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WILD FLOWER PLUG PLANTS IN GRASS LANDS

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THE ROLE OF WILD FLOWER PLANTS

The benefits of creating new wild flower communities as part of a wider environmental effort are now widely recognized. There is also increasing interest in exploiting the sensory appeal of wild flowers and their insect visitors in more formal settings, especially as the use of native plants often results in lower maintenance costs.

The techniques for establishing wild flowers, though, are less well understood. Memories linger of the high failure rates associated with sowing expensive seed over existing sward, and of the laborious and expensive hand-planting of large, pot-grown wild flowers into impenetrable turf.

However, rapid progress has been made in wild flower establishment techniques and especially in the production of small "plug plants". In the last decade modular or plug plant technology, which was developed for raising vegetable and bedding plants by the million, has been adapted for the production of small but vigorous wild flower plants. Using plants rather than seeds is reliable, offers total control over planting arrangement and flowering normally starts within the first season. Plants may be used both to enrich the existing flora and in conjunction with seed on bare sites. The wild flowers being raised are mainly the more showy herbaceous perennials with relatively broad applications. Species grown cover the main habitats of grasslands, hedgerows, woodlands and wetlands.

The techniques for the use of wild flower plug plants were pioneered at the University of Reading and have been put into commercial practice by H.V. Horticulture and marketed under the name "Really Wild Flowers". As a result the cost of plants has decreased sharply from over 50p each to less than 20p. Planting speeds, using simple specialist planting tools, exceed a hundred plants per man hour. The Department of Transport has sponsored experimental planting with wild flower plug plants, which now form an important part of its landscape program.

PLUG PLANT TECHNOLOGY

The wild flower plants are raised in plastic trays with 200 inverted pyramid shaped cells. At the base of each cell is a single large hole which provides drainage and pruning of roots (i.e. the formation of new root initials at the bottom of the module). When the seedling is planted into soil quick plant establishment is promoted by the formation of new roots produced from the base point.

Prior to sowing, the seed is treated to improve germination percentages. Inevitably with wild seeds, which are unselected and undeveloped, germination is erratic. Multiple seeding is practiced to compensate.

THE CHOICE OF SEED OR PLUG PLANTS

The relative advantages of seed or plugs, or a combination of the two, will depend primarily on site conditions.

On construction sites starting from bare soil where the ground is level and erosion is not a problem, a seed mix is the cheapest and usually the best method of establishing a naturalistic wild flower meadow. Plug plants are used in high visibility locations and for introducing species such as Harebell (*Campanula rotundifolia*) and Meadow Cranesbill (*Geranium pratense*) which are difficult to establish from seed or slow to flower.

On sloping sites the slow development from seed results in risk of erosion. Wild flower plugs are therefore often planted and then oversown with grass/wild flower seed mix to accelerate establishment.

Where there is already a vegetation cover, whether unwanted scrub, coarse tussock grasses or gang-mown park land, plug plants offer the cheaper and more effective means of creating a wild flower meadow. Here ploughing to produce a seed bed is expensive; it may destroy valuable fragments of the relict ecology and it will usually expose a seed bank of vigorous and undesirable species.

Where there is coarse vegetation, cutting to 5-10cm by frail mower and removing the cut material will normally leave open patches of soil. These are ideal sites for insertion of wild flower plugs. Repeated cutting and removal of cut material will maintain control over surviving vegetation, with spot treatments of glyphosate or other appropriate herbicide to eradicate and unwanted species.

When starting with closely mown turf, plants can be inserted directly into the sward, preferably into bare patches created by herbicide or by physical removal of small turfs.

SITE ASSESSMENT AND PLANTING

The soil type, pH and water status (very freely drained, moderately drained, periodically waterlogged etc.) and the levels of light on the site will determine which species will thrive (see characteristic table). Soil nutrients analysis is recommended. The key elements are Phosphate (P), Nitrogen (N) and, to a lesser extent, Potassium (K) and Magnesium (Mg). When P readings are below 15 ppm, or less index 1 and below (using Olsen's extractant) then the soil is infertile and ideal for wild flower establishment, but projects can still be successful, particularly using plants at P readings of 30 ppm, i.e. below index 3. Two Nitrogen analyses can be carried out to indicate soil fertility. If total Nitrogen should be below 1700 ppm then the site is relatively infertile. Similarly, when easily extractable nitrate is measured below 100 ppm, the site's fertility will be relatively low.

