TO:	Environmental Protection Authority reassessments@epa.govt.nz
DATE:	17 December 2021
SUBMISSION ON:	Hydrogen Cyanamide Reassessment
FROM:	New Zealand Kiwifruit Growers Inc (NZKGI)

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1. Executive summary

NZKGI opposes the EPA decision to ban Hydrogen Cyanamide (HC) and the corresponding five-year phase out period. HC has been used in the kiwifruit industry since it became commercially available in the 1980s and today's use is restricted by regulation and controls designed to keep people and the environment protected.

The New Zealand government has recognised the importance of horticulture and the kiwifruit sector to the Covid economic recovery. NZKGI actively works with the Ministry for Primary Industries on labour campaigns and attracting workers to the industry. Estimations of yield production, job losses and GDP contribution (nearly $2b) will seriously impact growers, supply chains and communities if HC is banned. There are no alternatives with comparable efficacy to HC. Retaining the use of HC is critical and throughout this submission the benefits of HC to the industry will be detailed.

NZKGI believes that the decision-making process and resulting conclusion of the EPA has been flawed for the following reasons:

- The EPA modelling is based on an overestimation of the risks while seemingly underestimating the benefits of HC to the industry and does not account for systems, controls and practices used in New Zealand

- The EPA has disregarded its own chemical priority reassessment modelling

- Consultation with Māori has not met obligations under the Treaty of Waitangi and the Cultural Impact Assessment is not representative of a range of views

- The risk to birds does not consider activity and food source availability on New Zealand kiwifruit orchards during winter (when the vines are dormant and exhibit zero leaf coverage)

- The EPA considers the economic benefit of HC to be medium-high. NZKGI considers the economic benefit should be re-classified as high

- NZKGI evidence on human health and environmental risks have been disregarded by the EPA. The EPA points to the risk to human health in a way that is overstated (by not taking into account the range of safety measures employed) and does not account in its findings (at all) of the severe mental health impact on growers that would arise should HC be removed.

This submission will outline the material financial impact that would see many green growers in particular, no longer able to maintain viable businesses, for which the mental health toll would be substantial on both orchard owners and employees who have lost their jobs.

The EPA has disregarded expert and considered findings from the Australian Environment Agency submitted by NZKGI during the Call for Information and therefore new experts have been engaged.

NZKGI will provide further information on applicator exposure and toxicology findings to the Decision-Making Committee (DMC) in March 2022.

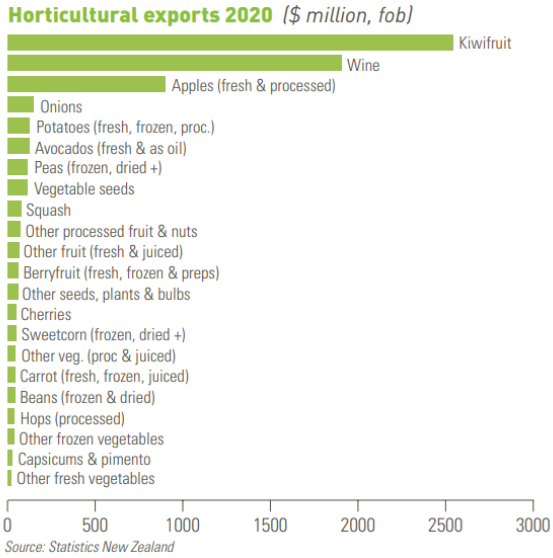
2. The kiwifruit industry in New Zealand

Kiwifruit have been grown commercially in New Zealand since the 1930s with exports starting in the 1950s through shipments to the UK. New Zealand kiwifruit company Zespri was created in the 1980s in response to prices crashing worldwide due to oversupply. Zespri controls all distribution and marketing of New Zealand kiwifruit to all countries other than Australia.

Kiwifruit is grown in eight regions, however much of New Zealand's kiwifruit (80%) is grown in the Bay of Plenty where the soils are generally deep and free draining.

Māori growers make up around 10 percent of the industry with 87 percent being based in the Bay of Plenty. In 2021, Māori growers produced 15.7 million trays which is approximately $165 million of income to Māori growers.

The kiwifruit industry is the biggest sector and largest exporter in New Zealand's horticultural industry making up 38% of total export value[1]



Kiwifruit has been a remarkable success story for New Zealand, delivering enduring and strong economic returns to the New Zealand economy. With exports worth $3.6 billion in the financial year 2020/2021 and with sales expected to grow to $4.5 billion by 2025, kiwifruit provides one of the highest per-hectare returns in New Zealand's primary sector – $76,722 per hectare for Zespri Green (green) and $177,846 per hectare for Zespri SunGold™ (gold) in 2020/21.

The kiwifruit industry is a major contributor to regional New Zealand returning $2.25 billion directly to rural communities in 2020/21. This has wide ranging benefits not only in terms of regional employment, but domino effects into rural communities for related services (everything from tractor distributers to farm supplies, cafes and schools).

Table one: Snapshot of regional contribution

Region	Regional Contribution
Auckland	$76m
Bay of Plenty	$1.78b
Hawkes Bay	$33m
Lower North Island	$7m
Nelson	$71m
Northland	$91m
Poverty Bay	$60m
Waikato	$67m

Source: Zespri

Not only does kiwifruit significantly contribute to regional and national GDP and provide returns to growers, the industry also has a low environmental footprint and low carbon emissions (0.6 tonnes of CO2-e per ha per year[2]).

[1] Fresh Facts
[2] Source: Zespri

Across the industry, there are 2,813 growers, 14,000ha of orchards, 9,250 permanent employees and up to 25,000 seasonal jobs during the peak season.

The total permanent workforce can be broken down to:

- 6,000 permanently employed staff (4,400 on-orchard and 1,600 post-harvest)
- 1,000 self-employed orchard owners and contracting business owner FTEs working in the business.
- 2,250+ workers in a long-term capacity in the sector, but not on a permanent employment agreement. This cohort are included in the seasonal worker estimates in this report, and many will be counted in both on-orchard- and post-harvest seasonal figures (working segments of the year in each).

Of the seasonal workforce, 60% are New Zealanders with 57% of these being Māori. The remainder of the seasonal workforce are supported by backpackers and workers from pacific nations.

3. New Zealand Kiwifruit Growers Inc

New Zealand Kiwifruit Growers Inc (NZKGI) is mandated under the Commodity Levies Act 1990 to advocate on behalf of New Zealand kiwifruit growers and does this by representing the commercial and political interests of kiwifruit growers in industry and government decision making. While this submission is on behalf of New Zealand kiwifruit growers, NZKGI has encouraged growers to make their own submission.

4. General comments

NZKGI categorically opposes the proposed ban of HC and submits that when used with the appropriate controls, HC is safe to use. HC has enormous benefits to not only the industry but also to regional and national GDP.

<u>EPA process</u>

NZKGI applied for an extension of the submission period on 3 November 2021 with an additional request from Māori Kiwifruit Growers Incorporated (MKGI) who applied for the same extension. This extension was requested as necessary to allow NZKGI sufficient time to engage experts to investigate and review the EPA findings in full so as to provide a robust and helpful submission. NZKGI submitted that without the extension they would be significantly impacted and unduly prejudiced.

On 24 November 2021, the DMC declined NZKGI and MKGI requests to extend the consultation to 6 April 2022 which would allow NZKGI sufficient time to engage experts to investigate and review the EPA findings. NZKGI submits that under Section 29 of the HSNO Act, it is implicit duty on the decision maker to act fairly and reasonably, listen to all parties, to come to the process with an open mind (no bias) and operate under duty to regard relevant matters and disregard irrelevant matters. NZKGI submits in coming to the decision to refuse the extension, the DMC has disregarded natural justice in this case. The only party prejudiced by the refusal to grant an extension are our grower members.

It has been acknowledged by various staff members of the EPA in recent months that there is a general shortage of toxicologists and demand for their services globally exceeds supply. Given that the EPA took 18 months to conduct its modelling following the Call for Information, we disagree with the conclusion that three months is sufficient time for affected parties to be able to review the EPA's work, look to improve on it, and suggest alternative proposals. The EPA's own economic analysis commissioned from Sapere concludes that the NZ kiwifruit industry will be significantly adversely affected by a ban on HC, and as such, we think it is appropriate that we are given fair opportunity to take an informed and meaningful submission which addresses all relevant areas of the EPA's application, including the toxicology modelling.

<u>Misrepresentation of lack of report due to EPA prior actions</u>

NZKGI provided expert evidence from the Australian Environment Agency during the Call for Information which showed comprehensively that HC could be managed with appropriate systems, equipment and controls.

The EPA has chosen to largely ignore this evidence and continues to rely on outdated modelling based on systems not used in New Zealand. NZKGI is now in a position of having to either re-engage or contract new experts which is a time-consuming and costly process.
The EPA made the following statement in the Science Memo relating to NZKGI not providing spray drift curve information during the Call for Information:

> *NZKGI's consultant argues that the EPA staff should use the spray drift curve generated during spray drift trials by NZKGI. The EPA acknowledges that specific spray drift curves can increase the certainty of the risk assessment and appropriateness of associated controls. The EPA has requested the full study reports of the spray drift trials to evaluate if the results can be used for further refinement. The full report was not provided to the EPA.*

This statement is misleading. The reason the report was not released is that NZKGI had previously provided an earlier risk assessment and requested it be kept confidential. The EPA wrongly released the report through the Official Information process. NZKGI filed a complaint to the Ombudsman who agreed with NZKGI and found that the EPA had made a mistake in law of releasing the information.

During this drawn-out process, the EPA requested further information from NZKGI and Zespri – namely how spray drift curves are determined. As the information was commercially sensitive, NZKGI sought assurance from the EPA that it would not be released. The EPA declined to give such assurances and said that the information would be released and therefore the information from NZKGI was not provided. As the Ombudsman has now instructed the EPA to change its processes, NZKGI understands that Zespri will now release this information to the EPA. The Ombudsman response is attached as Appendix 1.

