



EDITORIAL

From control to sustainability: 75 Years of the New Zealand Plant Protection Society

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By the early 20th century trade in primary production exports had become the cornerstone of New Zealand's economy. The economic prosperity from agricultural production was in large part a result of technological advances associated with the Green Revolution in the years following the Second World War. The post-war era saw the emergence of new synthetic chemicals, of which several were found to have utility in weed and pest management. The plant hormone herbicides (phenoxies including MCPA, 2,4-D, and 2,4,5-T) and organochlorine insecticides (most notably, DDT) led to spectacular advances that revolutionised agricultural pest management, reduced labour, and resulted in tremendous productivity gains. A leading figure in New Zealand's early agrichemical industry was Dan Watkins^a. In 1948, Dan hosted a sabbatical visit by Dr Alfred Pridham, a prominent weed scientist from Cornell University, with expert knowledge on the newly available phenoxy herbicides. It is said that the genesis of the Society, and its annual conference, took place at a tearoom in New Plymouth, where Dan and other pioneers of the agrichemical industry met with Dr Pridham. After this meeting, Dan suggested that a national conference be held, where government and industry representatives could come together to discuss matters related to weed control. Thus, the first 'National Weeds Conference' was held at Lincoln Agricultural College, in August 1948. There were just seven contributions to the first proceedings (Figure 1) but the success of the first conference led to it becoming an annual event.

The history of the Society and trends in the content of the conference proceedings were reviewed by Joan Pearson and Alison Popay and at the 50th anniversary (Pearson 1997; Popay 1997), and more recently by Terry Stewart who reviewed trends in the proceedings over a 40 year period, from 1976 to 2015 (Stewart 2016). Therefore, we do not wish to give an update on content trends, but rather use the occasion of the 75th anniversary as an opportunity to reflect on how and why the Society has evolved to its present state. Three periods of the Society can be recognised based on the changing content in the conference proceedings, and structural changes, including changing names and logos of the Society. We have termed these periods 'control', 'management', and 'sustainability'.

The control period: 1948 to 1978

In the first period of the Society, the emphasis was on 'control', particularly chemical control. This made sense given the initial purpose of the Society was to better understand newly available chemistry for solving weed and pest problems. The emphasis on control is evident in the subtle name change, applied at the fourth conference in 1952, to the 'New Zealand Weed Control Conference'. The addition of the word 'control' was likely a considered change to denote the focus on action, and not merely esoteric discussions about weeds. The post-war optimism about new technologies was obvious in the early proceedings and epitomised in a quote from Dan Watkins at the second conference saying: "I am confident that we really are on the threshold of a new era in agriculture, in which the age-old and laborious struggle with weeds that has so long been a millstone around the farmer's neck, is at last to be shaken off" (Watkins 1949). The newly available chemicals were revolutionary tools in the arsenal against weeds and pests, but needed to be understood, primarily from a practical point of view. The early proceedings consisted largely of anecdotal accounts of what chemicals to use, how much (rates and volumes), and when and how to apply them. These were undoubtedly

^a In 1946, a Taranaki company, Ivon Watkins Ltd, had become the New Zealand agent of 2,4-D (Weedone) produced by the American Chemical Paint Company. The company expanded during the next few years as New Zealand farm production increased, moving from simple distribution to manufacture of herbicides MCPA, and 2,4,5-T as well as 2,4-D. From 1948, Dan Watkins developed the company as an agrochemical business. 'Watkins, Daniel Anthony', *Dictionary of New Zealand Biography*, first published in 2000. Te Ara - the Encyclopedia of New Zealand, <https://teara.govt.nz/en/biographies/5w13/watkins-daniel-anthony> (accessed 5 October 2022).

