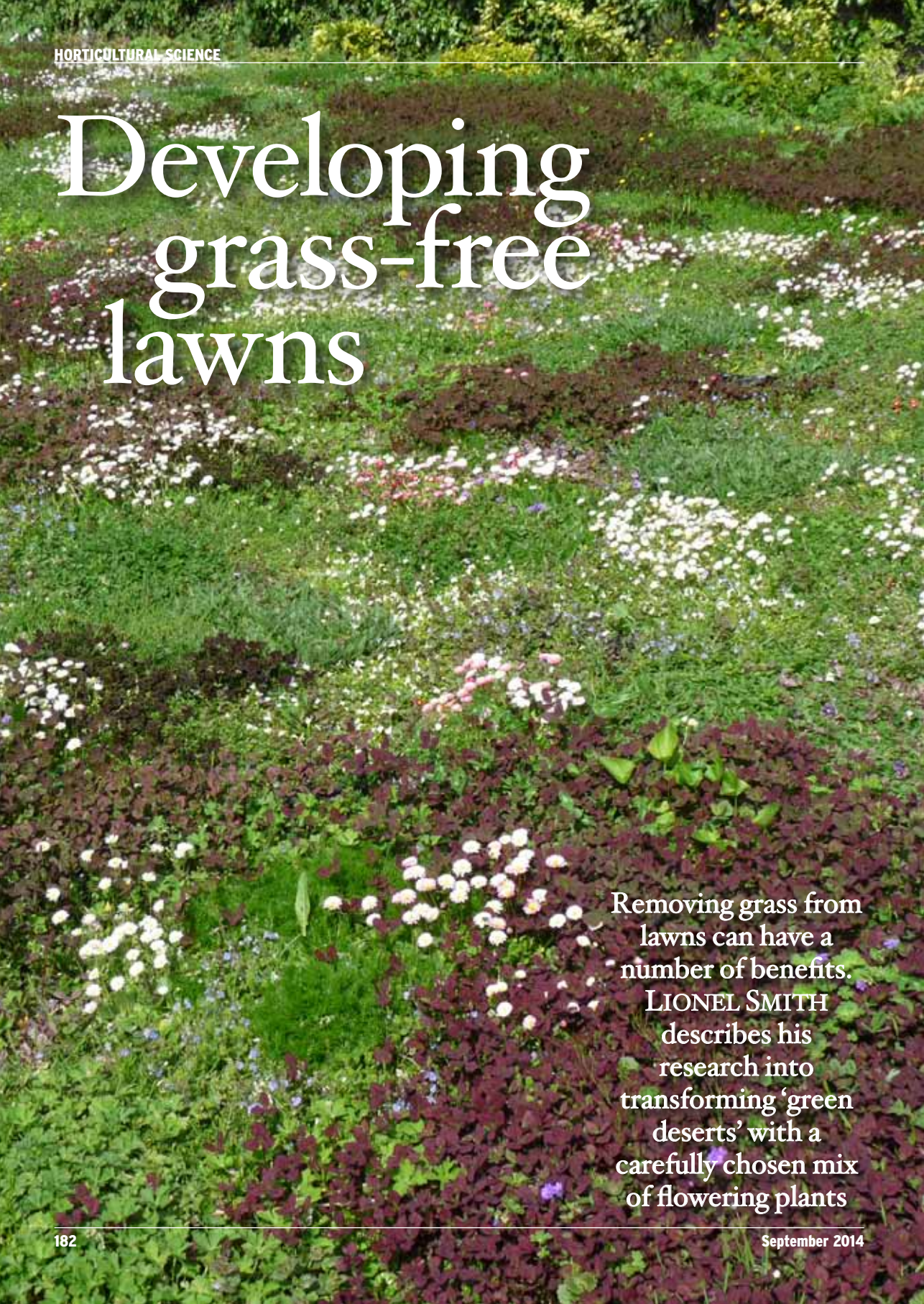
Developing grass-free lawns



Removing grass from lawns can have a number of benefits. LIONEL SMITH describes his research into transforming 'green deserts' with a carefully chosen mix of flowering plants

LAWNS ARE THE MOST common feature of urban green space worldwide (Ignatieva & Stewart 2009). In the UK, estimates suggest that domestic gardens occupy more than 414,000ha (Davies *et al*. 2009), and up to 60% of garden space can be occupied by lawns (Gaston *et al*. 2005). Therefore, UK domestic lawns potentially cover up to 248,000ha, an area approximately one and a half times the size of Greater London (Greater London Authority 2013), and more than seven times the area of local nature reserves in England (Natural England 2014).