Accordingly, NZKGI invites the EPA to reconsider the above statement because its prior actions which were the sole reason the full report was not provided to the EPA.

5. Industry submissions
NZKGI generally supports the submission from Zespri and MKGI and have worked together to be aligned as much as possible for the benefit of kiwifruit growers. NZKGI make the following comments regarding the EPA Maori consultation process

NZKGI believes that the EPA has failed to meet Treaty of Waitangi obligations in relation to consultation with Māori. Under the Treaty of Waitangi, the principle of consultation focuses on establishing open and active engagement with Māori.

The Courts have found that it is inherent in the Crown's duty to act in good faith and that it is legally obliged to make informed decisions on matters affecting the interests of Māori. This obligation will in some circumstances require the Crown to consult with Māori, depending on the importance of the issue in question.

In the case of Air Land Water Association v Waikato Regional Council[3] the Environment Court considered the previous relevant authorities and set out several principles for consultation which include:

- The nature and object of consultation must be related to the circumstances
- Adequate information of a proposal is to be given in a timely manner so that those consulted know what is proposed
- Those consulted must be given a reasonable opportunity to state their views
- The whole process is to be underlain by fairness.

We understand that the EPA attempted, for the first time, to trial the use of a Mātauranga framework in order to assess and determine impacts and severity of HC use on Māori.

[3] *Lands* (CA) [1987], per Richardson J at 682.

NZKGI applauds the efforts of the EPA to review the way in which they consult with Māori. However, in our view, the process and outcomes fell well short of what can be considered a thorough and robust consultation. The conclusion drawn by participants was that it was just another tick box exercise by the crown and a priority placed on speed and meeting a government department timeframe rather than the quality of engagement and consultation.

The EPA held three consultation hui with Māori in June 2021 (Kerikeri, Ōpōtiki and Tauranga) which were poorly communicated and consequently did not result in high attendance. These areas represent a very small subset of where kiwifruit is grown. From what NZKGI understands, the Ōpōtiki meeting was advertised on Facebook which meant a number of iwi were not aware of the hui and were upset they had not been invited.

While emails were sent to interested parties for the Tauranga hui – the email stated the hui was to be held on 10 August while the invite said 10 June. The lack of clarity and conflicting advice would have contributed to a lower turnout than otherwise would have occurred and many were not prepared for what was to be discussed which in turn increases the risk that key Māori stakeholders have not been meaningfully engaged. One participant highlighted the fact that Tauranga and Te Puke are not the same Māori and that there should be a Te Puke hui. There are 160 hapu and 35 iwi groups in the Bay of Plenty region with most not consulted. Confirmation of the conflicting dates is set out in Appendix 2.

NZKGI is concerned that the EPA has made conclusions in the Cultural Impact Assessment based on small representation and relied on several uninformed participants.

6. Hydrogen Cyanamide

HC is permitted for use in Australia, America and Chile. While it is voluntarily banned in the EU, emergency approval to use HC was issued to Greece during the last two seasons.

The United States EPA has classified HC as Group C (group 3)[4]: possibly carcinogenic to humans: agents with limited animal evidence and little or no human data. European agencies considered the same data as the US EPA and have concluded that HC is not a carcinogen.

The International Agency for Research on Cancer (IARC) states for group 3:

> *The agent (mixture or exposure circumstance) is not classifiable as to its carcinogenicity to humans. This category is used most commonly for agents, mixtures and exposure circumstances for which the evidence of carcinogenicity is inadequate in humans and inadequate or limited in experimental animals. Exceptionally, agents (mixtures) for which the evidence of carcinogenicity is inadequate in humans but sufficient in experimental animals may be placed in this category when there is strong evidence that the mechanism of carcinogenicity in experimental animals does not operate in humans. Agents, mixtures and exposure circumstances that do not fall into any other group are also placed in this category.*

IARC maintains a list of classifications[5] which was last updated on 30 November 2021. Although HC is not listed in any category, we have searched group 3 agents for common everyday possible carcinogens:

- Coffee
- Fluorescent lighting
- Printing inks
- Tea
- Paint
- Chlorinated drinking water
- Dental materials
- Hair colouring products

[4] Risk Assessment for Carcinogenic Effects | US EPA

[5] https://monographs.iarc.who.int/agents-classified-by-the-iarc/

- Alcohol
- Tobacco

If we dive deeper into solvent paint, the New Cancer Registry undertook a study in the 1980s that looked at increased rates of non-malignant diseases and cancers in nearly 20,000 male patients and found a clear link to bladder and kidney tumours and myeloma cancer.

The safety data sheet[6] for Resene solvent paint shows the product is suspected of causing cancer through inhalation and yet paint is widely sold without throughout New Zealand with no controls.

To evaluate the possible carcinogenicity of cyanamide, data from key regulatory agencies were searched for information which is summarised below:

Table Two: Evaluation of cyanamide carcinogenicity findings by regulators

Agency	Findings
IARC (International Agency for Research on Cancer 2021)	Returned no results – not listed as carcinogenic
ASTDR (Registry 2021)	Returned no results - not listed as carcinogenic
US EPA (US Environmental Protection Agency 2014)	Studies summarised in the risk assessment by the US EPA showed variable results with three studies positive for in vitro genotoxic risk and three studies negative. Mouse studies showed evidence of ovarian tumours (female) and blood vessel tumours (male) but there was no evidence of carcinogenicity in rats. The committee concluded that cyanamide is a possible human carcinogen.
ECHA (European Chemicals Agency 2014)	Results from two rat studies (91 week and 104-week durations) showed no carcinogenic effects and cyanamide is not proposed to be classified as a potential carcinogen.
EFSA (European Food Safety Authority 2010)	The European Food Safety Agency references the same mouse study as considered by the US EPA and concluded that there was limited evidence of a carcinogenic effect.
Health Council of the Netherlands (Pont 2004)	Results of six reported in vitro assays were all negative for genotoxicity. This council concluded that cyanamide has no mutagenic or genotoxic potential.

In 2010, the European Food Safety Authority (EFSA) undertook a *Peer Review of the pesticide risk assessment of the active substance cyanamide and under the medical data section concluded that:*

> *Cyanamide is used as a deterrent to alcohol consumption (>20 mg/person/day). Cyanamide exposure (ingestion or inhalation) alone when handled improperly, or more pronounced in combination with alcohol consumption, induces vasomotoric reactions, known as "Cyanamide Flush", including several clinical symptoms, eg: facial flushing, tachycardia, dyspnoea, hypotension, headache, nausea, vomiting, tightness in the chest and sensation of coldness in the extremities.*

[6] https://productspec.co.nz/media/5gbdgzff/super-gloss-material-safety-data-sheet.pdf

In general, these symptoms disappear with no residual effects on general health, without specific treatment. No signs of diseases or health impairments caused by cyanamide were found during medical surveillance on manufacturing plant personnel. Medical examinations also included special investigations of functional disorders regarding the testes and the thyroid gland, and potential sensitising properties.

In New Zealand, there are over 160 chemicals that have a priority rating higher than hydrogen cyanamide and yet are not part of any current/ongoing reassessment.

This includes substances such as Benzo(a)pyrene (priority A), TBBPA (priority B) and even 1080 (priority C), which we note according to the EPA's "Report on Aerial 1080 (sodium fluoroacetate) Operations 2020" resulted in multiple avian and animal deaths including that of nine kea". While NZKGI is not making comment on the use of 1080 in New Zealand, when it and many other substances have been classified as higher priority for reassessment, yet the EPA has chosen to focus on a priority D substance, we question whether the EPA is correctly recognising and providing for the principles it is required to in section 5 of the HSNO Act[7].

On the EPA website it states 'We, the EPA, screen hundreds of chemicals using a tool that assesses their risk to our health and to the environment. We then prioritise those chemicals that we believe present the greatest risk, and that need further review and scrutiny. This is called the priority chemicals list'.

There are 43 products listed on the priority chemicals list. HC is not one of them.

The screened chemical list classifies priority groups of products from A – F with A being the highest priority in terms of reassessment and F being the lowest. HC is in category D. The EPA own chemical reassessment programme shows that HC is not a high priority product and has not been included on the priority chemicals list. NZKGI and indeed the wider industry deserves to know why the EPA has chosen to reassess HC when it has not been classed as a priority product for reassessment.

Table Three: Priority group numbers on EPA screened chemical list

Priority group	Number
A	10
B	36
C	115
D	223
E	265
F	597

NZKGI has looked at other products banned and/or phased out by the EPA with a higher classification. In 2012/13, the EPA reassessed a group of organophosphates (OPCs) and carbamate-based insecticides used for plant protection purposes in New Zealand - one of the substances considered were products containing the active ingredient Diazinon.

The 2012/13 reassessment document noted that:

- The acute health effects resulting from exposure to high levels of OPCs are well known from animal studies and numerous human poisoning incidents

- Short term exposure can result in symptoms including increased sweating and salivation, dizziness, fatigue, runny nose or eyes, nausea, intestinal discomfort, confusion and changes in heart rate. At high levels of exposure more severe effects such as paralysis, seizures, loss of consciousness and death may occur

- As well as acute toxicity, concerns have been raised over the potential for OPCs to cause longer term adverse health effects in humans. These include the potential for chronic health

7 https://www.legislation.govt.nz/act/public/1996/0030/latest/DLM382992.html

effects following acute poisoning and for effects as a result of chronic exposure to low levels that do not cause the clinical signs or symptoms of poisoning.

- Research on these aspects is ongoing. OPCs are also harmful to the environment. The mode of action by which they kill pests (inhibition of the acetylcholinesterase enzyme) also affects humans and environmental species including aquatic organisms, birds and beneficial insects including bees. For example, OPCs have been known to kill birds that feed on crops and grass that have been treated to control pests.

The safety data sheet[8] for Diazinon states it is suspected of damaging fertility or the unborn child and causes damage to organs.

