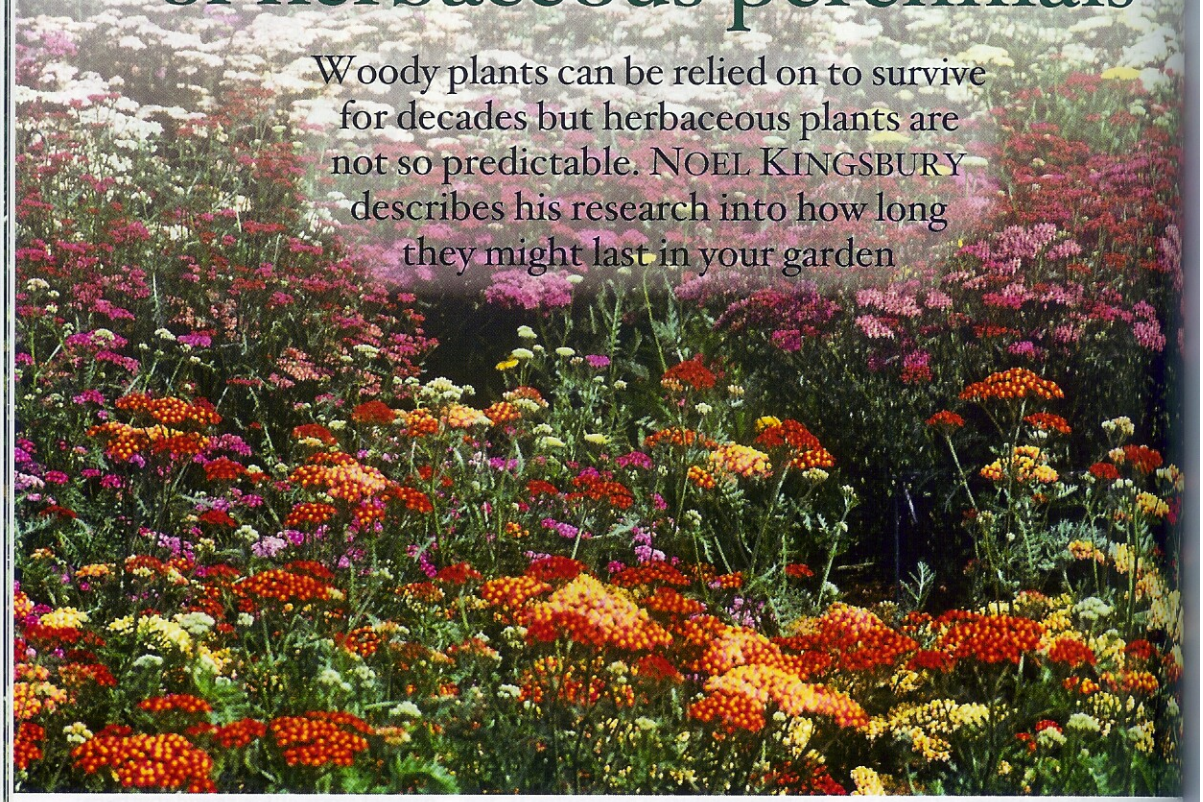
The long-term performance of herbaceous perennials



Woody plants can be relied on to survive for decades but herbaceous plants are not so predictable. NOEL KINGSBURY describes his research into how long they might last in your garden

GARDENERS ARE well aware that herbaceous perennials present a wide range of forms and behaviours, and that there is considerable variation in their long-term performance. As someone who has been a commercial grower, a designer working in both private gardens and public landscapes, and a keen gardener, I have always been fascinated by this. I chose the study of herbaceous perennials for a doctoral research project which I completed with the Landscape Department of the University of Sheffield a few years ago. I also undertook further research in 2009–10 as part of an EU-funded project.

The project

Here I present my findings from this latter research project, which focused on long-term plant performance. The overall project was aimed at addressing cost-effective management of public spaces. My particular research, however, is of relevance to private gardeners just as much as the landscape and nursery industries – it took the form of valuating the long-term performance of ornamental herbaceous plants using a questionnaire-based practitioner survey. By performance I mean issues relating to the establishment and long-term growth of plants in garden conditions, and whether they are likely to spread or to diminish with time.

