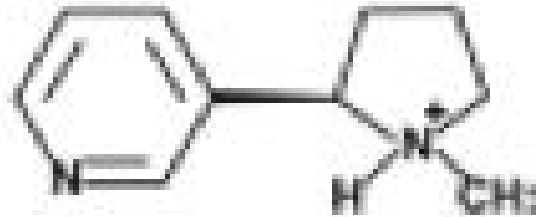


# NEONIC INSECTICIDES: THE NEW DDT



# NEONICOTINOID INSECTICIDES = NEW NICOTINES

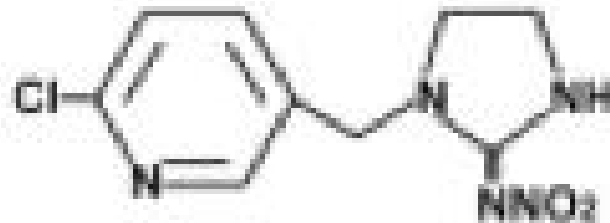
A. Nicotine



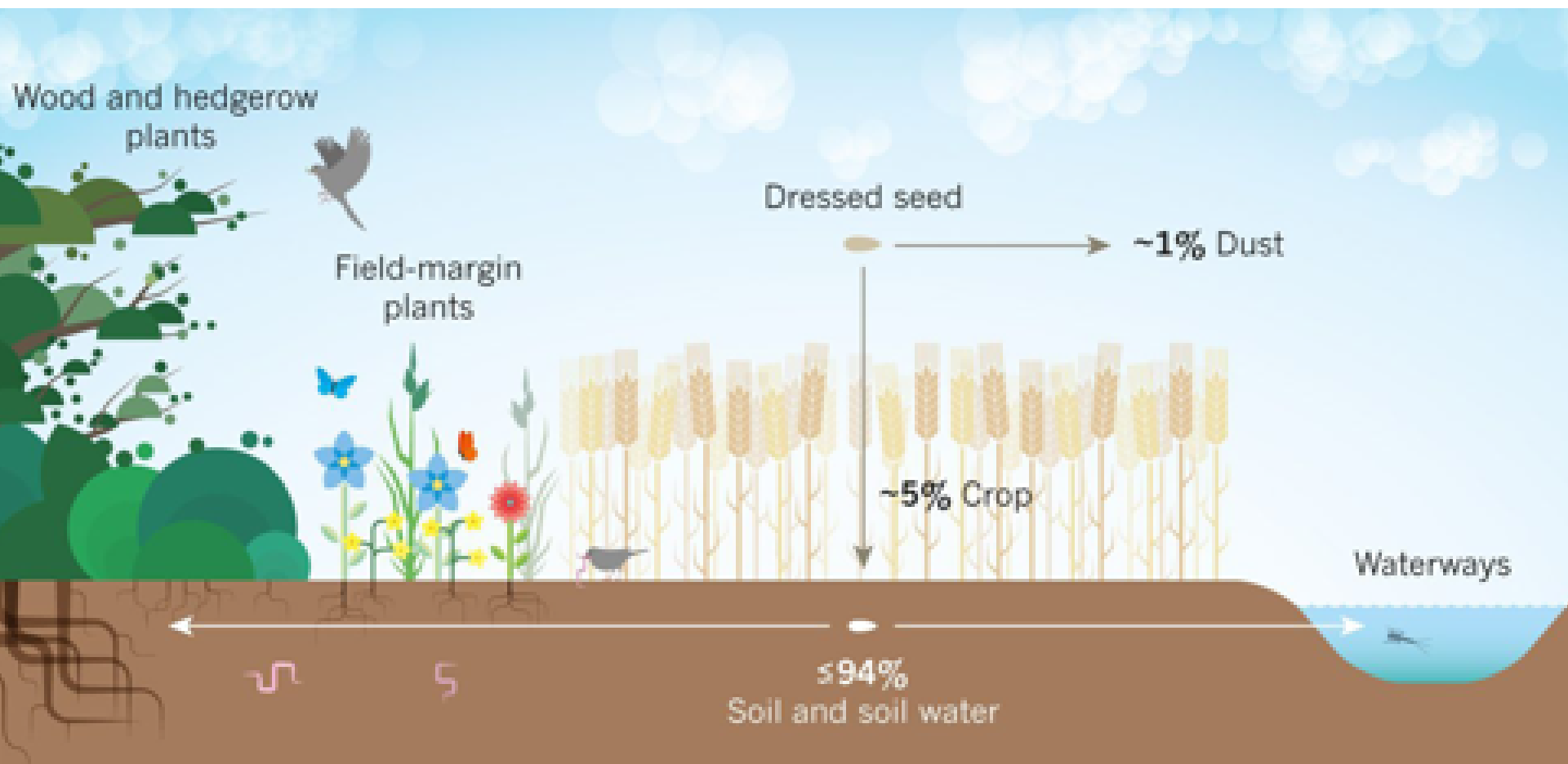
B. Neonicotinoid ACE



C. Neonicotinoid IMI

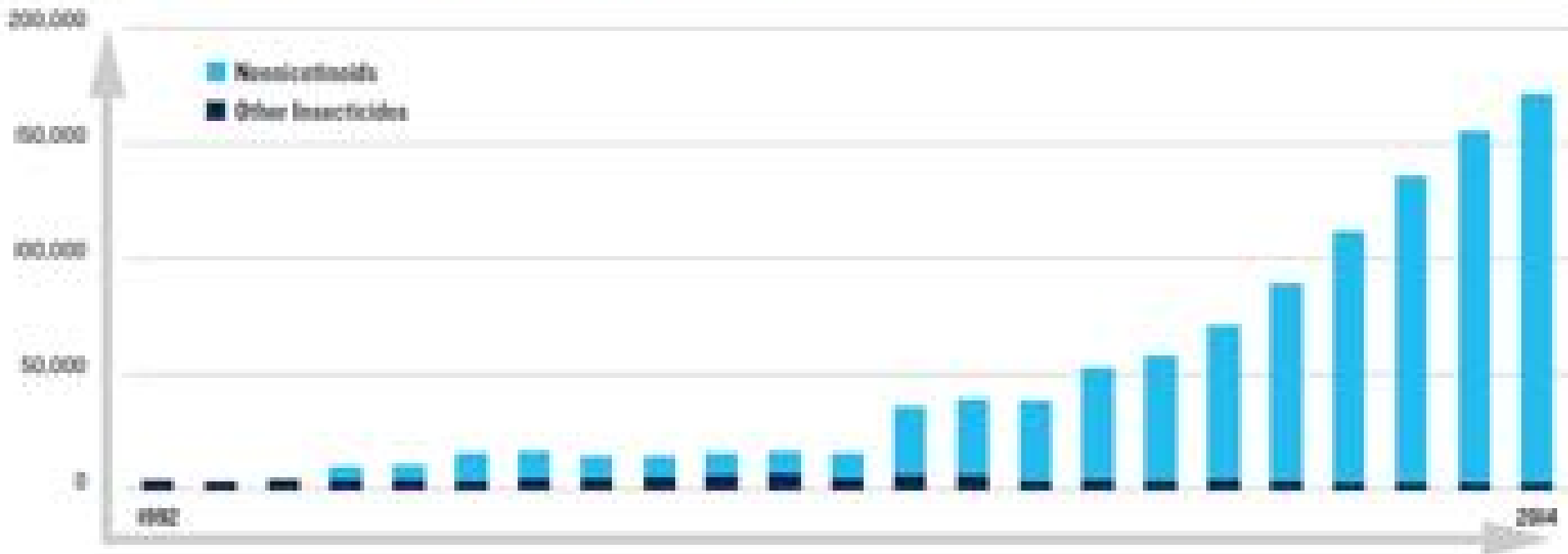






TOTAL ACUTE ORAL INSECT-TOXICITY LOAD OF INSECTICIDES IN U.S. AGRICULTURE BY YEAR (IN LD<sub>50</sub>-DAYS)

U.S. AGRICULTURE IS **48 TIMES MORE HARMFUL** TO INSECT LIFE NOW THAN 25 YEARS AGO—WHEN USING NEONIC PESTICIDES USE BEGAN



Data from Michael D. Williamson et al., "An Assessment of Acute Insecticide Toxicity Loading (AITL) of Chemical Pesticides Used in Agricultural Land in the United States," *Environ. Sci. Technol.* August 4, 2019.

	DDT	NEONICOTINOIDS
Name(s)	Dichlorodiphenyltrichloroethane	Multiple “neonics”: imidacloprid, thiamethoxam, clothianidin, thiacloprid, dinotefuran, acetamiprid, nitenpyram and sulfoxaflor
Chemical Properties	Lipophylic	Hydrophilic
Mode of Action	Stimulates nerves	Stimulates nerves and interrupts nerve and cell communication
Active Breakdown Products	Primarily DDE	Multiple
Half-life in Soil	2-15 years	1-15 years or more
Primary Harmful Impacts	Hollowing out of ecosystems	Hollowing out of ecosystems
Probable Human Impacts (acute)	Relatively non-toxic at low doses	Mimics acute nicotine toxicity: tremors, excitability, increased blood pressure, seizures, and death
Probable Human Impacts (chronic)	Carcinogenicity, reproductive	Teratogenicity, reproductive, neurological (note: nicotine is correlated with microcephaly in lab studies and increased incidence of cleft lip and palate in humans)
Public Attention	Thinning of egg shells in bald eagles (at risk of extinction) → “Silent Spring”	Reductions in pollinator and bird populations (possibly bats) → Pollinator, bird, environmental, health groups
Actions to Restrict Use	Federal and International	Individual US states (NY, NJ, MA)
Presence in Environment	Decreased to negligible in US	Increasing across the US (banned in Europe, restricted in Canada)

# HOLLOWING OUT OF ECOSYSTEMS

*Experiments in the Wild and  
“Natural Experiments”*

- Worms and soil organism
- Amphibians and reptiles
- Aquatic invertebrates and fish
- Small Mammals (mice, rats, rabbits)
- Large Mammals (white-tailed deer)
- Humans?



