Technical Note TN643

SRUC

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Weed Management in Grassland

SUMMARY

This technical note describes the most important weeds of grassland and their management. This note is designed to be of value to low and high conventional input grassland systems, as well as potentially to organic systems. This technical note updates Technical Note 643 published in 2012 with many changes in herbicide approval and labels.

- Weeds are directly competitive with grass. They may also reduce the nutritional value of grass in the field or as silage or hay, and may even be toxic to stock.

- Some apparently weedy plants do have nutritional value, listed in the note, and their removal may not be cost-effective and, indeed, may be useful in stock nutrition. However, some such weeds, such as nettle, may prevent stock accessing the grass.

- This note covers in detail weeds such as common chickweed and other annuals in short-term leys, chickweed, annual meadow-grass, plus weedy grasses, docks, thistles, nettles, buttercups and ragwort in rotational and longer-term grassland and these weeds plus bracken, rushes and broom and whins (gorse) in permanent pasture. The key characteristics of these plants are described as a basis for understanding how the chances of infestation may be reduced and to assist in control through cultural measures.

- Methods of direct control of these weeds by both physical and herbicidal approaches are described.

- Other less common, but locally important, weeds, and their control by herbicides, are also mentioned.

- Many weeds have environmental benefits in terms of being food sources to fauna. Some of these benefits are also listed in the note.

Introduction

This technical note describes the management of important weeds of short-term, rotational, long-term and permanent pastures, with and without clovers. The characteristics of the weeds are described which may influence how they are managed through cultural, physical and herbicidal methods. In organic systems where herbicides are not available, cultural and physical methods of management are used which may require very long-term strategies, including management of the weeds in other parts of rotations. However, even in conventional farming systems the use of herbicides may only be a partial answer to the management of weeds and the use of appropriate husbandry approaches will assist markedly their longer term management.

- Annual weeds are most commonly a problem in the establishment of grassland. A wide range of annuals may appear in newly sown grass, whether directly sown or as an undersow in cereal crops, but few persist once the grass has established and is cut or grazed. There are exceptions and the most common is common chickweed, which can persist in rotational grass and even establish in longer-term pastures where there are gaps in the sward. Of other annuals perhaps annual meadow-grass is of greatest concern as it is an unproductive grass in both new and established rotational swards.

  The most important biennial weeds (those that germinate and produce vegetative growth in one season, then flower and die in the second season) of grassland are ragwort and spear-thistle (sometimes known as scotch-thistle). These can be a problem in both short-term/ rotational grass and permanent pasture where there are gaps in the sward.

- There are a number of important perennial weeds of grassland. They may persist in the form of rhizomes or roots from previous crops in the rotation, or establish from the seed bank whilst the grass is being established. However, many such weeds will take advantage and germinate and establish where there are gaps due to low vigour in the grass sward. Docks, creeping thistle, perennial nettle and buttercups are found in both rotational and longer-term grassland, generally where fertility is reasonably high.

  Rushes are indicative of wetter conditions and whins (gorse) and broom of drier/ light soil conditions. Bracken is a serious weed of permanent pastures; particularly where there are deeper soils in relatively low-input hill and upland pastures.

- Weedy unproductive perennial grasses, such as common couch-grass, creeping soft-grass, marsh fox-tail, crested dogstail, wavy-haired grass, etc, and weedy annual grasses such as soft brome cannot be managed directly with herbicides in grassland, so husbandry approaches are required. They generally are problems in low-input longer-term or permanent grazed pastures. They can be indicative of poor soils or wet conditions, or poor grazing practices.

- A number of less common but locally important weeds not listed above are not described in detail but are included in the herbicide control tables

The Weeds

- *Common chickweed* is the most widespread seed spread annual weed of grassland, particularly in newly sown swards and undersown cereals in fertile soils. It also invades gaps in established grass on fertile soils and rapidly grows, flowers and set seeds. Seed may be spread in cut grass and encouraged to germinate with slurry applications.

  Its prostrate and rapid growth restricts tillering of grass and clover establishment. Up to 25% reduction in silage yield has been recorded after failure to control chickweed. It also reduces the dry matter of herbage and slows its wilting. This causes increased loss of soluble nutrients in the field and as effluent from silos. Chickweed may also upset the fermentation process, reducing silage quality. Large intake of chickweed by grazing animals, especially lambs or calves, can cause digestive upset.

- *Annual meadow-grass* is low-growing unproductive grass, tolerant of a wide range of conditions, and readily invades compacted and poorly aerated soils. It grows from seed and colonises gaps in established as well as newly sown swards. Most seeds germinate in early autumn when seedlings grow rapidly and limited growth can even occur in the winter. Spring growth starts early and flowering occurs rapidly, continuing through the summer. Some types then die out, but some enter a period of rapid tiller formation in the summer and persist into second and third seasons.

  Early invasion of new grass by annual meadow-grass may reduce tillering of the sown grass by over 50%, reducing production, but limited evidence suggests that the presence of up to 20% ground cover in established grass has limited impact on productivity.

- *Docks* are an important group of perennial weeds that are amongst the most important weeds of grassland. The most common by far is the *broad-leaved dock*, although *curled dock* is locally a problem, generally on lighter soils. They are listed in the Weeds Act, 1959, so occupiers of land infested with docks are encouraged to control the weed if agricultural production is substantially affected. Docks have large leaves and substantial tap roots from which they can readily regrow if defoliated. They flower prolifically, usually from the second season of growth. A large number of flattened seeds are produced from tall flowering spikes which can be transported short distances by the wind. The seed can germinate at any time in the growing season, but, if buried, can remain in a state of dormancy for years. There is evidence of broad-leaved dock seed lasting well over 25 years and curled dock seed 70 years.

  Dock seed can spread with cut hay or silage, and then readily survive passage through the gut and storage via slurries and manures, before being spread back on the land. This is considered as probably the most important method of spread.

  Docks thrive in high nitrogen conditions, and there is evidence that they can germinate in low light conditions, so can grow vigorously in dense swards where other weeds fail to establish. They can also tolerate heavy treading by stock.

Research has shown that the effect of docks on grass is directly proportional, with an approximately 1% reduction in grass dry matter yield for each 1% ground cover by docks. The yield loss tends to be higher in cut systems than grazed systems.

Grazing animals will eat young docks, but they are much less palatable than grass. Their digestibility is about 80% of that of perennial rye-grass, but including all factors, docks are only 65% as valuable as grass to the animals.

- *Thistles* are another important group of weeds in grassland. The two most important species, *creeping thistle* and *spear-thistle*, are scheduled as injurious weeds under the Weeds Act, 1959, and occupiers of infested land should prevent their spread and seeding.

  Creeping thistle is the most widespread and troublesome. It is a upright perennial that spreads by creeping underground roots which can persist for many years, and thrive in a wide range of soils. Rooting depth is usually 1-2m, but can be much more, with vertical roots seeking water tables. This means that cultivation may miss the deeper roots. Short fragments of roots can produce new plants. Colonies can expand by up to 6m a year. Aerial parts of the plants die-back in winter, then new rosettes develop in the spring, from which rise flowering stems in early summer. Plants are either male or female, so they need to be within 30m for cross pollination by insects to occur. Large numbers of seed can be produced with a plume which allows wind dispersal. However, the importance of this mechanism of spread has been queried, as the seed detaches easily from the plume. Nevertheless, spread by seed does occur and the seed readily germinates at high temperatures where there is open patches in the grass, whilst, if buried, the seed can remain dormant for up to 21 years.