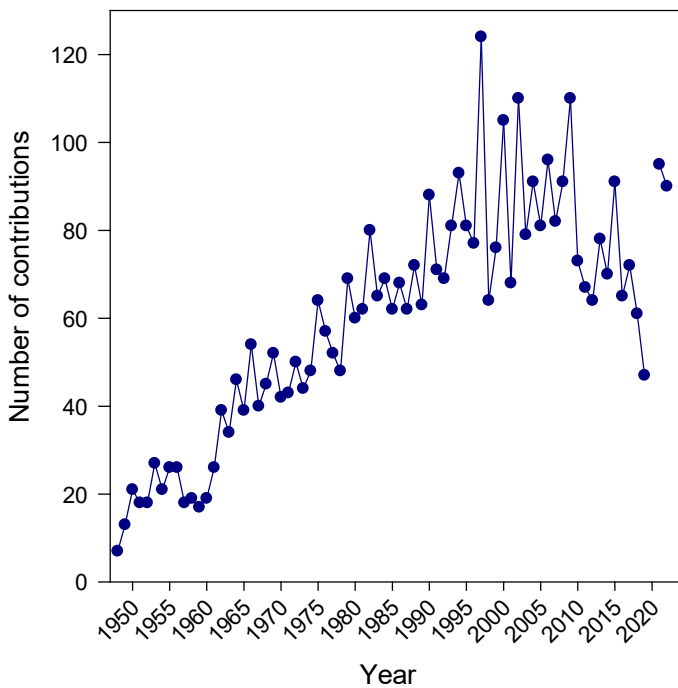


Figure 1 The total number of contributions (oral presentations and posters) at each conference. There was no conference in 2020 due to the covid-19 pandemic.

useful reports at the time, and it was clear that the Society played an important role in facilitating the sharing of knowledge that was being acquired from trials carried out by industry, government, and universities.

By the 10th conference, the formation of a professional society had occurred, with rules of the Society published in the proceedings, and the primary objective of the Society formally stated to 'pool and exchange information' concerning weeds and methods of weed control. Weeds and their control were the dominant focus of the Society for the first decade but papers on insecticides had become a regular feature by the early 1960s (Figure 2). In 1964, the name of the Society changed to the 'New Zealand Weed and Pest Control Society', to better represent the broader interests of the membership. The broadening of the Society to include pest control resulted in an immediate doubling of the number of contributions to the conferences, and a steady increase in contributions until about the year 2000 (Figure 1).

The control period of the Society saw the rise and fall of novel agrichemicals. The first decade of the Society was the heyday of unregulated use of pesticides, which ended with the passing of the Agricultural Chemicals Act of 1959. The Act was necessary and welcomed given the plethora of agrichemical products available. This early legislation was primarily concerned with the registration and labelling of agrichemicals to ensure they were safe and effective (Agricultural Chemicals Act, 1959 No. 51). However, this was just the beginning of progressive restrictions on the use of agrichemicals due to emerging issues with pesticide residues in food, frequent reports of crop damage from herbicide spray drift, and accidental poisonings. The most notable restrictions at the time were those imposed on DDT

through the 1960s until it was finally banned in 1970 (Hunt 2004). The banning of DDT was primarily due to fears that overseas markets might reject meat and dairy products due to the presence of residues (Harrison 1970; Thompson 1970). Then, in the 1970s, restrictions were imposed on the phenoxy herbicide, 2,4,5-T, due to concerns of a dioxin contaminant linked to human birth defects (Mason 1975). These issues featured prominently in the opening presidential addresses during this first period of the Society.

In considering this, it is important to remember that during this time, environmental hazards associated with pesticides were receiving increased public attention, in large part due to the publication of *Silent Spring*, by Rachel Carson, in 1962 (Carson 1962). Her book detailed the widespread and indiscriminate use of pesticides, particularly DDT, and is often credited with spawning the modern environmental movement (Dunn 2012; but see reply by Trewavas 2012). Negative effects of agrichemicals were taken seriously, and many papers in the proceedings were dedicated to avoiding spray drift and minimising effects of pesticides on non-target species, such as honeybees, and beneficial soil organisms (Palmer-Jones 1965; Kelsey 1969). While this was undoubtedly important work, much of it was done in effort to maintain the status quo of effective agrichemicals and avoid further restrictions. Based on the presidential addresses during this period, the general sentiment was that the benefits of agrichemicals outweighed possible negative side-effects, and the main problem was one of applicator error. For instance, Thompson (1964) began his opening address by recalling recent media headlines that highlighted environmental hazards of accidental or careless uses of agrichemicals. In his assessment, the real problem with these unfortunate incidents was that they "undermine[d]

