SUBMISSION

TO:	Environment Protection Authority
FROM:	Apiculture New Zealand
SUBMISSION ON:	Glyphosate: call for information
DATE:	24 September 2021
CONTACT DETAILS:	Apiculture New Zealand PO Box 10-414 Wellington 6140 04 471 6254 Email: ceo@apinz.org.nz

Submission to Environment Protection Authority's 'Call for information on glyphosate use'

Introduction

Apiculture New Zealand (ApiNZ) welcomes the opportunity to make this submission to the Environment Protection Authority's (EPA) call for information on glyphosate use.

ApiNZ is the national body representing the apiculture industry in New Zealand representing the full range of sectors in the industry, from hobbyist and commercial beekeepers to honey exporters and suppliers. ApiNZ aims to support and deliver benefit to the New Zealand apiculture industry by creating a positive industry profile, business environment and opportunities for members.

EPA has indicated that they are looking for the following information 'from importers, manufacturers, professional users, retailers, organisations, community groups and the public:

- information that is relevant to the current use, practices, and benefits of glyphosate products
- evidence of the effects of glyphosate products: positive or adverse impacts; toxicology; ecotoxicology; environmental fate studies; or monitoring results
- how glyphosate products are used and applied in different areas, for example, agricultural, domestic, in public areas, for conservation, or as an aquatic herbicide
- your views on the positive or negative impacts you think glyphosate products have on our environmental, economic, social and cultural wellbeing.'

Feedback on the 'Call for information'

Summary

The main points ApiNZ would like to make are:

- Bees collect pollen and nectar from any plant within a reasonable flying distance (usually up to 3 kilometres but can be up to 12 kilometres[1] [2]) from their hive. Bees pollinate many valuable crops. They turn the nectar and pollen they collect from these plants into honey.
- This is the first EPA review of glyphosate in 40 years. That the single most important herbicide in New Zealand has not been reviewed for such a long time is concerning. Environmental data is a good first step in enabling a proper review of the EPA's risk assessment process and to highlight any issues.
- Glyphosate is a very important herbicide for weed control in agriculture and horticulture. It is low cost and readily available. Banning the use of glyphosate would be problematic for farmers and growers. Our preferred option would be to see practical controls in place that support the safe use of glyphosate.

[1] Attachment 10
[2] Attachment 3

- A major industry concern is glyphosate residues in honey, and we would like the EPA, in conjunction with the primary sector, to determine how best to mitigate glyphosate residues in the environment as these residues end up in honey.
- While glyphosate residues in New Zealand pose no food safety concerns, they do affect consumer perceptions and their expectations for high quality, premium food, not just for honey, but across the New Zealand Inc. brand.
- The cost of Japan requiring that all honey they import from New Zealand is tested for glyphosate residues is considerable. Based on information from the main testing laboratories (Analytica and Hills), the number of tests each year since Japan introduced testing for glyphosate is likely to range between 6,000 and 8,000 tests per year. The cost to the apiculture sector could range between $594,000 (assuming 6,000 tests at the lowest price of $99 per test) and $960,000 (if there were 8,000 tests at the highest price of $120 per test).
- As a herbicide, glyphosate is toxic to plants, not bees and it is generally considered to be safe to apply around bees by regulatory bodies. However, research shows that some formulations of glyphosate can cause problems for bees due to the addition of surfactants and other co-formulants.

ApiNZ glyphosate use survey

ApiNZ ran a survey of our members based on the questions in EPA's submission response form. The survey was promoted in our weekly email to our members, and on our social media page. ApiNZ received a total of 36 responses to the survey: 18 from the North Island and 18 from the South Island. Most responses (61 percent) were from commercial beekeepers, with the remaining responses from hobbyists or packers. A summary of the results of the survey can be found in Attachment One. The survey questions can be found in Attachment Two.

Feedback on specific questions:

Question 6.1: Do you have any studies or technical reports on the following:

- ***toxicology of glyphosate***
- ***ecotoxicology of glyphosate***
- ***environmental fate of glyphosate***
- ***environmental monitoring data of the presence of glyphosate in the New Zealand environment***
- ***public health/occupational health data relating to glyphosate***

<u>Environmental monitoring data on the presence of glyphosate in the New Zealand environment</u>

Bees pick up traces of herbicides as they move from plant to plant, collecting pollen and nectar, unintentionally transferring residues from crops of weeds sprayed with glyphosates back into their hives. Liao and Berenbaum (2017) found that bees prefer nectar containing low levels of glyphosate over uncontaminated nectar. Similar preferences have been seen with many compounds including salts and electrolytes, caffeine and essential oils.

