2,4-D FACTSHEET

History

2,4-D was introduced in the 1940's and after more than 50 years of use, it is still the most widely used herbicide throughout the world, applied to many industrial crops such as wheat, corn, rice, sugarcane, soybeans, and pastures.[1] World population growth and the increasing demand for food has lead to higher overall pesticide used in order to increase yields.[2] In 2001, the EPA reported that 2,4-D use in the United States was ranked third to widely used herbicides glyphosate and atrazine.[3] Today, 46 million pounds of

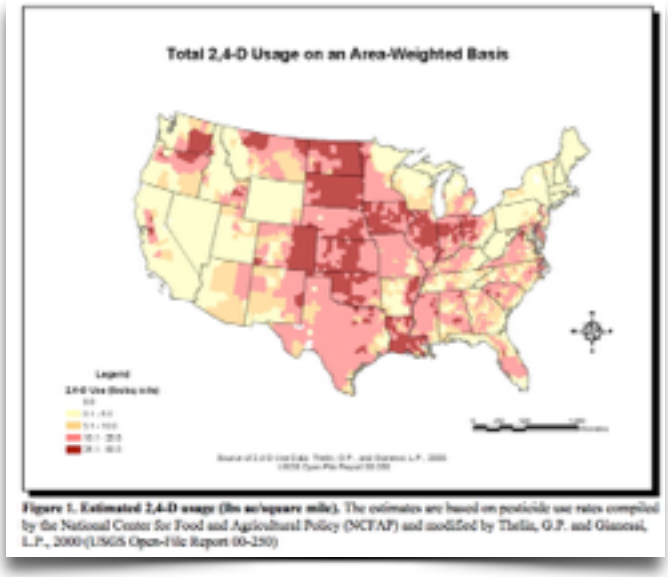

Figure 1. Estimated 2,4-D usage (lbs ac/square mile). The estimates are based on pesticide use rates compiled by the National Center for Food and Agricultural Policy (NCFAP) and modified by Thelin, G.P. and Gianessi, L.P., 2000 (USGS Open-File Report 00-250)

2,4-D is used per year with 30 million pounds used for agriculture and 16 million pounds used fro non-agricultural uses.[4] More than 10 million gallons of 2,4-D was used in the mixture known as Agent Orange to defoliate trees during the Vietnam War.[5]

What is 2,4-D?

2,4-D is an herbicide used to control broad-leaved weeds. Its basic formation is an acid, but is also produced as an inorganic salt, amine, or ester.[6] 2,4-D is a synthetic auxin, a naturally occurring plant growth regulator that, when used at high concentrations, causes growth abnormalities resulting in uncontrolled cell division and damage to the vascular tissue of plants.[7]

Exposure and hazards

Humans are exposed to 2,4-D through food, water and occupational hazards via oral, dermal and inhalation exposure pathways.[8] Agricultural and forestry workers, turf applicators, and manufacturers of 2,4-D have the greatest occupational hazard with manufacturers having the highest range with a maximum of 12,963 ppb. Although these workers are exposed, 2,4-D is often excreted unmetabolized in urine and not absorbed.[9] Additionally, 2,4-D is soluble in water and distributes widely throughout the body without accumulation in any specific organs.[10]

Outcomes effecting humans and the environment

According to the EPA, 2,4-D has low to slight acute toxicity with the exception of the acid and salt forms being severe eye irritants.[11] A study by Tanner et al. (2009) reported a strong and statistically significant increased risk of Parkinsonism along with other neurotoxic effects with exposure to 2,4-D.[12] Correlations between cancer, especially non-Hodgkin's

[1] Herbicide 2,4-D: A Review of Toxicity on Non-Target Organisms. Marcato, Souza, and Fontanetti. 2017.
[2] Herbicide 2,4-D: A Review of Toxicity on Non-Target Organisms. Marcato, Souza, and Fontanetti. 2017.
[3] https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/red_PC-030001_1-Jun-05.pdf
[4] https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/red_PC-030001_1-Jun-05.pdf
[5] Herbicide 2,4-D: A Review of Toxicity on Non-Target Organisms. Marcato, Souza, and Fontanetti. 2017.
[6] Herbicide 2,4-D: A Review of Toxicity on Non-Target Organisms. Marcato, Souza, and Fontanetti. 2017.
[7] Herbicide 2,4-D: A Review of Toxicity on Non-Target Organisms. Marcato, Souza, and Fontanetti. 2017.
[8] https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/red_PC-030001_1-Jun-05.pdf
[9] Review of 2,4-dichlorophenoxyacetic acid (2,4-D) biomonitoring and epidemiology. Burns and Swaen, 2012.
[10] Review of 2,4-Dicholorophenoxyacetic Acid (2,4-D) Epidemiology and Toxicology. Garrabent and Philbert. 2002.
[11] https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/red_PC-030001_1-Jun-05.pdf
[12] Review of 2,4-dichlorophenoxyacetic acid (2,4-D) biomonitoring and epidemiology. Burns and Swaen, 2012.

