Australian Government

Australian Pesticides and Veterinary Medicines Authority

PUBLIC RELEASE SUMMARY

on the Evaluation of the New Active Prosulfuron in the Product Casper Turf Herbicide

APVMA Product Number 63890

APRIL 2012

This document is published by the APVMA. In referencing this document the APVMA should be cited as both author and publisher.

ISBN: 978-0-9871919-8-4
ISSN: 1443-1335

Website: This publication is available from the APVMA website: http://www.apvma.gov.au

Comments and enquiries may be directed to:

Contact Officer

Pesticides Program
Australian Pesticides & Veterinary Medicines Authority
PO Box 6182
KINGSTON ACT 2604
Australia

Telephone: +61 2 6210 4748
Fax: +61 2 6210 4776
Email: pesticides@apvma.gov.au

CONTENTS

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 (OCS), Department of Sustainability, Water, Population and Community (DSEWPaC), 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. It provides a summary of the APVMA's assessment, which include details of:

- the toxicology of both the active constituent and product
- occupational exposure aspects
- environmental fate, toxicity, potential exposure and hazard
- efficacy and target crop or animal safety.

Comment is sought from interested persons on the information contained within this document.

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 CASPER **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 **Tuesday, 08/05/2012** 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:

Contact Officer, Pesticides Program
Australian Pesticides & Veterinary Medicines Authority
PO Box 6182
KINGSTON ACT 2604
Australia

Telephone: +61 2 6210 4748
Fax: +61 2 6210 4776
Email: pesticides@apvma.gov.au

[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 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

Syngenta Crop Protection Pty Limited.

Details of the product

It is proposed to register Casper Turf Herbicide (previously called A14031E Turf Herbicide), containing 50 g/kg of the new active ingredient, prosulfuron, and the already registered active constituent, dicamba, at 500 g/kg as a water dispersible granule (WG) formulation. Casper Turf Herbicide is intended for the post-emergence control of certain broadleaf weeds in established turf.

Prosulfuron is a member of the sulfonylurea class of herbicides. Its mode of action is inhibiting branched-chain amino acid biosynthesis, and consequently depressing cell division at the root tips. Growth of susceptible plant species is rapidly inhibited, with plant death occurring 14 - 21 days post-application.

Casper Turf Herbicide also contains the active ingredient dicamba, which has been approved for many years for application as a herbicide to turf and non-crop situations at a similar maximum rate to that proposed. The risk associated with the proposed use of dicamba in Casper Turf Herbicide is not greater than that previously assessed, as the overall application rate is the same or less.

The prosulfuron based turf herbicide as proposed is new to the Australian market. The active ingredients prosufuron and dicamba will be manufactured overseas, while Casper Turf Herbicide will be manufactured at either local or overseas facilities and imported to Australia. Prosulfuron is classified to be in the Group B and dicamba is in Group I for weed resistance management.

This publication provides a summary of the data reviewed and an outline of the regulatory considerations for the proposed registration of Casper Turf Herbicide containing the new active ingredient prosulfuron.

2 CHEMISTRY AND MANUFACTURE

2.1 Active constituent

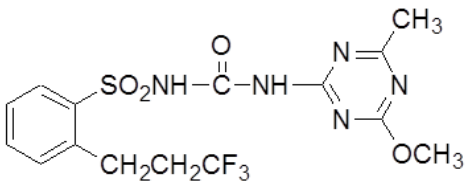
Prosulfuron is a new active constituent for use in the control of post-emergent broadleaf weeds in established turf.

Manufacturing site

The active constituent prosulfuron is manufactured by Syngenta Crop Protection, Monthey SA at its manufacturing site in Switzerland.

Chemical Characteristics of the Active Constituent

The chemical active constituent prosulfuron has the following properties:

COMMON NAME (ISO):	Prosulfuron
IUPAC NAME:	1-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)-3-[2-(3,3,3-trifluoropropyl)phenylsulfonyl]urea
CAS NAME:	*N*-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]-2-(3,3,3-trifluoropropyl)benzene sulfonamide
CAS REGISTRY NUMBER:	94125-34-5
MANUFACTURER'S CODE:	CGA 152005
MOLECULAR FORMULA:	$C_{15}H_{16}F_3N_5O_4S$
MOLECULAR WEIGHT:	419.4
STRUCTURE:	
CHEMICAL FAMILY:	Sulfonylurea

APVMA Active Constituent Standard for PROSULFURON

CONSTITUENT	SPECIFICATION	LEVEL
Prosulfuron	White to light beige solid	950 g/kg minimum

Physical and Chemical Properties of Pure Active Constituent

PHYSICAL FORM:	Solid
COLOUR:	White to light beige
ODOUR:	odourless
MELTING POINT:	155 °C (with decomposition)
DENSITY:	1.45 g/cm^3 (at 20-25 ºC)
UV ABSORPTION:	ε (L mol^{-1} cm^{-1}]): 2.7 at pH 7.0, 2.6 at pH 7.0, 2.0 at pH 9
PARTITION COEFFICIENT:	Log K_{ow}: At 25^{o}C, Corrected; 2.8 at pH 5.0; 3.0 at pH 6.9; 4.4 at pH 9.0
VAPOUR PRESSURE:	<3.5 x 10^{-6} Pa at 25^{o}C
FLAMMABILITY:	Not highly flammable
EXPLOSIVE PROPERTIES:	Not explosive
OXIDIZING PROPERTIES:	Not oxidising
SOLUBILITY IN WATER:	At 25°C: 87 mg/L at pH 5.0; 4 g/L at pH 6.8; 43 g/L at pH 7.7.
SOLUBILITY IN ORGANIC SOLVENTS:	Acetone, 160 g/L; ethyl acetate, 56 g/L; dichloromethane, 180 g/L; ethanol, 8.4 g/L; *n*-hexane, 6.4 g/L; *n*-octanol, 1.4 g/L; toluene, 6.1 g/L.
STABILITY (METALS AND METAL IONS):	Stable in the presence of metal and metal ions

2.2 Product

DISTINGUISHING NAME:	Casper Turf Fungicide (formerly A14031 Turf Herbicide)
FORMULATION TYPE:	Water Dispersible Granule (WG)
ACTIVE CONSTITUENT CONCENTRATION:	Prosulfuron (50 g/kg) and Dicamba (500 g/kg)

Physical and Chemical Properties of the Product

PHYSICAL FORM:	Solid
COLOUR:	Grey-beige
ODOUR:	Slightly pungent
BULK DENSITY:	0.646 g/mL (without taps)
PH (1% SOLUTION):	6 - 10
EXPLOSIVITY:	Not explosive
OXIDISING PROPERTIES:	Not oxidising
FLAMMABILITY:	Not highly flammable
STORAGE STABILITY:	Stability data provided by the applicant indicates that the product is expected to remain within specification for at least two years when stored under normal conditions in HDPE containers.

Recommendation

Based on a review of the chemistry and manufacturing details provided by the applicant, registration of Casper Turf Herbicide is supported.

3 TOXICOLOGICAL ASSESSMENT

3.1 Executive Summary

Public Health Aspects and Toxicology

The product Casper Turf Herbicide is a water dispersible granule formulation containing 50 g/kg of prosulfuron (a new active ingredient) and 500 g/kg of dicamba (an existing active ingredient), and is intended for use as a post-emergence broadleaf herbicide in turf. Prosulfuron is new to the Australian market and is a member of the sulfonylurea class of pesticides. Its mode of action is inhibiting branched-chain amino acid biosynthesis, and consequently depressing cell division at the root tips. Growth of susceptible plant species is rapidly inhibited in response to acetolactate synthase inhibition, with plant death occurring 14 - 21 days post-application.

Based on the submitted data, prosulfuron is of low acute oral, dermal and inhalational toxicity in rats, is not a skin irritant but a slight eye irritant in rabbits, and is not a skin sensitiser in guinea pigs. Casper Turf Herbicide is considered to be of low acute oral and dermal toxicity in rats, a slight eye irritant in rabbits, but not a skin irritant in rabbits or a skin sensitiser in guinea pigs based on available toxicology information.

Following repeat dosing of prosulfuron in rats, mice, dogs and rabbits, the most frequently observed adverse effect was reduced body weight gain and/or food consumption, and the major target organs were the liver and the haematopoietic system. Prosulfuron was not an in vivo genotoxicant and was not carcinogenic in mice. Although an increased incidence of tumours was seen in a rat 2-year dietary study, they were considered likely incidental and not treatment related. Prosulfuron was not a reproductive toxicant, and although skeleton variations and malformations were seen in rats and rabbits they were only seen in the presence of marked maternal toxicity and were considered a secondary non-specific consequence of such toxicity. From the available data, prosulfuron is not considered a neurotoxic hazard to human health.

Occupational Health and Safety

The main occupational use of the imported product will be by turf growers, maintenance workers and professional pesticide contractors. Workers may be exposed to the product when opening containers, mixing/loading, application, cleaning up spills and maintaining equipment, as well as entering treated areas for mowing, transplanting and hand weeding. The main route of exposure will be dermal and inhalation, although ocular exposure is also possible.

In the absence of exposure data for the proposed mode of application, the Pesticide Handler Exposure Database (PHED) Surrogate Exposure Guide was used to estimate exposure. Exposure to the product during ground-boom application, and mixing and loading, is acceptable when the operator is wearing a single layer of clothing (cotton overalls or equivalent clothing) with or without gloves. While exposure to the product during low-pressure hand wand application, and mixing and loading, is acceptable when the operator is wearing a second layer of clothing (cotton overalls over normal clothing), chemical resistant gloves and a respirator.