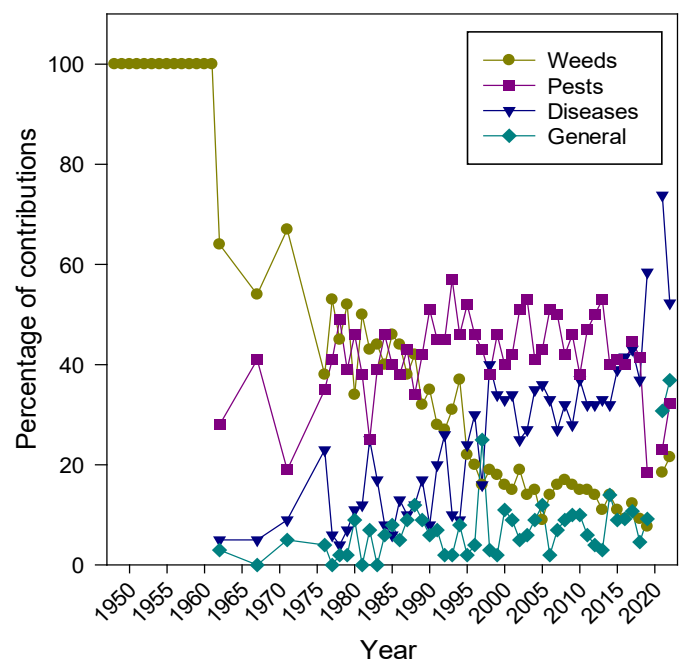


Figure 2 Percentage of contributions (oral presentations and posters) by topic (weeds, pests, diseases, or general). There was no conference in 2020 due to the covid-19 pandemic.

public confidence in the use of agricultural chemicals as a safe and satisfactory method of controlling weeds and insects". In a similar vein, Foreman (1965) remarked on the "Rachel Carson debate" and increasing restrictions, stating that "lack of knowledge resulting in improper usage can only result in more restrictive legislation". Thus, the plea to the Society was to better educate users of agrichemicals or face tighter restrictions on their use.

This period of the Society culminated with the opening address at the conference in 1978 by Dan Watkins. In his final address to the Society, he gave a scathing rebuke against "anti-technologists" who would seek to ban pesticides for environmental reasons and revert farming to the dark ages. Despite the dire warnings of Dan Watkins, the public and scientific thinking with respect to weed and pest control was changing. The Society was entering a new period, transitioning away from chemicals as the control panacea, towards more prudent usage of agrichemicals, integrated with non-chemical techniques.

The management period: 1979 to 1995

The second period of the Society began with the adoption of its first logo (Figure 3). In 1977, a compilation of possible logos was printed on the cover of the proceedings, and the winning logo was in use by 1979. The first logo was the depiction of a weed (a buttercup species) and a pest (a scarab grub), contained within a hexagon. The hexagonal shape denoted a benzene ring, a common chemical structure in pesticides. Thus, the first logo was intended as a literal depiction of a weed and pest under control of pesticides, which was still the predominant focus of the Society during this period^b. However, this second period of the Society, was a transitional stage, marked by a steady decline in the number of papers pertaining to chemical control (Figure 4). Over the course of this period, the emphasis shifted towards 'management' and learning how to live with pests, rather than attempting complete control.

There were many influences on the shift away from chemical control, including public pressure for safer food production, new technologies allowing for targeted pest management, and reduced efficacy of some agrichemicals due to evolved pest resistance. Presidential addresses at the time continued to extol the benefits of agrichemicals and dismiss public concerns as largely uniformed. In the 1980s, several Presidential addresses commented on the "2,4,5-T controversy". The issue was not new, but public attention on the possible link to birth defects was not going away (Wildblood-Crawford 2008). In reference to this controversy, the 1980 presidential address by Atkinson stated that it was "not the function of the Society to actively support any particular pesticide", but that the Society should not let false claims go unchallenged. Irrespective of conclusive evidence of the harmful human-health effects, the tide of public opinion had turned against this agrichemical (Wildblood-Crawford 2008). Along with public pressure, a new technology (glyphosate with an organosilicone adjuvant (Pulse®)) provided a safer and more effective alternative, making 2,4,5-T herbicide products unwanted and obsolete (Zabkiewicz 2008). Production and sale of 2,4,5-T ceased in New Zealand by the end of 1988, one of the last countries

in the world to ban or discontinue its use (Wildblood-Crawford 2008). The presidential address by Patterson in 1987 lamented the announced withdrawal of the herbicide, but astutely suggested broader communication with "environmentalists" and "those of different persuasions". He feared that the Society had become too introspective and noted that "the viability of the Society rests in its acceptance by others". The notion of 'social license' was taking root.

