Public Release Summary
on

Evaluation of the new active

1,3-DICHLOROPROPENE

in the products

Telone Soil Fumigant
and
Telone C-35 Soil Fumigant

National Registration Authority
for Agricultural and Veterinary Chemicals

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FOREWORD

The National Registration Authority for Agricultural and Veterinary Chemicals (NRA) 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 NRA works in close cooperation with advisory agencies, including the Department of Health and Family Services (Chemicals and Non-prescription Drug Branch), Environment Australia (Risk Assessment and Policy Section), the National Occupational Health and Safety Commission and State departments of agriculture and environment.

The NRA 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 NRA 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 NRA's publications *Ag Manual: The Requirements Manual for Agricultural Chemicals* and *Ag Requirements Series.*

This Public Release Summary is intended as a brief overview of the assessment that has been completed by the NRA 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 NRA. Alternatively, the reports can be viewed at the NRA Library Ground Floor, 22 Brisbane Avenue, Barton, ACT.

The NRA welcomes comment on the usefulness of this publication and suggestions for further improvement. Comments should be submitted to the Executive Manager—Registration, National Registration Authority for Agricultural and Veterinary Chemicals, PO Box E240, Kingston ACT 2604.

CONTENTS

LIST OF ABBREVIATIONS AND ACRONYMS

1,3-D	1,3-dichloropropene
ac	active constituent
ADI	Acceptable Daily Intake (for humans)
AHMAC	Australian Health Ministers Advisory Council
ai	active ingredient
BBA	Biologische Bundesanalstalt fur Land – und forstwirschaft
bw	bodyweight
^{14}C	radio-labelled carbon
d	day
DAT	Days After Treatment
DT_{50}	Time taken for 50% of the concentration to dissipate
EA	Environment Australia
E_bC_{50}	concentration at which the biomass of 50% of the test population is impacted
EC_{50}	concentration at which 50% of the test population are immobilised
EEC	Estimated Environmental Concentration
E_rC_{50}	concentration at which the rate of growth of 50% of the test population is impacted
EUP	End Use Product
Fo	original parent generation
g	gram
GAP	Good Agricultural Practice
GLP	Good Laboratory Practice
h	hour
ha	hectare
Hct	Heamatocrit
Hg	Haemoglobin
HPLC	High Pressure Liquid Chromatography *or* High Performance Liquid Chromatography
id	intradermal
im	intramuscular
ip	intraperitoneal
IPM	Integrated Pest Management
iv	intravenous
in vitro	outside the living body and in an artificial environment
in vivo	inside the living body of a plant or animal
kg	kilogram
K_{oc}	Organic carbon partitioning coefficient
L	Litre
LC_{50}	concentration that kills 50% of the test population of organisms
LD_{50}	dosage of chemical that kills 50% of the test population of organisms
LOD	Limit of Detection – level at which residues can be detected
LOQ	Limit of Quantitation – level at which residues can be quantified
mg	milligram
mL	millilitre
MRL	Maximum Residue Limit
MSDS	Material Safety Data Sheet
NDPSC	National Drugs and Poisons Schedule Committee
ng	nanogram
NHMRC	National Health and Medical Research Council
NOEC/NOEL	No Observable Effect Concentration Level
NPS	Non-protein sulfhydryl

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

INTRODUCTION

This publication provides a summary of the data reviewed and an outline of the regulatory considerations for the proposed application of the chemical 1,3-dichloropropene (here-after referred to as 1,3-D) as a soil fumigant for the control of certain insects, weeds and plant diseases. It also seeks public comment prior to the chemical product being registered and approved for use in Australia.

Responses to public consultation will be considered prior to registration of the products detailed in this document. They will be taken into account by the NRA in deciding whether the product should be registered and in determining appropriate conditions of registration and product labelling.

Copies of the full technical reports on public health, occupational health & safety, environmental impact and residues in food are available on request.

The NRA must receive written comments by 31 July 2001 for the attention of:

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Applicant

Dow AgroSciences Australia Limited has applied for registration of two agricultural chemicals, both containing the new active constituent 1,3-dichloropropene.

Product details

1,3-dichloropropene will be marketed under the trade name Telone, in the form of two products. Telone Soil Fumigant will be based on 1,3-dichloropropene, while Telone C-35 Soil Fumigant will also contain the approved active constituent, chloropicrin.

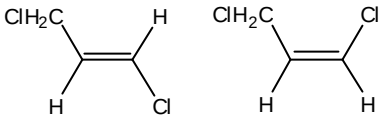
CHEMISTRY AND MANUFACTURE

ACTIVE CONSTITUENT

Manufacturing Site

The active constituent, 1,3-Dichloropropene is manufactured by: (i) The Dow Chemical Company, Building A-915, Freeport, Texas 77541, USA; and (ii) Dow Chemical G.m.b.H, Werk Stade, D-2160 Stade, Germany.

Chemical Characteristics of the Active Constituent

Common name:	1,3-Dichloropropene (ISO/SA approved)
Synonyms and code number:	3-chloroallyl chloride; alpha-chloroallyl chloride; gamma-chloroallyl chloride; DCP or DCPE; 1,3-dichloropropylene; NCI-C03985; Telone, Telone II; XRM-5048
Chemical name:	(EZ)-1,3-Dichloropropene (IUPAC)
	1,3-Dichloro-1-propene (CA)
CAS Number:	Racemate – 542-75-6; (E)-isomer – 10061-02-6; (Z)-isomer – 10061-01-5
Molecular formula:	$C_3H_4Cl_2$
Molecular weight:	110.98
Chemical structure:	 (E)-isomer (Z)-isomer

Physical and Chemical Properties of Pure Active Constituent and TGAC

Stereochemistry:	Racemate	
Physical state:	Liquid	
Colour:	Clear to straw coloured	
Odour:	Pungent	
Boiling point:	(Z)-isomer 104°C; (E)-isomer 112°C; Racemate 108°C	
Solubility in water (at 25 °C)	(Z)-isomer 2.8 g/L; (E)-isomer 2.32 g/L	
Density/specific gravity:	1.205 to 1.225 at 20 °C; 1.20 to 1.22 at 25 °C	
Solubility in organic solvents	(Z)/(E)-isomers – freely soluble in most organic solvents	
Octanol/water partition coefficient:	(Z)-isomer	Log Kow = 2.06 at 25 °C
	(E)-isomer	Log Kow = 2.03 at 25 °C
	Racemate	Log Kow = 1.94 at 20 °C
Vapour pressure:	(Z)-isomer	3.5 kPa at 20 °C; 4.6 kPa at 25 °C
	(E)-isomer	2.3 kPa at 20 °C; 3.1 kPa at 25 °C
	Racemate	3.1 to 3.7 kPa at 20 °C
Flash point:	27.5 °C	
Flammability:	May form a flammable mixture with air at >4.3 <10.6 mole %	
Explosive properties:	Not explosive	
Oxidising properties:	Reactive to potassium permanganate (colour change). Non-reactive to monoammonium phosphate, zinc dust and water	
Corrosion characteristics:	Not available	
Storage stability:	Stable for at least 14 days at 54 °C	
Chemical type:	Soil fumigant	
Chemical family:	Halogenated hydrocarbon	

Summary of the NRA's Evaluation of 1,3-Dichloropropene

The Chemistry and Residues Evaluation Section of the NRA has evaluated the chemistry aspects of 1,3-Dichloropropene TGAC (manufacturing process, quality control procedures, batch analysis results and analytical methods) and found them to be acceptable. On the basis of the data provided it is proposed that the following minimum compositional standards be established for 1,3-Dichloropropene TGAC:

Active constituent	
(EZ)-1,3-Dichloropropene (racemate)	Not less than 950 g/kg (The racemate should be comprised of not less than 474 g/kg of the (Z)-isomer and not less than 453 g/kg of the (E) -isomer.

PRODUCTS

Telone Soil Fumigant	
Formulation type:	Liquid / fumigant
Active constituents concentration:	1140 g/L 1,3-Dichloropropene

Telone C-35 Soil Fumigant	
Formulation type:	Liquid / fumigant
Active constituents concentration:	825 g/L 1,3-Dichloropropene and 460 g/L chloropicrin

Physical and Chemical Properties of the Products

Telone Soil Fumigant	
Physical state:	Liquid
Colour:	Clear to straw coloured
Odour:	Pungent
Density or specific gravity:	1.205 to 1.225 at 20 ^{o}C; 1.20 to 1.22 at 25 ^{o}C
Viscosity:	Kine: 0.636 mm^2/s at 20 ^{o}C; 0.544 mm^2/s at 40 ^{o}C Dynamic: 0.769 mPa at 20 ^{o}C; 0.658 mPa at 40 ^{o}C
Flash point:	27.5 ^{o}C
Flammability/autoignition:	May form a flammable mixture with air at >4.3 <10.6 mole %
Explodability:	Not explosive
Oxidising properties:	Reactive to potassium permanganate (colour change). Non-reactive to monoammonium phosphate, zinc dust and water
Storage stability:	The applicant provided storage stability data demonstrating that the product will be stable for at least 2 years when stored under ambient conditions in either moisture-proof, resin-lined, steel containers, or fluorinated HDPE containers.

Telone C-35 Soil Fumigant	
Physical state:	Liquid
Colour:	Pale straw coloured
Odour:	Pungent, lachrymatory
Density or specific gravity:	1.34 at 20 ^{o}C
pH value (1 % w/w in purified water):	6.9
Viscosity:	Kinematic: 0.665 mm^2/s (20 ^{o}C) 0.515 mm^2/s (40 ^{o}C) Dynamic: 0.891 mPa.s (20 ^{o}C) 0.690 mPa.s (40 ^{o}C)
Flash point:	27.5 ^{o}C
Autoignition temperature:	310 ^{o}C
Explodability:	Not explosive
Oxidising properties:	Reactive to potassium permanganate (colour change). Non-reactive to monoammonium phosphate, zinc dust and water
Storage stability:	The applicant provided storage stability data demonstrating that the product will be stable for at least 2 years when stored under ambient conditions in mild steel containers.

TOXICOLOGICAL ASSESSMENT

Summary

The two products, Telone Soil Fumigant, containing 1140 g/L 1,3-dichloropropene (1,3-D), and Telone C-35 Soil Fumigant, containing 825 g/L 1,3-D and 460 g/L chloropicrin, are soil fumigants. Although a similar product, Telone II, containing 1,3-D but with a different stabiliser, was previously available in Australia, it was withdrawn in 1987 due to low demand.

1,3-D is well absorbed through the gastro-intestinal tract or lungs into the body where it is quickly metabolised and cleared from the blood (<1 hour). Following oral administration, it forms 2 main metabolites and is excreted mainly in the urine. The acute toxicity of 1,3-D is high by the oral route, and moderate by the dermal and inhalation routes. It is a slight skin but a severe eye irritant in rabbits and a skin sensitiser in guinea pigs. Formulations similar to Telone Soil Fumigant and Telone C-35 Soil Fumigant gave similar results in acute toxicity tests, except for the high inhalation toxicity for the formulation similar to C-35 Fumigant.

In chronic studies using 1,3-D stabilised with 2% epoxidised soybean oil, 1,3-D caused increased benign lung tumours in mice following 24 months inhalation exposure, and increased benign liver tumours in rats when fed in their diet for 24 months. It is thought that these tumours develop once a detoxification enzyme has been overwhelmed by continuous exposure to high concentrations of 1,3-D. This is supported by studies showing an absence of genetic damage in animals, and the presence of genetic damage in bacteria and mammalian cell lines deficient in the detoxification enzyme. Continuous long-term exposure to low concentrations did not cause cancer. 1,3-D had no effect on reproduction in rats, or foetal development in rats or rabbits at doses that were also not toxic to the mother.

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

Assessment of toxicology

The toxicological database for 1,3-D, 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 at which no adverse health effects in humans would be expected.

Most of the toxicity tests were conducted with commercial preparations of 1,3-D, *i.e.* Telone, containing a stabilising agent. This stabiliser consisted of around 1% of the known genotoxic carcinogen, epichlorohydrin, or 2% epoxidised soybean oil. Chronic inhalation and dietary studies were conducted on Telone containing epoxidised soybean oil.

Toxicokinetics and Metabolism

1,3-D is well absorbed through the gastro-intestinal tract or lungs into the body where it is quickly metabolised and cleared from the blood (<1 hour). Following single oral doses in rats and mice, 1,3-D is absorbed, metabolised, and excreted with 69-76% in rats and 76-93% in mice of the administered radioactivity recovered as either urinary metabolites or as $^{14}CO_2$ within 48 hours of a single oral dose. Analysis of the urine revealed no unchanged parent compound, the primary metabolites of 1,3-D in the urine, N-acetyl-S-(3-chloroprop-2-enyl)cysteine *i.e.* the mercapturic acid of 1,3-D (1,3-D-MA), and its sulfoxide (or sulfone), suggesting a role for glutathione conjugation in the metabolism of 1,3-D. Non-protein sulfhydryl (NPS) depletion and

macromolecular binding of 1,3-D were noted in the non-glandular stomach, and to a lesser degree in the glandular stomach and liver of rats and mice following single oral doses of =25 mg/kg.

