Evidence:

…for SAFETY?

After 30+ years – where is NZ EPA's data proving evidence for safety?

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Physicians & Scientists for Global Responsibility

JR Bruning
B.Bus.Agribusiness,
MA Sociology (research).

Today's briefing.

1. Regulatory decisions: Glyphosate & Metsulfuron-Methyl
2. European approaches versus New Zealand EPA
3. Councils across NZ faced with information – often contradictory
4. What to do?

NB. Skimming over pages 7-12. Important to know the data exists, but today is more about the *absence of data* in the New Zealand context.

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Physicians & Scientists for Global Responsibility

NZ EPA

‘glyphosate, if used according to controls and regulations, is safe and highly beneficial’

‘Helps manage resistance’

2022 Summary, Call for Information









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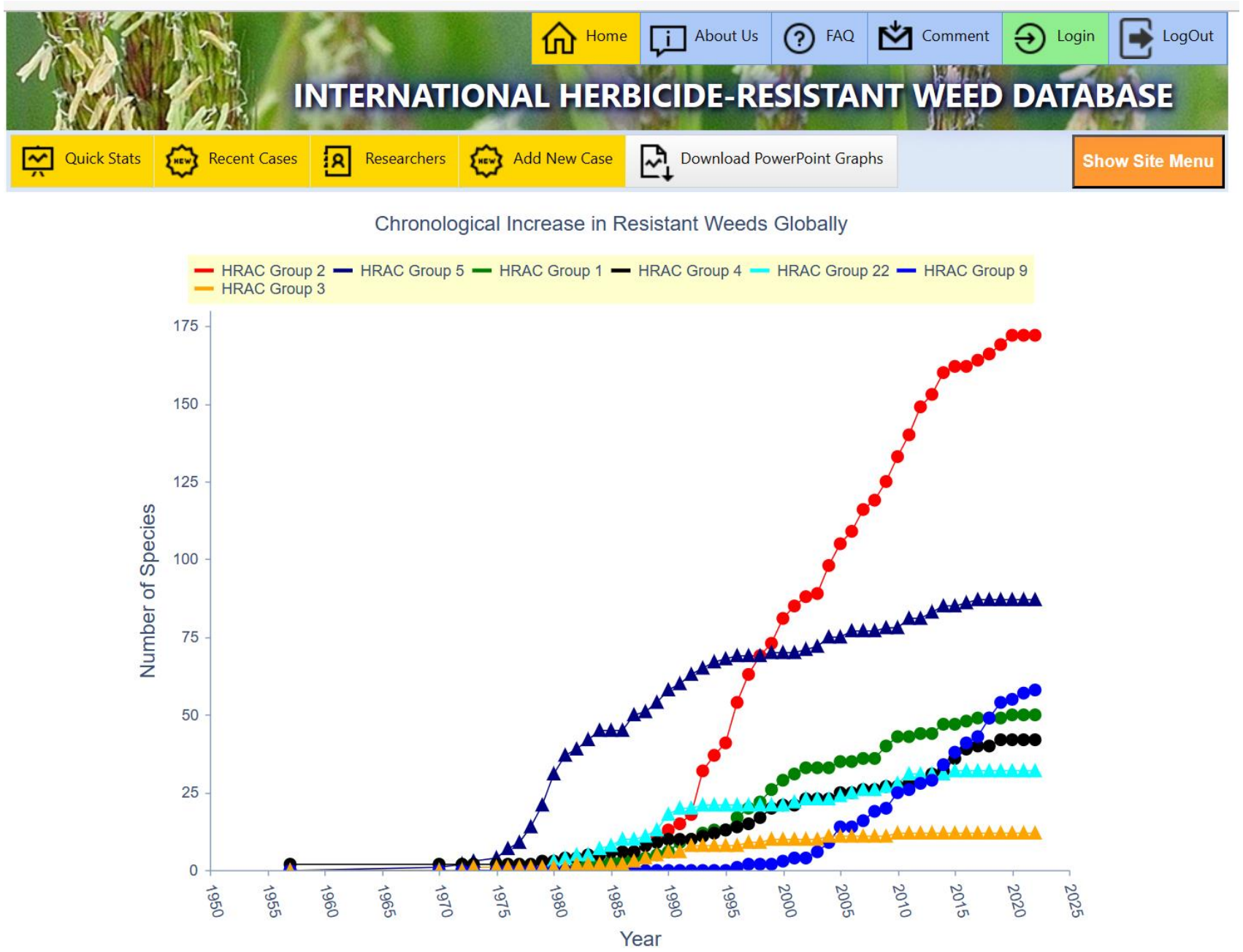
Glyphosate
HRAC group 9

