

Glyphosate Monitoring Study

Evaluation of the exposure risks from glyphosate
and associated degradation products from
road-side spraying for weed control

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Monitoring Strategy (Completed Feb 2016)

- **Goal** – To determine the risk posed by glyphosate and degradation products specifically from Government road-side weed-control to the public, government employee and the environment.
- **How to understand the risk** – To monitor the levels of glyphosate and degradation products and to compare to the most stringent regulatory limits, taken from other jurisdictions, for human exposure via drinking water, inhalation and ingestion.
- **What to monitor** – Glyphosate and degradation products in:
 - Drinking water (Public risk)
 - Air inside applicator cab (while spraying) (Applicator risk)
 - Air behind applicator vehicle (while spraying) (Public risk)
 - Groundwater, pond-water (Environmental risk)
 - Road-side soils and pond sediments (Environmental risk)
 - Foodstuffs from supermarket shelves (to provide scale to the exposure)



Methodology (1/2)

- Ministry of Public Works (MPW) use Dow Chemicals Glyphosate concentrate (Rodeo®) diluted in water to 0.53 to 0.56%.
- Two spray settings – average swath of 4ft. Approx. 40ml/m².
- 100 Gal container ~ 60 mins
- 5am-7.30am & 9am-12noon
- No spraying - wind >10mph or raining.
- Air sampling equipment based on US Occupational Safety & Health Administration (OSHA) Method PV2067.



In-Cab
Air Filter



Air Filter
at back
of truck



Methodology (2/2)

- AXYS Analytical Services Ltd, BC, Canada was down-selected from many laboratories in US, UK and Canada to monitor glyphosate and the two known degradation products in all matrices (air filters, water, soils/sediments, foodstuffs), at very low method detection limits.
- DENR could not identify a laboratory in the US, Canada or UK that could detect the surfactants used in *RoundUp*[®] and *Rodeo*[®] at the appropriate detection limits.
- AXYS Detection limits for glyphosate and degradation products:
 - **Water** - 10 nano-grams per litre (ng/l) (*i.e.* 0.000,000,01 g/l)
 - **Soils/Sediments** - 30 nano-grams per gram (ng/g) (*i.e.* 0.000,000,03 g/g)
 - **Air** - 0.7 nano-grams per litre (ng/l) (*i.e.* 0.000,000,000,7 g/l)
 - **Foodstuffs** – 0.4 nano-grams per gram (ng/g) (*i.e.* 0.000,000,000,4 g/g)



Glyphosate Legislative Limits – Other Jurisdictions

- Potable Water Limits**

Country	Organisation/ Standard	Glyphosate Concentration Limit (ng/l)	Comment
UK	Drinking Water Inspectorate (DWI) [1]	100	Measured at consumers tap. 2010
EU	Drinking Water Directive	100	Applies to any pesticide.
US	Environmental Protection Agency (EPA) [2]	700,000	Maximum contaminant Level Goal (MCLG) and Maximum Contaminant Level (MCL)
Canada	Guidelines for Canadian Drinking Water Quality 1987 [3]	280,000	Maximum Acceptable Concentration (MAC). 2008.
Australia	Australian Drinking Water Guidelines 6 (2011) [4]	1,000,000	February 2016

[1] UK Drinking Water Inspectorate (DWI). *Drinking Water Standards*. Jan 2010.

[2] US Environmental Protection Agency (EPA) *National Primary Drinking Water Regulations (NPDWR)*, EPA 816-F-09-004, May 2009.

[3] *Canadian Water Quality Guidelines and associated Report Rationale – prepared by the Task Force on Water Quality Guidelines of the Canadian Council of Ministers of the Environment*, Nov, 2008.