When I started my PhD research I was hoping to be able to develop a coherent system of categorization for herbaceous perennials – this proved illusory. Instead, I realized that there were several gradients of morphology (often referred to as architecture) and performance. These interacted to create some groups, fuzzy groups, but groups nevertheless. In the end I decided that the best way of thinking about herbaceous plants was through concentrating on a number of key performance indicators, which can often be guessed at from an initial

Achillea cultivars are often regarded as short-lived in gardens, mainly because the spreading clumps fail to maintain a core of growth

look at plant morphology, but which can only really be reliably known from the experiences of gardeners growing and observing over time. This was the rationale behind using a questionnaire to gather data on gardeners' experience of long-term performance.

I have grown a number of perennials which did not appear to be perennial. In discussing this with other gardeners who have had the same experience, I made the exploration of longevity a key part of the research. Indeed, I believe it is key to understanding wider issues of plant performance. Herbaceous plants have long been classified as annuals, biennials and perennials. The definition of perennial as 'a plant lasting longer than two years' (Griffiths 1992) is widely accepted. That not everyone agrees is illustrated by Graham Stuart Thomas who frequently uses the terms 'short-lived' or 'long-lived' (Thomas 1976). Lifespan has actually been little researched; work done at Weihenstephan in Germany being the most systematic (Hansen & Stahl 1993). It is my contention that the failure to address this fundamental issue is a serious weakness in the language of horticulture.

Performance indicators

Any gardener can no doubt list several perennials whose longevity they would regard as 'short'. Among currently fashionable plants, two stand out: *Knautia macedonica* and *Echinacea*. The behaviour of the former in seeding over a wide area in many gardens illustrates its lack of longevity is not really a problem, but also points us towards another key aspect of long-term garden performance – that of self-seeding.

Echinacea presents a particular problem for gardeners as it is undergoing much adventurous breeding work involving interspecific hybridization and is widely commercially available. It is generally accepted to be short-lived, yet there are no indications in any reference sources as to how short-lived, or what factors may influence longevity. In talking to growers in the US it is apparent that longevity in the wild is limited – it may vary considerably depending on conditions and it varies between species.

A key part of herbaceous plant performance is how effectively a plant will spread. Most species spread only slowly, some not at all. However, most gardeners can name several species which spread so aggressively as to be frequently seen as a problem: two 'notorious' examples, being *Euphorbia cyparissias* and *Lysimachia punctata*. Having some concept of spread is vital for anyone setting out new plantings, particularly in the design profession, but it is poorly articulated in garden reference books, and is frequently not actually given: Rice (2006) does not, whereas Thomas (1976) does. Hitchmough (2003) is one of the few who does address the issue, usefully discussing broad categories of herbaceous spread in a volume aimed at the landscape profession.

Competition is clearly related to degree of spread, and is an issue many gardeners accept as highly relevant. *Geranium* x *oxonianum* 'Claridge Druce', for example, being frequently seen as highly competitive – a good thing for ground cover if this is wanted, but possibly problematic in a small border. In ecological science 'competition' has a precise meaning, related to the ability of a plant to succeed at the expense of others, and to be able to effectively utilize high levels of resources more effectively than others (Grime 2001).

Two other performance issues are speed of establishment and self-seeding. Both are recognized anecdotally by many gardeners but have never been systematically explored, although Thomas (1976) and Gerritsen & Oudolf (2000 make frequent references to both characteristics. Pfälzner-Thomsen (1995) is one of the few with any kind of systematic exploration of self-seeding in garden conditions.

Plant trialling, as for example carried out by the RHS, fails to address many of these issues. This is partly because the time period (a maximum of three years) is not long enough for their evaluation and partly because there is no agreed framework for understanding long-term performance issues. Indeed, they have never even been formally articulated. Yet, any informal discussion with gardeners, amateur or professional, is full of anecdotal material about these very issues – hence my questionnaire.

The survey

I made contact with a number of organisations who put notices in their journals asking for volunteers: the RHS, the Hardy Plant Society and the Professional Gardeners Guild. Volunteers were also sought through emailing nurseries specializing in perennials (selected from the *RHS Plant Finder*) and larger private gardens open to the public on a regular basis (selected from the *Good Gardens Guide*).

