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2001/000870/07

Retrieval and scientific interpretation of ecotoxicological information

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Project conducted on behalf of AECI Limited

Toxicological Risk Assessment for the Purpose of Derogation of KNERSUS® 200 SL (L10631) Substance of Concern: Glufosinate Ammonium

Report No 031-2024 Rev 8.0

Compiled by
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29 June 2026

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Expertise and Declaration of Independence

This report was prepared by INFOTOX (Pty) Ltd ("INFOTOX"). Established in 1991, INFOTOX is a professional scientific company, highly focused in the discipline of ecotoxicological risk assessment. Both occupational and environmental human health risks, as well as risks to ecological receptors, are addressed.

Dr Willie van Niekerk, Managing Director of INFOTOX, has BSc, Hons BSc and MSc degrees from the University of Potchefstroom and a PhD from the University of South Africa. He is a Qualified Environmental Professional (QEP), certified by the Institute of Professional Environmental Practice (IPEP) in the USA (No 07960160), and a registered Professional Natural Scientist (Pr Sci Nat, Environmental Science, No 400284/04). Dr Van Niekerk has specialised in chemical toxicology and human health risk assessments, but he has experience in many other areas in the disciplines of analytical and environmental sciences.

Dr Marlene Fourie has BSc and Hons BSc degrees from the University of Stellenbosch and MSc and PhD degrees from the University of Pretoria. Her field of specialisation is reproductive biology/toxicology. Dr Fourie also has an MSc-degree in epidemiology from the University of Pretoria. Following positions as Medical Natural Scientist at the Andrology Unit, Department of Urology, University of Pretoria and the Pretoria Academic Hospital from 1987 to 2001, she joined INFOTOX as a Medical Biological Scientist. Dr Fourie has conducted many health risk assessments and projects relating to the health status of communities. She is registered as a Professional Natural Scientist (Pr Sci Nat, Toxicological Science, No 400190/14).

Dricky Simpson has a higher diploma in Quality Assurance as well as in Medical Technology. Dricky worked in pathology laboratories and she has done research in human toxicology and pharmacology. She also has experience in animal toxicology and pharmacology. During the last fifteen years as Director of INFOTOX she worked in human health risk assessment for a wide range of industries.

This specialist report was compiled for AECI Limited. We do hereby declare that we are financially and otherwise independent of AECI Limited.

Signed on behalf of INFOTOX (Pty) Ltd, duly authorized in the capacity of Managing Director:

Willem Christiaan Abraham van Niekerk

29 June 2026

Revision Record

Revision Number	Date	Detail of Revision
Rev 1.0	26 August 2024	
Rev 2.0	26 August 2024	AECI Plant Life changed to Nulandis.
Rev 3.0	6 October 2024	DALRRD changed to Act No. 36 of 1947 Changes to Health risk assessment results and conclusion.
Rev 4.0	25 August 2025	Minor editorial changes.
		Pop-up boxes and footnotes added throughout, to improve understanding of the report by non-experts.
		Additional Section 7.6: 7.6 Non-expert summary of the environmental fate of glufosinate ammonium.
		Previous Section 11 (Ecological incidents) incorporated into Section 9, as heading 9.2 (Ecological incidents).
		Additional occupational health risk scenarios (Section 12): pesticide handlers not using gloves.
		Additional Section 12.7: Occupational exposure in glufosinate ammonium production.
		Additional Section 13: Bystander exposure and risk assessment.
		Additional conclusions regarding risks if gloves are not used by handlers (Section 15).
Rev 5.0	6 May 2026	Assessed crops limited to Vineyards and Citrus.
		Request for derogation limited to a period of 2 years or until the Department of Agriculture (“DoA”) grants approval for an alternative product.
		Mechanically pressurized handgun applications are removed, since this method is relevant only to roadside applications, that are not included as an intended use on the product label.
		Restriction of sale to a Pest Control Operator (“PCO”) with a valid permit, used as a restricted agricultural remedy.
		Inclusion of KNERSUS® 200 SL benefits and the assessment of alternatives in the Executive Summary.
		Inclusion of documentation supporting the continued availability of KNERSUS® 200 SL in South Africa (Annexures 2 and 3)
		Expansion of the KNERSUS® 200 SL benefits and alternatives assessment, given the increasing problem of herbicide resistance.
		Emphasis of negligible risk to humans, animals and the environment under realistic worst-case conditions of use, in line with Section 8.6 of the Regulations Relating to Agricultural Remedies (Act 36 of 1947).
Rev 6.0	6 May 2026	Minor editorial changes.
Rev 7.0	9 June 2026	Inclusion of letters of support.
Rev 8.0	29 June 2026	Nulandis changed to AECI Limited. Updated Survey Report in Annexure 2.

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List of Abbreviations

AEL	Acceptable exposure level
CDC	Centers for Disease Control and Prevention
CMR	Carcinogenicity, mutagenicity, and reproductive toxicity
DNT	Developmental neurotoxicity
ECETOC	European Centre for Ecotoxicology and Toxicology of Chemical's
ECHA	European Chemicals Agency
EDSP	Endocrine Disruptor Screening Program
EEC	Estimated environmental concentration
EFSA	European Food Safety Authority
EIIS	Ecological Incident Information System
FFDCA	Federal Food, Drug, and Cosmetic Act
FQPA SF	FQPA Safety Factor
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
HEC	Human equivalent concentration
HED	Human equivalent dose
HHRA	Human health risk assessment
HIARC	Hazard Identification Assessment Review Committee
IDS	Incident Data System
IPCS	International Programme on Chemical Safety
LDT	Lowest dose tested
LOAELs	Lowest-observed-adverse-effect levels– the smallest dose that caused harm in a study
LOC	Level of concern – the point where scientists start worrying about health risks.
MOE	Margin of exposure – a safety measure comparing the harmful level to the actual exposure.
MRIDs	Master Record Identifiers
NIOSH	National Institute for Occupational Safety
NOAELs	No-observed-adverse-effect levels– the highest dose tested that did *not* cause harm.
NRC	US National Research Council
OC	Organic carbon
OECD	Organisation for Economic Co-operation and Development
OPP	USEPA Office of Pesticide Programs
PAD	Population adjusted dose (a = acute, c = chronic) – the safe level of exposure for people of different ages
PAN	Pesticide Action Network
PND	Postnatal day
POD	Point of departure– starting value for risk calculations
PPDB	Pesticide Properties Database
REI	Restricted-entry interval – time before workers can re-enter a treated field
RfC	Reference concentration
RfD	Reference dose
RQ	Risk quotient
SENSOR	Health Sentinel Event Notification System for Occupational Risk-Pesticides
STOT RE	Specific target organ toxicity (repeated exposure)

TRA	Targeted Risk Assessment
TSCA	Toxic Substances Control Act
UF	Uncertainty factors
UFA	Uncertainty in extrapolating animal data to humans
UFH	Variation in susceptibility among the members of the human population
UFL	Uncertainty in extrapolating from a LOAEL rather than from a NOAEL
USEPA	United States Environmental Protection Agency
WOE	Weight-of-evidence

List of terms and non-expert explanations

Acute	Happening suddenly or over a short time; can also mean at a high concentration or dose
Aerobic metabolism	Cells making energy when oxygen is available. Metabolism, including the production of cellular energy, with the consumption of oxygen.
Aerobic soil metabolism	Chemical changes in soil when oxygen is present, due to the metabolism of micro-organisms in soil
Amino acids	Building blocks that make up proteins
Bioaccumulation	The uptake of a chemical by an organism from all environmental sources, e.g. water, food and sediment.
Bioconcentration	The accumulation of a water-borne chemical by an organism living in the aquatic environment (in freshwater or the ocean)
Biodegradation	When bacteria or other living things break down chemicals.
Carcinogenicity	Substance that causes cancer
Chronic	Lasting a long time or happening many times.
Concentration	How much of a substance is in a certain amount of air, water, or soil
Cotyledon (monocot/dicot)	The first leaves that grow when a seed starts to sprout.
Degradation	The breakdown of a chemical into simpler parts.
Derogation	Special permission to use something that would normally be banned. An exemption from or relaxation of the consideration of this product for removal from the market due to it being considered a CMR product of concern.
Developmental toxicity	Any developmental malformation of the foetus, caused by a toxic substance. that is caused by the toxicity of a chemical or pathogen
Dicotyledonous (dicot)	Dicots are a group of plants that have two cotyledons or seed leaves after germination, generally referred to as broad-leaved plants, typically bearing flowers with petals in multiples of four or five.
Dose	The amount of a substance taken in, often described as an amount for each kilogram of body weight of the person/animal taking in the substance (e.g., mg/kg body weight).
Dose-response assessment	Addresses the relationship between levels of uptake of a substance and the degree of manifestation of adverse effects
Ecotoxicological	The study of how chemicals affect plants, animals, and ecosystems.
Endocrine disruptor	A substance that interferes with hormones in the body.
Endpoint	The main result measured in a study, e.g., death or a symptom or illness.
Environmental Fate	Behaviour in or movement of a chemical substance after having been released to the environment. The behaviour in or movements through the environmental compartments of air, soil and water, and the preferred final destiny compartment(s) are described.
Epidemiology	The study of diseases and health patterns in groups of people Study of the determinants, occurrence, and distribution of health and disease in a defined population
Exposure	Coming into contact with a chemical (by inhaling it, touching it, or eating it).
Exposure assessment	Identification of environmental pathways, potentially exposed groups, routes of direct and indirect exposure, and estimates of concentrations and duration of exposure.
Foliar	On or of the leaves of a plant
Half-life	The time it takes for half of a chemical to disappear or break down. The time needed for the removal of 50% of the original concentration of a substance in the environment
Glutamine synthetase	An enzyme that helps make proteins in cells.
Half-life	The time it takes for half of a chemical to disappear or break down
Hazard	Something that can cause harm
Hazard assessment	The identification of the chemical constituents of potential concern and the hazards it poses by these chemicals
Hazard classification	A system of grouping substances based on how dangerous they are
Hydrolysis	Chemicals break down when it comes in contact with water
Incident	An event, usually meaning an accident or harmful effect

Incidental	Happening by chance, not intentional
Inhalation	Breathing something into the lungs
Isomer/ enantiomer / racemic mixture	Different forms of the same chemical
Metabolism	The body's process of using and breaking down food or chemicals
Monocotyledonous (monocot)	Monocots are a group of plants that have one cotyledon or seed leaf after germination, typically flower-bearing herbaceous plants or grasses.
Mutagenicity	The ability of a substance to cause changes in DNA. Property of chemical agents to induce genetic mutation
Negligible	So small that it doesn't really matter
Non-selective	Kills many kinds of plants, not just specific weeds
Occupational exposure	Contact with chemicals while working
Organic carbon	The carbon that comes from living things and is found in soil
Oxidation	Chemical changes in a substance when oxygen is present
Pathways of exposure	The routes a chemical takes to reach people or animals (air, soil, water). The sequence of environmental compartments of air, soil, water, and/or sediment, through which a substance may be distributed or spread in the environment.
Pesticide residue	Tiny amounts of pesticide left on food, soil, or plants after spraying
Photolysis	When sunlight breaks down chemicals
Post-application	After the chemical has been sprayed
Qualitative	Descriptive, not measured in numbers
Quantitative	Measurable with numbers
Receptors	In risk studies, this means a person or animal that can be exposed. People exposed to the substance of interest
Registrar	Registrar of the fertilisers, farm feed, agricultural remedies and stock remedies Act, 1947 (Act 36 of 1947) in the Department of Agriculture, Land Reform and Rural Development
Reproductive toxicity	The ability of a chemical to harm fertility or unborn babies. A substance or agent that can cause adverse effects on the reproductive system, causing the inability to reproduce offspring
Residual / non-residual	A chemical that stays (residual) or does not stay (non-residual) in soil, water, or food
Risk assessment	The process of figuring out how dangerous a chemical is
Risk characterisation	Integration of the components described above. The risk characterisation will also provide a review of documented human exposure incidents
Routes of exposure	Inhalation, ingestion, and dermal contact
Surrogate	A chemical with properties, including potential toxicity, that are likely to be similar to another substance of interest for which little information about the properties and/or toxicity are known. "Transferring" the known properties of the surrogate to that of the uncharacterised substance is known as the "bridging principle", or "read-across" for the purposes of hazard and risk assessment.
Susceptibility	How easily someone or something can be harmed by a substance
Systemic	Spreading throughout a whole plant or body
Synthetase	Enzyme catalysing the joining of two molecules, with concomitant energy expenditure
Toxicology	The study of poisons and harmful substances
Translocation	Movement of the chemical from the point of uptake (leaves or roots) to other parts of the plant, e.g., fruits or edible parts of crops.
Target organ toxicity	Harm to a specific organ in the body (like liver or lungs). The effects on the organ impacted by a hazardous substance
Transformation products	New chemicals formed when the original one breaks down
Uncertainty factor	An extra safety margin used when scientists are unsure of the exact risk
Uncertainty review	Identifies the nature and, when possible, the magnitude of the uncertainty and variability inherent in the characterisation of risks

Executive Summary

This document is an independent risk assessment report supporting an application for derogation allowing restricted sale and use of the registered herbicide KNERSUS® 200 SL, with Act No. 36 of 1947 registration number L10631, for citrus and vineyards only, for a period of 2 years or until the Department of Agriculture ("DoA") grants approval for an alternative product.

KNERSUS® 200 SL is identified as a substance of concern due to its classification as a reproductive hazard category 1B (H360FD) according to the Globally Harmonized System of Classification and Labelling of Chemicals ("GHS"). The classification is due to the ingredient glufosinate ammonium, which is classified in GHS as reproductive toxicity category 1B.

Prepared for: AECI Limited
Product name: KNERSUS® 200 SL
Act No. 36 of 1947 registration number: L10631

Intended product use:

- A non-selective, non-residual, partly systemic contact herbicide formulated as a water-soluble concentrate, for the control of certain broadleaf weeds, grasses and sedges in crops as indicated (vineyards and citrus).
- The product is for use in large-scale agricultural crop production enterprises.
- The product is not intended for sale to residential gardeners. This means that it will not be sold to the public on the shelves of local nurseries or general gardening stores.

Occupational exposure assessment:
Two occupational designations are assessed:

- Occupational pesticide handlers, exposed by the dermal and inhalation routes of exposure (Table 1).
- Post-application (re-entry) workers, exposed by the dermal route only, since glufosinate ammonium and its residues are not volatile (inhalation exposure to residues on plants is excluded).

The product supplier has indicated that the herbicide is not intended for aerial application (e.g., by low-flying aircraft) and this method of application is excluded from the assessment.

Table 1: Occupational pesticide handlers' activities and crops assessment summary.

Pesticide handler activity: Mixing/loading/application		
Application method	**Vineyards**	**Citrus fruits**
Groundboom, broadcast spray	X	X
Backpack, ground-directed	X	X

Completely mechanised post-application re-entry activities are highly unlikely to be associated with any significant exposure to workers and are not assessed.

Herbicide sprays are not directed at the buds, flowers or fruit. KNERSUS® 200 SL is a herbicide and clear label instructions state that the applied spray must not make contact with the foliage or stems of young plants. Furthermore, the use of the correct anti-drift spray nozzles, e.g., the Air Induction Extended range ("AIXR") and Turbo TeeJet, are also recommended on the label.

Most post-application re-entry activities involves contact only or mainly with fruit, leaves, and the twigs and branches of fruit trees and vines, which are not sprayed. Thus, most re-entry activities will involve negligible contact with herbicide residues, such as:

- Harvesting, pruning, leaf pulling or thinning fruit by hand.
- Scouting or inspecting crops.
- Propping fruiting branches and other orchard or vineyard maintenance activities.
- Propagating or transplanting vines.
- Hand-setting of irrigation pipes, which should be done, in any case, with gloves protecting hands against superficial injury.

Dietary exposure to treated crops

Being a non-selective herbicide that will damage the crop on contact, it is understandable that contact with crops is avoided, and this caution appears on the product label. The herbicide is never applied directly to the commodity to be harvested, and insignificant [1]translocation of glufosinate ammonium within the various parts of the plant has been noted. Therefore, it is concluded that the herbicide residue content of the harvested fruits would be negligible and practically zero. This concurs with assessments by other international regulatory agencies, concluding that there would not be dietary risks to consumers of food originating from crops grown in farmlands where glufosinate ammonium herbicides had been applied.

Health risk assessment results and conclusion

The results of the health risk assessment indicated that there are not reasons for concern, including of reproductive/developmental toxicity effects, since risks to humans are negligible, even under realistic worst-case conditions (if gloves are not used) for:

- Occupational pesticide handler and applicator exposure:
  - Pesticide handlers preparing the spray mixture for application by groundboom or backpacks.
  - Pesticide applicators applying the herbicide with a groundboom.
  - Pesticide applicators using a backpack to spray the herbicide in agricultural crops listed on the label.

- Risks of bystanders in contact with spray drift were assessed, even though the product label clearly warns against this. Contact with spray drift presents a negligible risk to health, even if the bystander is a toddler (most sensitive receptor), under realistic worst-case conditions of use.

- Post-application re-entry workers usually do not wear gloves (realistic conditions). Risks to the health of such workers, including risks of reproductive/developmental toxicity effects, are negligible, even if treated fields are entered within 12 hours after application (realistic worst-case conditions of use).

