# The lucerne in Spain. Characterization of the cultivated and spontaneous ecotypes

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*in*

**Genier G. (ed.), Prosperi J.M. (ed.).**
**The Genus Medicago in the Mediterranean region: Current situation and prospects in research**

**Zaragoza : CIHEAM**
**Cahiers Options Méditerranéennes; n. 18**

**1996**
pages 65-70

# THE LUCERNE IN SPAIN. CHARACTERIZATION OF THE CULTIVATED AND SPONTANEOUS ECOTYPES

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## ABSTRACT

The aim of this works is to sum up the studies carried out on the characterization of the lucerne cultivated ecotypes and spontaneous ones by the Pasture and Forages Laboratory of the S.I.A. - D.G.A. in the last fifteen years.

These studies show the similitude and differences of the spanish cultivated ecotypes versus the flemish, african or intermediate kinds of ecotypes. The spontaneous ecotypes present the morphological characteristics of spp. *sativa* but they produce rhizomes and their growing habit is similar to spp. *falcata*.

**Key words:** *Medicago sativa*, morphology, physiology, agronomy, genetic resources, germplasm.

## INTRODUCTION

In Spain, two types of lucerne are growing in semi-arid areas on calcareous soils. The first one is cultivated for hay and eventually grazed by ruminants, mainly under irrigated conditions. It is upright, narrow-crowned and top-rooted. Different local ecotypes are being used.

The second one is not cultivated, grows spontaneously in pasture-grounds and has the ability of emission of rhizomes, making up creeping plants.

Several studies have been made in our laboratory in the last years in order to characterize those ecotypes to be used in breeding. The aim of this work is to sum up these studies.

## CULTIVATED ECOTYPES

The first works on the characterization of the lucerne cultivated ecotypes carried out in Spain (Hycka, 1964; Hidalgo, 1966; Casallo, personal communication) permitted the differentiation of 5 ecotypes: Aragon, Tierra de Campos, Ampurdan, Mediterranea and Alcoroches according to their winter regrowth efficiency, ratio leaf/stem, leaf shape, flowering date, percentage of variegated flowers and adaptation to the environment. Their location is showed in Figure 1. Those works proved the difficulty of classifying and identifying these ecotypes due to their variability.

In order to improve their classification, new studies have been made in the last years (Delgado, 1989). In these works, the classification is approached by considering the characters of the seedling such as the date of development of the first trifoliated leaf, the length of the first internode and the dimensions of the primary leaf, as well as the morphological and the growth characters of the adult plant under two extreme humidity conditions, dryland with 400 mm annual rainfall and irrigated land. The characters observed in the adult plant were the length and the diameter of the main stem, the length of the fifth internode, the leaf shape, the ratio leaf/stem, the flowering date, the number of variegated flowers, the height of the plants at first November and first February, the diameter and depth of the crown and the percentage of died plants. In this study the European ecotypes Europe, Romagnola and Provence and the African ecotype Moapa were included, with the aim of knowing the position of the spanish ecotypes in comparison with the already known ones.

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The principal components analysis made on the obtained data (Figure 2), with 36.8% of the explained variance by the axis 1 (grouping the morphological and physiological characters) and 20.3 by the axis 2 (grouping the agronomical characters) showed that the Alcoroches ecotype was approaching Europe; Ampurdan and Tierra De Campos were close to Provence, while Mediterranea appeared an african ecotype; Aragon occupied intermediate positions between both last groups (Delgado, 1988 and 1990a).

