Silicone wristbands detect individuals’ pesticide exposure in West Africa

Carey E. Donalda, Richard P. Scotta, Kathy Blaustinb, Mary L. Halbleibb, Makhfousses Sarrc, Paul C. Jepsonb, and Kim A. Andersona

*Food Safety and Environmental Stewardship Program, Environmental and Molecular Toxicology Department, Oregon State University;  †Integrated Plant Protection Center, Oregon State University;  ‡United Nations Food and Agriculture Organization, Dakar, Senegal

BACKGROUND

- Pesticide production is expected to increase with food demand of rising global population.
- Pesticide production is expected to increase with food demand of rising global population.
- Pesticides are greater for African farmers as a result of handling practices, unnecessary use, and the availability of banned and unauthorized pesticides (Jepson et al. 2014)
- Pesticides are greater for African farmers as a result of handling practices, unnecessary use, and the availability of banned and unauthorized pesticides (Jepson et al. 2014)
- Development of sensitive, easy-to-use exposure device will aid in future risk assessments

AIMS

1. Further demonstrate the utility of new personal wristband passive sampling technology in combination with an enhanced pesticide analytical method
2. Quantify pesticide exposure among a representative population of West African farmers & identify demographic risk factors associated with increased exposures

METHODS

- Silicone wristbands (SiliconeWristband.com, mass = 4.3 ± 0.4 g) were tested condition for 20 hours to remove volatiles and impurities
- Recruited 30 male and 5 female participants, aged 15–63, all involved in farming
- Each wrist was worn for two periods (up to 16 days)
- Wristbands were:
  - triplicates (n=2) in individual PTFE bags, cleaned with isopropyl alcohol
  - worn on non-fingga passive samplers (static collection)
  - each participant’s wristbands were analyzed with GC-MS using a 12x Extraction Method
  - non-parametric statistical analysis to compare concentrations between period worn (Wilcoxon rank sum test)

RESULTS

- 70 wristband samples collected, with 100% participant compliance
- Concentrations are reported as ng/g wristband and represent a composite inhalation and dermal exposure
- Concentrations of one pesticide are comparable among participants
- Conclusions from each participant’s wristband were not different (signed rank test, p-value < 0.05, Figure 1)
- Deltamethrin and cypermethrin were detected most frequently (Figure 1)

- 50% of compound detections were insecticides, of which 48% are pyrethroids
- 20 pesticides were detected in 1 or more wristband in the 63 analyte method (Figure 1): each wristband held between 2 and 10 detected compounds
- Deltamethrin and a-cypermethrin had higher frequencies in male participants’ wristbands than female participants’ wristbands (Wilcoxon rank sum test, p-value < 0.05, Figure 1): males had higher concentrations of two compounds
- Exposure profiles are visualized in Figure 1

CONCLUSIONS

- The analytical method and easy-to-wear wristbands provided sensitive and highly individualized pesticide exposure profiles
- Differences between genders are limited, but male participants had higher concentrations of two compounds
- Future applications in West Africa include correlating exposure profiles with health outcomes

Acknowledgements:

This project was supported in part by awards to OSU-EPSCoR from the U.S. Department of Agriculture, National Institute of Food and Agriculture (grant number 2016-02327), and the U.S. Department of Energy (grant number DE-SC0006572). The content is solely the responsibility of the authors and does not necessarily represent the official views of the U.S. Department of Agriculture, National Institute of Food and Agriculture, or the U.S. Department of Energy.

References: