Pasture improvement of marginal lands using annual and perennial legumes

Delgado I., Ochoa M.J.

in

Sulas L. (ed.).
Legumes for Mediterranean forage crops, pastures and alternative uses

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 45

2000
pages 167-170

Pasture improvement of marginal lands using annual and perennial legumes

I. Delgado[1], M.J. Ochoa[1]; S. Lozano[2], A. Albiol[2] and E. Sin[2]
[1]Servicio de Investigación Agroalimentaria; [2]Sección de Técnicas Agrarias
Diputación General de Aragón. Apartado 727. 50080 Zaragoza, Spain

Summary - The possibility of improving pastures in marginal lands by sowing wild lucerne («mielga», *Medicago sativa* L.) and annual medics (*M. polymorpha* L., *M. truncatula* Gaerten. and *M. rigidula* All.) was studied on uncultivated land at Ballobar (Huesca) in the 1995-99 period. Six treatments before sowing were applied with or without clearing the vegetation, mechanically or by fire, and with or without cultivation using a chisel cultivator. The establishment of the plants, vegetation cover and phytomass production were recorded. The initial establishment of mielga and annual medics was satisfactory but declined in each successive year, specially medics. Cultivation increased the persistence of mielga but reduced plant cover from 65% to 10%. However, plant cover recovered after four years. Total phytomass was greatly reduced by cultivation and increased by the end of the period. The contribution of mielga and medics to phytomass was negligible.

Key-words: *Medicago sativa* L., annual medics, rainfed areas, uncultivated lands, improvement

Résumé *- Amélioration du pâturage dans les terres marginales par l'ensemencement des medics annuels et de la luzerne sauvage. La possibilité d'améliorer les pâturages des terrains marginals par l'ensemencement de la luzerne spontanée («mielga»,* Medicago sativa *L.) et medics annuels (*M. polymorpha *L.,* M. trunculata *Gaerten et* M. rigidula *All.) a été étudiée sur des terrains incultivés à Ballobar (Huesca) dans la période 1995-99. On a appliqué six traitements avant l'ensemencement: sans ou avec l'éclaircissage de la végétation, fait mécaniquement ou par le feu, et en plus, sans ou avec culture, en utilisant un cultivateur léger. L'établissement des plantes, de la couverture végétale du sol et de la production de la phytomasse ont été rapportés. L'établissement initial des mielgas et des medics annuels a été satisfaisant mais a décliné dans chaque année successive, spécialement les medics. La culture a eu l'effet d'augmenter la persistance des mielgas mais a réduit la couverture végétale de 65% à 10% ainsi que la phytomasse totale. Cependant, la couverture végétale et la phytomasse ont été retrouvées à la fin de la période. La contribution des mielgas et des medics à la phytomasse a été négligeable*

Mots-clés: Medicago sativa *L., medics annuels, terrains non irrigués, terrains marginals, amélioration*

Introduction

The improvement of uncultivated and marginal lands has been studied from the end of the XIX century, being sowing forage plants one of the most usual techniques applied, when the initial flora is poor and limits other techniques as fertilisation and grazing control (Prosperi and Soussana, 1984). In recent years, when making decisions on methods of improvement, great emphasis has been put on environment factors and use of autochthonous species. However, the success of these species has been very limited because of lack of knowledge of their agronomy (Child and Pearson, 1995).

In Aragón there are 412.925 ha of severely degraded grazing land (M.A.P.A., 1997). Badía *et al.* (1994) and Delgado *et al.* (1995) found that the mean plant cover of these areas was 50% and the vegetation was predominantly bushes and perennial grass of limited nutritive value. There were many studies on the selection and improvement of the autochthonous forage species, wild lucernes («mielgas», *Medicago sativa* L.) and annual medics (*Medicago rigidula* All., *M. truncatula* Gaerten. y *M. polymorpha* L.). These

leguminous species that have the necessary potential to improve soil fertility and the nutritive value of vegetation could contribute to increase the production of forage and improve plant cover (Prosperi *et al.*, 1992; Delgado, 1995).

This experiment studied the establishment of mielgas and annual medics in degraded land using several treatments before sowing.

