

Other options for Weed Control

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This Technical Information Note provides information about options for weed control in situations where chemicals are not to be used. It includes some detailed information which will be useful for those directly responsible for weed control, and interest to those developing performance specifications.

1. Introduction

The Landscape Institute is not currently taking a formal view on the desirability or otherwise of using chemicals to control weeds. The purpose of this Technical Note is to equip landscape professionals with information to help them appreciate and communicate some of the implications of not using chemical methods of weed control where weed control is required by clients without the use of chemicals.

In approaching this subject, landscape practice in this area can be assisted by an understanding of:

- soils, which not only influence what species grow well through their properties but are also a source of potential weeds
- the reproductive cycle of plants and their reliance on vegetative spread, the relative speed of weed and desired plant growth during the year, the detailed effect the weeds may have on aesthetics, desired plant growth, or hazards (e.g. toxicity) and the ecology of weed species.
- Equipment for weeding, from the handheld, to street vehicle or agricultural
- Local and historic experience of weed growth and control without chemicals

Most of this is beyond the scope of this Technical Note which, although it assumes some basic understanding of plants, is at an introductory level to provide a background for further study, communicating with clients or specifying maintenance.

This Technical Note is also focused on general weed control situations. It does not cover particular noxious weeds such as Japanese Knotweed (which is well-covered by RICS' *Japanese Knotweed and Residential Property* and requires specialist input).

It reveals that without access to the quick fix of chemical control, weed control overall will need to be more carefully planned and resourced. Discouraging weed growth in the first place will be critical.

Having reviewed this Technical Information Note the LI's Technical Committee has suggested that readers may also need to refer to the [Landscape Institute's Technical Guidance note on Biosecurity](#). (This will be particularly relevant where weeds are associated with plant pests and diseases)

Given there is no recent British Standard dealing with weed control and none specifically relating to chemical-free weed control and few citations of other useful documents consolidating content for landscape professionals this Technical Note hopefully fills a gap.

2. To what extent is weed control necessary?

This is an important question for those responsible for sites. It is typically a matter of contextual judgement about cost-benefit but, in some situations, legislation or landowner policy.

Even in urban and domestic situations some areas of unit paving can accommodate certain low growing plants in the cracks, much amenity turf can accept at least buttercups, daisies or clover, and a wide range of plants can be accommodated in urban verges, ponds and hedgerows and woodland. There is an ecological and a carbon price paid for prioritising ornamental and aesthetic objectives and in ways we have yet to fully understand, particularly as regards soil fauna.

There will however be situations such as established fine turf, bedding schemes, rose beds, around newly planted trees¹, and in commercially managed woodland where weeds (including grass) will reduce target plant growth by competing for water or shading them. Also, for most urban paved areas, plants growing out of place are for many clients undesirable and, in the case of trafficked areas, sometimes cause a slip (or braking) hazard, possibly damage surfaces, obstruct visibility or obscure hazards. Weeds can also interfere with drainage infrastructure thereby contributing to localised flooding. Even if living weeds are tolerated, dead weeds are also likely to be of limited attractiveness in the public environment and thus a source of grief to elected Members' inboxes.

There may also be non-native ultra-competitive ([invasive](#)) plants or [injurious weeds](#) or plants affecting the integrity of structures which may need to be removed, such as Japanese knotweed ².

The amount of weed control necessary is heavily influenced by a site's history. For newly created schemes, weeds can also be discouraged from the outset, particularly if the designer designs-out or redesigns-out potential weed problems or if a manager can retrofit solutions or 'repurpose' areas. To design without thinking about such things is to both leave the design solution and the landscape professions open to future criticism. Prevention is also easier than cure.

In a very few situations, such as blooms of blue-green algae in lakes, controlling the behaviour of people rather than the weeds may be required³.

¹ "Weeding out the problems" Moffatt & Hockin, Landscape Design Feb 1993

² Model specification for the control of Japanese Knotweed in construction and landscape contracts. Welsh Development Agency, 1994

³ <http://www.wales.nhs.uk/sitesplus/888/page/53916> reviewed 24/10/2019

3. Historical and international context

Before chemicals became widely available, landscape sites were developed and managed using labour-intensive physical methods. A variety of hand tools were invented to assist this. Indeed, there was at one time a wider range of designs for hoes than any other gardening tool⁴. The gadgets of the day, thought leaders would commend their favourites. William Cobbett, for example recommended a hoe with prongs, tines or spanes 'A mere flat-hoeing does nothing but keep down the weeds. The hoeing when the plants are becoming stout, should be deep; and in general with a hoe that has spanes, instead of a mere flat plate.'⁵

Through the 20th century the chemical industry developed a range of specialist pesticides in the form of herbicides (plant-killers). These provided substantial savings in labour and cost; the Agriculture Horticulture Development Board, for example, considers that hand weeding of ornamentals is thirty times more expensive than using weed killer⁶ and one council quotes a factor of eight times⁷. But there were misgivings and some authorities have a long history of avoiding the use of these substances. The first local authority to ban the use of pesticides in Holland was Arnhem c.1984⁸. Denmark introduced a national pesticide reduction plan in 1986 to protect groundwater supplies of drinking water that is consumed directly without purification; and Sweden has the overall objective of becoming a non-toxic environment⁹.

A recent spur to reducing chemical use came when The EU passed the *Directive on Sustainable Use of Pesticides*¹⁰ in 2009; and the *UK National Action Plan for the Sustainable Use of Pesticides (Plant Protection Products)* was published in 2013¹¹. The initial industry response in the UK was that this was unlikely to affect pesticide use in public parks and open space¹².

