BEFORE THE ENVIRONMENT COURT **ENV-2020-AKL-000148**

AT AUCKLAND

I MUA I TE KŌTI TAIAO

I TĀMAKI MAKAURAU ROHE

IN THE MATTER	of the Resource Management Act 1991 (RMA or the Act)
AND	
IN THE MATTER	of Proposed Plan Change 1 of the Waikato Regional Plan

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STATEMENT OF EVIDENCE OF DR STUART DAVIS ON BEHALF OF PUKEKOHE VEGETABLE GROWERS ASSOCIATION

28 JULY 2023

INTRODUCTION

Qualifications and experience

1. My name is Stuart Ian Davis. I am the national Sustainability Manager for LeaderBrand Produce Ltd, based in Bombay, South Auckland. LeaderBrand was founded in Gisborne in 1975 and is a grower, processor, packer and marketer of fresh vegetable products, winegrapes and wine for both domestic and export markets. LeaderBrand produces crops in the Auckland, Waikato, Gisborne and Canterbury regions and total crop production is over 2500 hectares annually.

2. My qualifications relevant to this evidence include a BHortSc(Hons), PhD in Horticultural Science, and a Certificate in Sustainable Nutrient Management in NZ Agriculture (all from Massey University). I have also completed the 'Getting to know groundwater' short course (National Centre for Groundwater Research & Training, Flinders University).

3. My professional experience includes 21 years in agronomy, technical and management roles in LeaderBrand Produce, based in Gisborne and South Auckland. Prior to that, I worked for 16 years in the HeinzWattie's group based in Gisborne, Auckland, Manawatu and Hawke's Bay, ultimately as Crop Procurement Manager – responsible for crop procurement and research across NZ and Australia.

4. My industry involvement has included roles in Vegetables NZ inc (Director 2008-18) and Vegetable Research & Innovation Board (Director 2007-14, Chair 2014-18). I was a member of the FreshWater Advisory Group (2010-16) that assisted in the development of the first freshwater plan for the Gisborne region. I am currently a project team member in 3 multi-year Sustainable Food & Fibre Futures projects involving >$30 million in total investment: A Lighter Touch (Chair of Industry Stakeholder Advisory Group representing 15 horticultural product groups), Sustainable Vegetable Systems (member of

Technical group) and Regenerative Management Systems for NZ Vegetable Production (LeaderBrand project team lead).

5. In this evidence, parallels are drawn between developments in integrated crop protection and nutrient management in vegetable cropping systems. In addition to my current role in the Sustainable Vegetable Systems project, I have had some involvement with industry initiatives in sustainable management in areas such as sediment control, nutrient management - e.g. the Holding It Together project,[1] and vegetable nutrient management guidelines,[2] were commissioned by VR&I Board when I was a Director there - and overall catchment management (Gisborne District Council Freshwater Advisory Group).

Purpose and scope of evidence

6. This evidence will address the importance of crop rotation.

KEY CONCERNS WITH THE PROPOSED PLAN CHANGE

7. Unworkable policies and rules have the potential to impact on economic viability of vegetable growing, and on the supply of fresh vegetables for New Zealand.

8. In particular limiting crop rotation to the sub-catchment is too small and creates risks for plant and soil health.

9. The detail of these concerns is set out in the evidence of Kelly Deihl for Pukekohe Vegetable Growers Association and the evidence of Horticulture New Zealand.

CROP ROTATION FOR SOIL AND PLANT HEALTH

10. Crop rotation is the avoidance of continuous production of the same crop in the same soil by introduction of other crop species between repeated productions of a single

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[1] Barber, A. (2014). Erosion & Sediment Control Guidelines for Vegetable Production, version 1.1. Wellington: Horticulture NZ inc. 40 pp.

[2] Reid, JB; Morton, JD (2019). Nutrient management for vegetable crops in New Zealand. Wellington: Horticulture NZ inc., 133 pp.

crop. Over time, crops in a rotation generally perform better than those in continuous production. Crop rotations often include a cover crop i.e. a crop that is used to return organic matter to the soil.