'Improving' lawns

The 'ideal' grass lawn is a monoculture and has been termed the 'industrial lawn' (Bormann *et al*. 2001), due to the large amount of energy, resources and management techniques that are required to maintain it to an ideal standard. The ideal lawn has also been described as a 'green desert' (Allen 2010), since a highly managed grass lawn does not provide much in the way of above-ground habitat and flowers can be the unwelcome indicator that weeds have crept in.

However, not all lawns are so stringently maintained. In the UK the common garden lawn is regularly found with lawn weeds such as buttercups and daisies, but what would happen if the traditional approach to achieving the ideal lawn were completely turned on its head? What would happen if all the grass was removed from the common garden lawn and the other plants that can be found there, the weeds, were allowed to mingle and thrive? What would happen if those plants were carefully selected and their traditional status changed from weed to chosen plant? How might this influence lawn management, plant choice and wildlife in the garden?

Mowing grass-free lawns balances the competition between species and is required less than 10 times a year

A grass-free lawn designed by the author has been installed in Avondale Park, west London

All photographs by Lionel Smith

These are some of the questions that I addressed in a four-year RHS-sponsored PhD research project at the University of Reading's School of Biological Sciences. The answers are intriguing and may help to redefine how we approach and use lawn space in the 21st century.

Lawn alternatives

There are a surprising number of grass-lawn alternatives. Perhaps the most familiar to UK gardeners would be chamomile or thyme lawns, but elsewhere in the world it is possible to find peanuts, beach strawberries and ferns used in a similar manner (Smith & Fellowes 2013). These lawns may sound exotic but they are easily identified as lawns since they are low-growing, ground-covering and replicate the familiar monoculture format; they also show human intent, design and ongoing care. These human factors are almost more important than the plants themselves, since without these guiding cues it can be challenging to immediately appreciate what we are seeing.

When the traditional cue of mown grass is removed from the lawn what are we left with? A bunch of weeds perhaps, or, if we are a little kinder, a group of wildflowers? Let us suppose that this bunch of common native lawn weeds includes daisies, buttercups, white clover and cinquefoil. What do we have if the daisies are the fashionable peach-pink of *Bellis perennis* 'Robella', the buttercup the delicate pale yellowish white of *Ranunculus repens* 'Gloria Spale', the clover the dark-leaved *Trifolium repens* 'Atropurpurea', or the cinquefoil with the double flowers of *Potentilla reptans* 'Pleniflora'? Do we still have a bunch of weeds, or do we have a selection of carefully chosen ornamental plants? If we continue to mow these plants to keep them neat and tidy do we still have a lawn? If so, we now have a grass-free lawn that is ➤

a selected community of mowing-tolerant plants with the potential to produce flowers. The green desert has been transformed.

Regime change for mowing

This transformation has consequences. The architecture of grasses requires frequent mowing to keep them low, it is the cue that tells us that they are part of a lawn rather than untended grasslands, but forbs (non-grasses) have a different architecture. They do not require the same frequency of mowing. My research has determined that grass-free lawn communities require up to two-thirds less mowing than is applied to traditional lawns.

Instead of the usual 20 to 30 cuts a year, a grass-free lawn is more likely to require five to nine cuts, although it is essential that the clippings are removed to allow in light. This reduces considerably the amount of energy required to maintain a lawn, and can lead to a reduction of four fifths in CO2 emissions from fossil fuels associated with mowing.

The role that mowing plays in lawn management is also transformed. Instead of simply maintaining lawn height, the mower acts to balance the competition between plants that can be expected in any plant community. Some species, such as white clover, can get relatively tall quite quickly if left to their own devices and would soon shade out lower growing and less vigorous species; mowing acts to moderate this. Taller growing plant species are more severely affected by the mower than lower ones and take longer to recover from its affects. Mowing repeatedly allows light to reach plants that would otherwise be shaded out. This allows a community of plants with different characteristics to coexist in a manner that would not be possible without a mower. It also limits the type of plants that can be used in grass-free lawns.

A grass-free lawn remains colourful during a drought in 2013. Note the starry flowers of *Pratia* ?species?