Ecological risks

If glufosinate ammonium is used correctly to kill weeds, even under realistic worst-case conditions of use, a negligible risk is shown to birds, bees, terrestrial invertebrates, fish or other aquatic organisms. Although there are doubts that the use of glufosinate ammonium weedkillers in agricultural crops is without risk to foraging mammals, it is recommended that farmers should have uninterrupted access to glufosinate ammonium herbicides, since the likely detrimental impact on growers (and food production) is projected to outweigh the potential advantage in limiting chronic risk to mammals. It is recommended that the application rates remain as specified on the product labels, since reducing either the single application rate or the number of applications on glufosinate

[1] Movement of the chemical from the point of uptake (leaves or roots) to other parts of the plant, e.g., fruits or edible parts of crops.

ammonium labels would likely have an impact on growers (and food production) that outweighs the potential advantage in limiting chronic risk to mammals.

Benefits and alternatives assessment

The emergence of herbicide-resistant weeds is an increasing problem that has become a significant economic issue to growers. The recommendation of the continued availability of glufosinate ammonium herbicides stems from economic concerns regarding firstly lower crop yields, given the widespread resistance of *Conyza bonariensis* ("CONBON", known as greysheet goose weeds) to the herbicide alternative glyphosate. Secondly, the other alternative, namely mechanical weeding, is viewed as expensive. Potential detrimental effects on crop yields and on the economic viability of crop production are projected to exceed the likely lesser advantage in the protection of mammals, should glufosinate ammonium be removed from the market. Furthermore, glufosinate ammonium health risks to humans and other animals, and risks to the environment, under realistic worst-case conditions of use of KNERSUS® 200 SL as an agricultural remedy, are shown to be negligible.

Restricted sale and use application

The restricted sale and use applied for is according to the intended product use:

- Herbicide not for sale to and use by residential gardeners.
- Only for sale to a Pest Control Operator ("PCO") with a valid permit, used as a restricted agricultural remedy.
- Preparation and application of the treatment solution in accordance with the instructions on the product label, including the use of the correct anti-drift spray nozzles, e.g., the AIXR and Turbo TeeJet, which are recommended on the label.
- Personal hygiene instructions on the SDS must be followed; that is, washing hands, forearms and face thoroughly after handling chemical products.
- At least baseline PPE must be worn when applying the product; that is, clothing covering the arms and legs, closed shoes and chemical-resistant gloves. If gloves are used, risks to health are negligible.
- The recommended 12-hour post-application restricted-entry interval ("REI") must lapse before crop re-entry.
- For citrus and vineyards only, for a period of 2 years or until the DoA grants approval for an alternative product.

1 Background

In a document circulated to “All Regulatory Holders” on 14 April 2022, the Registrar: Act 36 Of 1947, of the then Department of Agriculture, Land Reform and Rural Development (“Registrar” and “The Department”) refers to an assessment that was carried out at the international level to determine risks to human health due to exposure to active ingredients and their formulations that meet the criteria of carcinogenicity, mutagenicity, and reproductive toxicity (“CMR”) categories 1A or 1B according to the Globally Harmonized System of Classification and Labelling of Chemicals (“GHS”). The Department then stated that “*the assessment identified the need to reduce risks to human health associated with such products*”.

Category 1A covers substances that are known to be CMR, mainly according to human evidence. Category 1B covers substances presumed to be CMR based on data from animal studies.

The Registrar stated his intention to “*prohibit the use of ingredients and their formulations that meets* (sic) *the criteria of CMR categories 1A or 1B of the GHS as from 01 June 2024*”.

However, in exceptional circumstances, the Registrar may grant registration of an implicated agricultural remedy when it can be demonstrated that:

“a) The risk to humans, animals or the environment from exposure to the active substance in an agricultural remedy, under realistic worst-case conditions of use, is negligible”
(and other conditions not relevant to this INFOTOX report).

In February 2024, the Registrar issued a Guideline for the Application for a Derogation for an Agricultural Remedy Identified as a Substance of Concern.

This INFOTOX report deals with the assessment of risk to humans, animals and the environment associated with the use of glufosinate ammonium

2 Deployment of this INFOTOX document

This INFOTOX report covers various aspects of the study in logical sections, as outlined below:

Section 1 states the intention of the Department of Agriculture to prohibit the use of ingredients and their formulations that meet the criteria for CMR categories in a notice dated 14 April 2022 (“Notice”). The Notice defines the point of departure for this INFOTOX study.

Section 2 outlines the deployment of this report, providing context of a particular section in the overall presentation.

Section 3 provides hazard information for glufosinate ammonium according the Globally Harmonized System of Classification and Labelling of Chemicals (“GHS”).

Section 4 describes essential, concise steps of the health risk assessment paradigm.

Section 5 explains the herbicide action and benefits assessment of glufosinate ammonium.

Section 6 explains more detail of the human health risk assessment methodology followed in this assessment report.

Section 7 provides an environmental fate assessment for glufosinate ammonium.

Section 8 summarises toxicological reviews and presents toxicological parameters for application in health risk assessment.

Section 9 presents an overview of ecological risk assessment.

Section 10 summarises human incident reports.

Section 11 deals with ecological incidents.

Section 12 describes occupational exposure calculations and results.

Section 13 describes bystander exposure calculations and results.

Section 14 describes dietary exposure and risk assessment.

Section 15 presents a summary of conclusions.

Section 16 presents recommendations for granting of derogation.

Section 17 lists the scientific literature references that were consulted in compiling this document.

Annexure 1 presents post-application agricultural workers glufosinate ammonium residue transfer coefficients.

Annexure 2 presents the results of a survey on KNERSUS® 200 SL use, conducted by AECI Plant Health among Crop Producers and Crop Advisors.

Annexure 3 provides letters from South African agricultural organisations in support of the requested derogation for KNERSUS® 200 SL.

3 Hazard identification

3.1 The need for GHS classification

Internationally, there is a demand for safer chemicals and technologies, and it is appropriate to utilise information in the GHS as a starting point. This INFOTOX report relates specifically to active ingredients and their formulations that meet the criteria of CMR categories 1A or 1B in the GHS. Information in the GHS represents hazard data, not information on risk.

3.2 Glufosinate ammonium CMR hazard classification

The GHS hazard classification identifying the product as a CMR hazardous substance of concern, is: Reproductive toxicity category 1B (H360FD); “F” indicating an effect on fertility, and a suspected detrimental effect on foetal development (Table 3.2.1).

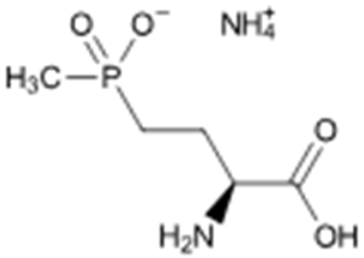
	**Glufosinate ammonium** **CAS # 77182-82-2**

Table 3.2.1: CMR GHS classification of glufosinate ammonium.

Hazard class and category code	Hazard Statement Code	Hazard statement	Signal word	Pictogram
Carcinogenic	Not classified	Not applicable	Not applicable	Not applicable
Mutagenic	Not classified	Not applicable	Not applicable	Not applicable
Reproductive Toxicity Cat. 1B	H360Fd	May damage fertility Suspected of damaging the unborn child	Danger	
Classification according to the European Chemicals Agency (ECHA online); harmonised EU classification.				

GHS Category 1B criteria for substance classification:

- **Presumed human reproductive toxicants - largely based on animal studies.**
- Clear evidence of adverse effects on sexual function and fertility or on development in absence of other toxic effects has been identified.
- If occurring with other toxic effects, the reproductive toxicity is not considered to be a second non-specific consequence of the other toxic effects.

4 The health risk assessment paradigm

A significant factor in the Organisation for Economic Co-operation and Development (OECD 2021) guidance document on key considerations for the identification and selection of safer chemical alternatives assessment, deals with the likelihood of exposure (human and ecological). OECD recommended that routes of exposure to a hazardous chemical that are unlikely, based on measured exposure data or physical-chemical properties of the substance of concern, should be excluded from the assessment. More correctly, the statement should refer to pathways of exposure (air, soil, water, and sediment), and routes of exposure (inhalation, ingestion, and dermal contact).

This recommendation of the OECD (2021) takes the assessment a step further from the hazard data of chemicals represented in the GHS, to the level where the potential for exposure of humans and ecological receptors is assessed, and through accounting for the toxicology of a substance or formulation, the level of risk is determined. This is aligned with the observations and recommendations of Karamertzanis et al. (2019).

Karamertzanis et al. (2019) evaluated the impact on classifications of carcinogenicity, mutagenicity, reproductive and specific target organ toxicity after repeated exposure in the first ten years of implementation of the REACH[2] regulation. The authors highlighted that classification for

[2] Registration, evaluation and authorization of chemicals.

carcinogenicity, mutagenicity, reproductive toxicity, and specific target organ toxicity (repeated exposure) ("STOT RE") triggers several obligations for manufacturers, importers, and professional users.

Karamertzanis et al. (2019) then stated:
"*In addition to such consequences under other legislations* (sic)*, registrants are required to carry out exposure assessment and risk characterisation for substances that are classified and, hence, classification under REACH is a trigger for risk assessment for human health."*

OECD (2021) refers to the European Centre for Ecotoxicology and Toxicology of Chemical's ("ECETOC")[3] Targeted Risk Assessment ("TRA") tool for calculating the risk of exposure from chemicals to workers, consumers, and the environment. This illustrates the logic of basing the final decision about the safety of a chemical or formulation on health risk assessment, rather than only on hazard identification, as represented in the GHS.

The original paradigm for regulatory human health risk assessment ("HHRA") in the USA was developed by the US National Research Council (NRC 1983). This model has been adopted and refined by the US Environmental Protection Agency ("USEPA") and other international agencies as published under the International Programme on Chemical Safety (IPCS 1999; IPCS 2010), and is widely used for quantitative human health risk assessments.

Figure 4.1 illustrates the health risk assessment paradigm in a simple diagram.

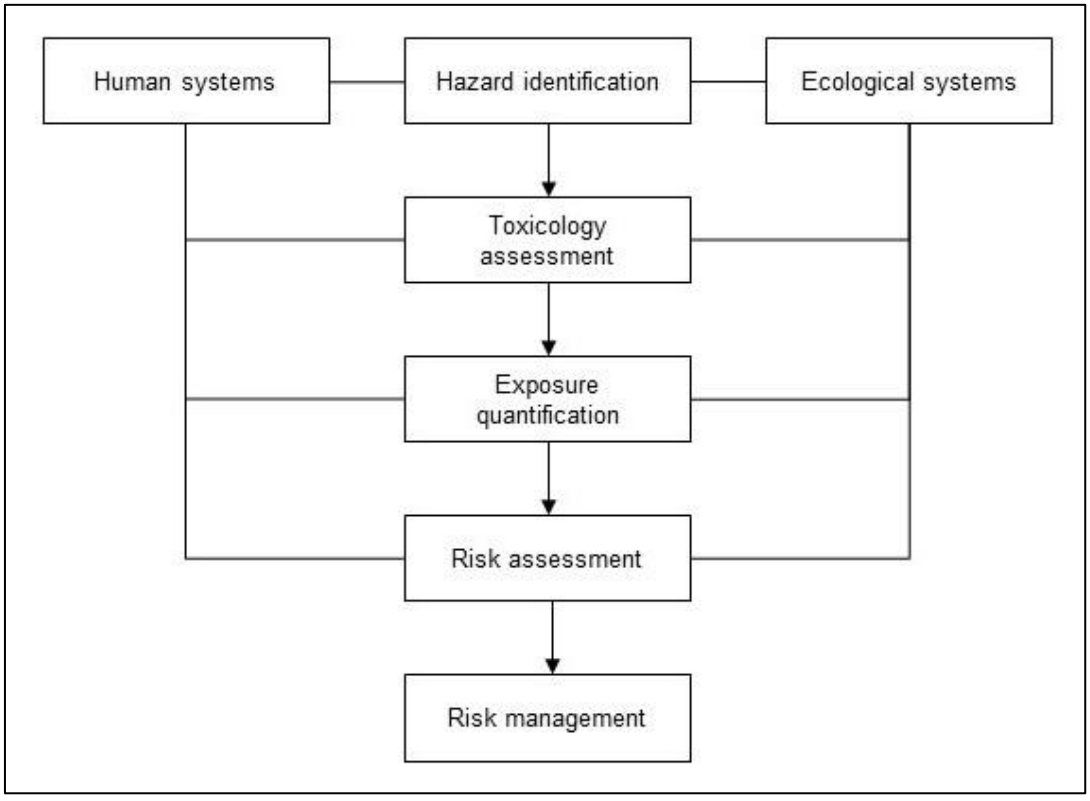


Figure 4.1: The holistic health risk assessment paradigm.

Exposure assessment and health risk quantification are essential steps in managing health risks associated with hazardous chemicals.

[3] http://www.ecetoc.org/tools/targeted-risk-assessment-tra/.

5 Herbicide action, benefits and alternatives assessment

Glufosinate ammonium is a non-selective, foliar herbicide that acts by inhibiting glutamine synthetase needed for the ammonification of glutamate to the amino acid glutamine. The disruption in the production of this key amino acid leads to disruption of the cell membrane, build-up of excess ammonium, and death of the cell. It dissociates to produce ammonium and glufosinate acid, a racemic mixture of ionic isomers. Of these, only the L-isomer (or (S)-enantiomer) mimics the enzyme glutamine synthetase and, therefore, is herbicidally active.

Glufosinate ammonium is registered in the USA and elsewhere in the world as a broad spectrum, non-selective foliar-applied herbicide for control of broad leaf, grass, and sedge weeds in numerous agronomic crops, orchards, vegetables, and non-crop sites (USEPA 2016). In the USA, glufosinate ammonium has been used on more than thirty crops and other use sites between 1998 and 2014. Quantities applied and areas treated with glufosinate ammonium have more than tripled over this period, primarily due to increases in weed species that are resistant to other herbicides, and the introduction and increased production of glufosinate-tolerant crops.

The emergence of herbicide-resistant weeds is an increasing problem that has become a significant economic issue to growers, also in South Africa. A recent survey on KNERSUS® 200 SL use, conducted by AECI Plant Health among Crop Producers and Crop Advisors (see Annexure 2), clearly illustrated the widespread problem of weed resistance to glyphosate. Glyphosate is the alternative herbicide suitable for the intended crops, that is available in South Africa. Widespread resistance of *Conyza bonariensis* (“CONBON”, known as greysheet goose weeds) to glyphosate emerged as a primary problem in the agricultural survey. Mechanical weeding is contemplated as the only successful alternative to the use of KNERSUS® 200 SL, since widespread glyphosate weed resistance nullifies glyphosate as an alternative option. However, weeding is viewed is a very expensive alternative.

USEPA (2016) acknowledged the benefits of glufosinate ammonium in its registration decision (USEPA 2016). In South Africa, as expressed in the attached letters (Annexure 3), and considering the problem of herbicide resistance, it is equally beneficial.

6 Human health risk assessment methodology

The human health risk assessment (“HHRA”) paradigm divides human health risk assessment into a number of logical steps. All of these are not fully applicable to the generic toxicological risk assessment for the purpose of derogation:

- **Hazard assessment** is the identification of the chemical constituent of concern and the hazard it poses, in this case Glufosinate ammonium and the reproductive/developmental toxicity hazard.

- **Dose-response assessment** (toxicological assessment) addresses the relationship between levels of uptake and the manifestation of adverse effects (reproductive/developmental toxicity). For this purpose, the following INFOTOX actions are needed:
    - Collection of human reproductive toxicity data on glufosinate ammonium from scientific publications.
    - Retrieval of toxicological information from available reproductive/ developmental studies, and will apply standard risk assessment methodologies to derive a point of departure

("POD") and level of concern ("LOC") or acceptable exposure level ("AEL") for the HHRA purposes, by applying appropriate uncertainty factors and safety factors for infants and children, referring to dose through the routes of exposure. The derived toxicological values will be protective specifically against potential reproductive effects of the product. This will ensure compliance with the Guideline for the Application for a Derogation for an Agricultural Remedy Identified as a Substance of Concern, issued by the registrar: Act 36 of 1947, in February 2024. Health risks will be assessed following the margin of exposure ("MOE") approach. The MOE approach is basically a comparison of the calculated exposure dose and the toxicity limit value for a specific health effect, referred to as the health effect endpoint.

- The calculated MOE is compared to the level of concern ("LOC"), also referred to as a benchmark MOE. The LOC is the margin of exposure between the calculated exposure and the POD that indicates a risk of health effects associated with the calculated exposure. Each POD is associated with a specific numerical LOC value. Therefore, if a calculated MOE is higher in value than the LOC associated with the POD used for the MOE calculation, a risk to health under the assessed exposure conditions is highly unlikely and excluded for all practical purposes. However, if the calculated MOE is lower than the associated LOC, a risk to health cannot be excluded.

- **Exposure assessment considers** the identification of environmental pathways, potentially exposed groups, routes of direct and indirect exposure, and estimates of concentrations and duration of exposure. A conceptual model/matrix of application practices and exposure pathways and routes applicable to the identified receptors will be constructed to guide the exposure assessment for the health risk assessment.