  Creeping thistle competes with grass and yield losses of up to 15% have been recorded in Canada from 2 shoots/m^2. Furthermore, there is an added effect in that stock will not graze close to them, which reduces grass utilisation. They may have some nutritious value when dry in hay but are otherwise inedible because of their spines to all stock except goats.

  Spear-thistle is a very common biennial species, producing a tap root and rosette of prostrate leaves in the first season, which expand and then produce a tall flowering shoot in the second season. It produces many seed which readily germinate in mild conditions. Cutting shoots just before flowering prevents the plant from dying back naturally, and allows plants to survive to a third season. Seed dispersal by wind is the only means of dispersal.

  As with creeping thistle, the spiny leaves prevents stock from grazing, and a direct proportional yield loss of 1% ground cover equated to 1% grass loss is assumed.

- *Common* or *stinging nettle* is generally found in clumps, favouring areas of high soil fertility. It is a perennial weed with an extensive system of tough roots. It overwinters below ground, but may retain short green shoots. Vegetative spread is by creeping underground stems which root at nodes and produce new plants. The shoots extend in the spring to produce flowering stems and viable seed.

  Grazing stock avoid mature nettles because of their stinging hairs, but they may be grazed when very young, and they have some feed value when cut and dried in hay, since they are high in protein and calcium.

- *Ragwort* is the common name of one of our most conspicuous grassland weeds which is particularly important because it is potentially deadly to livestock. It is listed as an injurious weed under the Weeds Act, 1959. Under this Act the appropriate authorities can insist on control by a landowner or tenant, which is usually undertaken when infestations are causing a major nuisance to third parties. The most common form is *common ragwort,* but *marsh ragwort* is found locally in areas such as Orkney and machair, and *Oxford ragwort* is found on drier, light soils in eastern Scotland, Orkney and southern Britain. A related weed, *groundsel,* is related to ragworts and is also poisonous to stock, but is rarely found in grassland. They all produce many yellow, composite flowerheads, with ragworts producing them in a loose head or umbel.

  Ragworts spread by feathery 'parachuted' seed which can travel long distances. They germinate readily in bare soils and open patches in grassland. If buried, they probably persist in the soil for several years. They develop a flat rosette of leaves in the first year of growth, flowering in the second year. In general, common ragwort dies after setting seed, although, particularly if flowering is checked, they may persist into a further season. Oxford ragwort is more persistent, but marsh ragwort is strictly biennial. In all cases, topping by cutting, tends to stimulate perenniality and encourages vigorous regrowth.

  Ragworts are a danger to all stock, but particularly horses, cattle, free range pigs and chickens. Sheep, goats and deer are more resistant, but their condition can be affected. The poisons are alkaloids which cause cirrhosis of the liver. There is no known antidote or preventative. It is poisonous fresh, but animals find it attractive to eat when dead or dying because of the release of sugars. So contamination of hay or silage is dangerous. Ensiled ragwort is very dangerous because only a few plants can contaminate a clamp. Do not leave dead or dying plants around where animals might graze.

  Further information on ragwort and its management can be found in SAC Technical Note No. 490 'Ragwort Poisoining in Livestock and Prevention and Control', and Scottish Executive/ SAC Campaign Leaflet 'Control that Ragwort', available from SRUC.

- *Buttercups* can establish from the seed bank with new grass, and where gaps occur in the sward. Once established, *creeping buttercup*, the most common species, spreads by creeping and rooting runners. *Meadow buttercup* and *bulbous buttercup* are also perennial, but do not spread by runners.

  Creeping buttercup is relatively prostrate and is a particular problem in less vigorous, heavily grazed or poached damper and even wet grassland. It is often a severe problem in horse paddocks where grazing tends to open the sward. It is not generally grazed by stock, but some grazing may take place where there is insufficient grass, and it has some nutritive value, but also some toxicity to stock when large quantities

are eaten fresh, but it is palatable in hay. The presence of creeping buttercup probably has a direct effect on grass yield and reduces the value of hay.

Meadow buttercup is the tallest flowering of the buttercups, and prefers damp meadows of reduced grass vigour. Bulbous buttercup has a swollen stem base and prefers neutral or alkaline drier grassland, again of low grass vigour. As with the other buttercups, they are not preferentially grazed by stock and have some toxicity when fresh, but are palatable in hay. These species are usually associated with herb-rich hay meadows where fertility and grass vigour are low.

- *Rushes* are particularly associated with poorly drained soils in permanent pastures and rough grazing. The most common and widespread is *common* or *soft rush.* This is recognised by the dense tuft of brown flowers coming from the side of the stems. The stems also contain a white pith when split open. Several other species may occur such as *heath rush*, which can be grazed by stock, *jointed rush* on very poor wet soils and *hard rush,* which can be poisonous to stock, but is not common in northern Britain. The rushes are directly competitive with grass, and reduce the accessibility to grazing.

  They all produce very large numbers of seed that are widely dispersed by wind. Huge numbers of seed are present in most soils, so the risk of infestation is very high where there are gaps in the sward. Once established rushes form tight clumps with deep fibrous roots. They become resistant to trampling damage and grazing damage and can withstand dry periods as their dense root mat can hold water. Clumps of rushes can also spread vegetatively by short creeping rhizomes to form new clumps.

- *Whins (Gorse)* and *Broom* are weeds of marginal and hill grassland, preferring bent/fescue hill pastures on well drained, acid mineral soils. They are leguminous and can fix nitrogen in the soil. Both species are woody perennials with bright yellow flowers and can grow to 3 metres tall from a thick basal stem. After cutting or burning, they can regenerate from the base of the stem and roots. Natural regeneration is otherwise from seed emerging in bare patches of soil.

  They are unpalatable to livestock and are not normally grazed, except when very young, and broom is mildly poisonous. The bushes can cause a direct reduction in grass growth by competition and severe populations restrict access of stock to grass. They can also make shepherding difficult and provide shelter for vermin such as rabbits. However, scattered bushes can provide some stock shelter.

- *Bracken* is spreading steadily on hill land in Britain as well as some lowland areas. Up to about twenty years ago grants were available to help farmers reclaim infested land, but since their withdrawal the economic value of bracken removal on hill land has become marginal. However, control on better and in-bye land is still required. Bracken is highly competitive with grass, and as it spreads the grass is shaded out. As it tends to spread into better soils it can rapidly colonise the best grazing land. In the summer, the bracken restricts access to grass by stock and hosts stock pests such as ticks, and vermin. All parts of the plant contain carcinogens, including the wind blown spores, so there are concerns about its spread into important watersheds for potable resources.

  Bracken spreads by a rhizome system, with fronds emerging in the spring and dying back in the early autumn. Although wind-blown spores are produced in huge numbers, which can start new populations, local spread is generally vegetative. On a hill the bracken population may be all of a single plant. Young shoots may be grazed by stock and the fronds have long been used until recent years for bedding for stock in the winter. This, along with higher stock numbers on the hill land trampling young shoots, helped contain populations in the past.