lymphoma, have been studied, but no case-control or cohort studies have indicated an association between cancer and 2,4-D.[13] Currently the International Agency for Cancer Research (IARC) classifies 2,4-D as Group D: not classifiable as a human carcinogen.[14] In the environment, 2,4-D has negative effects on soil, inhibiting or removing a source of enzyme production. Additionally, although 2,4-D is not considered persistent in the terrestrial environment, it poses a risk to aquatic environments because it is not easily biodegradable.[15]

Uncertainties and conflicts of interest

Many of the toxicological reviews that are most easily accessible to the public were authored and funded by DOW chemical company and published in Critical Reviews in Toxicology, a journal that has been discredited by some organizations.[16]

In many of these toxicological reviews, authors constantly criticize virtually all studies due to sample size, imprecision, timing, lack of generalizability, and not being confirmed in subsequent studies. The cancer studies are the most likely to provide "inconsistent evidence," probably due to industry not wanting their products to be associated with cancer in any capacity.[17] In the past, 2,4-D has often been mixed with a more toxic chemical, 2,4,5-T when used for weed control, making it difficult for scientists to specify health risks related to the use of 2,4-D alone.[18] Since it is difficult to ensure that study participants were not exposed to both chemicals, critical reviewers of studies discount the data stating that "authors were unable to specify the risk related to the use of 2,4-D alone."[19]

Additionally, there are data gaps within the scientific studies on 2,4-D. In order to be Re-registered as a pesticide with the EPA, the Registration Eligibility Decision called for studies on developmental neurotoxicity in the rate and a 2-generation reproduction study addressing concerns for endocrine disruption.[20]

Regulation

2,4-D is regulated by the EPA under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and the Food Quality Protection Act (FQPA) and was reviewed in 2005 for re-registration.[21] The maximum contaminant level (MCL) for 2,4-D, the enforceable limit under the safe drinking water act, is 70 micrograms/liter. For the EPA, the combination of residential, food, and drinking water exposures are of concern.[22]

The EPA determined that 2,4-D was eligible for reregistration provided that heightened measures to control spray drift and compliance with state and local pesticide drift regulations were implemented. Additionally, the FQPA directed the EPA to use an additional tenfold safety factor to protect for special sensitivity of infants and children to compensate for the incomplete database.[23]

Alternatives

Alternatives for 2,4-D include glyphosate and atrazine, which are also harmful pesticides. One study found that 2,4-D contaminated soils were more harmful to animals than than those exposed to glyphosate, highlighting the consequences of 2,4-D accumulation in soil.[24] The only viable alternative is that pesticides should be used more cautiously, applied only in indicated amounts, and replaced by other methods that are less harmful to the environment and biodiversity.[25]

[13] Review of 2,4-dichlorophenoxyacetic acid (2,4-D) biomonitoring and epidemiology. Burns and Swaen, 2012.
[14] Herbicide 2,4-D: A Review of Toxicity on Non-Target Organisms. Marcato, Souza, and Fontanetti. 2017.
[15] Herbicide 2,4-D: A Review of Toxicity on Non-Target Organisms. Marcato, Souza, and Fontanetti. 2017.
[16] Review of 2,4-dichlorophenoxyacetic acid (2,4-D) biomonitoring and epidemiology. Burns and Swaen, 2012.
[17] Review of 2,4-dichlorophenoxyacetic acid (2,4-D) biomonitoring and epidemiology. Burns and Swaen, 2012.
[18] Herbicide 2,4-D: A Review of Toxicity on Non-Target Organisms. Marcato, Souza, and Fontanetti. 2017.
[19] Review of 2,4-Dicholorophenoxyacetic Acid (2,4-D) Epidemiology and Toxicology. Garrabent and Philbert. 2002.
[20] https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/red_PC-030001_1-Jun-05.pdf
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[22] https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/red_PC-030001_1-Jun-05.pdf
[23] https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/red_PC-030001_1-Jun-05.pdf
[24] Herbicide 2,4-D: A Review of Toxicity on Non-Target Organisms. Marcato, Souza, and Fontanetti. 2017.
[25] Herbicide 2,4-D: A Review of Toxicity on Non-Target Organisms. Marcato, Souza, and Fontanetti. 2017.