

Competition time



NOËL KINGSBURY reports on a seven-year experiment aimed at transferring continental ideas of growing perennials to the UK climate

THE LAST 30-odd years have seen a huge increase in the growing of herbaceous perennials in Britain. Alongside this has been an interest in so-called 'naturalistic' planting which aims at incorporating something of the aesthetic of natural and semi-natural environments such as meadows and prairies into herbaceous planting. This style has been accompanied by a greater acceptance of natural ecological processes in planting, accepting that species may self-seed, spread, and move within the planting. This planting style, illustrated best by the work of James Hitchmough and Nigel Dunnett, and to some extent by Piet Oudolf,

Naturalistic planting involves dense combinations where individuals and different taxa will be in more intense competition than in conventional herbaceous planting. Late May in the author's garden in Herefordshire.

is therefore to a degree dynamic. It certainly involves higher planting densities than has conventionally been the case. The related and now very well-established, commercially successful, German approach known as Mixed Planting (*Mischpflanzungen*) is similar. These planting systems generally use up to nine plants per square metre, Oudolf often around seven or eight, compared to the more usual four or five.

The new planting styles inevitably cause the component plants to

compete; in other words ecology begins to take over from horticulture. We actually have very little knowledge of how ornamental perennials behave ecologically.

A better understanding of ornamentals as ecological actors could potentially allow us to design plantings which reduce the maintenance required (particularly in denying space to weeds) while maintaining a high level of floristic and aesthetic diversity.

I have long been interested in developing something similar to the German concept for British conditions. The long growing season in the UK is very different to that of continental Europe, as its many months of cool conditions and abundant moisture favours the growth of rapidly-spreading grasses and a number of other very competitive species.

Following on from a PhD study into the growth habits of ornamental perennials, consultancy work with Bristol City Council during the early 2000s, and participation in a research project surveying the experiences of gardeners with perennials (see *The Plantsman*, June 2011), I set up a trial plot in October 2010 in Herefordshire, which ran until October 2017, with the intention of assessing how feasible it might be to develop a system of British Mixed Planting.

Here I would like to outline how the trial was run and discuss its outcomes in relation to other research I have been conducting during this time into the growth habits of ornamental herbaceous perennials. The design of the trial is very different to that of formal scientific trials, but was intended for a 'citizen science' scale, realistic for gardeners without access to external sources of funding or extensive areas of ground.

Outline of the trial

The overall aim was to look at competition in order to learn more about how the selected species gained or lost ground over time, with the goal of reaching a better general understanding of the different ways in which garden perennials spread and interact over time in dense naturalistic plantings. One intention in choosing the combinations employed was to try to produce as dense a canopy of vegetation for as much of the year as possible, primarily to reduce weed infiltration.

The factors influencing choice of species were:

The need to have a wide seasonal spread of interest in ornamental plantings.

The idea that a ground-covering layer of low, clump-forming perennials with an emergent layer of erect-growing, later-flowering species is valuable aesthetically.

That co-existence between forbs and grasses is crucial to the success of the contemporary planting design aesthetic; the importance of this co-existence and a poor understanding of its dynamics led to the choice of the species used as variables.

Eight plots of 1.5 × 1.5m were set out on a gentle south-facing slope in western Herefordshire, at an altitude of 150m, on an Old Red Sandstone-derived soil – a heavy silty loam. Rainfall is relatively high (in the region of 1,500mm per annum) and the soil becomes rapidly saturated. Phosphorus content is high, pH neutral. Each plot was identical, with nine species of 'base plants', and one of four variables, as on page 32. Plants were put in as either fist-sized divisions or, in the case of the *Achillea*, *Aquilegia* and *Geranium sylvaticum*, from 9cm pots.

There were two groups of plants: 'base plants' used in every plot and

'variables', which varied between the plots. The base plants were:

Achillea Galaxy Hybrids

Alchemilla mollis

Aquilegia vulgaris

Eurybia divaricata

Geranium phaeum 'Lily Lovell'

Geranium sylvaticum

Hemerocallis 'Golden Chimes'

Phlomis russeliana

Solidago rugosa

Two of each were used apart from the *Hemerocallis* and the *Phlomis* where only one of each was used.