- *Grassy weeds* are difficult to define as they may have some nutritive value, and are never toxic to stock. However, some grasses offer such poor value that their presence greatly reduces the value of the grass as grazing or conserved fodder. Examples of annual weeds include *soft* and *meadow bromes* on drier grasslands which may encroach where there is substantial late winter grazing, particularly by sheep, opening up the sward, and is ignored by the stock. On wetter land, perennial grasses such as *marsh fox-tail* and *creeping soft-grass* may out-compete quality grasses, whilst on poorer soils and more marginal and hill land, perennial species *mat grass* and *wavy-haired grass* may replace more nutritious grasses. *Common couch-grass* may come to dominate rotational rye-grass swards where it has become a problem in arable parts of the rotation. It has some nutritive value but is of lower value than sown grasses.

  All these grasses readily spread by seed, although some common couch-grass clones are less fertile than others. The perennials often spread by vegetative means such as rhizomes or stolons. As they are grasses, their control in grass swards by herbicides is not generally possible, so control by cultural methods may be the only approaches available. In rotational grassland control in other parts of the rotation may be possible.

- There are many other species which are locally very weedy in grassland. For example on the machair of the Western Isles, *silverweed* is a serious perennial species. On grassland on poorer, and particularly lighter, soils, many composites such as *dandelion, cats-ears, hawkweeds* etc, *sorrels* and *plantains* can reduce grass production. Some of these grasslands on poorer soils are now conserved as species-rich grasslands. In wet grassland, weeds such as *horsetails*/*mare's-tails*, *yellow* or *flag iris*, *hemlock* and *water dropwort* can occur, which are highly toxic, but they are usually on the margin of fields, by water. We do not cover these weeds in detail in this technical note, but where there is some evidence for control with herbicides, we include that information in the tables.

The Nutritive Value of Weeds in Grassland

Sown grasses are generally an adequate source of energy and protein, but they are a poor source of minerals and may be deficient on both major and trace elements. Clovers and other legumes are a much richer source of protein and minerals. However, a number of weed species have a high level of useful minerals. Palatability is a problem with some of the species, except sometimes at earlier growth stages. Creeping buttercup

is also toxic in high quantities when fresh, but palatable in hay. The table below compares the mineral status of some of these weeds with that of perennial rye-grass (*).

	P	K	Ca	Mg	Na	Cu	Co
Broad-leaved dock	**	**	*	***	*	*	*
Common chickweed	***	***	*	**	***	*	*
Creeping buttercup	***	***	***	*	***	***	*
Common nettle	***	***	***	***	*	***	*
Creeping thistle	***	***	***	**	**	*	O
Dandelion	*	**	***	**	**	***	*
Sorrel	**	**	O	**	**	O	N/A
Spear-thistle	**	*	***	*	*	**	*
Yarrow	**	***	***	**	**	**	N/A

*N/A: not available; O: less than rye-grass; **/***: greater than rye-grass P: phosphorus; K: potassium; Ca: calcium; Mg: magnesium; Na: sodium; Cu: copper; Co: cobalt.*

Managing Weeds in Species-Rich Grassland

Species-rich grasslands are semi-natural communities in which most species are native and unsown. These grasslands tend to have been managed with extensive grazing and no additional manure or fertiliser inputs, and this has conserved the variety of wildflowers within the grassland. Sympathetically managed species-rich grasslands usually have a balance between the wildflowers and grasses, with no one species becoming dominant. The increasing rarity of these grasslands means that they are of increasing conservation value and efforts should be made to protect the remaining areas from damage. Where management problems have resulted in aggressive weedy species, such as thistles and ragwort, becoming abundant, then their control may be required. The variety of wildflowers throughout the grassland means that boom spraying with a selective herbicide is not an option, as this method will result in the loss of most of the wildflowers. Spot treatment is a possibility, using a knapsack or a 'weed wiper', taking care to only treat target species. Alternatively, cutting the weed species at appropriate times may provide sufficient control. Other cultural methods include pulling (for example of ragwort) or using a Lazydog tool

This is discussed in detail in SRUC Technical Note TN629 'Managing species-rich grassland'.

Poisonous Weeds of Grassland

wThere are number of weedy species of grassland that are variably poisonous to stock. In some cases both fresh and dead material are poisonous, such as ragwort, in others the fresh material is poisonous, but it is palatable in hay, such as creeping buttercup. The table below lists some of the weedy species of grassland which exhibit toxic properties.

Common name of weed	Toxic properties
Horsetails/ mare's-tails	Destruction of vitamin B1 by thiaminase; usually when in large quantities in hay.
Bracken	Destruction of vitamin B1 by thiaminase plus haemorrhagic syndromes in cattle and sheep. Sheep more tolerant than cattle, pigs and horses. Rhizomes contain more toxins than leaves. Poisonous in hay and bedding.
Creeping buttercup, common buttercup (crowfoot), bulbous buttercup, marsh marigold, celandines, etc (Ranunculaceae)	Poisonous when fresh, but safe dried in hay. When fresh they are acrid so stock tend to ignore them, except when hungry. Irritant poison is ptoto-anemonin, producing various symptoms in all stock.
Broom	Small amounts of poisonous alkaloids and glycosides, but a great deal would have to be consumed.
Hemlock, cowbane, water dropwort, fool's parsley (Umbelliferae)	Paralysing alkaloids in hemlock. Cicutoxin resin causing convulsions and asphyxia in cowbane, oenanthetoxin doing the same in water dropwort. These are usually taken when roots are left around after ditching,etc. There is no cure for these poisonings. Poisonous alkaloids occur in fool's parsley when fresh- but is unlikely to be eaten. Dried in hay, fool's parsley is harmless
Sheep's sorrel, common sorrel	Probably contain oxalates, causing calcium deficiency and milk fever (staggering) if eaten in large quantities by hungry stock, particularly on lime-free soils. Sheep usually more affected than cattle.
Ragworts	Pyrrolizidine alkaloids that directly affect the liver, culminating in toxic cirrhosis and death. It is poisonous fresh, but also dred in hay and ensiled ragwort is very dangerous as only a few plants can contaminate a clamp or bag. It may be eaten where there is insufficient grass, and animals can become 'hooked' and quickly ingest fatal amounts. There is no remedy. Horses and cattle are more sensitive than sheep and goats; deer are relatively resistant. Pigs and chickens are sensitive. Sheep and goats will graze rosettes over winter, and providing it is not too abundant, will rarely come to harm, but preferably do not graze with pregnant ewes as it may affect condition of the lamb.
Yellow or flag iris	A glycoside which acts as a severe purgative and irritant. Seldom eaten but rhizomes and leaves may be taken where grass is short, or they have been left when ditching, etc.

Conservation Value of Common Grassland Weeds

Many weedy species of grassland have conservation value. Herb-rich meadows are in themselves important sources of plant species biodiversity, but some individual species which are considered weedy in higher productivity grassland are important to biodiversity of fauna. The table below lists some of the weedy species with known conservation value in terms of invertebrates and bird species. Where invertebrates are available, there will probably be bird and some small mammal feeding activity.