Public policy has progressed and since 2016 pesticides have been banned nationally in Holland¹³ in public parks and open space except for control of Japanese knotweed and Oak Processionary Moth. In France, pesticides were also banned in public parks and open space in 2017 and in private gardens from 2019¹⁴. The Association of Public Service Excellence has also published some guidance for its c.250 member bodies on the topic¹⁵

⁴ The development and uses of garden tools, KN Saneki, in *Historic Garden Tools*, Museum of Garden History, 1990

⁵ *The English Gardener*, W Cobbett, 1829

⁶ https://horticulture.ahdb.org.uk/download/3867/file&usg=AOvVaw0gLJ8o_lteZMGbuv8kO7YL

⁷ Mills, A. North Herts District Council (priv comm)

⁸ Holden, R (priv comm)

⁹ <https://www.pan-europe.info/old/Resources/Reports/PANE%20-%202013%20-%20Reducing%20pesticide%20use%20across%20the%20EU.pdf>

¹⁰ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02009L0128-20091125&from=EN>

¹¹ http://c-ipm.org/fileadmin/c-ipm.org/British_NAP_in_EN_.pdf

¹² E.g. see <https://www.hortweek.com/eu-restriction-unlikely-affect-glyphosate-uk/plant-health/article/1404492>

¹³ <https://www.onkruidvergaat.nl/> (In Dutch)

¹⁴ <https://www.mnn.com/your-home/organic-farming-gardening/blogs/french-parks-and-public-gardens-bid-adieu-pesticides>

¹⁵ <https://www.apse.org.uk/apse/index.cfm/members-area/briefings/2019/19-32-glyphosate-where-do-local-authorities-stand/>

In the UK, a growing number of local authorities are determined to end use of chemicals in parks management. Examples are Croydon¹⁶, Hammersmith and Fulham, Southwark, Fareham¹⁷, Islington¹⁸ Exeter¹⁹ Cambridge²⁰, Vale of Glamorgan, Glastonbury, Lewes, Denbighshire²¹ and Bristol²². Some towns now support a Pesticides Action Network²³. Some link the reduced use of pesticide to positive planning for wildlife. For instance Cornwall has developed a Pollinator Action Plan²⁴ as has [Dorset](#), [Devon](#) and [Wales](#). One of the prompts for the development of this Technical Note even was a request from Hertfordshire County Council.

The Green Flag Awards, popular with many local authorities also promote non-pesticide management, e.g. *“In the interests of protecting the health of users and staff on the site, pesticides and chemical fertilisers should not be used. Minimal use may be acceptable as part of an Integrated Pest Management strategy and a full explanation is given.”*²⁵

Additionally, there is a growing public demand that chemicals should be avoided where possible with public petitions to local authorities. Just the sight of operatives in protective clothing²⁶ can be the trigger for complaints. Even the relatively harmless Acetic Acid is problematic and trials in Brighton were hampered because of complaints that the town was smelling like a fish and chip shop²⁷

Whatever the merits of the arguments for or against pesticides, there are situations where appropriate weed control or prevention can be achieved without the use of complex chemicals.²⁸ It requires, however, a strategic and comprehensive approach to design out problems, a return to intelligent but labour-intensive methods and the continued success of emerging technologies. The only alternative will be to find a way to co-exist better with weeds.

¹⁶ <https://www.hortweek.com/authorities-likely-follow-croydon-councils-decision-drop-glyphosate-2019/parks-and-gardens/article/1521853>

¹⁷ <https://twitter.com/WeedingTech/status/1059440394839166977?s=20>

¹⁸ <https://twitter.com/ClaudiaWebbe/status/1101417656291393536?s=20>

¹⁹ <https://twitter.com/ruthwilliams/status/1184243316319227905?s=20>

²⁰ <https://www.cambridge.gov.uk/restricted-use-of-herbicides>

²¹ <https://www.weedingtech.com/blog/how-uk-councils-benefit-from-using-foamstream-in-their-boroughs/>

²² Ayling, Dr S (priv comm)

²³ <http://www.pan-uk.org/pesticide-free/>

²⁴ <https://www.cornwall.gov.uk/environment-and-planning/grow-nature/about/pollinator-action-plan/>

²⁵ <https://www.mnn.com/your-home/organic-farming-gardening/blogs/french-parks-and-public-gardens-bid-adieu-pesticides>

²⁶ Niblett, A Hertsmeire Borough Council (priv comm) Even if only spraying water, from an experiment that was tried by the authority in response to claims from a member of the public about health impacts.

²⁷ Donaldson, V, Lee Valley Regional Park Authority (priv comm)

²⁸ Commercial strength Acetic acid (10%) has been used to control weeds on hard surfaces, e.g. in conjunction with steel brushing. It acts as a contact herbicide only and is not very effective on perennials. Used on a large scale the smell is sometimes unacceptable, (e.g. as discovered in [Bristol](#) in 2016)

4. The problem of weeds

As an aid to understanding the weed problem it can be helpful to group plants by the type of challenge they pose to eradication²⁹. The following is not a formal nor comprehensive classification system but provides a window on terrestrial plant strategies for survival.

Plants that regenerate from their roots

Anything that breaks up the roots creates many more shoots/plants. These plants subdivide into those with tap roots (like dandelion, dock etc.) and those that root sideways at depth (like bindweed, couch grass) and/or shallow (couch grass, ground elder, woodruff etc.). The solution is to get rid of the roots, e.g. by starving them of food or removal by hand but they are typically very difficult to get rid of. Mostly these are perennials.

Plants that sucker (they may be a part of the above group):

Removing the plant but not all the roots can lead to a flush of suckers, or established plants can just throw up suckers particularly when roots come against obstructions or when roots are damaged. Examples are Sumach, Aralia, Tree of Heaven, some grafted plants (e.g. roses) and lilac. Suckers are best removed when small and by tearing from the root from which they originate (they rarely regrow when torn out – this is also the best way to remove suckers appearing from below grafts but from above ground parts of plants (rubbing off the buds is even better) cutting off suckers solves nothing. Again, mostly perennials.

Plants with lateral shoots that root into the ground (but don't regenerate from their roots)

E.g. Ivy, strawberries, creeping jenny. They are not difficult to keep in check, just regular input of time and effort. Mostly perennials.

Plants that regenerate from seed prolifically (but don't regenerate from their roots)

Can be annual, herbaceous or woody perennials. Also not difficult to remove but need to be removed as early as possible and in the case of non woody plants before they flower and woody plants before they get too big to simply pull out. When woody plants get big if the root crown and above ground parts are removed control will be achieved. Examples range from poppy to cotoneaster, holly, rowan, ash, rhododendron and buddleia. The species are often spread by birds, squirrels, wind, water and the scope to control this spread is very limited.