Bees may also come into glyphosate in water in areas where glyphosate has been sprayed. Bees need a lot of water to cool the hive, dilute honey and rear brood. Bees collect water from ground water, ponds, puddles and even early morning dew from plants. All these sources can potentially be contaminated with herbicides such as glyphosates.

The EPA has set an Environmental Exposure Limit for glyphosate in water of 0.37 mg/l for some, but not all, herbicides containing glyphosate. There is no evidence that we can find that the EPA has conducted any environmental monitoring to determine if this limit is being exceeded or not[3].

Investigations have also been carried out to determine if supplements fed to bees contained glyphosate residues and if this is an avenue for glyphosate residues in honey. Supplements commonly used in New Zealand include bee patties (often made of protein) and sugar syrup. All sugar used to make sugar syrups fed to bees in New Zealand is food grade sugar suitable for human consumption. While this sugar is often imported into New Zealand, it still must meet New Zealand's requirements. Protein supplements do not play a part in honey production and are generally fed to the colony long before honey production begins.

Beekeeping supply companies in New Zealand who sell plant-based protein pollen supplements for bees have undertaken research to test whether glyphosate was transferred from their supplements to honey. The results of the research showed that there was no difference in glyphosate levels between hives that were fed their products and those that were not. Therefore plant-based protein pollen supplements are probably not a source for glyphosate residues in honey.

Bees are also fed sugar (either dry or mixed with water to form a syrup) when nectar is in short supply or unavailable and during winter. This sugar is food grade and is tested extensively for heavy metals, pesticide residues and other similar contaminants, so is unlikely to be a source of glyphosate residues in honey.

Harmful effects of glyphosate products on pollinators

'Pollinators underpin global food production, but they are suffering significant declines across the world. Pesticides are thought to be important drivers of these declines' (Straw et al 2021).

Herbicides, such as Roundup™, are widely applied to pesticides. They are considered to be safe to apply around bees by regulatory bodies. However, research shows that some formulations of glyphosate can cause problems for bees. Straw et al (2021) evaluated two Roundup™ products, and another product with the same active ingredient, glyphosate. The researchers concluded that the active ingredient, glyphosate, is not the cause of the problem, that it is surfactants and other co-formulants. Roundup™ products caused considerable matting of bee hair, and this incapacitated the gas exchange system of bumble bees (Straw et al 2021).

Siviter et al (2021) remarks that global concern over widely documented declines in pollinators has led to the identification of anthropogenic stressors that, individually, are detrimental to bee populations. Synergistic interactions between these stressors could substantially amplify the environmental effect of these stressors and could therefore have important implications for policy decisions that aim to improve the health of pollinators. A meta-analysis found an overall synergistic effect between multiple stressors on bee mortality. Environmental risk assessment schemes that assume additive effects of the risk of agrochemical exposure may underestimate the interactive

[3] https://www.epa.govt.nz/industry-areas/hazardous-substances/rules-for-hazardous-substances/controls-for-hazardous-substances/

effect of anthropogenic stressors on bee mortality and will fail to protect the pollinators that provide a key ecosystem service that underpins sustainable agriculture.

Goodwin and McBride (2000) evaluated the toxicity of surfactants applied topically and orally to honey bees (Apis mellifera L.) using laboratory bioassays. Eleven surfactants (Citowett®, Pulse®, Boost®, Codacide oil®, Contact®, Raingard®, Peptoil®, Sunspray®, Ethokem®, Multifilm® and Uptake®) were applied topically to anoxiated bees. Anoxiating bees and spraying them with water had no significant effect on their survival. Four surfactants (Citowett®, Pulse®, Boost® and Ethokem®) were toxic when applied topically. Ethokem® and Boost® also showed oral toxicity.

Polyethoxylated tallow amine pure (POEA) CAS No: 61791-26-2, was the co-formulated (excipient) surfactant used with Roundup™ when it was first released to the New Zealand market. It is still being used in formulations of glyphosate and other pesticides in New Zealand. Examples are Orion Crop Protection Turbo 300[4] (EPA approval HSR 000223 ACVM Approval P4602) and Nufarm Weedmaster 360[5] (EPA Approval HSR000227 ACVM Approval P5785). The EPA's Inventory of Chemicals has no restrictions, or any hazard classification assigned to Polyethoxylated tallow amine.