Soils with a pH of below about 4.5 to 5 are considered acidic, approximately pH 5.5 to 6.5 for neutral grasslands and above pH 6.5 for alkaline.

Low fertility is ideal for species diversity but moderate fertility does not preclude wild flower establishment. Problems can be countered by higher management inputs in early years (e.g. mowing and removing cut material 3-5 times each year) and by species selection. As a rule of thumb the larger or taller the plant the greater its capacity to compete in the more fertile soils. Good examples are Meadow Cranesbill, Black Knapweed (*Centaurea nigra*), Tufted Vetch (*Vicia*

cracca) and Meadow Sweet (*Filipendula ulmaria*). The conventional and expensive top soiling is not only unnecessary but damaging to meadow establishment.

The existing vegetation on site, and in the immediate vicinity, coupled with reference to local flora, will provide useful clues to site conditions and appropriate species. Ecological advice can be valuable and the suppliers of wild flower plants (usually ecologists themselves) will provide technical support. Reference to the appropriate National Vegetation Classification for the site can be used to extend a list of potential species for introduction.

In the first stages of establishment selection should usually focus on easy and widely adaptable species which are attractive in flower and/or known to be food sources for insects and other wildlife. As the meadow develops, more sensitive and demanding species may be introduced, usually with small scale trials followed by more extensive planting.

THE USE OF SEED

Wild flower seed mixes, normally containing 80% non-invasive grasses and 20% wildflowers, are supplied by the major native seedhouses. They carry specific cocktails made up for the important combinations of soil type, pH, and moisture status. More recently some companies have taken to marketing seed harvested from donor sites which are representative of specific grassland types, as categorised by the National Vegetation Classifications. Other companies can provide seed cocktails made up to reflect the species mix of specific habitats.

In practice designers will often specify a particular seed cocktail to be made up by the seed house. An example would be the use of a non-invasive grass seed cocktail containing some of the cheaper wild flower seeds to function as an 'under-coat' on the site, while drifts of wildflowers that readily develop from seed are oversown e.g. Oxeye Daisy.

Weed control is critical to the successful development of wild flower meadows. Deep ploughing, to a depth of 15 to 20 cm, will help bury vegetation and bring less fertile soil to the surface. The 'stale seed bed' technique is effective and involves allowing weed seedlings to germinate for some 4 to 6 weeks after seed bed cultivation and then using Glyphosate to kill the young weeds. The more often the treatment can be repeated the less residual problems experienced with weeds. Soil cultivation normally comprises ploughing and secondary cultivation to create a tilth using harrows, discs, tined cultivators or rotavator.

The optimum time for sowing is late Summer/early Autumn, with April-May the next best window. Sow onto the surface but do not harrow or rake in. Instead use one or two passes from a ribbed roll to firm and level the seed bed and create good seed soil contact.

Seed rates are normally 3 grams per m², but in some circumstances this is raised to 5 grams per m², e.g. on sites considered to be at risk from erosion. On large sites seed rates can be lowered to as little as 2 to 1.75 grams per m², when clients are prepared to allow a wild flower meadow to develop gradually.

The grass management program during the first year is critical for success. During this season the vegetation should be cut down to 5-7 cm whenever the sward reaches 10-20 cm. The number of cuts required will depend on the soil's fertility and can range from 1 to 4.

Wildflower plug plants are introduced after the sowing of the seed mix.

PLANTING DESIGN

Landscape designers use wild flower plants both to create naturalistic plant communities, and to draw on the inherent qualities of colour, structure and flowering season. The low maintenance requirements of wild flowers and their self sustainability in British conditions are a bonus for the client.