[4] *Australian Drinking Water Guidelines 6 2011. National Water Quality Management Strategy. National Health and Medical Research Council. Ver. 3.2, Updated February 2016. ISBN: 1864965118.*



Glyphosate Legislative Limits – Other jurisdictions

- **Inhalation Limits**

- American Conference of Government Industrial Hygienists (ACGIH) does not set Threshold Limit Values (TLV) for Glyphosate.
- EU does not have any defined occupational exposure limits.
- US Occupational Safety & Health Administration (OSHA) does not set Permissible Exposure Limits (PEL) for Glyphosate.
 - **However, OSHA has set an arbitrary limit of 1 mg/m³**
- DENR will consider any other occupational exposure limits for inhalation that are more stringent for glyphosate than that set by OSHA.



Glyphosate Legislative Limits – Other jurisdictions

Ingestion Limits (Acceptable Daily Intake Levels)

- Acceptable Daily Intake (ADI) levels are set based on a suitable safety margin below the lowest high-concentration displaying ‘No Observable Adverse Effect Level’ (NOAEL) for a particular effect on test animals.
- For a range of effects then the lowest high-concentration NOAEL is used.
- The safety margin is usually 100 times lower than the NOAEL (based on animal tests) or 10 times lower based on human data.
- ADI is considered the safe intake level for a healthy adult of normal weight who consumes average daily amounts of the substance in question.
- ADI levels identified include:
 - US EPA Chronic Reference Dose (cRfD) = 1.75 mg/kg body weight per day (1.75mg/kg bw /day)
 - European Food Safety Authority (EFSA) – Acceptable daily Intake (ADI) for consumers = 0.5 mg/kg bw /day
 - World Health Organization (WHO) – ADI = 0.3 mg/kg bw /day
 - **EFSA – Acceptable Operator Exposure Level (AOEL) = 0.1 mg/kg bw /day**



RESULTS – Potable Water / Groundwater

Description	Glyphosate (ng/l)	Degradation Products	
		Glufosinate (ng/l)	Aminomethyl- phosphonic Acid [AMPA] (ng/l)
GROUNDWATER Monitoring Well - Vesey St North (CVSN)	<10.4	<10.3	<10.2
GROUNDWATER Monitoring Well - Orange Valley (CORV)	10.2	<9.84	<9.74
Cloverdale POND WATER	10.8	<10.2	<10.1
GROUNDWATER FEED (INFLUENT) to Government Potable water RO Plant (Prospect location)	<10.2	<10.1	<9.98
POTABLE WATER * from Government (Prospect) RO Plant	<10.2	NQ	NQ

"NQ" - *Not Quantifiable - Low sample recovery (i.e. 10%) based on internal standard.*

"<" - *Below stated detection limit*

***** - *Potable water limits for EU: 100 ng/l; US: 700,000 ng/l; Canada: 280,000 ng/l; Australia: 1,000,000 ng/l*

- **MPW Water Section analyse for many chemicals in their potable water:
To date glyphosate always below detection limits (i.e. <10,000 ng/l)**



RESULTS – Other Chemicals Gov't Monitors in Potable Water

- Other chemicals listed (opposite) are determined from the Government potable water plants - 2015: Tynes Bay SWRO, Tudor Hill, Prospect, St George's and the Distribution Lines.
- These ensure that the water complies with standards of UK Drinking Water Inspectorate
- To date glyphosate always below detection limit (*i.e.* <10,000 ng/l)