Metsulfuron-methyl
HRAC group 2



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Environmental Science & Technology

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Policy Analysis

Outside the Safe Operating Space of the Planetary Boundary for Novel Entities

Linn Persson,* Bethanie M. Carney Almroth, Christopher D. Collins, Sarah Cornell, Cynthia A. de Wit,* Miriam L. Diamond, Peter Fantke, Martin Hassellöv, Matthew MacLeod, Morten W. Ryberg, Peter Søgaard Jørgensen, Patricia Villarrubia-Gómez, Zhanyun Wang, and Michael Zwicky Hauschild

Cite This: https://doi.org/10.1021/acs.est.1c04158

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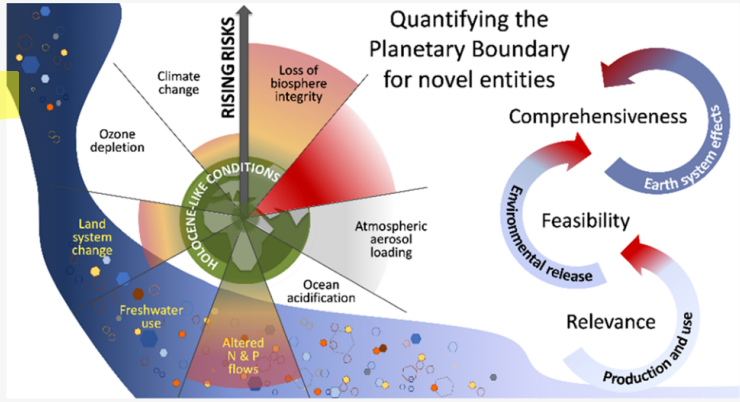
ABSTRACT: We submit that the safe operating space of the planetary boundary of novel entities is exceeded since annual production and releases are increasing at a pace that outstrips the global capacity for assessment and monitoring. The novel entities boundary in the planetary boundaries framework refers to entities that are novel in a geological sense and that could have large-scale impacts that threaten the integrity of Earth system processes. We review the scientific literature relevant to quantifying the boundary for novel entities and highlight plastic pollution as a particular aspect of high concern. An impact pathway from production of novel entities to impacts on Earth system processes is presented. We define and apply three criteria for assessment of the suitability of control variables for the boundary: feasibility, relevance, and comprehensiveness. We propose several complementary control variables to capture the complexity of this boundary, while acknowledging major data limitations. We conclude that humanity is currently operating outside the planetary boundary based on the weight-of-evidence for several of these control variables. The increasing rate of production and releases of larger volumes and higher numbers of novel entities with diverse risk potentials exceed societies' ability to conduct safety related assessments and monitoring. We recommend taking urgent action to reduce the harm associated with exceeding the boundary by reducing the production and releases of novel entities, noting that even so, the persistence of many novel entities and/or their associated effects will continue to pose a threat.



Production of Novel Entities. Production of novel entities is rapidly increasing. The chemical industry is the second largest manufacturing industry globally.[1] Global production increased 50-fold since 1950, and is projected to triple again by 2050 compared to 2010.[34] Material extraction as feed stocks for novel entities was approximately 92 billion tonnes globally in 2017, and is projected to reach 190 billion tonnes by 2060.[1] There are an estimated 350 000 chemicals (or mixtures of chemicals) on the global market.[35] Nearly 70 000 have been registered in the past decade; many chemicals (nearly 30 000) have only been registered in emerging economies, where chemical production has increased rapidly, but chemicals management and disposal capacity often are limited. The production of intended chemicals entails the

NZ EPA

'Because we ground our activities in evidence and risk assessment…'

2022 Annual Report

NZ EPA:

- Rarely does formal risk assessment (Declining). Amends existing approvals (non-statutory activity). Muddy.
- Reassessment by convention is based on applicant data.
- Brand New: Risk Assessment Methodology for Hazardous Substances 2020
  - No instructions for officials on precautionary approach in 2020
  - Calls for Information 'could be used to assess'.
  - When a reassessment of an existing substance is initiated, we seek comments from the public and industry, as part of a call for information
- Downplays epidemiology, focusses on toxicological models
- Fails to contract science to fill data gaps, fails to develop policy, e.g. EDC
- Doesn't support staff education on a precautionary approach.

- **Our carcinogenicity classifications less stringent** than Europe or the US EPA. T'Mannetje (2020)
- **Our groundwater protections weaker than Europe.**
- **Approve higher concentrations of substances than Europe.**

Hazardous substances applications

We assess and make decisions about applications regarding hazardous substances under the HSNO Act. The table shows a summary of these applications.