Typical wild flower planting densities range from 6/m² to 10/m². The percentage of grassed sites planted varies from 100% on small, high visibility sites, down to only 10%. In most meadows the percentage of area is in the 30% to 50% range. Lower planting densities, spread thinly across the site, are not recommended because they lack both visual impact and, most importantly, result in reduced seed production because of the difficulties that distance creates for effective cross pollination.

Naturalistic Communities

Natural meadows and pastures are an intricate tapestry of different flowers, with late flowering species succeeding early ones to maintain a succession of colour.

Closely graded species in rich chalk downland turf may have density of 40/m². It is not economical to imitate this on any large scale. Plant sizes and spacings in taller, mown meadows are much larger, the texture is correspondingly coarser and more easily reproduced. Begin with very few (3-5) species in irregular groups of varying size and variable spacing both within and between groups use plant densities of 3-5/m², either in intermingled drifts or in a complete mix species. Plant introductions can be increased to 10-12/m² and can include Spring and late Summer flowering plants to spread the season.

It is important not to have plants of one species too close together, forming a distinct clump, nor too evenly or widely spaced as their impact will be lost. The impression should be of drifts and clusters. To ensure a naturalistic distribution brightly coloured toy bricks can be scattered randomly and 10 plants placed irregularly around each brick. Ideally each species should be planted in a separate operation to overcome the natural aversion to planting two plants almost in the same spot.

The size of a planted area needs to reflect the time the observer has to respond. On a motorway embankment, a 10 metre drift registers as a fleeting incident - a patch - at 70 mph; 30-50 metres of plants will be necessary to make any appreciable impact. For the pedestrian in a country park every plant will be significant and species composition and spacing will be very important.

Some examples of species use by habitat are set out below:

Fertile Grassland Meadow

In a fertile grass area the taller and more vigorous wild flowers must be used. Possible choices are the Oxeye Daisy (*Leucanthemum vulgare*), Greater Knapweed (*Centaurea scabiosa*) and Black Knapweed, Meadow Cranesbill, Musk Mallow (*Malva moschata*) and Field Scabious (*Knautia arvensis*) Other effective plants include Tufted Vetch which can clamber over tall grass, Red campion (*Silene dioica*) and Yarrow (*Achillea millefolium*). Grass competition and growth needs to be controlled in the establishment year, the flowers actually use the long grass to provide support for their rather leggy growth. Mixed planting creates an attractive blend of white, blue and purple capable of maintaining appeal from May to September.

Low Fertility Calcareous Meadow

This low mixed sward can be planted with some of the most attractive wild flowers, many of which are important food sources for butterflies. Examples are Birds Foot Trefoil (*Lotus corniculatus*), Small Scabious (*Scabious columbaria*), Lady's Bedstraw (*Galium verum*), Clustered Bell Flower (*Campanula glomerata*) and the Knapweeds. Other attractive wild flowers which can be included are Marjoram (*Origanum vulgare*), Thyme (*Thymus drucei*) Yellow Toadflax (*Linaria vulgaris*), Selfheal (*Prunella vulgaris*) and Harebell.

Acid Grasslands

These grasslands generally have less floristic interest but important species include Common Tormentil (*Potentilla erecta*), Heath Bedstraw (*Galium saxatile*) along with Selfheal, Yarrow, Catsear, Birds Foot Trefoil, Harebell, Meadow Buttercup and Sheep Sorrel (*Rumex acetosella*)

Damp and Wet Areas

Yellow Flag Iris (*Iris pseudacorus*), Marsh Marigold (*Caltha palustris*) and Purple Loosestrife (*Lythrum salicaria*) thrive in wet sites and provide useful feature flowers at water margins. Cuckoo flower (*Cardamine pratensis*), Meadow Sweet, Yellow Meadow Vetchling (*Lathyrus pratensis*), and Ragged Robin (*Lychnis flos-cuculi*) are planted in drifts in damp grassland areas.

Wild Flowers in Landscape Design

It is possible to create a spectacular display by using restricted colour schemes of one or a few species in clearly defined blocks. Set out below are some design ideas that have proved highly successful:-

Cowslip Meadow

Cowslips (*Primula veris*) can be planted into a lawn which is kept mown at 5 cm until late February/early March. Grass cutting is stopped and the cowslips are allowed to flower for at least six to eight weeks in April and May. Cutting can be started after flowering is finished or in mid June to allow for seed dispersal. Thereafter the lawn is cut as normal.

