ARSENAL® is a pre and post-emergent herbicide for use by professional vegetation managers at a very low rate of only 3 L/ha for season-long control of most annual and perennial broadleaf and grassy weeds on railways, roadsides, industrial sites, power substations or other non-crop areas where bare ground is desired. ARSENAL can also be used to control brush species using low volume foliar and cut stump applications.

ARSENAL contains 240 g/L of the active ingredient imazapyr formulated as a water-based solution. ARSENAL works through both root and leaf uptake to interfere with an essential enzyme which is only found in plants. As a result, ARSENAL is safe for both applicators and the environment because it does not pose a hazard to animals, insects, worms, birds, or fish and it binds strongly to soil to resist leaching or lateral movement.

ARSENAL is also non-volatile and non-combustible.

Has ARSENAL Been Fully Tested?
ARSENAL’s active ingredient has been extensively tested both internationally and in Canada by Health Canada, Environment Canada, Agriculture & Agri-Food Canada and the Department of Fisheries & Oceans to evaluate performance, safety, environmental persistence and leaching, the effects of short and -term exposure, mutagenicity and carcinogenicity.

Tests were performed on a wide range of target plants and non-target organisms including algae, fish, earthworms, birds, bees and mammals.

How Does ARSENAL Work?
ARSENAL should be applied to actively growing target plants. Once applied, it is quickly absorbed through the leaves, roots or stump surface (within 24 hours) and translocated in both the phloem and the xylem (vascular tissue) to the growing points of the roots and shoots. Once there, ARSENAL binds to an enzyme (AHAS) found only in plants and interferes with the plant’s manufacture of three key amino acids – leucine, valine and isoleucine. Treated plants stop growing within several days and eventually die.

Non-target fauna do not manufacture the amino acids affected by ARSENAL and do not possess the target enzyme so that ARSENAL poses very low risk to organisms other than plants.
Acute Toxicity to Non-Target Fauna

Mammals:
- Oral LD$_{50}$
  - Rats, male and female ->5000 mg/kg
  - Mice, female ->2000 mg/kg
  - Rabbits, male and female ->4800 mg/kg
- Dermal LD$_{50}$
  - Rabbits, male and female ->2000 mg/kg
  - Rats, male and female -> 5000 mg/kg
- Intraperitoneal LD$_{50}$
  - Rats, male and female ->2500 mg/kg
  - Rats, male and female ->2500 mg/kg but <3200 mg/kg
- Inhalation LC$_{50}$
  - Rats, male and female ->1.3 mg/litre actual concentration

Primary Irritation
- Rabbits, eye - irritating with full recovery in 7 days
- Rabbits, skin - mildly irritating

Dermal Sensitization
- Guinea pig - negative

Birds:
- Oral LD$_{50}$
  - Bobwhite quail and mallard duck ->2150 mg/kg
- 8 Day Dietary LC$_{50}$
  - Bobwhite quail and mallard duck ->5000 mg/kg

Fish:
- 96-Hour LC$_{50}$
  - Rainbow trout, bluegill sunfish, channel catfish: >100 mg/litre

Arthropods (Insects):
- 48-Hour LC$_{50}$
  - Water fleas (Daphnia magna) ->100 mg/litre
- Dermal LD$_{50}$
  - Honey bee ->100 ug/bee

Annelids (Worms):
- 14-Day LC$_{50}$
  - Earthworm (Lumbricus terrestris) - 132.5 ppm
    (240 g/L formulation used in test)

Algae:
- 7-Day EC$_{50}$
  - Freshwater blue-green alga (Anabaena flos-aquae) - 11.7 mg/litre
  - Freshwater green alga (Selenastrum capricornutum) - 71 mg/litre
  - Freshwater diatom (Navicula pelliculosa) - 55.8 mg/litre
  - Marine diatom (Skeletonema costatum) ->85.5 mg/litre