Decision type	Number of applications considered	
	2021/22	2020/21
Applications in containment	32	63
Applications for release	42	48
Applications for transhipment of hazardous substances	2	4
Reassessment to update controls and hazard classifications	2	1

New organisms

We assess and make decisions about applications regarding new organisms under the HSNO Act. The table shows a summary of the applications we decided this year.

Decision type	Number of applications considered	
	2021/22	2020/21
Amendments	3	8
Containment approval	11	4
Release approval	1	1
Determinations (new organism status)	7	5
Grounds for reassessments	1	0

BANNED IN EUROPE BUT NOT IN NZ

Mancozeb, paraquat, chlorpyrifos, methyl bromide, hydrogen cyanimide, hexazinone, terbacil, atrazine, haloxyfop-P, thiram, methomyl, carbaryl, diazinon, dichlorvos, 1080, brodifacoum flamprop-M-isopropyl, isoproturon, fenitrothion, Iprodione, Methamidophos…
Outdoors neonicotinoid applications banned in Europe, but heavily in use here.

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METSULFURON METHYL

CAS No. 74223-64-6

NEW ZEALAND

- **Never undertaken risk assessment. Only reauthorisation based on industry supplied data.**
  - Added to the inventory of chemicals 2006. Does not have individual approval (group standard).
  - HSNO Application register? No.
  - Approved substance with controls? No.

- Aquatic toxicity (chronic): very toxic
- Aquatic toxicity (acute): very toxic with long lasting effects

➢ 1988, 2000, 1997

- **Metabolite:** Triazine amine/aminotriazine: Casper, Basis, HRAC GROUP 2
- **2012** modified reassessment extended use on to aquatic surfaces (APP201365). Decision HSR000232.
  - 2022 (Sept). Grounds for Reassessment of Aquatic Herbicides (APP204208)
  - Water dispersable granule (200g/kg & 600 g/kg), or wettable powder (600 g/kg)
  - Suspension concentrate containing 25 g/litre metsulfuron-methyl and 75g/litre triclopyr butoxyethyl ester
- 'Substance B'
- 2023. Call for information on **aquatic** herbicides. We are seeking information on how aquatic herbicides containing specific chemicals are used in Aotearoa New Zealand.