While agrichemicals still featured prominently, research on how they were being used, was changing. The messages of Rachel Carson were gaining traction, such as limited and more targeted usage of agrichemicals, informed by monitoring and pest thresholds. This was particularly evident in the horticultural industry, where new technologies were significantly reducing pesticide usage and making integrated management a reality. Many papers in the proceedings during this period showed that pesticides could be significantly reduced by using pheromones for monitoring, mass trapping, and mating disruption (Wearing et al. 1980). Furthermore, novel insect-growth regulator insecticides were proving to be highly selective at targeting pests while allowing for biological control with natural enemies (Walker et al. 1991). This transition away from calendar spraying to integrated management is detailed in the book, *Farewell Silent Spring*, written by Howard Wearing, the inaugural recipient of the Society's Plant Protection Medal in 2007 and published by the Society in 2019 (Wearing 2019).

Another technological breakthrough during this period was the use of novel endophytes to manage pasture pests. From the early 1980s to the present time, many papers in the proceedings were focused on understanding the symbiotic relationship between endophytic fungi and pasture grasses, and how to manipulate this association for pest management (e.g. Prestidge et al. 1982; Ball et al. 1994; Popay et al. 2003; Barker et al. 2015). The discovery that different strains of fungal endophytes (*Epichloë*



Figure 3 The first logo of the Society in use from 1979 to 1995 (left), and the current logo of the New Zealand Plant Protection Society, in use since 1996 (right).

^b Prior to the 75th anniversary conference, an article in the March 2022 Society Newsletter speculated that the hexagonal shape and the balanced light and dark halves of the logo might symbolise harmony, and hint at the interconnectedness of ecological systems. However, at the 75th Annual General Meeting of the Society, it was determined that the hexagonal shape of the first logo was intended to represent a benzene ring.

species) produced different alkaloid profiles, allowed for the development of endophytes with selective activity against invertebrate pests, while being safe for livestock. Decades of government and industry collaborations resulted in commercialisation of many grass cultivars in New Zealand with novel pest resistance mechanisms, which reduced reliance on pesticides for pasture-pest management (Easton et al. 2001; Caradus & Johnson 2020).

Another driver in the reduction of agrichemicals was the increasing number of cases of evolved pest resistance. The issue of resistance was not new (e.g. Perrott 1965) but, by the 1980s, there were growing concerns about the need to preserve the efficacy of the remaining agrichemicals available. The Society played a leading role in tackling the issue of resistance through the formation of the New Zealand Committee on Pesticide Resistance in 1987. This joint government and industry initiative identified existing and potential resistance problems, and published resistance-management strategies (Elliott et al. 1987; Bourdôt & Suckling 1996).

By the end of this period, it was clear that the approaches to pest management had changed and would continue on a different path. Looking toward the future path of the Society, the presidential address by Hartley in 1990 advised, albeit somewhat reluctantly, that “we will have to divert our attention to non-chemical methods, or techniques to reduce chemical use.” In 1992, the present name of the Society was adopted, the ‘New Zealand Plant Protection Society’. The change to Plant Protection, encompassed different scientific disciplines, primarily weed science, entomology, and plant pathology (Figure 2). An interdisciplinary approach to plant protection made sense. A common goal of these different disciplines was recognised, to protect agricultural crops from losses, and achieve productivity that contributed to the prosperity of the nation and global food security. The name change was not merely expansionary, but also reflected the shift in thinking towards integrated approaches to pest management. With regard to the name change, the presidential address by Willocks in 1992 said that “the change of name has been seen as a positive move in responding to the real function of the Society’s members, one of management rather than control”. Similarly, the new thinking was summarised by Popay in the 50th anniversary proceedings as: “What was once a question of finding a control is now a case of providing a management strategy.”

The sustainability period: 1996 to present

The third period of the Society started in 1996 with the adoption of the present logo (Figure 3) and was the beginning of the current form of the Society and conference that exists today. In 1996, the current logo (designed by competition winner Jane Mortimer) was described by the President at the time, Richard Falloon. The arrows indicate interactions and information exchange that occurs through the interdisciplinary approach to plant protection. The protective circle conveys plant health resulting from plant protection activities, and *sustained plant health* is depicted as the plant grows through the circle. The emphasis shifted towards working with nature and ensuring ‘sustainable’ solutions to pest problems.

