Effects of grazing intensity on some morphological parameters of Carpinus orientalis

Lempesi A., Eleftheriadou A., Kalkanas I., Papadimitriou A., Psyllidou A., Abraham E.M., Korakis G., Kyriazopoulos A.P.

in

Kyriazopoulos A.P. (ed.), López-Francos A. (ed.), Porqueddu C. (ed.), Sklavou P. (ed.). Ecosystem services and socio-economic benefits of Mediterranean grasslands

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 114

2016
pages 115-118

Effects of grazing intensity on some morphological parameters of *Carpinus orientalis*

A. Lempesi[1], A. Eleftheriadou[1], I. Kalkanas[1], A. Papadimitriou[1], A. Psyllidou[1], E.M. Abraham[2], G. Korakis[1], A.P. Kyriazopoulos[1]

[1]Department of Forestry and Management of the Environment and Natural Resources, Democritus University of Thrace, 193 Pantazidou str., 68200 Orestiada (Greece)
[2]Department of Forestry Natural Environment (P.O. Box 286), Aristotle University of Thessaloniki, 54124, Thessaloniki (Greece)

Abstract. *Carpinus orientalis* is an essential woody forage source for small ruminants, especially goats, grazing during summer in Mediterranean region. However, grazing affects the morphology of woody species, and consequently, their growth. The aim of this study was to examine the effects of relative grazing intensity on some morphological parameters (maximum diameter, height, volume, leaf dry matter content, leaf area, and specific leaf area) of *Carpinus orientalis*. The research was conducted in an open canopy *Quercus frainetto* forest, in Evros region, north-eastern Greece and is grazed by goats. The distance from a goat corral was used to represent relative grazing intensity. In June 2015, morphological parameters were measured and leaf samples were collected along transects placed at 50, 150, 300, 600 and 1200 m from the goat corral, running perpendicular to four replicates. According to the results, grazing intensity significantly altered leaf traits, while light and moderate grazing seems to favour the growth characteristics of *Carpinus orientalis*.

Keywords. Oriental hornbeam – Shrubs – Silvopastoral system – Leaf traits – Growth.

***Effets du pâturage intense sur certains paramètres morphologiques de* Carpinus orientalis**

Résumé. Carpinus orientalis *est une source de fourrage ligneux essentielle pour des petits ruminants, les chèvres en particulier, paissant pendant l'été dans la région méditerranéenne. Cependant, le pâturage affecte la morphologie des espèces ligneuses et par conséquent, leur croissance. Le but de cette recherche était l'examen des effets du pâturage relatif intense sur certains paramètres morphologiques (diamètre maximum, hauteur, volume, teneur en matière sèche des feuilles, surface foliaire, surface foliaire spécifique) de* Carpinus orientalis. *Cette recherche a été effectuée en plein air, dans la région d'Evros, au nord-est de la Grèce, dans une forêt avec voûte de feuillage de* Quercus frainetto *que l'on fait paître par des chèvres. La distance à un corral de chèvres a été utilisée pour présenter l'intensité relative de pâturage. En juin 2015, des paramètres morphologiques ont été mesurés et des échantillons ont été prélevés le long de transects se trouvant à 50, 150, 300, 600 et 1200 m du corral, perpendiculairement à quatre répétitions. Selon les résultats, l'intensité de pâture a changé considérablement les caractéristiques des feuilles, tandis que la pâture légère et modérée semble favoriser les caractéristiques de croissance de* Carpinus orientalis.

Mots-clés. Carpinus orientalis – *Arbrisseaux – Système sylvopastoral – Caractéristiques des feuilles – Croissance*.

I – Introduction

Although grazing is one of the fundamental interactions in ecology, its effect on vegetation spatial pattern has received little attention so far (Seifan and Kadmon, 2006). It is one of the most important drivers affecting morphology and physiology of plants and controlling structure and functioning of ecosystems (Zheng *et al.,* 2010). Furthermore, range management is based on the response of plant species and communities to grazing intensity. The identification of easily measured plant functional traits that consistently predict grazing response in a wide spectrum would be a major advance for sustainable range management (Diaz *et al.,* 2001).

Grazing by livestock can influence ecosystems in various ways, including altering plant communities as well as influencing woody plant growth and encroachment (Allred, 2012). Goat grazing in particular, has been widely blamed of causing environmental degradation, even though there is evidence that this activity is in harmony with local conditions of climate, terrain, vegetation, and even pathogens over centuries in many areas (García-Moreno *et al*., 2012). Recent studies have focused mostly on leaf-level traits or community level weighted traits to predict species responses to grazing and the consequent change in ecosystem functioning (Zheng *et al*., 2010). These studies are of great importance for a sustainable grazing management of these ecosystems (Arévalo *et al*. 2011).

