Australian Government

Australian Pesticides and Veterinary Medicines Authority

PUBLIC RELEASE SUMMARY

on the Evaluation of the New Active Foramsulfuron in the Product Tribute Turf Herbicide

APVMA Product Number 63240

MARCH 2011

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PREFACE

The Australian Pesticides and Veterinary Medicines Authority (APVMA) is an independent statutory authority with responsibility for assessing and approving agricultural and veterinary chemical products prior to their sale and use in Australia.

In undertaking this task, the APVMA works in close cooperation with advisory agencies, including the Department of Health and Aging, Office of Chemical Safety and Environmental Health (OCSEH), Department of the Environment, Water, Heritage and the Arts (DEWHA), and State Departments of Primary Industry.

The APVMA has a policy of encouraging openness and transparency in its activities and of seeking community involvement in decision making. Part of that process is the publication of public release summaries for all products containing new active ingredients.

The information and technical data required by the APVMA to assess the safety of new chemical products and the methods of assessment must be undertaken according to accepted scientific principles. Details are outlined in the APVMA's publications *Ag MORAG: Manual of Requirements and Guidelines* and *Vet MORAG: Manual of Requirements and Guidelines*.

This Public Release Summary is intended as a brief overview of the assessment that has been completed by the APVMA and its advisory agencies. It has been deliberately presented in a manner that is likely to be informative to the widest possible audience thereby encouraging public comment.

About this document

This is a Public Release Summary.

It indicates that the Australian Pesticides and Veterinary Medicines Authority (APVMA) is considering an application for registration of an agricultural or veterinary chemical.

Comment is sought from industry groups and stakeholders on the information contained within this document.

Any advice the APVMA receives through this consultation, which it relies on to grant this application will be noted in a subsequent Advice Summary.

Advice Summaries can be found on the APVMA website: http://www.apvma.gov.au

Making a submission

In accordance with sections 12 and 13 of the Agvet Code, the APVMA invites any person to submit a relevant written submission as to whether the application for registration of **TRIBUTE TURF HERBICIDE** should be granted. Submissions should relate only to matters that the APVMA is required by legislation to take into account in deciding whether to grant the application. These grounds include **occupational health and safety, chemistry and manufacture, safety and first aid, environmental fate and toxicity,** and

efficacy. Submissions should state the grounds on which they are based. Comments received outside these grounds cannot be considered by the APVMA.

Submissions must be received by the APVMA by close of business on **27 April 2011** and be directed to the contact listed below. All submissions to the APVMA will be acknowledged in writing via email or by post.

Relevant comments will be taken into account by the APVMA in deciding whether the product should be registered and in determining appropriate conditions of registration and product labelling. A summary of relevant comments and the APVMA's response will be published on the APVMA website.

When making a submission please include:

- Contact name
- Company or Group name (if relevant)
- Postal Address
- Email Address (if available)
- The date you made the submission.

All personal and ***confidential commercial information (CCI)***[1] material contained in submissions will be treated confidentially.

Written submissions on the APVMA's proposal to grant the application for registration that relate to the **grounds for registration** should be addressed in writing to:

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[1] A full definition of "confidential commercial information" is contained in the Agvet Code.

Further information

Further information can be obtained via the contact details provided above.

Copies of full technical evaluation reports covering toxicology, occupational health and safety aspects, residues in food and environmental aspects are available from the APVMA on request.

Further information on public release summaries can be found on the APVMA website:
http://www.apvma.gov.au

1 INTRODUCTION

APPLICANT

Bayer CropScience Pty Ltd.

DETAILS OF THE PROPOSED PRODUCT

It is proposed to register TRIBUTE® TURF HERBICIDE, containing foramsulfuron (22.5g/L) as an oil-based suspension concentrate (OD) formulation. The product is intended for use for the control of winter grass (*Poa annua),* ryegrass (*Lolium perenne*) and crowsfoot grass (*Eleusine indica*) in common and hybrid couchgrass only (not Queensland Blue Couch). TRIBUTE® TURF HERBICIDE is intended to be used at a rate of 1.5-2L product/ha.

Foramsulfuron is a new active constituent to the Australian marked. It is an herbicide, which belongs to the sulfonylurea chemical group, inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS). Foramsulfuron is registered in a number of overseas countries including the United States of America, Russian Federation, Europe, and some South American countries. The formulated product, TRIBUTE® TURF HERBICIDE is registered in the United States of America for use on turf. Foramsulfuron and a safener, isoxadifen-ethyl, is registered in Europe, Russian Federation and some South American countries for use on Maize, corn and sweetcorn. A mixed active constituent product including foramsulfuron is registered in Denmark for use on forestry and in Sweden for use in Nurseries.

TRIBUTE® TURF HERBICIDE is new to the Australian market. The active foramsulfuron as well as the end – use product will be manufactured overseas and imported into Australia. Foramsulfuron is in group B (Inhibitors of acetolactate synthase (ALS inhibitors)) for herbicides resistance management.

This publication provides a summary of the data reviewed and an outline of the regulatory considerations for the proposed registration of TRIBUTE® TURF HERBICIDE and approval of the new active constituent, foramsulfuron.

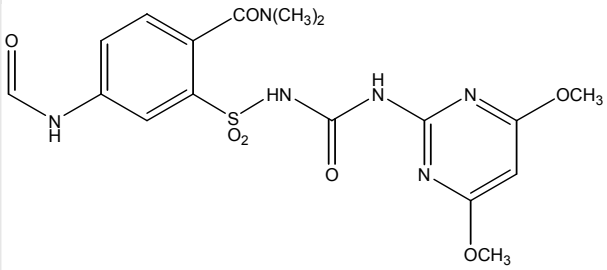
2 CHEMISTRY AND MANUFACTURE

2.1 Manufacturing Site

The active constituent foramsulfuron is manufactured by Lonza AG at Lonzagroup, Valais Works, CH. 3930, Visp, Switzerland and is approved by the APVMA (Approval number: 63278)

2.2 Chemical Characteristics of the Active Constituent

The chemical active constituent Foramsulfuron has the following properties:

COMMON NAME:	Foramsulfuron
IUPAC NAME:	1-(4,6-Dimethoxypyrimidin-2-yl)-3-[2-(dimethylcarbamoyl)-5-formamidophenylsulfonyl]urea
CAS NAME:	2-[[[[(4,6-Dimethoxy-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]-4-(formylamino)-N,N-dimethylbenzamide
CAS REGISTRY NUMBER:	173159-57-4
MANUFACTURER'S CODES:	AE F130360
MINIMUM PURITY:	970 g/kg
MOLECULAR FORMULA:	$C_{17}H_{20}N_6O_7S$
MOLECULAR WEIGHT:	457.49
STRUCTURE:	
CHEMICAL FAMILY:	Pyrimidinylsulfonylurea herbicide

2.3 Physical and Chemical Properties of Active Constituent

PROPERTY	RESULTS
PHYSICAL STATE	Light beige powder with agglomerates (Pure) 5Y9/1, visual light beige, powder with agglomerates (technical)
ODOUR	Slightly acidulous for both pure and technical grade
MELTING POINT	194 °C with decomposition (pure) 202 °C with decomposition (technical)
RELATIVE DENSITY	1.44 (pure active constituent) 1.45 (technical constituent)
PH OF 1%	6.28 at 25 ºC (pure active constituent)
SOLUBILITY IN VARIOUS SOLVENTS	acetone 1.925 acetonitrile 1.111 1,2-dichloroethane 0.185 ethyl acetate 0.362 heptane <0.010 methanol 1.660 p-xylene <0.010 water 0.04 (pH 5), 3.3 (pH 7), 94.6 (pH 8) (all in g/L, 20 °C)
VAPOUR PRESSURE	4.2×10^{-8} mPa (20 °C) 1.3×10^{-7} mPa (25°C)
HENRY'S LAW CONSTANT (25°C)	5.8×10^{-12} Pa m^3 mol^{-1} (20 °C)
OCTANOL/WATER PARTITION COEFFICIENT	Kow logP = 1.44 (pH 2), 0.603 (pH 5), -0.78 (pH 7), -1.97 (pH 9), 0.60 (distilled water, pH 5.5-5.7) (all 20 °C)

<table>
<tr><th>PROPERTY</th><th>RESULTS</th></tr>
<tr><td>HYDROLYSIS</td><td>Hydrolysis of AE F130360 followed first-order kinetics throughout.