11. In order to achieve operational efficiencies and return on specialist production and packing equipment, commercial vegetable growers often specialise in a small range of crops but have land swapping arrangements with other growers to achieve longer, more diverse rotations on the land they crop. This assists in the profitable use of high value land where long periods in lower margin cover crops or pasture can be economically undesirable.

Crop nutrition

12. Producing the same crop in one location means that the same mineral nutrients in similar proportions derived from the same depth in the soil are repeatedly taken up from the soil resulting in eventual poorer crop performance.

13. Better utilisation of mineral nutrients through the soil profile can often be made by rotation of crops (e.g. shallow-rooted versus deep-rooted, taproot versus fibrous root systems exploit different fractions of the available soil nutrient pools).

14. Some crop rotations include legumes (e.g. clover, lucerne, peas, beans, vetch) which fix atmospheric nitrogen that can be utilised by following crops in the rotation.

15. Cover crops (or ‘catch’ crops) in a rotation can assist with ‘mopping up’ mineral nitrogen in the soil between harvested crops reducing losses of nitrogen to the environment.

Soil structure

16. Improving soil structure provides a number of benefits to crop production including: reducing impediments to crop root growth, increasing water holding capacity and drainage,

reducing erosion and compaction, and encouraging the action of beneficial soil biota.

17. Pasture is sometimes used as a rotation crop because it may contain legumes (e.g. clover) that fix nitrogen. A pasture phase can also improve soil structure by adding organic matter to the soil as the pasture grows and when it is sprayed off and/or cultivated into the soil before the following crop. The fibrous root systems of pasture, the root exudates they produce and the activity of associated mychorrhizal fungi can also contribute to improving the soil structure and aggregate stability.

18. Cover crop residues encourage the surface and topsoil feeding of soli fauna such as earthworms which benefit soil structure by the creation of soil pores, improving soil water and air movement and plant root growth.

19. Some crops in a rotation with deep strong roots are also useful for opening aeration/percolation channels deeper in the subsoil than the harvested crop might penetrate e.g. lucerne is often used for this.

20. The use of a cover crop between harvested crops can also be used to protect from surface soil structure damage and crusting (from raindrop impact) and erosion (compared to a bare soil fallow between crops).

Weed, pests and diseases

21. The management of soil health and nutrient flows across a multi-crop rotation has a parallel in pest and disease management where practices developed to manage a single pest or disease must then be considered in the context of an integrated pest management (**IPM**) programme for that crop, then the whole crop rotation and the wider farm environment (including the surrounding region),

22. Rotating crops breaks pest and disease cycles by removing host material for a period and reducing pest populations and the inoculum levels of pathogens (assuming that the crops in the rotation are chosen so that they do not share key pests or diseases).

23. Some crops and their residues can act as soil bio-fumigants e.g. in NZ there are certain sorghum and brassica species used in this way. Some crops are auto-allelopathic i.e. in continuous cropping their growth becomes suppressed by self-emitted metabolites.

24. High density cover crops can suppress weed populations - compared to a fallow between harvested crops. A common practice is to rotate monocotyledonous crops with dicotyledonous crops as it is easier to have herbicides that are selective for dicotyledonous weeds in a monocotyledonous crop (and vice-versa) e.g.one of the biggest crop rotations in the Western world is soybean and maize.

25. Industry-led development in the management of pests and diseases over recent decades is a good example of how the vegetable industry has adapted its practices in response to, and often ahead of, changes in the natural, commercial and regulatory environments. The range of factors that have been taken into account in developing successful integrated pest and disease management programmes also provide an illustration of the complexity of vegetable crop rotation systems and their relationships to the environment.

26. Figure1 is a partial illustration of this complexity for the crop rotation used by our company's Gisborne operation (intensive vegetable rotations elsewhere would exhibit similar complexity). This was compiled as part of a current project investigating the incorporation of regenerative agriculture practices (cover crops, composts and biodiversity plantings)

into an intensive vegetable crop rotation.[3] This diagram shows known interactions of invertebrate pests (e.g. insects, mites and slugs) with crops in the rotation which need to be considered in making changes to production practices and the farm environment. This includes contaminant species (e.g. cockroaches in lettuce) and occasional pests (e.g. slugs, earwigs in lettuce) which are known to increase in incidence when additional organic matter and refugia are introduced into the crop environment.