  The HHRA focuses on the following <u>occupational exposure</u> scenarios:
  - The dermal and inhalation routes of exposure of herbicide mixers and applicators.
  - The dermal post-application exposure of workers re-entering treated fields.

  <u>Residential use</u> exposure scenarios are not assessed, because KNERSUS® 200 SL is not for sale in retail outlets catering to the general public. Although KNERSUS® 200 SL label instructions include "*Prevent spray drift onto other crops, grazing, rivers, dams and other areas not under treatment*", where "o*ther areas not under treatment*" should include potential nearby homes and lawns, a worst-case is considered where dermal contact and inhalation of spray drift by a child is assumed.

  <u>Dietary exposure</u>, by the ingestion of herbicide residues in fruit and vegetable crops, is considered for consumers, including children.

  INFOTOX covers the occupational and dietary exposure scenarios in the health risk assessment, referring to published risk assessment studies.

- **Risk characterisation** involves the integration of the components described above. The risk characterisation also provides a review of documented human exposure incidents, if available.

- **Uncertainty review** identifies the nature and, when possible, the magnitude of the uncertainty and variability inherent in the characterisation of risks.

Non-expert explanation

Health risk assessment is basically a way of asking: *"If people are exposed to something (e.g., the chemical substance glufosinate ammonium), how likely (what are the chances of) it harming their health, and how serious could that harm be?"*

It is a step-by-step process with four main steps to determine possible dangers:
1. **Hazard Identification** – What harm can the substance cause?
2. **Dose-Response Assessment** – How much of it causes harm?
3. **Exposure Assessment** – How much are people/animals actually taking/being exposed to?
4. **Risk Characterisation** – Putting all this together: is it risky in real life use?

Here is a step-by-step example of a risk assessment for paracetamol (contained in more than 100 products sold over the counter):
1. **Hazard Identification:** Paracetamol can relieve pain and reduce fever (useful effect). But in high doses, it can cause serious liver damage and even death.
2. **Dose-Response Assessment**: Safe at the recommended dose (usually up to 4 grams per day for adults). Above approximately 7.5–10 grams at once (depending on body weight), the risk of liver failure rises sharply.
3. **Exposure Assessment:** Most people take 1–2 tablets (500 mg to 1 g) when they have pain or fever. Some people may accidentally take more, especially if they also use cold/flu medicines that contain paracetamol.
4. **Risk Characterisation:** At normal doses: low risk, benefits outweigh harms. At high doses or with alcohol use (which stresses the liver): high risk, potentially life-threatening.

The suggested risk mitigation is: Packaging includes clear warnings and limits on the number of tablets per box to reduce overdose risk.

Information derived from Medscape: Acetaminophen Toxicity
Updated: Feb 02, 2024
Author: Susan E Farrell, MD; Chief Editor: Michael A Miller, MD

7 Environmental fate assessment

7.1 Summary of physical and chemical properties of glufosinate ammonium

All studies on the [4]fate and behaviour in the environment were performed with the ammonium salt of glufosinate (glufosinate-ammonium). Due to the fact the ammonium ion is ubiquitous in the environment; the fate of the ammonium resulting from the application of glufosinate-ammonium was not followed. The environmental fate descriptions are for glufosinate, which is expected to dissociate from the ammonium ion in aqueous media at environmentally relevant pH (5-9) (EFSA 2005). Physical/chemical properties and aspects of environmental fate are summarised in Table 7.1.1.

[4] What happens to a chemical or an organism once it is released into the environment

Table 7.1.1: Physical/chemical properties of glufosinate ammonium that determine its environmental fate.

Property	Value	Reference	Comments
Molecular weight (g/mol)	198.2	*Lewis et al. 2016	-
Solubility in water (mg/litre, 20°C)	1.37×10^{6}	USEPA 2013	Very soluble
Vapour pressure (mPa)	0.031	*Lewis et al. 2016	-
Henry's law constant (Pa m^3 mol^{-1})	4.48×10^{-9}		
Octanol-water partition coefficient (K_{OW}), pH7, 20 ºC	9.77×10^{-5}		
Octanol-water partition coefficient (Log K_{OW})	-4.01		
Soil-water distribution coefficient (K_d)	1.5		
Organic carbon adsorption coefficient (K_{OC})	173		
Hydrolysis half-life, 25 ºC (days)	No significant degradation at pH 5, 7 and 9	USEPA 2013	-
Aqueous photolysis half-life, pH 7 (days)	No significant degradation		
Soil photolysis half-life (days)	17		
Aerobic soil metabolism half-life (days)	8.5 (sandy loam) 8.7 (silty loam) 8.8 (loamy sand)		1.62 ppm applied
	8.5 (sandy loam) 8.7 (silty loam) 8.8 (loamy sand)		7.23 ppm applied
Anaerobic soil metabolism half-life (days)	37 (silty loam)		-
Aerobic aquatic metabolism half-life (days)	38 (sand)		1 ppm applied
	57 (silty loam)		
Anaerobic aquatic metabolism half-life (days)	415		-
Organic carbon normalised soil partition coefficient (litre/kg) (K_{FOC})	16.5 (sand)		-
	268 (silty loam)		
	605 (silty loam		
Fish bioconcentration factor (28 days)	0.19x (whole fish)		-
	0.13x(edible)		
Terrestrial field dissipation half-lives (days)	8 (cropped plot) 16.5 (cropped plot) 5.1 (bare ground) 10.3 (cropped plot) 10.6 (bare ground) 14 (grapes)		-
Aquatic field dissipation half-lives (days)	< 7 (soil, 1st application)		-
	12 (soil, 2nd application)		
	3 (water, 1st and 2nd applications)		

* Lewis et al. 2016 is the reference to glufosinate ammonium properties listed in the Pesticide Properties DataBase ("PPDB") of the University of Hertfordshire.

7.2 Transport and mobility

As shown in Table 7.1.1, glufosinate ammonium has high water solubility, and will not [5]volatilise significantly due to its low vapour pressure and Henry's law constant. Glufosinate is an ammonium salt, with a low octanol-water partition coefficient, and does not [6]bioconcentrate in fish.

Glufosinate ammonium is mobile to highly mobile, with a Freundlich organic carbon partition coefficient 16.5 to 605 litre/kg_{oc} in soils from sand to silty loam. The normalised organic-carbon-to-water partition coefficient (K_{OC}) is described as the ratio between the distribution coefficient K_d, and the organic carbon content of the sorbent, in units of mass of organic carbon ("OC") per mass of soil (g OC/g soil).

$$K_{OC} = {}^{K_d}/_{OC} \qquad \text{Equation 7.2.1}$$

Where:

K_{OC}	Normalised organic-carbon-to-water partition coefficient
K_d	Soil-water distribution coefficient
OC	Mass of organic carbon per mass of soil

The [7]mobility of glufosinate in soil can be expected to be lower for soils with higher organic carbon content.

> **Environmental fate** is what happens to a chemical or an organism once it is released into the environment.
> **Transport** refers to how contaminants in the environment move in response to wind, rain and human activities. Chemical, biological, or radiological contaminants can seep into the soil and enter groundwater, runoff into streams, or be transported through the air.
> **Persistence**, in terms of environmental protection, refers to the length of time a contaminant remains in the environment.
>
> USEPA Fate, Transport & Persistence Studies

7.3 Degradation

Data presented in Table 9.1 show that glufosinate ammonium does not significantly [8]degrade via the [9]abiotic mechanisms of [10]hydrolysis or [11]photolysis.

It is biodegraded moderately rapidly in aerobic soils, with some indication of sensitivity to concentration. At higher application rates (7.23 ppm applied, aerobic soil metabolism half-lives for

[5] The process whereby a chemical substance is converted from a liquid or solid state to a gaseous or vapour state. In this case, glufosinate ammonium will not easily move from water to air.
[6] Does not stay in fish for a long time after entering the body of fish, so the amount in fish does not increase over time.
[7] Glufosinate ammonium tends to "hang onto" the carbon that comes from living things in soil
[8] Breakdown of a chemical into simpler parts
[9] Not involving the metabolism of a living organism
[10] When it comes in contact with water
[11] When it comes in contact with sunlight

glufosinate ranged between 20.6 and 23.0 days, while at a lower application rate (1.62 ppm applied) shorter half-lives of 8.5-to-8.8 days were observed. Biodegradation occurs less rapidly in anaerobic soils and in aerobic water, half-lives ranging between 38 and 87 days in the soils, whereas biodegradation is insignificant in anaerobic water (EFSA 2005).

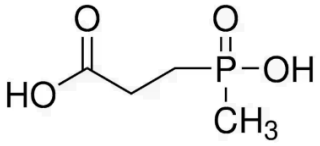
7.4 Field studies

USEPA (2013) reported on the results of several terrestrial field dissipation studies of glufosinate ammonium. It was found to dissipate from the upper 15 cm of soil with half-lives of 8-to-17 days. Despite the fact that glufosinate ammonium is expected to be mobile, it did not leach deeper than about 15 cm into loam or clay soils, or deeper than about 60 cm into a sandy soil.

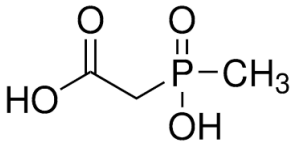
7.5 [12]Transformation products

Primary aerobic metabolism degradation products of glufosinate include MPP (3-methylphosphinicopropionic acid), MPA (2-methylphosphinico-acetic acid), NAG (2-acetamido-4-methylphosphinico-butanoic acid), and carbon dioxide (USEPA 2013; EFSA 2005).

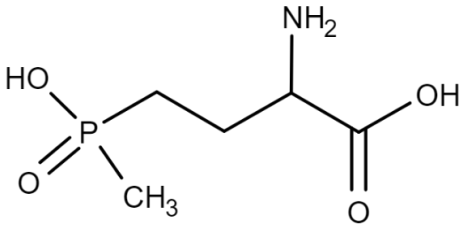
3-Methylphosphinicopropionic acid (MPP) CAS # 15090-23-0



2-Methylphosphinico-acetic acid (MPA) CAS # 72651-25-3



2-Acetamido-4-methylphosphinico-butanoic acid (NAG) CAS # 51276-47-2



The degradation products of glufosinate ammonium have lower mammalian toxicity than the parent compound (USEPA 2013).

7.6 Non-expert summary of the environmental fate of glufosinate ammonium

Glufosinate breaks down slowly when exposed to sunlight, but after 17 days at a normal night/day cycle, half of the original amount of glufosinate will have disappeared from the soil surface.

[12] New chemicals formed when the original one breaks down

It is also broken down by organisms in soil, even in the dark; this process needs the presence of oxygen. This means that glufosinate does not stay in soil for a long time as long as there is oxygen present in the spaces between soil. If all soil spaces are filled with water (water-logged soil that does not drain) glufosinate will stay in soil for a longer time. In South Africa, crops are not planted in water-logged soils, because such crops will fail to thrive.

Glufosinate can move through soil with water (irrigation or rain draining through soil), but the process is slow if the soil is rich in organic material (e.g., compost, dead plant material). The danger of groundwater contamination is low.

In surface water, glufosinate is not easily broken down and a small portion (10%) of glufosinate can end up in the sediment (the bottom, muddy part of rivers or dams). However, it has been found that glufosinate does not stay in fish for a long time after entering the body of fish, so the amount in fish does not increase over time, even if the fish lives in water with glufosinate at the low concentrations that are possible in rivers or dams.

After spraying onto weeds or soil, practically no glufosinate-ammonium will move into air from the sprayed weeds or soil.

8 Toxicological reviews

8.1 Background to toxicological information systems

The USEPA uses Master Record Identifiers (“MRIDs”) to track and manage information submitted to the pesticide program[13]. An MRID is unique eight-digit number assigned to each study submitted to USEPA. The first six digits are referred to as the 'root' MRID. Some of the studies have not been published in the open scientific literature, but USEPA evaluates the integrity of all studies, and information is used only from studies that are classified as acceptable, that means, according to good scientific principles. USEPA also refers to accession numbers (“Acc No”) to access data from the non-confidential Toxic Substances Control Act (“TSCA”) Inventory.

The USEPA often references MRID numbers in assessment reports of the pesticide program, but do not always provide the complete study reference. However, it is accepted that the USEPA has evaluated the integrity of these studies before integration of study information into the pesticide assessments.

8.2 Acute dietary endpoint - general population

A toxicological endpoint or POD for the assessment of health risks associated with a single acute dietary exposure for the general population, including infants and children, was not available in the glufosinate toxicity database.

[13] https://www.epa.gov/pesticide-registration/study-formatting-and-supplemental-information#establish%20MRID.

8.3 Acute dietary endpoint - females 13-to-49 years of age

The USEPA derives a population-adjusted dose ("PAD") for the purposes of dietary risk assessments. The PAD is the maximum acceptable dose that is not expected to result in unreasonable adverse health effects, including of reproductive effects, as determined by the USEPA. The USEPA (2022a) derived an acute PAD, referred to as the "aPAD", based on an acute dietary endpoint from a rabbit development toxicity study. The NOAEL was 6.3 mg/kg-day, based on increased foetal deaths at the LOAEL of 20 mg/kg-day (MRIDs 40345611 and 41144703, cited, but not referenced in USEPA 2022a). This acute PAD is thus suitable for the assessment of the potential reproductive effects of glufosinate ammonium.

8.4 Chronic dietary endpoint

The USEPA (2022a) derived a chronic PAD, referred to as the "cPAD", based on a weight-of-evidence ("WOE") assessment of four rat and dog studies:

- Rat studies based on altered brain glutamine synthetase in females:
  - Subchronic rat study with a LOAEL = 64 to 90 mg/kg-day (MRID 45179103).
  - A chronic/carcinogenicity rat study with a LOAEL = 24.4 mg/kg-day (MRIDs 40345607 and 41144701).
- A chronic dog study with a LOAEL = 8.5 mg/kg-day, based on altered EKG and mortality (MRID 40345608).
- A rat developmental neurotoxicity ("DNT") study with a LOAEL = 14 mg/kg-day) based on altered brain morphometrics in the postnatal day 72 ("PND72") adult offspring (MRID 46455701).

Based on the WOE approach, USEPA (2022a) chose the chronic NOAEL of 6 mg/kg-day, based on glutamine synthetase inhibition in the brains of male rats in the 13-week oral feeding study. Effects observed in the DNT study were at a dose only about two times higher than the NOAEL.

The reproductive toxicity study in rats indicated postnatal developmental toxicity at the highest dose tested as evidenced by a decrease in viable pups, but no parental toxicity was observed. This was taken as evidence of quantitative increased susceptibility in offspring. It is notable that the reproductive effect was only observed at the highest dose tested, which is 3.3 times higher than the NOAEL of 6 mg/kg-day used as a POD for the chronic risk assessment. Therefore, the POD based on glutamine synthetase inhibition in the brains of male rats is also protective of reproductive effects observed at higher doses.

8.5 Short- and intermediate-term incidental oral and dermal endpoints

USEPA (2022a) selected the short-term incidental oral and short- and intermediate-term dermal endpoints from the rat DNT study where the LOAEL = 14 mg/kg-day, based on alterations in brain morphometrics seen in adults on postnatal day 72 following in utero and/or early postnatal exposure.

As explained in Section 8.4, this endpoint is also protective of reproductive effects observed at higher doses.

Since an oral endpoint was used for a dermal exposure scenario, a dermal absorption factor ("DAF") of 1 per cent was used in calculating the human equivalent dose. This is also the absorption factor used by the USEPA (2022(b)) to calculate health risks associated with dermal exposure.

8.6 Short- and intermediate-term inhalation endpoint

USEPA (2022(b)) selected the short- and intermediate-term inhalation endpoint from a 28-day rat inhalation study with LOAEL = 0.056 mg/litre-day, based on lung/bronchial congestion and increased lung/bronchi weight in female rats. A NOAEC was not observed. HECs/HEDs for residential and occupational scenarios were calculated based on the health endpoint of lung bronchial congestion (MRID 47058101, cited but not referenced in USEPA 2022(b)).

The USEPA (2022(b)) inhalation absorption factor is 1 (100%).