²⁹ Moore, Colin CMLI (priv comm) whose text suggestions form the basis for this section.

5 Weed prevention by design and on construction

(N.B. This section does not include prevention by use of chemicals)

On the basis that prevention is better than cure the following are typical current practice:

Design

The use of dense groundcover planting can restrict weed growth. A balance needs to be struck, however, in the choice of species since vigorously spreading groundcover also has the potential to compromise adjacent areas. Groundcover plants will need to be specified at correct densities to achieve groundcover rapidly³⁰. This may be helpful if resources for weed control are limited beyond the typical establishment period.

Other design solutions that are intrinsically less likely to involve weeding can be considered. Colour and seasonal interest can perhaps be introduced via trees or urban meadows rather than ornamental shrub beds or bedding schemes.

The design of areas can contribute to the likelihood of weed problems. Future weed control needs can be reduced where beds are not located near trees or shrubs that seed, plants that spread via runners or near wildflower grassland.

Some suggest the use of harder informal paths within large beds (e.g. compacting the soil), or planting within a matrix where soil cells are separated by suitable material that will not grow weeds and will be hidden as target plants fill out.

If joints and the joints between vertical and horizontal surfaces (such as walls and paths, posts within surfaces, or kerbs and roads) are suitably designed or repaired this can reduce the risk of material accumulating which could grow weeds.

Soft landscape construction

Traditional recommendations were that soil that is imported for constructing soft landscapes arrives weed-free. This is becoming more difficult on many construction sites and may also not always be a sustainable approach in terms of carbon. Techniques involving preparing the soil over a year to reduce weed content may instead be considered useful.

Management of adjacent areas

If adjacent areas are a source of wind-blown seeds or runners they could be maintained before they can cause a problem for the main intervention area. A simple example would be mowing adjacent land containing weeds that spread by wind more frequently during soft landscape construction and establishment. This may require entering into agreements with adjacent land managers.

Mulching:

This is a very popular and for many the most important technique, especially if the ground is already weed free and can be hoed through if necessary. 75mm is a typically specified depth within a range of 50-100mm³¹. Types of mulch include:

³⁰ <https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/2019/04/tgn-2019-01-biosecurity-toolkit.pdf>

³¹ Spon's External Works and Landscape Price Book 2007 and 2013

- Wood chip/pulverised bark. Suitable if composted. If coarse can be more difficult to subsequently hoe if necessary although if very fine can strip nitrogen from the soil faster and create a seed bed for weeds. Could consider topping off a finer grade with a coarse surface grade³².
- PAS100 compost. If 75mm deep this can last 2-3 years before needing topping up.³³ Also feeds the soil beneath and improve texture.
- Mushroom waste. Has a blotchy appearance when weathered but generally free of weed seeds and rated by some as good in ornamental areas³⁴ but can blow away when dry³⁵
- Straw. May not be attractive enough for ornamental areas. Can blow around when first laid.³⁶Composted straw is more attractive.
- Leaf-mould. May contain weed seeds.
- Cocoa mulch.
- Corn gluten meal – apart from preventing many weeds germinating this is also a nitrogenous fertiliser³⁷
- Sheet mulch or mulch mats (preferably of biodegradable material). Need to be thick enough to exclude light.
- Granular rock, pebbles or sand. Can be effective if kept topped up to a minimum depth of 7.5cm, (whilst avoiding covering bulbs, other desirable plants or litter) to ensure suppression of established annual weeds. Can also reduce slug predation.
- Cardboard overlain with grass-cuttings is being trialled³⁸ noting that grass clippings can be a source of weed seeds.

It is typically viewed as important to keep woody stems clear of mulch to prevent rotting or damage from chemicals generated by composting³⁹. Note that organic mulching can acidify the soil or strip out Nitrogen. Where used as a mulch mat around trees typically at least 1m in diameter and maintained for four years⁴⁰. In ornamental situations mulch may need containing by edging as blackbirds especially will flick it about onto adjacent surfaces.

Mulching and hand-weeding are traditionally regarded as more cost-effective than digging and hoeing.⁴¹

³² Weeding without chemicals, B Flowerdew, p63

³³ Coslett, N (priv comm)

³⁴ Weeding without chemicals, B Flowerdew, p63

³⁵ Coslett, N (priv comm)

³⁶ Weeding without chemicals, B Flowerdew, p64

³⁷ Weeding without chemicals, B Flowerdew, p78

³⁸ Ayling, Dr S (priv comm)

³⁹ Weed control around newly planted trees and shrubs, Derek Patch, Plant User April 1989

⁴⁰ Weed control around newly planted trees and shrubs, Derek Patch, Plant User April 1989

⁴¹ The weed problem, FC King, Faber and Faber 1951, p123

Edging boards or strips:

Boarding can be used to grass areas to prevent unwanted spread of grass growth onto planting or loose hard surfaces (e.g. gravel). This is particularly useful where invasive rooted grasses are present (e.g. couch grass)

Root barriers:

Proprietary root barriers are widely available. Horizontal installation below all path base fill, loosely bound surfaces and flags will reduce deep-rooted perennial weeds

Weed-suppressing membranes:

Proprietary membranes are widely available however there are serious concerns about the introduction of plastic into the environment and there are alternative materials which degrade within different timespans. Some weed membranes can reduce the gaseous exchange at the soil surface⁴². There could be a case for temporary application where areas have been cleared to suppress re-growth of old weeds and prevent new weeds from establishing.

- Spun membranes: bonded plastic fibres forming sheet; suitable for broad usage, but most effective if covered with a protective mulch as can be lightweight. Very porous. Can be planted through. Consider for areas of new planting.
- Woven membranes: woven plastic/jute strands; use as temporary cover, or for the long-term on beds, borders and paths. Tougher and heavier than spun membranes. Mulch cover mostly unnecessary but may improve aesthetics.
- Sheeting: Very effective. Usually thick black sheeting. Can be unsightly if exposed or deteriorates. Non-porous, so will prevent water reaching soil. Less environmentally controversial and fire-resistant versions are available, e.g. made from Polylactic Acid⁴³

Membranes, even to construction specifications, offer little additional benefit for suppression of weeds (especially surface ones) within properly constructed hard surfaces.⁴⁴

New / replacement hard surfaces:

Unless forming part of a SuDS, mortaring of joints is helpful. Note this will have implications for drainage, aeration of soil below and invertebrates.