Fifteen daily doses of 1,3-D revealed a similar excretion profile to that following single oral doses (65% in the urine, 27% in expired CO_2, and 5% in faeces). Forty-eight hours after the cessation of repeat dosing, radioactivity was 2 to 3-fold higher in the non-glandular stomach and bladder than in other tissues examined. Major 1,3-D metabolites identified in the urine were the 1,3-D-MA, and its sulfoxide (or sulfone). The isomeric ratio of 1,3-D-MA excreted in the urine was 80% *cis* and 20% *trans.*

Differential excretion of 1,3-D isomers occurred in the urine (*cis*-isomer radioactivity 82-84% of dose over 96 hours, *trans*-isomer radioactivity 55-60% of dose over 96 hours) and in the expired CO_2 (*cis*-isomer radioactivity 2-5%, *trans*-isomer radioactivity 22-24% over 96 hours) following single oral administrations of *cis*- and *trans*-isomers of 1,3-D. In another study, blood levels of the *trans*-isomer were about 3 times that of the *cis*-isomer.

1,3-D uptake did not increase proportionally with inhalation exposure (136, 409, 1362, or 4086 mg/m^3 1,3-D for 3 hours) in male rats, and the time to achieve peak blood concentrations was increased at higher doses. There were dose-related decreases in breathing frequency and respiratory minute volume. Kidney and liver NPS levels were decreased immediately following 1,3-D exposure; lung NPS levels were unaffected.

Acute Studies

In acute studies in rats, *cis*-1,3-D had acute oral LD_{50}s of 93-126 mg/kg in males and 78-117 mg/kg in females, acute dermal LD_{50}s of 758-1068 mg/kg in males and 841-1109 mg/kg in females, and inhalation LC_{50}s of 3042 mg/m^3 in males and 3378 mg/m^3 in females. It was a slight skin and severe eye irritant in rabbits and a skin sensitiser in guinea pigs.

Telone II (containing 92% 1,3-D and 8% inert ingredients) in acute studies in rats had oral LD_{50}s of 300-713 mg/kg in males and 240-510 mg/kg in females, a dermal LD_{50} of >1.211 mg/kg in both sexes and inhalation LC_{50}s of 3882-4700 mg/m^3 in males and 4105 mg/m^3 in females. Oral LD_{50}s of 640 mg/kg for males and females and a dermal LD_{50} of >1.211 mg/kg in both sexes were obtained in acute mouse studies. In rabbits, Telone II produced dermal LD_{50}s of 333-504 mg/kg, and it was a slight skin and a severe eye irritant; it was also a skin sensitiser in guinea pigs.

Telone C-17 (containing 40.9% *cis*-1,3-D, 38.2% *trans*-1,3-D, 19.4% chloropicrin) studies in rats produced acute oral LD_{50}s of 519 mg/kg in males and 304 mg/kg in females, estimated dermal LD_{50}s of around 500 mg/kg for males and <500 mg/kg for females, and an inhalation LC_{50} of 477 mg/m^3 in both sexes. Telone C-17 was a severe skin irritant in rabbits.

Short-Term Studies

Rats and mice were exposed to 0, 17, 46, or 134 mg/m^3 of Telone II for 6 hours/day, 5 days/week for a total of 20 exposures. Mice had yellow stained fur and unkempt appearance from weeks 1 to 4 at 134 mg/m^3. In rats, yellow to brown stains on the head and back were seen in all treated female groups at week 4, and brown stains around ears and eyes occurred in 134 mg/m^3 females at weeks 3 and 4. There were no treatment-related effects on mortality, body weights gains, gross *post-mortem*, or histopathology.

Rats were exposed to 0, 51, 277, and 678 mg/m^3 of *cis*-1,3-D by inhalation for 6 hours/day, 5 days/week for a total of 9 exposures. Lethargy was seen after the first exposure to 678 mg/m^3. Body weight losses were recorded at 678 mg/m^3. Adrenal weights in both sexes and testes weights in males were increased at 678 mg/m^3. Histopathological effects were seen at 678 mg/m^3 and included hyperplasia of the respiratory epithelium, degeneration of the olfactory epithelium, and exudate in the nasal passages (histopathology was not conducted on adrenals or testes). Non-protein sulfhydryl (NPS) content was significantly decreased in 277 mg/m^3 male livers and 678 mg/m^3 male lungs at 1 hour post-exposure. At 18 hours, NPS content increased in the kidney and liver of both sexes at 277 mg/m^3.

In palatability studies in rats, reductions in body weight gain and food consumption occurred at =10 mg/kg/day. In the definitive probe study, rats were fed 0, 10, 25, 50, or 100 mg/kg/day Telone II in their daily diet. Significant reductions in body weight gain occurred in =50 mg/kg/day males. Slight thickening and hyperkeratosis of the ng-stomach mucosa at =50 mg/kg/day were revealed at histopathological examination, possibly the result of localised irritation by Telone II.

In a palatability study in dogs, emesis followed single capsule administrations of 20-40 mg/kg, and to a lesser extent following oral gavage administrations of 20-40 mg/kg/day. In the definitive toxicity study, dogs received oral gavage doses of 0, 10, 20, or 40 mg/kg/day Telone II in peanut oil. Emesis occurred in 1/4, 1/4, 2/4, and 3/4

dogs for ascending doses of Telone II. Body weight and food consumption variations, urinalysis, organ weight, and gross *post-mortem* findings were similar for control and treated dogs.

Rats received oral gavage doses of 0, 1, 3, 10, or 30 mg/kg Telone II 6 days/week for 13 weeks. Body weight gains (females only) and food consumption at 30 mg/kg increased, food efficiency in 30 mg/kg males decreased. Relative liver weights increased in 10 mg/kg males and at 30 mg/kg, relative liver weights increased in 30 mg/kg females. There were no treatment-related findings in clinical signs, haematology, clinical chemistry, urinalysis, gross *post-mortem*, and histopathology. The NOEL was 3 mg/kg.

Rats were exposed by inhalation to 0, 45, 136, 409, or 681 mg/m^3 of 1,3-D for 6 hours/day, 5 days/week for 13 weeks. Reduced body weight gains were seen in =409 mg/m^3 rats, resulting in reduced terminal body weights. Histopathology revealed degenerative changes in the nasal sensory olfactory epithelium and/or hyperplasia of the respiratory epithelium of the nasal mucosa at =409 mg/m^3. Submucosal aggregates of lymphoid cells in the urinary bladders of 136 mg/m^3 females were associated with hyperplasia of the urinary bladder transitional epithelium in =409 mg/m^3 females.

Rats were exposed by inhalation to 14 mg/m^3 of 1,3-D for ½, 1, 2, or 4 hours/day, 5 days/week for 6 months. Slight cloudy swelling of the tubular epithelium was seen in rats exposed 4 hours/day. There were no other exposure-related findings on mortalities, clinical signs, body weights, organ weights and gross and microscopic *post-mortem.*

Rats, guinea pigs, rabbits, and dogs were exposed by inhalation to 5 or 14 mg/m^3 of 1,3-D 125-130 times over a period of 185 days. Following the last exposure, cloudy swelling of the renal tubular epithelium was noted in 14 mg/m^3 male rats, which was reversible within 3 months. There were no other exposure-related findings on mortalities, clinical signs, body weights, organ weights and gross and microscopic *post-mortem.*

Rats were exposed to 0, 59, 147, or 409 mg/m^3 of *cis*-1,3-D for 6 hours/day, 5 days/week for 13 weeks. Body weight gain decreases were seen in 409 mg/m^3 males and on 3 weekly occasions in 409 mg/m^3 females and slight decreases in food consumption occurred at 409 mg/m^3 during the first week only. Slight multifocal bilateral degeneration and slight bilateral multifocal hyperplasia of the epithelium were observed in the nasal cavities at 409 mg/m^3. Examinations of mortalities, clinical signs and functional observation batteries, haematological and clinical chemistry parameters, macroscopic *post-mortem*, and organ weights revealed no significant findings that could be attributed to *cis*-1,3-D exposure.

Rats and mice were exposed to 0 (compressed air), 54, 146, or 422 mg/m^3 of Telone II for 6 hours/day, 5 days/week for a total of 65 exposures over 13 weeks. Wet fur was noted on 422 mg/m^3 mice during several exposures. Significant reductions in body weight gain occurred at 422 mg/m^3 in rats and female mice, with a slight, non-significant reduction in 422 mg/m^3 male mice. There were no clinical signs of toxicity in rats, or deaths related to Telone II exposure. With the exception of necrosis of the nasal turbinate epithelium in one 422 mg/m^3 female mouse, the type and incidence of findings at gross *post-mortem* and histopathological examinations were similar for control and exposed animals.

Mice were fed 0, 15, 50, 100, or 175 mg/kg/day microencapsulated Telone II in their diet for 13 weeks. There were significant reductions in body weight gain at =50 mg/kg/day. Clinical chemistry revealed significant decreases in glucose for 175 mg/kg/day males, and in triglycerides in =100 mg/kg/day females. There were treatment-related decreases in kidney weights at 175 mg/kg/day and in liver weights in =100 mg/kg/day males and in all treated female groups. Histopathological examination revealed very slight, diffuse, decreases in the size of hepatocytes in treated male groups, and decreased vacuolation of the renal tubules in three 175 mg/kg/day males. Organ weight variations and histopathological findings were secondary to treatment-related reduced nutritional status and decreased body weight gains. There were no deaths, clinical signs of toxicity, or ophthalmological findings, and no haematological findings attributable to Telone II treatment. A NOEL was not established in this study, due to reduced liver weights in 15 mg/kg/day females.

Rats were fed 0, 5, 15, 50, or 100 mg/kg/day microencapsulated Telone II in their diet for 13 weeks. Additional rats received 0 or 100 mg/kg/day microencapsulated Telone II in their daily diet for 13 weeks, followed by a 4-week recovery period. Significant reductions in body weight gain occurred in all treated male groups and in =15 mg/kg/day females after 13-weeks treatment, and in the 100 mg/kg/day groups after 4-weeks recovery. There were decreases in food consumption in all treated male groups and in =15 mg/kg/day females during the 13-week treatment. There were slight but significant decreases in alkaline phosphatase (AP) in =50 mg/kg/day males, triglycerides in =15 mg/kg/day males, albumin in 100 mg/kg/day females, total protein and globulin in =50 mg/kg/day females persisting in 100 mg/kg/day recovery females, and a slight but significant increase in cholesterol was observed in 100 mg/kg/day males. At gross *post-mortem*, adipose tissue was decreased in =50 mg/kg/day females treated for 13 weeks, these findings were not seen in the recovery group. Rats treated with =50 mg/kg/day had significant variations in a number of organ weights, which are considered secondary to

reduced food consumption and poor nutritional status. Histological findings following 13-weeks of treatment included hyperkeratosis and basal cell hyperplasia in the ng-stomach mucosa at =15 mg/kg/day, and are likely to be the result of localised irritancy caused by ingestion of Telone II in the diet. Basal cell hyperplasia was also seen in recovery groups, but in fewer animals and at a lower severity, suggesting these stomach effects may be reversible. There were no deaths, clinical signs of toxicity, or ophthalmological findings, and no haematological findings attributable to Telone II treatment. A NOEL was not established in this study, due to reductions in male body weight gain and food consumption at the lowest dose tested, 5 mg/kg/day.

Very slight cloudy swelling of the renal tubular epithelium was seen in the kidneys of rats exposed by inhalation to 12.7 mg/m^3 1,3-D for 4 or 7 hours/day, 5 days/week for around 6 months. This was reversible in similarly exposed-rats allowed a 3 month recovery period. There were no other exposure-related effects on mortality, clinical signs, body and organ weights, and gross *post-mortem*. There were no 1,3-D exposure-related effects in guinea pigs, rabbits, or dogs exposed to 12.7 mg/m^3 1,3-D for 7 hours/day, over 6 months. Seven of 10 human volunteers could detect (probably by smell) 4.1 mg/m^3 of 1,3-D when exposed in a whole-body chamber for 1-3 minutes.

Long-Term Studies

In NTP carcinogenicity bioassays, mice received of 0, 50, or 100 mg/kg and rats received 0, 25, or 50 mg/kg a Telone II formulation (89% 1,3-D, 1.5% trichloropropene, 1.0% epichlorohydrin) in corn oil, by oral gavage 3 times/week for 104 weeks. Survival was reduced in 100 mg/kg female mice, a high mortality in control males precluded estimates of survival in treated-males. Reductions in body weight gains occurred in treated mice and 50 mg/kg male rats. Significant (except epithelial hyperplasia in treated females) hyperplastic and neoplastic changes were observed in the fore-stomachs of treated mice. Transitional cell carcinomas were noted in 100 mg/kg male and in treated female mice. The incidence of lung adenomas significantly increased in treated mice, with some evidence of an increase in carcinomas in females. Hyperplastic changes at 25 mg/kg and squamous cell papillomas at 50 mg/kg, with some carcinomas in 50 mg/kg males were seen in the rat fore-stomach. NOELs for mice and rats could not be established due to the hyperplastic findings at the lowest doses tested.

Thirty female non-inbred Ha:ICR Swiss mice received weekly 3.0 mg s.c injections of 1,3-D into the left flank of 1,3-D for 76 weeks. Mean survival times ranged from 518 to 649 days. Sections of the liver and injection site were taken at *post-mortem* for histopathological examination. After 538 days, 6 mice had sarcomas at the injection site. It is likely that the presence of the known carcinogen epichlorohydrin as a stabiliser in the 1,3-D formulation, caused the sarcomagenic response.

