A post pesticide prognosis *for turf patients and carers*

Dr Terry Mabbett continues his thesis on the future of pesticide

It's April 1st (All Fools Day) 2015 and you wake up to find the EU has banned the last remaining chemical used as a pesticide on professional turf.

Ferrous (iron) sulphate applied to turf for centuries to control moss can no longer be used for this purpose although you can still use ferrous sulphate as a fertiliser and buy the tablets from the chemist to boost your blood iron level.

Rooks and crows are watching in a re-run of the iconic 'Hitchcock Movie' [The Birds], ready to tear up your turf and devour this year's exceptionally heavy infestation of chafer grubs. Last year's autumn mists crept up early during the first week of September and unleashed a flood of Fusarium and anthracnose into the turf still stressed from summer drought.

The air [in September] was still full of dandelion parachutes from what had been the biggest country-wide infestation in living memory. Most survived the extra mild winter and are now healthy-looking dandelion rosettes spreading rapidly across the turf still threadbare from Fusarium and anthracnose infections. If this summer is a repeat of 2014, the hottest and driest on record, then it won't be long before the fairways are parched with huge patches of drought resistant weeds taking over.

Those chemicals most sorely missed are herbicides and greenkeepers are now paying the price for others' excesses. There was always a much greater use of the same herbicides by farmers, while application to hard surfaces in the industrial sector caused fast heavy run-off of herbicide into water courses. And greenkeepers need these herbicides now more than ever before, after a series of hot dry summers to stop drought resistant turf weeds including white clover, bird's foot trefoil, yellow suckling clover, black medick, yarrow and now self-heal and cinquefoils taking over completely.

Your erstwhile 'chemical' rep, now something between a snake oil salesman and a witch doctor, has just pulled up behind the club-house in a green van and wearing a green jacket. Joking apart what will you do if virtually all chemical pesticides currently registered for use in managed turf disappear?

Looking back

Greenkeepers with turf 'in the blood' might recall what their grandfathers but that's not far enough back in time, because 'modern' turf

Once Himalayan balsam, the alien invasive weed shown here, gets a foothold it can only be 'shifted' by the use of chemical herbicides.

pesticides like hormone weedkillers (herbicides) were first used in the 1940's. The hormonal herbicide 2,4-D, a British discovery at Rothamsted Research Station in 1942 under the team leadership of Judah Hirsch Quastel, was first commercialised by a paint company in 1946. Not be outdone another paint company in North America commercialised MCPA soon after.

There's not too many greenkeepers still around who can tell you what happened much before 1940. Perhaps that's because the very first turf pesticides developed just after the First World War, and used up until the Second World War and sometimes beyond, sounded like something left over from the Battle of the Somme. There was gas lime, a by-product from the manufacture of coal gas which smelled of moth balls (naphthalene) and rotten eggs (hydrogen sulphide) and used to control chafer grubs into at least the 1930's.

And if that wasn't your particular poison then you could always consult Agatha Christie about 'arsenic and old lace' or 'sparkling cyanide' because both sodium cyanide and hydrocyanic acid were tried, tested and used at the time. Reason why initial commercialisation of hormonal weed-killers was carried out by paint companies was probably due their interest and expertise in arsenic-containing paints.

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Looking forward

There's clearly no safe message or mileage in looking back chemically so the only option is too look forward biologically and culturally by homing in on all the good turf management practice developed and refined by generations of greenkeepers. The 'boffins' call this approach integrated turf management, best of all worlds (cultural, chemical and biological controls) used in combination, but not in a post pesticide world because there will be no chemicals left to integrate.

Professional turf is just what its name implies, an immaculate playing or leisure surface without bare patches, holes, bumps, weed growth and discolouration, and when things do go wrong rapid remedial action is required. Whatever faults chemical pesticides may have they act and deliver quickly compared with biological pesticides. Biopesticides based on living organisms like friendly fungi, benign bacteria and non-naughty nematodes clearly require more exacting conditions (e.g. temperature, moisture and soil pH) and more time to work.

Turf is a perennial ecosystem and on face of things should respond to a balanced long term cultural care package without the use chemical pesticides, but will all the potentially destructive agents in turf, namely insect pests, fungal diseases and weeds, respond well enough. Answer is a qualified yes for fungal diseases and a definite no-no for insect pests and weeds.

Potential turf grass pathogens are always present in the thatch in a benign saprophytic mode, only changing up through the gears into parasitism if conditions, including turf grass species and varieties, soil moisture and fertility, leaf surface wetness and atmospheric humidity, combine in the right way at the right time. All this can be monitored and manipulated by the greenkeeper to his/her advantage but insect pests and weeds arrive from the wider environment outside the golf course affording greenkeepers little if any control over the situation.

Turf diseases

Thatch which is the layer of dead, dying and decaying grass material at base of the sward is the source of most turf disease and its manipulation and management a key solution for disease management in the absence of chemical fungicides. Most mainstream fungal pathogens like Microdochium nivale (Fusarium patch) and Colletotrichum graminicola (anthracnose) are perpetually present in thatch as saprophytes feeding on dead grass material.

They gear up into parasitic mode in response to changing environmental conditions and turf stress, which commonly come together as late summer moves into autumn.

Thatch and root zone soil is also home for the wide range of antagonistic microbes both fungal and bacterial which compete with, consume or secrete natural chemicals to kill potential grass pathogens. Root zone microbes including myccorrhizal fungi recycle root exudates to form a physical barrier against grass root infection.