The four grey plots were used for the variable, two replicate plots of each treatment was planted. The plants used as variables were:

Calamagrostis × *acutiflora* 'Karl Foerster'

Iris sibirica

Miscanthus sinensis 'Rot Fuchs'

Panicum virgatum 'Shenandoah'

The base plants were chosen because they are all vigorous perennials whose performance is known to be good on this site. Numbers used tended to reflect simple availability of material rather than any more substantive reason.

The variables were chosen to represent three of the most widely-used larger ornamental grasses; *Iris sibirica* was used as it has an unusual method of suppressing competition around it through self-mulching leaf litter – this was judged to be a useful attribute worthy of investigation.

Although there were no formal controls, all the species grown were also being grown in several locations elsewhere in the garden over at least several years, and in all cases for the period of the trial, but generally at lower densities.

Running the trial

During the course of each year, maintenance consisted of occasional weed removal; I was delighted at how little time I spent on this, ➤

only a few minutes per plot per year, much less than other areas of the garden where plant densities were lower. Dead herbaceous growth was cut back and removed in late winter.

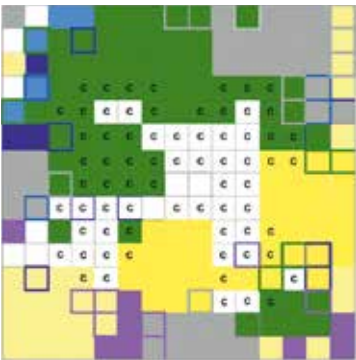
Every autumn I recorded a crude evaluation of plant condition (dead, growth small, growth good, growth very good). Weeds and seedlings of the plot components were noted. At the end of the trial each plot was overlain by a grid divided into 10cm squares, and the presence (shoots with roots) of the component plants recorded square by square (see images, right).

During the first three years most species established well. However all the *Achillea* were lost by the end of year two, the *Hemerocallis* grew very slowly (in the end the plant survived in only one plot), the *Panicum* and *Miscanthus* never established well, and were mostly lost during this period; *Iris sibirica* established poorly with major losses, although the survivors flourished. A feature in the first few years was *Aquilegia* seeding into gaps.

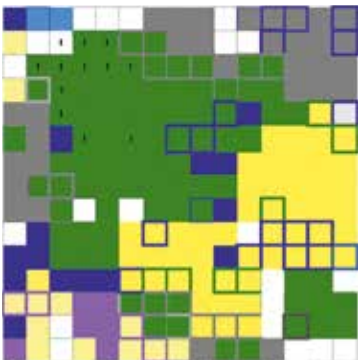
Once established, it was notable how effectively the plants in the plots covered the ground and how they began to form an intermeshed pattern of growth. This must have played a major role in minimising weed incursion. The main weed problems were *Geranium* × *oxonianum* ‘Claridge Druce’ seeding in from elsewhere in the garden along with stinging nettle. In the final year of the trial *Molinia caerulea* subsp. *arundinacea* began to seed heavily into the plots.

The outcome

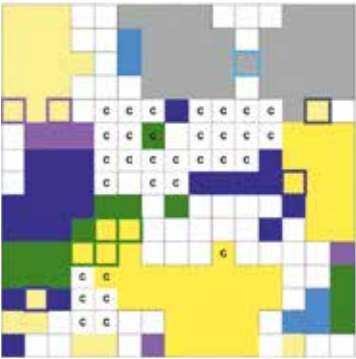
In discussing the trial with a wide range of fellow gardeners, the common response was ‘I expect one of them will take over’, and to some extent I expected the trial to result in a process of gradual elimination;



