Public Release Summary
on

Evaluation of the active

DIMETHENAMID – P

in the product

FRONTIER – P HERBICIDE

Australian Pesticides and Veterinary Medicines Authority

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FOREWORD

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 Ageing (Office of Chemical Safety), Department of Environment and Water Resources (Risk Assessment and Policy Section) and State departments of primary industries and environment.

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 and for all proposed extensions of use for existing products.

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 publication *The Manual of Requirements and Guidelines - MORAG for Agricultural and Veterinary Chemicals [AgMORAG & Vet MORAG]*.

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.

More detailed technical assessment reports on all aspects of the evaluation of this chemical can be obtained by completing the order form in the back of this publication and submitting with payment to the APVMA. Alternatively, the reports can be viewed at the APVMA Library, 18 Wormald St, Symonston, ACT 2609.

The APVMA welcomes comment on the usefulness of this publication and suggestions for further improvement. Comments should be submitted to the Program Manager, Pesticides Program, Australian Pesticides and Veterinary Medicines Authority, PO Box E240, Kingston ACT 2604.

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LIST OF ABBREVIATIONS AND ACRONYMS

AC	active constituent
ACR	Acute to chronic ratio
ADI	Acceptable Daily Intake (for humans)
AHMAC	Australian Health Ministers Advisory Council
ai	active ingredient
ARfD	Acute Reference Dose (for humans)
BBA	Biologische Bundesanalstalt fur Land – und forstwirschaft
bw	bodyweight
CRP	Chemistry and Residues Program
d	day
DAT	Days After Treatment
DM	Dry Matter
DT_{50}	Time taken for 50% of the concentration to dissipate
DT_{90}	Time taken for 90% 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
EC	Emulsifiable Concentrate
EEC	Estimated Environmental Concentration
E_rC_{50}	concentration at which the rate of growth of 50% of the test population is impacted
ESI	Export Slaughter Interval
EUP	End Use Product
FAO	Food and Agriculture Organisation of the United Nations
Fo	original parent generation
FW	Fresh Weight
g	gram
GAP	Good Agricultural Practice
GC/MS	gas chromatography/mass spectroscopy
GCP	Good Clinical Practice
GLP	Good Laboratory Practice
GVP	Good Veterinary Practice
h	hour
ha	hectare
Hct	Heamatocrit
HDPE	High-density polyethylene
Hg	Haemoglobin
HPLC	High Pressure Liquid Chromatography *or* High Performance Liquid Chromatography
HPLC-UV	High Performance Liquid Chromatography with Ultra-Violet Detector
HR	Highest Residue
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
JMPR	Joint FAO/WHO Meeting on Pesticide Residues
kg	kilogram
K_{oc}	Organic carbon partitioning coefficient
L	Litre
LC_{50}	concentration that kills 50% of the test population of organisms
LD_{50}	dosage of chemical that kills 50% of the test population of organisms
LC-MS/MS	liquid chromatography, mass spectroscopy
LOEC	Lowest Observable Effect Concentration
LOEL	Lowest Observable Effect Level
LOD	Limit of Detection – level at which residues can be detected
LOQ	Limit of Quantitation – level at which residues can be dquantified
mg	milligram
mL	millilitre
MRL	Maximum Residue Limit
MSDS	Material Safety Data Sheet
MSMS	mass spectroscopy/mass spectroscopy
NOAEC	No Observable Adverse Effect Concentration
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
NOEC/NOEL	No Observable Effect Concentration/Level
OC	Organic Carbon
OM	Organic Matter
PHED	Pesticide Handlers Exposure Database
PHI	Pre-harvest interval
po	oral
POEM	Predictive Operator Exposure Model (UK)
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
STMR	Supervised Trials Median Residue
SUSDP	Standard for the Uniform Scheduling of Drugs and Poisons
TGA	Therapeutic Goods Administration
TRR	Total Radioactive Residues
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
WHO	World Health Organisation
WHP	Withholding Period

INTRODUCTION

This publication provides a summary of the data reviewed and an outline of the regulatory considerations for the proposed registration of *Frontier-P Herbicide,* which contains the new active constituent Dimethenamid - P. The product is proposed to used as a pre-emergent herbicide in navy beans, green beans, processing peas, pumpkins, kabocha (Japanese squash) and sweet corn for the control of certain broadleaf weeds and annual grasses. In addition, it will be used as a post-emergent herbicide for the control of pink weed in poppy crops.

Responses to this Public Release Summary will be considered prior to registration of the product. They 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.

Copies of full technical evaluation reports Dimethenamid-P, covering toxicology, occupational health and safety aspects, residues in food and environmental aspects are available from the APVMA on request (see order form on last page). They can also be viewed at the APVMA library located at the APVMA offices, 18 Wormald St, Symonston, ACT 2609.

Written comments should be received by the APVMA by 5 September 2007. They should be addressed to:

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Applicant
BASF Australia Limited

Product Details
It is proposed to register Frontier-P Herbicide, containing Dimethenamid-P at 720 g/L as a emulsifiable concentrate formulation. Frontier-P Herbicide will be imported fully formulated and packaged in 5L or 10L containers.

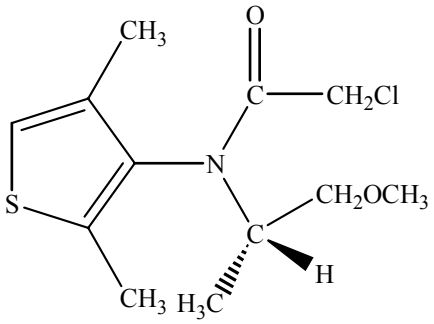
Frontier-P Herbicide is a new herbicide belonging to the mode of action group K.

CHEMISTRY AND MANUFACTURE

ACTIVE CONSTITUENT

Dimethenamid-P belongs to the chloroacetamide family of compounds, and is a pre-emergent herbicide. It acts through inhibition of cell division.

The active constituent dimethenamid-P has the following properties:

Common name:	Dimethenamid-P
IUPAC name:	*S*-2-Chloro-*N*-(2,4-dimethyl-3-thienyl)-*N*-(2-methoxy-1-methylethyl)acetamide
CAS Registry Number:	163515-14-8
Molecular formula:	$C_{12}H_{18}ClNO_2S$
Molar mass:	275.8 $gmol^{-1}$
Structure:	
Appearance (technical material):	Dark brown liquid with a strong unpleasant musty odour
Solidification point:	<-50 °C
Boiling point	≥280 °C
Density:	1.195 g/cm^3 (20 °C)
Water solubility:	1450±20 mg/L (25 °C)
Octanol/water partition coefficient ($logK_{OW}$):	1.89 (25 °C)
Vapour pressure:	$2.5±0.4 \times 10^{-3}$ Pa (25 °C)
Safety properties:	Auto-ignition temperature 395 °C, not explosive, flash point 79 °C, moderate reducing agent. Class 9 dangerous good (environmentally hazardous substance)
Chemical family:	Chloroacetamide
Mode of action:	Inhibition of cell division

The Chemistry and Residues Program (CRP) of the APVMA has evaluated the chemistry aspects of dimethenamid-P (physico-chemical properties, spectral data, stability, manufacturing process, quality control procedures, batch analysis results and analytical methods).

Dimethenamid-P is an approved active constituent. On the basis of the data provided, the following Active Constituent Standard has been established for dimethenamid-P:

Constituent	Specification	Level
Dimethenamid-P	Dimethenamid-P	Not less than 890 g/kg
1,1,1,2-Tetrachloroethane	1,1,1,2-Tetrachloroethane	Not more than 2 g/kg

Based on a review of the data provided by the applicant, the APVMA is satisfied that the chemistry and manufacturing details of dimethenamid-P are acceptable.

Other characteristics of dimethenamid-P (toxicology, environmental fate etc) are covered in subsequent sections of this Public Release Summary.

FORMULATED PRODUCT

The CRP has evaluated the chemistry aspects of the product, *Frontier-P Herbicide* (physico-chemical properties, formulation process, quality control procedures, batch analysis results, stability, analytical methods and packaging).

Frontier-P Herbicide has the following properties:

Appearance:	Brown to dark amber liquid
Formulation type:	Emulsifiable concentrate
Active constituent concentration:	720 g/L
Density (g/mL):	1.11-1.14 (25 °C)
pH (1% dilution):	5.0-7.0

The product will be formulated in the USA using technical dimethenamid-P manufactured at the same site. The manufacturing and quality control procedures, including compliance with the release specifications, are acceptable.

The applicant provided the results of real time stability testing conducted using samples stored in steel containers, polyamide-imide lined high density polyethylene containers, and fluorinated high density polyethylene containers. Testing of all of the important parameters for emulsifiable concentrate formulations was conducted. The results indicate that the formulated product is expected to be stable for at least two years when stored under normal conditions in the proposed commercial packaging.

Based on a review of the data provided by the applicant, the APVMA is satisfied that the chemistry and manufacturing details of *Frontier-P Herbicide* are acceptable.

Other characteristics of *Frontier-P Herbicide* (toxicology, occupational health and safety etc) are covered in subsequent sections of this Public Release Summary.

Toxicological Assessment

Evaluation of Toxicology

The toxicological database for Dimethenamid-P, 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.

Toxicokinetics and Metabolism

Oral administration of racemic-dimethenamid to mice led to nearly complete elimination in the urine (45-60%) and feces (31-45%) within 96 hr. Analysis of metabolites in the urine and feces detected low levels of dimethenamid sulfonate, and dimethenamid sulfoxide of thioglycolic acid (each < 1%).

Following oral dosing of radiolabelled racemic-dimethenamid to rats, the absorption was slow, sustained, and extensive ($\geq$ 88% at 10 mg/kg bw, $\geq$ 62% at 1000 mg/kg bw). The radioactivity rapidly reached tissues (1-4 hours) with the highest level observed in the liver and kidneys. High levels remained in the blood and spleen for 168 hr or longer, and a high blood/plasma ratio indicating its selective binding to blood components. High covalent binding of the chemical to globin was demonstrated in rat (97%), but not in human blood. A high proportion of biliary excretion (>72%) suggested a rapid initial hepatic clearance followed by re-absorption. Elimination through urine (35-63%) and feces (26-62%) was relatively slow (half-life $\geq$ 225 hr). The chemical was extensively metabolised by liver and kidney enzymes, primarily through glutathione conjugation, as well as reductive dechlorination and oxidation, to form over 40 metabolites (over 20 structurally identified). Less than 2% of unchanged parent compound was detected in the excreta. A low level (< 0.1%) of plant metabolites, sulfonate metabolite and sulfoxide of thioglycolic acid metabolite, were found in the excreta. There were no significant differences in absorption, distribution and elimination between sexes, low and high dose, single and repeated dosing regimes.

In dermal penetration studies with dimethenamid-P and racemic-dimethenamid, dermal absorption reached approximately 25% of the dose in rats. Isolated human and rat skin showed similar percutaneous absorption rates and permeability coefficients.

Acute Studies

Dimethenamid-P is of moderate oral toxicity (LD50 420/531 mg/kg bw for male/female rats), and low dermal (LD50 > 2000 mg/kg bw in rabbits) and inhalation toxicity (LC50 > 2000 mg/m^3 in rats). It is not a skin irritant but a slight eye irritant in rabbits, and also has potential for skin sensitisation in guinea pigs.

Racemic-Dimethenamid is of moderate oral toxicity (LD50 371/427 mg/kg bw for male/female rats), and low dermal (LD50 > 2000 mg/kg bw in rabbits) and inhalation toxicity (LC50 > 4990 mg/m^3 in rats). It is not a skin irritant, but a slight eye irritant in rabbits, and may be a potential skin sensitiser in guinea pigs.

BAS 656 07H, a formulation containing 720 g/L dimethenamid-P, is of low oral (LD50 1473/1686 mg/kg bw for male/female), dermal (LD50 > 4000 mg/kg bw) and inhalation toxicity (LC50 > 5600 mg/m^3) in rats. It is a slight skin irritant, and a moderate eye irritant in rabbits. It is a skin sensitiser in guinea pigs.

Short-term Studies

In rats receiving dimethenamid-P at 0, 150, 500, 1500 or 3000 ppm in the diet for 4 weeks, lower body weight gain was observed in males at 3000 ppm. Males and females of this group also had elevated plasma gamma-glutamyl transferase (GGT) levels and increased liver weight, without microscopic findings in the liver. No changes occurred at 1500 ppm and lower doses.

The potential of racemic-dimethenamid to induce liver enzymes was investigated in rats. Male rats received 0, 25, 100, 200 or 400 mg/kg bw/day for 4 days by gavage, with or without a withdrawal period of 4 days. There were slightly reduced body weight gain and increased kidney weight at 400 mg/kg bw/day. Dose-related increases in liver weights at 100 mg/kg bw/day and above correlated with changes in liver enzyme activities, suggesting enhanced liver metabolism. Clinical chemistry revealed slightly elevated plasma levels of alkaline phosphatase (ALP), alanine aminotransferase (ALT), aspartate aminotransferase (AST), GGT, lactate dehydrogenase (LDH), bilirubin, cholesterol, potassium and urea. The majority of changes recovered following withdrawal. No changes were observed at 25 mg/kg bw/day.

Rats received racemic-dimethenamid at 0, 30, 100, 300, 1000 or 3000 ppm in the diet for 5 weeks. At 3000 ppm, food consumption and body weight gain were reduced, and liver weights were increased, along with elevated plasma cholesterol and GGT levels, as well as mild centrilobular cytoplasmic swelling in the liver. Except for a higher plasma cholesterol level in males, no changes were found at 1000 ppm or less.

Rabbits received a dermal application of 0 or 1190 mg/kg bw racemic-dimethenamid, 6 hr/day and 5 days/week for 3 weeks. Skin irritation, inflammatory cell infiltration, acanthosis and hyperkeratosis were observed at the application site during week 1. Body weight gain was reduced in females.

