Investigating pesticide photodegradation in plastic-protected growing environments: development of a pesticide action spectrum

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Introduction

Soft fruit and salad crops grown under some sort of protection are a highly valuable part of the horticultural/agricultural economy. For example, in 2008, the total value in the UK of production of ‘protected’ vegetables (i.e. those grown under plastic or glass) was approximately £282M. However, concern by supermarkets and consumers over post-harvest pesticide residues warrants research into the fate and longevity of pesticides used within these environments.

Material and methods

To investigate this we examined the photochemical degradation of a number of photolabile, current-use pesticides under agricultural plastic films that possess different spectral properties. Speciality plastics, for example, may be engineered to inhibit or allow transmission of different parts of the solar light spectrum to aid crop growth/performance and therefore, in turn, may affect rates of photochemical loss.

Results

Our results show that the aqueous degradation of a selection of chemicals including fenitrothion (organophosphorus insecticide), pirimicarb (carbamate insecticide), cypermethrin (pyrethroid insecticide) and cyprodinil (anilinopyrimidine fungicide) were significantly reduced under standard and UV-opaque plastics compared to UV-transparent and no-plastic controls. As photochemical loss is an important degradation route for many pesticides, then this is likely to result in the enhanced longevity of these chemicals within plastic-protected environments. By carefully measuring the light irradiances during these experiments - conducted under both ambient and simulated sunlight - the rates of loss and chemical half-lives was investigated for different spectral band widths in the UVA and UVB regions of the light spectrum. This has allowed the development of a ‘Pesticide Action Spectrum’ (PAS), Figure 1, which relates the pesticide degradation to the effective light dose over different wavelengths or regions of the light spectrum. This approach provides a useful tool to aid pesticide use management not only in different plastic-clad structures, but also for any given light conditions (i.e. different global latitudes).
Figure 1. The 'Pesticide Action Spectra' for fenitrothion.

References