- Residential handler HEC (lung/bronchi endpoint) = 0.035 mg/litre-day, derived using Equation 8.6.1:

$$Residential\ handler\ HEC = Rat\ POD \times Thoracic\ RDDR \quad \text{Equation 8.6.1}$$

Where:

Residential handler HEC	Human equivalent concentration for the residential handler (mg/litre-day)
Rat POD	Point of departure from a rat study = 0.056 mg/litre-day
Thoracic RDDR	Thoracic regional deposited dose ratio = 0.618

- Residential handler HED (lung/bronchi endpoint) = 0.82 mg/kg-day, derived using Equation 8.6.2:

$$Residential\ handler\ HED = \text{Residential handler HEC} \times CF \times ED \quad \text{Equation 8.6.2}$$

Where:

Residential handler HED	Human equivalent dose for the residential handler (mg/kg-day)
Residential handler HEC	Residential handler human equivalent concentration = 0.035 mg/litre-day
CF	Human-specific conversion factor = 11.8 litre/hr-kg
ED	Exposure duration = 2 hours

- Occupational handler HEC (lung/bronchi endpoint) = 0.026 mg/litre-day, derived using Equation 8.6.3:

$$Occupational\ handler\ HEC = Rat\ POD \times EF \times ED \times Thoracic\ RDDR \quad \text{Equation 8.6.3}$$

Where:

Occupational handler r HEC	Human equivalent concentration for the occupational handler (mg/litre)
Rat POD	Point of departure from a rat study = 0.056 mg/litre-day
EF	Daily duration adjustment = 6 hours/8 hours)
ED	Weekly duration adjustment = 5 days/5 days
Thoracic RDDR	Thoracic regional deposited dose ratio = 0.618

- Occupational handler HED (lung/bronchi endpoint) = 2.46 mg/kg-day, derived using Equation 8.6.4:

$$Occupational\ handler\ HED = Occupational\ handler\ HEQ \times CF \times ED$$ Equation 8.6.4

Where:

Occupational handler HED	Human equivalent dose for the occupational handler (mg/kg-day)
Occupational handler HEC	Occupational handler human equivalent concentration = 0.026 mg/litre-day
CF	Human-specific conversion factor = 11.8 litre/hr-kg
ED	Exposure duration = 8 hours

8.7 Cancer (oral, dermal, inhalation)

Glufosinate ammonium was classified by the Hazard Identification Assessment Review Committee ("HIARC") as "*not likely to be a human carcinogen"*. There was no evidence of a treatment-related increase in tumours in either rats or mice (HIARC, TXR 0051833, B. Tarplee, 17-APR-2003, cited but not referenced in USEPA 2022(b)).

Glufosinate ammonium is also not classified as carcinogenic in the Pesticide Properties Data Base of the University of Hertfordshire (Lewis et al. 2016).

Table 8.7.1: Summary of glufosinate toxicological doses and endpoints for use in HHRA.

Point of Departure (POD)	Uncertainty/FQPA Safety Factors	RfD, PAD, Level of Concern for Risk Assessment	Study and Toxicological Effects
Acute dietary (general population, including infants and children)			
An endpoint attributable to a single exposure was not available from the toxicity studies, including the developmental toxicity and developmental neurotoxicity studies.			
Acute dietary (females 13-49 years of age)			
NOAEL = 6.3 mg/kg-day	UFA = 10× UFH = 10× FQPA SF = 1× Total UF = 100×	Acute RfD = 0.063 mg/kg-day aPAD = 0.063 mg/kg-day	Developmental toxicity study in rabbits LOAEL = 20 mg/kg-day based on increased foetal deaths
Chronic dietary (all populations)			
NOAEL= 6 mg/kg-day	UFA = 10× UFH = 10× FQPA SF = UFL = 10× Total UF = 1000×	Chronic RfD = 0.006 mg/kg-day cPAD = 0.006 mg/kg-day	"Weight of evidence" approach from four studies. 1. Rat subchronic LOAEL = 64-90 mg/kg-day and chronic studies with the LOAEL = 29 mg/kg-day based on inhibition of brain glutamate synthetase 2. Dog chronic study with the LOAEL = 8.5 mg/kg-day based on altered electrocardiogram and mortality 3. Rat developmental neurotoxicity study with a LOAEL = 14 mg/kg-day (without a NOAEL, basis for UFL) based on altered morphometrics in the offspring as adults
Incidental oral short-term (1-30 days) and Intermediate term (1-6 months)			
LOAEL = 14 mg/kg-day (LDT)	UFA = 10× UFH = 10× FQPA SF= UFL=10× Total UF = 1000×	Residential LOC for MOE = 1000	Developmental neurotoxicity study in rats LOAEL = 14 mg/kg-day based on brain morphometric changes at PND 72. No NOAEL identified.
Dermal short-term (1-30 days), and intermediate-term (1-6 months)			
LOAEL = 14 mg/kg-day (LDT) DAF = 1 %	UFA = 10× UFH = 10× FQPA SF = UFL = 10× Total UF = 1000×	Residential and occupational LOC for MOE = 1000 for short and intermediate term exposures	Developmental neurotoxicity study in rats LOAEL = 14 mg/kg-day based on brain morphometric changes at PND 72. Lowest dose tested ("LDT"), no NOAEL identified.
Inhalation acute, short-term (1-30 days), intermediate (1-6 months)			
LOAEL = 12.5 mg/kg-day (56 mg/m^3)	UFA = 3× UFH = 10× FQPA SF = UFL = 10×	Residential and occupational LOC for MOE = 300 for short and intermediate term	28-day inhalation study (LOAEL = 12.5 mg/kg-day based on lung/bronchial congestion and increased lung/bronchi weight in female rats and increased kidney and liver weights.

Point of Departure (POD)	Uncertainty/FQPA Safety Factors	RfD, PAD, Level of Concern for Risk Assessment	Study and Toxicological Effects
	Total UF = 300× Residential handler HEC = 0.035 mg/litre-day HED = 0.82 mg/kg-day Occupational handler HEC = 0.026 mg/litre-day HED = 2.45 mg/kg-day		
Cancer (oral, dermal, inhalation)			
Not likely to be a human carcinogen			

Point of Departure (POD) = A data point or an estimated point that is derived from observed dose-response data and used to mark the beginning of extrapolation to determine risk associated with lower environmentally relevant human exposures
NOAEL = no observed adverse effect level
LOAEL = lowest observed adverse effect level
UF =uncertainty factor
UFA = extrapolation from animal to human (interspecies)
UFH = potential variation in sensitivity among members of the human population (intraspecies)
UFL = use of a LOAEL to extrapolate a NOAEL.
FQPA SF = FQPA Safety Factor
PAD = population adjusted dose (a = acute, c = chronic)
RfD = reference dose
MOE = margin of exposure
LOC = level of concern
N/A = not applicable

9 Ecological risk assessment

9.1 Introduction

USEPA (2013) applied a surrogate-species approach in its risk assessment of glufosinate ammonium. Toxicity data generated from surrogate test species, intended to be representative of broad taxonomic groups, were used to extrapolate potential effects on a variety of species (receptors) included under these taxonomic groupings.

USEPA (2013) presented comprehensive data on ecological risk assessment. Acute and chronic toxicity data from studies submitted by pesticide registrants, together with available open literature data, were used to evaluate potential direct effects of glufosinate to terrestrial and aquatic receptors. The approach was based primarily on screening-level assessments, applying the risk quotient ("RQ") method. The RQ method involves dividing estimated environmental concentrations ("EECs") by point estimates of the most sensitive acute and chronic toxicity values. The resulting RQs are then compared to LOC values for the surrogate species.

The risk assessment results in USEPA (2013) must be evaluated together with the context presented in USEPA (2016), as discussed in this INFOTOX document.

9.2 Ecological incidents

USEPA (2016) searched the 2012 Ecological Incident Information System ("EIIS"), and found 51 incidents associated with the use of glufosinate, reported between 1999 and 2011. Of these incidents, 49 were associated with phytotoxic effects on agricultural crops, and 39 were associated with glufosinate alone.

Eighteen of the crop plant incidents were classified as having a "probable" association with glufosinate exposure, whereas the other 31 crop plant incidents were classified as having a "possible" association with glufosinate use. Most of the incidents of crop damage resulted from direct spray application on corn or canola.

Two freshwater fish-kill incidents were reported with nearby terrestrial applications of glufosinate. It was not known whether these fish incidents were associated with a particular glufosinate formulation, or whether these resulted from oxygen depletion from direct effects of glufosinate exposure on the aquatic plant community.

The USEPA (2016) found that the connection between the reported ecological (fish-kill) incident and actual glufosinate contact is not certain, and would have been prevented with proper application practices.

9.3 Terrestrial risks

9.3.1 Introduction

USEPA (2013) calculated terrestrial wildlife exposure estimates for birds and mammals by focusing on the dietary exposure route of uptake of pesticide active ingredients. These exposures served as surrogates for exposures of terrestrial-phase amphibians and reptiles. For exposures to terrestrial

organisms, such as birds and mammals, pesticide residues on food items were estimated on the assumption that organisms were exposed to pesticide residues as a function of the pesticide use pattern.

9.3.2 Risk to mammals

In the [14]preliminary risk assessment for glufosinate, USEPA (2013) identified chronic risks of concern for mammals, with dose-based RQs ranging from 48 for use on blueberries, to an RQ of 7 for potato vine desiccation, where the LOC for chronic risks to non-listed mammals[15] is 1.0. The calculated RQs were based on reductions in growth and in offspring fitness and viability, which effects were seen across generations and in multiple species. When assessed as chronic dose-based RQ values, risks to mammals of all sizes (except those that feed exclusively on seeds and grains) were of concern for most use sites.

When refinements in the assessment were introduced, namely, including the use of a foliar dissipation rate on measured glufosinate residues rather than the default value, median values rather than maximums, average rather than maximum application rates, and/or alternative application dates, risk quotients were reduced. For example, the highest dose-based chronic mammalian RQ for glufosinate ammonium use on blueberries was reduced from 48 to 9.

9.3.3 Risk to birds, reptiles and terrestrial-phase amphibians

Preliminary risk assessments conducted as chronic dietary-based RQs showed the highest risks for use on blueberry (RQ of 1.67) and lowest for stone fruit (RQ of 1.12). The LOC for chronic risks to birds is 1.0, and observed effects were lethargy, diarrhoea, and in bobwhite quail, decreases in the proportion of live-to-viable embryos after parental exposure.

The refinements referred to for mammals were also applied, that is, measured glufosinate residues on leaves rather than the default value, median values rather than maximums, average rather than maximum application rates, and/or application in alternative seasons, reduced all the RQs to below the LOC (RQs of 0.14 for blueberries and 0.22 for stone fruit). Therefore, risks to birds, reptiles and terrestrial-phase amphibians are negligible under the worst-case conditions, when it is assumed that animals will ingest unrealistically high amounts of treated food, e.g., blueberries (USEPA 2013).

9.3.4 Invertebrates (pollinators)

Glufosinate ammonium is practically nontoxic to honey bees, both on an acute contact and oral exposure basis (adults only), but USEPA (2013 and 2016) raised uncertainty regarding the toxicity of glufosinate ammonium to bee larvae, since no data on this age group of honey bees were available at the time of the review.

[14] An initial evaluation to identify possible risks of herbicide use. The initial risks are calculated using conservative or worst-case, assumed exposure values, that are planned to overestimate exposure to the environment. It is a crucial first step to focus the risk assessment on animals or environments (e.g., streams and rivers) that must be looked at in more detail, with more realistic exposure values.
[15] Endangered and threatened species are referred to as “listed”.

9.3.5 Terrestrial plants

As can be expected from its herbicidal mode of action, glufosinate ammonium adversely affected the most sensitive monocotyledonous (monocot) and dicotyledonous (dicot) species at all treatment levels in vegetative vigour studies (USEPA 2013 and 2016). Screening-level RQs for listed monocot species were as high as 10.9 and 6.2 for ground and aerial applications, respectively, in agricultural settings, and as high as 11.8 in non-agricultural settings. The LOC for terrestrial plants is 1.0.

Refinements to the assessment included, among others, application timing, precipitation, and percolation of water into the soil. These refinements reduced risk estimates, although not to below the LOC. The refined risk assessment for glufosinate ammonium identified potential risks of concern for non-target terrestrial plants[16] for nearly all the modelled exposure scenarios. The non-listed terrestrial plant RQs ranged from 1.25 and 1.35 for monocots, and to 1.91 and 2.06 for dicot species, for ground and aerial applications, respectively, at maximum label application rates.

9.3.6 Risks to aquatic organisms

Assessed organisms include aquatic plants, fish and aquatic invertebrates. The USEPA (2013) preliminary risk assessment did not identify risks of concern for aquatic plants, fish, or aquatic invertebrates, except for the use of glufosinate ammonium on rice. Considering that the use of glufosinate ammonium on rice is not relevant in South Africa, it can be concluded that the use of glufosinate ammonium poses no ecological risks of concern for aquatic organisms.

9.4 USEPA critical review of ecological risk assessment

The screening ecological risk assessment recorded by USEPA (2016) indicated that chronic RQs exceeded the LOC for mammals and birds at the maximum label single application rate for most crops, with the greatest exceedances in mammals. USEPA subsequently undertook a refined assessment that calculated RQs using average application rates and average EECs. These refinements reduced chronic avian RQs to below the LOC, but not the mammalian RQs.

In the final consideration, USEPA (2016) did not "*believe risk mitigation measures are warranted for birds, reptiles, and terrestrial-phase amphibians"*; therefore, risk mitigation measures for birds, reptiles, and terrestrial-phase amphibians were not recommended, and are also not necessary in the South African context. This decision took into account the low chronic dietary-based avian RQs in the screening-level assessment, and reductions of these RQs to below LOCs in the refined assessment, also considering the benefits of glufosinate ammonium uses.

USEPA (2016) also concluded that chronic risks to mammals from glufosinate ammonium use could be less than what had been estimated at the screening level:

- Firstly, the average number of glufosinate ammonium applications per year among growers in the USA was less than two for all agricultural use sites, except for table grapes. Based on these data, on a national basis, the amount of time during the growing season that mammalian exposure to glufosinate ammonium would lead to risks above the LOC would be less than what had been modelled.
- Secondly, the applied assessment methodology assumed that mammals (and birds) obtain their entire diet within the treated field. Even in situations where this might have been the case, the availability of treated foliage to mammals as a food item would be limited due to

[16] Plants adjacent to the treated site.

the fast-acting nature of glufosinate ammonium on target weeds. Signs of phytotoxicity would be observed within the first few days after application, and would increase over time, rendering the foliage unattractive as food.

To address chronic risk to mammals, the USEPA (2016) considered reductions in application rates and numbers of applications. However, "*Given the increasing threat of herbicide-resistance, glufosinate, as a broad spectrum postemergence herbicide used on a wide variety of crops, with little weed-resistance of its own, is a valuable tool for weed management*". Based on these considerations, the USEPA (2016) concluded that reducing either the single application rate or the number of applications on glufosinate labels could have an impact on growers that outweighs the potential chronic risk to mammals. Consequently, neither option has been pursued as mitigation measures in the USEPA Interim Decision, and are also not suggested for South Africa. it is recommended that the rates of application in South Africa should be as specified on the product labels.

9.5 Implications for use and ecological risks in South Africa

The points of reasoning by the USEPA are also valid for South Africa. In particular, the average number of glufosinate ammonium applications per year of the product KNERSUS® 200 SL should generally be not more than two (label instructions). Secondly, the dietary intake by mammals and birds is likely to be aligned with the lower intakes proposed by the USEPA, as explained in Section 9.4, rather than with the modelled high intake levels. Thirdly, the emergence of herbicide resistant weeds is also an increasing problem in South Africa, and a significant economic issue to herbicide-dependant farmers. Therefore, as assessed by the USEPA, limiting glufosinate ammonium application rates could have a negative impact on crop producers that outweighs the potential chronic risk to mammals. Consequently, limiting of application rates should also not be pursued as a mitigation measure in South Africa. It is recommended that the rates of application in South Africa should be as specified on the product labels.

In summary, regarding environmental risks in South Africa, it is concluded that the risks to animals in the environment from exposure to the agricultural remedy, under realistic worst-case conditions of use, is negligible:

- In the case of birds, reptiles, and terrestrial-phase amphibians, because chronic dietary-based RQs were all under the level of concern (Section 9.2.3).
- Glufosinate ammonium is practically nontoxic to honey bees, both on an acute contact and oral exposure basis (Section 9.2.4).
- The use of glufosinate ammonium poses no ecological risks of concern for aquatic organisms (Section 9.2.6).
- Although there are doubts that the use of glufosinate ammonium weedkillers in agricultural crops is without risk to mammals, it is not recommended that the rates of application in South Africa should be limited below that already recommended on the product labels, because of concerns regarding lower crop yields, that were projected by the USEPA to exceed the possible advantage in the protection of mammals (Section 9.4). It is recommended that the rates of application in South Africa should be as specified on the product labels.

If glufosinate ammonium is used correctly to kill weeds, even under realistic worst-case conditions of use, it is not harmful to birds, bees, fish, or other water life.

10 Human incident reports

USEPA (2016) consulted the USEPA Office of Pesticide Programs (“OPP”) Incident Data System (“IDS”), and the Centers for Disease Control and Prevention (“CDC”)/National Institute for Occupational Safety (“NIOSH”) and Health Sentinel Event Notification System for Occupational Risk-Pesticides (“SENSOR”) databases for poisoning incident data on glufosinate.

The main IDS, from 2007 to 2012, reported six incidents for glufosinate only, and three incidents involving glufosinate and at least one more pesticide. All of these incidents were classified as of moderate severity and occurred with residential applicators. Reported health effects included gastrointestinal, dermal, neurological, and cardiovascular outcomes. In aggregate IDS, from 2007 to 2012, there were 31 reported incidents classified as of minor severity.

SENSOR pesticides data from 1998 to 2008 identified five cases, resulting from three events involving glufosinate. Four of the five cases involved glufosinate only, and one case involving multiple active ingredients, all regarded as of low severity. Four of these cases reported dermal symptoms, and one case reported respiratory symptoms. Three of the cases were bystanders, one was a residential handler, and the circumstances of the fifth case were unknown, but described as work-related.

USEPA (2016) concluded on the basis of the low frequency and minor-to-moderate severity of the reported incidents for glufosinate, that there was not concern that would warrant further investigation at that time.

