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Summary: Protection of fodder trees from grazing is a big problem in communally used grasslands. In such a semi-arid grassland with poor sandy soils, located in Macedonia, Greece two protection measures of fodder trees planted in three spacings were tested for four years (1991-94). Species were : *Robinia pseudoacacia* L., *Gleditsia triacanthos* L., and *Morus alba* L. spacings : 4x4 , 8x8 and 12x12 m ; and protection measures were: plastic tubes 1,8 m tall and wire nets of the same height (replaced in the third year by a fence with barb wire). It was found that mortality was relatively high in all species, especially in *Gleditsia,* apparently due to the long dry summers combined with the poor sandy soils of the study area as well as the frequent damages of the protection measures by animals and shepherds. *Robinia* presented higher mortality rates within the plastic tubes than within the wire nets while the other species had an opposite response. Tree growth was favoured by plastic tubes in *Robinia,* especially in the first years of establishment, but the positive effect as tree height was reduced on plants grew out of the top of tubes. *Gleditsia* was not favoured by the tubes nor by the wire nets while *Morus* was positively affected by the plastic tubes only in the second year since its establishment. It is concluded that plastic tubes are effective means of protecting fodder tree saplings from damage in communally grazed grasslands.

Key words: *Robinia pseudoacacia* L., *Gleditsia triacanthos* L., *Morus alba* L., protection measures, plastic tubes.

INTRODUCTION

Trees are widespread in the mediterranean environment. In Greece, they are distributed from the arid to the prerhumid areas and from the sea level up to the top of the high mountains. Trees which produce fodder for the animals are important feed resources in the semi-arid mediterranean zone. This is due to the fact that they can grow in marginal areas and provide fruits and foliage rich in crude protein and minerals for the ruminants during the critical periods, when herbaceous vegetation is insufficient in quantity or dries up and loses its palatability. Considerable research has been carried out over the last 10-20 years on the role of fodder woody plants in the mediterranean production systems (Papanastasis, 1991). However, there is little information concerning the growth of fodder trees and the ways they should be protected when they are established in communal areas where grazing is uncontrolled. The acquisition of such information may help improve the communal grazing systems as well as the aesthetics and the protection of the environment.

The multiple role of fodder tree species in livestock production systems has been acknowledged in several mediterranean countries (Le Houerou, 1993; Papanastasis, 1993). Among the prominent such species are the leguminous *Robinia pseudoacacia* L. and *Gleditsia triacanthos* L. and the non-leguminous *Morus alba* L. *Robinia* is a multipurpose species economically and ecologically important for the temperate zones of the world because it provides several products and services: wood, honey, energy, fodder, soil conservation, erosion control, stabilization of the roadbanks, improvement of the wildlife habitat, reclamation of saline and sandy areas, etc. (Dini, 1990, 1991). Also, it enriches the soil with nitrogen (Papanastasis, 1991). It is very well adapted in sub-humid and humid mediterranean areas. *Gleditsia* produces pods with high protein content which livestock can self-harvest as they fall from the trees from November though March (Dupraz, 1986). *Morus*, finally, produces high quantity and quality foliage which can be used during the summer period (Armand, 1994).

The aim of this paper was to study the plant mortality and height of the above three fodder trees in relation to the protection measures from free grazing so that management guidelines are developed for integrating plantations of such species in the communally grazed silvopastoral systems.

MATERIALS AND METHODS

The research was carried out in the village community Scholari of Macedonia, Greece. The experimental area is a communaly overgrazed grassland with 7 Ha in size. The soils are derived from conglomerates of the tertiary period and colluvials from river or/and torrent bank deposits. The pH changes with depth; it is 5.1 in the surface layer (0-50 cm) and 6.1 in the layers from 30 cm to 70 cm. Annual rainfall is 450 mm. The climate of the area is characterized as semi-arid mediterranean with cold winters (Le Houerou, 1989). During the 4-year (1991-94) experimental period, several shepherded flocks of sheep were grazing in the study area or passing through on their way to or from other communal grazing lands of the village the whole year round.

Two species, *Robinia* and *Gleditsia*, were established as one-year old saplings in mid March of 1991. The experimental design for each species was split-plot with three replications (Steel and Torrie, 1980). Three spacings were employed as whole plots : 4x4 m, 8x8 m and 12x12 m. Two years later (in 1993), the plants of *Gleditsia* were replaced by two-year old plants of *Morus* due to their poor growth. Plant density was 625, 156 and 69 trees/ha respectively in the three spacings in all species. Half of the plants in each plot (sub-plot) were protected from free grazing by using 1.8 m tall plastic tubes and the other half by wire nets of similar height. In 1993, the wire nets were removed because not enough resistant to animal pressure and the whole sub-plot was fenced out by barb wire.

