

DuPont™ Lineage™ Prep

herbicide

Technical Bulletin



IDENTITY OF ACTIVE INGREDIENTS

Chemical Names

- (a) 2-(4-methoxy-6-methyl-1,3,5-triazin-2-ylcarbamoylsulfamoyl) benzoic acid
- (b) Methyl 2-[[[(4,6-dimethyl-2-pyrimidinyl)-amino]carbonyl]amino]sulfonyl]benzoate
- (c) 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-nicotinic acid

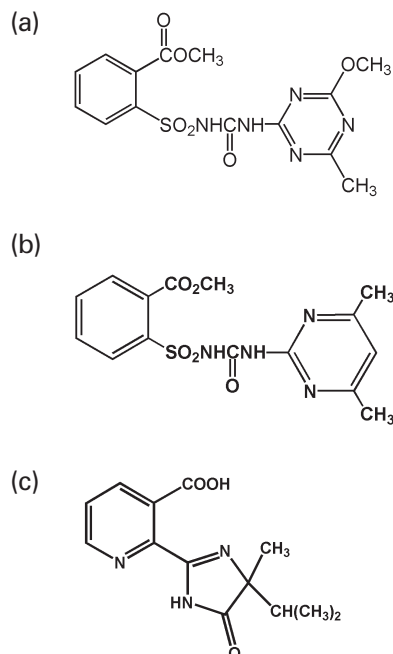
Common Names

- (a) Metsulfuron methyl
- (b) Sulfometuron methyl
- (c) Imazapyr

Chemical Families

- (a, b) Sulfonylurea
- (c) Imidazolinone

Chemical Structure



CAS Registry Number

- (a) 74223-64-6
- (b) 74222-97-2
- (c) 813434-34-1

Molecular Weight

- (a) 381.36
- (b) 364.38
- (c) 261.28

Empirical Formula

- (a) C₁₄H₁₅N₅O₆S
- (b) C₁₅H₁₆N₄O₅S
- (c) C₁₃H₁₅N₃O₃

PHYSICAL AND CHEMICAL PROPERTIES OF THE TECHNICAL INGREDIENT

State

- (a) Solid
- (b) Solid
- (c) Powder

Color

- (a) White to pale yellow
- (b) White
- (c) Off-white to tan

Odor

- (a) Faint, sweet ester-like odor
- (b) Odorless
- (c) Slight odor

Melting Point

- (a) 158°C
- (b) 203 - 205°C
- (c) 169 - 173°C

Density

- (a) 1.74 g/mL at 25°C
- (b) 0.73 g/mL
- (c) 0.34 g/mL

Solubility in Water at 25°C

- (a) 548 mg/L at pH 5; 2790 mg/L at pH 7; 213,000 mg/L at pH 9
- (b) 6.4 mg/L at pH 5; 244 mg/L at pH 7
- (c) 11,272 mg/L at pH 7

Octanol/Water Partition Coefficient (K_{ow})

- (a) 1 at pH 5; 0.018 at pH 7
- (b) NA
- (c) 1.3

Vapor Pressure

- (a) 3.3 x 10⁻¹⁰ Pa; Henry's Law constant is 2.3 x 10⁻¹⁵ atm-m³/mole
- (b) 7.2 x 10⁻¹⁴ Pa at 25°C
- (c) <0.013 mPa (< 10⁻⁷ mm Hg) at 45°C

Oxidizing/Reducing Activity (a,b,c)

Not available

Flammability (a,b,c)

Technical and formulated products are dry and noncombustible.

Explosibility (a,b,c)

Not an explosion hazard

Storage Stability (a,b,c)

Stable at normal temperatures and storage conditions

BIOLOGICAL ACTIVITY AND USE

Conifer Plantations

DuPont™ Lineage™ Prep herbicide is a water soluble granule to be mixed with water and generally applied as a postemergent spray for the control of many broadleaf weeds, annual and perennial grasses, brush, vines and brambles in conifer plantations (site preparation, herbaceous weeds and release) and wildlife management areas. In certain natural regeneration conifer sites, it may be used for selective herbaceous and woody weed control. Lineage™ Prep also can be used for cut stem and stump treatments, for the control of woody vegetation along forest roads and for establishing and maintaining wildlife openings, except in the state of California. It also may be used to control weeds along the banks of drainage canals or ditches. Only treat up to the outer edge of a drainage ditch or canal when it contains water. For perennial species listed on the label, a postemergence application should be used. For best performance, an adjuvant should be added to the spray solution.

