

CHARACTERISATION OF GERMPLASM OF ANNUAL MEDICS (*Medicago polymorpha* L.) IN THE “BAIRRO RIBATEJANO” REGION

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Abstract

This work corresponds to the first stage of a project whose aim is the further selection of cultivars of annual medics for the limestone massif of Central Portugal, and it reports on the characterisation and preliminary evaluation of 45 populations of annual medics (*Medicago polymorpha* L.) collected in the “Região Agrária do Ribatejo e Oeste”.

Thirty six traits, decided after the descriptors for annual medics of the International Board for Plant Genetic Resources (IBPGR), were observed throughout the vegetative and reproductive stages. Data were analysed by means of the NTSYS-pe (Numerical Taxonomy and Multivariate System) Program.

Traits that showed greater variation were peduncle hairiness, left surface hairiness at mean flowering, leaf area one month after transplantation, seed yield per plant, single pod weight and basal internode length.

Relatively long life cycles (140 to 181 days from sowing to flowering) were observed in all populations. Forage and seed yield were high in most populations. Hard-seededness, evaluated in the months of August, September and October following seed ripening, was always very high, though it decreased with time.

Introduction

The aim of this research is the characterisation and preliminary evaluation of 45 populations of annual medics (*Medicago polymorpha* L.) collected in the “Região Agrária do Ribatejo e Oeste”, which stands in the limestone massif of Central Portugal, in order to identify suitable germplasm for breeding. As commercial varieties are not well adapted to the region, new varieties are needed, based upon naturally well adapted germplasm.

Material and Methods

During the summer of 1995, 45 accessions of *M. polymorpha* were collected in the Agrarian Region of “Ribatejo e Oeste” (Fortunato, 1997). On October 4th of the same year, the 45 populations were sown in jiffy seven pots, and on November 14th the seedlings were planted in the field; by that time seedlings averaged the 2nd-3rd true leaf stage.

The field trial was conducted in the “Bairro Ribatejano”, in an homogeneous clay lime soil, alkaline [pH (H₂O) = 8.3], with high levels of phosphorous (149 ppm) and very high levels of potassium (352 ppm). The growing season happened to be unusually rainy (1234.8 mm against the thirty year average of 710 mm), particularly in the late season, with 157 mm in May. The field layout followed an experimental design of two completely randomised blocks, with spaced plants (the distances within and between rows were 0.5 and 1.0 m, respectively).

A total of 36 traits (Table 1), decided after the IBPGR list of descriptors for annual medics, were observed along the growing season and after harvest (IBPGR, 1991).

Numerical taxonomy techniques were used for the analysis of data, performed with the NTSYS-pc (Numerical Taxonomy and Multivariate System), version 1.8. Data were first

standardised. A cluster analysis by UPGMA (Unweighted Pair Group Method using Arithmetic Averages) and a principal components analysis were performed (Rohlf, 1992).

Results and Discussion

The mean, the limits of variation and the coefficient of variation (CV) observed for each of the traits under observation are shown in Table 1. Average and maximum seed yield per plant and averages and maximums of life cycle length traits are quite high if we take into account the data available in literature for the Australian commercial varieties.

The largest coefficients of variation were found in peduncle hairiness, leaf surface hairiness at mean flowering, leaf area one month after planting, seed yield per plant, pod weight and internode length (at 4th-5th internode stage from the base).

Table 1- Range of variation, means and coefficients of variation (CV) for 36 traits

