
**ASSESSING PESTICIDE RISKS TO NON-TARGET
TERRESTRIAL PLANTS**

**SECTION TWO: LIFE HISTORIES AND ECOLOGY OF KEY NON-
TARGET PLANTS OF FARMLAND**

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2.1 INTRODUCTION

Species representative of a) habitat types, b) taxonomic groups, c) functional groups and d) soil types, in agricultural systems have been selected under Objective 1. Non-crop flora are associated with the crop as weeds, and with the range of associated non-crop habitats, which include grasslands, heathland, wetlands, tall herbaceous communities, scrub and woodland, all of which may be represented in field margins. Functional groups can be determined by life form or by strategies (*sensu* Grime, 1979).

The timing of growth, flowering and recruitment of plant species may affect their susceptibility to pesticides. These characteristics may also influence their exposure to pesticides in the farmland environment. Recovery and recruitment of plant species are governed by their patterns of growth, reproduction and spread. Information on these characteristics of the 40 selected plant species are summarised below, based on information collected from floras (Clapham *et al.*, 1989; Fitter *et al.*, 1980; Stace, 1997), the Comparative Plant Ecology by (Grime *et al.*, 1988) and the BIDS EcoFlora database (Fitter & Peat, 1994).

2.2. TAXONOMY AND HABITATS OF KEY PLANT SPECIES OF FARMLAND

Collected data on the habitats of the selected species are summarised below in Table 2.1.

Table 2.1. Taxonomy of selected plant species and their habitats. Nomenclature is according to Stace (1997). Habitat use is taken from Grime *et al.* (1988) with the following key: ++ = very common and characteristic; + = common within habitat; . = widespread; - = infrequent; -- = largely absent

Species	English name (from Dony <i>et al.</i> 1986)	Family	Wetland	Skeletal	Arable	Pasture	Spoil	Waste	Wood- land	Terminal Habitat
										UCPE
<i>Agrostis stolonifera</i>	Creeping Bent	Poaceae	.	-	+	.	.	.	--	Arable
<i>Alliaria petiolata</i>	Garlic Mustard	Brassicaceae	--	.	--	-	.	++	.	River and stream banks
<i>Arum maculatum</i>	Lords-and-Ladies	Araceae	--	--	--	-	--	--	++	Woodland on limestone strata
<i>Brachypodium sylvaticum</i>	False Brome	Poaceae	--	.	--	.	-	--	+	Woodland on limestone strata
<i>Carduus crispus</i>	Wetted Thistle	Asteraceae	--	-	-	-	.	+	+	River and stream banks
<i>Centaurea cyanus</i>	Cornflower	Asteraceae								
<i>Centaurea nigra</i>	Common Knapweed	Asteraceae	--	.	--	.	.	+	--	Wasteland on calcareous strata
<i>Chamerion angustifolium</i>	Rosebay Willowherb	Onagraceae	--	.	--	-	+	.	.	Cinder tips and cindery railway tracks
<i>Chenopodium album</i>	Fat-hen	Chenopodiaceae	--	--	++	-	+	--	--	Arable
<i>Chrysanthemum segetum</i>	Corn Marigold	Asteraceae	--	--	++	-	.	--	--	Arable
<i>Cirsium arvense</i>	Creeping Thistle	Asteraceae	--	-	+	.	+	.	--	Coal-mine spoil
<i>Convolvulus arvensis</i>	Field Bindweed	Convolvulaceae	--	-	++	-	.	.	-	Arable
<i>Corylus avellana</i>	Hazel	Betulaceae	.	--	--	-	--	--	++	Scrub
<i>Crataegus monogyna</i>	Hawthorn	Rosaceae	-	-	--	-	--	--	++	Hedgerows