The EPA approved Diazinon with time limited controls for a period of 15 years until 1 July 2028 when it will be banned. Diazinon is more harmful to people, more harmful to the environment, more harmful to bees and birds than HC and yet was given a 15-year phase out period with few controls[9] which were not required to be put in place until 1 July 2016. We note that the consultation report from this application indicates that Diazinon posed greater risk to operators and the environment than the EPA have stated hydrogen cyanamide does. It is unclear then, why the EPA has proposed a ban and phaseout that is 10 years shorter than that for Diazinon.

In September 2021, the Vegetable Research and Innovation Board applied for a reassessment to extend the approvals of Diazinon by a further 10 years. The EPA decided that there were grounds for a reassessment (partly based on a lack of alternatives) and submissions closed in November 2021.

In summary, NZKGI submits that there appears to be very little consistency applied by the EPA in terms of internal policy and process when determining when and how to judge hazardous substances. We recognise the important role that the EPA plays in protecting the environment, animals, plants and humans, but the inconsistency in approaches adopted has prejudiced kiwifruit growers. NZKGI submits that the arguments by the EPA for banning HC are not based on objective, robust scientific studies and practices of New Zealand kiwifruit growers, and more is weighted to anecdotal commentary, and non-New Zealand studies that have very little in common and lack relevance to the New Zealand setting.

7. Previous reassessment of Hydrogen Cyanamide

The previous reassessment of HC in 2006 determined that if HC 'was used in conditions that minimised the likelihood of spray drift with adequate buffer zones in place, using calibrated equipment and an operator having at least minimum qualifications, then the risk should be considered as low'.

The DMC appointed by ERMA (now the EPA) in the 2006 reassessment and set out the following points:

- They were satisfied with the controls (set out in the reassessment document) to manage adverse effects
- The substance posed negligible to medium risks to the environment and to human health and safety, and massive benefits to the economy through greater returns to growers and in turn job creation for rural communities
- Some risks are non-negligible, but they were satisfied that the benefits outweigh the risks and costs.

The 2006 reassessment included a submission from a cluster of iwi orchard owners in the Te Puke area. Their view was that HC benefits included:

- Increases in production and profits which fund grants for education, the elderly, marae projects, and local schools for sports

[8] https://www.orionagriscience.co.nz/storage/products/March2021/Zagro%20Diazinon%20600EW%20SDS%20-%20July%202020.pdf

[9] https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP201045/989dca5648/APP201045-APP201045-Decision-Amended-with-s67As-and-APP202142-2015.07.28.pdf

- Increases to local employment opportunities for shareholders and their whānau. Many iwi growers are located in coastal areas that have moderate climates. Winter chilling in these areas is an issue so the use of hydrogen cyanamide is important for these growers.

Since the 2006 reassessment, many more Maori growers have entered the industry.

The final outcome of the reassessment was that the kiwifruit industry was best placed to regulate itself, through measures required by NZKGI and Zespri, and the only additional control imposed was the requirement for a label statement warning against consuming alcohol before and after using HC (to prevent cyanamide flush). The DMC considered that the standard controls prescribed in the Hazardous Substances Regulations, spray management provisions in regional plans, and Good Agricultural Practice (GAP) were adequate to manage the risks.

8. Hydrogen Cyanamide use on orchards

HC is applied once a year on green, gold and Zespri Ruby Red™ (red) and is not used on organic kiwifruit. The application of HC generally occurs from July through to September on a large number of orchards. During the 2021 season, around 90 percent of producing hectares were sprayed with HC.

There are strict controls in place that applicators must meet before and during HC application. Applicators are required to meet regulatory requirements including product label, regional plans and additional measures under the Health and Safety at Work Act, in line with WorkSafe guidance.

During the 2019 Call for Information, the EPA requested information on *any exposure mitigation measures that are currently being used to limit environmental or human exposure for substances containing hydrogen cyanamide.* This information was provided and is attached again as Appendix 3.

9. Benefit of Hydrogen Cyanamide to the kiwifruit industry

HC is a plant growth regulator which promotes uniform budbreak[10], flowering of kiwifruit and is used in late winter primarily to compensate for inadequate winter chill. Without the use of HC, the impact on yield will be so significant (particularly for green), that growing the crop is likely to become uneconomic for many growers as returns will not cover growing costs. HC ensures adequate and consistent yields and reduces labour and quality costs, allowing growers to achieve economic returns.

Picture: Dormancy to budbreak (green)

Source: Zespri Crop Protection Standard

The use of HC is of critical importance to kiwifruit growers, particularly in areas where warmer temperatures occur in the Bay of Plenty and further north. This is because kiwifruit require a degree of chilling in winter to ensure adequate and uniform budbreak and flowering. Uniform bud break means consistent flowering and pollination which means kiwifruit are ready for harvest all at the same time on an orchard which maximises labour efficiencies and volume flows to packhouse/transport and to export market – this is particularly important given that there is already a significant labour shortage across horticulture.

HC is critical for kiwifruit production and productivity (yield) gains associated with:

- Promoting uniform and increased bud break
- Increasing the number of flowers in a compact timeframe (standardisation)
- Increasing the number of king flowers and reducing the number of unwanted lateral flowers

[10] Bud break is the opening of a dormant bud as new growth appears, typically in spring. It is the first stage of the cycle that yields fruit in the autumn

- Developing a uniform leaf canopy and better bee efficiency, reducing the need for more expensive artificial pollination
- Ensuring early leaf growth giving a longer growing season and bigger fruit.

Picture: HC application on the left vs non-HC application on the right (same block)

HC provides a key foundation for the successful development of the kiwifruit industry and has multiple costs if removed:

- Significant on-orchard yield losses. Even in conservative scenarios, the use impacts of HC are significant. Without HC, the ability to 'standardise' production on-orchard from bud-break to picking is greatly reduced. This leads to fewer flowers, fewer fruit and more variable maturity

- The reduction in fruit picked and variable maturity will cause major disruption for packhouses and Zespri. Packhouses will suffer from reduced throughput, stranded assets, and poorer quality outcomes[11] while Zespri will find it difficult to develop and grow existing and new markets

- Removal of HC will make labour less efficient on orchard since the differing maturity levels of fruit in the same block will reduce standardisation of task. Increasing the costs per tray as workers will need to revisit production blocks several times to do one task and reduce employment since crop volume will be smaller

- Have a detrimental impact on regional development and government regional development objectives. The removal of HC would hamper government regional development efforts. The shrinkage of the industry will also have an impact on other businesses within specific regions. It will also reduce the tax take.

10. Reduction of profitability

The financial impact on green production will be more significant than for gold, in most parts of New Zealand. This is primarily because green is naturally less floral than gold and as a result needs HC to a larger extent. Green returns are lower than gold and so with a fixed cost base, the drop in production and therefore revenue means the impact on the green grower is starker.

Research indicates that HC improves green kiwifruit production by between 28.9% and 58.3%[12] depending on the region where kiwifruit is grown. Each growing region has different production levels depending upon climate, soil conditions and other factors. The Bay of Plenty is the most productive area with average production above 10,000 trays per hectare. Average kiwifruit production by region is as follows:

[11] There is a distinction between different maturity rates which lead to poor quality outcomes which likely to occur 'without' hydrogen cyanamide use and the underlying quality of the fruit produced which is a durable competitive advantage for the industry

[12] https://www.nzkgi.org.nz/wp-content/uploads/2020/07/Appendix-B-Hydrogen-Cyanamide-Reassessment-Final-NZIER.pdf

Table Four: Average kiwifruit production

	2020/21		2019/20		2018/19		2017/18		4 Yr Average
	Producing ha	TE supplied per ha	Producing ha	TE supplied per ha	Producing ha	TE supplied per ha	Producing ha	TE supplied per ha	TE supplied per ha
Northland	81	8,829	100	6,835	106	8,498	109	5,779	7,485
Auckland	243	8,030	256	7,175	262	9,974	273	7,719	8,225
Katikati	859	8,011	830	8,960	859	9,882	940	7,678	8,633
Opotiki	436	10,735	444	10,834	455	11,315	457	8,917	10,450
Tauranga	996	10,625	1,066	9,773	1,087	12,014	1,086	9,193	10,401
Te Puke	3,079	11,551	3,190	11,058	3,292	12,380	3,419	9,641	11,158
Waihi	106	7,608	132	7,771	138	9,858	100	6,569	7,952
Whakatane	309	7,434	331	8,369	366	10,541	402	7,728	8,518
Waikato	202	8,297	204	9,113	203	9,076	200	8,339	8,706
Poverty Bay	40	6,054	44	6,801	52	7,745	54	8,366	7,242
Hawkes Bay	41	6,005	41	6,916	45	7,358	43	6,620	6,725
Lower North Island	69	8,623	69	9,062	70	9,291	70	8,696	8,918
South Island	197	6,226	208	6,519	223	7,258	229	5,663	6,417
	6,658		6,915		7,158		7,382		
Average Production		10,133		9,932		11,320		8,812	

Source: Zespri Annual Report 2021

NZKGI has worked with one of the largest kiwifruit management companies, that manages or leases 1,048 hectares (7.9% of total kiwifruit grown in New Zealand) of kiwifruit orchards from Hawkes Bay to Whangarei. They have provided extensive data, including growing costs per hectare, per region. From this, robust analysis can be undertaken to illustrate the impact on profitability to when HC is removed and orchard production decreases.

Northland and Auckland with milder temperatures, the impact of loss of HC will make growing green in these regions largely uneconomic. In other regions, where current production is over approximately 9,000 trays per hectare, orchards can produce a positive Net Orchard Return[13] per hectare, but to cover all costs this would need to be in the order of 10,000 trays. Even at this level, this provides minimal return on investment for the orchard.

