

LOTUS SPECIES COLLECTION IN THE WESTERN MEDITERRANEAN, 1974

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Why Lotus and for what purpose? Why the Western Mediterranean area?

LOTUS RESEARCH

My research responsibility is part of a team development of pasture and forage plants for an extremely variable subtropical to warm temperate environment, the North Coast Region of New South Wales. My work with white clover established the value of winter-growth-period selections of temperate legumes for persistence in this subtropical area, which has a useful winter rainfall component. Thus adapted temperate legumes make most contribution during the critical production period.

Of particular interest in my Lotus program, is the group of species commonly known in Australia as "Lotus major"; for use on colluvial or alluvial soils in  $\geq 1000$  mm rainfall areas, or higher rainfall hill areas  $\geq 1500$  mm, as well as the traditional wet-soil areas. Commercial "Lotus major" is variable summer-growing material of L. uliginosus Schkuhr, from seed sources in cool temperate areas. Most lines are not well adapted in this subtropical climate.

Other Lotus species showing potential agronomic use are:- birdsfoot trefoil L. corniculatus L.; narrow leaf trefoil L. tenuis Waldst et Kit. ex Willd.; L. angustissimus L. and L. subbiflorus Lag. (L. hispidus Desf.). The agronomically distinct type of birdsfoot trefoil represented by the cultivars Sao Grabial and Vega, is more winter productive than other pasture legumes. Narrow leaf trefoil is more persistent than birdsfoot trefoil, through greater disease resistance. The annuals, L. angustissimus and L. hispidus, are found naturalised in a few locations. I am developing techniques to grow annual Lotus spp. in association with white clover, to utilise their phaseal occurrence to minimise bloat risk.

COLLECTION OBJECTIVE

Selection of material of "Lotus major" with more winter-spring growth was the main objective of my plant collecting trip in the Western Mediterranean area. The species in the complex, L. uliginosus Schkuhr, L. pedunculatus Cav. and L. granadensis Zertova, have an overlapping distribution in south west Spain, southern Portugal, and northwest Morocco. This is a mesophytic -- xerophytic area with a winter growth period, in the lowest latitudes of the geographic range of the species complex. The temperature and daylength regime is closest to that of the subtropical east coast of Australia.

Lotus corniculatus and numerous other perennial and annual species are naturally distributed in the area. Examination of the variation in these species and their ecological distribution, for possible agronomic or conservation uses, was an important added objective.

#### TAXONOMIC CONFUSION

To plan collection of a representative sample of Lotus specimens, the distribution of the species was discussed at Herbaria and other Research Institutions in London and the countries visited. Specialists in taxonomy, plant geography and ecology were approached for expert advice on the genus Lotus, but this advice was not available in a satisfactory form. Many conflicting ideas were propounded, mostly through taxonomic confusion, but also because insufficient attention has been paid to plant geography and the ecology of species distribution.

That the taxonomy of Lotus is confused is readily acknowledged in Flora Europea which states:

"1-12 L. corniculatus group.

A widespread, variable group containing diploid and tetraploid species. It is sometimes treated as a single species with a number of subspecies and varieties. Recent work has shown that there are a number of relatively local diploid taxa throughout C & S Europe and Asia, together with more widespread tetraploids. The data available at the present time are insufficient to produce a comprehensive account of the group and it is likely that some of the species recognised here are heterogeneous, while others may not be distinct species".

This group contains the species complex relating to "Lotus major", to which I have referred above. It also includes many agronomically very distinct types under L. corniculatus L., which is itself a species complex.

"7. L. corniculatus L.

As defined here this species is very variable. It may eventually be possible to recognise a number of subspecies, but the native distribution of this and some related species is very confused owing to their widespread use as a forage crop".

As an example, in the Iberian Peninsula I found 19 subspecies or varietal names being used, for a limited range of material, under the specific name L. corniculatus. Some of the 19 are not L. corniculatus L. and some are only polymorphic variants of the same subspecies or variety. Different systematic texts are being used with conflicting..... definitions.

There is some taxonomic revision of the genus, but this is too disjunct to be effective. As this is a genus of economic importance there is need for total revision. This revision should not only be acceptable throughout Europe but in the adjacent regions of Macronesia, North Africa, the Mediterranean Islands and Asia Minor.

#### REASONS FOR TAXONOMIC CONFUSION

There are major reasons for the confusion in taxonomy of the Lotus genus. These comments are made both as a result of this study and from previous agrastological experience with species of Lotus.

##### (1) Polymorphism

Polymorphism of characters used in taxonomic descriptions is not recognised as being as widespread as it is. There are a number of forms of polymorphism influencing Lotus spp.:

(a) Phenotypic, due to edaphic, light and moisture changes and the influence of grazing;

(b) Seasonal polymorphism, expressed in changes at different physiological ages and expressed at different stages between and within communities;

(c) Genetic, as seen in segregating communities; four examples were noted during the field collecting; and

(d) Genotypic, between spacially isolated communities; as it is common for the species to occur in isolation, genetic isolation is easy (normally allowed for in classification of some character sizes).