Based on the risk assessment, a First Aid Instruction, a Warning Statement, Safety Directions and a Re-entry statement have been recommended for the product label.

Conclusion

Based on an assessment of the toxicology and occupational health and safety, it was considered that there should be no adverse effects on human health from the use of Casper Turf Herbicide when used in accordance with the label directions.

3.2 Evaluation of Toxicology on Prosulfuron

The toxicological database for prosulfuron, which consists primarily of toxicity tests conducted using 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.

Chemical Class

Prosulfuron is a member of the sulfonylurea class of pesticides. Its mode of action is inhibiting branched-chain amino acid biosynthesis, and consequently depressing cell division at the root tips. Growth of susceptible plant species is rapidly inhibited in response to acetolactate synthase inhibition, with plant death occurring 14 - 21 days post-application.

Toxicokinetics and Metabolism

Based on the data from rat studies, the chemical is rapidly and extensively absorbed from the gastrointestinal tract (approximately 75% of the dose), and widely distributed to organs and tissues with the highest level in the liver. Approximately 90% of the administered dose was excreted within 48 hours. Females generally excreted more of the dose in the urine than males. Excretion also occurred via the enterohepatic circulation, though it does not play a significant role in excretion. There was no evidence of accumulation of the chemical even after repeated dosing or administration of a high dose.

Acute Toxicity Studies

Prosulfuron has low acute oral (LD_{50} of 949 and 546 mg/kg bw in male and female rats respectively, and 1208 and 1262 mg/kg bw in male and female mice, respectively), dermal (LD_{50} >2000 mg/kg bw in rabbits)

and inhalational toxicity (4-hr LC_{50} >5467 mg/m^3 in rats). The compound was not a skin irritant in rabbits but was a slight eye irritant in the same species, and was not a skin sensitiser in guinea pigs.

Based on the toxicology information available on a reference formulation which it was considered would have a similar toxicity profile to the proposed product, Casper Turf Herbicide is of low acute oral (LD50 >2000 mg/kg bw in rats) and dermal toxicity (LD50 >2000 mg/kg bw in rats), a slight eye irritant in rabbits, but not a skin irritant in rabbits or a skin sensitiser in guinea pigs. Although there is no acute inhalation study on the product, it was noted that both active ingredients are of low inhalational toxicity suggesting that the acute inhalational toxicity of the product will be low.

Systemic effects

In repeat dose studies, the most frequently observed adverse effect in all species (rats, mice, dogs and rabbits) was reduced body weight gain, while the major target organs were the liver and the haematopoietic system. Effects seen on the hematopoietic system were restricted to reductions in red blood cell parameters, with the exception of the dog sub-chronic and chronic study where effects on the bone marrow (e.g. erythroid hyperplasia) were seen at higher dose levels. Effects seen in the liver were increased liver weight and histopathological changes (e.g. hepatocyte hypertrophy). These effects (reduced body weight gain, effects on the liver and the haematopoietic system) were evident in almost all short and long term studies. Furthermore, the available data would suggest the dog is the most sensitive species to prosulfuron induced toxicity.

Carcinogenicity and Genotoxicity

Prosulfuron was not carcinogenic in male and female mice at dose levels close to or exceeding the limit dose (1000 mg/kg bw/day) in an 18-month dietary study.

In the 2-year rat dietary study, an increase in the incidence of testicular interstitial cell tumours was seen at 200 ppm and above compared to concurrent controls. However, the incidence was only (slightly) outside the historical control range only at 2000 ppm but not the top dose, 4000 ppm, and there was no progression to malignancy or supportive treatment related non-neoplastic changes in the testes that would suggest the observed tumours occurred by a chemical carcinogenesis mechanism. The incidence of thyroid tumours in males only at 4000 ppm was only slightly above that seen at 10 ppm, which from the dose response data has to be incidental. In females, increases were seen in the incidence of mammary gland adenocarcinoma, adenoma and fibroma. However, not only was there no dose response for the observed tumour findings that were not statistically significant, but there was no consistency for each tumour in the dose producing the greatest incidence (200 ppm for fibromas and 2000 ppm for adenocarcinomas and adenomas). Furthermore, there was no supportive treatment related non-neoplastic changes in the mammary gland in females that would suggest the observed tumours occurred by a chemical carcinogenesis mechanism. Consequently, prosulfuron was not considered carcinogenic in male and female rats as the observed tumours are likely to be incidental and not treatment related.

Prosulfuron was not mutagenic or genotoxic in an array of in vitro assays with and without metabolic activation, and was not genotoxic in an in vivo assay.

Reproduction and developmental toxicity

Prosulfuron was not a reproductive toxicant in a 2-generation reproduction study in the rat. In the P1 generation, while the mating index, fertility, pregnancy, gestation and parturition indices were comparable in all groups except the 4000 ppm group which had reduced fertility and gestation indices, this finding is considered secondary to observed parental toxicity and not evidence of a direct effect on reproductive performance.

In all the available oral (gavage) developmental studies in the rat and rabbit a consistent finding was an increase in the incidence of minor skeletal variations in the presence of marked maternal toxicity (decreased body weight gain). In the rat study, extra rudimentary rib(s), and extra full-sized and short rib(s) were observed. Rabbit studies were available, from studies identifying a NOEL to studies undertaken to assess the developmental toxicity in the presence of overt maternal toxicity. In these rabbit studies, irregularly shaped sternebrae and split sternebrae were observed at the lower dose levels, with an increased incidence of general whole body runts and general whole body small (variations) observed as the dose increased, and instances of foetal soft-tissue malformations only seen at dose levels that produced extreme maternal toxicity (e.g. body weight loss). Thus, prosulfuron was not considered to be a developmental toxicant in rats and rabbits as the observed skeletal findings were seen in the presence of marked maternal toxicity and considered a secondary non-specific consequence of such.

Neurotoxicity

In the acute neurotoxicity study in rats, following a single oral dose by gavage, evidence of transient neurotoxicity was observed with the most affected FOB parameters being neuromuscular functions (ataxic and/or abnormal gait, impaired righting reflex) and rectal temperature, with a low incidence (in most cases a single animal) of slight tremors, repeated clonic convulsions and mydrias observed at higher dose levels. These findings were seen at the time of peak effect (3 hrs post dosing). Similarly, figure-8 maze activity counts were also affected at the time of peak effect only (the first 60 minutes post dosing), either as the mean of the total sessions or by time interval. However, in a 90-day dietary study in rats no toxicologically significant effects were seen on FOB parameters and figure-8 maze activity counts were similar for control and treatment groups, at dose levels where such effects were seen in the acute neurotoxicity study.

It is considered that the method of administration, gavage in the acute neurotoxicity versus dietary in this study, is a likely factor in the difference in findings between the two studies, which consisted of transient neurotoxicity findings in the acute study (i.e. only seen for testing at the peak hour). Additionally, it is noted that no histopathological changes to the nervous system were seen in either study, and neurotoxic findings were not detected in other repeat dosing dietary studies in rats and dog, as well as an oral gavage study in the rabbit, that examined the nervous system.

It is noted that a developmental range-finding study in rabbits evaluated in this assessment reports degenerative changes in the sciatic nerve of does in another rabbit study submitted and evaluated for this assessment, and the US Federal Register (2009) also reported such findings in a developmental rabbit study at doses of 300 mg/kg bw/day, but notes that no evidence of neurotoxicity to foetuses or offspring was observed in any of the developmental and reproductive studies. However, no data from neuropathological examinations were provided in the submitted study to allow an independent evaluation of the ‘reported’ findings to be undertaken. Though the available data allows a dose response of maternal toxicity in the doe

to be constructed, and it can be seen that at 100 mg/kg bw/d marked decreases in maternal body weight were seen, at 150 mg/kg bw/d some animals had to be sacrificed and all animals died or had to be sacrificed at 300 mg/kg bw/d. Thus, the 'reported' findings in the literature occur at a dose level that produced extreme maternal toxicity. Thus, overall, the information in the reported literature is not supported by the data evaluated in this assessment report, and if prosulfuron does possess a neurotoxic potential it is at best weak and expressed at levels that are clearly toxic.

Consequently, overall, from the available data prosulfuron is not considered a neurotoxic hazard to human health.

Studies on Impurities/Metabolites

Impurity CGA 150829 (4-methoxy-6-methyl-1,3,5-triazine-2-amine) was of low acute oral, dermal and inhalational toxicity in rats, and was not a skin or eye irritant in rabbits, or a skin sensitiser in guinea pigs. Additionally, it was negative in a battery of *in vitro* mutagenicity and genotoxicity tests with and without metabolic activation and an *in vivo* genotoxicity test.

Impurity CGA 159902 (2-(3,3,3-trifluoropropyl)-benzenesulfonic acid) was of low acute oral and dermal toxicity in rats, was not a skin irritant in rabbits but was a slight eye irritant in the same species, and a skin sensitiser in guinea pigs. It was negative in an Ames test with and without metabolic activation but positive in two *in vitro* assays in mammalian cells (a gene mutation assay with metabolic activation only, and a chromosomal aberration assay without metabolic activation). However, it was negative *in vivo* assays (a micronucleus assay in mice and an unscheduled DNA synthesis assay in rats). Thus, it is not an *in vivo* genotoxicant.