Table Five: Average growing costs 2020/21 growing season (green)

	2020/21 Producing ha	4 Yr Average TE supplied per ha	HiCane Impact	Non Hicane TE supplied per ha	2021/22 Nov F/cast OGR per Tray	Non Hicane OGR per ha	2020/21 Average Production Cost per ha	2021/22 Non Hicane NOR per ha
Northland	81	7,485	48.2%	5,051	$6.34	$32,021	$35,983	-$3,962
Auckland	243	8,225	58.3%	5,196	$6.34	$32,942	$46,931	-$13,989
Katikati	859	8,633	28.9%	6,697	$6.34	$42,462	$41,342	$1,120
Opotiki	436	10,450	28.9%	8,107	$6.34	$51,401	$47,591	$3,810
Tauranga	996	10,401	28.9%	8,069	$6.34	$51,160	$43,340	$7,820
Te Puke	3,079	11,158	28.9%	8,656	$6.34	$54,880	$41,642	$13,238
Waihi	106	7,952	28.9%	6,169	$6.34	$39,111	$41,342	-$2,231
Whakatane	309	8,518	28.9%	6,608	$6.34	$41,897	$44,713	-$2,816
Waikato	202	8,706	58.3%	5,500	$6.34	$34,871	$41,665	-$6,794
Poverty Bay	40	7,242	28.9%	5,618	$6.34	$35,619	$42,728	-$7,109
Hawkes Bay	41	6,725	28.9%	5,217	$6.34	$33,077	$42,728	-$9,651
Lower North Island	69	8,918	28.9%	6,919	$6.34	$43,865	$42,728	$1,137
South Island	197	6,417	28.9%	4,978	$6.34	$31,561	$42,728	-$11,167

Notes: Average growing costs used for regions where company does not manage/lease orchards
OGR/Tray – from Zespri November grower forecast
OGR = Orchard Gate Return
NOR = Net Orchard Return

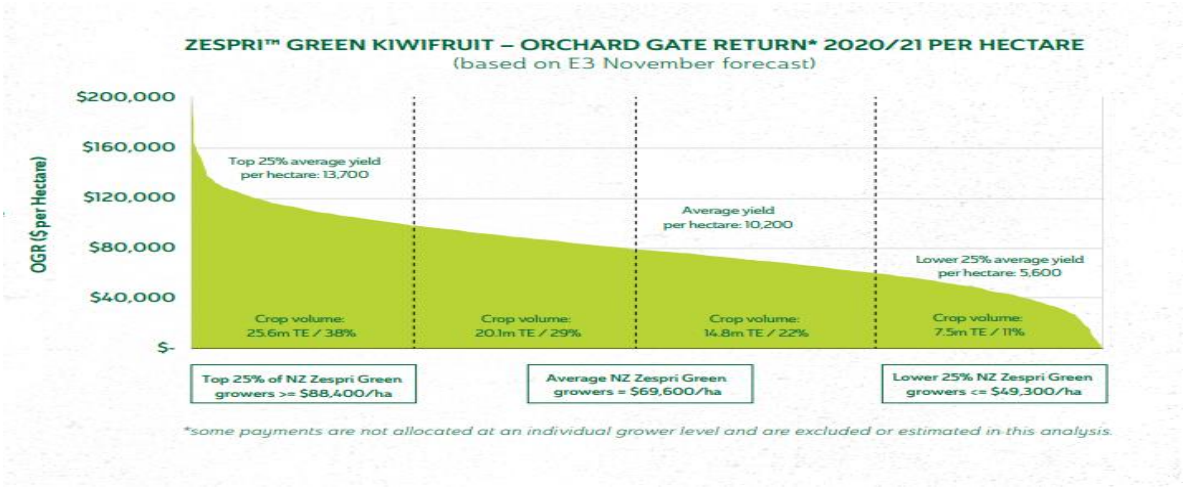
It is critical to note that Net Orchard Return does not include costs such as management fees, rates, water usage, electricity, insurance or capital costs (Interest etc.). If these were managed orchards using a third-party manager, management fees, rates, insurance etc would average in the order of $4,000 to $5,000 per hectare.

What is not represented here is the direct cost to families and the impact on take home pay and being able to pay rent/mortgage and general living expenses.

[13] Orchard gate return (OGR) is generally referred to as grower income. Net orchard return is OGR minus on orchard costs

It should also be noted that there has been significant cost inflation in 2021 with contract and labour rates increasing well above CPI. The expected cost increase in 2021/22 is over 5% which would push average Katikati and Lower North Island Net Orchard Return into negative.

Zespri published the chart below in their 2021 Outlook Document. Based on the above data it is likely that all the lower two quartiles or 50% of HW orchards by number (= 38% of production) would be uneconomic. The 2nd quartile – 25% of orchards (=29% of production) would be marginal and only 25% of HW orchards (38% of production) would be economic.



The above analysis is indicative, with every orchard having different yields and costs but shows that the impact of loss of HC will be significant with green kiwifruit possibly only being able to be grown economically in the Bay of Plenty.

In May 2020, NZKGI commissioned NZIER to assess the costs and benefits of withdrawing HC from the New Zealand market[14]. The analysis found estimating removing HC would result in direct costs to the industry of up to $2.8 billion over ten years and other indirect costs (i.e. to related parts of the economy) of up to $1.3 billion over ten years. What needs to be understood is that the loss is not shared equally, and some growers will find their orchards unviable and will be forced to exit the industry. NZKGI provided this report to the EPA during the Call for Information process[15].

A report by Sapere *Economic Assessment of Hydrogen Cyanamide Use in New Zealand* to the EPA estimated the economic value of HC use to New Zealand found that removing HC would result in a reduction of ~$2 billion (range of $1.8 billion - $2.35 billion) in present value terms over a ten-year period. This includes a one- year impact on growers of around $212 million (range of $180 million-$238 million).

The report concluded:

> *We find that there are likely costs to growers and the national economy (expressed in GDP terms) if HC is not available. The main driver of the estimated costs is the reduced efficacy of alternative chemicals currently available. In simple terms, relative to the alternatives, HC reduces the risk of lower yields and also contributes to better fruit quality in a cost-effective manner. We also include additional costs to growers due to alternatives being more expensive than HC. Our estimates of potential harm are reasonably closely aligned with economic analysis prepared as part of the call for information. The broad similarity in cost/harm estimates is not surprising given essentially the same process was used in both studies.*

[14] https://www.nzkgi.org.nz/wp-content/uploads/2020/07/Appendix-B-Hydrogen-Cyanamide-Reassessment-Final-NZIER.pdf

[15] https://www.nzkgi.org.nz/wp-content/uploads/2020/07/Appendix-B-Hydrogen-Cyanamide-Reassessment-Final-NZIER.pdf

Impacts on labour and orchard costs

Labour accounts for 75 percent of on orchard costs and while labour costs per hectare will increase, the number of workers overall will reduce. Labour costs increased by 16 percent (picking) during the 2021 season.

NZKGI has analysed the total lost earnings across the industry if a 30 percent reduction of production occurred - this is likely to equal the same percentage reduction in labour.

Table Six: Loss of earnings across the industry for orchard and packhouse staff

Type of staff	Total lost earnings
Orchard	$30,531,600
Packhouse	$72,468,900
Total	**$103,000,500**

Source: NZKGI

With this significant reduction of earnings, rural communities will suffer as kiwifruit incomes are reduced. This will result in fewer jobs and reduced ability of these communities to grow. Regional GDP will reduce. Many green growers will go out of business or change land use. Tax revenue will be affected because of the large decrease in earning power and spending in regional communities.

While NZKGI has focused on the financial impacts for green growers, this is also true for some gold growers as HC does have an impact on gold production too however generally orchard profitability should remain.

To show the likely increase of costs to a key orchard task that would be most impacted, NZKGI has analysed the increase of costs of artificial pollination.

NZKGI will provide more information on reduction of profitability to the DMC in March 2022.

Likely impact on pollination costs

HC assists in pollination by triggering a compact flowering period which means that pollination has to occur over a short timeframe. Without HC, it is much more likely that flowering will happen over a longer timeframe with flowers appearing at different times. This requires extra pollination mainly with the use of artificial pollination methods however there will be a requirement for more demand on hives to remain in orchards longer. Hives generally cost between $2,200 and $3,000 per hectare. We would expect that cost to double (eg: an additional $2,200-3,000 per hectare) without HC.

With extra pollination required, pollination costs will rise, and the price of artificial pollen will increase as demand rises.

Table Seven: Additional artificial pollination costs

Application	Amount	Cost
With HC 1- 2 times	$450 ha	$900
Without HC 3-5 times	$450 ha	$1,800

NZKGI analysis shows that artificial pollination costs are around $6000 per kilo and is applied 1-2 times at 100-250gm/ha. With no HC, an additional 3-5 applications could be required.

11. Mental Health implications

There is a widely known link that financial problems adversely impact mental health which can result in anxiety, depression and is a leading catalyst for suicide. There is wide-spread concern about suicide levels in the rural sector.[16]

[16] Ministry of Health – Suicide Web Tool – sorted by DHB: https://minhealthnz.shinyapps.io/suicide-web-tool/

The uncertainty that growers are facing due to the proposed HC ban has added an unnecessary level of anxiety for growers and is impacting on grower mental health. The EPA recommendations are based on conservative modelling and systems and applications that are not commonly used in New Zealand. NZKGI submits that if the EPA had of included the data in the Call for Information provided by NZKGI in 2019, based their modelling on systems used in New Zealand, and performed a more in-depth analysis of the carcinogen link (rather than relying on a summary report) then a different conclusion may have been arrived at and stress and anxiety levels for growers would have been averted.

As shown in the economic section of this submission– a majority of green growers will no longer be financially viable if HC is banned. Unless a new green variety is found to produce the same (or better) yields as a HC application would produce, then it is unlikely that these growers will remain operational. Orchards will likely be sold for other land use activities (at reduced value) with debt still to be paid. Workers will lose jobs. The financial stress will be extreme and the mental health impacts huge as can be consistently observed in the Dairy[17] and Dry Stock farming sectors when owner/operators are loss-making in years of low pay-outs.