27. For simplicity, Figure 1 does not encompass all of the plant health issues to be considered in this case. For example, it does not include plant diseases (some transmitted by insects), vertebrate pests (birds, rabbits, hares, possums, rats) which also attack these crops and whose incidence is also affected by the presence of alternative hosts, organic matter and refugia. Similar diagrams have been drawn of the (much less-understood) interactions between proposed native biodiversity plantings and invertebrate pests and beneficial species (predators and parasitoids) that help control them.[4]

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3 Howlett, BG; Davis, SI; Lambert, C; Davidson, MM (2022). Regenerative management systems for New Zealand vegetable production: Work stream 3 – Ecosystem restoration. Christchurch: Plant & Food Research report PFR SPTS#23119, 22 pp.

4 Howlett, BG; Davis, SI; Lambert, C; Davidson, MM (2022). Regenerative management systems for New Zealand vegetable production: Work stream 3 – Ecosystem restoration. Christchurch: Plant & Food Research report PFR SPTS#23119, 22 pp.

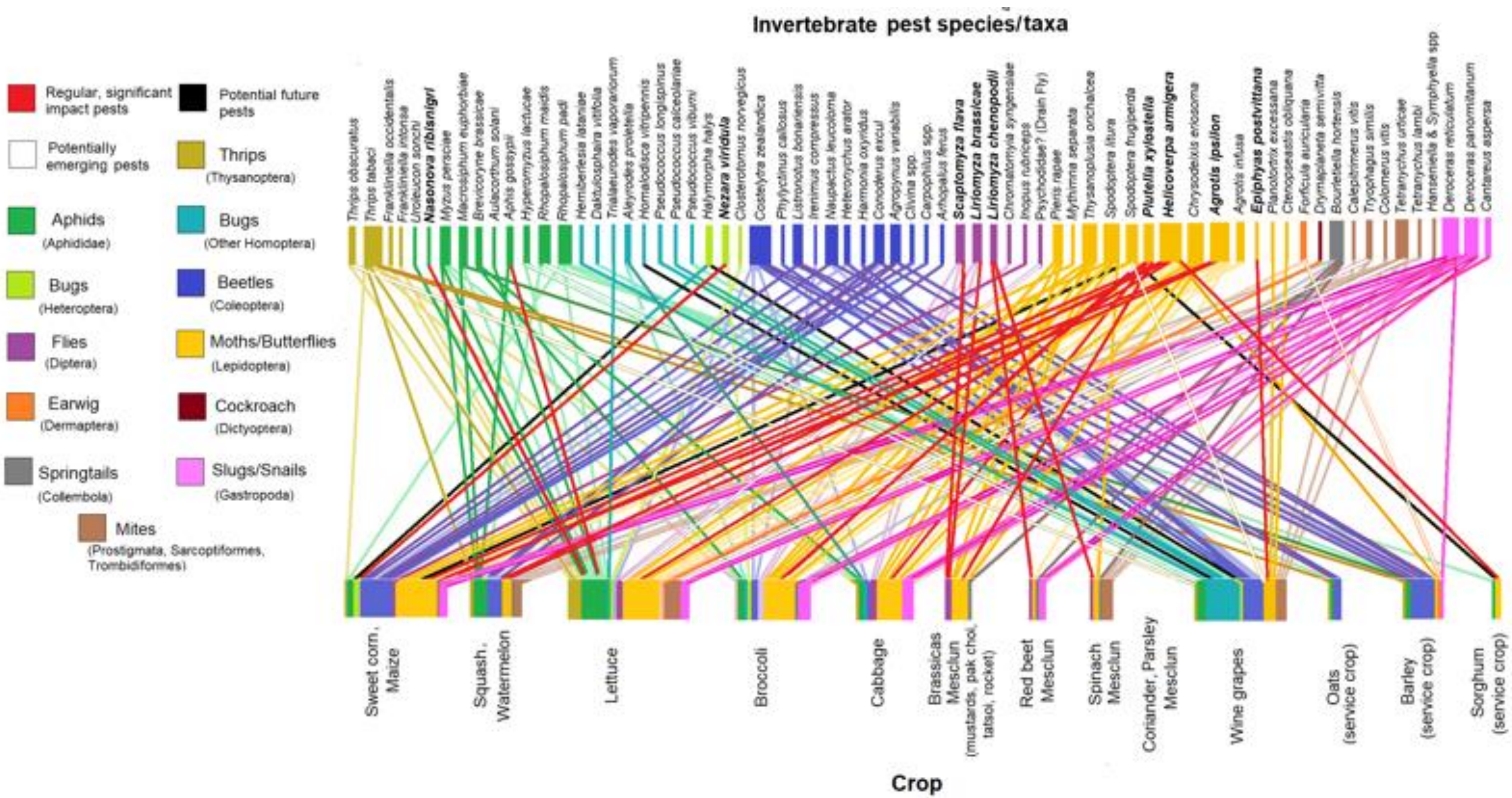

Figure 1: Invertebrate-plant network diagram for invertebrate pests and crops in a vegetable rotation (Howlett *et al.*, 2022).

28. Similarly, to soil and nutrient management, vegetable growers initially began tackling these complex farm environment issues by breaking them down to address single crop-pest problems with the chemical and cultural control tools available at that time. Then, as better tools – such as introduced biological control agents, softer chemistry, and knowledge (e.g. control action thresholds) - became available, these tools began to be incorporated into Integrated Pest Management (**IPM**) programmes which took account of some of the wider interactions (especially between pests, agrichemicals and beneficial species).

29. These IPM programmes, and parallel developments in on-farm management of agrichemicals,[5] have progressively been incorporated into the standards included in industry Good Agricultural Practice (**NZGAP**) accreditation programmes. All of these improvements have largely been developed ahead of regulation and the industry has sought to have NZGAP standards (with modifications where needed) recognised in regulations.