Common name of weed	Value to invertebrates	Value to birds/ mammals
Annual meadow-grass	3 red data list species; various butterfly larvae	Grey partridge and chicks- seed and invertebrates
Bur chervil	Butterfly and moth caterpillars	
Buttercups		Seeds eaten by small mammals, tree sparrow, turtle dove
Chickweed, common	26 species of insects including honey-bees, small bees, aphids, moth larvae	Skylark, linnet, grey partridge adult and chicks
Couch-grass, common	Speckled wood, gatekeeper and ringlet butterfly caterpillars	
Cow parsley	Some moth caterpillars	
Daisy	Larvae of some moths, aphids and flies	
Dandelion	Large red-tailed bumblebees	
Dock, broad-leaved	80 species found	Small mammals and birds use seed
Dock, curled	Several aphis, beetles and moths. Lar-vae of blood-vein moth	Small mammals and birds use seed
Fool's parsley	Bees visit flowers. Parasitoids of wheat blossom midge feed on flowers.	
Groundsel	Host to many insects	Number of birds eat seeds
Hawksbeard, smooth	Moth caterpillars	
Knapweeds	Great yellow bumblebee and male shrill carder bee	
Mouse-ear chickweed	Hosts flies and bugs	Various birds eat seed
Nettle, common	Small tortoiseshell caterpillars; peacock butterfly	Dunnock eat seed
Nettle, small	Various moths and aphids	Bullfinch, dunnock eat seed
Plantains	Plantain aphid	Various adult birds eat seed
Ragworts	Cinnabar moth caterpillar; long- and short-tailed bumblebees	
Thistle, creeping	Short-haired and large red-tailed bumblebees	Goldfinch eat seed
Thistle, spear-	Short-haired and large red-tailed bumblebees; 4 species of moth larvae	Goldfinch eat seed
Yarrow		Small mammals eat seed
Yorkshire-fog	Wall brown, speckled wood and small skipper caterpillars	

Weed Species Listed in this Note

Common Name	Scientific Name	Grassland Habitat
Grasses and rushes		
Annual meadow-grass	*Poa annua*	Widespread
Brome, soft	*Bromus mollis*	Poorly grazed grassland
Couch-grass, common	*Elytrigia repens*	Lowland grass
Fox-tail, marsh or floating	*Alopecurus geniculatus*	Wet grassland
Mat grass	*Narduus stricta*	Infertile heaths and moors
Rush, common or soft	*Juncus effusus*	Damp grassland
Rush, hard	*Juncus inflexus*	Damp, alkaline grassland
Rush, jointed	*Juncus articulatus*	Damp grassland
Soft-grass, creeping	*Holcus mollis*	Acid, open grassland
Wavy-haired grass	*Deschampiai fkexuosa*	Acid, drained heaths and moors
Yorkshire-fog	*Holcus lanatus*	Widespread in low management
Broad-leaved weeds and others		
Blinks	*Montia fontanum*	Damp, open grassland
Bracken	*Pteridium aquilinum*	Widespread on good soils
Broom	*Cytisus scoparius*	Sandy and gravely soils
Buttercup, bulbous	*Ranunculus bulbosus*	Drier, alkaline grass
Buttercup, creeping	*Ranunculus repens*	Widespread in damp areas
Buttercup, meadow	*Ranunculus acris*	Damper grassland
Chickweed, common	*Stellaria media*	Widespread where fertile soil
Cat's-ears, Hawkbits, Hawkbeards etc	*Hypocharis, Leontodon, Lapsana, Crepis,Picris etc*	Open grassland on better drained soils
Celandine, lesser	*Ranunculus ficaria*	Damp grassland
Cowbane/ water hemlock	*Cicuta virosa*	Water margins/ wet soils
Cow parsley	*Anthriscus sylvestris*	Moving in from margins
Dandelion	*Taraxacum complex*	Widespread in open grassland
Dock, broad-leaved	*Rumex acetosella*	Widespread on fertile soils
Dock, curled	*Rumex crispus*	Widespread; slightly drier
Fool's- parsley	*Aithusa cynapium*	Lowland
Gorse/ whins	*Ulex spp*	Acid, sandy soils
Hemlock	*Conium maculatum*	Open areas grassland margins
Horse-tails/ mare's-tails	*Equisetum spp*	Widespread, especially drier
Marsh marigold	*Calthus palustris*	Wet grassland
Mouse-ear, common	*Cerastium fontanum*	Widespread
Nettle, common or stinging	*Urtica dioica*	Fertile lowland soils
Nettle, small	*Urtica urens*	Open grassland
Plantains	*Plantago spp*	Widespread
Ragwort, common	*Senecio jacobaea*	Widespread where openings
Ragwort, marsh	*Senecio aquaticus*	Damper grassland
Ragwort, Oxford	*Senecio squalidus*	Open grassland
Sorrel, common	*Rumex acetosa*	Acid soils, open short grassland
Silverweed	*Potentilla anserina*	Open, short grassland
Sorrel, sheeps'	*Rumex acetosella*	Open, short grassland- not lime
Spear-thistle	*Cirsium vulgare*	Widespread where gaps
Thistle, creeping	*Cirsium arvense*	Widespread, fertile soils
Water dropwort	*Oenanthe crocata*	Wet grassland, water margins
Yarrow	*Achillea millefolium*	Widespread lowland grassland
Yellow or flag iris	*Iris pseudocoras*	Wet grassland, water margins

In organic farming systems, or where herbicide use is limited, cultural methods of weed management become very important. Good husbandry and cultural control methods can also improve the activity of herbicides. For example, a vigorous sward may reduce the vigour of many weeds, making them more susceptible to weed control measures. Below we list some common weeds and husbandry/ cultural measures which can reduce their spread and vigour.

There is a useful web site provided by Garden Organics which looks at their and other research projects on weed management in organic systems, which includes participative case studies where farmers provide their own ideas on management: http://www.gardenorganic.org.uk/organicweeds/index.php.

Common chickweed and other annuals' germination in new grass is reduced where grass emergence is rapid and vigorous, and particularly where clover is also sown. In established grass, chickweed and other annuals can be mob grazed with sheep in the autumn. Tall annuals can be readily killed by cutting, whilst chickweed and other prostrate annuals can be reduced by harrowing of the grass in the autumn.

Annual meadow-grass tends to be swamped by other more vigorous grasses in a well managed sward. Early grazing with sheep tends to favour this weed as it shortens and opens the sward.

Docks tend to favour fertile swards, and can germinate and grow in apparently competitive grassland. The key method of spread of seed is in slurries and manures, after passing through the animal gut. When the seed lands on the ground in the manure, it has its own local supply of nutrients, and germinates rapidly. Key approaches include avoiding feeding of hay or silage containing remains of dock heads to stock where the manures and slurries will go onto other fields on the farm. Composting can help reduce the viability of the seed, but high temperatures are required and the compost turned frequently in production. Some grazing of young dock leaves will occur, but this is insufficient to give control. Frequent cutting reduces vigour but the plants tend to prostrate growth and complete control is not possible. In rotational grass in conventional systems, docks can be controlled with herbicides in cereal crops. A participative research programme has been undertaken with organic farmers by HDRA (see above) which may provide useful ideas for those not wanting to use herbicides.