<i>Dactylis glomerata</i>	Cock's-foot	Poaceae	--	.	.	.	.	.	-	Meadows
<i>Daucus carota</i> ssp. <i>carota</i>	Wild Carrot	Umbelliferae	--	.	--	-	.	+	--	Wasteland on calcareous strata
<i>Digitalis purpurea</i>	Foxglove	Scrophulariaceae	--	.	.	-	.	-	+	Broadleaved plantations
<i>Dipsacus fullonum</i>	Wild Teasel	Dipsacaceae								
<i>Festuca rubra</i>	Red Fescue	Poaceae	--	.	-	.	.	+	--	Road verge
<i>Galium aparine</i>	Cleavers	Rubiaceae	-	--	+	-	-	.	.	Hedgerows
<i>Galium mollugo</i>	Hedge Bedstraw	Rubiaceae								
<i>Heracleum sphondylium</i>	Hogweed	Umbelliferae	--	-	.	.	.	+	.	Wasteland on calcareous strata
<i>Hyacinthoides non-scripta</i>	Bluebell	Liliaceae	--	--	--	-	--	--	++	Broadleaved plantations
<i>Lamium galeobdolon</i>	Yellow Archangel	Lamiaceae	-	--	--	-	--	--	++	Woodland on limestone strata
<i>Lamium album</i>	White Dead-nettle	Lamiaceae	--	.	.	-	+	.	--	Soil heaps
<i>Leucanthemum vulgare</i>	Oxeye Daisy	Asteraceae	--	.	.	.	+	.	--	Limestone quarry spoil
<i>Lotus corniculatus</i>	Common Bird's-foot-trefoil	Fabaceae	--	.	--	+	+	+	--	Pasture on limestone strata
<i>Lychnis flos-cuculi</i>	Ragged-Robin	Caryophyllaceae	++	--	--	.	--	-	--	Unshaded mire
<i>Matricaria recutita</i>	Scented Mayweed	Asteraceae	--						--	
<i>Papaver rhoeas</i>	Common Poppy	Papaveraceae	--	--	++	-	.	.	--	Arable
<i>Polygonum aviculare</i>	Knotgrass	Polygonaceae	--	--	++	-	.	.	--	Arable
<i>Primula vulgaris</i>	Primrose	Primulaceae	-	.	--	.	.	-	++	Scrub
<i>Ranunculus repens</i>	Creeping Buttercup	Ranunculaceae	.	--	+	+	.	.	--	Meadows
<i>Tamus communis</i>	Black Bryony	Dioscoreaceae	--	--	--	-	--	.	++	Hedgerows
<i>Taraxacum officinale</i>	Common Dandelion	Asteraceae	--	.	.	.	.	.	--	Meadows
<i>Torilis japonica</i>	Upright Hedge-parsley	Umbelliferae	--	.	--	.	+	.	.	Rock outcrop
<i>Trifolium repens</i>	White Clover	Fabaceae	-	--	+	+	.	.	--	Enclosed pasture
<i>Urtica dioica</i>	Common Nettle	Urticaceae	.	.	.	-	.	.	.	Soil heaps
<i>Vicia sativa</i>	Common Vetch	Fabaceae	--	-	.	.	.	++	--	Dry sandy wasteland
<i>Vicia sepium</i>	Bush Vetch	Fabaceae	--	--	--	.	.	+	.	Soil heaps

2.3. GROWTH, GERMINATION AND REPRODUCTION OF KEY PLANT SPECIES OF FARMLAND

Details of the life forms, flowering and seed biology of the key plant species are summarised in Tables 2.2 and 2.3.

Table 2.2. Life forms and flowering times of key plant species of farmland.

Key: Life history - As = summer annual, Aw = winter annual, B = biennial, M = monocarpic (once-flowering) perennial, P = polycarpic (multiple-flowering) perennial.
Life form (UCPE) - Ch = chamaephyte (plants that maintain perennating buds close to the soil), G = geophyte (surviving as underground storage organs), H = helophyte (salt-adapted plants), Ph = phanerophyte (tree-like plants), Th = therophyte (annuals surviving as seeds).
Life form (Ellenberg) - C = herbaceous chamaephyte, H = hemicryptophyte (plants with persistent rhizomes and stolons), G = geophyte, N = nano phanerophyte (woody plants <2 m high), P = phanerophyte, T = therophyte, li = liana (climber).
Established strategy (UCPE) - C = competitor, S = stress-tolerator, R = ruderal.
Reproduction - S = seasonal regeneration by seed, Sv = seasonal regeneration by vegetative means (offsets soon independent of parent), V = lateral regenerative spread, (offsets remaining attached to the parent for a long period, usually for more than one growing period), (V) = instances where the period of attachment is intermediate between those of V and Sv, W = regeneration involving numerous widely-dispersed seeds or spores, Bs = a persistent bank of buried seeds or spores, ? = strategies of regeneration by seed uncertain.

