New Zealand Food Safety
Haumaru Kai Aotearoa

Clopyralid residues in potatoes, kumara and mushrooms

2016 New Zealand Total Diet Study Follow Up Survey

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1 Executive Summary

Phenoxy and aromatic acid herbicides are a common group of agricultural chemicals in use in New Zealand. Detection in food requires the use of specialised analytical methods not used in routine sampling.

The 2016 New Zealand Total Diet Study (NZTDS) undertook testing of cereal and vegetable based foods for a number of phenoxy and aromatic acid herbicides to establish typical levels of exposure in the New Zealand diet (Pearson *et al*., 2018). One of the analysed herbicides, clopyralid, was unexpectedly found in a number of crops, albeit at levels not representing a food safety concern.

The current survey was carried out to establish if residues of clopyralid were consistent in subsequent seasons and, if so, potentially reflective of changes to, or a failure to follow, good agricultural practice (GAP).

Residues of clopyralid, as well as 16 other phenoxy and aromatic acid herbicides, were not detected in a total of 145 potato, kumara and mushroom samples collected from both the North and South Island growing regions from March 2017 to May 2018.

It is concluded that the clopyralid residues reported in the 2016 NZTDS may have been an incidental occurrence, potentially a limited contamination of a composting operation that has since been rectified. There is no evidence that growing practices or non-adherence to GAP have changed.

2 Introduction

Herbicides are a group of agricultural chemicals used for control of weeds in crops and pasture. A number of herbicides are currently registered in New Zealand, covering distinct chemical classes. As with other agricultural chemical types, the use of herbicides can result in residues in crops, either through direct treatment of crops or through inadvertent contact or transfer to crops.

Two commonly used chemical classes of herbicide are the phenoxy acid herbicides (phenoxyacetic acid, phenoxybutyric acid, phenoxypropionic acid and arylphenoxypropionic acid) and the aromatic acid herbicides (benzoic acid and picolinic acid). Within these classes are compounds such as 2,4-D (2,4-dichlorophenoxyacteic acid) and dicamba which have been in use in New Zealand for many decades, as well as more recently commercialised compounds. Detection of phenoxy and aromatic acid herbicides in food requires the use of specialised analytical methods not commonly used in routine sampling.

A survey was commissioned to undertake testing for phenoxy and aromatic acid herbicides in selected crops as a follow-up to detection of these herbicides in the 2016 New Zealand Total Diet Study (NZTDS; Pearson *et al*., 2018).

2.1 2016 NZTDS FINDINGS

In the 2016 NZTDS, clopyralid, an aromatic acid herbicide, was the most commonly detected herbicide residue, being present in 44 out of 1056 food samples tested. In Quarter 1 of the 2016 NZTDS, mushroom samples from all four regions had residues of clopyralid. Clopyralid was also detected in kumara (two out of eight samples). The detection of clopyralid in mushrooms was of particular interest as mushroom cultivation is usually in controlled conditions and likely to be isolated from agricultural spraying of herbicides. Findings for two phenoxy acid herbicide residues were also reported in the 2016 NZTDS. These were for fluazifop (four samples out of 1056, including in individual samples of potatoes peeled, and potatoes with skin) and haloxyfop (three samples out of 1056, including in a sample of potato chips).

Clopyralid is approved in New Zealand for selective control of broad-leaved weeds. As of the end of 2018, the New Zealand Agricultural Compound Veterinary Medicine (ACVM) register recorded 20 commercial products with clopyralid as an active ingredient. As clopyralid does not cause toxicity to grass species it is commonly used in lawn maintenance and weed control. Clopyralid has a persistent residual effect and subsequent plants exposed to the residue often show phytotoxicity, such as stunted growth. If animals feed on contaminated grass or fodder, the resulting clopyralid may also persist in the manure, as it can pass through the animals without breaking down. The Environment Protection Authority (EPA) has set controls under the Hazardous Substances and New Organisms Act to prevent contaminated organic matter from being used as compost (EPA, 2009).

The levels of clopyralid found in the 2016 NZTDS were not an identified food safety concern, with total exposures estimated across the population cohorts at less than 0.1% of the health based guidance value. However, the increased prevalence of clopyralid, and the presence of residue in crops such as mushrooms, was unexpected. It was hypothesised that a change in farming practices could have occurred, with the result being more frequent residue occurrence. An alternative explanation was that residue uptake into crops from use of contaminated compost or manure could have occurred.

2.2 SURVEY PURPOSE

The present survey was designed to follow up on the findings of the 2016 New Zealand Total Diet Study, specifically to provide more comprehensive data on clopyralid in targeted crops from which to better quantify adherence to good agricultural practice (GAP) by the growers. The follow up survey was designed to answer the following risk management question:

- Is there a consistent prevalence of clopyralid in targeted crops in subsequent seasons, compared to that reported in the 2016 NZTDS, and, if so, is this the result of changes in growing practices, or a failure to adhere to GAP?

On the basis of the prevalence of clopyralid, fluazifop and haloxyfop in the tested crops in the 2016 NZTDS, New Zealand Food Safety decided to target residue testing to potatoes, kumara and mushrooms.

