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Scientific paper

Stem and root growth of sugar cane for the use of humic acid and L-glutamic acid

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Abstract

A greater rooting of crop usually allows increased growth in the plant shoots. In this sense, this study aimed to test the effect of humic acid and L-glutamic acid on the growth of the root system of the sugarcane crop. The experiment was conducted in a greenhouse with the cultivar RB867515. The evaluation of the root system was performed 90 days after sowing, through the digital image analyzer Winrhizo LA 1600®. The variables evaluated were: length, surface area, volume, diameter and dry mass of root system, height, number of leaves, leaf area and dry mass of the shoots. It was possible to conclude that the humic acids influenced the largest growth in relation to the length, surface area, volume and dry mass of the root system, differing statistically from L-glutamic acid and from the control. However, was not observed influence on the diameter of the roots and over the variables of the shoots.

Keywords: amino acid; biofertilizer; *Saccharum* spp; humic substance

Crescimento caulinar e radicular de cana-de-açúcar em função da utilização de ácidos húmicos e ácido L-glutâmico

Resumo

Um maior enraizamento da cultura normalmente possibilita aumento do crescimento da parte aérea das plantas. Neste sentido este estudo teve por objetivo, testar o efeito dos ácidos húmicos e do ácido L-glutâmico sobre o crescimento do sistema radicular da cultura da cana-de-açúcar. O experimento foi conduzido em casa de vegetação com a cultivar RB867515. As avaliações do sistema radicular foram realizadas aos 90 dias após o plantio, através do analisador digital de imagens Winrhizo LA 1600®. As variáveis avaliadas foram: comprimento, área superficial, volume, diâmetro e massa seca do sistema radicular, estatura, número de folhas, área foliar e massa seca da parte aérea. Foi possível concluir que os ácidos húmicos influenciaram no maior crescimento em relação ao comprimento, área superficial, volume e massa seca do sistema radicular, diferenciando estatisticamente do ácido L-glutâmico e da testemunha. Porém, não foi observado influencia sobre o diâmetro das raízes e sobre as variáveis da parte aérea.

Palavras-chave: aminoácido; biofertilizante; *Saccharum* spp; substância húmica

Crecimiento caulinar y radicular de la caña de azúcar en función de la utilización de ácido húmico y ácido L-glutámico

Resumen

Un mayor enraizamiento en general permite aumento en el crecimiento de la parte aérea de la planta. Este estudio tuvo como objetivo poner a prueba el efecto del ácido húmico y el ácido L-glutámico en el crecimiento del sistema radicular del

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cultivo de la caña de azúcar. El experimento se llevó a cabo en un invernadero con el cultivar RB867515. Las evaluaciones del sistema radicular se realizaron a los 90 días después de la siembra, a través de un analizador digital de imágenes WinRHIZO LA 1600®. Las variables evaluadas fueron: longitud, superficie, volumen, diámetro y masa seca de la raíz, altura, número de hojas, área foliar y masa seca de la parte aérea. Se concluyó que los ácidos húmicos influyeron en el mayor crecimiento en relación con la longitud, superficie, volumen y masa seca de las raíces, difiriendo estadísticamente del ácido L-glutámico y testigo. Sin embargo, no se verificó influencia sobre el diámetro de las raíces y en las variables de la parte aérea de la planta.

Palabras clave: aminoácido; biofertilizante; *Saccharum spp*; sustancia húmica

Introduction

To attend the increasing demand of byproducts of sugarcane, it has become constant the search for new techniques which possibility increase in the productivity. Recently, it is observed that the use of bio fertilizers can become a strategy for new incomes. Being available in the market of bio fertilizers, are the humic acids and the amino acid L-glutamic acid.

For MENDES et al. (2009) there are many endogenous and exogenous factors that affect the initial development of sugar cane, as in the emergence and in the tillering, thus justifying the use of varied treatments, such as vegetal regulators, bio fertilizers, bio stimulants and nutrients to promote improvements in the development. SILVA et al. (2010) complement, stating that these functions as activators in the vegetal metabolism, improve the immunological system, reactive physiological processes in the different phases of the development, stimulate the root system growth, induce the formation of new sprouts and improve production.

To AGUIAR et al. (2009) stimulate the root system growth of the plants allows to exploit a greater volume of the soil, facilitating the adaptation in environments of low fertility, with water restriction or, even in systems of organic cultivations, in which the liberation of nutrients is not always immediate.

The humic substances are the main components of the organic matter of the soil and influence in the chemical, physical and biological properties (MARQUES JÚNIOR et al. 2008).

CANELLAS et al. (2003) complement arguing that the formation of humic substances is characterized by a complex process based in the synthesis and, or, resynthesis of products of mineralization of organic compounds that reach the soil.

As for the As for the L-glutamic acid it is about an amino acid obtained from the fermentation of cane molasses by the bacteria *Corinebacterium glutamicum*, with proven effects on the plant metabolism and frequently used as a complexing agent in fertilizer formulations for the foliar application and fertirrigation (MÓGOR et al., 2008).

