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## **USE OF WOODLAND HERBACEOUS PLUG PLANTS FOR THE ENHANCEMENT OF FIELD LAYERS IN ESTABLISHING PLANTATIONS.**

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### **THE ROLE OF WILD FLOWER PLANTS IN WOODLANDS**

A range of grants, schemes and initiatives has resulted in a dynamic tree planting programme throughout Britain to re-create woodland areas. In the short term, however, there has been little colonisation by interesting and attractive field layer species into the developing plantations. This is due to a number of factors: they are from mature woodlands, woodland herbaceous plants have poor dispersal mechanisms, are slow colonisers and relatively weak competitors. This field layer species may need assistance to become established at new woodland sites. Without their introduction the development of typical woodland field layers may take many hundreds of years.

Sowing and planting are both useful techniques for introducing wild flowers and have been widely reported in scientific journals (Buckley & Knight 1989, Packman & Cohn 1990, Francis 1992, Francis & Street 1993). The advantages of plants over seeds in landscaping are their predictability and reliability whilst their use provides far greater control over plant location and ratio between species. Plants also mature more rapidly than introductions from seed to the flowering and propagating stage. Planting techniques are particularly useful for the introduction of some woodland herbaceous species which are predominantly vegetative in nature, such as Bugle (*Ajuga reptans*) and Yellow Archangel (*Lamium galeobdolon*).

Woodland field layer plants have established very successfully in large-scale trials (Francis 1992). Establishment rates, including subsequent seedling production, are higher for species introduced as plants than for those introduced by seeds.

The aim of this article is to present practical guidelines for the use of wild flower plants and seeds in woodland landscape design schemes.

### **PLANT RAISING TECHNOLOGY**

Using both plant and vegetative propagation techniques, perennial wild flowers are raised in plastic modular trays with peat free composts. Bulbs are propagated by seed in weed-free raised beds, often under natural shade. Wild flower plug plants are dispatched throughout the year with peak seasons in the Autumn and Spring. Bulbs and rhizomes are dispatched during their dormant phase i.e. July to November.

### **SITE ASSESSMENT AND PLANNING**

The growth and establishment of field layer species is governed predominantly by competition levels, i.e. the amount of vegetation existing as ruderals and shade-tolerant forbs and grasses. The growth of these competing plants is controlled by shade levels. Both the amount of existing vegetation at a site as well as the level of shade cast by the tree canopy need to be assessed. Field layer introductions should not be made into very open sites with little or no shade since substantial management would be required to control the natural colonisation of competing vegetation. Established trees, which are at least five years old, should be present at a new site. Under medium to high shade levels, where there is sparse or no existing site vegetation, conditions are ideal for wild flower introduction. If there is some existing vegetation then the introductions should be targeted into the shadier, weed-free areas of the site.

The decision tree in Fig. 1 summarises the interactions between the shade and vegetation levels in terms of the manner in which field layer enhancement can proceed. This allows the determination of different groups of field layer species for introduction. (Such groups are described further in 'Species choice.')

