ISSN 1510-7809

LOTUS NEWSLETTER 2005
Volume 35, Number 2

Editor: M. Rebuffo
INSTITUTO NACIONAL DE INVESTIGACION AGROPECUARIA

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Front cover: The photographs on the front cover exhibit one specimen of *Lotus oroboides* (Humb., Bonpl. and Kunth) Ottley, from Chihuahua, Mexico (MEXU 130133) related to botanical study performed by Stenglein and Arambarri (pp. 174-181). On the left, the specimen collected by Richard M. Straw and Michael Forman on 11-08-1960 at Cerro Mohinora, 10 miles south of Guadalupe y Calvo, (det. in duplicate by R. Mc Vaugh). Habitat: steep slopes with pine-oak-juniper forest; small openings near streams. Elev. 2300-2400 m. On the right, an enlarged view of its dehiscent, reddish brown, linear-oblong and puberule pods.

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Epidermal features of *Lotus oroboides* =*Ottleya oroboides* (Leguminosae: Loteae)

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Introduction

Lotus oroboides (Humb., Bonpl. and Kunth) Ottley ex Kearney and Peebles is distributed from southern United States to north-central part of Mexico. It is a polymorphic species adapted to a broad range of habitats. Since was described by the first time as *Tephrosia oroboides* by Kunth (1823) a considerable disagreement has been existed among systematists about the generic and specific delimitation, and if this species should be treated as one or two species and/or varieties.

The polymorphism of *L. oroboides* was attributed by Ottley (1944) to the existence of hybrids, and she created two varieties: (*i*) *Lotus oroboides* var. *plebeius* (Brandegee) Ottley, and (*ii*) *L. oroboides* var. *ramulosus* (M.E. Jones) Ottley. Later, Isely (1978) cited two new combinations for this species (*i*) *L. oroboides* var. *nanus* (A. Gray) Isely, and (*ii*) *L. oroboides* var. *nummularius* (M.E. Jones) Isely. Isely (1981) reported the possibility that this species would include several ecotypes influenced by local environmental conditions or perhaps it may be a consequence of genetic infiltration, as was interpreted by Ottley (1944). Barneby (1989) on the basis of his observations included all (species and varieties), into two species (*i*) *L. plebeius* (Brandegee) Barneby, with dimorphism between the lower and upper leaves, and frequently leaves 3-4 foliolate, and (*ii*) *L. oroboides* (Humb., Bonpl. and Kunth) Ottley ex Kearney and Peebles with upper leaves 7-9 foliolate. Later, Sokoloff (1999) suggested that the New World taxa should be excluded from the genus *Lotus* L., and referred to the genera *Acmispon* Raf., *Hosackia* Benth., and *Syrmatium* Vog., and created the genus *Ottleya* D.D. Sokoloff to contains the species of *Simpeteria* Ottley, including *L. oroboides* as *Ottleya oroboides* (Humb., Bonpl. and Kunth) D.D. Sokoloff, however the author did not mention the varieties.

We suppose that the polymorphism exhibited by this species may be present in its anatomical characters. In fact, the aim of this study was to establish the probable existence of relationships among the exomorphology polymorphism and variability in epidermal characteristics.

Materials and methods

The study was performed by using specimens from the Herbario Nacional de Mexico (MEXU), Instituto de Botánica, Departamento de Biología, Universidad Nacional Autónoma de Mexico. Dried plant materials are deposited in the Herbario del Área de Botánica, Facultad de Ciencias Agrarias y Forestales (LPAG), Universidad Nacional de La Plata, Argentina. The six specimens studied from Chihuahua (C) and Durango (D), their collections and growth sites with altitude (m a.s.l.), collection date and vouchers are detailed in Table 1.

Three mature, fully expanded and unshaded leaves positioned on the middle of each specimen were selected for the study. Dried leaves were reconstituted in water with a drop of detergent and dried in oven at 30-35 ºC for 24 h (D' Ambrogio de Argüeso 1986). To avoid alterations of the leaf samples each one was fixed in formalin: glacial acetic acid: 50% ethanol (FAA). The leaflets become transparent after treatment according to the method of Dizeo de Strittmatter (1973). Epidermal tissue was surveyed with a light microscope. The leaflet area examined was 1 cm^2 located in the centre of the mid-lamina, and in the intervenial area, on both the adaxial and the abaxial leaflet surfaces. Trichome density was established by counting the number of trichome basal cell. Trichomes located above leaf veins and all the trichomes, stomata and epidermal cells that were intersecting the edges of the observational area were not counted. Results were expressed per unit of leaf area (mm^{-2}). Stomatal index was calculated as: [number of stomata / (number of stomata + number of epidermal cells)] x 100 (Salisbury, 1927). Measurements were taken with an ocular micrometer. Stomatal length (guard cells length) and width (interdorsal wall distance) were determined based on measurements performed on 25 replicates, respectively. Comparison of the trichome density, stomatal index and stomata size were performed by means of the *t*-test at a probability level of 0.05. Images were obtained with a colour PAL CCD camera attached to a light microscope and they were captured and digitalized by using Photo Express 1.0 software.

Table 1. *Ottleya oroboides* (Humb., Bonpl. and Kunth) D.D. Sokoloff (Leguminosae: Loteae)

Identity	Collection site	Growth site	Collection altitude (m a.s.l.)	Collection date	Vouchers
C 1641	**Chihuahua** 'Casas Grandes' (Mexico)	yellow lime soil; slopes with grasses	1450	1982-09-23	P. Tenorio *1641* and C. Romero (MEXU)
C 1903	**Chihuahua** 'El Molinito' (Mexico)	yellow soil; in pine forest area	2600	1982–09-30	P. Tenorio *1903* and C. Romero (MEXU)
C 10016	**Chihuahua** W de 'Ocampo' (Mexico)	yellow clay soil; in pine forest area	1750	1985-09-29	P. Tenorio *10016* C. Romero, J. Ignacio, and Patricia Davila (MEXU)
D 649	**Durango** N de 'El Salto' (Mexico)	in black soil; slopes in pine forest area	2200	1982-06-27	P. Tenorio *649* C. Romero, and R. Hernández (MEXU)
D 4169	**Durango** W 'Tepehuanes' (Mexico)	white lime soil; in pine forest area	2590	1983-08-27	P. Tenorio *4169* R. Torres, and Eva Torrecillas Nevarez (MEXU)
D 6047	**Durango** W 'El Salto' (Mexico)	yellow clay soil; in pine forest area	2100	1984-06-29	P. Tenorio *6047* C. Romero, and T. Ramamoorthy (MEXU)

Results and discussion

Anticlinal cell walls thickness in surface view, in the *O. oroboides* sample D 649 was statistically different on both the adaxial and the abaxial epidermis respect to the other specimens (Table 2; Figure 1a-d). Anticlinal cell wall patterns were straight to curved (C 1641, C 10016, D 649, and D 6047), curved to undulate U-shaped (D 4169) and undulate U-V-shaped (C 1903) (Figure 1a-d). This result coincides with the relationships found among the variability of anticlinal cell wall patterns with the environmental conditions where the species grow, and this waviness of cell walls have been found associated with environmental factors such as latitude, altitude and combined temperature and precipitation (Baas, 1975; Steiner, 1999).

Trichome density on the adaxial and the abaxial leaf surfaces was different among *O. oroboides* specimens investigated (Figure 2a). As a general rule, the abaxial leaf surface presented more trichomes than the adaxial one (except for C 10016). Furthermore, the *O. oroboides* samples from Durango always presented more trichomes than the samples from Chihuahua (Table 2; Figure 2a). Although Stace (1965) reported that trichomes density vary within leaves of plants that are grown under different environmental conditions, there are currently few evidences upon the environmental effect on trichome number (Bird and Gray, 2003). Since *O. oroboides* samples were collected from different sites, differences in trichomes density on both adaxial and abaxial epidermis might have been due to the environmental influence on trichome development and/or to genetic diversity among samples.

