 4. DRY YIELD AND CONTENT OF CHEMICAL QUALITY OF THE VIRGINIA TOBACCO K – 236 UNDER FOUR FERTILIZERS PROCESSES, 1995/1996.

PROCESS	**DRY WEIGHT kg/ha**	% N.T.	% NIC.	% AR	% K	% Cl	% ASHES
1. NO FERTILIZERS (A)	2594.0 a	3.5 a	3.2 a*	9.3 a	3.2 b	0.5 a	15.1 ab
2. (A)+MICROSOIL 0.5 % (B)	2623.2 a	1.9 c	3.7 a	7.9 ab	3.1 b	0.7 a	14.6 b
3. (B)+ 20 - 46 - 55	2749.5 a	2.0 c	3.6 a	6.5 ab	3.2 b	0.6 a	15.0 b
4. 40 - 46 - 10	2413.5 a	2.8 b	3.8 a	4.6 b	3.6 a	0.6 a	16.8 a

*Means that are united with the same letter are statistically the same (Tukey 5%)

Another of the important aspects of the evaluation of this experiment was the industrial quality of the tobacco; therefore, the Chart 4 shows the dry yields in parallel to their chemical qualities.

As we can observe, the total nitrogen (N.T.) for the zero fertilizer process was greater and significantly different to the remaining processes, followed by the (4) 40 – 46 – 55, both are graded as high. However, the remaining is statistically equal, and qualified as appropriate.

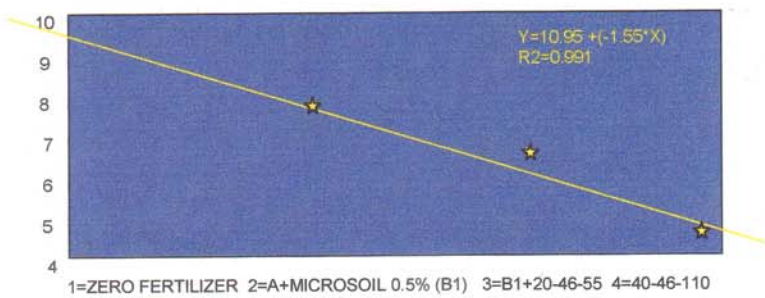
About the nicotine percentage (% Nic) in the tobacco leafs, they fluctuated between 3.2 and 3.8 %; In that range there are not any significant differences.

Comparing this results with the average. data in the production area in Nayarit (Barrera y Llanos, 1981), the first ones are from 31.6% to 42% higher than the second ones. However, comparing with data from the United States (Collins, 1993), the only process that stays in this range is the absolute witness (zero fertilizers) and slightly out, by 0.1%, is the #(3) process with MICROSOIL 0.5% plus 20 – 46 – 55 , and the remaining are very high. With the latter we can assure that this kind of tobacco is sensitive to high fertility, particularly to the nitrogen available in the soil.

You have to have in mind that this one, the soil, has a content of 4.8% of organic matter.

Statistically, there are significant differences between the processes, specifically for the #(1) process of zero fertilizer (natural fertility of the soil) and the 40 – 46 – 110 (highest fertility), obtaining the best quality in the #(1) process, as is shown in the Fig. 1. Here it can be seen that there is a high correlation between the processes and the sugar content; however, this correlation is associated in the sense that only with the initial fertility you get a higher content in sugar reducer. The #(1) process is statistically similar with the #(2) and #(3) processes. Making a relative comparison with the Nayarit data, this ones are higher than those obtained in this study; however, the one that is nearer is the #(1) process. Making a comparison with results in the Unites States the process that fulfills with this norm is the one with zero fertilizers and the other process that is close with a difference of only 0.1% is the #(2) process of zero fertilizers plus MICROSOIL 0.5%.

Fig. 1 EFFECTS OF THE SOIL FERTILITY OVER THE % OF SUGAR REDUCTION IN THE LEAFS OF THE VIRGINIA TOBACCO FURNACE 1995/1996



We can see that the total nitrogen (TN) for the zero fertilizer process was higher and significantly different to the remaining processes, followed by the #(4) process of 40 – 46 – 110, both been graded as high. Nevertheless, the other two processes are statistically equal but grades as appropriate.

