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TILLAGE SYSTEMS IN THE ESTABLISHMENT OF PASTURES IN ARGENTINIAN SUBHUMID AREA

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Abstract

The effect of three tillage systems on the number of plants produced and forage production of a pasture the first year of establishment was assessed in this experiment. The components of the pasture were alfalfa (*Medicago sativa* L.*)*, tall fescue (*Festuca arundinacea* Shreb), orchard grass (D*actilys glomerata* L), and prairie grass (*Bromus unioloides)*. Treatments were three tillage systems: conventional tillage (CT), reduced tillage (RT), and direct sowing (DS). Sowing was performed with (NI) and without fertilizers (N0) in each treatment. A split-plot experimental design with two repetitions was used, with tillage being the main factor and the fertilization levels the secondary one. Results were subjected to ANOVA while means were compared by the Duncan Test Counts. These were conducted 90 days after sowing to determine the number of emerged alfalfa and grass seedlings. In November, before starting direct grazing, hand cut samples were taken to determine total biomass and also biomass production of each component of the pasture. Total stand plant and grass stand, was significantly affected ($P < 0.05$) by the tillage factor. Forage production of both alfalfa and grass, and total production was higher with conventional tillage (CT) and differed significantly ($P < 0.05$) from direct sowing (DS). The fertilizing effect and its

interaction with the tillage factor was not statistically significant ($P < 0.05$) for any of the components measured. Results indicate that direct sowing seems to condition grass plant stand and forage production of each of the pasture components in the year of establishment.

Keywords: Tillage, fertilization, alfalfa, grass, mixtures

Introduction

Pastures sown with alfalfa perform two important functions in farming: to provide food of good quality and in sufficient amount, and at the same time, to contribute to soil fertility recovery and improvement once the growing season is over. For these goals to be fully met it is essential to have pastures of great productivity and persistence. This is achieved with correct establishment of the pasture (Rossanigo, 1992). Carambula (1977) points the establishment technology and initial management among the most important factors that determine pasture productivity and persistence. Smith (1962) considers that soil refinement to achieve a uniform and firm soil surface is necessary for pasture establishment. For Rey (1999), direct sowing is normally accepted, though he adds that previous tillage is needed for pasture establishment. Direct sowing is considered an exclusive grain-farming alternative, however, adopting this technique for pasture establishment has the advantage of reducing erosion, improving water economy and controlling weeds. Pasture establishment with direct sowing systems is feasible (Fontanetto, Gambaudo y Keller, 1994). Then, the fact that the soil is not ploughed implies that N mineralization proceeds more slowly, making application of nitrogenous fertilizers necessary to meet crop requirements.

The aim of this paper was to assess the effect of three tillage systems with two fertilization levels on the number of seedlings and total biomass production and on each component before the first spring utilization.

Material and Methods

A plot was sown with 7 kg of alfalfa (cv. Romagnola), 3 kg of tall fescue, (cv. El Palenque) 3 kg of orchard grass (cv Currie), and 3 kg prairie grass (cv Martín Fierro) at the experimental field of National University of Rio Cuarto, on April 28th, 1999. The experimental area had been used for the five preceding years for a sequence of crops alternating corn and sunflower, under three tillage systems: conventional tillage (CT), gang plow, disk harrow with tooth harrow; reduced tillage (RT), disk harrow with tooth harrow; and direct sowing (DS) without previous tillage and glyfosate herbicide.

During the five years the option with and without fertilization was used; rates varying according to the crop planted. The pasture was established on sunflower stubble. The treatments were three tillage systems CT, RT and DS without previous tillage. In each of them planting was done with (NI) and without (N0) fertilizers.

The fertilizer used was diammonium phosphate at rates of 30 kg/ha applied at planting time. The latter was carried out with a direct sowing seeder, adjusted to meet the requirements of each treatment. A split-plot experimental design with two repetitions was used, with tillage as the main factor and fertilization levels as the secondary one. Results were previously turned to $\text{Log}_{10} + 1$**,** and subjected to ANOVA while means were compared with the Duncan Test.

