ROOT DISTRIBUTION STUDY OF FORAGE GRAMINA UNDER CONSERVATION TILLAGE SYSTEMS, BY A TRACER TECHNIQUE

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ABSTRACT
The aim of this work is to evaluate the root activity patterns of three forage graminaceous species under different tillage systems. The field experiment was carried out during 1993-94 in a Mollisol under three tillage systems: plowing, chiseling tillage and subsoiling tillage system cultivated with ***Lolium multiflorum, Bromus catharticus*** and ***Phalaris aquatica***. Significant differences were found in lateral root distribution between tillage systems. Subsoiling tillage system treatment showed the largest presence of roots at 10 cm lateral distance from the plants. No differences in root activity at 10, 20, and 30 cm from the plant were found in chiseling tillage treatment. Plowing treatment showed a higher root activity in the first 20 cm from the plant. The total root activity was the highest in subsoiling treatment and significantly different from chiseling and plowing tillage systems.

KEYWORDS
roots, forage, tillage, tracer techniques.

INTRODUCTION
Tillage systems affect soil characteristics and its conservation condition and modify the root development and the soil volume explored. Papers about subsoiling tillage and chiseling tillage show an increase in water absorption and root penetration (Unger 1980). Other authors (Barrios *et al.*, 1993) report increases in forage production with a subsoiling tillage compared with a plowing tillage system. Different rooting habits may result in more efficient use of soil moisture and nutrients from various soil depths and lateral distances from the centre of plants.

The aim of this work is to evaluate the root activity distribution patterns of three forage crop species under different tillage systems.

MATERIAL AND METHODS
The field experiment was carried out in Esteban Echeverria, near Buenos Aires, Argentina; on a Mollisol with an Ap horizon 0-15 cm, silty clay loam with the following analytical properties: organic matter 4.9%; total N 0.09%; pH 6.7. A B2t horizon, clay loam is present at 90-130 cm depth.

A split plot design with three replications was used. Each main plot was one of the three tillage treatments: plowing tillage, chiseling tillage and subsoiling tillage at 15, 25 and 35 cm depth respectively.

Each main plot also had three forage grass species treatments: ***Lolium multiflorum, Bromus catharticus*** and ***Phalaris aquatica.***

Root activity was evaluated by a tracer technique, the procedures of which consisted of the soil injection of a Phosphorus-32 labelled Phosphoric acid solution, prepared by dilution and carrier (potassium dihidrogen phosphate) addition.

This was injected at 15, 25, 35 and 60 cm depth, in spring season in October 1994 and October 1995 respectively.

Fifteen days after labelling, to allow for stabilisation of P-32, samples of aerial parts of forage species were taken at 10, 20 and 30 cm lateral distance from the center of the labelled plants. All plant material was dried at 80½C, ground, and two-minute counts were made on a Geiger-Müller meter.

Statistical analysis was performed using analysis of variance procedures (Proc GLM; SAS, 1989). Homogeneity and normality were satisfactorily confirmed.

RESULTS AND DISCUSSION
Significant differences were found in the interaction tillage*distance. No significant differences were found either in the interaction tillage*specie or tillage*depth. When tillage*distance interaction was considered, the root activity values (test Tukey $P<0.05$) showed different root distribution between tillage systems.

These values (table 1) indicate the following considerations:

In the first 10 and 20 cm, root activity was high in plowing tillage system, rapidly decreasing at 30 cm lateral distance from the center of the plants.

The chiseling treatment had uniform distribution at the three distances considered, no significant differences were found in these values.

The subsoiling treatments showed the highest root activity in the first 10 cm lateral distance. Significant differences were found for all lateral distances.

The total root activity (figure 1), considering the three lateral distances in a hole, were significantly different. The subsoiling treatment had the largest root activity.

REFERENCES
Barrios. M.B; Buján A; Bozzo A. (1993) Efectos de las labranzas en suelos hidromórficos. Actas del XIV Congreso Argentino de la Ciencia del Suelo, Mendoza, p.365.

Böhm, W. 1979. Methods of studying root systems. Berlin, Springer-Verlag.188 pp.

Unger, P, W; Eck, H, V; Musick, Z, T; (1981) Alleviating plant water stress en Arkin y Taylor pp 379-393.

SAS Institute, Inc. 1989, SAS/SAT User's Guide, version 6, Fourth Edition, volume 2, cary, NC: SAS Institute Inc, 891-896.

Table 1
ROOT ACTIVITY (C.P.M.) ($P<0.05$) Critic value = 114

TILLAGE	DISTANCE (CM)	ROOT ACTIVITY (CPM)	TUKEY ($P<0.05$)
PLOWING	10	218	A
	20	106	A
	30	73	B
CHISELING	10	180	A
	20	127	A
	30	133	A
SUBSOILING	10	365	A
	20	162	B
	30	70	C

Means with different letters, within each tillage system, are significantly different ($P<0.05$) by the Tukey's test.