Metabolite CGA 349707 (N-guanidinocarbonyl-2-(3, 3, 3-trifluoro-propyl)benzenesulfonamide) was negative in *in vitro* assays (Ames test, gene mutation assay and chromosomal aberration assay) with and without metabolic activation.

3.3 Public Health Standards

Poisons Scheduling

The delegate to the Secretary of the Department of Health and Ageing sought advice from the Advisory Committee on Chemical Scheduling (ACCS) on the scheduling of prosulfuron. Prosulfuron was discussed at the October 2011 meeting of the ACCS. The delegate noted and agreed with the ACCS recommendation that prosulfuron be included in Schedule 6 of the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) with no cut-off. This was the interim decision of the delegate. The delegate's final decision made on 1st February 2012 confirmed that prosulfuron be included in Schedule 6 of the SUSMP with no cut-off, along with an implementation date of 1 May 2012.

NOEL/ADI/ARfD

The Acceptable Daily Intake (ADI) is that quantity of an agricultural or veterinary chemical which can safely be consumed on a daily basis for a lifetime and is based on the lowest NOAEL obtained in the most sensitive

species. This NOAEL 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.

Since the current application for registration is not associated with food producing use, no ADI for prosulfuron is set at this stage.

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 as a single or short-term dose which causes no adverse 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.

Since the current application for registration is not associated with food producing use, no ARfD for prosulfuron is set at this stage.

4 Occupational Health and Safety Assessment

4.1 Health hazards

Prosulfuron

Prosulfuron (CAS: 94125-34-5) is listed on the Safe Work Australia's (SWA) Hazardous Substances Information System (HSIS) Database (SWA, 2011) with the following risk phrases:

Xn; R22	Harmful if swallowed

With the available toxicology information, OCSEH recommends that the current classification of prosulfuron on HSIS according to NOHSC *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 2004) is appropriate.

The following cut-off concentrations apply for prosulfuron:

Conc. ≥ 25%	Xn; R22 Harmful if swallowed

Dicamba

Dicamba (CAS: 1918-00-9) is listed on the Safe Work Australia's (SWA) Hazardous Substances Information System (HSIS) Database (SWA, 2011) with the following risk phrases:

Xn; R22	Harmful if swallowed
Xi; R41	Risk of serious eye damage

The following cut-off concentrations apply for dicamba:

Conc. ≥ 25%	Xn; R22 Harmful if swallowed R41 Risk of serious eye damage
10% ≤ Conc. < 25%	Xi; R41 Risk of serious eye damage
5% < Conc. < 10%	Xi; R36 Irritating to eyes

Casper Turf Herbicide

There are acute toxicity studies available on a reference formulation A14031B, which was considered to be toxicologically equivalent to Casper Turf Herbicide (A14031E). These studies will be the key data for

classification for acute endpoints (i.e. take priority over the default cut-off concentrations for prosulfuron and dicamba which would be used when no appropriate data is available on the product for a classified endpoint).

The available information indicates that the product is not classified as a hazardous substance in accordance with NOHSC *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 2004).

4.2 Formulation, packaging, transport, storage and retailing

The active constituent prosulfuron will be manufactured overseas. The product Casper Turf Herbicide will be manufactured and imported into Australia in 1 kg, 2.5 kg and 3 kg high-density polyethylene (HDPE) containers. Re-packing may occur in Australia.

4.3 Use pattern

Casper Turf Herbicide is a water dispersible granule containing 500 g/kg dicamba and 50 g/kg prosulfuron and is intended for use as a post-emergent broadleaf herbicide. Casper Turf Herbicide is not intended for domestic use. The proposed use rate is 0.6 to 1.2 kg product / ha for control of broadleaf weeds in established turf (such as golf courses, turf farms and sporting grounds) at a minimum of 400 L water/ha.

The product is applied once per season from autumn to early spring, though a repeated application may be needed after 4 to 6 weeks if lower rates are used in high weed pressure situations, or during extended germination periods due to environmental conditions. The product should be applied to weeds using low level ground boom equipment or low-pressure hand wand equipment.

4.4 Exposure during use

Turf growers, maintenance workers and professional pesticide contractors will be the main users of the product. Workers may be exposed to the product when opening containers, mixing/loading, application, cleaning up spills and maintaining equipment, as well as entering treated areas for mowing, transplanting and hand weeding. The main route of exposure will be dermal and inhalation, although ocular exposure is also possible.

For dicamba, a dermal absorption rate of 0.08% for the undiluted product (i.e. mixer loader activities) and 10.81% for the diluted product (i.e. application activities) are used for risk assessment purposes. A default absorption value of 100% was used for dermal absorption of prosulfuron and inhalation absorption of both chemicals.

In the absence of exposure data for the proposed mode of application, OCS used the Pesticide Handler Exposure Database (PHED) Surrogate Exposure Guide (1998) to estimate potential worker exposure during mixing/loading and application. The toxic endpoint of concern and identified NOAEL is derived from repeat dose study in animals, and in this instance a margin of exposure (MOE) of 100 or above is acceptable for each active ingredient (i.e. prosulfuron and dicamaba).

The MOE takes into account both interspecies extrapolation, intraspecies variability and the seriousness of the critical health effect of concern. The MOE for ground-boom application, and mixing and loading, is acceptable when the operator is wearing a single layer of clothing (cotton overalls or equivalent clothing) with or without gloves. The MOE for low-pressure hand wand, and mixing and loading, is acceptable when the operator is wearing a second layer of clothing (cotton overalls over normal clothing), chemical resistant gloves and a respirator.

4.5 Exposure during re-entry

Based on calculations using the ARTF Occupational Post-Application Risk Assessment Calculator Version 1 EPA Policy 003.1, after use of the products (at the proposed use pattern and use rates) MOEs for worker re-entry to treated areas are acceptable for low-exposure activities at day 0 (i.e. after the spray has dried). However, acceptable re-entry MOEs for high-exposure activities are not achieved until day 14 for dicamba and day 8 for prosulfuron. Therefore, the following re-entry statements will apply:

- Do not allow entry into treated areas until the spray has dried for low exposure activities such as mowing, unless wearing cotton overalls buttoned to the neck and wrist (or equivalent clothing) and elbow-length chemical resistant gloves. Clothing must be laundered after each day's use.
- Do not allow entry into treated areas for 14 days for high exposure activities such as hand weeding or transplanting, unless wearing cotton overalls buttoned to the neck and wrist (or equivalent clothing) and elbow-length chemical resistant gloves. Clothing must be laundered after each day's use.

4.6 Recommendations for safe use

Users should follow the First Aid Instruction, Warning Statement and Safety Directions on the product label.

4.7 Conclusion

The registration of Casper Turf Herbicide containing 50 g/kg of prosulfuron and 500 g/kg of dicamba for use as a post-emergent broadleaf herbicide in turf is supported.

Casper 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 Material Safety Data Sheet.

5 ENVIRONMENTAL ASSESSMENT

Syngenta Crop Protection Pty Limited has applied for registration of the new product Casper Turf Herbicide, containing 50 g/kg of the new active ingredient, prosulfuron, and the already registered active constituent, dicamba, at 500 g/kg for the post-emergence control of specified weeds in established fine and amenity turf. A comprehensive data package was provided for assessment with the data provided considered being adequate to allow an environmental assessment of the application.

5.1 Environmental fate

Physico Chemical degradation

Hydrolysis

Two studies on hydrolysis were provided by the applicant, using the technical grade prosulfuron.

Hydrolysis is not expected to be a major route of degradation at neutral or moderately basic pH levels. The half-life at pH = 7 was between 420-660 days. The degradation of prosulfuron is expected to be very slow at alkaline pH values, as results indicated a half-life of 680-1700 days at pH = 9. In an acidic environment, however, prosulfuron is expected to undergo a quicker hydrolysis; the results indicated a half-life of 4.5-12 days at pH = 5. Typical products of sulfonylurea hydrolysis predominated.

Photolysis

A total of six studies on photodegradation of prosulfuron were provided and reviewed; two on each soil, water and air.

Aquatic photolysis is not expected to be a major route of degradation of prosulfuron. However soil photolysis is expected to contribute more to the environmental degradation, as photolysis in an aquatic environment is slower than in soils. Aqueous photolysis studies showed that half-lives for irradiated samples ranged between 156-200 days, compared to dark samples with half-lives between 175-340 days. Photolysis in soil was slightly faster. Half-lives for irradiated samples in soil ranged between 110 and 131 days, while for dark samples it was between 260-311 days. This indicates that while some photodegradation may occur this is not likely to be a significant degradation pathway in soil. Given that prosulfuron is non-volatile, evaporation to air is not expected to be significant. However, modelling studies showed that if it moves into the air it will degrade quickly with a half-life of <2 days.

Biodegradation

Aerobic soil metabolism

Aerobic soil metabolism studies with phenyl and triazine radiolabelled prosulfuron in a variety of soil types (loam, loamy sand, sand, sandy clay loam, sandy loam and silt loam) were conducted under a variety of conditions. The effects of parameters such as soil pH and moisture, temperature, soil type, microbial biomass on the soil metabolism/degradation of prosulfuron were investigated.

Although, aerobic degradation in soils is expected to be one of the important routes of degradation of prosulfuron, the degradation rate is expected to vary greatly in different types of soils. Therefore, this degradation can be very slow under conditions such as low soil moisture or low microbial biomass. This is indicated by the results of a number of studies provided. Some studies showed that prosulfuron had a primary and secondary degradation rate. These studies showed half-lives for the primary degradation ranging between 69-140 days and secondary half-lives of up to 540 days. Studies comparing degradation in different types of soil showed a variation of half-lives between 74-199 days, where the longer half-lives occurred in soil of lower microbial activity. In soils that are biologically active with high microbial biomass prosulfuron has a half-life which can be as fast as 26 days, noting that this low half-life was obtained in laboratory conditions that can be considered as optimum for aerobic degradation.