Parameter Determined	Units	Concentration
Inorganics		
Nitrate + Nitrite	mg/L	0.1 - 2.3
Nitrate	mg/L	0.1 - 2.3
Nitrite	mg/L	<0.01
Turbidity	NTU	<0.2
Dissolved Sulphate	mg/L	8 - 21
Phenols-4AAP	mg/L	<0.001
pH	pH	7 - 8
Fluoride	mg/L	<0.1
Total Dissolved Solids	mg/L	240 - 320
Mercury	mg/L	<0.0001
Pesticides and Herbicides (&Semi-Vol)		
Simazine	µg/L	<1
Prometryne	µg/L	<0.25
Picloram	µg/L	<5
Phorate	µg/L	<0.5
Pentachlorophenol	µg/L	<0.5
Ethyl Parathion	µg/L	<1
Metribuzin (Sencor)	µg/L	<5
Metolachlor	µg/L	<0.5
Malathion	µg/L	<5
Dinoseb	µg/L	<1
Dimethoate	µg/L	<2.5
Diclofop-methyl	µg/L	<0.9
Dicamba	µg/L	<1
Diazinon	µg/L	<1
Cyanazine (Bladex)	µg/L	<1
Chlorpyrifos (Dursban)	µg/L	<1
Carbofuran	µg/L	<5
Carbaryl	µg/L	<5
Bromoxynil	µg/L	<0.5
Bendiocarb	µg/L	<2
Atrazine + Desethyl-atrazine	µg/L	<1
Des-ethyl atrazine	µg/L	<0.5
Atrazine	µg/L	<0.5
Aldicarb	µg/L	<5
Alachlor	µg/L	<0.5
2,4-Dichlorophenol	µg/L	<0.5
2,4-D	µg/L	<1
2,4,6-Trichlorophenol	µg/L	<0.5
2,4,5-T	µg/L	<1
2,3,4,6-Tetrachlorophenol	µg/L	<0.5
Terbufos	µg/L	<0.5
Triallate	µg/L	<1
Trifluralin	µg/L	<1
Benzo(a)pyrene	µg/L	<0.009

Parameter Determined	Units	Concentration
Pesticides and Herbicides		
Temephos	µg/L	<10
Paraquat	µg/L	<1
Guthion (Azinphos-methyl)	µg/L	<2
Diuron	µg/L	<10
Diquat	µg/L	<7
Glyphosate	µg/L	<10
Lindane	µg/L	<0.006
Heptachlor	µg/L	<0.006
Aldrin	µg/L	<0.006
Heptachlor epoxide	µg/L	<0.006
Oxychlorthane	µg/L	<0.006
a-Chlordane	µg/L	<0.006
g-Chlordane	µg/L	<0.006
Methoxychlor	µg/L	<0.02
Dieldrin	µg/L	<0.006
p,p-DDT	µg/L	<0.006
o,p-DDT	µg/L	<0.006
p,p-DDD	µg/L	<0.006
o,p-DDD	µg/L	<0.006
p,p-DDE	µg/L	<0.006
o,p-DDE	µg/L	<0.006
Poly-Chlorinated BiPhenyls (PCBs)		
Aroclor 1248	µg/L	<0.05
Aroclor 1242	µg/L	<0.05
Aroclor 1232	µg/L	<0.05
Aroclor 1221	µg/L	<0.05
Aroclor 1016	µg/L	<0.05
Aroclor 1254	µg/L	<0.05
Aroclor 1260	µg/L	<0.05
Volatile Organics		
Bromodichloromethane	µg/L	<0.1
Chloroform	µg/L	0.1
Bromoform	µg/L	0.4 - 1.8
Dibromochloromethane	µg/L	<0.2
Total Trihalomethanes	µg/L	0.4 - 1.8
Calculated Parameters		
Total PCB's	µg/L	<0.05
Total Endosulfan	µg/L	<0.005
o,p-DDT + p,p-DDT	µg/L	<0.006
o,p-DDE + p,p-DDE	µg/L	<0.006
o,p-DDD + p,p-DDD	µg/L	<0.006
Heptachlor + Heptachlor epoxide	µg/L	<0.006
DDT+ Metabolites	µg/L	<0.006
Chlordane (Total)	µg/L	<0.006
Aldrin + Dieldrin	µg/L	<0.006



RESULTS – Potable Water / Groundwater

- Environmental Limits

- Canadian Water Quality Guidelines and California State Water Resources Board for the protection of aquatic life all provide limits that are well above the EU/UK drinking water limit. Organisms within **Bermuda's ponds** are therefore not expected to be impacted by glyphosate.

- Conclusions:

- Glyphosate was not detected in the potable water of Bermuda that is generated by Government from groundwater resources.
- Glyphosate was detected in the groundwater and pond water at a concentration that was close to the detection limit of the methodology and was well below the most stringent drinking water standard found (*i.e.* EU/UK) by a factor of 10.
- Glyphosate concentrations in pond water were many orders of magnitude below the stated toxic level effects on organisms that inhabit the ponds.
- Results are consistent with understood partitioning of glyphosate from aqueous/water to solid/particulate fractions.