Excavation of waterbodies

Typha and Phragmites are sometime welcomed and sometimes unwanted components of a waterbody. If the aim is to keep sizeable open water areas then the water bodies need to be deeper than 1.2m. Deeper water bodies are also less prone to algal blooms.

⁴²

https://www.researchgate.net/publication/335224039_Carbon_dioxide_and_oxygen_exchange_at_the_soil-atmosphere_boundary_as_affected_by_various_mulch_materials

⁴³ www.Hy-Tex.co.uk

⁴⁴ Driveways, Paths & Patios, McCormack, T. p84

6. Methods of weed control without using chemicals

Options for weed control without chemicals include rediscovering the art of grounds maintenance well-practised prior to chemicals. Looking ahead they will include the successful development of emerging technologies.

All techniques will have to be applied often enough, at the correct times and in the correct ways to achieve the objectives of control.

Understanding the strategies relied on by weed species to spread (e.g. whether vegetatively by rhizomes or runners) or through seeds dispersed physically, and whether the weeds are annuals or perennials will influence the choice of methods.

It is important to note that some plants are regarded as weeds because they are highly toxic, and hand-weeding will require taking suitable precautions⁴⁵.

Options include:

Hoeing (in soil):

Prior to the use of chemicals hoeing could typically done every two or three weeks⁴⁶. The process involves shearing the roots on or just below the soil surface using a long-handled tool with a cutting edge at its end – a hoe. It is best undertaken in dry weather so weed seedlings dry out on surface and do not re-root. It works better for the removal of occasional emergent annuals in low groundcover and in small treeplanted areas where it is better than surface vegetation removal⁴⁷ especially if weed growth has already been reduced by pre-planting screening or cultivation⁴⁸. It seldom goes deep enough to destroy roots of perennial weeds and just cutting of the roots of perennials which can regenerate can either not solve the weed problem or make it worse⁴⁹. The technique also risks damaging nearby plants/trees if done too enthusiastically or carelessly particularly as roots of desired plants may spread. Hoeing can also leave a seedbed for weeds and may bring to the surface other weed seeds only too happy to then germinate. For this reason, some suggest soil disturbance should be kept to a minimum by hand-weeding. After hoeing the large weeds are typically raked up to prevent re-rooting or setting seed and for tidiness. Some studies also suggest that hoeing is not necessarily more cost-effective than hand-weeding⁵⁰. It is a technique requiring little capital investment but much hard labour and thus likely to be expensive without access to volunteers seeking exercise or others on a community payback scheme. Tools also need to be kept sharp.

Harrowing

Suggested as an effective treatment on gravel surfaces if these are laid loose and deep without large stones.

⁴⁵ <https://www.landscapeinstitute.org/blog/toxic-plants/>

⁴⁶ Weed control in amenity plantings, University of Bath, Sept 1980, p80

⁴⁷ Davies, RJ in Advances in Practical Arboriculture, Forestry Commission 1987, p 98

⁴⁸ Silviculture of Broadleaved Woodland, J Evans, Forestry Commission 1981

⁴⁹ The weed problem, FC King, p105

⁵⁰ The weed problem, FC King, p118

Hand-pulling or hand-weeding with tools

This suits smaller areas/lawns, small islands in water bodies or spits or following on from hoeing. It is more effective on perennials because it is possible to remove whole plant and prevent regeneration). It has the advantage of causing minimum damage to target plants for retention. It is best undertaken in soft soil and on young weeds:

- Annuals - can be hand pulled, grasping the whole plant since leaving roots behind is unlikely to be a problem
- Perennials – whilst hand-pulling in very wet soils may sometimes be possible, if this does not work then these will need to be dug out with as much root as possible

After pulling the weeds are typically removed to prevent re-rooting or setting seed. Perennial weeds are often destroyed. The use of gloves is essential.

Machine excavation of soil and plants

This more dramatic approach is indicated in waterbodies for Bur-reed, Reedmace, Reed-grass and an option for land that is grossly contaminated with invasive or seriously troublesome weeds if not capable of being improved using other techniques in time. If there are target plants for retention these are lifted and saved first although there is a likelihood that the soil around their roots will harbour some of the troublesome weeds and target plants may need to have their root ball cleaned up as far as cost-effective (which outside of domestic and botanic gardens is unlikely).

Cultivation by hand or machine:

There are a number of approaches to cultivation, but all involve replacing the surface with fresh topsoil garnered from below the surface. This is a traditional and popular approach for creating a starting point for a new landscape feature which gives the impression of relatively quickly creating a weed-free soil as a starting point for new works. This is misleading as the turned soil contains a variety of weed seeds. This approach has also been implicated in breaking down soil structure and changes in soil flora and possibly even encouraging vigour in weeds.⁵¹ It is worth noting here how interest is growing in no-till approaches to agriculture and forestry which avoid the minimum of soil cultivation. If it is used then it is important that the final soil surface is raked to remove fragments of perennial weeds. The soil may then be left to create a first crop of weeds which are then removed before proceeding with the landscape construction. As with hoeing attempting to cultivate within an established plant bed is likely to damage the roots of target plants reducing their vigour and their ability to use below-ground competition to out-compete weeds.

Abrasion:

This is a method for dealing with annuals on paved surfaces where the neighbouring surfaces are not susceptible to damage. One system, for example, involves switching a brush head for a strimmer head⁵². Steel brushing can be used for large-scale areas such as pavements and roads although may need to be done frequently. Long-handled slimline wire brushes can be used between paving slabs and along road and path edges. The method inevitably leaves roots of perennials which can regenerate⁵³.

