Chemical saviours

The discovery and development of selective herbicides for turf.
By Graham Paul

Selective herbicides used to kill broad-leaved weeds in turf were developed from agricultural chemicals. Much of the first part of this article deals with the search for weed control in cereals, which are members of the same botanical family as grasses; the Gramineae. Therefore, the situation in amenity is the same as in agriculture, in that we are trying to control unwanted dicotyledonous plants in a monocotyledonous crop.

The use of chemicals to kill vegetation is not new; the first examples in history date back to around 1200BC when conquering armies, in what we now call the Middle East, used salt and ash to wipe out their enemy's crops. In effect, these were chemicals used to spite others; the beneficial use of chemicals took much longer to emerge.

In mid nineteenth century Germany, a mixture of sulphuric acid and iron sulphate was used in possibly the first selective weed control experiment in European agriculture.

However, it was not until later in the 19th century that the early beginnings of the herbicide industry started to have an impact on agricultural practices.

The first products to come to market were copper salts that were found to provide a degree of selective weed control in cereal crops and boost the yield.

About a dozen other metal salts including such efficacious offerings as iron sulphate and sodium nitrate soon followed to add to the product portfolio!

These metal salts had a contact action against the broad-leaved weeds, killing the aerial growth but leaving the roots intact, which could allow weed re-growth to occur in many cases.

Selectivity was partly due to differences in spray retention on the leaf between the crop and target. The finer, upright leaves of the cereal plants have a waxy coating and therefore retain less of the chemical than the leaves of broad-leaved weeds; which are rounder, have a greater surface area and are often horizontally oriented.

Also, the growing tips of cereals and grasses are less vulnerable to

sprays, being located in the base of the plant and protected by older leaves, whereas those of broad-leaved plants are terminal and more exposed to attack by chemicals.

Broad leaved weeds present a rounder, wider, horizontal target

These early selective herbicides were slow to be taken up by farmers due to the high cost of the active ingredients and their relatively poor cost/benefit – without modern formulation technology the performance was erratic and the salts could be easily washed away by heavy rainfall before the full effect was seen.

The long-term use of certain metal salts, e.g. copper sulphate, could also lead to the build-up of toxic residues in the soil that would eventually reduce the crop vigour.

However, one positive thing that emerged from these early agrochemicals was that they established the concept of chemical weeding and encouraged research into finding a more reliable means of achieving it.

In the 1930's a team of scientists working for ICI at the Jealott's Hill Research Station were working on a project to eradicate weeds in cereal crops by spraying with sulphuric and other acids.

The report published by G.E. Blackman and W.G. Templeman in 1936 showed up to 90% control of Charlock and Wild Radish in cereal crops sprayed with 9.2% sulphuric acid and slightly better control with similar concentrations of nitric acid.

It took a few more years of research and the sudden pressing need to feed a world at war, for the real breakthrough to come.

This was the introduction of the hormone herbicide 2,4-D, developed by a British team at Rothamstead Experimental Station in Hertfordshire led by Judah Hirsch Quastel. 2,4-D was the first of the group known as the phenoxy or hormone herbicides whose activity was due to its chemical similarity to naturally occurring plant growth hormones.

The use of phenoxy herbicides causes the plant to undergo uncontrolled growth, resulting in twisting of the leaves and stems – a symptom known as 'epinasty' where one surface of the leaf or one side of the stem grows faster than the other.

Only dicotyledonous plants are affected by the phenoxy herbicides, monocotyledonous plants such as cereals and grasses are largely unaffected – although a very high dose will cause scorching in monocots.

2,4-D was released commercially in 1946 and was quickly followed by several other similar products from the same chemical group– some of which will be familiar to those working in the amenity turf industry; MCPA, 2,4-DB, dichlorprop, fenoprop, mecoprop and 2,4,5-T.

Many of these herbicides found uses in weed control in the main monocotyledonous crops throughout the world; cereals, maize and rice. Selective turf herbicides came a little later, borrowing the technology from the larger agricultural market.

The chemical structures of the phenoxy herbicides are very similar but small differences can dramatically change the spectrum of weeds they control.

For example MCPA and mecoprop differ only in the replacement of one hydrogen atom (H) in MCPA with a methyl group (CH3).