METSULFURON METHYL

CAS No. 74223-64-6

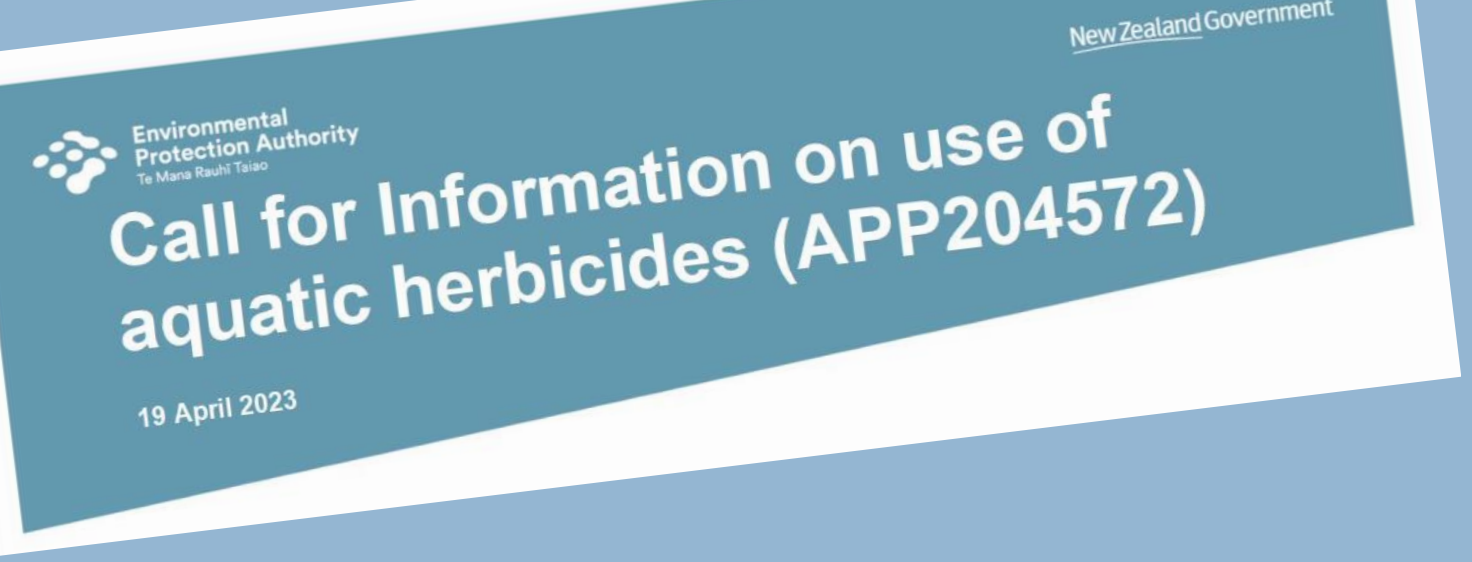
EUROPE

- In **Europe in 2010** -
- — must pay particular attention to the **protection of groundwater;**
- — must pay particular attention to the impact on aquatic organisms and must ensure that the conditions of authorisation include, where appropriate, risk mitigation measures
- **2015: CONCLUSION ON PESTICIDE PEER REVIEW - Conclusion on the peer review?**
- Candidate for substitution
- Not readily biodegradable, half-life between 50-579 days.
- Oral absorption: 80% in 96 hours. Distribution: rats – hide and gastrointestinal tract
- **Technical specifications (because of impurities) are not supported by the toxicological studies**. Toxicological reference values don't relate to the substance.
- **Genotoxic metabolite triazine amine** IN-A4098 might be found as a metabolite in plant and animal commodities - consumer risk assessment cannot be finalised. Half life 43.2 – 324.7 d (Metabolite common to the triazinylsulfonylurea herbicide group)
- **Groundwater data gap**: groundwater exposure assessment for metabolite triazine amine (IN-A4098). Moderate to high persistence.
- **Europe limits sprays to a couple of sprays in agriculture** (Spring and Winter) because persistence in groundwater
- Metsulfuron-methyl and metabolites are **highly mobile**. Triazine metabolite end up in groundwater.
- To protect non-target terrestrial plants – *20m no spray buffer zone*.

AQUATIC HERBICIDES

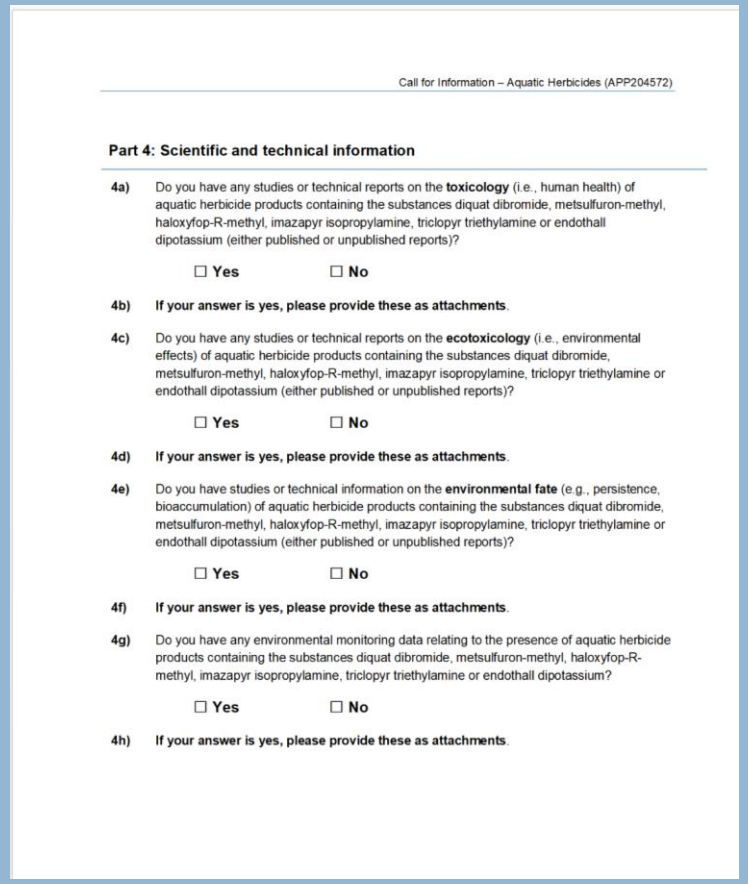
NEW ZEALAND

- *Not looking at epidemiology, mixtures…*
- *The current permission holders are local and regional councils, as well as the Ministry for Primary Industries, Department of Conservation, Land Information New Zealand and Landcare Services Limited, in the plant pest control and biosecurity sectors.*
- *Forestry is a massive user*
- **No scientific research community with block funding**
- **No monitoring**
- ….Not even groundwater monitoring
- Toxicological (not epidemiological) perspective in NZ EPA
- Won't look at complex ecosystem interaction
- Most science will be from industry
- That will reflect old regulatory studies
- Industry suppliers will not draw attention to absence of data



EPA's aim?
'prepare an application for reassessment'

We are looking to receive any relevant information relating to the current use, practices, and benefits of ***aquatic herbicide products****. This includes any information relating to the effects of the products, positive or adverse; on the relationship of Māori and Māori culture to the environment; toxicology; ecotoxicology; environmental fate studies; or monitoring results.*



Call for Information – Aquatic Herbicides (APP204572)

Part 4: Scientific and technical information

4a) Do you have any studies or technical reports on the **toxicology** (i.e., human health) of aquatic herbicide products containing the substances diquat dibromide, metsulfuron-methyl, haloxyfop-R-methyl, imazapyr isopropylamine, triclopyr triethylamine or endothall dipotassium (either published or unpublished reports)?