Lineage™ Prep may be applied on conifer plantations and wildlife management areas that contain areas of temporary surface water caused by the collection of water between planting beds, in equipment ruts or in other depressions created by management activities in these sites, except in the states of California and New York. It is permissible to treat drainage ditches, intermittent drainage sites, intermittently flooded low-lying sites, seasonally dry flood plains and transitional areas between upland and lowland sites when no water is present, except in the states of California and New York. It also is permissible to treat marshes, swamps and bogs after water has receded, as well as seasonally dry flood deltas, except in the states of California and New York.

Lineage™ Prep may be applied by ground spray equipment (boom sprayers, backpack sprayers,

tree injection etc.) and by aerial spray equipment. Fixed-wing aircraft and helicopters can be used to apply Lineage™ Prep; however, do not make applications by fixed-wing aircraft unless appropriate buffer zones can be maintained to prevent spray drift out of the target area, or when treating open tracts of land, spray drift as a result of fixed-wing aircraft application can be tolerated.

Non-Crop Sites

Lineage™ Prep herbicide is to be mixed with water and a surfactant, unless otherwise directed, and applied as a spray for the control of undesirable vegetation in terrestrial non-crop sites and unimproved turf.

Lineage™ Prep herbicide is to be applied as a spray solution for general weed and brush control on private, public and military lands as follows: uncultivated nonagricultural areas (such as airports, highway, railroad and utility rights-of-way, sewage disposal areas etc.); uncultivated agricultural areas — non-crop producing (such as farmyards, fuel storage areas, fence rows, nonirrigation ditch banks, barrier strips etc.); industrial sites — outdoor (such as lumberyards, pipeline and tank farms etc.).

This product may be applied to terrestrial non-crop sites and unimproved turf sites that contain areas of temporary surface water caused by collection of water,



in equipment ruts or in other depressions created by management activities. It is permissible to treat intermittently flooded low-lying

sites, seasonally dry flood plains and transitional areas between upland and lowland sites when no water is present. It also is permissible to treat marshes, swamps and bogs after water has receded, as well as seasonally dry flood deltas. It also may be used to control weeds along the banks of drainage canals or ditches. Only treat up to the outer edge of a drainage ditch or canal when it contains water. Do not apply on irrigation canals or ditches. Do not apply on dry irrigation canals or dry irrigation ditches.

Mode of Action

(a) Metsulfuron methyl, (b) sulfometuron methyl and (c) imazapyr inhibit acetolactate synthase (ALS), also called acetohydroxyacid synthase (AHAS), a key enzyme needed in the biosynthesis of the branched amino acids isoleucine, leucine and valine in plants. Animals do not possess this enzyme to synthesize proteins.

Use Rate and Biological Activity

Lineage™ Prep is to be applied at use rates of 10 to 29 ounces of product per acre. When applied as a spray, DuPont™ Lineage™ Prep is absorbed by both roots and foliage of plants, rapidly inhibiting the growth of susceptible weeds. Warm, moist conditions following application accelerate the herbicidal activity of Lineage™ Prep; cold, dry conditions delay the herbicidal activity. Weeds hardened off by drought or other plant stresses are less susceptible to Lineage™ Prep.

Low rates of Lineage™ Prep can kill or severely injure most crops. Following a Lineage™ Prep application, the use of the spray equipment to apply other pesticides on crops for which Lineage™ Prep or its active ingredients are not registered may result in crop damage. The most effective way to reduce crop damage potential is to use dedicated mixing and application equipment.

Weeds Controlled

Lineage™ Prep controls many grasses, broadleaf weeds and brush, including bahiagrass, Johnsongrass, ryegrass, Japanese stiltgrass, panicums, vaseygrass, dandelion, dogfennel, goldenrod, pigweeds, sowthistle, vetch, blackberry, halogeton, field bindweed, multiflora rose, thistles, ash, cherry, oaks, red maple, sweetgum and vaccinium species (refer to product label for a complete weed list).

The degree and duration of control may depend on the weed spectrum and infestation intensity, weed size at application, soil type, organic matter content and environmental conditions at and following application.