Studies conducted on the major metabolites of prosulfuron -CGA150829 (4-methoxy-6-methyl-1,3,5-triazine-2-amine), CGA159902 (2-(3,3,3-trifluoropropyl)-benzenesulfonic acid), CGA325025 (1-(4-amino-6-methyl-triazin-2-yl)-3-[2-(3,3,3-trifluoropropyl)-phenylsulfonyl]-urea or N-[[(4-amino-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl)-2-(3,3,3-trifluoropropyl)benzenesulphonamide), SYN524604 (N-(N'-carbamoyl-guanidinocarbonyl)-2-(3,3,3-tri-fluoropropyl)-benzenesulfonamide), and CGA349707 (N-guanidinocarbonyl-2-(3, 3, 3-trifluoro-propyl)benzenesulfonamide), showed that these degrade at rates that are comparable to those of the parent compound. The half-lives of the metabolites generally ranged from <100-300 days, except for that for CGA159902 being <10 d in two soils.

Anaerobic soil metabolism

Four studies on the anaerobic soil metabolism of prosulfuron were provided.

Studies conducted in soils at pH between 6.5-7, showed a half-life of 89 and 123 days. At pH approximately 6, the half-life increased to 137 days. The major metabolites in these conditions were CGA150829, CGA159902, CGA300406 (1-(4-hydroxy-6-methyl-triazin-2-yl)-3-[2-(3,3,3-trifluoropropyl)-phenylsulfonyl]-urea), CGA325025 and CGA325027. It was not demonstrated that anaerobic conditions were reached, and the results are similar to equivalent tests done under aerobic conditions.

Aerobic and anaerobic aquatic metabolism

A total of nine laboratory water/sediment studies were provided; two examined the aerobic aquatic metabolism of phenyl and triazine ring labelled prosulfuron, two studies included the metabolism of phenyl or triazine labelled prosulfuron under aerobic or anaerobic conditions (with a third using to data from the triazine labelled prosulfuron study to model prosulfuron and desmethylprosulfuron degradation). Four studies investigated the fate of phenyl and triazine ring labelled prosulfuron under anaerobic conditions. Two of the latter four were performed specifically for the identification of metabolites formed under anaerobic conditions.

In 30 day natural pond water and sediment systems under aerobic conditions, phenyl and triazine ^{14}C labelled prosulfuron had system DT50s of 68.4 and 59.5 days respectively when added directly to the sediment.

In natural (pond and river) water/sediment studies conducted under either aerobic or anaerobic conditions, the radiolabelled prosulfuron was added to the water surface. Prosulfuron (phenyl ring label) disappeared at 20°C from these natural waters with half-lives of 46.3 to 61.5 days under aerobic and anaerobic conditions

respectively whereas at 9°C, the aerobic half-life was 85.2 days and anaerobic half-life, 196.5 days. Under sterile conditions, no significant disappearance from the water column took place (half-life 738.3 days). In the whole water/sediments systems, the half-life of prosulfuron at 20°C was in the range 116.1 to 149.3 days under aerobic conditions and 115.4 days under anaerobic conditions. At 9°C, longer half-lives (392.5 to 426.3 days) were seen in all these systems. The principal metabolite CGA 300406 (desmethylprosulfuron) had half-lives of 34-91 days in aerobic waters and 165.3 days in anaerobic water. System half-lives for this metabolite were 141.5 to 196 days under aerobic conditions and 216.2 days under anaerobic conditions.

When the triazine labelled prosulfuron was used, the DT50 values for the aerobic water systems were 32.9 and 35.2 days for the pond and river water systems respectively at 20°C, but 118.8 days for the pond water at 9°C. Under anaerobic conditions, the DT50s at 9 and 20°C were 266.8 and 51.8 days respectively. System (water and sediment) DT50s were 190.8 and 174.1 days for the aerobic pond and river waters respectively and 143.8 days under anaerobic conditions at 20°C. Aerobic and anaerobic system DT50s at 9°C were both >1000 days.

The anaerobic water/sediment study with phenyl ring labelled prosulfuron showed less than 10% of the initial prosulfuron remaining in the water column at one month with the major degradation products being the cleavage product 2-(3,3,3-trifluoropropyl)-benzenesulfonic acid or CAG 159902 which made up 51.3% of the applied radioactivity in the water column after 12 months. When the triazine labelled prosulfuron was studied, prosulfuron remained predominantly in the water phase and was not quantifiable in either water or sediment after 6 months. The system half-life for the triazine labelled prosulfuron (biphasic degradation) was 13.3 and 25.8 days for the primary and secondary phases respectively.

Mobility

Volatility

Two radiolabelled studies on the volatility of prosulfuron were provided, in addition to one modelling study.

Prosulfuron is not volatile, <0.01% of an applied rate of 71 g ac/ha to the soil surface volatilised after 24 hours. After a post-emergent application to plants and soil no volatilisation was observed. Modelling studies also indicated that volatilisation from the water is negligible. Therefore, partitioning to the atmosphere is expected to be negligible.

Adsorption/desorption of the active constituent

There were three studies on the adsorption and desorption of prosulfuron in 14 soils, and Koc ads/des were determined.

Prosulfuron is not very strongly adsorbed to soil particles; this is due to the very high solubility of the herbicide. The Koc values of prosulfuron ranged from 4 in light soils (such as loamy sand) for radio labelled prosulfuron to a maximum of 250 in heavier soil for non-labelled prosulfuron. Therefore, the chemical is expected to be of very high to medium mobility.

The adsorption and desorption of eight metabolites of prosulfuron on 4 soils were studied. These showed very high to medium mobility. The range of the K_{oc} of the metabolites were as follows CGA150829 = 64-200,

CGA159902 = 48-97, CGA325025 = 60-238, CGA325028 = 11-23, CGA325030 = 18-41, CGA300406 = 42-126, CGA349707 = 36-52, CGA28533 = 12-19.

Soil Column Leaching

Soil column leaching studies consisted of one freshly applied and three aged soil studies with a variety of soils examined (loam, loamy sand, sand, sandy loam and silty clay loam) with phenyl and triazine ^{14}C- ring labelled prosulfuron. Prosulfuron showed substantial mobility in soil. However, mobility decreased significantly with aging. This behaviour is consistent with the solubility and adsorption/desorption (K_{oc}) of prosulfuron and its metabolites. When a formulated radiolabelled prosulfuron was leached through sand, loamy sand, silt loam and loam columns, the majority of the radioactivity, with the exception of the silt loam, was found in the leachates accounted for 81.37 to 94.40 % of the dose applied. The amount of radioactivity found in the leachate of the silt loam was 1.04 % with some 98.15 % of the applied radioactivity retained on the column. The silty loam Vetroz soil had the highest organic carbon and clay contents which may have contributed to the lack of significant leaching.

Lysimeter studies conducted under field conditions showed that prosulfuron is not likely to reach the groundwater in significant quantities. The amount of prosulfuron in the lysimeters, after an application of 30 g ac/ha was a maximum of 0.31 µg/L. The main metabolites, accounted for most of the recovered radiocarbon in lysimeters; noting that up to 39% radiocarbon (Parent and several metabolites) were also found in overflow water.

Field Dissipation

A total of twenty six reports were provided and the data package also addressed the field dissipation in water.

Prosulfuron can dissipate quickly from soils; however the rate of dissipation varies in different soils. Microbial degradation seems to be a significant route of dissipation of prosulfuron. The DT50s for prosulfuron, therefore, ranged significantly, from <1 day to 52 days. The DT90s for prosulfuron in different soils ranged from <30 to 222 days. Based on these studies it can be concluded that prosulfuron is non-persistent and is expected to dissipate relatively quickly from soils.

Dissipation of prosulfuron in an artificial pond (depth >70 cm) with a well-established biological community, showed that prosulfuron disappeared completely from the water after 38 days, and no residues were found in the sediment or in the layer of water above the sediment. The half-life of prosulfuron was estimated to be approximately 19 days in water.

Bioconcentration

Because of its high water solubility and low K_{ow} values at environmental pH, prosulfuron is not expected to bioconcentrate in aquatic species.

Modelling studies

Modelling studies of the concentration of prosulfuron and its major metabolites in the ground water, using the data from the field dissipation studies, and the FOCUS-PELMO or FOCUS-PRZM and FOCUS PEARL

groundwater models were presented. These showed that in ground water, the concentration of the parent compound would be ≤0.1 µg/L and metabolites ≤0.5 µg/L. FOCUS surface water modelling based on a 15 g prosulfuron/ha application to maize predicated a maximum initial concentration of 0.614 µg prosulfuron/L in a stream scenario with an associated maximum sediment concentration of 0.079 µg prosulfuron/kg.

5.2 Environmetal effects

Avian

Three acute oral toxicity, 2 short term dietary and one reproduction study on bobwhite quail and mallard duck were presented.

The acute toxicity tests consisted of two 21 day studies in addition to one 14 day study on mallard ducks. These studies showed that the 21 day LD50 of prosulfuron for bobwhite quail is >2150 mg prosulfuron/kg body weight and >1300 mg prosulfuron/kg body weight for mallard duck. The respective NOECs were <1470 and <464 mg prosulfuron/kg body weight. The 14 day acute study on mallards showed an LD50 of 1094 mg ac/kg body weight. Based on the observed effects the 14 day NOEC was 215 mg prosulfuron/kg body weight.

