INFLUENCE OF THE FUNGAL ENDOPHYTE ACREMONIUM LOLII ON DRY MATTER YIELD OF PERENNIAL RYEGRASS IN GALICIA, SPAIN

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ABSTRACT

A field experiment studying the impact of the ryegrass endophyte (*Acremonium lolii*), was carried out at two locations in Galicia (Northwest Spain): Mabegondo on the Atlantic coast and Puebla de Brollón in the interior. Of 56 half-sib families of Galician perennial ryegrass (*Lolium perenne* L.) studied, 28 held endophyte (E+) and the other 28 not (E-). All these families were established in trial plots in 1992. Significant differences between E- and E+ families were obtained, and E+ families had a higher ($P < 0.05$) first cut, spring and total yield than E- families at Puebla de Brollón (dry location) in the third year after planting. The infection of perennial ryegrass with some strains of *A. lolii* seems to benefit the host in stressful conditions. In some areas of Galicia, climatic conditions are often stressful for perennial ryegrass and the chances of E+ plants being favored by either natural or artificial selection seems high.

KEYWORDS

Acremonium lolii, Lolium perenne, Galicia, endophyte, dry matter

INTRODUCTION

There is considerable interest in the effects of the ryegrass endophyte (*Acremonium lolii*) upon pasture production and animal performance. This symbiosis apparently has several advantages for the ryegrass. These advantages range from improved tolerance to biotic and abiotic stress (van Heeswijck and McDonald, 1992) to enhanced growth (Latch *et al*., 1995). In a spaced-plant experiment in the United Kingdom, Lewis & Clements (1990) showed positive and negative yield responses of perennial ryegrass infected with *Acremonium lolii*. In France, on an agronomical experiment with breeding material of perennial ryegrass (families), Ravel *et al*. (1995) reported that some strains of *A. lolii* seemed to benefit perennial ryegrass in dry locations. The objectives of this study were to decide if dry matter in perennial ryegrass from Galicia is affected by presence of endophyte.

MATERIALS AND METHODS

In perennial ryegrass, the occurrence of *A. lolii* was assessed in plot trials established at two locations: Mabegondo Agronomic Research Station (La Coruña) and Puebla de Brollón (Lugo). *A. lolii* was detected by removing epidermal strips from the inner surface of green leaf sheaths and staining the strips with aniline blue (Latch *et al*., 1984). Five plants per family and four tillers per plant were examined per location. Each family was derived from one donor plant obtained by one generation of random mating between plants from several wild populations (Oliveira, 1992) after mass selection. Thus, the set of families had different geographic origins in Galicia. Also, it was likely that there were a variety of strains of *A. lolii* within this set of families. In November 1992 each family was sowed in trial plots (size $1m^2$). The plots were sown at a rate of 3.0 g/m^2 in a randomized block design with three replicate blocks. Fertilizer was applied to each plot at a rate of 150 kg N-P-K/ha before sowing and 40 kg N/ha after each cut. Herbage yields were assessed at four or five weeks intervals. Yields for each harvest were accumulated to obtain a total for spring (March to June harvests), summer (July to September harvests), autumn (October to November harvests). The yields for the first harvest of each year were analyzed separately. For all traits, family's E+ and E- were compared using the analysis of variance. Data from plots were analyzed using the following model:

$$Xij = Mu + ri + ej + Eij$$

where: Xij is the phenotypic value, Mu is the overall mean, ri is the replication effect, ej is the entry effect, and Eij is the residual. All the statistical analyses were performed using SAS (SAS Institute 1995).

RESULTS AND DISCUSSION

The ten plants from each half-sib family examined for the presence of *A. lolii* infections were, always, either E+ or both E-. The proportion of E+ families were 50%. The water supply deficit during July, August and September is given for each location in Figure 1. Significant differences between E- and E+ families were obtained only in the dry location (Puebla de Brollón) for some traits evaluated in the third year after planting (Table 1). In all comparisons showing a significant difference there was a positive response to A.lolii infection. The traits showing significant differences were the first cut, the spring harvest and the total yield of the third year in Puebla de Brollón. Fifty percent of Galician breeding material examined (half-sib families) hold *Acremonium lolii*. This value is superior to the infection percentages found by Ravel *et al*., (1995) in French perennial ryegrass families. In Portugal, Valle Ribeiro *et al*. (1996) showed that 12 of 16 wild populations of perennial ryegrass were endophyte infected. In all comparisons between E+ and E- families for seasonal yields that were significantly different, E+ families had a superior rating for the trait. Therefore, it appeared that endophyte infection benefited perennial ryegrass, at least in some conditions, and was never detrimental in contrast to results from the United Kingdom (Levis and Clements, 1990). The yield at the first cut, at the spring and the total yield of the third year were increased by the infection. Herbage from the spring harvest is often conserved as silage, and increased yields at this time would be of benefit to farmers. Improved drought tolerance due to *A. lolii* infection could explain the improvement of a total yield of the third year in Puebla de Brollón.

The results from the present work agree with Ravel *et al*. (1995) and provide some evidence that *A. lolii* infection could have an impact on dry matter yields of perennial ryegrass in some conditions in Galicia. However, generalizing the effects of infection is not possible because of the interactions between host genotypes, strains of *A. lolii*, environmental and cultural factors. In the non stressed areas of grassland there may be no selective advantage of E+ plants, which could explain why E- plants are common in European pastures (Lewis 1993).

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Table 1
Effects of endophyte infection (E- or E+) on yields (t DM/ ha), in a set of families of perennial ryegrass in trial plots.

	Location			
	Mabegondo		Puebla de Brollón	
	E-	E+	E-	E+
1993				
First cut yield	4.4	4.4	2.4	2.2
Spring yield	5.1	4.8	4.0	4.0
Summer yield	2.2	2.2	2.3	2.4
Autumn yield	3.0	2.9	2.7	2.7
Total yield	14.7	14.3	11.4	11.3
1994				
First cut yield	0.7	0.7	2.9	2.9
Spring yield	4.4	4.6	4.0	4.0
Autumn yield	0.7	0.8	1.7	1.8
Total yield	5.8	6.1	8.6	8.7
1995				
First cut yield	1.6	1.7	2.3	2.4 *
Spring yield	8.7	8.3	2.8	3.0 *
Summer yield	0.8	0.9	1.6	1.6
Autumn yield	2.1	2.2	1.9	2.1
Total yield	13.2	13.1	8.6	9.1 *

* Significant differences between means at P<0.05.

Figure 1
Water deficits (cumulated data from July, August and September) in two locations: Mabegondo (Ma) and Puebla de Brollón (Pu).