The potassium (K) is another of the parameters that has some influence in the quality of the cigarettes. This element was statistically different within the processes under study; the better process was the #(4) 40 – 46 – 110, that belongs to the higher level in potassium. Making comparisons with the data from Nayarit, the first three processes produced potassium within the normal levels (2.93 - 3.48%); nevertheless, the fourth process was higher than the level mentioned before. However, in accordance with the IFA, 1991 (Fertilizer Industry International Association the potassium level can be as high as 4..32%. Therefore, we could generalize that all the potassium levels under study are acceptable.

The chlorides (Cl) are other elements that are distinctive in the industrial quality of tobacco; for this study, every process generated optimum levels of chlorides and there is not any significant difference and in agreement with what is said by other authors.

The ashes were also analyzed in this work, observing significant differences among the processes and being the best one the 40 - 46 - 110. Comparing with Collins (1993), all the processes are in the appropriate rank.

4.3 COST - BENEFIT RATIO

To know the economical impact of the processes over the crop and what is the productivity that it can generate for the farmers, next we are showing some aspects that can allow an evaluation.

a) For the first analysis we need to know which is the actual cost of each of the processes, and those are shown in the Chart 5.

CHART 5. FERTILIZER PRODUCTS AND APPLICATION COST OF THE PROCESSES PER HECTARE.

PROCESS	$ PRODUCT	$ APPLICATION	$ TOTAL COST
1. ZERO FERTILIZER (A)	000.00	00.00	000.00
2. (A) + MICROSOIL 0.5% (B)	375.00	25.00	395.00
3. (B) + 20 - 46 - 55	932.20	85.00	1017.20
4. 40 - 46 - 110	886.50	60.00	946.50

1996: $1.00 dll=$7.20 pesos

b) secondly, we compared every one of the processes against the absolute witness (# 1 process) and the results show that the #2 process has an additional amount of 29.2 kg/ha of dry tobacco, the process #3 had 155.3 kg/ha and the process #4 had 180.5 kg/ha less dry tobacco. That is, that the witness had a higher

yield.

c) Analyzing the tobacco prices for the cycle in study, the Virginia tobacco furnace had an average price of $ 8,973.00 pesos. Having in mind this last number, the effects of the processes #2 and 3 were the better ones, they surpass the witness in a positive manner:

I. The economical difference and the weight difference of process #2 against the witness are : with the process #2 the yield is not enough to recover the production and labor cost. That is, it is not recommended to use only MICROSOIL 0.5%.

II. However, the process #3, the one that has the application of MICROSOIL 0.5% plus 20 - 46 - 55 kg/ha of N - P_20_5 - K_20 can generate a profit of approximately $ 376.30 pesos per hectare.

III. On the contrary, the process 4 did not work in the study. That is, it did not get to cover the costs and was clearly surpassed by the absolute witness.

Conclusion

1) The analysis with respect to industrial quality and furnace tan, the Virginia tobacco K-236 has an appropriate production in fertile soils with organic matter >4%.

2) However, in the short term, it is feasible to apply MICROSOIL 0.5% in fertile soils with organic matter ><4% in combination with 50% of the chemical inorganic suggested fertilizer based in the soil analysis to increase the yields, the industrial quality and the productivity.

3) In the middle and long term it is convenient the application of MICROSOIL at 0.5% to increase the mineralization of the organic matter and the availability of the nutrients, and therefore, increase the industrial quality and reduce the use of inorganic fertilizers in a significant way.

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Collins, W.K. and Hawks. S.N. 1993. Principles of cures tobacco production. North Carolina State University. Raleigh, North Carolina. USA.