The short term acute dietary studies showed that the 8 day LC50 for bobwhite and mallard ducks was >5000 ppm in the diet. In these studies the 8 day NOECs were 1250 and <312 ppm in the diet respectively.

A mallard reproduction study showed the observed NOEC to be 28 ppm (mg prosulfuron/kg diet). A statistically significant reduction was observed in the 14-day-old survivors of eggs set (%) in the 100 ppm test group which sets the no-observed-effect level based on the 14-day survival at 28 ppm. This is supported by the reported reductions in survival for 14 day old survivors per hen (67 and 63.6%) for the 100 and 350 ppm treatment groups respectively.

The acute avian oral toxicity tests show prosulfuron technical is slightly to practically non-toxic to birds while the dietary acute toxicity studies show prosulfuron is practically non-toxic to birds.

Fish

Seven acute toxicity studies with the technical grade prosulfuron, one acute study with the formulation A14931B, and five acute studies on metabolites (all on rainbow trout) were considered in this report. This formulation has the same combination of active constituents as the proposed formulation (i.e. A14031E-Casper Turf Herbicide). Further, two studies on early life stage and on sub-chronic toxicity were also reviewed.

The studies with the active constituent showed that the 96 h LC50 to fish is >100 mg ac/L and the NOEC was determined to be 100 mg ac/L. The study on the formulation also showed a 96 h LC50 >100 mg product/L and the NOEC = 100 mg product/L.

The most toxic metabolite to fish was CGA19902; the 96 h LC50 was 44 mg and 63 mg CGA19902/L and the 96 h NOEC = 8.4 mg CGA19902/L. Other metabolites tested had LC50s in excess of >100 mg

metabolite/L. The 96 h NOEC for CGA349707 was 42 mg metabolite/L, as higher concentrations were above the solubility limit.

The early life stage study on fathead minnow showed a NOEC = 150 mg ac/L. The prolonged subchronic study on rainbow trout showed a 21 day LC50 >5.8 mg ac/L and a NOEC = 5.8 mg ac/L (the highest rate tested).

Based on these studies prosulfuron, its formulation and most of its metabolites can be considered to be practically non-toxic to fish. The most toxic metabolite CGA19902 is slightly toxic to fish. Prosulfuron is chronically very slightly toxic to fish.

Aquatic Invertebrates

Three acute toxicity studies of prosulfuron, one study of the formulation A14031B, five acute toxicity studies on the metabolites and one reproduction study were reviewed.

The acute toxicity studies of prosulfuron (technical) showed a 48 h EC50 to daphnia of >120 mg ac/L. For mysid shrimp and eastern oysters the 96 h EC or LC50 values were >150 mg ac/L and >125 mg ac/L, respectively. The NOEC for daphnia and eastern oyster were 120 and 125 mg ac/L, respectively. The exposure to the formulation A14031B resulted in a 48 h EC50 >100 mg formulation/L with NOEC = 100 mg formulation/L.

Of the five metabolites tested, CGA150829 and CGA159902 were the most toxic to daphnia, resulting in 48 h EC50s of 16 and 74 mg metabolite/L, respectively. An earlier non-GLP test on the former metabolite had a daphnia 48 h EC50 >100 mg metabolite/L. Other metabolites, CGA349707, CGA300406 both had 48 h daphnia EC50 >100 mg metabolite/L. The reproductive toxicity of prosulfuron to daphnia was determined resulting in a 21 d NOEC = 148 mg ac/L.

Based on the results prosulfuron, metabolites CGA349707 and CGA300406 and the formulation A14031B (prosulfuron 50g + Dicamba 500 g) are practically non-toxic to aquatic invertebrates. Metabolites CGA150829 and CGA159902 are slightly toxic to these organisms.

Algae, Diatoms and Aquatic Plants

Five algal toxicity tests on four species with the active constituent and one test on lemna (duckweed) were provided. In addition, the toxicity of the formulation A14031B on green algae and lemna was also assessed and five metabolite toxicity studies and two toxicity of lysimeter leachates studies were reviewed.

The growth inhibition studies on prosulfuron resulted in a 72 h ErC50 of 74 µg ac/L and 120 h (5 d) EC50 of 10.6 µg/L for green algae. For blue-green algae the 96 h ErC50 and NOEC for this organism were 1.13 and 0.31 mg ac/L. Due to limited effects on marine and fresh water diatoms at the levels tested, their respective 5 day EC50s were >28.6 and >83.6 µg prosulfuron/L and the 5 day NOEC for fresh water diatom was set by DSEWPaC at 23.0 µg/L and the 5 day NOEC for saltwater diatom was set at 28.6 µg/L. The calculated 14 d EC50 of prosulfuron for duckweed (*Lemna gibba*) was 1.26 µg ac/L based on mean frond count values.

The toxicity of the formulation A14031B to green algae was calculated; the 72 h and 96 h ErC50 were 0.249 and 0.319 mg formulation/L, respectively. *Lemna* again was the most sensitive species; the 7 d ErC50 for *Lemna* was 62.3 µg A14031B/L based on growth rate and 35.5 µg A14031B/L based on frond number.

The toxicity studies of the growth inhibition effects of the metabolites on green algae found the following results; the 72 h ErC50 = 238 mg CGA159902/L and NOEC = 21 mg CGA159902/L, 72 h EbC50 >90 mg CGA150829/L, 72 h ErC50 >100 mg CGA300406/L and 72 h ErC50 >64.3 mg CGA349707/L. The effect of metabolite CGA150829 on lemna showed a 72 h ErC50 >100 mg metabolite/L and NOErC = 100 mg metabolite/L based on frond number. The results of lysimeter studies showed varying degrees of effect ranging from stimulatory to inhibitory effects. These effects depended on the age of the leachates.

Based on these results prosulfuron and the proposed formulation are very highly toxic to aquatic plants and algae while the metabolites CGA150829, CGA300406, CGA349707 and CGA19902 are at worst slightly toxic to these organisms.

Honey Bees

Two studies on the acute and oral toxicity of prosulfuron and one study on the formulation A14031B on honey bees were provided.

For acute oral and contact toxicity, the 48 h LD50 of prosulfuron to bees is greater than 100 µg/bee. For the formulation, which as noted has the same combination of active constituents as the proposed product, the 48 h LD50 oral toxicity was determined to >1000 µg A14031B/bee and the 48 h contact LD50 is >2000 µg A14031B/bee.

Therefore, prosulfuron and its combination with dicamba can be considered to be very slightly toxic to bees.

Soil dwelling organisms

Acute toxicity studies of prosulfuron (one study), the formulation A14031B (one study) and metabolites (four studies) to earthworms were provided . The metabolites tested were CGA159902, CGA150829, CGA300406 and CGA349707. Further, studies on sublethal effects of prosulfuron and the formulation on earthworms and collembolans were reviewed.

Prosulfuron and the formulation had little acute effects on earthworms with 14 d LC50s for both being >1000 mg/kg and the NOEC was 1000 mg/kg. Most metabolites also resulted in a 14 d LC50 >1000 mg metabolite/L; the exception being CGA159902. The 14 d LC50 for this metabolite was 520 mg CGA159902/kg and the NOEC = 333 mg CGA159902/kg. Prosulfuron and the formulation are, therefore, very slightly acutely toxic to earthworms.

The sublethal toxicity tests on the effect of the formulation on the reproduction of earthworms and collembolans showed the following results. The EC50 for the number of juvenile earthworms (counted after 8 weeks) was 25.1 mg A14031B/kg; the NOEC was 10 mg A14031B/kg. For collembolans, following a 28 day exposure, a NOEC of 3 mg A14031B/kg was calculated.

Non-target terrestrial beneficial invertebrates

Seven studies on *T. pyri*, *P. cupreus, A. bilineata*, *C. carnea*, *C. septempunctata*, *O. albidipennis*, *A. rhopalosiphi* were provided. Some of these studies also determined effects on reproduction. The tests on *T. pyri* and *A. rhopalosiphi* were conducted using formulation A14031B. A different solid formulation, containing only prosulfuron (A-8714-C 75.5% w/w) was used in the rest of the studies.

The effects of A14031B (applied in conjunction with the wetting agent Trend 90) on the predatory mite, *Typhlodromus pyri*, were evaluated under extended laboratory test conditions. The 7-day LR50 (median lethal rate) was determined as being greater than the highest test rate of 400 g A14031B/ha. A14031B had no statistically significant effect on the reproduction of mites at rates of up to and including 40 g product/ha, however a biologically significant difference, i.e. >10% was observed at rates as low as 0.4 g formulation/ha with a NOEC of 0.04 g formulation/ha.

When the predatory wasp, *Aphidius rhopalosiphi*, was exposed to 200 and 400 g of A14031B/ha there were no mortalities observed at either rate and the 48 h LR50 was greater than the highest test rate (i.e. >400 g A14031B/ha) and the 48 h NOECs for mortality and reproduction are both set at 400 g A14031B/ha.

20 g prosulfuron/ha in the form of 75.5% formulation had no significant effect on *P. cupreus.* At approximately the same rate no effect on reproduction and parasitic capacity of *A. bilineata* was found. When applied at 15 and 30 g ac/ha, this formulation had no significant effect on mortality of *C. carnea, C. septempunctata* and *O. albidipennis*.