RESULTS – Soils and Sediments

Description	Glyphosate (ng/g)	Degradation Products	
		Glufosinate (ng/g)	Aminomethyl-phosphonic Acid [AMPA] (ng/g)
SEDIMENT - Cloverdale Pond	<31.3	<31.0	<30.7
SEDIMENT - Cloverdale Pond (DUPLICATE)	<30.4	<30.1	<29.8
SOIL - McGall's Hill - Roadside (sprayed more than 4 months prior)	886	<27.1	618
SOIL - Harrington Sound Road - Roadside (Near Quarry) (sprayed more than 4 months prior)	949	<29.3	1,310
SOIL - North Shore Road - Roadside (near Tynes Bay) (Sprayed within 1 week of sampling)	6,120	<27	1,670
SOIL - Black Watch Pass - Roadside (Western side) (Sprayed within 1 week of sampling)	51,200 *	<27.4	7,250

- DENR is not aware of any sediment quality guidelines for glyphosate.
- Canadian Council of Ministers of the Environment (CCME) Pesticide limits:
 - 0.7mg/kg (**700 ng/g**) – Agricultural and Residential zoned Land.
 - 12 mg/kg (**12,000 ng/g**) – Commercial and Industrial zoned land.



RESULTS – Soils and Sediments

- It is noted that the Canadian CCME limits apply to any “Pesticide” irrespective of relative toxicity.
- It is noted that the CCME have more stringent standards for soils in residential/commercial zoned land (compared to industrial zoning).

This is due to increased risk of ingesting soil (with associated pollutants) from residential (*i.e.* from playing in gardens) or agricultural (*i.e.* from soil attached to crops) zoned areas.

- Data suggests that:
 - Roads located alongside agricultural land should have an alternative, non-pesticide weeds control measure applied in order to ensure that the agricultural land meets appropriate soil quality guidelines. Run-off captured into catch basins / soakaways will capture the herbicide.
 - Soils along roadsides that have glyphosate directly applied should be considered as indicative of ‘Industrial/Commercial’ soil grade and, based on Canadian CCME, are not recommended for growing of produce.
 - Glyphosate does not appear to be present in pond sediments in Bermuda.



RESULTS – Air Inside Applicator Cab & Air Behind Applicator Vehicle – Inhalation Limit

Sample No.	Description	Vehicle Route	Glyphosate (ng/litre)	Glyphosate (mg/m ³)	Glufosinate (ng/litre)	Aminomethyl-phosphonic Acid [AMPA] (ng/litre)
1C	Inside Cab	BlackWatch Pass, North Shore Road	13.3	0.013	<0.71	<0.70
1R	Behind Vehicle		17.6	0.018	<0.71	<0.70
2C	Inside Cab	North Shore Road Devonshire	33.7	0.034	<0.71	<0.70
2R	Behind Vehicle		33.8	0.034	<0.71	<0.70
3C	Inside Cab	North Shore Road, Devonshire.	31.6	0.032	<0.71	<0.70
3R	Behind Vehicle		24.7	0.025	<0.71	<0.70
4C	Inside Cab	Southside Road, St George's	25.9	0.026	<0.71	<0.70
4R	Behind Vehicle		46.8	0.047	<0.71	<0.70
5C	Inside Cab	Barkers Hill, North Shore Road.	21.7	0.022	<0.71	<0.70
5R	Behind Vehicle		28.0	0.028	<0.71	<0.70

- Concentrations inside the applicator cab and behind the vehicle were not significantly different.
- Airborne concentrations were well below the **OSHA inhalation limit of 1 mg/m³** (*i.e.* equivalent to 1000 ng/litre) (*i.e.* 46.8 ng/l = 0.047 mg/m³ = <5% OSHA limit)