Hydrolysis of AE F130360 is highly dependent upon temperature with activation energies of 114, 113, 98 and 67 kJ/mol at pH 4, 5, 7 and 9 respectively.

<table>
<tr><th rowspan="2">PH</th><th colspan="2">HALF LIFE (DAYS)</th></tr>
<tr><th>25 °C</th><th>40 °C</th></tr>
<tr><td>4</td><td>3.7</td><td>0.41</td></tr>
<tr><td>5</td><td>10.1</td><td>1.1</td></tr>
<tr><td>7</td><td>128</td><td>19.4</td></tr>
<tr><td>9</td><td>132</td><td>36.3</td></tr>
</table>
</td></tr>
<tr><td>PHOTOCHEMICAL DEGRADATION</td><td>Practically not degraded by direct photolysis in aqueous solution due to a low adsorption above 290 nm. As the half-life of the irradiated samples (250 - 270 d) is in the same range as that of the dark control (233 d) the overall degradation is mainly due to the dark reaction. Therefore, the quantum yield of direct photolysis is consequently derived to be practically zero.</td></tr>
<tr><td>DISSOCIATION CONSTANT (PK_A)</td><td>pKa 4.6 (21.5 °C)</td></tr>
<tr><td>QUANTUM YIELD OF DIRECT PHOTOTRANSFORMATION IN WATER AT > 290 NM</td><td>Practically zero.</td></tr>
<tr><td>UV/VIS ABSORPTION (MAX.)</td><td>UV absorption 202, 219 and 252 nm (ε=4.2e4, 3.2e4 and 3.3e4 L/(mol*cm), respectively); and 291 nm (ε=3.2e3 L/(mol*cm));

No absorbance above 350 nm</td></tr>
<tr><td>FLAMMABILITY</td><td>The test substance was found to be non-flammable.</td></tr>
<tr><td>AUTO- FLAMMABILITY</td><td>No self-ignition was registered until a temperature of 400 °C</td></tr>
<tr><td>EXPLOSIVE PROPERTIES</td><td>No danger of explosion according to the explosive properties</td></tr>
<tr><td>SURFACE TENSION</td><td>W= 65.1 mN/m (20 °C)</td></tr>
<tr><td>OXIDISING PROPERTIES</td><td>The structural argument provided shows that the substance is incapable of reacting exothermically with a combustible material.</td></tr>
</table>

2.4 Product

DISTINGUISHING NAME:	TRIBUTE® TURF HERBICIDE
FORMULATION TYPE:	Oil-based suspension concentrate (OD)
ACTIVE CONSTITUENT CONCENTRATION:	Foramsulfuron (22.5 g/L)

2.5 Physical and Chemical Properties of the Product

PROPERTY	Results
APPEARANCE, COLOUR, ODOUR, PHYSICAL STATE	Beige liquid with aromatic odour
PH VALUE	6.6 (1% in distilled water)
SPECIFIC GRAVITY (LIQUIDS)	D_4^{20}=0.996
SURFACE TENSION (LIQUIDS)	30 mN/m @ 40 °C
VISCOSITY	60 – 500 mPa/s @ 20 °C and a shear stress of 20 s^{-1}
	20 – 200 mPa/s @ 20 °C and a shear stress of 100 s^{-1}
FLASH POINT	> 100 °C (closed)
EXPLOSIVE PROPERTIES	Not explosive
OXIDISING PROPERTIES	The decomposition energy is lower than 500 J/g
AUTOFLAMMABILITY	Self ignition temperature: 350 °C
CORROSIVE HAZARD	Not tested
PERSISTENT FOAM	8 mL (after 10 sec) and 6 mL after 1 min
ACTIVE SUSPENSIBILITY	94%
DISPERSION STABILITY	No cream or oil after 30 minutes
WE SIEVE TEST	< 0.01% residue on a 75 micron sieve
POURABILITY	Residue: 18% After 1 rinse: 0.79% After 2 rinses: 0.05% After 3 rinses: 0.03%

3 TOXICOLOGICAL ASSESSMENT

3.1 Executive Summary

Foramsulfuron is a new herbicide to the Australian market. The product, TRIBUTE® TURF HERBICIDE, contains 22.5 g/L of foramsulfuron. TRIBUTE® TURF HERBICIDE is a new herbicidal product, which will be used for the control of various grasses in turf, including Winter grass, Ryegrass, and Crowsfoot grass. Foramsulfuron belongs to the chemical class of sulfhydryl herbicides, which inhibit the synthesis of amino acid in plants through inhibition of acetolactate synthase (ALS). Inhibition of ALS by sulfhydryl chemicals is only relevant in plants.

Following oral administration in rats, foramsulfuron was readily but poorly absorbed through the gastrointestinal tract and was rapidly excreted in the faeces and urine. The compound underwent limited metabolism with only two metabolites detected in the excreta, with the parent compound being the most prevalent recovered compound. Foramsulfuron showed no indication of being bioaccumulative. An *in vivo* dermal absorption study in male rats indicated foramsulfuron had low potential to be absorbed when applied as either an undiluted formulation concentrate or an aqueous spray dilution.

Foramsulfuron was of low acute oral, dermal and inhalational toxicity in rats. It was non-irritating to the skin, but is a slight eye irritant in rabbits. It was not a skin sensitiser in guinea pigs. The formulated product, containing 22.5 g/L of foramsulfuron was of low acute oral, dermal and inhalational toxicity in rats. It was a moderate skin irritant and a slight eye irritant in rabbits, and was not a skin sensitiser in guinea pigs. It may cause lung damage if swallowed and enters the airways.

In short-term repeat dose studies with foramsulfuron (active constituent), the toxicity effects were restricted to decreased body weight gain in female rats at very high dose levels following oral administration. No treatment-related effects were observed in similar studies in mice or dogs. There was no evidence of systemic toxicity in a repeat dose dermal study in rats with doses up to and including 1000 mg/kg bw/day. There were no treatment–related effects observed in oral subchronic and chronic studies in mice, rats and dogs.

With the exception of weak evidence of clastogenicity in a human lymphocyte chromosome aberrations test *in vitro* without metabolic activation, foramsulfuron was negative in a series of *in vitro* assays (including a further chromosome aberration assay) and in two *in vivo* tests. Furthermore, no carcinogenic potential was detected in long-term studies in both rats and mice. Formasulfuron was neither a reproductive toxicant in rats nor a developmental toxicant in rats and rabbits.