FIG.1 Effects of the soil fertility over the tobacco Virginia K-326
1995/1996

FIG. 2 Effects of the application of MICROSOIL 0.5% in the farming of the tobacco Virginia K-326,1995/1996

FIG.3 Effects of the application of MICROSOIL 0.5% plus the NPK Formula 20-46-55, in the farming of tobacco Virginia K-326, 1995/1996

FIG.4 Effects of the NPK formula 40-46-110 on the farming of the Tobacco Virginia K-326, 1995/1996

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PLANT NUTRITION

Study of the application of microorganisms (MICROSOIL) in the soil.

For the production of tobacco Virginia in Chiapas.

AGRICULTURE CYCLE 1996/1997

AGREEMENT: AGRICOLA GENETICA, S.A. DE C.V.
Lic. Pablo Martinez del Rio Petricioli
Representative

DEVELOPED BY: Illegible Signature
Q.A. Jorge Luis L6,pez
Plant Nutrition

Tapachula Chiaps, December of 1997.

O.K. Dra. Velitchka B. Nikolaeva
Director of CIICA

STUDY FOR THE APPLICATION OF MICROORGANISMS IN THE SOIL FOR THE PRODUCTION AND INDUSTRIAL QUALITY OF THE VIRGINIA TOBACCO.

Summary

This is the second consecutive farming cycle in which we are studying the effect of the microorganisms that are applied to the soil and the results show that when you mix between the 25 - 50 % range of the chemical fertilizers with MICROSOIL 2% to the soil, you get the best yield and productivity. This results are similar to those that were gotten in the agricultural cycle 1995 - 1996.

Introduction

The soil is the environment in which the life of innumerable plant and animal forms grow and develop, animals that vary in size from those that you need a microscope to see them as the microorganisms to the earthworms. Through a great variety of activities, this organisms make a contribution to the soil ability to enhance the productivity of itself. The desired activities of the microorganisms of the soil can be stimulated through the correction of unfavorable conditions, by means of using some practices as the application of lime, the application of organic matter, the parasite control, the inoculation of microorganisms, etc. (Ortiz y Ortiz, 1984).

In reference to the inoculation of microorganisms, in the last agricultural cycle (1995 - 1996), we developed a study of the effect of MICROSOIL as a source of a complex of enzymes and bacteria in the Virginia tobacco crop, and the results showed that mixing 50% of the chemical fertifizers with MICROSOIL at 2% the best results were gotten in yield and productivity (Luis, 1996).

As a continuation of the previous study, in this farming cycle (1996 - 1997) the study was repeated.

Objective

To study the effects of the product named MICROSOIL in the production and the industrial chemical quality of the Virginia tobacco.

Method and Materials

The study was developed in the CIICA's experimental site, with a soil that

had a texture generous-clay. The chemical analysis is shown in the **Chart 1**.

CHART 1. CHEMICAL ANALYSIS OF THE EXPERIMENTAL SOIL.

Parameter	Concentration	Level
ppm N - NO3	3.6	Low
ppm P	47.5	High
ppm K	675.0	High
ppm Ca	1552.5	Medium
ppm Mg	361.0	High
% M.O.	2.0	Low
pH	6.2	Slightly Acid
ms/cm C.E.	0.1	Low

The experiment was transplanted on the December 16, 1996, with tobacco Virginia K - 326, to a designed plot with random blocks and 4 repetitions. The experimental plot was settled out with 4 lines of 5 meters long. The distance separation between lines was of 1.10 m (3'7") and the interval between plants was of 0.45 m (1'6"). The useful plot had 7.97 m^2. The processes under study are shown in the **Chart 2.**

CHART 2. PROCESSES APPLIED IN THE EXPERIMENT.

Process	kg/ha N-P_2O_5-K_20	% Fertilizers	MicroSoil 2%	Others
1	37 - 25 - 75	50	YES	50% IRRIGATION
2	19 - 12 - 37	25	YES	NORMAL
3	37 - 25 - 75	50	YES	50% FUNGICIDE AND INSECTICIDE
4	37 - 25 - 75	50	YES	NORMAL
5	75 - 50 - 150	100	NO	NORMAL

Before the application of MICROSOIL a mix was prepared with a dosage of 2 liters of the product in 100 liters of water and it was kept 3 days in the sun in a plastic recipient. The application was made one week before transplanting was made.