##### (2) Taxonomy of rooting system

No attention is paid to the rooting system in classification. For example, L. corniculatus as now classified can have:- (i) a simple crown with deep taproot system, (ii) a taproot system with sub-crown development, (iii) a strongly divided root system with single crown, or (iv) a strongly rhizomatous root system with multiple crowns; each system being the type familiar to different researchers.

##### (3) Collection Range

There is incomplete collection over the geographic range, giving incomplete range of characters within the recognisable groupings. Collections have been concentrated in the geographic area around Herbaria or from known "good collecting localities". A few specimens are considered sufficient.

(4) Geographic Distribution

Knowledge of the geographic range and distribution of the species/subspecies/variety is incomplete. It is a "chicken and egg" situation, but without knowledge of the geographic range of groups of characters, definition of meaningful groupings is hazardous because of polymorphism. Development and updating of records by which the true geographic distribution and ecology of a particular taxonomic group can be determined has been mostly neglected.

(5) Ecological Habitats

Ecological knowledge on the habitats of recognised groupings is limited. What is there is confounded in the taxonomic confusion. As with geographic range, improved knowledge of the habitats of plants would help in organizing sensible taxonomic units. Obviously some groups will have broader environmental adaptation than others. But if they are meaningful groupings they will have definable habitats and definable distributions.

(6) Taxonomic Approach

The concepts summarised by J. Heslop-Harrison in his book "New Concepts in Flowering Plant Taxonomy", as early as 1953, are particularly relevant to the clarification of the taxonomy of Lotus. Other authors have made considerable comment on taxonomic methodology. However, the observed approach to taxonomy seemed to be that of a static art-form rather than a dynamic science.

FIELD COLLECTION

The collection made by me was of insufficient size to help resolve knowledge of the taxonomy of Lotus. But in some cases it did increase the available knowledge on distribution and habitat. The objective of my collection was distinct, to collect for pasture research. The descriptions of sites and associated species in my report, are made from a pasture viewpoint and are not complete descriptions of the plant communities.

Exploration for collecting localities was necessary. This was supplemented by sampling the previously frequented collecting localities. The route was chosen to sample the distribution of "Lotus major", other species being of secondary importance. Where possible, acid soil areas were favoured and the warmer parts of provinces sampled. Collecting was kept below 1000 m altitude in Spain and Portugal to increase the probability of adaptation to lower latitudes. In Morocco, because of the lack of evidence of collection from lower altitudes, acid soil areas of the Middle Atlas were sampled.

My collection is a representative sample covering variation in habitat, morphology and genotype. In the seed collection there are 22 samples of the "Lotus major" group and 10 samples of the L.

Forty-three soil and nodule samples were collected for isolation of Rhizobia. This collection is being handled by J. Brockwell, Senior Research Scientist, Division of Plant Industry, C.S.I.R.O. (P.O. Box 1600, Canberra, A.C.T. 2601, Australia).

Herbarium specimens were collected for many of the samples. These are with M. Gray, Herbarium Australiense, C.S.I.R.O. (P.O. Box 109, Canberra, A.C.T. 2601, Australia). Copies will be forwarded to the National Herbarium (Royal Botanic Gardens, Sydney, 2000, Australia) and Herbario Del Laboratorio de Botanica de la Facultad de Farmacia (M.A.F.) (Ciudad Universidad Campos, Madrid) for northern hemisphere reference. A fourth set will be available for borrowing from M. Gray. Taxonomists at M.A.F. have offered to be responsible for verification of identity.

Colour photographs were taken of the morphological variation in living plants of "Lotus major" and L. corniculatus and of the variation in habitat. Despite care in pressing the herbarium specimens, there appeared to be a marked change in the shape of the softer leaf of the "Lotus major" during drying. Colour distinction and morphological variation, readily recognised in the field, is less evident in the herbarium specimens. Thus colour photography is an important part of the investigation of polymorphism in revision of the taxonomy of Lotus spp.

Detailed descriptions of location, site and associated pasture species were made at each collection site. These descriptions are recorded in my Churchill Fellowship Report (copies obtainable from the author), on computer tape with the C.P.I. accession numbers of the seed at Genetic Resources Section, Division of Plant Industry, C.S.I.R.O. (Address above), and on the herbarium specimen sheets.

#### CONCLUSION

While I have succeeded in my initial objective of sampling variation in "Lotus major" for agronomic research, I feel it is very important to stimulate positive action towards a worthwhile revision of the taxonomy of the genus.

Inter-disciplinary research is becoming an established part of the scientific world. It is to be hoped that the increasing agronomic value of species of Lotus and the co-ordinating role of this Newsletter, will lead to more inter-disciplinary research on the taxonomy, ecology and geography of Lotus.

The agronomic evaluation of this important genus, in many parts of the world, is dependent on this inter-disciplinary research for its proper sampling of resource materials,