The biology and non-chemical control of Gallant Soldiers (*Galinsoga parviflora* Cav.)

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Gallant soldiers

(Joey Hooker, small-flowered galinsoga)
***Galinsoga parviflora* Cav.**

Occurrence

Gallant soldiers is an introduced annual weed of cultivated and waste ground, locally frequent in the UK (Stace, 1997). It is especially frequent on sandy soil (Guyot *et al.*, 1962). It prefers a damp, rich soil and an open situation where there is little competition for light (Warwick & Sweet, 1983). Gallant soldiers was introduced from Peru into Kew Gardens in 1796 and by 1863 was described as 'quite as common as groundsel' in the area between Kew and East Sheen (Gray, 1863). In 1892 there was a record of gallant soldiers at Woolwich docks so there may have been introductions other than that from Kew (Wolley Dod, 1892).

Gallant soldiers has become a well established weed of arable land especially in south east England (Clapham *et al*., 1987). It was tolerant of the herbicides used in lettuce in the 1970-1980s and increased rapidly in parts of the southern counties where this crop was grown repeatedly (Roberts, 1983, Davison & Roberts, 1976). In a survey of arable weeds in 1971-1973 it was recorded mainly in horticultural situations but was found in less that 2% of the areas surveyed (Chancellor, 1977). In a comparison of the ranking of arable weed species in unsprayed crop edges in the Netherlands in 1956 and 1993, gallant soldiers moved from 27th to 16th place (Joenje & Kleijn, 1994).

Gallant soldiers is a useful salad plant rich in minerals (Barker, 2001). It is host to a number of pests and diseases (Warwick & Sweet, 1983).

The closely related 'shaggy soldiers', *G. quadriradiata* (*G. ciliata*), is similar in appearance to gallant soldiers but is generally less common (Hanf, 1970). It occurs in the same situations.

Biology

Gallant soldiers flowers from May to October (Clapham *et al*., 1987) or until killed by frost (Baskin & Baskin, 1981). It can cross or self-fertilize and may have 3-4 generation in a year. The composite flower head has 3-8 ray flowers and 15-50 disc flowers (Espinosa-García *et al*., 2003). There is an average of 26 seeds (achenes) per flower head (Warwick & Sweet, 1983). The average number of seeds per plant is 2,000 but a large plant can have up to 15,000 seeds (Salisbury, 1961). Usami (1976) gives figures of 13,400 for average seed numbers per plant and 400,000 as possible on a large plant. The average seed number per plant is given as 14,204 by Pawlowski *et al.* (1970). Guyot *et al*. (1962) give the seed number per plant as 5,000 to 300,000. Plant density has a considerable effect on seed production (Rai & Tripathi, 1983). Seed numbers are reduced as plant density increases. The 1,000 seed weight is 0.267 g. Gallant soldiers produces both disc and ray seeds (Espinosa-García *et al*., 2003). The former have a pappus for dispersal, the latter are dispersed by winged structures

formed by the capitulum bracts. Seeds are generally disseminated 11-14 days after flowering (Warwick & Sweet, 1983).

When seeds were put to germinate under a leaf canopy or in diffuse white light there was just 3% germination under the canopy and 66% in diffuse light (Górski *et al.*, 1977). Some of the seeds sown in a 75 mm layer of soil in open cylinders in the field and stirred periodically emerged in the autumn immediately after sowing in August (Roberts, 1986). Germination began again in the following March and emergence continued to October, particularly after cultivations. Emergence in subsequent years was from March to October and a decreasing number of seedlings emerged over the 5 years of the study. Viable seeds still remained in the soil after 5 years. In the USA, seeds can germinate soon after shedding and will germinate in spring and summer but most germination is in the autumn (Baskin & Baskin, 1981). Light is needed for germination and seeds buried in soil can remain viable for long periods. Because of the light requirement soil burial induces dormancy in the seeds (Espinosa-García *et al.*, 2003). Seeds germinate in the surface 0-20 mm of soil (Hanf, 1970; Warwick & Sweet, 1983). Germination may be relatively greater in a sandy loam than in a clay soil (Rai & Tripathi, 1983).

Plant growth is encouraged by high temperatures (Usami, 1976). At elevated temperatures the time from germination to seeding was 50 days (Guyot *et al.*, 1962). Seedlings are sensitive to frost (Hanf, 1970). Moisture stress reduces seed germination and the subsequent growth and seed production of emerged seedlings is reduced (Rai & Tripathi, 1983). There may be increased germination if seeds are clumped together in soil. When seedlings emerge in high numbers or in dense clumps many die due to self-thinning

Persistence and Spread

Seeds retain viability in soil for 2-3 years according to Salisbury (1961), and for more than 20 years according to Baskin & Baskin (1981). Some seeds remained viable after 5 years in a cultivated soil (Roberts, 1986). In the soil seedbank, ray achenes remain viable longer than disc but both will persist for up to 2 years (Espinosa-García *et al.*, 2003). The ray achenes may then persist in low numbers beyond this time. Seed recovered during house demolitions and dated at 20 years old has been reported to germinate (Ødum, 1974).

Seeds are dispersed by wind and on clothing (Salisbury, 1961; Warwick & Sweet, 1983). The spread rate of gallant soldier has been calculated at 1.6 km in 10 years.

Management

Seedlings should be hoed off when small as they can come into flower very quickly (Hopen, 1984). Broken stem pieces are able to re-root easily. The lack of seed dormancy means that provided no further seeding occurs, gallant soldiers can be eliminated in 3-4 years (Warwick & Sweet, 1983). A heavy organic mulch will prevent emergence. Putting a field down to grass for 3-4 years has also proved effective. Gallant soldiers is very susceptible to competition from other plants (Rai & Tripathi, 1983).

In its native Mexico, fungal colonisation of the seeds is responsible for the decline of seed viability in the soil (Espinosa-García *et al.*, 2003).

Acknowledgement
This review was compiled as part of the Organic Weed Management Project, OF 0315, funded by DEFRA.

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