Table 2. Leaf epidermal characteristics of *Ottleya oroboides* (Humb., Bonpl. and Kunth) D.D. Sokoloff (Leguminosae: Loteae). Values in parentheses are means.

Identity	**Leaflet Surface**	**Anticlinal cell Wall patterns**	**Anticlinal cell thickness** (µm)	**Stomatal index** (%)	**Stomata length** (µm)	**Stomata width** (µm)	**Trichome density** (mm^{-2})
C 1641	adaxial	straight to curved	1-3 (1.3)	17-19 (17.4)	25-30 (27.4)	20-25 (22.6)	0-4 (2.0)
	abaxial	straight to curved	1-3 (1.3)	13-14 (13.2)	25-35 (27.8)	20-25 (23.6)	0-8 (6.0)
C 1903	adaxial	undulate U-V-shaped	1-2 (1.1)	15-16 (15.8)	25-30 (25.2)	20-25 (20.2)	0-1 (0.8)
	abaxial	undulate U-V-shaped	1-2 (1.3)	14-15 (14.4)	25-35 (30.6)	20-30 (25.4)	0-8 (4.0)
C10016	adaxial	straight to curved	1-3 (1.4)	14-16 (14.9)	25-35 (29.6)	20-30 (24.6)	0-8 (2.8)
	abaxial	straight to curved	1-3 (1.6)	10-12 (11.2)	25-35 (28.2)	20-30 (24.8)	0-8 (2.0)
D 649	adaxial	straight to curved	4-8 (5.4)	15-16 (15.3)	20-25 (24.0)	20-25 (20.6)	0-16 (7.2)
	abaxial	straight to curved	4-8 (5.6)	8-9 (8.6)	25-30 (25.6)	20-25 (23.0)	8-20 (12.4)
D 4169	adaxial	curved to undulate U-shaped	1-1 (1.0)	12-13 (12.9)	25-30 (27.6)	20-25 (23.4)	16-32 (22.4)
	abaxial	curved to undulate U-shaped	1-1 (1.0)	8-9 (8.6)	25-30 (27.2)	20-25 (23.6)	20-40 (27.6)
D 6047	adaxial	straight to curved	1-1 (1.0)	22-23 (22.2)	20-25 (23.4)	15-20 (19.4)	8-20 (13.2)
	abaxial	straight to curved	1-1 (1.0)	12-13 (12.9)	20-25 (23.2)	15-20 (19.4)	28-40 (33.6)

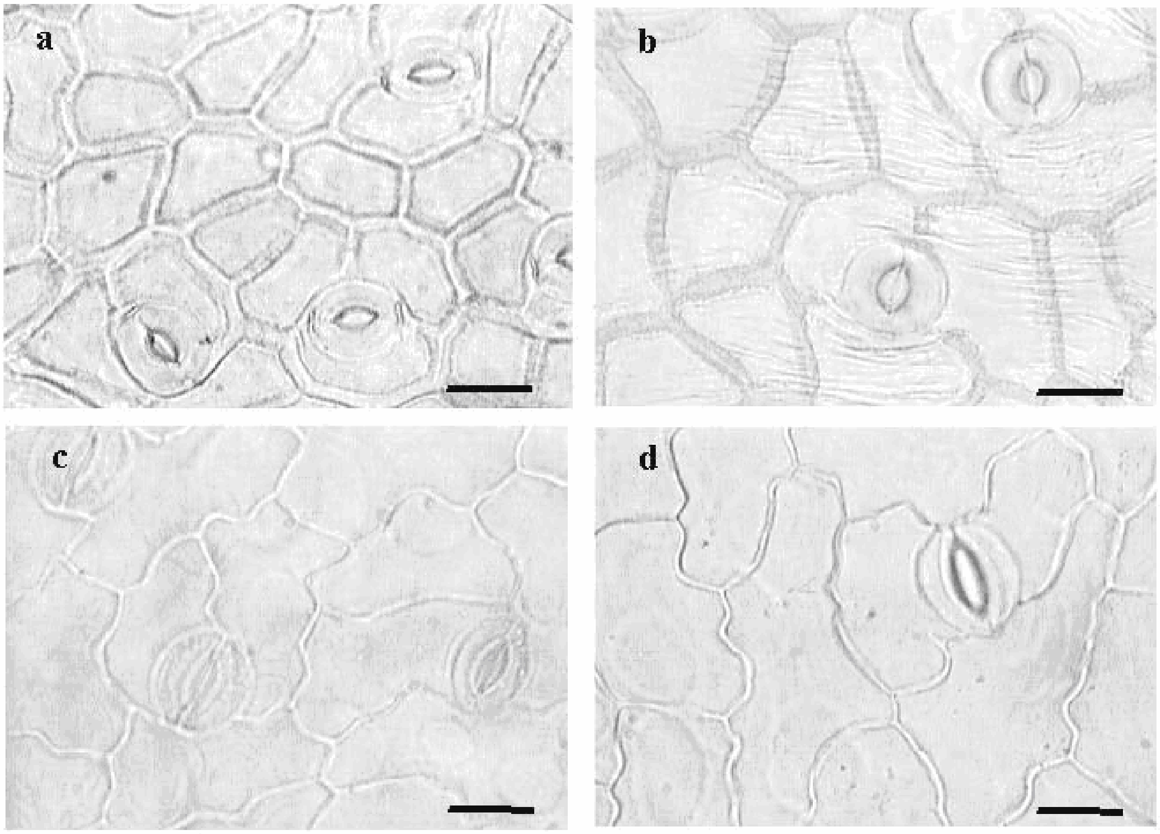
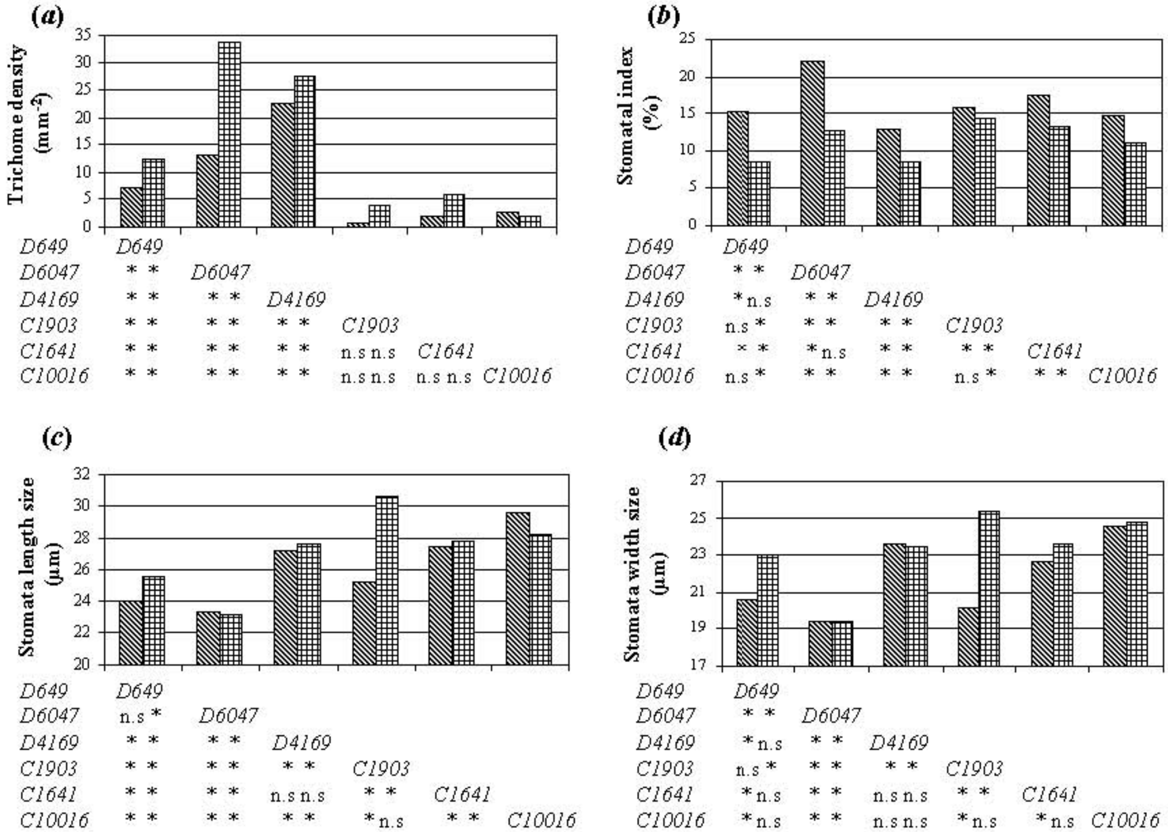