Species	Life history	Life form UCPE	Life form Ellenburg	Established Strategy	Reproduction	Flowering	
						1st month	period (m)
<i>Agrostis stolonifera</i>	P	H	H	CR	V,Bs	7	2
<i>Alliaria petiolata</i>	A/M	H	H	CR	S	4	3
<i>Arum maculatum</i>	P	G	G	SR	V,?S	4	2
<i>Brachypodium sylvaticum</i>	P	H	H	S/SC	V,S	7	2
<i>Carduus crispus</i>	M	H	H	CR	W	6	3
<i>Centaurea cyanus</i>	A		T			6	3
<i>Centaurea nigra</i>	P	H	H	S/CSR	V,S	6	4
<i>Chamerion angustifolium</i>	P	G	H	C	V,W	7	3
<i>Chenopodium album</i>	As	Th	T	R/CR	Bs	7	4
<i>Chrysanthemum segetum</i>	As	Th	T	R	Bs	6	3
<i>Cirsium arvense</i>	P	G	G	C	V,W, Bs	7	3
<i>Convolvulus arvensis</i>	P	G	G H li	CR	(V), Bs	6	4
<i>Corylus avellana</i>	P	Ph	N	SC	V,S	1	4
<i>Crataegus monogyna</i>	P	Ph	N P	Sc	S	5	2
<i>Dactylis glomerata</i>	P	H	H	C/CSR	S	5	3
<i>Daucus carota ssp. carota</i>	M	H	H	SR/CSR	?S,Bs	6	2
<i>Digitalis purpurea</i>	P/M	H	H	CR/CSR	V,S,Bs	6	4
<i>Dipsacus fullonum</i>	B		H			7	2

<i>Festuca rubra</i>	P	H	H	CSR	V,S	5	3
<i>Galium aparine</i>	Aws	Th	T li	CR	S	6	3
<i>Galium mollugo</i>	P		H			6	4
<i>Heracleum sphondylium</i>	P/M	H	H	CR	S	6	4
<i>Hyacinthoides non-scripta</i>	P	G	G	SR/CSR	V,S	4	3
<i>Lamium album</i>	P	Ch	C	S/SC	V,S	5	2
<i>Lamium album</i>	P	H	H	CR	V,Bs	5	8
<i>Leucanthemum vulgare</i>	P	H	H	CR/CSR	V,S,Bs	6	3
<i>Lotus corniculatus</i>	P	H	H	S/CSR	Bs	6	4
<i>Lychnis flos-cuculi</i>	P	H	H	CSR	V,Bs	5	2
<i>Matricaria recutita</i>	Asw	T	T	R	Bs	6	1
<i>Papaver rhoeas</i>	Asw	Th	T	R	Bs	6	3
<i>Polygonum aviculare</i>	As	Th	T	R	Bs	7	5
<i>Primula vulgaris</i>	P	H	H	S	Bs	12	6
<i>Ranunculus repens</i>	P	H	H	CR	(V),Bs	5	2
<i>Tamus communis</i>	P	G	G li	C/CR	S	5	3
<i>Taraxacum officinale</i>	P	H	H	R/CSR	W	3	8
<i>Torilis japonica</i>	A/B	Th	T H	SR/CSR	S,Bs	7	2
<i>Trifolium repens</i>	P	H/Ch	H	CR/CSR	(V),Bs	6	4
<i>Urtica dioica</i>	P	Ch/H	H	C	V,Bs	6	2
<i>Vicia sativa</i>	Aw	Th	T li	R/CSR	Bs	5	5
<i>Vicia sepium</i>	P	H	H li	C/CSR	V	5	4

Data on seedbanks is available in Thompson *et al.* (1997), as well as the EcoFlora database.

Table 2.3. Seed biology characteristics of key plant species of farmland

Key: Seed bank type – 1 = transient, 2 = short-term persistent, 3 = longer-term persistent.
Germination requirements - Chill = chilling, Dry = dry storage at room temperature, Scar = scarification, Warm = warm moist incubation, Wash = water-washing to remove inhibitor in seed coat. - = immediate germination, / = different seeds have different requirements, , = several alternative mechanisms are effective, Unclassified = lack capacity for immediate germination, but mechanism has not yet been identified, ? = mechanism requires confirmation.
Time of germination - Sp = spring, Su = summer, Au = autumn, Wi = winter.
Normal method of propagation - Seed or vegetative or seed & vegetative (S&V).
Seed bank longevity – m = months; y = years
Seed bank type - A score from 0-1 where 0 = all records transient, and 1 = all records persistent.
Confidence - Species where there are less than 10 records are marked *.

Species	UCPE Seed bank type	Germination requirements	EcoFlora Time of germination	EcoFlora Normal propagation	EcoFlora Seed viability	EcoFlora Seedbank longevity	Thompson Seed bank type	Confidence
<i>Agrostis stolonifera</i>	3	\	Sp/Au	S&V			0.489	
<i>Alliaria petiolata</i>	2	Chill	Sp/Wi	S&V		3-12m	0.5	*
<i>Arum maculatum</i>	1	Chill	Sp/Wi	S&V		1-5y	0	*
<i>Brachypodium</i>	1	Dry	Sp	S&V			0.222	*