MCPA is generally more effective on the deeper rooting weeds such as Dandelion, Docks and Cat's-ear whilst mecoprop gives better control of many smaller leaved weeds such as White Clover, Black Medick, Common Chickweed and Procumbent Pearlwort. By careful mixing of two or more active ingredients in a single product, manufacturers have been able to extend the weed spectrum in a bid to provide a complete answer to weed problems in one spray application.

One early example of this was 'Supertox' (now withdrawn) from May & Baker, which combined 2,4-D and mecoprop to control 18 out of the 22 commonly occurring turf weeds in the UK. It served the amenity market for some 40 years before disappearing in 2009 having been superseded by the newer products such as the 3 way mixes with dicamba, MCPA and mecoprop-P, which offer a slightly broader weed spectrum.

The suffix –P that appears after mecoprop denotes the use of an isomeric form of this molecule. When certain chemicals are manufactured, the end product can be a mixture of two stereoisomers of the desired molecule.

Without going into great detail, the best way to illustrate stereoisomers is to look at your left and right hands. They are mirror images of one another, having the same number of fingers and thumbs attached to the palm in a similar but opposite way.

The manufacture of mecoprop produces a mixture of two molecules known as the '-' and '+' isomers; i.e. both left and right handed forms of the same chemical.

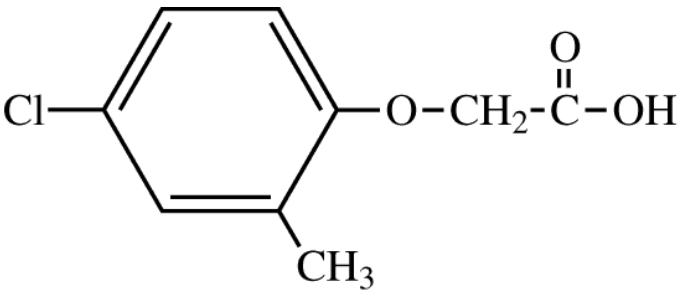
Both isomers will have the same physical and chemical properties. However, in nature usually only one isomeric form of a molecule is produced so when a pesticide works by mimicking a natural product, such as a plant growth hormone, it follows that a mixture of the '-' and '+' isomers will have only half of the activity of a pure solution of the one that is closest to natures genuine part.

Modern chemical technology now allows us to manufacture mecoprop that contains only the '+' isomer (mecoprop-P) so we can reduce the amount of chemical applied to the environment without losing the effectiveness of the product.

The period from the end of the Second World War through to the 1980's saw exponential growth in the discovery and development of new herbicides with companies investing heavily in screening and development programmes aimed at finding new active ingredients.

In addition to the phenoxy hormone herbicides, several other important selective herbicides used on turf and grassland were discovered including; dicamba, triclopyr, asulam and the hydroxybenzonitrile (HBN) herbicides ioxynil and bromoxynil.

Dicamba and triclopyr are also described as 'plant hormone' herbicides but belong to a different chemical group. The HBN herbicides work by interfering with pho-



tosynthesis, a process that occurs in both grasses and broad-leaved vegetation. Selectivity is achieved by this group because grasses can rapidly break up the herbicide as soon as it enters the plant and before it reaches the target.

The mode of action of asulam is not fully understood but researchers believe that selectivity comes from rapid degradation of the chemical in the same manner as the HBN herbicides.

The rate of discovery of new herbicides slowed during the latter part of the 20th century with increased public awareness and concerns about environmental and health issues.

Increasing pesticide legislation and food surpluses also helped to apply the brakes. European Council Directive 91/414/ECC was issued to harmonise national arrangements for authorising pesticides within the EEC.

It resulted in the removal of two thirds of the active ingredients from the approved chemicals list in the UK by the time the exercise was completed in 2009.

Thankfully we still have a trickle of new chemicals getting through these tight controls. In recent years we have seen the introduction of products containing florasulam, fluroxypyr and carfentrazone, which have all found a place in this ever changing market.

Probably the most infamous 'chemical hoe' and member of the phenoxy group is the herbicide 2,4,5-T, whose activity as a brushwood killer took it into the service of the American Forces fighting in the jungles in 1960's Vietnam.