Volunteers were then requested to select around 20 plants from a list of 96 for filling in data. The 96 were the species I had made seasonal observations of during my PhD research. They largely reflected the range of herbaceous perennials popular in contemporary garden design (including a few grasses), ➤

with a stress on robust plants which might be expected to survive in low-maintenance situations. Excluded were taxa such as *Aster novi-belgii* and *Delphinium* cultivars which are part of an older flora of perennials noted for their high-maintenance needs.

The questionnaire asked respondents to score each of the 20 species they had chosen on five criteria, by ticking boxes (see table below). Respondents also gave details of their garden conditions, although in the end there were not enough to make any use of these details. In actual fact, I would argue that the long-term performance issues I address are driven by genetic traits and so environmental effects (e.g. garden microclimate and soil type) have only a limited impact. In addition, it is well-established in plant ecology that most herbaceous perennials are 'generalists' i.e. they thrive over a wide range of conditions (Grime 2001).

I had 66 responses, from all over the UK, overwhelmingly from experienced amateur gardeners, with around a third professionally involved in horticulture (designers, gardeners, nursery owners). Some were in their 80s or 90s, with decades of experience in growing some of the plants on the list – it was a very special feeling to be able to systematically gather information from such venerable gardeners.

Once the results were in, I analysed data for all taxa where there were more than ten responses, then averaged out the responses. I also undertook a standard deviation test which was useful for indicating the variation in reporting of the various performance indicators. In the table (opposite, p101) the means for the indicators are given. This number does not indicate the value of the indicator itself, but the level of reporting of the indicator, e.g. a value of 3.5 for longevity does not indicate that the plant is long-lived but that a large number of respondents reported it to be so.

THE 5 CRITERIA AND SCORES USED IN THE QUESTIONNAIRE

Longevity (Long. in table opposite)
1 very short-lived, rarely more than 3 years
2 short-lived, 3–5 years
3 medium-lived, plants may live 5 years or more, but suddenly disappear
4 long-lived, plants appear to survive for ever

Vegetative spread (VS in table opposite)
1 not spreading, staying in same place
2 slowly expanding clump
3 strongly expanding clump
4 spreading through occasional runners
5 spreading strongly through extensive runners
6 discontinuous spread, i.e. spreading outwards but older (1–2-year-old) growth dying
7 as 6, but more vigorously

Competitiveness (Comp. in table opposite)
1 very readily overwhelmed by neighbours or weeds
2 readily overwhelmed, but with some ability to survive competition
3 moderately robust, with ability to survive competition
4 moderately spreading, ability to suppress or infiltrate neighbours, or resist weed encroachment
5 characteristically aggressively spreading, suppressing or heavily infiltrating neighbours

Speed of establishment (SoE in table opposite)
1 slow, acceptable plant size reached in 3 years or longer after planting
2 moderate, acceptable plant size reached in 2 years after planting
3 fast, acceptable plant size reached in first year after planting

Spread by self-seeding (S-S in table opposite)
1 never self-seeds
2 rarely self-seeds, or seedlings rarely reach maturity
3 moderate self-seeding
4 extensive, even nuisance, level of self-seeding

Longevity

This is a key performance indicator for planning plantings on any scale. As can be seen from the table opposite there is wide variation among the perennials studied. As might be expected, respondents reported that most 'perennials' are indeed just that.

What is interesting, though, are those which are reported as being 'less perennial'. In some cases (e.g. *Dictamnus albus*) this may be because the plants are slow to establish and are therefore easily lost in the first few years; in others mollusc predation may affect perceived lifespan (e.g. *Aster* x *frikartii* 'Mönch') or lack of hardiness, as in *Crocosmia* taxa, or *Anemanthele lessoniana*. There are also those which spread clonally, but in such a way as to make them very vulnerable – chiefly through failure to maintain core growth under the conditions of standard garden management (e.g. *Achillea* taxa, *Heuchera micrantha* hybrids and *Monarda* hybrids).

