Australian Government

Australian Pesticides and Veterinary Medicines Authority

PUBLIC RELEASE SUMMARY

on the evaluation of the new active, cloquintocet acid, in the product Crusader Go DRI Herbicide

FEBRUARY 2017

ISSN: 1443–1335 (electronic)
ISBN: 978-1-925390-65-0 (electronic)

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

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PREFACE

The Australian Pesticides and Veterinary Medicines Authority (APVMA) is the Australian Government regulator 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 Ageing, Department of Environment and Energy, Department of Agriculture and Water Resources, and State Departments of Primary Industries.

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 products containing new active constituents.

The information and technical data required by the APVMA to assess the safety of new chemical products, and the methods of assessment, must be consistent with accepted scientific principles and processes. Details are outlined on the APVMA website at www.apvma.gov.au.

This Public Release Summary is intended as a brief overview of the assessment that has been conducted by the APVMA and of the specialist advice received from 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 APVMA is considering an application for registration of an agricultural or veterinary chemical. It provides a summary of the APVMA's assessment, which may include details of:

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

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

Making a submission

In accordance with section 13 of the Agvet Code, the APVMA invites any person to submit a relevant written submission as to whether the application for registration of Crusader GoDRI 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 matters include aspects of public health, occupational health and safety, chemistry and manufacture, residues in food, environmental safety, trade, and efficacy and target crop or animal safety. Submissions should state the grounds on which they are based. Comments received that address issues outside the relevant matters cannot be considered by the APVMA.

Submissions must be received by the APVMA by close of business on Tuesday 21 March 2017 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.

When making a submission please include:

- contact name
- company or group name (if relevant)
- email or postal address (if available)
- the date you made the submission.

All personal information, and confidential information judged by the APVMA to be confidential commercial information (CCI)[1] 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:

Case Management and Administration Unit
Australian Pesticides and Veterinary Medicines Authority
PO Box 6182
Kingston ACT 2604
Phone: +61 2 6210 4701
Fax: +61 2 6210 4721
Email: enquiries@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, 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 at www.apvma.gov.au.

1 INTRODUCTION

1.1 Applicant

Dow Agrosciences Australia Ltd.

1.2 Purpose of application

Dow Agrosciences Australia Limited has applied to the APVMA for registration of the new product Crusader GoDRI Herbicide containing 451.5 g/kg cloquintocet (as the acid) 215 g/kg pyroxsulam and in a water dispersible granule (WG) formulation.

This publication provides a summary of the information reviewed and an outline of the regulatory considerations for the proposed registration of Crusader GoDRI Herbicide, containing the active constituent cloquintocet acid.

Cloquintocet acid is a crop safener which modifies the physiology of the target crop to make it more resilient to the impact of selective herbicides. Pyroxsulam has previously been considered by the APVMA. Pyroxsulam is an APVMA approved active constituent and is present in the APVMA registered product Crusader Herbicide.

The APVMA has previously considered a similar crop safener, cloquintocet-mexyl. cloquintocet-mexyl is an approved active constituent which is present in a range of currently registered selective herbicides.

The active constituent, cloquintocet acid, is an active constituent approved by the APVMA. Crusader GoDRI Herbicide is the first product containing the active cloquintocet acid proposed for the Australian market.

1.3 Product claims and use pattern

Crusader GoDRI Herbicide is a selective herbicide. The proposed use pattern is as a foliar spray to post-emergent wheat (excluding durum varieties) and triticale, at the 3 leaf up to 1st node stage, to control various grass and broadleaf weeds. The product is to be applied by ground boom, only once per annum at a rate of 70 g product per hectare which equates to 15 g a.i. pyroxsulam per ha and 32 g a.i. cloquintocet acid per ha.

1.4 Mode of action

Cloquintocet acid is a crop safener, which accelerates the detoxification of herbicides in cereals and is not subject to a resistance management strategy.

The active constituent pyroxsulam is a sulfonamine herbicide (Group B) that provides broad spectrum post-emergent annual grass and broadleaf weeds control in cereals. Crusader GoDRI Herbicide is designated as a Group B herbicide for resistance management purposes.

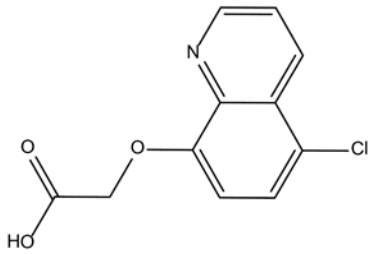
1.5 Overseas registrations

This product is currently registered in Canada as Simplicity Go DRI Herbicide for control of grass and broadleaf weeds in spring wheat, durum wheat and winter wheat.

2 CHEMISTRY AND MANUFACTURE

2.1 Active constituent

The active constituent cloquintocet acid is manufactured overseas, and has the following nomenclature and physico-chemical properties:

COMMON NAME (ISO):	Cloquintocet
SYNONYM:	Cloquintocet acid
IUPAC NAME:	(5-Chloroquinolin-8-yloxy)acetic acid
CAS REGISTRY NUMBER:	88349-88-6
EMPIRICAL FORMULA:	$C_{11}H_8ClNO_3$
MOLECULAR WEIGHT:	237.6
STRUCTURAL FORMULA:	
CHEMICAL FAMILY:	Herbicide safener

Physico-chemical properties of cloquintocet acid

<table>
<tr><td>PHYSICAL FORM:</td><td>Yellow to tan powder</td></tr>
<tr><td>ODOUR:</td><td>Mild to odourless</td></tr>
<tr><td>MELTING POINT:</td><td>223.7°C</td></tr>
<tr><td>RELATIVE DENSITY AT 20°C:</td><td>1.52</td></tr>
<tr><td>DISSOCIATION CONSTANT (PK_A):</td><td>4.8</td></tr>
<tr><td>SOLUBILITY AT 20°C:</td><td>In water:
pH 5: 3.12 g/L
pH 7: >50 g/L
pH 9: >50 g/L

Inorganic solvents:
<table>
<tr><th>Solvent</th><th>Solubility (mg/L)</th></tr>
<tr><td>Methanol:</td><td>2400</td></tr>
<tr><td>Acetone:</td><td>680</td></tr>
<tr><td>n-Octanol:</td><td>540</td></tr>
<tr><td>1,2-Dichloroethane:</td><td>370</td></tr>
<tr><td>Ethyl acetate:</td><td>190</td></tr>
<tr><td>Xylene:</td><td>39</td></tr>
<tr><td>n-Heptane:</td><td>0.03</td></tr>
</table></td></tr>
<tr><td>STABILITY:</td><td>Stable to accelerated storage conditions (54°C for 2 weeks).
Stable in the presence of metals and metal ions (copper, brass, aluminium, 304 stainless steel, 316 stainless steel, cuprous chloride, nickel (II) chloride and ferric chloride).</td></tr>
<tr><td>SAFETY PROPERTIES:</td><td>Not explosive, oxidising or flammable.</td></tr>
</table>

The APVMA has evaluated the chemistry aspects of cloquintocet acid (manufacturing process, quality control procedures, batch analysis results and analytical methods) and found them to be acceptable. The active constituent cloquintocet acid was recently approved by the APVMA on 26 August 2016, with the approval number 70324.

On the basis of the data provided, and the toxicological assessment, it is proposed that the following APVMA Active Constituent Standard be established for cloquintocet acid:

APVMA Active Constituent Standard for cloquintocet

CONSTITUENT	SPECIFICATION
Cloquintocet	Cloquintocet: 956 g/kg minimum

2.2 Formulated product

The active constituent cloquintocet acid and the product Crusader GoDRI Herbicide will both be manufactured overseas.

Crusader GoDRI Herbicide is a water dispersible granule containing 215 g/kg of the herbicide pyroxsulam, and 451.5 g/kg of the new active, cloquintocet acid, and it will be available in 1.4 kg and 2.8 kg HDPE containers with self-adhesive labels. Key physicochemical properties of the product are tabulated below.

DISTINGUISHING NAME:	Crusader GoDRI Herbicide
FORMULATION TYPE:	Water Dispersible Granule (WG)
ACTIVE CONSTITUENT CONCENTRATIONS:	215 g/kg pyroxsulam 451.5 g/kg cloquintocet acid

Physical and chemical properties of product

PHYSICAL FORM:	Tan granule
ODOUR:	Mild odour
PH VALUE (1% DILUTION):	4.1 @24.4°C
BULK DENSITY:	0.591 g/mL @24.0°C
FLASH POINT:	Not applicable
OXIDISING PROPERTIES:	No significant increase (> 5°C) in temperatures were observed
EXPLOSIVE PROPERTIES:	No potential explosive properties
FLAMMABILITY:	Not applicable
PACK SIZES:	1.4 kg or 2.8 kg
PACKAGING MATERIAL:	HDPE
PRODUCT STABILITY:	Stable to accelerated storage conditions (54 °C for 2 weeks) in the commercial packaging material

2.3 Recommendations

Based on a review of the chemistry and manufacturing details provided by the applicant, the registration of Crusader GoDRI Herbicide is supported from a chemistry perspective.

