DRY MATTER ALLOCATION AND NUTRITIVE VALUE OF TROPICAL AND TEMPERATE FODDER TREES AND SHRUBS IN THE GAUTENG PROVINCE OF SOUTH AFRICA

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ABSTRACT
Fodder tree and shrub species from the genera *Albizzia, Atriplex, Cassia, Chamaecytisus, Cytisus, Leucaena, Lupinus, Medicago, Sesbania* and *Teline* were evaluated in terms of their adaptation to local conditions and potential production of protein-rich forage and fuelwood. *Atriplex nummularia, Cassia sturtii, Chamaecytisus palmensis, Cytisus maderiensis, Leucaena species, Sesbania sesban* and *Teline stenopetala* offer considerable potential, both in terms of yield of protein-rich forage and/or fuelwood.

KEYWORDS
Agroforestry, forage, fuelwood, nutritive value, woody material.

INTRODUCTION
The high lying areas of Gauteng are characterized by a drastic decline in nutritive value during the autumn and winter months. This necessitates the use of expensive protein supplementation. Protein rich fodder crops, such as leguminous trees and shrubs, may play an important role as supplements for poor quality roughage. The objective of this investigation was to evaluate a range of fodder trees and shrubs in terms of adaptation to ecological conditions, and in terms of productivity and nutritive value, for possible use in livestock production systems.

METHODS
The trial was conducted on the Hatfield Experimental Farm of the University of Pretoria (1360 m.a.s.l.) on a well drained soil (38% clay) with a good pH (pH_{water} 6.6) and nutrient status. The area receives an average annual rainfall of 650 mm, which is concentrated in the summer months from October to March. Late summer and autumn are often characterized by dry conditions, which may persist through the winter period. The winter months are normally cold, with sub-zero temperatures and frost a frequent occurrence.

Seedlings of *Albizzia julibrissin, Atriplex nummularia, Chamaecytisus palmensis, Cytisus maderiensis, Leicaena esculenta-paniculata, L. leucocephala, L. pulverulenta, Lupinus arborea, Medicago arborescens, Sesbania sesban,* and *Teline stenopetala* were planted in a replicated trial during September (spring) 1993 at a density of 3,333 plants/ha. From November 1993 to July 1994 plants of all species except *Albizzia*, which was very slow under local conditions, were harvested randomly at regular intervals to assess the productivity (fuelwood and edible material) and quality of forage over the season. Productivity of material was expressed as oven dry material, whereas nutritive value was assessed in terms of *in vitro* digestibility of organic matter (IVDOM), crude protein (CP), acid detergent fibre (ADF), neutral detergent fibre (NDF) and lignin. In the 1994/95 season seedlings of *Cassia sturtii*, a species which has exhibited potential in arid zones, were also planted. After a winter pruning in 1994 and 1995, the potential forage and fuelwood production was assessed again at the end of the 1995/96 season.

RESULTS AND DISCUSSION
Dry matter production: Apart from differences in yield potential (Table 1) it is notable that species appear to differ markedly in terms of their perenniality under local environmental conditions and in their sensitivity to local diseases and insect pests.

With respect to the sub-tropical species evaluated the following observations:

Albizzia is slow growing and even at the end of the third growing season yielded only 4.7 $tDMha^{-1}$, of which only 28% was edible forage. Although it is characterized by a complete leaf loss in winter the stem is not damaged by local frost conditions and, if harvested for fuelwood, would have to dry out before use.

Leucaena species are very promising under local conditions. The yield potential was excellent, despite annual winter pruning to a height of 10-15 cm, and appears to be improving with age. *L. leucocephala* was the most frost sensitive with 60-100% of stem material being killed by frost. All three species were strongly deciduous with edible material in the winter months being restricted to pods. Unless hay is made in the growing season, the use of these species will be restricted to the growing season.

Sesbania was characterized by excellent productivity in the establishment season, which also featured a high proportion of fuelwood and a deciduous nature. It was, however, very frost sensitive. Together with its invasive potential it was, therefore, decided to eliminate it from the trial.

The *Atriplex* evaluated in this trial (oldman saltbush) has a wide adaptation under local conditions and has been widely researched in South Africa (Verschoor, 1992). Although the yield potential is relatively low and variable (because of genotypical variation) the species has a very high proportion of edible material and an excellent leaf retention through the cold and dry winter period making it highly suitable for winter grazing.