3 Survey Methodology

3.1 FOODS SAMPLED

3.1.1 Potatoes

Twenty varieties of potatoes were sampled over a 12 month period from wholesalers, supermarkets, other retailers and organic stores (Table 1). The collected varieties were classified by cooking purpose. Traceability information for potatoes was gathered from pre-packaged bags (if available) or pack-houses where contacted. The samples were traced to 28 potato growers. The key regions for potato cultivation are Auckland, Waikato, Manawatu, Hawkes Bay and Canterbury (Potatoes New Zealand Inc, 2018).

Table 1. Sample details of potatoes collected for residue analysis of phenoxy and aromatic acid herbicides.

Potato variety	Samples (Total: 59)
All purpose (varieties such as Rua, Moonlight, Karaka, Vivaldi)	21
Starchy/floury (varieties such as Agria, Ilam Hardy, Red Jacket, Marabel)	21
Waxy (varieties such as Nadine, Jersey Bennes, Frisia Annabelle)	17

3.1.2 Kumara

Three varieties of kumara were collected over a 12 month period from wholesalers and supermarkets (Table 2). Traceability information for kumara was gathered from pre-packaged bags or pack-houses where contacted. The samples were traced to 16 kumara growers. Kumara are typically grown and harvested in the Northland region (Vegetables NZ, 2019).

Table 2. Sample details of kumara collected for residue analysis of phenoxy and aromatic acid herbicides.

Kumara variety	Samples (Total: 30)
Gold	6
Orange	7
Red	17

3.1.3 Mushrooms

Seven varieties of mushrooms were collected from wholesalers, supermarkets, other retailers and organic stores (Table 3). The sampled mushrooms were classified as either Asian (*Flammulina velutipes*, *Pleurotus ostreatus* and *Lentinula edodes*) or European (*Agaricus bisporus*) cultural varieties.

Table 3. Sample details of kumara collected for residue analysis of phenoxy and aromatic acid herbicides.

Mushroom variety	Samples (Total: 56)
Asian cultural varieties (Enoki, Oyster, Shiitake)	11
European cultural varieties (brown button, white button, portobello)	45

Traceability of Asian cultural varieties was poorly documented even though they were commercially available in specialty grocers and independent produce shops. The Asian cultural varieties, collected over a 12 month period, were able to be traced to ten mushroom growers. Farms that grow the Asian style mushrooms were from small scale growers and made up approximately 20% of total mushroom samples.

Traceability information for the European cultural varieties was readily available and easy to establish. As there were only three mushroom farms that grow European style mushrooms in New Zealand, they were collected over a longer period of 14 months to reflect the larger production volumes and more established distribution chains. Farms that grow European cultural varieties were based in the Hawkes Bay and Canterbury regions.

3.2 SAMPLING

Sample collection took place from March 2017 to May 2018. The sampling protocols were adapted from international (United Nations Food and Agricultural Organisation) guidelines with respect to the minimum sample sizes for fresh produce. For example, one potato sample was made up of ten or more potatoes from a randomly selected batch and weighed (at least) one kg in weight.

3.3 ANALYTES

A total of 17 phenoxy and aromatic acid herbicide compounds were tested in this survey (Appendix 1), this included the three analytes detected in the 2016 NZTDS: clopyralid, fluazifop and haloxyfop.

The New Zealand Maximum Residues Levels (MRLs) were used to establish residue compliance for any detected result.

4 Results and Discussion

The prolonged period of sampling of 12-14 months and the number of samples taken of each food crop presents a comprehensive in-depth analysis of the prevalence of phenoxy and aromatic acid herbicide residues in potatoes, kumara and mushrooms. A total of 145 samples (59 potato, 30 kumara and 56 mushrooms) were analysed for 17 phenoxy and aromatic acid herbicide residues.

Unlike in the 2016 NZTDS, there were no clopyralid residues, nor any residues of the other phenoxy and aromatic herbicides, detected above the limit of reporting in any of the food samples. This suggests that the occurrence of clopyralid in these crops is uncommon, and the earlier findings may have resulted from an isolated occurrence of growing media/compost contamination with clopyralid. There is no consistent pattern of residues that would indicate that growing practices or adherence to GAP have changed.

5 Conclusion

It is concluded that the clopyralid residues reported in the 2016 NZTDS may have been a sporadic occurrence, potentially a limited contamination of a composting operation that has since been rectified. There is no consistent pattern of clopyralid residues in targeted vegetables, and as a result, there is no evidence that growing practices or adherence to GAP have changed.

6 References

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Appendix 1. Phenoxy and aromatic acid herbicide analytes and method reporting limits.

Analyte	Limit of reporting (mg/kg)
2,4,5-T (2,4,5-Trichlorophenoxyacetic acid)	0.02
2,4-D (2,4-Dichlorophenoxyacetic acid)	0.02
2,4-DB (4-(2,4-Dichlorophenoxy)butyric acid)	0.05
Bentazone	0.05
Bromoxynil	0.02
Clopyralid	0.05
Dicamba	0.05
Dichlorprop	0.05
Fluazifop	0.02
Fluroxypyr	0.05
Haloxyfop	0.02
Ioxynil	0.02
MCPA (2-Methyl-4-chlorophenoxyacetic acid)	0.02
MCPB (4-(4-Chloro-2-methylphenoxy)butanoic acid)	0.1
Mecoprop	0.05
Picloram	0.05
Triclopyr	0.02