3 TOXICOLOGICAL ASSESSMENT

3.1 Evaluation of toxicology

The product Crusader GoDRI Herbicide, contains a new active constituent cloquintocet acid (451.5 g/kg) and the existing active constituent pyroxsulam (215 g/kg) in a water-dispersible granule (WG) formulation. The following summary discusses the toxicity of cloquintocet acid with additional information on the toxicity of Crusader GoDRI Herbicide.

Cloquintocet acid is the primary *in vivo* mammalian metabolite of cloquintocet-mexyl, and hydrolysis of the mexyl form of cloquintocet occurs rapidly *in vivo* so that systemic exposure is primarily to the acid form of cloquintocet (cloquintocet acid). The toxicological assessment of cloquintocet acid was limited to the conduct of key studies to confirm toxicological equivalence of cloquintocet acid to the mexyl form, thereby verifying that the toxicological database already available for cloquintocet-mexyl for human health risk assessment is relevant to cloquintocet acid.

The data submitted for cloquintocet acid consisted of a study on toxicokinetics/metabolism (rat), acute toxicity studies and short-term/subchronic studies (rat), a reproduction/ developmental screening study (rat) and *in vitro* genotoxicity studies. The toxicological studies were conducted in accordance with contemporary test guidelines. Neurotoxicity endpoints as per OECD Test Guidelines were also specifically evaluated in a subchronic, repeat dose toxicity study.

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. However, from a conservative risk assessment perspective, 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.

Chemical class

Cloquintocet acid acts as a safener to prevent the phytotoxic action of the accompanying herbicide with which it is mixed.

Toxicokinetics and metabolism

Toxicokinetic data from a guideline-compliant study submitted in rats suggests cloquintocet-mexyl is metabolised to cloquintocet acid *in vivo* following oral gavage. The similarity in absorption, tissue distribution, elimination kinetics and excretion and metabolite profiles between cloquintocet acid and cloquintocet-mexyl, in particular the similar blood radioactivity levels (Area Under the Curve (AUC)) following dosing at similar low doses and the similarity of the metabolite profiles between cloquintocet acid and cloquintocet-mexyl, indicates that cloquintocet-mexyl is likely to be extensively hydrolysed *in vivo* to cloquintocet acid, resulting in bioequivalence between these two test compounds.

Acute toxicity

Based on the findings from the acute toxicological studies evaluated, cloquintocet acid is of low acute oral, dermal and inhalational toxicity, is a slight eye irritant but is not considered to be a potential skin irritant or skin sensitiser in mice up to 50% w/v in the Local Lymph Node Assay (LLNA).

Systemic toxicity

A subchronic 13 week repeat dose dietary study indicated that cloquintocet acid has relatively minor effects on rodents. At the highest dose of cloquintocet acid tested (2100 ppm; equivalent to 116 and 127 mg/kg bw/day in males and females, respectively), there were a number of treatment related but not toxicologically significant findings in haematology, clinical chemistry, urinalysis and spleen weight.

No evidence of genotoxic potential for cloquintocet acid was seen in the submitted *in vitro* assays. Genotoxic or carcinogenic potential *in vivo* was not investigated.

In a one-generation reproductive/developmental toxicity study, cloquintocet acid did not show any reproductive toxicity in rats and was not a developmental toxicant based on limited observations of offspring up to lactation day 4.

No standard neurotoxicity studies in experimental animals were available. However, cloquintocet acid did not show any signs of neurotoxicity in rats in the acute toxicity studies or in a functional observation battery (FOB) conducted in the subchronic 13 week toxicity study.

A comparison of the No Observable Effect Level (NOEL)/ No Observable Adverse Effect Lebel (NOAEL) and clinical signs in comparable studies indicated that cloquintocet acid had a remarkably similar toxicity profile to the cloquintocet-mexyl form. On this basis, the APVMA considers that the bridging toxicology data package provided by the applicant demonstrates toxicological equivalence between cloquintocet acid and cloquintocet mexyl. In addition, there were no new toxicologically significant findings identified in animals following exposure to cloquintocet acid.

Overall, cloquintocet acid has a low acute toxicity profile with the exception of slight eye irritation. Based on bridging to the toxicological profile of cloquintocet-mexyl endpoints, the likely potential systemic short-term repeat dose, subchronic and chronic toxicity of cloquintocet acid are consistent with a chemical of low toxicity. Similarly, based on submitted bridging studies to the toxicological database of cloquintocet-mexyl, cloquintocet acid was unlikely to be an *in vivo* genotoxicant, a reproductive toxicant in rats, a developmental toxicant in rats and rabbits or carcinogenic in mice and rats.

Product toxicity

The Crusader GoDRI Herbicide formulation was demonstrated to be of low acute oral (LD50 between 2000 and 5000 mg/kg bw), dermal (LD50 >5000 mg/kg bw), and inhalational toxicity (LC50 >5.72 mg/L air) in rats. The formulation was also non-irritating to the skin of rabbits, and was not a skin sensitiser (mouse LLNA), but was a mild irritant to eyes (rabbits).

3.2 Public health standards

Poisons scheduling

On 17 March 2016, the Delegate of the Secretary of the Department of Health published a final scheduling decision to amend the current Schedule 5 entry for cloquintocet mexyl, removing reference to the mexyl ester so that cloquintocet and all its salts and esters are captured by the entry. An implementation date of 1 June 2016 was notified for this decision.

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

The Acceptable Daily Intake (ADI) for humans is the level of intake of an agricultural or veterinary chemical which can be ingested daily over an entire lifetime without appreciable risk to health. It is calculated by dividing the overall NOEL / NOAEL for the most sensitive toxicological endpoint from a suitable study (typically an animal study) by an appropriate safety factor. The magnitude of the safety factor is selected to account for uncertainties in extrapolation of animal data to humans, intra-species variation, and the completeness of the toxicological database and the nature of the potential toxicologically significant effects.

Based on the demonstration of bioequivalence and toxicological equivalence of cloquintocet acid to cloquintocet mexyl, the APVMA considers that the ADI can be the same. Consequently, an ADI was established for the sum of cloquintocet, its acid and esters, expressed as cloquintocet-mexyl. An ADI of 0.04 mg/kg bw/day was established on the basis of the NOEL / NOAEL of 4.3 mg/kg bw/day for thyroid follicular epithelium hyperplasia in females at 41.3 mg/kg bw/day and above in a 2–year dietary rat study and using a 100–fold safety factor.

Acute Reference Dose (ARfD)

The Acute Reference Dose (ARfD) is the estimate of the amount of a substance in food or drinking water, expressed on a milligram per kilogram body weight basis, that can be ingested over a short period of time, usually in one meal or during one day, without appreciable health risk to the consumer on the basis of all known facts at the time of the evaluation. Based on the demonstration of bioequivalence and toxicological and bridging to the cloquintocet-mexyl database, the ARfD for cloquintocet acid would be set based on the ARfD value for cloquintocet-mexyl.

Since there was no toxicity observed following acute exposure an ARfD was not considered to be necessary.

4 RESIDUES ASSESSMENT

4.1 Introduction

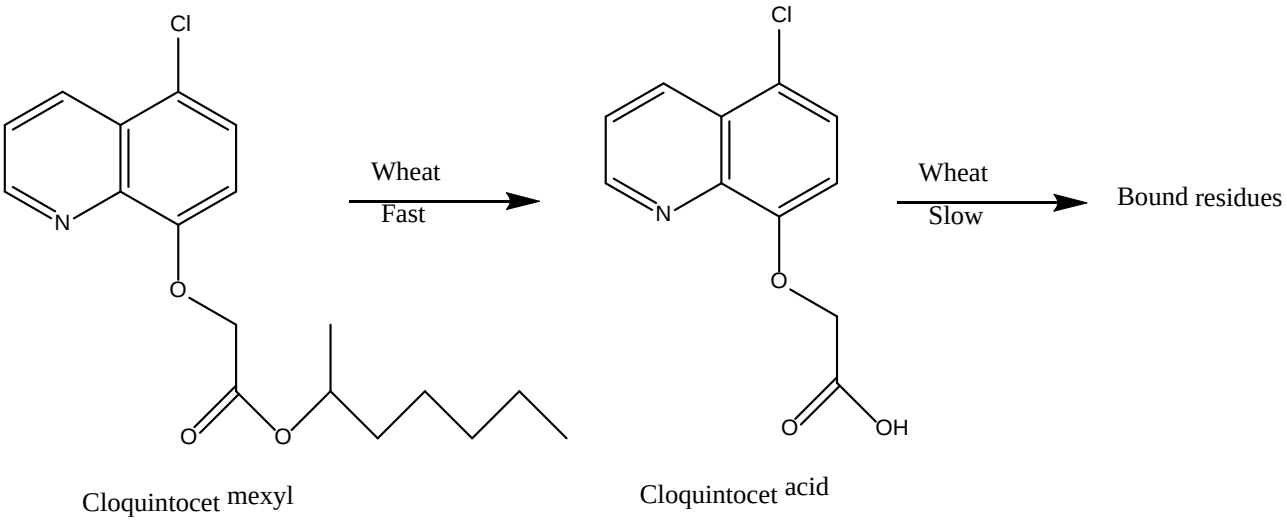
Crusader GoDRI Herbicide contains the active constituents cloquintocet acid and pyroxsulam. As part of the residues assessment of cloquintocet acid, plant metabolism studies, supervised residue trials, analytical methodology, fate in storage and processing data and residues in trade information were considered. Supervised residue trials and trade aspects were also considered for pyroxsulam.

