

# IMPACT OF EXTENSIVE MANAGEMENT ON DEMOGRAPHY OF ONE INVASIVE SPECIES OF PERMANENT GRASSLANDS

D. Magda

Unité de Recherches sur les Systèmes Agraires et le Développement, I.N.R.A., 31326 Castanet-Tolosan, France

## ABSTRACT

The objective of this study is to show the effect of extensive practices on the population dynamics of a grassland species (*Chaerophyllum aureum*) in order to control invasion process. Fertilisation intensity (none or 45g/m<sup>2</sup>), number (none, one or two) and date of cutting (before or after seed maturity) have been experienced on permanent plots in fields to follow consequences on demography of adults and seedlings. Adult density is regulated through cutting effect and intraspecific competition process. Reduction of competition by cutting leads to a paradoxical highest adult survival rate in on cut treatment compared with abandoned invaded fields. Cutting seems to reduce seeds storage ability of this species and the effect of adult competition against seedlings at emergence. Surprisingly, one late cut is more severe on seedling survival than two successive cuts.

## KEYWORDS

Extensive management, organic fertilisation, hay-making, population dynamics, invasion, sexual reproduction, vegetative growth

## INTRODUCTION

Extensification of livestock farming systems leads, with changes in practices, to disturbances at the field grassland community level creating locally suitable conditions for establishment of large scale invasive species (Bakker et al., 1980; Bergh van Den, 1979). In order to control the undesirable colonizers, we study impact of intensity practices and their spatial arrangement on population dynamics of one invasive species (*Chaerophyllum aureum*, Umbelliferae), at a Pyrenean valley level (Magda et Balent, 1995). In the first step, we follow local demography of this species in relation to fertilisation and cutting practices. Our objective is to determine on which life-history traits this perennial species can develop a strategy of colonization and which demographic parameters are directly sensitive to management practices.

## METHODS

An experimental design has been set up for three consecutive years in a Central Pyrenean valley devoted to sheep and cattle production to test the effect of fertilisation and hay-making on different demographic parameters of *C. aureum* concerning the production and storage of seeds, number and survival of adults and seedlings. Measures are realized each month from April to October from selective and permanent marking of adults and seedlings on 18 permanent plots of 1 m<sup>2</sup> (3 plots by treatment). Six different treatments combine two levels of fertilisation (none or 45g/m<sup>2</sup>) and the number and date of cuts (before or after maturity of *C. aureum* seeds). These plots are established on 18 different fields with actual and recent management similar to the plot treatment associated, permitting interpretation of the first year data.

## RESULTS AND DISCUSSION

Comparison between treatments show significant variability in plant density resulting from direct effect of practices on sexual recruitment and vegetative growth associated to an indirect effect through modifications of intraspecific competition relationships. But while cutting plays a determinant role, fertilisation intensity seems to act only through the establishment of a minimal threshold of fertility below which *C. aureum* cannot develop. For this reason, the results are grouped and discussed only according to the different cutting treatments.

**Adult density and perennity:** The early growth of seeds and adults, clearly characteristic of competition ability (Grime, 1979), is common for all treatments but adult population density decreases significantly with cutting intensification (Table 1a). In abandoned fields, *C. aureum* adults population reach maximum density measured as 133 individus by m<sup>2</sup>.

Adult survival rate remain very high for the different management intensity confirming the ability of this species to regeneration and resources management (Table 1a). This rate is paradoxically more important for adults submitted to one late cut compared with adults belonging to populations of abandoned fields. We suppose that one late cutting by regulating population density prevent severe intraspecific competition present in high density population of the controls. Nevertheless, a negative effect of cutting probably through resources limitation on adults survival is demonstrated for intensive management with two successive cuts.

**Seed production and storage:** The important variability for seed production observed by individu is partly discriminated between control and treatment with one late cutting probably due to a direct or indirect limitation of resource to seed production process (Table 1b). Despite the autogamy strategy of this species, we observe a relative great proportion of aborted flowers by umbella which appears as a characteristic of this species. Nevertheless an amplification of this phenomenon seems to appear with cutting but this effect is not significant.

Seed-bank appears to be only transient during winter. The proportion of non viable seeds counted in seed-bank varies greatly between the different treatments opposing significantly the control plots to the treatments with cutting (Table 1b). Evidently highly reduced for population submitted to a cut before seed maturation the small proportion recovered in the seed-bank is mainly the result of dispersion process from populations from neighbours fields.

