Bicyclopyrone

CAS 352010-68-5; EPA PC CODE 018986

New Active Ingredient Review
May 2015

PESTICIDE TYPE	**HERBICIDE**
CHEMICAL CLASS HRAC Code	HPPD inhibitor, subclass triketone Group 27
COMMON TRADE NAMES	Acuron
MAJOR DEGRADATE	Five major transformation products
APPLICATION RATE (lbs a.i./A)	Single: 0.045 Max Annual: 0.045
REGISTRATION STATUS	EPA: April 2015 Minnesota: May 2015
TOXICITY PROFILE FOR APPLICATORS	Signal word: Caution IV (oral, dermal, and inhalation)
BASIC MANUFACTURER	Syngenta Crop Protection
MDA LABORATORY CAPABILITIES	In discussion

HUMAN HEALTH	
NON-CANCER	Acute PAD = 0.01 mg/kg/day Chronic PAD = 0.00028 mg/kg/day
CANCER	Suggestive evidence of cancer

Acute and chronic PADs are doses that include all relevant uncertainty and safety factors

ENVIRONMENTAL AQUATIC TOXICITY	
FISH	Acute: >46,850 ppb Chronic: >10,000 ppb
INVERTEBRATE	Acute: 46,650 ppb Chronic: >103,700 ppb
AQUATIC PLANTS	Vascular: 13 ppb Non-vascular: >2400 ppb

POLLINATOR TOXICITY	
HONEY BEE	Acute Contact: >80 µg a.i./bee Acute Oral: >84.8 µg a.i./bee

Level of Concern (LOC) has been applied to all values.

Values above indicate toxicity from the technical grade active ingredient (TGAI).

MINNESOTA DEPARTMENT OF AGRICULTURE

Introduction

Bicyclopyrone belongs to the hydroxyphenylpyruvate dioxygenase (HPPD) inhibitor class of herbicides (Herbicide Resistance Action Committee (HRAC) group F2). Bicyclopyrone acts by blocking the function of HPPD required for producing essential compounds for carotenoid pigments. Without carotenoid pigments, the plant bleaches and eventually dies. Bicyclopyrone selectively kills weeds without damaging corn plants because corn plants can rapidly metabolize bicyclopyrone into inactive compounds. The USEPA has registered bicyclopyrone for weed control in field corn, seed corn, silage corn, yellow popcorn, sweet corn, and sugarcane. Bicyclopyrone is registered for single pre-emergence or post-emergence application of 0.045 lb a.i./ac; however, split application with minimum 14 day retreatment interval (RTI) is allowed.

Projected Use in Minnesota

Bicyclopyrone is registered for use on field corn, seed corn, silage corn, yellow popcorn, and sweet corn in Minnesota. According to University of Minnesota extension, bicyclopyrone's efficacy is similar to other HPPD products and provided excellent weed control in trials in Minnesota. Bicyclopyrone will be of use in Minnesota for controlling foxtail, wild buckwheat, common ragweed and many other annual grass and broad leaf weeds.

This herbicide is found in 2 end-use unconditionally registered products:

- **Acuron™** *(EPA Reg. No. 100-1466)* –Acuron is a restricted use pesticide. It may be used for pre-emergence or post-emergence weed control in corn. The product comprises premix of four active ingredients (bicyclopyrone-0.65%. S-metolachlor-23.40%, atrazine-10.93%, and mesotrione-2.60%) and a safener “benoxacor”. Acuron carries 0.06 pound bicyclopyrone, 1.0 pound atrazine, 2.14 pound S-metolochlor, and 0.24 pound mesotrione a.i. per gallon.
- Another bicyclopyrone product containing 18.5% a.i. is approved by the USEPA. However, to date (May, 2015) this product is not currently registered for use in Minnesota.