Sub-chronic Studies

Mice received racemic-dimethenamid at 0, 300, 700, 2000 or 5000 ppm in the diet for 13 weeks. Subdued behaviour, reduced food consumption and body weight gain were seen at

5000 ppm. Liver weights were increased dose-dependently in males from 700 ppm and in females from 2000 ppm, and so were kidney weights at 2000 and 5000 ppm, without histopathological findings in either organ. The NOEL was 300 ppm (46 mg/kg bw/day).

In rats receiving dimethenamid-P at 0, 500, 1500 or 3000 ppm in the diet for 3 months, body weight gain was reduced at 1500 and 3000 ppm. The activated partial thromboplastin time was higher in females at 3000 ppm. A higher GGT level and lower AST and ALP levels were observed in males at 1500 and 3000 ppm. Liver weight was increased in all male groups and in females at 1500 and 3000 ppm. Males at 1500 and 3000 ppm showed periportal hepatocellular hypertrophy associated with eosinophilic inclusions, and all treated female groups exhibited centrilobular hepatocellular hypertrophy, as well as necrosis at 1500 and 3000 ppm. Kidney weight was increased in males at 3000 ppm. No NOEL was established. The LOEL was 500 ppm (37 mg/kg bw/day).

Rats received racemic-dimethenamid at 0, 50, 150, 500, 1500 or 3000 ppm in the diet for 13 weeks, with or without a 4-week withdrawal period. Body weight gain and food and/or water consumption were reduced at 1500 and 3000 ppm. Plasma total protein, albumin, globulin, urea nitrogen and cholesterol were generally increased at 500 ppm and above. GGT activity was higher at 3000 ppm, whereas slightly lower AST and ALT occurred at 1500 and 3000 ppm. Increased liver weights were detected in males at 3000 ppm accompanied by periportal hypertrophy and eosinophilic inclusions, and in females at 1500 and 3000 ppm along with centrilobular hepatocyte enlargement at 500 ppm and above. The changes were fully or partially reversed following the recovery period. The NOEL was 150 ppm (10 mg/kg bw/day).

Dogs received racemic-dimethenamid at 0, 100, 750 or 2000 ppm in the diet for 13 weeks. Dogs at 2000 ppm showed reduced food consumption, lower body weight gain or weight loss, and elevated plasma levels of ALP, ALT and cholesterol. Increased liver weights were associated with periportal cytoplasmic vacuoles and sinusoidal dilatation in the liver at 750 and 2000 ppm. Higher thyroid, adrenal (male) and prostate weights, and lower spleen and thymus (male) weights were also observed at 2000 ppm. The NOEL was 100 ppm (2.5 mg/kg bw/day).

Chronic & Carcinogenicity Studies

Mice received racemic-dimethenamid in the diet for 65 weeks at 0 or 3000 ppm or for 94 weeks at 0, 30, 300, 1500 or 3000 ppm. At 1500 and 3000 ppm, body weight gain was significantly impaired during the first 52 weeks, and liver weight was increased. An increased incidence of centrilobular enlargement of hepatocytes (some with vacuolation) appeared at 300 ppm and above. Kidney weight was increased in females at 1500 and 3000 ppm, and there were increased cases of cortical mineralisation at 3000 ppm in males. Hyperkeratosis at the limiting ridge of the stomach was revealed at 3000 ppm. The NOEL was 30 ppm (4 mg/kg bw/day).

Rats received racemic-dimethenamid at 0, 100, 700 or 1500 ppm in the diet for 52 or 104 weeks. Survival rates were higher, and food consumption and body weight gains were reduced at 700 and 1500 ppm. A higher incidence of posterior capsular lenticular opacities was revealed at 1500 ppm by ophthalmoscopy. Males showed increased plasma GGT at 700 and 1500 ppm, and a higher incidence of urinary ketone at 1500 ppm. Females had elevated blood cholesterol at 1500 ppm and increased liver weight at 700 and 1500 ppm. There was an

increased incidence of eosinophilic hepatocytes in males at 700 and 1500 ppm, and bile duct hyperplasia and cystically dilated bile ducts in females at 1500 ppm. Parathyroid hyperplasia was present in all treated male groups, with a dose-related pattern. At 1500 ppm, males also showed an increased incidence and severity in epithelial hyperplasia at the limiting ridge of the stomach, and females had slightly higher incidences of hyperplasia or metaplasia in the ovary, uterus, cervix, thymus and pituitary. Neoplastic findings consisted of increased incidences of liver cell tumours in males at 1500 ppm, but significance was not achieved. No NOEL was established and the LOEL was 100 ppm (5.1 mg/kg bw/day).

Dogs received racemic-dimethenamid at 0, 50, 250 or 1250 ppm in the diet for 52 weeks. Dogs at 250 and 1250 ppm had lower body weight gain or weight loss. At 1250 ppm, plasma levels of ALP, cholesterol, and GGT (in 1/4 females) were higher, and increased liver weights were associated with hepatocyte vacuolation or hypertrophy. The NOEL was 50 ppm (2 mg/kg bw/day).

Reproduction Study

Rats received racemic-dimethenamid at 0, 100, 500 or 2000 ppm in the diet for two generations. Reduced food consumption and impaired body weight gain were observed in F0 and F1 adults at 2000 ppm. Treatment did not affect precoital time, fertility, conception rate or gestation in either generation. In the first generation, the number of implantation and the number of live pups at birth were slightly reduced at 500 and 2000 ppm, but the findings were not duplicated in the second generation. No treatment-related abnormal external findings and malformation were noted in both generations at necropsy. Increased liver weights were observed in F0 and F1 adults at 2000 ppm. The NOEL was 500 ppm (24 mg/kg bw/day) for adults, with no effects on reproduction.

Developmental Studies

Pregnant rats receiving 0, 25, 150 or 300 mg/kg bw/day dimethenamid-P by gavage during gestation days 6-15, did not show abortions or premature deliveries. Clinical signs included excess lacrimation, piloerection, excess salivation and decreased motor activity at 300 mg/kg bw/day. Reduced food consumption and lower body weight gain or body weight loss were seen in all treated groups during the dosing period. Liver weight was increased at 300 mg/kg bw/day. Fetal body weights tended to be reduced at 150 and 300 mg/kg bw/day, associated with increased incidences of incomplete ossification of sternal centra, pelvis pubis and ischium. The number of corpora lutea, implantations, litter size, live fetuses, early and late resorptions, were similar across groups. No NOEL was established for maternal toxicity. The NOEL was 25 mg/kg bw/day for fetal toxicity.

Racemic-dimethenamid at 0, 50, 215 or 425 mg/kg bw/day was administered by gavage to rats on gestation days 6-15. Excess salivation was seen in all treated groups, dose-dependently. At 215 mg/kg bw/day and above, food consumption and body weight gain were impaired during the dosing period. Liver weights were increased in all treated groups in a dose-related manner. Early resorption was increased, and live litter size was reduced at 425 mg/kg bw/day. Incidences of external, soft tissue or skeletal alterations were low. No NOEL was established for maternal toxicity. The NOEL was 215 mg/kg bw/day for embryo toxicity.

Artificially-inseminated rabbits were dosed with 0, 37.5, 75 or 150 mg/kg bw/day of racemic-dimethenamid by stomach tube on gestation days 6 to 18. Food consumption and body weight

gain were impaired at 75 and 150 mg/kg bw/day, and some treated rats had abnormal feces and localised alopecia. Abortion or premature delivery appeared at 150 mg/kg bw/day. Implantation, live litter size, sex ratio or foetal body weight were not affected. Higher incidences of irregular ossification of intraparietals and angulated hyoid alae occurred at 150 mg/kg bw/day. The NOEL was 37.5 mg/kg bw/day for maternal toxicity, and was 75 mg/kg bw/day for foetal toxicity.

Genotoxicity Studies

Dimethenamid-P was not mutagenic or genotoxic in a battery of studies consisting of Ames tests, a gene mutation test on CHO/HGPRT system, an *in vitro* UDS test and an *in vivo* micronucleus assay in mouse bone marrow. The slightly higher incidence of chromosome aberration in CHO-K1 cells in the absence and presence of rat liver metabolism activation system was within the range of historical controls, and was not seen in a similar study with racemic-dimethenamid.

Racemic-dimethenamid was negative in the following tests: an Ames test, a gene mutation assay in V79 Chinese hamster cells/HPRT, a chromosome aberration assay, and micronucleus tests in mouse bone marrow *in vivo*. In one of three *in vitro* UDS assays, positive responses appeared in the non-cytotoxic, low concentration range (0.025 – 1.0 μg/mL). However, in view of the negative results in other studies, in particular *in vivo* studies, the genotoxic potential of dimethenamid is considered to be low.

Other Studies

Dimethenamid oxalamide (M23), a metabolite, had low oral toxicity in rats (LD50 > 5000 mg/kg bw), and did not show mutagenic potential in an Ames test.

SAN 582H sulfonate metabolite (M27) was of low oral toxicity in rats (LD50 > 5000 mg/kg bw), and in an Ames test, was negative in all bacterial strains except in TA102 where the result was considered to be invalid.

Another two metabolites, Reg.Nr.360715/M13 and Reg.Nr.360 714/M27, did not show potential to induce micronuclei in mouse bone marrow *in vivo*.

PUBLIC HEALTH STANDARDS

Poisons Scheduling

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

On the basis of its toxicity, the NDPSC has included dimethenamid (dimethenamid-P) in schedule 6 of the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP). There are provisions for appropriate warning statements and first-aid directions on the product label.

NOEL/ADI

The Acceptable Daily Intake is that quantity of an agricultural compound which can safely be consumed on a daily basis for a lifetime and is based on the lowest NOEL obtained in the most sensitive species. This NOEL is then divided by a safety factor which reflects the quality of the toxicological database and takes into account the variability in responses between species and individuals.

No NOEL was established in a 2-year dietary study in rats due to parathyroid hyperplasia at the lowest dose tested, and the LOEL was 5 mg/kg bw/day. The ADI for dimethenamid-P was hence established at 0.03 mg/kg bw/day using a 200-fold safety factor.

Acute Reference Dose (ARfD)

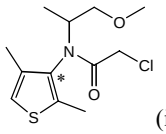
The acute reference dose is the maximum quantity of an agricultural or veterinary chemical that can safely be consumed as a single, isolated, event. The ARfD is derived from the lowest single or short term dose which causes no effect in the most sensitive species of experimental animal tested, together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

The highest acute dose of dimethenamid-P at which no evidence of toxicity was detected was 25 mg/kg bw (eg. a developmental study and a 4-day oral study in rats). The ARfD was established at 0.25 mg/kg bw on the basis of this NOEL and using a 100-fold safety factor.

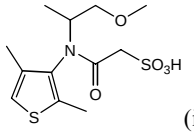
RESIDUES ASSESSMENT

Metabolism

Field grown corn was treated with [3-^{14}C-thienyl]-dimethenamid (i) at 1.68 kg ai/ha, applied as a pre-emergence treatment. The test substance was extensively metabolised with no parent compound detected in forage collected 50 days after treatment or in silage, fodder or hay collected 116-130 days after treatment. The metabolite profiles of the vegetative parts of the crop were qualitatively similar. Six metabolites individually accounting for 0.6-7.5% of the total radioactive residue (TRR) were identified. The predominant residue in forage and silage was a sulfonate of the parent compound (ii) accounting for 6.1% (0.019 mg equiv./kg) and 7.5% (0.03 mg equiv./kg) of the TRRs respectively. In fodder the predominant residue was a thioglycolate sulfoxide of the parent compound (iii) accounting for 6.8% (0.034 mg equiv./kg) of the TRR. Other minor metabolites in forage and fodder included thiolactate, thioglycolate and oxalamide analogues of the parent compound. Metabolism of dimethenamid was proposed to initially proceed via glutathione conjugation followed by various transformations of the conjugate. A glutathione conjugate was not isolated but the terminal residues are consistent with initial glutathione conjugation. No individual metabolites accounted for greater than 10% of the TRR. Total radioactivity in mature grain was very low (0.02 mg equiv./kg) and consisted predominantly of unextractable radiocarbon. Individual residue components in grain could not be characterised further.



(i) * = ^{14}C position



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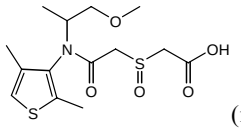
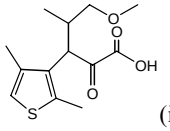


(iii)

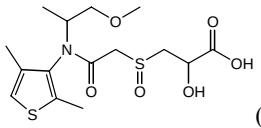
Field grown soya bean plants were treated with [3-^{14}C-thienyl]dimethenamid at 1.68 kg ai/ha, applied as a pre-emergence treatment. The test substance was applied to the soil 1 day after seeding. Total radioactive residues were highest in forage collected 48 days after treatment (2.16 mg equiv./kg). The TRR in the vegetative parts of the crop declined slowly to be 1.88 mg equiv./kg in hay (100 days after treatment) and 1.22 mg equiv./kg in straw (118 days after treatment). The TRR in mature grain (0.24 mg equiv./kg) was approximately 5-fold lower than in straw. The metabolite profiles of forage, straw and grain were qualitatively similar. Predominant metabolites were the sulfonate of the parent compound (up to 24.6% of the TRR in hay), the oxalamide (up to 16.8% of TRR in forage, structure iv) and the thioglycolate sulfoxide (up to 10.6% of the TRR in grain). The metabolism of dimethenamid was extensive with a large number of minor polar species also present. The identified metabolites were consistent with initial glutathione conjugation of the parent compound.