Nevertheless, a significant proportion of viable seeds seems to persist in the seed-bank of the abandoned fields representing then a strategy of population perennisation based on long-term new genotypes recruitment.

**Seedlings recruitment:** The relative few seedlings appearing within the population in regard with the number of seeds produced presents sexual reproduction acting as a security for the maintenance of population density mainly ensured by perennisation of adults.

The smallest effective of total seedlings emerged are found within the fields cuts twice a year due obviously to the fact that the first cut occurs before the seed maturity (Table 1c).

The most important effective of total seedlings is encountered within the fields submitted to only one late cut suggesting also a positive effect of cutting through reduction of adult competition against seedlings.

But the average values of survival rate between treatments show that one late cut is more important for seedlings mortality than two successive cuts (Table 1c). This can be explained by the fact that the

first cut occurring at an early stage of development of seedling preserve the most part of the unique tiller developed at this stage. This partial removing favour probably the ramification on this tiller and therefore the global resistance of the seedling to a second cut.

**REFERENCES**

**Bakker, J.P., M. Dekker and Y. de Vries.** 1980. The effect of different management practices on a grassland community and the resulting fate of seedlings. *Acta Bot. Neerl.* **29**: 469-482.

**Bergh, J.P. van den.** 1979. Changes in the composition of mixed populations of grassland species. Pages 57-80 in M.J.A. Werger, ed. *The study of vegetation.* Junk the Hague.

**Grime, J.P.** 1979. *Plant strategies and vegetation processes.* Wiley, Chichester. 222 pp.

**Magda, D. and G. Balent.** 1995. Extensification and new scales for population dynamics of grassland species. Proc. 50th Ann. MTG. British Grass. Cong., Harrogate, UK, p. 266.

**Mullahey, J.J., S.S. Waller, K.J. Moore, L.E. Moser, and T.J.**

**Klopfenstein.** 1992. In situ ruminal protein degradation of switchgrass and smooth brome grass. *Agron. J.* 84:183-188.

**Wilkerson, V.A., S.M. Hannah, R.C. Cochran, and T.J.**

**Klopfenstein.** 1990. Rinsing procedures for in situ protein degradation as influenced by technician and method. *J. Anim. Sci.* 68(Suppl. 1):517.

**Yang, J.H., G.A. Broderick, R.G. Koegel, and D.B. Ricker.** 1990. The effect of heat treatment on the estimated ruminal escape protein in alfalfa hay. U.S. Dairy Forage Research Center 1990 Research Summaries, USDA, Madison, WI, pp. 69-70.

**Table 1a**  
Comparison of mean adult densities (by m<sup>2</sup>) at emergence and at the end of one year growth and survival ratio between control and treatments plots (two cuts, one late cut). The fourth column shows the results significantly different (test of Kruskal-Wallis, a=0.05).

	Control plots T5	Treatment T1 (two cuts)	Treatment T2 (one late cut)	a = 0.05
Total adults emerged	85.5	43.4	30.8	T5>T1 T5>T2
Adult survival ratio (%)	79.8	86	91.6	T2>T1 T2>T3
Surviving adult density	70	38	27.8	T5>T1 T5>T2

**Table 1b**  
Comparison of mean seed production and seed bank (by m<sup>2</sup>) between control and treatments plots (two cuts, one late cut). The fourth column shows the results significantly different (test of Kruskal-Wallis, a=0.05).

	Control plots T5	Treatment T1 (two cuts)	Treatment T2 (One late cut)	a =0.05
Sexual production				
Seed production (by individu)	44.4	-	28 .3	T5>T2
Aborted seed (by individu)	22.9	-	23.7	
Total seed-bank	186.3	14.6	33.2	T5>T1 T5>T2
Viable seeds (%)	19.2	0.4	2	T5>T1 T5>T2

**Table 1c.** Comparison of mean seedling densities at emergence and at the end of one year growth and survival ratio between control and treatments plots (two cuts, one late cut). The fourth column shows the results significantly different (test of Kruskal-Wallis, a=0.05).

	Control plots T5	Treatment T1 (two cuts)	Treatment T2 (one late cut)	a=0.05
Total seedlings emerged	50.5	10.2	80.2	T2>T5>T1
Survival ratio (%)	42.1	40.6	27.9	
Surviving seedlings	17.7	3.4	17.2	T5>T1 T2>T1