<i>sylvaticum</i>								
<i>Carduus crispus</i>	?	\	Sp	seed			1	*
<i>Centaurea cyanus</i>				seed			0.6	
<i>Centaurea nigra</i>	2	Dry	Sp	seed		1-5y	0.385	
<i>Chamerion angustifolium</i>	1	Dry	Sp/Su/Au/Wi	S&V		1-5y	0.524	
<i>Chenopodium album</i>	3	- / Chill, Dry	Sp/Su	seed		>20y	0.931	
<i>Chrysanthemum segetum</i>	3	Scar	Sp/Au	seed		5-20y	0.857	*
<i>Cirsium arvense</i>	3	- / Unclassified	Sp/Au	S&V	some non-viable	5-20y	0.521	
<i>Convolvulus arvensis</i>	3	Scar	Sp/Au	S&V		>20y	0.353	
<i>Corylus avellana</i>	1	Chill	Sp				0	*
<i>Crataegus monogyna</i>	1	Warm / Chill	Sp	seed	some non-viable		0	*
<i>Dactylis glomerata</i>	1	Dry	Sp	seed		1-5y	0.426	
<i>Daucus carota ssp. carota</i>	3	Chill	Sp/Au	seed	some non-viable		0.722	
<i>Digitalis purpurea</i>	3	-	Sp/Au	seed		1-5y	0.8	
<i>Dipsacus fullonum</i>				seed		1-5y	0.5	*
<i>Festuca rubra</i>	1	-	Au/Wi	S&V	high	1-5y	0.304	
<i>Galium aparine</i>	1	Chill	Sp/Au/Wi	seed	high	1-5y	0.31	
<i>Galium mollugo</i>				S&V		3-12m	0.214	
<i>Heracleum sphondylium</i>	1	Chill	Sp/Wi	seed	some non-viable	1-5y	0.25	
<i>Hyacinthoides non-scripta</i>	1	Warm / Chill	Au	S&V	high		0	*
<i>Lamium album</i>	1	Chill	Sp	S&V			0.077	
<i>Lamium album</i>	3	?	Sp/Wi	vegetative			0.75	
<i>Leucanthemum vulgare</i>	3	-	Sp/Au	S&V	some non-viable		0.523	
<i>Lotus corniculatus</i>	3	Scar	Sp/Au	seed	high	1-5y	0.441	
<i>Lychnis flos-cuculi</i>	3	-	Sp/Au	seed		1-5y	0.6	
<i>Matricaria recutita</i>	2		Sp/Su/Au	seed			0.778	*
<i>Papaver rhoeas</i>	3	Chill	Sp/Au	seed	high	>20y	0.867	
<i>Polygonum aviculare</i>	3	Chill	Sp	seed			0.813	
<i>Primula vulgaris</i>	3	Wash		seed			1	*
<i>Ranunculus repens</i>	3	(Dry)	Sp/Su	S&V		>20y	0.724	
<i>Tamus communis</i>	1	Chill	Sp	seed	high		0	*
<i>Taraxacum officinale</i>	2	-	Sp	seed		1-5y	0.472	
<i>Torilis japonica</i>	3	Chill	Sp/Au	seed		5-20y	0.4	*
<i>Trifolium repens</i>	3	Scar	Sp/Su	S&V	high	1-5y	0.6	
<i>Urtica dioica</i>	3	-	Sp	S&V			0.796	
<i>Vicia sativa</i>	3	Scar	Sp/Au	seed			0.45	
<i>Vicia sepium</i>	1	Scar		S&V			0.111	*

Species show a variety of adaptations to survival and reproduction, with seed production and vegetative propagation commonly shown.

2.3. REFERENCES

- Clapham, A.R., Tutin, T.G. & Moore (1989). *Flora of the British Isles*. Cambridge University Press
- Dony, J.G., Jury, S.L. & Perring, F.H. (1986) *English Names of Wild Flowers*. 2nd edn. The Botanical Society of the British Isles.
- Ellenberg, H. (1988). *Vegetation Ecology of Central Europe*. 4th edition. CUP.
- Fitter, A.H. & Peat, H.J. (1994) The Ecological Flora Database. *Journal of Ecology*, **82**, 415-425.
- Fitter, R., Fitter, A. & Blamey, M. (1980). *The Wild Flowers of Britain and Northern Europe*. (3rd ed.). Collins.
- Grime, J.P., Hodgson, J.G. & Hunt, R. (1988). *Comparative Plant Ecology. A functional approach to common British species*. Unwin Hyman, London.
- Stace, C.A. (1997). *New Flora of the British Isles*. 2nd edn. CUP, Cambridge.
- Thompson, K., Bakker, J. & Bekker, R. (1997). *The Seed Banks of North West Europe*. CUP, Cambridge.