4.2 Metabolism

Cloquintocet acid is covered by the residue definition for cloquintocet-mexyl. The metabolism of cloquintocet-mexyl in plants and animals has been previously evaluated.

A study was submitted with the current application showing the uptake, transport and metabolism of cloquintocet acid and cloquintocet-mexyl ester using 14C cloquintocet acid or 14C cloquintocet-mexyl ester in wheat plants (treated with either cloquintocet-mexyl or acid at 25 g/ha). Cloquintocet acid was exclusively found in the ethanol washes (plant surface) indicating a lack of penetration into the cuticle. For cloquintocet-mexyl ester the percentage of the radioactivity recovered in the ethanol wash decreased with time, thus showing that the ester penetrates into the plant tissue more readily compared with the acid. Furthermore the ester was converted rapidly to the acid in the treated leaf. At 24 hours and later after treatment there was no ester detected in the treated leaf. Also, all of the radioactivity present out of the treated leaf in the rest of the plant samples, was acid or metabolites. This data is consistent with the previously evaluated metabolism pathway of cloquintocet-mexyl which involves rapid conversion to the acid and slow formation of bound material.

The metabolism pathway of cloquintocet-mexyl in plants is shown below:



Cloquintocet mexyl Cloquintocet acid

4.3 Analytical methods

The method for determination of cloquintocet acid and cloquintocet-mexyl in plant matrices involved extraction of samples with acetone/citrate buffer, with clean-up by solid phase extraction followed by HPLC with positive ion electro-spray tandem mass spectrometry. The limit of quantitation was 0.01 mg/kg for each analyte.

4.4 Stability of the pesticides in stored analytical samples

Residues of cloquintocet acid and cloquintocet-mexyl were stable for at least 24 months of frozen storage in a range of plant matrices (lettuce, wheat grain, rapeseed, and whole orange), covering high-water content, dry, high-fat content, and high-acid content.

4.5 Residue definition

Cloquintocet acid is included in the residue definition of cloquintocet-mexyl which is 'Sum of cloquintocet-mexyl and 5-chloro-8-quinolinoxyacetic acid, expressed as cloquintocet-mexyl.'

There are no proposed changes to the residue definitions of cloquintocet-mexyl and pyroxsulam.

4.6 Residue trials

The proposed GAP for pyroxsulam and cloquintocet acid in Crusader GoDRI Herbicide on triticale and wheat (excluding durum varieties) is a single application at 15 g ai/ha pyroxsulam and 32 g ai/ha cloquintocet acid between the 3 leaf up to 1st node of the crop, in conjunction with a harvest WHP of 'not required when used as directed' and a grazing WHP of 4 weeks.

Residue trials in wheat (n=6) and triticale (n=2) were conducted in Australia in 2014 addressing the proposed use pattern.

Cloquintocet mexyl

Residues of cloquintocet acid and cloquintocet-mexyl were determined for all of the samples. Residues were expressed as cloquintocet-mexyl after converting the acid to mexyl equivalents.

Residues of cloquintocet-mexyl in wheat and triticale grain following one application at a nominal rate of 32 g cloquintocet acid/ha (1× GAP) were < Limit of Detection (LOD) (8) (LOD = 0.003 mg/kg) at commercial maturity [69–114 days after application (DAA) at GAP]. The current cloquintocet-mexyl MRLs of *0.1 mg/kg each for wheat and triticale are considered appropriate to cover residues arising from the proposed use pattern.

Cloquintocet-mexyl residues of < 0.014 mg/kg (6) on a fresh weight basis were observed in wheat and triticale forage at 28/29 DAA at GAP. The current cloquintocet-mexyl MRL of *0.1 mg/kg for cereal forage (fresh weight) is considered appropriate to cover residues arising from the proposed use pattern.

Cloquintocet-mexyl residues of < LOD (8) (LOD = 0.003 mg/kg) on a dry weight basis were observed in wheat and triticale straw at commercial maturity (69–114 DAA at GAP). The current cloquintocet-mexyl MRL of *0.1 mg/kg for straw and fodder (dry) of cereal grains [except rice] is considered appropriate to cover residues arising from the proposed use pattern.

Pyroxsulam

Residues of pyroxsulam in wheat and triticale grain following one application at a nominal rate of 15 g ai/ha (1× GAP) were < LOD (8) (LOD = 0.003 mg/kg) at commercial maturity (69–114 DAA at GAP). The current pyroxsulam MRLs of *0.01 mg/kg each for wheat and triticale are considered appropriate to cover residues arising from the proposed use pattern.

Pyroxsulam residues of < LOD (3) (LOD = 0.003 mg/kg on a fresh weight basis), 0.02, 0.03 and 0.035 mg/kg on a dry weight basis were observed in wheat and triticale forage at 28/29 DAA at GAP. The current pyroxsulam MRLs of 0.5 mg/kg each for wheat forage (green) and triticale forage (green) are considered appropriate to cover residues arising from the proposed use pattern.

Pyroxsulam residues of < LOD (8) (LOD = 0.003 mg/kg) on a dry weight basis were observed in wheat and triticale straw at commercial maturity (69-114 DAA at GAP). The current pyroxsulam MRLs of 0.1 mg/kg each for wheat straw and fodder, dry and triticale straw and fodder, dry are considered appropriate to cover residues arising from the proposed use pattern.

4.7 Rotational crops

Pyroxsulam is registered on wheat and triticale at rates similar to the proposed rates. The proposed rate for cloquintocet acid (32 g ai/ha) is the same as the registered rate for cloquintocet-mexyl on wheat and triticale (45 g ai/ha), when converted to cloquintocet-mexyl equivalents using a molecular weight conversion factor of 1.4. Therefore consideration of potential residues in rotational crops from the proposed use pattern of cloquintocet acid was considered equivalent to that already established for cloquintocet mexyl where residues in rotational crops are not expected to occur.

4.8 Animal commodity MRLs

Pyroxsulam is registered on wheat and triticale at rates similar to the proposed rates. The proposed rate for cloquintocet acid (32 g ai/ha) is the same as registered for cloquintocet-mexyl on wheat and triticale (45 g ai/ha), when converted to cloquintocet-mexyl equivalents. The residues in wheat and triticale fodder and forage as a result of the proposed use are within the established MRLs of cloquintocet-mexyl and pyroxsulam for relevant animal feed commodities. Therefore, residues in animal commodities are not expected to exceed the levels resulting from registered use patterns for these actives in cereal crops and existing animal commodity MRLs for these actives remain adequate.

4.9 Estimated dietary intake

Chronic dietary exposure assessment

Cloquintocet acid is covered by the residue definition of cloquintocet-mexyl. The chronic dietary exposure to cloquintocet-mexyl and pyroxsulam is estimated by the National Estimated Daily Intake (NEDI) calculation encompassing all registered/temporary uses of the chemical and the mean daily dietary consumption data derived primarily from the 1995 National Nutrition Survey of Australia. The NEDI calculation is made in accordance with WHO Guidelines[1] and is a conservative estimate of dietary exposure to chemical residues in food. The NEDI for cloquintocet-mexyl is equivalent to < 5% of the Acceptable Daily Intake (for humans) (ADI). The NEDI for pyroxsulam is equivalent to < 1% of the ADI.

It is concluded that the chronic dietary exposure is acceptable.

Acute dietary exposure assessment

The acute dietary exposure is estimated by the National Estimated Short Term Intake (NESTI) calculation. The NESTI calculations are made in accordance with the deterministic method used by the JMPR with 97.5th percentile food consumption data derived primarily from the 1995 National Nutrition Survey of Australia. NESTI calculations are conservative estimates of short-term exposure (24 hour period) to chemical residues in food.

Acute Reference Dose (ARfDs) for cloquintocet-mexyl and pyroxsulam have not been established in Australia or the JMPR, therefore NESTI calculations are not possible.

4.10 Bioaccumulation potential

The Log of the octanol-water partition coefficient (KOW)($Log_{10}K_{ow}$) value at 20°C for cloquintocet acid is -0.7 indicating that it is unlikely to partition preferentially into fat.