The concept of sustainable pest management was evident in the papers presented at the 50th anniversary conference in 1997 (e.g. Waage 1997; Wearing 1997; Wratten et al. 1997). This conference was held jointly with the New Zealand Biosecurity Institute and had the greatest number of contributions to date (Figure 1). The conference was convened under the banner: “Plant Protection in a Green Oasis – the next 50 Years”. The notion of New Zealand as a ‘clean green’ oasis had emerged, both as a marketing tool, and an ambitious target (Richards 1997; Coyle & Fairweather 2005). It was clear that the public not only wanted safe, residue-free food, but also food produced in an environmentally responsible manner. Sustainable agriculture was the answer. While somewhat murky in its inception, it was an aspirational goal to achieve enduring agricultural systems – agriculture for now and forever. The connection of sustainable agriculture and New Zealand’s image as a trusted producer of primary products was highlighted in the presidential address by Stevens in 2007, who noted that the many aspects of sustainability “link together to represent the ‘clean green’ New Zealand, which is precious to us all”.

This period of the Society is marked by far fewer papers presented on the control or management of particular weeds, pests, and diseases (Figure 4). A notable difference is that about half of the papers presented at the conference are of a general nature, often pertaining to understanding pests within ecological systems. The other half consist of papers on chemical, biological, or cultural control methods, with chemical and biological control represented in roughly equal numbers (Figure 4). During this period, most papers have been presented in the context of promoting sustainable agriculture; for instance, by reducing pesticide usage, managing resistance, enhancing ecosystem services, or protecting biodiversity.

In line with the concept of sustainability, this period contains more future-focused work pertaining to biosecurity and protecting against potential threats to our primary production sectors and the natural environment. The Biosecurity Act of 1993 and the Hazardous Substances and New Organisms Act of 1996 provided the modern legal framework for managing pests and unwanted organisms (Teulon et al. 2012). However, the term ‘biosecurity’ was not frequently used in research papers until after the 2002 symposium “Defending the Green Oasis: New Zealand Biosecurity and Science” (Goldson & Suckling 2003). After this, biosecurity became a common theme of papers at the conferences and a regular topic of pre-conference symposia.

With increasing international trade and tourism, biosecurity in New Zealand took on a heightened sense of importance, both from economic and ecological perspectives. New Zealand’s economic dependence on agricultural exports necessitated increasingly stringent biosecurity measures to ensure products were free from pests and diseases. From an ecological perspective, the isolated biogeography of New Zealand has created unique ecosystems that are highly vulnerable to exotic pest species. Agricultural systems in New Zealand are almost entirely comprised of imported plant species, primarily from the northern hemisphere. These are highly productive, but simple, systems that lack biotic resistance to pest incursions and, therefore, impacts can be devastating (Goldson et al. 2020).

The vulnerability of New Zealand’s ecosystems extends to its unique native flora, of which 80% of species are found nowhere else in the world. Until this period of the Society, native plants or ecosystems were scarcely mentioned. The Society’s role in facilitating biosecurity research led to a logical expansion in the scope of the Society. The plant protection skills and expertise applied to the primary production sectors were now being used for the protection of the natural environment and native species. Sustainable pest management is an ongoing goal, and the Society continues to play a leading role in facilitating the exchange of information related to protecting agricultural and native plants against current and potential future pests.

People make the Society

The success of the Society is due to the commitment of its diverse (industry, government, and academia) and interdisciplinary (weed science, entomology, plant pathology etc.) membership. Over the years, there have been many changes to the science structure in New Zealand, including the formation of the Crown Research Institutes (CRIs) in 1992. Commenting on the newly formed CRIs, the presidential address by Willocks stated that “it is inevitable that barriers will develop, inhibiting the free flow of information to the detriment of plant protection research”. Indeed, his prediction became reality; but despite these changes, the Society remained an independent body where everyone contributing to plant protection research and extension could come together to share their knowledge and experiences.

