Effects of cutting frequency on productivity of eleven woody fodder plants

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SUMMARY - Total and grazable aboveground biomass of 11 deciduous fodder trees and shrubs in relation to cutting frequency were studied in a sub-humid Mediterranean environment with cold winters in Macedonia, Greece. The species tested were: *Amorpha fruticosa* L., *Carpinus orientalis* Mill., *Colutea arborescens* L., *Corylus avellana* L., *Fraxinus ornus* L., *Ostrya carpinifolia* Scop., *Pirus amygdaliformis* Vill., *Quercus pubescens* Wild, *Quercus sessiliflora* Salish. and *Robinia pseudoacacia* L. with two accessions, common and spineless. Frequencies included cutting at 20 cm aboveground once (end of August), twice (end of July and August) and thrice (end of June, July and August). It was found that three cuts significantly reduced total and grazable biomass as compared to the one cut, while two cuts did not significantly differ from the one cut for the majority of the species tested.

Key words: Fodder trees, fodder shrubs, biomass, grazable material, frequency of cutting, Greece.

RESUME *- "Effets de la fréquence de coupe sur la productivité de onze espèces d'arbustes fourragers". On a étudié la biomasse aérienne totale et pâturable de 11 arbres et arbustes fourragers à feuillage caduc par rapport à la fréquence de coupe dans des conditions méditerranéennes sub-humides avec hivers froids en Macédoine, Grèce. Les espèces testées étaient :* Amorpha fruticosa *L.,* Carpinus orientalis *Mill.,* Colutea arborescens *L.,* Corylus avellana *L.,* Fraxinus ornus *L.,* Ostrya carpinifolia *Scop.,* Pirus amygdaliformis *Vill.,* Quercus pubescens *Wild,* Quercus sessiliflora *Salish. et* Robinia pseudoacacia *L. avec deux accessions, commune et sans épines. Les fréquences ont été la coupe à 20 centimètres au-dessus du sol une fois (fin août), deux fois (fin juillet et août) et trois fois (fin juin, juillet et août). Il a été observé que la fréquence à trois coupes a réduit considérablement la biomasse totale et pâturable comparée à celle d'une coupe, tandis que celle à deux coupes n'a pas été différente de celle à une coupe pour la majorité des espèces testées.*

Mots-clés *: Arbres fourragers, arbustes fourragers, biomasse, matière pâturable, fréquence de coupe, Grèce.*

Introduction

Deciduous in the winter cut-back trees and shrubs are common fodder plants in semi-dry and sub-humid Mediterranean environments. Their importance lies on the fact that they grow in the summer period, when herbaceous vegetation is dormant, thus providing the animals with green foliage of high nutritive value (Papachristou and Papanastasis, 1994; Papachristou and Nastis, 1996). As a result, they can complement or entirely substitute the nutrient requirements of ruminants during the dry period of the Mediterranean climate.

Earlier studies on productivity of deciduous fodder trees and shrubs have shown that it varies among species and between years within the same species with air temperature being the single most important factor affecting the interannual changes (Dini-Papanastasi, 1997; Papanastasis *et al.*, 1997a). Also, they have indicated that such species can withstand annual clear cutting at the end of the growth period from the very beginning of their establishment without being damaged, although their total production is reduced, but its grazable portion is increased (Papanastasis *et al.*, 1997b).

Following these studies, the question was raised whether more than one cuttings during the growth period can stimulate the regrowth ability of deciduous woody species and, more important, if they can increase the grazable at the expense of non-grazable material. In this paper, the results of such an experiment are reported, aiming at providing information on how to better utilize plantations of deciduous woody and fodder plants for the benefit of ruminants in the extensive Mediterranean production systems.

Materials and methods

The research was conducted in the Experimental Centre of Chrysopigi, in central Macedonia, at an altitude of about 600 m. The soil is derived from conglomerates of the tertiary period and the pH is 6.1. The climate is sub-humid Mediterranean with mean annual precipitation 550 mm and a mean annual air temperature 13°C, with a range of minimum and maximum mean from -0.3°C (Jan.) to 27.7°C (July).

The woody fodder species tested were *Amorpha fruticosa* L., *Carpinus orientalis* Mill., *Colutea arborescens* L., *Corylus avellana* L., *Fraxinus ornus* L., *Ostrya carpinifolia* Scop., *Pirus amygdaliformis* Vill., *Quercus pubescens* Wild, *Quercus sessiliflora* Salish. and *Robinia pseudoacacia* L. with two accessions the common *Robinia* and a spineless accession from Macedonia (Dini, 1990) of the above species; the first six are shrubs and the remaining four trees.

The experimental plan was a randomized complete block design. Each species covered a plot of 42 m^2 with four replications. The original plants were one year old and planted in the spring of 1986 at a spacing of 1.0 x 1.5 m (i.e. 40 plants per plot). Beginning in 1987, plants were cut at 10 cm aboveground at the end of the growing period until 1994.

