

Analysis of Environmental Pesticides in Asia

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Introduction

- Pesticide pollution follows use and production
- Largest agricultural areas
 - China
 - India
 - South-East Asia
 - Korea
 - Pakistan
- Largest Pesticide Producers
 - India
 - China



Harmonization?

- Unlike the EU, no consistent regulation for all of Asia
- Southeast Asia → Food and Agricultural Organization of the United Nations (FAO)
- China and India running their own methods
- Different areas are analyzing their local pesticides
 - Exception : export crops may follow importer' s regulations



MINISTRY OF ENVIRONMENT AND FORESTS
Government of India

Analysis of Pesticides - China

- Largest consumer and second largest producer of pesticides in the world
 - Produces 850,000 tons/year
 - 2,600 manufacturing facilities
 - \$190 Billion in agricultural business
- Immediate focus is on manufacturing safety
 - Largest exposures are reported to blowing dust, poor storage at manufacturing and local use levels
- Little use of protective equipment while applying pesticides
 - Does result in contamination and spills



Analysis of Pesticides – China (cont.)

- Environmental contamination is monitored by State Environmental Protection Administration (SEPA)
 - Established in 1988
- Specifics are left to each state
- Regulations are still evolving
 - Fipronil used on rice killed nearby shrimp farms
 - Carbofuran used has proven detrimental to red-crowned cranes
 - Aldicarb has resulted in large scale contamination of ground waters
- Environmental samples are analyzed like food samples, often in the same facilities



Analysis of Pesticides – China (cont.)

- Ministry of Agriculture regulates nearly 400 residue limits (crop based)
- Each province responsible for testing residues within the province (54 units doing testing)
 - Some state labs, some working with universities
 - Most using GC or LC (non-MS)
 - Oversight and enforcement not consistent
- Main focus is food for export, not environment
- Trailing production of new pesticides
 - >2500 new pesticide products since 2005.



China Summary

- Environmental analysis is required at the federal level, but specifics are left to the state levels.
- As of 2011, LC and GC were most common, but not for long
- Analysis is continually evolving, but mainly internally
 - Based upon exposure and experience
 - Methods and state regulations were reactionary
- Implementing strict regulations for food exports
 - When will environmental regulations catch up?



Analysis of Pesticides - India

- Sixth largest producer of pesticides
 - 85 Million metric tons (2011), \$3.8 Billion
 - 55% are for export
 - Insecticides account for most production
- ~25 % of arable land registered as using pesticides



Analysis of Pesticides - India

- Insecticide Act, 1968 and the Insecticides Rules, 1971
 - Prevention of risk to human beings and animals
- Environment Protection Act, 1986
- Though rules exist, education and enforcement is very limited
 - Use of illegal pesticides
 - Spills, storage leaks, and illegal disposal
 - Farmers looking for immediate results
 - Labeling and usage not monitored
 - Monocrotophos kills 23 school children in June, 2013



Analysis of Pesticides – India (cont.)

- “According to the Alliance for Sustainable and Holistic Agriculture (ASHA), out of the top 15 most-consumed pesticides in India, 11 figure in the list of 67 globally-banned pesticides.”
- Testing does occur
 - GCMS screening methods for 240+ pesticides that vary depending on the crop
 - Soil and water samples are also run, though rare
 - Insufficient infrastructure to adequately monitor
 - Most crops are locally grown by family farms



India Summary

- Testing procedures do exist and are relatively advanced.
 - GCMS is used, as well as ECD and NPD
- The frequency of food and environmental testing is sorely lacking
- Regulation focuses more on quality of pesticides than detection of residues or environmental contamination



South East Asia

- Recent collaboration under FAO from 2000
- Cambodia, Indonesia, Malaysia, Philippines, Thailand, Vietnam, Singapore, Lao Peoples Democratic Republic, Myanmar
- All countries were not consistent
 - Lists of pesticides
 - Procedures
 - Quality Control
 - Resources
- Pesticides were illegally being imported from other countries
- Harmonization based upon input from other organizations and documents (US FDA, EU, OECD, NAFTA, etc...)
- Programs approve, register, and monitor pesticides
- Continual work in progress (2000-2011+)