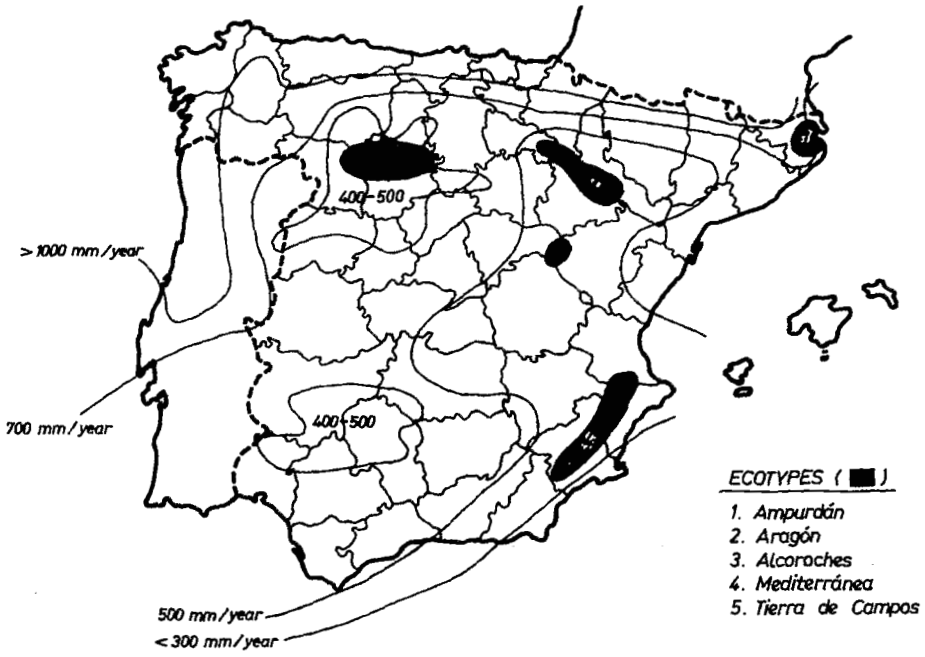


Figure 1. Geographical distribution of the autochthonous cultivated ecotypes.

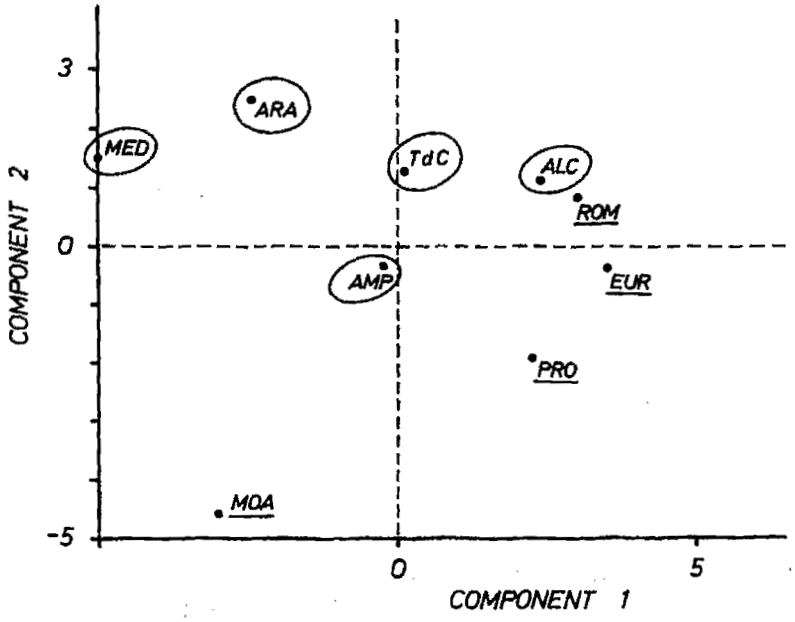


Figure 2. Plan 1 -2 of the analysis of principal components applied to rhizomatous and upright ecotypes.

## RHIZOMATOUS ECOTYPES

Rhizomatous lucernes grow spontaneously in extensive areas of Spain with an annual precipitation ranging from 350 to 600 mm and in altitudes of at least 200 m. The forage value of this wild lucerne was outstandingly remarked by García-Salmeron *et al.* (1966) in their studies on the spontaneous pasture-grounds in Spain.

In 1979, some seed samples were collected to study this plant from the morphological, physiological and agronomical points of view in order to determine its variability and interest for further breeding programs (Delgado, 1989). This collection was increased in 1985 and 1986 with a prospecting organized by the Agricultural Research Institute of Montpellier (France) with the collaboration of the Agricultural Research Institute of Aragón (Spain) (Prosperi *et al.*, 1989).

The studies carried out showed that rhizomatous lucernes presented a high percentage of hard seeds, blue-violet flowers, coiling pods, lower forage yield, prostrate growing, long winter dormancy, poor regrowth after cutting in the summer and rhizomes (Delgado, 1986 and 1989; Ben Chaabane, 1990; Delgado and Hycka, 1991).