FATE AND BEHAVIOR IN THE ENVIRONMENT

(a) Metsulfuron methyl degrades at a moderate rate in soil, having half-lives in soil ranging from 9 to 43 days under laboratory conditions, with an average half-life of 23 days (13 soils). Half-lives in soil under field conditions ranged from 7 to 211 days, with an average half-life of 51 days (17 soils). The longer field half-lives can be attributed to fall applications for some of the field studies. Metsulfuron methyl degrades slowly in aquatic

systems, having half-lives which ranged from 53 to 279 days in two water sediment systems. Metsulfuron methyl is stable to photolysis.

(b) Photodegradation is believed to play a minor role in the overall degradation of sulfometuron methyl under field conditions. Chemical hydrolysis is moderately rapid at pH 6, but extremely slow at pH 8. Microbial breakdown is relatively more important in alkaline soils where chemical hydrolysis is slower. Field half-lives average 37 days at pH < 7 and 49 days at pH > 7. Persistence is increased by cool temperatures and generally by higher pH. Potential soil mobility is generally greater at higher pH and lower OM content.

(c) Field half-lives for imazapyr range from 25 to 142 days depending on soil type and environmental conditions. Half-life in water is 1 to 2 days when exposed to a xenon arc lamp. Half-life in shallow ponds ranged from 2 to 3 days. Photolysis on the soil surface is limited and is a minor contributor to degradation in soil. Microbial degradation is the principal means of dissipation in soil. Anaerobic microbial degradation occurs at much slower rates.

Plant Selectivity, Sensitivity and Residues

Lineage™ Prep herbicide is registered for use in non-crop situations only, and care should be exercised when it is used in the vicinity of crop plants. Exposure to Lineage™ Prep may injure or kill most crops.

Toxicity and Metabolism in Animals

(a) Metsulfuron methyl, (b) sulfometuron methyl and (c) imazapyr have low toxicity to mammals, birds and insects. They do not bioaccumulate in warm- or cold-blooded animals. **(a) Metsulfuron methyl, (b) sulfometuron methyl and (c) imazapyr** are rapidly absorbed and eliminated by mammalian systems.

RESIDUES IN FOOD — Not Applicable

Lineage™ Prep is not labeled for use on food crops.



TOXICITY OF TECHNICAL ACTIVE INGREDIENT

| Acute Toxicity | | | |
|--|-----------------------|---------------------|-----------------|
| | Metsulfuron methyl | Sulfometuron methyl | Imazapyr |
| Acute oral toxicity — LD ₅₀ rat | >5000 mg/kg | 5000 mg/kg | >5000 mg/kg |
| Acute dermal toxicity — LD ₅₀ rabbit | >2000 mg/kg | 2000 mg/kg | >2000 mg/kg |
| Acute inhalation toxicity — LC ₅₀ rat | >5.3 mg/L/4-h | 5.5 mg/L/4-h | >1.3 mg/L/4-h |
| Skin irritation — rabbit | Not irritating | Not irritating | Not irritating |
| Eye irritation — rabbit | Moderately irritating | Moderate | Irreversible |
| Skin sensitization — guinea pig | Not sensitizing | Not sensitizing | Not sensitizing |

| Subchronic Toxicity | | | |
|--|--|---------------------------|---------------------------|
| | Metsulfuron methyl | Sulfometuron methyl | Imazapyr |
| 90-day dietary — mouse | NOAEL: 814 mg/kg bw/d; highest dose tested (HDT) | NA | NA |
| 90-day dietary — rat | NOAEL: 68 mg/kg bw/d; based on body weight changes at higher doses | NOAEL: 1000 ppm | NOAEL: 1695 mg/kg bw/d |
| 90-day dietary — dog | NOAEL: 129 mg/kg bw/d; (HDT) | NOAEL: 200 ppm | NOAEL: 250 mg/kg bw/d |
| Repeated dose dermal toxicity — rat, rabbit, guinea pig | NOAEL: 125 mg/kg bw/d for local effects, based on dermal irritation at higher doses; NOAEL: 2000 mg/kg bw/d for systemic effects, (HDT) | NOAEL: 2000 mg/kg bw/d | NOAEL: 400 mg/kg bw/d |