Trends by Country

- Malaysia – nine labs (1,000 samples / year; 2-3% > MRL)
 - Following Environmental Quality Act 1974 (air and waste)
 - Environmental Quality Act 1985 (waste from factories)
 - Food Act 1983
 - Department of Environment monitors the effects of pesticides in the environment
 - chlorpyrifos, profenophos, fenvalerate, cypermethrin, cyfluthrin, ethion, prothiophos, phosalone, dichlorvos and dithiocarbamate



Trends by Country

- Thailand – nine labs (60,000 samples / 8 years; 2-5% > MRL)
 - GC, LC, GCMS, LCMS
 - cypermethrin, chlorpyrifos, profenophos, triazophos and dimethoate
- Phillipines – six labs (4,300 samples / year; 2-4% > MRDL)
 - GC, GCMS, LC
 - cypermethrin, chlorpyrifos, profenophos and permethrin
- Vietnam – five labs (5,000 samples / year; 9.5% > MRL)



Summary Southeast Asia

- Some countries have previously developed methods
- Not everyone is at the same point
- Not all countries have the infrastructure to monitor domestically
 - Myanmar, Lao PDR, Cambodia
- Pesticides methods are still being harmonized
 - Resources and information are being shared

Korea

- Not officially participating in FAO program
- Have a developed pesticide program for foods and feeds
- Rather low rate of foods above MRL (<1%)
 - Farmers are notified of positive tests, resulting in probation
 - Testing at field, transportation, and retail sites
 - Testing for 252 compounds over 41 crops



Japan

- A significant user of pesticides (~150,000 tons/year)
- Are a significant producer of pesticides (sixth in world)
- Import 34 million tons of agricultural products annually
- Developed program for testing toxic compounds for imported products
 - 2006 introduced a positive list of 758 compounds
 - Most are pesticides (~600)
 - Provided MRL based upon Codex toxicity data
 - Some compounds cannot be found at any levels
 - Each year approx 150 chemicals are re-examined



Testing???

- A Japanese import company is typically primarily responsible for import quality.
 - Exporter can test and certify through approved labs
- There is no one method to test for all of these compounds
- Some compounds are not amenable to GC
- Some compounds are not amenable to LC
- Both approaches are being used in parallel to achieve the greatest coverage



Positive List Testing

- Utilize both GC/MS and LC/MS/MS methods
- Japanese Ministry of Health, Labour, and Welfare (MHLW) provides methods for detection
 - >260 pesticides by GC/MS with SIM conditions, retention indices, ions, and detection limits.
 - 42 pesticides by LC/MS/MS with conditions, retention times, ions, and detection limits
 - 25 additional pesticides by LC/MS/MS
 - Provide extraction methods from vegetables, animals, fats, honey, milk, etc...



Further Information

- GC/MS methods have been published that analyze and quantitate >400 pesticides
- LC/MS/MS methods published identify and quantitate >160 pesticides
- There are analytical labs in the US that test for the positive list compounds
 - 3 Official labs
 - 23 Registered labs



Scope of Pesticides Analysis

- Though environment is a priority, environmental analyses are not always separate
- Many regulations cover Water, Food, and Feed
 - Little mention of soils
- Most requirements are performance based and DON' T provide analysis guidelines
 - No column
 - No extraction technique
 - No analysis technique
 - Only safety levels

Trends of Pesticide Analysis

- This lack of prescriptive methodology has allowed methods to evolve
- Instrumentation is shifting from GC/ECD and GC/NPD to GC/MS and LC/MS/MS
- Analyte lists are growing
- Nobody has currently the full answer
 - If they did, it would already be out of date

Questions?

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