Thatch is a necessary evil that provides the cushion for turf as a playing and leisure surface. Secret of disease management is to maintain a dynamic thatch kept at a depth appropriate to turf type. A dynamic thatch ensures continual and fast recycling of nutrients for grass growth and health while avoiding high stress, especially during high traffic and wear periods. In addition it will lessen dependence on synthetic fertilizer.

Thatch degradation is accelerated and sustained using physical techniques to boost aeration while number and activity of thatch degrading microbes can be supplemented by inoculants and compost tea. Together with use of disease resistant grass species and varieties and taking measures against those conditions conducive to disease development, by for instance removing surface moisture and reducing shade in the case of Fusarium Patch, disease management in professional turf without use of chemical fungicides becomes a feasible option. That said blemish free surfaces and 'fast fixes' will no longer be an option.

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Turf pests and weeds

UK turf gets off relatively lightly from insect pests (compared with North America). Chafer grubs (Phyllopertha horticola) and leatherjackets (Tipula paludosa) are the only two of any real consequence. Direct damage with severed roots causing loose dried out turf is bad enough, but collateral damage from corvids (rooks and crows) and badgers and foxes tearing up turf to get at the grubs can prove almost terminal. Chafer grubs historically present the worst problem not least because in the period after withdrawal of gamma HCH (lindane) and before approval of imidacloprid there was a gaping hole in the market and even bigger holes in turf.

Biopesticides based on entomopathogenic nematodes are available but being natural enemies they are by definition density dependent factors, dependent that is on the density of the insect pest host. The nematodes multiply gradually with rising numbers of chafer grubs then fall away as the insect pest population is controlled. As such they are not a fast control option. As biological control agents they generally require more exacting conditions than do chemical insecticides. For instance, ideal time for application is when the soil is already moist and soil temperature is within the 12-20°C range. They are clearly not the quickest and most appropriate option for golfing greens already being damaged by predators in late autumn and winter with an important tournament just weeks away

It is difficult to imagine professional turf with an acceptable level of weeds if the current arsenal of approved herbicides is taken away. Damage to turf from disease and insect pests exacerbates weed problems by creating additional niches of bare ground for germinating weed seeds to exploit. Similarly, the disappearance of chemical wormicides would lead to greater worm caste problems and create even more ideal sites for weed seed germination.

Greenkeepers already face several dedicated turf weeds with little or no suitable chemical control available Only a small number of selective herbicide actives provide one-off control of slender speedwell (Veronica filiformis) and there is essentially no selective herbicide for control of field woodrush (Luzula campestris).

Mycoherbicides which are biological control products based on fungal pathogens used to kill specific weed species are used elsewhere against woody weeds such bramble (blackberry) in Australia. However, these highly specific mycoherbicides would be of little use to greenkeepers faced with anything up to a dozen completely different turf weed spe-


Dandelion (dente-de-lion) is already 'showing its teeth' in fine turf


Drought-stricken turf gives a free run to weeds like yarrow shown here


Worm casts and weeds will become two of the biggest problems in turf without the use of chemical pesticides

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This stream flows pristine through a golf course then confronted by some much heavier pesticide users - it runs under railway, across an industrial estate and through miles of wheat and barley fields.

cies at the same time. Visions into the future are turf managers down 'on all fours' digging out weeds just like their great grandfathers did. But this won't work for deep tap-rooted offenders like dandelion and ragwort that produce new plants from fragments of root left in the ground. Some of the most intractable problems will result alien invasive weeds like Japanese knotweed and Himalayan balsam.

Doesn't make sense

The more you look at EU attitudes to chemical pesticides the less it makes sense. The current conundrum around the management of surface casting earthworms and control of the mole (the main predator of earthworms) sums this up in a nutshell.

Naphthalene was traditionally used to deter moles. Turf managers would place mothballs in mole holes to deter digging and tunnelling. Moth balls are freely available and as far as I know you can still put them in the wardrobe to kill cloths moths without ending up in court.

But together with disinfectant and diesel oil (also used to deter moles) it is illegal to use moth balls because under provision of the 'Control of Pesticides Act 1986' there is no approval to use naphthalene as a deterrent against moles. But the EU still allows you to catch and kill moles using wicked looking traps and to wipe them out using phostoxin, a highly toxic gas released when aluminium phosphide tablets deposited in mole holes react with moisture.

The long term future of carbendazim the only chemical wormicide left on the market looks less than secure. One reason is pending reclassification as a 'Biocide' which means carbendazim will eventually be subject to another directive and forced to jump through different and perhaps more difficult hoops to ensure continued use. One of these will almost certainly be environmental in nature and could include any negative impact on soil fauna including earthworms.

The main component of a mole's diet is earthworms and wherever moles are found in number and activity you can bet your bottom dollar that the soil profile is rich in earthworms. The question I often ask is does phostoxin, which is legally allowed as a soil application to control moles, have any deleterious effect on earthworms? I can't find any solid information either way but I would be surprised if it does not.

It really doesn't make sense for EU to dismantle half a century of scientific research and development that has given greenkeepers highly effective and much cleaner and safer pesticides to manage turf diseases, kill turf weeds and manage surface casting earthworms. And at the same time allow such methods to kill moles which are a protected species in some EU countries like Germany. If you can solve this conundrum and come up with a clear and logical answer then please let me know.

There will be no quick and easy solutions to this problem (chafer grubs and collateral bird damage) without chemical pesticides, especially in winter when soil temperature is too low for good biological control agent activity

Drought-stressed turf in July 2010 (southern England) with white clover and birds-foot trefoil (yellow) as far as the eye can see