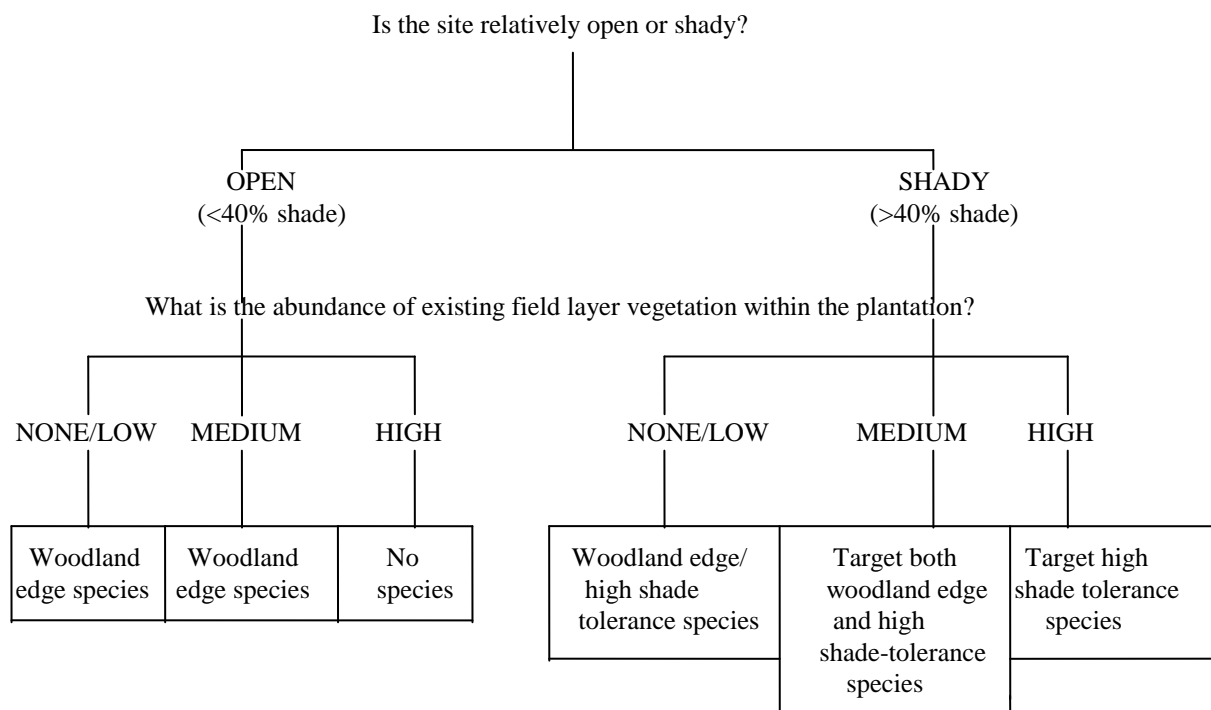


Figure 1. *A decision tree for the evaluation of site characteristics to determine the appropriate species group for introduction.*

***Use of Seed and Plants***

Seed can be highly effective in establishing woodland flora, provided that the seed is available, viable and reasonably priced. Plants are essential for species who mainly propagate vegetatively or when more rapid results are required. Typically blue bell seed is the primary seed species, sown at around 200 seeds per m<sup>2</sup>, along with a cocktail of other species with a composite seed rate of a further 500 seed per m<sup>2</sup>. The seed cocktail cost varies with the species used but is commonly in the range of 8p to 12.5p per m<sup>2</sup>.

The table below serves to provide some budget prices per m<sup>2</sup> for individual woodland species for seeding.

**Table 1 Budget Seed Prices per Meter Squared for Woodland Species**

Latin Name	Common Name	Seed rate /m <sup>2</sup>	Price in Pence/m <sup>2</sup>
Hyacinthoides non-scripta	Bluebell *	200	30p
Conopodium majus	Pignut	500	17.5p
Hypericum hirsutum	Hairy St John's Wort	500	1.5p
Silene dioica	Red campion*	500	3.5p
Galium mollugo	Hedge Bedstraw	500	3.5p
Myosotis sylvatica	Wood Forget me not	500	3.5p
Geum urbanum	Wood Avens*	500	4.5p
Digitalis purpurea	Foxglove*	500	1p
Stachys officinalis	Betony*	500	19p
Hypericum perforatum,	Perforate St John's Wort*	500	1p
Alliaria petiolata	Hedge Garlic*	500	12p
Campanula trachelium	Nettleleaved Bellflower*	500	4p
Fragaria vesca	Wild Strawberry*	500	12p
Stachys sylvatica	Hedge Woundwort	500	14p

Notes: \* donates also commonly available as plant or bulb

Seed is generally distributed by hand from the Autumn through to March. Generally no ground preparation is required, save for some raking. It takes about 1 working day to distribute seed over 1 ha. Most species will germinate in the first season. Bluebells are slower requiring a warm and a cold treatment to germinate. They may not germinate until the second season. Thereafter it can take four to five seasons to produce flowering Bluebell plants.

A listing is found in table 2 (at the end of this document) of those species most commonly, or exclusively, introduced as plants.