30. This is so that growers accredited (and audited) against GAP standards can maintain (or exceed) compliance across multiple streams of regulation within a single assurance framework. For example, MPI recognises NZGAP as meeting Food Control Plan template requirements. As necessary, other additional modules (e.g. Environmental Management System, Social Practice Add-on) have been 'bolted on' to the GAP framework.

31. The development of formal industry IPM programmes for vegetable crops commenced in the 1990's with the

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[5] NZAET (2023). https://www.growsafe.co.nz/

development of a crop IPM manual for vegetable brassicas.[6] Following a further period of research, this programme has since been revised[7] and a 'ute guide' produced to assist with in-field identification of pest and diseases on vegetable brassica crop.[8]

32. In the intervening years, various NZ vegetable industry bodies have developed the following full or partial IPM programmes and resources for outdoor vegetable crops:

    (a) Lettuce;[9]

    (b) Sweet corn;[10]

    (c) Peas;[11]

    (d) Onions;[12] and

    (e) Potatoes.[13]

33. In recognition that comprehensive crop programmes are not yet available for all of the more than sixty types of vegetable crops produced commercially in NZ, the industry has also

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6 Berry, NA (2000) ed. Integrated pest management for brassicas. Christchurch: Crop & Food Research IPM Manual No. 11 ISBN 0-478-10817-6, 71 pp.

7 Walker, GP; Wright, PJ; Cameron, P; Berry, NA (2009). Information guide for integrated pest management in vegetable brassicas. Wellington: Fresh Vegetable Product Group of Horticulture NZ. ISBN 978-0-473-14901-7, 167 pp.

8 Walker, GP; Wright, PJ; Cameron, P; Fletcher, j; Walker, M; Bulman, S; Berry, N (2016). Pests, natural enemies, diseases and disorders of vegetable brassicas in New Zealand. Wellington: Vegetables NZ inc. ISBN 978-0-9876680-9-7, 120 pp.