RESULTS – AIR - Inside Applicator Cab

Comparison to Ingestion Limits

- Comparing the air borne concentrations of glyphosate to the most stringent ingestion limit from other jurisdictions (*i.e.* **EFSA AOEL ADI 0.1 mg/kg bw /day**) requires certain assumptions:
 - All inhaled air and associated aerosols is retained in the body (*i.e.* not exhaled). Also assumes operator not wearing a PPE mask.
 - Average weight of person ~60kg (*i.e.* **EFSA ADI = 6 mg glyphosate /day**)
 - Breathing rate of average person = 11 litres air per minute (While driving) DENR assumed double the breathing rate = 22 litres/min (equiv. to walking)
 - Critical group considered to be MPW herbicide applicator employee who spends ~5.5 hours per day spraying. DENR assumes 8-hour working day.
 - Worst case highest volume of air inhaled by applicator = 10.6 m³/day.
 - Using highest airborne glyphosate concentration (*i.e.* 46.8 ng/l) equates to a daily intake of (10,600 x 46.8) 496,080 ng = **0.496 mg glyphosate per day.**
 - 0.496 mg of inhaled glyphosate compared to an EFSA ADI of 6mg/day is **less than 9% of the most stringent Acceptable Daily Intake by ingestion.**



RESULTS – FOODSTUFFS from Supermarkets

(Imported items purchased locally)

Sample Description	Glyphosate (ng/g)	Glufosinate (ng/g)	Aminomethyl-phosphonic Acid [AMPA] (ng/g)
Whole Wheat Flour	603	<0.459	40
All Purpose Flour - Triplicate	171	<0.465	11
	190	<0.461	9.48
	241	<0.447	16.4
Quick Oats	1140	<0.439	34.7
Popcorn	<0.47	<0.466	<0.461
Popcorn - Non-GMO	<0.467	<0.463	<0.458
Cornflakes	10.8	<0.422	<0.418
Cornmeal (Organic)	<0.452	<0.447	2.01
Cornmeal	26	<0.452	3.04



RESULTS – FOODSTUFFS from Supermarkets

(Imported items purchased locally)

Sample Description	Glyphosate (ng/g)	Kilograms of food stuff required to exceed EFSA AOEL ADI daily limit of 0.1 mg/kg bw /day (kg) ‡	Amount of foodstuff to be consumed per day to be equivalent to the exposure risk of the MPW herbicide applicator employee at 0.496 mg per 8-hr day (kg)
Whole Wheat Flour	603	10	0.82
All Purpose Flour - TriPLICATE sample for determination of analytical precision.	171	35	2.90
	190	32	2.61
	241	25	2.06
Quick Oats	1140	5.3	0.44
Popcorn	<0.47	N/A	NA
Popcorn - Non-GMO	<0.467	N/A	NA
Cornflakes	10.8	556	45.93
Cornmeal (Organic)	<0.452	N/A	NA
Cornmeal	26	231	19.08

‡ European Food Safety Agency (EFSA) Acceptable Operator Exposure Level (AOEL) limit of 0.1 mg/kg body weight per day for a 60 kg person equates to 6 mg/day per person.



RESULTS – FOODSTUFFS from Supermarkets

(Imported items purchased locally)

- The foodstuffs were analysed only to provide some scale to the exposure posed by Glyphosate from the MPW road-side weed control programme.
- Glyphosate was present in most foodstuffs sampled, however, the **levels are considered to be safe** according to both the World Health Organization (**WHO**) and European Food Safety Agency (**EFSA**) relative to their most stringent Acceptable Daily Intake (ADI) levels from ingestion.



CONCLUSIONS

- The purpose of this study was to determine whether there was a health risk to the public, to the MPW employee and to the environment from glyphosate exposure, specifically from the MPW roadside weed control programme.
- Comparison with the most stringent inhalation and ingestion standards stipulated in legislation from overseas jurisdictions suggests that the exposure risk to the public and the MPW employee posed by roadside weed control using glyphosate in Rodeo® is negligible.
- Similarly, the glyphosate exposure risk to organisms that inhabit Bermuda's ponds was negligible.
- Public exposure to glyphosate from foodstuffs imported to Bermuda from overseas and purchased locally was shown to exist. However, the level of exposure was shown to be well within the most stringent acceptable ingestion limits assessed from other jurisdictions.
- If, as a result of substantiated data and studies, overseas jurisdictions reduce their legislated acceptable levels of glyphosate in air, water and foodstuffs then DENR can revisit the existing data to determine whether further mitigation is required.