⁵¹ The weed problem, FC King, p114

⁵² www.weed-go.com

⁵³ <https://twitter.com/BensBotanics/status/1184712173454540800?s=20>

Mowing:

For established turf, correct mowing with removal of clippings reduces weeds. Suitably timed raking/scarifying and application of coarse sand can assist with reducing moss (often a symptom of waterlogging) and reducing some weeds. Most weeds in grass are perennials regenerating from roots. Where the weeds in question are undesirable grass species, sedges, or rosette weeds such as plantain, dandelion and cat's-ear, mowing will be insufficient, and they would have to be removed by hand. Turf that is riddled with weeds but needs to perform as fine turf may be easier to replace in toto. Newly seeded grass areas, despite good preparation, may still contain annual weeds but these may well not persist once the turf is being mown regularly.

Cutting or strimming:

In large weedy areas, cutting plants low will weaken and if done repeatedly may sometimes kill them. Cutting before flowering and particularly seeding is helpful in weakening plants and reducing future problems. Cutting is usually done with a mower, reciprocating blade cutter, trimmer or sickle. Tree seedlings or scrub may require the use of secateurs or loppers. As a technique this is more about checking weed growth than controlling weeds. It suits small areas or linear areas that can be walked along. It is only practical doing by hand where safe to do so (i.e. not central reservations). It is thus a possible approach for fence lines, wall lines and around street furniture but not without problems of damage to trimmer or structures and risk of damage to plants it is wanted to keep, particularly trees. Again, it will only check the above ground growth of perennial weeds, not often kill them outright.

[Dyke] raking:

In ponds many weeds in ponds can be raked out – if necessary with rake with teeth upward - (e.g. with a dyke rake) or collected with a boom. Weeding of ponds can have the additional benefit of reducing excess nutrients although may not be very selective. It is typical to aim for a limited area cleared thoroughly.

Ordinary cold water powerwashing

This removes algal and moss growth and some small weeds off hard surfaces but otherwise is not that effective. A nearby suitably clean water supply is required and regulations must be complied with to prevent back siphonage when devices are connected to the mains.

Hot water:

Hot water (c.60 degrees plus) treatments, typically at high pressure, can be effective on hard surfaces and have other uses such as chewing gum removal. This is a technique being evaluated by the Environment Agency⁵⁴. It may, however, have an increased carbon footprint. It is less effective on grasses⁵⁵ It may need to be repeated every 25 days.⁵⁶ *HeatWeed*® is argued to have a systemic effect on roots⁵⁷

Hot foam systems,

Again, typically used on hard surfaces, these can be used in all weather conditions as the foam helps maintain the heat on the plant's surface. With *Foamstream*®, for example, the foaming element is

⁵⁴ <https://twitter.com/EnvAgencyNW/status/927506039217455105/photo/1> as viewed 24/10/2019

⁵⁵ Parrish as referenced in A review of non-chemical weed control on hard surfaces, Rask & Kristoffersen, Weed Research 47, 370-380

⁵⁶ Influence of development stage and time of assessment on hot water weed control. Hanson and Ascard Weed Research 42, 307-316

⁵⁷ <https://heatweed.com/method-en/>

made from natural, sustainable plant oils and sugars and is biodegradable⁵⁸. This system has been adopted by a number of councils⁵⁹ 'Herbicide-free', it arguably requires stretching the definition of 'chemical-free' used in this Technical Note. The carbon footprint would also need to be considered, especially given the need to transport the foam by vehicle and the stop/start requirement necessary alongside verges⁶⁰.

Flame treatment.

The approach is to cook, not char weeds. It is regarded as helpful for large areas of soil (including newly seeded areas prior to seed germination) or gravel.⁶¹ Sometimes it is used at speed from a vehicle. It may be helpful for weeds in cracks in paving. In a highways context it is suggested it is best done in late winter.⁶² Weeds must be visible to be destroyed. The carbon footprint of this technique may also need to be considered. It is not very effective on *Poa Annua*⁶³ Safety aspects are a paramount consideration⁶⁴ Using what is effectively a blowtorch on a lance is potentially hazardous, particularly if operatives do this in public areas.

Electric:

Electronic control systems that kill stems and roots instantly are coming available with many hoping in their success. Ubiquitek's *Rootwave*⁶⁵ has won an Innovate UK grant to make its approach scalable and its use is being trialled in Exmoor National Park⁶⁶ on Japanese Knotweed and Montbretia⁶⁷. The carbon footprint of this technique may need to be considered.

Grazing:

Weeds in large areas of grassland can be controlled by grazing animals at an appropriate stocking level. Grazing with different animals may be required to achieve the desired look and species composition in grassland and those responsible for grazing animals will also be particularly keen that species that are hazardous for grazing animals, such as Oxford Ragwort, are removed by hand before grazing is allowed. Introduction of grazing near urban areas is problematic for other reasons (e.g. fencing requirements, community-resistance, and dogs worrying stock)

Sweeping

Frequent sweeping (especially of road surfaces) can remove material that could provide a substrate for weed seeds to germinate into plants that send roots into cracks. This process can be assisted if wire/plastic brushes are used and mechanical sweepers are fitted with weed ripping channel brushes⁶⁸ although these can cause damage to surfaces. It is argued that by far the most effective method of weed control in highway locations is frequent and efficient sweeping, notwithstanding the cost.⁶⁹

Selective watering

⁵⁸ <https://grminc.ca/grm-facility-contract-management/services/foamstream/>

⁵⁹ <https://www.weedingtech.com/blog/how-uk-councils-benefit-from-using-foamstream-in-their-boroughs/>

⁶⁰ Hackney, R (priv comm)

⁶¹ Weeding without chemicals, B Flowerdew, p78-9

⁶² Control of weed growth on public footpaths and highways, CIWM, p12

⁶³ Thermal weed control, Ascard, Swedish University of Agricultural Sciences Report 130, 1988

⁶⁴ <https://www.weedfree.co.uk/2017/08/weed-killing-weeds.html>

⁶⁵ <http://rootwave.com/>

⁶⁶ <http://rootwave.com/news/> as viewed 21/10/2019

⁶⁷ Farris, A, Exmoor National Park (priv comm)

⁶⁸ Control of weed growth on public footways and highways, CIWM, 2003

⁶⁹ Control of weed growth on public footways and highways, CIWM, 2003 P 27

In situations where desired plants need to be watered, using focussed methods that only water those plants and not the weeds around will be helpful.

