Reversing the Spread

How can we prevent gaultheria becoming the next rhododendron?

Ian H. Willoughby and **Suzanne Peace** explain why gaultheria is a growing problem and what we can do about it.

Salal (*Gaultheria shallon*), often referred to as gaultheria, is a vigorous, evergreen perennial shrub. It is becoming an increasing problem in some lowland forests in southern England, and also in the west of Scotland, for as with rhododendron, once gaultheria is established it is extremely difficult to control, and if left unchecked it can ultimately make tree regeneration impossible (see Figure 1). It is now an offence to plant or otherwise allow gaultheria to be grown in the wild in Scotland under the terms of the Wildlife and Countryside Act 1981 (Variation of Schedule) (Scotland) Order 2005.

In its native environment in the Pacific Northwest of America, gaultheria tends to grow within Douglas fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*), or Sitka spruce (*Picea sitchensis*) forests. It is a strong competitor, particularly with younger, regenerating trees but also with mature ones. It was introduced into the UK in the 1830s to provide cover for game and it is thought the original source of most of the larger woodland infestations is likely to be from nineteenth century garden and estate plantings.

Most British woodlands on freely draining acid soil are likely to be a suitable habitat for gaultheria. Initially it spreads to new sites by seed, then grows relatively slowly for two years. However, once established it spreads almost exclusively via rapidly growing rhizomes, which produce new plants which can go on to form a dense, uniform canopy up to 2.5m in height.

Also of concern is the identification of gaultheria as a host of *Phytophthora ramorum* in nursery plants. Although so far infection has not yet been reported in the wider environment, it is not known whether or not gaultheria might act as a sporulating host for this disease and hence drive infestation of other species, as is the case with for example, rhododendron (*Rhododendron ponticum*).

Compared to the spread of rhododendron, gaultheria is still relatively limited. However, forests comprised of light demanding tree species that cast little shade on the forest floor such as pines, particularly where they are established on podzols adjacent to an existing population of gaultheria, are at severe risk of infestation. Gaultheria therefore has the potential to become as serious a problem as rhododendron in the future unless effective, timely action is taken now to reverse its spread.

How can we control the spread of gaultheria?

Gaultheria is extremely difficult to control. Fires have been used but unless they are very intense, burning does not tend to kill gaultheria. Cutting and scarification will generally invigorate the plant, and the production of fragments of cut stems may spread the infestation. Grazing by horses, sheep or deer has been effective in reducing its spread but control is not likely unless other food sources are limited. Pigs will uproot, but not eat, the stems and rhizomes, allowing

Figure 1. The problem – a typically dense understory of gaultheria, forming an impenetrable barrier to tree regeneration.

surviving plants to be pulled out by hand or sprayed, but the pigs must be penned and need feeding and specialist care, all of which are expensive, and their use is therefore unlikely to be a viable option in many circumstances.

The main option for the future large scale control of gaultheria in the UK seems to be the use of herbicides. However, treatments are often ineffective, and it is likely that, as with rhododendron, the plant's waxy leaves will reduce chemical penetration. In North America, where gaultheria also needs to be controlled, the most effective treatment appears to be the repeated use of the herbicide triclopyr, diluted in diesel. However, in many cases plants are not killed outright, and live roots persist below ground level, despite the apparently good control of above ground parts. This suggests that in the UK, eradication of gaultheria may require repeated herbicide sprays and the establishment of a dense follow on crop of a heavily shading tree species. However, plant protection products containing only triclopyr, and that can be applied at sufficiently high rates to control gaultheria, are no longer available in the UK.

What research has been done to identify effective herbicide control methods?

Given the potential future spread of gaultheria, and the lack of effective, large scale control options, Forest Research set up an experiment to try to identify a suitable herbicide treatment regime. We investigated a range of broad spectrum herbicides that, at the time of setting up our research, were approved for use in UK forests by the Chemicals Regulation Division of the Health and Safety Executive, and that might be suitable as an alternative to triclopyr. This included picloram, aminopyralid, glyphosate, and mixtures of triclopyr and fluroxypyr, and we investigated the use of the adjuvant Mixture B NF® (AmegA, 2009) as a potential alternative to diluting pesticides in diesel. We also looked at the effects of treating the gaultheria at different dates during the growing season, as previous work in North America suggested that identifying the optimum timing was likely to be key if we were to have any hope of achieving acceptable levels of control with the limited range of herbicides we had available.

What did the research tell us about the most effective herbicide treatment available?

The research found clear differences in effectiveness between the different herbicides tested, and between timings. Applications that were made to plants where flower buds were swelling or flushed but vegetative buds were dormant (late April in southern England) (see Figure 2), were generally far more effective than those made to plants experiencing rapid vegetative extension growth (late June in southern England) (see Figure 3). Peak control seemed to occur up to two growing seasons following treatment, but in many cases plants that appeared to be dead or severely damaged at this point had recovered by the end of the third year of our experiment.