In March 2021 the European Union prohibited POEA from being used as a pesticide co-formulant. The EU expressed 'concerns or data gaps related to potential effects on human health or the environment' (EU 2021). It is not the active ingredient that does the damage, it is often what is in the formula and in the tank mix that causes health and environmental effects. ApiNZ asks the EPA to consider the effects of co-formulants with glyphosate on health and environment outcomes.

Environmental fate of glyphosate: soil

The following two studies provide research on what happens to glyphosate once it is sprayed on plants.

Mamy and Barriuso (2005) report that glyphosate is a broad-spectrum herbicide, and its behaviour - as well as that of other herbicides - in soils is an important consideration for the overall environmental evaluation of genetically resistant crop introduction. Their research compared glyphosate adsorption in soil with that of other herbicides frequently used in rape (trifluralin and metazachlor), sugarbeet (metamitron) and corn (sulcotrione). Glyphosate was found to be the most strongly adsorbed herbicide, thus having the weakest potential for mobility in soils. Ranking the adsorption properties among the five herbicides, glyphosate and trifluralin have the lowest availability and mobility in soils, but glyphosate has the broadest spectrum for weed control.

Morillo et all (2000) reported that the results of glyphosate adsorption on three soils of different characteristics show that the interaction of this pesticide with the soils was not related to their CEC and clay minerals content, but to the content of iron and aluminium amorphous oxides and organic matter. The presence of Cu in treatment solutions enhanced glyphosate adsorption, due to several reasons: glyphosate coordinates strongly to Cu, and Cu glyphosate complexes formed seem to have higher ability to be adsorbed on the soil than free glyphosate; glyphosate adsorption can take place on sites where Cu was previously adsorbed, acting as a bridge between the soil and glyphosate; when Cu was present the solution pH decreased, and glyphosate adsorption increased, since lower

[4]Attachment 12
[5]Attachment 11

pHs lead to the formation of glyphosate species with lower negative charge, which are adsorbed more easily on the negatively charged soil surfaces.

Question 7.1: If you use glyphosate products, why do you choose to use glyphosate products?

Glyphosate products are very effective at controlling unwanted weeds. Feedback from beekeepers has indicated that there are few alternatives at a similar price. Some beekeepers have indicated that they have a policy of using no glyphosate products. Others have started using non glyphosate products such as vinegar and agricultural salt. Many beekeepers report that they only cut weeds back manually at apiary sites to minimise the chances of any glyphosate contamination of their honey.

Question 8.6: What positive or negative impacts do you think glyphosate products have on environmental, economic and cultural wellbeing?

Glyphosate residues in honey

The Ministry for Primary Industries (MPI) conducted targeted surveys on honey samples for glyphosate residues in 2017/18 and in 2018/19. None of the samples taken from honey available for sale had glyphosate residues above the domestic maximum residue limit (MRL) for glyphosate of 0.1 mg/kg and there were no food safety concerns. While a small number of raw honey samples showed glyphosate residues the above the MRL, MPI emphasised that there were no food safety concerns associated with these samples. The results of these surveys showed that residue levels and prevalence are comparable to or lower than levels published in other international reports and studies. MPI released a report detailing these findings in January 2020 (MPI 2020a).

In the middle of 2020, New Zealand's honey industry was thrown into the media spotlight with reports on the honey industry and glyphosate residues following the release by MPI of the 'New Zealand National Chemical Residues Programme: Results for agricultural compound residues in honey' in January 2020 which included information on glyphosate residues. In October 2020, the Japanese Ministry of Health, Labour and Welfare (MHLW) added glyphosate testing in honey to their imported food monitoring programme. On 20 October 2020, MPI issued a 'For your information' (FYI) advisory recommending that exporters should have a plan in place to ensure that any honey that they export to Japan meets Japan's MRL of 0.01 mg/kg. Since January 2021 Japanese authorities have tested one hundred percent of all honey imported into Japan for glyphosate residues. To support these requirements from Japan, since 20 January 2021, MPI will only certify honey for export to Japan if the glyphosate residue in the honey is less than 0.01mg/kg.

Beekeepers are aware of this issue and carefully consider where they place their hives and communicate regularly with landowners to avoid placing hives near areas where spraying with glyphosate could occur. The apiculture industry is aware of the need to test for residues so that they can manage and address this issue proactively. Apiculture NZ has also been working with Government and primary sector agencies on proactively managing awareness around glyphosate residues in honey.

