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Nitrogen fixation of annual Medicago-Rhizobium associations during cool season in Mediterranean dry areas

Introduction

Annual medics represent a great potential of forage production in areas suffering shortage of livestock food. Low winter temperature delays the growth and reduce nitrogen fixation of those plants in Mediterranean dry areas. The objective of the experiment was to investigate yield and N₂ fixation of Medics-Sinorhizobium associations at low temperature. The choice of associations well adapted to cold conditions is crucial in order to extend the grazing period (Sultan *et al.*, 2001)

Methods

The experiment was carried out at ICARDA in Syria (Aleppo) in 1999. Three accessions were used, two of *M. aculeata*, accessions 80 (A) and 5099 (B) and one of *M. rigidula*, accession 716 (R). Each accession was inoculated with *Sinorhizobium* strains appropriate for nodulation under low temperature (*S. meliloti* strain 620 with accession A, strain 508 with B and strain BZI with R). Yield was determined at the end of cold period, in March and at physiological maturity, in May).

The percentage of fixation-derived shoot nitrogen was quantified at 4 growth stages using ¹⁵N dilution technique with barley as reference plant.



Results

	End of cold period		At maturity	
	inoculated	control	inoculated	control
A (<i>M. aculeata</i> 80)	476 ^{cd}	377 ^d	2331 ^d	2096 ^e
B (<i>M. aculeata</i> 5099)	757 ^a	566 ^{bc}	3110 ^{bc}	2730 ^{cd}
R (<i>M. rigidula</i> 716)	715 ^b	504 ^c	3706 ^a	2810 ^{cd}

For a given period, data with similar superscript letters do not differ at p<0.05 level, LSD test

Table 1: Production of dry matter (kg ha⁻¹, at the end of cold period and at maturity)

At the end of cold period, accession B exhibited the highest DM production, accession A showed the lowest value (table 1). Inoculation increased significantly the DM production by 35% for B and 42% for R. Therefore, *M. aculeata* 5099 showed the best potential in cold conditions. At physiological maturity, dry matter yield was significant, amounting from 2 to 3.7 tons per ha. *M. rigidula* 716 (R) is the most performing, with the highest inoculation effect.

Conclusion

The study showed a genotypic variability in the response of Medics-*Sinorhizobium* associations to low temperature in Mediterranean areas. Therefore, the use of more cold tolerant accessions should contribute to satisfy forage needs during cool season.

	5-7 leaves		16-18 leaves		End flowering		Maturity	
	Total N in plant (kg ha ⁻¹)							
A	2 ^{bc}	7 ^b	30 ^b	66 ^b				
B	3 ^a	14 ^a	87 ^a	129 ^a				
R	2 ^c	13 ^{ab}	104 ^a	129 ^a				
Ndffa (kg ha ⁻¹)								
A	0.2 ^a	1 ^a	19 ^b	41 ^b				
B	1.6 ^b	8 ^a	63 ^a	109 ^a				
R	0.6 ^c	7.8 ^a	86 ^a	113 ^a				
Ndffa (%)								
A	10 ^c	14 ^b	62 ^c	62 ^b				
B	56 ^a	58 ^a	71 ^b	85 ^a				
R	35 ^b	63 ^a	83 ^a	87 ^a				

Data in same column with similar superscript letters do not differ at p<0.05 level, LSD test.

Table 2: Nitrogen fixation (total N in plants, amounts of N derived from fixation; Ndffa and percentages of N derived from fixation ; %Ndffa) at different growth stages

Nitrogen fixation was initiated at low temperature, as early as growth stage 5-7 leaves (table 2). Accession A had the lowest N fixation activity among the accessions tested. Percentages of N derived from fixation increased regularly during growth and reached 62, 85 and 87% at maturity stage for A, B and R accessions respectively. Extrapolated to a field surface, the N fixed amounted to 41, 109 and 113 kg.ha⁻¹ for A, B and R accessions respectively.