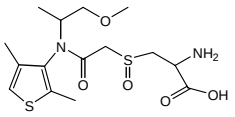
(iv)

Sugarbeet plants were treated with 3 applications of [3-^{14}C-thienyl]-dimethenamid at 450 g ai/ha with the first application made after the cotyledons had unfolded. Samples of roots and leaves with tops were collected 126 days after the last application. Total radioactive residues at harvest were higher in leaves with tops (0.28 mg equiv./kg) than roots (0.078 mg equiv./kg). The extractability of the total radiocarbon in methanol:water was 80% for roots and 94% for leaves and tops. Approximately 70% of the non-extracted radiocarbon in root

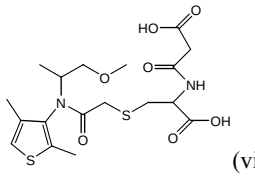
was extractable by a combination of acid and base hydrolysis. The test substance was extensively metabolised with a large number of minor polar metabolites present in both roots and leaves. The parent compound was not observed in any sample. No individual metabolite accounted for >10% of the TRR and >0.01 mg equiv./kg. The most predominant metabolite in leaves with tops was the thiolactate sulfoxide (v) accounting for 9.4% of the TRR (0.027 mg equiv./kg). The most predominant metabolite in roots was the sulfonate (ii). Two additional metabolites to those observed in corn and soybean were observed in sugarbeet roots. These were a sulfoxide cysteine conjugate (2.3% of TRR, 0.0018mg equiv./kg, structure vi) and an N-malonylcysteine conjugate (5.7% of TRR, 0.004 mg equiv./kg, structure vii). The metabolism of dimethenamid in sugarbeets was also proposed to proceed via initial glutathione conjugation.



(v)



(vi)



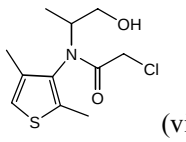
(vii)

The plant metabolism studies were conducted with racemic test substance only. A comparative metabolism study of dimethenamid (racemic) and dimethenamid-P was conducted in soil under aerobic conditions. The metabolic pathways were qualitatively and quantitatively similar irrespective of the isomeric composition of the test substance. Most of the metabolites identified in plant metabolism studies, including the sulfonate (ii) and oxalamide (iv), were also identified in soil after application of dimethenamid and dimethenamid-P. The observed plant metabolites may occur through uptake of soil metabolites as well as transformation of the parent compound in plant tissues.

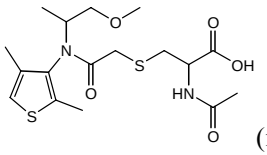
The absorption, distribution, metabolism and excretion of racemic [3-^{14}C-thienyl]dimethenamid were investigated in rats. In rats given a single oral or intravenous dose at 10 mg/kg bw, the radiocarbon was almost completely excreted in urine (up to 49% of the dose) and faeces (up to 57% of the dose). Excretion was rapid with 57-70% of the dose excreted in the first 24 hours and 72-83% of the dose excreted in the first 48 hours. Urinary excretion was slightly higher in female rats. The radiocarbon was extensively excreted in the bile, accounting for 75% and 82% of the dose respectively in male and female mice. Urinary excretion was significantly higher in mice dosed orally at 1000 mg/kg bw indicating that the biliary excretion pathway may be saturable. Pre-treatment with 14 daily doses prior to administration of the radiolabelled dose did not significantly affect the excretion profile. A large number of minor metabolites were identified in urine, faeces and bile. No single residue component accounted for more than 10% of the administered dose. The parent compound, oxalamide, thiolactate conjugate and thiolactate sulfoxide were observed in excreta. The presence of the sulfonate metabolite in urine was confirmed in a separate study. Metabolism of dimethenamid in rats was similar to plants with evidence of glutathione conjugation followed by various transformations including O-demethylation, oxidation of the methyl groups on the thiophene ring and several cyclisation reactions.

A lactating goat was orally dosed with [3-^{14}C-thienyl]dimethenamid at 8.9 mg/kg bw for 4 consecutive days and then slaughtered 7 hours after the last dose. Approximately 27% and 9% of the total dose was excreted in urine and faeces respectively, although the recovery of the dose was incomplete due loss of samples. Only 0.02% of the total dose was excreted in milk. Total radioactive residues were highest in liver (16.6 mg equiv./kg) followed by kidney (9.9 mg equiv./kg), muscle (1.0 mg equiv./kg) and fat (1.0 mg equiv./kg). The parent compound

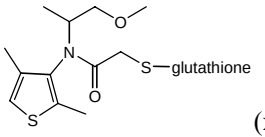
was not present in excreta, milk or tissues. The O-demethylated compound (viii) was a significant metabolite in kidney and fat accounting for approximately 25% of the TRR. In muscle the predominant metabolites were a cysteine conjugate (14.2%, xi), mercapturate conjugate (11.4%, ix) and a glutathione conjugate (8.3%, x). The mercapturate conjugate (2.7%), glutathione conjugate (2.2%) and cysteine conjugate (7.2%) were also identitfied in liver. An additional metabolite comprising a dimer of the parent compound linked by a dithio bridge was also observed in liver (6.1%, xii). The dithio dimer was possibly an artefact as it could be formed from the glutathione conjugate under alkaline conditions. In milk the cysteine conjugate (11.2%) was the predominant metabolite followed by the glutathione conjugate (7.9%).



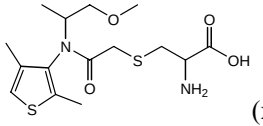
(viii)



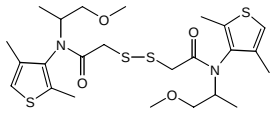
(ix)



(x)



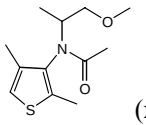
(xi)



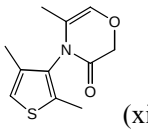
(xii)

In a separate material balance study a lactating goat received a single oral dose of [3-^{14}C-thienyl]dimethenamid at 10 mg/kg bw. Approximately 58% and 25% of the dose was excreted in urine and faeces in the first 24 hours after administration.

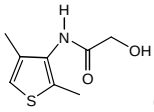
Laying hens were dosed orally with [3-^{14}C-thienyl]dimethenamid at 10 mg/kg bw for 4 consecutive days. Approximately 77% of the total dose was recovered in excreta up to the time of sacrifice. Only 0.01-0.02% of the total dose was recovered in egg white and egg yolk. The parent compound was extensively metabolised in tissues and eggs to form a large number of minor metabolites. The parent compound was only observed to be present in fat (34.7% of TRR, 0.1 mg equiv./kg) and excreta (2.0% of TRR). Other metabolites observed in excreta included the previously identified dithio dimer (xii), the mercapturate (ix) and the cysteine conjugate (xi). In liver the only metabolites positively identified were the dechlorinated metabolite (7.8%, 0.65 mg equiv./kg, xiii) and a cyclized metabolite (5.1%, 0.43 mg equiv/kg, xiv). In egg white and egg yolk a hydroxy acetamide metabolite (xv) accounted for 20.2% (0.06 mg equiv./kg) and 8.4% (0.05 mg equiv./kg) of the TRR respectively.



(xiii)



(xiv)



(xv)

The metabolism of dimethenamid was extensive in both plants and animals. The parent compound was not present in any plant samples and was only present at low levels in excreta and fat of rats and hens. In plants the parent compound was largely transformed to more polar products through conjugation with glutathione followed by various transformations including formation of cysteine, thiolactate and thioglycolate conjugates. Transformation by glutathione conjugation was also observed in animals. Additional transformation pathways identified in animals included O-demethylation, reductive dechlorination, oxidation of the thiophene methyl groups and cyclisation reactions involving the acetamide group.

Analytical Methods

Dimethenamid residues in commodities of plant origin were determined by GC-TSD or GC-MSD following extraction in methanol:water and solid phase cleanup. Quantitation was by external calibration. The validated LOQs were 0.01-0.02 mg/kg depending on the matrix.

A similar validated procedure is used to determine residues of dimethenamid in commodities of animal origin. The validated LOQs for meat, fat, liver, kidney, eggs and milk were 0.01 mg/kg.

The analytical methods determine dimethenamid-P and its (R)-isomer as a single chromatographic peak.

Residue definition

In metabolism studies using radiolabelled test substance the parent compound was not found to be present in any crop samples including foliage, fodder and seeds. Dimethenamid was metabolised to a large number of minor metabolites, mostly polar in nature. The most significant plant metabolite in any study was the sulfonate of dimethenamid, which accounted for 25% of the TRR (0.46 mg equiv./kg) in soya bean hay. In a repeat soya bean study the sulfonate metabolite accounted for 19% of the TRR (0.17 mg equiv./kg) in hay. In both cases the application rate was 2.3× the maximum proposed rate for the majority of Australian uses. No individual metabolites were present at greater than 0.05 mg equiv./kg in the seeds of corn and soya bean

Under the proposed use patterns it is not expected that significant residues of dimethenamid or its individual metabolites will be present in food commodities. The parent compound is considered to be an acceptable residue definition. The applicant indicated that a residue definition of "parent compound" applies to MRLs established in Japan, South Africa, Switzerland, USA, Belgium, France and Germany. The US tolerances have a residue definition of "dimethenamid" (ie. the racemic compound).

The analytical methods do not distinguish between the (R)- and (S)-isomers of dimethenamid. Residue trials were conducted with racemic dimethenamid and residues of total dimethenamid isomers were invariably <LOQ. Due to the isomeric composition of the active constituent in Frontier-P Herbicide, any residues would consist primarily of dimethenamid-P (ie. the (S)-isomer) with a small amount of the (R)-isomer. The residue definition should be sum of dimethenamid-P and its (R)-isomer.

Residues in sweet corn and maize

Registration is sought for both sweet corn and maize. The only significant difference between the crops is the form in which they are consumed. Sweet corn is consumed as "corn-on-the-cob" while maize crops are harvested for the grain. Sweet corn would be harvested earlier while still succulent.

Three Australian trials on sweet corn were provided. Dimethenamid was applied prior to crop emergence at 1.9-3.8× the proposed rate for dimethenamid-P. Residues in mature sweet corn cobs (husks removed) were <0.01 mg/kg in all samples (n=6). It is noted that husks were removed from the ears, which is not consistent with the analytical portion ("whole

commodity") defined by Codex. Given the method of application, extended PHI and absence of detectable residues in other crop parts, this oversight is unlikely to have significantly affected the results.

Seventeen US trials conducted on corn were also provided. Dimethenamid was applied either pre-planting, pre-emergent or post-emergent (5-6 leaf stage) at 2.3× the proposed rate for dimethenamid-P. Residues in mature corn grain were <0.01 mg/kg in all samples from all treatment regimes (n=48).

Seven Canadian trials conducted on sweet corn were provided. Dimethenamid was applied either pre-planting, pre-emergent or early post-emergent at up to 4.2× the proposed rate for dimethenamid-P. Residues in mature corn grain were <0.01-<0.02 mg/kg in all samples from all treatment regimes.

The metabolism study in corn also supports the contention that quantifiable residues of dimethenamid are unlikely to occur in corn crops. Radiolabelled parent compound was extensively metabolised to a range of minor metabolites and was not found to be present in the grain or vegetative crop parts.

The data support the following MRLs based on the highest reported LOQ of 0.02 mg/kg:

VO 0447	Sweet corn (corn-on-the-cob)	*0.02 mg/kg
GC 0654	Maize	*0.02 mg/kg

The following harvest withholding period is appropriate as the product is applied prior to crop emergence:
Maize and sweet corn: Not required when used as directed.

Samples of corn forage, silage and fodder were sampled in the US trials. Residues of dimethenamid were <0.01 mg/kg in all samples following pre-plant, pre-emergent or post-emergent application at 2.3× the proposed rate for dimethenamid-P. The ranges of pre-harvest intervals for collection of forage following pre-emergent and post-emergent applications were 56-74 days and 18-47 days respectively.

Samples of corn forage and fodder were sampled in the Canadian trials. Residues of dimethenamid were <0.01-<0.02 mg/kg in all samples following pre-planting or pre-emergent application at up to 4× the proposed rate for dimethenamid-P. The shortest pre-harvest interval for collection of forage following pre-planting and pre-emergent applications was 30 days. Residues of 0.01 mg/kg were observed in several forage samples but only after early post-emergent application at 3 kg ai/ha. When dimethenamid is used according to the proposed Australian use pattern residues should be below the LOQ in forage and fodder.

The data support the following MRLs based on the highest reported LOQ of 0.02 mg/kg:

Forage and fodder of maize and sweet corn	*0.02 mg/kg

The following grazing withholding period is appropriate:
Maize and sweet corn: Do not graze or cut for stock feed for 4 weeks after application.

Residues in navy beans

No Australian data for pulses and no specific data for navy beans were provided. The applicant provided twelve US trials conducted on soya beans and two Canadian trials conducted on white beans.

In US trials dimethenamid was applied either pre-planting, pre-emergent or post-emergent (5-6 leaf stage) to soy beans at 2.3× the proposed rate for dimethenamid-P on navy beans. Residues in mature soya bean grain were <0.01 mg/kg in all samples from all treatment regimes (n=33).

In Canadian trials on soybeans dimethenamid was applied either pre-planting or pre-emergent at 1-4.2× the proposed rate for dimethenamid-P on navy beans. Residues in mature soya bean grain were <0.01 mg/kg in all samples from all treatment regimes.

In Canadian trials on white beans dimethenamid was applied either pre-planting or pre-emergent to white beans at 1.8-3.6× the proposed rate for dimethenamid-P on navy beans. Residues in mature dry white beans were <0.02 mg/kg in all samples from all treatment regimes (n=32).

The metabolism study in soy bean supports the contention that quantifiable residues of dimethenamid are unlikely to occur in pulse crops. Radiolabelled parent compound was extensively metabolised to a range of minor metabolites and was not found to be present in the grain or vegetative crop parts.