Creeping thistle management is assisted by frequent topping. The amount of topping that is required will depend on the extent of the rhizome system. In rotational grassland in conventional systems, thistles can be controlled or reduced with herbicides in a range of crops. *Spear-thistle* topping will stop seed set but the prostrate base of the plant will live on to flower the next season. Such plants can be successfully dug out from below the crown as it only has a tap-root. If cutting can be done precisely when the seed is just about to set, then this may result in the prevention of regrowth of the prostrate base of the plant. Spear-thistle does not germinate readily in well established swards which are not grazed heavily in early spring. Goats will graze young thistles, and over time will reduce their population.

Common or *stinging nettle* management is also assisted by frequent topping. The amount of topping that is required will depend on the extent of the rhizome system. Goats will graze young nettles, and over time will reduce their population.

Ragwort populations can be reduced by winter grazing with sheep; avoid use of pregnant ewes as there may be some effect on vigour. Goats and deer will also graze ragwort without apparent harm. Ragwort plants can be dug out by cutting well below the growing crown of the plant. Alvan Blanch developed a ragwort puller, the Eco-Puller, which pulls the plant out of the ground. These have been used by various environmental agencies, but are not widely used; speed of use, terrain and ground conditions all provide limitations to effectiveness. Manual pulling is not easily done as the crown can be left in the ground. New plants readily develop in poorer swards which are heavily grazed; maintaining a dense sward assists in reducing ragwort infestation.

Buttercups tend to invade moist meadows which are open or heavily grazed. Maintaining good grass and clover growth helps reduce the problem.

Rushes are indicators of poor drainage. Cutting will reduce their vigour but they will rapidly regrow if drainage is not improved. Liming will also tend to reduce establishment of rushes.

Bracken can be managed by regular cutting. Until recently, bracken fronds were used as winter bedding in some areas, which helped reduce its spread. Cattle will crush young fronds in the spring and sheep and deer may graze them, reducing the vigour of the bracken. The loss of stock on marginal land has had an effect on the spread of bracken.

Grassy weeds such as soft brome, meadow foxtail, couch-grass, crested dog's-tail, etc, do not become a problem in well managed grassland. They are encouraged by early grazing by sheep, opening up the sward and reducing competition from sown grasses. Grasses such as soft-grasses and marsh fox-tail are encouraged by poor drainage.

Weed Management Through Herbicidal Control

Control of weeds in grassland with herbicides must not be viewed in isolation and should always be viewed as part of an integrated approach with good husbandry/cultural techniques as described in the previous section. However cultural control may not always be easy or cost effective to implement especially in upland areas with rough terrain, areas of extensive grazing and areas with poor drainage. Poor drainage can be difficult to rectify in low lying areas to aid control of rushes necessitating use of herbicides. It may not be possible to cut rushes or bracken and sheep are moving off the hills allowing easy entry of bracken where grazing grass once predominated. A herbicide may be the only control measure to regain pasture. Over wintering of cattle on fertile pasture quickly churns up the ground and, if feeding hay or silage, this quickly allows docks to establish thus herbicides are often the only control measure to improve the grazing quality of the pasture.

The Herbicides

Herbicides for grassland can be divided into two groups, the older hormonal herbicides such as Phenoxy Acetic Acids (e.g.

MCPA, 2,4-D) and the Phenoxy Carboxylic Acids (e.g. mecoprop – p, dichlorprop-p) and the second group of Pyridine Carboxylic Acid herbicides, such as clopyralid, triclopyr and fluroxypyr.

Use of Phenoxy Herbicides

MCPA is a good and cheap option for permanent pasture to control spear thistles, creeping thistles and docks. Repeat applications are usually necessary from year to year to give suppression of the weeds. MCPA is not translocated well into root systems so will not kill the rhizomes or tap root of creeping thistle and spear thistle. MCPA may be used in conjunction with cutting to treat the re-growth.

MCPA is widely used as a straight product or in conjunction with 2,4-D, either in tank mix or formulated mix , e.g. Headland Polo/Nufarm Lupo, to control rushes, particularly in the wetter parts of Britain. Often repeat applications are required. Note under new EU legislation MCPA and MCPA mixtures may not be applied by knapsack sprayer.

MCPA can be used in newly sown or in under-sown grass, but not if there is if there in the grass mix. MCPA is kinder to newly sown grass than 2,4-D. If clover is in the mix straight 2,4-DB is approved but has a limited weed spectrum.

The main use of 2,4-D is in permanent pasture where the predominant use is for ragwort control . Ragwort, like spear thistle is a biennial, so needs to be tackled in autumn and then in the spring before flowering. 2, 4-D is more active on docks and nettles than MCPA (table 1).

Both 2,4-D and MCPA, at the rates used to control established perennial grass weeds, are not clover safe. Weed control on new grass leys with clover is not easy with the range of approved phenoxy herbicides. Currently the only clover safe phenoxy herbicide is 2, 4-DB marked as Headland Spruce usually mixed with a the sulfonylurea, tribenuron marked as Headland Triad, (refer to following section)

In summary, 2,4-D and MCPA can be used in grassland both alone in tank mix and co-formulation to “control” the main grassland weeds. Control is rapid with the typical hormonal twisting of the top growth followed by tissue death. Application is best applied during conditions of rapid growth before flowering in conjunction with cutting, or at the seedling stage for weeds in new pasture, where both are at their most effective.

Use of Pyridine Herbicides

The alternatives to the phenoxy hormones 2,4-D and MCPA are the pyridine based actives. As with the hormones, pyridines disrupt plant growth but tend to be better translocated to root systems, giving more persistent control than the phenoxy hormones 2,4-D and MCPA. Like the phenoxy herbicides the pyridines are not clover safe.

Dow Agrosciences produce a range of straight and mixture products based around clopyralid, fluroxypyr and triclopyr. The combination product containing all three actives is marketed as Pastor which has broad weed spectrum controlling docks, thistles and nettles in both established grass and grass less than one year old. The pyridine group, as with the phenoxy hormones, disrupt plant growth but are translocated to root systems thus giving more persistent control than for example 2,4-D and MCPA. This results in improved longer lasting control of deep rooted grassland weeds such as docks and thistles. However this comes with an increased cost over the phenoxy hormones. Other combinations of pyridine herbicides and their control spectrums (also see Table 1) include:-

DoxstarPro, contains the actives triclopyr and fluroxypyr, is predominately used for docks in established grass but may also be used on young established grass less than one year old to control seedling docks and chickweed. A split dose is possible with DoxstarPro as long as the total dose of 2.0L/ha is not exceeded. Note it is not recommended to use DoxstarPro in tank-mix with phenoxy herbicides as they can disrupt translocation to the root system.

Thistlex, containing clopyralid and triclopyr, is aimed at controlling creeping thistle in established grassland. If used in conjunction with cutting, or the grass has been cut for silage, then there must be sufficient re-growth before application.

Pastor is currently the market leader for long term dock control in young grass, for silage and aftermath grazing, and also has label recommendations for creeping, and spear thistle control, perennial sow-thistle and common nettle . . The key to get the best from the pyridine herbicides such as Pastor is to apply early in the season when the weeds are at the rosette stage and actively growing in spring, well before flowering. If applying after cutting or grazing wait until there is sufficient re-growth before application. A split dose is possible, spring and autumn when targeting docks as long as the total dose per crop of 4.0lL/ha is not exceeded.