Main morphological and physiological characteristics of rhizomatous ecotypes in comparison with upright cultivated ones, tested under dryland conditions of 400 mm rainfall/year, are showed in Table 1 (Delgado, 1986 and 1990b). Stem development and dry matter yield of rhizomatous and upright cultivated ecotypes are showed in Figure 3, two years average (Delgado, 1986).

Table 1. Main characteristics of rhizomatous wild lucernes (R) in comparison with upright cultivated ecotypes (C)

| Trait | R<br>X ± SD | C<br>X ± SD | Signification |
|---|---|---|---|
| Chromosomes number | 32 | 32 | - |
| 1000 seeds weight (gr) | 1,6 ± 0,16 | 2,36 ± 0,15 | *** |
| Hard seeds number (p.100) | 63 ± 11 | - | - |
| Coils number in the pod | 1,8 ± 0,1 | 2,0 ± 0,1 | NS |
| Stem diameter (1-3 scale) | 1,8 ± 0,2 | 2,9 ± 0,1 | *** |
| Leaf size (1-5 scale) | 2,3 ± 0,3 | 4,3 ± 0,2 | *** |
| Crown diameter 1st year (cm) | 15,5 ± 2,6 | 8,4 ± 2,3 | *** |
| Tillering (1-3 scale) | 2,7 ± 0,2 | 2,8 ± 0,1 | *** |
| Foliage (1-5 scale) | 3,1 ± 0,2 | 3,9 ± 0,2 | *** |
| Growth habit (1-5 scale) | 3,5 ± 0,2 | 2,2 ± 0,2 | *** |
| Growth 1st cut (1-5 scale) | 3,2 ± 0,6 | 4,6 ± 0,8 | *** |
| Autumn regrouth (cm) | 2,0 ± 0,6 | 11,2 ± 4,1 | *** |
| Late winter regrowth (cm) | 2,0 ± 0,8 | 12,2 ± 3,5 | *** |
| Summer regrowth (cm) | 3,0 ± 0,8 | 9,7 ± 3,5 | *** |

1 = Smallest or upright. 3 and 5 = Biggest or creeping
*** = Significant at 0,001 level . NS = No significant at 0,05 level

Some studies were carried out to identify rhizomatous lucernes in the field, on seedlings and adult plants, in order to facilitate the screening in breeding programs. On seedling, the studies showed that rhizomatous plants had lower emergence, higher earliness in secondary stems emissions, smaller unifoliate leaves and less internode length than narrow-crowned cultivars (Table 2) (Delgado and Ben Chaabane, 1990). On adult plant, the rhizomatous ecotypes were tolerant to cuttings carried out every 15 days in the first year after sowing, while in Aragon, an upright ecotype, 100% of the plants died; the diameter of the crown in rhizomatous plants 10 cm apart was 12.1 cm *vs* 5.5 cm in Aragon (Table 3) (Ben Chaabane and Delgado, 1994). Finally, salt tolerance during germination was studied in rhizomatous ecotypes in comparison with narrow-crowned ones. Twelve days after sowing, germination percentage was always lower in rhizomatous than in narrow-crowned lucernes; most intervarietal discrimination was apparent at 12 g/l salt level of NaCl plus $CaCl_2$ mixture in the same amounts (Table 4).