Figure 1. Ligth microscope images of epidermis in surface view of *Ottleya oroboides* (Humb., Bonpl. and Kunth) D.D.Sokoloff. **(a, b)** sample **D 649**: anticlinal epidermal cell walls straight to curved and thick, periclinal cell walls exhibiting cuticular ornamentation on the abaxial surface. **(c, d)** sample **C 1903**: anticlinal epidermal cell walls undulate U-V-shaped and thin, periclinal cell walls without cuticular ornamentation. **a** and **c**: adaxial epidermis; **b** and **d**: abaxial epidermis. Bars: 20 µm.

Stomatal index of the *O. oroboides* leaflets ranged from 12.9% to 22.2% on the adaxial surface and from 8.6% to 14.4% on the abaxial surface (Table 2). Statistically significant differences were observed in stomatal index among *O. oroboides* samples (Figure 2b). In addition, the stomatal index value was always higher on the adaxial epidermis than on the abaxial one.

Stomatal measurements were 20-30 µm long and 15-30 µm wide on the adaxial surface, and 20-35 µm long and 15-30 µm wide on the abaxial surface (Table 2). The stomatal size differed significantly among *O. oroboides* samples (Figure 2c-d). Although, the biological significance of the existence of different stomata sizes remains to be determining, it might be related to the plant's ability to withstand water stress and/or differences in gas-exchange.



*statistically significant differences at a 0.05 probability level.
n.s.= non significant differences at a 0.05 probability level.

Figure 2. Statistical results of data from leaf epidermal characteristics of *Ottleya oroboides* (Humb., Bonpl. and Kunth) D.D.Sokoloff on both the adaxial (striped) and abaxial (cross-hatched) surfaces. **(a)** trichome density; **(b)** stomatal index; **(c)** stomata length; **(d)** stomata width. Each pair of columns corresponds to the measurements performed on the *O. oroboides* sample, indicated underneath. The tables presented below the figures correspond to the comparison of the means by the *t*-test. Each column shows the mean compared with the correspondent mean of the *O. oroboides* sample indicated in the column on the left of the table.

Conclusion

Our results demonstrated that exomorphological differences correlates with the variability of epidermal microcharacters. We believe that *Lotus oroboides = Ottleya oroboides* have been evolved given varieties or subspecies.

Acknowledgments

We thank to Mario Sousa S. and Alfonso Delgados S., Herbario Nacional de Mexico (MEXU), who gift the studied specimens to Herbario de Agronomía de La Plata (LPAG).

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Lotus Newsletter (2005) Volume 35 (2), 182-186.

Responses of mycorrhizal infection in the drought resistance and growth of *Lotus glaber*

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Introduction

The drought stress is considered the main factor that imposes limitations to yield crops. The effects of water deficiencies depend of several factors such as its intensity, duration, phenologycal phase of growth and genetic resistance capacity of plants (Panozzo and Eagles, 1999).

In the pampas lowlands, water limitation is usually an environmental restriction and in spite of natural *Lotus glaber* drought tolerance, this factor affects its persistence and forage production in grassland community.

The arbuscular mycorrhizal are fungus that live in roots of a great number of plant species, enhancing host drought resistance modifying soil-plants water relations and increasing water absorption capacity (Ruiz-Lozano et al. 1995; Augé et al 1987; Subramanian et al. 1995). Moreover it is known that plants with mycorrhizal roots infection recover faster compared with plants without infection, in water stress conditions (Al-Karaki 1998).

In severe drought stress conditions, several reports demonstrated that leaf numbers, chlorophyll contents, stomata conductance and rate of transpiration were greater in plants with mycorrhizal roots infection compared with plants without mycorrhizal infection (Beltrano *et al*, 2003).

The response of *Lotus glaber* to mycorrhizal infection is practically unknown. Therefore, the objective of this work was to study the mycorrhizal infection response of *Lotus glaber* in different water stress conditions with the purpose of incorporate these adaptative mechanism to reach great potential forage yield in *Lotus glaber*, in abiotic stress conditions.

Materials and methods

Seeds of *Lotus glaber* were disinfected with Ca hypochlorite, washed thoroughly and sown in 0,5 L pots filled with substrate composed of a mixture of cultured soil (Argiudol vértic soil, containing 50 ppm Phosphorus and pH 6,8)-vermiculite and perlite (2:1:1), tindalized previously. Pots were placed under natural conditions in a greenhouse at La Plata, Argentina (34º S.L., 54º W.L.). Inoculum (1 g) composed by a mixed of soil, spores (50 spores/g inoculum), mycelia and root fragments of *Trifolium sp*. plants, colonized by Glomus mosseae was incorporated to the substrate of half plants at sowing time. The rest of plants were not inoculated. Inoculated and not inoculated plants were subjected to the following treatments 45 days after sowing (DAS): a) Control (C) watered daily, to maintain solute potential to field capacity values (-0.03 Mpa) along all trial; b) Stress (S) plants subjected to water stress by withholding watering, reaching substrate solute potential approximately -1.3 Mpa, and maintain this value during all treatments; c) ABA plants were sprayed with 10^{-5} M ABA solutions. The experimental design was a randomized blocks with 3 replicates. Seventy days after sowing and at 10 days intervals, 5 plants of each treatment were collected to determine morphological parameter such as plant height (H), leaf area (LA), roots volume (RV) and roots length (RL). Fresh and dry weight, oven drying at 60 ºC until constant weight, were determined in leaves (LFW/LDW), shoots (SFW/SDW) and roots (RFW/RDW). Colonization development by Glomus mosseae was determined in roots at 80, 100 and 120 days after sowing. It was evaluated according to Trouvelot et al. (1986) method and expressed as intensity of colonization (M %). The roots were cleared with 10% KOH and stained with trypan blue in lacto-phenol (Phillips and Hayman, 1970). Thirty randomly chosen root fragments of 1 cm long were mounted on slides and examined microscopically. M % was calculated as the ratio of infected roots over total root fragments. ANOVA was applied for all parameters studied, and Tukey test was used to separate means with significant differences.

Results and discussion

All treatments had significant higher and uniform percent of mycorrhizal infection. These results are in agreement with Bryla and Duniway (1997) and Morte *et al*. (2001) for mycorrhizal inoculated plants, since water stress did not affected the proportion of mycorrhizal infection (Table 1).

Table 1. Intensity of root colonization (M %) inoculated with *Glomus mosseae* evaluated at 80, 100 and 120 days after sowing (DAS), in control, stressed and ABA treated plants.

Treatments	80 DAS	100 DAS	120 DAS
C	81.73	91.1	91.06
S	76.5	90.53	85.4
ABA	82.1	91.2	86.6

Inoculated plants growing to field capacity had a significant increase in aerial parameters as SDW and a significant reduction in LA and LDW (Table 2). In roots parameters inoculated plants growing to field capacity had a significant increase in RV, RFW and RDW and a significant reduction in RL compared with not inoculated plants at 80 DAS (Table 3). Inoculated plants subjected to water stress treatments had a significant increment in aerial parameters as LA, LFW and SFW (Table 2) and in roots parameters as RV and RDW (Table 3) meanwhile a significant reduction in RL (Table 3) compared with not inoculated plants for same treatment. Inoculated plants subjected to ABA treatments showed an significant reduction in aerial parameters as LA, LFW and LDW (Table 2), and roots parameters as RV and RFW (Table 3) compared with not inoculated plants for same treatment.