The data demonstrate that quantifiable residues are unlikely to occur in pulse grain when Frontier-P Herbicide is used according to proposed GAP. Extrapolation of the soya bean and white bean residue data to the proposed use on navy bean is acceptable. It is noted that the applicant has only proposed registration for use on navy beans at this stage, however, given the use pattern and the demonstrated absence of finite residues, a group MRL for pulses can be recommended at this time.

The data support the following MRL based on the highest reported LOQ for pulses:
VD 0070 Pulses *0.02 mg/kg

The following harvest withholding period is appropriate as the product is applied prior to crop emergence:
Navy beans: Not required when used as directed.

Samples of soy bean forage, hay and straw were sampled in the US trials. Residues of dimethenamid were <0.01 mg/kg in all samples following pre-plant, pre-emergent or post-emergent application at 2.3× the proposed rate for dimethenamid-P. The ranges of pre-harvest intervals for collection of forage following pre-emergent and post-emergent applications were 34-54 days and 22-41 days respectively.

Samples of white bean forage and straw were sampled in 2 Canadian trials. Residues of dimethenamid in forage harvested 30 days after pre-planting or pre-emergent treatments at 1.8-3.6× the proposed rate for dimethenamid-P were <0.02 mg/kg.

In a Canadian trial on soy beans residues of dimethenamid in forage sampled 30 days after pre-planting or pre-emergent application at up to 3.5× the proposed rate for dimethenamid-P were <0.01 mg/kg in all samples.

The residue data indicate that detectable residues are unlikely to occur in pulse forage and fodder when dimethenamid is used according to the proposed use pattern with a 28 day withholding period. A group MRL for pulse forage and fodder can be established as follows:
Forage and fodder of pulses *0.02 mg/kg

The following grazing withholding period is appropriate:
Navy beans: Do not graze or cut for stock feed for 4 weeks after application.

Residues in peas

Four Australian trials conducted in succulent peas were provided. Dimethenamid was applied at 1.35-2.7 kg ai/ha (1.9-3.3x) prior to crop emergence. Residues of dimethenamid in succulent peas with pods sampled 51-116 days after application were <0.01 mg/kg.

The data support the following MRL based on the highest reported LOQ for pulses/legumes:
VP0063 Peas *0.01 mg/kg

The following harvest withholding period is appropriate as the product is applied prior to crop emergence:
Peas: Not required when used as directed.

From a residue perspective the data support use on peas grown for production of shelled peas or pea varieties sold as whole pea pods. The applicant has proposed use on "processing peas".

Samples of pea forage were collected 42 days after application in a single trial. Residues of dimethenamid in forage were <0.01 mg/kg. Samples of pea straw were collected in 3 trials. Residues of dimethenamid in straw collected 51-116 days after application were all <0.01 mg/kg.

Based on the extensive forage data for other legume crops it is concluded that quantifiable residues of dimethenamid are unlikely to be present in forage at 28 days after application. Therefore, the following MRLs and grazing withholding period are appropriate and are consistent with other legume crops:

AL 0528 Pea vines (green) *0.02 mg/kg
AL 0072 Pea hay or Pea fodder (dry) *0.02 mg/kg

Peas: Do not graze or cut for stock feed for 4 weeks after application.

Residues in green beans

A single Australian residue trial was provided for green beans. Dimethenamid was applied at 1.8-7.2 kg ai/ha (2.5-10× the proposed rate for dimethenamid-P) prior to crop emergence. Residues in green beans harvested 67 days after application were <0.02 mg/kg in all cases.

The residue data for green beans are limited, however, extensive residue and metabolism data for other legume/pulse crops support the contention that pre-emergent application of Frontier-P is unlikely to result in quantifiable residues of dimethenamid in crop parts collected as early as 28 days after application.

The data support the following MRL based on the highest LOQ reported pulses/legumes:
VP 0526 Common bean (pods and/or immature seeds) *0.02 mg/kg

No data were provided for forage or fodder of green beans. Based on the extensive forage and fodder data provided for soy beans, dry beans and peas it is considered unlikely that quantifiable residues would occur in forage or fodder of green beans. Therefore, the following MRLs and grazing withholding period are appropriate and are consistent with other legume crops:

AL 1030 Bean forage (green) *0.02 mg/kg
AL 0061 Bean fodder *0.02 mg/kg

Beans: Do not graze or cut for stock feed for 4 weeks after application.

Residues in pumpkin and kabocha

Two Australian residue trials on pumpkin were provided. Pumpkins were treated at 1.35-2.7 kg ai/ha (1.9-3.8×) prior to crop emergence. Residues of dimethenamid in pumpkins harvested 101-122 days after application were <0.02 mg/kg.

In Australia "Kabocha" refers to varieties of pumpkin that are preferred by Japanese consumers. Kabocha is a commercial hybrid bred from a *Cucurbita maxima* × *C. moschata* cross. The fruit are typically quite small (1-2.5 kg) and have a distinct sweet nutty flavour.

The residue data for pumpkins is limited, however, extensive residue and metabolism data for other crops support the contention that pre-emergent application of Frontier-P is unlikely to result in quantifiable residues of dimethenamid in crop parts collected as early as 28 days after application. Extrapolation from pumpkin to kabocha is considered acceptable. The reported LOQ for pumpkin was 0.02 mg/kg rather than 0.01 mg/kg.

The data support the following MRL:
VC 0429 Pumpkins *0.02 mg/kg

The following harvest withholding period is appropriate as the product is applied prior to crop emergence:
Pumpkins and kabocha: Not required when used as directed.

Residues in poppies

Two residue trials on poppies were conducted in Tasmania. Dimethenamid was applied early post-emergently (cotyledon to 2-leaf stage) at 1.4× the proposed rate for dimethenamid-P. Residues of dimethenamid in poppy seed harvested 100-136 days after application were <0.01 mg/kg.

The data support the following MRL:

SO 0698 Poppy seed *0.01 mg/kg

The following harvest withholding period is appropriate:
Not required when used as directed.

No residue data for poppy forage or straw were provided. The straw from mature poppy crops is unlikely to be fed to animals as it is used for opioid manufacture. Due to the value of the crop poppies are only likely to be grazed in the event of a failed crop. Forage data for other crops indicates that residues are not expected to occur in forage or straw. The grazing withholding period applied to other crops can be extrapolated to poppies.

The following grazing withholding period is appropriate for poppies:
Poppies: Do not graze or cut for stock feed for 4 weeks after application.

No MRLs will be recommended for poppy forage or straw.

Animal commodity MRLs

Measurable residues of dimethenamid(-P) are not expected to occur in potential animal feeds including forage, fodder and seeds of sweet corn, pulses, beans, peas and oilseed poppies. Residues in livestock tissues, milk and eggs should be <LOQ. An analytical method for determination of dimethenamid in animal commodities is available.

The following MRLs are appropriate:

Edible offal (mammalian)	*0.01 mg/kg
Eggs	*0.01 mg/kg
Meat [mammalian]	*0.01 mg/kg
Milks	*0.01 mg/kg
Poultry meat	*0.01 mg/kg
Poultry offal	*0.01 mg/kg

Spray drift

Frontier-P Herbicide will not be applied by aircraft. The active constituent is not fat soluble and is extensively metabolised and rapidly excreted in animals. Finite residues are not expected to occur in livestock as a result of spray drift contamination.

Storage

Samples collected from residue trials were stored frozen for up to approximately 19 months prior to determination of residues. Storage stability data for samples of corn grain, forage, silage and straw were provided and indicate that residues do not degrade significantly when stored frozen for 21 months. The results obtained in the residue trials are considered an accurate reflection of the residues present at sampling.

Processing

Residues of dimethenamid are unlikely to exceed 0.01 mg/kg in any raw agricultural commodity. No processing data are required.

Fat solubility and bioaccumulation potential

The log Po/w for dimethenamid-P is 1.9. The compound is not considered to be fat soluble. Dimethenamid was extensively metabolised in lactating goats with no parent compound present in tissues or milk. Bioaccumulation of dimethenamid-P in animals is considered unlikely to occur.

Dietary risk assessment

The chronic dietary exposure to dimethenamid-P is estimated by the National Estimated Daily Intake calculation encompassing all registered/temporary uses of the chemical and dietary intake data from the 1995 National Nutrition Survey of Australia. The NEDI calculation is made in accordance with *Guidelines for predicting dietary intake of pesticide residues (revised)* [World Health Organisation, 1997].

The NEDI for dimethenamid-P is equivalent to 0.4% of the ADI. It is concluded that the chronic dietary exposure is acceptably low.

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 using 97.5th percentile food consumption data from the 1995 National Nutrition Survey of Australia.

The NESTIs for all relevant commodity/consumer group combinations are less than 1% of the ARfD. It is concluded that the acute dietary exposure is acceptably low.

Recommendations

The following changes will be made to the *MRL Standard*:

Table 1

Compound	Food		MRL (mg/kg)
Add:			
Dimethenamid-P	VP 0562	Common bean	*0.02
	MO 0105	Edible offal (Mammalian)	*0.01
	PE 0112	Eggs	*0.01
	GC 0654	Maize	*0.02
	MM 0095	Meat (mammalian)	*0.01
	ML 0106	Milks	*0.01
	VP 0063	Peas	*0.02
	SO 0698	Poppy seed	*0.01
	PO 0111	Poultry, Edible offal of	*0.01
	PM 0110	Poultry meat	*0.01
	VD 0070	Pulses	*0.02
	VC 0429	Pumpkins	*0.02
	VO 0447	Sweet corn (corn on the cob)	*0.02

Table 3

Add:	Dimethenamid-P	Sum of dimethenamid-P and its (R)-isomer

Table 4

Compound	**Animal Feed Commodity**		**MRL (mg/kg)**
Add:			
Dimethenamid-P	AL 0061	Bean fodder	*0.02
	AL 1030	Bean forage (green)	*0.02
		Forage and fodder of maize and sweet corn	*0.02
		Forage and fodder of pulses	*0.02
	AL 0072	Pea hay or Pea fodder (dry)	*0.02
	AL 0528	Pea vines (green)	*0.02

The MRL recommendations indicated above will be conveyed to Food Standards Australia New Zealand (FSANZ) for consideration for incorporation into Standard 1.4.2 of the Food Standards Code and consequent adoption into the State/Territory food legislation.

Withholding periods

The following withholding periods are required in conjunction with the above MRLs:
Green beans, Kabocha, Maize, Navy beans, Peas, Pumpkin, Sweet corn, Oilseed poppies
Harvest: Not required when used as directed
Grazing: Do not graze or cut for stockfeed for 4 weeks after application

ASSESSMENT OF OVERSEAS TRADE ASPETCS OF RESIDUES IN FOOD

Export of treated produce containing finite residues of dimethenamid 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.

BASF Australia advised that the following MRLs are established in overseas countries:

Country	Commodity	MRL, mg/kg [1]
Japan	Cereal grains (except wheat)	0.1
	Maize (grain)	0.1
	Leaf, stem vegetables	0.1
	Soybean	0.1
	Peanut	0.01
	Bean	0.01
South Africa	Maize (grain)	0.05
Switzerland	Maize (grain)	0.01
	Soybean	0.01
	Sunflower (kernel)	0.01
	Bean	0.01
USA	Maize (forage, fodder, grain)	0.01
	Peanut (hay, kernel)	0.01
	Sweet corn (fodder, forage, grain)	0.01
	Grain sorghum (fodder, grain, forage)	0.01
	Bean (dried)	0.01
Belgium	Maize (grain)	0.01
France	Maize grain	0.02
Germany	Maize grain	0.02

1. The residue definition is the parent compound in all cases

Residues of dimethenamid greater than the limit of analytical quantitation are not expected to occur in any commodities of plant or animal origin as a result of the use of Frontier-P Herbicide. The use of the product is unlikely to unduly prejudice export trade between Australia and places outside Australia.

OCCUPATIONAL HEALTH AND SAFETY ASSESSMENT

Assessment of Occupational Health and Safety

BASF Australia Limited has applied for registration of a new product, Frontier P Herbicide (referred to in this report as Frontier), containing a new active ingredient (ai) dimethenamid-P at 720 g/L. Frontier is an emulsifiable concentrate (EC) formulation and will be used as a pre-emergent herbicide in navy beans, green beans, processing peas, pumpkins, kabocha (Japanese squash) and sweet corn for the control of seven economically important broadleaf weeds and annual grasses. In addition, it will be used as a post-emergent herbicide for the control of pink weed in poppy crops.

Dimethenamid belongs to the chloroacetamide chemical group. The chemical was originally produced as a "racemic" (50/50) mixture of stereoisomers. The (S)-isomer of dimethenamid (dimethenamid-P) is claimed to be the entity showing herbicidal activity.

According to the applicant, the product is currently approved for use on food crops in USA and France, with approval pending in several other countries (New Zealand, Brazil and South Africa).

Packaging

Frontier will be packed in 5 and 10 L containers made of high-density polyethylene.

Handling prior to end use

Frontier-P will be formulated overseas and imported to Australia in ready-to-sell packages. Transport workers, store persons and retailers will handle the packaged product and could become contaminated if packaging is breached.

Use pattern of the product

Frontier will be used as a pre-emergent herbicide in navy beans, green beans, processing peas, pumpkins, kabocha (Japanese squash) and sweet corn, as well as the early post-emergent herbicide in poppies. One application per season using calibrated boom spray equipped with flat fan nozzles in a spray volume of 200 to 300 L/ha is recommended on the draft label. The details of use including application rates are provided in Table 1.

Table 1. Recommendations for the use of Frontier on different crops.

