

Supplemental Materials

A critical review on the potential impacts of neonicotinoid insecticide use: current knowledge of environmental fate, toxicity and implications for human health

There are over 1000 U.S. Environmental Protection Agency (EPA) primary and supplementary registered neonicotinoid-containing products on the market. The EPA allows primary registrants to distribute or sell their registered product under another company’s name or their name. The distributor, or sub-registrant, product is referred to as a “supplemental registration” or “distributor product.” As of August 2019, there were 58 primary registrants (50 sub-registrants) for acetamiprid, 44 primary registrants (50 sub-registrants) for clothianidin, 59 primary registrants (26 sub-registrants) dinotefuran, 460 primary registrants (407 sub-registrants) for imidacloprid, and 66 primary registrants (42 sub-registrants) for thiamethoxam.¹ Examples of other agricultural and non-agricultural uses for the neonicotinoids are presented below.² Updated information on currently approved uses for EPA registered pesticides are listed in the EPA supporting documents at the EPA’s Schedule for Review of Neonicotinoid Pesticides website.²

Table S-1. Examples of Agricultural and Non-Agricultural EPA Registered Uses of Neonicotinoids ^a

Neonicotinoid	Agricultural Uses		Non-Agricultural Uses	
Acetamiprid	asparagus bush berries cane berries citrus clover grown for seed cotton crops grown for oil edible-podded legumes forage crops (alfalfa, clover) forest trees head and stem cole crops	low growing berries onions and other bulbs vegetables ornamental and flowering plants pome fruit soybeans stone fruits succulent shelled peas and beans sweet corn tobacco tuberous and corm vegetables	ant control (dens, hills, mounds) commercial and private households eating establishments food and feed processing plants or areas food marketing hospitals industrial and institutional maintenance irrigation supply systems	outdoor (perimeter only) general household pest control outdoor and indoor insect control when formulated as a bait for flies outdoor buildings and structures poultry houses public health uses storage and distribution facilities termite control wood and wood structure protection treatment
Clothianidin	artichokes berry and small fruits bulb vegetables cereal grains corn (field, pop, and sweet) cotton figs	peach pome fruit pomegranate rice root and tuber vegetables seed treatment stone fruits	airfields, airport buildings cockroach gel domestic dwellings golf courses Indoor and outdoor house fly bait and insecticide interior landscapes	playgrounds poultry houses residential and commercial building use to treat all life stages of bed bugs schools sod farms turfgrass

	legume vegetables (soybeans) non-bearing fruits and nut trees low-growing berries oilseed crops (canola, corn, cotton)	soybeans strawberries tobacco tuberous and corm vegetables	livestock pens ornamentals	wheat, triticale, teosinte, buckwheat, sorghum
Dinotefuran	brassica head and stem vegetables cottonseed forest trees fruit trees – non bearing greenhouse grown tomatoes low growing berries onion, bulb and green ornamentals in indoor and outdoor nurseries, greenhouses outdoor and indoor landscapes (including residential)	peach, nectarine pineapple rice small fruit vine climbing tree plantations (including Christmas trees) tuberous and corm vegetables vegetable transplants grown in enclosed structures watercress	animal premises commercial institutional/industrial buildings control of stable flies fly control in industrial, commercial, and agricultural settings flea and bedbug control in indoor environments flea and bedbug control in homes, hotels, commercial structures, kennels, veterinary clinics food handling establishments general insecticide control in homes, institutions, warehouses and barns	hospitals fly control in indoor/outdoor environments lawns and turfgrass (residential, recreational and commercial turfgrass including golf courses) outside surface of buildings pets (cats and dogs) – spot- on treatment picnic areas structural and perimeter control (indoor and outdoor) – ant and roach baits structural and perimeter control (indoor and outdoor) in commercial, institutional, industrial, food/feed, handling, and residential premises transportation vehicles
Imidacloprid	artichokes bananas beans/peas bulb vegetables bush berries cane berries Christmas trees citrus coffee cotton cranberries herbs and spices	lettuce ornamental plantings oyster beds (WA State) peanuts pomegranates potatoes roots and tubers seed treatment soybeans stone fruit strawberries sugar beets	agricultural /farm premises animal sleeping quarters commercial/industrial lawns commercial/institutional premises and equipment drainage systems food processing forestry golf course turf Indoor and outdoor residential indoor residential (crack and	ornamental lawns and turf ornamental sod farms (turf) ornamentals (grown in nurseries and greenhouses) paths/patios pets (cats and dogs) – spot- on treatment and collar plantations plastics products pre- and post-construction termiticide recreational and residential lawns residential ornamental