Table 2. Height (H), leaf area (LA), fresh and dry weight of leaves (LFW/LDW) and shoots (SFW/SDW), in not inoculated (NI) and inoculated (I) *Lotus glaber* plants with *Glomus mosseae*, and treated with ABA or subjected to water stress (S), after 80 days after sowing.

Treatments	H (cm)	LA (cm^2)	LFW (g)	SFW (g)	LDW (g)	SDW (g)
NI-C	42.42a	167.42a	4.23a	3.90a	0.91a	0.84b
NI-S	29.08b	37.11d	0.84d	1.29c	0.62b	0.77b
NI-ABA	38.17a	170.85a	4.59a	3.96a	1.02a	1.10a
I-C	37.00a	127.03b	3.80a	3.93a	0.78b	1.01a
I-S	30.58b	64.06c	1.58c	1.90b	0.66b	0.66b
I-ABA	37.42a	124.61b	3.03ab	3.81a	0.75b	1.08a

(*) values with different letters within the same row are significantly different (P>0.05)

Table 3. Roots volume (RV) and roots length (RL). Fresh and dry weight of roots (RFW/RDW), in not inoculated (NI) and inoculated (I) *Lotus glaber* plants with *Glomus mosseae*, and treated with ABA or subjected to water stress (S), after 80 days after sowing.

Treatments	RV (cm^3)	RL (cm)	RFW (g)	RDW (g)
NI-C	6.33b	9.17a	5.91b	0.30c
NI-S	5.67b	7.75b	4.94b	0.66b
NI-ABA	8.50a	6.17c	8.30a	0.87a
I-C	9.33a	7.50b	7.40a	0. 96a
I-S	9.08a	4.17c	4.22b	0. 99a
I-ABA	5.70b	4.75c	4.63b	0. 88a

(*) values with different letters within the same row are significantly different (P>0.05)

Similar results were obtained at 90 and 100 DAS, where there was a significant reduction in the number of inflorescences (approximately 50 %) comparing ABA-inoculated and ABA-not inoculated plants (data not shown).

These results showed *Lotus glaber* as a mycotrophic specie reaching a high mycorrhizal infection percent (90 % around), for all treatments. Moreover there are evidence that the mycorrhizal infection is supported for host photosynthates, in first steps, according to lower values found in parameters analyzed, when inoculated vs. not inoculated plants at 70 DAS, were compared (Data not shown). This effect was reverted in the following determinations, particularly for plants subjected to water stress treatments. These results confirmed others research, respect to mycorrhizal infection is more favorable to hosts when water stress affected plants. Likewise ABA treatments plants did not show significant differences between inoculated and not inoculated plants, except for inflorescences number.

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Lotus Newsletter (2005) Volume 35 (2), 187-190.

Responses of *Lotus glaber* to mycorrhizal infection in salinity environment

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Introduction

High salinity naturally occurring in soils or through irrigation water is a common environmental problem that affects around 7 % of crop areas in earth surface. Salinity factor imposes two principal kinds of stress on plants: an osmotic and a toxicity stress. In the first case there is a water limitation through osmotic potential reduction, affecting plant growth and productivity. In second case an excess of Cl^- and Na^+ ions produce membrane integrity alterations. The most typical symptom of salinity injury in higher plants is a retarded growth due to an inhibition of cell wall extension and cell elongation by water limitation (Nieman, 1965; Staple and Toenniessen, 1984).

In the pampas lowlands, high salts contents in soils is the usual environmental condition and in spite of natural *Lotus glaber* drought and salinity resistance, these factors affect its persistence in grassland community and forage production.

The arbuscular mycorrhizal are funguses that usually live in saline soils. Though salinity affects growth and physiology of fungus too, several studies showed that mycorrhizal inoculation enhance growth plants in high salinity conditions, representing a biological improve of these soils (Al-Karaki, 2000).

The response of *Lotus glaber* to mycorrhizal infection is practically unknown. Therefore the purpose of this research was to analyze this response, searching adaptative mechanism to abiotic stress and incorporate it to a great potential forage crops as *Lotus glaber*, through the study of the mycorrhizal infection response of *Lotus glaber* growing in high salt contents substrates.

Materials and methods

Seeds of *Lotus glaber*, obtained from naturalized population (Saladillo, Buenos Aires Province), were disinfected with Ca hypochlorite, washed thoroughly and sown in 0,5 L pots filled with two different substrates. Substrate 1 (S1) was a mixed of cultured soil (Argiudol vertic soil, containing 50 ppm Phosphorus and pH 6.8), vermiculite and perlite (2:1:1).

Substrate 2 (S2) was cultured soil (Argiudol vertic soil, containing 50 ppm Phosphorus and pH 6.8) with a high conductivity (5.5 dsm). Both substrates were tindalized previously to sowing. Pots were placed under natural conditions in a greenhouse in La Plata, Argentine (34º S.L., 54º W.L.). The inoculum was incorporated at sowing time to half plants of each substrate: 1 g of inoculum composed by a mixed of soil, spores (50 spores/g inoculum), mycelia and root fragments of *Trifolium sp.* plants, colonized by *Glomus mosseae*. The remaining plants were not inoculated. Inoculated and not inoculated plants of each substrate were watered daily, to maintain water potential to field capacity values (-0.03 Mpa), along all trial. The experimental design was randomized blocks with 3 replicates. 5 plants of each treatment were collected 70 days after sowing and at 10 days intervals to determine morphological parameter such as plant height (H), leaf area (LA), roots volume (RV) and roots length (RL). Fresh and dry weight, oven dried at 60 ºC until constant weight, were determined in leaves (LFW/LDW), stems (SFW/SDW) and roots (RFW/RDW). Colonization development by *Glomus mosseae* was determined in roots at 80, 100 and 120 days after sowing. It was evaluated according to the method developed by Trouvelot *et al.* (1986) and expressed as intensity of colonization (M%). The roots were cleared with 10% KOH and stained with trypan blue in lacto-phenol (Phillips and Hayman, 1970). Thirty randomly chosen root fragments of 1 cm long were mounted on slides and examined microscopically. M% was calculated as the proportion of infected roots over total root fragments. ANOVA was applied for all parameters studied, and Tukey test was used to separate the means with significant differences.

Results and discussion

Plants growth in S1 showed percents of mycorrhizal infection significant higher compared with plants growth in S2, reaching S1 plants more than 90 % (Table 1).

Table 1. Percent of roots infected after inoculation with *Glomus mosseae,* at 80, 100 and 120 days after sowing (DAS), in S1 and S2 plants.

Treatments	80 DAS	100 DAS	120 DAS
S1	81.73 a	91.1 a	91.06 a
S2	52.70 b	62.73 b	63.3 b

Inoculated and non inoculated plants growing in S1 substrate showed a significant increase in all parameters at 80 DAS, compared with S2 plants (Table 2). S2 inoculated plants had non significant effect on H, SDW and RDW, and significant increment of RV, compared with S2 not inoculated plants. S1 inoculated growing plants had significant enhance of RFW, RV, SDW and RDW compared with S1 not inoculated plants.

Similar results were found in all treatments at 90 and 100 DAS. S2 plants had approximately 50% reduction in the inflorescences number reduction in both inoculated and not inoculated plants (data not showed) compared with S1.

Table 2. Height (H), leaf area (LA), roots volume (RV) and roots length (RL). Fresh and dry weight of leaves (LFW/LDW), shoots (SFW/SDW) and roots (RFW/RDW), of *Lotus glaber* plants growing in S1 and S2 substrates and not inoculated (NI) and inoculated (I) with *Glomus mosseae*.