During the PSA crisis in 2011/12, growers faced extreme hardship due to the bacteria wiping out most of the gold crop. The industry put in place a range of mental health measures to help growers get through. This included emergency meetings with the Minister of Health and the Minister of Agriculture. There was a clear recognition from government to provide urgent assistance to growers. If the proposed HC ban goes ahead, growers are likely to face the same mental health impacts that were felt in 2011/12.

A NZ Herald[18] article from 2012 shows the direct impact on mental health due to job losses when the bacterium PSA was rampant on orchards. Another NZ Herald article from 2019 showcases the suicide prevention measures that was undertaken across the industry. The impact of job losses will be greater due to industry growth since 2021/12 if HC is banned.

13. Grower stories

During the consultation period, NZKGI has been contacted by a significant number of growers that are anxious, not only for their livelihood but for the workers they employ and their families. It is critical that growers have the opportunity to express their views and below you will find two personal stories from growers in their own words.

We own 12 hectares of kiwifruit, 50/50 green and gold, across 3 sites in the Eastern Bay of Plenty. We also run a kiwifruit contracting business. We employ 20-30 staff during the year, increasing to 40-50 at harvest.

Having a mixture of green and gold, plus a contracting business, gives us the ability to employ people all year round. There are times when the contracting business supports the kiwifruit business and other times when we rely on the income from kiwifruit to support the full-time employment of our staff.

We have built our business on employing 100% local people.

We are proud of the difference we are making to our local community. We have had an ex-mongrel mob member working for us for the last 14 months. He has got off meth and is focussed on making sure the next generation does not go down the path he did. He has recruited his sons, their cousins, neighbours and friends. All are aged 17-23. There are now eight of them who come to work 8:30-5pm five days a week. We purchased a van for them so they could all get to work.

We see potential in many of them. We've offered to support a number of them to obtain their truck licence, so they have the option to move out of the orchard and into driving machinery.

[17] https://www.dairynz.co.nz/news/dairy-sector-calls-for-action-on-rural-mental-health/

[18] https://www.nzherald.co.nz/nz/psa-related-job-losses-causing-anxiety-stress/K4WWO7OMO3NQXAF7ZFTRWJKLJE/

We are concerned that the loss of hicane, and resulting loss in profitability, would require us to downsize our workforce, directly impacting the lives of these young people. The kiwifruit industry is helping to break the cycle and giving them hope and a positive future.

Over the years we have stuffed up the timing of hicane application. We have seen the impact on our Hayward crop. We believe yields will fall from 14,000 trays to approximately 5,000 trays, which would make half our orchards unprofitable.

The reality is the loss of hicane will result on the loss of a significant number of jobs in the Eastern Bay of Plenty.

We bought a dairy farm in 1980. The dairy farm operation was retired, and kiwifruit development began. Initially 16 canopy hectares and over the years this increased to 26.6 canopy hectares on this site. After shelter belt establishment, we planted our first vines in 1982. By 1987 the vines were producing to their mature potential.

Personally, and also as a family business, we have always been environmentally aware of what we did day to day on our orchard. I spent eight years as Chairman of the Ballance Farm Environment Awards Committee for Bay of Plenty. I was also on the New Zealand Farm Environment Trust as a Trustee for five years.

We are currently developing a native restoration project along the banks of a small stream on our property.

We began using Hydrogen Cyanimide in 1986. Our orchard is 100 metres above sea level and only very occasionally at this altitude do we receive a frost which is essential to achieve a strong bud break. Hydrogen Cyanimide has greatly improved two facets for our kiwifruit plantings.

No 1 is drastically improved bud numbers.
No 2 is minimising the bud burst spread from 15 to 22 days to 6-8 days maximum.

In 1993, after seven years of applying Hydrogen Cyanimide, we decided to experiment by not applying to block 11 as well as the rest of the orchard.

This had a very significant lowering of production and also affected the next year as well. Our total production in

- *1992 was 104,185 trays*
- *1993 was 42,500 trays*
- *1994 was 102,000 trays*

Our current production from green, gold and red varieties is 340 to 380,000 trays per year

A total ban on Hydrogen Cyanimide would be disastrous for not only our business but for our staff as well. Currently we employ 12 full time staff and 10 to 14 are supplied by a contractor. If we could not use Hydrogen Cyanimide this level of employment would reduce by 70% or more.

The impact on families would be horrendous. Five of our staff live in accommodation which is based on our orchard. Most of our staff have been employed on our orchard for several years. Their children attend the local school.

NZKGI supports growers to be profitable not just for their own growing operation but to help those in the community and provide opportunities to people that need them.

12. Climate change

The Climate Change Commission (CCC) in their advice to government has identified land use change to horticulture as a key mitigation for climate change because horticulture has lower emissions than pastoral farming. However, the CCC identified barrier were preventing expansion and recommended that work is done to unlock options for shifts towards these farming systems. Recommendation 24 5 c states19: Supporting deployment of the systems and infrastructure needed for alternative lower emissions farming systems and products, including enabling Māori-collectives to participate in these new opportunities

HC is one of the systems that supports Kiwifruit growing, which is New Zealand's largest low emissions farming system. If the HC ban goes ahead before alternatives are in place, it will undermine New Zealand's transition to a low emission food production system.

New Zealand is a country reliant on primary production and tourism for much of its economic wealth and is vulnerable to the economic and environmental impacts of climate change. In areas like Northland and Bay of Plenty, temperature increases will further reduce winter chill which means without HC, the industry's production will be severely impacted. The impact of climate change may mean that the need for HC will increase as growers from Hawke's Bay and further south could require its use.

Kiwifruit need proper winter chilling in order to break dormancy for the following spring. More often over the past five years, there has been inadequate chilling to break dormancy properly. Spring weather sees more late frosts which is more of a concern for gold budbreak which happens about four-to-five weeks earlier than green.

'**As air temperatures in New Zealand continue to rise, the potential for more years with marginal or poor winter chilling conditions steadily increases. This could put significant stress on the kiwifruit industry particularly if hydrogen cyanamide is banned'** Dr Andrew Tait, Chief Scientist - Climate, Atmosphere and Hazards, NIWA

<u>Northland</u>

Most of the Northland region lies beneath 150m elevation which dictates mild winters with a few light frosts. NIWA recorded frost information for Northland show frosts have decreased 55% from the 1980s to 2020. The Ministry for the Environment climate change projections for Northland show a winter temperature increase of up to 3 degrees[20] and 13 to 75 increase of days per year where the maximum temperature exceeds 25 degrees. Without HC to substitute for the lack of winter chill, it is likely that green production in Northland will become uneconomic and gold will be severely impacted resulting in job losses and reduction of GDP contribution to the region ($91m for the 2020/21 season).

<u>Bay of Plenty</u>

The key growing areas of Te Puke and Katikati sit at 86m elevation and 9m respectively. Frosts are generally restricted to 1-3 per year. Since the 1980s, frosts in the Bay of Plenty region have decreased by 38%. The Ministry for the Environment climate change projections for Bay of Plenty show an increase of 32 - 99 of days where the temperature exceeds 25 degrees and a decrease of frosts from 7 – 2 days.

6,102 hectares of green are grown in the Bay of Plenty. With an increasing warm climate and less frost activity, the use of HC is critical for ongoing production and GDP contribution to the region ($1.7b for the 2020/21 season).

13. EPA request for information

In the consultation document, the EPA has requested submitters to provide information in key areas. NZKGI makes the following commentary:

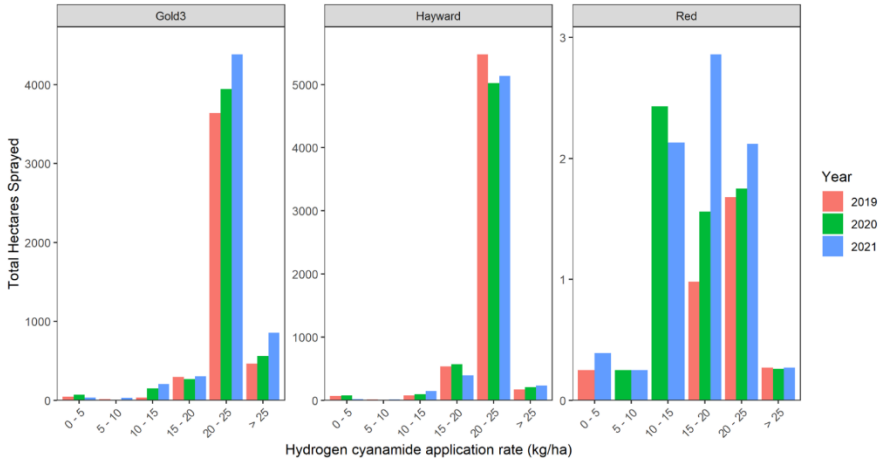
19

20 https://environment.govt.nz/facts-and-science/climate-change/impacts-of-climate-change-per-region/projections-northland-region/

Feedback on selection of human health risk assessment input values for the quantitative modelling
NZKGI will provide commentary to the DMC in March 2022

Input on proposed maximum application rate restrictions, and information on effectiveness of lower application rates
NZKGI supports the maximum application rate of 25 kg ai/ha. Application rates from Zespri's Spray Diary for the 2019, 2020 and 2021 seasons shows that application rates are generally around 22 - 25 kg ai/ha. The data is broken down by variety (gold, green and red).

Table Eight: Application rates from 2019-2021



Source: Zespri Spray Diary

Information on advances in closed cab application, closed systems for mixing and loading, and other technological developments

Occupational exposure monitoring data, if available
As noted earlier, NZKGI has engaged an occupational hygienist (recommendation from Worksafe) to advise us further on the risks to operators. This is likely to include exposure trials, which will be conducted in early 2022. We consider that the risk to operators is such an important aspect of the reassessment that the reference values used by the EPA, which are generated from trials conducted in crops and production scenarios quite different to kiwifruit, are insufficient to make estimations about such exposure and the consequent risk.