### ***Ground pre-treatment for Planting***

No site preparation is necessary when introducing species as young plants into weed-free, semi-shaded or shaded areas. If vegetation levels are high, however, then establishment success will be greatly reduced if species are introduced without initial ground pre-treatment. As it is unlikely and possibly unnecessary for an entire site to be planted with introduced species, it is rare for the whole site to need weed control treatment. Herbicide or mulch can be used to control weed growth in areas of the site that appear to be more suitable for introduction. By eliminating weeds in shadier areas, for example, the natural increase of shade as trees establish further will allow the growth and spread of any introduced field layer species.

### ***Planting details***

#### *Timing*

Late Autumn (October/November) and early spring (February/March) are recommended for wild flower planting to ensure that sufficient soil moisture is available for plant establishment. Timing is particularly important for the introduction of young plants so that the growth of roots into the surrounding soil can be encouraged. Linking the timing of planting with maintenance of soil conditions helps plant establishment and should ensure that no further after care is necessary. By omitting Winter (December/January) planting, cold, hard ground conditions are avoided, although mid-Winter conditions permit field layer plants to be introduced at any time.

Bulbs are planted from July to late November. The optimum planting time is before mid September, as root initials tend to be damaged by later planting. As a result bulbs do not develop a full root system in the first year, producing a weak growth and poor flowering.

#### *Planting patterns and density*

In order to mimic the mosaics of species that exist within natural woodland field layers, introduced species should be clustered in groups instead of being spread through a site as discrete individuals. Some species such as Primrose and Bluebell establish more successfully at high rather than low planting densities, setting more seed and giving rise to higher seedling numbers (Francis 1993). Close planting facilitates pollination and therefore seed production. Densities of 6-9 plants/m<sup>2</sup> are considered suitable for the introduction of most field layer species. For species with good vegetative growth such as Bugle, Enchanter's Nightshade (*Circaea lutetiana*) and Yellow Archangel a density of 3-4 plant m<sup>2</sup> allows enough space for vegetative spread.

Whereas seeds of field layer species may be sown all over a new site, budgets for field layer enhancement will rarely be sufficient. Normally about 10-15% of site is a suitable level for introducing plant species. If weed-free semi-shaded or shaded areas are targeted for planting, a nucleus of species should establish successfully and subsequently spread out to colonise other areas.

### ***Subsequent management***

In general, if young field layer plants have been carefully selected to suit site conditions and have been introduced at appropriate planting times, no direct after care in terms of watering/feeding should be necessary for successful establishment. However, some management is important to ensure continued successful growth and subsequent spread of the woodland field layer species.

### Management of light levels

Woodland herbaceous species need light for continued survival and spread and will benefit from light as long as competition levels remain low. As in the coppice cycle it is beneficial for plants to receive light periodically so that flowering is encouraged and seeds are set. When plantations reach the thicket stage shrubs may be coppiced or standard trees thinned to allow in more light. The timing of such management will differ from one site to another and will probably be covered by the general management regime for trees and shrubs.

### Colonisation by invasive weed species

If field layer species have been introduced into areas with moderate to high light levels it is necessary to monitor the growth of invasive weed species. The growth of some competitive weed species e.g. Common Nettle (*Urtica dioica*), Cow Parsley (*Anthriscus sylvestris*), Cleavers (*Galium aparine*), Brambles (*Rubus fruticosus agg.*), Docks (*Rumex spp.*) and grasses, such as Couch (*Elymus repens*), may need to be checked by cutting in early and late Summer in the first two growing seasons after introductions have been made. Only if the weed problem becomes very bad will selective herbicides be necessary. The successful colonisation of invasive weed species may hamper or completely inhibit woodland field layer establishment and is the main reason for not introducing species into high light site conditions.

## **RESULTS AND COSTS**

Survey results of planted wild flowers in young plantations indicate a decline in number in the first season. Subsequently the number of plants rapidly increases particularly when individual species are clustered together in high density plantings. The increases in total numbers varies considerably. For example total Red Campion numbers increased 2000% in three years, whilst Primrose numbers increased 800% and Bluebells by 40%. The rate of increase is high for the shorter lived, seed producing perennials and slower for the longer lived perennials whose main strategy for spread is by vegetative propagation.

An expert system specifically for the enhancement of plantations with the introduction of woodland field layer species is being developed.