Treatment	S1-NI	S2-NI	S1-I	S2-I
H (cm)	42.4a	27.8b	37.0a	28.9b
LA (cm^2)	167a	100c	127b	91c
LFW (g)	4.2a	3.0b	3.8a	2.0c
SFW (g)	3.9a	1.7b	3.9a	1.4b
RFW (g)	5.9a	3.3b	7.4a	2.8c
RL (cm)	9.2a	8. 7a	7.5a	4.2b
RV (cm^3)	6.3b	3.2c	9.3a	6.1b
LDW (g)	0.9a	0.5bc	0. 8b	0.4c
SDW (g)	0.8b	0.4c	1.0a	0.4c
RDW (g)	0.3b	0.3b	0.6a	0.3b

(*) values with different letters within the same row are significantly different (P>0.05)

Results of this research confirm *Lotus glaber* as a mycotrophic plant, but the mycorrhizal infection was dependent of the substratum, according to the higher proportion of S1 roots infected plants compared with S2 roots infected plants. There are evidences that *Lotus glaber* has a great variability in stress saline tolerance (Sannazzaro *et al.,* 2005; Clúa, unpublished data).

Different responses between substrates could be explained by differential radical systems growth of plants in S1 and S2, confirming the results obtained by Bressan and Vasconcellos (2002), in the sense that mycorrhization could modify roots architecture. The results of the present study had shown that roots volume was significantly modified by treatments, although roots length was neither affected by the substratum or the mycorrhization.

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SANNAZZARO A.I., ALBERTÓ E., RUIZ O.A. and MENÉNDEZ A.B. 2005. Influence of de arbuscular mycorrhizal fungus *Glomus intraradices* on the saline stress physiology of *Lotus glaber*. *Lotus Newsletter*, **35 (1),** 29-30.

Lotus Newsletter (2005) Volume 35 (2), 191.

Use of water-stress tolerant *Lotus creticus* and *Cynodon dactylon* in soil revegetation on different slopes in a Mediterranean climate

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Paper published in ANNALES BOTANICI FENNICI 2005 Volume 42 Number 3, 195-205.
Link to free Acrobat file: *http://www.sekj.org/PDF/anb42-free/anb42-195.pdf*

Abstract

The performance of the legume *Lotus creticus* growing in mixture with the grass *Cynodon dactylon* was compared with a *L. creticus* pure stand in field conditions on 0°, 19° and 32° slopes in Barcelona, Spain. Two harvests were carried out, the first in early summer and the second in mid-autumn. From winter to spring, *Lotus creticus* growing in mixture contributed a greater biomass than the grass. Total shoot biomass of pure stand and mixture differed among slopes. On the same slope shoot biomass in the mixture and pure stands was not significantly different. The vegetation cover of the mixture was approximately 100%, 90% and 86% on the 19°, 0° and 32° slopes, respectively. The vegetation cover in the pure stand on the three former slopes was approximately 100%. During summer the water deficit was important on the 32° slope and *L. creticus* plants mortality in the mixture and pure stands was recorded. In autumn, legume biomass in mixture was lower than grass. The vegetation cover in the mixture and pure stands was nearly 100% on the 0° and 19° slopes, and 60% on the 32° slope. During the experiment changes in photosynthesis, water use efficiency and water potential in both species were recorded. *Lotus creticus* plants growing in mixture were not affected in their physiological variables as compared with those in the pure stand. On a same slope, the mixture and pure stands did not differ in total shoot biomass. In mixture the lowest biomass production in one species was compensated by an increase in the other.

Lotus Newsletter (2005) Volume 35 (2), 192-194.

Twentieth International Grassland Congress: Satellite Workshop- Fourth International Symposium on the Molecular Breeding of Forage and Turf July 2005, Aberystwyth, UK.

MARK P. ROBBINS

Plant Cell Biology Team, Plant Animal and Microbial Sciences Department, Institute of Grassland and Environmental Research, Plas Gogerddan, Aberystwyth, Ceredigion, SY23 3EB, UK.

**Corresponding author*

The 20th International Grassland Congress was held in Dublin, Ireland in the summer of 2005. A number of presentations representing the genus *Lotus* were included in that meeting and are described elsewhere in this volume. The focus of the work presented in Dublin focused on the advantages (and disadvantages) of *Lotus* spp. in an agricultural context. By contrast, the papers presented in the satellite workshop at Aberystwyth related to the use of *Lotus* to answer more fundamental questions related to plant biology. The three most relevant papers are described below and also cross-reference to some of the papers at the main congress.

L. japonicus research work in Japan and accompanying genetic resources was outlined in the following presentation:

Structural and functional genomic research in model legume plants: The National Bioresource Project (NBRP) in Japan.
S. TSURUTA, M. HASHIGUCHI and R. AKASHI
Department of Biological Production and Environmental Science, Miyazaki University, 1-1, Gakuen-Kibanadai-Nishi, Miyazaki, 889-219, Japan.
Corresponding author: rakashi@cc.miyazaki-u.ac.jp
Contribution 165

Additionally, two presentations were made regarding the molecular regulation of condensed tannin biosynthesis in *Lotus*, together with one paper at the main meeting:

Identification of putative *At* TT2 R2R3-MYB transcription factor orthologues in tanniferous tissues of *L. corniculatus* var. *japonicus* cv *Gifu.*
D.N. BRYANT[1], P. BAILEY[2], P. MORRIS[1], M. ROBBINS[2], C. MARTIN[2] and T. WANG[2]
[1] *Institute of Grassland and Environmental Research, Aberystwyth, UK.*
[2] *John Innes Centre, Norwich , UK.*
Corresponding author: *david.bryant@bbsrc.ac.uk*
Contribution 166

Polyphenolic phenomena: transgenic analysis of some of the factors that regulate the cell-specific accumulation of condensed tannins (proanthocyanidins) in forage crops

M.P.ROBBINS, G. ALLISON, D. BRYANT and P. MORRIS
Institute of Grassland and Environmental Research, Aberystwyth, UK.
Corresponding author: mark.robbins@bbsrc.ac.uk
Contribution 226

Light intensity is positively correlated with the synthesis of condensed tannins in *Lotus corniculatus*

S. ARCIONI, T. BOVONE, F. DAMIANI and F. PAOLOCCI
Plant Genetic Institute - Research Division of Perugia-CNR, via Madonna Alta 130, 06128 Perugia, Italy.
Corresponding author: sergio.arcioni@igv.cnr.il
Main Congress offered paper 244

Also of particular interest in the main congress were three papers quantifying the levels of condensed tannins in *Lotus* spp. Methodologies ranged from very simple methodologies to highly sophisticated and reproducible methods in micro-titre plates suitable for high-throughput applications.

Variation in tannin content and morphological traits in *Lotus corniculatus* L. (bird's-foot trefoil)

A.H. MARSHALL, F. RIBAIMONT, R.P. COLLINS, D. BRYANT and M.T. ABBERTON
Institute of GrassIand and Environmental Research, Plas Gogerddan, Aberystwyth, Ceredigion, SY23 3EB, UK.
Corresponding author: athole.marshall@bbsrc.ac.uk
Main Congress offered paper 245

Condensed tannins in different varieties of *Lotus corniculatus*

C.L. MARLEY, R. FYCHAN and R. JONES
Institute of Grassland and Environmental Research, Plas Gogerddan, Aberystwyth, SY23 3EB, UK.
Corresponding author: christina.marley@bbsrc.ac.uk
Main Congress offered paper 246

Herbage production, nitrogen fixation and condensed tannin concentrations in *Lotus glaber* Mili, germplasm

H. ACUÑA, M. FIGUEROA, P. HELLMAN and A. CONCHA
Instituto de Investigaciones Agropecuarias, INIA, Centro Regional de Investigación Quilamapu, Casilla 426,Chillan, Chile.
Corresponding author: hacuna@quilamapu.inia.cl
Main Congress offered paper 247

It is clear from the above that the biological variation contained in *Lotus* spp. is a potentially valuable resource for the biological sciences community. The members of this genus and their genetic variation complement resources found for one of the legume models used for functional genomic studies ie. *Lotus japonicus* (Kawaguchi *et al.*, 2001; Udvardi *et al.*, 2005)

KAWAGUCHI M., MOTOMURA T., IMAIZUMI-ANRAKU H., AKAO S. and KAWASAKI S. 2001. Providing the basis for genomics in *Lotus japonicus*: the accessions Miyakojima and Gifu are appropriate crossing partners for genetic analyses. *Molecular Genetics and Genomics,* **266,** 157-166.