Carpinus orientalis Mill is a small tree or large shrub, rarely attaining 15 m in height. It is native of south-eastern Europe and western Asia. It occurs in Italy and Sicily, reaching its northern limit in Istria, Croatia, Slavonia, Banat and Transylvania and extending southwards through the Balkan States to FYROM and Greece (Elwes and Henry, 2007). It is widely distributed in the semi-mountainous regions of northern Greece and is browsed by goats (Papachristou *et al*., 1999) as its foliage consists an essential source of protein for small ruminants during the dry Mediterranean summer (Papachristou, 1997). Nevertheless, the effects of grazing on its morphological parameters have not been studied in details.

The main objective of the present study was to examine the effects of relative grazing intensity on some morphological parameters (maximum diameter, height, volume, leaf area, specific leaf area and leaf dry matter content) of *Carpinus orientalis*.

II – Materials and methods

The research was conducted in the area of Pentalofos, which is located in Evros region, NE Greece. The oak forest of Pentalofos occupies a total area of 10199 ha. It mainly serves the needs of the local population for firewood while it is also used for livestock grazing. The dominant oak species are *Quercus frainetto, Quercus petraea*, *Quercus pubescens* and *Quercus cerris*. The spread of oak covers almost the entire area of the forest. Other common woody species include *Carpinus orientalis, Fraxinus ornus*, *Juniperus oxycedrus*, *Cornus mas*, *Tilia tomentosa*, *Phillyrea latifolia* and *Acer monspessulanum*. The climate of the area is classified as sub-Mediterranean, with cold, moist winters and warm, dry summers. The average maximum temperature which occurs in July is 30.5 ˚C and the average minimum which occurs in January is -7.0 ˚C. The annual precipitation is 539.5 mm. The study area is grazed mainly by goats.

The distance from a goat corral was used to represent relative grazing intensity. In June 2015, leaf samples of *Carpinus orientalis* were selected along transects of 20 m long running perpendicular to four replicates. The transects were placed at 50, 150, 300, 600 and 1200 m from the goat corral. These distances stand for very heavy, heavy, moderate, light and very light grazing respectively. Leaves were taken from five individual shrubs near the transect. Additionally, the height (H), the maximum (D1) and vertical diameter (D2) as well as the percentage of dead canopy of these shrubs were measured and the volume was calculated as V= [π*(D1/2)*(D2/2)*H]/2. Leaf samples were weighed hydrated (FWL) and dried (WL), while leaf area (LA) of dried leaves was measured using Image – Pro Plus 6.0. The specific leaf area (SLA) and leaf dry matter content (LDMC) were calculated as SLA = LA/WL, LDMC = WL/FWL.

One-way ANOVA was used to analyse the effect of grazing intensity on some morphological parameters of *Carpinus orientalis*. The LSD at the 0.05 probability level was used to detect the differences among means (Steel and Torrie 1980). The obtained data were analysed using the SPSS statistical software v. 17.0 (SPSS Inc. Chicago, IL, USA).

III – Results and discussion

Grazing intensity did not significantly affect maximum diameter, height, volume, and dead canopy percentage of *Carpinus orientalis* (Table 1). Plant height has been reported among the best single predictor of plants grazing response (Diaz *et al*., 2001). The fact that it was not affected by grazing intensity indicates that this species is tolerant to grazing. Moderate grazing tended to favor *Carpinus orientalis* growth, but these differences did not produce any significant results.

Table 1. Effect of goat grazing intensity on maximum diameter (D1), plant height (H), volume (V) and dead canopy (DC) of *Carpinus orientalis*

Distance from the corral (m)	D1 (cm)	H (cm)	V (m^3)	DC (%)
50	145.7 a	103.6 a	1.56 a	2.3 a
150	192.2 a	100.1 a	2.04 a	7.8 a
300	183.5 a	178.1 a	3.18 a	12.6 a
600	142.1 a	128.5 a	2.18 a	7.4 a
1200	156.4 a	110.1 a	1.62 a	1.1 a
Significance	*NS*	*NS*	*NS*	*NS*

*Means in the same column followed by the same letter are not significantly different (P≤0.05)

Leaf fresh weight (FWL), leaf dry weight (WL) and leaf dry matter content (LDMC) of *Carpinus orientalis* did not affected by grazing intensity (Table 2). Significantly lower LA (leaf area) was recorded at the distances close to the goat corral indicating that leaf area decreased gradually as grazing intensity increased. Hui and Guoqi (2014) supported that LA generally decreases with increasing grazing intensity as an avoidance strategy adopted by plants in order to decrease the palatability and selectivity by herbivores. Additionally, SLA (Specific leaf area) was significantly lower at the closest distance to the goat corral (Table 2), indicating that SLA decreased as grazing intensity increased. SLA is a comparatively poor predictor of grazing response (Diaz *et al*., 2001). Moreover, the SLA, or more precisely the factors affecting the value of SLA, partly determines the response of a species in a specific habitat or a disturbance (Arendonk and Poorter, 1994).

