Using colour to protect woodlands

Ian Willoughby explains how dye markers might be used to reduce pesticide use in woodlands

In Britain today, woodlands are managed for a wide range of objectives, including conserving biodiversity, providing areas for recreation and producing a sustainable renewable resource, such as the paper used to produce this magazines like this one.

The good news is that after centuries of decline, woodland cover of both broadleaves and conifers is expanding. But this hasn't occurred by accident, it's the result of decades of hard graft by landowners, professionals and volunteers alike. As you'll know if you're a gardener, some of the hardest grafting comes when you have to start weeding. Like any other plant, young trees can get swamped by weeds, which compete for scarce resources such as moisture, nutrients and light. In days gone by, great landowners sped along the process of woodland establishment by employing hordes of poorly-paid peasant labourers to weed the trees by hand. In the modern world though, we've had to find different approaches.

In larger woodlands, one of the cheapest ways that has been found to control weeds is to kill them with herbicides. You only spray for a metre or so around each tree, and then only for the first couple of years in a tree's life span, which might extend to several hundred years. However, despite the tiny amounts of pesticide used in woodlands compared with agriculture, there are pressures to reduce what is applied still further. This is particularly the case for woodlands that are signed up to initiatives that aim to independently certify sustainable management, such as the UK Woodland Assurance Standard. In addition to all this, actually using pesticides safely isn't a simple job. You usually need to make sure the spray doesn't touch your trees, and you always need to ensure operators don't get contaminated with the pesticides, and that you only treat the correct size of spot or band of weed vegetation around the tree. All of that is often easier said than done. It's not always simple to tell whether it's sweat or pesticide on the inside of your protective clothing, or to see where you've just been spraying.

CI Acid Blue 9 dries scarlet on green vegetation, but stains dead material blue

A 1% solution of CI Acid Red 73 makes the sprayed area clearly visiible

A niche for dyes

This is where dyes might just have a place. The principle behind their use is to add a dye to the diluted spray mix, so you can make sure the pesticide is going where it's meant to. This has the added benefit of reducing the likelihood of having to go back and repeat the job, hence lessening the overall amount of pesticide used. Ideally you'd want such a dye to be cheap, safe to the operators and the environment, not alter pesticide efficacy and be visible when spraying and for a few days afterwards before completely fading. In addition the dye should be easy to handle, not stain skin or clothing and be water-soluble.

Woodlands cover about 12% of Britain and although only small amounts of pesticide are used relative to other land uses (less than 0.1% of the total active ingredient used in Britain), this still amounts to perhaps up to 12 million litres of diluted spray (pesticide plus water) being applied each year. It is not surprising then that marker dye products are already marketed for use in pesticide sprays. However, when the Forestry Commission looked at some of these commercially-produced dyes we found a problem. Many of the spray marker dyes were designed either for use as turf colorants or for use with pesticides at low application volumes. We found that these commercially available colorants usually weren't so good in higher volume sprays (200 litres of diluent applied per hectare) on the mixed herbaceous vegetation present on woodland replanting sites. The colorants were visible if used at higher-than-recommended concentrations, but this made them prohibitively expensive.

Expert advice

So, we looked for alternatives. But where to start? We knew very little about the science of colorants and there appeared to be hundreds of different types and colours to choose from. We approached the SDC, the Ecological and Toxicological Association of Dyes and organic pigment manufacturers (ETAD), Leeds University and a pesticide manufacturer, Monsanto, for ideas. Colour was obviously important – green dye will not show up well on green foliage. People's perceptions of a dye colour also change as it dries; a red dye on green foliage appears brown as it dries.

We also needed to consider safety, but information on the environmental fate of dyes was difficult to come by. The UK Pesticides Safety Directorate (PSD) of DEFRA advised us that dyes used as pesticide markers are not covered by pesticide regulations. However, it seemed prudent to restrict ourselves to dyes used in cosmetics or food, on the basis that they have already been tested by EC expert committees for toxicological safety, and the PSD views them as safe to use when formulating pesticides. This meant we had to reject CI Basic Violet 10 (Rhodamine B), a promising candidate up to this point.

Marking territory

We took dyes from our new list and tried spraying them at different dilutions at a volume rate of 200 l/ha on various site types to see how visible they were, as we had with the commercially available dyes. Eventually, we concentrated on two dyes: CI Acid Red 73 and CI Acid Blue 9, a blue dye already used to mark stumps in woodlands. CI Acid Blue 9 at 1% of the final spray was highly visible when wet and immediately after drying. After 48 hours, it was still well visible on bare ground or woody debris, but had started to fade on vegetation. After a period of seven days with 5.6 mm of rainfall it had faded completely. CI Acid Red 73 was again highly visible when wet, particularly on bare ground and dead material. However, a disadvantage of red dyes for this type of use is that they are not as distinct if you are red/green colour-blind, as are around 20% of the male population.

Finally, we tried mixing the dyes with various pesticides to see if they had any effect on efficacy. There was a suggestion that if relatively resistant weeds are treated, or spray distribution is poor, or low rates of herbicide are used, dyes may significantly reduce efficacy, particularly of herbicides that act through contact with plant foliage.

The solution

In the end, we thought CI Acid Blue 9, which is available cheaply in liquid form, was a particularly promising candidate as a marker dye for dilute pesticide sprays, in order to better target and reduce overall pesticide use. Time will tell whether or not woodland managers choose to use marker dyes such as this on a large scale. In the meantime, perhaps a dye specialist out there might be able to come up with a better solution?

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