

Longevity of soil based seeds of *Onopordum illyricum*

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Summary

Seeding was prevented for eight years, in a paddock containing a dense population of *Onopordum illyricum*, initially by grazing with mature bush goats for five years, then by chemical/mechanical means. The population of residual soil based seeds was monitored annually following autumn germination. Initially the soil based seed population was estimated to be 5 million seeds per hectare. After four years of seeding prevention, the soil based seed population decreased to 1.6 million seeds per hectare and maintained a steady state at that level. Seedling counts following germination reflect the decline in population of soil based seeds. After five years of seeding prevention in a 2.8 hectare paddock the area was reduced to 0.5 hectare. Within two years of no seeding control the soil based seed population in the foregone 2.3 hectares increased to levels commensurate with the population when monitoring began. Plant counts after seven years were 0.05 and 9 plants m⁻² in goat and 'no-control' (sheep grazed) paddocks respectively.

Introduction

Longevity of the residual soil-based seed population is an important determinant in devising control or eradication strategies for weeds. Populations of *O. illyricum* are increasing and traditional attempts at control have been thwarted by recurring populations after several years of apparent control of seeding. As a component of an experiment investigating control of *O. illyricum* by grazing with goats (Campbell and Holst 1990), residual soil seed populations were monitored.

Materials and methods

A description of the experiment can be found in Campbell and Holst (1990). Specifically, mature domesticated feral goats at 14 per hectare in a 2.8 hectare paddock

successfully prevented any seed replenishing the residual soil based seed population. The experiment commenced in 1988 and was maintained until 1996. In 1993 the paddock was reduced to 0.5 hectare and the goats removed. However, prevention of seeding was continued by spraying and chipping the thistle.

Soil samples were collected following the autumn break in each year; cores to 7 cm depth being taken randomly across the paddock. The number of cores collected each year was modified over the duration of the experiment, but ranged from 150 in the 2.8 hectare paddock to 300 in the 0.5 hectare paddock from 1993 onwards. An adjoining paddock grazed by sheep was also monitored for soil based seeds of *O. illyricum*. The seeds, collected by wet sieving the cores, were cut and their viability determined by the presence of an embryo. Seedling counts were made from random 0.25 m² quadrats across the paddock following the autumn break.

Results

The initial viable soil based seed populations in sheep and goat grazed paddocks were 12 and 5 million seeds per hectare respectively. The soil based seed populations of the goat grazed paddock quickly declined over the initial four years to a steady state around 1.6 million seeds per hectare. In the adjoining sheep paddock, where no control was exerted on the flowering thistle, seed populations fluctuated but were significantly higher than the

Table 2. Seedlings per square metre following the autumn break in goat and sheep grazed paddocks.

	Sheep	Goat
1990	7.7	8.0
1991	22.8	1.5
1992	20.6	2.5
1996	77.0	0.5

Table 1. Viable soil based *Onopordum illyricum* seed (million per hectare) from goat (seeding controlled), ex-goat (seeding controlled for first five years, then ineffective) and sheep (seeding not controlled) grazed paddocks.

	1989	1990	1991	1992	1994	1995	1996
Sheep	12	30	32	17	19	43	23
Goat	5	3.5	4.0	1.6	1.2	1.8	1.6
Ex-goat					11.0	19.0	7.0

goat grazed paddock (Table 1). Within two years of removing goats from part of the original experimental plot in 1993 and where subsequent ineffectual control was exerted on the thistle, soil based seed populations increased to 11 million seeds per hectare. (Table 1).

Seedlings

Counts of rosettes at the two leaf stage reflected the decline in soil based seed within the goat grazed paddock (Table 2).

The number of established thistle plants in May 1996 was 0.05 and 9 plants m⁻² in goat and sheep grazed paddocks respectively.

Discussion

Soil based seeds populations of *O. illyricum* progressively declined over the duration of the experiment where replenishment of the soil reserve was prevented by grazing with goats. Little or no control was exerted in the paddock grazed by sheep and populations of the soil based seed were maintained at a high level producing significantly higher numbers of seedlings. The cessation of seeding in the goat grazed paddock has produced significant visible differences in frequency of *O. illyricum* when compared to the adjoining sheep paddock. Plants are still present in the goat grazed paddocks, however, at levels of 0.05 m⁻², the population is more manageable and pasture production greater than in the adjoining paddock where pasture had been greatly reduced due to thistle density (Allan *et al.* 1993).

After reducing the seed population in the soil for five years, it rose within two years of ineffective control of seeding to a level commensurate with the level at the start of monitoring. This has direct implications for the development of control programs which must annually prevent seeding. Also, because soil based seeds have a strong dormancy characteristic (Young and Evans 1972), a management strategy would need to be implemented over a long period to be successful (Campbell *et al.* 1991).

References

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