☐ **Yes** ☐ **No**

4b) **If your answer is yes, please provide these as attachments.**

4c) Do you have any studies or technical reports on the **ecotoxicology** (i.e., environmental effects) of aquatic herbicide products containing the substances diquat dibromide, metsulfuron-methyl, haloxyfop-R-methyl, imazapyr isopropylamine, triclopyr triethylamine or endothall dipotassium (either published or unpublished reports)?

☐ **Yes** ☐ **No**

4d) **If your answer is yes, please provide these as attachments.**

4e) Do you have studies or technical information on the **environmental fate** (e.g., persistence, bioaccumulation) of aquatic herbicide products containing the substances diquat dibromide, metsulfuron-methyl, haloxyfop-R-methyl, imazapyr isopropylamine, triclopyr triethylamine or endothall dipotassium (either published or unpublished reports)?

☐ **Yes** ☐ **No**

4f) **If your answer is yes, please provide these as attachments.**

4g) Do you have any environmental monitoring data relating to the presence of aquatic herbicide products containing the substances diquat dibromide, metsulfuron-methyl, haloxyfop-R-methyl, imazapyr isopropylamine, triclopyr triethylamine or endothall dipotassium?

☐ **Yes** ☐ **No**

4h) **If your answer is yes, please provide these as attachments.**

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GLYPHOSATE

CAS No. 1071-83-6

NEW ZEALAND

- **Never undertaken risk assessment. Only reauthorisation based on industry supplied data.** Added 2006.
- IARC 2015 Probably causes cancer – open literature
- 2016 NZ EPA single toxicologist – cancer review. Private industry studies
- 2017 Public Health Concern: Why did the NZ EPA ignore the world authority on cancer?
- 2018 Carcinogenicity of glyphosate: why is New Zealand's EPA lost in the weeds?
- 2020: Glyphosate litigation $10 billion
- 2021: Sub-committee to assess whether there was *significant new information have never met to discuss this* (HSNO Act s.62).
- 2021: Call for Information. 'First step understanding how glyphosate is used' … a non-statutory process. Reporting on public submission – no *judgement*.

GLYPHOSATE

CAS No. 1071-83-6

NEW ZEALAND

- No risk assessment? No DT50 for NZ conditions; no TEL/EEL (NZS 8409:204 irrelevant)
- 2022: Glyphosate in Aotearoa New Zealand. Summary report on the Call for information.
  Community health ignored. Summary report did not summarise the science that was submitted. E.g. dermal/inhalation/childhood
- *… EPA NZ next steps.* 'Grounds' for reassessment; engage with Māori on the topic of glyphosate; review POEA; use existing channels to reinforce the safe use of glyphosate.

PREVARICATION

- HSNO Act: EPA granted power so as to
  - **'Protect the …health and safety of people and communities.**
- Significant information - Why are the key scientists with the most knowledge of cancer & epidemiology ignored & dismissed, when the EPA has no equivalent expertise?
- Why is there **no splitting out risk scenarios** i.e., agriculture Vs residential?
- 2022 Neil Pearce: 'The NZ EPA simply refuses to concede it could be carcinogenic at all'

Professor of Epidemiology and Biostatistics, and Director of the Centre for Global Non-communicable Disease, at the London School of Hygiene and Tropical Medicine.

FACT CHECK

COUNCILS ACROSS NEW ZEALAND

1. *Human health research* not supported by Ministry of Health:

- MoH responsible for monitoring human health – but don't do it.
- 30+ years roadside spraying
- Complainants have no access to biomonitoring funds
- No scientists with core funding for long-term research (drip-fed)

2. *Environmental health research* not supported by Ministry for the Environment:

- PCE has demonstrated that environmental monitoring is non-existent, Iorns-Magellanes (2018) mixture effects ignored.

