

by ROGER EVANS

The aim of the golf greenkeeper is to produce the best possible quality of turf with the resources available. In general, this means that the presence of broad-leaved weeds in any number is unacceptable not merely from an aesthetic point of view but also because weeds can actually influence play.

If weeds are beginning to become a problem, there may well be an underlying reason. The most common causes are over-acidity of the surface soil, poor drainage, or poor nutrition. Weeds can act as indicators of an underlying problem and without tackling the underlying cause then weeds will always be present. It is a wise policy to try to discover why weeds are present, particularly if they are a recurring problem, and to adjust turf management in conjunction with chemical control measures accordingly. For example, sheep's sorrel (*Rumex acetosella*) is associated with an over-acid surface soil, creeping buttercup (*Ranunculus repens*) is often found in damp, boggy corners and white clover (*Trifolium repens*) is often seen in areas that have not been fertilised for several seasons.

The greenkeeper must be familiar with the common broad-leaved weeds and if there any doubt about identification, then advice should be sought or a good flora purchased.

Hand weeding

Before reaching for the sprayer it is always worth considering hand weeding, particularly in small areas. Much effort and money can be saved by always carrying a knife to remove weeds during the course of the day. Even some grass weeds can be significantly discouraged by regular slashing, for example the spread of Yorkshire fog (*Holcus lanatus*) can be limited in this way.

Spot treatment

In general, spot treating individual weeds needs to be done carefully, as so often weed-killer is over-applied with the result that as well as the weed, surrounding turf is killed. A single nozzle, lance-type sprayer is not recommended for spot treating weeds in turf for this reason. However, provided care is taken, correct doses can be applied to small areas using, for example, aerosol spot weeders.

Wiping out

WEEDS

As is the case when hand weeding, spot treating weeds is really only practical over fairly small areas of putting surface or tee.

Spraying - choosing a herbicide

Once it has been decided there is a weed problem and the weeds have been identified, the next step is to choose the appropriate herbicide for selective control.

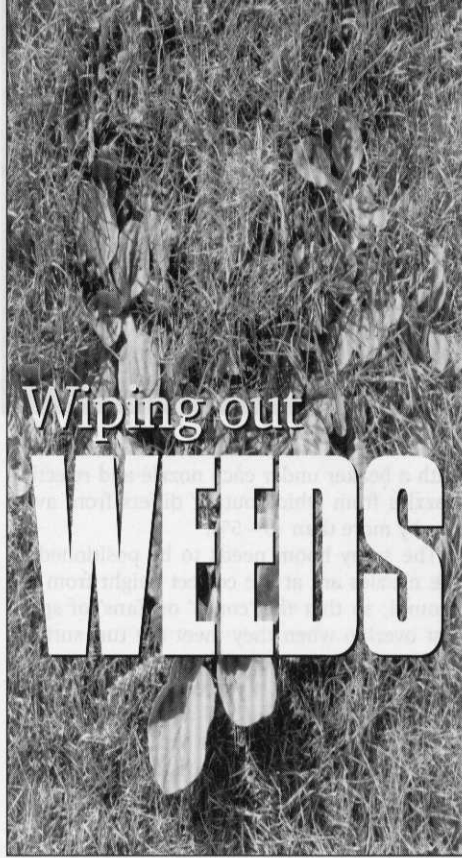
Commonly available selective herbicides are

based on the active ingredients MCPA, 2,4-D, dicamba, dichloroprop, fenoprop, mecoprop and ioxynil. Normally proprietary products contain one or more herbicides. The different combinations increase the number of weed species it is possible to control. The choice of product should be based on the susceptibility of the weed species to any of the available herbicides or a mixture of herbicides. Information is available and the table lists a selec- ➔ 43

41 • tion of common weeds and their susceptibility as mature plants to various herbicides and mixtures.

Selective weedkillers

Selective weed-killers or herbicides will control most broad-leaved weeds of turf. They may contain one or more active ingredients. At least one of the active ingredients is normally a foliage-applied translocated herbicide with growth-regulating activity, such as MCPA, 2,4-D or mecoprop. These chemicals are taken into plants chiefly through leaves, but also through roots, and upset normal plant growth processes and distort growth within susceptible weed species. Effects can be seen in twisting of leaves and distorted growth within a day or two of application, but weeds may not die for four to eight weeks. Resistant species may take in less chemical (eg. because of angle and type of leaf, which partly accounts for selectivity between grasses and broad-leaved species) and also avoid the toxic effects in various ways. Some herbicides, eg. ioxynil, act primarily by contact, producing a rapid contact scorch and then yellowing of foliage on susceptible plants as photosynthesis and



other processes are affected.