Forefront T is a co-formulation of aminopyralid plus triclopyrr for control of docks, nettles, thistles and creeping buttercup, dandelion, ragwort and chickweed in established grassland. Forefront T can only be sold by distributors or recommended by agronomists who are BASIS qualified and have been trained by Dow AgroSciences. Farmers wishing to use Forefront T must also be “trained” in its use and sign a declaration of understanding. Forefront T may only be applied to grass grazed by cattle or sheep. It may not be applied between 1st September and 28th February. Any silage or hay produced from treated fields must stay on the farm. Any manure produced by cattle or sheep fed treated grass must stay on the farm and only be applied to grassland. It is not recommended to follow treated grass in the next calendar year with potatoes, vegetables, fodder or sugar beet or a legume. Potatoes, sugar beet, vegetables, beansand other legumescan be planted in the second calendar following Forefront T application.

Use of Sulfonylureas

In addition to the MCPA, 2,4-D phenoxy hormones and pyridines, the sulfonylureas make up another group of herbicides for grassland weed control (Table 1).

The sulfonylureas group are mainly used to target docks and can be divided into clover safe and non clover safe products Amidosulfuron as Squire Ultra, marketed by Interfarm is targeted only on control of mature docks in established grassland. It has the advantage of being clover safe Cimarron as metsulfuron-methy is again targeted at docks in established grassland and is not clover safe. Pinnacle as thifensulfuron—methyl again is target on dock in established grassland but unlike Cimarron is relatively clover safe although it may be checked. Headland Triad as tribenuron can be used on new leys and does benefit

from the addition of Headland Spruce , 2-4,DB which broadens the weed spectrum of Triad. The combination is clover sage once the clover gets beyond the 1 true leaf.

Like all sulfonylurea herbicides the docks must be actively growing for best effect. For rotational grass the application window for Squire Ultra is between 1st of February and the end of June. The treated grass sward, if for hay or silage, must not be cut within 21 days of application. Pinnacle can check the grass and is not recommended on short term leys cut for silage The weed spectrum of the sulfonylureas can be enhanced by the addition of a low rate of MCPA, or other phenoxy herbicides , (although this will effect their clover safe property, (other than Headland Spruce which is clover safe). Indeed Cimarron is recommended with a hormone to improve grass safety. Note unlike other herbicide groups the visible affect on the docks is slower acting and will initially appear as a yellowing of the growing point.

Use of Carbamates

The most important herbicide in this group is asulam, marketed as Asulox, principally used for bracken control in upland in-bye and marginal land. Asulam is systemic and translocated to the rhizomes of bracken where it causes the death of frond buds. Asulox has lost its full approval for bracken control and only continues to be available for use under a short term 120 day window each year through an emergency authorisation granted by CRD. This period of use effectively starts from the 18th May to the 14th of September after which it is illegal to have Asulox in store. This authorisation allows for the use of Asulox until such time that a full label for use can be granted by CRD. For more information on the use of Asulox for bracken control refer the Heather Trust . www.heathertrust.co.uk.

Herbicide use for some difficult grassland weeds

Ragwort. Control of ragwort by cultural and husbandry methods can only be partially effective. The phenoxy hormones 2,4-D and MCPA as Headland Polo/Nufarm Lupo, (Table1) offers the best control of ragwort but this needs to be a targeted programme applied at the rosette stage and again before flowering in the second year. Forefront T has ragwort on the label but has restriction for use and would be more expensive than traditional phenoxy herbicides,. Ragwort is very dangerous to stock if grazed, ensiled or incorporated into hay during die back following herbicide application. As mentioned earlier in this technical note, ragwort becomes attractive to stock as it senesces.

As an alternative to the phenoxy hormones for ragwort control it is possible to spot treat small populations using citronella oil as Barrier H. Citronella oil is a non-toxic natural oil and is best applied at the rosette stage, although can be used up to flowering . Ragwort foliage is totally killed after application. It is spot treated as grass is also damaged.

Docks. In newly drilled pasture, docks readily establish from seed within the seed bank, contaminated hay, silage or straw or can re-establish from sections of root stock following cultivation. The choice of herbicide control for seedling docks in newly drilled pasture depends on whether clover is part of the seed mix and timing of herbicide. The options are greater on grass with no clover and on grass more than one year old. On a grass+ clover mix in its first year, to control seedling docks, the best option is a 2,,4-DB + Headland Triad tank-mix. . For a more specific dock herbicide with clover safety then Squire Ultra is also an option on young grass. Where no clover is present in the mix then the options are wider and include MCPA+Mecoprop-p+Dicamba combinations (Tables 1 & 3) or Starane/Pastor.

On grass more than one year old there is a wide selection of herbicide options depending on the use to which the grass is put and whether clover safety is required and the presence of other perennial weeds such as creeping thistle. Many of these solutions are described in Tables 1 & 3 and Figures 1 and 2. In essence where clover safety is required use Squire Ultra, where clover safety is not required then there is a choice of phenoxy hormone combinations such 2,4-D + MCPA/Mecoprop-p/ Dicamba or the pyridines such as Pastor and Doxstar. For optimal control of established docks in young grass, or in permanent pasture, apply the herbicide early at the rosette stage in the spring or autumn post grazing or cutting. The pyridine herbicides although more costly will generally give longer and more persistent control than the phenoxy hormones.

Thistles. As with docks the choice of herbicide depends on whether it is seedlings thistles in new re-seeds or established thistles that are being targeted. The choice is between the phenoxy hormones and the pyridines herbicides and also depends on whether clover safety is required. On new re-seeds where clover safety is required, then 2,4-DB will control seedlings of both spear and creeping thistles. Where clover safety is not required on young grass, then Pastor, although more expensive, will control seedling thistles. The choice of herbicide for thistle control in rotational and permanent pasture is between the old inexpensive hormones 2,4-D , MCPA and dicamba alone or in mixes, or the more expensive pryridine combinations that will give longer and more persistent control; i.e. those based on clopyralid+fluroxypyr/triclopyr (Pastor/Thistlex/Forfront T). The choices are shown in Tables 1 and 3.

Rushes. MCPA and 2,4-D, either as straights or better in co-formulation, provide the best control of rushes and should be applied when they are actively growing from May to early June. The alternative is to treat the re-growth after cutting. It may also be possible to use a weed wiper with glyphosate if the sward contains valuable clover. For example, the Rotawipe is a trailed or tractor mounted weed wiper that may be used for rushes, ragwort and docks or the new Contact 2000 weed wiper from Logic. Ideally herbicide control of rushes should also be part of a concerted effort to improve drainage.

Gorse (Whins) and Broom. While cutting and burning are the usual methods of control unless the roots are removed and the soil fertility improved gorse will re-grow. Treating the stumps directly, or re-growth through a hand lance/knapsack with Grazon Pro, (fluroxypyr + triclopyr), or alternatively glyphosate is usually effective. Note Grazon Pro may only be used between the 1st of March and the 31st of October.