Soil solarisation

This involves stretching a material across the surface which weeds cannot grow through but which allows solar radiation to effectively cook emerging weeds. It suits the preparation of planting beds. The material may have to be removed and its carbon footprint may have to be considered.

7. Weed control plans

Developing a scientific and strategic approach, linked to a weed control plan is helpful in the situation where chemicals can neither be used as an instant fix, nor to prevent future weed growth. An understanding of weeds and how weed flora may adapt to the consistent use of a single technique will be a prerequisite here. Clients and higher levels of management may also need to be made aware of the importance of proper planning for weed control over time if their objectives for the site are to be met without recourse to chemicals.

Plans for weed control balance the **multifunctional aims** for visual amenity, biodiversity, soil conservation, enhancing growth of target plants, potential for harvesting weed growth for compost. These may be **zoned spatially and temporally**. Unlike some areas of maintenance, where delays in maintaining may only lead to a proportionate increase in maintenance work, there are optimum periodicities for weeding, hence the adage ‘one year’s seeding, seven years weeding’. A balance between objectives is struck, for instance in general the greater the weeded zone around trees the better they will grow⁷⁰ There are, however, cost and visual effects as the size of vegetation-free areas around trees increases.

The **site context** will have a significant bearing on what can be achieved. If it is in proximity to other land with lots of weeds growing that spread seeds either by wind or have aggressively spreading rhizomes then it may be extremely challenging⁷¹ This is one reason why neglected allotments are so disliked. But even if the surrounding environment is filled with an overwhelming population of weed sources, suggesting an uphill battle, a high level of control may still be necessary e.g. along public rights of way (to prevent a legal obstruction) or to maintain access to areas which might otherwise be overtaken by bramble or stinging nettles.

Practicalities and politics may need to be considered when planning. For instance, it is typical to weed small sites in a day to reduce the spread of weeds and to avoid complaints. Teams will certainly be needed for more complex sites. Large areas of grass, scrub, young woodland and trees in grass may have to be tackled progressively. Weed disposal needs to take place promptly both to avoid complain but also to reduce weed spread. Timing of interventions is also very important – ideally while weeds are young but in the correct weather depending on methods being used.

Stakeholder involvement may be helpful. Collaboration with other bodies that are engaged in non-chemical weed control, such as other tiers of local authorities or wildlife trusts may assist development of solutions. For water bodies, ecologists’ advice is also often sought as they may advise only removing part of the weed growth at a time in order to reduce impact on other pond-life, e.g. as a result of increased turbidity, changes in oxygen concentration or loss of habitat. Some on-site interpretation to the public may help with recruiting support for any obligatory chemical weed control or volunteers.

Past **governmental guidance** on this subject suggests plans go into greater detail and has said that “The manager’s weed control plan should indicate the best time of day, season, stage of plant growth and weather conditions for the various methods of weed control. It could also provide for dealing with changes in weather or other unexpected circumstances. **But in all cases the plans must be subject to regular review.** Managers need to consider that the same strategies will not be appropriate for all

⁷⁰ Silviculture of Broadleaved Woodland, J Evans, Forestry Commission 1981

⁷¹ Weeding without chemicals, Bob Flowerdew, p104

amenity areas [seasons or surfaces]⁷². This point about monitoring the efficacy of techniques has also been proposed by other authorities.⁷³

Once a site has been brought under control, some weeding in one form or another will need to continue indefinitely with appropriate documentation for handover to successive managers unless the nature of the site is such that target plants produce cover that excludes weeds to any noticeable extent.

⁷² Weed control and environmental protection, DOE, 1992

⁷³ Non chemical weed control in urban areas Lefevre, Blanchet, Angoujard, British Crop Protection Council Conference, Weeds 2001 p 709-14

8. Specifying weed control

Plant supply

Practitioners may need to consider how to handle situations where asked for plants that have been grown organically without using pesticides since supplies are likely to be very limited and expensive. Contract growing may be a solution.

Site Maintenance

Specifications for chemical-free weed control as with chemical-based control can be written in different ways, sometimes used in combination:

1. Frequency
2. Performance/Output
3. Outcome/Continuous Improvement

The specification is likely to differ according to the performance standards required at the site or in particular zones of the site (e.g. “Sponsored”, “High Amenity”, “General Amenity” etc). Visits by those maintaining sites are also typically multi-purpose, bound together with parallel actions on pruning, litter removal, and adjustment to plant support structures and the approach to the site spatially and the detail of specifications may reflect this.

Timing of weeding

Weeding is needed at times of year whenever weeds are growing, a period which is extending as the growing season for plants is more generally extending with climate change. Weeding is particularly helpful before weeds set seed. Some knowledge of the particular weed problem and weed life cycle and its response to weather, probably gained through experience of maintenance, is thus helpful.

Having said this, it can be difficult to prescribe the number or frequency of weeding needed in a year owing to differences in type and vigour of weed growth and the control method used⁷⁴. At the same time this means that where an outcome specification is used, realistic pricing by contractors may need to have a substantial contingency figure built in.

To illustrate, high amenity areas such as rose beds may require 12 visits p.a., even if mulched, for handweeding. Even areas such as highway beds, may need 8 visits⁷⁵

Outcome-based performance measures

For many the complexity of weed control and the desire to keep specifications simple mean that outcome-based performance specifications are likely to be preferred. To assist this, photographs are sometimes used, either as part of the specification to illustrate trigger points for action, desired (and un-desired) states, or provided by the tenderer/contractor to demonstrate typical/actual performance. **East Malling Research Station, with the support of Defra, has provided a guide on weed control (albeit including chemical use) which contains a very helpful set of photographs of trigger points for weed control on hard surfaces**⁷⁶ which will be of interest and value to many readers of this Technical Note.

Apart from general weeding, individual troublesome weed species may be targeted in the specification for removal, e.g. using some of the techniques discussed in this note.

⁷⁴ Silviculture of Broadleaved Woodland, J Evans, Forestry Commission, 1981

⁷⁵ Specification developed for Herts Association of Cultural Officers Environmental Management Group (ParksHerts) by KMC Consultancy

⁷⁶ <http://www.emr.ac.uk/wp-content/uploads/2015/03/BPWeeds2015web1.pdf>

9. Some individual weed species

Know your weeds!

