

VARIATION IN NATURALISED *MEDICAGO POLYMORPHA* COLLECTED FROM INLAND EASTERN AUSTRALIA: I - NSW

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Summary. Burr medic (*Medicago polymorpha*) is an important source of stock fodder on heavy soils in inland eastern Australia. Considerable variation has been recorded in this species both in imported collections and from field observations in Australia. We believe that a systematic study of the characteristics of naturalised accessions from diverse environments in eastern Australia will provide valuable information and genetic material for the selection of cultivars for crop/pasture systems on heavy soils in semi-arid areas. Consequently, 90 accessions were collected from sites on heavy soils throughout central and western New South Wales. These were grown out and their morphology and phenology described.

INTRODUCTION

In the Mediterranean regions of the middle east and northern Africa, local plant resources are more likely to provide adapted pasture plants than imported cultivars (1). In Syria, for example, *M. rigidula*, *M. noeana*, and *M. rotata*, which were the most successful annual *Medicago* spp. sown in pasture wheat rotations, were indigenous to Syria and surrounding areas whereas Australian cultivars failed to persist (2, 3).

In eastern Australia, several species of annual *Medicago* have become naturalised. The most widespread are probably the spiny podded species: cut leaf medic (*M. laciniata*), which is adapted to sandy surfaced red earths and also occurs on clay soils; woolly burr medic (*M. minima*), adapted mainly to sandy and loamy soils; and burr medic (*M. polymorpha*) which grows on a wide range of soils but does best on alkaline, heavy clay soils (4, 5). Other naturalised but less widespread species include *M. truncatula*, *M. praecox*, *M. lupulina* and *M. orbicularis* (4). Some early Australian annual medic cultivars were selected from naturalised populations: *M. truncatula* cvv. Hannaford (short spined barrel medic ecotypes on a property near Noarlunga, SA, 1930's), cv. Jemalong (a single plant collected on Jemalong Station, Forbes NSW, 1939); *M. polymorpha* cv. Circle Valley (near Coolgardie, WA, 1967) and the spineless parent (Coolgardie, WA) of cv Serena (registered 1976) and *M. tornata* cv. Murrayland (Pooncarie NSW, registered 1971) (6). However, more recent cultivars have been selected from accessions collected from Mediterranean regions.

A well adapted annual legume is needed for crop rotations and perennial grass pastures in northwest NSW and central and southern Queensland. Because *M. polymorpha* is widespread and thrives on most heavy soils in these drier areas, we believed it worthwhile to collect and study representative populations of this species from these and other areas where it is known to persist. Firstly, a collection of accessions from eastern Australia may yield suitable cultivars, material for breeding programs and benchmark genotypes with which to compare promising accessions from imported collections. Secondly, correlations between phenotypic variation and environment characteristics may indicate appropriate criteria for the selection of *M. polymorpha* cultivars for these regions. In this paper, we describe the collection and grow out of *M. polymorpha* collected in New South Wales.

MATERIALS AND METHODS

Collection

Western and northern NSW was divided into 8 regions (Table 1). These regions were predominantly of heavy clay and duplex soils where *M. polymorpha* is naturalised. Sampling areas were marked on a map to give a wide distribution. Seed pods were collected in summer 1993/94. On arriving at each area, a representative sampling site was selected, as often as possible, in a typical grazed or farmed paddock. Roadside collections were infrequent.

Pods were collected from 20, 0.1 m² circles randomly placed at 50-100m intervals in either a rectangular grid or a line transect depending on the shape of the site. If pods were not abundant, a second transect was sampled. After collection of pods from the 1st, 5th, 10th, 15th and 20th circles, 2 soil samples (0-15cm) were taken for chemistry and estimation of populations of *Rhizobium meliloti*. Soil samples were air dried at 40°C. At each site we recorded position using a GPS, a broad description of soil type, slope, runoff/runoff, vegetation and assessment of land use.

Table 1. Characteristics of collection sites.

Region (Number of collection sites)	Rainfall (mm)	Vegetation	Soil type	pH (CaCl ₂)	Ranges in selection site characteristics	
					Organic C %	P (Colwell) mg/kg
Broken Hill (4)	≤ 250	Grassland, chenopod shrubland	Grey clay, duplex	7.41 - 8.08	0.35 - 0.41	20.4 - 30.3
Hay (19)	300 - 400	(Degraded) chenopod shrubland	Grey clay, duplex	5.70 - 8.12	0.56 - 1.79	15.6 - 80.7
Lachlan (16)	400 - 500	Eucalypt, belah, myall	Grey clay, duplex	6.11 - 8.08	0.91 - 1.81	15.1 - 33.3
Coonamble (21)	450 - 550	Eucalypt, belah, myall, chenopod	Grey clay, duplex	6.46 - 7.83	0.63 - 2.00	10.5 - 100.9
Brewarrina (9)	375 - 425	Brigalow, myall, chenopod shrubland, grassland	Grey clay, duplex	6.47 - 8.08	0.36 - 0.96	18.7 - 53.9
Walgett (6)	425 - 500	Eucalypt, myall	Grey clay	7.46 - 7.75	0.33 - 1.58	20.2 - 116.4
Moree (7)	500 - 625	Eucalypt, belah	Grey clay	6.28 - 7.89	0.84 - 2.48	20.5 - 82.1
Liverpool Plains,	600 - 850	Eucalypt, grassland	Blackearths	5.72 -	1.58 -	22.6 -

Nundle (9)

shale

7.50

2.18

144.6

Grow out

After collection, pods were sorted into species, threshed and the seed scarified. Accessions were hand sown (16 May 1994) into unreplicated plots consisting of 4 x 2 m rows containing around 50 plants after thinning. *M. polymorpha* cvv. Serena and Santiago were each sown into 5 plots as control lines. The grow out site was in a burr medic free paddock on the Agricultural Research and Advisory Station, Condobolin. The site was fertilized with 130kg/ha single superphosphate (9.1% P, 11.5% S) and watered with a linear move irrigation boom when necessary.

