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This research project aims to investigate occupational exposure to pesticides using aerosol technologies among amenity horticulturalists. Aerosol technology studies aerosol behaviour and applies this knowledge to measurement and control (Hinds, 1982). Pesticides were sprayed using booms sprayers, hand held lances and with pressurised lances which were grouped into four similar exposure groups. Previous research has found that up to 99% of exposure is due to dermal absorption (Aprea et al., 2005; Flack et al., 2008; Tuomainen et al., 2002; Vitali et al., 2009), so biological monitoring was chosen to determine total body exposure. Biomonitoring protocols were created, which were reviewed and approved by the National University of Ireland, Galway's Ethical Committee. Biomonitoring was conducted by taking urine samples of workers before the task began and within one hour of the task completion, for the chemicals glyphosate and fluroxypyr. 40 paired samples of two substances were collected, 80 samples in total. The Health and Safety Laboratory (HSL) in the United Kingdom developed a novel analytical method for the analysis of the urine samples for the project.

Results from this study show a potential risk for exposure among amenity horticulturalists using small quantities of pesticides. For both glyphosate and fluroxypyr, workers had elevated urinary pesticide levels above what would be expected from dietary exposures. There is no human biomonitoring data available for the non-occupationally exposed Irish population but the mean exposure values in this study are  $1.35 \mu\text{g L}^{-1}$ , which are higher than mean values of  $0.21 \mu\text{g L}^{-1}$  reported in an European environmental exposure study (Hoppe, 2013). The maximum values in this study,  $10.66 \mu\text{g L}^{-1}$  are also higher compared to maximum urinary glyphosate concentrations,  $0.41 \mu\text{g L}^{-1}$ , reported by Conrad et al. (2017) for German adults with no specific occupational exposure to glyphosate.

Further research is warranted to investigate 24 hour exposures and to identify factors that are contributing to total body burden of the pesticides. A biological monitoring study incorporating 24 hour sampling and dermal wipe samples from the hand, the perioral region and contaminated objects will be conducted, to determine the route of exposure for glyphosate and fluroxypyr compounds. Contextual information will also be collected including information on the type and frequency of hand to mouth contacts to investigate the relationship between dermal exposure and inadvertent ingestion exposure. Ethical approval has already been granted for this second study from the National University of Ireland, Galway's Ethical Committee.

A fluorescent dye pilot study was also conducted to evaluate the feasibility of conducting a qualitative exposure study in the field. Fluorescent tracer studies are often used to identify and quantify routes of dermal exposure (Aprea et al., 2005; Flack et al., 2008; Honeycutt, 1986; Tuomainen et al., 2002; Vitali et al., 2009), which involves mixing a pesticide product with a fluorescent dye, only visible in the long-wave ultraviolet (UV) light spectrum. The pattern of contamination can be used to infer the route of exposure (Cherrie et al., 2000), whether it is from emission, deposition and surface transfer (e.g. small droplet from deposition of aerosolised pesticides, smears from surface transfer). A larger study has been scheduled for 2017, to obtain better quality images to display contamination for research and to be used as a training tool for workers.

I presented a poster at the UK Irish exposure science meeting in Brixton in April 2016. I attended the International Exposure Science meeting in the Netherlands in October 2016 where I presented a poster presentation and an oral presentation. I will also be presenting an oral presentation to the Colt Foundation in the King's College London in January 2017. I hope to attend the International Symposium on Biological Monitoring and the Annual Aerosol Science Conference 2017.

**References:**

- Aprea, C., Terenzoni, B., De Angelis, V., Sciarra, G., Lunghini, L., Borzacchi, G., Vasconi, D., Fani, D., Quercia, A., Salvan, A. and Settimi, L. (2005) 'Evaluation of skin and respiratory doses and urinary excretion of alkylphosphates in workers exposed to dimethoate during treatment of olive trees', *Archives of Environmental Contamination and Toxicology*, 48(1), 127-134.
- Cherrie, J. W., Brouwer, D. H., Roff, M., Vermeulen, R. and Kromhout, H. (2000) 'Use of qualitative and quantitative fluorescence techniques to assess dermal exposure', *Annals of Occupational Hygiene*, 44(7), 519-522.
- Conrad, A., Schröter-Kermani, C., Hoppe, H. W., Rütther, M., Pieper, S. and Kolossa-Gehring, M. (2017) 'Glyphosate in German adults – Time trend (2001 to 2015) of human exposure to a widely used herbicide', *International Journal of Hygiene and Environmental Health*, 220(1), 8-16.
- Flack, S., Goktepe, I., Ball, L. M. and Nylander-French, L. A. (2008) 'Development and application of quantitative methods for monitoring dermal and inhalation exposure to propiconazole', *Journal of Environmental Monitoring*, 10(3), 336-344.
- Hinds, W. C. (1982) *Aerosol technology : properties, behavior, and measurement of airborne particles*, New York ; Chichester Wiley.
- Honeycutt, R. C. (1986) 'NACA overview on assessment of mixer-loader-applicator exposure to pesticides', *Toxicology Letters*, 33(1-3), 175-182.
- Hoppe, H. W. (2013) *Determination of glyphosate residues in human urine samples from 18 European countries.*, Internal Medical Laboratory Bremen, German. Report, unpublished.
- Tuomainen, A., Makinen, M., Glass, R. and Kangas, J. (2002) 'Potential exposure to pesticides in Nordic greenhouses', *Bulletin of Environmental Contamination and Toxicology*, 69(3), 342-349.
- Vitali, M., Protano, C., Del Monte, A., Ensabella, F. and Guidotti, M. (2009) 'Operative Modalities and Exposure to Pesticides During Open Field Treatments Among a Group of Agricultural Subcontractors', *Archives of Environmental Contamination and Toxicology*, 57(1), 193-202.