The number of emerged alfalfa and grass seedlings was counted 90 days after sowing. In October, leveling cutting and weed mechanical removal were carried out with a mower and the forage was collected with a rotary baler. Before starting defoliation, hand cut samples were taken to determine total biomass and also the biomass of each pasture component. After being separated into alfalfa and grasses, the material was dried in a forced-air stove at 105º C for 12 hrs and then weighed to determine the amount of dry matter (DM).

Results and Discussion

Data on number of emerged plants in the establishment period for each treatment, expressed in number of plants of alfalfa, grasses and the sum of both /0.175 m^2 is presented in Table 1. The number of alfalfa plants was not significantly affected by the tillage factor and fertilization level, while grass plant stand and the addition of both was significantly affected ($P < 0.05$) but was not affected by the fertilization factor. In all cases, the effect of the tillage x fertilization interaction was negative.

Forage production of both alfalfa and grasses and total production at the time of the first grazing in Spring in the month of November, was higher with conventional tillage (CT) and differed significantly ($P < 0.05$) from direct sowing though not from reduced tillage (RT). The fertilizing effect and its interaction with the tillage factor was not statistically significant for any of the components of the pasture.

Fontanetto et al. (1995) did not find differences in plant number when different tillage systems and N fertilization rates were evaluated. However, there were differences in dry mater production due to N fertilization. In contrast, in the present study we did not fend differences due to fertilization ($P < 0.05$), which might be due to the law fertilization rates.

Under the conditions of this experiment, pasture direct sowing seems to condition grass plant stand and forage production of each of the pasture components at least at the time of the first spring grazing in the year of establishment.

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Table 1 - Number of alfalfa, grasses and total plants in a pasture sown under different tillage and fertilization treatments in Rio Cuarto, Argentine

TREATMENTS		NUMBER OF PLANTS / 0,175 M^2		
Tillage	N	Alfalfa	Grasses	Total
Direct sowing	With	8.8	7.3	16.1
	Without	8.8	4.5	13.3
	Mean	8.8	5.9b	14.7b
Reducid Tillage	With	9.4	8.1	17.5
	Without	10.8	8.1	18.9
	Mean	10.1	8.1a	18.2a
Conventional Tillage	With	11.2	10.6	21.8
	Without	10.4	12.1	22.5
	Mean	10.6	11.3a	21.9a
SIGNIFICANCE				
Tillage		n.s.	*	*
Fertilization		n.s.	n.s.	n.s.
Tillage x fertilization		n.s.	n.s.	n.s.
Variation Coefficient (%)		23.1	31.0	23.5

Note
n.s: non significant (P<0,05)
***** : Statistically significant differences (P<0,05)
Means with the same letter in the same column do not differ significatly (P<0,05)

Table 2 - Forage production of alfalfa and grasses and total production in a pasture sown under different tillage and fertilization treatments in Rio Cuarto, Argentine

TREATMENTS		NUMBER OF PLANTS / 0,175 M^2		
Tillage	N	Alfalfa	Grasses	Total
Direct sowing	With	717	82	799
	Without	363	82	445
	Mean	540b	82b	622b
Reducid Tillage	With	1185	375	1560
	Without	993	423	1416
	Mean	1089a	399a	1488[a]
Conventional Tillage	With	1046	405	1451
	Without	852	283	1135
	Mean	949a	344a	1293a
SIGNIFICANCE				
Tillage		n.s.	*	*
Fertilization		n.s.	n.s.	n.s.
Tillage x fertilization		n.s.	n.s.	n.s.
Variation Coefficient (%)		6.32	38.8	6.73

Note

n.s: non significant (P<0,05)

***** : Statistically significant differences (P<0,05)

Means with the same letter in the same column do not differ significatly (P<0,05)