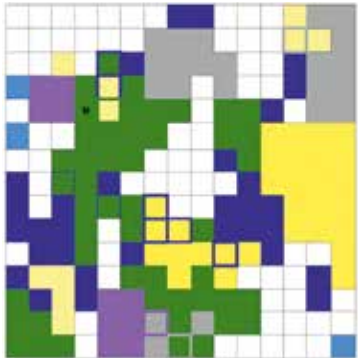
Calamagrostis 1



Iris 1



Calamagrostis 2



Miscanthus 1

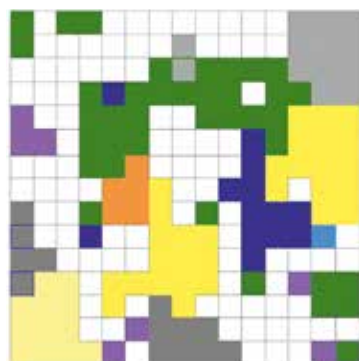
<i>Achillea</i> Galaxy Hybrids	<i>Aquilegia</i> <i>vulgaris</i>	<i>Eurybia</i> <i>divaricata</i>	<i>Achillea</i> Galaxy Hybrids	<i>Eurybia</i> <i>divaricata</i>
<i>Geranium</i> <i>sylvaticum</i>		<i>Alchemilla</i> <i>mollis</i>		<i>Achillea</i> Galaxy Hybrids
<i>Eurybia</i> <i>divaricata</i>	<i>Hemerocallis</i> ‘Golden Chimes’	<i>Phlomis</i> <i>russelliana</i>	<i>Geranium</i> <i>phaeum</i>	<i>Solidago</i> <i>rugosa</i>
<i>Geranium</i> <i>phaeum</i>		<i>Solidago</i> <i>rugosa</i>		<i>Geranium</i> <i>sylvaticum</i>
<i>Alchemilla</i> <i>mollis</i>	<i>Geranium</i> <i>sylvaticum</i>	<i>Eurybia</i> <i>divaricata</i>	<i>Achillea</i> Galaxy Hybrids	<i>Aquilegia</i> <i>vulgaris</i>

The layout of each 1.5 x 1.5m plot (left). The grey indicates the variables.

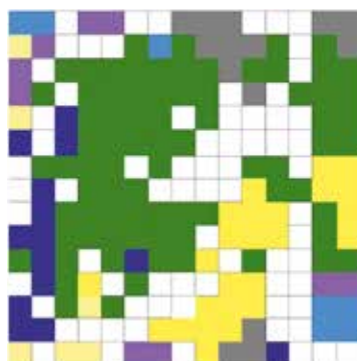
The final plot surveys (above). In plot *Calamagrostis* 1, for example, *Calamagrostis* ‘Karl Foerster’ is the variable; it has done well, along with *Solidago rugosa* and *Phlomis russelliana*. The white squares indicate how much ground was unoccupied, although it was generally shaded by foliage.

on several occasions I am sure I said ‘I want to see which is the overall survivor’. In the end however, this did not happen, and perhaps the most interesting, and encouraging, outcome was how different all the

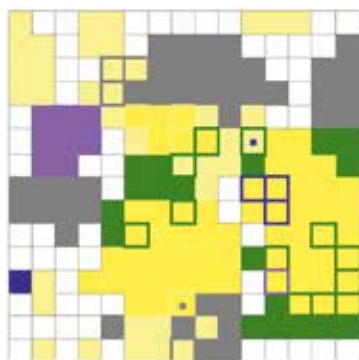
plots were; the process of inter-species competition appearing to play out differently in each one. This can be appreciated by the overview of the plots shown above. No one species took over.