Economic cost of glyphosate residues in honey

This policy change in Japan has come at quite a large cost to New Zealand companies who export honey to Japan. These companies report that they now test all honey from their suppliers for glyphosate residues prior to purchase, regardless of which country it is likely to be exported to. If glyphosate residues in this honey are too high, they will not purchase it. Some companies re-test all

honey soon after purchase to ensure the results from glyphosate testing undertaken by their suppliers was accurate. Companies that have their own hives and produce their own honey will test all of it. Once honey is mixed and packed for export, the honey is tested again for glyphosate residues. Another major change is that prior to the change in Japan, many companies would only test a sample of drums of honey from their suppliers. Some now test every single drum of honey that they purchase.

Analytica and Hills Laboratories, who do this testing for many honey companies, report that testing volumes have increased substantially since the middle of 2020. Analytica has reported that prior to the middle of 2020 they were receiving 10-20 samples per week and charging $120 per sample. Testing volumes since the middle of 2020 have increased to thousands per calendar year. Hills Laboratories have reported that prior to October 2020 they charged $237 per sample. Since October 2020 they are testing 14 times as many samples and have been able to reduce the cost per sample to $99.

While we don't have any information about the total number of tests conducted since Japan changed their requirements in October 2020, we can make some estimates. Based on information from the main testing laboratories (Analytica and Hills), the number of tests each year since Japan introduced testing for glyphosate is likely to range between 6,000 and 8,000 tests per year. The cost to the apiculture sector could range between $594,000 (assuming 6,000 tests at the lowest price of $99 per test) and $960,000 (if there were 8,000 tests at the highest price of $120 per test).

European experience

Information on the website of the Dutch Board for the Authorisation of Plant Protection and Biocides (CTGB) comments that 'glyphosate is a much-discussed weed killer. The European Commission allowed glyphosate in December 2017 for a limited period of 5 years'. Glyphosate 'should therefore be re-evaluated after a period of five years, i.e., by December 2022 at the latest'[6]. Attachment 4 also contains information on the stance on glyphosate of other government agencies in Europe.

The information on the CTGB website also included information on the International Agency for Research on Cancer (IARC)'s stance on glyphosate. 'On 20 March 2015, the IARC published a note, as well as a short summary (both 2 pages) in the scientific journal 'The Lancet Oncology' proposing a new classification of carcinogenic properties for 5 active substances of plant protection products (including glyphosate). The full IARC evaluation (including the data allowing its assessment) was only published on 29 July 2015. IARC has proposed that glyphosate should be classified in class 2A as 'likely carcinogenic to humans'. The IARC maintains that this classification is based on:

- studies on human exposure to glyphosate published since 2001; and
- studies with laboratory animals'[7].

Effects of glyphosate on bee health in New Zealand

There is a lack of research in New Zealand on the effects of herbicides and insecticides on bee health. The main research on bee health in New Zealand is conducted by MPI in their annual colony loss survey. The survey asks beekeepers why they thought the bee colonies had been lost. The survey does not collect data on losses due to pesticide or herbicide poisoning. The nearest this

[6] Attachment 4
[7] Attachment 4

survey gets is asking if the beekeeper thought that colonies had been lost due to suspected toxicity. In the 2020 survey results, beekeepers reported losses of 11.3 percent of hives (99,150 hives) with the key reasons being queen problems or varroa. (MPI 2020b).

As a herbicide, glyphosate is toxic to plants, not bees and it is generally considered to be safe to apply around bees by regulatory bodies. However, research shows that some formulations of glyphosate can cause problems for bees with the addition of surfactants and other co-formulants. ApiNZ stresses its earlier requests to the EPA to reassess surfactants and other co-formulants in relation to bee health.

Appendix One: List of attachments

The attachments to this submission are as follows:

Attachment Number	Reference
1	Summary data from ApiNZ glyphosate use survey
2	ApiNZ glyphosate use survey questions
3	www,buzzaboutbees.net 'How far do bees fly for food?' downloaded from https://www.buzzaboutbees.net/how-far-do-bees-fly.html
4	Glyphosate: the state of affairs Dutch Board for the Authorisation of Plant Protection Products and Biocides (Ctgb)
5	European Union (March 2021) 'Commission Regulation (EU) 2021/383 of 3 March 2021 amending Annex III to Regulation (EC) No 1107/2009 of the European Parliament and of the Council listing co -formulants which are not accepted for inclusion in plant protection products' Official Journal of the European Union Downloaded from https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1621418116038&uri=CELEX%3A32021R0383
6	Goodwin RM, McBrydie HM (2000) 'Effect of surfactants on honey bee survival' New Zealand Plant Protection 53:230-234 (2000)
7	Liao L, Wu W, Berenbaum M (2017) 'Behavioural responses of honeybees (Apis mellifera) to natural and synthetic xenobiotics in food' Scientific Reports 2017 7:15924 DOI:10.1038/s41598-017-15066-5 (www.nature.com)
	Mamy L, Barriuso E (2005) 'Glyphosate adsorption in soils compared to herbicides replaced with the introduction of glyphosate resistant crops' Chemosphere 2005 Nov;61(6):844-55 PMID: 15951002 downloaded from https://pubmed.ncbi.nlm.nih.gov/15951002/
	Mead T (2020) 'Controversial weed killer found in premium honey' One News downloaded from https://www.tvnz.co.nz/one-news/new-zealand/controversial-weed-killer-found-in-premium-honey
8	Ministry for Primary Industries (2020a) 'New Zealand National Chemical Residues Programme: Results for agricultural compound residues in honey, January 2020' downloaded from: https://www.mpi.govt.nz/dmsdocument/39578/direct
9	Ministry for Primary Industries (2020b) 'Report on the 2020 New Zealand Colony Loss Survey' downloaded from https://www.mpi.govt.nz/dmsdocument/44590-Report-on-the-2020-New-Zealand-Colony-Loss-Survey
10	Ministry of Agriculture, Food and Fisheries, British Columbia 'Apiculture Factsheet, factsheet #111 downloaded from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/animal-and-crops/animal-production/bee-assets/api_fs111.pdf
	Morillo E, Undabeytia C, Maqueda C, Ramos A (2000) 'Glyphosate adsorption on soils of different characteristics. Influence on copper addition' Chemosphere 2000 Jan;40(1):103-7. doi: 10.1016/s0045-6535(99)00255-6. PMID 10665451 https://pubmed.ncbi.nlm.nih.gov/10665451/
11	Nufarm (2019) Safety Data Sheet Weedmaster G360 downloaded from https://cdn.nufarm.com/wp-content/uploads/sites/17/2018/02/31151608/WeedMaster_G360_SDS-1.pdf
12	Orion Agriscience (July 2020) 'Safety Data Sheet Turbo 30' downloaded from https://www.orionagriscience.co.nz/storage/products/March2021/Turbo%20300%20SDS%20-%20July%202020.pdf

13	Siviter H, Bailes EJ, Martin DC, Oliver TR, Koricheva J, Leadbeater E, Brown MJF (2021) 'Agrochemicals interact synergistically to increase bee mortality' Nature 596, 389-392 (2021) Agrochemicals interact synergistically to increase bee mortality | Nature
14	Straw E, Carpentier E, Brown M (2021) 'Roundup causes high levels of mortality following contact exposure in bumble bees' Journal of Applied Ecology 2021; 58:1167-1176

Attachment One: Summary data from ApiNZ glyphosate use survey

ApiNZ conducted a survey of its members to gather information on their use of glyphosate. The questions were based on the questions in the EPA's call for submissions response form. The questions that were used in the ApiNZ survey are in Attachment One to this submission.

Survey promotion

The survey was open from Friday 23 July 2021 for two weeks. The survey was promoted in the ApiNZ weekly email to members, on Apiculture NZ's social media page, and on the Apiarist Advocate website (https://www.apiaristsadvocate.com/).

Stakeholders included in the sample

ApiNZ's survey received a total of 36 responses, 18 from the North Island and 18 from the South Island. Most responses (61 percent) were from commercial beekeepers, with the remaining responses from hobbyists or from honey packers and exporters.

Summary of survey results

Question 1.1: what glyphosate products do you use?

Respondents that use glyphosate products mentioned the following products:

- Generic from Farm Source
- Roundup
- Tag G2
- Roundup 420
- Synergy 500
- Glyphosate 360
- Glyphosate 520
- Weed Out
- Orion Glyphosate 360

Question 1.4: What is the volume of glyphosate products you use annually in New Zealand?

- There were 23 commercial beekeepers in the survey, with 6 saying that they do not use any glyphosate products,
- Of the commercial beekeepers that use glyphosate, 13 used less than 10 litres a year, two used between 10-99 litres a year and one used over 100 litres per year,
- There were 12 hobbyists in the sample, with four saying that they do not use any glyphosate products, and
- Of the hobbyist beekeepers that use glyphosate products, all except one said that they use less than 10 litres per year. One hobbyist used between 10-99 litres in a year.