Mice were exposed by inhalation to 0 (compressed air), 23, 91, or 273 mg/m^3 of Telone II for 6 hours/day, 5 days/week for 24 months (510 exposures). Significant reductions in body weight gain occurred at 273 mg/m^3. Gross *post-mortem* revealed an increase in lung masses/nodules in 273 mg/m^3 males and a decrease in body fat in 273 mg/m^3 females. Stereo microscopy revealed roughened, irregular and opaque appearance to the surface of urinary bladders in 273 mg/m^3 males and =91 mg/m^3 females, which was manifest histologically as significant increases in incidence and severity of hyperplasia of the transitional epithelium in the urinary bladder at =91 mg/m^3. At 273 mg/m^3, there were decreased heart, kidney, and liver weights in males. Other histopathology revealed significant increases in bronchioalveolar adenomas in 273 mg/m^3 males, hypertrophy and hyperplasia of the respiratory mucosa in 91 mg/m^3 females and at 273 mg/m^3, degeneration of olfactory epithelia at 273 mg/m^3, and epithelial hyperplasia of the ng-stomach in 273 mg/m^3 males. There were significant decreases in kidney vacuolation in 273 mg/m^3 males and hepatocellular vacuolation in 273 mg/m^3 females. There were no treatment-related effects on mortalities or clinical signs. There were no effects observed at 23 mg/m^3 Telone II.

Mice were fed 0, 2.5, 25, or 50 mg/kg/day microencapsulated Telone II in their diet for up to 24 months. Significant decreases in body weight gains and slight decreases in food consumption occurred at =25 mg/kg/day. Absolute heart, kidney, and liver weights were decreased in =25 mg/kg/day males and females. Relative weights were unchanged or slightly increased, suggesting an association with poor nutrition and reduced body weight gain. Mortalities, clinical signs of toxicity, ophthalmological, urinalysis, gross *post-mortem*, and histological findings were similar in control and treated animals, and there were no haematological findings attributable to Telone II treatment. A NOEL was established at 2.5 mg/kg/day, based on the decreased body weight gain and food consumption, and variations in organ weights at the next highest dose.

Rats were exposed by inhalation to 0 (compressed air), 23, 91, or 273 mg/m^3 of Telone II for 6 hours/day, 5 days/week for 2 years (509 exposures). Significant reductions in body weight gain occurred in =91 mg/m^3 males and 273 mg/m^3 females. Histopathology revealed significant treatment-related changes to the nasal tissues at 273 mg/m^3, including decreased thickness and erosions of the olfactory epithelium and submucosal fibrosis of the underlying olfactory mucosa. There were no treatment-related effects on mortalities, clinical signs,

haematology, clinical chemistry, urinalysis, gross *post-mortem*, organ weights, or tumour incidence. No effects were observed at 23 mg/m^3.

Rats were fed 0, 2.5, 12.5, or 25 mg/kg/day microencapsulated Telone II in their diet for up to 24 months. Significant decreases in body weight gains occurred at =12.5 mg/kg/day and there were slight decreases in food consumption for =12.5 mg/kg/day males and 25 mg/kg/day females. Decreases in serum triglycerides were recorded in males at =12.5 mg/kg/day and in 25 mg/kg/day females. At gross *post-mortem* and at histopathological examination, a slight increase in the incidence of erosions/ulcers of the glandular mucosa of the stomach was seen in 25 mg/kg/day males. Significant decreases in absolute adrenal, heart, and liver weights were seen. Relative weights were slightly increased or unchanged, suggesting an association with poor nutrition. Kidney weight was increased at 25 mg/kg/day. Histopathology at 24 months revealed an increase in primary hepatocellular adenomas in =12.5 mg/kg/day males and in 25 mg/kg/day females, and an increased incidence of uterine primary benign endometrial stromal polyps in 25 mg/kg/day females. Basal cell hyperplasia of the ng-stomach was noted at 12 and 24 months in =12.5 mg/kg/day animals. Gross *post*-mortem and histopathological findings in the stomach were likely to be the result of localised irritancy caused by ingestion of Telone II in the diet. Mortalities, clinical signs of toxicity, ophthalmological and urinalysis findings were similar in control and treated animals, and there were no haematological findings attributable to Telone II treatment. A NOEL was established at 2.5 mg/kg/day, based on the decreased body weight gain, decreased food consumption (males only), variations in organ weights, and increases in basal cell hyperplasia in the ng-stomach at the next highest dose.

Dogs were fed 0, 0.5, 2.5, or 15 mg/kg/day microencapsulated Telone II in their diet for up to 12 months. Pale mucous membranes were observed in three 15 mg/kg/day dogs, one of which had alopecia, roughened and occasional reddened skin. Reductions in body weight gain occurred at 15 mg/kg/day. There were significant variations in red cell parameters, with increases in RBC counts, and decreases in Hb, HCT, MCV, and MCH at 15 mg/kg/day. Alterations to erythrocyte morphology at 15 mg/kg/day included slight to marked polychromasia, hypochromasia, and the presence of nucleated RBCs, with an increase in severity at later time points. There were increases in platelet counts and in platelet size at 15 mg/kg/day. Serum CPK was significantly increased in 15 mg/kg/day females. At gross *post-mortem*, one 15 mg/kg/day dog had decreased body fat and alopecia. Liver weights were increased in 15 mg/kg/day males. Histopathological examination revealed increased haematopoiesis in the bone marrow and spleen, characterised by increased numbers of erythroid, myeloid, and megakaryocytic cells, with a decrease in marrow fat. The pale appearance, haematological and histological findings at 15 mg/kg/day dogs indicate the presence of treatment-related hypochromic, microcytic anaemia in these animals. There were no deaths, and no treatment-related ophthalmological findings. A NOEL was established at 2.5 mg/kg/day, based on the clinical signs, reductions in body weight gain, haematological, organ weight, and histopathological findings at 15 mg/kg/day.

Reproduction and Developmental Studies

F_0 male and female rats were exposed to 0, 45, 135, or 404 mg/m^3 of Telone II by inhalation for 6 hours/day, 5 days/week for 10 weeks prior to and during breeding, gestation, and lactation of 2 generations. Two litters were produced per generation. One 404 mg/m^3 F_2 parental female died from an exposure-related perforated gastric ulcer. Reductions in body weight gain occurred in adult rats exposed to 404 mg/m^3, except females during gestation and lactation. A roughened surface and erosions and/or ulcers were seen at gross *post-mortem* in the non-glandular stomachs of 404 mg/m^3 F_0 parental rats. Histopathological findings included hyperplasia of the respiratory epithelium and degeneration of the olfactory epithelium in nasal tissues, and acanthosis, inflammation, and ulceration of the non-glandular stomach in both parental generations at 404 mg/m^3. There were no exposure-related clinical signs, and no effects on reproductive performance or neonatal parameters. No effects were observed at 135 mg/m^3.

Mated rats and inseminated rabbits were exposed by inhalation to 0, 91, 272, or 545 mg/m^3 of Telone II during gestation days 6-15 (rats) or 6-18 (rabbits). Rat maternotoxicity was evident as a dose-related decrease in body weights and body weight gains during gestation in all exposed groups. Pregnancy, implantation, resorption or pre-implantation loss rates were unaffected by exposure. Litter size, foetal sex ratios and body measurements, and incidences of external, soft tissue, and skeletal malformations were similar in all groups. There were three deaths amongst maternal rabbits, one from each of the control, 272, and 545 mg/m^3 groups (control and 272 mg/m^3 rabbits died of pneumonia. Maternal rabbits exposed to =272 mg/m^3 had body weight losses on gestation days 6-8, and a reduction in body weight gain over the exposure period. There were no exposure-related effects on pregnancy rates, implantations, resorption or pre-implantation loss rates, litter size, foetal sex ratios and body measurements, and incidences of external, soft tissue, and skeletal malformations. The maternal NOEL in rabbits was 91 mg/m^3 (a maternal NOEL was not established in rats due to body weight effects in then

lowest dose). No evidence of embryo- or foeto-toxicity related to Telone II exposure was seen at the highest dose exposure 545 mg/m^3, in rats and rabbits.

Genotoxicity

1,3-D and associated products been tested in over 30 genotoxicity tests, with results generally being positive in most *in-vitro* studies and negative in most *in-vivo* studies. When tested in *in-vitro* studies, highly purified preparations of 1,3-D i.e.>99% pure or purified through a silicic column, were negative. Where *in-vitro* and *in-vivo* positives were obtained, most of the 1,3-D preparations (generally 95-98% pure) would have contained around 1.0% of the known genotoxin epichlorohydrin as a stabiliser. The addition of physiological concentrations of glutathione (GSH) in *in-vitro* tests was shown to lessen the magnitude or eliminate mutagenic potential.

Special Studies

Following inhalation of 1,3-D in mice, GSH levels decreased initially in the nasal tissues, followed by the lungs and liver as nasal tissue GSH becomes depleted at higher 1,3-D inhalation exposures. Experiments involving the modulation of cytochrome (cyt) and enzyme activities in mouse liver concluded that cyt P-450 is involved in the biotransformation of 1,3-D, that hepatotoxicity is caused by 1,3-D metabolites, and that GSH plays a key role in 1,3-D detoxification.

There were no clear treatment-related effects on cell proliferation or rates of apoptosis, or evidence of DNA damage in the urinary bladders and lungs of mice for up to 20 exposures of 0-703 mg/m^3 Telone II by inhalation, or in the livers of rats receiving 0-100 mg/kg/day for up to 26 oral doses. No highly mutagenic excretion products were found in the urine of mice receiving 100 mg/kg/day Telone II for 2 weeks.

Behavioural changes were noted in Rhesus monkeys following 20-50 minutes inhalation exposure to 2152-2751 mg/m^3.

Inhalation pharmacokinetics of 1,3-D in human volunteers showed blood concentrations to plateau within 1 hour of exposure and disappear from the blood within 20 minutes after a 6 hour exposure. Absorption was 70-80% for both isomers, with higher blood concentrations for the *trans*- isomer, and a greater proportion of the *cis*- isomer was excreted as the mercapturic acid metabolite than the *trans*- isomer. In an interspecies comparison, the percentage of absorbed 1,3-D excreted in the urine and the ratio of *cis-/trans*- conjugates excreted in the urine were similar in rats and humans, showing the rat to be an appropriate model for human pharmacokinetics. Estimated uptake of 1,3-D following dermal exposure to air levels of around 86 mg/m^3 in humans is approximately 2-5% that of inhalation absorption.

In studies involving human exposure, off-site air collections (at 0-1600 m from edges of treated fields at a height of around 5 feet) from various sites in the USA showed that lifetime average daily doses were calculated to be 0.04-0.6 µg/kg/day, and that normal agricultural use of Telone was unlikely to result in significant toxicity to the local population.

Following a tank truck spill of Telone II involving around 80 people (firemen, traffic officers, and bystanders), symptoms such as headaches, chest and abdominal discomfort were evident for up to 14 days and were related to levels of exposure (although exposure levels were not quantified). Increases in blood AST and ALT occurred up to 72 hours post-exposure. When followed up 2 years later, persisting symptoms did not relate to levels of Telone II exposure.

Male workers engaged in the production of 1,3-D, allyl chloride, and epichlorohydrin suffered were no detrimental effects upon their fertility. Biological monitoring of fifteen 1,3-D applicators showed that increased excretion of the renal tubular enzyme N-acetyl glucosaminidase (NAG) was related to air exposures of >700 mg/min/m^3 1,3-D or urinary excretion of >1.5 mg of a urinary metabolite of 1,3-D.

A 27 year old farm worker developed gastro-intestinal distress, adult respiratory distress syndrome, haematological, hepatic and renal impairment prior to death, 40 hours after drinking a liquid containing 1,3-D.

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 1,3-dichloropropene in Schedule 7/Appendix J 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 lowest NOELs for 1,3-D were 2.5 mg/kg/day in 24-month rat and mouse dietary studies and in a 12-month dietary dog study.

An ADI for 1,3-D is not required since there are no detectable residues (see Residue Assessment – next section) when Telone Soil Fumigant and Telone C-35 Soil Fumigant are used as a pre-plant soil fumigant. Expansion of the use pattern of 1,3-D may result in situations where residues would be expected, consequently the establishment of an ADI would be considered at that time.

RESIDUES ASSESSMENT

Residues in food commodities

Residue data were provided for various vegetable crops (including potatoes, onion, lettuce, cantaloupe, soybeans, green beans, broccoli, tomato, radish and Chinese cabbage) and other plant commodities (dry beans, pineapple, sugar beet) from trials conducted in the USA and Japan.

The applicant has requested that the NRA place 1,3-dichloropropene in Table 5 of the *MRL Standard*. This request is supported by metabolism and residue trial data, which show no detectable residues in crops grown in treated soil.

Test plots were prepared and soil was injected with 1,3-dichloropropene at 1X – 2X the maximum proposed use-pattern (approximately 200 – 400 L/ha). Crops were planted 14 – 21 days after treatment and allowed to grow to maturity. At maturity, ranging from 66 to 320 days, samples were homogenised and stored frozen until analysis. The samples were analysed by GC/ECD, following liquid/liquid extraction into hexane. The data from these trials indicate no residues were detected (LOQ = 0.01 ppm).

