THE HISTORY OF PLANT PROTECTION IN NEW ZEALAND: A SURVEY OF CONFERENCE PROCEEDINGS

A.J. POPAY

AgResearch, Ruakura Research Centre, Private Bag 3123, Hamilton

ABSTRACT

Eleven conference Proceedings spanning 50 years were surveyed. Weeds, pests and pathogens in pasture and crops have been the main fields of research. Chemical control has been the major focus of research for weeds and pathogens but there has been an increasing emphasis on biological control in recent years, particularly for invertebrate pests. Government personnel have been the major contributors to Conferences, but representatives of the pesticide industry also contributed many papers from the 1960s to the early 1980s. The weeds, pests and pathogens which have dominated research are outlined and some control measures highlighted. The importance of pesticides to plant protection and changes in their use in the last 50 years are summarised.

Keywords: weeds, invertebrate pests, pathogens, pesticides, biological control

INTRODUCTION

Throughout the first half of this century as more and more land was developed for agriculture, weeds had become an increasing menace and a major barrier to continued land development. As W.J. Tripe (4th Proc., 1951) commented: "Fifty years ago today the axes were ringing in the bush on my country - in the winter of 1901 - and in the following summer, after the burn, the packmen, and some of the bushmen would be cutting tracks for the horses with the grass seed. Today people look at gorse and thistle-covered gullies and ridges not far away and say that it would cost more to clear the country and get it back to grass than the land is worth. Good land has become marginal land solely because of the spread of weeds and the cost of weed control. What a betrayal of our heritage! What a problem for posterity if it has to maintain an expanding political economy still based on a contracting farm economy!" Prior to the second world war there had been few options for controlling these weeds but in the late 1940s the advent of hormonal weedkillers revolutionised weed control. Although expensive, these herbicides made control, and even eradication, of weeds seem possible.

It was against this background that the idea of a national Weeds conference was first conceived, apparently in a tea shop in New Plymouth, in June 1948. The first conference was convened at Lincoln Agricultural College two months later in August and brought together representatives of scientific research, agricultural departments, pesticide manufacturers, Federated Farmers, New Zealand Railways and County Councils. Seven papers were presented, four on chemical control, one on control of aquatic weeds and two on weeds in pastures, playing fields and field crops.

From these small beginnings grew a Society which has become a major vehicle for the communication of scientific research on weeds, pests and pathogens in New Zealand. By the 10th Conference rules governing the Society had been laid down and among them was the stated aim of the Society "to pool and exchange information concerning weeds and methods of weed control". Over the years the aim of the Society has changed little apart from the incorporation of pests and pathogens into the programme. The question is - has the sort of information we pool and exchange changed much in the last 50 years? This paper sets out to examine this question.

FIELDS OF RESEARCH

Proc. 50th N.Z. Plant Protection Conf. 1997: 344-354

Table 1 represents the results of a survey of 11 Proceedings over the last 50 years, giving the number of papers in each field of research. Where papers span topic areas a proportional estimate of the content of the paper has been made.

Not surprisingly pasture and crops have been dominant fields of research but in recent years fruit crops have also become of major importance and now rank alongside the former two in terms of numbers of papers. The pastures area includes papers on lucerne of which there have been a considerable number over the years, particularly in the 1970s. Lucerne's value to the New Zealand pastoral industry was reflected at the 30th Conference in 1977 when a whole session of 11 papers was devoted to the Blue Green Lucerne Aphid, a recent and unwelcome immigrant and a major threat to the viability of lucerne. In the crops area, cereals have been a regular focus of attention throughout the last 50 years but no more so than at the 35th Conference in 1982 when 20 papers were concerned with problems in cereals. In a situation analogous to that of lucerne in 1977, it was the arrival of a pathogen, stripe rust, which sparked much of the interest in cereals that year. Papers on various vegetable crops, such as brassicas, peas, carrots, onions and potatoes, have also abounded in the last 50 years although potatoes have received little recent attention. Other crops have come and gone. In the early years a few papers made mention of weed problems in linen flax and linseed was another crop which has largely disappeared from the agricultural industry. Yet others, such as asparagus, have emerged to become important in the export trade while herbs and ornamentals reflect New Zealand horticulture's increasing diversification. In the fruit crops area, papers on kiwifruit and pipfruit have been predominant but papers on grapes, blueberries, tamarillos and many others are also indicative of a burgeoning fruit and wine industry in this country. The environment section includes research into aquatic weeds, weeds and pests of urban and amenity areas, and weeds associated with railways, while general papers cover topics such as general pesticide use, policy issues and technique papers.

TABLE 1: Number of papers in each topic area in 11 Proceedings spanning 50 years.