Occupational Health and Safety

Workers may be exposed to the product when opening containers, mixing/loading, application and cleaning up spills and equipment. The main route of exposure to the spray will be dermal and inhalational, with potential accidental ocular exposure. Given the short term intermittent use pattern and lack of systemic toxicity in a 28-day dermal toxicity in rats (i.e. the 28 day dermal NOEL is 1000 mg/kg bw/d the highest dose tested), together with foramsulfuron's very low inherent toxicity in subchronic tests and its low volatility (4.2 x 10^{-11} Pa (20^{o}C)), a quantitative occupational health and safety risk assessment is not required. However,

First Aid Instruction and Safety Directions and a Re-entry statement have been recommended and are shown on the product label.

Conclusion

Based on an assessment of the toxicology, it was considered that there should be no adverse effects on human health from the use of TRIBUTE® TURF HERBICIDE when used in accordance with the label directions.

3.2 Evaluation of Toxicology

The toxicological database for foramsulfuron, which consists primarily of toxicity tests conducted in laboratory animals, is quite extensive. In interpreting the data, it should be noted that toxicity tests generally use doses that are high compared with likely human exposures. The use of high doses increases the likelihood that potentially significant toxic effects will be identified. Findings of adverse effects in any one species do not necessarily indicate such effects might be generated in humans. From a conservative risk assessment perspective however, adverse findings in animal species are assumed to represent potential effects in humans, unless convincing evidence of species specificity is available. Where possible, considerations of the species specific mechanisms of adverse reactions weigh heavily in the extrapolation of animal data to likely human hazard. Equally, consideration of the risks to human health must take into account the likely human exposure levels compared with those, usually many times higher, which produce effects in animal studies. Toxicity tests should also indicate dose levels at which the specific toxic effects are unlikely to occur. Such dose levels as the No-Observable-Effect-Level (NOEL) are used to develop acceptable limits for dietary or other intakes (ADI and ARfD) at which no adverse health effects in humans would be expected.

Toxicokinetics and Metabolism

Foramsulfuron is rapidly (Cmax approx 1h with low dose, and 4h with high dose) but only partially (about 20.6%) absorbed through the gastrointestinal tract of rats, and rapidly excreted in the faeces and urine (1.4-5.4%). The majority of administered doses were excreted in the faeces as unchanged parent compound (91.5% in the 0-24 hour excreta at both low and high doses). Foramsulfuron underwent limited metabolism, with only two metabolites detected in the excreta - the parent compound was the most prevalent recovered compound. The two metabolic pathways are deformylation to give the amine AE F130619 and cleavage of the sulfonylurea bridge to produce AE F153745. Administration of a single low or high dose, and multiple low doses of foramsulfuron resulted in similar kinetics.

In a percutaneous study in male rats, foramsulfuron had low potential to be absorbed when applied as either an undiluted formulation concentrate (7%) or an aqueous spray dilution (24%).

Acute toxicity studies

Foramsulfuron was of low oral, dermal and inhalational toxicity in rats (LD_{50} > 5000 mg/kg bw, LD_{50} > 2000 mg/kg and 4-h LC_{50} > 5040 mg/m^3 respectively). It was a slight eye irritant in rabbits, but was not a skin irritant in rabbits or a skin sensitiser in guinea pigs. The formulated product, TRIBUTE® TURF HERBICIDE,

has low acute oral, dermal and inhalational toxicity in rats (LD_{50} > 5000 mg/kg bw, LD_{50} > 5000 mg/kg bw and 4-h LC_{50} >5250 mg/m^3 the highest obtainable exposure concentration, respectively). It was a moderate skin irritant and slight eye irritant in rabbits, and not a skin sensitiser in guinea pigs. Based on the formulated product ingredients, the product may cause lung damage if swallowed and enters the airways.

Short term and subchronic toxicity studies

Foramsulfuron is a member of the sulfhydryl group of herbicides, and its mode of action is through inhibition of acetolactate synthase (ALS). This process results in inhibition of amino acid synthesis then slow or stunted plant growth and/or ultimate plant death. Though an ALS inhibitor in plants, this does not appear to be applicable to mammals.

In mice, rats and dogs, foramsulfuron consistently exhibited low toxicity after repeated dosing via oral and dermal routes. The only treatment related findings were decreased body weight gains in female rats receiving 20,000 ppm (~1884 mg/kg bw/d) in a 28-day dietary study. However this very high dose findings was not observed in any other repeat dose studies in rats, mice and dogs with highest oral doses up to 1135 mg/kg bw/d and, thus, it is concluded that the changes in the body weight, though treatment related, have little relevance to humans. No other treatment related effects or clinical signs were observed in rats at lower doses in either sex. No treatment related effects were observed in 28-day dietary studies in mice or dogs.

No signs of clinical toxicity or adverse treatment-related effects were observed in rats, mice or dogs in repeat 90-day oral studies. There was no evidence of systemic toxicity during a 28-day repeat dose dermal study with doses up to 1000 mg/kg bw/d.

Chronic toxicity and carcinogenicity studies

No treatment related effects were observed in dogs during a 12 month oral study. No treatment related effects, or indications of oncogenicity, were observed in mice or rats in chronic oral studies. Thus, there was no evidence of carcinogenicity in animals treated with foramsulfuron.

Reproduction and Developmental Studies

There was no indication of parental or foetal toxicity or teratogenicity in rat developmental and reproduction studies. However in an oral developmental study in rabbits, treatment related reduced bodyweight gain were observed in pregnant animals at the intermediate and high dose (i.e 50 and 500 mg/kg bw/d) during the dosing period. There were no treatment related effects on developmental indicators. Reduced body weight gain was observed in females rats in a 28-day dietary study at very high dose (20000 ppm equivalent to 1884 mg/kg bw/d), suggesting that females may be more sensitive to this endpoint. However, in comparison with female rats, a significant reduction in body weight gain was seen in female rabbits at a much low dose level (1884 vs 50 mg/kg bw/d). The difference in sensitivity may be due to the pregnant status of the rabbits.

Genotoxicity Studies

In an *in vitro* human lymphocyte chromosome aberrations test for genotoxicity, foramsulfuron showed weak evidence of clastogenicity in the absence of metabolic activation. However, formasulfuron was negative in a range of *in vitro* tests (± metabolic activation) including a further assay for chromosome aberration assay,

and an *in vivo* micronucleus and UDS assay. Thus, formasulfuron is not mutagenic *in vitro* or genotoxic *in vivo*.

Neurotoxicity Studies

No neurotoxicity tests were available for evaluation.

Other members of the sulfhydryl herbicides have been evaluated by the OCSEH. Members of this group have low acute toxicity, and are generally slight eye irritants. Treatment related effects observed during repeat dose studies are generally limited to higher doses. The target organs of this group of chemicals are generally the liver and kidneys and male reproductive organs. The sulfhydryl class of chemicals has no notable effects on reproduction and development nor is there any indication of carcinogenicity or genotoxcity. The toxicological profile of foramsulfuron is consistent with the other members of the sulfhydryl class.

3.3 Public Health Standards

Poisons Scheduling

The National Drugs and Poisons Schedule Committee (NDPSC) considered the toxicity of the product and its active ingredients and assessed the necessary controls to be implemented under states' poisons regulations to prevent the occurrence of poisoning.

At its 58th meeting of February 2010, the NDPSC agreed that on the basis of the persistency of observed eye irritation, and as it was likely that the irritation was inherent to the chemical, foramsulfuron should be included in Schedule 5.