RECOMMENDATIONS (1/3)

- Based on the data collected and the most stringent legislated standards from overseas jurisdictions DENR cannot justify the continuation of the current suspension on importation of concentrated glyphosate for use with roadside weed control.
- DENR recommends to the Minister of the Environment that the current import suspension on glyphosate concentrate be lifted **once all of the following recommendations have been adhered to:**
- DENR will monitor overseas legislation (UK, EU, CAN, US, AUS, etc and WHO) for any future changes (*i.e.* changes to most stringent glyphosate limits for ingestion and inhalation) to determine whether these recommendations need to be revised.
- DENR will continue to monitor and manage the import of various pesticides into Bermuda as it is mandated to do under the Pesticide Safety Act 2009. Environmental monitoring of groundwater, soils and Bermuda's ponds will require further budget to maintain such a baseline dataset going forward.



RECOMMENDATIONS (2/3)

- DENR acknowledges that with any environmental chemical treatments that a precautionary approach be taken. Use of chemical inhibitors should only be considered once other more environmentally-sustainable control measures have been considered and their use discounted for acceptable reasons.
- DENR recommends that the importation of concentrated pesticide formulations (*i.e.* Not *Ready-To-Use*) or restricted pesticides should be controlled and limited to personnel who have demonstrated sufficient training and certification.
 - Dept. of Health (DoH) to oversee a competency applicator programme with **training, certification and named competent persons** (Timing – TBD).
 - DoH competent applicator programme – Expected to be based on US National Core Pesticide Applicator Programme (TBD by DoH).
 - Competent personnel must follow a **Risk Assessment** process and an **Integrated Pest Management** (IPM) process in order to consider minimizing the reliance on chemical controls.
 - Competent person to have **Annual Health Assessments** (managed by DoH and Chief Medical Officer).



Recommendations: Integrated Pest Management

- Also referred to as Integrated Pest Control (IPC) the United Nations Food and Agriculture Organisation defines IPM as:
 - *“the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimise risks to human health and the environment.”*
- The main emphasis of IPM is on ‘Control’ of pests (incl. weeds) and not on their eradication which is deemed as impossible, expensive and potentially unsafe.
- IPM puts emphasis on preventative practices, monitoring, mechanical controls (weeding crews, burning, steam) and biological controls before moving to the responsible use of synthetic pesticides. Suggestions welcome!
- Recent IPM Activities:
 - While the suspension of concentrated glyphosate has been occurring DENR did conduct some trials in Sept 2016 on using alternative methods of roadside weed control. DENR used the saline concentrate (1.5 times seawater concentration) from one of the SWRO plants with 0.1% detergent to determine its effect on weed control. Unfortunately, the results showed that after a short die back period that the weeds grew back quickly (within days) compared to the 0.53% glyphosate test (many weeks).



RECOMMENDATIONS (3/3)

- Subsequent to the Pesticide Applicator following the 'Risk Assessment' and 'IPM' processes DENR recommends that MPW do not use glyphosate in roadside areas that drain directly into agricultural land. In many areas roadside run-off is captured by catch basins (1147 catch basins in Bermuda) and glyphosate is known to readily partition out of the water and into sediments and particulates that are subsequently caught by these catch basins.
- DENR can provide data in Geographical Information System (GIS) format to MPW to assist in the allocation of exclusions around all existing agricultural zoned areas that are not serviced by roadside catch basins. This data will need to be translated into a GPS hardware system that alerts the applicator of **'where-to-spray'** and **'where-not-to-spray'**.
- In addition to mitigating the herbicide risk DENR would recommend that all roadside drainage that will contain chemicals from vehicle exhaust soot be managed via appropriately maintained catch basins before being allowed to drain into agricultural and sensitive areas (*i.e.* ponds). More catch basins should be installed in these areas identified.
- DENR recommends that MPW provide a mechanism of informing the public of the Government portal of which roadside routes are due to be sprayed and when the roadsides were last sprayed.