Residue trials were not provided for grain crops or fruit and nut trees. Extrapolation from the trial conducted on dry beans is satisfactory to account for grain. The harvest period (excess of 140 days) and crop habit are of similar nature. Therefore, the likelihood of residues in grain is negligible. This is further supported by the metabolism study conducted on wheat, which shows no residues of concern. In the case for fruit and nut trees, groves are expected to be treated before planting bare-root stock and these trees are not expected to be commercially harvested for a number of years. Accordingly, there are unlikely to be residues remaining after this period.

Metabolism

The applicant provided data concerning the metabolism of 1,3-dichloropropene in plants (bush beans, carrots, lettuce, spinach, soybean, tomatoes, wheat, and radish) and animals (chickens, and lactating goats).

Plant metabolism

^{14}C -1,3-dichloropropene was applied 0 – 21 days prior to crop planting. Crops were established and grown to maturity, which varied between 66 and 320 days from the date of application. At maturity, samples were analysed for total radioactive residues (TRRs), and the composition of the TRRs was determined using various techniques including HPLC, TLC, liquid/liquid partitioning and ion exchange chromatography. The results show 1,3-dichloropropene is readily absorbed through the root system, and within 48 hours of absorption, complete metabolism of the parent compound occurs. The studies suggest metabolism is via a central metabolite, possibly pyruvate, where it is assimilated into natural plant products. No residues of concern have been indicated.

Animal metabolism

Two studies were provided for. These consisted of feeding radio-labelled ^{14}C 1,3-dichloropropene to chickens and lactating goats for 7 and 5 days respectively. Doses were exaggerated (approximately 3,500 to 4,000X), assuming the animal's diet was composed entirely of soybean products. At completion, animals were sacrificed and the total ^{14}C-residue levels were determined in the edible and other appropriate tissues using combustion radio-analysis and liquid scintillation spectrometry. The radioactive residues recovered in the various solvents where analysed by HPLC, and degradates were identified by HPLC and TLC or by using LC/MS.

The results indicated that 1,3-dichloropropene is metabolised by hens through glutathione conjugation. The terminal residue was 1,3-D cysteine conjugate (1,3-D CYS), which was found in the muscle and liver. At normal exposure rates (*i.e.*, taking into consideration of the exaggerated dose rate), the levels are well below the LOQ of 0.01 ppm. The terminal residues found in laying hens present no residue concern.

For lactating goats, metabolism of 1,3-dichloropropene is through glutathione conjugation, however the only metabolite found was 1,3-D-mercapturic acid conjugate in urine. It is considered that the time from last dose to

slaughter, 22 hours, to be sufficient to allow clearance of 1,3-dichloropropene in the edible tissues and milk. The terminal residues that were identified were consistent with radioactivity into natural products, and accordingly, pose no residue or toxicological concern.

MRL Standard

The following amendment to the *MRL Standard* is recommended:

Table 5

Compound	Use
ADD	
1,3-dichloropropene	Pre-plant fumigant for vegetables, cereal grains, and fruit and nut trees.

A WHP will not be required.

ASSESSMENT OF OVERSEAS TRADE ASPECTS OF RESIDUES IN FOOD

Trade Implications

In the USA, 1,3-dichloropropene is registered for use as a pre-plant soil fumigant. It is classified as a non-food use pesticide when used as a pre-plant soil fumigant and, accordingly, no residue tolerances, or exemptions from the requirements of a tolerance, are required.

There are no Codex standards for 1,3-dichloropropene. However, residue data submitted by the applicant showed no detectable residues when used according to the proposed use-pattern. Consequently, the use of 1,3-dichloropropene as a pre-plant fumigant for vegetables, cereal grains and nut trees is unlikely to impact upon trade of treated produce.

OCCUPATIONAL HEALTH AND SAFETY ASSESSMENT

1,3-Dichloropropene (1,3-D) is on the NOHSC *List of Designated Hazardous Substances*. Substances containing 1,3-D are hazardous when it is present in concentrations at and above 1%.

1,3-D will be manufactured overseas as a white to amber liquid with a sweet odour. There were no acute toxicity data submitted for the mixed (*cis* and *trans*) 1,3-D isomers. The isomer cis 1,3-D had moderate acute oral and dermal toxicity, and low acute inhalation toxicity. It was a slight skin irritant, a severe eye irritant and a skin sensitiser.

Telone products, Telone Soil Fumigant (Telone) and Telone C-35 Soil Fumigant (Telone C-35), are liquid formulations. The applicant has classified Telone products as hazardous in accordance with the NOHSC *Approved Criteria for Classifying Hazardous Substances*. Telone products have moderate acute oral, dermal and inhalation toxicity. The products were slight to moderate skin irritants, severe eye irritants and skin sensitisers.

Formulation, repackaging, transport, storage and retailing

Telone products will be formulated in the formulation plant at Wingfield, South Australia. The products will be packed in refillable reusable 100 L closed transfer, dry disconnect metal cylinders. Under normal conditions, workers are not expected to come in contact with the finished and packed products. Advice on safe handling of the product during routine transport, storage and use is provided in the Material Safety Data Sheet (MSDS) for Telone and Telone C-35.

Use and exposure

The products are applied undiluted prior to crop planting using specialised tractor-drawn rigs, which inject the product at approximately 35 cm beneath the soil surface by broadcast (broad acre) and row. After application, the injection site is sealed to prevent fumigant loss using mechanised equipment, either by compacting the top layer of soil, applying water seal, using plastic sheeting or a combination of these methods.

Application rates for Telone vary from 85 to 515 L/ha and 250 to 1570 mL/100 m of row. For Telone C-35, broad acre application rate ranges from 200 to 700 L/ha.

Considering the proposed use-patterns, workers may be exposed to Telone during and after normal use. The main routes of exposure to Telone are dermal, ocular and inhalation. Potential exposures are identified to be associated with the following activities: leaks at hose connections, breaking hose connections, accidental spill, during repair, cleaning and maintenance of equipment, off-gassing (release of fumigant from the treated soil), or at re-entry into fumigated areas.

Telone products can cause severe skin and eye irritation, and are skin sensitisers. Repeated exposures to Telone products caused irritation that were route specific (e.g. irritation of the stomach in oral studies and respiratory tract irritation in inhalation studies). Telone product containing 1,3-D and chloropicrin showed moderate inhalation toxicity. Telone has a high vapour pressure and therefore, inhalation of fumes is also of concern.

Exposure monitoring studies (inhalation and biological monitoring) were submitted to determine worker exposure associated with Telone products when loading and applying the product and at re-entry following product application. The studies indicated that important mitigation measures include the use of proper engineering controls and personal protective equipment and the imposition of entry restrictions. All of these mitigation measures are recommended in the draft label for Telone.

Tractor drivers are responsible in fitting the cylinder into the tractor and applying the soil fumigant. Based on the nature of work done ("ready to use" Telone products in cylinders only and the use of specialised tractor-drawn rigs, which inject the product) proposed in Australia, worker exposure is expected to be minimal since there is no direct contact with the product contained in the cylinder. However, given the irritating effects of Telone products, moderate acute toxicity in general and their skin sensitisation potential , the use of cotton overalls buttoned to the neck and wrist and a washable hat, chemical resistant apron, elbow length neoprene gloves, impervious footwear and full face piece respirator with organic vapour/gas cartridge or canister are warranted when using the product.

Some workers will be looking over the application of the fumigant and the proper laying of plastic sheeting to prevent fumigant loss during fumigation. These workers are expected to have lower dermal and inhalation exposure than tractor drivers since fumigant loss is minimised by deep injection and soil sealing. NOHSC recommends the use of cotton overalls buttoned to the neck and wrist and a washable hat, chemical resistant gloves, impervious footwear and full face piece respirator with organic vapour/gas cartridge or canister when carrying these tasks during fumigation.

Entry into treated areas or handling treated crops

The information booklet accompanying the draft label states that treated soil should be left undisturbed for at least 7 days and unplanted for at least 14 days post-application.

Farmers may not need to re-enter the fumigated areas; however, other workers may re-enter. The draft label for Telone and Telone C-35 included a re-entry period of 5 days after treatment. NOHSC supports the restricted re-entry period stated on the draft label, which is also consistent with that recommended by the US-EPA. Cotton overalls buttoned to the neck and wrist (or equivalent clothing), chemical resistant gloves, chemical resistant footwear and full face piece respirator with organic vapour/gas cartridge or canister should be worn when prior entry is necessary, or when odour persists beyond 5 days after treatment and entry is required.

Recommendations for safe use

Users should follow the instructions and Safety Directions on the product label. Safety Directions include the use of cotton overalls buttoned to the neck and wrist and a washable hat, chemical resistant apron, elbow-length neoprene gloves, impervious footwear and full face piece respirator with organic vapour/gas cartridge or canister when using the product.

The PPE recommended should meet the relevant *Standards Australia*.

Re-entry statement

"Do not allow entry into treated areas for 5 days after treatment. When prior entry is necessary, or when odour persists beyond 5 days after treatment and entry is required, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing), chemical resistant gloves, chemical resistant footwear and full face piece respirator with organic vapour/gas cartridge or canister."

Precautionary Statement

"Workers within the vicinity of the treatment area should wear cotton overalls buttoned to the neck and wrist and a washable hat, chemical resistant gloves, chemical resistant footwear and full face piece respirator with organic vapour/gas vapour cartridge or canister."

Other controls

NOHSC supports that warning signs at all approaches to the fumigation site should be in place during and after fumigation. The warning signs should include the name of the applicator, the address and the contact details for poisons information centre.

Information provision

Material Safety Data Sheet (MSDS)

Manufacturers and importers should produce a MSDS for Telone and Telone C-35. These should contain information relevant to Australian workers, as outlined in the NOHSC *National Code of Practice for the Preparation of Material Safety Data Sheets*. Employers should obtain the Material Safety Data Sheets from the supplier and ensure that their employees have ready access to it.

Occupational controls

Exposure standards

NOHSC has established an exposure standard of 1 ppm or 4.5 mg/m3 TWA (time weighted average) for 1,3-D. 1,3-D is also designated as carcinogen category 3 with skin notation in the NOHSC *Exposure Standards for Atmospheric Contaminants in the Occupational Environment*. Employers should ensure that exposure to 1,3-D does not exceed this standard.

Health surveillance

NOHSC has not placed 1,3-D on the Schedule for Health Surveillance (Schedule 3 Hazardous Substances for which Health Surveillance is Required).

NOHSC does not consider placing 1,3-D on this schedule at this stage.

Conclusion

Telone products can be used safely if handled in accordance with the instructions on the product label and any other control measures and re-entry restrictions described above. Additional information will be available on the product MSDS.

ENVIRONMENTAL ASSESSMENT

Summary of Environmental Fate

Proposed Use

1,3-Dichloropropene will be injected directly into the soil to a depth of at least 20 cm below the soil surface and the soil sealed immediately after application. Proper application and soil sealing are important and instructions are given on the label for soil preparation, application and sealing.

Hydrolysis

Hydrolysis of 1,3-dichloropropene in phosphate buffers at pHs 4.9, 6.9 and 9.0 at temperatures of 10-30^{o}C showed the rate of hydrolysis varied directly with the temperature but was independent of the pH. In citrate/phosphate buffers of pH 5.5 and 7.5, half-lives for the *cis* and *trans*-1,3-dichloropropene isomers at 15^{o}C were 11 and 13 days and 9.4 and 10 days while at 29^{o}C, the respective half-lives were 1.9 days for both isomers and 1.4 and 1.2 days. Hydrolysis to 3-chloroallyl alcohol [3-chloro-2-propen-1-ol] can be expected to be a route of degradation of 1,3-dichloropropene in aquatic systems.

Photolysis

1,3-dichloropropene does not absorb visible light and the expected lack of atmospheric degradation was confirmed experimentally with no photodegradation of 1,3-dichloropropene exposed to a sunlamp for 30 days. In the presence of chemicals such as methane, nitrogen dioxide and water vapour, the tropospheric half-lives of *cis* and *trans*-1,3-dichloropropene were about 50 and 30 hours respectively. Reaction of 1,3-dichloropropene with hydroxyl radicals gave estimated half-lives of 1.9 and 1.1 days for the cis and trans isomers respectively while in the presence of ozone had respective half-lives of 76 (*cis*) and 17 (*trans*) days. 1,3-Dichloropropene is therefore expected to have a short atmospheric existence with degradation primarily via mechanisms other than direct absorption of sunlight. While 1,3-dichloropropene contains chlorine constituents suggesting a potential effect on stratospheric ozone, the atmospheric half-life is relatively short due to the reaction with photochemically produced hydroxyl radicals to formyl chloride which in turn reacts with water to form formic and hydrochloric acids. The chlorine from the 1,3-dichloropropene is thus removed from the atmosphere (via precipitation of the HCl) within a few weeks. Consequently 1,3-dichloropropene is not expected to deplete ozone to any significant extent. The proposed use of 1,3-dichloropropene is also not expected to have any significant global warming potential because of its ready degradation.

Photolysis of 1,3-dichloropropene in sterile pH 5 buffer held at ca. 25^{o}C showed that after correcting for the effect of hydrolysis, the photolytic half-life was ca. 430 days. This confirms that the predominant route of 1,3-dichloropropene degradation in water will be via hydrolysis and not photolysis.