The $Log_{10}K_{ow}$ values at 20°C for pyroxsulam at pH's 4, 7 and 9 are 1.08, -1.01 and -1.60, respectively, which indicates it is hydrophilic and is unlikely to partition preferentially into fat.

4.11 Spray drift

Pyroxsulam is registered on wheat and triticale at rates similar to the proposed rates. The proposed rate for cloquintocet acid (32 g ai/ha) is the same as registered for cloquintocet-mexyl on wheat and triticale (45 g ai/ha), when converted to cloquintocet-mexyl equivalents. Therefore residues arising from spray drift of cloquintocet acid and pyroxsulam was considered equivalent to that already likely from current registrations of pyroxsulam and cloquintocet mexyl, where no spray drift restraints have been considered necessary.

4.12 Recommendations

The following amendments to the APVMA MRL Standard are required for the current application:

Table 1

COMPOUND	FOOD	MRL (mg/kg)
Cloquintocet acid		
ADD:		
Cloquintocet acid *see* Cloquintocet mexyl		

Table 3

COMPOUND	RESIDUE
ADD:	
Cloquintocet acid *see* Cloquintocet mexyl	Residues arising from the use of cloquintocet acid are covered by the MRLs for cloquintocet mexyl.

Table 4

COMPOUND	ANIMAL FEED COMMODITY	MRL (mg/kg)
Cloquintocet acid		
ADD:		
Cloquintocet acid *see* Cloquintocet mexyl		

MRL amendments recommended for Tables 1 and 3 above will be considered for inclusion in Schedule 20 of the Australia New Zealand Food Standards Code.

5 ASSESSMENT OF OVERSEAS TRADE ASPECTS OF RESIDUES IN FOOD

5.1 Commodities exported

Wheat and triticale are exported, as are commodities of animal origin, such as meat, offal and dairy products, which may be derived from livestock fed feeds produced from treated wheat and triticale. Residues in these commodities resulting from the use of Crusader GoDRI Herbicide may have the potential to unduly prejudice trade.

5.2 Destination of exports

The total exports of Australian wheat (including wheat flour) were 15,777 kt in 2015/16 valued at $5.12 billion[2].

Major export markets for Australian wheat are presented below.

CROP	MAJOR DESTINATIONS
Wheat	Indonesia, China, Vietnam, Rep. of Korea, Yemen, Japan, Malaysia, Philippines, New Zealand, Nigeria, Thailand and Kuwait

Export figures for triticale are not readily available.

The significant export markets for Australian beef, sheep, pig meat and offals are listed in the APVMA Regulatory Guidelines—Data Guidelines: Agricultural—Overseas trade (Part 5B).

5.3 Proposed Australian use-pattern

The proposed use pattern is as a foliar spray to post-emergent wheat (excluding durum varieties) and triticale, at the 3 leaf up to 1st node stage, to control various grass and broadleaf weeds. Refer to the draft label for details.

5.4 Overseas registration and approved label instructions

An equivalent product is registered in Canada as Simplicity Go DRI Herbicide and the US as TeamMate for control of grass and broadleaf weeds in spring wheat, durum wheat and winter wheat.

[2] Agricultural Commodity Statistics 2016, Department of Agriculture and Water Resources, December 2016; http://data.daff.gov.au/data/warehouse/agcstd9abcc002/agcstd9abcc0022016_Sn9Dg/ACS_2016_v1.0.0.pdf

5.5 Comparison of Australian MRLs with Codex and International MRLs

The Codex Alimentarius Commission (Codex) is responsible for establishing Codex Maximum Residue Limits (CXLs) for pesticides. Codex CXLs are primarily intended to facilitate international trade, and accommodate differences in Good Agricultural Practice (GAP) employed by various countries. Some countries may accept Codex CXLs when importing foods. Cloquintocet acid, cloquintocet-mexyl and pyroxsulam have not been considered by Codex.

Cloquintocet acid is covered by the residue definition of cloquintocet-mexyl. No changes to the established MRLs for cloquintocet-mexyl are proposed in connection with this application.

Current Australian and overseas MRLs/tolerances for cloquintocet-mexyl

COMMODITY	MRLS FOR CLOQUINTOCET-MEXYL (mg/kg)			
	AUSTRALIA	CANADA[3]	JAPAN[4]	USA[5]
Residue Definition	Sum of cloquintocet-mexyl and 5-chloro-8-quinolinoxyacetic acid, expressed as cloquintocet mexyl	1-methylhexyl[(5-chloro-8-quinolinyl)oxy]acetate, including the metabolite [(5-chloro-8-quinolinyl)oxy]acetic acid		Combined residues of cloquintocet-mexyl, (acetic acid [(5-chloro-8-quinolinyl)oxy]-, 1-methylhexyl ester) and its acid metabolite (5-chloro-8-quinolinoxyacetic acid), expressed as cloquintocet-mexyl
Barley	*0.1	0.01	0.1	0.1
Rye	*0.1			
Triticale	*0.1			
Wheat	*0.1	0.01	0.1	0.1
Edible offal (Mammalian)	*0.1		0.1 (cattle, pig and other terrestrial mammals)	
Eggs	*0.1		0.1 (chicken and other poultry)	

[3] http://www.hc-sc.gc.ca/cps-spc/pest/part/protect-proteger/food-nourriture/mrl-lmr-eng.php

[4] http://www.m5.ws001.squarestart.ne.jp/foundation/search.html

[5] http://www.ecfr.gov

COMMODITY	MRLS FOR CLOQUINTOCET-MEXYL (mg/kg)			
	AUSTRALIA	CANADA3	JAPAN4	USA5
Meat [mammalian]	*0.1		0.1 (cattle, pig and other terrestrial mammals, muscle)	
Milks	*0.1		0.1	
Poultry, Edible offal of	*0.1		0.1 (chicken and other poultry)	
Poultry meat	*0.1		0.1 (chicken and other poultry, muscle)	

5.6 Potential risk to trade

Export of treated produce containing finite (measurable) residues of cloquintocet-mexyl and pyroxsulam may pose a risk to Australian trade in situations where (i) no residue tolerance (import tolerance) is established in the importing country or (ii) where residues in Australian produce are likely to exceed a residue tolerance (import tolerance) established in the importing country.

No changes are proposed to the MRLs for cloquintocet-mexyl and pyroxsulam. The MRLs for cloquintocet-mexyl in triticale, wheat and animal commodities are set at the LOQ.

Residues of cloquintocet-mexyl and pyroxsulam, in wheat, triticale and edible animal commodities, resulting from the proposed use are not expected to exceed the levels resulting from registered use patterns for these actives in cereal crops. The overall risk to export trade in cereals and edible animal commodities is considered to be low.

6 WORK HEALTH AND SAFETY ASSESSMENT

6.1 Formulation, packaging, transport, storage and retailing

The active constituent cloquintocet acid and the formulated product Crusader GoDRI Herbicide will be manufactured overseas. Crusader GoDRI Herbicide will be available in 1.4 and 2.8 kg HDPE containers.

6.2 Use pattern

The draft label indicates that the product is intended to be diluted in water and applied using conventional boom sprayer, at a maximum use rate of 70 g/ha for grass weed control or suppression and broadleaf weed control. Application work rates of up to 240 ha/day are expected.

6.3 Exposure during use

The product, Crusader GoDRI Herbicide, will be used in commercial situations, by farmers, their employees, and contract sprayers. Workers may be exposed to the product when opening containers, using the product, cleaning up spills, maintaining equipment and entering treated areas. The main routes of exposure to the product/spray will be dermal and inhalation, although ocular exposure is also possible.

An exposure assessment was conducted, and in conjunction with the hazard profile, used to determine whether the proposed use of the product would be an undue health hazard to humans. In the absence of exposure data for the proposed mode of application, the US Environmental Protection Agency (US EPA) Pesticide Handler Exposure Database (PHED) Surrogate Exposure Guide (1998) was used to estimate exposure.

The toxic endpoint of concern and identified NOEL (NOAEL) for risk assessment was derived from a repeat dose study in animals, and in this instance a margin of exposure (MOE) of 100 or above was considered acceptable. The MOE takes into account both potential inter-species extrapolation and intra-species variability. Based on the risk assessment, the proposed use of the product for grass weed control or suppression and broadleaf weed control was considered acceptable when used with appropriate PPE (cotton overalls and chemical resistant gloves).

Application of Crusader GoDRI Herbicide by groundboom may lead to unintended bystander exposure via chemical spray drift. This may be in the form of a single random exposure or repeat exposures of residents who reside adjacent to areas being treated with the product. Adherence to good agricultural practices will minimise the potential risks associated with chemical spray drift.

As the general public are unlikely to be exposed to the product under normal conditions of use, the risk to the public was considered negligible.