No Observable Effect Level (NOEL) and Acceptable Daily Intake (ADI)

The Acceptable Daily Intake (ADI) is that quantity of an agricultural compound, which can safely be consumed on a daily basis for a lifetime and is based on the lowest NOEL obtained in the most sensitive species. This NOEL is then divided by a safety factor, which reflects the quality of the toxicological database and takes into account the variability in responses between species and individuals. Chemicals that are not used in food-producing situations do not require the establishment of an ADI. An ADI for foramsulfuron has not been set as the use pattern is for treatment of turf (i.e. non-food producing).

Acute Reference Dose (ArfD)

The acute reference dose (ARfD) is the maximum quantity of an agricultural or veterinary chemical that can safely be consumed as a single, isolated event. The ARfD is derived from the lowest NOAEL (NOEL) as a single or short-term dose which causes no effect in the most sensitive species of experimental animal tested, together with a safety factor which reflects the quality of the toxicological database and takes into account the variability in responses between species and individuals.

Based on the non-food producing use pattern and lack of significant treatment related effects or mortalities in any of the submitted studies an ARfD has not been set for foramsulfuron.

4 OCCUPATIONAL HEALTH AND SAFETY ASSESSMENT

Health hazards

Foramsulfuron has low acute oral, dermal and inhalational toxicity in rats. The compound was not a skin irritant in rabbits or a skin sensitiser in guinea pigs. It was a slight eye irritant in rabbits. Foramsulfuron is not listed on the Safe Work Australia's (SWA) Hazardous Substances Information System (HSIS) Database (SWA, 2009)

The formulated product, containing 22.5 g/L of foramsulfuron has low acute oral, dermal and inhalational toxicity in rats, it was a moderate skin irritant and slight eye irritant in rabbits or eye irritant in rabbits, and was not a skin sensitiser in guinea pigs. Based on the product toxicology information and concentrations of foramsulfuron and other ingredients in the product, TRIBUTE® TURF HERBICIDE is classified as a hazardous substance according to NOHSC *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 2004), with the following risk phrases.

R38	Irritating to skin
R65	Harmful, may cause lung damage if swallowed

Formulation, packaging, transport, storage and retailing

TRIBUTE® TURF HERBICIDE will be manufactured overseas and imported into Australia as an oil based suspension concentrate in nylon extruded in high-density polyethylene (HDPE) bottles. It will be available in a 1 to 1.14 L pack size. Transport workers and store persons will handle the packaged products and could only become contaminated if packaging were breached.

Use pattern

TRIBUTE® TURF HERBICIDE is a new herbicidal product, which will be used for the control of various grasses in turf. It is to be applied to turf consisting of couchgrass, both common and hybrid, but not Queensland Blue Couch, and will control Winter grass, Ryegrass, and Crowsfoot Grass. It contains 22.5 g/L foramsulfuron and the formulation is an oil-based suspension concentrate (OD).

Exposure during use

Farmers and their employees will be the main users of the products. The users may be exposed to the product when opening containers, mixing/loading, application and cleaning up spills and equipment. The main route of exposure to the product/spray will be dermal and inhalation, although ocular exposure is also possible.

There are no worker exposure studies on foramsulfuron or the product (TRIBUTE® TURF HERBICIDE) available for assessment. In the absence of worker exposure data, the OCSEH generally uses the Pesticide Handler Exposure Database (PHED) Surrogate Exposure Guide (1998) to estimate the worker exposure

during mixing/loading and application based on the maximum product use rate according to the Australian use pattern. However, a quantitative OH&S assessment, including post application exposure assessment, is not required for TRIBUTE® TURF HERBICIDE due its toxicological profile and lack of toxic effects observed in a 28-day dermal rat study.

The toxicology data demonstrates that provided that workers wear a single layer cotton overall and chemical resistant gloves, no further PPE is required for potential repeat exposure effects when using TRIBUTE® TURF HERBICIDE to control various grasses in turf.

Exposure during re-entry

Do not allow entry into treated areas until the spray has dried, unless wearing cotton overalls buttoned to the neck and wrist (or equivalent clothing) and chemical resistant gloves. Clothing must be laundered after each day's use.

Recommendations for safe use

Users should follow the First Aid Instructions and Safety Directions on the product label.

Conclusion

The registration of TRIBUTE TURF® HERBICIDE containing 22.5 g/L of foramsulfuron, for the control of various grasses in turf, is supported.

TRIBUTE® TURF HERBICIDE can be used safely if handled in accordance with the instructions on the product label and any other control measures described above. Additional information is available on the product MSDS.

5 ENVIRONMENTAL ASSESSMENT

5.1 Environmental Fate Summary

Hydrolysis

Foramsulfuron is readily or fairly hydrolysing in environmentally relevant acidic pH values but only slightly hydrolysing in neutral and environmentally relevant basic conditions. Foramsulfuron was hydrolysed to give AE F153745 and AE F092944 after cleavage of the sulfonylurea bridge. The half-lives in acidic conditions were 3.7 to 10.1 days and 128 to 132 days in neutral and basic conditions. The data show that none of the degradation products is completely stable against hydrolysis at all pH values.

Photolysis

Foramsulfuron did not significantly absorb UV/VIS light in the environmentally significant wavelength range of 290-800 nm. In standard soil photolysis and aqueous photolysis studies the degradation rates were not significantly different from the dark controls. Photolysis is not expcted to be a significant degradation pathway for foramsulfuron.

Foramsulfuron is unlikely to remain stable in the atmosphere, due to reactions with photo-chemically produced hydroxyl radicals with an estimated half-life of 0.07 days.

Biodegradation

Aerobic

The metabolism of foramsulfuron in aerobic soil was studied in six soils at a range of temperatures between 10 and 25°C. In all cases foramsulfuron was found to be readily degraded with half-life values between 1.3 and 20.9 days. As expected the half-life was longer at 10°C than at 20 or 25°C. The longest half-life at 20 - 25°C is 12.7 days. Metabolites observed in the soil were AE F130619, AE F153745, AE F148003, AE F092944 and AE F099095, the latter four are all formed through hydrolysis of the sulphonylurea. A large amount of non-extractable residue (NER), remained associated with the soil. The likely predominant mechanism of NER formation is believed to involve strong association of the benzamine moiety in the phenyl side of AE F130619 with soil. The metabolite AE F130619 accounted for up to 27.3% of the applied radioactivity, before declining and AE F092944 rose to 17.8% of applied radioactivity. The metabolite AE F130619 is rapidly degraded in soil, with DT50 values in the range of 0.4 to 0.9 days. The only other metabolite to account for more than 10% of the applied radioactivity was AE F153745, which accounted for up to 12.9%. Extensive mineralisation also occurred.

In aerobic aquatic conditions (two water/sediment systems) foramsulfuron dissipates by a combination of partitioning to the sediment from the water phase and also degradation in water and sediment. Degradation of foramsulfuron proceeds via three pathways. The major route is O-demethylation to form AE 0338795, which subsequently degrades completely in the test system. Foramsulfuron also degrades via hydrolysis of the formamide moiety to form AE F130619, as well as hydrolysis at the sulfonylurea bridge to form AE F153745 and AE F092944. Lower pH and microbial activity facilitate the degradation of foramsulfuron. The

half-life for degradation of foramsulfuron in the complete system (sediment plus water) ranged from 34 days to 55 days and may be regarded as fairly degradable. The DT_{50} for dissipation from the water phase ranged from 13 days to 21 days.