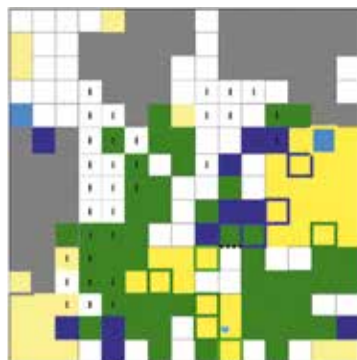
Miscanthus 2



Panicum 1



Panicum 2



Iris 2

KEY

- *Alchemilla mollis*
- *Aquilegia vulgaris*
- C** *Calamagrostis* 'Karl Foerster'
- *Eurybia divaricata*
- *Geranium phaeum* 'Lily Lovell'
- *Geranium sylvaticum*
- *Hemerocallis* 'Golden Chimes'
- I** *Iris sibirica*
- M** *Miscanthus sinensis* 'Rot Fuchs'
- P** *Panicum virgatum*
- *Phlox russelliana*
- *Solidago rugosa*

Cells with borders = two plants

■ Small squares, a third plant

Every square is 10x10cms

Individual species performance

Achillea Galaxy Hybrids

disappeared rapidly. All *Achillea* species spread vegetatively, but

the lifespan of the rhizomes appears to vary. It is the experience of many gardeners that modern cultivars of the genus often fail to persist, especially on heavier soils. It is suggested that short-lived rhizomes are very vulnerable; if they meet difficult conditions they are unable to draw on the resources of an integrated network of rhizomes, and so can die rapidly. *Rudbeckia fulgida* may be more resilient as a garden plant, but it too shows this characteristic, one outcome of which is that weeds are able to readily infiltrate the clump, as with many cultivars of *Monarda*.

Alchemilla mollis survived, largely as scattered small plants, along with a number of seedlings. This contradicts the experience of many gardeners who find that this plant forms extensive mats.

It is suggested that it was probably outcompeted by taller components, however its ability to seed into gaps would make it a valuable component to ensure continuous ground cover.

Aquilegia vulgaris plants flourished for many years, with the appearance of some seedlings; numbers were reduced in 2016 and few were noted in 2017. A short-lived non-clonal species, this is dependent on seeding to survive in borders; here competition may well have been too great to allow this to happen for the full length of the trial.

Eurybia divaricata largely survived as dense, slowly expanding clumps. There was no sign of seeding or adventitious vegetative spreading. Examination of the roots indicates a very tough dense mat of overlapping rhizomes, which appear to be long-lived, while the clumps of foliage early in the year are notably dense and weed infiltration is rare.

Geranium phaeum 'Lily Lovell' plants were dispersed, sometimes extensively so. Partly this must be the result of seeding, as seedlings were observed during annual evaluations, and the species seeds extensively elsewhere in the garden. However it may also be due to rhizome migration. In lower density garden conditions the plants are usually observed to form a dense clump; however anecdotal evidence suggests that the plants will also move around. It is possible that in competitive conditions the rhizomes move forward into new territory.

Geranium sylvaticum generally survived, sometimes forming dense and expanding clumps, but often remaining small. Little seeding was observed, although this species is often noted as being a vigorous self-seeder in the garden. Rhizome growth was observed to be slow and the plants relatively uncompetitive. ➤

Hemerocallis 'Golden

Chimes' survived only as a single plant. The growth habit of most *Hemerocallis* is that of a very dense clump, with an equally dense root network, but sideways spread is slow. The plants were almost certainly outcompeted by the more vigorous subjects under trial.

Phlomis russeliana moved away from its position in the centre of each plot, but to a very variable degree. Seeding was observed but in most cases the increase in spread appeared to be through adventitious production of new growth. Of all the plants in the trial, this was perhaps the most interesting. It has been noted as a very effective ground-cover species, forming extensive mats elsewhere in the garden. In the experiment, however, with competition, it also performed as a gap filler. Given that it is functionally evergreen, this makes it an extremely valuable component in any kind of naturalistic planting scheme.

Solidago rugosa was the most predictable in its behaviour, with each of the two clumps in each plot surviving and in most cases steadily spreading in what plant ecologists call phalanx fashion, i.e. marching outwards at an equal pace from the centre. The plants form very dense clumps (not spreading rapidly like older garden cultivars) with a dense root system. This pattern of plant growth appears to favour strong long-term persistence and might be a good model to look for in selecting other perennials for Mixed Planting.