Selective herbicides are sold as proprietary products containing variable amounts of active ingredient (a.i.). For some herbicides, the active ingredient is expressed as acid equivalent (a.e.). Although the two terms are not the same, they have a similar meaning for the layman, both being used to distinguish the active

ingredient from the 'carrier' or solvents in a proprietary product. The proportion of active ingredient varies between products. Thus, if two firms sell weed-killers with the same active ingredient, firm A may formulate its product with 20% a.i. while firm B formulates its product with 30% a.i. Manufacturer's label recommendations must be followed at all times.

Approved products

All pesticides, including herbicides, currently used must be approved by MAFF; this can be checked by ensuring the product label displays a MAFF number.

Choice of application equipment

Herbicide application by sprayer generally gives the best results for professional users. The spray droplets give good cover, reaching, at least partially, the undersides of leaves and lower parts of the plants, but spray drift may give risks to non-target plants, the operator and the general public.

There is a wide range of spraying equipment available. For comparatively small areas or for spot treatment (putting greens) a knapsack sprayer may be acceptable. For larger areas there are 'knapsacks on wheels' or other pedestrian equipment, e.g. Walkover sprayers, while for larger areas, e.g. fairways, tractor-mounted or tractor-drawn models are available. The volume of liquid applied by a sprayer depends partly on the machine itself (e.g. pump output), partly on nozzle size, and partly on speed of movement over the ground. The following are generally accepted definitions of the various volumes of application appropriate to conventional sprayers with nozzles:

- low volume - 55 - 225 litre ha⁻¹
- medium volume - 225 - 675 litre ha⁻¹
- high volume - 675 - 1125 litre ha⁻¹

Details of application volumes for herbicides may be found on product labels and must be strictly followed.

Controlled droplet application (CDA) sprayers based on a spinning disc principle work at very low (11-55 litre ha⁻¹) or ultra-low volumes (1-11 litre ha⁻¹)

There are several traditional application methods still in use, eg. wick applicators, fluted rollers, or a watering can with a rose or dribble bar). These methods are generally less efficient than spraying and the product label must be checked to ensure these methods are recommended. For areas containing low populations of weeds only, spot treatment may be appropriate. This is often difficult to achieve with any degree of accuracy in practice.

Checking spraying equipment

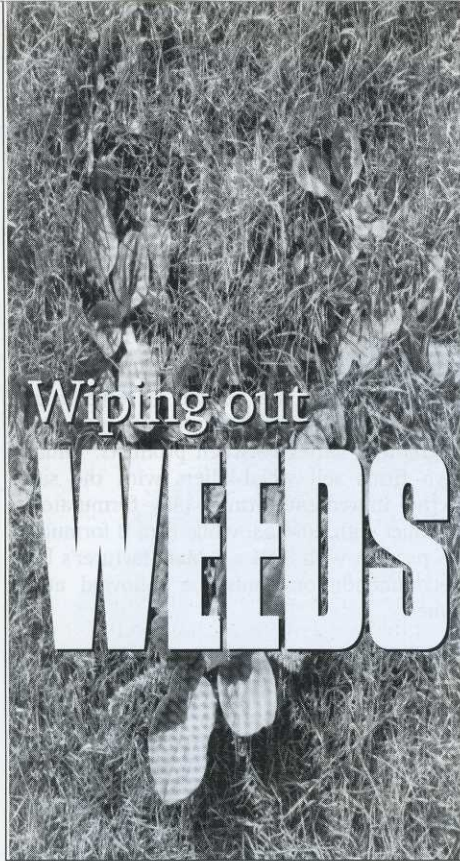
Prior to every spraying operation make sure that the application equipment is in good working order and that pressure hoses, joints and unions are watertight. Ensure that the jets and filter screens of spraying machines → 44