UDVARDI M.K., TABATA S., PARNISKE M. and STOUGAARD J. 2005. *Lotus japonicus*: legume research in the fast lane. *Trends in Plant Science*, **10,** 222-228.

Lotus Newsletter (2005) Volume 35 (2), 195-203.

Twentieth International Grassland Congress: Main Congress - Offered Papers July 2005, Dublin, Ireland.

MÓNICA REBUFFO

INIA, National Institute of Agricultural Research, La Estanzuela, Colonia, Uruguay.

The Main Congress of the XX International Grassland Congress had 894 offered papers, mainly focus on the main temperate forage species, such as perennial ryegrass, white clover, alfalfa. This review describes 33 papers related to the genus *Lotus*, and includes details such as title, authors (with email links to the emails for all scientists registered at LN), page number, addresses, email of the corresponding author and keywords. The index and the publication is available at http://www.wageningenacademic.com/books/igcpapers.htm

THEME EFFICIENT PRODUCTION FROM GRASSLAND

Section "Grass and forage plant improvement"

There were two papers related to *Lotus* species breeding. The paper from Australia compared two testing techniques for screening cyanide content in a native perennial tetraploid *Lotus*, whereas the paper from Uruguay presented data of participatory collection of local landraces of *Lotus corniculatus*, red clover and alfalfa.

Breeding *Lotus australis* Andrews for low cyanide content.
REAL D.[1], SANDRAL G.A.[1,2], WARDEN J.[1], NUTT L.[1], BENNETT R.[1] and KIDD D.[1].
Main Congress offered paper 85.
[1]*Cooperative Research Center for Plant-Based Management of Dryland Salinity. The University of Western Australia, University Field Station, 1 Underwood Avenue, Shenton Park, WA 6009, Australia.* Email: dreal@cyllene.uwa.edti.au
[2]*NSW Department of Primary Industries, Wagga Wagga Agricultural Institute, PMB, Fine Gully Roud, Wagga Wagga, NSW2605, Australia*
Keywords: *Lotus australis*, cyanide

Participatory collection of forage species in Uruguay.
REBUFFO M., CONDÓN F. and CUITIÑO M.J.
Main Congress offered paper 61.
INIA, National Institute of Agricultural Research, La Estanzuela, Colonia, Uruguay.
Email: rebuffo@inia.org.uy
Keywords: germplasm collection, *Lotus*, luceme, clover.

Two other papers of this section quote *Lotus* species as examples for model legume and condensed tannins.

New approaches to clover breeding.
ABBERTON M.T., WILLIAMS T.A., MICHAELSON-YEATES T.P.T., MARSHALL A.H., JONES C., SIZER-COVERDALE E. and COLLINS R.P.
Main Congress offered paper 78.
Institute of Grassland and Environmental Research, Plas Gogerddan, Aberystwyth, Ceredigion, SY 23 3EB, UK. Email: michael.abberton@bbsrc.ac.uk
Keywords: white clover, red clover, environment, quality, breeding programmes.

Foliar expression of candidate genes involved in condensed tannin biosynthesis in white clover *(Trifolium repens).*
PANTER S.N.[1,2], SIMMONDS J.[1,2], WINKWORTH A.[1,2], MOURADOV A.[1,2] and SPANGENBERG G.C.[1,2]
Main Congress offered paper 167.
[1]*Primary Industries Research Victoria, Plant Biotechnology Centre, La Trobe University, Bundoora, Victoria3086, Australia.*
[2]*Molecular Plant Breeding Cooperative Research Centre, Australia.* Email: stephen.panter@dpi.vic.gov.au
Keywords: transgenic white clover, condensed tannins, chalcone synthase, anthocyanidin and leucoanthocyanidin reductases, bloat safety. [Mention of *Lotus corniculatus* as an example]

Section "Animal production"
Two papers from Uruguay compared meat production obtained with *Lotus corniculatus* and *L. subbiflorus* in comparison with white clover.

Mixed fattening of steers and lambs on improved grasslands in Uruguay: I. pasture performance.
RISSO D.F., MONTOSSI F., BERRETTA E.J., CUADRO R., DE BARBIERI I., SAN JULIÁN R., DIGHIERO A. and ZARZA A.
Main Congress offered paper 170.
Instituto Nacional de Investigación Agropecuaria (INIA), Ruta 5 Km 386, Tacuarembó, Uruguay. Email: drisso@tb.inia.org.uy
Keywords: improved grasslands, mixed grazing, availability.

Mixed fattening of steers and lambs on improved grasslands in Uruguay: II. animal performance and productivity.
RISSO D.F., MONTOSSI F., BERRETTA E.J., CUADRO R., DE BARBIERI I., SAN JULIÁN R., DIGHIERO A. and ZARZA A.
Main Congress offered paper 171.
Instituto Nacional de Investigación Agropecuaria (INIA), Ruta 5 Km 386, Tacuarembó, Uruguay. Email: drisso@tb.inia.org.uy
Keywords: mixed fattening, steer, lamb, performance.

Section "Improving quality of products from grassland"

There was only one paper from New Zealand that compared legumes with different *condensed tannin concentrations (white clover, Lotus comiculatus and Lotus pedunculatus [=L. uliginosus]).*

Effect of three legumes containing different condensed tannin concentrations on the *in vitro* formation of the pastoral flavour compound; skatole.

SCHREURS N.M.[1,2], TAVENDALE M.H.[1], LANE G.A.[1], BARRY T.N.[2] and MCNABB W.C.[1].

Main Congress offered paper 195.

[1]*AgResearch Ltd, Grasslands Research Centre, Private Bag 11008, Palmerston North, New Zealand.* Email: nicola.schreurs@agresearch.co.nz

[2]*Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Private Bag 11222, Palmerston North, New Zealand*

Keywords: legumes, skatole, pastoral flavour, condensed tannins.

Section "Forage quality for animal nutrition"

This is one of the most prolific sections of the Main Congress. It includes eight papers of *Lotus*, mainly research from European countries related to tannins and chemical composition. The influence of condensed tannins on reproductive parameter of sheep grazing *L. corniculatus* compared with perennial ryegrass / white clover was studied in New Zealand. The paper from Germany compares protein degradation of Red clover, birdsfoot trefoil, alfalfa, kura clover and white clover. There were two contributions from Italy; one determines the influence of light on tannin production of *L.corniculatus*, and the other compares several especies of *Lotus* spp. *(L .cytisoides, L. corniculatus, L. ediilis, L. ornithopodioides)* with *Hedysarum* and *Onobrychis* in terms of proanthocyanidins and condensed tannins. Two papers from United Kingdom compare varieties of *L. corniculatus* (forage yield, plant height, tannin content). Forage yield and chemical composition of perennial swards containing *Trifolium repens, Trifolium hybridum, Trifolium pratense* or *Lotus corniculatus* and complementary grasses for organic farming were evaluated in Finland. There is only one paper from South America that compares Chilean accessions of *L. glaber* in terms of yield, N-fixation and forage quality parameters, including total condensed tannins.

Mating ewes on condensed tannin-containing forages increases ewe reproductive rate and reduces lamb mortality.

BARRY T.N., RAMIREZ-RESTREPO C.A., MCWILLIAM E.L., LÓPEZ-VILLALOBOS N. and KEMP P.D.

Main Congress offered paper 222.

Massey University, Palmerston North, New Zealand. Email: T.N.Barry@massey.ac.nz

Keywords: condensed tannin, reproduction, lamb mortality.

Variation in protein quality of forage legumes during spring growth.

GIERUS M., KLEEN J. and TAUBE F.

Main Congress offered paper 240.