3. Universities & CRI's don't supply scientists with core funding for long-term research

4. NZ EPA has not undertaken risk assessments for Glyphosate or Metsulfuron-Methyl (or adjuvants)

- Ignored roadside risk, risk from mixtures, & to children in reauthorisations based on applicant (industry) data.
- Ignored dermal exposures from court cases
- Failed to convene sub-committee – new evidence glyphosate.
- Has never advocated for general government no core funding for basic science research.

5. Applicators are failed – WorkSafe looks at occupational health injury but no funding/resources for chronic disease

6. Europe – no authorisation for roadside spraying for G or MM

Summary of representative uses evaluated

Crop and/or situation (a)	Member State or Country	Product Name	F, G or I (b)	Pests or Group of pests controlled (c)	Formulation		Application				Application rate per treatment			PHI (days) (l)	Remarks: (m)
					type (d-f)	conc. of as (i)	method kind (f-h)	growth stage & season (j)	number min-max (k)	interval between appl. (min)	g as/hL min-max	water L/ha min-max	g as/ha min-max		
Cereals spring	EU	Ally® 20 SG	F	Broadleaf weeds	SG	200 g/kg	Tractor mounted sprayer Broadcast, ground directed spraying	Post emergence: two leaves to flag leaf stage (BBCH 12-39)	1	Not applicable	1.5-12	50-400	6	Not applicable	Label recommendation surfactant (*i.e.* Trend® 90)
Cereals Winter	EU	Ally® 20 SG	F	Broadleaf weeds	SG	200 g/kg	Tractor mounted sprayer Broadcast, ground directed spraying	Post emergence: autumn (BBCH 12-20) Post emergence: spring (BBCH 21-39)	1*	Not applicable	1.5-12	50-400	3 6	Not applicable	Label recommendation surfactant (*i.e.* Trend® 90)

Crop and/or situation (a)	Member State or Country	Product Name	F, G or I (b)	Pests or Group of pests controlled (c)	Formulation		Application				Application rate per treatment			PHI (days) (l)	Remarks: (m)
					type (d-f)	conc. of as (i)	method kind (f-h)	growth stage & season (j)	number min-max (k)	interval between appl. (min)	g as/hL min-max	water L/ha min-max	g as/ha min-max		
Cereals	EU	MSM 200 g/kg WDG (CHA 1710)	F	Broadleaf weeds	WG	200 g/kg	Tractor mounted sprayer Broadcast, ground directed spraying	Post emergence: two leaves to flag leaf stage (BBCH 12-39)	1	Not applicable	1.5 - 6	100-400	6	Not applicable	Applicant recommendation: Spring application only
Cereals winter and spring	EU	MSM 20 % WG	F	Broadleaf weeds	WG	200 g/kg	Tractor mounted sprayer Broadcast, ground directed spraying	Post emergence: two leaves to flag leaf stage (BBCH 12-39)	1	Not applicable	1.5 - 6	100-400	6	Not applicable	Applicant recommendation: Spring application only

*Either autumn application at the lower rate or spring application at the higher rate

Summary of representative uses evaluated (*Glyphosate*)*

Crop and/ or situation (a)	Member State or Country	Product name	F G or I (b)	Pests or Group of pests controlled (c)	Formulation		Application				Application rate per treatment			PHI (days) (l)	Remarks: (m)
					Type (d-f)	Conc. a.s. (i)	method kind (f-h)	growth stage & season (j)	number min-max (k)	interval between applications (min)	L/ha product [1] min-max	water L/ha min-max	kg as/ha min-max		
All crops** (all seeded or transplanted crops)	EU	MON 52276	F	Emerged annual, perennial and biennial weeds	SL	360 g/L	Spray	Pre planting of crop	1-2	21 d (see remark)	1-6	100-400	0.36-2.16		Spring & autumn after harvest (incl. stubble and/or seedbed prep.) For all crops: Max. application rate 4.32 kg/ha glyphosate in any 12 month period across use categories, equivalent to the sum of pre-plant, pre-harvest and post-harvest stubble applications. The interval between applications is dependent on new weed emergence after the first treatment, relative to the time of planting the crop.
All crops** (all seeded crops)	EU	MON 52276	F	Emerged annual, perennial and biennial weeds	SL	360 g/L	Spray	Post planting/ pre emergence of crop	1		1-3	100-400	0.36-1.08		
Cereals (pre-harvest) wheat, rye, triticale,	EU	MON 52276	F	Emerged annual, perennial and biennial weeds	SL	360 g/L	Spray	Crop maturity < 30 % grain moisture	1		2-6	100-400	0.72-2.16	7	Max. application rate 4.32 kg/ha glyphosate in any 12 month period across use categories, equivalent to the sum of pre-plant, pre-harvest and post-harvest stubble applications Pre-harvest uses in all crops include uses for weed control (higher doses) and harvest aid, sometimes referred to as desiccation (lower doses). The critical GAP is the high dose recommended used for weed control.
Cereals (pre-harvest) barley and oats	EU	MON 52276	F	Emerged annual, perennial and biennial weeds	SL	360 g/L	Spray	Crop maturity < 30 % grain moisture	1		2-6	100-400	0.72-2.16	7	
Oilseeds (pre-harvest) rapeseed, mustard seed, linseed	EU	MON 52276	F	Emerged annual, perennial and biennial weeds	SL	360 g/L	Spray	Crop maturity < 30 % grain moisture	1		2-6	100-400	0.72-2.16	14	