Broad-leaved weeds and their herbicide susceptibility as mature plants

Common Name	Botanical Name	MCPA	2,4-D	Mecoprop	Mecoprop/ 2,4-D	Ioxynil mecoprop
Creeping buttercup	<i>Ranunculus repens</i>	S	S	MR	S	MS
Bulbous buttercup	<i>Ranunculus bulbosus</i>	MS	MS	MR	MS	MR
Mouse-ear chickweed	<i>Cerastium holosteoides</i>	MS	MR	S	S	S
Common chickweed	<i>Stellaria media</i>	MS	MS	S	S	S
Pearlwort	<i>Sagina Procumbens</i>	MR	MR	S	S	S
Blinks	<i>Montia fontana</i>	-	-	-	MR	-
Black medick	<i>Medicago lupulina</i>	R	R	MS	MS	MS
Suckling clover	<i>Trifolium dubium</i>	R	R	MR	MR-MS	MS
White clover	<i>Trifolium repens</i>	MR	R	MS	MS	S
Cinquefoil	<i>Potentilla reptans</i>	MR-MS	MR-MS	MR-MS	MR-MS	MS
Parsley Piert	<i>Aphanes arvensis</i>	R	R	MR-MS	MR-MS	MS
Sheep's sorrel	<i>Rumex acetosella</i>	MS	MS	R	MS	MS
Common sorrel	<i>Rumex acetosa</i>	MS	MS	R	MS	MS
Curled dock	<i>Rumex crispus</i>	MS	MS	MR	MS	-
Slender speedwell	<i>Veronica filiformis</i>	R	R	MR	MR	MS
Self-heal	<i>Prunella vulgaris</i>	MR	MR	MS	MS	MS
Broad-leaved plantain	<i>Plantago major</i>	S	S	S	S	S
Ribwort plantain	<i>Plantago lanceolata</i>	S	S	S	S	S
Common ragwort	<i>Senecio jacobaea</i>	MS	MS	-	MS	-
Daisy	<i>Bellis perennis</i>	MR	MS	MR	MS	MR
Yarrow	<i>Achillea millefolium</i>	MR	MR	MR-MS	MR-MS	MS
Cat's ear	<i>Hypochaeris radicata</i>	MS	MS	MS	MS	MS
Mouse-ear hawkweed	<i>Hieracium pilosella</i>	S	S	S	S	MS
Dandelion	<i>Taraxacum officinale</i>	MS	MS	MR	MS	MR
Toadrush	<i>Juncus bufonius</i>	R	R	MR	MS	MS
Field woodrush	<i>Luzula campestris</i>	R	R	MR	MR	MR

Note: Herbicides used at full recommended rates according to manufacturers' instructions.

- Key: S = Susceptible, one application kills
 MS = Moderately susceptible, one application usually kills, sometimes a second needed
 MR = Moderately resistant, two to three applications needed
 R = No useful effect
 - = No information.



White Clover



Speedwell

41 → are free from blockages and are suitable for the job in hand. The nozzles fitted should be of the type and size specified by the equipment manufacturer or, for particular jobs, those recommended by the chemical manufacturer as described on the label.

Make sure nozzles are clean and giving their proper spray pattern. As part of the calibration process check their uniformity of output, by operating a stationary water-filled sprayer

with a beaker under each nozzle and rejecting nozzles from which output differs from average by more than $\pm 5\%$.

The spray boom needs to be positioned so the nozzles are at the correct height from the ground, so that the 'cones' or 'fans' of spray just overlap when they meet the turf surface. To keep this correct height consistently, make sure that on a 3 or 4 wheel sprayer the boom is level and securely fixed at the right height, and that a 2 wheel sprayer can always reliably be held at the correct distance from the ground (eg. using a chain of just the right length hanging from the boom). The nozzles of hand-held booms on knapsack sprayers or the working height of controlled droplet applicators are even more difficult to keep a consistent height above target level during operation, but unless this is done, calibration will be meaningless and the application rate quite different from what is intended.

Cleanliness of spray machines is of paramount importance, especially where one machine is used for many different products. If equipment is shared with other users, it is advisable to wash it out thoroughly both after

spraying is complete and also before the next use. Ideally, a separate sprayer should be kept for total herbicides or other similar chemicals, to avoid problems of contamination which damage turf.

Calibration of equipment

The first essential of accurate treatment is to know what volume per unit area you will actually be applying when you start work: otherwise you cannot possibly work out the correct rates of chemical. Establishing this volume per unit area is calibration. Calibration is not a magical process, but it is all important. It must be done afresh every time you spray and must also be done every time equipment is altered or changed, or a change in herbicide product is made.

The volume of liquid applied by a sprayer depends on nozzle size, pressure and travelling speed.