Question 3.1: How is glyphosate used in the agricultural sector?

- The ApiNZ survey asked how beekeepers use glyphosate products, and as many keep their hives on property owned by others, how glyphosate products are used by landowners,
- Most beekeepers used glyphosate products to control weeds at apiary sites or where honey is stored,

- Beekeepers reported that many landowners use glyphosate products near apiary sites, with 27 out of 36 survey respondents reporting that owners of land near their apiary sites use glyphosate products, and 7 respondents reporting being unsure,
- Glyphosate is also used to maintain sites where trees are planted for bees to forage on, at other premises owned by the business, or to maintain driveways and fence lines, and
- Where beekeepers keep their bees on land owned by other people, they observe glyphosate products being used:
    - to control weeds on driveways and fence lines,
    - on agricultural crops,
    - to spray out paddocks for regrassing,
    - to control weeds in forestry blocks.

Question 3.2: How is glyphosate used in the non-agricultural sector

Beekeepers reported glyphosate being used extensively on land owned by Councils, especially to control weeds on berms and the edges of roads.

Question 3.4: How do you apply glyphosate products when you are using them?

- 7 hobbyists who use glyphosate products said that they apply it using a knapsack sprayer,
- 1 hobbyist who uses glyphosate products said that they use a quad bike mounted tank with a small pump sprayer to apply it,
- 1 commercial beekeeper who uses glyphosate products said that they apply them using a boom sprayer,
- 1 commercial beekeeper who uses glyphosate products said that they apply them using a hand sprayer, and
- The remaining 14 commercial beekeepers said that they use a knapsack sprayer to apply glyphosate products.

Beekeepers were also asked about how glyphosate products are applied by landowners near their apiary sites. Responses were as follows:

- 27 respondents said that landowners near their apiary sites used glyphosate products,
- 2 beekeepers said landowners used knapsacks to apply glyphosate products,
- 9 beekeepers said landowners used boom sprayers to apply glyphosate products, and
- 5 beekeepers said landowners near their apiary sites used either helicopters or boom sprayers to apply glyphosate products.

Question 3.5: Where do you use glyphosate products?

Beekeepers reported that they use glyphosate products to:

- control weeds around their apiary sites,
- control weeds around plantings for bees to forage in,
- control weeds around honey storage and processing facilities,
- controlling weeds around other premises owned by the business, and
- controlling weeds on driveways and fence lines.

Where beekeepers keep their bees on land owned by other people, they observe glyphosate products being used as per the answer in section 3 above.

Question 3.6: When and how often do you use glyphosate products?

The survey only collected information on how often glyphosate products are used. Information from the survey showed the following trends:

- 24 respondents use glyphosate products
- 5 respondents use glyphosate products annually
- 2 respondents use glyphosate products monthly
- 6 respondents use glyphosate products quarterly
- 9 respondents use glyphosate products every six months
- 2 respondents use glyphosate products as required

No information was collected about the frequency that beekeepers see landowners using glyphosate products.

Question 4.1: What mitigation measures do you put in place to limit environmental or human exposure to substances containing glyphosate?

While a small number of beekeepers said they do not take any precautions why spraying, most who answered the survey do take precautions. Beekeepers reported using a variety of measures to limit environmental or human exposure to substances containing glyphosate. These measures included:

- Following the directions on the label of the product,
- Wearing appropriate personal protection equipment (PPE),
- Not spraying any plants that are flowering,
- Only spraying on still days, and
- Not spraying when bees are foraging – only spraying in the early morning or late evening.

Beekeepers were asked about what communication they receive from landowners when they spray glyphosate products. 20 beekeepers said that they generally receive no communication from local landowners when they are spraying glyphosate products. Only three beekeepers reported communication about spraying from local landowners.

Most beekeepers said landowners did not take account of the impact on bees when they use glyphosate products. Where beekeepers were aware of mitigation measures put in place by landowners when spraying, they said that landowners:

- 1 beekeeper reported that the local landowner avoids apiary sites and flowering plants when spraying, and
- 3 others reported that local landowners only spray on still days or in the early morning when bees are not flying.

Question 4.2: How effective do you think these measures are in managing the adverse effects that arise from using glyphosate products?

Answers to this question varied widely, with 21 beekeepers answering this question. Four respondents did not feel their mitigation measures had any effect, while on the other hand, 6 respondents felt their mitigation measures were over 90 percent effective. The graph below gives more information on the spread of answers.

Figure 1: Range of answers from respondents on the effectiveness of their mitigation measures