Anaerobic

Foramsulfuron is slightly degradable based on the treatment of a single soil under anaerobic conditions, with DT_{50} values in the range of 165 to 230 days. It is degraded via chemical hydrolysis of the formamide moiety to form AE F130619, as well as hydrolysis at the sulfonylurea bridge to form AE F153745 and AE F092944. The hydrolytic breakdown products readily form non-extractable residues (up to 23% of applied radioactivity). The anaerobic soil degradation pathway is identical to the aerobic soil degradation pathway albeit at a slower rate.

In aquatic conditions, tested at 20°C foramsulfuron is fairly degradable in an anaerobic sediment-water system with a DT_{50} value of 31 days. It dissipated from the water column with a DT_{50} of 22.3 days by a combination of degradation and partitioning to the sediment. Once in the sediment it was found to degrade with an estimated half-life of 50 days. The predominant fate of foramsulfuron in the anaerobic sediment/water system was the formation of water-soluble polar products (probably associated with fulvic acid components) and non-extractable residue. At 10°C the DT50 value for the system was 72 days, longer than that at 20°C, as expected.

Mobility

Foramsulfuron has high or moderate mobility in soils with Koc values of between 38 and 151 with a mean of 78. The K_{des} values are generally greater than the K_{ads} values suggesting that once foramsulfuron is adsorbed on soil it is generally more difficult to desorb it. The slope (1/n) was close to but less than 1 suggesting that foramsulfuron will partition slightly more to water as the concentration of foramsulfuron increases. The correlation of adsorption (K) with cation exchange capacity was significant, whilst that with organic carbon was not. This suggests that the major mechanism for adsorption to soils is through mechanisms other than organic carbon and this may be due to the interaction with the sulfonylurea bridge.

The major metabolite AE F130619 has similar properties to its parent with Koc values of 40 to 144 with a mean of 73 which classifies it as very highly or highly mobile. Its binding to soil is likely to be through several mechanisms including organic carbon and pH may also influence the binding.

Another major metabolite AE F153745 is also very highly or highly mobile with Koc values of 35 to 63 with a mean of 49. However, unlike its parent there is reasonable correlation between organic carbon content and adsorption to soil indicating that it is likely to adsorb to organic carbon.

A further metabolite AE F092944 was found to have highly variable mobility with Koc values from 89 to 11292 with a mean of 1861. However, this is probably largely due to organic carbon not being significant mechanism for binding of AE F092944 to soil.

Volatilisation is not expected to be a major route of dissipation of foramsulfuron.

Accumulation

Foramsulfuron is unlikely to bioaccumulate in organisms or accumulate in soil.

5.2 Environmental Effects

Avian

Birds were not sensitive to foramsulfuron, with no effects being shown in acute, short term or reproductive studies, to the levels tested. This equated to 2000 mg/kg body weight for both the Bobwhite quail and Mallard duck in acute tests; 5000 ppm in feed equivalent to a mean uptake of > 985 and 1792 mg/kg bw/day for bobwhite quail and mallard ducks, respectively, in short term tests; and 1000 ppm in feed equivalent to 104 and 132 mg/kg body weight/day in bobwhite quail and mallard ducks, respectively, in reproduction tests. Similarly a formulation containing 2.42% foramsulfuron and 2.44% isoxadifen-ethyl was found to be non-toxic to the level tested in an acute study, with a NOEL of 2000 mg formulation/kg bw.

Fish

Fish were not sensitive to foramsulfuron with NOECs of 100 mg/L in acute and sub-chronic studies. The formulation containing 2.42% foramsulfuron and 2.44% isoxadifen-ethyl is of higher toxicity. The most sensitive fish was the bluegill sunfish with a 96 h LC_{50} of 7.8 mg formulation/L and Rainbow trout have a 28 day NOEC of 0.65 mg formulation/L based on survival and growth.

Aquatic Invertebrates

Daphnia were not sensitive to foramsulfuron with NOECs of 100 mg/L in acute and sub-chronic studies. The formulation containing 2.42% foramsulfuron and 2.44% isoxadifen-ethyl is of higher toxicity. The 48 h EC50 for the exposure of daphnia to the formulation was 6.9 mg/L, whilst for 21 days the NOEC was 0.4 mg/L based on length and reproduction.

Algae and Aquatic Plants

As expected for a herbicide algae and aquatic plants were sensitive to foramsulfuron. Foramsulfuron is slightly or moderately toxic to green and blue-green algae. Blue-green algae were the most sensitive with an EbC50 of 2.5 mg/L and an ErC50 of 3.9 mg/L at 72 hours. The marine and freshwater diatoms were not sensitive to foramsulfuron with a NOEC and LOEC of 100 mg/L, respectively. The formulation in spite of containing a crop safener was slightly more toxic to green algae with an EbC50 of 3.5 mg/L and an ErC50 of > 5 mg/L. Duckweed was very sensitive to foramsulfuron with a 7 day EbC50 of 0.65 µg/L and an ErC50 of 1.01 µg/L. However, when exposed to clean water duckweed recovered completely from exposure to foramsulfuron to levels of up to 5.0 µg/L and recovered in terms of growth up to levels of 20 µg/L. The major metabolites AE F153745 and AE 0338795 were practically non-toxic and slightly toxic to duckweed, respectively.

Terrestrial Invertebrates

Earthworms, and bees were not found to be sensitive to foramsulfuron to the level tested. In the case of bees the LD_{50} is > 163 and > 1.9 µg/bee for oral and acute contact exposure respectively. No effects were observed in earthworms for exposure levels of up to 1000 mg/kg dry weight of soil. Similarly the major metabolite AE F153745 showed no effects at up to 1000 mg/kg dry weight of soil. The formulation containing 2.42% foramsulfuron and 2.44% isoxadifen-ethyl is slightly toxic to earthworms with an LC_{50} of 453 mg/kg dry weight of soil. Similarly this formulation was found to be very slightly toxic to bees with the lowest LD50 (72 hour oral) determined as 226 µg/bee. A formulation containing 2.42% foramsulfuron and 2.44% isoxadifen-ethyl was tested on other terrestrial arthropods. In laboratory tests on glass, the parasitic wasp and predatory mite were sensitive to the formulation containing foramsulfuron. At rates equal to or greater than 2 L/ha 100% mortality occurred for the parasitic wasp. At 0.16 L/ha, equivalent to 4% of the proposed application rate in Australia, the overall effect on the parasitic wasp was 45% reduction in beneficial capacity. The predatory mite was also sensitive to the formulation, with applications of 2.67 L/ha (≡ 60 g ac/ha) having an overall reduction in beneficial capacity of 69%. At 6 g ac/ha applications of the formulation showed no reduction in beneficial capacity to the predatory mite. However, whilst applications of the formulation of up to 90 g ac/ha to leaves did not adversely influence the mortality and the reproduction of the predatory mite, it did have a weak repellent effect. Slight reductions in beneficial capacity (≤ 15%) were observed for the rove beetle exposed to the formulation and the NOEL was considered to be 2 L/ha. The wolf spider and other beetles were not sensitive to the tested formulation containing foramsulfuron at a field rate of at least 4 L/ha. The lacewing was not very sensitive to the tested formulation to a field rate of 2 L/ha, but 44% reduction in beneficial capacity was observed at 4 L/ha.