11 Endocrine disruptor screening programme

As required by the Federal Food, Drug, and Cosmetic Act (“FFDCA”), glufosinate is subject to the endocrine screening part of the Endocrine Disruptor Screening Program (“EDSP”) of the USA.

The EDSP applies a two-tiered approach in assessing potential endocrine disrupting effects. Tier 1 consists of a set of 11 screening assays to identify the potential of a chemical substance to interact with the oestrogen, androgen, or thyroid (“E, A, or T”) hormonal systems. Chemicals that show in Tier 1 screening to have the potential to interact with E, A, or T hormonal systems, proceed to the next stage of the EDSP where USEPA determines which, if any, of the Tier 2 tests are necessary based on the available data. Tier 2 testing is designed to identify any adverse endocrine-related effects caused by the substance, and to establish a dose-response relationship for the E, A, or T effect.

Results of testing for endocrine disrupting effects of glufosinate ammonium are not available in USEPA documentation at this time. The Pesticide Action Network (PAN online) North America states that endocrine disrupting effects of glufosinate ammonium have been insufficiently studied. The Pesticide Properties Database (“PPDB”) of the University of Hertfordshire (Lewis et al. 2016) listed glufosinate ammonium as not an endocrine disrupter.

There is thus insufficient data to classify glufosinate ammonium as an endocrine disruptor.

12 Occupational exposure

12.1 Proposed use pattern and exposure profile

Personal Protective Equipment ("PPE") requirements

The KNERSUS® 200 SL label should include the following PPE requirements for applicators: at least baseline attire or single layer clothes, defined as a long-sleeved shirt, long pants, shoes, and socks.

The use of chemical resistant gloves while handling the herbicide product is recommended on the product label. Thus, gloves should be used while mixing, loading or applying (spraying) the pesticide; whether by pesticide operators or other agricultural workers. However, accepting that PPE use is not necessarily diligently adhered to, risks presented in this report were all calculated based on the assumption that gloves are not worn. In mixing/loading/application scenarios where unacceptable levels of health risks were indicated if gloves are not used, the calculations were repeated, based on the assumption that gloves are used (Section 12.4).

Restricted-entry interval ("REI")

Generally, labels recommend an REI, that is, the period to lapse before re-entering the treated area. The REI for KNERSUS® 200 SL is 12 hours.

The occupational exposure profile is summarised in Table 12.1.1.

Table 12.1.1: Occupational exposure profile.

Type of worker	Exposure duration	Inhalation exposure	Dermal exposure	Oral exposure
Occupational pesticide handlers	Short-term (1 to 30 days)	✔	✔	N.a.
	Intermediate-term (1 to 6 months)	✔	✔	N.a.
Post-application workers	Short-term (1 to 30 days)	N.a.	✔	N.a.
	Intermediate-term (1 to 6 months)	N.a.	✔	N.a.

N.a: Not applicable

Handler exposures

The term "handlers" describes those involved in the pesticide application process. Distinct job functions or tasks related to applications and exposures were identified by the USEPA, depending on the specifics of each task, such as:

- Job requirements (amount of chemical used in each application).
- Kinds of equipment used.
- Treated target.
- Level of protection used by a handler.

Post-application exposures

The term post-application to describe exposures that occur when individuals are present in an environment that has been previously treated with a pesticide (also referred to as re-entry exposure). Such exposures may occur when workers enter previously treated areas to perform job functions, including activities related to crop production, such as scouting for pests, moving irrigation pipes, or harvesting (USEPA 2022(b)).

12.2 Exposure and risk equations

Risk assessment example calculations for occupational handler and post-application workers are presented in this section. USEPA examples results for occupational handlers are presented in Section 12.3. Example results for post-application worker exposure and risk calculations in crops targeted in South Africa are not provided by the USEPA (2022(b)).

Occupational handler equations

Potential daily exposures for handlers are calculated using the following formulas:

$$E = UE * AR * A * 0.001\ mg/ug$$

Equation 12.2.1

where:

E	exposure (mg a.i./day)
EU	unit exposure (µg a.i./kg a.i.)
AR	maximum application rate according to proposed label (kg a.i./ha or kg a.i./litre)
A	area treated or amount handled (e.g., ha/day, litre/day)

The daily doses are calculated using the following formula:

$$ADD = \frac{E * AF}{BW}$$

Equation 12.2.2

where:

ADD	average daily dose absorbed in a given scenario (mg ai/kg-day)
E	exposure (mg ai/day)
AF	absorption factor (dermal and/or inhalation)
BW	body weight (kg)

Non-cancer risk estimates for each scenario are calculated using the Margin of Exposure (MOE) approach, which is a ratio of the POD to the daily dose of concern.

All MOE values are calculated using the following formula:

$$MOE = \frac{POD}{ADD}$$

Equation 12.2.3

where:

MOE	margin of exposure: value used by the USEPA to represent risk estimates (unitless)
POD	point of departure (mg/kg-day)
ADD	average daily dose absorbed in a given scenario (mg ai/kg-day)

Occupational post-application equations

Potential daily exposures for occupational post-application workers are calculated using the following formulas:

$$DFR_t = AR * F * (1-D)^t * \left(4.54E8 \frac{ug}{lb}\right) * \left(2.47E\text{-}8 \frac{A}{cm^2}\right)$$

Equation 12.2.4

where:

DFR_t	dislodgeable foliage residue on day "t" (µg/cm^2)
AR	application rate (kg a.i./ha)
F	fraction of a.i. retained on foliage, or default of 25% (unitless)
D	fraction of residue that dissipates daily, or default of 10% (unitless)
T	number of days after application day (days)

$$E = TC * DFR_t * ET * 0.001 \frac{mg}{ug}$$

Equation 12.2.5

where:

E	exposure (mg ai/day)
TC	transfer coefficient (cm^2/hr)
DFR_t	dislodgeable foliar residue on day “t” (µg/cm^2)
ET	exposure time (hours/day)

The transfer coefficients (“TCs”) used for these calculations, and presented in Annexure 1, are based on standard clothing worn by agricultural field workers: shoes, socks, long-legged pants, and long-sleeved shirts. Gloves, face/head and respiratory protection are not included.

Regarding the DFR_t, the USEPA (2022(b)) noted that residue dissipation follows first-order kinetics; generally declining to below detection after 2 to 7 days, with an estimated half-life of 1.2 days.

The daily doses are calculated using the following formula:

$$ADD = \frac{E * AF}{BW}$$

Equation 12.2.6

where:

ADD	average daily dose absorbed in a given scenario (mg a.i./kg-day)
E	exposure (mg a.i./day)
AF	absorption factor (dermal and/or inhalation)
BW	body weight (kg)

The MOE is calculated with Equation 12.2.3.

Summary of terms and values for calculations

A summary of terms and values for the above calculations is presented in Table 12.2.1.

Table 12.2.1: Summary of terms and values for calculations.

Term	Term symbol	Units	Value
Unit exposure	UE	µg a.i./kg a.i.	Table 12.3.1, for different exposure scenarios
(Maximum) application rate	AR	kg a.i./ha or kg a.i./litre	According to product label
Area treated or amount handled	A	ha/day or litre/day	Default values in Table 12.3.1

Term	Term symbol	Units	Value
Absorption factor	AF	unitless	Dermal: 1% Inhalation: 100%
Adult body weight	BW	kg	80 (USEPA 2011)
Point of departure	POD	mg/kg-day	Table 8.7.1, for different routes of exposure
Fraction of a.i. retained on foliage	F	unitless	0.25 (25%, default)
Fraction of residue that dissipates daily	D	unitless	0.10 (10%, default)
Number of days after application day	T	days	Restricted-entry interval (REI) recommended on label, or general value of 12 hours (0.5 days) Moving irrigation pipes: 2 days
Transfer coefficient	***TC	cm^2/hr	See Annexure 1
Dislodgeable foliar residue on day "t"	DFRt	$\mu g/cm^2$	*1.59 **Half-life = 1.2 days
Exposure time	ET	hours/day	Assumed 8 hours (workday), but only one exposure event before complete dissipation of deposited pesticide.

* Residue level on corn leaves, day 0 (USEPA 2022(b)).
** Biological half-life: time required for the dissipation, by natural processes, of half of the amount of pesticide deposited on day 0.
***TC: based on standard clothing worn by agricultural field workers: shoes, socks, long-legged pants, and long-sleeved shirts. Gloves, face/head and respiratory protection are not included.

12.3 USEPA exposure and risk example results

Occupational handler exposure and risk assessment data and results, using the example calculations presented in Section 12.2, are summarised in Table 12.3.1. The USEPA did not prepare an example of post-application worker exposure and risk calculations. Handler exposure resulting from outdoors application of pesticides was thought to result in higher levels of exposure than post-application re-entry worker exposures. Therefore, it was expected that handler inhalation exposure estimates would be protective of most occupational post-application inhalation exposure scenarios, and a quantitative occupational post-application inhalation exposure assessment was not performed (USEPA 2022(b)).

It should be noted that dermal and inhalation PODs are based on different effects, and doses determined for these routes cannot be combined.

Table 12.3.1: USEPA example of glufosinate ammonium occupational handlers' exposure doses and MOEs.

Exposure scenario	Crop or Target[1]	Unit exposure[2] (µg/kg a.i.) [PPE types]		Maximum App. Rate[3]	Area treated daily or amount handled daily[4]	Dermal[5]		Inhalation[6]	
		Dermal	Inhalation			Dose (mg/kg-day)	MOE LOC=1 000	Dose (mg/kg-day)	MOE LOC=300
Mixer / loader									
Liquid, groundboom, broadcast	Orchard/ Vineyard	82.9 [SL/G]	0.483 [No-R]	3.31 kg a.i./ha	16.2. ha	0.00033	43 000	0.00016	15 000
	Field crop, typical hectares				32.4 ha	0.00065	21 000	0.00033	7 500
	Field crop, high hectares			1.74 kg a.i./ha	80.9 ha	0.00086	16 000	0.00043	5 700
Applicator									
Spray groundboom, broadcast	Orchard/ Vineyard	35.5 [SL/G]	0.75 [No-R]	3.31 kg a.i./ha	16.2. ha	0.00014	100 000	0.00026	9 600
	Field crop, typical hectares				32.4 ha	0.00028	50 000	0.00050	4 800
	Field crop, high hectare			1.74 kg a.i./ha	80.9 ha	0.00037	38 000	0.00067	3 700
Mixer/loader/ applicator									
Liquid, Backpack, Ground/soil-directed	Orchard/ Vineyard	18 210.18 [SL/G]	5.69 [No-R]	0.004 kg a.i. / litre solution	151.4 litres solution	0.0015	9 500	0.00004	62 000

Notes to table:

1. Orchard/Vineyard crops include tropical and subtropical, small fruit, edible peel, and fruit, small, vine climbing, except fuzzy kiwifruit.
   Typical field crops include bushberries and cucurbits.
   High hectares field crops include expanded use on tuberous vegetables and corn.
2. Based on the "Occupational Pesticide Handler Unit Exposure Surrogate Reference Table" (USEPA 2021).
   Type of PPE: SL/G: Single layer clothes (baseline attire) with gloves.
   No-R: No respirator (baseline inhalation PPE)
3. Based on end-use label proposed to USEPA
4. Exposure Science Advisory Council Policy #9.1.
5. Algorithms for dermal and inhalation dose and MOE calculations presented in Section 12.2.

12.4 KNERSUS® 200 SL risks for pesticide handlers: mixers, loaders and applicators

Completely mechanised application or post-application re-entry activities are highly unlikely to be associated with any significant exposure to workers and are not assessed. Specific examples of nut- and fruit types are assessed (Table 12.4.1), aligned with the product label instructions. These crops are assessed in order to present a range of possible exposures.

Table 12.4.1: Assessed crops and examples of fruits.

Crop	Examples
Vineyard	Grapes: table / raisin / juice / wine
Orchard: Citrus	Oranges, etc.

KNERSUS® 200 SL is supplied as a concentrated liquid product. The calculation of the spray parameter input values needed for the KNERSUS® 200 SL occupational exposure and risk calculations are presented in Table 12.4.2, based on spray solution mixing and application instructions on the product label.

Table 12.4.2: Input values for KNERSUS® 200 SL mixing, loading and application exposure and risk calculations.

Crop	Groundboom broadcast spray			Spot spray (backpack)	
	Label: kg glufosinate / litre product	Label: Litre product / ha, maximum	Calculated kg glufosinate / ha, maximum	Label: Maximum product (ml) / litre spray solution	Calculated spot spray solution concentration (kg glufosinate / litre)
Citrus	0.2	7.5	1.5	25	0.005
Vineyard	0.2	7.5	1.5	25	0.005

Notes to table:
Calculated kg glufosinate / ha = (kg glufosinate / litre product) * (litre product / ha, maximum)
Calculated spot spray solution concentration (kg glufosinate / litre)
= 25 ml * (kg glufosinate / litre product) / 1000 ml
Calculated broadcast spray solution concentration (kg glufosinate /litre)
= (Calculated kg glufosinate / ha, maximum) / (maximum total litre solution / ha)
Label: litre solution / ha is the volume solution associated with the highest concentration of glufosinate per litre solution

Exposure calculations according to the USEPA equations described in Section 12.2, performed for occupational herbicide handlers, these are mixers, loaders and applicators, are presented in Table 12.4.3 and 12.4.4 for groundboom and backpack (knapsack) application, respectively. The product supplier has indicated that the herbicide is not intended for aerial application (e.g., by low-flying aircraft) and this method of application is excluded from the assessment.

Table 12.4.3: Groundboom application: occupational handler exposure and MOEs.

Crop	AR: Maximum Application Rate (kg/ha)	*Dermal exposure (no gloves)			*Inhalation exposure (no respirator)		
		Dose (mg/kg-day)	LOC = 1000		Dose (mg/kg-day)	LOC = 300	
			MOE	MOE > LOC?		MOE	MOE > LOC?
Mixer / loader: Liquid, groundboom, broadcast							
Orchard: Citrus	1.5	0.0015	9 501	Yes	0.00015	16 699	Yes
Vineyard	1.5	0.0015	9 501	Yes	0.00015	16 699	Yes
Applicator: Groundboom broadcast spray							
Orchard: Citrus	1.5	0.0005	26 594	Yes	0.00023	10 754	Yes
Vineyard	1.5	0.0005	26 594	Yes	0.00023	10 754	Yes
Notes to table: * PPE use: dermal exposure calculated assuming that gloves are not used, inhalation exposure without a respirator.							

Table 12.4.4: Backpack application: occupational handler exposure and MOEs.

Crop	AR (kg/litre solution)	Dermal exposure without/with gloves			*Inhalation exposure		
		Dose (mg/kg-day)	LOC = 1000		Dose (mg/kg-day)	LOC = 300	
			MOE	MOE > LOC?		MOE	MOE > LOC?
Mixer / loader / applicator: Liquid, backpack, ground/soil-directed. "Spot spraying" on product label.							
Agricultural crops: dermal exposure calculated assuming gloves are not used.							
Orchard: Citrus	0.005	0.0122	1 149	Yes	0.00005	45 504	Yes
Vineyard	0.005	0.0122	1 149	Yes	0.00005	45 504	Yes
Notes to table: **AR:** Maximum Application Rate. Dermal exposure: calculated assuming that gloves are not used, unless otherwise indicated. * PPE use: inhalation exposure calculated assuming a respirator is not used.							

12.5 KNERSUS® 200 SL risks for post-application re-entry workers

Post-application (re-entry) agricultural workers are exposed by the dermal route only, since glufosinate ammonium and its residues are not volatile (inhalation exposure is excluded). It was assumed that gloves are not used during re-entry activities.

Re-entry exposure is assessed for the crop types indicated on the KNERSUS® 200 SL label, and summarised in Table 12.4.1. Re-entry exposure and risk results are presented in Table 12.5.1. The assumed re-entry period is 12 hours, as noted on the product label.

KNERSUS® 200 SL is a herbicide, and clear instructions on the labels caution that foliar parts of plants, and the stems of young plants, must be protected to ensure that the applied spray does not make contact with the foliage. Furthermore, herbicide sprays are also not directed at the buds, flowers or fruit of orchards or other crops. Most post-application re-entry activities involves contact only or mainly with fruit, leaves, and the twigs and branches of fruit trees and vines, which are not sprayed.

Thus, most re-entry activities will involve negligible contact with herbicide residues, such as:

- Harvesting, pruning, leaf pulling or thinning fruit by hand.
- Scouting or inspecting crops.
- Propping fruiting branches and other orchard or vineyard maintenance activities.
- Propagating or transplanting vines.
- Hand-setting of irrigation pipes, which should be done, in any case, with gloves protecting hands against superficial injury.

The only activities that might involve more-than-negligible contact with residues on weeds is weeding by hand.

In conclusion, none of the re-entry activities in any of the assessed crops are associated with a risk to health.

Table 12.5.1: Post-application re-entry workers exposure and risks.

Activity	AR: Maximum App. Rate	Dermal			
		Dislodgeable foliar residue at time of entry	Dose	LOC=	1000
	kg/ha	DFR_t (µg/cm^2)	(mg/kg-day)	MOE	MOE > LOC?
Weeding by hand					
Vineyards	1.5	3.6	0.0023	6 149	Yes
Citrus fruit orchards	1.5	3.6	0.0004	39 353	Yes
Note to table: The use of gloves is not assumed for the post-application re-entry workers.					