Weed control in undersown cereals (new)

Under-sowing cereals, usually spring barley is a common method of establishing a grass clover ley in the spring with the advantage that after the spring barley is cut there is a well established grass pasture with autumn grazing potential. The

spring barely acts as a cover for establishing grass and also minimises potential erosion on light soils. The disadvantages are that grass competes for the same nutrients as the cereal and the moisture held in the grass can delay harvest. Undersown spring barley can yield 20% less than a conventional drilled crop. From a weed control perspective there are few herbicides available for under sown cereals that are clover safe. The combination of Headland Triad in tank- mix with Headland Spruce, 2,4-DB offer the best solution where clover is in the under sown grass mixture. but is limited in its weed spectrum.. Where clover is not an issue in the under sown-grass the Spitfire, fluroxypyr + florasulam, from Dow AgroSciences is an option,. See table 3. Unusual for this market is Spitfire is broad spectrum. Where clover is required in the new grass ley then the best technique is to stitch it in after the grass has established.

Weed control in new grass (new)

The weed control options in newly drilled grass in the first year that are clover safe are few. Headland Triad, tribenuron, has a useful recommendation for use on new grass and is clover safe. Note Triad is formulated as a 10gm tablet. As with under-sown cereals Headland Spruce has a label recommendation for use in a grass clover mix and is useful in tank-mix with Headland Triad Where clover is not part of the grass mix then hormone mixes with low rate mecoprop-p + dicamba+ MCPA, (Mircam Plus/Relay P) may be used from the 3 leaf stage. Other options include Pastor, low rate MCPA + 2,4-D or low rate Starane is possible. Check with your local SRUC Office and read the label before use as label approvals are changing all the time.

Table1. Weed Spectrum of Common Grassland Herbicides

		Established Docks	Seedling Docks	Creeping Thistle	Spear Thistle	Common Nettle	Ragwort	Butter-cup
MCPA	Various	**	***	**(*)	***	**	**(*)	**
2,4-D	Various	*(*)	***	**(*)	**	**(*)	***	***
2,4-D + MCPA	Headland Polo/Lupo	*(*)	***	**(*)	**	*(*)	***	***(*)
Clopyralid	Dow Shield	-	-	****	****	-	-	-
Clopyralid+ Fluroxypyr + Triclopyr	Pastor	****	****	***(*)	***(*)	****	-	-
Clopyralid + Triclopyr	Thistlex	-	-	****	****	-	-	-
Fluroxpyr + Triclopyr	Doxstar PRO	****	****	-	-	-	-	-
Amidosulfuron	Squire Ultra	***(*)	****	-	-	-	-	-
Thifensulfuron	Pinnacle	***(*)	****	-	-	-	-	-
Aminopyralid+ Triclopyr	*Forefront T*	****	****	****	****	****	****	****
Metsulfuron -Methy	Cimarron	****	****	-	-	-	-	-

Key
* = some activity on aerial top growth of small seedling plants under good condition
** = suppression of aerial top growth of seedling plants under good conditions
*** = control of seedlings and suppression of perennial growth under good conditions
**** = long term control of seedlings and perennial growth

Flow Charts indication options for Dock control with herbicides in conservation and grazing regimes