14-Day EC$_{50}$
- Duckweed (Lemna gibba) ->0.024 mg/litre

Chronic Toxicity to Non-Target Fauna

21-Day Dermal
- Rabbits - no systemic toxicity at 400 mg/kg/day

13-Week Dietary
- Rats - no-effect level of 10,000 ppm
  (highest dose tested)
- Dogs - no-effect level of 10,000 ppm
  (highest dose tested)

1-Year Dietary
- Dogs - no-effect level of 10,000 ppm
  (highest dose tested)

18-Month Dietary & Oncogenicity
- Mice - no-effect level of 10,000 ppm
  (highest dose tested)

2-Year Dietary & Oncogenicity
- Rats - no-effect level of 10,000 ppm
  (highest dose tested)

Reproduction Studies

2-Generation Reproduction
- Rats - no treatment-related signs of systemic toxicity and no adverse effects upon reproductive performance or pup development at dietary levels up to 10,000 ppm
  (highest dose tested)

18-Week Toxicity & Reproduction
- Mallard ducks and bobwhite quail - no treatment-related signs of systemic toxicity and no adverse effects upon reproductive performance and egg production, thickness, quality, and hatchability at dietary levels up to 2000 ppm
  (highest dose tested)
**Mutagenicity and Teratogenicity**

No mutagenic effects were observed at doses tested in the Ames, Dominant Lethal, Unscheduled KDNA Synthesis, in vitro Chromosomal Aberrations in Chinese Hamster Ovary Cells, and CHO.HGPRT tests. No teratogenic or foetotoxic effects were observed at doses up to 1000 mg/kg body weight in rats of up to 400 mg/kg in rabbits (highest doses tested).

**Rat Metabolism**

In rats dosed by gavage with imazapyr, approximately 87% of the dose was excreted in the urine and faeces within 24 hours. Residual levels in liver and kidney tissues were 0.03 and 0.02 ppm, respectively, at 24 hours and <0.01 ppm in both tissues at 192 hours after dosing. In muscle and fat tissue and blood, residue levels were <0.01 ppm at both 24 and 192 hours.

**Bioaccumulation**

Results of a bioconcentration study with bluegill sunfish indicate that imazapyr does not accumulate in fish tissues and that the bioconcentration factor is less than 1.

**Effect on Soil Microorganisms**

Studies to determine the effects of ARSENAL treatments on soil microorganisms show that the active ingredient, imazapyr, has no adverse effect on numbers of soil organisms, growth rates of microbial populations, soil enzymes, nitrogen cycling, sulphur oxidation, mineralization of organic substrates, or normal soil respiration.

**Environmental Fate**

**Volatility:** Non-volatile

**Persistence:**
- Half-life in water: 1.3 - 2.7 days
- Half-life in soil: Depends on temperature and moisture
  - Broken-down microbialy
  - Low temperatures and dry conditions lengthen persistence

**Movement in Soil:**
- >90% of active ingredient remains in top 7.5 cm of soil profile, even on coarse soils and high rainfall
- No active ingredient moves deeper than 15 cm in soil profile
- No lateral movement

**Handling Precautions**

- READ LABEL BEFORE USING ARSENAL
- Do NOT apply to saturated soils
- Use goggles, gloves and coveralls when mixing and wash thoroughly after using
- Launder clothes separately
- Re-entry after spray has dried.

**First Aid**

Eye Contact: Flush with water
Skin Contact: Wash with soap & water
Inhalation: Remove to fresh air
Ingestion: drink water, seek immediate medical attention
Call 1-800-454-2673 for 24 hour assistance.

**Summary**

ARSENAL herbicide provides vegetation managers with an effective new tool which poses no risk to the environment based on extensive laboratory and field tests conducted over 10 years in Canada and in over 50 other countries worldwide.

For more information as well as technical and sales support for ARSENAL, contact your local ENGAGE Agro or TrueNorth Specialty Products representative.

For copies of an ARSENAL label or MSDS, visit www.engageagro.com or www.truenorthspecialty.com

Technical Support Provided by **ENGAGE AGRO**