The product, known as 'Agent Orange', was a mixture of 2,4-D and 2,4,5-T.

This was applied to large areas of Vietnam to remove the cover provided by the jungle. Over the 10 years of the campaign in Vietnam a staggering 77 million litres of the defoliant was sprayed, so it had to be manufactured as quickly and cheaply as possible. The side effects of exposure to 'Agent Orange' started to emerge after a few years of spraying.

Studies showed a dramatic increase in horrific birth defects in children and skin problems in adults living in the treated areas. Researchers soon found out that it wasn't 2,4-D or 2,4,5-T that caused these effects but highly toxic bi-products of their manufacture known as dioxins.

Today, such impurities are removed to ensure that the commercial product is safe enough to use but in the 'military policing action' in Vietnam, the US Forces had neither the time nor the budget to produce a clean product. Many books have been written on the side effects of 'Agent Orange' because it affected so many people from both sides of the conflict.

It is fairly safe to say that the eventual withdrawal of the herbicide 2,4,5-T in the 1980's was in part due to the high levels of publicity that arose from its use in Vietnam.

SELF ASSESSMENT

Use the questions below to check your understanding of this topic. Readers can claim two BASIS points if the questions are answered correctly, by filling in the form at:
www.sherriff-amenity.com/technical.asp?newsid=21
Circle the correct answer(s)

1) When was the herbicide 2,4-D first released commercially?
a) 1896 b) 1940 c) 1946 d) 1964

2) How do 'hormone' type herbicides kill broad-leaved weeds?
a) Interfere with growth processes in the target plant.
b) Prevent transpiration causing loss of cooling.
c) Corrode aerial parts of the weed.
d) Poison the growing tips.

3) The suffix –P given to some selective herbicides such as mecoprop-P denotes: -
a) Professional formulation for use by certified spray operators only.
b) It contains only the active (+) stereoisomer.
c) Pure formulation – containing no dioxins.
d) Poisonous to bees.

4) The disfigurement of leaves and stems caused by all hormone type herbicides is known as: -
a) epiphany b) contracture c) epinasty d) exogamy

5) What is the mode of action of the HBN herbicide ioxynil?
a) Inhibits cell elongation
b) Inhibits DNA replication in target plants.
c) Interferes with photosynthesis
d) Causes uncontrollable growth

6) In the report published by G.E. Blackman and W.G. Templeman in 1936, what weed species were involved in their experiments?
a) Chamomile and Wild Rocket
b) Cleavers and Wild Carrot
c) Corn Marigold and Wild Oats
d) Charlock and Wild Radish

References:
1) G. E. Blackman and W. G. Templeman (1936). The eradication of weeds in cereal crops by sulphuric acid and other compounds. The Journal of Agricultural Science, 26, pp 368-390

James de Havilland takes a closer look at the intricacies of current machinery

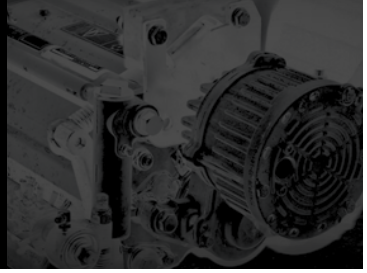
The anatomy of...

Vredo Super Compact Overseeders

Timing is key to overseeding success. Grass seed applied through any form of overseeding equipment should germinate just fine in the right conditions. The key to success, however, remains in ensuring the germinating seedling then survives. On sports turf that is allowed the luxury of a rest before it is played and tightly mown, overseeding can be carried out through a wider time frame. But year-round play makes overseeding golf greens a real challenge.

Step-by-step Analysis...

Vredo Super Compact Overseeders



The steel flat fingers that run alongside the cutting discs help ensure a clean slice is cut into fine turf, and also help ensure an even depth is maintained across the full width of the machine.

Viewed from the side, the depth of slit can be clearly gauged by the amount of disc protruding through the fingers. The toothed wheel drives the metering unit.

Metered seed is drip between the slit-cutting discs via tubes. Note inter-disc scrapers, the chain supports allowing the scraper to move out of the way and subsequently eject an object as the disc space opens up.