Crop and/ or situation (a)	Member State or Country	Product name	F G or I (b)	Pests or Group of pests controlled (c)	Formulation		Application				Application rate per treatment			PHI (days) (l)	Remarks: (m)
					Type (d-f)	Conc. a.s. (i)	method kind (f-h)	growth stage & season (j)	number min-max (k)	interval between applications (min)	L/ha product [1] min-max	water L/ha min-max	kg as/ha min-max		
Orchard crops, vines, including citrus & tree nuts	EU	MON 52276	F	Emerged annual, perennial and biennial weeds	SL	360 g/L	Spray	Post emergence of weeds	1-3	28 d	2-8	100-400	0.72-2.88	N/A	Stone & pome fruit, olives Applications to avoid contact with tree branches. Maximum cumulative application rate 4.32 kg/ha glyphosate in any 12 month period Note: Because applications are made to the intra-rows (inner strips between the trees within a row), application rates per ha are expressed per 'unit of treated surface area' the actual application rate per ha orchard or vineyard will roughly only be 33 %
Orchard crops, vines, including citrus & tree nuts	EU	MON 52276	F	Emerged annual, perennial and biennial weeds	SL	360 g/L	(ULV) Sprayer or Knapsack use (spot treatment)	Post emergence of weeds	1-3	28d	2-8	0-400	0.72-2.88		Stone & pome fruit, olives Applications made round base of trunk [0.0 L/ha water addresses ULV application of the undiluted product] Max. cumulative application rate 4.32 kg/ha glyphosate in any 12 month period Note: Because applications are made round base of trunk and to the intra-rows , (inner strips between two trees within a row), application rates per ha are expressed per 'unit of treated surface area' the actual application rate per ha orchard or vineyard will roughly only be 33 % - 50 %

GLYPHOSATE

DT50

EFSA (2015)

EFSA (2013)
143.3 days for glyphosate
and 514.9 days for AMPA

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Rate of degradation in soil (Annex IIA, point 7.1.1.2, Annex I

Laboratory studies

Glyphosate	Aerobic conditions			
Persistence endpoints at 20 and 25°C				
Soil type	pH (H_2O)	T (°C) / soil moisture	DT_{50} (d)	DT_{90} (d)
Gartenacker, loam	7.1	20/ pF2.5	7.86	56.29
Arrow, sandy loam	6.5[a]	20/ 40% MWHC	37.75	1661
Soil B, sandy loam	6.7	25/ 75% of 1/3 bar	1.2	20.8
Les Evouettes, Silt Loam	6.1[b]	20/ 40% MWHC	8.55	83.92
Maasdjik, sandy loam	7.5[a]	20/ 1/3 bar	4.61	62.00
Drusenheim, loam	7.4	20/ pF2.5	2.06	15.38
Pappelacker, loamy sand	7.0	20/ pF2.5	3.94	43.45
18-Acres, clay loam	5.7	20/ pF2.5	67.72	471.4
Speyer 2.3, Loamy Sand	6.9	20/40% MWHC	5.78	21.99
Speyer 2.1, sand	6.5[a]	20/ 45% MWHC	8.3	51.3
Speyer 2.2, loamy sand	6.2[a]	20/ 45% MWHC	18.7	428
Speyer 2.3, loamy sand	6.9[a]	20/ 45% MWHC	2.70	13.03
Dupo, silt loam	7.3[b]	25/ 75% FC	1.01	9.31
Speyer 2.2, loamy sand	6.0	20/ 40% MWHC	43.53	144.61
Speyer 2.1, sand	6.9[b]	20/ 40% MWHC	11.11[$]	144.25[$]

EFSA Journal 2015;13(11):4302

efsa European Food Safety Authority

Peer review of the pesticide risk assessment of the active substance glyphosate

Route of degradation (aerobic) in soil (Annex IIA, point 7.1.1.1.1)