6.4 Exposure during re-entry

Risks associated with re-entering treated areas are expected to be limited to exposure via the dermal route. The MOEs determined for re-entry activities associated with use of Crusader GoDRI Herbicide were considered acceptable on day zero after application once the spray had dried.

6.5 Recommendations for safe use

Based on the human health risk assessment, Crusader GoDRI Herbicide is supported for professional use, and users should follow the First Aid Instructions and Safety Directions on the product label. No warning statements or general safety precautions are indicated.

6.6 Conclusion

The registration of Crusader GoDRI Herbicide, containing cloquintocet acid (451.5 g/kg) and pyroxsulam (215 g/kg) in a water-dispersible granule formulation for grass weed control or suppression and broadleaf weed control, is supported.

Crusader GoDRI Herbicide can be used safely if handled in accordance with the instructions on the product label.

7 ENVIRONMENTAL ASSESSMENT

7.1 Introduction

It is proposed to register Crusader GoDRI Herbicide for the control of grass and broadleaf weeds in triticale and wheat (excluding durum varieties). The product incorporates a new crop safener, cloquintocet acid.

7.2 Environmental fate and behaviour

Hydrolysis

At 50°C, cloquintocet acid was hydrolytically stable at pH 4, 7 and 9 after incubation for 5 days with >95% of applied radioactivity recovered as unchanged acid. There were minor degradation products detected at each pH (maximum 4%).

Fate and behaviour in soil

A kinetics degradation study was provided where degradation kinetics of cloquintocet acid as the main metabolite of cloquintocet-mexyl were modelled. The APVMA calculated cloquintocet acid degradation rates from the time of peak formation of this metabolite in the three different soils. Kinetics were determined based on either Double First Order in Parallel (DFOP) or Single-Phase First Order (SFO) modelling with overall DT50 values ranging from 1.3 days to 103 days. The overall DT90 values ranged from 59.1 days to 329 days.

Fate and behaviour in water

A kinetics degradation study was included considering degradation of cloquintocet acid as the major metabolite in two water/sediment systems following application of cloquintocet-mexyl. Whole system DT50s for cloquintocet acid ranged from 29.8 days to 86.7 days.

Mobility

The adsorption and desorption characteristics of cloquintocet acid were determined in seven soils using a standard batch equilibrium method, in the dark at 20°C. Sorption was dependent on concentration, with it decreasing as the concentration increases. For six soils where organic carbon was <5%, Kf (adsorption) values ranged from 18.4 L/kg to 52.5 L/kg and Kf (desorption) values ranged from 29.6 L/kg to 74.5 L/kg. The Kf is expected to underestimate sorption in the field as the application rate of cloquintocet acid is relatively low. The APVMA determined a regression Kd for all soils with organic carbon <5% based on a soil concentration of 1 mg/kg and Kd values ranged from 44.5 L/kg to 132 L/kg. There was no correlation between organic carbon and Kd, suggesting that adsorption to soil is via mechanisms other than binding to organic carbon. Cloquintocet acid is expected to have low mobility in soil.

Bioaccumulation

Cloquintocet acid has a modelled LogKow = 2.12 L/kg and is not expected to bioconcentrate.

7.3 Environmental effects

A suite of environmental toxicity data were provided for the assessment of cloquintocet acid to environmental organisms.

Table 1: Toxicity of active constituent cloquintocet acid and the product Crusader GoDRI Herbicide for various organisms

ORGANISM		MEASURE OF TOXICITY OR EFFECT	PARAMETER (TEST PERIOD)	TOXICITY (UNIT)
Terrestrial species				
Bird	Bobwhite quail	Acute toxicity (oral)	LD_{50}	>2250 mg ac/kg bw
Honeybee (*Apis mellifera*)		Acute oral toxicity Acute contact toxicity	LD_{50}	>105.6 µg/bee >200 µg/bee
Non-target arthropods		No data		
Earthworms		No data		
Terrestrial Plants – most sensitive results		Seedling emergence, ryegrass	21 d ER50	27.1 g product/ha
		Vegetative vigour, carrot	21 d ER50	1.5 g product/ha
Aquatic species				
Fish	Bluegill sunfish	Acute toxicity	LD_{50} (96 h)	82.6 mg ac/L
	Fathead minnow	Early life stage toxicity	NOEC (28 d)	0.284 mg ac/L
Aquatic invertebrate	*Daphnia magna*	Acute toxicity	EC_{50} (48 h)	>9.7 mg ac/L
	Daphnia magna	Reproduction	NOEC (21 d)	>100 mg ac/L
	Mysid shrimp	Acute toxicity	LC_{50} (96 h)	>120 mg/L
	Eastern oyster	Acute toxicity	EC_{50} (96 h)	>101 mg/L
Aquatic plants	*Lemna gibba*	Growth inhibition	EC_{50} (14 d)	>11 mg ac/L
Algae	*Pseudokirchneriella subcapitata* *Navicula pelliculosa* *Anabaena flos-aquae*	Growth inhibition	E_rC_{50} (72 h) (96 h) (72 h)	66.5 mg/L >9.04 mg/L 23.7 mg/L

ORGANISM		MEASURE OF TOXICITY OR EFFECT	PARAMETER (TEST PERIOD)	TOXICITY (UNIT)
	Skeletonema costatum (marine species)		(96 h)	12.5 mg/L

7.4 Risk assessment

The APVMA has previously assessed the product Crusader Herbicide (APVMA No. 61277) which contains pyroxsulam and the crop safener cloquintocet-mexyl. In the proposed product, Crusader GoDRI Herbicide, cloquintocet acid replaces cloquintocet-mexyl as the crop safener and there is no change in the concentration of pyroxsulam, application rates, use patterns and potential tank mixes. It was demonstrated that toxicity of the end use product to algae and aquatic plants (the most sensitive aquatic organisms to pyroxsulam) was a function of the pyroxsulam component of the formulation, which was also the driver for the aquatic risk assessment for the existing APVMA registration 61277, containing the same active and the crop safener cloquintocet-mexyl that is approved for equivalent uses. A regulatory acceptable level (RAL) of 1.5 µg product/L was determined based on the product toxicity to aquatic plants (Lemna). The change from the soluble liquid (SL) formulation to the WG formulation is not expected to result in any enhanced ecotoxicity. The risk to the aquatic environment could be managed with appropriate downwind no-spray zones.

Cloquintocet acid is practically non-toxic to birds and bees and it is at most moderately toxic to aquatic organisms. A comparison of ecotoxicity between cloquintocet-mexyl and cloquintocet acid demonstrated little difference, where data were available. As cloquintocet acid is the degradation product of cloquintocet-mexyl, the risk of cloquintocet acid has already been partially, intrinsically determined from the assessment of cloquintocet-mexyl. The risk to birds, bees and macroscopic aquatic species is acceptable, based on their lack of sensitivity to cloquintocet acid. Other non-target arthropods were found to have an acceptable risk based on being exposed to cloquintocet acid as a degradation product of cloquintocet-mexyl and the acceptable risk of cloquintocet-mexyl in the existing APVMA registration 61277, containing the same active and the crop safener cloquintocet-mexyl that is approved for equivalent uses. As cloquintocet acid is no more toxic than cloquintocet-mexyl its inclusion in mandatory tank mixes is unlikely to result in any higher toxicity, than the existing APVMA registration 61277,containing the same active and the crop safener cloquintocet-mexyl that is approved for equivalent uses. It was therefore concluded that the mandatory tank mixes as supported by the registration of the existing APVMA registration 61277, containing the same active and the crop safener cloquintocet-mexyl that is approved for equivalent uses required no further assessment as combination toxicity assessments would not result in any higher toxicity.

A screening level runoff assessment of cloquintocet acid demonstrated an acceptable risk.

The end use product, Crusader GoDRI Herbicide, is toxic to terrestrial plants and a regulatory acceptable level of 1.5 g product/ha was determined applying a deterministic method. The risk to non-target terrestrial plants could be managed with appropriate downwind no-spray zones.

7.5 Conclusions

The risk of cloquintocet acid present as a crop safener at 451.5 g/L in the product Crusader GoDRI Herbicide was found to be acceptable provided label restraints for spray-drift for the protection of the aquatic environment and non-target plants are mandated. For ground application downwind no-spray zones of 5 m and 40 m are required, respectively.

8 EFFICACY AND SAFETY ASSESSMENT

8.1 Proposed product use pattern

The proposed product is for use as a foliar spray to post-emergent wheat (excluding durum varieties) and triticale, at the 3 leaf up to 1st node stage, to control various grass and broadleaf weeds. The product is to be applied by ground boom, only once per annum at a concentration of 70 g product per hectare which equates to 15 g pyroxsulam/ha and 31.6g cloquintocet acid/ha.