Label Environmental Hazards

Water Quality:

- The acuron label carries a groundwater advisory that bicyclopyrone is known to leach through soil into groundwater under certain conditions as a result of labeled use. Bicyclopyrone and S-metolachlor may leach into ground water in permeable soils with shallow water table.
- Atrazine can enter groundwater and should not be applied to sand and loamy sand soils where the groundwater table is close to the surface and where these soils are very permeable.
- Application setbacks from surface waters are required for Acuron because of the high potential for atrazine to reach surface water and groundwater.
- Acuron must not be mixed/loaded or used within 50 ft of wells, including abandoned wells, drainage wells, and sink holes.

Other:

- The acuron label carries caution statements for using chemical resistant gloves, footwear, socks, and headgear.
- The product contains atrazine, which is toxic to aquatic invertebrates.

Toxicology and Exposure

EPA's screening models generate high-end, conservative exposure estimates for active ingredients and toxicologically significant degradates. Model inputs include annual usage at maximum use rates, maximum treated acres, maximum food residues, peak runoff and drift scenarios, etc. Some proposed products, application rates and use scenarios are not relevant to Minnesota. EPA's estimates, therefore, may not reflect future use and impacts in Minnesota.

Human Health

- Carcinogenic Effects- Classified as "Suggestive evidence of cancer." Based on data, quantification of cancer potential was not required.
- Drinking Water Guidance- Model estimates suggest that bicyclopyrone has a high potential to reach groundwater through leaching. Bicylopyrone may move from the treated field to surface water through run-off, erosion, and spray drift. High mobility of bicyclopyrone may be of concern for drinking water; however, USEPA concludes that residues do not concentrate in approved commodities therefore dietary risk estimates are not a concern for the general population and all population subgroups.
- Occupational Exposure- Occupational risks do not exceed EPA's levels of concern.

Environment- Non-target Species

- Stressor of concern – Because of high mobility, bicyclopyrone may move from the treated field to surface water through run-off and erosion.
- Aquatic Life Exposure – Bicylopyrone is slightly to practically non-toxic to fresh water fish, aquatic invertebrates, and mammals; slightly to moderately toxic to birds; and toxic to vascular and nonvascular plants. Although, peak environmental concentration estimates exceed the levels of concern for aquatic vascular plants, label language is intended to mitigate these risks.
- Pollinators –Bicyclopyrone is practically nontoxic to honey bees for acute contact exposure.

Environmental Fate

The fate of bicyclopyrone in the environment is highly dependent on whether it is in a soil system, groundwater system, or surface water system. Environmental fate characteristics are listed for parent and all relevant degradates where appropriate.

Soil

- Half-life- Aerobic: = Classified as slightly persistent to persistent with half-life up to 213.2 days depending upon the soil type.
  Anaerobic: Stable
- Adsorption- Bicyclopyrone is classified as higly mobile. K_{FD}=0.59 (mL/g_{oc}); K_{oc} undetermined.

Water

- Surface water- Bicyclopyrone is characterized as highly mobile and is expected to be persistent in aquatic environments; therefore, it can move to surface water through run-off, erosion, and spray drift and persist in water with a potential for both short-term and long-term exposure to aquatic plants. Bicylopyrone dissipation is very slow in aerobic aquatic conditions with half-life of 393-681 days and photodegrades slowly with half-life of 11 to 75 days.
- Groundwater Bicyclopyrone potential to reach and persist in groundwater following application is high.
- Half-life via hydrolysis: Stable.
- Sediment: Partitioning to sediment is not expected.

Air

- Volatilization- Not a major route of dissipation. Vapor pressure = 3.75×10^{-8} Torr; Henry's Law Constant = 1.67×10^{-13} atm m^3 $mole^{-1}$.

Degradates

Bicyclopyrone (parent) has five major degradates; CSCC163768 (SYN504810), CSAA589691 (NOA412101), CSCD642512 (SYN545859), CSCD656832 (SYN545680) and SYN503780 (CSAA794148). Based on the estimated concentration of bicyclopyrone and its major transformation products in groundwater and predicted acute and chronic toxicity values to aquatic organisms only the parent was included in the risk assessments.