12.6 Conclusions on the occupational risks of KNERSUS® 200 SL herbicidal use

The risks associated with KNERSUS® 200 SL herbicidal use in the agricultural sector are characterised according to the relevant occupationally exposed group of workers and the method of herbicide application assessed in Section 12.4.

Groundboom applications

Risks to pesticide handlers (mixers, loaders and applicators) preparing or applying spray mixtures for groundboom applications (Table 12.4.3) on all crops listed on the product label are associated with acceptable levels of exposure and risk, meaning that the risk to health is negligible.

The risks were calculated for workers not wearing gloves and not wearing respirators. Although the product label clearly indicates that gloves should be worn, risk calculations were performed assuming that gloves are not used, since it is possible that PPE use is not always diligently enforced.

Assuming that not using PPE is representative of realistic worst-case conditions, it is concluded that risk to humans (mixers, loaders and applicators) are negligible under realistic worst-case conditions of groundboom product application.

Backpack applications (spot spraying or spraying of small crop areas by hand)

This involves applying spray mixtures with a handheld “wand” attached to a backpack (knapsack)

with a small tank reservoir for the herbicide mixture. Even though the product label clearly states that gloves should be worn, the risks were calculated for workers not wearing gloves and not wearing respirators, since it is possible that PPE use is not always diligently enforced.

Exposure of pesticide handlers (mixers, loaders and applicators) (Table 12.4.4) on all crops listed on the product label are associated with acceptable levels of exposure and risk, meaning that a risk to health is not indicated, even if gloves are not used.

Assuming that not using PPE is representative of realistic worst-case conditions, it is concluded that risk to humans (mixers, loaders and applicators) are negligible under realistic worst-case conditions of product application with a backpack.

Post-application re-entry workers

It was assumed throughout that post-application re-entry workers would not wear gloves and that workers enter the treated area not before 12 hours after herbicide spraying, in practical terms meaning the day after treatment.

The health risks calculated for re-entry workers (Table 12.5.1) are acceptable in all assessed crops. Assuming that not using gloves is representative of realistic worst-case conditions, it is concluded that risks to humans (post-application re-entry workers) are negligible under realistic worst-case conditions. This conclusion is applicable to all assessed methods of application.

Risks to health are negligible, even under realistic worst-case conditions (if gloves are not used) while:

- Handling the product to prepare the spray mixture.
- Applying the herbicide with a groundboom.
- Using a backpack to spray the herbicide in agricultural crops listed on the label.
- Re-entering the sprayed area to weed by hand.
- It is safe to enter the sprayed area to handle crops (e.g., citrus trees and vines) or produce (e.g., fruit), because the weedkiller is not applied to crops or produce.

12.7 Occupational exposure in glufosinate ammonium production

12.7.1 Regulatory context

Occupational health and safety

The overarching obligation of employers in South Africa is to provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to employee health (section 8 of the Occupational Health and Safety Act, 85 of 1993 ("OHASA")). The yardstick of *"as far as is reasonably practicable*" is the requirement for the provision and maintenance of systems of work, production plants and machinery that are safe and without risks to health (section 8(2)(a)); eliminating or mitigating health and safety hazards (section 8(2)(b)) and establishing precautionary measures regarding any substance which is produced, processed, used, handled, stored or transported (section 8(2)(d)).

Occupational exposure to hazardous substances is controlled under the Regulations for Hazardous Chemical Agents, 2021, as governed by the Occupational Health and Safety Act no 85 of 1993, *Government Gazette* No 44348 of 29 March 2021 ("HCA Regulations") and amendments or revisions thereafter. The Regulations apply to an employer or self-employed person who carries out tasks at a workplace, which may expose any person to the intake of a hazardous chemical substance. The Regulations apply to chemical production processes, including of KNERSUS® 200 SL.

For each production process an occupational *health risk management plan* is compiled, with the assistance of an Approved Inspection Authority ("AIA") and an Occupational Medicine Practitioner ("OMP"), in accordance with the requirements of the Department of Employment and Labour under the HCA Regulations. If an assessment indicates that an employee might be exposed, the employer is expected to ensure the provision of adequate protection of the employee, and that exposure monitoring is carried out in accordance with the provisions of the Regulations regarding air monitoring, biological monitoring and medical surveillance. *The occupational health risk management plan spells out detail of such exposure monitoring and health risk management, and requirements and procedures for medical surveillance*.

An example of high-level (least detail) information on the occupational health risk management plan applied by the manufacturer of KNERSUS® 200 SL is presented here:

Health Monitoring and Occupational Health Surveillance
Exposure Limits: Workplace air concentrations must comply with time-weighted average ("TWA") and short-term exposure limit ("STEL") as stipulated in the HCA Regulations. Regular air sampling and documentation are mandatory.
Medical Surveillance: Pre-employment, periodic, and post-employment health examinations focusing on neurological, hepatic, and renal functions.

Since South Africa has adopted the GHS, all hazardous substances have to be classified according to the GHS, and safety data sheets ("SDSs") prepared to assist in managing exposure to hazardous substances and potential occupational risks. It is a legal requirement that all employees handling the hazardous substances, including KNERSUS® 200 SL and its ingredients, must be made aware of the content of the SDSs, which include personal protective equipment ("PPE") that must be worn, and extensive other measures to limit exposure to the hazardous substances. Measures to protect the environment against contamination with such substances are also prescribed in the SDSs.

Environmental regulations

Pollution of the environment by hazardous chemicals and human exposure to that pollution is regulated by the National Water Act, 36 of 1998 ("NWA"); National Environmental Management Act, 107 of 1998 ("NEMA") and the National Environmental Management: Waste Act, 59 of 2008 ("NEM:WA"). These laws also govern the handling and disposal of waste generated during chemical production processes.

The NWA governs the pollution of water; it criminalises an intentional or negligent act or omission which pollutes or is likely to pollute or detrimentally affect a water resource (section 151(1)(i)) and (j)). It also compels landowners and land users to take reasonable measures to prevent pollution of a water resource from occurring, continuing or recurring (section 19(1)). This is referred to as the "duty of care". It also gives competent authorities powers to direct landowners and users to take measures to prevent pollution from occurring, continuing or recurring (section 19(3)) and to take

those measures and recover the costs of implementing them from anyone who fails to comply with the directive adequately or at all (section 19(5)).

As in the case of the NWA, NEMA imposes a duty of care on landowners and users to prevent pollution of the environment from occurring, continuing or recurring. Directive and cost recovery powers are also conferred on competent authorities under NEMA. These provisions, collectively, require the manufacturer of a chemical substance, e.g., KNERSUS® 200 SL, to take reasonable measures to prevent pollution of the environment during the manufacturing process or when disposing of chemical waste generated during the process.

The legislation and standards presented above provide a framework for safe management of chemicals in KNERSUS® 200 SL production facilities.

12.7.2 Exposure management in the production facility

SOPs and Work Instructions

Production processes proceed according to standard operating procedures ("SOPs") that are documented methods of chemical manufacturing with instructions not only meant to ensure the quality of the product, but also the correct application of safe production processes, to protect workers from exposure to hazardous substances, or to limit exposure as far as possible.

SOPs are not the first line of exposure management, since Work Instructions come into effect even before SOPs. Work Instructions are compiled and executed with the aim of producing chemical product batches correctly and safely and with the aim of using and operating all plant equipment correctly and safely. Appropriately trained and experienced supervisors are responsible for the execution of the Work Instructions.

Here is an example of such Work Instructions, provided to illustrate the detail and depth of safety instructions.

WORK INSTRUCTION: OPERATING AT HERBICIDE LIQUID PLANT
Special comment: Before an Operator may operate and produce batches at the Herbicide Liquid plant he must; 1. Have received "theoretical training" on Herb Liq – 00 and on the SOP for the relevant batch to be produced. 2. Have received "on plant training" by an experienced operator. 3. Have received training on the "Herbicide Liquid Plant Cleaning / Preparation procedure" (including suggested vessel to be used). 4. Have received the "go–ahead" from the Production Manager to produce the relevant batch. 5. Know what the maximum batch size is that can be produced in the selected vessel.
Safety, Health, Environment and Quality ("SHEQ") The Operator must adhere to the stipulated SHEQ points (*selected points are provided for purposes of illustration*): 1. When not in used, all lids on tanks must be in closed position – *prevent unnecessary fumes* and possible contamination. 2. Before disconnecting of chemical hoses / pipes, ensure that there is no pressure build up inside the line – *prevent possible splashing, injury* and product loss. 3. When using a forklift to transport or lift raw material to upper level, ensure that the raw material is secured onto the pallet (stacked correctly, no raw material hanging off the sides of the pallet) - *prevent possible spillages, injury* and product loss.

4. Ensure extraction system, when and where required, is fully operational … - *prevent unnecessary fumes / dust / gasses on the plant*.
5. Ensure correct “spillage clean up procedure” is followed, should spillages occur on the plant. The Operator must ensure to do *training* on the “spillage clean up procedure”.
6. *PPE* that is contaminated with chemicals must immediately be removed and thoroughly washed with water before re-use. *Gloves* that are contaminated on the inside must be disposed and replaced immediately.
7. Always *wash hands thoroughly after handling chemicals*, ensure good hygiene.
8. Make sure of location of nearest *safety shower and eye wash facilities*.
9. Follow the correct sampling procedure, Operator to ensure to do *training* on the “Sampling procedure”.
10. Operator to *wear the correct PPE* as stipulated on the SHE boards displayed in the plant.
11. Operator to wear *Full face respirator* when charging powders to any batch, and when found that a liquid is an irritant.

Other exposure management practices

Presented here are examples of *Management Regulations for Worker Exposure to Glufosinate Ammonium in Production Processes*, which operators and supervisors are expected to enforce.

PPE requirements:

Respiratory Protection:

Operators must wear self-contained breathing apparatus (“SCBA”) or filtering facepiece respirators (“FFR”) to avoid inhalation of glufosinate ammonium dust or aerosols.

Body Protection:

Wear chemical-resistant gloves, aprons, and full-body protective suits. Footwear should be anti-slip and corrosion-resistant.

Eye Protection:

Use splash-proof goggles or face shields to prevent contact with eyes.

Operational Procedures and Workspace Management

Enclosure and Ventilation:

Production processes must occur in enclosed systems with local exhaust ventilation (“LEV”) to minimize airborne concentrations.

Access Restrictions:

Separate production and storage areas; restrict unauthorized personnel. Limit simultaneous workers in a single production zone to a maximum of 9 individuals, with real-time occupancy monitoring systems.

Prohibited Activities:

No eating, drinking, or smoking during operations. Thorough hand and skin decontamination required post-task.

Training and Administrative Controls

Pre-Service Training:

Workers must complete *safety training* covering toxicity, emergency response, and PPE usage. *Certification is required before onboarding.*

Standard Operating Procedures (SOPs):

Regular *equipment maintenance* for *safety systems* (e.g., pressure relief valves).

Special Population Protection

Exclude pregnant or lactating individuals and those with hypersensitivity from direct exposure.

12.7.3 Conclusions on the health risks of workers manufacturing the product

The employer is ultimately responsible for ensuring that a healthy and safe work environment is provided for all employees. This duty is usually delegated to a fully trained person competent in health and safety matters, such as a SHEQ manager. The SHEQ manager conducts or delegates occupational health risk assessments at frequent intervals. The risk assessments are based on exposure monitoring in the workplace, usually done by occupational hygiene officers. These tasks are performed in adherence to the Occupational Health and Safety Act, and adherence is monitored by the Department of Employment and Labour. The Department has the jurisdiction to intervene if, for example, an employer fails to limit workplace air concentrations of hazardous substances to those promulgated in the HCA Regulations. Therefore, a work environment where exposure to chemical hazards is limited to that prescribed in the applicable regulations is deemed to be sufficiently protective of risks to the health of the occupationally exposed.

The information presented in Section 12.5 illustrates the steps taken by the manufacturer of KNERSUS® 200 SL to ensure that levels of exposure to hazardous chemical substances are within those prescribed in the HCA Regulations, thereby managing occupational health risks to the regulatory acceptable level. Additional occupational health risk assessments are thus not within the scope of this report, but are the responsibility of the Department of Employment and Labour, if and when the Department finds reasons to conduct such assessments.

The manufacturer of KNERSUS® 200 SL is legally obliged to take certain steps to protect the health of workers in the manufacturing plant. These steps include occupational exposure and risk assessments reported to the Department of Employment and Labour (DEL). DEL is responsible for the enforcement of worker safety based on the manufacturer's reports to DEL. Additional processing plant occupational health risk assessments are thus not needed in this report.

13 Bystander exposure and risk assessment

13.1 Approach

KNERSUS® 200 SL label lists a clear precaution to "*Prevent spray drift onto other crops, grazing, rivers, dams and other areas not under treatment*". "*Other areas not under treatment*" should include potential nearby homes and lawns. Preventing spray drift is crucial to protect non-target plants and sensitive areas; therefore, bystander exposure in properly managed herbicide spray applications should thus be minimal. However, a worst-case is considered where inhalation and dermal contact with spray drift by a child is assumed.

Children, and particularly young infants (younger than 2 years of age) are exposed to higher doses of environmental contaminants, such as herbicide spray-drift, than older age groups. The reason is that young infants, toddlers and children are prone to and increased intake of substances from the environment, while they are smaller (lower body weight), resulting in higher doses relative to older groups, because dose is calculated as intake divided by bodyweight ($\frac{intake}{body\ weight}$).

The Royal Children's Hospital Melbourne (online) summarises the reasons for the increased vulnerability of children as follows:

- Larger body surface area ("BSA"):

- Children have a proportionately larger BSA to volume ratio than adults do, meaning that the ratio of surface area (skin) to size (body weight) is greater in children than in adults.
- As a result, the dose of substances absorbed through the skin is greater in children.

- Thinner skin:
  - Children have thinner skin epidermis than adults and the epidermis contains less keratin.
  - As a result, children absorb substances more easily through the skin.
- Higher respiratory rate:
  - Children have higher respiratory rates than adults.
  - As a result, at similar air concentrations, children absorb relatively more airborne substances by inhalation than adults.

Therefore, calculating risks for young children of toddlers, with relatively higher exposure doses, is sufficient to also understand the potential risks of older age groups (EFSA et al. 2022), with heavier bodies and lower intake rates, resulting in lower exposure doses.

13.2 Dermal and inhalation exposure of children

Exposure calculations for this scenario were developed by the European Food Safety Authority ("EFSA") (EFSA 2022). EFSA recommended that exposures from spray drift should be calculated based on default spray drift exposure volumes derived by EFSA from measurements taken at crop spraying events using a ground boom sprayer in agricultural practice.

Measurements were taken at a distance of 2 m from the sprayer, viewed as a realistic worst-case distance:

- Dermal exposure of children: 0.33 ml spray solution per person.
- Inhalation by children: 0.00016 ml spray solution per person.

The above values are the 75th percentiles for residents, meaning that the values used for calculations are higher (more conservative) than the average values at a distance of 2 m from the sprayer:

- Dermal exposure of children: 0.18 ml spray solution per person.
- Inhalation by children: 0.00012 ml spray solution per person.

The dermal dose of children exposed to glufosinate ammonium spray drift is calculated based on:

- Calculated glufosinate concentration (Table 12.4.2): 0.005 kg glufosinate/litre spray solution.
- Toddler 1 to 2 years body weight: 10 kg (EFSA et al. 2022).
- Dermal absorption factor for glufosinate: 1% (Table 12.2.1). This value was derived by rounding up the calculated valued of 0.63% (USEPA 2022(b); therefore, a factor of 1% should be protective of children as well.

The dermal dose of glufosinate absorbed by a toddler, based on the conservative exposure volume of 0.33 ml is then:
= glufosinate concentration x volume spray solution on skin x skin absorption factor ÷ body weight
= (0.005 kg glufosinate/litre x (1 x 10^6) mg/kg x 0.33 ml spray solution x 0.001 litre/ml x 1/100)/10kg
= 0.0017 mg/kg-day

The inhalation dose of a toddler exposed to spray drift is calculated based on the following values:

- Calculated glufosinate concentration (Table 12.4.2): 0.005 kg glufosinate/litre spray solution.
- Toddler 1 to 2 years body weight: 10 kg (EFSA et al. 2022).
- Inhalation absorption factor for glufosinate: 100% (Table 12.2.1).

The inhalation dose of glufosinate absorbed by a toddler, based on the conservative exposure volume of 0.00016 ml is then:
= glufosinate concentration x volume spray solution inhaled x absorption factor ÷ body weight
= (0.005 kg glufosinate/litre x (1 x 10^6) mg/kg x 0.00016 ml spray solution x 0.001 litre/ml x 1)/10kg
= 0.00008 mg/kg-day

The MOEs are calculated with Equation 12.2.3 and compared with the LOCs of 1 000 and 300 for dermal and inhalation short-term exposure, respectively (Table 8.7.1). MOEs and the comparison with LOCs are presented in Table 13.2.1.

Table 13.2.1: Groundboom application: risks of a toddler exposed to spray drift.