Material and methods

The establishment of mielgas and annual medics was carried out in an uncultivated land. It was located on the Northeast side of the mountain with a slope ranging from 34% at the top to 12% in the base, at Ballobar (41° 37' Lat. N, 3° 48' Long. EM, 157 m a.s.l.), in the 1995-99 period . Maximum and minimum average temperatures in that period were 20.7±0.9 °C and 8.6±0.3 °C respectively and -7°C absolute extreme minimum. Annual rainfall ranged, from 231.2 mm in 1994/95 to 428.4 mm in 1998/99. The soil was calcium Xerosol type (Alberto and Montañés, 1982), presenting in the first 15 cm a loam texture, basic pH, a high contents in total carbonates, scarcity of organic matter, a low contents of assimilable phosphorus and average assimilable potassium. Vegetation covered 65% of the soil before tilling and was composed of bushes, being dominant *Artemisia herba-alba* Asso, *Genista scorpius* D.C. and *Thymus vulgaris* L. as well as perennial grasses, *Brachypodium ramosum* R. and S., *Asphodelus fistulosus* L. and *Phlomis lychnitis* L.

Two treatments were studied; mielgas and an homogeneous mixture of annual medics (*M. Polymorpha* cv. 34003, *M. trunculata* cv. 83005 and *M. rigidula* cv GR 09). Mielgas came from selections made in autochthonous populations of wild lucerne in the Servicio de Investigación Agroalimentaria of Zaragoza (Spain); annual medics were obtained in the Institut National de la Recherche Agronomique of Montpellier (France).

The first trial (1995-99) was established on the low part of the mountain after a superficial tilling of the soil with a chisel cultivator, on 90 m2 plots distributed in three randomised blocks.

The second trial (1997-99) was made on the high part of the mountain slope. Six treatments were applied previously to the leguminous sowing, mechanical or by fire clearing and control, all of them with and without soil tilling on 20 m2 plots. The statistical design was in a split-split plot arrangement in three randomised blocks.

The seeding rate was 20kg/ha. Seeds were sown broadcast, without burying the seed. The trials seeding dates were 01.02.95 and 16.10.97 respectively. No mineral suplementation was applied.

The evolution of the following data was studied: plants establishments, soil cover and total dry matter phytomass (DM) by cutting three 0.25 m2 squares/plot. Data was statistically analysed using the ANOVA analysis (SAS programme). When the F value exceeded the 5% level of significance, the treatment means were further analysed by de LSD test.

Results and discussion

The number of established plants, the soil cover and the phytomass present in spring in each one of the trials is given in Tables 1 and 2.

Initially, mielgas and annual medics were established in all treatments between 72 and three plants/m2, but their number was notably reduced in the following years, over all in uncultivated plots. Annual medics disappeared in most plots. That fact was attributed to their difficulty for annual reseeding, which must overcome every year different stresses (drought, frosts and wild fauna).

Table 1. Establishment of leguminous, vegetation cover and dry matter yield whith cultivation before sowing in spring. Trial 1.

Year	Pl/m2 established		% plant	Kg/ha DM yield		
	lucerne	medics	Cover	total (2)	lucerne	medics
1995-96	72 a	7 a	10 (1)	-	0	0
1996-97	33 b	3 b	29 b	600 c	0	0
1997-98	28 b	4 b	52 a	912 b	66	0
1998-99	29 b	7 a	44 ab	1835 a	88	0
Signification	**	*	*	***	-	-

(1) = Estimation; (2) = 2040 DM kg/ha before cultivation; * = P < 0.05; ** = P < 0.01; *** = P < 0.001

Table 2. Establishment of leguminous, vegetation cover and dry matter yield with six treatments before sowing. Trial 2.

Year/	Pl/m2 established		% plant	Kg/ha DM yield		
treatment	lucerne	medics	Cover	total	lucerne	medics
1997/98						
Uncultivated	16	24 b	73 a	2508 a	0	0
+ mech.clearing	3	8 b	70 a	524 b	0	0
+ fire	21	40 ab	53 b	612 b	0	0
With cultivation	28	16 b	20 c	876 b	0	0
+ mech.clearing	16	68 a	13 c	220 b	0	0
+ fire	8	32 ab	13 c	352 b	0	0
Signification	NS	*	***	**	-	-
1998/99						
Uncultivated	0 c	0	68 a	2382 a	0 b	0
+ mech.clearing	1 c	0	60 a	1040 b	0 b	0
+ fire	0 c	0	57 a	1312 b	0 b	0
With cultivation	8 bc	0	20 b	712 b	0 b	0
+ mech.clearing	17 ab	1	28 b	822 b	0 b	0
+ fire	21 a	11	30 b	852 b	66 a	0
Signification	*	NS	***	***	*	-

NS = P > 0.05; * = P < 0.05; ** = P < 0.01; *** = P < 0.001

Both, cultivation as well as clearing by fire practically eliminated the initial cover of the soil. This cover was recovered along the studied period, becoming equal at the end of the fourth year in Trial 1. The present phytomass as well as soil covering were increased every year till reaching the initial ones. Forage production attributed to mielgas and annual medics was slight in mielgas and inestimable in annual medics.