Figure 1 Dock control in grass for silage if hay

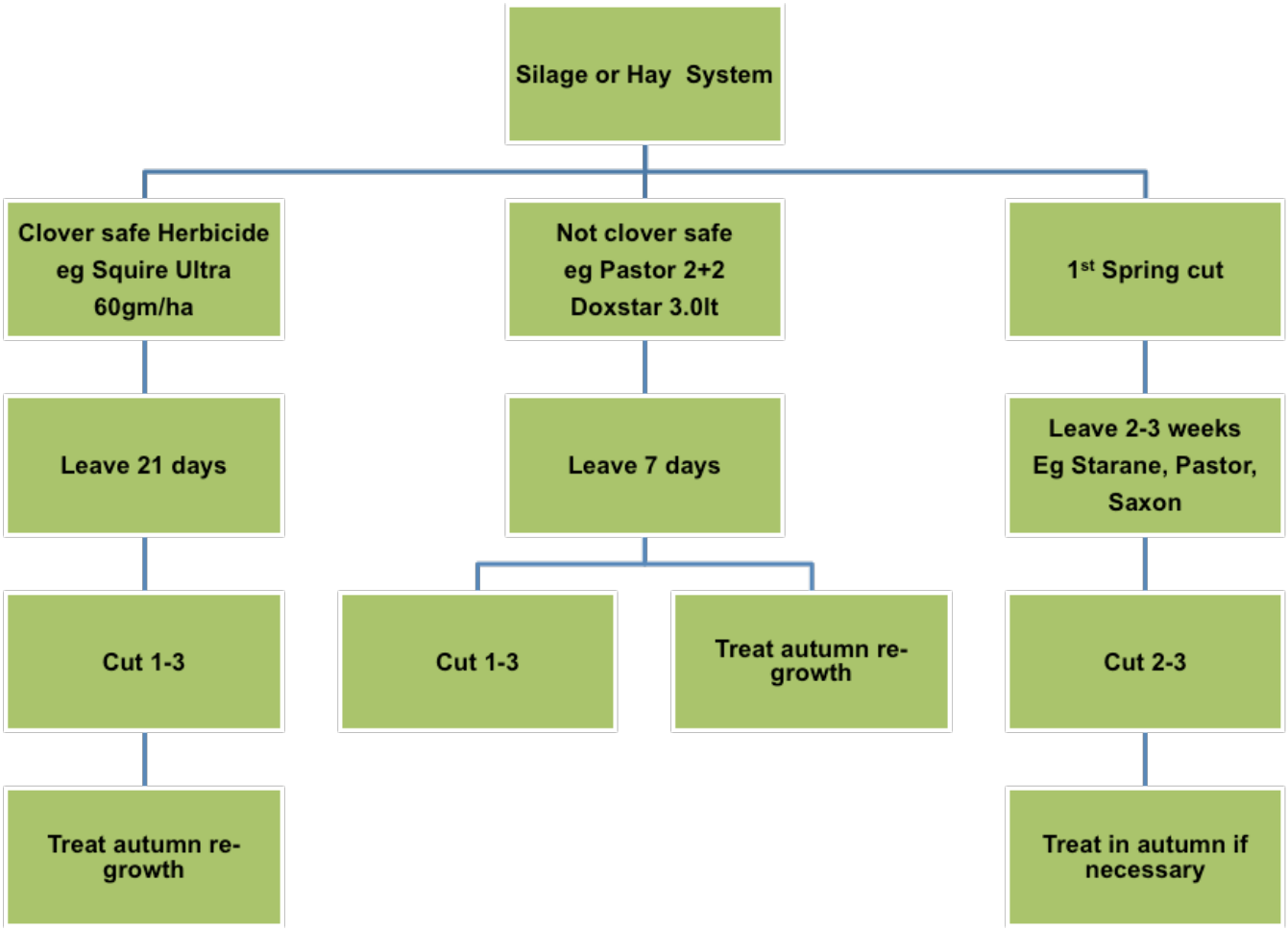

Figure 2 Dock control in grazing

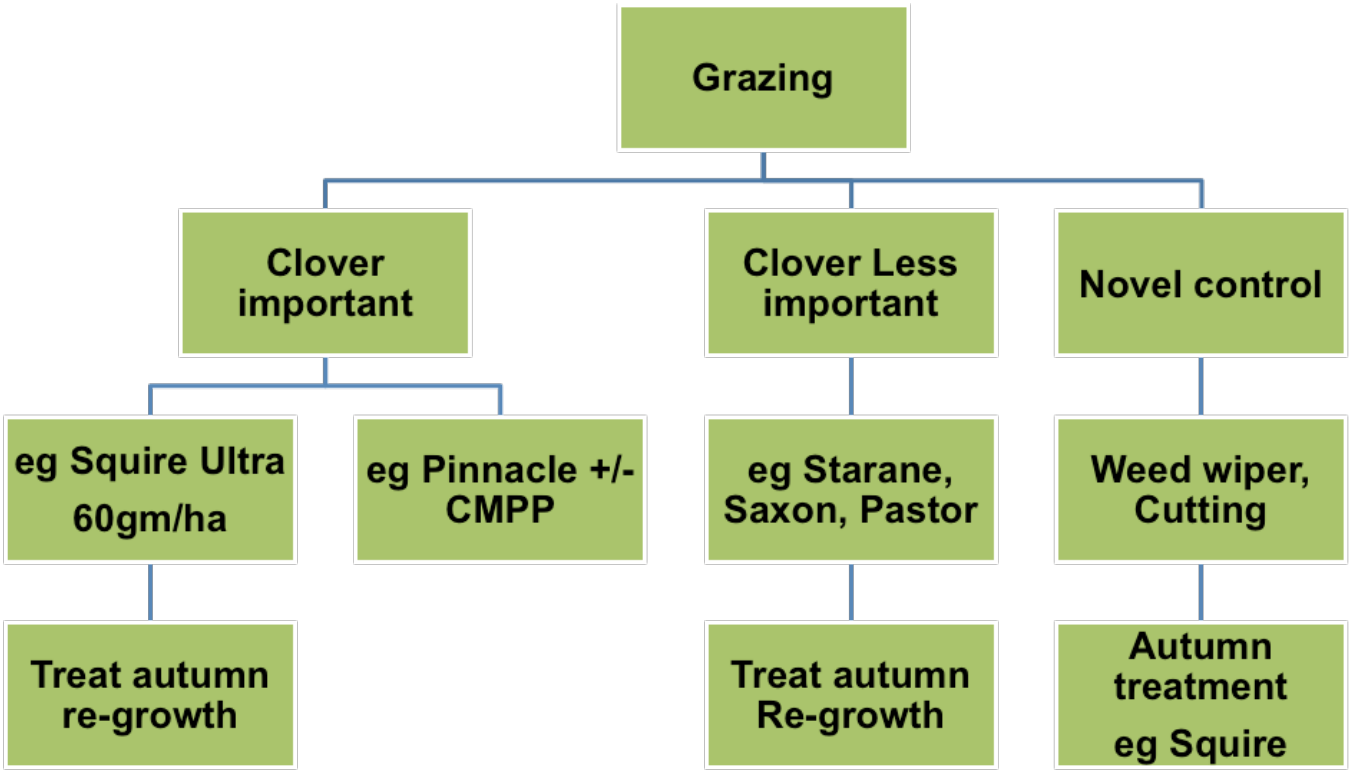

Table 2 Herbicide control of some less common weed in pasture. Note there is not a herbicide solution for all weeds that may occur in pasture.

	MCPA	2,4-D	Me-coprop-p MCPA+ Dicamba	MCPA+ Dicam-ba+ Me-coprop-p	Glypho-sate (weed wiper)	Metsul-furon-methyl	Etho-fumesate #	Triclopyr	Triclopyr + Clopy-ralid
Silver- weed	**	**	**	***					
Dandelion	**	**(*)	***	**					****
Cats Ear	**(*)	**(*)		***					
Hawkweed		***		**					***
Sorrels		**(*)	**(*)			***			
Plantains	****			***				****	****
Horesetail		**			**				
Yellow or Flag Iris		**	**		****				
Hemlock		**		***	****	**(*)		***	***
Water Dropwort					****	***			
Daisy		**(*)	***	***					
Yarrow		**		**					
Common Knapweed	**(*)								
Creeping soft grass									
Marsh fox-tail	-	-	-	-	-	-	-	-	
Brome							**		
Couch-grass	-	-	-	-	-	-	-	-	
AMG							****		

Amenity Grass or grass seed crops only

Note that in unimproved grassland, some species such as Cats Ear, Hawkweed, Sorrels and Iris can be a valuable part of the habitat and food source for rare and endangered species. **Bodies such as SRUC, SNH, RSPB and SGRPID should be consulted before herbicides are applied to such areas.**

Key

* = some activity on aerial top growth of small seedling plants under good condition
** = suppression of aerial top growth of seedling plants under good conditions
*** = control of seedlings and suppression of perennial growth under good conditions
**** = long term control of seedlings and perennial growth

Table 3 Product Information for Common Grassland Herbicides

Active Ingredient	Product	Application Rates	Supplier	Application comments
MCPA 500g/lt	Various	1.4- 3.3lt/ha	Various	Weeds controlled depend on application rate. Refer to label
2,4-D 500g/lt	Various	2.8 – 3.3lt/ha	Various	For Ragwort use higher rate. Keep stock out until Ragwort has completely died back
2,4-D + MCPA	Polo/Lupo	2.5 – 3.5lt/ha	Headland Agriculture	Use lower rate for newly drilled grass, higher rate for established grass
Clopyralid 200g/lt	Dow Shield	1.0lt/ha	Dow AgroSciences	Beware use of manure from animals fed on grass treated with Clopyralid
Clopyralid 75g/lt+ Fluroxypyr 108g/lt + Triclopyr 139g/lt	Pastor	3.0 - 4.0lt/ha	Dow AgroSciences	Use the lower rate for nettles, otherwise 4.0lt. A split rate of 2.0 + 2.0lt/ha spring and autumn is possible
Clopyralid + Triclopyr	Thistlex Pro	1.0lt/ha	Dow AgroSciencies	Do not apply within 7 days of cutting or grazing.
Amidosulfuron	Squire Ultra	60gm/ha	Interfarm	Apply between 1st Feb and 30th June on rotational grass and 1st Feb to 15th Oct on permanent grass.
Metsulfuron -Methyl	Cimarron	3gm/ha (one tablet to 2.5Ha)	Headland	Note a transient check to grass may occur after application especially Ryegrass
Thifensulfuron	Pinnacle	Sold in 45g pack to cover 2 ha	Headland	Do not apply to young grass or intensive short term leys. Clover can be checked but not killed. The sward may also be initially checked.
Tribenuron	Triad	10gm/ha or 1 tablet /ha	Headland	Clover tolerant
Asulam Used only for bracken control under 120 day emergencey authisation	Asulox	Helicopter:- non forest areas 11.0lt/ha + Agral Adjuvant @ 100ml/100lt water. Forest Areas: 5.0-10lt	United Phosphorus	Adjuvant only required in non forest areas.
Glyphosate 360	Various	Grassland destruction 3.0-6.0lt/ha Weed wiper 1:1 dilution	Various	Use higher rates if controlling perennial weeds
Citronella Oil	Barrier H	Ready to use 5lt pack to treat 1600 seedlings	Barrier Animal Healthcare	Use any time of year, but best on rosettes 15-20cm Keep animals out of treated area for two weeks post application

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