Crop: any in Table 12.4.2	Spray solution glufosinate concentration (kg/litre)	Dermal exposure			Inhalation exposure		
		Dose (mg/kg-day)	LOC = 1000		Dose (mg/kg-day)	LOC = 300	
			MOE	MOE > LOC?		MOE	MOE > LOC?
	0.005	0.0017	8 500	Yes	0.00008	30 600	Yes

13.3 Conclusion

MOEs were calculated based on a very conservative scenario of a toddler (most sensitive bystander) standing only 2 m away from a groundboom spraying a glufosinate solution on weeds in any of the agricultural crops indicated on the KNERSUS® 200 SL label. MOEs were based on the most conservative estimates of the spray drift exposure volume provided by EFSA (2022). The results of this very conservative assessment indicate the absence of a health risk to such exposed toddlers (MOE > LOC for dermal and inhalation exposure). It is accepted that the risks of toddlers account for the risks to older age group bystanders, as discussed in Section 13.1.

Therefore, it can be concluded that the risk to bystanders from exposure to the agricultural remedy, under realistic worst-case conditions of use, is negligible.

There are no health risks to bystanders, including toddlers, from accidental contact with spray drift from this product. There are no health risks, even in a realistic worst-case condition of use, when a toddler is standing only 2 m away from where weeds are being sprayed.

14 Crop consumers' dietary exposure and risk assessment

14.1 Background

Dietary risk assessment of glufosinate ammonium residues in food is based on its toxicity, on consumer crop intake rates, and on the pesticide residue concentrations in fruits and vegetables at the time of consumption. As discussed in Section 8, the assessment is based on the population-adjusted dose ("PAD"). The acute PAD is referred to as the "aPAD", and the chronic PAD is referred to as the "cPAD". The PAD is equivalent to the POD, the NOAEL, or the LOAEL, divided by applicable uncertainty factors, including the FQPA Safety Factor. For acute and non-cancer chronic exposures, concern is raised when estimated dietary risk exceeds 100 per cent of the aPAD (USEPA 2022(a)).

14.2 Residue intake from food and water

Although there were no dietary risks of concern for glufosinate ammonium from exposure to residues in either food or drinking water, drinking water exposure resulting from use of glufosinate ammonium on rice was a significant contributor to previous estimates of dietary risk (USEPA 2013). However, the use of glufosinate ammonium on rice is currently not applicable to South Africa.

The USEPA (2016) concluded that there would be no dietary, residential, or aggregate risks of concern for glufosinate ammonium from exposure to residues in food and drinking water. The 2016 assessment had included citrus, currants and grapes (vines).

- Insignificant [17]translocation occurs from roots to leaves, etc.
- Do not apply within 6 hours of expected rain. Do not apply to wet foliage if leaf runoff is likely to occur.

There are no health risks from the ingestion of crops grown in fields where glufosinate ammonium had been used to kill weeds, even under realistic worst-case conditions of use.

15 Summary of conclusions

- KNERSUS® 200 SL is not intended for sale to residential gardeners; therefore, risks to health, associated with the herbicidal application of KNERSUS® 200 SL, are assessed only for agricultural pesticide handlers and post-application (re-entry) workers.

- Risks of bystanders in contact with spray drift were assessed, even though the product label clearly warns against this. Contact with spray drift does not present a risk to health, even if the bystander is a toddler (most sensitive receptor), under realistic worst-case conditions of use.

- Risks to health, including risks of reproductive/developmental toxicity effects of agricultural pesticide handlers are negligible, even under realistic worst-case conditions (if gloves are not used) while:
  - Handling the product to prepare the spray mixture for application by groundboom or backpacks.
  - Applying the herbicide with a groundboom.
  - Using a backpack to spray the herbicide in agricultural crops listed on the label.

- Post-application re-entry workers usually do not wear gloves. Risks to the health of such workers, including risks of reproductive/developmental toxicity effects, are negligible, even if treated fields are entered within 12 hours after application (realistic worst-case conditions of use).

- Dietary exposure of consumers or treated produce is highly unlikely and not an issue of concern, firstly because the herbicide is never applied directly to the commodity to be harvested. Secondly, translocation of glufosinate ammonium within the various parts of the plant, e.g., root-to-fruit, is insignificant. Therefore, there are no health risks from the ingestion

[17] Movement of the chemical from the point of uptake (leaves or roots) to other parts of the plant, e.g., fruits or edible parts of crops.

of crops that were grown in fields where glufosinate ammonium had been used to kill weeds, even under realistic worst-case conditions of use.

- If glufosinate ammonium is used correctly to kill weeds, even under realistic worst-case conditions of use, ecological risks are negligible. Although risks to mammals foraging in treated weeds cannot be totally excluded, reducing either the single application rate or the number of applications on glufosinate ammonium labels is not contemplated. Such reductions could have an impact on growers (and food production) that outweighs the potential decrease in chronic risk to mammals.

16 Recommendations

An application for the restricted sale and use of the glufosinate ammonium-containing commercial herbicide KNERSUS® 200 SL should be granted according to the intended product use:

- Herbicide not for sale to and use by residential gardeners.
- Only for sale to a Pest Control Operator ("PCO") with a valid permit, used as a restricted agricultural remedy.
- Preparation and application of the treatment solution in accordance with the instructions on the product label, including the use of the correct anti-drift spray nozzles, e.g., the Air Induction Extended range ("AIXR") and Turbo TeeJet, which are recommended on the label.
- Personal hygiene instructions on the SDS must be followed; that is, washing hands, forearms and face thoroughly after handling chemical products.
- At least baseline PPE must be worn when handling and applying the product; that is, clothing covering the arms and legs, closed shoes and chemical-resistant gloves. If gloves are used, risks to health are negligible.
- The recommended 12-hour post-application restricted-entry interval ("REI") must lapse before crop re-entry.
- For restricted sale and use on citrus and vineyards only, for a period of 2 years or until the Department of Agriculture ("DoA") grants approval for an alternative product.

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[18] INFOTOX insert.
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18 Annexure 1

Table A1: Post-application agricultural workers glufosinate ammonium residue transfer coefficients.

Crop group USEPA TC Table	Crop or Target	Crop USEPA TC Table	Activity with highest-to-lowest TC values	Transfer coefficient (TC)
				cm^2/hr
Vine / trellis	Vineyard	Grape, table	Girdling / Turning	19 300
Vine / trellis	Vineyard	Grape, juice / wine	Harvesting hand, Tying / training, Leaf pulling	10 100
Vine / trellis	Vineyard	Grape, raisin / table	Harvesting hand, Tying / training, Leaf pulling	5 500
Vine / trellis	Vineyard	Grape, table / raisin / juice / wine	Pruning / weeding by hand, Scouting, propagating	640
Vine / trellis	Vineyard	Grape, table / raisin / juice / wine	Irrigation hand set	1 900
Vine / trellis	Vineyard	Grape, table / raisin / juice / wine	Transplanting	230
Vine / trellis	Vineyard	Grape, table / raisin / juice / wine	Irrigation (non-hand set) & All mechanised activities	0
Tree, "fruit", evergreen	Citrus	Orange, Grapefruit, Lemon	Harvesting hand	1 400
Tree, "fruit", evergreen	Citrus	Orange, Grapefruit, Lemon	Pruning hand, Scouting	580
Tree, "fruit", evergreen	Citrus	Orange, Grapefruit, Lemon	Transplanting	230
Tree, "fruit", evergreen	Citrus	Orange, Grapefruit, Lemon	Weeding by hand / Orchard maintenance	100
Tree, "fruit", evergreen	Citrus	Orange, Grapefruit, Lemon	Irrigation (non-hand set) & All mechanised activities	0

19 Annexure 2: Survey Summary

SUMMARY OF RESPONDENT RESPONSES:

Survey on *Knersus 200 SL*: Conducted by *AECI Plant Health* among Crop Producers and Crop Advisors

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Table of Contents

Section A: Crop producers are the respondents

Note: Of the 23 forms received, nine (9) did not have sections B, C, D, and E completed, i.e., only 14 of the 23 forms were fully completed.

Table A1: Sections and topics in the AECI survey form for crop producers

Form Section A: Producer-specific information (not repeated here)	
Section B: Dependencies and Alternatives	
B1	How important is KNERSUS in a weed control program?
B2	Which weeds are a problem?
B3	Weeds controlled by KNERSUS but not by glyphosate or paraquat
B4	What are the alternatives to KNERSUS?
B5	How effective are alternatives compared to KNERSUS?
B6	What are the costs of the alternatives relative to KNERSUS?
B7	Agronomic problems when using alternatives?
B8	What is the financial impact of using alternatives?
B9	What do you do without an alternative like paraquat?
B10	What are the challenges with physical/mechanical control versus chemical control?
Section C: Economic and Operational Impact (Response to tested statements)	
C1	Ban on KNERSUS will increase production costs
C2	Without KNERSUS, weed control will be less effective.
C3	Currently, there is no affordable alternative to KNERSUS
C4	Ban on KNERSUS will lower farm profitability
C5	Farmers were sufficiently consulted before the ban on KNERSUS
C6	Will jeopardize citrus and grape production
Section D: Health and Safety Practices	
D1	Safety measures to protect workers from exposure to KNERSUS
D2	Have workers received safety training on handling Highly Hazardous Pesticides
Form Section E: Public Feedback	
E1	What is the biggest challenge with the ban on KNERSUS?
E2	What alternatives are being used or considered?
E3	How can the government or industry help adapt to the ban?
E4	Would the PCO route be considered as a compromise for reinstating KNERSUS?

Table A2: Producers and the main crops

Particpant Number	Crops	Region	Crop Adviser Number
1	Table and wine grapes	Western Cape	1C
2	Grapevine	Western Cape	1C
3	Grape	Western Cape	1C
4	Grape	Western Cape	1C
5	Grape	Western Cape	1C
6	Grape	Western Cape	1C
7	Grape	Western Cape	1C
8	Grape	Western Cape	1C
9	Table grapes	Western Cape (Piketberg)	2C
10	Citrus; Table grapes	Western Cape (Piketberg)	2C
11	Grape; Apricots; Peaches	Ladismith	3C
12	Grape; Small fruits	Western Cape (Koeberg)	4C
13	Grapes; Corn	Agter-Paarl	4C
14	Grapes for wine and table; Small fruits	Western Cape (Koeberg)	4C
15	Grapes; Olives:		
16	Grapes: Durbanville		
17	Grapes: Durbanville		
18	Grape Varieties: Durbanville		
19	Grape; Small berries		
20	Grape; Small berries		
21	Grape; Small seeds		
22	Grapes		

Table A3: Respondent feedback on form section B: Dependence and alternatives

Producer respondents (Table 2)	*B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
1	Essential	**CONBON	CONBON glyphosate resistance	None	Less	More	CONBON resistance to glyph	Negative	Resistance problem	High cost
2	Essential	CONBON	CONBON glyphosate resistance	None	Less	More	Weed resistance	Negative	Resistance	High cost
3	Essential	CONBON	CONBON glyphosate resistance	None	Less	More	Poor control; >costs	Negative	Poor control; higher costs	High cost
4	Essential	CONBON	CONBON glyphosate resistance	None	Less	More	Poor control; >costs	Negative	Poor control; higher costs	High cost
5	Essential	CONBON	CONBON glyphosate resistance	None	Less	More	Poor control; >costs	Negative	Poor control; higher costs	High cost
6	Essential	CONBON	CONBON glyphosate resistance	None	Less	More	Poor control; >costs	Negative	Poor control; higher costs	High cost
7	Essential	CONBON	CONBON glyphosate resistance	None	Less	More	Poor control; >costs	Negative	Poor control; higher costs	High cost
8	Essential	CONBON	CONBON glyphosate resistance	Glyphosate	Less	More	Poor control; >costs	Negative	Poor control; higher costs	High cost

9	Essential	Ryegrass; CONBON	Glyphosate resistance	Glyphosate; Paraquat	Less	More	-	-	-	-
10	Essential	Ryegrass; CONBON	Glyphosate resistance	Glyphosate; Paraquat	Less	More	-	-	-	-
11	Essential	Ryegrass; CONBON; Tongue blade	Glyphosate resistance	MCPA; Poquer	Less	More	Poor control; >costs	Negative	Poor control; higher costs	High cost; moisture loss
12	Essential	Summer weed	Resistance	Glyphosate; 2,4-D; paraquat	Less	More	Poor control; >costs	Negative	Poor control; higher costs	High cost; <productivity
13	Essential	CONBON; cockscomb; morning glory	Resistance	Glyphosate; Paraquat	Less	More	Poor control; >costs	Negative	Poor control; higher costs	High cost; <productivity
14	Essential	CONBON; ryegrass; copper wire; morning glory	Resistance	Glyphosate; Paraquat	Less	More	Poor control; >costs	Negative	Poor control; higher costs	High cost; <productivity

*B1 scale: 1=unimportant; 5=essential

**CONBON = Conyza bonariensis (false proso)

Table A4: Respondent feedback on form section C: Economic and operational impact

Producer	C1	C2	C3	C4	C5	C6
1	100% agree	100% agree	100% agree	100% agree	Neutral	Yes
2	100% agree	100% agree	100% agree	100% agree	Neutral	Yes
3	100% agree	Agree 100%	100% agree	100% agree	Neutral	Yes
4	100% agree	Agree 100%	100% agree	100% agree	Neutral	Yes
5	100% agree	Agree 100%	100% agree	100% agree	Neutral	Yes
6	100% agree	Agree 100%	100% agree	100% agree	Neutral	Yes
7	100% agree	Agree 100%	100% agree	100% agree	Neutral	Yes
8	100% agree	Agree 100%	100% agree	100% agree	Neutral	Yes
9	100% agree	Agree 100%	100% agree	100% agree	Disagree completely	-
10	Agree 100%	Agree 100%	100% agree	100% agree	I completely disagree	Yes
11	100% agree	-	Agree 100%	100% agree	Strongly disagree	Yes
12	100% agree	Agree 100%	100% agree	100% agree	Disagree	Yes
13	100% agree	Agree 100%	100% agree	100% agree	Disagree	Yes
14	Disagree	100% agree	100% agree	100% agree	Disagree	Yes

Table A5: Respondent feedback on form section D: Health and safety practices

Producer	D1	D2
1	Fully trained; has protective clothing	Yes
2	Fully trained; follows injection procedures	Yes
3	Operators are trained; follow injection procedures	Yes
4	Operators are trained; follow injection procedures	Yes
5	Operators are trained; follow injection procedures	Yes
6	Operators are trained; follow injection procedures	Yes
7	Operators are trained; follow injection procedures	Yes
8	Operators are trained; follow injection procedures	Yes
9	Operators are trained; follow injection procedures	Yes
10	Operators are trained; follow injection procedures	Yes
11	Operators are trained; follow injection procedures	Yes
12	PCO certificate and safe handling training	Yes
13	PCO certificate and safe handling training	Yes
14	PCO certificate	Yes

Table A6: Respondent feedback on form section E: Open feedback

Producer	E1	E2	E3	E4
1	Control of *CONBON	Glyphosate, but there is resistance	Lift ban on KNERSUS	Yes
2	Control of CONBON	No, due to resistance	Lift ban on KNERSUS	Yes
3	Control of CONBON	Resistance to glyphosate	Lift the ban on KNERSUS	Yes
4	CONBON control	Resistance; Mechanical is expensive	Lift the ban on KNERSUS	Yes
5	Control of CONBON	Resistance; Mechanical is expensive	Lift ban on KNERSUS	Yes
6	Control of CONBON	Resistance; Alternatives are expensive	Lift the ban on KNERSUS	Yes
7	Control of CONBON	Resistance to glyphosate	Lift the ban on KNERSUS	Yes
8	Poor weed control	Weeds are resistant	Lift the ban on KNERSUS	Yes
9	Problem weeds	No alternatives for resistance	Lift the ban on KNERSUS	Yes
10	***Page missing***			
11	Control of CONBON	Glyphosate and paraquat considered	Make new products available	Yes
12	Control of CONBON	No product as good as KNERSUS	Financial assistance	Yes
13	Poor weed control	Mixtures are ineffective	Set up subsidies	Yes
14	Poor weed control	No alternatives in the summer season	Set subsidies	Yes

*CONBON = Conyza bonariensis (greasyweed)

Section B: Crop advisers are the respondents

Table B1: Sections and topics in the AECI survey form for crop advisors

Form Section A: Crop Advisor Specific Information (not repeated here)	
Form Section B: Market Share and Dependence	
B1	How important is KNERSUS 200 SL to your business's revenue?
B2	How often do customers specifically ask for KNERSUS 200 SL?
B3	What are the main reasons why customers prefer KNERSUS 200 SL?
Section C: Expected business impact (Response to tested statements)	
C1	A ban on KNERSUS will significantly reduce my sales revenue
C2	Customers will struggle to find equally effective alternatives
C3	Ban will harm my business relationships with farmers
C4	I will have to restructure or downsize my product portfolio.
C5	There are affordable and effective substitutes available
C6	I believe the ban could reduce the overall effectiveness of weed control in the market
Section D: Economic and Strategic Outlook	
D1	With the ban on KNERSUS 200 SL, what percentage loss in total sales do you expect?
D2	Which product(s) would you recommend as alternatives?
D3	What support would you need from suppliers or the government to adapt to the ban?
D4	Will citrus and vineyard production be harmed if KNERSUS is not available?
Section E: Health and Safety Aspects	
E1	What safety measures do you have in place to protect farmers and farm workers from exposure to KNERSUS?
E2	Have your farmers received safety training on handling Highly Hazardous Pesticides?
Form Section F: Public Feedback	
F1	What do you see as the biggest business challenge with the ban on KNERSUS 200 SL?
F2	What impact do you expect on your clients' (farmers') operations or yields?
F3	What policy or regulatory proposals would you recommend to balance safety and economic impact?
F4	Any further comments or recommendations?