Flowering Lawns

These are mixed swards made up of grasses and a range of wild flowers that are extremely tolerant of cutting. The grass is cut four to six times during the season. Wild flowers that can be planted include Birds Foot Trefoil, Cats Ear (*Hypochoeris radicata*), Selfheal, Rough Hawkbit (*Leontodon hispidus*), Small Scabious and Musk Mallow.

Red Campion Hedgerow

A particularly effective way to use Red Campion (*Silene dioica*) is to plant along the edge of woodland and hedges. These vivid pink wild flowers can create a solid mass colour in May and June. The plants can be cut back any time after flowering.

Oxeye Daisy Drifts

Oxeye Daisy planted at 10/m² will, within two years, create a dramatic, highly visible and reliable block of white flowers from June to August. The key to sustainability is to open up the grass sward after the Autumn cut, for example by chain harrowing. Other effective plants to use in solid drifts include Chicory (*Cichorium intybus*) on dry sites, Toadflax, Musk Mallow (*Malva moschata*), Greater and Black Knapweed, Field Scabious, Sainfoin (*Onobrychis vicifolia*) and Meadow Cranesbill.

Primrose Bank

Primroses (*Primula vulgaris*) are shade loving and can be planted into steep North and East facing grass banks. Normal grass management is introduced after flowering.

Wild Flower Herbaceous Borders

Dense plantings of wildflower plants will provide a long flowering season, attract butterflies. require no weeding and will only need to be cut down at the end of the season. At the front of the bed spring flowering and the lower species are planted such as Cowslips, Wild Thyme, Harebell, Birds Foot Trefoil, Yellow Toadflax, Primrose, Lady's Bedstraw, Cuckoo Flower and Small Scabious. In the Middle of the border are planted Self Heal, Musk mallow, Yarrow, Red Campion, White Campion, Ragged Robin, Vipers Bugloss, Water Avens, Purple Loosestrife, Clustered Bellflower, Agrimony, Betony, Devils Bit Scabious, Meadow Cranesbill. At the back of the border the tallest plants are planted such as Oxeye daisy, Greater and Black Knapweed, Field Scabious, Chicory, Sainfoin, Meadowsweet. Tufted Vetch will clamber over other species and makes an excellent climber of low fences.

PLANTING

The best season for planting is Autumn. The plants can establish a good root system through the Winter before facing competition from existing vegetation in late Spring. The soft ground conditions also facilitate planting. Spring planting is also usually satisfactory, especially if the existing vegetation is temporarily suppressed by spraying with foliar acting growth retardant before planting. The small root volume of plug plants renders them susceptible to desiccation so late Spring and Summer planting should be avoided unless spot irrigation can be applied at half litre per plant per week after planting until significant rain falls.

Plant survival and growth rates are enhanced if plugs can be planted into bare patches. Spraying small patches with glyphosate or paraquat will create the desired gaps very quickly and inexpensively. (With paraquat patches will be visible within a few hours and planting can take place the following day). Alternatively the gaps can be created physically using a spade or mattock. H. V. Horticulture have developed a scuttion (a type of winged auger) which removes a disc of turf to create a planting space for 2 to 3 plug plants. Experience shows that if the mechanically or chemically cleared area exceeds 30 cm in diameter then weed germination is likely to be a problem. Planting speeds are typically over 100 plants per hour.

Specialist dibbers can be used to create a planting hole identical to the shape of the module, thus ensuring good root to soil contact. The dibber also creates a chet at the bottom of the planting hole to encourage deep rooting.

POST PLANTING MANAGEMENT

Establishment Year

Experience has shown that grass cutting in the first Spring and early Summer is critical. It is most important to cut the grass before it is tall enough to lodge as this is the major factor in the loss of young plants by slug damage. Whenever the grass reaches a maximum of 20cm it should be cut to around 5 to 7cm and the clippings removed, this is particularly important in the first year. The cutting program normally involves one or two cuts in the spring and/or early Summer, with one or two in the late Summer/early Autumn.