In 1995, 13 plants of each species within each plot were randomly selected and cut at 20 cm aboveground level at the end of June, July and August (3 cuts), another 13 plants were cut at the same height at the end of July and August (2 cuts); and the remaining 14 plants were cut at the end of August (1 cut).The same plants were re-cut in 1996 in a similar way. Half of the samples of each treatment were hand separated into grazable material (leaves and twigs of up to 2 mm diameter) while all samples (separated and non-separated) were weighed in the laboratory after oven drying at 70°C. Data were expressed in g DM per plant and were subjected to an ANOVA test while significant differences among means were detected at the 0.05 probability level, using the Duncan's test (Steel and Torrie, 1980).

Results and discussion

Cutting frequency affected total aboveground biomass of the various species in a different way (Table 1). In 1995, three cuts resulted in significantly lower biomass than one cut in all species except *Corylus*, where no significant effects were detected. Two cuts produced significantly higher biomass as compared to one cut in *Ostya*, *Quercus* species and common *Robinia* but significantly lower biomass in *Carpinus* and spineless *Robinia* while the remaining species *Amorpha*, *Colutea*, *Fraxinus* and *Pirus* were not affected. In 1996, the negative effects of three cuts were continued in the majority of the species (except *Corylus*, *Colutea and Quercus sessiliflora*) while two cuts either produced no significant differences (*Amorpha*, *Carpinus, Fraxinus, Pirus* and *Quercus pubescens*) or significantly reduced the biomass (*Ostrya* and *Robinia*).

The negative effects on total aboveground biomass of the high frequency (three cuts) as compared to the middle frequency (two cuts) suggest that cutting at the end of June seems to reduce the regrowth ability of plants apparently because it affects the amount of non-structural carbohydrates reserved in their roots (Kramer and Kozlowski, 1979). The same reason should be behind the reduction of the stimulating effect of two cuts in 1996 as compared to 1995; plants cut twice in 1995 (in July and August) lost their regrowth ability in 1996.

The cutting frequency had a similar effect on the grazable material portion of total biomass, too (Table 2). In 1995, this portion was making 71% of the total biomass in the once cut plants on an average for all species and only 48% in the thrice cut plants, while in the twice cut plants it was intermediate (68%). In 1996, the differences almost disappeared probably due to the additive effect of cutting.

It may be concluded that if Mediterranean deciduous woody species are to be used as fodder resources for providing green feed to the animals during the dry period, it is better to be cut once, or at the most, twice towards end. Such treatments will ensure not only higher amounts of total biomass but also richer in grazable material.

Table 1. Effects of cutting frequency on total aboveground biomass (g DM/plant) of 11 woody fodder plants

Species	Cutting frequency					
	1995			1996		
	1	2	3	1	2	3
Amorpha fruticosa	443a	419a	284b	356a	372a	225b
Carpinus orientalis	90a	54b	50b	133a	121a	65b
Colutea arborescens	593a	562a	274b	328a	355a	260a
Corylus avellana	138a	180a	104a	190a	215a	188a
Fraxinus ornus	169a	158a	72b	257a	229a	120b
Ostrya carpinifolia	199a	268b	73c	281a	215b	89c
Pirus amygdaliformis	278a	226a	46b	200a	154a	68b
Quercus pubescens	101a	141b	72c	166a	168a	123b
Quercus sessiliflora	72a	108b	54a	97a	90a	94a
Robinia pseudoacacia (common)	720a	956b	222c	1034a	587b	177c
Robinia pseudoacacia (spineless)	1006a	697b	236c	1251a	424b	158c

Means within the same species and year with different letter are significantly different ($P \leq 0.05$)

Table 2. Effects of cutting frequency on the grazable material (g DM/plant) of 11 woody fodder plants

Species	Cutting frequency					
	1995			1996		
	1	2	3	1	2	3
Amorpha fruticosa	280a	242a	103b	175a	231b	113c
Carpinus orientalis	68a	46a	18b	95a	91a	60b
Colutea arborescens	361a	323a	115b	149a	195a	110b
Corylus avellana	100a	133a	96a	128a	71a	120a
Fraxinus ornus	1	99a	33b	180a	148a	82b
Ostrya carpinifolia	161a	202b	33c	193a	175a	54b
Pirus amygdaliformis	191a	141b	28c	133a	87b	55c
Quercus pubescens	86a	105a	25b	134a	151a	94b
Quercus sessiliflora	60a	75a	32b	65a	79a	74a
Robinia pseudoacacia (common)	479a	671b	106c	704a	349b	102c
Robinia pseudoacacia (spineless)	643a	457b	74c	816a	252b	88b

Means within the same species and year with different letter are significantly different ($P \leq 0.05$)

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