However, I believe that there is another category which is important to recognize with a new name – 'short-lived perennials'. These are those species which are not strictly speaking clonal, but form tight, ➤

MEANS OF LEVEL OF REPORTING OF INDICATOR VALUES (FIGS. IN BRACKETS ARE MAX. SCORES POSSIBLE)					
Taxon	**Long.** (4)	**VS** (7)	**Comp.** (5)	**SoE** (3)	**S-S** (4)
Acanthus mollis	4.0	2.9	4.0	2.1	1.7
Achillea interspecific hybrids	2.6	1.9	2.3	2.0	1.0
Achillea millefolium cultivars	2.8	2.6	2.7	2.1	1.7
Aconitum napellus, and cultivars	3.9	2.6	3.3	2.2	1.4
Alchemilla mollis	3.9	2.6	3.9	2.4	3.5
Amsonia orientalis	3.5	1.9	2.6	1.6	1.1
Anaphalis triplinervis, and cultivars	3.6	2.5	3.0	2.1	1.1
Anemanthele lessoniana	3.1	2.2	3.3	2.4	3.4
Anemone x *hybrida* 'Honorine Jobert'	3.7	2.7	3.6	1.7	1.3
Anemone (other Japanese)	3.8	3.1	3.5	1.7	1.4
Aquilegia vulgaris, and cultivars	2.6	1.4	3.0	2.1	3.6
Artemisia lactiflora, and cultivars	3.7	2.5	3.4	2.3	1.5
Aruncus dioicus	3.9	2.4	3.7	2.0	1.5
Aster x *frikartii* 'Mönch'	3.1	1.8	2.7	1.8	1.1
Astrantia major, and cultivars	3.4	2.3	2.9	1.9	1.9
Baptisia australis	3.7	1.7	2.8	1.5	1.2
Brunnera macrophylla	3.9	2.6	3.5	2.2	2.6
Brunnera macrophylla variegated cultivars	3.6	2.4	3.0	2.1	1.1
Campanula latifolia, and cultivars	3.4	2.2	2.9	1.9	1.6
Centaurea montana, and cultivars	3.6	3.0	3.6	2.5	2.5
Cephalaria gigantea	3.6	2.5	3.3	2.1	2.2
Chelone obliqua, and cultivars	3.8	2.7	3.3	2.4	1.4
Crocosmia 'Lucifer'	3.9	2.8	3.5	2.1	1.5
Crocosmia cultivars (excl. 'Lucifer')	3.4	2.4	2.8	1.9	1.2
Dictamnus albus, and cultivar	3.1	1.6	2.4	1.2	1.0
Echinacea purpurea and hybrids	2.4	1.5	2.0	2.0	1.5
Echinops ritro, and cultivars	3.6	2.4	3.3	2.1	1.6
Euphorbia cyparissias, and cultivars	3.5	4.4	4.3	2.6	1.4
Euphorbia polychroma, and cultivars	3.5	1.7	2.9	1.8	1.5
Filipendula rubra, and cultivars	3.8	3.7	3.6	2.2	1.4
Geranium 'Johnson's Blue'	3.8	2.4	3.1	2.1	1.2
Geranium phaeum cultivars (excl. 'Samobor')	3.5	2.4	3.1	2.2	2.0
Geranium phaeum 'Samobor'	3.9	3.0	3.7	2.3	3.0
Geranium pratense, and cultivars	3.6	2.0	3.3	2.5	2.5
Geranium renardii, and cultivars	3.3	1.7	2.7	1.8	1.3
Geranium sylvaticum cultivars	4.0	2.3	3.2	2.2	2.3
Geranium x *oxonianum* cultivars	4.0	3.2	4.0	2.5	2.8
Helianthus 'Lemon Queen'	4.0	3.3	4.0	2.4	1.1
Helleborus x *hybridus*	3.8	1.8	3.1	1.8	2.9
Heuchera cultivars	2.9	2.0	2.9	2.3	1.2
Hosta, various taxa	4.0	2.4	3.2	2.4	1.1
Iris sibirica cultivars	3.9	2.7	3.2	1.9	1.4
Knautia macedonica, and cultivars	3.0	1.8	2.8	2.2	2.1
Kniphofia, various taxa	3.7	2.4	3.3	2.0	1.0
Liriope muscari, and cultivars	4.0	2.3	3.1	1.9	1.0
Lunaria rediviva	3.5	1.9	3.1	2.1	2.4
Lysimachia clethroides	3.8	3.6	4.0	2.4	1.2
Lythrum salicaria, and cultivars	3.6	2.8	3.0	2.3	2.3
Macleaya cordata	3.9	4.3	4.2	2.2	1.2
Miscanthus sinensis cultivars	4.0	2.6	3.5	2.1	1.1
Monarda hybrids	2.9	3.5	3.0	2.4	1.1
Nepeta x *faassenii*, and cultivars	3.9	2.8	3.4	2.5	1.5
Papaver orientale, and cultivars	3.8	2.3	3.0	2.2	1.2
Persicaria amplexicaulis, and cultivars	3.9	3.7	3.9	2.3	1.3
Persicaria bistorta 'Superba'	3.9	4.1	4.0	2.5	1.2
Phlomis russeliana	3.9	3.3	3.9	2.5	1.8
Pulmonaria, various taxa	3.4	2.6	2.9	2.2	1.7
Rudbeckia fulgida, and cultivars	3.6	2.8	3.4	2.2	1.5
Sedum (Herbstfreude Group) 'Herbstfreude'	3.9	2.4	3.3	2.3	1.4
Sedum spectabile, and cultivars	3.7	2.4	3.0	2.4	1.5
Sedum telephium cultivars	3.8	2.4	3.3	2.1	1.5
Stipa gigantea	3.8	2.5	3.4	2.0	1.4
Thalictrum aquilegiifolium, and cultivars	3.5	1.9	2.7	1.9	2.4
Veronicastrum virginicum, and cultivars	3.9	2.3	3.0	2.1	1.3