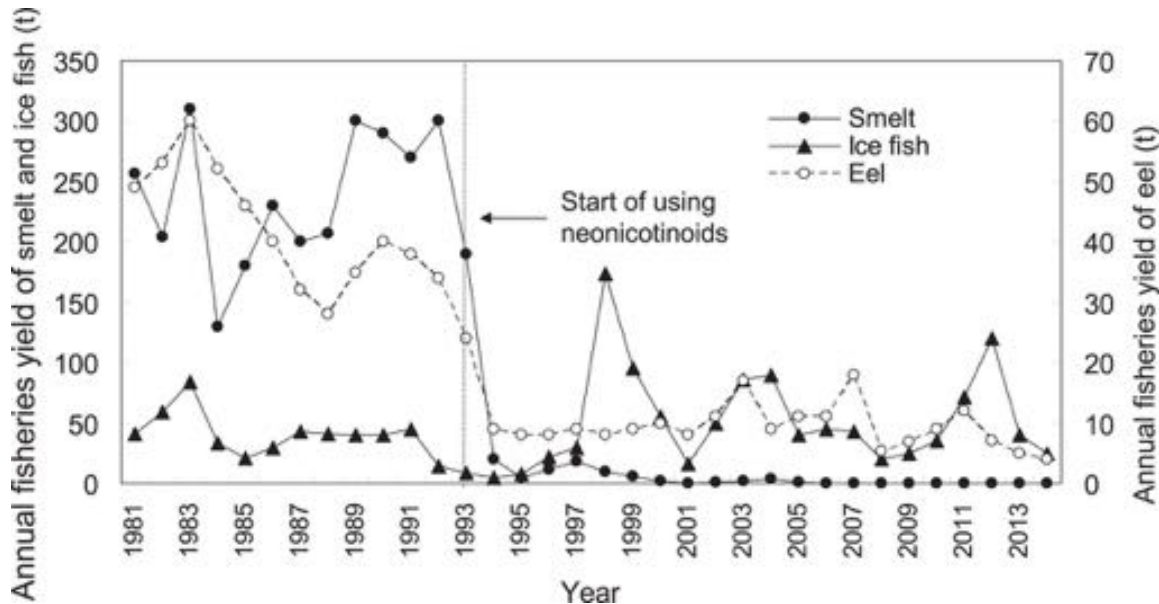
# WORMS AND OTHER INHABITANTS OF SOIL

- **Necessary for agriculture**
- **Wide varieties**
- **“Pesticides used in crop management are known to be most over-purchased and irrationally used soil toxicants....”**
- **Among the six chemical classes of insecticides, “... the neonicotinoids are the most toxic to Eisenia Foetida [an earthworm adapted to decaying organic material]”**



# FISH AND AQUATIC ORGANISMS

- “Natural experiment” in Japan
- Plankton, eels, ice fish, and smelt
- “Toxicity of multiple neonicotinoids seems to be synergistic in aquatic systems.”
- Bioaccumulation (in food/prey)



# WHITE-TAILED DEER

- **Field observations in Montana: abnormal development of genitalia and abnormal jaw length**
- **Controlled experiments in South Dakota (neonics in water of penned deer)**
- **Baseline exposure in “controls”**
- **Decreased survival, activity, size, and health of offspring (immune suppression)**
- **Bioaccumulation (from crops?)**



# PEOPLE

- **Acute Toxicity**
- **Chronic Toxicity**
- **Case Studies**
- **Case-control Studies**
- **Troubling, “Suggestive” Findings**



“Four ... studies reported associations between chronic neonatal exposure and adverse developmental or neurological outcomes, including tetralogy of Fallot..., anencephaly ..., autism spectrum disorder ..., and a symptom cluster including memory loss and finger tremor....”





## EVIDENCE OF INCREASING EXPOSURES IN HUMANS

- CDC finds half of Americans exposed to neonics on any given day (2016 data). Ospina et al. (2019)
- **Environmental influences on Child Health Outcomes (ECHO): 2022 study of 171 pregnant women finds neonics in 94%, with increasing frequency and levels over course of study (2017-2020) and higher rates in Hispanic women. Buckley et al. (2022)**
- Exposure linked to:
  - Birth defects in heart and brain
  - Autism-like symptoms
  - Decreased sperm quantity and quality
  - Decreased testosterone, altered insulin regulation, and changes in fat metabolism

# RECOGNIZING PATTERNS

- Chemistry: structure = “new” nicotine-like substances
- Toxicologic profile: highly potent, highly toxic (lethal to many species, including insects, birds, bats, fish, and soil organisms)
- Mechanism of action: interrupts neurotransmission (cell-to-cell communication); possible Endocrine Disrupting Compound —> teratogenic (causing congenital malformations)
- Ecological impact: hollowing out of ecosystems
- Animal studies: developmental abnormalities, congenital malformations, and decreased survival in large mammals
- Human studies: highly troubling, in parallel with animal studies
- Risk/benefit profile: extremely high risk, very low benefit