Crop	Weeds controlled	Product application rate (L/ha)	Comments
Poppies	Pink weed / fumitory (*Fumaria* spp)	1.4	Post-emergent when the pinkweed is at the cotyledon to 2 leaf stage, but not before the crop is at the early 2 leaf stage
Navy beans,	Crowsfoot grass (*Eleusine indica*)	0.5	Pre-emergent, must be applied

green beans, processing peas, pumpkins, kabocha (Japanese squash) and sweet corn	Barnyard grass (*Echinochloa crus galli*), potato weed (*Galinsoga parviflora*), summer grass (*Digitaria ciliaris*)	0.7 to 1.0	post-plant before the crop and weeds emerge
	Amaranthus (*Amaranthus powellii*), fumitory/pinkweed (*Fumaria* spp), wild hops (*Nicandra physaloides*)	1.0	

Maximum 0.7% EUP; 0.5% dimethenamid-P based on spray volume of 200 L/ha

The draft label states that a withholding period is not required for harvest when used as directed. A withholding period of up to 6 weeks is recommended for the grazing of residues of pea forage.

Hazard Characterisation

A detailed assessment of the toxicity of dimethenamid-P and Frontier is available in the separate Therapeutic Goods Administration (TGA) Toxicology Report (CPAS number 12173, April 2003).

Toxicological end-points

Active constituent

In rats, the kinetics of dimethenamid is characterised by its slow absorption, distribution and elimination, which may be attributed to biliary secretion and reabsorption (enterohepatic circulation) and high binding to blood cells. However, *in vitro* haemoglobin binding was not observed in human blood, which may be explained by the structural difference of haemoglobin proteins between rats and humans. Hence, faster elimination may be expected in humans.

The chemical was extensively metabolised in animals by liver and kidney enzymes. Less than 2% of unchanged parent compound was detected in the excreta.

Dimethenamid-P is of moderate oral toxicity (LD_{50} 420/531 mg/kg bw for M/F rats), and low dermal (LD_{50} > 2000 mg/kg bw in rabbits) and inhalation toxicity (LC_{50} > 2200 mg/m^3 in rats; no deaths, lacrimation, chromodacryorrhea, red and clear nasal discharge, dried red facial material, laboured breathing, moist rales and wet fur were observed in all animals during first 2 days post exposure). It is a slight eye irritant but not a skin irritant in rabbits, and also has potential for skin sensitisation in guinea pigs (by a modified Buehler method).

End use product

The acute toxicity, irritancy and dermal sensitisation properties of Frontier have not been investigated. However, BAS 656 07H, a formulation containing 64% dimethenamid-P has low oral (LD_{50} 1473 mg/kg), dermal (LD_{50} >4000 mg/kg) and inhalation (LC_{50} >5600 mg/m^3) toxicity in rats. It is a slight skin irritant and a moderate eye irritant in rabbits and a skin sensitiser in guinea pigs. The proposed product Frontier and BAS 656 07H used in acute toxicity studies in the present submission, possess similar compositions and hence share similar toxicity. On this basis, the TGA report concluded that the submitted data with BAS 656 07H should also represent the acute toxicity of Frontier.

Dermal absorption

The rates of skin permeation were similar between rats and humans (<1% over 8 h) when tested *in vitro*. However, dermal absorption reached approximately 25% of the dose when applied to rats (*in vivo*) for 72 h. As the *in vitro* and *in vivo* values in rats varied substantially, NOHSC was unable to rely on the human *in vitro* data for this assessment. The rat *in vivo* rate of 25% was considered the most appropriate.

Hazard classification

Active constituent

Dimethenamid-P is not listed on the NOHSC *List of Designated Hazardous Substances* (NOHSC, 2003 draft). Based on the available information NOHSC classified dimethenamid-P as a hazardous substance in accordance with the NOHSC *Approved Criteria for Classifying Hazardous Substances* (NOHSC: 1999). The following risk phrases apply for dimethenamid-P:

R22 Harmful if swallowed

R43 May cause sensitization by skin contact

The following cut-off concentrations apply for dimethenamid-P

Conc ≥ 25%: R22, R43
1% ≥ Conc < 25%: R43

End use product

Based on the toxicity of BAS 656 07H, a formulation containing 64% dimethenamid-P, and concentration of dimethenamid-P (72%) present in the product, NOHSC classified Frontier as a hazardous substance, according to the *NOHSC Approved Criteria for Classifying Hazardous Substances* (NOHSC, 1999). The following risk phrases apply to Frontier:

R22 Harmful if swallowed

R36 Irritating to eyes

R43 May cause sensitization by skin contact

OCCUPATIONAL EXPOSURE

Exposure information

There are no worker exposure studies on dimethenamid-P available for assessment.

The applicant has estimated worker exposure for mixer/loaders and applicators, using the German model and UK Predictive Operator Exposure Model (POEM). The applicant has not provided the details of the assumptions used in these models for the calculation of operator exposure.

Using the German model, the applicant estimated exposure without any personal protective equipment (PPE) and with PPE i.e. standard protective garment and gloves when preparing spray. Estimated margin of safety (MOS) was 760 for the unprotected operator and 1570 for the operator wearing PPE during mixing. Using POEM, the applicant estimated that MOE for the operator wearing gloves during mixing only or during mixing and loading were 260 and 890, respectively.

NOHSC has used POEM and PHED Surrogate Exposure Guide (1998) to estimate worker exposure to Frontier during mixing/loading and application by ground boom-sprayers.

UK Predictive Operator Exposure Model

NOHSC used the UK Predictive Operator Exposure Model (POEM) to estimate worker exposure to Frontier during ground application using the model for vehicle mounted (without cab) ground boom-sprayer.

<u>The assumptions used are:</u>

- Concentration of active ingredient: 720 g/L
- Formulation type: Emulsifiable Concentrate (EC)
- Container size: 5 L
- Application rate (highest): 1.4 L/ha
- Spray volume (minimum): 200 L/ha
- Hand contamination: 0.01 ml/operation
- Work rate: 50 ha/day
- Duration of applicator exposure: 6 hours/day
- Dermal absorption for dimenthenamid 25%

Details of the POEM estimates are provided in Attachment 1.

Estimated worker exposure values are presented in the following table.

Table 3: Exposure during mixing/loading and application of Frontier

Estimate	***Gloves protection***		***Systemic Exposure to dimethenamid-P (mg/kg bw/day)***				
	Mixer/ Loader	*Applicator*	*Mixer/Loader Dermal*	*Mixer/Loader Inhalation*	*Applicator Dermal*	*Applicator Inhalation*	*Total*
1.4 L/ha EUP	N	N	0.36	No data	0.165	0.002	0.527
200 L/ha spray	Y	N	0.036	No data	0.165	0.002	0.203
5 L container	N	Y	0.36	No data	0.019	0.002	0.381
	Y	Y	0.036	No data	0.019	0.002	0.057

Pesticide Handlers Exposure Database (PHED) Surrogate Exposure Guide
NOHSC used the following scenarios of the Pesticide Handlers Exposure Database (PHED) Surrogate Exposure Guide (1998) to estimate worker exposure to Frontier.

PHED surrogate scenario 3: All liquids, open mixing and loading

PHED surrogate scenario 13: Ground boom application, open cab

PHED surrogate scenario 28: All liquids, open pour, ground boom, open cab

It was assumed that the work rate is 50 ha/day using ground boom-sprayer with open or close cab and the worker is exposed to dimethenamid 6 h/day. The application rate is 1.4 L/ha of the EUP.

Table 4: Exposure during mixing/loading and spray of Frontier (PHED)

PHED Scenario / Gloves		Systematic Exposure to dimethenamid-P* (mg/kg bw/day)				
		Dermal		Inhalation		Total exposure
		Mixer/Loader	Applicator	Mixer/Loader	Applicator	
Scenario 3: All liquids, open mixing and loading	N	1.151	-	0.002	-	1.153
	Y	0.009	-	0.002	-	0.011
Scenario 13: Ground boom application, open cab	N	-	0.006	-	0.001	0.007
	Y	-	0.006	-	0.001	0.007
Scenario 28: All liquids, open pour, ground boom, open cab	N	0.147		0.002		0.149
	Y	0.023		0.002		0.025

*Exposure values for PHED were converted to systemic doses based on 70 kg person, 25% dermal absorption and 100% inhalation absorption.

Re-entry information

The applicant suggests that it is not necessary to enter the treated crops shortly after spraying and it is, therefore, not necessary to determine a particular re-entry time for workers. NOHSC believes re-entry may occur following use, for crop checking or for checking effectiveness of the application. Workers re-entering crops treated pre-emergence are unlikely to be exposed to foliar residues. However, if the spray is still wet, depending on the weed height, foot or leg exposure may occur. Workers re-entering crops treated post-emergence (poppy crops) may be exposed during checking.

RISK ASSESSMENT
Frontier will be applied once per season as a pre-emergent or early post-emergent herbicide. Contract workers may be exposed to Frontier repeatedly. Workers may become contaminated with the product during mixing, loading, spraying, cleaning up spills, and maintaining equipment. The main routes of exposure to Frontier will be dermal and inhalation. Ocular exposure can also occur.

Acute risk assessment
The acute hazards associated with Frontier are oral toxicity, moderate eye irritation, slight skin irritation and skin sensitisation. Dermal exposure may occur during mixing/loading. Eye exposure may also occur if product splashes.

Repeat dose risk assessment
In the absence of worker exposure data, NOHSC used the UK POEM model and PHED surrogate exposure guide to estimate the exposure to dimethenamid-P during mixing, loading and application of Frontier. Although single application in a season is recommended, end-users may apply the product over a number of days. Therefore, a NOEL of 2.5 mg/kg bw/day established in a 13-week dietary study in dogs was chosen for the OHS risk assessment. The NOEL is similar (2 mg/kg/day) to that in a 52-week dietary study in dogs. Given that the NOEL is based on animal data, a MOE at or around 100 is considered acceptable to account for both interspecies extrapolation and intraspecies variability.

MOE calculated from POEM and PHED data are presented in Table 5.
Table 5: MOE estimates for workers during mixing/loading and application of Frontier.

Estimate	*Gloves*	**MOE***				
		Mixer/Loader Dermal	*Applicator Dermal*	*Mixer/Loader Inhalation*	*Application Inhalation*	*Total MOE*
POEM Estimate: 1.4L/ha EUP; 200L/ha spray; 5L container	N	7	15	No data	1250	5
	Y	69	132	No data	1250	44
PHED Scenario 3 and 13: All liquids, open mixing / loading, ground boom, open cab	N	2	417	1250	2500	2
	Y	278	417	1250	2500	156
PHED Scenario 28: All liquids, open pour, ground boom, open cab	N	17		1250		17
	Y	109		1250		100

*Based on NOEL of 2.5 mg/kg bw/day

In POEM, the MOE are low irrespective of wearing gloves during mixing/loading and application. The low MOE are mainly due to mixer/loader exposure. In PHED, the MOE are low when workers did not wear gloves during mixing/loading and application. MOE improved significantly and were adequate when gloves were worn during these operations. PHED Scenario 13 data show no advantage in using gloves during ground boom application (MOE = 417 with and without gloves). NOHSC believes this to be related to the data subset for this Scenario. Data from other subsets conducted by NOHSC show significant decreases (up to 50%) in total dermal exposure when gloves are worn during ground boom application. This difference was similar to that seen in the POEM data. NOHSC therefore considers gloves to be useful in lowering dermal exposure during application.

POEM assumes applicators wear one layer of clothing and PHED estimates assume workers wear long pants, long sleeved shirt.

Personal protective equipment indicated by the risk assessment
The personal protective equipment required to protect end users against health effects following acute and repeated exposure is given in Table 6.

Table 6: Personal protective equipment required in Safety Directions resulting from acute and repeat dose risk assessment

Risk assessment	Personal protective equipment
Acute risk (***Section 4.1***)	
• Eye irritation (moderate)	Faceshield or goggles (*when opening the container and preparing spray*)
• Skin irritation (slight)	Elbow-length PVC gloves (*when opening the container and preparing spray*)
• Skin sensitisation	Cotton overalls and elbow-length PVC gloves (*when opening the container and preparing spray*)
Repeat dose risk (***Section 4.2***)	
• Systemic effects (POEM / PHED)	Cotton overalls and elbow-length PVC gloves (*when opening the container, preparing spray and using prepared spray*)

PPE requirements in Table 6 are consolidated in the Safety Directions for Frontier in Section 6.1.

Re-entry assessment

In case of post-emergence application (poppy crops), workers entering treated areas can be exposed to product residues and degradation products during crop checking or other management activities.

NOHSC determined a re-entry period using the US Occupational Post-Application Risk Assessment Calculator (US EPA Policy 003.1). Based on the toxicity profile and use pattern of the active ingredient, the risk to workers from re-entering treated areas is low (MOEs = 4372) from day one of spraying to carry out activities such as crop checking.

NOHSC recommends that re-entry to treated areas be restricted until the spray has dried unless wearing cotton overalls buttoned to the neck and wrist (or equivalent clothing) and chemical resistant gloves. A statement to this effect should be included on the product label.

Risk Control Measures

This section contains the product-specific controls in accordance with requirements under the National Model Regulations (NOHSC 1994).

Information provision

Hazard classification

Frontier is classified as a hazardous substance according to NOHSC criteria. The following risk phrases apply to Frontier:

R22 Harmful if swallowed

R36 Irritating to eyes

R43 May cause sensitization by skin contact

Classification of Frontier according to NOHSC and Globally Harmonized System (GHS) of classification and labelling of chemicals is provided as Attachment C.

Labels

The applicant has provided a draft label for Frontier. The draft label includes a reference to the material safety data sheet (MSDS).

Product labels should contain the safety directions provided in Section 6.1.

Material safety data sheet
The Material Safety Data Sheet for Frontier herbicide was provided by BASF Australia Ltd as part of the submission for registration. The accuracy of this information remains the responsibility of BASF Australia Ltd.

The product MSDS should contain a statement of hazardous nature and reflect the NOHSC hazard classification provided in section 2.3.2 of this report.