Trait	Range	Mean	CV (%)
1 - Growth habit (1-4)	1 - 2	1.07	23.7
2 - Internode length, at 4th-5th internode stage from the base (cm)	1.48 - 4.49	2.86	26.3
3 - Number of primary branches	3.50 - 12.75	7.57	24.8
4 - Early vigour, one month after planting (1-10)	4 - 10	6.69	20.3
5 - Leaf area, one month after planting (cm ²)	1.43 - 7.58	3.89	32.0
6 - Leaf area, at mean flowering (cm ²)	5.98 - 15.58	11.31	22.5
7 - Winter hardiness (1 - 10)	3.50 - 9.50	6.23	18.5
8 - Herbage yield (dry matter/plant) at mean flowering (g)	210.75 - 567.25	376.11	21.2
9 - Herbage yield (dry matter/plant) at pod maturation (g)	272.50 - 580.00	433.58	17.0
10 - Leaf surface hairiness, one month after planting (1 - 9)	1 - 3	1.82	24.2
11 - Leaf surface hairiness, at mean flowering (1 - 9)	1 - 2	1.40	35.4
12 - Petiole hairiness, one month after planting (1 - 3)	1 - 1	1.00	-
13 - Petiole hairiness, at mean flowering (1 - 3)	1 - 1	1.00	-
14 - Peduncle hairiness, at mean flowering (1 - 3)	1 - 3	1.49	39.5
15 - Days to the first flower bud primordium	134 - 173	156.29	7.9
16 - Days to mean flowering	140 - 181	163.24	7.7
17 - Days to last flowering	245 - 254	246.93	1.1
18 - Days to first mature pod	210 - 230	219.36	3.4
19 - Days to last mature pod	247 - 268	255.49	1.7
20 - Maturation period (number of days)	37 - 77	56.11	17.3
21 - Days to death plant	251 - 275	263.96	1.9
22 - Node number at first flowering	6.75 - 17.25	11.28	17.6
23 - Mean number of florets per inflorescence	2.80 - 5.50	4.40	12.9
24 - Mean number of pods per inflorescence	2.60 - 5.00	4.08	14.5
25 - Pod whorl number range	2.13 - 5.63	4.60	14.5
26 - Pod hairiness (1 - 3)	1 - 2	1.04	20.0
27 - Pod spininess (1 - 4)	3 - 4	3.69	12.7
28 - Amount of pod spininess (1 - 10)	5 - 9	6.84	12.0
29 - Pod weight (mg)	26.05 - 161.70	84.20	27.7
30 - Seed yield per plant (g)	20.85 - 118.86	76.64	28.6
31 - Pod yield per plant (g)	127.34 - 295.00	217.09	18.7
32 - Weight of 1000 seeds (mg)	2529.60 - 5277.90	4053.40	15.2
33 - Number of seeds per pod	3.60 - 10.30	8.08	15.4
34 - Seedcoat permeability, the 2 nd of August 1996 (%)	89.00 - 100.00	96.28	3.0
35 - Seedcoat permeability, the 12 th of September 1996 (%)	79.00 - 100.00	95.29	4.5
36 - Seedcoat permeability, the 17 th of October 1996 (%)	61.00 - 100.00	85.69	10.9

The phenogram after the UPGMA method is presented in Figure 1. Population 42, which is well separated from the others, seems to belong to *Medicago polymorpha* var. *vulgaris*; the remaining populations, which apparently belong to *M. polymorpha* var.

polymorpha, do not separate into clear-cut clusters, but some populations show a tendency to cluster together. Such is the case of the group formed by populations 1, 41, 45, 46, 63 and 48, as well as that formed by populations 23, 38, 33, 37 and 24. The populations of the first group showed low early vigour, below average winter hardiness, early flowering, long maturation period, below average herbage, pod and seed yield per plant and a low percentage of hard seeds in October. The populations of the second group showed long basal internodes, high early vigour and winter hardiness, and above average herbage, pod and seed yield per plant; as in the first group, the populations of the second group are early flowering and present a slightly below average percentage of hard seeds in October.

A principal component plot is given in figure 2. The first two principal components together account for 36.5% of the total variation. The first principal component mostly consisted of winter hardiness, seed yield per plant, early vigour, leaf area and internode length. Population 19 is well distinguished from the others as it shows high winter hardiness, very high early vigour, large leaf area (mainly at flowering) and the highest seed yield per plant (118.86 g). Inversely, populations 42, 64 and 72 showed low early vigour, low winter hardiness, small leaf area and low seed yield. Population 37 and population 2 are clearly distinguishable from the others as they presented the longest and shortest internode length, respectively. The second principal component was strongly associated with seed coat permeability in September and, particularly, in October, the number of days to the first flower bud primordium, number of days to flowering, number of days to the first mature pod and herbage yield at pod maturation. Populations 11 and 23 showed the highest percentage of hard seeds in September and October, while the populations 1, 33, 46 and 48 had the lowest percentages. Populations 2 and 9 were the most late flowering and populations 6, 16, 33, 37 and 41 the most early flowering.