With respect to the **temperate species**, the yield potential in the establishment year was particularly promising with a relatively high proportion of edible material and good winter leaf retention. In subsequent seasons the yields have been disappointing. This may be ascribed to poor adaptation (*Lupinus* and to a lesser extent *Medicago*) or to the negative impact of *Phytophtera* root rot (*Chamaecytisus* and *Lupinus* and to a less extent *Cytisus*) and leaf eating insects (*Teline* and *Cytisus*). The decision to prune these shrubby species into a hedgerow and only harvest regrowth beyond this height might, however, may also have had a negative influence on yield. The proportion of edible material (fall harvest in 1996) definitely benefited from this practice. Although little information on *Cassia* is available at this stage, the production of strongly evergreen material with a very high proportion of edible material makes it a strong candidate for further evaluation.

The **nutritive value** of leaves of most of the species - the exceptions being *Albizzia* and *Cassia* - is presented in Table 2. These data indicate that, with the exception of *Sesbania*, sub-tropical species had a good protein content but a disappointingly high fibre (ADF, NDF and lignin) and a poor digestibility. *Sesbania* was comparable with *Atriplex, Cytisus, Chamaecytisus, Lupinus* and *Medicago*, being as good or better with respect to all parameters. In this respect the species deserves to be reconsidered, possibly under a frequent harvest system, which would improve the proportion of edible material and reduce - or eliminate seed production.

CONCLUSIONS

It is evident that, once adapted tree and shrub species have been identified for different ecological conditions, such species could make a valuable contribution to systems requiring protein supplementation and/or fuelwood. In Gauteng *Leucaena* species and *Sesbania sesban*, amongst the sub-tropicals, warrant more detailed investigation, whereas of the temperate species *Chamaecytisus, Cytisus* and *Teline*, and possibly *Cassia*, hold promise despite limitations of disease and insect sensitivity.

REFERENCES

Verschoor, A. 1992. The possible role of *Atriplex nummularia* as a forage crop in high rainfall areas. M.Sc(Agric) thesis. University of Pretoria, Pretoria, South Africa.

Table 1
Yields of fodder tree and shrub species, in the 1993/94 and the 1995/96 seasons, and the proportion of forage and fuelwood over the season

Species	tDMha^{-1}		% forage (94/96)		
	93/94	95/96	Summer	Fall	Winter
Sub-tropical					
A. julibrissin	-	4.7	-/-	-/28	-/-
L.escu-pani.	22.0	42.3	66/-	43/29	10/-
L. leuco.	8.0	34.9	93/-	55/45	14/-
L. pulver.	9.3	28.1	90/-	53/53	17/-
S. sesban	53.3	-	32/-	17/-	1/-
Semi-arid					
A. numm.	9.8	3.4	84/-	67/63	63/-
Temperate					
C. sturtii	-	3.7	-/-	-/87	-/-
C. mader.	29.7	6.8	72/-	51/79	39/-
C. palm.	23.0	11.7	91/-	52/78	39/-
L. arbor.	6.6	-	55/-	44/-	35/-
M. arbor.	5.6	1.3	81/-	46/91	45/-
T. steno	7.7	8.0	72/-	45/74	28/-

Table 2
Average nutritive value of leaf material of various fodder trees over the growing season

Species	IVDOM	CP	ADF	NDF	Lignin
Sub-tropical					
L. escu-pani.	42.4	18.0	29.8	42.1	15.3
L. leuco.	49.1	21.6	35.5	40.8	15.3
L. pulver.	38.9	16.7	31.5	47.1	17.7
S. sesban	68.6	23.6	16.4	24.2	7.9
Semi-arid					
A. numm.	71.5	20.0	20.5	41.2	15.0
Temperate					
C. mader.	68.1	19.3	23.3	38.3	9.2
C. palm.	64.9	19.6	23.7	39.9	10.5
L. arbor.	65.0	20.7	23.2	32.7	9.6
M. arbor.	67.5	18.2	22.4	31.9	8.0
T. steno.	55.1	20.2	24.0	39.9	13.1