First and foremost, grass-free lawn plants must be mowing tolerant; they should be able to recover between mowing. Secondly, if long-term persistence is required they need to be able to reproduce, either by seed in the window of opportunity between mowing, or to be able to reproduce clonally. Daisies, buttercups, white clover and cinquefoil are able to persist in grass lawns because they can produce stolons in addition to setting seed.

Influence of species

A grass-free lawn plant community can also be influenced by the number of species used within it. Without intervention the strongest competitor in a small community of plants can come to dominate. However, as more and more species are added and the number of competitors goes up, the competitive advantage any single species has is reduced. Experiments suggest that a minimum of 12 different species should make the basis for a grass-free lawn (Smith & Fellowes 2014a). However, many more can be included, which allows for some quite creative 'lawn gardening'. For examples of suitable plants, see table (p186).

The role that each species plays in a grass-free lawn has been found to fall into one of three categories. Some plants are useful for their flowers, some are useful for ground cover, and some can provide both. A mix of all three types makes for the most aesthetic and useful grass-free lawn. My research has also shown that plant species or cultivars that have relatively large leaves, highly vigorous growth, or which can grow taller than 9cm should be avoided or treated with caution (Smith & Fellowes 2014b). Alpine plants can prove difficult too, as they tend to suffer root rot in the cold, water-saturated soils of a typical British winter.

Biodiversity benefits

With a greater diversity of plant species, substantially reduced levels of mowing, and flowers as a ➤

EXPERIMENTAL WORK

Experiments on grass-free lawns at the University of Reading were carried out over a four-year period [w[illegible] years?]. 147 experimental lawn plots (above) were constructed with a wide variety of plant compositions. Both native and non-native plants were used and their performance was assessed individually and in mixed-species lawns.

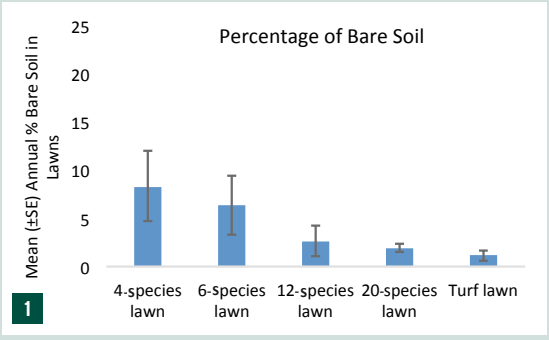
The lawns had to offer the equivalent area of plant cover provided by traditional grass lawns. I found that annual amounts of bare soil in grass-free lawns with more than 12 species was not significantly different from that found in turf lawns (graph 1).

The number of flowers in the grass-free lawns was greatest in those composed of species native to the UK (graph 2). Also, the native plants chosen tended to have larger flowers than the non-natives. However, non-natives can provide different flower colours, extend the flowering season, and add novelty. Native plants are adapted to UK conditions

Although greater species number gives improved ground cover and, in line with ecological theory, provides greater stability to grass-free lawns, there is a trade-off between greater species number and the visual impact provided by the flowers (graph 3). By introducing flowers to lawn space the opportunities for pollinators are greatly improved.

I also found that grass-free lawns have improved water infiltration compared to bare soil or turf (graph 4), so reducing the impact of run-off during heavy rain.

I also assessed plant-pollinator visitations by bees, butterflies and ha[illegible]ies. I compared the number of visitations to one [illegible]y grass-free lawns with the number of visitations to a commercially available 'flower lawn' of grasses plus 10 wildflowers. The observations revealed tha[illegible] pollinators visited a broad range of species in my grass-free lawn but primarily to only one species (red clover, *Trifolium pratense*) in the commercial 'flower lawn'.



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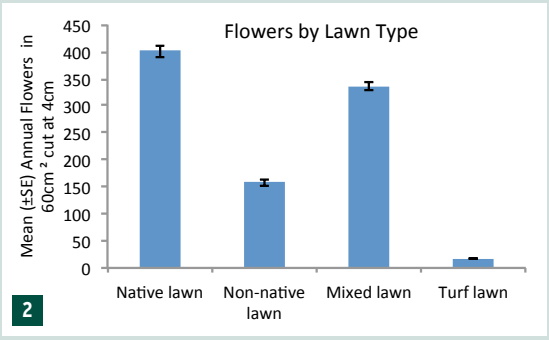