8.2 Assessment of study/trial data

Eight efficacy trials were undertaken across three states to assess efficacy in wheat and nine field trials were undertaken across four states to assess crop safety in wheat and a further six field trials were undertaken in three states to assess efficacy and crop safety and compatibility with tank mix herbicides. Trials were conducted in the main cereal growing regions of Western Australia, South Australia, Victoria and New South Wales during the 2014 and 2015 seasons. All of the trials were conducted under field conditions. In this respect, the soil types, seasonal and treatment application conditions reflected commercial conditions.

Efficacy

Eight replicated field trials were undertaken in three States to assess the efficacy of Crusader GroDRI Herbicide for the control of grass weeds in wheat crops. The grass weeds included oats (wild oats or oats, 6 trials), brome grass (5) and annual ryegrass (2). Weed control was assessed from 28 DAA (days after application) until final weed control was reached at 56–70 DAA. On each occasion, the plots were assessed in terms of weed brownout (0–100 scale where 0 = no control and 100 = complete weed death). Crusader GoDRI was compared to the registered product Crusader Herbicide (61277).

The efficacy trials demonstrated that Crusader GroDRI Herbicide was equivalent to Crusader Herbicide for control of a range of grass and broadleaf weeds.

Crop safety

Nine replicated field trials were undertaken in four States to determine the safety/tolerance of wheat crops to Crusader GoDRI Herbicide.

Crusader GoDRI Herbicide was applied at the proposed label rate of 1x at 70 g/ha and 2x label rate at 140 g/ha and compared to the registered product Crusader Herbicide (61277) also applied at 1x and 2x label rate.

Some trials also applied Crusader GoDRI Herbicide alone and in combination with MCPA.

Crop injury was assessed from 7–30 DAA and compared with untreated plots. On each occasion, the plots were assessed in terms of crop injury (0–100 scale where 0 = no control and 100 = complete crop death).

It was observed that pyroxsulam herbicides (both Crusader Herbicide and the proposed product) generally caused moderate temporary symptoms of crop injury (up to 35% on the scale applied). However there was no significant difference in the crop injury resulting from the application of the registered Crusader Herbicide, and the proposed product and no significant difference between application at 1x and 2x the label rate. Crop yield was similar for both pyroxsulam herbicides and as such the conclusion can be drawn that the crop safener cloquintocet acid is equivalent in action to cloquintocet-mexyl.

Tank mixes

Six replicated field trials were undertaken in three States to assess the efficacy and crop safety of Crusader GoDRI Herbicide when applied with tank mix partners targeting broadleaf weeds and for the control of grass weeds in wheat crops. The weeds included wild oats/crop oats (5 trials), brome grass (4 trials) and canola (1 trial). The trials demonstrated Crusader GroDRI Herbicide was effective when mixed with all proposed tank-mix partners and that crop safety was equivalent to that observed when the product was used alone.

Resistance management

The active constituent pyroxsulam is a sulfonamide herbicide (group B) that provides broad spectrum post-emergent annual grass and broadleaf weeds control in cereals. Cloquintocet acid is a crop safener, which accelerates the detoxification of herbicides in cereals and is not subject to a resistance management strategy. Crusader GoDRI Herbicide is designated as a group B herbicide for resistance management purposes.

8.3 Conclusions

The crop safener, cloquintocet acid, is equivalent to the crop safener cloquintocet-mexyl.

The proposed product, Crusader GoDRI Herbicide, acts as a selective herbicide and can be used in specific crop situations without causing undue damage to the crop while providing acceptable control and suppression of a range of annual grass and broadleaf weeds.

9 LABELLING REQUIREMENTS

POISON

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

Dow AgroSciences

Crusader™ GoDRI

Herbicide

ACTIVE CONSTITUENT: **215 g/kg PYROXSULAM**
CROP SAFENER: **451.5 g/kg CLOQUINTOCET**

GROUP B HERBICIDE

A water dispersible granule formulation for post-emergent control of grass and broadleaf weeds in triticale and wheat, excluding durum varieties, as specified in the Directions for Use.

IMPORTANT: **READ THE ATTACHED BOOKLET BEFORE USE.**

Dow AgroSciences Australia Limited ABN 24 003 771 659
20 Rodborough Road FRENCHS FOREST NSW 2086
www.dowagrosciences.com.au
CUSTOMER SERVICE TOLL FREE: **1-800 700 096**

Contents: 1.4kg, 2.8kg

DIRECTIONS FOR USE:

RESTRAINTS

DO NOT apply to crops or weeds which may be stressed due to prolonged periods of extreme cold, moisture stress (water-logging or drought) or previous herbicide treatment, as crop damage or reduced levels of control may result (see crop safety warning below).
DO NOT spray if rain is likely to occur within 6 hours.
DO NOT apply later than the 1st node (Z31) stage of the crops.
DO NOT apply by air.
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.
DO NOT apply to durum varieties of wheat.
DO NOT double overlap or double spray crop.
DO NOT apply to paddocks where there is a high risk of weeds resistant to Group B herbicides.

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 produce MUST make an accurate written record of the details of each spray application within 24 hours following application, and must KEEP this record for at least 2 years.
The spray application details that must be recorded are:
1. date with start and finish times of application 2. location and 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 or situation and weed or 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 records details may be required by the state or territory where this product is used.)

DOWNWIND MANDATORY NO-SPRAY ZONES

DO NOT apply if there are aquatic or wetland areas including aquacultural ponds, surface streams and rivers downwind from the application area and within the mandatory no-spray zones shown in the table below:

Table 1: No-Spray Zones for Protection of the Aquatic Environment	
FOR GROUND APPLICATION	
From 3 to 20 kilometres per hour	**5 metres**

DO NOT apply if there are sensitive crops, gardens, landscaping vegetation, protected native vegetation or protected animal habitat downwind from the application area and within the mandatory no-spray zones shown in the table below:

Table 1: No-Spray Zones for Protection of the Terrestrial Environment	
FOR GROUND APPLICATION	
From 3 to 20 kilometres per hour	**40 metres**

Table 1. Grass weed control or suppression

For application to wheat and triticale (excluding durum varieties) only from 3 leaf up to 1st node of the crop.			
WEEDS	**WEED STAGE**	**RATE g/ha**	**CRITICAL COMMENTS**
Control Brome grass (*Bromus diandrus*), Phalaris spp., Wild oats (*Avena* spp.) **Suppression** Annual ryegrass (*Lolium rigidum*) Barley grass (*Hordeum leporinum*) Silver grass (*Vulpia spp.*)	1–3 leaf (pre-tillering)	**70**	**Always use BS1000 or Chemwet 1000 at 250 mL/100 L.** **Weed suppression**: Weeds may only be suppressed where densities of > 150 plants/m^2 are treated and may survive treatment, but will usually show reduced growth and seed set. Always use together with other methods of control to stop weed seed set.

Table 2. Broadleaf weed control

For application to wheat and triticale (excluding durum varieties) only from 3 leaf up to 1st node of the crop.			
WEED	**WEED STAGE AND SIZE**	**RATE g/ha**	**CRITICAL COMMENTS**
Bedstraw (*Galium tricornutum*)	**Cotyledon—6 whorl Up to 10cm**	**70**	**Always use BS 1000 or Chemwet 1000 at 250 mL/100 L.** **High weed density:** For high densities (> 50/m^2), use tank-mixes and highest rate of partner herbicide where a range is stated. **Crop stage for tankmixes:** treat crop at the labelled growth stage for the partner herbicide. **MCPA tankmixes:** LVE 600 MCPA at 400 mL/ha must be applied from 5 leaf stage onwards in NNSW and Qld.
Volunteer Canola (*Brassica napus*)	**Cotyledon—4 leaf Up to 10 cm**		
Capeweed (*Arctotheca calendula*)	**Cotyledon—6 leaf Up to 12 cm**	**70** + 40-60 g of Lontrel 750 SG + 300mL LVE 600 MCPA **or** + 500 mL Bromoxynil/MCPA (200 + 200 g/L) **or** + 500 mL Bromoxynil / MCPA + 40 g Lontrel 750 SG	
Chickpea (*Cicer arietinum*)	**Cotyledon—6 leaf Up to 15 cm**	**70**	
Climbing buckwheat (Black bindweed) (*Fallopia convolvulus*)	**Cotyledon—4 leaf Up to 10 cm**	**70** + 375-500 mL Hotshot Herbicide	
Deadnettle (*Lamium amplexicaule*)	**Cotyledon – 4 leaf Up to 5cm**	**70**	
Doublegee or spiny emex (*Emex australis*)	**Cotyledon—4 leaf Up to 10 cm**	**70** + 5g Metsulfuron (600g/kg)	
Faba bean (*Vicia faba*)	**Cotyledon—4 leaf Up to 10 cm**	**70**	