| Chronic Toxicity | | | |
|--------------------------|---|---------------------|---|
| | Metsulfuron methyl | Sulfometuron methyl | Imazapyr |
| 18 month dietary — mouse | NOAEL: 666 mg/kg bw/d, (HDT); Not oncogenic | NA | NOAEL: 1500 mg/kg bw/d; Not oncogenic |
| 24 month dietary — rat | NOAEL: 22/30 mg/kg bw/d males/females, based on mild body weight effects at higher doses; Not carcinogenic up to the highest dose tested 226/300 mg/kg bw/d in males/ females | Not oncogenic | NOAEL: 500 mg/kg bw/d; Not oncogenic |
| 12 month dietary — dog | NOAEL: 125 mg/kg bw/d, (HDT) | NA | NOAEL: 250 mg/kg bw/d |

| Teratogenicity | | | |
|----------------|--|---|---|
| | Metsulfuron methyl | Sulfometuron methyl | Imazapyr |
| Rat | NOAEL maternal: 250 mg/kg/d, severe body weight changes and salivation at 1000 mg/kg/d; NOAEL developmental: 1000 mg/kg bw, (HDT); Not teratogenic or embryotoxic | NOAEL maternal and fetal: 90.6 mg/kg/d Not teratogenic | NOAEL maternal: 300 mg/kg /d, NOAEL fetal: 1000 mg/kg bw/d; Not teratogenic |
| Rabbit | NOAEL maternal: 25 mg/kg/d, mortality and decreased body weight gain at > 100 mg/kg/d; NOAEL developmental: > 700 mg/kg bw/d (HDT); Not teratogenic or embryotoxic | NOEL maternal and fetal: 300 mg/kg/d; Not teratogenic | NOAEL: 400 mg/kg bw/d; Not teratogenic |

| Multigeneration Reproductive Toxicity: RAT | | | |
|--|--|---|---|
| | Metsulfuron methyl | Sulfometuron methyl | Imazapyr |
| Reproductive Toxicity | NOAEL: 5000 ppm (342 - 386 mg/kg in males, 406 - 474 in females); HDT | NOAEL: 5000 ppm | NOAEL: 10000 ppm 738 & 933 mg/kg bw/day |
| Paternal/Systemic | NOAEL: 500 ppm (34 and 35 mg/kg bw F0 and F1 males; 39 and 43 mg/kg bw F0 and F1B females); based on body weight effects at 5000 ppm | NOAEL: 500 ppm Reduced maternal body weights at 5000 ppm | NOAEL: 500 ppm |
| Offspring | NOAEL: 5000 ppm (342 - 474 mg/kg bw); HDT | NA | NA |

| Genotoxicity | | | |
|--|----------------------------------|---------------------|--------------------------------|
| | Metsulfuron methyl | Sulfometuron methyl | Imazapyr |
| Gene mutation bacterial: <i>Ames test</i> | Negative | Negative | Negative; E. coli, negative |
| Gene mutation mammalian cell culture: <i>CHO HPRT</i> | Negative | NA | Negative |
| Structural chromosome aberration: <i>In vitro</i> cytogenetics — CHO <i>In vivo</i> rat chromosome aberration <i>In vivo</i> mouse micronucleus | Positive Negative Negative | Negative | Negative |
| DNA damage/repair: Primary rat hepatocytes/UDS | Negative | Negative | Negative |
| Other | NA | NA | Negative rat dominant lethal |

| Neurotoxicity — (a), (b) and (c) |
|---|
| No indication of neurotoxicity seen in the available studies. |

HUMAN EXPOSURE, RISK AND SAFETY INFORMATION

| Metsulfuron methyl | |
|---|---|
| Toxicity Criteria | U.S. EPA Chronic RfD — 0.25 mg/kg bw/day |
| U.S. EPA Cancer Classification | “Not likely to be a human carcinogen.” |
| Consumer — Aggregate Exposure and Risk | EPA estimates aggregate exposures well within acceptable limits, < 1.0% of cPAD. |
| Occupational Exposure and Risk (mixer, loader and applicator) | Exposures are well within the acceptable limits when label directions are followed. |

| Sulfometuron methyl | |
|--|--|
| PEL (OSHA) | None established |
| TLV (ACGIH) | 5 mg/m ³ , 8 hr. TWA, A4 |
| AEL* (DuPont) | TWA 10 mg/m ³ , 8 & 12 hr. TWA total dust |
| PPE (Personal Protective Equipment) | Applicators and other handlers must wear: long-sleeved shirt and long pants; shoes plus socks. |
| * AEL is the DuPont Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence. Sulfometuron methyl: In case of contact with eyes , hold eye open and rinse slowly and gently with water for 15 to 20 minutes. Call a poison control center or doctor for further treatment advice. | |