The application of fertilizer with N-P_2O_5-K_20 was made in to parts; the first one 5 days after transplanting with 60% of the nitrogen, 100% of the phosphorus and 50% of the potassium, and the second application, with the remaining 40% and 50% of the nitrogen and the potassium. The tobacco was cures in string - sun.

The evaluation was made for the foliar index, the plant height, the yield and the chemical quality. In the chemical quality the analysis was made in sugar reduction (AR), total nitrogen (NT), potassium (K), chlorides (Cl) and the total alkaloids (AT).

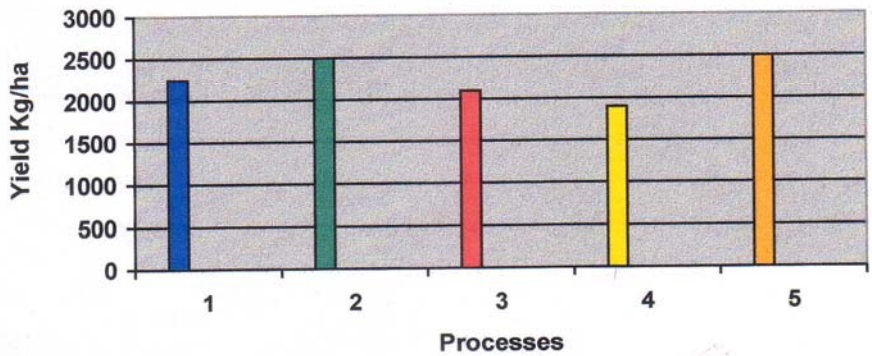
Results

There is not any significant difference between the processes for all the variables that were analyzed. Under the chemical quality point of view. the AR are low (< 5.26 %) in all the processes; the NT, only the processes 2 and 3 have the appropriate level (2.10% - 2.77%); for the AT, all the processes in consideration are appropriate (2.09% - 3.23%). All the chlorides are in an excellent level because they are below 1% (See **Chart 3.**)

CHART 3. CHARACTERISTICS OF THE PLANT AND INDUSTRIAL CHEMICAL QUALITY OF TOBACCO UNDER DIFFERENT MIXES OF MICROSOIL 2%. CIICA, 1996 - 1997.

Process	Foliar Index (cm)	Height (cm)	Chemical Quality (%)				
			AR	NT	K	Cl	AT
1.	22.75a	96.50a	1.37a	2.85a	3.57a	0.42a	2.65a
2.	21.13a	101.94a	2.56a	2.61a	3.57a	0.40a	2.94a
3.	21.77a	98.40a	2.05a	2.67a	3.17a	0.37a	3.21a
4.	20.28a	98.09a	1.43a	2.98a	3.40a	0.38a	3.11a
5.	22.32a	99.75a	1.52a	3.01a	3.47a	0.38a	3.83a

FIGURE 1. PERFORMANCE OF THE VIRGINIA TOBACCO AFTER THE APPLICATION OF MICROSOIL TO THE SOIL. CIICA,1996-1997.



In the **Figure 1**. we can observe that there are not any significant difference between the processes; however, the two best processes in terms of yield are the process with 19 - 12 - 37 plus MICROSOIL 2% applied to the soil before the transplant and the process with 100% of the chemical fertilizers (75 - 50 - 150). The cost of the first one is $1345.00/ha and the cost for the second one is $1379.00/ha, being the difference of $34.00/ha in favor of de process with MICROSOIL; besides, an additional 18 kg/ha of tobacco comparable to $142.50/ha that makes a great total of an additional income of $176.50/ha when MICROSOIL 2% is applied with 25% of the total fertilizers.

Conclusions.

There is an alternative to mix between 25-50% of the chemical fertilizers with a stock of microorganisms (MICROSOIL 2%) to the soil and produce yields similar to those obtained with the use of 100% chemical or traditional fertilizers.

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