Field pea (*Pisum sativum*)	**Cotyledon—6 node Up to 12 cm**		
Indian hedge mustard (*Sisymbrium orientale*)	**Cotyledon—6 leaf Up to 10 cm**	**70** + 300 – 400 mL LVE 600 MCPA	
Lentil (*Lens esculentum*)	**Cotyledon—6 leaf Up to 8 cm**	**70**	
Lupins—suppression (*Lupinus albus*) Medic spp.	**Cotyledon—4 leaf Up to 6 cm Cotyledon—4 leaf Up to 8 cm**	**70**	
Medic spp.	**Cotyledon—4 leaf Up to 8 cm**		
Prickly lettuce (*Lactuca serriola*)	**Cotyledon—6 leaf Up to 10 cm**	**70** + 400 mL LVE 600 MCPA	
Small flowered mallow—suppression (*Malva parviflora*)	**Cotyledon—4 leaf Up to 10 cm**	**70** + 400 mL LVE 600 MCPA **or** + 300 mL LVE 600 MCPA + 5 g Metsulfuron (600g/kg)	**Mallow suppression—** ensure excellent crop competition for best suppression.
Sowthistle (*Sonchus oleraceus*)	**Cotyledon—4 leaf Up to 10 cm**	**70** + 500 mL Hotshot + 400 mL LVE 600 MCPA	
Subclover (*Trifolium subterraneum*)	**Cotyledon—4 leaf Up to 5 cm**	**70**	
Turnip weed (*Rapistrum rugosum*)	**Cotyledon—4 leaf Up to 10 cm**		
Vetch - suppression (*Vicia sativa*)	**Cotyledon—4 leaf Up to 10 cm**		
Wild radish (*Raphanus raphanistrum*)	**Cotyledon— 4 leaf Up to 15 cm**	**70** + 300–400 mL LVE 600 MCPA	
Wireweed (*Polygonum aviculare*)	**Cotyledon—4 leaf Up to 8 cm**	**70**	

NB – only volunteer triazine tolerant and conventional canola will be controlled.

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

WITHHOLDING PERIODS

When using Crusader GoDRI in a tank mix with another product, observe whichever Harvest or Grazing/Stockfood Withholding Period that is the longer.

Harvest: **NOT REQUIRED WHEN USED AS DIRECTED**.

Grazing/Stockfood: **DO NOT GRAZE OR CUT TREATED CROPS FOR STOCK FEED FOR 4 WEEKS AFTER APPLICATION.**

Rinse water should be discharged onto a designated disposal area or, if this is unavailable, onto unused land away from desirable plants and their roots and watercourses.

GENERAL INSTRUCTIONS

Crusader GoDRI is a selective triazolopyrimidine sulfonanilide herbicide. It is a foliar herbicide for post-emergence use in wheat. It will not reliably control weeds that emerge after treatment. Best results are achieved under good growing conditions. Treatment of crop or weeds that are stressed must be avoided.

Adjuvant: Always use BS1000 or Chemwet 1000 at 250 mL/100 L spray volume.

Crop Safety

Yield is normally unaffected by treatment with Crusader GoDRI Herbicide or tank mixes. However, transient stem shortening and crop yellowing may occur. Symptoms may be worse where the crop is stressed, heavy rain/irrigation follows application, crops are grown in alkaline soil conditions, crop has poor root growth, double overlap of spray has occurred or a combination of any or all the above. Where crop stress occurs, a longer period may be required for recovery, especially if the crop is stressed by root or foliar disease, poor nutrition, water logging, drought or cold stress. In severe cases and seasons where a hot, dry spring occurs, flowering may be delayed and yield may be reduced. Crusader GoDRI Herbicide has been tested over major commercially grown crop varieties, but not all of those that may be grown. For information on crop variety selectivity consult your local reseller or Dow AgroSciences.
Note: Application of another Group B herbicide to the same crop before or after Crusader GoDRI's use may result in more injury than described above. Consult Dow AgroSciences for advice.

Crop Rotation Recommendations

Safe recropping periods apply for all crops following Crusader GoDRI application. Planting crops 'dry' without the minimum rainfall (as stated in the table below) increases the risk of injury to susceptible crops. Susceptible crops include, but are not limited to, those listed in the table below.

Plant-back Periods

Crop to be sown	Application rate (g product/ha)	Minimum time from application to planting	Minimum rainfall requirement from application to planting
Barley, oats, wheat, canola, chickpeas, faba beans, field peas, lupins, lucerne, medics, ryegrass, subclover, vetches, white clover. Note: For all other crops, consult your reseller or local Dow AgroSciences' representative.	70	9 months	25 mm rain or more
Nth NSW and QLD (Summer dominant rainfall areas) Vertosol soils	70	6 months	50 mm or more rain or irrigation
For all situations, sufficient rainfall to enable soil wetting for at least one week is essential to enable residue breakdown before planting following crops other than wheat.			

*on shallow, duplex or low organic matter soils and/or where rain or irrigation in one fall or over subsequent days is insufficient to thoroughly wet soil to 10 cm for one week or more in the summer to autumn period, extended plant-back times will apply and susceptible crops should not be planted for at least 12 months after application of Crusader GoDRI Herbicide. Contact Dow AgroSciences, your farm chemical supplier, consultant or local Department of Agriculture for advice.

Resistant Weeds Warning

GROUP	B	HERBICIDE

Crusader GoDRI Herbicide contains a member of the triazolopyrimidine sulfonanilide group of herbicides. The product has the acetolactate synthase (ALS) inhibitor mode of action. For weed resistance management, the product is a Group B herbicide. Some naturally occurring weed biotypes resistant to the product and other Group B 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 this product or other Group B herbicides. Since the occurrence of resistant weeds is difficult to detect prior to use, Dow AgroSciences accepts no liability for any losses that may result from the failure of the product to control resistant weeds.

Do not rely solely on Crusader GoDRI or other Group B herbicides for weed control. Always use an Integrated Weed Management program with herbicides that have other modes-of-action, together with non-chemical methods of control. CropLife Australia resistance management strategies are available from local agricultural chemical suppliers or at www.croplifeaustralia.org.au. Use these strategies to limit the build up of resistant weeds on your farm.

Application

Apply in 80–100L/ha water by ground boom.

APVMA compliance instructions for mandatory COARSE or larger droplet size categories

Important information

These instructions inform those using 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 of these documents, to identify droplet size categories; however, for a nozzle to comply with this requirement, the manufacturer must refer to at least one.

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.

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 in ASAE S572 or BCPC. Choose a nozzle that is 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

Mixing

Measure the required amount of Crusader GoDRI granules by weighing on scales or using measuring device. Crusader GoDRI Herbicide should be added to the spray tank with simultaneous agitation to ensure adequate granule dispersion. If agitation is limited, premix the Crusader GoDRI Herbicide in a bucket or hopper before adding to the main tank. Once diluted correctly, Crusader GoDRI Herbicide remains in suspension. Ensure that agitation in the spray tank is maintained at all times during mixing and application.

Tankmixing
If Crusader GoDRI is to be mixed with other products, use the following order making sure that each addition is fully mixed before adding the next one:

1. **Quarter** fill the spray tank, maintaining agitation,
2. Add Crusader GoDRI granules and ensure granule if fully dispersed, (as described above),
3. Add water to half fill the spray tank,
4. Add wettable powders, water dispersible granules or suspension concentrates,
5. Add emulsifiable concentrates,
6. Add non ionic surfactants or other adjuvants when spray tank is half-full,
7. Add water to bring to the final spray volume.

Crusader GoDRI Herbicide should be mixed and sprayed out within 8 hours.

Cleaning Spray Equipment
After using Crusader GoDRI Herbicide, empty the tank completely and drain the whole system. Thoroughly wash inside the tank using a pressure hose, drain the tank and clean tank, pump, line and nozzle filters.

***Partial Cleaning*—Rinse only—**before using sprayer to treat triticale or wheat:

After cleaning the tank as above, quarter fill the tank with clean water and circulate through the pump, line, hoses and nozzles. Drain and repeat procedure twice.

Complete Cleaning - **Decontamination** - before using sprayer to treat crops that are susceptible to Crusader GoDRI Herbicide:

After cleaning the tank as above, quarter fill the tank with clean water and add a liquid alkali detergent at 500 mL/100 L water and circulate throughout the system for at least fifteen minutes. Drain the whole system. Then remove filters and nozzles and clean separately. Finally rinse inside the tank thoroughly using a pressure hose and flush system with clean water and allow to drain. Note: Chlorine-based cleaners are NOT recommended. These tank cleaning recommendations are for Crusader GoDRI only. Please consult tankmix partner labels to determine requirement for decontamination for other products.