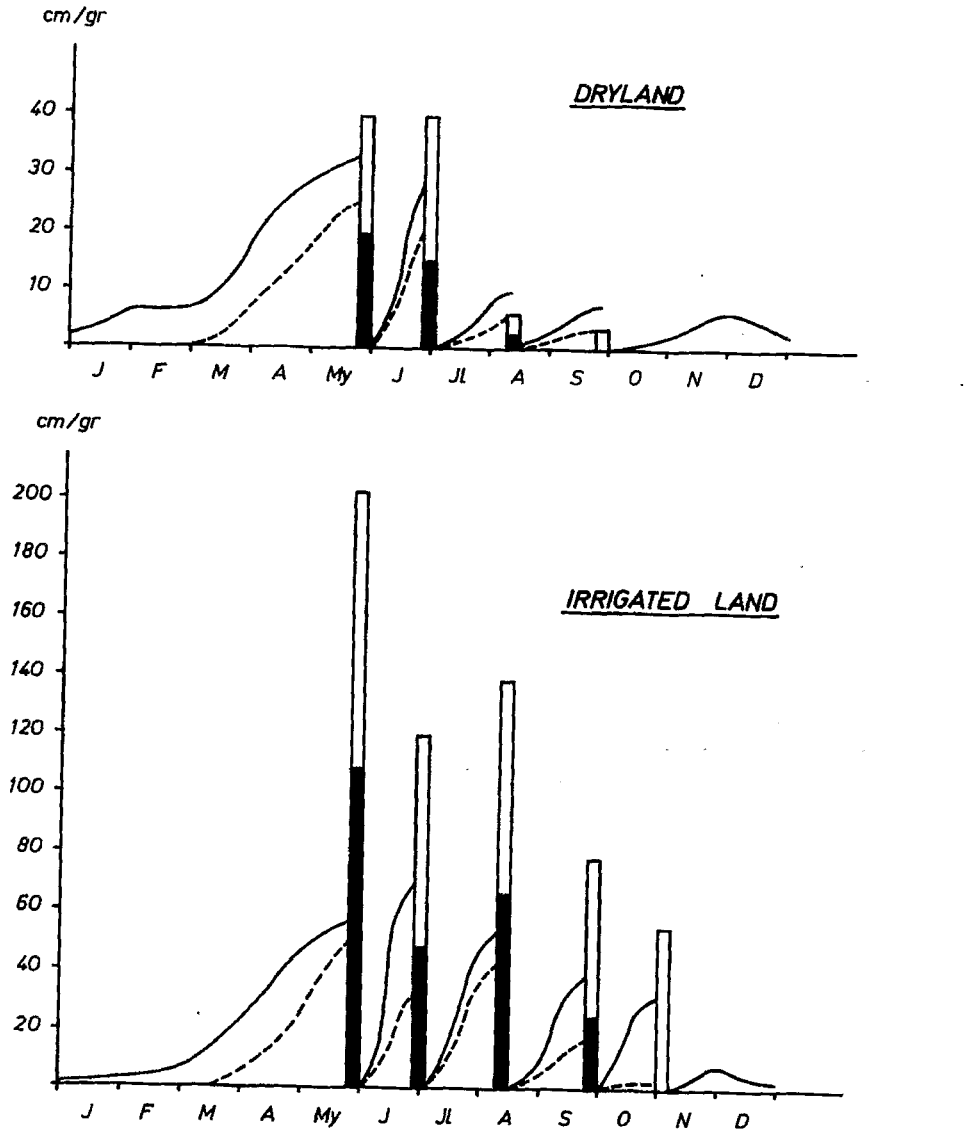


Figure 3. Stems development and dry matter yield of upright ( ——— , □ ) and rhizomatous ecotypes ------ , ■ ).

Table 2. Seedling characteristics of rhizomatous (R) and narrow-crown lucerne cultivars (C), seeded in spring

| Trait | R<br>X ± SD | C<br>X ± SD | Signification |
|---|---|---|---|
| Emergence date: | | | |
| § unifoliate leaf (day) | 12,9 ± 0,3 | 12,3 ± 0,3 | * |
| § first branching (day) | 32,9 ± 1,9 | 37,9 ± 1,2 | ** |
| Stems number | 2,6 ± 0,4 | 2,2 ± 0,2 | NS |
| Internode length (mm) | 1,3 ± 0,2 | 4,9 ± 1,8 | *** |
| Unifoliate leaf: | | | |
| § length (mm) | 4,5 ± 0,4 | 6,5 ± 0,6 | *** |
| § width (mm) | 6,0 ± 0,5 | 8,9 ± 0,7 | *** |

*, **, *** = Significant at 0,05, 0,01 and 0,001 level; NS = no significant at 0,05 level.

Table 3. Percentage of the died plants according to the frequency of cutting and diameter of the crown in relation to the distance between plants (cm) in wild lucernes (R) in comparison with ARAGON upright ecotype (C)

| | R<br>X ± SD | C<br>X ± SD | Signification |
|---|---|---|---|
| Frequency of cutting: | | | |
| 15 days | 6,7 ± 5,5 | 100,0 ± 0,0 | |
| 30 days | 1,1 ± 3,4 | 1,1 ± 3,4 | *** |
| 60 days | 1,1 ± 3,4 | 1,1 ± 3,4 | |
| Distance between plants: | | | |
| 10 cm | 12,1 ± 1,1 | 5,5 ± 0,6 | |
| 15 cm | 12,1 ± 1,0 | 7,3 ± 0,4 | |
| 30 cm | 13,5 ± 0,5 | 9,0 ± 0,5 | *** |
| 60 cm | 15,4 ± 1,0 | 11,4 ± 0,6 | |