Subsequent Years

In the long term the management program will heavily influence the species composition of the meadow and soil fertility.

Mowing and removing the new grass growth once each year is the minimum requirement for survival of a wider range of species. The timing of mowing will vary between sites, but it should be consistent from year to year.

Mowing in September/October ensures the maximum time for plants to flower and set seed but large volumes of standing or flattened vegetation (with its attendant fire risks) may then need to be removed.

A July cut enables many Spring and early Summer species to seed; the vegetation remains quite short and tidy during the later Summer months (useful for informal recreation in the school holidays) and some species will flower a second time in the Autumn.

A May-June (traditional hay-making time) cut will selectively weaken the most vigorous grasses, leaving a tidy appearance in Summer and giving the maximum period for late flowering species to set seed.

Where tidiness is particularly important, mowing in July and again in October may be desirable and, on fertile soils, more frequent mowing may be necessary at least in the first few years.

There are many other possible permutations of cutting, including monthly mowing in the early or later part of the year to create Summer or Spring meadows respectively. Some rougher areas can be cut every other year to leave standing cover for over-wintering insects. Finally as the sward develops and thickens some thought should be given to gap creation, deliberate damage to the surface approximating poaching by cattle, to allow new plants to establish by seed and ensure the continued evolution of the meadow community.

RESULTS, COSTS AND FUTURE

Independent monitoring has shown that survival percentages of around 75% to 80% of plants can be expected after 12 months. The problems most often associated with lower percentages are:-

- * inappropriate species selection,
- * the omission of the first Spring grass cut,
- * early Summer planting when irrigation is required but not available.

Provided there are areas of bare earth in the sward which are over 2-3 cm across second generation propagation will start by the second year after planting. The increase in numbers varies enormously, even between different planting locations in a site, but has been recorded at about 10% to 15% per year for the longer lived perennials such as Meadow Cranesbill and the Knapweeds and much higher percentages for shorter lived perennials such as Oxeye Daisy.

The matrix below sets out an estimate of costs. If, for example, the total grassland site is 10,000 m² and the landscape architect wants half the area planted with a plant density within the planted area of 6/m² the cost of plants will be £5,400 (i.e. 10,000 x £0.54) and the total cost for plants and planting £8,400.

The range of plants being raised is constantly being expanded. Work is underway on techniques for controlling grass growth so as to facilitate wild flower establishment in more fertile conditions. Graminicides such as fluazifop-P-butyl (Fusilade) and sethoxydim (Checkmate) can prove effective at suppressing aggressive grasses but do not affect either the Fescues or the broad-

leaved herbs. Yellow Rattle seed (*Rhinanthus minor*) is sometimes introduced into the wild flower planting site as the plant is a semi-parasite on grasses and may have a role in mildly suppressing the grass growth immediately around the wild flower. In small trials stable butterfly communities have been created using sedentary butterfly species, provided the plant food sources at the juvenile and adult phases are planted, coupled with the introduction of the butterfly species at the larval state. Shortly it will be possible to create butterfly meadows, a technology which will add a totally new dimension to landscaping.

**BUDGET COST MATRIX FOR THE SUPPLY AND PLANTING
OF WILD FLOWER PLUG PLANTS IN £ PER METRE SQUARED
FOR TOTAL GRASSLAND AREA
(figures in brackets cover only costs of plants)**

Plug Plants m2 in planted area	Percentage of Site Planted		
	33%	50%	100%
4	0.37 (0.24)	0.56 (0.36)	1.12 (0.72)
6	0.56 (0.36)	0.84 (0.54)	1.68 (1.08)
8	0.75 (0.48)	1.12 (0.72)	2.24 (1.44)
10	0.93 (0.60)	1.40 (0.90)	2.80 (1.80)

Note: Budget prices used are 18p/plug plant and 10p/plant for planting (1000 plants/man day at £100/day) to give a planted price 28p for each plant.

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