Soil photolysis is not expected to be of significance given the mode of application, which results in the 1,3-dichloropropene being sealed beneath the soil.

Biodegradation

Nine aerobic soil studies were presented, two of which were relatively old being conducted in the late 1960s. In the other studies with a large variety of soil types half-lives were <1-37 days [with one outlier of 61 days] for temperatures of approximately 15-30^{o}C in laboratory studies with the rate dependent on temperature and soil moisture content. The degradation pathway involved hydrolysis of the parent to give 3-chloroallyl alcohol, which in turn was microbially degraded to firstly 3-chloroacrylic acid and eventually to bound residues and carbon dioxide [ca. 1 to 40% of the applied radioactivity (ca. 60-70% in one study, but possibly contaminated with 1,3-dichloropropene or its breakdown products)]. Volatilisation from the soil was identified as a major route of 1,3-dichloropropene removal from the soil. 1,3-dichloropropene is expected to dissipate from treated soils via field volatilisation and ready degradation with eventual mineralisation.

Under anaerobic conditions, two US soils treated with 1,3-dichloropropene and held at 15 or 25^{o}C had half-lives of 7 to 9 days at 15^{o}C and 2.4 days at 25^{o}C.

Mobility

Early (pre-1980) studies and reports indicated that in closed systems, the majority of added 1,3-dichloropropene was adsorbed to the soil with the adsorption dependent on the organic matter content and that there was strong affinity between 1,3-dichloropropene and clay systems with the primary adsorption in soils possibly being via an ion exchange process. There were no more recent conventional batch adsorption/desorption studies for 1,3-dichloropropene but Environment Australia considers the column leaching studies provided sufficient alternative information. A study with four US soils showed that 59 to 84% of the applied radioactivity was leached with no degradation of 1,3-dichloropropene occurring. Average Koc values were 20-42, indicating very high mobility. When 1,3-dichloropropene was aerobically aged on a US loamy sand for 31 days, there was extensive degradation recorded with 3-chloroallyl alcohol the major metabolite found (25% of the applied radioactivity) along with 22% unchanged 1,3-dichloropropene. Approximately 30% of the applied radioactivity was found in the leachate with 53-56% retained in the top soil segment with indications that the mobility of 1,3-dichloropropene markedly decreased on aging but at worst, still in the high mobility class. The aerobic soil metabolites of 1,3-dichloropropene were 3-chloroallyl alcohol and 3-chloroacrylic acid, both of which were highly mobile.

Field Volatility Studies

In recognition of the high volatility of 1,3-dichloropropene and its loss to the atmosphere after field application, five studies on a variety of soils treated with 1,3-dichloropropene at between 100-340 L/ha under a variety of conditions and depths showed that maximum air concentrations generally occurred within 24 hours of treatment near the soil surface (at 15 cm above the field, the maximum concentrations ranged from 2.3 to 4.7 ppm [~500 ppb to ~ 1 ppm volume/volume]) with residue concentrations decreasing as the distance from the treated site increased. Three further field volatility studies reported on the amount of 1,3-dichloropropene estimated to have been lost to the atmosphere after soil application with formulations equivalent to Telone Soil Fumigant applied at rates of ca. 50-110 L/ha. In the two studies conducted in California, between 4.2 and 25% of the applied 1,3-dichloropropene was lost through volatilisation while at the third site in Florida, there was an apparent 100% loss of the applied 1,3-dichloropropene, a result put down to either the sandy nature of the soil, the shallow injection depth or the incomplete sealing after injection. These latter studies confirm that a significant loss of applied 1,3-dichloropropene to the atmosphere can be expected.

Field Dissipation Studies

Seven studies were presented which dealt with the field dissipation of 1,3-dichloropropene. Two early studies (1970s) showed that soil applied 1,3-dichloropropene moved through the soil with ca. 15% of the original 1,3-dichloropropene still present in the soil together with residues that included 3-chloroallyl alcohol and that residues could be present for periods of up to 30 months. The remaining field dissipation studies generally measured 1,3-dichloropropene and 3-chloroallyl alcohol concentrations in the soil using treatment rates equivalent to and greater than those proposed for Australian use and a variety of soil types. Movement of 1,3-dichloropropene through the soils was demonstrated, and was attributed to diffusion rather than leaching. Volatilisation was identified as a major dissipation route with maximum losses shortly after treatment. Soil dissipation was considered to be biphasic, with the losses through volatilisation predominant during the first 15 days. The overall half-lives for 1,3-dichloropropene in soil were estimated as about 50 days in one study and about 6 days in another. 3-Chloroallyl alcohol was the major degradation product with maximum residues found shortly after treatment and distributed throughout the soil layers. 1,3-Dichloropropene, 3-chloroallyl alcohol and 3-chloroacrylic acid were not detected in groundwater associated with the areas treated nor in a study conducted in Spain where eight wells were analysed for these residues following use of 1,3-dichloropropene.

Prospective groundwater and field volatility studies

A US prospective groundwater and field volatility study in the cold climate of Wisconsin using a loamy sand/sand soil with a formulation and treatment rate (ca. 300 kg 1,3-dichloropropene per ha) similar to that proposed for Australian uses showed that 1,3-dichloropropene in soil pore water taken from lysimeters at a 0.9 m depth was measurable within 3 days of treatment and peaked at ca. 22000 ppb 62 days after treatment and declined to <0.5 ppb 820 days after treatment. 3-Chloroallyl alcohol and 3-chloroacrylic acid were also detected, respectively peaking at ca. 690 ppb 21 days after treatment and at ca. 260 ppb 28 days after treatment. Similar results were recorded in deeper lysimeters but with higher 1,3-dichloropropene peaks. In groundwater wells associated with the treated area, 1,3-dichloropropene residues were measurable from 3 days after treatment and reached maximum concentrations of ca. 580 ppb in shallow and ca. 170 ppb in deep wells 91 days after treatment. The allyl alcohol and acrylic acid metabolites were also identified and confirmed as peaking round

300-690 and 60-480 ppb respectively then falling to <1 ppb some 800 plus days after the treatment. Consistent with previous studies, there was a calculated loss of 1,3-dichloropropene through volatility equivalent to ca. 22% of the applied material. The soil half-life was calculated as 17 days, a result also in line with previous half-life estimations.

In a second US study conducted in Florida on a sand soil and treatment with a 1,3-dichloropropene and chloropicrin formulation at a rate equivalent to ca. 230 kg 1,3-dichloropropene per ha, soil concentrations were at their maximum one day after treatment (ca. 80,000 ppb in the 0-30 cm layer and ca. 400 ppb in the 30-60 cm layer and rapidly declined to ca. 1.1 and 27 ppb respectively after 19 days and <2 ppb in both layers 81 days after treatment. In the top 0-30 cm of soil, 3-chloroallyl alcohol residues in the soil peaked three days after treatment (ca. 7200 ppb) while 3-chloroacrylic acid residues peaked at 19 days after treatment (ca. 2400 ppb). Residues in the lower level were all <10 ppb throughout the study. In shallow (0.5 metre) on-site wells, the maximum 1,3-dichloropropene concentration was recorded at days 1 to 3 after treatment (ca. 6400 ppb) and declined to <5 ppb at 81 days after treatment. Residues in intermediate and deeper wells were of a significantly lesser magnitude [22 and 1.8 ppb respectively] and after 145 days no residues (<0.025 ppb) were detected in any on-site wells. No significant residues were detected in any off-site wells, indicating no lateral movement of the 1,3-dichloropropene from the treatment site. The highest 3-chloroallyl alcohol concentrations were in the shallow wells (maximum ca. 1200 ppb at day 5) with <1 ppb present after 110 days. 3-chloroacrylic acid concentrations peaked at day 13 (ca. 460 ppb, shallow wells). In ditches surrounding the treated area, the maximum 1,3-dichloropropene concentration was 1.9 ppb recorded one day after application with residues not detected (<0.027 ppb) by day 13. There were no significant detections of either the allyl alcohol or the acrylic acid in the ditch waters. A loss of ca. 40% of the applied 1,3-dichloropropene via volatilisation from the soil was estimated, confirming the importance of this route of dissipation of field applied 1,3-dichloropropene. Laboratory half-lives for the various soil horizons in this study were between 4 and 38 days dependent on soil depth and incubation temperature while the field half-life for the previous study was about 17 days.

Retrospective groundwater studies

To examine whether there was significant leaching of 1,3-dichloropropene or its metabolites into shallow groundwater, studies conducted in California, Nebraska, North Carolina and Washington with application rates of ca. 67-260 kg of 1,3-dichloropropene per ha showed that there were no detections of 1,3-dichloropropene or its metabolites in the soil pre-treatment or ground waters at all sites except in Nebraska. Residues of 1,3-dichloropropene (0.23-3.9 ppb) were detectable from four to about nine months after treatment. No metabolites were detected. These studies show that it is uncommon for 1,3-dichloropropene residues to be measurable in groundwater following treatment with Telone products and that when detections did occur, they were < 5 ppb and have a transient nature. US survey data has shown that, despite extensive use of 1,3-dichloropropene, occurrences of the chemical in groundwater are not expected.

Runoff

Runoff of 1,3-dichloropropene from a plot susceptible to runoff after soil injection at a rate of ~300 L/ha [~60% of the maximum rate proposed for Australian use] was investigated. After natural and simulated rainfall of ~130 mm with the simulated rainfall over a 2 hour period, 62-81% of the applied rainfall was collected as runoff. Of the approximately 15 kg of 1,3-dichloropropene applied to the soil, 0.0015 to 0.0028% was lost in runoff. Concentrations of 1,3-dichloropropene in the runoff water were approximately 0.6 to 17 ppb. The study showed that under conditions that favoured runoff, only a very low amount of the applied 1,3-dichloropropene was transferred to the runoff waters.

Modelling

A study on the fate and transport of 1,3-dichloropropene using the CHAIN-2D concluded the model was not as an effective representation of 1,3-dichloropropene volatile phase transport as that of other models previously investigated. However, a second study modelled shallow and deep subsurface drip irrigation applications of 1,3-dichloropropene and concluded there was a reasonable prediction for soil gas concentrations and volatilisation losses of 1,3-dichloropropene in these treatments. Respective measured flux values were 93 and 67 $\mu g/m^2/s$ with predicted values of 125 and 58 $\mu g/m^2/s$ while measured volatilisation results were 66 and 57% respectively with predicted values of 69 and 52%. For the shank injection there was a larger difference between measured and modelled flux values [measured flux density of 1150 $\mu g/m^2/s$, predicted 38 $\mu g/m^2/s$] and between the amounts lost by emission [>90% measured, 40% predicted]. This was attributed to possible shank fractures of the soil allowing ready 1,3-dichloropropene volatilisation. Two studies with the US EPA's Industrial Source Complex

Short Term (ISCST) computer model concluded that both versions were equally accurate in predicting 1,3-dichloropropene concentration profiles.

Soil accumulation

Soil accumulation of 1,3-dichloropropene is not expected because of the proposed use pattern, the loss of the chemical via hydrolysis and volatilisation, and its relatively short half-life under field conditions.

Bioaccumulation

The low value of the octanol/water partition coefficient [K_{ow} ~80-120] and high water solubility [~2 g/L at 25^{o}C] imply a low potential for bioaccumulation by 1,3-dichloropropene.

Summary of Environmental Toxicity

Avian

In acute oral tests on bobwhite quail, the LC50 was 152 mg/kg body weight with a no observed effect concentration <68 mg/kg body weight with such results indicating 1,3-dichloropropene is moderately toxic to birds. In dietary feeding studies with bobwhite quail chicks and mallard ducklings, 1,3-dichloropropene was practically non-toxic to birds with no treatment related effects at the maximum doses used, approximately 10000 mg/kg (in feed).

Aquatic

A range of studies using 1,3-dichloropropene were conducted to meet US EPA and OECD guidelines current at the time the trials were conducted. The 96 hour LC50s for fish ranged from 1.6 to 7.1 mg ai/L, based on five studies using static or semi-static conditions, indicative of moderate toxicity to fish while exposure to the *cis* and *trans* 1,3-dichloropropene isomers in a 96 hour flow-through study with sheepshead minnow reported an LC50 of 0.968 mg/L for the *cis* isomer and 0.29 mg/L for the *trans* isomer, indicative of high toxicity under these conditions. In two studies with *D. magna* exposed to 1,3-dichloropropene the 48 hour LC50s were 1.4 and 6.2 mg 1,3-dichloropropene/L, indicating a moderate toxicity. A chronic flow-through study with the mysid, *Mysidopsis bahia*, had a NOEC of 1.4 mg/L, based on survival, which identified very slight toxicity as a result of the exposure.

The 96 hour acute toxicity of 3-chloroallyl alcohol to rainbow trout showed the alcohol was more toxic to the trout (96 hour LC50 of 0.99 mg/L) than was the parent 1,3-dichloropropene (96 hour LC50 of 1.6 mg/L). In contrast, this alcohol had a toxicity of similar magnitude as 1,3-dichloropropene itself to *D. magna* (48 hour EC50 of 2.3 mg/L for the alcohol and 1.4 mg/L for the parent). Acute exposure studies of rainbow trout and daphnids to 3-chloroacrylic acid indicated it was less toxic than 1,3-dichloropropene to both these species (respective 96 hour LC50 and 48 hour EC50 values were 69.5 and 55 mg/L). All the studies were conducted according to relevant US EPA and OECD guidelines.

