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THE USE OF DIMENSION ANALISYS TO ESTIMATE PLANT RESPROUT BIOMASS

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RESUM

S'ha utilitzat l'anàlisi dimensional per estimar la biomassa de rebrots d'arbust sotmesos a diferents tipus de pertorbació. Segons els nostres resultats, les equacions al.lomètriques multivariables que incorporen la longitud i l'àrea basal del rebrot o bé la longitud del rebrot i el nombre de branques són les que ofereixen una millor estima de la biomassa perquè determinen més bé l'arquitectura tridimensional de la planta.

RESUMEN

Se ha utilizado el análisis dimensional para estimar la biomasa de rebrotes de arbustos sometidos a diferentes tipos de perturbación. Según nuestros resultados, las ecuaciones alométricas multivariables que incorporan la longitud y el área basal del rebrote o bien la longitud del rebrote y el número de ramas son las que ofrecen una mejor estima de la biomasa porque describen en mayor medida la arquitectura tridimensional de la planta.

ABSTRACT

Dimensional analysis has been used to estimate the resprout biomass of shrubs subjected to disturbance. According to our results, the multivariate equations that include the length and the basal area of the resprout or the length of the resprout and number of branches of the resprout are the ones that offer a better estimation of resprout dry weight because they define better the architecture of the plant.

Keywords: dimensional analysis resprout.

INTRODUCTION

Field experiments about regeneration of Mediterranean shrubs after fire or clipping need to be analysed periodically in order to know accuratelly the response of the plants to the disturbance. In this case, the measurements of the growth is done by non-destructive measurements of the plant. The regression or dimensional analysis approach has been widely used in forestry in order to estimate the biomass of diferents components of a tree or the productivity of a woodland (Whittaker & Marks, 1975). This analysis relate size parameters of the plant that are easy to measure with its weight. For instance, the biomass of a tree (dependent variable) can be estimated by its trunk diameter (independent variable) as it has been done to estimate the biomass for *Quercus ilex* in the Montseny Massif (Canadell et al., 1988). The logarithmic relationships between plant size parameters are the ones that offer best fit

$\mathbf{y = a\,x^b}$ or its linearly expression: $\mathbf{\log y = \log a + b \log x}$

where **a** and **b** are constants, **b** express the manner in which the two dimensions (**x, y**) change in relation to each other. These relationships are known as allometric.

Some of these equations have been recently used by Canadell et al. (1991), Pysek (1991), Riba (1990) to predict shrub resprout biomass by some resprout size parameter. The size parameters usually are unidimensional or bidimensional as the resprout length or basal area respectively. Our hypotesis is that the use of tridimensional size parameters as the estimation of resprout volum (p.e. length per basal diameter) or the incorporation of some other parameter which defines better the architecture of the resprout, like the number of branches, will improve the estimation of the resprout biomass.

The objective of this paper is to show some of the allometric relationships to estimate the biomass of the resprouts when considering more than one simple resprout size parameter in *Arbutus unedo* and *Erica multiflora* shrubs. These equations are going to be used to estimate the biomass of resprouts in some field experiments about early stages of regeneration after fire, clipping and herbivorism.

MATERIAL AND METHODS

The study species were *Arbutus unedo* and *Erica multiflora*. That are two shrub species widely distributed in shrublands of the Mediterranean Basin. Both species have resprouting capacity after aerial biomass elimination. Resprouts emerge from subterranean structure known as lignotuber and also from superficial roots in the case of *E. multiflora*. The resprouts used to stablish the dimensional analysis had 7.5 regeneration months in *A. unedo* and 1.5 years in *E. multiflora*.

We collected a set of some resprouts from adjacent plants within the experimental stands. We measured the basal diameter, the length and the number of resprouts branches. Samples were dried (48h at 70 Cº) and their individual dry weight obtained.

We used univariate and multivariate regressions which related individual resprout biomass to the size variables mentioned above. The significance of the regressions for the diferent parameters were tested with a t-Student.

RESULTS AND DISCUSSION

The multivariate regressions offered better fit than the univariate ones (Table 1 and 2). The length of the resprout explained the 96.7 % of the *Arbutus unedo* biomass. Nevertheless, when we add in the allometric model the basal area as an additional independent variable the coeficient of determination (r^2) increases. This function accounts for 98.7 % of the variance in log dry weight of individual resprout in our sample (p=0.0001). The length of the resprout and its number of branches explained the 71.9 % and 61.8 % of *Erica multiflora* resprout biomass variance respectively.

Table 1. Allometric equations to estimate the biomass of *Arbutus unedo* resprouts.