Proc. No.	Number of papers in each topic area					
	Forestry	Pasture	Crops	Fruit	Environ.	General
1		3	2		1	2
5		7	3		1	1
10		10	8			
15		11	18		1	6
20		19	18		2	1
24	9	10	17			2
30	2	28	15	2	4	
35	4	23	35	13	1	5
40	2	21	17	14	1	4
45	4	9	20	32	3	2
49	3	20	13	21	4	
Total	24	161	166	82	18	23

WEEDS

Weeds, of course gained a head start on pests and diseases in terms of amount of information presented with the first 14 conferences devoted entirely to different aspects of weed control. Even with the introduction of pests and pathogens to the conferences in 1962, weeds continued to be the main subject of papers and it is only in the last 10 years or so that pest papers have started to regularly outnumber those on weeds.

The dominance of weeds in agriculture was well illustrated in a comprehensive paper given at the 5th Conference (1952) by that doyen of the weeds world, Arthur Healy, on the introduction and spread of weeds. He showed that there had been a steady accession

of weeds from 1786 up to that time so that the alien flora now numbered some 1200 species. Of these, over 500 were estimated to be widely established while the remainder were more local in their distribution and were less abundant. Only a small proportion of these alien species became serious and persistent weeds. Chief among those, if numbers of papers published on them can be used as a measure of their importance, are gorse, thistles and barley grass, with ragwort, wild oats, fathen, black nightshade and dock of slightly less consequence. All these, with the possible exception of barley grass, remain popular subjects of research - once a weed, always a weed! Indeed it is interesting to note that in the late 1800s the spread of Californian thistle was taken so seriously that the Government offered the princely sum of £250 for an effective eradicator.

Papers at the first four conferences were largely uncluttered by anything remotely resembling experimental data, but nevertheless contained many words of wisdom which are as relevant today as they were 50 years ago. Mr G.S. Harris, Grasslands Division, D.S.I.R., posed the critical question at the 1st Conference (1948): "Why is this plant growing where it is undesirable?". He went on to say that "unless we have a knowledge of why weeds invade pastures and turfs we cannot formulate control measures to eliminate undesirable plants and retain those which we require our first excursion must therefore be into the realms of ecology and ecological relationships of the sward...Any treatment of a sward, be it pasture or turf, which will maintain a dense, healthy cover of the desired species all year round will be the best insurance against the development of a weed flora. This, in itself, opens up a further large field in the study of species and strains, fertilisers and their effect on the growing plant, soil fertility and the appropriate species for best growth at varying fertility standards, grazing management, and a host of others".

Although this sort of message was echoed several times in the first four Proceedings, there have been few ecological papers published on weeds in the last 50 years compared with the number on chemical control (Fig. 1). Of the 234 papers presented on weeds in the 11 Proceedings surveyed, 77% were on chemical control, 13% were concerned with other forms of control, while the biology and ecology of weeds was the subject of only 6% of papers.

This emphasis on chemical control is perhaps not surprising given the enormous developments in the pesticides industry which took place after the introduction of the hormone weedkillers, 2,4-D and 2,4,5-T. The only weedkillers which had been available prior to this were almost totally non-selective and often highly dangerous, while mechanical and cultural methods of weed control involving cultivation, fire and fallow were arduous and often not particularly effective. For instance the following was recommended by A.H. Flay (5th Proc., 1952) to get rid of grassy weeds before planting a crop: Old pastures should be skim ploughed in November/December and fallowed through the summer and autumn during which time three ploughings, as many as 10 or a dozen grubblings and four or five harrowings are carried out before a crop is finally sown in late April or May.

While the arrival of the hormone weedkillers was generally greeted with great enthusiasm and hope for the future, others were less than confident about their usefulness: Dr Yeates (1st Proc., 1948) in discussion said "I think at this stage of the development of weedkillers for pasture work, there can be very grave dangers if there is any general impression given to farmers that the weed-killer as such is going to bring about much improvement in his pasture. ... It is no use using a weedkiller if you do not manage your pasture properly. It is far better to manage your pasture and do without the weedkiller". Also at the 1st conference Doak in his paper warned that "the exploitation of 2,4-D and related chemicals is following a pattern which has become all too familiar in recent years. First comes the subdued but natural enthusiasm of the discoverer, followed closely by the extravagant and largely imaginary claims of the 'popular press', in which miraculous results are described. Following this comes a more reasonable but probably overenthusiastic attitude to the new development. Scientific investigations gradually show the strengths and weaknesses and if the weaknesses overshadow the successes, then the product is on the way to oblivion". Doak's concerns were largely unfounded and 2,4-D and 2,4,5-T went on to play a large part in agriculture up until the

FIGURE 1: Number of papers published on chemical and biological (includes cultural measures) control of weeds in 11 Conference Proceedings spanning 50 years.

withdrawal of the latter from the market at the end of 1988.