However, the use of humic substances and the L-glutamic acid in sugarcane is a new technique that needs many studies and confirmations. Thus, this study had as objective, to test the effect of these substances over the growth of the root system and in the crop shoots.

Material and Methods

The experiment was conducted in a greenhouse, of the Sector of Agricultural Sciences (SCA), Federal University of Paraná. Being implemented in 2011, with the cultivar RB867515,cultivated in plastic trays with a volume of 8 liters. The substrate was composed based of pine bark and vermiculite. The manure used was proportional to 500 kg ha^{-1} of the 08-20-20 formulation.

The products used were: the commercial formulation containing 30% of humic substances and the experimental product having 300 g L^{-1} of the L-glutamic amino acid. For both, the concentration used was of 1L ha^{-1}, being diluted 3ml in a liter of water.

The application consisted of the immersion of the mini toletes for 30 seconds in the solutions containing the products, the mini toletes of the control were submersed for the same time in water.

The evaluations of the root system were done 90 days after sowing, being that the roots initially were separated of the shoots and washed in running water for the removal of the substrate, over a sieve. Next were put in plastic pots with alcohol at 50%, to be later analyzed through the digital image analyzer WinRhizo LA 1600 ®.Then the roots were sent to the greenhouse with forced circulation at the temperature of 60 °C, until the material achieve constant mass to determine the dry mass of the roots.

The assessed variables of the root system

were: length (cm), superficial area (cm^2), volume (cm^3) e diameter (mm) e dry mass (g).

In the shoots the variables assessed were: number of leaves, height (cm), foliage area (cm^2) and dry mass of the shoots (g). The number of leaves was considered, when they were totally open and with the minimum of 20% of green area. The height was determined from the substrate until de leaf +1. And the foliage area was established through the image analyzer.

The experimental design was completely randomized with three repetitions. The results were submitted to analysis of variance and the means were compared by Tukey test at 5% probability. Being the analysis done by the computational program system for Analysis of Variance – SISVAR.

Results and Discussion

Observing the table of analysis of variance (Table 2), for the analyzed variables, it is possible to identify significant differences (P <0.05) of the application of bio fertilizers over most of the characteristics of the root system, among them, the length, surface area, volume and root dry mass. The exception was for the root diameter. However, it was not possible to observe significant differences (P <0.05), for the characteristics of the shoot, which were height, number of leaves, dry mass and foliage area.

The humic acids influenced in the greater growth in relation to the lenght of the root system, with average value of 4062. 71cm per plant, differing statistically from the L-glutamic acid and the control which allowed an increase of 3208.90 and 3134.37 cm, respectively (Figure 1).

Consequently the humic acids also strongly influenced the increase in surface area, volume and root dry mass, reaching values of 1478,64 cm^2, 38,91 cm^3 and 4,66 g per plant, respectively, being statistically superior to the others.

Thus these results are in agreement with those found by BALDOTTO et al. (2009) who found that the root system was significantly changed with the application of humic acids, with increases in fresh weight, dry mass and root area, corresponding to approximately 70, 57 and 39% respectively when compared to control.

MARQUES JUNIOR et al. (2008) complemented at describing the effects of humic acids are reflected in accelerated rates of root growth, being observed by the authors of the surface area, length and the dry mass of the root system and also increase over the vegetal biomass.

Regarding the diameter of the root system, was not possible to verify statistical differences in function of the application of the bio fertilizers.

In relation to the L-glutamic acid was not observed effects also over the root system, contradicting the results observed by OLINIK et al. (2011) , who working with cabbage crop, observed this bio fertilizer providing an increment over all characteristics analyzed, being them, the number of leaves, height, fresh mass of the shoots and root.

Table 2. Table of variance analysis with the respective coefficients of variation (CV), minimum significant differences (MSD) and average squares (AS) for the variables of the shoot: height, number of leaves, dry mass and foliage area and for length, surface area, diameter, volume and dry mass of the root system in function of the application of L-glutamic acid and humic acid.

Analyzed variables	CV	DMS	Average Squares	
			Treatment	Repetition
Height (cm)	8.33	3.44	0.0833$^{n.s.}$	0.5277$^{n.s.}$
Number of leaves	9.12	0.95	0.0833$^{n.s.}$	0.111$^{n.s.}$
Shoot dry mass (g)	9.31	1.11	0.1821$^{n.s.}$	0.0102$^{n.s.}$
Foliage area (cm^2)	12.46	65.84	162.333$^{n.s.}$	156.22$^{n.s.}$
Root length (cm)	7.68	578.03	1064246.85**	164312.71$^{n.s.}$
Root surface area (cm^2)	9.29	244.15	241924.86**	6413.95$^{n.s.}$
Root diameter (mm)	4.72	0.10	0.0085$^{n.s.}$	0.0045$^{n.s.}$
Root volume (cm^3)	6.74	4.48	214.97**	6.8077$^{n.s.}$
Root dry mass (g)	6.68	0.54	2.6782**	0.0609$^{n.s.}$