Conclusions

The morphological characterisation indicates that, for many traits, there is a significant variation between populations. Leaf surface and peduncle hairiness at mean flowering, leaf area one month after planting, seed yield per plant, pod weight and internode length at 4th - 5th internode stage from the base were the traits that exhibited the largest variations.

Numerical taxonomy techniques allowed the identification of several differentiating traits, in particular, winter hardiness, early vigour, seed yield per plant, leaf area, internode length, hardseededness in September and October and some life cycle length traits. However, these results must be taken with care, as they have come out of a single year study.

Some populations clearly exceeded the Australian commercial varieties for traits such as early vigour, winter hardiness, herbage and seed yield. Besides, most populations showed late flowering (140 to 181 days from sowing to flowering) when compared with standard commercial varieties, which is much convenient for many regions of Portugal. Such performances clearly recommend the use of some of this germplasm for breeding.

References

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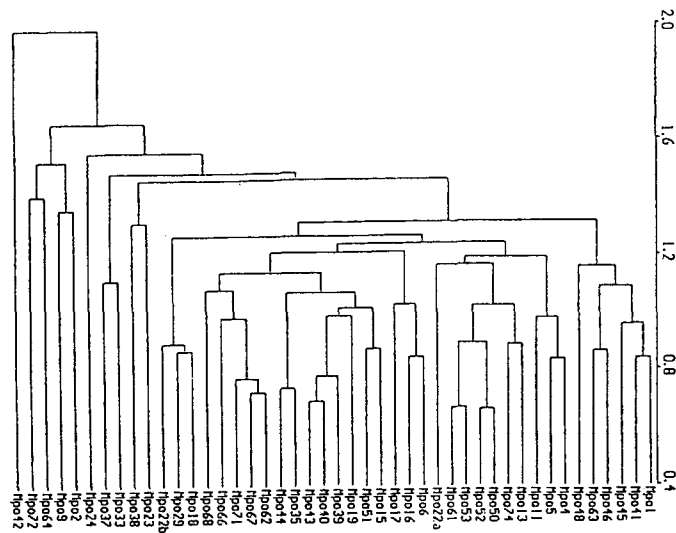


Figure 1 - Phenogram of 45 populations obtained by UPGMA applied to the matrix of distances ($r = 0,770$) Mpo - *M. polymorpha*.

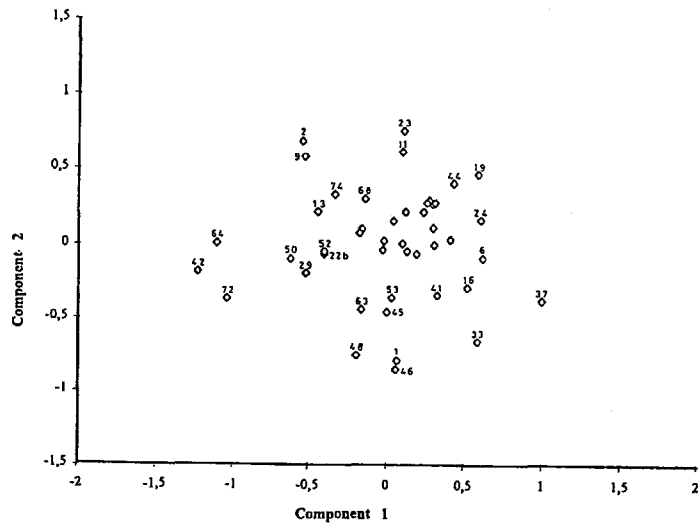


Figure 2 - Plot of 45 populations on the plan defined by the two first principal components.