Soil Microorganisms

One study on the short term effect of prosulfuron on soil respiration and nitrification was reviewed. The 28 day test used 30 g and 150 g ac/ha. The study showed the effect of prosulfuron on microbial activity was <15% after 28 days compared to untreated soils.

Terrestrial Plants

A total of seven studies were presented and reviewed; one on seed germination, three on seedling emergence and three on vegetative vigour. Prosulfuron technical was used in an *in vitro (*Petri dish) seedling germination study and also in standard seedling emergence and vegetative vigour studies, while the proposed formulation of Casper Turf Herbicide was used in two studies of seedling emergence and vegetative vigour. Similarly seedling emergence and vegetative vigour studies were also conducted using dicamba.

In the *in vitro* seedling emergence study, the most sensitive endpoint was the ryegrass 6 day NOEC of 24.6 g prosulfuron/ha with no LR50 values determined. The standard seedling emergence study with prosulfuron (technical) showed that the most sensitive species with respect to seedling emergence was ryegrass with a 14 day NOER of 1.4 g prosulfuron/ha. The most sensitive seedling survival endpoint was for onion with a 21 day LR50 survival of 41.4 g prosulfuron/ha and, with respect to the no observable effect rate (NOER), lettuce and radish with the 21 day NOER for survival set at 11.2 g prosulfuron/ha. In the standard vegetative vigour study with prosulfuron, the most sensitive plant survival endpoints were the 21 day LR50 of 2.8 g

prosulfuron/ha reported for onion and the 21 day NOEC of 1.4 g prosulfuron/ha reported for ryegrass and onion.

In the seedling emergence study with the proposed Australian prosulfuron/dicamba formulation, the most sensitive endpoint was the sugar beet 21 day seedling emergence NOER of 16 g formulation/ha based on a greater than 10% difference from the control mean number of emerged seedlings. The most sensitive seedling emergence and seedling survival LR50s in this study were >250 g formulation/ha, both for sugar beet. In the vegetative vigour study with the formulated material, the most sensitive plant survival endpoint was the 21 day NOER of 40 g formulation/ha reported for sugar beet, carrot and lettuce. The most sensitive survival LR50 was the sugar beet 21 day LR50 of 255 g formulation/ha.

5.3 Risk assessment

Prosulfuron and dicamba are, both, practically non-toxic to birds. The risk assessment to birds showed that even at the double rate of the proposed dose there will be an acceptable risk to birds.

The risk to terrestrial invertebrates was also assessed. The risk of the formulation to earthworms and collembola at the highest application rate was considered acceptable. Similarly the formulation is also very slightly toxic to bees and the risk to these at the maximum application rate was acceptable.

However, statistically and biologically significant effects on both reproduction and mortality of *T. pyri* was found, when the formulation was applied at 40 g and 400 g/ha. The effects on mortality was generally <50% and the effect on reproduction was >50%. Noting that these rates are substantially smaller than the proposed rates, up to six times lower, there is a risk to beneficial invertebrates that are important for turfgrass IPM, therefore an appropriate IPM warning on the label is required.

Both active constituents have either <25% or no significant effect on soil microorganisms and are not expected to pose an unacceptable risk to soil microorganism mediated nitrogen turnover or carbon mineralisation processes.

The aquatic risk assessment showed that the risk of spray drift to aquatic environments is acceptable if a downwind no spray zone or buffer distance of 25 m is maintained with respect to aquatic systems. It should be emphasised that all the restraints on the label related to spray quality and boom heights (low boom height is mandatory) were taken into account

The risk of spray drift to non-target terrestrial plants was assessed. The assessment showed that there is a potential risk to non-target plants but that a downwind no spray zone or buffer distance of 10 m would be expected to result in an acceptable risk to non-target plants with this distance taking into account the possible application by high boom sprayer.

The APVMA has considered the findings of the DSEWPaC and accepts these conclusions.

6 EFFICACY AND SAFETY ASSESSMENT

The applicant seeks registration of the proposed new product, Casper Turf Herbicide, a water dispersible granule product containing 500g/kg dicamba and 50g/kg prosulfuron for the post-emergence control of certain broadleaf weeds in established turf.

6.1 Proposed Use Pattern

The intended use of Casper Turf Herbicide is for the post-emergence control of certain broadleaf weeds in established fine and amenity turf.

6.2 Summary of Evaluation of Efficacy and Crop Safety

Data from 24 field trials conducted on commercially managed turf demonstrated that Casper Turf Herbicide can be used to control specific broadleaf weeds as claimed on the label. The results of the crop safety tested in these trials demonstrate that Casper Turf Herbicide will not damage established fine and amenity turf grasses while the proposed restraint against use on buffalo grasses is confirmed.

These trials demonstrate that acceptable commercial control (>90%) of the claimed broadleaf weeds can be expected at the proposed label rates when good spray coverage is achieved and weeds are actively growing. The results also point to the need to follow the various critical comments and restraints to achieve maximum efficacy.

The weed densities (medium to high) and weed growth stages (immature, 6-8 leaf, flowering and mature) in the trials provide sufficient range of challenge to the herbicide. They are considered equivalent to label claims.

All the efficacy trials compared the performance of Casper Turf Herbicide to accepted industry standard herbicides. The performance of Casper Turf Herbicide is shown in the majority of these cases to be equal to these currently registered products and in the rest more efficacious for the proposed label claims.

6.3 Assessment of Trial Results

Twenty four field trials were conducted on commercially managed turf in golf courses, sports fields, parks, reserves, turf farms or research institutes, in NSW, Qld and Vic during 2006, 2007, 2008 and 2009 to demonstrate that Casper Turf Herbicide can be used to control the specific broadleaf weeds as proposed on the label. All trials were carried out by suitably qualified personnel, used scientific methodology and were conducted under conditions and management practices equivalent to label instructions. The range of turf situations in the trials conducted adequately covers the label claim of ‘Established fine and amenity turf’. All the efficacy trials compare the performance of Casper Turf Herbicide to accepted industry standard herbicides. All trials used Randomised Complete Block design, with 3-4 replicates, industry standard and untreated controls. Results were analysed using standard statistical procedure. The formulations tested demonstrated its efficacy and crop safety and the rates used are consistent with those proposed for registration.

The weed densities (medium to high) and weed growth stages (immature, 6-8 leaf, flowering and mature) in the trials provide sufficient range of challenge to the herbicide. They are considered equivalent to label claims.

The results from the efficacy trials demonstrate that acceptable commercial control (>90%) of the proposed broadleaf weeds can be expected at the proposed label rates when good spray coverage is achieved and weeds are actively growing. The performance of Casper Turf Herbicide is shown in the majority of these cases to be equal to these currently registered products and in the rest, more efficacious for the proposed label claims. The results also point to the need to follow the various critical comments and restraints to achieve maximum efficacy.

Acceptable turf safety is demonstrated against 30 different established turf grasses in the trials. No phytotoxicity was evident on any of these grasses in any of the trials at up to 2x the proposed maximum label rate. This adequately supports the proposed claim for use of Casper Turf Herbicide in “Established fine and amenity turf” at up to the maximum rate of 1.2 kg/ha. The coarse turf Buffalo grass is included in some of the crop safety assessments. In all these situations unacceptable phytotoxicity to buffalo grass was recorded at all rates of Casper Turf Herbicide. This supports the proposed label restraint “DO NOT apply to Buffalo Grass”.

6.4 Conclusions

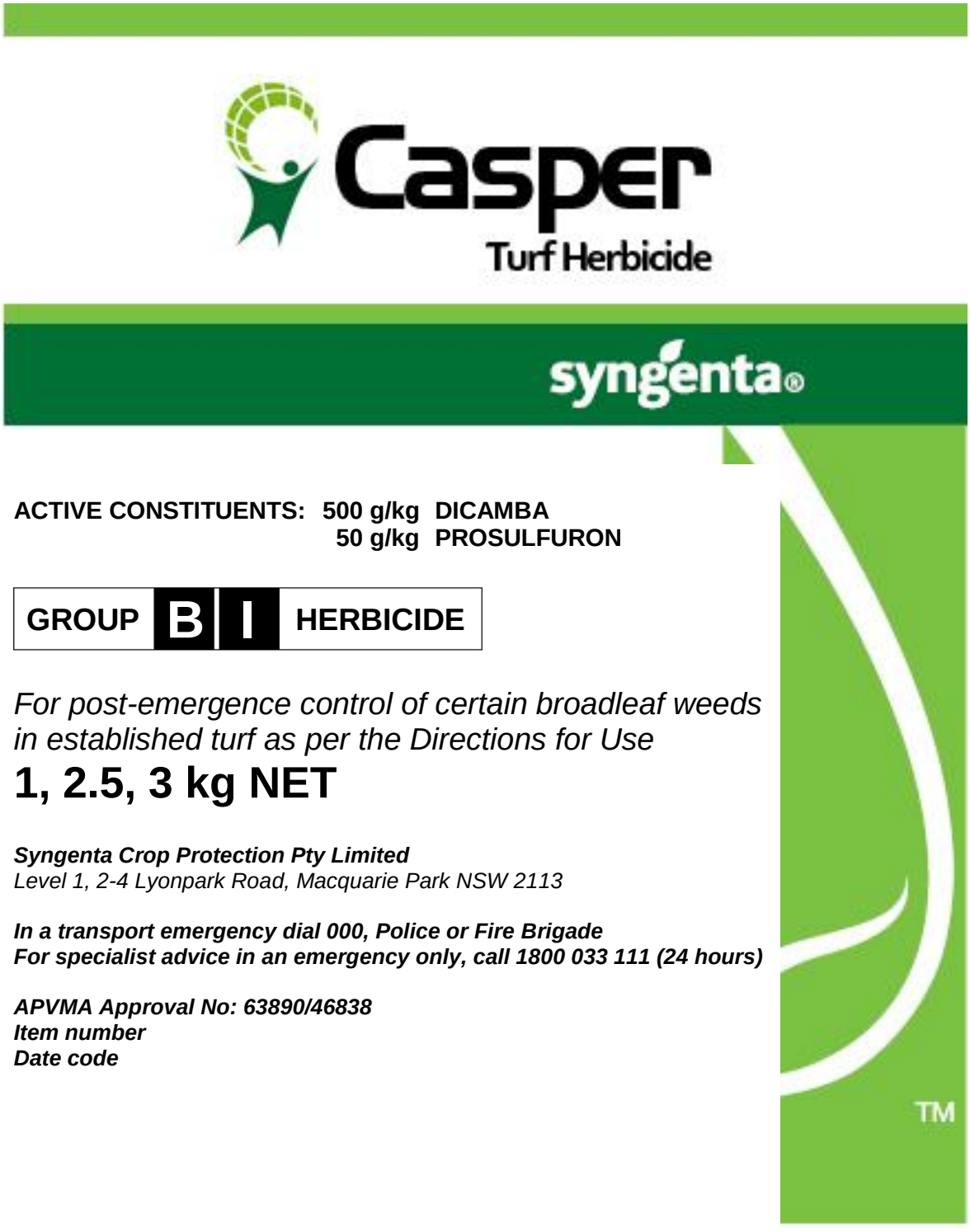
The label claims and instructions proposed in the Claims for Use statement, Directions for Use table and label instructions for Casper Turf Herbicide are generally consistent with the results of the trials and other information presented.