Thank you – Any Questions?

Questions will be gathered from this meeting and by email (PollutionControl@gov.bm) up until the 18th January and will be published on the Government portal with appropriate answers in February 2017.



Pesticide Imports to Bermuda (1/3)

- Controlled and Managed by HM Customs and DENR – Plant Management Section
- Registered Pesticides that are currently controlled at point of import:

Restricted pesticides: *These active ingredients are restricted due to environmental or health concerns related to the percentage of active ingredient in the product, the packaging of the product, the formulation of the product, or the intended end use (location) of the product.*

- Abamectin
- Atrazine
- Azoxystrobin
- Bifenthrin
- Carbaryl
- Clothianidin
- Deet
- Dicamba
- Etridiazole
- Glufosinate ammonium
- Glyphosate
- Total release home foggers
- Hydramethylnon
- Mancozeb
- Neo-nicotinoids
- Oxadiazon
- Pentachloronitrobenzene
- Permethrin
- Propxur
- Rimsulfuron
- Tridimefon
- Trifloxysulfuronsodium



Pesticide Imports to Bermuda (2/3)

Prohibited pesticides: *These active ingredients are prohibited importation due to environmental or health concerns.*

- Aldrin
- Bendiocarb
- Bromethalin
- Captan
- Chlordane (and all related chemicals)
- Chlorpyrifos
- Dacthal
- DDD (and all related chemicals)
- DDE (and all related chemicals)
- DDT
- DDVP
- Diazinon
- Diclofop-methyl
- Dieldrin
- Dioxin
- Endosulfan
- Ethion
- Heptochlor
- Isofenphos
- Isoxaben
- Kepone
- Lindane
- Methoxychlor
- Methyl-bromide
- Mirex
- Oryzalin
- Oxyfluorfen
- Paraquat
- Prodiamine
- Pronamide
- Quinclorac
- Tetrachlorvinphos
- Toxaphene
- Trichlorfon
- Triforine



Pesticide Imports to Bermuda (3/3)

- Controlled and Managed by HM Customs and DENR – Plant Management Section
- Registered Pesticides that are currently controlled at point of import:

Approved for Importation

- 2,4 –D
- Bromoxynil –One importer (Nursery)
- Dimethoate
- Diquat (diquat dibromide)
- Malathion
- Trifluralin



WHO International Agency for Research on Cancer (IARC) (1/3)

- Definitions of Chemicals or Activities with Respect to Carcinogenicity to Humans.

Table A.2.1. Agents Classified by the IARC with respect to carcinogenicity

IARC Group #	Carcinogenic rating to humans	Number of agents/chemicals
Group 1	Carcinogenic to humans.	118 Agents
Group 2A	Probably carcinogenic to humans.	79 Agents
Group 2B	Possibly carcinogenic to humans.	291 Agents
Group 3	Not classified as to its carcinogenicity to humans.	507 Agents
Group 4	Probably not carcinogenic to carcinogenic to humans.	1 Agent

(<http://monographs.iarc.fr/ENG/Classification/>)



WHO International Agency for Research on Cancer (IARC) (2/3) “Probable Carcinogens”