Micro-organisms

Exposure of foramsulfuron, its formulation and its bound soil residues to micro-organisms resulted in no significant toxic effects on glucose simulated respiration or microbial mineralisation up to 0.6 kg ac/ha. Foramsulfuron similarly had no effect to sewage micro-organisms, with a NOEC of 100 mg/L.

Terrestrial Plants

A representative formulation containing 22.5 g/L foramsulfuron and 22.5 g/L isoxadifen-ethyl was used for all studies. Isoxadifen-ethyl is a crop safener but is selective for corn and rice. Most other species of plants are expected to show similar sensitivity to the formulation as to foramsulfuron alone. Foramsulfuron caused toxic effects on the germination of both dicot and monocot species. Six of the ten species tested were affected with lettuce and radish being the most sensitive. Plant weight was the most sensitive parameter and the EC_{50} and NOEC for lettuce is 38.8 and 0.74 g ac/ha respectively. All of the ten species treated with formulation containing foramsulfuron, exhibited toxic effects for vegetative vigour except for corn. However, the effects on corn are likely to have been reduced due to the presence of the crop safener. It is, however, noted that from the efficacy trials with foramsulfuron alone, corn is unlikely to be the most sensitive species. The most sensitive species was radish with an EC_{50} and NOEC based on plant weight of 1.88 and ≤ 0.25 g ac/ha. The least sensitive species was onion with an EC_{50} based on plant weight of 38.5 g ac/ha.

5.3 Risk Assessment

TRIBUTE® TURF HERBICIDE containing 22.5 g foramsulfuron/L may be applied up to 3 times with a 14 day interval. The resulting estimated environmental concentration of foramsulfuron and its formulation showed an acceptable risk to birds, bees, earthworms, fish, daphnia and algae. However, a formulation having toxicity representative of TRIBUTE® TURF HERBICIDE was found to be toxic to some beneficial invertebrates. The risk to duckweed was found to be unacceptable unless a downwind no spray zone was imposed. Standard APVMA modelling for low boom spraying with medium spray nozzles was used. Consideration was given to the accumulation of foramsulfuron in the water body from multiple sprays. As duckweed recovered from exposure of levels up to 5 µg foramsulfuron/L for 7 days when subsequently exposed to clean water, consideration was given to a concentration of foramsulfuron that was regarded as approximating clean water. A value of ≤ 0.1 µg foramsulfuron was considered to approximate clean water and duckweed was expected to recover as long as the maximum concentration was below 5 µg/L. The downwind no spray zone was found to be 40 m for a single spray and 100 m for three sprays. Within these bounds, a downwind no spray zone, which resulted in an EEC of ≤ 0.1 µg/L, after seven days degradation of formasulfuron was considered. This resulted in a downwind no spray zone of 80 m for the protection of the aquatic environment.

Due to foramsulfuron's high mobility, contaminated run-off water posed a risk to duckweed. Rapid degradation of foramsulfuron on well established turf reduced this risk. However, it was found to be unacceptable in the worst case scenario. Consideration was given to the topography (slope) for its use in turf growing and playing fields. Similarly the amount of treated to untreated area was considered for golf courses. In all cases the risk to duckweed was on the margins of what is considered acceptable and mitigable. Therefore as long as it is applied to turf that is well established and measures are taken to prevent run-off, the risk to duckweed can be mitigated. A formulation containing a crop safener was tested on non-target plants. However, the safener is expected to have a selective mode of action and the toxicity to the most sensitive species tested is expected to be representative of the toxicity of TRIBUTE® TURF HERBICIDE formulation, which does not contain a crop safener. Again using standard APVMA modelling (as described previously) the risk to non-target plants may be mitigated by the imposition of a 30 m downwind no spray zone.

6 EFFICACY AND SAFETY ASSESSMENT

6.1 Proposed use pattern

TRIBUTE® TURF HERBICIDE is intended to be used at a rate of 1.5-2L product/ha on common and hybrid couchgrass only (not Queensland Blue Couch) to control winter grass (*Poa annua),* ryegrass (*Lolium perenne*) and crowsfoot grass (*Eleusine indica*). Use is proposed in all Australian states and territories.

6.2 Summary of Evaluation of Efficacy and Crop Safety

Data from 16 field trials conducted on commercially managed turf in golf courses, sportsfields, turf farms and research institutes, during 2003, 2005, 2006 and 2007 demonstrate that TRIBUTE® TURF HERBICIDE can be used safely to control wintergrass (*Poa annua*), ryegrass (*Lolium perenne*) and crowsfoot grass (*Eleusine indica*) in couchgrass (*Cynodon dactylon*) turf. Crop safety was tested on common and named varieties of couch (*Cynodon dactylon*), but not on Qld blue couch. All the trials used suitable methodology and were conducted in situations equivalent to commercial practice throughout couchgrass turf growing areas in NSW, Qld and WA. All trials used Randomised Complete Block design, with 3-4 replicates and untreated controls and were conducted by suitably qualified personnel. The formulation tested and rates used are consistent with the product TRIBUTE® TURF HERBICIDE.

The proposed label has both broadacre and spot treatment listed as methods of application. The trials consisted of 14 trials conducted with a hand held boom to replicate broadacre application, one trial conducted with a backpack sprayer to replicate spot treatment, and one trial conducted with both hand held boom and backpack sprayer. Four of the trials mixed TRIBUTE® TURF HERBICIDE with another turf herbicide Destiny® Selective Turf Herbicide (iodisulfuron-methyl-sodium) to look at a broad spectrum control to include other grass and some broadleaf weeds. A number of different rates ranging from 0.4L/ha to 3L/ha of TRIBUTE® TURF HERBICIDE were used in the trial to establish the safest and most effective rate.

The weed densities and growth stages in the trials were sufficient to warrant control under the commercial management regimes of the trials. The turf and weeds were growing under good conditions and provided sufficient challenge to the herbicide. They were considered equivalent to label claims. The results from these trials were adequate to establish the efficacy claimed on the proposed label for TRIBUTE® TURF HERBICIDE. The assessments for weed control were completed as either a visual percentage of control or a plant survival count twice to four times with dates ranging from 15 Days After Treatment (DAT) to 85 DAT. The assessments for crop safety were completed as a visual phytotoxicity assessment once to three times with dates ranging from 15 DAT to 85 DAT. The majority of these trials also compare the performance of TRIBUTE® TURF HERBICIDE to accepted industry standard herbicides. Data were analysed using standard ANOVA with means separated at 95% level of probability.

The trials demonstrate control for wintergrass, ryegrass and crowsfoot grass at the proposed label rates. It was noted in two of the trials that a second treatment might be required, which is also recommended on the proposed label. There was no significant difference between TRIBUTE® TURF HERBICIDE and the industry standards, which supported the proposed label. There was no phytotoxicity noted in any of the trials.

It is recommended that in relation to efficacy and crop safety the proposal to register TRIBUTE® TURF HERBICIDE for the post emergence control of wintergrass, ryegrass and crowsfoot grass in couchgrass turf as proposed in the label claims, directions for use and other instructions is supported.

7 LABELLING REQUIREMENTS

CAUTION

KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING OR USING

Tribute®

SELECTIVE TURF HERBICIDE

ACTIVE CONSTITUENT: 22.5 g/L FORAMSULFURON

GROUP B HERBICIDE

1 L

For post-emergent control of certain grass weeds in turf as specified in the Directions for Use table.