*** = Significant at 0,001 level.

Table 4. Percentages of seed germination in different salt solutions, taking 100% as germination in distilled water

| Level of concentration | Rhizomatous wild lucernes<br>X ± SD | Upright cultivated ecotypes<br>X ± SD | Signification |
|---|---|---|---|
| 4 g/l | 87,1 ± 8,8 | 97,9 ± 2,6 | * |
| 8 g/l | 67,9 ± 12,1 | 97,5 ± 1,9 | *** |
| 12 g/l | 22,0 ± 10,5 | 83,6 ± 7,7 | *** |
| 16 g/l | 5,3 ± 4,0 | 50,3 ± 15,8 | *** |
| 24 g/l | 0,0 ± 0,0 | 1,3 ± 1,8 | *** |

* = Significant at 0,05 level.
*** = Significant at 0,001 level.

## REFERENCES

Ben Chaabane A.A., 1990. Etude de la variabilité d'une collection de luzernes spontanées (*Medicago sativa* L.) dans le but de son amélioration génétique, 150 pp. Master of Science. Centre International de Hautes Etudes Agronomiques Mediterranéennes de Saragosse (Spain).

Ben Chaabane A.A., Delgado I., 1993. Variabilidad en la tolerancia a sales de las alfalfas espontáneas durante la germinación. Investigación Agraria. Producción y Protección Vegetales, 8(1): 29-35.

Ben Chaabane A.A., Delgado I., 1994. Caracterization of rhizomatous-rooted lucernes. Proceedings of the Meeting FAO-Eucarpia "Medicago". Lusignan (France).

Delgado I., 1986.Characterization of wild lucernes (*Medicago sativa* L.) from Aragon (Spain). Proceedings of the International Meeting Eucarpia Group "Medicago sativa", 91-98. Pleven (Bulgaria).

Delgado I., 1988. Characterization of the cultivated spanish ecotypes. Meeting of Eucarpia Group *Medicago sativa*. Radzilow (Poland).

Delgado I., 1989. Estudio de la variabilidad de las mielgas aragonesas (*Medicago sativa* L.) en áreas de precipitación anual inferior a 600 mm, 180 pp. Tesis Doctoral. Universidad Politécnica de Madrid. ETS de Ingenieros Agrónomos.

Delgado I., 1990a. Variabilidad de los ecotipos cultivados de alfalfa. Actas de la Reunión Científica de la Sociedad Española para el Estudio de los Pastos, 216-223. San Sebastian (Spain).

Delgado I., 1990b. Agricultural interest of mielgas (*Medicago sativa* L.) from Spain. Proceedings of the 6th Meeting of the FAO European Sub-Network on Mediterranean Pastures and Fodder Crops, 57-58. Bari (Italy).

Delgado I., Ben Chaabane A.A., 1990. Identification of rhizomatous wild lucernes on seedling. Proceedings of the Meeting of Eucarpia Subgroup "Medicago sativa". Kompolt (Hungría).

Delgado I., Hycka M., 1991. Características diferenciales de las mielgas frente a los ecotipos cultivados de alfalfa. Actas de la XXXI Reunión Científica de la Sociedad Española para el Estudio de los Pastos, 37-40. Murcia (Spain).

Garcia-Salmeron J., Monserrat P., Buendia F., Ruiz Del Castillo A., Allue J.L., 1966. Studies of botany, ecology, biology and pascicology of the principal existing species in the spontaneous pasture-grounds of the mountains of our semiarid regions. Final rapport of the project of research sponsor by P.L.480. IFIE, Madrid (Spain).

Hidalgo F., 1966.. Clasificación de las alfalfas españolas, 86 pp. Asociación de Investigación para la Mejora de la Alfalfa. Zaragoza (Spain).

Hycka M., 1964. Posibilidades de clasificación de los ecotipos de alfalfas españolas, 13 pp. Actas de la V Reunión Científica para el Estudio de los Pastos. Pamplona-Jaca (Spain).

Prosperi J.M., Delgado I., Angevain M., 1989. Prospection du genre Medicago en Espagne et au Portugal. Plant Genetic Resources News Letter, 78/79, 27-30.