Example IARC Group 2A Compounds (79 total)	Products and Activities where the agent is either used or is present
Certain Poly Aromatic Hydrocarbons (PAH's)	Including Dibenz[a,h]anthracene and Dibenzo[a,i]pyrene. Found in motor oil, soot, smoke, open fires, road runoff, etc.
Dichorormethane.	Occurs naturally in the environment at low levels but is largely produced industrially as a solvent in paint strippers, degreasers, decaffeinated coffee/tea.
Acrylamide.	Used in binding chemicals, cement, pesticides and cosmetics. Found in cigarette smoke, certain starchy foods after heating (Frying, baking) though expected dose is 500 times lower than dietary intake limits.
Malathion	Used in Bermuda as a general use insecticide and for household use from retail stores (e.g. Ortho), used in treatment of head lice.
Creosotes (from coal and wood tars)	Used as a preservative for treating wood and has some medical uses.
Anabolic steroids	Found in certain sports/body building dietary products to enhance performance, prescribed medicines,
Glyphosate	Herbicides manufactured by Monsanto, Dow Chemicals and a range of companies in China.
Activities/Occupation:	Manufacture of glass, art glass, burning wood, Hairdresser/barber, high temperature frying, Petroleum refining, consumption of red meat.



WHO International Agency for Research on Cancer (IARC) (3/3) “**Carcinogenic**”

Example IARC Group 1 Compounds (118 total)	Products and Activities where the agent is either used or is present
Certain Poly Aromatic Hydrocarbons (PAH's) Benzo[a]pyrene	Found in motor oil, soot, smoke, open fires, road runoff, etc.
Acetaldehyde	Present in indoor air in especially new buildings and associated with other volatile organic compounds. Present in emulsion paint, particle board, chipboard and other woods and tobacco smoke.
Formaldehyde	Naturally forming and also present in particle board, various coatings and resins.
Ethanol	Alcoholic beverages
Benzene	Crude oil, gasoline (exposure via automobile service stations), coal, tobacco smoke.
PCB's	Used as a dielectric or coolant in early electrical transformers. Replaced with environmentally friendly alternatives in Bermuda.
Outdoor air pollution	Includes both gases/vapours/VOC's and particulates (i.e. PM-10) from combustion processes (See PAH's)
Mixtures	Processed meats, wood dust, paints, mineral oils, Oestrogen-based contraceptives, coal tars, exhaust from Diesel engines.
Activities/Occupation:	Painting, sand blasting, tanning devices, smoking, furniture/cabinet making.



Timeline

- Mar 2015** – WHO/IARC - Classification of glyphosate raised from '*Possible carcinogen to humans*' to '*Probable carcinogen to humans*'.
- May 2015** – Petition from Bermuda public to Minister. Minister decided to suspend importation of glyphosate and associated products.
- Nov 2015** – EFSA - Stated glyphosate not carcinogenic to humans.
- Nov 2015** – Minister relaxed importation ban on dilute products (<2%).
- Feb 2016** – DENR/DoH – Stakeholder presentation and monitoring strategy
- May 2016** – WHO/FAO - Glyphosate unlikely to pose carcinogenic risk to humans from exposure through diet. No reason to change existing Acceptable Daily Intake (ADI) limits.
- Jun 2016** – Samples collected for analysis (air, water, sediment, soil, food stuffs).
- Oct 2016** – Results received from AXYS Analytical Services Ltd, BC, CAN.
- Nov 2016** – DENR monitoring study report completed.



Background - Glyphosate Use (1/2)

- Glyphosate was originally developed by Monsanto to be the herbicide that their Genetically-Modified (GM) crops are resistant to.
- The patent of glyphosate ran out in 2000 and now there are a range of companies manufacturing glyphosate products.
- Glyphosate has the highest global production volume of all herbicides – primarily in agriculture but it is also used in forestry and urban/home settings.
- It is not only applied to GM crops but is now also applied to non-GM crops as a pre-harvest desiccant.
- ***In Bermuda***, GM crops are not grown and glyphosate is not known to be used by farmers on any non-GM crops.
- ***In Bermuda***, glyphosate is primarily understood to be used for weed control.
- Importers ***in Bermuda*** of >2% glyphosate include: Government, Hotel/Condo's, Golf Courses, Plant Nurseries, Landscapers, Farmers, Pest Control Companies, Hardware/Retail Stores, Construction Companies, Private Use.
- Some farmers ***in Bermuda*** use glyphosate for weed control only (it is not applied to crops). Weed control at field borders and to prep before seeding.