Results show the difficulty to recover uncultivated lands for grazing in Aragón. Superficial tilling or fire made easier leguminous seeding, but the original vegetation was initially depressed, leaving the soil submitted to erosion. Mielgas were better adapted to this situation than annual medics which showed a low capacity of persistence as already observed in other experiments (Delgado, 1997). At the end of the study, the proportion of established mielgas was fairly higher than medics.

The seeding rate, 15 and 20 kg/ha was considered enough for the establishment of a number of leguminous according to the soil dryness. This seeding rate was notably lower to that used for degraded mountains recuperation which goes up to 200-300 kg/ha (Badía *et al.*, 1994; Generalitat Valenciana, 1995), the cost of which would make unfeasible the uncultivated lands recuperation. Forage production was however, inestimable for medics and scarce in mielgas. That can be due to the low fertility of uncultivated lands and to the competence suffered by the remaining flora, but also to the fact that they were the most affected by wild fauna, specially medics, greedily profited by rabbits and hares. Medics, being annual species of selfseeding, need to be established every year. That reduces their persistence capacity due to frosts during emergence and to wild fauna who eats the seeds and seedlings. Similar results were obtained by Prosperi and Soussana (1984) when they experimented the establishment of lucernes and annual medics in Mediterranean rangelands.

Conclusions

Results obtained show the possibility of introducing grazing leguminous in the degraded mountains, though the forage contributions can be not very important. Mielgas proved to be more appropriate than annual medics in the studied environment. The seeding rate used, 15 to 20 kg/ha, was considered adequate for their establishment. Soil tilling, if applied, increases the persistence of mielgas but reduces the soil cover severely.

Acknowledgements

The authors thank Mr. Sasot and Mr. Salas from Ballobar for their collaboration in these trials. This study has been financed by the Consejo Superior de Investigación y Desarrollo of the Diputación General de Aragón, Project nº 48/96.

References

Alberto, F., Montañes, L. (1982). *Mapa de suelos de la Depresión Ebro en la Región Central.* Consejo Superior de Investigaciones Científicas, Zaragoza.

Badía, D., Martí, C., Terreros, J. (1994). Nutritional value of semi-arid pastures: influence of soil type and grass sowing, *Agr. Med.*,124, 289-300.

Child, R.P., Pearson, H.A. (1995). Rangeland and Agroforestry. In: *Forages*, vol II, 225-242. Ed. Iowa State University Press. Ames; Iowa, USA.

Delgado, I. (1995). Evaluación de diferentes tipos de alfalfa en secano. *ITEA*, 91V (2): 120-128.

Delgado, I., Ochoa, M.J.; Albiol, A.; Luna, L.; Muñoz, F. (1995). Descripción y evaluación de la fitomasa presente en áreas no cultivadas de la comarca de Monegros (Aragón). *Pastos,* XXV (1), 87-97.

Delgado I. (1997). Evaluación de medicagos anuales y de su asociación con *Lolium rigidum* Gaud. *Actas de la XXXVII Reunión Científica de la SEEP*. Sevilla, 205-213.

Generalitat Valenciana (1995). *Plan de reforestación de la Comunidad Valenciana,* 1994-1999. Ed. Generalitat Valenciana, 98 pp.

M.A.P.A. (1997). *Anuario de Estadística Agraria 1995*. Madrid, 710 pp.

Prosperi, J.M., Soussana, J.F., 1984. L´amélioration pastorale des parcours de garrigue par sursemis: premiers résultats. *Fourrages*, 99, 83-110.

Prosperi, J.M., Angevain, M., Mansat, P. (1992). Adaptation écotypique et amélioration des *Medicago* annuelles. *Réunion annuelle de la Association des Sélectioneurs Francais*. 1-2 de abril, Montpellier (Francia), 7 pp.