Function	r^2	SEE	n
log B = - 5.000 + 1.849 log H	0.967	0.291	29
log B = 3.860 + 1.030 log BA	0.917	0.459	29
log B = 0.679 + 0.689 log V	0.973	0.261	29
log B = - 1.949 + 1.237 log H + 0.383 log BA	0.987	0.183	29

r^2 = coefficient of determination; SEE = standard error of the estimate; B = dry weight of the resprout; H = length of the resprout; BA = basal area of the resprout. V = H x BA

Table 2. Allometric equations to estimate the biomass of *Erica multiflora* resprouts.

Function	r^2	SEE	n
log B = - 1.953 + 0.897 log R	0.618	0.123	35
log B = - 5.332 + 1.888 log H	0.719	0.206	35
log B = - 4.638 + 0.482 log R + 1.304 log H	0.828	0.208	35

r^2 = coefficient of determination; SEE = standard error of the estimate; B = dry weight of the resprout; H = length of the resprout; R = number of the branches resprout.

Multivariate regresssions which incorporate length and number of branches for *Erica multiflora* increases the coeficient of determination and it accounts for a 82.8% of the resprout biomass variance.

Our results suggest that best fits are obtained when we incorporate more than one independent variable that contains more information about the architecture of the resprout (Fig. 1). For *Erica multiflora* the resprouts 1.5 years after the disturbance are very thin and it is not worth to estimate its biomass only from its basal area. The use of its length explains only the 71.9% of the variance of the biomass (Fig 2),

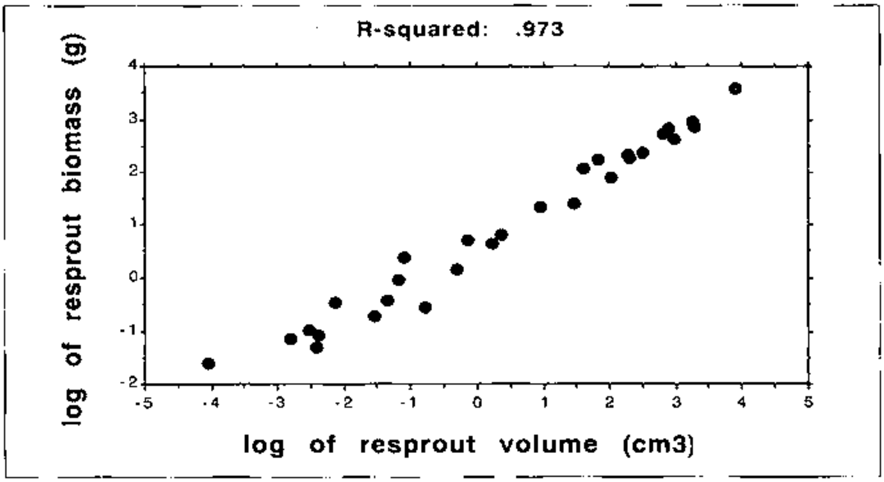

Figure 1. Relationship between estimated resprout volume and dry weight in *Arbutus unedo.*

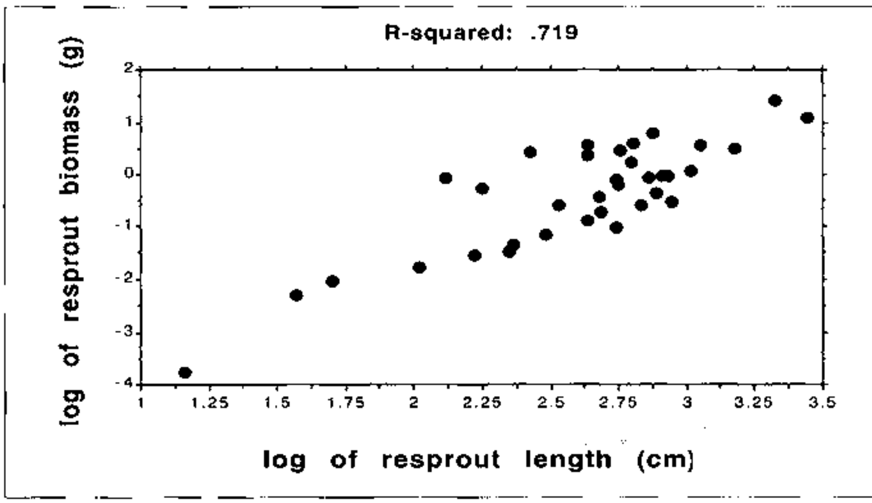

Figure 2. Relationship between resprout length and dry weight in *Erica multiflora.*

because as a result of branching, resprouts can have greater biomass. To include the number of branches as another independent variable toghether with the length of the resprout improve the estimation of the resprout biomass.

We conclude that the use of multivariate or univariate regression models that include tridimensional size parameters offer best fit of resprout biomass because they define better the architecture of the plant.

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