The proposed, restraints, general Instructions (including spray volumes), compatibility statements, resistance group herbicide classification & mode of action statements and critical comments all appear appropriate.

Therefore, in terms of the evidence of the efficacy and crop safety of the product, the application by Syngenta Crop Protection Pty Limited to register Casper Turf Herbicide for the post-emergence control of certain broadleaf weeds in established turf as per the label claims is supported when used in accordance with the proposed label instructions.

7 LABELLING REQUIREMENTS

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



Restraints

DO NOT apply with aircraft or through any type of irrigation equipment

DO NOT apply using spraying equipment carried on the back of the user

DO NOT apply with a nozzle height greater than 50 cm above the ground

DO NOT apply when the turf or weeds are not actively growing

DO NOT apply to golf course putting greens or bowling greens

DO NOT apply to Buffalo Grass

DO NOT apply to turf which is not well established

DO NOT apply if heavy rain has been forecast within 48 hours

DO NOT apply to waterlogged soil

DO NOT irrigate to the point of runoff within 3 days of application

Spray Drift Restraints

DO NOT apply with spray droplets smaller than a **COARSE** spray droplet size category according to "*APVMA Compliance Instructions for Mandatory COARSE or Larger Droplet Size Categories"* located under this title in the GENERAL INSTRUCTIONS section of this label

DO NOT apply when wind speed is less than 3 or more than 20 kilometres 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 by the State or Territory where this product is used.)

Mandatory No-Spray Zones

DO NOT apply if there are aquatic and wetland areas including aquacultural ponds, surface streams and rivers within 25 metres downwind from the application area

DO NOT apply if non-target vegetation is within 10 metres downwind from the application area

SITUATION	WEEDS	RATE	CRITICAL COMMENTS
Established fine and amenity turf	Blackberry Nightshade (*Solanum nigrum*), Catsear (*Hypochoeris radicata*), Chickweed (*Stellaria media*), Creeping Oxalis (*Oxalis corniculata*), Curled Dock (*Rumex crispus*), Milk Thistle (*Sonchus oleraceus*)	600 to 800 g/ha	Apply to weeds after emergence from autumn to early spring. Use the higher rates during cooler months of the year or if weed pressure is high. Complete control may take 4 to 6 weeks depending on weed growth stage at application and also soil and air temperature. Weed death will generally take longer when an application is made during winter (May to August). A repeat application may be needed in 4 to 6 weeks if lower rates are used in high weed pressure situations or during extended germination periods due to environmental conditions. Add a non-ionic surfactant to the spray solution at a ratio of 0.25 to 0.5% v/v. Refer to Application section for detailed information.
	Bindii (*Soliva sessilis*), Burr Medic (*Medicago polymorpha*), Cotula (*Cotula australis*), Dandelion (*Taraxacum officinale*), Fleabane (*Conyza bonariensis*), Lambs Tongue/ Plantain (*Plantago lanceolata*), Subterranean Clover (*Trifolium subterraneum*), Wireweed (*Polygonum aviculare*)	800 g to 1 kg/ha	
	Pennywort (*Hydrocotyle bonariensis*), White Clover (*Trifolium repens*)	1 to 1.2 kg/ha	

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

WITHHOLDING PERIOD: DO NOT GRAZE TREATED TURF/LAWN OR FEED TURF/LAWN CLIPPINGS FROM ANY TREATED AREA TO POULTRY OR LIVESTOCK.

GENERAL INSTRUCTIONS

Mixing

CASPER mixes readily with water, no pre-mixing is required. This product must be mixed with water and applied by suitable spray equipment.

Clean the spray tank before using. If it is contaminated with other materials, mixing problems and/or clogging may occur, or injury to the turf may result.

Fill tank no more than 25% full with clean water before adding CASPER. Begin agitating tank contents vigorously and continue agitation during entire mixing and spraying operation.

Pour required amount of CASPER steadily into tank. Allow vigorous bypass agitation to completely disperse product.

After adding required quantity of CASPER and obtaining complete dispersion, continue to fill tank to desired level for spraying.

Add required quantity of non-ionic surfactant if using and continue agitation.

Thorough agitation (preferably mechanical) of the spray liquid is essential during the addition of the product and during the entire spraying operation. Recirculate if left to stand.

Note: Spray solution should NOT be left standing in the tank overnight.

Compatibility

As formulations of other manufacturers' products are beyond the control of Syngenta, and water quality varies with location, all mixtures should be tested prior to mixing commercial quantities.

Application

DO NOT apply by air or through any type of irrigation equipment.

DO NOT apply using spraying equipment carried on the back of the user.

Ground Application: Spray nozzles should be uniformly spaced and of the same size, and should provide accurate and uniform application. Use spray nozzles that produce no smaller than a COARSE spray quality. To ensure accuracy, calibrate sprayer at the beginning of the season before use and recalibrate frequently. Apply at a volume of 400 to 800 L water/ha. Higher volumes should be used for severe weed infestations and higher cut turf (>15 mm) to ensure adequate spray coverage. It is recommended that a non-ionic surfactant be added to the spray solution at a 0.25 to 0.5% v/v ratio. Good weed coverage with the spray mixture is essential for optimum weed control. Observe sprayer nozzles frequently during the spraying operation to ensure that the spray pattern is uniform. Avoid overlapping of spray runs. Ensure that boom

height for broadcast application does not exceed 50 cm above the leaf blades of the turf. Avoid application under conditions when uniform coverage cannot be obtained or when spray drift may occur.

APVMA Compliance Instructions for Mandatory COARSE or Larger Droplet Size Categories

Important Information

These instructions inform users of this chemical product how to lawfully comply with the requirement of a COARSE or larger spray droplet size category for spray application.

Spray droplet size categories are defined in the ASAE S572 Standard (newer name may also be shown as ASABE) or the BCPC guideline. Nozzle manufacturers may refer to one or both to identify droplet size categories, but for a nozzle to comply with this requirement, the manufacturer must refer to at least one.

In the following instructions, Section 1 is for ground application and Sections 2 and 3 are for aerial application.

Complying with the label requirement to use a specific droplet size category means using the correct nozzle that will deliver that droplet size category under the spray operation conditions being used. The APVMA has approved only the following specific methods for choosing the correct nozzle. Use one of the methods specified in these instructions to select a correct nozzle to deliver a COARSE or larger droplet size category.

SECTION 1 Instructions for Ground Application – for COARSE droplet size or larger categories

Mandatory Instructions for Ground Applications

USE ONLY nozzles that the nozzles' manufacturer has rated to deliver a COARSE, a VERY COARSE or an EXTREMELY COARSE droplet size category as referenced to ASAE S572 or BCPC. Choose a nozzle specified to provide the droplet size category required in the label Spray Drift Restraints.

DO NOT use a higher spray system pressure than the maximum the manufacturer specifies for the selected nozzle to deliver the droplet size category required in the label Spray Drift Restraint.

Sections 2 and 3 are not applicable to this label.

Instructions to Avoid Spray Drift

DO NOT allow spray to drift onto adjacent turf sites or ornamental plants as even small amounts may injure sensitive plants. When drift may be a problem, take steps to reduce spray drift.

DO NOT apply when wind speed is less than 3 or more than 20 kilometres per hour as measured at the application site

Use extreme caution when conditions are favourable for drift, i.e. high temperatures and low relative humidity, especially when sensitive plants are located nearby. All plants not listed as turf species on this label should be considered as sensitive plants.

If sensitive plants are downwind, extreme caution must be used under all conditions. Drift from applications of this herbicide is likely to result in damage to sensitive plants adjacent to the treatment site. This damage can occur at levels below the concentrations that can be detected with chemical analysis.