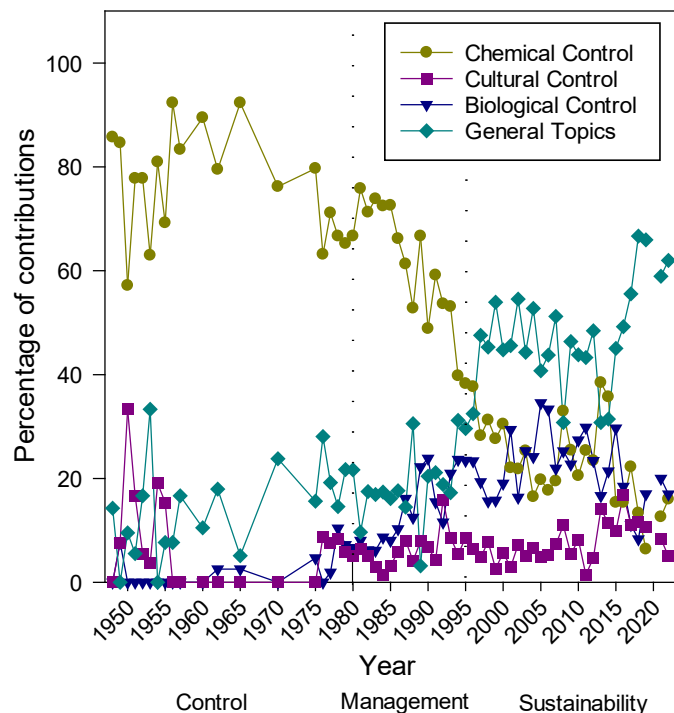


Figure 4 Percentage of contributions (oral presentations and posters) categorised by type of control method. There was no conference in 2020 due to the covid-19 pandemic.

Members have contributed to the functioning of the Society in various ways, including leadership and governance roles on the Executive Committee, and regular attendance and participation at the conferences. Since the inception of the Society, at least 135 individuals have served on the Executive Committee. Five of these committee members stand out for exceptional service with over 20 years on the committee: Les Matthews, Frank Allen, Anis Rahman, Jennifer Hartley, and Trevor James. Appropriately, all five are life members of the Society.

Some members stand out for their exceptional contributions to the Society’s annual conferences. As part of the 75th anniversary celebration, authors with over 50 contributions (full papers and poster abstracts) in the proceedings/journal were recognised at the conference in 2022 (Table 1). It is important to note that these papers represent presentations at the conference since, until 2020, it was required to publish in the proceedings or journal to present at the conference. Thus, more than merely prolific authors, these contributions demonstrate decades of support for the Society and its annual conferences.

In 2007, the Society instituted its ‘Plant Protection Medal’ to recognise individuals who have made exceptional contributions to plant protection in the widest sense. The medal is awarded based on outstanding services to plant protection, whether through research, education, implementation, or leadership. To date, there have been 15 recipients representing some of the best contributions to New Zealand plant protection from industry, government, and academia. Medal recipients are nominated by their peers, and the award is announced at the Society’s annual conference. The Society proudly acknowledges the influence that these individuals have had on delivering new products to the market, enacting practice change in industry, enhancing biosecurity, and generally ensuring New Zealand is recognised on the international stage for sustainable, safe food production. Often their influential work is evident in articles published in the Society’s journal over many years.

The Society’s journal is highly valued by members, however, wider changes to research funding, and scientific publishing, have had major impacts. Contestable funding has led to a focus on outputs and the measurement of quality via metrics such as journal impact factors. Since presenters at the conference were required to publish their work in the proceedings, the number of contributions declined over the decade from 2010 to 2020 (Figure 1) as researchers prioritised publishing their work in higher ranked outlets. Fewer papers meant fewer presentations and a more limited range of topics, which had a negative impact on the conference, and the primary objective of the Society to ‘pool and exchange information’ related to plant protection. Therefore, in 2019, a decision was made to separate the conference and the journal. The two conferences since then have benefitted from higher attendance and a greater number of presentations (Figure 1) on a broader range of topics. At the same time the number of journal papers has declined, as expected. Printed copies of the journal have not been produced since 2019.