9 Walker, G; Cameron, P; Workman, P; Wright, P; Fletcher, J; Stufkens, M (2008a). Information guide for integrated pest management in outdoor head lettuce in New Zealand. Wellington: Fresh Vegetable Product Group of Horticulture NZ. ISBN 978-0-473-13196-8. See also: Walker, G; Cameron, P; Workman, P; Wright, P; Fletcher, J; Stufkens, M (2008b). Handbook of pest, diseases, disorders and beneficials of outdoor head lettuce in New Zealand. Wellington: Fresh Vegetable Product Group of Horticulture NZ. ISBN 978-0-473-13197-5, 98 pp.

10 Reid, JB (2016a) ed. The sweet corn toolkit manual. 2nd edtion. Wellington, Process Vegetables NZ, 61 pp. See also: Reid, JB (2016b) ed. Sweet corn toolkit – ute guide. Wellington: Process Vegetables NZ, 96 pp.

11 Greenwood, R; Aves, C; Catherwood, D (2008) eds. Moking peas pay. Christchurch: Foundation for Arable Research. ISBN 978-0-473-13958-5, 68 pp. See also: Falloon, RE; Fletcher, JD; Scott, RE; Russell, AC; Goulden, DS; Ashby, JW (1998). Pea disease identification guide. NZ Institute for Crop & Food Research. ISBN 0-978-04682-0, 26 pp.

12 Munro, P (2007) ed. Best practices for integrated pest management in New Zealand allium crops. Wellington: Onions NZ inc. ISBN 978-0-473-12704-6, 94 pp. Also updated online 2019.

13 Anderson, S; Ogden, S; Williamson, S (2018) eds. Handbook of pests and diseases for New Zealand potato growers. Wellington: Potatoes NZ Inc. ISBN 978-0-473-45954-3, 148 pp.

produced a generic IPM guideline.[14] This resource, illustrated with NZ examples of vegetable IPM in action, is aimed at providing growers with an understanding of the key components and strategies for growing vegetables using IPM. It assists growers in demonstrating that they have implemented activities consistent with the key principles (Prevention, Observation & Monitoring, Intervention) required to meet the IPM requirements of NZGAP certification.

34. These programmes have undergone constant review as the industries concerned adapt to actual and anticipated changes in factors such as agrichemical availability (NZ and overseas regulations, consumer perceptions), development of new crop protection products (including biopesticides), biosecurity incursions, and climate change (distribution and frequency of pest and disease problems).

35. In some cases, application of IPM principles have achieved significant reductions in agrichemical applications to vegetables, only for these gains to be at least partially lost due to the subsequent emergence or arrival of new pest problems. For example:

(a) The introduction of imported parasitoids, crop monitoring and action thresholds saw process tomato insecticide applications reduced from 8 to 1 per crop from 1989 to 2006.[15] This trend was almost completely reversed following the arrival of the tomato-potato psyllid in 2006 and similar reassessments of insecticide programmes were required for potatoes.[16]

(b) The emergence of green vegetable bug (present in NZ since c. 1940) as a major pest in sweet corn in the

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14 Walker, M; Davidson, M; Wright, P (2019) Generic IPM guideline for vegetable crops. Wellington: Vegetable Research & Innovation Board, Horticulture NZ. PFR SPTS#17561, 56 pp.

15 Cameron, PJ; Walker, GP; Hodson, AJ; Kale, AJ; Herman, TJB (2009). Trends in IPM and insecticide use in processing tomatoes in NZ. Crop Protection 28: 421-427.

16 For example: Berry, NA; Walker, MK, Butler, RC (2009). Laboratory studies to determine the efficacy of selected insecticides on tomato/potato psyllid. NZ Plant Protection 62: 145-151

Gisborne region in the 1990's – possibly as a result of reduced insecticide use for other pests, combined with climate warming and expansion of crop areas.[17]

36. In order to manage pest and disease incidence, vegetable crops require frequent rotation. Part of the complexity of vegetable crop rotations is attributable to the fact that in order to reliably produce high value crops, vegetables are generally grown on highly valuable land. As a consequence of this, rather than rotating with pasture or arable crops (as occurs where land values are lower), vegetable crop rotations tend to involve other high value vegetable crops. As with nutrient budgeting, crop protection planning needs to take account of all the crops in the rotation and, sometimes, in the neighbouring region.

