LEGUME SEEDLING DEVELOPMENT IN NO TILL PASTURE ESTABLISHMENT

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ABSTRACT
The objective of this study was to compare no-till and conventional seeding of pasture and their effects on legume establishment. The presence of residue cover reduced legume seedling establishment and weed population under no-till seeding. The reduction in establishment was associated with the physical impediment of the residue cover and the decay of seedling vigor when passing through that cover.

KEYWORDS
Forage legumes, no-till and conventional seeding, residue cover.

INTRODUCTION
Direct drilling area is increasing in the Pampean Region of Argentina, where it is usual to establish pastures after several years of cropping. The benefits of no-tillage agriculture are generally recognized as energy, water and time saving and reduction of soil erosion through maintenance of soil structure (Phillips *et al*., 1980). An additional benefit is the widening of pastures seeding opportunities and reduced interval between seeding and grazing.

Seeding a pasture following a crop may be done by conventional or no-till cultivation. The differences between systems are related to the conditions given to seeds for germination and establishment (Naylor *et al*., 1983). Conventional tillage improves the uniformity of physical conditions at soil surface and improves seeder regulation, increasing the possibility of placing seeds in safe sites. No-till cultivation maintains a residue layer that affects the work of the seeding mechanism but, may assure a higher soil moisture content and moderate temperature conditions, promoting seedling establishment.

The aim of this study was to analyze the difference in development and establishment of legumes when drilled conventionally or directly, evaluating also the effects of residue covering the soil.

MATERIALS AND METHODS
The experiment was carried out on a farm at the center of the Pampa (37 S, 61 W) in Argentina, during autumn and winter of 1994. Rainfall in this area average 1000 mm per year well distributed, soils are clayey and cropping is frequent.

A 105 hectare uniform paddock, previously cropped with oat, was selected. After harvest in early summer, half of the area was conventionally cultivated and the other half was treated 20 days prior to seeding with 4 l t/ha of glyphosate (N-(phosphonomethyl)glycine) to kill existing vegetation (principally Cynodon dactylon). To prevent insect damage to seedlings, insecticide was simultaneously sprayed.

Plant residue biomass was evaluated fifteen days after herbicide application (cutting with electric scissors at ground level 10 samples of 0.30*0.30 m^2 and oven dried 48 hs) and averaged 6200 DM kg/ha over the soil surface.

Both sectors were seeded in early autumn with the same no till seeder (Imasa S-2000, double disc no till seeder) with a mixture of red clover (*Trifolium pratense* L.), white clover (*Trifolium repens* L.), birdsfoot trefoil (*Lotus corniculatus* L.), tall fescue (*Festuca aruncinacea* Schreb.) and oat (*Avena sativa* L.). Diammonium phosphate was added in the seed row (50 kg/ha).

The first observation was done 30 days after seeding (DAS), to evaluate seedlings' appearance (number of legumes, grasses and weeds), and development of legumes (number of leaves and length of hipocotyledonal internode) at twelve randomized positions of 0.30*0.60 m^2 along two seed rows.

At 180 DAS the biomass and morphology of sixteen plants of red clover was observed (number of leaves, number of branches, plant dry matter (mg), length of principal root (cm), diameter of root under the crown (mm) and height of first branch (mm)).

Simultaneously, a second experiment was carried out at the same farm in the other nine direct drilled paddocks and three conventionally seeded ones. Residue cover was visually estimated in three rank categories: low, medium and high, where high was similar to the previously recorded at the first experimental site. These situations represent four treatments of different cover. Legume stands were recorded as previous described at 180 DAS.

Data were analyzed by ANOVA and differences between average values from both seeding conditions were tested by LSD at the 5% significance level.

RESULTS AND DISCUSSION
When the seed-bed was prepared conventionally, the legume stand 30 days after seeding was significantly higher than when no-till was practiced. This effect was similar for each legume species (Table 1a). Also more weeds emerged when the soil was cultivated.

The presence of residue cover in the direct drilled situation influenced site condition where seedlings had to develop. This observation was previously done by Teasdale and Mohler (1993) who recorded micro-environmental modifications at the seedling level and principally a decline of light transmittance as residue biomass increased.