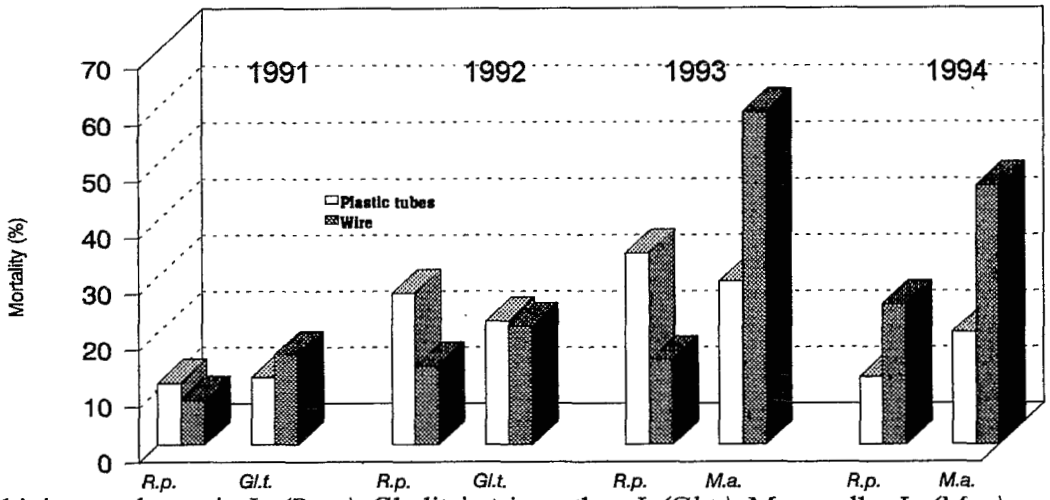
At the time of planting, saplings of *Robinia* were cut to a uniform height of 0.5 m while *Gleditsia* and *Morus* saplings had a height of only 0.2 m. Every year (in the winter and early spring), the dead plants were replaced by new saplings of the same age. During the experimental period all the species were irrigated every 20 days from the middle of June and for two months in the summer with a quantity of about 10 litres of water per plant. This irrigation was necessary because young trees were suffering from the drought due to the very hot and long summers of the study area and its sandy soils. Serious damages were created to the protection measures by both sheep and especially by some curious shepherds that resulted in eating up of several plants by the animals.

Plant establishment and the effectiveness of the protective materials (plastic tubes or wire fences) were evaluated by measuring plant mortality and tree height at the end of each growing season (early October) for four years (1991-94). Tree height was expressed in cm. Data of tree height were subjected to analysis of variance; if significant, the means were compared with the Duncan test at the 0.05 level. In the analysis, the two protection measures with net and barb wire were considered as one treatment because they did seem to be different in affecting the tree growth.

RESULTS AND DISCUSSION

Plant mortality

Despite the irrigation of all the species during the summer period, they suffered from the drought which resulted in the death of several plants. The mortality percentages are shown on figure 1. *Robinia*, which was protected by plastic tubes, had an average mortality of 12% over the whole study period. The highest mortality occured in 1993, when the percentage reached 34%. On the contrary, the mortality of plants protected with the wire nets was much lower than in the ones protected by the plastic tubes. The same happened and with the bard wire fence except the fourth year 1994, when the mortality was twice as high as the one found in the plastic tubes (fig.1).



Robinia pseudoacacia *L. (R. p.)*, Gleditsia triacanthos *L.(Gl.t.)*, Morus alba *L. (M.a.)*

Figure 1: Percentage mortality of fodder trees at different years planted with various protection measures.

Gleditsia on the average presented higher mortality than *Robinia*. The wire net was much worse in the first year but it resulted in about the same mortality as plastic tubes in the second year (21%). *Morus* also presented higher mortality rates of the free growing plants in the barb wire fences, where almost half of the saplings planted were dried up (50%), than the plants grown in plastic tubes. This suggests that plastic tubes had a beneficial role in reducing mortality during the first years of plant establishment in *Morus*.

The important point was that a number of plants of *Robinia* and *Morus* presented dying symptoms in their apical shoot moving from the top to the lower parts of the trees in early August of 1993. These symptoms constitute a phenomenon which indicates that plants faced a high water stress during the summer of 1993. In fact, 1993 was a very dry year for the study area ; after a very rainy May, the rainfall in the rest of the growing season up to the end of October was no more than 10 mm.

Tree height

The tree height of all the species during the 4 year - period which were planted at various spacings and under two pretection measures is shown on table 1. *Robinia* displayed greater height than the other two species as it was expected. This fact illustrates the great adaptability of the species in the different environments during the first years of establishment (Dini, 1991). *Robinia* and *Morus* showed an increase in height in the first two years, whereas there is a decrease in the case of *Gleditsia*. This decrease of *Gleditsia* is contrary to what it was found in southern France, where the species presented a remarkable growth (Dupraz, 1986), apparently due to the better soils where it is planted. The reduction of the height of *Robinia* in the third as compared to the second year was caused by the drying up of the shoot of the upper part of the plants during the summer period.

