ENVIRONMENTAL HEALTH SCIENCE RESEARCH CENTER

Neonicotinoids: IMPLICATIONS FOR PUBLIC HEALTH

INTRODUCTION

Neonicotinoids ("neonics") are a relatively new class of systemic insecticides that, prior to the 2000's, were virtually unheard of; today, they are the most widely used class of insecticide in the world.[1] Despite the scale of their use, little research has been done on their impacts to human health.[2] Spurring renewed interest in these insecticides is their recent discovery in treated drinking water for the first time in Iowa in 2017.[3,4] What are Neonics, and what do researchers know about them?

FIGURE 1: COATED CORN SEED

SYSTEMIC MECHANISM OF ACTION

Named for their chemical similarity to nicotine, these insecticides selectively target the nicotinic acetylcholine receptors (nAChRs) in insects, and were therefore through to be less harmful to humans and other vertebrates. They are an entirely new type of pesticide, designed in the 90's to replace toxic organophosphate and carbamate insecticides.[5] While several chemical structures exist, the four most commonly used in agriculture are imidacloprid, clothianidin, thiamethoxam, and acetamiprid.[1,3,] Neonics are systemic in design, transfusing throughout all parts of a treated plant (leaves, roots, produce, pollen and nectar); they are highly effective against hard-to control sucking, boring, and root-feeding insects.[1] However, unlike most other pesticides, neonics cannot be washed off produce prior to consumption and have been found in fruits, vegetables, and in byproducts of crops treated with neonicotinoids.[1]

PERVASIVE USE

Neonic use has increased dramatically in the past decade. They are widely used in agriculture, horticulture, and forestry sectors, and in hundreds of crops and applications: from fruits, vegetables, and grains, to pest control on pets and livestock and household pest management.[1] The most common application of neonicotinoids is a seed coating which is absorbed by the plant during germination.

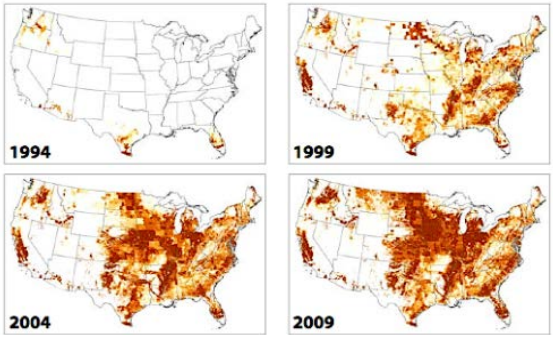

FIGURE 2: 15-YEAR CHANGE IN NEONICOTINOID USE IN THE UNITED STATES

Currently more than 90% of all corn and 44-50% of soybeans are grown from seeds coated with neonics.[1] Other application practices take advantage of these chemicals' high water solubility

and can be applied via irrigation or spraying. Between 140 and 200 million acres are treated with 4 million pounds of neonics annually in the United States alone.[1]

There is significant industry pressure to continue to produce and use these substances. Treated seeds alone are worth approximately $1.4 billion to the United States economy, and their use is likely to continue to grow.[1,4]

PRESENCE IN THE ENVIRONMENT

Roughly 2% of neonics applied via seed coating are up-taken by the plant. Another 2% is volatilized in the air, and the remaining environmentally-persistent 96% remains in the soil[5]—as mentioned above, neonics are very water soluble and freely transport into surface and groundwater.[3,5] In 2017, trace amounts of neonics were found in finished drinking water in Iowa, raising the concern of public health practitioners.[5] Neonics have also been found in non-target plants, vertebrate prey, wetland ecosystems, and food by-products common to the American diet.[1] Neonicotinoids have also been linked to honeybee and local pollinator extinctions.[5]

HUMAN HEALTH IMPACTS

Though neonicotinoids have reached a critical mass in agricultural application, only a handful of studies have been conducted, and many are methodologically weak.[1,2] Despite the limited research available, there is emerging evidence that these insecticides could negatively impact humans and other vertebrates. Sub-lethal doses have been implicated in recent in vitro and in vivo studies, in addition to ecological field studies, for having adverse effects on mammals.[1] More troubling still, certain neonic metabolites have been found to be similarly or more toxic than the parent compound.[5] What little research does exist implicates endocrine effects, central nervous system disorders, and other reproductive and developmental effects.[1]

SUMMARY

Though environmentally persistent and ubiquitous in use, the human health implications of neonics remain mostly a mystery to researchers.

Resources:

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5. Perry MJ. Neonicotinoid Pesticide Exposure, Mechanisms of Action and Human Health Outcomes. 2017. Collaborative on Health and the Environment. https://www.healthandenvironment.org/partnership_calls/95106

Photo credit:

1. Marcotty J. Fields of Green a Desert for Bees. 2014. Star Tribune. Retrieved from: http://apps.startribune.com/news/bees/part3.html
2. USGS. 2017. National Water-Quality Assessment Program Pesticide National Synthesis Project. Retrieved from: https://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=2014&map=IMIDACLOPRID&hilo=L

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