IMPORTANT: READ THE ATTACHED BOOKLET BEFORE USE

STORAGE AND DISPOSAL

Store in the closed, original container in a cool, well-ventilated area. DO NOT store for prolonged periods in direct sunlight. Triple or preferably pressure rinse containers before disposal. Add rinsings to spray tank. DO NOT dispose of undiluted chemicals on site. If recycling, replace cap and return clean containers to recycler or designated collection point. If not recycling, break, crush, or puncture and deliver empty packaging to an approved waste management facility. If an approved waste management facility is not available bury the empty packaging 500 mm below the surface in a disposal pit specifically marked and set up for this purpose clear of waterways, desirable vegetation and tree roots, in compliance with relevant Local, State or Territory government regulations. DO NOT burn empty containers or product.

SAFETY DIRECTIONS

May irritate the eyes. Will irritate the skin. Avoid contact with eyes and skin. If product in eyes, wash it out immediately with water. If product on skin, immediately wash area with soap and water. When opening the container, preparing and using the product, wear cotton overalls buttoned to the neck and wrist and a washable hat and elbow-length chemical-resistant gloves. Wash hands after use.

FIRST AID: If poisoning occurs contact a doctor or Poisons Information Centre. Phone Australia 13 11 26; New Zealand 0800 764 766.

MATERIAL SAFETY DATA SHEET

Additional information is listed in the Material Safety Data Sheet which may be found at www.bayeres.com.au.

EXCLUSION OF LIABILITY

This product must be used strictly as directed, and in accordance with all instructions appearing on the label and in other reference material. So far as it is lawfully able to do so, Bayer CropScience Pty Ltd accepts no liability or responsibility for loss or damage from failure to follow such directions and instructions.

APVMA Approval No.: 63240 / 45114

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FOR 24 HOUR SPECIALIST ADVICE
IN EMERGENCY ONLY
PHONE 1800 033 111

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Website: www.bayeres.com.au

Batch Number: Date of Manufacture: (label code)

CAUTION
KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING OR USING

TRIBUTE SELECTIVE TURF HERBICIDE

ACTIVE CONSTITUENT: 22.5 g/L FORAMSULFURON

GROUP	HERBICIDE
B	

For post-emergent control of certain grass weeds in turf as specified in the Directions for Use table.

READ THIS BOOKLET BEFORE USE

STORAGE AND DISPOSAL
Store in the closed, original container in a cool, well-ventilated area. DO NOT store for prolonged periods in direct sunlight. Triple or preferably pressure rinse containers before disposal. Add rinsings to spray tank. DO NOT dispose of undiluted chemicals on site. If recycling, replace cap and return clean containers to recycler or designated collection point. If not recycling, break, crush, or puncture and deliver empty packaging to an approved waste management facility. If an approved waste management facility is not available bury the empty packaging 500 mm below the surface in a disposal pit specifically marked and set up for this purpose clear of waterways, desirable vegetation and tree roots, in compliance with relevant Local, State or Territory government regulations. DO NOT burn empty containers or product.

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APVMA Approval No.: 63240 / 45114

DIRECTIONS FOR USE

RESTRAINTS

DO NOT apply with aircraft.
DO NOT apply through any type of irrigation equipment.
DO NOT apply with a nozzle height greater than 50cm above the ground.
DO NOT apply to turf or weeds under stress.
DO NOT apply on turf exhibiting injury from previous applications of other products.
DO NOT apply to turf which is not well established.
DO NOT apply to short mown turf (less than 10mm).
DO NOT apply if heavy rain has been forecast within 48 hours.
DO NOT apply to waterlogged soil.
DO NOT apply within two weeks of couchgrass sprigging.
DO NOT apply within four weeks prior to overseeding couchgrass with a cool season grass such as ryegrass, as some temporary stunting may occur for up to two weeks.

SPRAY DRIFT RESTRAINTS

DO NOT apply with spray droplets smaller than a **MEDIUM** spray droplet size category according to nozzle manufacturers specifications that refer to the ASAE S572 Standard or the BCPC Guideline.
DO NOT apply when wind speed is less than 3 or more than 20 km per hour as measured at the application site
DO NOT apply during surface temperature inversion conditions at the application site

Users of this product **MUST make an accurate written record** of the details of each spray application within 24 hours following application and **KEEP** this record for a minimum of 2 years. The spray application details that must be recorded are: **1** date with start and finish times of application; **2** location address and paddock/s sprayed; **3** full name of this product; **4** amount of product used per hectare and number of hectares applied to; **5** crop/situation and weed/pest; **6** wind speed and direction during application; **7** air temperature and relative humidity during application; **8** nozzle brand, type, spray angle, nozzle capacity and spray system pressure measured during application; **9** name and address of person applying this product. (Additional record details may be required by the state or territory where this product is used.)

MANDATORY NO-SPRAY ZONES

DO NOT apply if there are aquatic or wetland areas including aquacultural ponds, surface streams and rivers within 80 metres downwind from the application area.
DO NOT apply if there are sensitive crops, gardens, landscaping vegetation, protected native vegetation or protected animal habitat within 30 metres downwind from the application area.

DIRECTIONS FOR USE TABLE

SITUATION	WEEDS CONTROLLED	RATE	CRITICAL COMMENTS
Turf - only apply to couchgrass (common and hybrid couchgrass NOT Queensland Blue Couch)	Winter grass *(Poa annua)* Ryegrass *(Lolium perenne)*	1.5 L/ha	A repeat application may be required if a dense weed cover or larger plants are present. Ryegrass control is improved with the addition of DESTINY at 25 g/ha.
	Crowsfoot Grass *(Eleusine indica)*	2 L/ha	Two to three applications at 14-day intervals may be required for effective control.
	Winter grass *(Poa annua)* Ryegrass *(Lolium perenne)* Crowsfoot Grass *(Eleusine indica)*	8 to 15 mL / L water	Spot treatment only: Use the higher rate for the more difficult to control or larger weeds (crowsfoot and larger ryegrass plants). Spray to wet, but do not apply beyond runoff.

NOT TO BE USED FOR ANY PURPOSE OR IN ANY MANNER CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION.

DO NOT GRAZE TREATED TURF OR FEED TURF CLIPPINGS FROM ANY TREATED AREA TO POULTRY OR LIVESTOCK
DO NOT USE CLIPPINGS FROM TREATED AREAS FOR MULCH AROUND VEGETABLES OR FRUIT TREES

GENERAL INSTRUCTIONS

TRIBUTE Selective Turf Herbicide is a selective sulfonylurea herbicide. It is predominantly a foliar herbicide with less activity via the soil. TRIBUTE will not reliably control weeds that emerge after spraying. Best results are achieved when the product is applied under good growing conditions and to weeds and turf which are actively growing and not under stress. Avoid mowing during the three to four days preceding or following treatment. Application to very dry sandy soils followed by soaking rainfall may cause turf damage. Turf damage may also be increased in highly alkaline soils (soil pH >8.5 as determined by soil in water suspension). Avoid excessive mechanical disruptions such as aerification and verticutting within one week prior to or after application.