Morphological changes, such as fewer growing leaves per plant and longer hipocotyledonal internode, were recorded on the three legumes (Table 1b), and may be assumed to be the seedling adaptations to a shaded environment caused by the residue layer. Novoplansky *et al*. (1994) also observed differences in plant development in response to shade and suggested these allows the plant to buffer its fitness under heterogeneous conditions. Nevertheless, the changes observed in our experiment may have reduced seedling vigor and caused the death of part of the population a few days after germination. Seedlings of shade-intolerant species might die even before emerging above the residue cover. Red clover seems to be less affected by shade than the other legumes, as indicated by less variation of the morphological changes recorded.

In addition to this, the legume cotyledons suffered from mechanical impediments of the residue cover, greatly affecting the initial stand of legumes as we saw in a previous work (Rossi *et al*., 1995). Although this impediments was related to the position and structure of the residue elements and may also be influenced by the size of the cotyledons, a thick layer of residue would also provide a physical barrier for a seedling to penetrate before it exhausted its energy reserves (Teasdale and Mohler, 1993).

Additionally, conditions under the residue benefit insects and other invertebrates which cause seedling damages (Grant *et al*., 1982) and losses at early stages of plant development (Byers *et al*., 1985). This effect may be higher on less developed seedlings, with a thin principal stem.

The similarity in the morphology of surviving plants under conventional and direct drilling condition after 180 DAS (Table 1c), suggest some plant compensation or the existence of less stressed gaps. The first branches were higher for plants that developed when no-till was used in coincidence with the higher cotyledon position previously observed. A greater length of the principal root was also observed which may be related to a less competitive situation (Table 1c).

When treatments with different cover were compared (Table 2), the stand establishment of red clover and birdsfoot trefoil decreased as dead residue cover increased. Small establishment differences were detected between direct drilled paddocks with low residue cover and conventionally seeded paddocks (no cover situation).

Therefore the presence of residue over the soil affected the stand population of legumes, the reduction of residue cover before seeding could be a principal management goal to improve seed bed condition for direct drilling pastures, especially when dense legumes stand is desirable. The use of devices to remove residue from the seeding row may be effective to combine a high legume establishment in the rows with less weeds appearance between seeding rows.

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Table 1
Seedlings establishment (30 DAS) and development (30 and 180 DAS), at two different drilling conditions.

A) Seedling/m² (30 DAS)			
	Drilling treatments		
Specie	Conventional	Direct	Drilling
Legumes	114	61	*
Red clover	88	26	*
White clover	114	34	*
Birdsfoot trefoil			
Grasses			
Oat	308	211	NS
Tall fescue	224	169	NS
Weeds			
Dicots	790	417	*
Monocots	39	9	*
Seedling development (30 DAS)			
	Number of expanded leaves		
Red clover	2.75	0.55	*
White clover	2.8	1.57	*
Birdsfoot trefoil	4.3	1.22	*
	Length of hipocotylendonal internode (mm)		
Red clover	2.37	9.1	*
White clover	3.56	10.32	*
Birdsfoot trefoil	2.35	9.05	*
B) Plant development (180 DAS)			
Number of leaves	8.00	8.11	NS
Number of branches	2.00	2.22	NS
Height of first ramification (mm)	3.40	7.55	*
Length of principal root (cm)	10.30	14.77	*
Root diameter under the crown (mm)	2.34	2.03	NS
Plant dry matter (mg)	185.80	152.80	NS

* Significative differences between drilling treatments (LSD, P<0.05)
NS No signicative differences

Table 2
Plants establishment (180 DAS) in paddocks with different residue cover when seeding

	Plants/m²		
Drilling treatments	Red clover	Birdsfoot trefoil	Total legumes
Conventional (no residue cover)	94 a	82 a	176 a
Direct drilling Low cover	66 b	59 ab	125 b
Direct drilling Medium cover	43 c	51 ab	94 c
Direct drilling High cover	42 c	29 b	71 c

Different vertical letters indicate significative differences between residue cover treatments (LSD, P<0.05).