Grass and Forage Science/Organic Agriculture, Institute of Crop Science and Plant

Breeding, Christian Albrechts University of Kiel, 24118 Kiel, Germany. Email: mgierus@email.unl-kiel.de
Keywords: protein quality, forage legumes

Light intensity is positively correlated with the synthesis of condensed tannins in *Lotus corniculatus*.
ARCIONI S., BOVONE T., DAMIANI F. and PAOLOCCI F.
Main Congress offered paper 244.
Plant Genetic Institute - Research Division of Perugia-CNR, via Madonna Alta 130, 06128 Perugia, Italy. Email: sergio.arcioni@igv.cnr.il
Keywords: condensed tannins, DFR, gene expression, light, real time PCR

Variation in tannin content and morphological traits in *Lotus corniculatus* L. (bird's-foot trefoil).
MARSHALL A.H., RIBAIMONT F., COLLINS R.P., BRYANT D. and ABBERTON M.T.
Main Congress offered paper 245.
Institute of GrassIand and Environmental Research, Plas Gogerddan, Aberystwyth, Ceredigion, SY23 3EB, UK. Email: athole.marshall@bbsrc.ac.uk
Keywords: *Lotus corniculatus*, agronomic traits, tannin content

Condensed tannins in different varieties of *Lotus corniculatus*.
MARLEY C.L., FYCHAN R. and JONES R.
Main Congress offered paper 246.
Institute of Grassland and Environmental Research, Plas Gogerddan, Aberystwyth, SY23 3EB, UK. Email: christina.marley@bbsrc.ac.uk
Keywords: *Lotus* varieties, *Lotus* species, condensed tannins, birdsfoot trefoil

Herbage production, nitrogen fixation and condensed tannin concentrations in *Lotus glaber* Mili. germplasm.
ACUÑA H., FIGUEROA M., HELLMAN P. and CONCHA A.
Main Congress offered paper 247.
Instituto de Investigaciones Agropecuarias, INIA, Centro Regional de Investigación Quilamapu, Casilla 426,Chillan, Chile. Email: hacuna@quilamapu.inia.cl
Keywords: *Lotus glaber*, N-fixation, extractable condensed tannins, bound condensed tannins

Proanthocyanidins from *Hedysarum, Lotus* and *Onobrychis* spp. growing in Sardinia and Sicily and their antioxidant activity.
TAVA A.[1], DE BENEDETTO M.G.[1], TEDESCO D.[2], DI MICELI G.[3] and PILUZZA G.[4].
Main Congress offered paper 271.
[1]*Istituto Sperimentale per le Colture Foraggere, v.le Piacenza 29, 26900 Lodi, Italy*. Email: aldotava@katamail.com
[2] *Dipartimento di Scienze e Tecnologie Veterinarie per la Sicurezza Alimentare, Universifá di Milano, v. Celoria 10, 20133 Milano, Italy*.
[3] *Dipartimento di Agronomía Ambiéntale e Territoriale, Universitá di Palermo, v.le delle Scienze, 90128 Palermo, Italy*.

[4]*CNR, Istituto per il Sistema Produzione Animale in Ambiente Mediterraneo Sez. Sassari, v. E. de Nicola, 07100 Sassari, Italy*
Keywords: proanthocyanidins, condensed tannins, quantification, antioxidant activity, quality

Characterisation of herbage from temperate organic pastures.
KUUSELA E.
Main Congress offered paper 274.
University of Joensuu, Department of Biology, PO Box 111, FIN-80101 Joensuu, Finland. Email: eeva.kuusela@joensuu.fi
Keywords: organic dairy farming, pastures, herbage nutritive value.

This section also includes a French paper that mention *Lotus corniculatus* as an example for tannins.

Effect of condensed tannins in sainfoin on *in vitro* protein solubility of Lucerne.
AUFRERE J., DUDILIEU M., PONCET C. and BAUMONT R.
Main Congress offered paper 248.
INRA, Unité de Recherches sur les Herbivores, Centre de Clermont-Theix-Lyon F-63122 St Genes Champanelle, France. Email: aufrere@clermont.inra.fr
Keywords: tannin, soluble nitrogen, protein, sainfoin, lucerne

Section "Grassland management"
There was only one paper from United States that analyses the effect of defoliation management on the botanical balance of binary mixtures with *Lotus corniculatus.*

The interaction of management with botanical composition of irrigated grass-legume pasture mixtures in the Intermountain West USA.
MACADAM J.W., GRIGGS T.C. and MILESKI G.J.
Main Congress offered paper 357.
Utah State University, Logan, Utah 84322-4820 U.S.A. Email: jenmac@cc.usu.edu
Keywords: irrigated pasture, *Lotus corniculatus, Trifolium repens,* rotational stocking management

Section "Grass and forage agronomy"
This section includes only one study carried out in Colombia that compares the compatibility of several grass species with *L. corniculatus.*

Adaptation, compatibility and acceptability of grass-legume pastures in the Andean region of Colombia.
CÁRDENAS E. and CASTRO E.
Main Congress offered paper 426.
Universidad Nacional de Colombia, 30th Avenue with 45th Street, Bogotá, Colombia. Email: eacardenasr@unal.edu.co
Keywords: *Pennisetum clandestinum, Lotus corniculatus,* adaptation, acceptability

Section “Overcoming seasonality of production”

There was only one paper from United States that compared several mixtures combines with forage allocation under grazing, including one system with fescue/birdsfoot trefoil (*Lotus corniculatus* L.).

Year-round forage systems for beef cows and calves.
FONTENOT J.P.[1], CLAPHAM W.M.[2], SWECKER W.S.Jr.[1], FISKE D.[1], HALL J.B.[1], FIKE J.[1] and SCAGLIA G.[1].
Main Congress offered paper 464.
[1]*Virginia Polytechnic Institute and State University, Blacksburg, VA 2406, U.S.A.* Email: cajunjoe@vt.edu
[2]*USDA-Agricultural Research Service, Beaver, WV25813, USA.*
Keywords: beef cows, forages, systems

Section “Animal-plant relations”

This section includes two papers from Uruguay studying the effect of the animal on sward characteristics of *Lotus corniculatus*, *Lotus pedunculatus* (=*L.uliginosus*), *Lotus subbiflorus* and *Trifolium repens.*

Effect of forage legume species and stocking rate of lambs on sward characteristics in Uruguay.
MONTOSSI F., RISSO D.F., SAN JULIÁN R., IGLESIAS M., RAMOS N., DE BARBIERI I., CUADRO R. and ZARZA A.
Main Congress offered paper 536.
Instituto Nacional de Investigación Agropecuaria (INIA), Ruta 5, km 386, PC: 45000, Tacuarembó, Uruguay. Email: fmontossi@tb.inia.org.uy
Keywords: stocking rate, lambs, legume species, sward height

The effect of stocking rate and lamb grazing system on sward performance of *Trifolium repens* and *Lotus corniculatus* in Uruguay.
MONTOSSI F., SAN JULIÁN R., NOLLA M., CAMESASCA M. and PREVÉ F.
Main Congress offered paper 537.
Instituto Nacional de Investigación Agropecuaria (INIA), Ruta 5, km 386, PC: 45000, Tacuarembó, Uruguay. Email: fmontossi@tb.inia.org.uy
Keywords: stocking rate, grazing system, lambs, sward height

THEME GRASSLAND AND THE ENVIRONMENT

Section “Biodiversity in grassland”

This section has a large number of contributions, and several refer to *Lotus* species. One study on diversity carried out in Algeria mention a high number of species of *Lotus* present in the country. *Trifolium subterraneum* L. and *Lotus ornithopodioides* L. are described as the most represented legume species in overgrazed areas of Sardinia, Italy. Two studies on floristic composition in Serbia describe *Lotus corniculatus*, among other legumes, as useful legumes. One paper from Germany studies the establishment under grazing of *Lotus corniculatus*, among other legumes and herbs. Species diversity and productivity in mixtures describes birdsfoot trefoil (*Lotus corniculalus* L.), together with grasses, described as the most abundant species (United States). Two papers refer to saline environments, indicating the presence of *Lotus tenuis* (=*L.glaber*), among other species in a saline community (Germany), and indicating that *Lotus* genus is among high priority legumes (Australia).