Occupational exposure monitoring
Atmospheric monitoring
Exposure standards have not been established for dimethenamid-P or any other ingredients in Frontier.

Safety Directions
New Entry:
The safety directions recommended by NOHSC and the TGA are presented below:

Dimethenamid-P	EC 720 g/L or less in liquid hydrocarbon, 250 g/L or less		***Hazard Statement***
		129 133	Harmful if swallowed
		161 162 164	Will irritate the eyes and skin
		180	Repeated exposure may cause allergic disorders
		181	Sensitive workers should use protective clothing
		210 211	Avoid contact with eyes and skin
		340 343	If product in eyes, wash it out immediately with water
		351	Wash hands after use
			Personal Protection
		279 280 281 290 292 294 299	When opening the container and preparing spray wear cotton overalls buttoned to the neck and wrist, a washable hat, elbow-length PVC gloves and faceshield or goggles
		279 282 290 292 294	When using the prepared spray wear cotton overalls buttoned to the neck and wrist, a washable hat and elbow length PVC gloves

Restricted entry statement

RE-ENTRY

"Do not allow entry into treated areas until the spray has dried unless wearing cotton overalls buttoned to the neck and wrist (or equivalent clothing) and chemical resistant gloves."

Environmental Assessment

The submission used data generated with dimethenamid (Frontier) in addition to bridging studies comparing dimethenamid and dimethenamid-P (Frontier-P) that demonstrate bioequivalence (note, neither are currently registered in Australia).

Environmental Aspects

Dimethenamid-P is stable to hydrolysis but photolysis is relatively quick (3-5 weeks) in water and on soil. Degradation of dimethenamid-P was rated as being moderate with half-lives of 10 to 38 days under aerobic conditions (soil and water) and slightly longer under anaerobic conditions, 54 days (soil only). The field dissipation was similar with half-lives of <1–5 weeks. Laboratory data showed the chemical and its metabolites to be very mobile in a range of soils. Field dissipation studies showed the parent compound to be much less mobile although the metabolites were still found in the soil profile at low levels. Volatilisation from the soil is likely to be limited. Data provided are considered sufficient to demonstrate that this chemical cannot be classed as persistent or bioaccumulative.

Dimethenamid-P (or dimethenamid as a surrogate) was shown to be practically non-toxic to birds, honeybees and most beneficial insects except for predatory mites and aphids. It is moderately toxic to fish and aquatic invertebrates under acute exposure conditions. There were chronic effects on fish and daphnia with NOECs of 0.12 and 1.36 mg/L respectively. As expected with a herbicide, toxicity to algae and aquatic plants is very high with the most sensitive being duckweed with a 14 day EC50 of 8.9 µg/L. The results for algae tended to indicate effects were algistatic rather than algicidal. Earthworms where shown to be slightly sensitive with an LD50 of 294 mg/kg soil and a NOEC of 125 mg/kg soil. There were no significant adverse effects on soil respiration at 1.8 kg/ha but in one soil there was stimulation of nitrogen turnover. Testing on non-target plants showed that perennial ryegrass was determined to be the most sensitive to dimethenamid-P with an EC25 for seedling emergence test of 7.7 g/ha.

When used in the proposed manner, dimethenamid-P is not expected to pose a risk to birds, soil dwelling organisms, fish or aquatic invertebrates. Based on testing provided, the chemical may prove toxic terrestrial invertebrates, ie parasitic wasps but when used as proposed, risk to them is considered acceptable. The chemical is also very highly toxic to aquatic plants, algae and terrestrial plants. In the event of exposure through spray drift and assuming medium spray quality, to protect these plants spraydrift buffers of 20 metres for aquatic plants, or 15 m for terrestrial plants are required. If a fine spay is used, then the risk is higher and buffers of 50 metres for aquatic plants and 40 metres for terrestrial plants are required. Risks to algae and terrestrial and aquatic plants have also been identified from run-off events. Recommendations have been made to manage these risks.

Environmental Fate

Most fate studies related to the R/S mixture rather than dimethenamid-P itself. However, some comparative studies were provided to demonstrate the similarity in behaviour of the two. Based on the outcomes of these studies, it is accepted that behaviour of dimethenamid-P in the environment will be approximately the same as that for dimethenamid.

Hydrolysis
One comparative hydrolysis study was provided. The outcome of this study showed both dimethenamid-P and dimethenamid were hydrolytically stable at pH 5, 7 and 9. There was no difference between the two and the half-lives were determined to be much greater than 30 days.

Photolysis
Aqueous: Two studies were provided, one on dimethenamid and the other on dimethenamid-P. Both reports demonstrated that photodegradation from aqueous solutions is expected to be a factor in the degradation in the environment, with a half-life of 25.7 days for dimethenamid-P (compared to 23.9 days for the R/S mixture). The proposed photodegradation pathway of dimethenamid-P involved replacement of the chlorine atom with a hydroxyl group; reductive dechlorination; and ring cyclization.

Soil: Two studies were discussed in the submission, but only one report was provided. This was a comparative study undertaken on a clay loam. During the study (23 days of continuous irradiation), some degree of mineralisation was indicated with 10-12% CO_2 being produced. Overall, degradation was relatively slow with half-lives of 37.5 and 28.6 days for dimethenamid-P and dimethenamid respectively.
The second study for which a full report was not provided suggested several degradative pathways: replacement of chlorine by a hydroxyl group, o-demethylation, two modes of cyclization and hydroxylation at one of the thiophene methyls or the thiophene itself.

Degradation in Soil and Water
Soils aerobic: A total of four studies were referred to in the submission. Two reports were provided and analysed in this assessment. The main study was a comparative study undertaken on a clay loam and demonstrated again the very similar degradation behaviour of dimethenamid and dimethenamid-P. Metabolism was rapid and the decline in parent material corresponded to the formation of CO_2 (29% after 6 months), several extractable degradation products and bound residues. The half-life for both chemicals was around 10 days indicating they do not persist in microbially active soils. The second study analysed was for dimethenamid only in a loam soil. This study showed a similar breakdown pattern to the first, but with a considerably longer half-life of 38 days and slower mineralisation (18% CO_2 after 365 days).
Test reports for the remaining two studies were not provided or requested. The company had provided summaries for them and they confirmed findings of the previous two studies with respect to formation of metabolites, bound residues and mineralisation. The tests were performed on a loamy sand, sandy loam and sandy clay loam. While calculated half-lives were not provided, the data indicate them to be around two weeks.

Soils anaerobic: One test on one soil type (loam) was provided where dimethenamid only was tested. Test material was applied to the fresh soil with samples aged aerobically for 30 days, then flooded and purged with nitrogen to establish anaerobicity. Degradation appeared to follow a similar pattern to that under aerobic conditions, although it was slower. Only 3.3% CO_2 was formed during the 93 day study. The calculated half-life was 54 days.

Water: One aerobic experiment was submitted with dimethenamid. The test system consisted of two separate water/sediment systems, one from a pond and the other from a river. The parent compound disappeared at a moderate rate from water bodies (half-life around 28 and 20 days for pond and river respectively). There appeared to be gradual partitioning to

sediment with maximum levels reached within 2 weeks (23%) prior to declining over the remainder of the study. For the whole water/sediment systems, half-lives were calculated as 33 and 23 days for the pond and river system respectively. Only one metabolite was detected at a level >10%. It is worth noting that in the sterile control, significant degradation was also achieved with less than 30% parent remaining after 105 days. It is unclear why this occurred, photolysis was ruled out due to the dark conditions, and dimethenamid does not hydrolyse. The metabolite pattern was also different than from soil, probably due to the anaerobic conditions of the sediment.

Mobility

Volatility: A volatility study investigating evaporation of dimethenamid from plant surfaces and soil was provided. The experiment was done in a model chamber in the dark with constant wind velocity allowing the air volume to be exchanged 6 times per hour. After the 24 hour study period, 6.6% had been shown to volatilise from bare soil while 14.1% was shown to volatilise from plants.

A further study conducted under sterile conditions considered volatility of the chemical from soils treated both topically and pre-plant incorporated (PPI). Volatilisation was shown to be minimal with 0.84% and 1.18% volatilising from PPI and topical treatments respectively after 30 days. The calculated Henry's Law Constant (4.8×10^{-4} $Pa.m^3$/mole) suggests very low volatility from water.

Adsorption/desorption: One batch equilibrium experiment in 10 soils was provided for dimethenamid-P. The chemical showed Koc values ranging from 90 (sandy loam) to 474 (sandy clay loam) demonstrating medium to very high mobility through the range of soils. A further batch equilibrium study for dimethenamid was also provided with 9 soils tested. Koc values for this chemical ranged from 40 (silty clay) to 233 (silt loam), again showing dimethenamid to have medium to very high mobility.

Information on metabolite adsorption/desorption was provided, but study reports were not included with the submission. The information suggests the two metabolites considered (oxalamide and sulfonate) are very highly mobile in soils.

Column Leaching: The leaching potential of dimethenamid was investigated in one non-aged column leaching study with 5 soils. Dimethenamid was detected in the leachates of four soils along with several metabolites that did not exceed 3% applied radioactivity. In one low OC sandy soil, 33.4% of the applied radioactivity was found in the leachate and shown to be dimethenamid. Radioactivity moved quickly through the soil columns and was found in all soil segments.

Two aged residue column-leaching studies were provided using a sand and a sandy loam. Residues were aged for 22-30 days in the dark under aerobic conditions. Movement was greater through the sandy column with dimethenamid being found throughout the 30 cm soil column. However, it was only found in the leachate of one replicate at <0.1% and not detected in any other leachate. The transformation products showed a tendency to move through the soil. Among the metabolites, the oxalic acid (M23) was found in concentrations of 11-17% in leachates, with others found at less than 2.5% radioactivity.

Lysimeter studies: A field leaching (lysimeter) study was provided testing dimethenamid mobility in the field in a sandy soil with low organic carbon content. The study was conducted over several years. At the end of the experiment, soil monoliths were sectioned into layers. The majority of the radiocarbon was found in the top 3 layers (24 cm) but the active substance was not detected in any layer below 17 cm. The majority of radiocarbon in the layers was in the form of bound residues. At least 17 unknown and two known metabolites (M23 and M27) showed a high mobility in the sandy soil. Over the course of the study, in the order of 60-65% of radioactivity was lost to the atmosphere as a result of mineralisation or conversion to volatile products. Radioactivity was determined in the leachates during all years with 7-8% TAR found during year 1, reducing to 1-4.5% in year 3. None of this was attributed to the parent compound.

Field Dissipation

Soils: Three field dissipation studies were provided to investigate the degradation and dissipation of dimethenamid in soil and to determine the concentrations of the oxalamide (M23) and sulfonate (M27) metabolites. Dimethenamid was applied to bare ground on 6 different sites at higher rates than proposed in Australia. Data obtained from the studies showed dimethenamid to be almost exclusively located in the top 10 cm soil layer. Only at early samplings could residues be detected below this layer. Degradation was shown to be fairly quick in soil. After 7 days, less than 10% of the applied substance could be detected in the soil and shortly after application, the metabolites being considered were found in soil samples. The metabolites were found a low concentrations and could be characterised as largely transient in nature. They were not found consistently, although could sometimes be found at up to 180 days after treatment. Half-lives ranged from 3.2-34.7 days for dimethenamid, 18-45 days for M23 and 22-76 days for M27.

Two further field studies were provided investigating the leaching potential of dimethenamid under field conditions. In the first study, no dimethenamid residues above 0.1 µg/L were detectable in any of the pore water samples collected with dimethenamid residues in soil decreasing from a maximum of 0.9 mg/kg after application to <0.01 mg/kg five months on, sampled up to a depth of 3 metres. Residues of metabolites were very low and found mainly in the upper 10 cm of soil. The second study analysed soil and groundwater samples for dimethenamid up to 90 days after application. No residues were detectable in any of the groundwater samples. Residues in soil decreased from a maximum of 0.67 mg/kg after application to <0.01 mg/kg three months on. These studies indicate rapid dissipation from soils and no leaching effect was observed.

Accumulation/Bioaccumulation

The logKow for dimethenamid-P is 1.89 indicating it is not significantly lipophilic. A bioconcentration study was provided to address potential accumulation in aquatic biota, using bluegill sunfish as the test organism. The average of the actual BCFs determined for the three sample periods at or near steady-state were 57, 20 and 100 for the whole body, edible and non-edible tissues respectively indicating the chemical will not bioconcentrate to any significant extent. The study demonstrated an elimination half-life of 10.7 days indicating the chemical only slowly dissipates from fish tissues.

The M3, M23 and M27 metabolites had LogKow determinations undertaken. These were 2.58, 2.43 (pH 7) and –1.57 (pH 7) respectively suggesting they are unlikely to bioaccumulate.

Environmental Toxicology

Avian

One acute test was provided with dimethenamid-P, administered as a single dose to bobwhite quail. This test showed birds to be relatively insensitive to the chemical although sub-lethal effects were noted (loss in body weight). When administered in the diet over five days (mallard duck and bobwhite quail tested), dimethenamid-P was shown to be practically non-toxic. Again, a decrease in body weight was noted in the birds at high doses. In a reproductive study on the mallard duck, no effects in body weight, food consumption, mortality or reproductive performance were noted at the maximum level tested of 1800 mg ai/kg diet. A reproduction study on bobwhite quail with dimethenamid showed a treatment related decrease in egg shell thickness at 1800 mg ai/kg in the diet, but there were no effects (body weight, food consumption, mortality or reproductive parameters) at 900 mg ai/kg diet.

