The biology and non-chemical control of Goat's-beard (*Tragopogon pratensis* L.)

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Goat's-beard

(buck's-beard, common goatsbeard, Jack-go-to-bed-at-noon, meadow goat's-beard, meadow salsify, noon flower)
***Tragopogon pratensis* L.**

Occurrence

Goat's-beard is an annual, biennial or monocarpic perennial, native in grassy places, on roadsides and in rough and cultivated land (Stace, 1997; Clapham *et al.*, 1987). There are 3 subspecies of which ssp. *minor* is the native form that is common in most of Britain. Goat's-beard grows on a variety of soil types ranging from sand to clay.

Hybrids may result from crosses with other *Tragopogon* species.

The root and leaves have been eaten by man (Barker, 2001).

Biology

Goat's-beard flowers from June to July in the UK (Clapham *et al.*, 1987; Barker, 2001) and May to September in Canada (Frankton & Mulligan, 1977). Flowering usually occurs in the second or subsequent year of growth (Clements *et al.*, 1999). There is a minimum root crown diameter at which flowering occurs but this varies from year to year because other factors are involved. The flowers are insect pollinated. The plants senesce after producing seeds.

Each compound flower head (capitulum) contains 20-127 seeds (Clements *et al.*, 1999). Average seed numbers per plant range from 100 to 850. Pawlowski *et al.* (1970) give the seed number for an average plant as 1,266. Two seed types are produced that differ in morphology. Heavier darker seeds with a greater concentration of phenolic compounds are produced from the outer ring of florets. Seed weight increases from the central to the outer seeds.

More than 75% of freshly shed seeds exhibit innate dormancy (Clements *et al.*, 1999). Seeds also develop a secondary dormancy that is rapidly broken by dry storage. In some studies seeds germinate poorly in the dark but in other studies seeds do not appear to have a light requirement. Some seeds may have a light requirement for germination due to the retention of chlorophyll by the maternal tissue that surrounds the developing seed (Cresswell & Grime, 1981). The chlorophyll filters the light that reaches the seeds. In Petri-dish tests at low and high light levels and in darkness, seeds gave 100%, 86% and 90% germination respectively (Grime & Jarvis, 1976). A high percentage of seeds germinate between 15 and 21^{o}C (Clements *et al.*, 1999). Few seeds germinate at 5^{o}C, and at 30^{o}C imbibed seeds do not germinate and begin to decay. Seeds lose viability after 12 days at 25^{o}C in anaerobic conditions.

Twelve percent of seed sown in a 75 mm layer of soil in cylinders sunk in the field emerged in the autumn after sowing in July (Roberts, 1986). In the following year the

main emergence period was February-March. Very few seedlings emerged in subsequent years. Seed mixed in the surface 25 mm of soil in boxes outdoors and stirred periodically, emerged throughout the year with slight peaks in spring and autumn (Chancellor, 1979). In field conditions, seedlings originate largely from recently shed seeds (Clements *et al.,* 1999). Many of the seedlings that emerge in the autumn do not survive the winter.

Seedlings develop an erect rosette of leaves that is able to penetrate through standing vegetation (Clements *et al.,* 1999). An extensive root system also develops. Under favourable conditions it may form dense stands that exclude other vegetation.

Persistence and spread

Goat's-beard does not maintain a persistent seedbank in soil. Persistence of a population depends on seed production, dispersal and successful seedling establishment. Seeds did not persist longer than 2 years in cultivated soil (Roberts, 1986). After 13 months burial in soil less than 3% of seeds remained viable (Clements *et al.,* 1999). Seeds lose viability after prolonged exposure to the anaerobic conditions in waterlogged soil

The seed's large pappus is ideal for wind dispersal (Clements *et al.,* 1999).

Management

In grassland goat's-beard should be spudded out and the growth of the surrounding vegetation encouraged (Morse & Palmer, 1925). In pasture it begins growth early in the season and is heavily grazed by livestock at this time (Clements *et al.,* 1999). Mature plants are less likely to be grazed. Grazing and mowing limit seed production and can result in a gradual reduction in the weed.

Plants should be reduced by hoeing and other surface cultivation in row crops (Morse & Palmer, 1925). Seed production must be prevented.

In North America, the rust fungus *Puccinia hysterium* is considered to have to have potential as a biocontrol agent (Clements *et al.,* 1999). Insects feed on seeds in the flowerhead. The seeds also suffer post-dispersal predation soon after shedding.

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