This section has been included, notwithstanding its incompleteness as to species, because it illustrates some of the complexities in dealing with weeds. It also highlights that in the right place or with a different mindset, some of the species referred to may not be regarded as weeds at all. At the same time, the notes about the difficulty of dealing with some species also by implication reveal the helpfulness chemical control has been where it has been permitted.

In the description that follows some ecosystem services provided by some species *frequently cited* as weeds are described before a description of its properties as a weed and traditional non-chemical methods of control. It is worth re-iterating that apart from their individual ecosystem service offerings, weeds in situ can help retain and improve soil structure, microfauna and fertility.

Note: any references to medicinal and culinary uses have been drawn from the Hamlyn Guide to Edible and Medicinal plants and are in no way intended to endorse these uses.

Dandelion (Taraxacum spp.)

These perennials can bring pleasure to many as they turn grassland a spotted yellow at times when there may not be other flowers to be seen. Children and lovers also like blowing dandelion seed heads ('clocks') to the message "He loves me...he loves me not". The plant has various culinary and medicinal uses. During drought, dandelions may remain green when grass turns brown. Dandelion flowers are popular with ladybirds and attract at least 93 different insect species.⁷⁷

Dandelions are, however, unwelcome in fine turf (such as bowling greens, golf greens or prestige lawns) and particularly in or near flower or shrub beds. Dandelions can regenerate from any fragment of their root⁷⁸. The seeds can last seven years⁷⁹. Dandelion control is best achieved via hand-weeding (including removing the entire taproot and backfilling the hole with suitable material). If removal is impractical then at least mowing of grassland or hoeing of beds or loose surfaced paths will be required before they set seed (which occurs between 9-15 days after flowering). Dandelions growing in cracks in bound hard surfaces may be difficult to dig out. There have been patchy results from using flames or hot water in hard surfaces. Sometimes, however, after very wet weather by grasping every leaf at once, the whole plant can be removed from cracks in paving.

[Field] Horsetail (Equisetum arvense)

These interesting looking primitive plants, which were abundant 300-350 million years ago, have medicinal properties but can be toxic to grazing animals (especially horses) if they become a significant component of their diet, e.g. in hay⁸⁰.

It avoids disturbed soil, prefers waterlogged areas and can die down in summer⁸¹ however it is a perennial which spreads via rhizomes which can be up to 2m deep and so difficult to eradicate. The plant will also regenerate from rhizome fragments. It can be unbeatable unless it is possible to control

⁷⁷ Weeding without chemicals, B Flowerdew, p110

⁷⁸ Weed control in amenity Plantings, University of Bath Sept 1980, p24

⁷⁹ Ayling, Dr S (priv comm)

⁸⁰ Poisonous plants and fungi, MAFF

⁸¹ Ayling, Dr S (priv comm)

its whole territory⁸². In turf it can be held in check by mowing. *Rootwave* may prove a cost-effective technology⁸³

Plantain (*Plantago major* & *P. lanceolata*)

Some medicinal and culinary uses. Reported to have characteristics that amuse children⁸⁴. Host species to some moths.

Widespread but not invasive perennial. Tough leaves very tolerant of trampling. May be reduced in turf by mowing or grazing. More difficult to remove via uprooting in wet weather as the leaves are difficult to gather together and have a greater tendency to break off the stem than dandelion. Can be hand-weeded in lawns or soil with a knife, daisy grubber or corer but has a long root⁸⁵.

Ground Elder (*Aegopodium podagraria*)

Some medicinal and culinary uses. Can arguably act as groundcover with some ornamental value⁸⁶

One of the most difficult perennial plants to eradicate with roots penetrating many metres into the soil. Can be kept in check by frequent mowing and cutting⁸⁷

Creeping Thistle (*Cirsium arvense*)

Some culinary uses. Attractive to many species of insect.

Thistle has a creeping rootstock that enables it to spread. It is a highly problematic weed. In semi-natural grassland some check to its spread is achieved by repeated cutting and trampling. Repeated frequent deep cultivation also works. Thistles are not so easily controlled by grazing, except possibly by donkeys or goats. In turf it can be hand-weeded when young.

Celandine

Once known as 'spring messenger'⁸⁸ this is one of the first flowers of the year, providing visual interest and food for insects. It. Wordsworth wrote three poems about it. It has medicinal and culinary uses.

Although not competitive its roots persist and it can be difficult to eradicate and may be best tolerated. If this is not possible then the soil may need to be replaced.

Poppy (*Papaver* spp.)

An annual which adds colour to recently cultivated sites. Seed heads can be used ornamentally.

Extremely long-lived seeds, hence soil which may not have been cultivated for many years can sprout poppies. If required, easily killed via hoeing or attempting to uproot.

Daisy (*Bellis perennis*)

Popular with all ages for making daisy-chains, daisy caterpillars and for games. Adds interest to grassland. Some medicinal and culinary uses. Chaucer wrote a tribute to the plant.

Regarded as a weed in fine turf but difficult to eradicate once well established.

⁸² Weeding without chemicals, B Flowerdew, Kyle Cathie, 2010

⁸³ <https://twitter.com/i/status/1144555736896352256> viewed 24/10/2019

⁸⁴ Flora Britannica, R Mabey, Chatto & Windus 1996

⁸⁵ <https://twitter.com/OliverDurham10/status/1169502177150361600?s=20>

⁸⁶ Flora Britannica, R Mabey, Chatto & Windus 1996

⁸⁷ <https://www.sncv.org.uk/problematic-plants/> as viewed on 20/10/2019

⁸⁸ Flora Britannica, R Mabey, Chatto & Windus 1996 p 48

Creeping buttercup (Ranunculus)

Adds colour to grassland and used for play by children. Frequently figures in medieval church carvings.

In fine turf can be controlled by raking before mowing. In bare soil can be controlled by cultivation and hoeing. In planted beds that are heavily infested the RHS recommends lifting desired plants (kept safe elsewhere) while the bed is comprehensively subjected to control.⁸⁹

Chickweed (Stellaria media)

Some medicinal uses. Stays green throughout winter. A food for poultry or caged birds.