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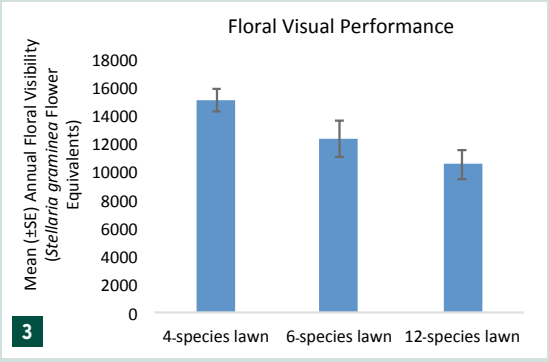

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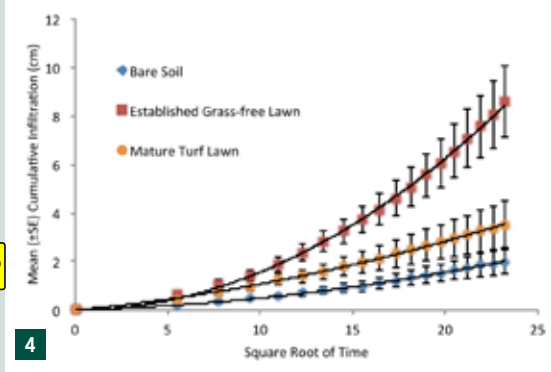

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As well as flowers, a tapestry of different leaf colours and textures is one of the defining features of a grass-free lawn

SUITABLE SPECIES FOR GRASS-FREE LAWNS

UK Native Species	Common name	Non-native Species	Common name
Bellis perennis	daisy	*Diascia integerrima*	entire-leaved twinspur
Pilosella officinarum	mouse-ear hawkweed	*Lindernia grandiflora*	savannah false pimpernel
Potentilla reptans	creeping cinquefoil	*Lobelia oligophylla*	Chilean lobelia
Prunella vulgaris	selfheal	*Pratia angulata*	lawn lobelia
Ranunculus repens	creeping buttercup	*Pratia pedunculata*	blue star creeper
Stellaria graminea	lesser stitchwort	*Mazus reptans*	creeping mazus
Trifolium repens	white clover	*Mentha pulegium*	pennyroyal
Veronica chamaedrys	germander speedwell	*Parochetus communis*	shamrock pea
Veronica officinalis	common speedwell	*Phuopsis stylosa*	large-styled crosswort
Viola odorata	sweet violet	*Pilosella aurantiaca*	fox and cubs

Grass-free lawns can be constructed from single-species mats laid like carpet tiles

component of the lawn, the habitat and resource opportunities for wildlife are also changed. The number and variety of insects that can be found in grass-free lawns is greater than that found in common domestic grass lawns (Smith *et al*., in prep. a) and may offer insectivorous birds an improved food resource.

The floral resources available to pollinators are also dramatically increased. A comparison of grass-free lawns with traditional monoculture lawns and commercial 'flower lawns' (grass and wildflower mixes) showed grass-free lawns receive 80 times more visits from pollinators than grass lawns and more than twice as many as flower lawns. In one survey 45 pollinator species utilized experimental grass-free lawns whereas just eight pollinator species were found to visit grass lawns (Smith *et al*., in prep. b).

Another unexpected benefit is that a mature grass-free lawn (three or more years old) can absorb rainfall three times faster than bare soil, and twice as fast as a traditional grass lawn (Smith 2013). During short periods of drought, grass-free lawns can stay green when grass lawns become crispy and brown.

Construction

Currently, the best method of constructing a grass-free lawn uses plants grown in single-species trays and then laid like carpet tiles on subsoil to create a random mosaic, rather than broadcasting seeds. This allows plants to establish without being competitively overwhelmed. More importantly, it allows for the use of selected cultivars and non-native plants that are propagated from cuttings. It also creates new opportunities for lawn design. For the most part, this method was used to create the 100m^2 grass-free lawn that can now be seen in Avondale Park, west London.

Conclusion

It is hoped that more lawns, with refinements to the planting format, will soon be planted at RHS Garden Wisley and other locations around the country.

I am now working to transform my research into commercially available formats. Perhaps, in the near future, there may be a little less grass in the lawns of the UK and a lot more flowers.

DR LIONEL SMITH is somewhere at Reading with RHS connections – short biography please

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FURTHER INFORMATION

Further information and images can be found at my blog (http://blogs.reading.ac.uk/grass-free-lawns), research website (www.grassfreelawns.co.uk) and on a BBC news video (www.bbc.co.uk/news/science-environment -22846419)