In a 72 hours test conducted to US EPA guidelines current at the time of the study, 1,3-dichloropropene was moderately toxic to algae with an EbC50 of 2.8 mg/L. More recent studies on freshwater and bluegreen algae and on freshwater and saltwater diatoms showed that 1,3-dichloropropene was slightly toxic to the algae and saltwater diatom but highly toxic to the freshwater diatom. 3-chloroallyl alcohol was of slight toxicity to the algae and freshwater diatom but of high toxicity to the saltwater diatom. 3-chloroacrylic acid was of high toxicity to the freshwater algae, moderately toxic to bluegreen algae and freshwater diatom and slightly toxic to the saltwater diatom. 1,3-dichloropropene was of moderate toxicity to duckweed while the 3-chloroallyl alcohol and 3-chloroacrylic acid were of high toxicity to this aquatic plant.

Non-target invertebrates

In an early study on the contact toxicity to bees, conducted to an in-house protocol, 1,3-dichloropropene was relatively non-toxic to bees in the contact test. Based on a test conducted to OECD and EEC Guidelines, 1,3-dichloropropene was rated as moderately toxic to earthworms.

Phytotoxicity

No studies presented. Based on the use pattern and expected limited environmental exposure, the lack of phytotoxicity studies is not considered critical for the proposed use.

Environmental Hazard

The mode of application of 1,3-dichloropropene is via deep injection into the soil. Consequently there is expected to be no spray drift hazard associated with the proposed uses. The deep soil injection also minimises hazard to birds, mammals and bees. Runoff offers a potential source of contamination of water bodies but a US runoff study showed that less than 0.005% of the applied 1,3-dichloropropene was in the runoff waters at concentrations of 20 ppb or less with such levels unlikely to be of major environmental concern. Movement of 1,3-dichloropropene to the water table is possible but the proposed label Ground water advisory statement warning against application where soils are permeable and ground water is near the surface should minimise this risk.

Hazard evaluation with respect to environmental impacts has indicated that the proposed uses are unlikely to be a concern to birds, mammals or bees. Earthworm and other ground dwelling beneficials may be adversely affected. The relatively short half-life of 1,3-dichloropropene and ready dissipation from the top soil layers is expected to result in soil concentrations of 1,3-dichloropropene decreasing to levels that allow recolonisation from untreated areas.

The hazard to fish, aquatic invertebrates, algae and duckweed from 1,3-dichloropropene concentrations found in surface waters adjacent to treated areas is expected to be low with Q values for fish, *D. magna*, algae and duckweed all being less than 0.01. Runoff offers a potential source of contamination of water bodies but a US runoff study showed that less than 0.005% of the applied 1,3-dichloropropene was in the runoff waters with concentrations of 20 ppb or less with such concentrations unlikely to be of major environmental concern. Hazard from the 1,3-dichloropropene degradation products 3-chloroprop-2-en-1-ol (3-chloroallyl alcohol) and 3-chloroacrylic acid to aquatic species is expected to be low and mitigated by use of a 5 metre buffer zone between the treated area and nearby water bodies.

Environment Australia concludes that a low hazard to the environment may be predicted provided products containing 1,3-dichloropropene are used according to the proposed label recommendations and good agricultural practice and in accord with State and Territory requirements relating to disposal of rinsates and use in areas where soils are permeable and ground water is near the surface.

EFFICACY AND SAFETY ASSESSMENT

Proposed use pattern

1,3-dichloropropene is proposed to be used by soil injection to control a range of pests, weeds and fungal diseases of vegetable, field, nursery and fruit and nut tree crops in all States. Detail of the use pattern can be seen in the Directions For Use tables (for the two products) in the following section (Labelling Requirements).

Telone Soil Fumigant and Telone C-35 Soil Fumigant will be available on 100 L closed transfer, dry disconnect metal cylinders.

The rate of use varies according to crop and soil type. For vegetable and field crops, the proposed rate is 200 – 350 L/ha for light soils(coarse textured) and 350 – 600 L/ha for heavy soils (fine textured). For fruit and nut crops, the proposed rate is 350 – 700 L/ha for all soil types.

Based on the assessment that residues are not detectable at harvest, withholding periods will not be required.

Evaluation of efficacy data

Data presented by Dow AgroSciences Pty Ltd supported claims that when used in vegetable, field and fruit and nut crops, Telone Soil Fumigant will adequately control plant parasitic nematodes and that Telone C-35 Soil Fumigant will adequately control plant parasitic nematodes, symphylans (centipedes), wireworms, soil borne diseases and suppress weeds.

The data were adequate (accompanied by appropriate discussion) to satisfactorily assess efficacy when used according to the proposed label instructions.

Phytotoxicity

Phytotoxicity was not observed in trials.

LABELLING REQUIREMENTS

The draft label for Telone Soil Fumigant is given below. It reflects the assessments made by the NRA.

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

Dow AgroSciences

Telone*

Soil Fumigant

ACTIVE CONSTITUENT: 1150 g/L 1,3-DICHLOROPROPENE

FOR THE CONTROL OF PLANT PARASITIC NEMATODES IN SOIL AS SPECIFIED IN THE DIRECTIONS FOR USE TABLE

FOR USE BY PROFESSIONAL AND ACCREDITED FUMIGATORS

Dow AgroSciences Australia Limited. A.C.N. 24 003 771 659

20 Rodborough Road
FRENCHS FOREST NSW 2086
www.dowagrosciences.com.au

CUSTOMER SERVICE TOLL FREE 1-800 700 096

Contents: 75L
NRA Approval No.: GMID:

* Trademark of Dow AgroSciences

DIRECTIONS FOR USE

RESTRAINTS

DO NOT use on extremely heavy clay soils

DO NOT dilute with water.

DO NOT apply Telone Soil Fumigant through any type of irrigation system.

DO NOT use when soil temperature is below 5°C or above 27°C.

DO NOT treat soil when very wet or very dry.

DO NOT use transplants, tools or move crop residues that could carry soil-borne pests from infested land onto treated areas.

Treatment Rates for Nematode Control

CROP	PEST	SOIL TYPE	TREATMENT[1]		CRITICAL COMMENTS
			Broadacre L/ha	Rate/tyne in mL/100m of row[2]	
Vegetable crops[3]	Plant Parasitic Nematodes	Light soils (*eg*. Coarse-textured sands, sandy loams and loams)	85 – 112[4,5]	250 – 340[5]	**Pre-plant treatment only:** At time of application soil should be in good seed bed condition free of clods and undecomposed plant material and with adequate soil moisture. **Application Timing, Soil Conditions and Soil Moisture, Soil Preparation and Placement of Fumigant, Application Methods and Equipment and Sealing the Soil After Application:** See **APPLICATION** **Exposure period:** Leave soil undisturbed for at least 7 days after treatment. **Aeration period before planting:** Use a minimum of 14 days (see also **Soil Fumigation Interval** under **APPLICATION**). Longer intervals are required if the soil becomes cold or wet, and for deep-rooted tree, shrub and vine planting sites.
		Heavy soils (*eg.* Fine textured clay loams and clays or soils with very high organic matter such as peats.	235	720	
Field crops		Light soils (*eg*. Coarse-textured sands, sandy loams and loams)	85 – 112[5]	250 – 340[5]	
		Heavy soils (*eg.* Fine textured clay loams and clays or soils with very high organic matter such as peats.	168	515	
Fruit and Nut crops, Ginger[6,7,8]		Light soils (*eg.* Coarse-textured sands, sandy loams and loams)	250 - 325[5]	765 - 930[5]	
Nursery crops		All types	390 - 515[5]	1205 - 1570[5]	

[1] Do not exceed specified maximum application rates.

[2] Flow rates are based on 30.5 cm outlet spacing. Flow rates for alternate spacings can be calculated using the following formula: mL/100m of row/outlet = 0.1 X rate in L/ha X outlet spacing in cm. See Technical Brochure for more detail on row spacings and flow rates.

[3] Potatoes: Before fumigation, soil sampling for the type and number of pests present is recommended and can help to determine the need for additional treatment with a contact nematicide. Pre-harvest tuber sampling for nematodes also is recommended. If the nematode population is high enough to damage the crop, potatoes can be harvested early. Do not store potatoes with a detectable nematode infestation.

[4] For cyst-forming nematodes use 168 L/ha.

[5] For high pest pressure use higher rates.

[6] Pineapple: For best results, seal the soil with polyethylene film, which acts as a gas permeability barrier.

[7] Tree Planting Sites: Apply 700 mL of Telone at a single point in the centre of each planting site. For sites where no restrictive soil layers are present, the fumigant can be applied to a depth of 1.5m using an injection auger, however, optimum results are obtained using a split application (half at 1.5m and the rest at 0.5m depth) and cover the replant sites with plastic sheeting. For best results prepare and treat planting sites in autumn and plant in the spring. Sites prepared by backhoeing to break up restrictive soil layers that may retard fumigant movement should be dug in the approximate dimensions of 3 x 3 x 3m; the hole should then be backfilled to a depth of 1.5m.

[8] For shallow-rooted plants grown only one year, use 140 - 250 L/ha (425 - 765 L/100m) row/outlet).

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

THIS PRODUCT IS TOO HAZARDOUS FOR USE IN THE HOME GARDEN

IN TASMANIA, THIS PRODUCT IS NOT TO BE SOLD OR USED WITHOUT A LICENCE FROM THE REGISTRAR OF PESTICIDES

GENERAL INSTRUCTIONS

Telone Soil Fumigant is a liquid fumigant for pre-plant treatment of cropland soil that can be used as part of a management programme involving rotation, resistance varieties, and other cultural practices designed to alleviate plant parasitic nematodes.

General Information

- Before fumigation, soil sampling for the type and number of pests present is recommended. In fields where pre-treatment soil samples indicate the presence of high population levels of nematodes, a successful fumigation cannot be expected to eradicate entire populations. Therefore, post-treatment sampling is recommended to determine the need for additional pest management practices.
- For best results, it may be necessary to treat annual crops every year.
- Fumigation may temporarily raise the level of ammonium nitrogen and soluble salts in the soil. This is most likely to occur when heavy rates of fertiliser and fumigation are applied to soils that are either cold, wet, acid or high in organic matter. To avoid injury to certain crops including beetroot, carrots, corn, radishes, cole crops, legumes (beans), lettuce and onions, fertilize as indicated by soil tests made after fumigation. To avoid ammonia injury or nitrate starvation (or both) to crops grown on high organic soils, DO NOT use fertilisers containing ammonium salts and use only fertilisers containing nitrates, until after the crop is well established and the soil temperature is above 18°C. Certain crops, including cotton, sugar cane and pineapple are tolerant to ammonia and the above rule does not apply to them. Liming highly acid soils before fumigation stimulates nitrification and reduces the possibility of ammonia toxicity.
- Certain nursery crops such as citrus seedlings and vegetable crops such as cauliflower have shown evidence of phosphorus deficiency following fumigation. To avoid this possible effect, additional phosphate fertilizer (foliar applied) is recommended where experience indicates a deficiency may occur.

APPLICATION

Application Timing

Telone can be applied at any time of the year when soil conditions permit. Conditions that allow rapid diffusion of the fumigant as a gas through the soil normally give best results. Because Telone does not provide residual control of soil pests, it would be used as a pre-plant application before planting each crop. The following soil temperature and moisture conditions should exist at time of treatment. Failure to meet these conditions may result in unsatisfactory product performance.

Soil Conditions

Optimal temperatures for application are between 10^{o}C and 20^{o}C.

Soil Moisture

It is critical to manage soil moisture properly before fumigation. Plan fumigation for seasons, crop rotations, or irrigation schedules, which leave moisture in the soil. The soil must be moist from 5 cm below the soil surface to at least 30 cm deep as determined by the feel method (see below). The amount of moisture needed in this zone will vary according to soil type. The surface soil generally dries very rapidly and should not be considered in this determination. If there is insufficient moisture at the 5 cm to 15 cm depth., the soil moisture must be adjusted. If irrigation is not available and there is adequate soil moisture below 15 cm, it may be brought to the surface by disking or ploughing before or during the injection.

In general, no irrigation should immediately precede subsoiling or fumigation; however, when irrigation is available and surface soil moisture conditions are not likely to provide an adequate seal against fumigant loss, a very light sprinkler irrigation to wet the top 2.5 to 5 cm of soil may be used to bring soil moisture content to the desired level.

The following descriptions will aid in determining acceptable soil moisture conditions by the "feel method". For coarse soils (sand and loamy sand), there must be enough moisture to allow formation of a weak ball when compressed in the hand. Due to soil texture, this ball is easily broken with little disturbance. In loamy or medium textured soils (coarse sandy loam, sandy loam and fine sandy loam), a soil sample with the proper moisture content can be formed into a ball which holds together with moderate disturbance, but does not stick between the thumb and forefinger. Fine textured soils (clay loam, silty clay loam, sandy clay, silty clay, sandy clay loam and clay), should be pliable and not crumbly, but should not form a ribbon when compressed between the thumb and forefinger.