Mineralisation after 100 days	16.9 - 79.6 % after 60 – 366 d (n = 12)
Non-extractable residues after 100 days	2.5 - 43.2 % after 60 – 366 d (n = 12)
Metabolites requiring further consideration - name and/or code, % of applied (range and maximum)	AMPA: 13.3 - 50.1 % max. at 7- 120 d (n = 12) Field: AMPA: 19.65 - 53.8 % max. after 56 - 271 d (n = 10)

Route of degradation in soil - Supplemental studies (Annex IIA, point 7.1.1.1.2)

Anaerobic degradation

Mineralisation after 100 days	0.87 - 45.42 % after 66 - 120 d (n = 3)
Non-extractable residues after 100 days	20.88 - 24.6 % 66 - 120 d (n = 3)
Metabolites that may require further consideration for risk assessment - name and/or code, % of applied (range and maximum)	AMPA: max. 30.2 % after 84 days (n = 3)
DT_{50}	DT_{50} = 142 d (n = 1), no significant degradation (n = 1), no DT_{50} calculated (n = 1)

Soil photolysis

Metabolites that may require further consideration for risk assessment - name and/or code, % of applied (range and maximum)	1st study: DT_{50} in d (experimental): 90 d (irradiated), 96 d (dark) AMPA: max. 13.0 % max. (irradiated), 9.6% max. (dark) 2nd study: DT_{50} in d (experimental): 101 d (irradiated), 1236 d (dark) AMPA: max.8.2% (irradiated), 6.1 % (dark) 3rd study: DT_{50} in d: 5.5 d (at 50°N) AMPA: max.24 %

WHAT TO DO?

Overwhelmed by contradictions?

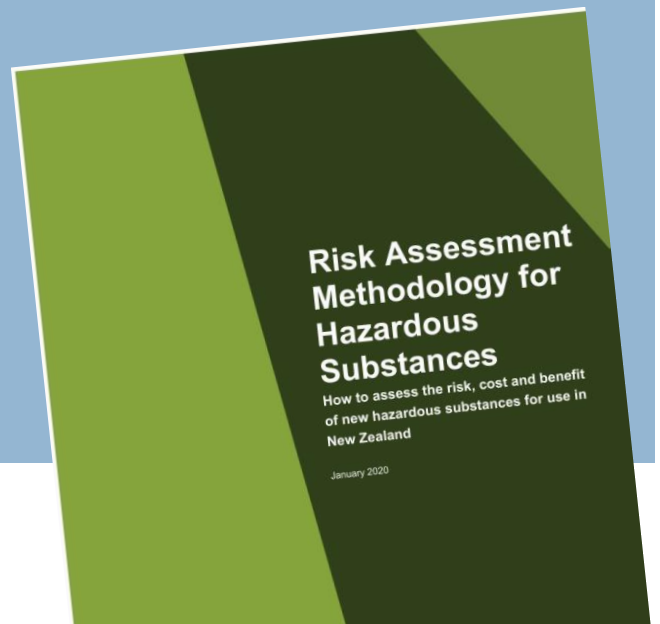
1. **Precautionary approach.** There is evidence of exposure; known harm associated with exposures; & groundwater risk.
2. **Recognise the power of the HSNO Act 'protect people & communities'.** Precautionary approach – you ***can*** value people & communities over council property, even in **uncertainty**.
3. **No risk assessment by NZ EPA?** Councils in awkward position!
4. **Europe?** Doesn't approve these chemicals for roadside/public use.
5. **Herbicide resistance?** This problem can't be plastered over by more toxic sprays.
6. **Mixture toxicity?** No evidence for safety of ingredients or mixtures.
7. **Warnings to public not feasible?** But chemicals persist for days, weeks & months.
8. **Increase transparency.** Require all quotes for non-chemical maintenance to be available to elected members and staff. No secret sub-contracts.
9. **Increase flexibility.** Would one more cut a month over the growing season ensure safe vision on roadsides? Explainers to residents - why parks no longer look like a film set.
10. **Look more broadly.** Arrange equipment purchase through RCs in a lease arrangement?

7 Precautionary approach

All persons exercising functions, powers, and duties under this Act including, but not limited to, functions, powers, and duties under sections 28A, 29, 32, 38, 45, and 48, shall take into account the need for caution in managing adverse effects where there is scientific and technical uncertainty about those effects.

Section 7: amended, on 31 December 2000, by section 4 of the Hazardous Substances and New Organisms Amendment Act 2000 (2000 No 89).

PRECAUTIONARY PRINCIPLE



Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.' (UNCED 1992)

- Morally unacceptable harm:
  - Threatening to human life or health; or
  - Serious and effectively irreversible; or
  - Inequitable to present or future generations; or
  - Imposed without adequate consideration of the human rights of those affected.

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