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!

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

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Broad leafed weeds present a rounder, wider, horizontal profile when compared to monocotyledonous plants such as cereals and grasses. The long-term use of certain metal salts, e.g. copper sulphate, could lead to a 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 weed control and encouraged research into the much 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 control weeds in cereal crops by spraying with sulphuric acid 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 0.2% 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 Dr. H.H. Quastel. 2,4-D was the first of the ‘hormone’ type herbicides, several other herbicides, including MCPA, were also developed in the 1940’s and 1950’s. MCPA is generally more effective on the deeper rooting weeds such as Dandelion, Docks and Crabgrass whilst mecoprop gives better control of many smaller leaved weeds such as White Clover, Black Medick.

The suffix –P that appears after MCPA is generally more effective on broad-leaved weeds present exposed to attack by chemicals. Leaved plants are terminal and more of the plant and protected by older leaves. They are mirror images of one another, having the same physical and chemical properties.

The manufacture of mecoprop produces a mixture of two molecules with mirror image properties known as stereoisomers; i.e. both left and right handed forms of the same chemical. MCPA is generally more effective on the deeper rooting weeds such as Dandelion, Docks and Crabgrass whilst mecoprop gives better control of many smaller leaved weeds such as White Clover, Black Medick.

The suffix -P that appears after mecoprop denotes: -
1. The isomeric form of the molecule.
2. How do ‘hormone’ type herbicides kill broad-leaved weeds?

- Interfere with growth processes in the target plant.
- Prevent transpiration causing loss of cooling.
- Corrode aerial parts of the weed.
- Poison the growing tips.
- The phenoxy group is the herbicide ‘chemical hoe’ and member of the group containing florasulam, MCPA and a methyl group (CH3).

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

Broad-leaved weeds present a rounder, wider, horizontal front exposed to attack by chemicals. Of the plant and protected by older sprays, being located in the base of the stem grows faster than the other.

Tom known as ‘epinasty’ where one hormone causes the plant to undergo uncontrolled bending. Hormones.

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, dichlobenil, fenoprop, mecoprop and 2,4,5-T. Many of these herbicides found uses in weed control in the main monocotyledonous crops through the whole of 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, Dock and Cocksfoot. Whist mecoprop gives better control of many smaller rooted weeds such as White Clover, Black Medick.

When certain chemicals are manufactured, the end product can be a mixture of two stereoisomers of the same 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 atoms in their structures but in a different order.

The manufacture of mecoprop produces a mixture of two molecules with mirror-image structure, the so-called ‘+’ and ‘−’ isomers; i.e., both left and right handed forms of the same chemical.

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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, Dock and Cocksfoot, whereas mecoprop gives better control of many smaller rooted weeds, such as White Clover, Black Medick.

The mixture of two stereoisomers 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 the pure solution of the one that is closest to nature's genuine pair.

Modern chemical technology now allows us to manufacture mecoprop that contains only the ‘−’ isomer (mecoprop−) so we can reduce the amount of chemical necessary for the job.

Common Chickweed and Purslane. By careful mixing of two or more active ingredients in a single product, manufactur- ers 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 ‘Supermix’ (now withdrawn) from May & Baker, which combined 2,4-D and mecoprop to control 18 species. However, one positive thing was due to its chemical similarity to 2,4-D it was the first of the phenoxy herbicides but belong to a different chemical group. The HBN herbicides work by interfering with photo- synthesis, a process that occurs in both grasses and broad-leaved weeds and 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 action is not fully understood but research- ers believe that selectivity comes from rapid degradation of the chemical in the same manner as the HBN herbicides.

The rate of discovery of new her- bicides slowed during the latter part of the 20th century with increased public awareness of the need to feed a world at war, for the side effects of exposure to ‘Agent Orange’ were found.

In children and skin problems in the American Forces fighting in the jungles in 1960's Vietnam. Thankfuly we still have a trickle of new chemicals, in nature usually only one stereoisomer of a form is produced so when a pesticide works by mimicking a natural product.