Soil Preparation

The soil should be free of clods. Large clods can prevent effective soil sealing and reduce effectiveness of Telone. Plant residues should be thoroughly incorporated into the soil prior to treatment to avoid interfering with application. Undecomposed plant material may harbour pests that will not be controlled by fumigation. Little or no crop residue should be present on the soil surface. Crop residue that is present should lie flat to permit the soil to be sealed effectively. Compacted soil layers within the desired treatment zone should be fractured before or during application of the fumigant. Deviation from the above conditions may result in unsatisfactory results.

Placement of fumigant

Telone may be applied as either a broadacre (overall) or row treatment. It must be placed at least 20cm below the final soil surface. When soil conditions allow, placement a minimum of 35cm below the final soil surface is recommended. Deeper placement is recommended when fumigating soil to be planted to deep-rooted plants, such as perennial fruit and nut crops, or to control deeply distributed pests. For row application, the fumigant must be placed at least 30cm from the nearest soil/air interface (e.g. furrow).

Application Methods and Equipment

Use equipment specifically designed for application of fumigants to soil. See "Telone Guide to Application" for more information.

Minimizing end row spillage: Product spillage at the end of rows should be minimized. An effective flow shut-off device must be used to prevent discharge of fluid at the end of rows. After shutting off flow, run tynes underground for 30 cm to limit spillage that may occur when the tyne is raised from the ground.

Broadacre Application: Choose application equipment which allows the deepest application and best soil seal under existing conditions.

The fumigant outlet spacing varies with the type of application equipment used:

With tyne equipment a fumigant tyne spacing of 30 cm is recommended. The outlet spacing for this equipment may be up to 1½ times the application depth but generally should be equal to the application depth and should not exceed the soil-shattering capability of the tynes.

Row Application (for row spacing greater than 60 cm): Use tyne equipment to treat a band of soil where the crop is to be planted, i.e. the plant row. When multiple tynes per plant row are used, space the tynes (fumigant outlets) 20 to 30 cm. Regardless of the number or spacing of tynes used, the fumigant must be placed at least 30cm from the nearest soil/air interface (e.g. furrow). To prevent seed germination problems caused by improper seed-to-soil contact or improper seeding depth, do not place the seed directly over the furrow left by the applicator tyne(s).

Sealing the Soil After Application

Immediately after tyne application of Telone the soil must be "sealed" to prevent fumigant loss and ensure that an effective concentration of fumigant is maintained within the soil for a period of several days. **For broadacre treatment (flat fumigation),** sealing can be accomplished with equipment that will uniformly mix the soil to a depth of 8 to 10 cm to effectively eliminate chisel or plough traces which can allow direct escape of the fumigant. A tandem disc or similar equipment may be used for this purpose. To maximize sealing, steps should also be taken to compact the soil surface to further retard the rate of fumigant loss by following with a ring roller or roller in combination with tillage equipment. Compaction of the soil surface alone does not effectively disrupt tyne or plough traces.

For row treatment, forming the beds at the time of application should be accomplished in a manner that places the fumigant at least 30cm from the nearest soil/air interface (e.g. furrow). The closest soil/air interface could be the furrow for multiple tyne applications or the top of the beds for single tyne applications. Row treatments into pre-formed beds must be sealed by disrupting the tyne trace using press sealers, ring rollers or by reforming the beds and following with such equipment.

Sealing can also be improved by applying non-perforated plastic film, such as polyethylene, over the entire area or in strips. Use of a film to seal the soil surface does not eliminate the need to eliminate chisel traces prior to application of the plastic film.

Proper soil conditions at the time of application (see **Soil Preparation)** are important to ensure proper placement of fumigant (see **Placement of Fumigant**) and obtaining adequate sealing. Prior tillage should be adequate to eliminate clods and thoroughly mix crop residues into the soil.

Soil Fumigation Interval

Leave the soil undisturbed for at least 7 days after treatment and unplanted for at least 14 days after application of the fumigant. Longer intervals are required if the soil becomes cold or wet, and for deep-rooted tree, shrub and vine planting sites.

Allow the fumigant to dissipate completely before planting the crop. Seeds, previously soaked in water, may be used as a bioassay to determine if Telone is present in the soil at concentrations sufficient to cause plant injury. Do not plant if the odour of Telone is present within the zone of fumigation.

Recontamination prevention

Telone will control pests that are present in the soil treatment zone at the time of fumigation. It will not control pests that are introduced into soil after fumigation. To avoid reinfestation of treated soil DO NOT use irrigation water, transplants, seed pieces, or equipment that could carry soil borne pests from infested land. Avoid contamination from moving infested soil onto treated beds through cultivation, movement of soil from below the treated zone, dumping contaminated soil in treated fields and soil contamination from equipment or crop remains. Clean equipment carefully before entering treated fields.

CLEANING EQUIPMENT

- Clean equipment of all soil or plant debris before using but **DO NOT** allow water to enter fumigant lines or containers.
- Since this product is corrosive under certain conditions, flush all application equipment with diesel oil or kerosene immediately after use. Dispose of flushing solution by incorporation into the treated field or by other means in accordance with appropriate State legislation.
- Fill pumps and meters with new motor oil or a 50% motor oil/diesel oil mixture before storing.

PRECAUTIONS

Signs or placards as follows must be prominently shown at all approaches to the fumigation site: **"DANGER KEEP OUT – POISONOUS GAS - FUMIGATION IN PROGRESS - KEEP AWAY".** These signs should also include contractor's name and address plus "Poisons Information Centre Tel. 13 11 26".

Workers within the vicinity of the treatment area should wear cotton overalls buttoned to the neck and wrist and a washable hat, chemical resistant apron, elbow length neoprene gloves, chemical resistant footwear and full facepiece respirator with organic vapour /gas cartridge

Re-Entry Period

Avoid re-entry into treated areas for 5 days after treatment. When prior entry is necessary, or when odour persists beyond 5 days after treatment and entry is required, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing), elbow length neoprene gloves, chemical resistant footwear and full facepiece respirator with organic vapour /gas cartridge.

Ground Water Advisory Statement

The 1,3-dichloropropene in Telone Soil Fumigant is known to move through soil and under certain conditions has the potential to reach ground water. Application in areas where soils are permeable and ground water is near the surface could result in ground water contamination for a period of time after treatment. Do not apply within 30 metres of any well used for drinkable water.

Other Precautions

- **DO NOT** use in enclosed greenhouses or other enclosed areas. Telone can be used in large greenhouses with both ends removed to allow ventilation.
- **DO NOT** drop, bump or drag cylinders.
- **DO NOT** unload cylinders by rope-sling, hooks or tongs.
- Keep cylinders upright in tamper-proof airy stores, away from dwellings and food and feed stuffs.
- Put out all pilot lights and glowing heating units.
- **DO NOT** use containers, pumps or other transfer equipment made of aluminium, magnesium or their alloys, as under certain conditions this product may be severely corrosive to such metals.
- **DO NOT** contaminate food.
- **DO NOT** allow this chemical to contaminate water used for irrigation, drinking or other domestic purposes.

PROTECTION OF CROPS, NATIVE AND OTHER NON-TARGET PLANTS

- **DO NOT** apply within 1.5m of desirable plants or living trees.

PROTECTION OF WILDLIFE, FISH, CRUSTACEANS AND ENVIRONMENT

- **DO NOT** contaminate streams, rivers or waterways with the chemical or used containers.
- **DO NOT** fumigate more than once per crop.
- **DO NOT** apply Telone Soil Fumigant within 5 metres of aquatic environments such as rivers, streams, marshes and other water bodies.

STORAGE AND DISPOSAL

- Store in the closed, original container in a cool, well-ventilated area. Do not store for prolonged periods in direct sunlight.
- Store in a locked room or place away from children, animals, food, feedstuffs, seed and fertilisers.
- Empty contents fully into application equipment. Close all valves and return to point of supply for refill or storage.

SAFETY DIRECTIONS

- Poisonous if absorbed by skin contact or swallowed.
- Harmful if inhaled.
- Will damage eyes and irritate the nose, throat and skin.
- Repeat exposure may cause allergic disorders.
- Avoid contact with eyes and skin.
- Do not inhale vapour.
- The fumes first cause smarting, then watering of the eyes. This should be taken as a warning sign.
- If product in eyes, wash it out immediately with water.
- If product on skin, immediately wash area with soap and water.
- If clothing becomes contaminated with product remove clothing immediately.
- After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.
- When using the product wear cotton overalls buttoned to the neck and wrist and a washable hat, chemical resistant apron, elbow length neoprene gloves, chemical resistant footwear and full facepiece respirator with organic vapour /gas cartridge.
- After each day's use, wash gloves and goggles and respirator (if rubber wash with detergent and warm water) and contaminated clothing.
- Do not re-use footwear until thoroughly aired.

FIRST AID

- If poisoning occurs, contact a doctor or Poisons Information Centre. (*Phone Australia*: 131 126).
- Remove from contaminated area. Apply artificial respiration if not breathing.

MATERIAL SAFETY DATA SHEET

Additional information is listed on the Material Safety Data Sheet for Telone Soil Fumigant, which is available from Dow AgroSciences on request. Call Customer Service Toll Free on 1-800 700 096.

NOTICE

Seller warrants that the product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with directions under normal conditions of use. No warranty of merchantability or fitness for a particular purpose, express or implied, extends to the use of the product contrary to label instructions or under off-label permits not endorsed by Dow AgroSciences, or under abnormal conditions.

UN No.: 2047
DICHLOROPROPENES PKG III HAZCHEM 2W

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

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

Barcode
for stock
identification

NRA Approval No.:
GMID:
D.O.M./Batch No.:

DANGEROUS POISON

KEEP OUT OF REACH OF CHILDREN

READ SAFETY DIRECTIONS BEFORE OPENING OR USING

Telone* C-35

Soil Fumigant

ACTIVE CONSTITUENT: **825 g/L 1,3-DICHLOROPROPENE**
465 g/L CHLOROPICRIN

FOR THE CONTROL OF A WIDE RANGE OF SOIL BORNE DISEASES, PLANT PARASITIC NEMATODES, SYMPHYLANS, WIREWORMS AND SUPPRESSION OF WEEDS AS SPECIFIED IN THE DIRECTIONS FOR USE TABLE

Contents: 75 L

FOR USE BY PROFESSIONAL AND ACCREDITED FUMIGATORS

DIRECTIONS FOR USE
RESTRAINTS
DO NOT dilute with water.
DO NOT apply Telone C-35 through any type of irrigation system.
DO NOT use when soil temperature is below 5°C or above 27°C.
DO NOT treat soil when very wet or very dry.
DO NOT use transplants, tools or move crop residues that could carry soil-borne pests from infested land onto treated areas.

Broadacre Application Rates for Control of a wide range of Soil Borne Diseases, Plant Parasitic Nematodes, Symphylans, Wireworms and Suppression of Weeds

CROP	PEST	SOIL TYPE	Broadacre rates[1] L/ha	CRITICAL COMMENTS
Vegetables, Field crops and Nursery crops	**Soil borne diseases** including Fusarium and Verticillium wilts, Rhizoctonia, Pythium; **Plant parasitic Nematodes**; *Symphylans* (garden centipedes); *Wireworms* For **Suppression of Weeds** see Footnote 3	Light soils (*eg.* coarse-textured sands, sandy loams and loams)	200 – 350[2,4]	**Pre-plant treatment only:** At time of application soil should be in good seed bed condition free of clods and undecomposed plant material and with adequate soil moisture. **Application Timing, Soil Conditions and Soil Moisture, Soil Preparation and Placement of Fumigant, Application Methods, Equipment and Sealing the Soil After Application:** See **APPLICATION** **Exposure period:** Leave soil undisturbed for at least 7 days after treatment. **Aeration period before planting:** Use a minimum of 14 days (see also **Soil Fumigation Interval** under **APPLICATION**). Longer intervals are required if the soil becomes cold or wet, and for deep-rooted tree, shrub and vine planting sites.
		Heavy soils (*eg*. fine textured clay loams and clays or soils with very high organic matter such as peats)	350 – 600[3,4]	
Fruit and Nut crops, including Strawberries		All soil types	350 - 700[3,4]	

[1] Rates given may be concentrated in the row, but in no case should the amount applied per hectare exceed the maximum broadacre application rates (L/ha) given in the above table.
[2] For cyst-forming nematodes use at least 250 L/ha
[3] For control of apple replant diseases and for suppression of weeds, higher rates (>500L/ha) are recommended
[4] For high disease and weed pressure use higher rates. Some weed species e.g. nutgrass, may not be suppressed at these rates.

NOT TO BE USED FOR ANY PURPOSE, OR IN ANY MANNER, CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION
THIS PRODUCT IS TOO HAZARDOUS FOR USE IN THE HOME GARDEN
IN TASMANIA, THIS PRODUCT IS NOT TO BE SOLD OR USED WITHOUT A LICENCE FROM THE REGISTRAR OF PESTICIDES
IN SOUTH AUSTRALIA, THIS PRODUCT IS NOT TO BE SOLD OR USED WITHOUT A LICENCE FROM THE HEALTH COMMISSION

Calibration
Calibration must be done in a manner that does not release Telone C-35 above the soil. Recommended methods are use of a flow meter or determining flow rate by dispensing an alternate fluid such as water or diesel fuel into collection cups. Flow meter capacity previously calibrated for water or methyl bromide may be converted to Telone C-35 capacity using the following equations:
Flow capacity for water X 0.85 = flow capacity for Telone C-35
Flow capacity for methyl bromide X 1.2 = flow capacity for Telone C-35
Flow capacity for diesel fuel is roughly the same as for Telone C-35.
Flow rates for individual outlets an be calculated using the formula:
mL/100M of row/outlet = 0.1 X broadacre rate in L/ha X outlet spacing in cm. For example, the application rate is 250 L/ha and desired row spacing is 45 cm, the flow rate per outlet is: 0.1 X 250 x 45 = 112.5 mL/1000m/outlet. If dispensing water to determine flow rate, multiply the amount dispensed by 0.85 to determine the amount of Telone C-35.