However, it is important to note that NZKGI provided a risk assessment from the Australian Environment Agency during the Call for Information process. The risk assessment for operator exposure found that:

> *The human health assessment considered occupational handler exposure through mixing/loading and application activities, and bystander risk. The methodology and refinements followed the guidance from EPA (2020). Risk quotients for handlers during mixing/loading/application operations following the EPA model showed an unacceptable risk with full PPE and respirator. However, the risk quotients with full PPE were >2, so a refined modelling approach was adopted using the latest dermal and inhalation exposure values applied in their 2020 calculator. Using their modelling, mixing/loading operations were acceptable provided chemical resistant gloves were worn. However, applicators are required to either operate within an enclosed cab, or wear coveralls, a washable hat, chemical resistant gloves and a respirator.*

The risk modelling can be found in the *Australian Environment Agency New Zealand Environmental and Human Health Risk Assessment Report to Support Reassessment*[21]

[21] https://www.nzkgi.org.nz/wp-content/uploads/2020/07/Appendix-A-Hydrogen-Cyanamide-FINAL-150520-AEA-Env-and-Human-Health-Risk-Assessment.pdf

While NZKGI does reserve comment on applicator exposure risks and controls, we have compared the 2010 Agricultural Handler Exposure Task Force (AHETF) Monograph: Closed Cab Airblast Application of Liquid Sprays with common practices used in the kiwifruit industry. NZKGI understands that the EPA relied on this report for their operator exposure modelling.

The AHETF report was based on five separate studies in various US States that were carried out using 24 individual applicators. The applicators wore cotton whole body dosimeters under their protective equipment and had regular swabs of their hands, necks and faces. Inhalation exposure was calculated using personal air sampling pumps. The applications were all carried out using trucks or standard tractors with cabs towing an airblast sprayer. Internationally this is the most common platform for applying agrichemicals. Traditionally these tractor cabs are only fitted with dust and at most pollen filters meaning that there is potential for chemical fumes to enter the cab. They also have multiple openings through windows and doors increasing the risk of leaks into the cab.

In comparison, the New Zealand kiwifruit industry are unable to utilise this style of conventional tractor due to strict height requirements driven by the overhead pergola growing technique that is prevalent. The entire vehicle needs to be less than1.4m high to operate without causing significant damage to the crop. Instead of being able to use standard tractors with cabs, the industry has had no choice but to invest in highly specialised orchard sprayers primarily sourced from a single small operation in Northern Italy - Andreoli Engineering and their Fantini Atom 2000. These purpose-built vehicles retail for over twice the price a standard tractor and towed sprayer would cost, and you still must buy another tractor anyway to carry out other tasks such as mowing. The sprayers retail for just under $200k and there is a limited number produced each year so there is only a very small supply second hand. It is estimated there are only around 150 in NZ

The Atom sprayers are designed with only a single access door which reduces the possibility of any chemical entry to the cab. The cab is also operating with positive air pressure through a carbon filtered air conditioning system, further reducing the risk of chemical entry to the cab and providing an air quality comparable to that of a respirator. The Atom is rated to Category 4 protection level in the EU.

The result is that the risk of being exposed to chemicals whilst operating an Atom sprayer is significantly less and therefore is not comparable to the risk of exposure from the equipment used during the AHETF trial.

During the AHETF trial, applicators were wearing long sleeve shirts, pants, socks and shoes. No respirators were used at any stage and when the applicators were outside the cab, they were wearing chemical resistant gloves. The observations of the assessors indicate that, on several occasions, despite coming in to contact with spraying equipment these gloves weren't worn. In summary the only chemical resistant PPE in use were gloves and they were not worn consistently.

When you look at the exposure data in the AHETF trial and separate out the applicators who were engaging in poor, high risk of exposure activities, such as contacting surfaces without gloves, then their level of exposure was greater than twice that of the applicators observed consistently using appropriate PPE. If you exclude the poor practices, then the level of exposure reduces from an average of .05665 (µg/lb ai) to .03975 (µg/lb ai). This equates to a 30% reduction in exposure simply by consistent wearing of minimal levels of PPE.

The AHETF trial was run over a decade ago, and in that time not only has the safety of the equipment that we operate improved, but also the attitudes towards worker safety and the risk of exposure to the chemicals we handle. If you looked at what was happening a decade ago in terms of safety practices within the kiwifruit industry, you would have observed some of the poor practices seen during the AHEFT trial. The industry in terms of its knowledge around the risks of chemicals and the attitudes towards wearing appropriate PPE has moved on and these poor practices are no longer acceptable. The levels of PPE used by New Zealand's kiwifruit operators is vastly different to the levels used by the operators during the AHETF trial. Rather than a long sleeve shirt and trousers, it is now standard practice to wear a certified chemical resistant one-piece spray suit. The operators will remain in that suit for the duration of the day even when they are inside the sprayer. Instead of socks and shoes, operators will wear waterproof boots or gumboots. Any time the operators are outside of the cab and are exposed to chemicals, they will always be wearing a fit tested respirator. The use of these respirators means any data including inhalation exposure needs to be excluded. The use of gloves when touching any surface that may be contaminated is now standard and many operators are now commonly using more than one layer of gloves when handling HC.

When you consider the 30% reduction in exposure achieved simply by correct use of PPE and look at the level of protection that is now standard practice for New Zealand operators and compare it to the equipment and practices observed in the trials, the exposure rating from the trial and the exposure faced by kiwifruit spray operators is not comparable. Because of the differences any decision based on exposure data from the AHEFT trial in relation to agrichemical application in the New Zealand kiwifruit industry would therefore be fundamentally flawed.

To further assist the EPA to understand the steps that are taken to keep workers safe, one of the larger spray contractors in the Bay of Plenty has provided a summary of how they keep workers safe and the safety measures which are implemented. This is attached as Appendix 4.

Spray complaint exposure data

Information summarising spray complaint data sets relating to HC use on kiwifruit was provided to the EPA in the NZKGI submission during the Call for Information process. This includes data from the National Poisons Centre from 2002 – 2019 relating to HC exposure and spray complaints received by NZKGI since 2014.

Of the 82 spray complaint calls received from 2014 to 2019 - 48 related to HC. This is an average of nine per year and only two of these complaints related to direct exposure which resulted in mild symptoms. This information is attached as Appendix 5.

During the 2021 HC spray season, NZKGI received a total of nine spray complaints relating to HC – all within the Bay of Plenty region.

Table Nine: Spray drift complaints 2021 HC season

Type summary table	
Notification	4
Spray drift	5
Spray Signage	1
Windy Conditions	2

Of the nine complaints, two non-compliance notices were issued. One was for lack of signage and the other for lack of notification. Across all 3,222 orchards, this equals a non-compliance rate of 0.06%.

Additionally, during the 2021 HC spray season, Zespri undertook over 50 unnotified audits checking key areas for compliance, including:

- Notification
- Spray plan
- Applicators appropriately qualified
- Environmental protections in place
- Disposal
- Signage
- Storage.

87% of orchards were found to be compliant. For those non-compliant, it is worth noting that all had sufficient spray drift reduction measures in place and had good shelter. Non-compliance notices were issued for:

- Permanent signage not in correct place
- Notification procedure not in place
- Re-entry procedures sub-standard
- Orchard map not showing sensitive areas
- No listed procedure for the disposal of empty agrichemical containers

Zespri is working with those growers who failed the audit to ensure procedures are compliant.

There were ten exposures to HC reported to the New Zealand National Poisons Centre[22] from 1 January 2020 to 30 September 2021. All were adults (aged 20 or over). Four patients were advised to seek medical assessment, one patient was referred to a non-medical service, and five patients were not advised to seek assessment. Six exposures were at workplaces, and four were exposures involving people in the vicinity of workplaces using HC products:

Table Ten: National Poisons Centre HC exposures 2020 - 2021

Exposure incident scenario	Patients
Working at orchard, exposure to spray aerosol	3
Working at orchard, topical exposure from plants previously sprayed	2
Exposed via accidental ingestion at their unspecified workplace	1
Exposure to spray drift from nearby orchard	3
Topical exposure from nearby orchard	1
Total patients	**10**

A 2008 study by Otago University - *The adverse effects of hydrogen cyanamide on human health: An evaluation of inquiries to the New Zealand National Poisons Centre*[23] evaluated the calls received by the New Zealand National Poisons Centre (NZNPC) attributed to acute HC exposure between 1990 - 2006, to ascertain the clinical effects of such exposures. Based on the calls received by the NZNPC, the study found that acute exposure to HC in the workplace or acute exposure to those living within the vicinity of its use may not pose a significant immediate threat to human health.

For the avoidance of doubt, NZKGI supports the ongoing improvement of practices adopted with the use of all sprays, as illustrated by the proactive approach to mandate shelter and support of compliance measures.

[22] NPC does not perform any laboratory testing etc. to verify product identities, and toxins and circumstances are recorded as reported by the person contacting the NPC service.

[23] https://www.researchgate.net/publication/23414543_The_adverse_effects_of_hydrogen_cyanamide_on_human_health_An_evaluation_of_inquiries_to_the_New_Zealand_National_Poisons_Centre

Crop-specific spray drift curve information with full supporting data, or refined risk assessments
Please refer to the Zespri submission

Information on bird behaviour in New Zealand orchards, or further data to refine the modelling of risks to birds
During the 2019 Call for Information, NZKGI commissioned the Australian Environment Agency to undertake a risk assessment looking at the risk to birds from HC application on orchards. The Agency found that after considering additional evidence from a field study, it was shown birds are not expected to spend much more than 20% of their time in treated fields, and therefore risk quotients were acceptable for threatened and non-threatened species.[24]

NZKGI has contacted the Ornithological Society for New Zealand to confirm bird activity on kiwifruit orchards during winter and early spring. The Society provided a website which can show bird activity within 10km of an orchard over the last two seasons. The website can be filtered to winter and early spring months and shows that bird activity is limited around kiwifruit orchards during winter months https://ebird.org/atlasnz/effortmap.