In the early years there was very little definitive information on what weeds could be killed by which chemicals, the rates that should be used (Mr Watkins believed that all plants were susceptible to the weedkillers - it just depended on the rates applied), whether use of chemicals should be supplementary or complementary to use of other farm practices and even whether they could be used in the rain. On this latter point there was some disagreement between Mr Dan Watkins and Mr Paul Lynch. Mr Lynch maintained in his introductory address that rainfall immediately after application of hormone sprays would minimise their effectiveness but Dan Watkins disagreed with this statement. However it was subsequently pointed out that Mr Watkins trials had been conducted on the New Plymouth Golf Course and application of the sprays had been followed by mowing of the grass with the grass clippings protecting the spray.

The testing of new chemicals on different weeds, application techniques, optimising rates and times of spraying have all been the subject of many papers at Conferences in the last 50 years. There is no doubt that herbicides and the associated research has contributed enormously to reducing the weed problem in New Zealand. As J.E. Bell said in his Presidential address to the 13th Conference 1960: "The introduction of 2,4-D and 2,4,5-T made sweeping changes in weed control and gave the basis of the present weed control industry in New Zealand. ... Advances in herbicides have been so great and so rapid that we have in some instances reduced weeds to impotency. However the job is largely unfinished, all weeds are still a problem". He went on to say that a knowledge of the ecology of weeds was also needed so that more complete information could be obtained on the action of herbicides, and that "more recognition should be given to the integration of chemical and cultural methods".

While many placed great faith in the ability of herbicides to get rid of weeds with predictions of Californian thistle becoming "museum exhibits" and "blackberry pie becoming a thing of the past", others were more circumspect. Harris (1949) ... "by use of chemicals to eradicate the weed population of an established sward, we succeed in our objective, we have merely removed the effect (the weed in the sward) and may not at all have affected the cause (the reason why the weed appeared in that sward). This being so it is entirely probable that reinvasion of weeds will occur in a very short time, and the control measures will be largely wasted. The whole problem, immense as it is, boils down

in the end to a problem of ecology". While this was all very well in theory, the practical reality was much more difficult to achieve as W.J. Tripe, a farmer from Wanganui, reported in a most interesting paper to the 4th Conference (1951) on the difficulties of controlling variegated thistle. He found that rotational grazing was effective in reducing the thistles but the problem was then to establish a suitable pasture plant which would "compete with and subdue variegated thistles on what has become the thistle's home ground". He tried to establish various conventional and not so conventional plants in the place of thistles but found the only one which would compete successfully with the thistle was barley grass. He did not, however, expect many people to be impressed by the idea of sowing barley grass, as indeed they weren't. Nevertheless he had made his point - there was no use in endeavouring to control weeds if suitable pasture could not be found to replace them.

Although throughout the last 50 years there has been a strong emphasis on chemical control of weeds, other forms of control have not been ignored. In his comprehensive paper at the 1st conference, G.S. Harris mentioned several different control measures that could be employed on a variety of weeds with an emphasis on the use of grazing pressure and plant competition... "Much labour has been wasted in the control of gorse through the failure to appreciate the assistance which may be gained through the competitive effect of a dense, healthy pasture sward". Ragwort - "under cattle grazing ragwort can become a serious pest, but under sheep the plant never becomes a serious menace due to the influence of the grazing animal on plant competition". Control of blackberry and gorse by goats was also mentioned as was biological control of gorse by gorse weevil. In 1949 at the 2nd Conference Dr D. Miller of the Cawthron Institute presented a paper on the biological control of weeds. Candidates seen as suitable for use of biological control agents at the time were blackberry, ragwort, piri-piri, gorse, St John's Wort and manuka. Some work had also been done on control of bracken and variegated thistle but these had not been pursued. Biological control of blackberry was subsequently abandoned when it was found that the insect concerned was also partial to apple foliage. Control of ragwort by cinnabar moth met with some minor success but this moth was unable to maintain its populations because of predation and parasitism. The ragwort seed-fly had also been established but not yet evaluated. An insect imported from Chile to control piri-piri did exceedingly well on experimental plots at the Cawthron Institute but failed to establish in the field despite being liberated in large numbers. Gorse weevil was established throughout New Zealand and had in some areas been judged to be very successful in reducing the amount of viable gorse seed, so successful, in fact, that it was exported to Tasmania, Hawaii and other parts of the United States. A beetle imported from Australia for control of St John's wort proved to be highly successful, virtually eliminating this weed from large areas. Another unintentional introduction was manuka blight, caused by a scale insect, which was considered to be very successful in reducing the long term viability of manuka scrub.