GENERAL INSTRUCTIONS

Telone C-35 Soil Fumigant is a multi-purpose liquid fumigant for pre-plant treatment of cropland soil that can be used as part of a management programme involving rotation, resistance varieties, and other cultural practices designed to alleviate soil borne diseases, plant parasitic nematodes. Telone C-35 will also suppress weeds.

General

- Before fumigation, soil sampling for the type and number of pests present is recommended. In fields where pre-treatment soil samples indicate the presence of high population levels of soil-borne pathogens, a successful fumigation cannot be expected to eradicate entire populations. Therefore, post-treatment sampling is recommended to determine the need for additional pest management practices.
- For best results, it may be necessary to treat soils carrying annual crops every year.
- Fumigation may temporarily raise the level of ammonium nitrogen and soluble salts in the soil. This is most likely to occur when heavy rates of fertiliser are applied to soils before fumigation, especially if the soils are cold, wet, acid or high in organic matter. To avoid ammonia injury or nitrate starvation (or both) to crops grown on high organic soils, DO NOT use fertilisers containing ammonium salts and use only fertilisers containing nitrates, until after the crop is well established and the soil temperature is above 18°C. In mineral soils, do not apply more than 2/3 of the nitrogen requirements from fertilizers containing ammonium salts until the crop is well established and the soil temperature is above 18°C.

Certain nursery crops such as citrus seedlings and vegetable crops such as cauliflower have shown evidence of phosphorus deficiency following fumigation. To avoid this possible effect, additional phosphate fertilizer (foliar applied) is recommended where experience indicates a deficiency may occur.

APPLICATION

Application Timing

Telone C-35 can be applied at any time of the year when soil conditions permit. Conditions that allow rapid diffusion of the fumigant as a gas through the soil normally give best results. Telone C-35 does not provide residual control of soil pests and must be applied before planting each crop. The following soil temperature and moisture conditions should exist at time of application. Failure to meet these conditions may result in unsatisfactory product performance.

Soil Conditions

Optimal temperatures for application are between 10°C and 20°C.

Soil Moisture

It is critical to manage soil moisture properly before fumigation. Plan fumigation for seasons, crop rotations, or irrigation schedules that leave moisture in the soil. For fumigation depths of 40- 45 cm (as for apple replants), the soil should be moist within a 40 cm radius upwards from the point of injection as determined by the feel method (see below). For all other applications, the soil must be moist from 5 cm below the soil surface to at least 30 cm deep as determined by the feel method (see below). The amount of moisture needed in this zone will vary according to soil type. The surface soil generally dries very rapidly and should not be considered in this determination. If there is insufficient moisture at the 5 cm to 15 cm depth, the soil moisture must be adjusted. If irrigation is not available and there is adequate soil moisture below 15 cm, it may be brought to the surface by disking or ploughing before or during the injection.

In general, no irrigation should immediately precede subsoiling or fumigation. However, when irrigation is available and surface soil moisture conditions are not likely to provide an adequate seal against fumigant loss, a very light sprinkler irrigation to wet the top 2.5 to 5 cm of soil may be used to bring soil moisture content to the desired level.

The following descriptions will aid in determining acceptable soil moisture conditions by the "feel method". For coarse soils (sand and loamy sand), there must be enough moisture to allow formation of a weak ball when compressed in the hand. Due to soil texture, this ball is easily broken with little disturbance. In loamy, or medium textured soils (coarse sandy loam, sandy loam and fine sandy loam), a soil sample with the proper moisture content can be formed into a ball which holds together with moderate disturbance, but does not stick between the thumb and forefinger. Fine textured soils (clay loam, silty clay loam, sandy clay, silty clay, sandy clay loam and clay), should be pliable and not crumbly, but should not form a ribbon when compressed between the thumb and forefinger.

Soil Preparation
The soil should be free of clods. Large clods can prevent effective soil sealing and reduce effectiveness of Telone C-35. Plant residues should be thoroughly incorporated into the soil prior to treatment to avoid interfering with application. Undecomposed plant material may harbour pests that will not be controlled by fumigation. Little or no crop residue should be present on the soil surface. Crop residue that is present should lie flat to permit the soil to be sealed effectively. Compacted soil layers within the desired treatment zone should be fractured before or during application of the fumigant. Deviation from the above conditions may result in unsatisfactory results.

Placement of fumigant
Telone C-35 may be applied as either a broadacre (overall) or row treatment. It should be placed at least 20cm below the final soil surface. When soil conditions allow, placement to a minimum of 35cm below the final soil surface is recommended. Deeper placement is recommended when fumigating soil to be planted to deep-rooted plants, such as perennial fruit and nut crops, or to control deeply distributed pests. For row application, the fumigant must be placed at least 30cm from the nearest soil/air interface (e.g. furrow).

Application Methods and Equipment
Use equipment specifically designed for application of fumigants to soil. See "Telone C-35 Guide to Application" for more information.
Minimizing end row spillage: Product spillage at the end of rows should be minimized. An effective flow shut-off device must be used to prevent discharge of fluid at the end of rows. After shutting off flow, run tynes underground for 30 cms to limit spillage, which may occur when the tyne is raised from the ground.
Broadacre Application: Choose application equipment that allows the deepest application and best soil seal under existing conditions.
The fumigant outlet spacing varies with the type of application equipment used:
With tyne equipment a fumigant tyne spacing of 30 cm is recommended. The outlet spacing for this equipment may be up to 1½ times the application depth but generally should be equal to the application depth and should not exceed the soil-shattering capability of the tynes.
Row Application (for row spacing greater than 60 cm): Use tyne equipment to treat a band of soil where the crop is to be planted, i.e. the plant row. When multiple tynes per plant row are used, space the tynes (fumigant outlets) 20 to 30 cm. Regardless of the number or spacing of tynes used, the fumigant must be placed at least 30cm from the nearest soil/air interface (e.g. furrow). To prevent seed germination problems caused by improper seed-to-soil contact or improper seeding depth, do not place the seed directly over the furrow left by the applicator tyne(s).

Sealing the Soil After Application
Immediately after tyne application of Telone C-35 the soil must be "sealed" to prevent fumigant loss and ensure that an effective concentration of fumigant is maintained within the soil for a period of several days. **For broadacre treatment (flat fumigation),** sealing can be accomplished with equipment that will uniformly mix the soil to a depth of 8 to 10 cm to effectively eliminate tyne or plough traces which can allow direct escape of the fumigant. A tandem disc or similar equipment may be used for this purpose. To maximize sealing, steps should also be taken to compact the soil surface to further retard the rate of fumigant loss by following with a ring roller or roller in combination with tillage equipment. Compaction of the soil surface alone does not effectively disrupt tyne or plough traces.
For row treatment, forming the beds at the time of application should be accomplished in a manner that places the fumigant at least 30cm from the nearest soil/air interface (e.g. furrow). The closest soil/air interface could be the furrow for multiple tyne applications or the top of the beds for single tyne applications. Row treatments into pre-formed beds must be sealed by disrupting the tyne trace using press sealers, ring rollers or by reforming the beds and following with such equipment.
Sealing can also be improved by applying un-perforated plastic film, such as polyethylene, over the entire area or in strips. Use of a film to seal the soil surface does not eliminate the need to eliminate tyne traces prior to application of the plastic film.
Proper soil conditions at the time of application (see **Soil Preparation**) are important to ensure proper placement of fumigant (see **Placement of Fumigant**) and obtaining adequate sealing. Prior tillage should be adequate to eliminate clods and thoroughly mix crop residues into the soil.

Soil Fumigation Interval
Leave the soil undisturbed for at least 7 days after treatment and unplanted for at least 14 days after application of the fumigant. Longer intervals are required if the soil becomes cold or wet, and for deep-rooted tree, shrub and vine planting sites.
Allow the fumigant to dissipate completely before planting the crop. Seeds, previously soaked in water, may be used as a bioassay to determine if Telone C-35 is present in the soil at concentrations sufficient to cause plant injury. Do not plant if the odour of Telone C-35 is present within the zone of fumigation.

Recontamination prevention
Telone C-35 will control pests that are present in the soil treatment zone at the time of fumigation. It will not control pests that are introduced into soil after fumigation. To avoid reinfestation of treated soil DO NOT use irrigation water, transplants, seed pieces, or equipment that could carry soil borne pests from infested land. Avoid contamination from moving infested soil onto treated beds through cultivation, movement of soil from below the treated zone, dumping contaminated soil in treated fields and soil contamination from equipment or crop remains. Clean equipment carefully before entering treated fields.

CLEANING EQUIPMENT

- Clean equipment of all soil or plant debris before using but **DO NOT** allow water to enter fumigant lines or containers.
- Since this product is corrosive under certain conditions, flush all application equipment with diesel oil or kerosene immediately after use. Dispose of flushing solution by incorporation into the treated field or by other means in accordance with appropriate State legislation.
- Fill pumps and meters with new motor oil or a 50% motor oil/diesel oil mixture before storing.

PRECAUTIONS

Signs or placards as follows must be prominently shown at all approaches to the fumigation site: "DANGER KEEP OUT – POISONOUS GAS - FUMIGATION IN PROGRESS - KEEP AWAY". These signs should also include contractor's name and address plus "Poisons Information Centre Tel. 13 11 26".

Workers within the vicinity of the treatment area should wear cotton overalls buttoned to the neck and wrist and a washable hat, chemical resistant apron, elbow length neoprene gloves, chemical resistant footwear and full facepiece respirator with organic vapour /gas cartridge.

Re-Entry Period
Avoid re-entry into treated areas for 5 days after treatment. When prior entry is necessary, or when odour persists beyond 5 days after treatment and entry is required, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing), elbow length neoprene gloves, chemical resistant footwear and full facepiece respirator with organic vapour /gas cartridge.

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Other Precautions

- **DO NOT** use in enclosed greenhouses or other enclosed areas. Telone C-35 can be used in large greenhouses with both ends removed to allow ventilation.
- **DO NOT** drop, bump or drag cylinders.
- **DO NOT** unload cylinders by rope-sling, hooks or tongs.
- Keep cylinders upright in tamper-proof airy stores, away from dwellings and food and feed stuffs.
- Put out all pilot lights and glowing heating units.
- **DO NOT** use containers, pumps or other transfer equipment made of aluminium, magnesium or their alloys as under certain conditions this product may be severely corrosive to such metals.
- **DO NOT** contaminate food.
- **DO NOT** allow this chemical to contaminate water used for irrigation, drinking or other domestic purposes.

PROTECTION OF CROPS, NATIVE AND OTHER NON-TARGET PLANTS

- **DO NOT** apply within 1.5m of desirable plants or living trees.

PROTECTION OF WILDLIFE, FISH, CRUSTACEANS AND ENVIRONMENT

- **DO NOT** contaminate streams, rivers or waterways with the chemical or used containers.
- **DO NOT** fumigate more than once per crop.
- **DO NOT** apply Telone C-35 Soil Fumigant within 5 metres of aquatic environments such as rivers, streams, marshes and other water bodies.

STORAGE AND DISPOSAL

- Store in the closed, original container in a cool, well-ventilated area. Do not store for prolonged periods in direct sunlight.
- Store in a locked room or place away from children, animals, food, feedstuffs, seed and fertilisers.
- Empty contents fully into application equipment. Close all valves and return to point of supply for refill or storage.

SAFETY DIRECTIONS

- Poisonous if absorbed by skin contact or inhaled or swallowed.
- Will damage eyes, nose, throat and skin.
- Repeat exposure may cause allergic disorders.
- Avoid contact with eyes and skin.
- Do not inhale vapour.
- The fumes first cause smarting, then watering of the eyes. This should be taken as a warning sign.
- If product in eyes, wash it out immediately with water.
- If product on skin, immediately wash area with soap and water.
- If clothing becomes contaminated with product remove clothing immediately.
- After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.
- When using the product wear cotton overalls buttoned to the neck and wrist and a washable hat, chemical resistant apron, elbow length neoprene gloves, chemical resistant footwear and full facepiece respirator with organic vapour /gas cartridge.
- After each day's use, wash gloves, contaminated clothing and respirator (if rubber wash with detergent and warm water).
- Do not re-use footwear until thoroughly aired.

FIRST AID

- If poisoning occurs, contact a doctor or Poisons Information Centre. (*Phone Australia*: 131 126).
- Remove from contaminated area. Apply artificial respiration if not breathing.

MATERIAL SAFETY DATA SHEET

Additional information is listed on the Material Safety Data Sheet for Telone C-35 Soil Fumigant, which is available from Agencies on request. Call 08 8347 3838.

GLOSSARY

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

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