Table B2: Crop advisers as respondents

Particpant Number	Area	*Producer respondents
4C	Paarl	Numbers 12,13,14 (see Table A2)
2C	Porterville	Numbers 9 and 10
1C	Olifants River, Western Cape	Numbers 1 to 8
5C	Western Cape	-
5C	Western Cape	-
3C	Boland	-

*Producers where the crop advisor's name appears on the form.

Table B3: Crop advisors' respondents' feedback on form section B: Market share and dependence

Crop Adviser (Table B2)	B1	B2	B3
1	Very important	Regularly	Effective on resistant weeds; Crop safety; Product Reliability
2	Essential	Always	Effective on resistant weeds
3	Fairly important	Always	Effective on resistant weeds
4	Essential	Regularly	Effective on resistant weeds
5	*Moderately important*	*Often*	*Product reliability*
6	Very important	Regularly	Effective on resistant weeds; Crop safety

Table B4: Crop advisers' feedback on form section C: Expected business impact

Adviser	C1	C2	C3	C4	C5	C6
1	100% agree	Agree 100%	100% agree	100% agree	Disagree completely	100% agree
2	Agree 100%	Agree 100%	Agree 100%	Agree 100%	Disagree completely	100% agree
3	Agree 100%	Agree 100%	Agree 100%	Agree 100%	Disagree completely	100% agree
4	Agree 100%	Agree	Agree	Agree	Disagree	Agree
5	*Agree*	*Strongly agree*	*Agree*	*Agree*	*Neutral*	*Agree*
6	100% agree	100% agree	100% agree	100% agree	Disagree completely	100% agree

Table B5: Crop advisers' feedback on form section D: Economic and strategic outlook

Advisor	D1	D2	D3	D4
1	11-25%	None	New product options	Yes; KNERSUS controls summer weeds that alternatives cannot.
2	11-25%	Glyphosate; Paraquat	New product options	Yes; Resistant weeds will not be controlled
3	26-50%	None	New product options	Yes; Grey goose drinks vineyards' water
4	26-50%	Paraquat	Information Sessions	Yes; Lower yield
5	0-10%	*Depends on season*	*New product options*	*Yes; KNERSUS controls resistant weeds, e.g. tongblaar*
6	11-25%	Glyphosate; Paraquat	New product options	Yes; There is no other advice for resistant weeds

Table B6: Crop adviser respondent feedback on form section E: Health and safety aspects

Advisor	E1	E2
1	All have completed the PCO course	Yes; Farmers have been trained on the handling of Highly Hazardous Pesticides
2	-	Yes; Farmers are trained on handling Highly Hazardous Pesticides
3	PPE, protective clothing, masks	Yes; Farmers are trained in the handling of Highly Hazardous Pesticides
4	PPE, protective clothing and masks	Yes; Farmers are trained on handling Highly Hazardous Pesticides
5	PPE equipment	Yes; Farmers are trained on handling Highly Hazardous Pesticides
6	PPE equipment	Yes; Farmers are trained on handling Highly Hazardous Pesticides

Table B7: Crop adviser respondent feedback on form section F: Open-ended feedback

Advisor	F1	F2	F3	F4
1	Weed control; prevent losses for the farmer	Input costs are rising; production is falling	PCO course for farmers	-
2	Weed Control	Reduced yields	-	-
3	*CONBON control is critically important	20-30% yield loss due to weeds	PCO course for farmers	Grinder needed!
4	Weed resistance	Yield loss	Training	-
5	*Cultivation costs*	*Lower yields*	*Product training* (KNERSUS)	-
6	Loss of income	Reduced income	PCO and stewardship courses	-

*CONBON = Conyza bonariensis (greysheet goose)

20 Annexure 3: Supporting letters

Date: 25 May 2026

Mr Jonathan Mudzunga
The Registrar: Act No. 36 of 1947
Department of Agriculture
Private Bag X343
PRETORIA
0001

SUPPORT FOR DEROGATION REQUEST: EXTENSION OF THE USE OF GLUFOSINATE-AMMONIUM IN VINEYARDS FOR WINE PRODUCTION

Dear Mr. Mudzunga

Vinpro, as the representative body of South Africa's wine grape producers, cellars, and industry stakeholders, wishes to express its support for extending the use of the herbicide glufosinate-ammonium in vineyards, given the challenges created by the current regulatory situation.

Context and current challenge

As you are aware, the registration of various agricultural remedies, including glufosinate-ammonium, expired on 30 June 2025 following amendments to the Regulations relating to Agricultural Remedies (25 August 2023), which prohibit registration of "substances of concern" unless a special derogation is granted.

This letter serves to support AECI's derogation application for glufosinate-ammonium, an indispensable product in the integrated production of wine grapes, with no viable alternatives currently available to South African wine grape producers.

Strategic importance of glufosinate-ammonium in viticulture

Glufosinate-ammonium is a broad-spectrum, burndown herbicide that has become a key component of modern vineyard weed management. Its mode of action (HRAC Group 10) makes it one of the few remaining

tools available to growers for controlling challenging, hard-to-manage, and herbicide-resistant weeds, especially where resistance to glyphosate (HRAC 9) is already present.

In vineyard systems, where mechanical weed control is often limited by terrain, row spacing, or soil conservation concerns, chemical control options are vital. This is particularly true in efforts to reduce the use of broad-spectrum pre-emergent agents. However, the range of post-emergence herbicides suitable for use in vineyards is becoming increasingly limited due to well-intentioned regulatory restrictions, environmental sensitivities, and concerns for human and crop safety.

Furthermore, the long-term absence of glufosinate-ammonium is likely to increase dependence on a smaller range of herbicides, heightening selection pressure for resistance in weed populations. This contradicts the principles of Integrated Weed Management (IWM) and sustainable production guidelines, as promoted by our Integrated Production of Wine Scheme (IPW), which supports both national policies and international market standards for the responsible use of agrochemicals.
Therefore, glufosinate-ammonium remains a vital substance for effectively managing herbicide resistance in various weed species and controlling specific problematic weeds in vineyards, as only a limited number of effective active substances with different modes of action are currently approved for use in permanent crops.

Risk of resistance and lack of viable alternatives

Although various agricultural remedies from different HRAC groups are registered for weed control in vineyards, many are primarily pre-emergence herbicides. While they can contribute to post-emergence control to some extent, most need to be applied in combination with, or after, a herbicide that targets existing weeds.
Such products include those containing active ingredients such as sulfonylurea flazasulfuron (HRAC 2), HRAC group 3 substances like propyzamide and trifluralin (mainly pre-emergence grass herbicides), s-metolachlor (HRAC 15), and indaziflam (HRAC 29). Regarding indaziflam, it is important to note that its use is restricted to specific conditions to prevent crop damage, as indicated by numerous warnings on the product label.

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Use of triazines, such as simazine and terbuthylazine (HRAC 5), is limited due to the sensitivity of vines to triazines under certain growing conditions, such as medium to high pH soils, base-saturated soils, and very light soils (sandy, low in organic matter).

Some post-emergence herbicides are limited to specific weed types or weed species only. For instance, herbicides from the acetyl CoA carboxylase inhibitors (HRAC 1) group, such as clethodim, haloxyfop-methyl, propaquizafop and others, control existing grass weeds, but require use with a suitable broadleaf herbicide to provide the broad-spectrum control generally required in vineyards. Here, specifically, noxious weeds such as fleabane, Conyza spp., have developed significant and well-documented resistance in wine growing areas. Effective resistance management relies on rotating active ingredients with diverse modes of action, and glufosinate-ammonium has played a key role in such strategies for many years. Without it, producers are increasingly limited to:

- Diquat and paraquat (HRAC 22). However, paraquat is already classified as a restricted product and therefore earmarked for phase-out over the next few years.
- Glyphosate (HRAC 9). The product may damage trees and vines with green bark when applied. Therefore, it should preferably not be applied before four years after establishment. Furthermore, glyphosate resistance in key weed species is well documented, and thus the successful use of glyphosate will be limited to sensitive populations.

For this reason, glufosinate-ammonium, classified as HRAC group 10, is one of the few effective, broad-spectrum burndown herbicides outside the glyphosate (HRAC 9) and paraquat/diquat (HRAC 22) groups. As such, it is essential for resistance management in vineyards.

Integrated Production of Wine Scheme advocates for the responsible use of glufosinate-ammonium

We also wish to highlight notable progress in the wine industry's sustainability efforts through its sustainability certification scheme, which has operated since 1998. The Integrated Production of Wine Scheme (IPW) comprises a set of guidelines outlining good agricultural practices (GAP) for grape production. In 2024, 91.52% of the total South African wine grape crop (1,116,780 tons) was IPW certified, indicative of the wine

industry's commitment to sustainability. Herein, the use of glufosinate-ammonium is tracked annually alongside the use of all other registered herbicides to promote and ensure responsible use.

IPW adheres to international environmental sustainability standards in the wine industry, including the “Global Wine Sector Environmental Sustainability Principles” published by the International Federation of Wine and Spirits (FIVS) and the “OIV Guidelines for sustainable vitiviniculture: Production, processing and packaging of products” issued by the International Organisation of Vine and Wine (OIV).
While we support the pursuit of safer and more environmentally benign alternatives in the long term, no single registered product currently replicates glufosinate-ammonium’s efficacy, spectrum of control, and contribution to resistance management in permanent crops such as vineyards.

Conclusion and request

Vinpro therefore respectfully requests the consideration of derogation for the continued use of glufosinate-ammonium in vineyards, as applied for by AECI and subject to the same conditions proposed for other permanent crops.

Such a derogation will allow industry and regulatory stakeholders sufficient time to identify and validate alternatives, adapt production systems, and refine best-practice guidelines for weed and resistance management without compromising crop sustainability or regulatory compliance. We remain fully committed to responsible product stewardship, continued collaboration with regulators and research institutions, and the development of sustainable alternatives.

Yours sincerely,

Conrad Schutte,
Vinpro CEO

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14 April 2025

Jonathan Mudzunga

The Registrar: Act No. 36 of 1947

Department of Agriculture, Land Reform and Rural Development

Private Bag X343

PRETORIA

0001

Dear Mr. Mudzunga,

GRAIN SA APPEAL FOR DEROGATION OF KNERSUS 200 SL (L10631) GLUFOSINATE-AMMONIUM (PHOSPHINIC ACID)

In compliance with the regulatory requirements, AECI Limited conducted a comprehensive risk assessment to evaluate the continued safe and effective use of Glufosinate-ammonium (phosphinic acid) with an active load of 200 g/L. This report is accessible on the company's website or in hard copy at DALRRD.

Grain SA requests the reconsideration of Knersus 200 SL (L10631), containing the active ingredient glufosinate ammonium for derogation to ensure its uninterrupted use in agriculture. This herbicide is essential for the control of citrus, pome fruits, stone fruits, subtropical fruits, tree nuts, sugarcane, and vines in the winter rainfall region; all of which contribute significantly to sustainable agricultural practices and national food security.

Table 1: Agricultural Remedy for Reconsideration

Company name and registration number	**The active ingredient in the product**	**Trade name and registration number**	**Website**
AECI Limited (1924/002590/06)	Glufosinate-ammonium (phosphinic acid)- 200 g/L	Knersus 200 SL (L10631)	https://www.aeciph.com/

Grain SA, therefore, requests that the Registrar (Act 36 of 1947) reconsider the registration of the above-mentioned product to safeguard the sustainability of the grain industry. AECI Limited has conducted a toxicological risk assessment containing ways to minimise any potential risks. If there are additional risk-mitigating factors that can be implemented to lessen the risk of this product, they will be implemented as such.

Kind regards,

Corné Louw

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Alenti Office Park, 457 Witherite Street, The Willows, Pretoria, 0400

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28 May 2026

The Registrar of Act No. 36 of 1947
Directorate: Agricultural Inputs Control
Private Bag X343, Pretoria, 0001, South Africa

Subject: Glufosinate Ammonium Importance in Citrus Production

The Citrus Growers' Association of Southern Africa has been approached by the registration holder of KNERSUS (Reg. No. L10631) for a letter of support for the active substance, glufosinate ammonium.

KNERSUS is a (semi-systemic) **contact** herbicide registered to control certain broadleaf weeds, grass weeds, and sedges in citrus orchards post-emergence. The management of these weeds is critical for effective irrigation, fertilization, orchard monitoring and ant control (of the last-mentioned being critical for integrated pest management as ants disrupt natural enemies). Weeds under the canopy can also hamper orchard sanitation (removal of fallen fruit), elevating levels of false codling moth, fruit flies and decay-causing fungal spores. Certain weed species may also attract pests such as leafhoppers, which threaten crop quality.

Several of the registered alternatives targeting the same weed species are used for traditional pre-emergence sprays as a sort of motive to "reset" and clean the dedicated herbicide zone. These products are generally much more expensive and contact herbicides are still required, as weeds re-emerge throughout the season. **Glufosinate ammonium** is **highly cost effective** for growers targeting a **broad spectrum of weeds** (compared to alternatives that may only target broadleaf weeds or grass weeds, as an example) especially when weed management is required on a large scale. This means that growers only need to spray one active ingredient as opposed to two or three. Importantly, glufosinate ammonium has a unique mode of action classified under **HRAC Code 10** and although there are other registered active substances to control the same weed species, to our best knowledge, this is the only available herbicide with this particular mode of action. **Certain ubiquitous weeds in South Africa**, including those prevalent in orchards, have **become resistant to other herbicides**, making glufosinate ammonium a compelling alternative for growers to combat these nuisance plants.[1,2] There are limited cases of glufosinate ammonium resistance in South Africa relative to other herbicides.[2]

Glufosinate ammonium is currently not legally permitted for sale and use in South Africa, due to its hazard classification (i.e., being a substance of concern). While CGA is not disputing the hazard classification, we believe that the product can still be used safely and responsibly under the precautionary measures as instructed by the registration holder – that is, on the condition that the Registrar approves the derogation.

By expressing our support for this derogation, we are not endorsing or recommending this specific trade name above other glufosinate ammonium containing registrations. However, we believe it is to the benefit of the exporting citrus industry to be able to effectively use KNERSUS. The

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responsibility lies with the registration holder to ensure that the information provided to the Registrar's Office is compliant with the necessary requirements for a derogation. We would sincerely appreciate consideration of this application.

Sincerely,

Paul Hardman
Chief Operating Officer
Citrus Growers' Association of Southern Africa

1: https://www.up.ac.za/sahri/glyphosate-resistant-weeds-research
2: Matshidze, M.M. & Ndou, V. (2023). Herbicide resistance cases in South Africa: A review of the current state of knowledge, URL: https://scielo.org.za/pdf/sajs/v119n11-12/16.pdf

BOSMAN ADAMA

19 May 2026

Support for registration of KNERSUS 200 SL (L10631)

Dear Sir/Madam

We hereby wish to express our support, as Bosman Adama (Pty) Ltd, for the approval and registration of KNERSUS 200 SL (Reg. No. L10631) in South Africa.

KNERSUS® 200 SL is identified as a substance of concern due to its classification as a reproductive hazard category 1B (H360FD) according to the Globally Harmonized System of Classification and Labelling of Chemicals ("GHS"). The classification is due to the ingredient glufosinate ammonium, which is classified in GHS as reproductive toxicity category 1B. Sine the South African government has put a ban on all CMR Class 1A and 1B substances, we have experienced significant challenges with effective weed control in our vineyards. As a Fairtrade-accredited producer, we are already not permitted to use glyphosate or paraquat, and glufosinate ammonium was the **only practical alternative,** that we could successfully use together with Alion in a pre-emergence program.

Our practice was to apply glufosinate ammonium in combination with Alion on the vineyard rows early after the first winter rains, when the weeds were still small. This ensured excellent control and good soil coverage for the Alion.

With glufosinate ammonium no longer available, we are now forced to rely mainly on selective grass herbicides such as clethodim. However, these products do not control broadleaf weeds such as tongue-leaf and morning glory, which are in direct competition with the vines.

The use of MCPA is also limited due to its volatility, as it can only safely be applied during winter when the vines are dormant and without foliage. At that stage, the broadleaf weeds are already large and more difficult to control effectively. This necessitates two separate

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Direkteure: *J C Bosman, P W J Bosman & I Thomas*

weed control actions instead of one, which significantly increases production costs due to higher diesel consumption, increased wear on tractors, and additional soil compaction under wet winter conditions.

We believe that the derogation approval of KNERSUS 200 SL will provide a very important alternative for the industry and will help producers maintain sustainable and responsible weed control programmes within the constraints of existing accreditations and regulatory requirements.

Kind Regards

_____

Dan Swart (Technical Manager)

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