The three spacings did not produce any significant differences in plant height in *Robinia*. Protection measures, on the contrary, affected significantly tree height. Trees in plastic tubes were 44%, 36%, 38% and 14% taller than the ones protected with wire nets or freely grown in fenced plots respectively in the four years (1991-94). The reduction of the difference in the last years, especially the fourth, may be explained by the fact that the plastic tubes ceased to affect the plant growth with time, as trees grew out of their tops. Among the other species, *Gleditsia* did not show statistically significant growth between spacings and the two protection measures. *Morus* did not present significant differences between spacings and the two measures in the first year; in the second year, however, trees protected with plastic tubes were 134% taller than the plants grown freely in the fenced plots.

CONCLUSIONS

The main conclusions of this study are the following:

1. *Robinia pseudoacacia* has grown much taller than the other species tested, namely *Gleditsia triacanthos* and *Morus alba,* which were established in a semi-dry communal pasture with sandy soils.
2. *Robinia* was favoured by protection with plastic tubes more than by wire net while *Morus* presented significant differences only in the second year.
3. Plastic tubes not only offer protection from grazing in the communal system but also provide more favourable conditions for the growth of plants. However, further experimentation is required for the improvement of the conditions of ventillation within the tubes during the high temperatures of the summer period.
4. The high mortality of plants of all species was caused by the long summer droughts in relation to the poor sandy soils.
5. *Gleditsia* is an unsuitable species in semi-arid environments with poor sandy soils.

Table 1. Average tree height (cm) at different years of Robinia pseudoacacia, Gleditschia triacanthos *and* Morus alba *planted at various spacings and protection measures.*

Plant species	Spacing (m)	1991		1992		1993		1994	
		Plastic tubes	Wire	Plastic tubes	Wire	Plastic tubes	Wire	Plastic tubes	Wire
Robinia pseudoacacia	4x4	160.3a	111.9b	211.8a	126.9b	166.6a	136.7cd	161.6a	158.3a
	8x8	172.1a	117.0b	208.7a	182.9b	191.7a	155.5bc	208.4a	190.2a
	12x12	162.2a	111.7b	204.2a	111.6b	207.5a	118.7d	180.4a	131.7a
Gleditsia triacanthos	4x4	60.1a	43.0a	51.9a	44.1a	-	-	-	-
	8x8	54.6a	42.0a	51.2a	41.3a	-	-	-	-
	12x12	56.0a	38.2a	50.1a	45.0a	-	-	-	-
Morus alba	4x4	-	-	-	-	72.9a	51.1b	113.7a	33.9b
	8x8	-	-	-	-	63.5ab	47.0b	87.6a	26.6b
	12x12	-	-	-	-	62.7ab	53.0b	90.9a	37.3b

1. Means followed by different letters in the same species and year denote significant differences at 0.05 level of significance.

REFERENCES

Armand D., 1994. Modeles pour une estimation rapide de la biomasse foliaire de *Morus alba* (cv. Kokuso 21) croissant en conditions diverses. Proceedings of the ECC-CAMAR 8001-CT90-0030 Research. Project Meeting held at Palermo, Italy 12-13 October 1992. "Fodder Trees and shrubs". *Options* 4: 77-83

Dini O., 1990. Variation in morphological traits within a population of *Robinia pseudoacacia* L. 6th Meeting FAO on Mediterranean Pastures and Fodder Crops. Bari. Italy pp. 169-172

Dini - Papanastasi O., 1991. Black Locust: A neglected forest tree. *Geotechnic Scientific Issue* 4: 55-58. In Greek with English summary.

Dupraz C., 1986. Un aliment concentre pour l' hiver, les gousses de *Gleditsia triacanthos* L. 5th Meeting FAO on Mediterranean Pastures. Montpellier. France. *Bulletin* 5: 79-85

Le Houerou H.N., 1989. Classification ecoclimatique des zones arides (SL) de L' Afrique du Nord. *Ecologia Mediterranea* XV (34): 95-144

Le Houerou H.N., 1993. Ånvironmental aspects of fodder trees and shrubs plantation in the mediterranean basin pp 11-34. In Agriculture, Agrimed Research Programma, Commission of the European Communities Report EUR 14459 EN.

Papanastasis V., 1991. Ligneous fodder species in the mediterranean pastoral systems. *Herba* 4: 17-21

Papanastasis V., 1993. Fodder trees and shrubs in the mediterranean production systems. Objectives and expected results of the EC research contract, pp 3-8. In Agriculture, Agrimed Research programma, Commission of the European Communities, Report EUR 14459 EN.

Steel R.G.O., Torrie J.H., 1980. Principles and procedures of statistics 2nd Ed. Mc Graw - Hill Book Co., Inc., New York.