The following recordings were made on each plant (total 5,000) leaf mark (on 2 occasions), dry matter rating (on 2 occasions), time to flowering, pod type. Plants, on a plot basis, were assessed for habit, leafiness of the crown and variability of these two characters within the accession. Selections were made within most accessions and were physically isolated for collection of seed pods. Seed pods were harvested, cleaned, assessed for spines, weighed and threshed.

RESULTS AND DISCUSSION

The collection was characterised by large variation within accessions, particularly for leaf markers (Table 2). Six leaflet marker types were described: plain leaf, plain leaf with dentate margin, small to variable mark on basal midrib, small dark basal marks (dots or smudges) either side of mid rib (similar to some Serena types), dark basal inverted Y like mark most often enclosing a lighter coloured region (similar to that of Santiago). Leaf colour was either green or greyish green (similar to Santiago), some accessions had dark or white flecks on the leaflets. Of the 90 accessions, only two contained plants with one type of leaf mark.

Table 2. Characteristics of *Medicago polymorpha* accessions.

Region (Number of Accessions)	Range in characters						
	Leaf ¹ markers	Flowering times (DAS ⁴) 1st Mode		Habit ²	Dry matter (Score ⁵)	Pods Number of wt, mg coils and spine length ³	
Broken Hill (4)	All	81-88	84-91	S,E	3.0-5.0	3xs,3s,4m	29.4- 45.2
Hay (19)	All	81-95	88-107	S,E	2.5-4.5	3s, 3m, 4m, 4s	28.8- 60.8

Lachlan River (16)	All	88-94	88-107	S,P	3.0-5.0	3s, 3m, 4s, 4m	25.1-60.7
Coonamble (21)	All	84-95	88-107	S,E,P	2.5-5.5	3xs, 3s, 3m, 4m, 4s	26.2-73.4
Brewarrina (9)	All (2*)	70-93	88-107	S,E,P	3.0-5.5	3xs, 3s, 4m	35.9-62.8
Walgett (6)	All	66-88	70-107	E,S	3.0-4.0	3m, 4m	29.8-64.6
Moree (7)	All	65-88	70-107	E	3.0-4.0	3s, 3m, 4m	35.2-54.5
Liverpool Plains - Nundle (9)	All	88-107	103-108	S,P,E	3.5-4.0	3m, 4m	29.5-62.4
Serena (5 plots)	2 types	64-65	70-77	E,S	3.0-5.5	spineless	
Santiago (5 plots)	1 type	77-81	84-88	E,S	3.5-5.5	spineless	

¹ all, all types present; 2*, 2 accessions with 1 marker type only.

² P, prostrate; S, semi erect; E, erect; B, bush.

³ numerals, number of coils; letters, spine length xs < 1 mm, s 1-2 mm, m 3 mm.

⁴ Days after sowing.

⁵ 1 to 9, 1 = low dry matter production, 9 = high dry matter production.

Flowering times (days from sowing to first open corolla) also varied between individual plants with some exceptions. As an indication of this variability, the difference in time between first flower and when most plants were flowering (mode, Table 2) varied from no time elapsed (5 accessions) to ≥ 15 days (27 accessions). The most frequent differences (28 accessions) were in the range 10-14 days. These distributions in flowering contrast with those of the controls; Serena (6 days) and Santiago (4 days). Three accessions from the north west (Brewarrina, Walgett, Moree) flowered as early as Serena. Accessions from the Liverpool Plains tended as a group, to be late flowering. However, some late flowering accessions (1st flower 90 days, mode > 105 days) were collected from all other regions except Broken Hill. Plants with a more erect habit were found in all regions except the Liverpool Plains. Seven accessions consisted of prostrate plants with leafy crowns and were collected from Lachlan, Coonamble, Brewarrina and Liverpool Plains. Pods had either 3 or 4 coils and spines varied from very short (< 1 mm) to medium or long (3 mm). Again there was considerable variation within accessions, but less than for leaf marks. This variation in *M. polymorpha* contrasts with the uniformity that appeared in *M. laciniata* collected in NSW (7).

Some of the variation within and between accessions may have been due to differences in the quality of seeds. However, it appears that at almost all sites there was a mixed population. This species, irrespective of habit or flowering time, would seem to be able to persist in most of the environments we sampled. There were few sites (near Lightning Ridge, south west of Walgett and east of West Wyalong) where *M. polymorpha* was expected on the basis of soil type but not found. Some red soils with bimple box and/or white cypress pine were checked for the presence of *M. polymorpha* but none was found. These limited observations agree with findings from earlier collections of *M. laciniata* (7) and surveys (5) (8) which showed *M. polymorpha* seldom occurred on light textured red soils. Similarly in Morocco, *M. polymorpha* was found to have a significant preference for soils high in clay but was also found to be the most widespread species and thus should be of high priority in cultivar development (9).

In 1995, selections from both New South Wales and Queensland, together with imported lines are being tested in replicated trials at two sites located at Condobolin and Warwick.

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