RESISTANT WEEDS WARNING

GROUP	B	HERBICIDE

TRIBUTE Selective Turf Herbicide is a member of the sulfonylurea group of herbicides and has the inhibitor of ALS mode of action. For weed resistance management TRIBUTE is a Group B herbicide. Some naturally-occurring weed biotypes resistant to TRIBUTE, and other Group B herbicides, may exist through normal genetic variability in any weed population. These resistant individuals can eventually dominate the weed population if these herbicides are used repeatedly. These resistant weeds will not be controlled by TRIBUTE or other Group B herbicides. Do not rely exclusively on TRIBUTE for weed control. Use as part of an integrated weed management program involving herbicides with other modes of action and non-chemical methods of control. Since occurrence of resistant weeds is difficult to detect prior to use Bayer CropScience Pty. Ltd. accepts no liability for any losses that may result from the failure of TRIBUTE to control resistant weeds.

MIXING
Ensure that the spray tank is completely clean prior to mixing. Half fill the spray tank with water, then with agitators in motion, add the correct amount of TRIBUTE directly into the spray tank. Complete filling the tank with agitators in motion. Agitation must continue before and during spraying. If pH of water carrier is less

than 5.5, use a buffer solution to raise pH to meet 7.0. **DO NOT** mix TRIBUTE with acid-forming compounds in the spray vat. **DO NOT** leave spray mix standing in the vat overnight.

APPLICATION
Ensure spraying equipment is properly calibrated before use. Ensure that complete and even spray coverage of all weeds is achieved. DO NOT overlap sprayed areas.

Broadcast Application:
Aim to apply a thorough and even coverage of spray to the target weed. Dense stands of weeds should be thoroughly wetted with spray. Incomplete coverage may result in poor control. Equipment set-up should be such that adequate coverage, penetration and volume of spray liquid can be achieved while the potential for off-target movement is minimised.

Application should be at the recommended rate in sufficient water to give thorough coverage of weeds. Apply in a minimum of 200 L/ha through nozzles that will deliver a MEDIUM spray droplet as defined by ASAE S572 Standard or BCPC Guideline. Use higher spray volumes (up to 500 L/ha) for dense weed populations or under adverse growing conditions.

The product should dry on the leaf surface prior to allowing traffic on the treated area. Risk to sensitive grasses such as bentgrass, ryegrass, and *Poa trivialis* adjacent to TRIBUTE applications is decreased when the soil is at less than field capacity. **DO NOT** apply if heavy rain has been forecast within 48 hours. **DO NOT** apply to waterlogged soil. TRIBUTE is foliar absorbed; irrigation is not recommended immediately after application. However, for the next two mornings after application, if dew is present, irrigate lightly (3-5 mm) prior to allowing traffic each day in the area. Avoid water run-off during these irrigation cycles. **DO NOT** irrigate to the point of run-off within 7 days of application.

SPRAYER CLEAN UP
The sprayer must be thoroughly decontaminated before being used again to spray susceptible plants or turf. Ensure that the following operation is carried out in an area that is clear of waterways, desirable vegetation and tree roots, and preferably in an area where drainings can be contained.

1. Drain sprayer completely and wash out tank, boom and hoses with clean water.
2. Drain again.
3. Fill the tank with clean water and add 300 mL of chlorine bleach (containing 4% chlorine) per 100 L of water with agitation running.
4. Flush some bleach solution through booms and hoses and allow remainder to agitate in tank for 10 minutes.
5. Remove nozzles and filters and leave to soak in a bleach solution of 500 mL per 10 L of water while tank cleaning is in progress.
6. Briefly run the pump at periodic intervals to refresh chlorine solution in spray lines.
7. Drain tank and repeat the procedure of flushing with bleach solution.
8. Flush the tank, boom and hoses with clean water.

COMPATIBILITY
No information is available that indicates physical compatibility with products other then those detailed in the Direction for Use table. Tank-mixing other products with TRIBUTE Selective Turf Herbicide cannot therefore be recommended. As formulations of other manufacturers' products are beyond the control of Bayer, all mixtures should be tested prior to mixing commercial quantities. Note that organophosphate insecticides should not be tank-mixed or applied within 7 days prior or 3 days after application as there may be increased potential for turf injury.

PRECAUTIONS
RE-ENTRY PERIOD
DO NOT allow entry into treated areas until the spray has dried, unless wearing cotton overalls buttoned to neck and wrist (or equivalent clothing), chemical resistant gloves and footwear. Clothing must be laundered after each days use.

PROTECTION OF CROPS, NATIVE AND OTHER NON-TARGET PLANTS
DO NOT apply under weather conditions, or from spraying equipment, that may cause spray to drift onto nearby susceptible plants/crops, cropping lands or pastures. **DO NOT** use clippings from treated areas for mulch around vegetables or fruit trees.

PROTECTION OF LIVESTOCK, WILDLIFE, FISH, CRUSTACEANS AND ENVIRONMENT
TRIBUTE Selective Turf Herbicide may kill or harm non-target beneficial invertebrates where IPM is practised. Very toxic to aquatic life. **DO NOT** contaminate streams, rivers or waterways with this product or used containers. **DO NOT** apply if heavy rain has been forecast within 48 hours. **DO NOT** graze treated turf or feed turf clippings from any treated area to poultry or livestock.

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ABBREVIATIONS

ac	active constituent
ADI	Acceptable Daily Intake (for humans)
ac	Active constituent
ALS	Acetolactate synthase
ai	active ingredient
ARfD	Acute reference dose
bw	bodyweight
d	day
DAT	Days After Treatment
°C	Degrees Centigrade
DT_{50}	Time taken for 50% of the concentration to dissipate
E_bC_{50}	concentration at which the biomass of 50% of the test population is impacted
EC_{50}	concentration at which 50% of the test population are immobilised
E_rC_{50}	concentration at which the rate of growth of 50% of the test population is impacted
g	gram
h	hour
ha	hectare
HDPE	High-density polyethylene
in vitro	outside the living body and in an artificial environment
in vivo	inside the living body of a plant or animal
kg	kilogram
K	Adsorption
K_{ads}	Equilibrium constant for adsorption
K_{des}	Equilibrium constant for desorption
K_{oc}	Organic carbon partitioning coefficient
L	Litre

LC_{50}	concentration that kills 50% of the test population of organisms
LD_{50}	dosage of chemical that kills 50% of the test population of organisms
LOEC/LOEL	Lowest Observable Effect Concentration/Level
mg	milligram
mL	millilitre
MSDS	Material Safety Data Sheet
NDPSC	National Drugs and Poisons Schedule Committee
NER	Non-extractable residue
NOEC/NOEL	No Observable Effect Concentration/Level
OD	Oil-based suspension concentrate
Pa	Pascals
PHED	Pesticide handler Exposure Database
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million
s	second
sc	subcutaneous
UV	Ultraviolet
µg	microgram
VIS	Visible light

GLOSSARY

Active constituent	The substance that is primarily responsible for the effect produced by a chemical product
Acute	Having rapid onset and of short duration.
Carcinogenicity	The ability to cause cancer
Chronic	Of long duration
Desorption	Removal of an absorbed material from a surface
Efficacy	Production of the desired effect
Formulation	A combination of both active and inactive constituents to form the end use product
Genotoxicity	The ability to damage genetic material
Hydrophobic	Water repelling
Leaching	Removal of a compound by use of a solvent
Log Pow	Log to base 10 of octonol water partitioning co-efficient
Metabolism	The conversion of food into energy
Photodegradation	Breakdown of chemicals due to the action of light
Photolysis	Breakdown of chemicals due to the action of light
Subcutaneous	Under the skin
Toxicokinetics	The study of the movement of toxins through the body
Toxicology	The study of the nature and effects of poisons

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