Pictured on the assembly bench at the Vredo factory, the workings of the metering drive can be seen. A key design aim is to ensure low seed rates of small seed, to include Bent grass, can be accurately maintained.

Although shown in a ryegrass winter sports turn sward, the slit cut by the seeder is 'closed' by the unit's roller. On a golf green, the slits typically only show during an early morning dew.

The flutes of the metering unit are partially covered by a flap, the aperture of which is adjusted to seed the seed and desired application rate.

As is so often the case, it can be dangerous to make sweeping generalisations, this applying particularly to the subject of overseeding. But when it comes to accurately placing fresh seed into an existing green, there is generally a consensus when it comes to timing; the optimum period will typically be between late August and then on through September. The job can also be carried out in October, but the later into the autumn the job is done the higher the risk of frost or late season fungal attack.

It is also fair to say there are those who prefer to overseed in conjunction with sand slitting or other aeration methods, adding seed at the same time as the sand allowing two jobs to be done at once. Others prefer a direct overseed, with an emphasis upon minimal visual impact and allowing a green to be put back into play almost as soon as the equipment leaves the green. As always there will be a play off between getting the job done and minimising disruption.

If the latter is the goal, the choice of 'straight' overseeding equipment on offer will include the Vredo models offered by Campey Turf Care Systems.

A reason for taking a look at the Super Compact model featured here is that it has been purpose developed to suit overseeding golf greens and that the first models have now been in use in the UK long enough to be considered.

The Vredo Super Compact overseeder was originally developed for use on golf greens and tees though in practice users suggest the tool can also be used for patch repair on fairways, particularly landing zones subject to divot damage.

As to the actual Super Compact unit, its design follows the established Vredo seeding principle; a pair of angled discs cut a V-shaped slit into the turf into which metered seed is placed.

The idea behind the system is that the roller at the rear of the unit seals the slits. So although an overseeded green can be played on immediately the job is completed, the closed slit also helps to seal in moisture. This helps to provide good seed to soil contact, with users suggesting this results in good germination rates. Vredo suggest germination can be as high as 95%.

The Super Compact is offered in trailed and mounted versions, the build of the unit allowing the chosen model to be converted

Shown in a typical greens overseeding application, the 1.60m Vredo SUPERCompact is based around the existing mounted and trailed Compact series also includes narrower 0.80m and 1.20m alternatives. Staggered discs allow a row spacing of just 35mm. With respective hopper capacities of 90, 135 and 180 litres, the units can be operated at speeds as high as 9 to 10kph. Note weight pack over rear roll.

between the two. In trailed form, weights are added to help ensure the discs penetrate the turf, the aim being to allow trailed units to be operated behind a light tractor that may not have the lift capacity for the seeder in its mounted form.

The idea is to allow overseeding to be undertaken with as light a tractor as possible, front weights on the tractor possibly compromising the operation on some greens.

By offering the Super Compact in trailed form, overseeding can possibly take place with a lighter tractor, reducing the risk of compromising the green, particularly when overseeding in ideal damp conditions – check this and the paragraph below – this states it's ideal in damp conditions.

Although the operating principle of the Vredo Super Compact is easy enough to understand - metered seed drops via tubes between the cutting discs, the resultant slit being closed by a rear roller – actually setting up the unit can take a while to get right. A key point is to ensure the unit runs level and that a close eye is kept on the resultant finish.

The narrowest 0.80 and lightest Vredo Super Compact is ideally suited to mounting on a tractor with a modest 510kg lift capacity, the narrow width allowing good contour following.

How long it will take to overseed a green will of course relate to the green's size, but operators of the wider 1.20 models suggest a green can be completed in around 20 minutes, making it feasible to complete 18 holes in a day.

With regard to conditions, the Vredo needs to work on a dry surface – this says it needs dry surfaces – this needs checking, with morning dew being enough to potentially upset the ability of the machine to leave a good finish.

Sowing depths can of course be varied but a slit depth of between 3 to 4mm is typically seen as being ideal. At 35mm spacing, a single one-way pass is also normally about right, a counter pass the next season helping where a variety or species change is a priority.

With regard to prices, mounted models of the Super Compact are priced from £14,750, a trailed 1.60m Super Compact listing at £27,625. ex VAT.