Diversity and adaptatíon of perennial plants from North Africa: legumes and grasses.

ABDELGUERFI A.[1], LAOUAR M.[2], ABBAS K.[3] and M'HAMMEDI BOUZINA M.[4].
Main Congress offered paper 608.
[1]*Lab-RGB, INA Belfort, El Harrach 16200 Alger, Algérie.* Email: aabdelguerfi@yahoo.fr
[2]*WRAA Belfort, El Harrach 16200 Alger, Algérie.*
[3]*INRAA. Unité de Sétif, Algérie.* [4]*Université de Chief, Chief, Algérie.*
Keywords: species, diversity, forage, pastoral, adaptation.

The effect of sheep grazing at two stocking rates on the seedling recruitment of grassland forbs.

ISSELSTEIN J., KOWARSCH N., BONN S. and HOFMANN M.
Main Congress offered paper 625.
Institute of Agronomy and Plant Breeding, University of Goettingen, Von-Siebold-Str. 8, 37075 Goettingen, Germany. Email: jissels@gwdg.de
Keywords: oversowing wildflower seeds, seedling establishment, sward management

Development of saline vegetation on embanked grasslands at the Baltic Sea coast after 10 vears of extensive pasture use.

BOCKHOLT R., SCHMITZ S. and NOEL S.
Main Congress offered paper 629.
The Faculty for Agricultural and Environmental Science at the Rostock University, 18051 Rostock, Federal Republic of Germany. Email: Renate.bockholt@uni-rostock.de
Keywords: saline grassland, plant community, permanent grassland, extensive pasture, *Juncus gerardii*

Overgrazing influence on the presence of legumes in a natural pasture of Sardinia.

SALIS L.[1], VARGIU M.[1,2], SPANU E.[1] and LOCHE F.[1].
Main Congress offered paper 635.
[1]*Centro Regionale Agrario Sperimentale, Víale Trieste 111, Cagliari, Italy.* Email: foraggisassari@tiscali.it
[1,2] foraggicoltura@cras.sardegna.it
Keywords: natural pasture, botanical composition, legumes, forage production

Floristic composition as a parameter of the quality of the grassland type *Festucetum vallesacae* in the Stara Planina hilly-mountainous region of Serbia.

NESIC Z., TOMIC Z., MRFAT-VUKELIC S., ZUJOVIC M., DJALOVIC I. and DJORDJEVIC S.
Main Congress offered paper 638.
Institute for Animal Husbandry, Autoput 16, Beograd, SCG, Serbia. Email: zonen@eunet.yu
Keywords: floristic composition, quality, natural meadows, Stara Planina Mountain

Floristic composition as parameter of quality of ass. *Agrostietum vulgaris.*
TOMIC Z, MRFAT-VUKELIC S., NESIC Z., ZUJOVIC M. and DJORDJEVIC-MILOSEVIC S.
Main Congress offered paper 639.
Institute for Animal Husbandry, Autoput 16, Beograd, SCG, Serbia. Email: zotom@mail.com
Keywords: floristic composition, useful grasses, useful legumes, other species.

The relationship between species diversity and productivity of cool-season grassland.
FLORINE S.E., MOORE K.J., FALES S.L. and HINTZ R.L.
Main Congress offered paper 642.
Department of Agronomy, Iowa State University, Ames, lowa, 50011, USA. Email: kjmoore@iastate.edu
Keywords: diversity, species richness, biomass productivity

Selecting grassland species for saline environments.
ROGERS M.E., CRAIG A.D., COLMER T.D., MUNNS R., HUGHES S.J., EVANS P.M., NICHOLS P.G.H., SNOWBALL R., HENRY D., DERETIC J., DEAR B. and EWING M.
Main Congress offered paper 696. *Cooperative Research Centre for Plant-Based Management of Dryland Salinity, Perth, Western Australia 6909, Australia.* Email: MaryJane.Rogers@dpi.vic.gov.au
Keywords: genetic diversity, plant sait tolerance, soil salinity

Section "Soil quality and nutrients"

There were three papers on this section. One paper from *Colombia* analyses the N balance of 10 grass species sown with *L. corniculatus*. The other two papers are from Uruguay, and involved studies on the effect of P on production of *Lotus pedunculatus* (=*L. uliginosus*) and the production of *L. subbiflorus, L. corniculatus, L. pedunculatus* (= *L.uliginosus*), compared *Trifotium repens,* under different cutting regimes under acidic stress.

Sustainable pastures for the high altitude Andean tropics of Colombia.
CÁRDENAS E. and PANIZZO L.
Main Congress offered paper 704.
Universidad Nacional de Colombia 30th Avenue 45th Street Bogotá, Colombia. Email: eacardenasr@unal.edu.co
Keywords: nitrogen, pastures, grass, *Lotus*, sustainable grassland farming

Effect of different phosphorous sources and levels on the productive behaviour of a *Lotus pedunculatus* cv. Grasslands Maku oversown pasture.
BERMÚDEZ R.E. and AYALA W.
Main Congress offered paper 711.
INIA National Institute of Agricultural Research, Uruguay, R8 Km 281, Treinta y Tres, Uruguay, PC 33000. Email: rbermudez@tyt.inia.org.uy
Keywords: *Lotus*, phosphorous sources, phosphorous response, oversown pastures, rhizomes

Soil constraints (pH and aluminium) for legume performance in hill country of Uruguay.
AYALA W. and BERMÚDEZ R.
Main Congress offered paper 740.
National Institute of Agricultural Research of Uruguay, Casilla de Correo 42, Treinta y Tres, Uruguay CP33000. Email: wayala@tyt.inia.org.uy
Keywords: *Lotus* spp., white clover, pH, aluminium tolerance

THEME DELIVERING THE BENEFITS FROM GRASSLAND

Section "Adoption of new technology"

One paper from United States mention *Lotus corniculatus*, among other legumes, that did not persist or contribute significantly to the overall system.

Sustaining grass-legume pastures for cow-calfherds: a case study.
CADDEL J.L.[1], REDFEAM D.D.[1] and WOODS R.L.[2] .
Main Congress offered paper 788.
[1]*Plant and Soil Sciences Department, Oklahoma State University, Stillwater, OK 74078, USA.* Email: john.caddel@okstate.edu
[2]*0klahoma Cooperative Extensión Service, Muskogee, OK 74401, USA*
Keywords: grasslands, mixed pastures, beefcattle

Section "Tools for grassland management"

There was only one paper from France that evaluated the soil fertility status through in native pastures, where *Lotus corniculatus* is present, among other legumes.

Diagnosing nitrogen, phosphorous and potassium status of natural grassland in the presence of legumes.
JOUANY C., CRUZ P., THEAU J.P. and DURU M.
Main Congress offered paper 860.
*UMR 1248 ARCHE - INRA, BP27, 31326 Castanet-Tolosan Cedex, France.*Email: cjouany@toulouse.inra.fr
Keywords: diagnosis, grassland, legume, nutrition index.

Section "The role of the International Grassland Congress and Grassland Socieites in technology interaction and influencing policy"

This section includes posters about the National Grassland Societies of Ireland, United Kingdom, Portugal, Northern Ireland, Scotland, Estonia, Slovenia, Greece, Bosnia and Herzegovina, Czech Republic, Germany, Spain, New Zealand, Australia, Japan and United States. *Lotus* Newsletter was the only reference to an international group. The poster is on the web site: http://www.inia.org.uy/sitios/lnl/vol35/poster.html

REBUFFO M. **The *Lotus* Newsletter: an electronic *Lotus* research community.** Main Congress offered paper 951. *INIA, National Institute of Agricultural Research, La Estanzuela, Colonia, Uruguay.*Email: rebuffo@inia.org.uy
Keywords: *Lotus* Newsletter, *Lotus*, research.