DO NOT apply when a surface temperature inversion exists. If an inversion condition is suspected, consult with local weather services before making an application.

DO NOT apply with smaller than COARSE spray droplets according to ASAE S572 definition for standard nozzles

If conditions favour drift, recalibrate sprayer by reducing spray pressures and increasing spray volumes to produce larger droplets.

Apply as close to surface of target turf as practical to obtain a good spray pattern for adequate coverage according to the manufacturer's recommendations. Ground applications are limited to a nozzle height of 50 cm above the ground.

Sprayer Cleanup

1. Thoroughly clean spray equipment using the following procedure when you have finished spraying highly active materials such as sulfonylurea products. Start with a thoroughly cleaned sprayer before beginning the next job.

2. Mix only as much spray solution as needed. Immediately after spraying, clean equipment thoroughly using this procedure. Wear appropriate protective clothing.
   As a first step, flush tank, hoses, boom and nozzles with clean water.

3. Prepare a cleaning solution of 300 mL of household ammonia/100 L water. Ensure ammonia used is fresh as it can degrade significantly over time resulting in a reduction in cleaning ability.

4. When available, use a pressure washer to clean the inside of the spray tank with this solution. Take care to wash all parts of the tank, including the inside top surface and lid.

5. Completely fill the sprayer with the cleaning solution to ensure contact of the cleaning solution with all internal surfaces of the tank and plumbing. Start agitation in the sprayer and thoroughly recirculate the cleaning solution for at least 15 minutes. All visible deposits must be removed from the spraying system and, in cases where there is the possibility of heavy build-up of residues, the cleaning solution may need to be left in the tank for extended periods to ensure adequate decontamination of the tank.

6. Flush hoses, spray lines and nozzles for at least 1 minute with the cleaning solution.

7. Dispose of rinsate from steps 1 to 5 in an appropriate manner.

8. **Repeat steps 2 to 5.**

9. Remove nozzles, screens and strainers and clean separately in the cleaning solution after completing the above procedures. Be careful with filters, as they are a main source of contamination.

10. Rinse the complete spraying system with clean water.

The above method is only effective if the cleaning solution comes into contact with every surface or contact point that may contain even minute sulfonylurea herbicide residues. In some boom sprayers this may not be physically possible and hence it may be advisable to use a different boomsprayer that has not been used to spray sulfonylurea herbicides, when spraying sensitive crops or turf species.

Herbicide Resistance Warning

GROUP	B	I	HERBICIDE

CASPER Turf herbicide is a member of the sulfonylureas and benzoic acid groups of herbicides and has the ALS inhibitor and disruptor of plant cell growth modes of action. For weed resistance management CASPER is a Group B and I herbicide. Some naturally occurring weed biotypes resistant to CASPER and other Group B and I herbicides may exist through normal genetic variability in any weed population. The resistant individuals can eventually dominate the weed population if these herbicides are used repeatedly. These resistant weeds will not be controlled by CASPER or other Group B or I herbicides. Since the occurrence of resistant weeds is difficult to detect prior to use, Syngenta Crop Protection Pty Limited accepts no liability for any losses that may result from the failure of CASPER to control the resistant weeds. Advice as to strategies and alternative treatments that can be used should be obtained from your local supplier, consultant, local Department of Agriculture, Primary Industries Department or a Syngenta representative.

Integrated Pest Management

The possible effects of CASPER on integrated pest management (IPM) strategies in the turf industry have not been studied at the proposed rates. However, based on available information, it cannot be ruled out that CASPER may have an adverse effect on non-target beneficial turfgrass invertebrates where such IPM is practised.

PRECAUTION

General Safety Precaution

DO NOT apply using spraying equipment carried on the back of the user.

Re-entry Period

DO NOT allow the general public to enter treated areas until the spray has dried.

DO NOT allow entry into treated areas until the spray has dried for low exposure activities such as mowing, unless wearing cotton overalls buttoned to the neck and wrist (or equivalent clothing) and elbow-length chemical resistant gloves. Clothing must be laundered after each day's use.

DO NOT ALLOW entry into treated areas for 14 days for high exposure activities such as hand weeding or transplanting, unless wearing cotton overalls buttoned to the neck and wrist (or equivalent clothing) and elbow-length chemical resistant gloves. Clothing must be laundered after each day's use.

PROTECTION OF CROPS, NATIVE AND OTHER NON-TARGET PLANTS

This product is highly toxic to non-target plants including aquatic plants.

DO NOT apply under weather conditions or from spraying equipment that may cause spray to drift onto nearby susceptible plants/crops, cropping lands, pastures and other non-target plants or natural and impounded lakes, dams or other waterways. Avoid applications to areas where product may accumulate under the drip line of trees or where product may come into contact with roots of desirable plants.

PROTECTION OF LIVESTOCK, WILDLIFE, FISH, CRUSTACEANS AND ENVIRONMENT

Very toxic to aquatic life. DO NOT contaminate streams, rivers or waterways with the chemical or used containers. DO NOT apply if heavy rain is forecast.

STORAGE AND DISPOSAL

Store in the closed, original container in a dry, cool, well ventilated area out of 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 for appropriate disposal 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 it 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. Avoid contact with eyes. When using the prepared spray by low pressure hand wand, wear:

- **cotton overalls, over normal clothing, buttoned to the neck and wrist**
- **a washable hat**
- **elbow-length chemical resistant gloves**
- **half facepiece respirator**

If product in eyes, wash it out immediately with water. Wash hands after use. After each day's use, wash gloves, contaminated clothing and respirator, if rubber, wash with detergent and warm water.

FIRST AID

If poisoning occurs contact a doctor or Poisons Information Centre. Phone 131 126.

MATERIAL SAFETY DATA SHEET

If additional hazard information is required refer to the Material Safety Data Sheet. For a copy phone 1800 067 108, or visit our website at www.greencast.com.au or www.syngenta.com.au

MANUFACTURER'S WARRANTY AND EXCLUSION OF LIABILITY

Syngenta has no control over storage, handling and manner of use of this product. Where this material is not stored, handled or used correctly and in accordance with directions, no express or implied representations or warranties concerning this product (other than non-excludable statutory warranties) will apply. Syngenta accepts no liability for any loss or damage arising from incorrect storage, handling or use.

Batch No	
Date of Manufacture	

BARCODE

ABBREVIATIONS

ac	active constituent
ACCS	Advisory Committee on Chemical Scheduling
ADI	Acceptable Daily Intake (for humans)
AHMAC	Australian Health Ministers Advisory Council
ai	active ingredient
BBA	Biologische Bundesanalstalt fur Land – und forstwirschaft
bw	bodyweight
d	day
DAT	Days After Treatment
DSEWPaC	Department of Sustainability, Environment, Water Population And Community
DT_{50}	Time taken for 50% of the concentration to dissipate
EA	Environment Australia
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
EEC	Estimated Environmental Concentration
E_rC_{50}	concentration at which the rate of growth of 50% of the test population is impacted
EUP	End Use Product
Fo	original parent generation
g	gram
GAP	Good Agricultural Practice
GCP	Good Clinical Practice
GLP	Good Laboratory Practice
GVP	Good Veterinary Practice
h	hour
ha	hectare

Hct	Heamatocrit
Hg	Haemoglobin
HPLC	High Pressure Liquid Chromatography *or* High Performance Liquid Chromatography
id	intradermal
im	intramuscular
ip	intraperitoneal
IPM	Integrated Pest Management
iv	intravenous
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_{oc}	Organic carbon partitioning coefficient
K_{ow}	Octanol-water 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
LOD	Limit of Detection – level at which residues can be detected
LOQ	Limit of Quantitation – level at which residues can be quantified
mg	milligram
mL	millilitre
MRL	Maximum Residue Limit
MSDS	Material Safety Data Sheet
NDPSC	National Drugs and Poisons Schedule Committee
ng	nanogram
NHMRC	National Health and Medical Research Council
NOEC/NOEL	No Observable Effect Concentration Level
OC	Organic Carbon

OM	Organic Matter
po	oral
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million
Q-value	Quotient-value
RBC	Red Blood Cell Count
s	second
sc	subcutaneous
SC	Suspension Concentrate
SUSM	Standard for the Uniform Scheduling of Medicines and Poisons
TGA	Therapeutic Goods Administration
TGAC	Technical grade active constituent
T-Value	A value used to determine the First Aid Instructions for chemical products that contain two or more poisons
µg	microgram
vmd	volume median diameter
WG	Water Dispersible Granule
WHP	Withholding Period

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
Codex MRL	Internationally published standard maximum residue limit
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

REFERENCES

Felton, J.C., Oomen, P.A. & Stevenson, J.H. 1986, 'Toxicity and hazard of pesticides to honeybees: harmonisation of test methods', *Bee World*, vol. 67, no. 3, pp. 114-24.

Goring, C.A.I. et al. 1975, 'Principles of pesticide degradation in soil', in *Environmental Dynamics of Pesticides*, edited by R. Haque and V.H. Freed, Plenum Press, New York, pp 135-72.

Matthews, G.A. 1992, *Pesticide Application Methods*, 2nd ed., Longman, London.

Australian Pesticides and Veterinary Medicines Authority 2008, *Ag MORAG: Manual of Requirements and Guidelines*, APVMA, Canberra.

Australian Pesticides and Veterinary Medicines Authority 2008, *Vet MORAG: Manual of Requirements and Guidelines*, APVMA, Canberra.