| Imazapyr | |
|---|---|
| Toxicity Criteria | U.S. EPA Chronic RfD — 2.5 mg/kg/day |
| U.S. EPA Cancer Classification | “Not likely to be carcinogenic.” |
| Consumer — Aggregate Exposure and Risk | EPA estimates aggregate exposures well within acceptable limits, < 0.1% of cPAD. |
| Occupational Exposure and Risk (mixer, loader and applicator) | Exposures are well within the acceptable limits when label directions are followed. |

WILDLIFE AND OTHER NON-TARGET SPECIES

| | Metsulfuron methyl | Sulfometuron methyl | Imazapyr |
|--|--------------------------|---------------------|--------------------------|
| Bobwhite quail — 8 day dietary LD ₅₀ | >5620 ppm | >5620 mg/kg | >5000 ppm |
| Mallard duck — Oral LD ₅₀ 8 day dietary LC ₅₀ | >2510 mg/kg >5620 ppm | >5000 mg/kg NA | >2150 mg/kg >5000 ppm |
| Bluegill sunfish — 96 hours LC ₅₀ | >150 mg/L | 12.5 mg/L | >100 mg/L |
| Rainbow trout — 96 hours LC ₅₀ | >150 mg/L | 12.5 mg/L | >100 mg/L |
| Daphnia — 48 hour LC ₅₀ | >120 mg/L | NA | >100 mg/L |
| Earthworm — LC ₅₀ in soil | >1000 mg/kg | NA | NA |
| Honey bee — Topical LD ₅₀ | >100 µg/bee | >100 µg/bee | >100 µg/bee |

INFORMATION SOURCES

Chlorsulfuron

(a) Metsulfuron methyl

Primary Industry Source: DuPont.

1. Doig, R.I. et al. 1983. *Proc. 10th Intern. Congr. Plant Prot.* 1:324.
2. Hershberger and Brennan. 1988. *Anal. Meth. Pestic. Plant Growth Regul.* 16:83.
3. LaRossa and Schloss. 1984. *J. Biol. Chem.* 259:8753.
4. Wauchope, R.D. et al. 1992. *Rev. Environ. Contam. Toxicol.* 123 :1.
5. Schmuckler, M.E. et al. 2000. *Pest Mangmt. Sci.* 56 :521-532.

(b) Sulfometuron methyl

Primary Industry Source: DuPont.

1. Anderson, J.J.; Dulka, J.J. 1985. Environmental fate of sulfometuron methyl in aerobic soils *Journal of Agricultural and Food Chemistry.* 33 (4):596-602.
2. Baird, J. H. et al. 1989. *Weed Sci.* 31:42.
3. LaRossa and Schloss. 1984. *J. Biol. Chem.* 259:8753.

4. Wauchope, R. D. et al. 1992. *Rev. Environ. Contam. Toxicol.* 123:1.
5. Roberts, T. 1998. *Metabolic Pathways of Agrochemicals*, Vol. 1, 552.
6. Schmuckler, M.E. et al. 2000. *Pest Management Science.* 56:521.
7. Trubey, R.K, Bethem, R. A. & Peterson, B. 1998. Degradation and mobility of sulfometuron methyl (Oust® herbicide) in field soil. *Journal of Agricultural and Food Chemistry.* 46 (6):2360-2367.

(c) Imazapyr

Primary Industry Source: BASF.

1. Orwick, P.L. et al. 1983. *Proc. South. Weed Sci. Soc.*36:291.
2. Shaner, D. L. and S. L. O'Conner. 1991. *The Imidazolinone Herbicides.* CRC Press, Boca Raton, FL.
3. Wauchope, R. D. et al. 1992. *Rev. Environ. Contam. Toxicol.* 123 :1.

This reference guide is not intended as a substitute for the product label for the product(s) referenced herein. Product labels for the above product(s) contain important precautions, directions for use and product warranty and liability limitations that must be read before using the product. Applicators must be in possession of the product label(s) at the time of application. Always read and follow all label directions and precautions for use when using any pesticide alone or in tank mix combinations.

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