Aquatic

Both dimethenamid-P and dimethenamid appear moderately toxic to fish under acute exposure conditions. While no sub chronic or chronic tests were provided for dimethenamid-P, using the R/S mixture as a surrogate, it may be expected to be toxic to fish with 21 day and 90 day NOECs <1 mg/L. In early life stage testing, at low concentrations (0.24-0.48 mg ai/L), there was a reduction in growth noted. Observations of fish exposed to 0.95 mg ai/L group showed lethargy, dark colouration, slowed development and increased mortality. Evaluation of development at this concentration indicated reductions in hatching success, survival and growth and an increased time to swim up. Testing of metabolites and leachates obtained from lysimeter studies on fish showed little to no toxicity.

Dimethenamid-P is only moderately toxic to aquatic invertebrates based on studies for *Daphnia magna* and *Mysidopsis bahia.* Using dimethenamid as a surrogate, chronic (21 d) daphnia exposure suggests only limited toxicity with a NOEC >1 mg/L. Testing of metabolites and leachates obtained from lysimeter studies on fish showed no toxicity.

As expected with a herbicide, toxicity to algae and aquatic plants is very high with testing on several algal species and one aquatic plant (*Lemna gibba*) resulting in EC50 values less than 1 mg/L. *L. gibba* was the most sensitive with a 14 day EC50 of 0.0089 mg/L, and a NOEC of 0.0012 mg/L. Testing of metabolites and leachates obtained from lysimeter studies on algae showed no toxicity. Where tests to algae were continued to determine recovery following cessation of exposure, results tended to indicate effects were algistatic rather than algicidal, with good recovery being demonstrated.

Terrestrial organisms

Testing on honeybees and earthworms showed negligible impacts on these organisms from exposure to dimethenamid-P but there were some impacts on soil micro-organisms. Several non-target arthropods were tested with differing results. Beneficial capacity of wolf spiders, green lacewing, rove and ground beetles was shown to largely unchanged following application of dimethenamid-P at rates similar to those proposed for use in Australia. However, a predatory mite was determined to decrease beneficial capacity by almost 40% at the same application rates (990 g/ha) while testing on a parasitic wasp showed complete loss of beneficial capacity with 100% mortality after 48 hours.

Using dimethenamid results as a surrogate for dimethenamid-P, earthworms were shown to be slightly sensitive to the chemical with an LD50 of 294 mg/kg soil and a NOEC of 125 mg/kg

soil. Laboratory studies on the influence of dimethenamid on typical activities of soil microorganisms, i.e. nitrogen turnover and respiration, in two types of agricultural field soils did not exhibit significant adverse effects at test concentrations up to 1.8 kg/ha application rate for respiration, but in one soil there was stimulation of nitrogen turnover.

Testing on non-target plants was provided with 10 different crop plants exposed to various concentrations of dimethenamid-P. Results showed that off target movement may result in adverse impacts on non-target plants when considering seedling emergence and vegetative vigour. Perennial ryegrass was determined to be the most sensitive species to the treatment of dimethenamid-P for both life stage tests. The EC25 for perennial rye in the seedling emergence test (7.7 g/ha) is around 0.76% of the maximum application rate proposed in Australia. As expected, seedling emergence was more sensitive than application to plants already emerged.

ENVIRONMENTAL RISK ASSESSMENT

Birds

The most probable route of exposure to birds will be through dietary uptake of dimethenamid-P residues contained in treated plant material or prey.

Dietary Q values for application of dimethenamid-P at 1008 g ai/ha (maximum annual application rate in Australia) estimated for quail and mallard ducks using the Kenaga nomogram predict these as 106 and 39 mg/kg bodyweight respectively. With dietary LC50's >5620 ppm, these residue values represent Q values of a maximum of 0.02 for quail and 0.01 for mallard, supporting a conclusion of a low potential risk to birds. Application will only be once per season and with the lack of persistence of dimethenamid-P in the environment, chronic exposure is not likely.

Bees and other terrestrial invertebrates

Using the provided in the bee study for dimethenamid-P the 24 h NOEL was determined to be 64 µg ai/bee (oral) and 50 µg ai/bee (contact). Assuming a bee has a surface area of 1 cm^2, a bee when directly oversprayed will receive 10 µg of dimethenamid-P, which is below the NOEC and therefore a low potential risk to bees.

The maximum application rate in testing was 990 g ai/ha, which approaches the maximum rate proposed for use in Australia of 1000 g ai/ha. While impacts on spiders, rove beetles, ground beetles and green lacewings were shown to be minimal or non-existent, it was determined that loss of beneficial capacity in a species of predatory mite was 37.5% (11% from mortality and 26.5% from a reduction in fecundity) while a species of parasitic wasp lost all beneficial capacity with 100% mortality after 48 hours. Impacts on predatory mites may be considered acceptable as mortality was only slightly and egg laying was still viable. Also, it may reasonably be expected that mite populations will recover as there is only one application per season.

Impacts on parasitic wasps are more of a concern as the loss in beneficial capacity was all due to mortality. However, application of this product will be predominantly to bare soil (pre-emergent), and when applied to poppy crops, the crops are at an early stage, so impacts on parasitic wasps are not really expected as populations are unlikely to exist in the crop area.

Soil-dwelling organisms
No effect was seen on earthworms at a concentration of 125 mg/kg soil. Based on the maximum likely soil concentration in the top 10 cm of soil of 0.84 mg/kg soil, one application per season and the limited persistence of the chemical in the environment, the potential risk to earthworms is expected to be low. While a subacute/reproduction study was not presented, this is acceptable to DEH given the slight acute toxicity and rapid degradation in field studies.

Application rates up to 1.44 kg/ha of dimethenamid did not impact on respiration of soil micro-organisms, but did impact on nitrogen turnover. However, the effect was stimulatory, relatively mild (37% increase in available total nitrogen [ammonium and nitrate]) and was only seen in one soil. Therefore, as it may not be an adverse effect and will not occur in all soils, the risk to soil micro-organisms was considered acceptable. Given that there is only one application per season, the overall impact of dimethenamid on soil micro-fauna is expected to be minimal.

Aquatic organisms
Aerial application is prohibited on the label. Therefore, no environmental exposure will occur through this route and it is not considered in this assessment.

Ground Application

Two exposure situations to water bodies will be considered, namely exposure through spray drift and exposure through run-off. As the maximum rate of 1008 g ai/ha for use in poppies will also cover the risk from pre-emergent (720 g ai/ha), only the higher rate will be examined here.

Assuming a 10% spray drift the concentration in 15 cm deep water would be 67.2 µg/L and comparison with the most sensitive values for fish and aquatic invertebrates indicated an acceptable risk to fish and aquatic invertebrates. For algae and duckweed there was an unacceptable risk, indicating that further refinement is necessary.

The risk to duckweed, the most sensitive organism tested, was on calculated using the predicted spray drift entering a water body 15 cm deep from both European (Ganzelmeier) spray drift tables and the US EPA model AgDrift. Spray drift buffers of 20 metres (medium spray) or 50 metres (very fine/fine) were calculated from AgDrift and only 5 m from the European drift tables, taking into account that duckweed was only slightly affected at the LOEC (7.3 µg/L) and the presumed ability of the plants to recover. As applications are pre-emergent or post emergent (2 leaf stage) with minimal cover, the AgDrift results were considered to be more appropriate (the European drift tables are average values from trials conducted on wheat [early and late season] whereas AgDrift applications were to bare soil).

Run-Off

The concentration of dimethenamid-P in runoff water was calculated using a simple model (1 ha area treated running into a 1 ha pond) as 24.5 and 2.4 ppb assuming that 5 and 0.5% chemical run-off respectively. This calculation demonstrates there is an unacceptable risk to algae and aquatic plants where run-off of the chemical is 5%, and at 0.5% there is still a potential risk, although it may be able to be mitigated by controlling the use pattern. The predictive accuracy of these calculations is difficult to gauge.

Three scenarios were the considered based on the use directions of dimethenamid-P and using an European model that takes into account hydrological aspects, rainfall intensity and infiltration capacity. The outcomes showed an unacceptable risk to aquatic plants and algae in all scenarios with rates of run-off predicted to range between 3.4% (high organic carbon) to almost 11% (no organic carbon). Again, there is no real consideration of distance between the edge of the field and any receiving waters, and therefore any mitigating effects of herbicide removal through buffer zones. Also, these scenarios assume the storm event immediately follows application.

The models use a small field (1 ha) runoff into a pond (1 ha), which is not realistic, and therefore were refined. The refined model also included calculations of adsorption to soil using the lowest Kd for dimethenamid-P. The new model showed a moderate risk from run-off and with the presumed ability of the plants to recover, which mitigates this risk to some extent, was considered to be just acceptable.

There is a clear relationship between the time following application until a storm event in reducing run-off. Therefore, where farms do not have irrigation facilities and hence the ability to control amounts of water put on the crops, it is recommended that restrictions on application when there is the expectation of heavy rain should be included. This would provide a better chance for dimethenamid to bind/degrade prior to a run-off event and therefore limit the risk from runoff.

Groundwater

While the adsorption/desorption and column leaching studies demonstrated mobility of dimethenamid-P, the lack of persistence of dimethenamid-P in the field, along with field data showing limited vertical movement through soils even with low organic carbon, suggests leaching to groundwater is not likely to be significant.

Non-Target Vegetation

Higher plants on non-target areas can be exposed to pesticides via the air or run-off. The major route is likely to be through drift. Testing on terrestrial plants demonstrated that the major impacts are on seedling emergence rather than established plants.

Calculations using the German tables again demonstrate the need for a suitable buffer zone to protect non-target terrestrial vegetation and a buffer zone of 15 metres is considered acceptable. Using AgDrift with fine to medium/coarse spray the buffer needed is 15 metres and for fine spray quality, a buffer of 39 metres is required using a US EPA method to evaluate the risk (the US EPA method takes into account that effects on terrestrial plants are non-lethal and these plants can recover). The potential for established off-site plants to intercept drift, and thereby reduce the amount of drift likely to deposit on the ground, has not been considered but DEH notes that it is site specific and therefore is not assumed to apply to all application sites.

In conclusion, noting that the EC50 is for a non-lethal endpoint, a buffer zone of at least 15 metres is needed to protect non-target vegetation from spray drift using medium or coarser spray quality while a buffer of 40 metres is required for fine spays or as default (spray quality not given on label).

As with aquatic systems, run-off is likely to pose a significant exposure pathway for terrestrial plants, particularly in the event of a storm event soon after application. As with aquatic plants, modelling outcomes showed an unacceptable risk to terrestrial plants in several scenarios. Again, these scenarios assume the storm event immediately follows application. Therefore, where farms do not have irrigation facilities and hence the ability to control amounts of water put on the crops, restrictions on application when there is the expectation of heavy rain should be included.

Efficacy and Safety Assessment

Justification for use

To register Frontier-P Herbicide which is a group K herbicide will provide a useful tool for resistance management purposes. The product is proposed for post-emergence control of pinkweed in poppies and pre-emergent control of grass and broadleaf weeds in a number of horticultural crops

Evaluation of Efficacy data and use pattern

A total of 109 trials were submitted in support of efficacy of Frontier-P Herbicide. The trials were generally conducted well and the important details documented clearly in the text or the appendices. In most cases the differences were clearly indicated by suffix lettering on the tables. The analysis of variance was also provided in full in the appendices.

Trials were conducted over a satisfactorily wide range of climatic conditions and soils in all Australian States and in New Zealand, depending on the crop involved. Methods of assessment were often visual and subjective and these parts of the trials could not be rigorously analysed, which is needed to justify label claims. Some of the trials planned and achieved objective comparisons, which yielded statistical data, which in most cases produced some verifiable and reliable data on the power of Frontier –P as a an effective and safe herbicide to use on a range of horticultural crops. The trials showed very little phytotoxic damage except for beans. Even for beans, any damage observed was not generally associated with a reduction of crop yield.

Of the submitted trials, 32 contributed to an objective assessment of this proposed label. They have substantiated that that pre-emergence use of Frontier-P is effective and safe to use to control 14 named weeds at dosage rates of 0.15 to 1.0 L/ha for the treatment of sweet corn, corn, green peas, pumpkins and kabotcha. The post-emergence claims of the label for the use of Frontier-P on pinkweed in poppies was established. The pre-emergence part of the label needed adjustments to increase clarity and these were carried out.

There were significant herbicidal effects of Frontier-P on target weeds at the rates and timings specified in the label. Also several weeds not included in the label were shown to be suppressed by Frontier-P. These were yellow bristle grass, red root, subterranean clover, stonecrop, white clover, ryegrass, scrambling speedwell, penny royal, twin cress and purple nut grass. The applicant included some of these weeds suppressions claims on the propsed label where there was adequate grounds to do so.

Crops Safety

At the label rates Frontier-P was found to be safe to use on most crops. The only exception to this is green beans and beans where some crop vigour reduction and phytotoxic symptoms could occur at label rates. In neither case, however, did this result in a yield reduction.

Conclusions

On the basis of the efficacy data assessment, it is established that Frontier-P would be safe and effective to use against the weeds listed on the proposed label and when used in accordance with the instructions of the proposed label.

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Labelling Requirements

POISON

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

FRONTIER®-P
Herbicide

ACTIVE CONSTITUENT: 720 g/L DIMETHENAMID-P

GROUP ___ HERBICIDE

For the control of certain broadleaf and grass weeds in green beans, navy beans, sweet corn, corn, poppies, green peas, pumpkins and kabocha, as specified in the DIRECTIONS FOR USE table.

IMPORTANT: READ THE ATTACHED LEAFLET BEFORE USE

5, 10 L

BASF

STORAGE AND DISPOSAL

Store in the closed, original container in a cool, well-ventilated area. Do NOT store for prolonged periods in direct sunlight. Triple or preferably pressure rinse containers before disposal. Add rinsings to spray tank. Do NOT dispose of undiluted chemicals on-site. If recycling, replace cap and return clean containers to recycler or designated collection point. If not recycling, break, crush, or puncture and bury empty containers in a local authority landfill. If no landfill is available, bury the containers below 500 mm in a disposal pit specifically marked and set up for this purpose clear of waterways, desirable vegetation and tree roots. Empty containers and product should NOT be burnt.