NKZGI undertook further to understand bird activity on orchards and surveyed several growers from different regions who noted the following birds were present on orchards, but not during the HC application period:

Table Eleven: Types of birds on kiwifruit orchards

Bird type	Present on orchard
Pukeko	Late September onwards
Sparrows	Mid-September
Black birds	Late October onwards
Pheasants	Mid-September
Minors	Late October onwards
Starlings	Late October onwards
Fantail	Late September
Waxeye	Late September
Quails	Mid-September

To further support nil bird activity, prior to HC application, vines have been winter pruned and cuttings either removed from the orchard or mulched. Birds do not roost in orchards during winter due to the lack of foliage and food source.

Picture: Orchard that has been winter pruned, the vines tied down and is being mulched (which is required in order to get the sprayer through).

The EPA's own assessments show that over the HC application period, the risk tends to be low:

- In the Cultural Impact Assessment, the EPA concluded that HC is not likely to pose a significant threat to culturally important species of birds and that there are not many small seed-eating native species that are likely to frequent environments where HC is used

[24] https://www.nzkgi.org.nz/wp-content/uploads/2020/07/Appendix-A-Hydrogen-Cyanamide-FINAL-150520-AEA-Env-and-Human-Health-Risk-Assessment.pdf

- *Appendix F Analysis of Risks and Practical Control Measures* acute risks are reported as medium-high however consideration of application over the winter period, the risk has been refined too negligible

- Page 171 of *Appendix B Science Memo* states the chronic tier 1 risk assessment has indicated that chronic risks for birds are above the level of concern for all scenarios evaluated (4.5 – 100x above LOC). It should be considered however that the substance is applied prior to bud break, which is in winter. Birds will not be in their reproductive season. This assumes that if a bird is exposed while it is not in a reproductive phase then exposure to pesticides is unlikely to cause an adverse effect on reproduction.

Table Twelve: Summary of key risks for birds and options for possible control measures

Receptor	Exposure scenario	Details	Initial level of risk‡	Risk mitigation options	Residual risk
Birds	Application – airblast	Use of hydrogen cyanamide presents significant acute risks to birds. The level of risks could be reduced with lower application rates.	Medium-high (most sensitive species)	Application parameter restrictions apply: Maximum application rates of ≤ 25 kg ai/ha for kiwifruit and ≤ 16.9 kg ai/ha for apples Maximum number of applications = 1 per year	Medium-high
Birds	Application – airblast	Use of hydrogen cyanamide presents chronic risks to birds linked to reproductive effects that occur during exposure.	High (most sensitive species)	Application timing control limiting application to winter months (when birds are less likely to be breeding): Use limited to 15 July – 1 September	Negligible

Source: EPA Science Memo

NZKGI submits that the risk to birds is low, simply because there are no birds on orchard during HC application and no food sources to sustain bird activity.

<u>Information on alternatives to hydrogen cyanamide, their relative cost and effectiveness, and any recent developments</u>

While some of the commercial alternative products have been available for some time, there has been limited uptake by growers because effectiveness is highly variable and impact of failure on profitability is high. Growers cannot afford to take the risk of using alternatives unless they are proven to provide consistent results.

Alternatives require growers to have a much better sense of the conditions through winter and an understanding of the likely physiological stage of the vines to get the timing right. HC products are much more forgiving and can be applied within a longer period of time relative to alternatives. Alternatives typically have a very narrow window for application however if the narrow window of opportunity is misjudged and it rains, or you have other conditions that don't allow full application, then the crop can be less than expected. Alternative products provide only a narrow window of use (three days without rain is optimum) where they can be effective. If it rains during this period or the spray contractor is not available, then alternatives are generally ineffective. The chances of a consecutive three-day period without rain in July – September[25] is noted in the table below which illustrates that for the period of 1981 to 2019, the proportion of periods containing three days or more of no rainfall was as low as 10% in Northland and 23% in Bay of Plenty

[25] Raw data obtained from NIWA website

Table Thirteen: Average three days of 0 rainfall 1980-2019 1 July to 8 Sep

Region	Location	Proportion
Northland	Kerikeri	10.41%
Northland	Whangarei	10.30%
Auckland	Auckland	12.11%
Bay of Plenty	Tauranga	22.86%
Waikato	Hamilton	15.65%

Source: Niwa

Growers that have tried alternative products have reported a drop in green tray production per hectare of 7,000 to 10,000 trays. In economic terms, this could mean a loss of income of ~$48,860 per hectare for green and ~$85,120 per hectare for gold (based on Orchard Gate Returns (grower income) for November) based on 7,000 tray reduction.

With an average orchard size of 3.4 hectares the reduction of income is significant - $166,124 for green and $289,408 for gold. This would make some orchards uneconomic and would likely result in significant unemployment in affected regions. The uncertainty that would come with needing to rely on alternatives would also constrain investment in staff.

The economic analysis the EPA commissioned found that the increased chemical costs as a result of HC not being available was $45 million to $63 million over ten years[26].

For more information on alternatives and Zespri's breeding programme, please refer to the alternatives section in the Zespri submission.

14. EPA Recommendations

Several recommendations have been proposed by the EPA during the proposed five-year phase out period if HC was to be banned. This section sets out the proposed EPA recommendations and NZKGI commentary however NZKGI reserves the right to provide definitive recommendations once our expert evidence has been received.

EPA recommendation: Ban HC and phase out period of five years

NZKGI categorically opposes any ban of HC and contends that HC is safe to use when the appropriate controls and rules are followed. As shown by the EPA's own modelling, HC is not on the chemical priority reassessment list, and has been classified in priority D. Further, the carcinogenic classification (group c) places HC in the same category as everyday consumables like coffee and tea and there is limited to no evidence that HC causes cancer in humans.

NZKGI will provide more information to the DMC in March 2022.

EPA recommendation: Set the maximum application rate at 25 kg ai/ha

NZKGI supports the maximum application rate of 25 kg ai/ha (see section 13 for more information).

EPA recommendation: Application use is limited to the period from 15 July to 1 September

NZKGI preferred position is to support application use from **1 July to 8 September** with allowance to use for one week outside this period in the event of unforeseen circumstances – eg – adverse weather events. Late winter, early spring weather is generally unpredictable.

[26] https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203974/APP203974_20210920.3_Appendix_D_Economics_assessment_report.pdf

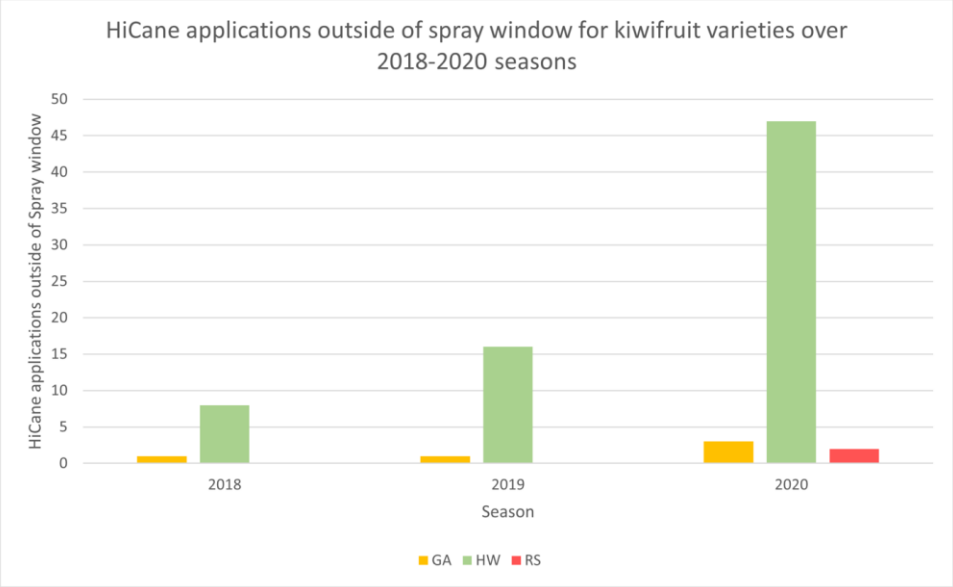
The proposed application window of 15 July to 1 September is too restrictive and would cause implications for red, Northland orchards, spray contractors and would unfairly impact high altitude green growers who naturally target late August which is the optimal time for them to apply HC.

Red variety

Red is a new variety with just 254 hectares planted however this is expected to grow to 1350ha by 2023. Red tends to enter bud break early and is therefore treated with HC earlier than green and gold. 22% of red hectares were sprayed with HC earlier than 15 July in 2021.

All growers must record agrichemical use in Zespri's Spray Diary system. Analysis of HC use over the past three seasons shows the current application window is wider than the EPA's proposed recommendation.

Table Fourteen: HC applications outside EPA recommended application timeframe



Source: Zespri Spray Diary Data

Northland orchards

Northland has a warmer climate with lower winter chill than other regions and is generally later to break bud therefore applications of HC in this region are generally later – towards the end of the first week of September. For the 2021 season, there were 13 applications from 1 September to 8 September in Northland, which supports NZKGI recommendation to extend the application period.

Impact on spray applicators

Setting a restrictive application period will put pressure on contractors to complete applications and if there is bad weather, it may result in contractors being pressured to apply in poor conditions to meet compliant standards. It is likely that there would be an unfair impact to high altitude green growers who naturally target late August which is the optimal time for them to apply.

EPA recommendation: Not to be applied when wind speeds are less than 3 km/hr or more than 20 km/hr as measured at the application site

NZKGI supports the EPA recommendation. Applying spray in winds of less than 3km/hr means that when wind resumes the direction is not predictable. Spraying only when there is at least some wind ensures that wind direction is known (so that drift onto sensitive areas can be avoided).

EPA recommendation: Introduction of a range of buffer zones

NZKGI supports effective shelter as a tool for mitigating spray drift risks rather than imposing lengthy buffers. Effective shelter can almost completely prevent movement of spray into non-target areas.

