INDAZIFLAM (Alion,™ Specticle™ and Esplanade™)

BEWARE: IS THIS THE ROUNDUP WEED KILLER ALTERNATIVE?

EDITOR'S NOTE. *This factsheet is based on a review of U.S. Environmental Protection Agency (EPA) reports, New York State Department of Environmental Conservation reviews, and the Australian Pesticides and Veterinary Medicines Authority assessment.*

SUMMARY

Indaziflam (N-[(1R,2S)-2,3-dihydro-2,6-dimethyl-1H-inden-1-yl]-6-[(1RS)-1fluoroethyl]-1,3,5-triazine-2,4-diamine) is a pre-emergent and post-emergent weed killer with a broad spectrum of action against annual grasses and broadleaf plants. It was originally registered by Bayer CropScience in 2010 under a conditional registration for residential areas. Since then, its uses have been expanded to citrus, tree nuts, grapes, sugarcane, and more. This review identifies inadequacies in study design, species tested for reproductive toxicity, and endocrine disruption. EPA issued an emergency exemption to expand uses in 2018 through 2020 on forage and grass, fodder, and hay grown on rangeland and pastures. Despite its high cost and the lack of data to evaluate it, some look at indaziflam as a potential alternative to glyphosate (Roundup).[1]

Indaziflam's primary mode of action is inhibition of seedling emergence and root development, by inhibiting cellulose biosynthesis (CB Inhibitor). Originally not registered for food production, uses now include woody trees, shrubs, and vining fruits and nuts.

In mammals, the nervous system is the major target for toxicity, and adverse effects observed on the thyroid in rat studies indicate a potential for endocrine disruption. Indaziflam shows no evidence of carcinogenicity, according to EPA.

As an herbicide, indaziflam is extremely toxic to aquatic and terrestrial plants. Adverse impacts to nontarget plants are expected from all of the labeled uses. Data for indaziflam are inadequate to fully assess chronic toxicity to fish, chronic toxicity to estuarine/marine invertebrates, and endocrine disruption in fish and birds. Without data or sufficient evidence to demonstrate otherwise, an unacceptable risk to fish, aquatic invertebrates, and birds is presumed.

ChemicalWATCH Summary Stats

Chemical Name: Indaziflam; N-[(1R,2S)-2,3-dihydro-2,6-dimethyl-1H-inden-1-yl]-6-[(1RS)-1fluoroethyl]-1,3,5-triazine-2,4-diamine

CAS Registry Number: 950782-86-2

Trade Names: Alion™, Specticle™ and Esplanade™

Toxicity Rating: Toxic.

Signal Words: Caution, Warning.

Health Effects: Neurotoxicity, adverse effects on thyroid at low doses. Higher doses affect sexual organs and reproduction.

Environmental Effects: Highly toxic to aquatic and terrestrial plants.

GENERAL

Indaziflam is a fluoroalkyltriazine herbicide, part of the broader triazine herbicide family. It differs from other triazine herbicides in having a fluoroethyl group in place of a chloride in the chlorotriazines (e.g., atrazine).

Indaziflam is registered for application to residential and commercial areas (lawns, ornamentals, and hardscapes including patios, walkways, etc.), turf (parks, cemeteries, golf courses, sod farms, sports fields, and commercial lawns), field-grown ornamentals, and Christmas trees, commercial nursery and landscape plantings, and forestry sites. Food use sites include woody trees, shrubs, vine fruits, and nuts.

Indaziflam products include, in addition to products containing concentrations of indaziflam alone, products that also contain diquat dibromide, isopropylamine salt of glyphosate, synthetic amorphous silica, for homeowner use to control annual grasses and broadleaf weeds. There are indaziflam formulations with the herbicides 2,4-D, dicamba, mecoprop, and penoxsulam.

[1] D. Chiotti, L. Ritter, D. Schlenk, C. Wilen, and K. Schiff, 2020. Alternatives to Glyphosate for Vegetation Management in Los Angeles County: A technical report. Southern California Coastal Research Project. SCCWRP Technical Report #1103. *http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/1103_GlyphosateAlternativesPanel.pdf*.

HUMAN HEALTH RISK

The nervous system is the major target for toxicity in mammals. Evidence of neurotoxicity (e.g., decreased motor activity, clinical signs, and neuropathology) was observed in rats and dogs, in acute, subchronic, and chronic toxicity studies.

Organs affected by indaziflam in mice and rats include the kidney, liver, thyroid, stomach, seminal vesicles, and ovaries. Adverse effects on the thyroid indicating potential endocrine disruption include increased thyroid stimulating hormone (TSH) and thyroid histopathology. Chronic exposures also led to atrophied small seminal vesicles (produce semen) in male rats and glandular erosion/necrosis in the stomach and blood-filled ovarian cysts/follicles in female mice.