37. For example, lettuce and brassica crops are often grown in sequential plantings in close proximity (often by the same grower). In recognition of this, the brassica and lettuce IPM programmes have been modified to align seasonal windows for use of insecticide modes of action. This is so that efficacy of the available insecticides is maximised across both crop types while minimising the risk of resistance development due to local or region-wide exposure of multiple pest generations to a single insecticide mode of action.[18] Absence of such a co-ordinated approach is suspected as a cause of insecticide resistance development in one of the key pests involved elsewhere in the world.[19]

38. In order to reduce negative environmental and off-target impacts, growers need to move away from older broad

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17 Rea, JH; Wratten, SD; Sedcole, R; Cameron, PJ; Davis, SI; Chapman, RB (2002). Trap cropping to manage green vegetable bug Nezara viridula (L.) (Heteroptera: Pentatomidae) in sweet corn in New Zealand. Agricultural & Forest Entomology 4:101-107.

18 Walker, GP; Davis, SI; MacDonald GH; Herman, TJB (2012). Update on diamondback moth (Plutella xylostella) insecticide resistance and the vegetable brassica insecticide management strategy. NZ Plant Protection 65: 114-119.

19 Zhao, J-Z; Li, Y-X; Collins, HL; Gusukuma-Minuto, L; Mau, RFL; Thompson, GD; Shelton, AM (2002) Monitoring and characterisation of diamondback moth (Lepidoptera: Plutellidae) resistance to Spinosad. Journal of Economic Entomology 95: 430-436.

spectrum crop protection products while maintaining enough modes of action to avoid the development of pest and disease resistance. Aside from a few significant export crops, most of the NZ horticulture industry can be regarded as minor crops in terms of production area. This means that only relatively few crop production products are brought into New Zealand to be specifically registered for use on vegetables.

39. To counter this, beginning in 2009, the vegetable industry has taken a collaborative strategic view to crop protection, often in collaboration with other minor crop groups, to prioritise gaps in existing crop protection programmes to address the key challenges of access (regulatory review, commercial withdrawal) and acceptability (residues, non-target effects, resistance, non-compatibility with IPM).

40. An initial project (Sustainable Agrichemicals for Minor Crops, 2011-15) developed minor use patterns for multiple products and strengthened working relationships across the sector (5 vegetable and 7 fruit product groups) and with crop protection companies, research providers, regulators and international minor use programmes. Following this initial success, the VR&I Board initiated a proposal to build a broader programme across the food crop production industries. This evolved into A Lighter Touch (**ALT**) – a 7-year (2020-27), $27 million Sustainable Food & Fibre Futures project, hosted by Horticulture NZ, with 15 horticulture, wine and arable product groups participating.

41. A Lighter Touch has two main workstreams which involve improving access to crop protection products and taking a more integrated approach to crop protection. The first workstream is aimed at reducing off-target effects of crop protection practices and embedding increased use of biopesticides and biological control agents into crop protection programmes. The second workstream is to understand and better manage agroecosystems to reduce

the need for crop protection interventions and integrate more sustainable crop protection practices where they are still required.

42. A Lighter Touch has numerous research and extension projects underway in vegetable crops including 'softer' agrichemicals and biopesticides, biological control agents, soil health management, and decision support tools. Updated detail about these projects and the programme overall can be found on the programme website.[20]

43. Some of this work is being integrated into a 5-crop commercial vegetable crop rotation system on the Pukekohe Vegetable Demonstration Farm. This is a 5-year ALT project supported by Onions NZ, Vegetables NZ and Process Vegetables NZ and hosted by Balle Brothers Group. There are currently discussions underway about broadening this approach to form a Vegetable Industry Centre of Excellence based in the Pukekohe district. It is envisaged that this would provide a shared space for research and extension in sustainable vegetable crop rotations, particularly demonstrating best practice in an integrated farm system setting. In addition, the Centre would provide a platform for provision of on-farm horticultural education and workforce training across the vegetable industry.

Stuart Ian Davis

28 July 2023

[20] A Lighter Touch (2023). www.a-lighter-touch.co.nz