SAFETY DIRECTIONS

Harmful if swallowed. Will irritate the eyes and skin. Repeated exposure may cause allergic disorders. Sensitive workers should use protective clothing. Avoid contact with eyes and skin. If product is in eyes, wash it out immediately with water. When opening the container and preparing spray wear cotton overalls buttoned to the neck and wrist, a washable hat, elbow-length PVC gloves and faceshield or goggles. When using the prepared spray wear cotton overalls buttoned to the neck and wrist, a washable hat and elbow-length PVC gloves. Wash hands after use.

FIRST AID

If poisoning occurs, contact a doctor or Poisons Information Centre, telephone 131126 Australia-wide.

MSDS

Additional information is listed in the Material Safety Data Sheet.

CONDITIONS OF SALE

All conditions and warranties rights and remedies implied by law or arising in contract or tort whether due to the negligence of BASF Australia Ltd or otherwise are hereby expressly excluded so far as the same may legally be done provided however that any rights of the Buyer pursuant to non excludable conditions or warranties of the Trade Practices Act 1974 or any relevant legislation of any State are expressly preserved but the liability of BASF Australia Ltd or any intermediate Seller pursuant thereto shall be limited if so permitted by the said legislation to the replacement of the goods sold or the supply of equivalent goods and all liability for indirect or consequential loss or damage of whatsoever nature is expressly excluded. This product must be used or applied strictly in accordance with the instructions appearing hereon. This product is solely sold for use in Australia and must not be exported without the prior written consent of BASF Australia Ltd.

THIS PRODUCT IS NOT CONSIDERED TO BE A DANGEROUS GOOD UNDER THE AUSTRALIAN CODE FOR THE TRANSPORT OF DANGEROUS GOODS BY ROAD AND RAIL.
FOR SPECIALIST ADVICE IN AN **EMERGENCY ONLY** **PHONE 1 800 033 111** TOLL FREE - ALL HOURS - AUSTRALIA WIDE

APVMA Approval No.: 56059/ 5/10 /

® = Registered trademark of BASF
Label Version: V2205507

Product number:
Batch Number:
Date of Manufacture:
Fax on Demand: 0500 544 044
Customer Service Hotline: 1800 635 550

BASF Australia Ltd
ABN 62 008 437 867
500 Princes Highway
Noble Park
Vic 3174

POISON

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

FRONTIER®-P
Herbicide

ACTIVE CONSTITUENT: 720 g/L DIMETHENAMID-P

GROUP ___ HERBICIDE

For the control of certain broadleaf and grass weeds in green beans, navy beans, sweet corn, corn, poppies, green peas, pumpkins and kabocha, as specified in the
DIRECTIONS FOR USE table.

THIS LEAFLET IS PART OF THE LABEL.

BASF

DIRECTIONS FOR USE:
RESTRAINTS:
DO NOT apply to green beans, navy beans, green peas, pumpkins, kabocha, corn or sweet corn crops sown in soils with a cation exchange capacity (CEC) of less than 5 meq / 100 g (or cmol / kg) OR soils with a clay content of less than 10% AND organic carbon content of less than 2%.

DO NOT apply through aircraft or irrigation equipment.

CROP & STAGE	WEEDS CONTROLLED	RATE PER HA	CRITICAL COMMENTS
	POST-EMERGENCE		
Poppies (2 – 6 leaf stage)	Pinkweed / Fumitory (*Fumaria* spp) Cotyledon to 2 leaf stage	1.4 L	Apply FRONTIER-P when the pinkweed is at the cotyledon to 2 leaf stages and the crop is at the early 2 leaf to 6 leaf stages. A follow-up spray of Starane™ must be applied within 15 days for complete control of pinkweed. For improved post-emergent control of other weeds, such as hogweed (*Polygonum aviculare*), fat hen (*Chenopodium album*) and blackberry nightshade (*Solanum nigrum*), Command™ Herbicide should be tank mixed with FRONTIER-P. Do NOT tank mix FRONTIER-P with Brodal ™.
	PRE-EMERGENCE		
Sweet Corn, Corn (Maize), Green Beans, Navy Beans, Green Peas, Pumpkins, Kabocha	Toad Rush (*Juncus bufonius*)	150 to 200 mL	Apply at or immediately after sowing and before crops and weeds emerge. Apply to moist soil. Rain or irrigation following application is desirable. Use rates toward the higher end of the range where longer residual control is required.
	Crowsfoot Grass (*Eleusine indica*)	500 mL to 1.0 L	FRONTIER-P is mainly absorbed by the emerging shoot (coleoptile). FRONTIER-P must be present in the top soil layer as the weeds germinate and the coleoptiles pass through the treated soil layer. Apply at or immediately after sowing and preferably before crops and weeds germinate. Emerged, or soon to emerge, weeds present at the time of application are unlikely to be controlled. Delays in applying FRONTIER-P after sowing, particularly if irrigation or rain moistens soil and initiates germination before the application of FRONTIER-P, will lead to reduced control. Apply to moist soil if possible. If applied to dry soil, irrigation or rain must follow soon after application for best results. Irrigation or rain is required within 7 days after application. FRONTIER-P is best applied to freshly
	Wild Hops / Apple of Peru (*Nicandra physaloides*) Summer Grass (*Digitaria ciliaris*) Barnyard Grass (*Echinochloa crus-galli*)	700 mL to 1.0 L	
	Amaranthus spp.) Fat Hen (*Chenopodium album*) Blackberry Nightshade (*Solanum nigrum*) Giant or Black Pigweed (*Trianthema portulacastrum*) Sow or Milk Thistle (*Sonchus oleraceous*) Brazilian White-eye (*Richardia brasiliensis*) Shepherd's Purse (*Capsella bursa-pastoris*)	1.0 L	

	Suppression of; Ryegrass (*Lolium* spp.) Subterranean Clover (*Trifolium subterraneum*) White Clover (*Trifolium repens*) Pigweed (*Portulaca oleracea*) Pale Pigeon Grass (*Setaria glauca*) Stonecrop (*Crassula sieberiana*) Scrambling Speedwell (*Veronica persica.*) Pennyroyal (*Mentha pulegium*) Bittercress (*Coronopus didymus*)	1.0 L	prepared soil with fine tilth and as soon as possible after sowing. Use the lower rate on light textured, low organic matter, low CEC soils and the higher rate on heavier textured soils as per the tables below. Refer to **CROP SAFETY** section. FRONTIER-P can be used on trickle irrigated fields if rain or overhead irrigation follows application or the trickle irrigation sufficiently moistens the soil surface. Untreated soil thrown onto treated areas will reduce weed control. Do not disturb the FRONTIER-P treated soil layer as this may lead to weed emergence. Application to crop trash covering the soil surface may lead to reduced control. Do not use on soil in which crops will be transplanted nor over already transplanted crops.

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

WITHHOLDING PERIODS:

GRAZING:
GREEN BEANS, NAVY BEANS, GREEN PEAS, CORN, SWEET CORN, PUMPKINS, KABOCHA: DO NOT GRAZE OR CUT FOR STOCKFEED FOR 4 WEEKS AFTER APPLICATION.

HARVEST:
GREEN BEANS, NAVY BEANS, GREEN PEAS, CORN, SWEET CORN, PUMPKINS, KABOCHA: NOT REQUIRED WHEN USED AS DIRECTED.
POPPIES: DO NOT HARVEST FOR 100 DAYS AFTER APPLICATION.

GENERAL INSTRUCTIONS

FRONTIER-P is a selective pre-emergent herbicide for control of weeds in sweet corn, corn (maize), green beans, navy beans, green peas, pumpkins and kabocha,. FRONTIER-P controls susceptible germinating seedlings before or soon after they emerge from the soil. FRONTIER-P will not control emerged weeds except cotyledon to two leaf pinkweed (fumitory) in 2 to 6 leaf poppy crops. FRONTIER-P will be most effective when incorporated by rainfall or overhead irrigation prior to weed germination. Reduced weed control may occur when trickle irrigation is used and there is insufficient soil surface moisture.

MIXING

Add the required amount of herbicide directly to the partly filled spray tank with agitation running. Complete filling and maintain agitation until spraying is complete.

APPLICATION

Apply FRONTIER-P with a calibrated boom spray equipped with flat fan nozzles in a spray volume of 200 to 300 L/ha.
Do NOT apply by aircraft.
For medium quality spray (BCPC/ASAE);
DO NOT apply if waterbodies, watercourses or wetlands are within 20 metres downwind of the application area.
DO NOT apply if non-target vegetation is within 15 metres downwind of the application area.

For fine quality spray (BCPC/ASAE) or an undefined spray quality;
DO NOT apply if waterbodies, watercourses or wetlands are within 50 metres downwind of the application area.
DO NOT apply if non-target vegetation is within 40 metres downwind of the application area.

EQUIPMENT CLEAN-UP

Clean application equipment thoroughly using a strong detergent or tank cleaner. Rinse equipment thoroughly before re-use.

COMPATIBILITY

FRONTIER-P is compatible with Command, atrazine, Gesaprim® and Stomp®.
Do NOT mix FRONTIER-P with Brodal.

RESISTANT WEEDS WARNING

GROUP [redacted] **HERBICIDE**

FRONTIER-P Herbicide is a member of the amide group of herbicides. The product has the herbicides with diverse sites of action mode of action. For weed resistance management, the product is a Group K herbicide.

Some naturally occurring weed biotypes resistant to the product and other amide 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 amide herbicides.

Since the occurrence of resistant weeds is difficult to detect prior to use, BASF Australia accepts no liability for any losses that may result from the failure of this product to control resistant weeds.

PROTECTION OF CROPS, NATIVE AND OTHER NON-TARGET PLANTS

Do NOT apply under weather conditions or from spraying equipment that may cause spray to drift onto nearby susceptible plants/crops, cropping lands or pastures.
Do NOT transplant brassicas, plant potatoes or sow crops **other than** green beans, kabocha, green peas, pumpkins, corn and sweet corn within 6 months of application of FRONTIER-P.
Do NOT sow carrots or pyrethrum within 12 months of application of FRONTIER-P.

Crop safety:
Injury to green beans, kabocha, green peas, pumpkins, corn and sweet corn may occur at label rates on soils with very low cation exchange capacity (CEC). Soils containing low levels of clay and organic matter normally have a low CEC. **Do NOT apply to green beans, kabocha, green peas, pumpkins, corn or sweet corn crops grown on soils with a cation exchange capacity (CEC) of less than 5 meq / 100g (or cmol / kg) OR soils with a clay content of less than 10 % AND organic carbon content of less than 2%.**

CEC (meq/100 g or cmol/kg)	**FRONTIER-P Rate**
<5	Do not use FRONTIER-P
5-9	500 to 700 mL/ha
9-14	700 mL to 1.0 L/ha
>14	1.0 L/ha

Soil Texture	**Clay Content**	**Organic Carbon Content**	
		<2%	**>2%**
Sand, Loamy Sand, Silt	<10%	Do not use FRONTIER-P	500 - 700 mL/ha
Loam, Sandy Loam, Silt Loam	10-15%	500 - 700 mL/ha	700 mL – 1 L/ha
Sandy Clay Loam, Clay Loam, Silt Clay Loam, Silty Clay, Sandy Clay, Clay	>15%	1 L/ha	1 L/ha

Before treating large areas of new plant varieties with FRONTIER-P, treat a small area first and determine the level of tolerance to FRONTIER-P at the applied rate.

PROTECTION OF WILDLIFE, FISH, CRUSTACEANS AND ENVIRONMENT

Toxic to fish.
Toxic to bees.
This product is very highly toxic to algae and aquatic plants. Do NOT contaminate streams, rivers or waterways with the chemical or used containers.
FRONTIER-P Herbicide should be prevented from entering waterways. DO NOT apply if heavy rain is expected within 48 hours. After spraying, DO NOT irrigate to the point of run-off within 48 hours of application.

STORAGE AND DISPOSAL

Store in the closed, original container in a cool, well-ventilated area. Do NOT store for prolonged periods in direct sunlight. Triple or preferably pressure rinse containers before disposal. Add rinsings to spray tank. Do NOT dispose of undiluted chemicals on-site. If recycling, replace cap and return clean containers to recycler or designated collection point. If not recycling, break, crush, or puncture and bury empty containers in a local authority landfill. If no landfill is available, bury the containers below 500 mm in a disposal pit specifically marked and set up for this purpose clear of waterways, desirable vegetation and tree roots. Empty containers and product should NOT be burnt.

SAFETY DIRECTIONS

Harmful if swallowed. Will irritate the eyes and skin. Repeated exposure may cause allergic disorders. Sensitive workers should use protective clothing. Avoid contact with eyes and skin. If product in eyes, wash it out immediately with water. When opening the container and preparing spray wear cotton overalls buttoned to the neck and wrist, a washable hat, elbow-length PVC gloves and faceshield or goggles. When using the prepared spray wear cotton overalls buttoned to the neck and wrist, a washable hat and elbow-length PVC gloves. Wash hands after use.

RE_ENTRY

Do not allow entry into treated areas until the spray has dried unless wearing cotton overalls buttoned to the neck and wrist (or equivalent clothing) and chemical resistant gloves.

FIRST AID

If poisoning occurs, contact a doctor or Poisons Information Centre, telephone 131126 Australia-wide.

MSDS

Additional information is listed in the Material Safety Data Sheet.

CONDITIONS OF SALE

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To receive a copy of the full technical report for the evaluation of acibenzolar-S-methyl in the product *BION PLANT ACTIVATOR SEED TREATMENT*, please fill in this form and send it, along with payment of $30 to:

David Hutchison
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Australian Pesticides and Veterinary Medicines Authority
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