Developmental toxicity is evidenced by decreased fetal weight with decreased maternal body weight gain and food consumption. Decreased pup weight and delays in sexual maturation were observed in offspring in the rat two-generation reproductive toxicity study, along with clinical signs of toxicity, at a dose causing parental toxicity.

Indaziflam shows no evidence of carcinogenicity in the two-year dietary rat and mouse bioassays. All genotoxicity studies that were conducted on indaziflam were negative. Testing in acute lethality studies with indaziflam resulted in low toxicity via the oral (Category III), dermal (Category III), and inhalation (Category IV) routes of exposure. Indaziflam was not an irritant to eyes (Toxicity Category IV) or skin (Toxicity Category IV), and was not a skin sensitizer.

Despite the evidence of endocrine disruption, EPA reduced the required additional margin of safety from 10X safety factor to 1X.

ENVIRONMENTAL FATE

Indaziflam and its principal degradate, fluoroethyldiaminotraizine (FDAT), have a potential to leach to groundwater. Indaziflam is expected to be moderately mobile to mobile in soil, moderately persistent to persistent in aerobic soil, persistent in anerobic soil, and persistent in aerobic and anaerobic aquatic environments. Indaziflam is subject to aqueous photolysis in clear shallow waters. Indaziflam is not volatile and therefore it is not likely to be transported via atmospheric processes. Indaziflam degradates are more mobile than the parent, and were detected in field studies at the deepest depths sampled —particularly the degradate FDAT, which is mobile to highly mobile.

EFFECTS ON NONTARGET PLANTS AND ANIMALS

Aquatic Organisms

Indaziflam is categorized as highly toxic to freshwater and estuarine/marine fish, moderately toxic to highly toxic to estuarine invertebrates, and slightly toxic to moderately toxic to freshwater invertebrates on an acute exposure basis. Subchronic toxicity studies are only available for freshwater fish and invertebrates using the species *P. promelas* and *D. magna*, respectively. The one chronic freshwater fish toxicity endpoint used in this assessment was based on fry (young fish), survival, total length, and dry weight, with sublethal effects immediately preceding mortality at the highest concentrations tested. Of the parameters assessed in the one submitted invertebrate life cycle study, indaziflam inhibits both parental (F0) growth and reproduction. Effects to offspring (F1) were not evaluated.

Results of aquatic plant toxicity studies of technical grade indaziflam indicate that this pesticide is extremely toxic to aquatic plants. Risk Quotients (RQs) for all vascular aquatic plants exceed the agency's aquatic plant risk Level of Concern (LOC) by up to two orders of magnitude. Risks to aquatic plants are expected across all of the proposed uses evaluated.

In addition, degradate toxicity data on aquatic vascular and nonvascular plants indicate that indaziflam-olefin and indaziflam-hydroxyethyl are of equal or similar toxicity to the parent indaziflam. Indaziflam-hydroxyethyl, FDAT, and triazine indanone demonstrate toxicity to these same taxa at magnitudes 2–7 times less than the parent.

Terrestrial Organisms

Indaziflam is categorized practically nontoxic to birds and mammals on an acute oral basis and (and to birds on a subacute dietary exposure basis). Reproductive toxicity has been observed in mammals. Parental effects include tremors in females, decreased body weights and body weight gains, decreased food consumption, and effects on kidneys in males. Offspring effects include decreased body weights, body weight gains, and secondary delays in sexual maturation. Evidence of reproductive toxicity includes delayed sexual maturation. Results of available toxicity studies on terrestrial invertebrates indicate that indaziflam in short-term exposures is practically nontoxic to honey bees and earthworms, but toxic to earthworms in extended exposures. Seedling emergence and vegetative vigor in terrestrial plants are affected by indaziflam at application rates much lower than the registered uses.

Thus, evidence indicates that adverse effects can be expected to nontarget terrestrial plants and birds. A screening level assessment does not predict direct risk to mammals. Direct adverse effects on terrestrial invertebrates are uncertain.

UNCERTAINTIES AND DATA GAPS

EPA used the fathead minnow early-life stage test results to characterize chronic toxicity for fish. This is inappropriate because EPA estimated the risk to be based on a chronic no effect value higher than the acute lethality value, indicating that the fathead minnow used for the acute study is less sensitive than other fish species. In addition, the study did not address reproduction endpoints, and actual measured concentrations in the aquatic tests were improperly determined. EPA should require that these tests be repeated.

Endocrine disrupting (thyroid and reproductive) effects observed in rat studies warrant Tier II Endocrine Disruptor Screening Program tests, which have not been conducted.

CONCLUSION

The statutory standard requiring sufficient data to demonstrate indazifam will not pose any unreasonable adverse effects on the environment has not been met, so all registrations should be suspended until these data are available and fully assessed to confirm otherwise.