Of the plants used as variables, *Iris sibirica* was slow to establish, perhaps for similar reasons to the *Hemerocallis*, with densely-packed shoots taking time to build up. Only half survived. The pattern of grass growth was very distinct: the *Panicum* and *Miscanthus* established very poorly and were effectively



Surveying the plots after seven years' growth. Expressed diagrammatically, an overview can be taken of the plots, revealing how there were always different outcomes.



Late May, the period with the most intense flowering. *Geranium sylvaticum* and *G. phaeum* 'Lily Lovell' are visible along with some colour forms of *Aquilegia vulgaris*.



Phlomis russeliana flowering in mid-June. It and *Solidago rugosa* (dark upright foliage) appear to be in intense competition; in most cases neither species proved dominant.



The dense growth of *Eurybia divaricata* by mid March is an example of the type of perennial growth which is very resistant to weed infiltration.



Geranium sylvaticum showing a relatively small number of short rhizomes after three years growth, making it a relatively uncompetitive, but still persistent, plant.



The growth of *Solidago rugosa* was one of the clearest outcomes of the trial. The dense root network illustrates its potential for domination of its environment.

eliminated within two years, the *Calamagrostis* took off with no hesitation. The first two species are both 'warm season' species with C_4 carbon fixation that means they will only initiate growth at relatively high temperatures, not usually until late April or even May, and they make poor growth in cool Welsh border summers at the best of times. *Calamagrostis* × *acutiflora* 'Karl Foerster' is a hybrid of two European species and starts into growth in February or March.

One final point is worth noting, that even after seven years, there were considerable areas unoccupied by plant shoots, with between 8% and 43% of squares unoccupied. This perhaps illustrates the need for low, shade-tolerant groundcover species to be included as well in order to give even coverage, minimising weed infiltration and providing invertebrate habitat.

Conclusions

Academic plant ecologists would critique many aspects of this trial but I believe that it shows how small-scale plots are easy for non-academics to set up and gain useful knowledge from.

■ The main outcome, that no one species shows total dominance is

encouraging and suggests the concept of continental Mixed Planting is sound for UK gardens.

■ Two patterns of dominance are suggested: 1) tight overlapping rhizome mats, as in *Eurybia divaricata*. 2) dense, slowly-expanding rhizomes with an extensive root system as in *Solidago rugosa* or *Calamagrostis* × *acutiflora* 'Karl Foerster'.

■ Slow-growing perennials are vulnerable to being out-competed by more vigorous species in the early years of a planting. These are often examples of what prairie ecologists in the USA dub 'conservative plants': long-lived, resilient, but slow to establish and therefore vulnerable in the early stages. It is proposed that these need to be planted as larger plants in dense plantings.

■ Certain perennials can be regarded as 'mobile' plants, e.g. *Phlomis russeliana* and *Geranium phaeum*. They are capable of filling in the gaps between others, therefore reducing opportunities for weed infiltration, and repairing gaps left by losses. This niche is one which conventional horticulture has tended to ignore or even to be wary of. The experience of this trial suggests that we should be ready to include spreading species in dense plantings

where their performance may be a useful contribution to a dense weed-proof intermingled combination.

■ While they played only a minimal role in the outcome of this trial, self-seeding, non-clonal species such as *Aquilegia vulgaris* are also potentially very useful as gap fillers.

I hope to be able to use the experience gained here to try to develop a commercially viable Mixed Planting system for British conditions, and as a guide for future researches into the growth patterns of perennial plants. The greatly reduced weed management resulting from dense intermingled perennial growth is certainly something we can also all learn from. If pollinator-friendly and other diversity-supporting species can be used or incorporated into these planting systems then they can also do much to improve the biodiversity supported in our gardens.

NOEL KINGSBURY has been designing and writing about plants for some 25 years, focusing on where horticulture and ecology meet.

If anyone wishes to participate in setting up a similar trial plot, I would be delighted to hear from them: noelk57@gmail.com