This is a considerable investment but one that should be viewed in relation to the potential life of the unit. Most golf courses would struggle to wear a machine out in 20 plus years. The Vredo Compact range starts at £10.025 for a Compact 210, up to £14,545 for a Compact 222.

Steve Oultram, Golf Course Manager at Wilmslow Golf Club has been using a mounted Vredo SUPERCompact to mainly establish bent grass into the course's 18 greens but has also overseeded with some fescue seed. A key reason for choosing the Vredo was its minimal surface disturbance and its speed; all 18 greens were seeded in a period stretching from 6am to 3pm.

"My first aim is to get a good rate of germination," he says, adding. "Once the seed has germinated it needs to establish. By sowing in September we are able to mow the greens at a winter cutting height and have stopped verticutting and using wetting agents. This allows the young grass plants to establish over the autumn".

BIGGA Regional Conferences

All forthcoming conferences are as follows...

REGION	DATE	LOCATION	CONTACT
South East	16 November 2011	Stock Brook Manor Golf Club, Essex	Clive Osgood, RA, 01737 819343
South West & South East	17 November 2011	Oaktree Arena, Highbridge, Somerset	Jane Jones, RA, 01454 270850
Scotland	6 March 2012	Carnegie Conference Centre, Dunfermline	Peter Boyd, RA, 0141 616 3440

BIGGA

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BIGGA

Promoting best practice in sports turf management

Happy snapping

BIGGA's Golf Photographic Competition is back for 2011, so it's time to dust down your trusty camera, go out on your golf course and get snapping!

The BIGGA Golf Photographic Competition, back for its sixth year, creates an opportunity for members to display their artistic flair, while also earning some publicity for their club.

The winner will receive a full course profile in GI and a special prize, while the 12 best pictures will be selected for the 2012 BIGGA Calendar.

Digital pictures need to be high resolution, at the largest size capable by the camera, as it may ultimately be scaled up to A3 print size (42cm wide x 29.7cm high).

Please label your entries with captions - the name of the course plus a brief description (around 10 words). It would be great if you could also tell us the spec of camera it was taken on too.

Please try to avoid reducing the file size to fit on email as this will reduce the quality of the image.

If the file size is too large to send, we recommend using a compression facility such as winzip or a website such as:

www.mailbigfile.com.

Please note, cropping may occur if photos are to appear in the magazine or calendar. Also ensure digital photos do not show the time/date display!

Anyone wishing to enter should email them to: tom@bigga.co.uk, entering 'BIGGA PHOTO COMP 2011' as the email subject header.

All entries need to be received by July 31, 2011, and only BIGGA members are eligible to enter.

Section Notes
Please email your notes to scott@bigga.co.uk by the 5th of the month

All the latest news from your Section

Around The Green

Scottish Region

Central

A good turnout of 30 people came to hear Stan Zontek, of the USGA Greens Section, speak at Elmwood on April 21. Stan gave an interesting slide show showing some of the changes made to Pebble Beach for the 2010 US Open and at Congressional for this year's Championship.

Our Spring meeting was held in glorious weather at Ladybank GC on April 28. The main prizewiners were, Scratch, G. Duncan, Carnoustie, 75; Best Nett, Elliott Small, 70; Class 1, 1. J. Watson, St Andrews, Nett 73. Class 2, D. Scott, Scoonie, Nett 70. A full report of winners is on the website www.biggacentralsection.org.uk

Our thanks go to Ladybank GC and their Captain, Bill Pettigrew, and also to the Course Manager, Colin Powrie, and his team, for the excellent condition and presentation of the golf course.

There were 16 teams entered the Pairs tournament and again the draw and results will be posted on the website.

Finally for this month, one of the greenkeepers at The Dukes Course, Steven Horsburgh had a baby girl Amy 8lb 5oz on Sunday, April 24, and Steven Wilson has left The Duke's to work up at the Trump project in Aberdeen (take your thermals, Steve).