This annual or biennial produces up to 2500 seeds per plant and thus difficult to eradicate. Although it can spread to cover the surface it not always regarded as a problem weed since it does not unduly compete with ornamental plants.

Dock (Rumex spp.)

Used in folk practice for alleviation of nettle stings. Some culinary use reported.

Considered to be one of the most troublesome weeds in intensively managed permanent grassland⁹⁰ Can regenerate. The root needs to be removed or cut at least 10cm below the ground in planted beds. Mowing or grazing with goats and cows has been found effective control in grassland. When fully grown, in suitable soil, can be pulled out by hand with roots⁹¹

Bindweed (Convolvulus arvensis)

Some medicinal uses. Flowers can look attractive.

As a climber, can appear to strangle other target plants. Sends roots to great depths which are difficult to remove. Arguably unbeatable unless you can control its whole territory⁹². It is suggested that control can be achieved by repeated cultivation for up to seven years or the use of a dark membrane for several⁹³

Self-heal (Prunella vulgaris)

Medicinal and culinary uses. Adds a splash of purple colour to grassland. *P. vulgaris* subsp. lanceolata has been grown to produce lawns in the Pacific Northwest USA and has the potential to be used as a cover crop to provide habitat for pollinators and other beneficial species in vineyards, orchards, cane fruit or blueberry plantations.⁹⁴

Regarded by some as a tenacious perennial weed of lawns, spreading by rhizomes and smothering grass. Can be (laboriously) removed by hand.

Couch grass (Elymus repens /Agropyron repens)

Medicinal uses.

Tends to spread vegetatively via shallow rhizomes. For amenity grassland in most cases it has to be tolerated. For fine turf where this is not possible, there may be no alternative to removal of soil and

⁸⁹ <https://www.rhs.org.uk/advice/profile?pid=784>

⁹⁰ <https://www.cabi.org/isc/datasheet/48064>

⁹¹ The Weed Problem, FC King p105

⁹² Weeding without chemicals, B Flowerdew, Kyle Cathie, 2010

⁹³ <https://extension.usu.edu/archive/tips-on-controlling-bindweed>, retrieved 23/10/2019

⁹⁴ <https://www.cabi.org/isc/datasheet/116556>

reseeding or turfing if there are bad infestations. In ornamental beds whole plants are laboriously removed by hand.

Stinging nettle (*Urtica* spp.)

Long history of medicinal and culinary uses. Occasional use for textiles and dyes⁹⁵ Larval foodplant of a significant number of moths, butterflies and other insects. Provides evidence of human habitation and in patches a form of 'natural security'.

Perennial nettles can spread vigorously but can be controlled by repeated digging/hoeing/cultivation or mowing.

Groundsel (*Senecio vulgaris*, *Senecio cambrensis*)

Prolific and abundant on cultivated land. Used as a food for cage-birds. Foodplant of cinnabar moth. Can cause liver damage in stock.

Up to 1500 seeds per plant. Can be controlled by repeated cultivation/hoeing (if not allowed to set seed) or in grassland by trampling and mowing. Larger plants can recover from flame-weeding⁹⁶

[Hairy] Bitter cress (*Cardamine hirsuta*)

Some culinary uses.

Small and short-lived plant in cultivated soil (including soil in containers) which can produce up to 600 seeds per plant, distributed by an 'explosive' dispersal mechanism which can be activated by the act of weeding. Seeds can persist in the soil or germinate quickly, growing into plants capable of seeding within 6 weeks. Best removed by hoeing or hand before seeds have set. In turf can be kept in check and sometimes reduced by frequent mowing

Ivy (*Hedera*)

All parts (especially berries) are toxic if eaten by man and contact with skin can cause a reaction. Bees visit flowers. Some birds will eat its fruit.

Seeds are readily spread by birds and the plant can also spread vegetatively, covering fences and walls and smothering ground and trees.

Cutting and burning are effective. Underground runners, however, need to be completely removed by hand. Removing older plants from dry surfaces can generate a dust which may be a respiratory irritant.

Brambles or Blackberries (*Rubus fruticosus* agg)

Brambles have well-known culinary uses; blackberrying is a popular recreational activity. In some situations may provide a barrier hedge. Provides cover and food for birds and small mammals. Associated with other species. May help protect young coppice regrowth.

Highly invasive spreading plant that forms dense impenetrable thorny thickets that crowd out any low growing vegetation and restrict access. Can be held in check by repeated cutting and digging.

⁹⁵ Flora Britannica, R Mabey, Chatto & Windus, 1997

⁹⁶ <https://www.gardenorganic.org.uk/weeds/groundsel> as viewed on 20/10/2019

Clover (Trifolium spp.)

This has some edible and medicinal properties. Four-leaved clovers are sought after as a sign of luck. Clover flowers are popular with bees and clover can aid with soil stabilisation on slopes and improve grazing

In turf this can be a sign that the original grass mix used contained clover deliberately or otherwise of nitrogen shortage or not watering during drought. Once established it is difficult to remove. Raking before mowing to lift up the stems and the use of lawn sand are recommended.

Yarrow (Achillea millefolium)

Medicinal and culinary uses. Component of some grazing seed mixes.

Prolific (long-surviving) seed producer, also spreading via rhizomes. Regarded as potentially invasive⁹⁷. Resistant to mowing, grazing and trampling. May be controlled by deep cultivation

Common Cats' Ear

Needs to be distinguished from Smooth cat's ear and Spotted cat's-ear which are UK vulnerable and UK Threatened species respectively⁹⁸.

Difficult to remove from grassland since it is resistant to grazing and survives close mowing.

Pearlwort (Sagina spp.)

In turf, cutting grass too short is the usual cause⁹⁹. Spring raking associated with the use of lawn sand may help control.

⁹⁷ <https://www.cabi.org/isc/datasheet/2636>

⁹⁸ Flora of Hertfordshire, T James, HNHS, 2009

⁹⁹ Be your own lawn expert, DG Hessayon, PBI, 1967

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