Always wear suitable protective clothing when mixing chemicals. (Refer to product label for details.) Follow any specific instructions given on the label but, as a general rule, add half the required quantity of water, then the chemical, then the remainder of the water (which can be used to rinse out the container in which the chemical was measured). Powder formulations can usually be added to the water and stirred to give a suspension or solution, but it may be necessary to pre-mix the powder by adding a small amount of water to it and mixing thoroughly, to the consistency of a thin cream. This 'cream' can then be added to half the quantity of water in the spray tank and topped up in the normal way.

Patterns of spraying

Accurate marking of strips is essential to minimise misses or overlaps. If chemicals do not contain a dye, or sprayer wheelings cannot be followed, lines and/or marker pegs should be used or a marker dye added to the spray, particularly on important areas such as golf greens.


For such areas, it is also advisable to spray twice over with a half-strength tank mix, the second time at right angles to the first. This makes misses or overlaps less serious. All spray work using a boom should be done in parallel lines, not curves (to avoid different speeds at the two ends of the boom). Even with single-nozzle equipment, parallel working is more methodical.

Special points on applying growth regulator herbicides against broad leaved weeds

Timing
Apply any time from spring to early autumn, preferably in fine, warm weather when the soil is moist and growth is vigorous. Late spring is generally considered best. Avoid applying herbicide treatments during hot, dry weather, or in late autumn (when weed control may be good but the turf may not fill in adequately before winter). Heavy rain shortly after application may reduce effectiveness. Wind gives risk of drift, but a slight constant breeze may allow better work than light variable winds. Growth-regulator herbicides act best when both weeds and grass are growing vigorously. Therefore, if the turf normally receives nitrogenous fertiliser, give some a week or two before spraying. Fertiliser/herbicide mixtures are convenient and avoid risks of spray drift, but they do not boost growth in readiness for herbicide treatment like a separate fertiliser dressing, and a granular herbicide may be washed off by rain more easily than a spray, especially a rain-fast one.

Mowing before and after spraying


Turf mown infrequently (every seven to ten days, or more).



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Plantain



Yellow suckling clover



Mouse ear chickweed

A large leaf area of weeds allows maximum herbicide absorption: therefore delay spraying until a few days before a cut. But then make sure not to cut for two to three days, to give time for herbicide absorption before weed leaves are removed by mowing.

Frequently mown turf

Weed growth between cuts will not matter. Some people would advise not to spray freshly cut grass, but many greenkeepers mow fine turf and spray the same day with no apparent damage. Also, there is no need to refrain from mowing to allow herbicide uptake if all weed foliage is below mowing height.

Disposal of clippings

After use of growth-regulator herbicides, the clippings from the first four mowings must not be used directly as a mulch round broad-leaved plants or shrubs but may be incorporated into compost heaps, provided that they remain there for at least six months before the compost is used for broad-leaved plants or shrubs.

After the first four mowings no special precautions are needed.

Grass weeds

The three most common grass weeds found in fine turf are annual meadow-grass (*Poa annua*), Yorkshire fog (*Holcus lanatus*) and perennial ryegrass (*Lolium perenne*). There are no suitable chemicals available for their control in fine turf and the best way to avoid them is by employing suitable management practices. Removal of grass weeds is possible on a small scale by, for example, hand weeding, plugging or re-turfing.

Certain resistant broad-leaved weeds may require more than one application of herbicide for effective control. Consult the product label for instructions on repeat treatments.

Precautions

Growth-regulators are very powerful and can affect non-target plants even in minute doses. Risks are very real where crops and plants other than grass and cereals are grown in the vicinity of spraying. Do not treat areas of turf near valued plants in flower beds, etc. except on a calm day. If contamination of such plants is suspected, wash them down copiously with clean water. Clean out spraying

equipment thoroughly after use.

All herbicides are potentially harmful to the user; follow safety instructions on the product label carefully. Always be careful when measuring out and mixing concentrated herbicides, avoid inhaling the spray, and store and dispose of containers carefully. Always wear minimum protective clothing, i.e. gloves, protective clothing and face mask. Above all, read everything on the label before opening the container. It should be understood that herbicide users are under an obligation to comply with legal requirements governing the usage of such materials and that the instructions included with each product are mandatory, including instructions regarding application rates. Users should be familiar with the FEPA (1985)m Part 3: Control of Pesticides Regulations (1986).

•The author, Roger Evans, is an advisory agronomist with the Sports Turf Research Institute.

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