non-spreading clumps (e.g. *Aquilegia vulgaris*) or form no clonal growth whatsoever (*Knautia macedonica*). These are plants of unstable habitats where investment in clonal growth is not worthwhile, but investment in seed is. We all know how well *Aquilegia vulgaris* seeds around in almost any garden.

What is worrying is how many of these short lifespan species are currently among the most widely promoted garden centre perennials: *Achillea*, *Echinacea* and *Heuchera*. The failure to recognize longevity as a highly variable issue in the reference literature, let alone on plant labels, leads to frequent disappointment among the gardening public.

Vegetative spread and competitiveness

Degree of vegetative spread produced the least amount of agreement among respondents, partly because of the problems of designing a meaningful numerical scale to express it. There was clear agreement, though, on the following list of species with a highly effective ability to spread vegetatively through questing ramets (a ramet is material, derived from either roots or shoots, capable of becoming an independent plant through natural processes):

Acanthus mollis
Anemone x *hybrida*
Centaurea montana
Euphorbia cyparissias
Filipendula rubra
Geranium x *oxonianum*
Lysimachia clethroides
Macleaya cordata
Monarda hybrids
Persicaria amplexicaulis
Persicaria bistorta 'Superba'
Phlomis russeliana

There is a clear link with competitiveness. In some cases the behaviour of these plants is seen as a problem – the runners of *Euphorbia cyparissias* attracted much venom in the 'comments' section of the questionnaire! However, this negative attitude is not shared by all gardeners; those more interested in low-maintenance or naturalistic approaches may welcome this ability to occupy space.

Competitiveness is an indication of those species with the most staying power. These are immensely useful for situations where regular maintenance is difficult (e.g. slopes), or in wild garden areas, or where maintenance may be erratic or unskilled, as in community gardens. Common sense suggests that they are not appropriate for combining with slower-growing or smaller plants.

The means of spreading varies, which may impact on how the plant is used in the garden. Some form a clump, with all edges advancing equally, such as *Acanthus mollis* and *Geranium* x *oxonianum* (ecologists call this phalanx spread). Others eventually form clumps but through underground ramets (dubbed guerrilla spread), such as *Euphorbia cyparissias*, *Lysimachia clethroides*, *Macleaya cordata* and *Persicaria bistorta*. There is an important distinction to be made here. In the wild these guerilla-spreading species generally intermingle with other vegetation as competition, especially from grasses, prevents them forming solid clumps as they generally do in the low-competition environment of the garden. Those of us who have experimented with denser, more naturalistic plantings have found that it is possible to have these and other guerrilla spreaders intermingling. That they are strong spreaders does not necessarily translate into strongly competitive behaviour.