	hops legume vegetables	tropical fruit	crevice) indoor residential – bed bugs) wood preservative wood protection treatment to buildings/products	lawns/turf textiles/textile fibers/cordage
Nitenpyram	No Current EPA registered pesticide uses		Regulated by the FDA as an oral formulation (i.e., tablet) for dogs and cats as a flea adulticide	
Thiacloprid	No Current EPA registered pesticide uses			
Thiamethoxam	artichokes barley bush berries cane berries Christmas trees citrus cotton cranberries leafy green vegetables low growing berries mint/spearmint/ peppermint ornamentals in greenhouses, lath- and shade-houses, containers pecans	pome fruits root vegetables seed treatment sod farms soybeans stone fruits strawberries sugar beets tobacco vine climbing small fruits tropical fruit tuberous and corm vegetables	artichokes barley bush berries cane berries Christmas trees citrus cotton cranberries leafy green vegetables low growing berries mint/spearmint/ peppermint ornamentals in greenhouses, lath- and shade-houses, containers pecans	pome fruits root vegetables seed treatment sod farms soybeans stone fruits strawberries sugar beets tobacco vine climbing small fruits tropical fruit tuberous and corm vegetables

³EPA registered pesticide use information obtained from supporting documents for neonicotinoid pesticide registration review.

Table adapted from EPA, Pollinator Protection: Schedule for Review of Neonicotinoid Pesticides.²

Table S-2. Dietary exposure and tolerance levels for neonicotinoids

Neonicotinoid	WHO ADI mg/kg bw	CODEX MRL mg/kg	EPA Acute Dietary NOAEL (RfD) mg/kg/day	EPA Chronic Dietary NOAEL (RfD) mg/kg/day	Acute Population Adjusted Dose % General Population (1-2 Year Old)	Chronic Population Adjusted Dose % General Population (1-2 Year Old)
Acetamiprid	0 – 0.07	0.01 (poultry) – 40 (sweet corn fodder)	10 ^a (0.1)	7.1 ^a (0.071)	38 (87)	18 (52)
Clothianidin	0 – 0.1	0.01 (poultry, sweet corn, and other items) – 2 (leafy vegetables)	25 ^b (0.25)	9.8 ^a (0.098)	9 (29)	4 (9)
Dinotefuran	0 – 0.2	0.02 (poultry) – 8 (rice)	125 ^b (1.25)	99.7 ^a (1.0)	3.7 (12)	1.7 (6)
Imidacloprid	0 – 0.06	0.02 (poultry, sweet corn) – 50 (tea, soya bean fodder)	8 ^b (0.08)	8 ^a (0.08)	38 (93)	5.6 (12)
Nitenpyram	-	-	-	-	-	-
Thiacloprid	0 – 0.01	0.02 (eggs, poultry, potato, rice, tree nuts) – 10 (almond hulls)	4.4	1.2	-	-
Thiamethoxam	0 – 0.08	0.01 (eggs, legume, poultry, sweet corn) – 20 (tea)	34.5 ^a (0.35)	1.2 ^a (0.012)	4 (8)	21 (48)

NOAEL = no-observed-adverse-effect-level; RfD – Reference Dose; ^a For all populations; ^b For general populations

Table adapted from Kathleen A. Lewis, et al., *Human and Ecological Risk Assessment*, 2016. **22**(4): p. 1050-1064.³; [World Health Organization, Food and Agriculture Organization, 2019.](#)⁴; and [U.S. Environmental Protection Agency.](#)⁵⁻²¹

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