Table 2. Effect of goat grazing intensity on leaf fresh weight (FWL), leaf dry weight (WL) leaf area (LA), specific leaf area (SLA) and leaf dry matter content (LDMC) of *Carpinus orientalis*

Distance from the corral (m)	FWL (gr)	WL (gr)	LA (cm^2)	SLA ($g^* cm^{-2}$)	LDMC ($m^*g^*g^{-1}$)
50	0.0244 a	0.0121 a	2.27 c	201 b	0.52 a
150	0.0212 a	0.0102 a	2.42 c	277 a	0.50 a
300	0.0247 a	0.0115 a	2.74 bc	261 ab	0.45 a
600	0.0244 a	0.0128 a	3.49 a	312 a	0.54 a
1200	0.0216 a	0.0110 a	3.39 ab	323 a	0.53 a
Significance	*NS*	*NS*	*0.66*	*62.5*	*NS*

*Means in the same column followed by the same letter are not significantly different (P≤0.05).

IV – Conclusions

Grazing intensity did not significantly affect most growth parameters of *Carpinus orientalis* indicating that this species has high tolerance to grazing. Heavy grazing reduced leaf area (LA) and specific leaf area (SLA). As moderate grazing had a minimal effect upon the analyzed parameters, it can be a viable way of managing ecosystem sustainability.

References

Allred B. W., Fuhlendorf S. D., Smeins F. E. and Taylor C. A., 2012. Herbivore species and grazing intensity regulate community composition and an encroaching woody plant in semi-arid rangeland. In: *Basic and Applied Ecology*, 13, p. 149-158.

Arendonk V. J. J. C. M. and Poorter. H., 1994. The chemical composition and anatomical structure of leaves of grass species differing in relative growth rate. In: *Plant, Cell and Environment*, 17, p. 963-970.

Arévalo J.R., Nascimento L., Fernández-Lugo S., Mata J. and Bermejo L., 2011. Grazing effects on species composition in different vegetation types (La Palma, Canary Islands). In: *Acta Oecologica*, 37, p. 230-238.

Diaz S., Noy – Meir I. and Cabido M., 2001. Can grazing response of herbaceous plants be predicted from simple vegetative traits? In: *Journal of Applied Ecology,* 38, p. 497–508.

Elwes H. J. and Henry A., 2007. The trees of Great Britain and Ireland. Edinburgh. Privately printed by R. & R. Clark, Ltd. In: Volume III p. 451 -711.

García-Moreno A. M., Carbonero-Munoz M. D., Serrano-Moral M. and Fernández-Rebollo P., 2014. Grazing affects shoot growth, nutrient and water status of *Quercus ilex* L. in Mediterranean open woodlands. In: *Annals of Forest Science*, 71, p. 917-926.

Hui A. and Guoqi L., 2014. Differential effects of grazing on plant functional traits in the desert grassland. In: *Polish Journal of Ecology*, 62, p. 239-251.

Papachristou T.G., 1997. Intake, digestibility and nutrient utilization of oriental hornbeam and manna ash browse by goats and sheep. In: *Small Ruminant Research*, 23 (2-3), p. 91-98.

Papachristou T.G., Platis P.D., Papanastasis V.P. and Tsiouvaras C.N., 1999. Use of deciduous woody species as a diet supplement for goats grazing mediterranean shrublands during the dry season. In: *Animal Feed Science and Technology*, 80, p. 3-4.

Seifan M. and Kadmon R., 2006. Indirect effects of cattle grazing on shrub spatial pattern in a mediterranean scrub community. In: *Basic and Applied Ecology*, 7, p. 496-506.

Steel R.G.D. and Torrie J.H., 1980. Principles and Procedures of Statistics. In: 2nd edition. McGraw-Hill, New York. 481 pp.

Zheng S. X., Ren H. Y., Lan Z. C., Li W. H., Wang K. B. and Bai Y. F., 2010. Effects of grazing on leaf traits and ecosystem functioning in Inner Mongolia grasslands: scaling from species to community. In: *Biogeosciences*, 7, p. 1117–1132.