Over the years, the Society has published a number of books written by members. Alan Uprichard’s book *A Guide to*

the *Identification of New Zealand Common Weeds in Colour*” was published by the Society in 1985, and reprinted four times, last in 1997 (Upritchard 1997). Sales of this book were said to have ‘saved’ the Society at time when finances were tight. This book was superseded by another great earner for the Society, *An illustrated Guide to Common Weeds of New Zealand*, written by Bruce Roy, Ian Popay, Paul Champion, Trevor James, and Anis Rahman, and first published by the Society in 1998 (Roy et al. 1998). This was an expanded weed identification book that included supporting text along with the weed photos. It has undergone three editions, the third edition published in 2010 (Popay et al. 2010). The dedicated, and largely volunteer effort of these authors, has resulted in valuable resources for the plant protection community and substantial financial support to the Society. While the weed identification books have been financial earners, the Society is also committed to publishing books that might have a narrower focus on aspects of plant protection, such as *Plant Protection in Organic Arable and Vegetable Crops*, (Teulon et al. 2005), and the more recent, *Farewell Silent Spring: the New Zealand Apple Story* by Howard Wearing, published in 2019 (Wearing 2019). The success of the Society today is due to these contributions of the past, and the ongoing support of approximately 360 current members.

The future of plant protection and the Society

In a future with increasing global trade, rising human population, and changing climate, plant protection research and extension activities that deliver innovative and sustainable plant protection solutions are vital for the wellbeing of New Zealand. While the structure of the society has changed over the years, and the approaches to pest management have changed, the essence of the vision set out 75 years ago to bring together industry, government, and university researchers, to ‘pool and exchange information’, is still relevant today.

In a general sense, future issues for plant protection are bound to centre around the age-old debate about whether to embrace technological versus ecological solutions for a sustainable and productive future. Of course, the two

Table 1 Authors with more than 50 contributions (full papers and poster abstracts) published in the Society’s conference proceedings/journal between 1948 and 2020.

Author Name	No. papers as first author	No. co-authored papers	Total
Anis Rahman	60	77	137
Trevor James	55	69	124
M. Jennifer Hartley	59	7	66
Max Suckling	25	38	63
Jim Walker	14	48	62
Robert Beresford	20	38	58
Monica Walter	16	40	56
David Teulon	25	27	52

approaches are not mutually exclusive; but New Zealand will need to grapple with which technologies to embrace, and which to avoid, in order to achieve its specific future goals.

Many future challenges will likely be familiar. Continued restrictions on the availability of agrichemicals will be a challenge in the near future. Organophosphate insecticides are scheduled to be phased out over the next five years and even glyphosate, once generally regarded as safe and environmentally benign, is under review for a second time by the New Zealand Environmental Protection Authority. As in the past, the removal of agrichemicals creates an immediate crisis, but also an opportunity for further research and practice change. Legislative restrictions and public opposition to synthetic agrichemicals may yet spur the long-anticipated age of biopesticides and bioherbicides (O’Callaghan et al. 2015).

Climate change mitigation and adaptation will continue to be a cross-cutting theme of plant protection research, as every aspect of agricultural production must be scrutinised for means to achieve a lighter environmental footprint. Along with new technologies, ecological approaches to plant protection will be important to meet international commitments to reducing greenhouse gas emissions and achieving a ‘clean green’ image. Consequently, there will likely be increased uptake of holistic farming systems supported by transdisciplinary research. Such research emphasises minimal agrichemical inputs and aims to protect plants by promoting ecosystem services.

Like an echo from the past, the structure and funding of government research is set to change again. However, unlike the past formation of the CRIs, change to the present system is generally welcomed. The current Te Ara Paerangi – Future Pathways government review of the science system in New Zealand provides a high-level plan to breakdown some of the barriers to efficient and effective collaborative research. Changing cultural values will also feature prominently in future restructuring with the aim to embed the principles of Te Tiriti o Waitangi within the science system and provide more opportunities for mātauranga Māori. Thus, shifting cultural values will continue to shape plant protection science and the Society. As far as we are aware, the 75th anniversary conference in 2022 was the first to begin with a mihi whakatau. This practice is intended to continue, and the Society will undoubtedly continue to change in various ways to incorporate Māori views and knowledge.

The Society remains as relevant as ever in a world plagued with plant protection challenges that threaten food security. As long as the Society continues to be a place of robust and constructive debate and remains able to adapt to the needs of the plant protection community in New Zealand, it has a great future.

LIST OF ABBREVIATIONS

2,4-dichlorophenoxyacetic acid (2,4-D)
 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)
 2-methyl-4-chlorophenoxyacetic acid (MCPA)
 Dichlorodiphenyltrichloroethane (DDT)

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