Gordon Moir

Section Notes
Please email your notes to scott@bigga.co.uk by the 5th of the month

East of Scotland

The Spring Outing was played overthe Craigielaw Golf Links on the 19th of April and the weather was sunny and calm just as I ordered. Course Manager, Mark Reid, and his staff presented the links well although some tricky hole positions were mentioned. A huge thanks to all the staff at Craigilaw for the hospitality shown to our section. Some 24 members attended the event amongst those the Scottish Chairman, Stuart Taylor scored a 72 with seven three putts (well done Stuart) scores as follows:

Scratch Winner. Philip Butler, Murrayfield GC, 72. 1st Class Winner. Grant Moran, Mortonhall GC, 68 Nett; 2. Sean Cunningham Mortonhall GC, 69 Nett. 2nd Class Winner. Ryan McCulloch, Goswick GC, 70 Nett; 2. Robbie Murdoch, Dundas Parks GC, 76 Nett

Best Nett. Ian Lauder, Kelso GC, 69 Nett; Veterans' Prize, Alastair Holmes, Seahouses GC, 75 Nett. Trade Prize. Hugh Fraser, Huxley Golf Ltd , 69 Nett (BIH). Longest Drive 4th hole, Ian Lauder, Thomas Sherriffs

Nearest to Pin at Hole 10 - Philip Butler, Murrayfield GC

Congratulations to all!

Jimmy Nelson, Vice Chairman, delivered the After Dinner speech, which went down very well in my absence. Thanks to Jimmy, and nice to see Jimmy Combe playing with Jimmy for 16 holes. Both still have tremendous golf swings!

Next outing at Mortonhall (Willie Woods Tournament). Entry forms should be with you soon. Date for tournament is August 9.

Stewart Crawford - Chairman

Ayrshire

Hi to you all once again. Summer seems to have come early this year. As I write the notes for this month the weather man has forecast rain. Woohoo! Never thought I'd say that. But we need it.

Not just because I've got the greenkeepers t-shirt tan but the ground is overdue a soaking of the good stuff!

Hope all of you guys have managed to get the wetting agents and sprinklers on in the meantime!

The Spring Outing was held over Prestwick St Cuthbert's on April 26 on what was more of a summer's day, the driest April on record I believe!

The turnout for the day ahead was poor although given the good weather following the Easter weekend it's maybe not surprising.

Thanks to all those who did make the journey to the sunny town of Prestwick. Thanks must go to St Cuthbert's for allowing us the use of the course facilities....

Special thanks must go to Richard Fulton and his staff for presenting the course in first class condition!

Results for the day are as follows:- visitor/trade prize-P.Boyd

1st Class. 1. G. Morrison; 2. W. McMeiken; 3. R. Fulton; 4. D. Wilson;

2nd Class. 1. M.Lothian; 2. I. Barr; 3. D. Watson; 4. J. Wilson.

That's the latest news for this month. As usual I ask you to get in touch with any news.

Until next time.

John Mair

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johnmair982@hotmail.co.uk

North

Firstly, may I apologise for there not being any notes in last month's edition. The plain and simple answer as to why this was that there wasn't any news from the biggest Section in Britain to report. If no one contacts me with news then I can't put anything in the magazine. I can't just make stuff up. Sorry, rant over.

We finally managed to get a date for our Spring Outing at Montrose. Back in April the weather was fantastic and Niall Bruce actually consulted his diary and found a day suitable for the outing. I personally think he's been a little side tracked by a certain young lady he's met - but these are purely rumours!

Niall, full credit to you and your squad for presenting the course in the way you did - just toasting perfectly. We had a good turn out as usual and I think that everyone that was there said that the weather and the course made their day.

Here goes with the results: Nearest the Pin. Gary Tough and Neil Sadler

Sweep. 1. Richard Watt; 2. Dave Middleton; 3. Gary Tough; 4. Jim McCormack. Guest Winner. George Bain; Trade Winner. Kevin Peace

Committee. Hugh McLatchie; Veterans'. 1. Jim McCormack; 2. Brian Hunter. Class 3. 1. Brian Hunter; 2. Hugh McLatchie; 3. Mike Braidwood.

Class 2. 1. Richard Watt; 2. Dave Middleton; 3. Richard Pirie. Class 1. 1. Jim McCormack; 2. Derek Green; 3. Fraser Downie. Scratch. 1. Gary Tough; 2. George Mitchell.

I had the pleasure of playing with a certain James