A cost matrix is set out below for the introduction of plants, Bluebells and Wood Anemones per metre<sup>2</sup>

**BUDGET COST MATRIX FOR THE SUPPLY  
AND PLANTING OF WILD FLOWER PLUG PLANTS  
BULBS & RHIZOMES IN £ PER METRE SQUARED  
WOODLAND AREA  
(figures in brackets cover only costs of plant material)**

<b>Plug Plants m2 in planted area</b>	<b>Plug Plants</b>	<b>Bluebells &amp; Wood Anemones</b>
1	0.28 (0.18)	0.275 (0.12)
4	1.12 (0.72)	1.10 (0.48)
6	1.68 (1.08)	1.65 (0.72)
8	2.24 (1.44)	2.20 (0.96)
10	2.80 (1.80)	2.75 (1.20)

Note: Budget costs 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. For bulbs and rhizomes the budget costs are used are 12p/plant and 15.5p/plant planting (640 plants per day at £100/day) to give a planted cost per plant of 27.5p.

### ***Acknowledgments***

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Table 2 Characteristics of woodland field layer species selected for introduction into new sites

Latin Name	Common Name	Shade Tolerance	Soil pH Ac/N/A1	Soil Moisture	Height (cm)	Flowering Time	Flower Colour
Alliaria petiolata	Hedge Garlic*	Medium	N/A1	M	20-100	April-June	White
Allium ursinum	Ransom**	High	N/A1	W/M	45	April-June	White
Anemone nemorosa	Wood Anemone**	High	Ac/N/A1	M/D	5-30	March-May	White
Anthriscus sylvestris	Cow parsley**	Medium	N/A1	M/D	100-150	April-June	White
Ajuga reptans	Bugle**	High	Ac/N/A1	W/M	30	May-July	Blue
Circaea lutetiana	Enchanter's Nightshade**	High	N/A1	W/M	60	June-August	White
Digitalis purpurea	Foxglove*	Medium	Ac/N	M/D	200	June-Sept.	Pink
Ranunculus ficaria	Lesser Celandine**	High	N/A1	W/M	10-15	February-April	Yellow
Viola riviniana	Common (Dog) violet*	High	N/A1	W/M	10-15	April-June	Violet
Galium mollugo	Hedge Bedstraw*	Medium	N/A1	M/D	150	June-Sept.	White
Galium odoratum	Woodruff**	High	N/A1	M	45	May-June	White
Hyacinthoides non-scripta	Bluebell*	High	Ac/N	M/D	50	April-June	Blue
Hypericum hirsutum	Hairy St. John's Wort	Medium	N/A1	M	100	July-August	Yellow
Glechoma hederacea	Ground Ivy**	Medium	N/A1	M/D	15	March-May-	Violet
Lamium galeobdolon	Yellow Archangel**	High	Ac/N/A1	M/D	60	May-June	Yellow
Primula vulgaris	Primrose**	High	Ac/N/A1	M/D	15	Feb.-May	Pale Yellow
Geranium robertianum	Herb Robert*	Medium	Ac/N/A1	M/D	50	April-Sept.	Pink
Silene dioica	Red Champion*	Medium	N/A1	W/M	100	May-June	Deep Pink
Stachys officinalis	Betony*	Medium	N/A1	M/D	50-75	June-Sept.	Pink/purple
Oxalis acetosella	Wood Sorrel**	High	N/A1	W/M	100	July-August	Red/purple
Stellaria holostea	Greater Stitchwort**	Medium	N/A1	M/D	60	April-June	White
Teucrium scorodonia	Wood sage**	Medium	Al & Ac	M/D	40	July-Sept	White
Vicia cracca	Tufted vetch**	Medium	N/A1	M/D	100	July-Sept	Blue/Purple
Campanula trachelium	Nettle Leaf Bellflower**	High	N/A1	M/D	75	June-Sept	Blue/Purple
Viola odorata	Sweet Violet*	High	N/A1	M/D	10	Feb.-April	Violet

Ac: Acid; N:Neutral; A1 Alkaline; W:Wet; M:Moist; D:Dry, \* available as plants and bulbs, \*\* exclusively used as plants and bulbs