Encouragingly, we found that a single application of 2.69 kg active ingredient (a.i.) ha^{-1} picloram (as 11.2 litres ha^{-1}

Figure 2. Typical growth of gaultheria in late April in southern England, which represents the optimum timing for an initial herbicide application – flower buds have flushed, but vegetative buds are still largely dormant.

Figure 3. Typical growth of gaultheria in late June in southern England, which represents a sub optimum timing for the application of glyphosate – rapid vegetative growth is taking place, and single applications made during this stage of growth will be completely ineffective.

Figure 4. A picloram in water plus Mixture B NF adjuvant treatment plot, three growing seasons after the first herbicide application, resulting in 100% kill of the gaultheria and all other vegetation.

Tordon 22K® (240 g l^{-1} picloram); Dow AgroSciences, 2012) diluted in water plus the adjuvant Mixture B NF® (AmegA, 2009) at 2% of final spray volume, applied between spring and mid summer, killed all treated plants within two growing seasons (see Figure 4). In addition we found that treatment with 3.84 kg a.i. ha^{-1} triclopyr (as 8 litres ha^{-1} Timbrel® (480 g l^{-1} triclopyr); Dow AgroSciences, 2007) diluted in water plus Mixture B NF® (AmegA, 2009) at 2% of final spray volume, sprayed initially when flower buds are swelling or flushed but vegetative buds are largely dormant (late April in southern England), with a repeat application made four to eight weeks later, was also very effective. However, unfortunately, since setting up the trial, suitable triclopyr or picloram products are now no longer available for use in the UK.

The next most effective herbicide treatment in our work, and the most effective currently available, was an application of 3.6 kg a.i. ha^{-1} glyphosate (for example as 10 litres ha^{-1} Roundup ProActive® (360 g l^{-1} glyphosate); Monsanto, 2015) diluted in water plus Mixture B NF® (AmegA, 2009) at 2% of final spray volume, applied initially when flower buds were swelling or flushed, but vegetative buds were largely dormant (late April in southern England), with a repeat application made four to eight weeks later (May-June), followed by a repeat of this treatment programme the following year (i.e. four sprays in total) (see Figure 5).

Crucially, our work suggested that the default herbicide treatment that many managers may be tempted to try if they are faced with eradicating gaultheria, which is often a single application of glyphosate made during the summer, is likely to be completely ineffective, even if a high dose rate is used

Figure 5. A glyphosate in water plus Mixture B NF adjuvant treatment plot, the initial applications made when flower buds were swelling or flushed, but vegetative buds were largely dormant (late April in southern England), with a repeat application made 4-8 weeks later (May-June), followed by a repeat of this treatment the following year (i.e. four sprays in total). Three growing seasons after the first herbicide application around 70-80% of plants were dead – given currently available herbicides, this is recommended initial regime, but follow up treatments will be required.

(see Figure 6).

Whatever herbicide programme is used, even if it involves spraying over two years as we would recommend for glyphosate, some follow up treatment will be needed once the initial sequence of applications have taken place. This may be necessary due to the recovery of plants, or vegetative spread from adjacent sites, or regeneration from seed, or because plants were missed in the initial applications.

Figure 6. A glyphosate in water plus Mixture B NF adjuvant treatment plot, three growing seasons after a single herbicide application was made in mid summer during the period of rapid vegetative extension growth. This is the default treatment often adopted by forest managers attempting to use herbicides to control gaultheria, and it is almost completely ineffective.

Therefore any control programme should include provision for follow up inspections at three, four and five years after the initial sequence of spraying treatments have been completed. Any reinvading or recovering gaultheria should be immediately sprayed or uprooted by hand.

What else can land managers do to help to discourage gaultheria?

In addition to the treatment described above, long term site management should use silvicultural practices that discourage the re-establishment of gaultheria. For example, on restock sites this could include rapidly replanting with heavily shade bearing evergreen species such as Sitka spruce, western hemlock, or western red cedar, at initial densities of at least 2500 stems ha^{-1}. Where it is not desirable to plant conifers, the creation of a heavily shading understory of native shrub species such as yew or holly could be attempted. Ideally, shade should be maintained until the time of first thinning of the tree crop, or until nearby sources of likely gaultheria reinvasion are also dealt with.

Unless the original source of infestation is also removed, attempting to permanently eliminate gaultheria from a site is likely to be a long, frustrating, and ultimately futile exercise. Management at a landscape or population scale, to try to systematically eradicate all sources of reinfestation, taking a similar systemic approach as is advocated in the UK for dealing with invasive rhododendron plants (Edwards, 2006) is likely to be essential.

Full details of the research referred to in this article can be found in the scientific paper Willoughby et al. (2017 in press), a full text version of which is freely available by following this link https://www.forestry.gov.uk/fr/gaultheria.

Disclaimer

All of the herbicides tested in our work are likely to kill or severely damage any non-target vegetation, including young trees, that are oversprayed in addition to the gaultheria, and applications should therefore be carefully directed away from desirable plants. In addition, picloram will kill overstory trees, so should only be used on clearfell sites prior to restocking.

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