***significant at 0,01; *significant a 0,05; $^{n.s.}$ non significant by the Tukey test.*

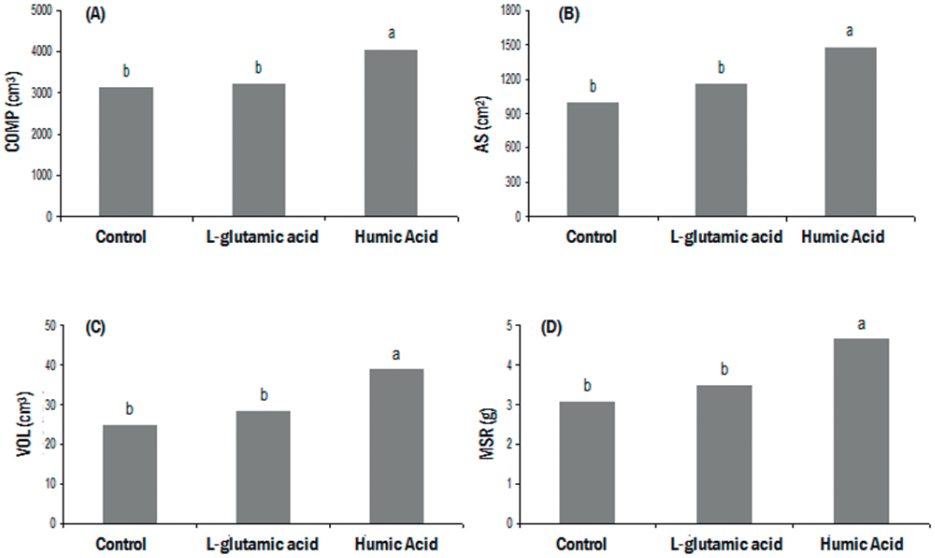

Figure 1. Length (LEN), surface area (SA), volume (VOL) and diameter (DIA) of the root system in function of the application of L-glutamic acid and humic acids. Curitiba – PR. Averages followed by the same letter do not differ between themselves, by the Tukey test at 5% of probability.

As for the effect of these substances over the number of leaves, height, foliage area and dry mass of the shoots, was not observed statistical differences (Figure 2).

The results are according with SARTO et al. (2010) that also verified beneficial effect of the humic substances, promoting greater number of tillers and greater foliage area in the end of the tillering periods, however according to the authors these effects disappear in the stage of plant growth.

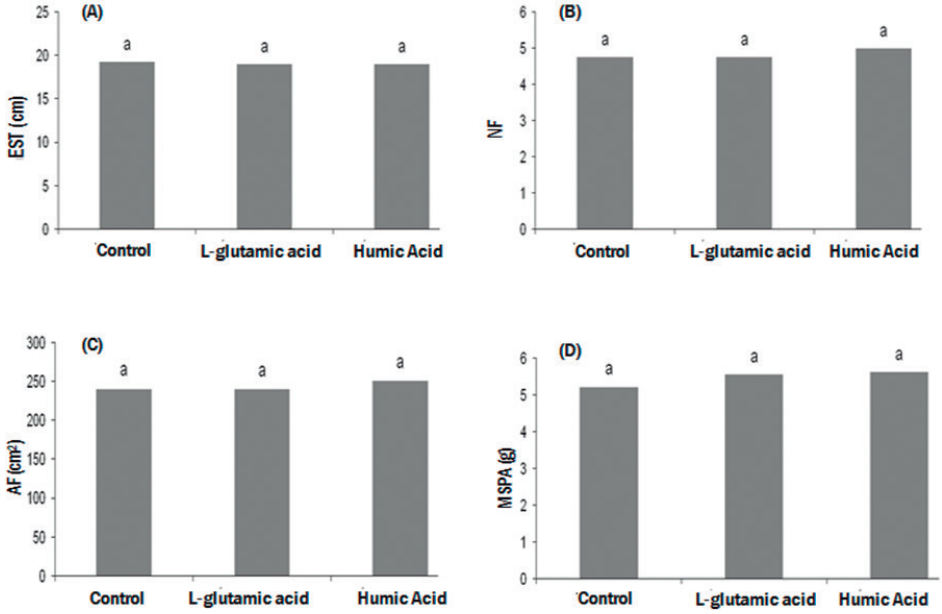

Figure 2. Height (HEI), number of leaves (NL), Foliage area (FA) and dry mass of the shoots (DMS) in function of the applied L-glutamic acid and humic acids. Curitiba – PR. Averages followed by the same letter do not differ between themselves, by the Tukey test at 5% of probability.

Conclusions

The humic acids influenced in the greater growth of the root system.

It was not observed increase over the variables of shoots in relation to the use of humic acids and of the L-glutamic acid.

It is verified the necessity of more studies in the crop complete cycle which prove the advantages in the use of humic acids.

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