Compatibility

Crusader GoDRI Herbicide is compatible with the following:
Broadleaf herbicides: metsulfuron (*eg.* Ally® Herbicide), bromoxynil, bromoxynil-MCPA, Paradigm™ Herbicide, Lontrel™ Advanced Herbicide , Lontrel 750 SG Herbicide, Dow AgroSciences LVE 600 MCPA, MCPA LVE, Starane™ Advanced Herbicide , Jaguar Herbicide, Tigrex herbicide, Precept herbicide
Adjuvants: Always use either BS1000, Chemwet 1000 at 250 mL/100L spray volume or Uptake Spray oil at 500 mL/100L spray volume for best performance of Crusader GoDRI Herbicide.
If mixing with other herbicides refer to label for appropriate adjuvant. Not all adjuvants are of equal quality. Consult Dow AgroSciences before selecting any other alternatives.

PRECAUTION

Re-entry Period: DO NOT re-enter treated areas until spray has dried, unless wearing cotton overalls buttoned to the neck and wrists and gauntlet length chemical resistant gloves.

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 native and other non-target plants or susceptible plants/crops, cropping lands or pastures.

PROTECTION OF WILDLIFE, FISH, CRUSTACEANS AND ENVIRONMENT

Crusader GoDRI is highly toxic to aquatic life. **DO NOT** contaminate streams, rivers or waterways with chemical or used containers.
DO NOT apply under meteorological conditions or from spraying equipment that could be expected to cause spray to drift onto wetlands, natural surface waters, neighbouring properties or other sensitive areas. For ground application, a buffer zone of 5 metres is required between the downwind edge of the boom and the closest edge of waterbodies.

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STORAGE AND DISPOSAL

- Store in the tightly closed original container in a securely locked place, out of direct sunlight.
- DO NOT store near food, feedstuffs, fertilisers or seed.

This container can be recycled if it is clean, dry, free of visible residues and has the ***drum****MUSTER* logo visible. Triple or pressure rinse container for disposal. Dispose of rinsate by adding to the spray tank. Do not dispose of undiluted chemicals on site. Wash outside of the container and the cap. Store cleaned container in a sheltered place with cap removed. It will then be acceptable for recycling at any ***drum****MUSTER* collection or similar container management site. The cap should not be replaced but may be taken separately. 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 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.

SMALL SPILL MANAGEMENT

Sweep up material and contain in a refuse vessel for disposal in the same manner as for containers (see STORAGE AND DISPOSAL section).

SAFETY DIRECTIONS

- May irritate the eyes.
- Avoid contact with the eyes.
- If product in eyes, wash out immediately with water.
- Avoid inhaling dust.
- When opening the container and preparing spray, wear cotton overalls buttoned to the neck and wrist, and elbow-length chemical resistant gloves.
- Wash hands after use.
- After each day's use wash gloves and contaminated clothing.

FIRST AID

If poisoning occurs contact a doctor or Poisons Information Centre. Phone *Australia* 131126.

MATERIAL SAFETY DATA SHEET

Additional information is listed in the Material Safety Data Sheet for **CRUSADER GoDRI HERBICIDE** which is available from Dow AgroSciences on request. Call Customer Service Toll Free on 1-800 700 096 or visit www.dowagrosciences.com.au .

EMERGENCY RESPONSE
(All Hours)
RING FROM ANYWHERE IN AUSTRALIA
1-800 033 882
(LOCAL CALL FEE ONLY)

IN A TRANSPORT EMERGENCY ONLY
DIAL 000
FOR POLICE OR FIRE BRIGADE

Barcode for stock identification

APVMA Approval No. 61277/XXXXX

ABBREVIATIONS

ac	active constituent
ACCS	Advisory Committee on Chemicals Scheduling
ADI	Acceptable Daily Intake (for humans)
ai	active ingredient
ARfD	Acute Reference Dose
bw	bodyweight
^{o}C	Degrees Celsius
Codex	Codex Alimentarius Commission
Codex CXLs	Codex Maximum Residue Limits
COEX	Co-extruded (packaging material)
COEX E-VAL	COEX material using EVOH Ethylene vinyl alcohol) resin under trade name EVAL
COEX PA	COEX material using polyamide
DAA	Days after Application
DofE	Department of Environment
EC	Emulsifiable Concentrate
EC	European Commission
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
EI	Export Interval
EGI	Export Grazing Interval
Eq	equivalent
ESI	Export Slaughter Interval
EUP	End Use Product
Fo	original parent generation
F_1	first generation offspring

FRAC	Fungicide Resistance Action Committee
FSANZ	Food Standards Australia and New Zealand
g	gram
GAP	Good Agricultural Practice
GCP	Good Clinical Practice
GJR	Global Joint Review
GLP	Good Laboratory Practice
GPMT	Guinea Pig Maximisation Test
GVP	Good Veterinary Practice
h	hour
ha	hectare
Hb	haemoglobin
Hct	Heamatocrit
HDPE	High Density Polyethylene
HEEG	Human Exposure Expert Group
Hg	Haemoglobin
Hg	Mercury
HPLC	High Pressure Liquid Chromatography *or* High Performance Liquid Chromatography
HR	Highest Residue
HSIS	Hazardous Substances Information System
id	intradermal
Idf	food ingestion rate (dry weight) in grams per day
ID_{50}	dose that infects50% of the target population of organisms
im	intramuscular
ip	intraperitoneal
IPM	Integrated Pest Management
IRM	Integrated Resistance 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
JMPR	Joint Meetings on Pesticide Residues
kg	kilogram
K_{oc}	Organic carbon partitioning coefficient
K_{ow}	Octanol-water partition coefficient
Kd	Absorption
Kf	Desorption
Kt	kilotonne
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
LOAEL	Lowest Observable Adverse Effect Level
LOD	Limit of Detection – level at which residues can be detected
LOEL	Lowest Observable Effect Level
LOQ	Limit of Quantitation – level at which residues can be quantified
mg	milligram
mL	millilitre
mN	milliNewton
MoA	Mode of Action
MOE	Margin of Exposure
mPa	milliPascal
MRL	Maximum Residue Limit
ND	Not Detectable
NDPSC	National Drugs and Poisons Schedule Committee
NEDI	National Estimated Daily Intake

NESTI	National Estimated Short Term Intake
ng	nanogram
NHMRC	National Health and Medical Research Council
Nm	nanonmetre
NOEC	No Observable Effect Concentration
NOEL/NOAEL	No Observable Effect Level/No Observable Adverse Effect Level
NOER	No Observable Effect Rate
OC	Organic Carbon
OD	Oil Dispersion (oil-based suspension concentrate)
OECD	Organisation of Economic Cooperation and Development
OGTR	Office of the Gene Technology Regulator
OM	Organic Matter
Pa	Pascals
PCV	Pack Cell Volume
PE	PolyEthylene
PEC	Predicted Environmental Concentration
PE/EVOH	Polyethylene with ethylene vinyl alcohol
PET	Polyethylene terephthalate
PHI	Post-Harvest Interval
pKa	Dissociation constant (acid)
PMRA	Pest Management regulatory Agency (Canada)
PNEC	Predicted No Effect Concentration
po	oral
PP	PolyPropylene
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million

Q-value	Quotient-value
RBC	Red Blood Cell Count
RCP	Restricted Chemical Product
RNA	Ribonucleic acid
s	second
sc	subcutaneous
SC	Suspension Concentrate
SCBA	Self-Contained Breathing Apparatus
SDS	Safety Data Sheet
SE	SuspoEmulsion
SL	Soluble liquid
STMR	Supervised Trials Median Residue
STMR-P	STMR corrected for processing
SUSDP	Standard for the Uniform Scheduling of Drugs and Poisons
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TGA	Therapeutic Goods Administration
TGAC	Technical grade active constituent
T_{max}	Time to achieve maximum concentration
T-Value	A value used to determine the First Aid Instructions for chemical products that contain two or more poisons
$T_{1/2}$	Elimination half-life
µg	microgram
US EPA	United States Environmental Protection Agency
UV	Ultra Violet light
vmd	volume median diameter
WBC	White Blood Count
WG	Water Dispersible Granule

WHP	Withholding Period
w/v	Weight/volume

GLOSSARY

Active constituent	The substance that is primarily responsible for the effect produced by a chemical product
Actinobacteria	A group of Gram-positive bacteria
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 a material from or through a surface
Efficacy	Production of the desired effect
Excretion	The process of eliminating or expelling matter
Formulation	A combination of both active and inactive constituents to form the end use product
Gram-positive bacteria	Bacteria which have a very thick cell wall made of a protein called peptidoglycan.
Genotoxicity	The ability to damage genetic material
Hydrophobic	repels water
Leaching	Removal of a compound by use of a solvent
Log Pow	Log to base 10 of octanol water partitioning co-efficient, synonym K_{OW}
Mycoparasitism	A parasitic fungus whose host is another fungus
Metabolism	The chemical processes that maintain living organisms
Photodegradation	Breakdown of chemicals due to the action of light
Photolysis	Breakdown of chemicals due to the action of light
Siderophores	A molecule which binds and transports iron in microorganisms
Subcutaneous	Under the skin
Total Radioactive Residue (TRR)	The total amount of ^{14}C-labelled active constituent and its metabolites detected in residue studies
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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