Unless kiwifruit vines are sheltered, high winds cause loss of replacement canes, damage growing points on young vines, defoliation and loss of flowers. Pollination efficiency, fruit set, plant and fruit size can all be reduced. Excessive wind also causes fruit abrasion, increased water use of the crop, desiccation of vines, reduced opportunity to spray, unpleasant working conditions and disruption of irrigation. To protect crops from damage, most kiwifruit growers have shelter in place. The most common shelter species are pines including cryptomeria and casuarina which different characteristics and are chosen for their sites.

A recent mapping exercise by GPSIT[27] showed that 97% of orchards in New Zealand have some type of shelter.

NZKGI supports all orchards having effective shelter. Not only does this promote optimum growing conditions but also provides an added level of protection to prevent spray drift and reduces the requirement of buffer zones to protect sensitive areas and significantly reduces spray drift risks by:

- Reducing wind speeds experienced within sprayed blocks; allowing spray droplets to deposit before they leave the sheltered area
- Potentially reducing air turbulence and lifting and dumping effects that can carry droplets projected above the crop higher into the air, and by
- Presenting a collection surface that spray droplets can deposit onto.

Shelter will directly capture drifting droplets, but a big part of the shelter effect on preventing spray drift is slow wind speeds and allow potential drift droplets to fall out within the block.

In July this year, NZKGI started a conversation around mandating shelter across the industry which has been endorsed by the NZKGI Executive Committee and by NZKGI Forum members (all growers). NZKGI is now working with Zespri on defining effective shelter (both natural and artificial), what a shelter implementation programme would look like (including a maintenance programme) in consultation with growers. The outcome will be developed into a required standard in Zespri GAP (Good Agricultural Practice) requirements that all growers must comply with.

More information will become available over the coming months and NZKGI will provide an update to the DMC in March 2022.

There are three types of shelter generally found on kiwifruit orchards:

1. Natural shelter
   Generally, boundary shelter is evergreen and is around eight metres tall (once fully grown). Shelter trimmer machinery can only reach to around eight metres which is why shelter doesn't generally grow taller. Shelter is maintained and trimmed every 12-18 months and growers self-monitor for any gaps.

The below examples are of an eight metre, highly condensed, evergreen, cryptomeria shelter which separates a **conventional** and an **organic** orchard. The conventional orchard is sprayed with HC. The controls in place (buffer and shelter) are accepted by Bio-Gro[28] as to not effecting the status of the organic orchard

[27] GPSIT have mapped 95% of kiwifruit orchards in New Zealand
[28] https://www.biogro.co.nz/

2. Artificial shelter

Historically, artificial shelter has been one single layer with different cloth porosity options available. A Zespri project tested single and double-layer cloth combinations to reduce downward drift. The study looked at single layers of wind break cloth versus double layer (with a gap of 10 cm between layers), using shelter cloth with 30%, 50% and 80% closure (70%, 50% or 20% gaps). The preliminary findings are that all the shelter cloth tests significantly reduced spray drift through direct collection of droplets and all of them reduced the droplet fallout area to a zone close to the downwind side of the shelter (as expected with wind speed reductions).The double layers of cloth provided greater wind speed reductions, greater droplet collection and greater reductions in downwind spray movement than single shelter layers. While this work is still ongoing, it has already demonstrated the potential for artificial shelter to be used to close potential gaps in natural shelter belts and this type of artificial shelter can provide a level of drift reduction comparable to natural shelter.

3. Overhead netting

Overhead netting significantly reduces windspeeds within netted blocks and can greatly reduce wind turbulence and help to reduce losses of very fine droplets. This type of netting also prevents hail from damaging crops.

Considering research on how Air Induction nozzles and drift-reducing adjuvants reduce drift from sprayed kiwifruit orchards and with evidence of the drift capture potential of shelter belts (natural or artificial), these should be considered as a drift mitigation practice and the presence of effective shelter should allow buffer zones to be eliminated. This is particularly relevant to the downwind buffer zones for non-target plants. The EPA definition of non-target plants is:

In the risk assessment, the term 'non-target plants' encompasses all non-crop vascular plants growing outside of the treated area. The land "outside of the treated area" is typically referred to as off-field" and is defined as the area of non-treated land surrounding the site that has been treated.

This off-field area is considered to begin at the edge-of-field (eg directly adjacent to the treated area) and extends to the maximum distance that the substance can travel by spray drift.

Based on this current definition, shelter belts as well as grass on the grower's own property would be considered off-target plants to which the proposed buffer zones would apply. We suggest that this is changed to a more practical definition that better captures what we understand the intention of the control to be – protection of valued plants that are valued and to which hydrogen cyanamide may drift.

The EPA proposed buffer distances have been modelled using bare soil run-off and modelling has not accounted for the effect of shelter belts. Most kiwifruit orchards have natural shelter and large areas of grass on the boundary. Where orchards have water bodies, there is generally riparian or other plantings evident. Trees, grass and other vegetation have a significant impact on run-off and sediment movement following rain. Therefore, NZKGI requests that the EPA reassess their modelling and include vegetation and shelter which will no doubt lead reduced buffer zone for waterbodies.

Picture: Areas of grass/trees between orchard boundary and water body

The proposed buffer zones for orchards next to waterways are significant and if adopted would see productive vines retired.

Zespri has modelled the run-off buffer zones to aquatic environments area of affected hectares with an indicative financial impact of:

- $8.74m total OGR revenue reduction run off buffer zone to aquatic environment > 10% slope: 25m (> 10.4 -25 kg ai/ha)
- $6.26m total OGR revenue reduction run-off buffer zone to aquatic environment < 10% slope: 20m (> 10.4 -25 kg ai/ha)

The aquatic environment buffer impacts are likely understated as the dataset cannot identify all aquatic environments on or close to orchards.

Managing spray drift

One of the major sources of risk when spraying HC is spray drift which occurs when the spray moves away from the target area, particularly if HC comes into contact with non-target areas. In general, all size classes of spray droplets can move off target, but the smaller drops are likely to move further before depositing on the ground of a non-target area. Droplet size is probably the single most important factor to controlling spray drift.

With good spraying practices, the drift proportion of even a fine droplet spray plume would typically be a very small proportion (less than about 1%) of the total spray volume. The use of Air Induction nozzles and the inclusion of Driftstop™ or other drift-reducing adjuvants have been industry mandated as compulsory since 2014 for all applications of HC. Air Induction nozzles produce large, air-filled, coarse droplets, substantially reducing the risk of spray drift. Driftstop is a drift retardant spray additive which helps to increase the droplet size, reducing the drift of spray particles.

The use of Air Induction nozzles means that droplets are less likely to be picked up by air movement and drift offsite. Air Induction nozzles therefore substantially reduce the risk of spray drift. Drift-reducing adjuvants, such as Driftstop™, further reduce this risk by reducing the percentage of very small drift droplets within the spray mix. Along with drift control, Driftstop is designed to improve adhesion of large droplets and to improve their spread (coverage) on cane surfaces. A number of trials (Gaskin et al. 2006, Gaskin & Manktelow 2007, 2008, Gaskin et al. 2008, 2014) have explored drift reduction, spray coverage and biological efficiency of HC applications using Air Induction nozzles. These studies demonstrated that drift is significantly reduced by the use of Air Induction nozzles with a drift reducing adjuvant.

Spray drift using conventional nozzles and 600l/ha

Spray drift using AI nozzles, DriftStop and 600l/ha water and yellow dye

Source: Zespri Kiwitech Bulletin Dormant and Early Spring Spray Application N98

In 2013, research[29] showed that increasing Driftstop rates improved drift control, rain free period, drying time and absorption and it was therefore recommended that growers look to increase the rate of Driftstop to 250 mL/100L. Under these conditions, historically typical grower will spray (using an air blast sprayer with Air Induction nozzles) 6% of the formulated product at 600-700L/ha with the addition of Driftstop adjuvant at 0.2%however, increasing of droplet size in order to reduce spray drift resulted in poor budbreak and forced applicators to increase water rates to compensate this. Therefore, application rates are now between 650-750L.

Air Induction nozzles in combination with drift-reducing adjuvants typically reduce downwind losses over 9 meters from the sprayer by 85% compared to the previous standard, hollow cone nozzles. Research in 2018, found that approximately 2% of the applied mass of product sprayed may leave as spray drift using this system (Air Induction nozzles + drift reducing adjuvants). The use of other drift-reducing techniques can further reduce the risk of off-target spray drift.

Connell, et al. (2018) indicated increased efficiency of shelter capturing drift produced when using Air Induction nozzles and a drift reducing adjuvant, compared with standard nozzles. This was attributed to the larger droplet size produced by Air Induction nozzles. This suggests that the use of Air Induction nozzles, which produce larger droplets, further increases the potential of shelter as a drift mitigation tool.[30]

For more information on the impacts to orchards based on the proposed buffer zones, please refer to the Zespri submission.

15. Conclusion

NZKGI agrees that there are risks associated with HC however these risks can be managed. The industry has good controls in place and are looking at other ways to further protect people and the environment – mandating shelter for example.

HC is critical for production of New Zealand's biggest horticultural export. A ban will severely impact production and cause significant loss of income for growers and GDP. Many will no longer be in business. Regions and communities will be impacted.

NZKGI's is committed to ensuring a safe, profitable industry not only for today's growers but for generations to come. Growers are committed to keeping HC and know there are likely to be further controls they will need to adopt.

Kiwifruit growers are an integral part of the communities they live in and want good relationships with neighbours. NZKGI will work with Zespri to ensure stricter measures and enforcement are put in place, so non-compliant applicators know they are not welcome in the industry.

During the 2006 HC reassessment, the public hearing was held at Mt Maunganui. This was due to the large number of submissions received. NZKGI respectively requests that the DMC consider holding the public hearing in Mt Maunganui or Tauranga.

NZKGI requests to be heard at the hearing.

Colin Bond
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NZKGI

[29] Gaskin, R.E., Manktelow, D.W.L. & Steele, K.D. 2006. Adjuvant and application technologies to minimise off target drift from kiwifruit sprays. New Zealand Plant Protection, 59: 217-222

[30] Source Connell, et al. 2018

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