Speed of establishment

Gardeners are often aware that certain plants have a reputation for being slow to establish, but once there are there for ever. An example is *Anemone* x *hybrida* which can be among the most long-lived of any herbaceous plant. The table indicates that there is a category of plants which typically perform in this way. It is known that some of these species are very long-lived in the wild, but spend their first few years building up root mass (Kingsbury 2008) – e.g. *Baptisia australis*. Others are evergreen or semi-evergreen, such as *Helleborus* and *Liriope*. It is well established that evergreen foliage or other physically tough foliage is 'expensive' for plants to grow, in terms of resource allocation (Grime 2001).

These species are notable for forming very stable clumps, either forming an exclusive ground cover (as with *Liriope*) or tight, long-lived clumps (as with *Baptisia*). If care can be taken to avoid them being overwhelmed when young, the longevity of these plants makes this early effort a good investment.

Self-seeding

This is an aspect of gardening which many of us take great joy in – the feeling that if a desired plant propagates itself this is a good thing and that it is happy with our garden. Self-seeding is seen positively by many contemporary design and horticulture practitioners who regard it as part of a healthy ecological dynamic and naturalistic aesthetic. In some cases, however, the seedlings may become too much of a good thing and the plant gets relegated to weed status. Comments on the questionnaire indicated that for many gardeners *Alchemilla mollis* has achieved exactly this status.

Unlike vegetative spread, self-seeding is very difficult to predict, and may relate to soil type. Self-seeding of garden perennials may

also be limited by genetic factors; a great many garden plants are propagated clonally or from a very reduced genepool which may reduce their ability to set viable seed. It is also possible that species originating in continental climates (e.g. North American perennials which form a large contingent of our garden flora) do not get enough late-season warmth to fully ripen seed.

The data shows that there is a wide range of competitiveness among the most frequently self-sowing species. Whether a self-sowing species has the capacity to become a weed depends very much on circumstances and habit.

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Spreaders such as *Geranium* x *oxonianum* and *Alchemilla mollis* are far more problematic than those species which form only a very tight non-spreading clump, such *Aquilegia vulgaris* and *Geranium sylvaticum*. In the case of short-lived species such as *Knautia macedonica* and *Aquilegia vulgaris* the readiness to self-sow can be seen as a valuable aspect of the plant, ensuring their continued presence in the garden. The fact that *Echinacea purpurea* self-sows only infrequently will no doubt count against its long-term popularity.

Conclusions

The traditional division of non-woody plants into three categories of annual, biennial and perennial looks pretty threadbare. The questionnaire results plus other evidence has persuaded me that it is more realistic, and helpful to gardeners, to think in terms of a gradient. In addition, there is a key distinction between clonal perennials and non-clonal perennials, biennials (and other monocarps) and annuals. Even among the clonal perennials there is a tendency for some to be highly spatially mobile (e.g. some *Achillea* and *Monarda* taxa) and therefore to be short-lived in practice. Among the non-clonal perennials I believe that there is a large group of short-lived species which readily self-sow, if certain other factors are favourable. There is no doubt that plants such as *Knautia macedonica* and *Echinacea purpurea* are of great ornamental value, but we should be aware of their limitations and be prepared to educate the wider public with this knowledge.

Long-lived, robust, spreading, and indeed competitive, perennials have their place in the garden, especially with increasing numbers of gardeners seeking to experiment with naturalistic designs. On moist and fertile soils these plants are a boon, as only they can hope to compete with aggressive weedy species where levels of maintenance are reduced.

There is another reason for paying more attention to plant competitiveness and increasing our knowledge of these plants. As cuts in public services bite, it is highly likely that keen gardeners will become more involved in voluntary management of public spaces or community garden projects; more ornamental 'lovable thugs' are just what these places need.

In addition to strongly-spreading species there are species with considerable staying power over time, but which do not spread, or at least not vigorously. These can be expected to long-term elements in planting, but there is a trade-off – that they are slow to establish and vulnerable to competition or predation in their early years.

At the beginning I mentioned that an initial look at a plant might provide indications as to its long-term performance. I believe that in many cases we can 'read' the plant, and have in fact successfully included this approach into workshops which I have run for designers, the landscape profession and amateur gardeners. The number of length of ramets can give strong clues as to potential spreading ability, their absence or very tight integration strongly indicates a potentially short-lived perennial etc. To make such observations and to be able to make predictions from them can potentially do much to enrich our knowledge of the plants we grow and improve our ability to use them effectively in the garden.

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