For the next 30 years papers on biological control and use of grazing management were relatively scarce but in recent years numbers of papers on these topics have increased as aspects of control mentioned in very early Proceedings are being revisited. For instance fungi, first investigated in 1910, for control of Californian thistle, have been the subject of several recent papers. So too has the use of grazing management and pasture competition for control of this weed. Both of these were mentioned by Saxby in 1952.

One area of research into weed control which has been neglected is damage assessment and economic impact studies. Amongst the 234 papers surveyed, only 1.5% of them dealt with these aspects. It was the great Dan Watkins at the 1st conference (1948) who said: "I feel this conference should be able to decide what loss of production there is to the country through weeds, by competition, starving out the useful grasses ... If weeds are as important as we believe they are, then I feel sure that the greatest publicity should be given to the fact that those weeds cost money through the lack of production". Nineteen years later this message was echoed by M.S. Foreman in his Presidential address.. "Surprisingly we have little idea just what weeds and pests are costing us today in terms of productivity. In all conscience this is a gross deficiency". With some notable

exceptions these statements remain largely true today.

INVERTEBRATE PESTS

Although the first insect pest papers did not appear until the 15th Conference in 1962, first mention of them was made at the 2nd conference (1949) when Dr Miller in a paper on biological control of weeds warned against the indiscriminate use of pesticides such as DDT and gammexane and the effect of these on non-target organisms. Subsequently in the 4th conference some mention of grass grub and porina was made in relation to weed infestation of damaged areas. At the 15th Conference 11 papers concerning invertebrate pests and their control were published and by the following year pests had attained sufficient status to have a sketch of an adult grass grub on the front cover of the Proceedings. Two years later and 'Pest' had been incorporated into the title of the Proceedings.

During the 15 years following the second world war, DDT and other organochlorine insecticides had kept many of the major pests of crops and pastures at bay. By the early 1960s, however, there were increasing concerns about DDT residues accumulating in pastures and food products and this, coupled with the threat of pesticide resistance developing, meant that the future use of these insecticides was far from secure. Unfortunately DDT had not only suppressed the insect populations - it had also suppressed the need for research on them as J.M. Hoy pointed out in a paper at the 16th Conference (1963). Thus when invertebrate pests were included in the papers published by the Society there was a dearth of information on them. Indeed at the 15th Conference J.E. Bell gave a paper on the control of pasture insects which dealt with chemical control of black field cricket, black beetle, white-fringed weevil and army caterpillar. Grass grub described as "probably New Zealand's worst insect" was not dealt with in the paper because there was "little that was new to report".

In the first 15 years of publication of insect papers in the Proceedings chemical control trials largely dominated the work reported (Fig. 2). In the last 15 - 20 years an increasing number of papers have concentrated on alternative methods of control. Of the 188 invertebrate pest papers surveyed in eight Proceedings, 32% have been on chemical control compared with 25% on other forms of control. This is in stark contrast to the situation with weeds and pathogens (outlined below). Unlike weeds and pathogens too, a significant proportion of papers have included aspects of biology and ecology (13%) and damage assessment and economic impact studies (21%). On the latter point one of the most comprehensive studies on economic impact of pests was presented to the 20th Conference by R.C. Jensen in 1967. In his paper, which largely focused on determining the economic impact of grass grub, he pointed out the difficulties of doing economic studies ... "Measures of the contribution of improved technology to agricultural productivity largely overlook the contribution of the scientist in the defensive field". The defensive field referred to the maintenance of existing productivity levels against natural causes which tended to reduce them. Jensen went on to say that "the more successful a farmer is in eradicating pests and diseases, the more difficult it is to assess their effects". In other words, although pasture pest control contributed to national production, its costs and benefits often lay hidden.

Biological control has been a major focus of attention, particularly in recent years with several introductions of parasites and predators to control pasture, crop and fruit pests. In the last 20 years integrated control has become a catch cry, particularly in the orchard, while, more recently technological developments such as the identification and use of sex pheromones are proving successful in reducing insecticide use. Much of the research in both horticultural and fruit crops has been aimed at reducing the reliance on chemicals by various monitoring methods, and there is now a much greater awareness of the need to protect parasites and predators from sprays. Papers on pesticide resistance have also proliferated in recent years.

Not surprisingly grass grub takes top honours for being the most popular subject of papers on invertebrate pests. Up until 1963, however, there was a "very limited precise knowledge" of the biology and ecology of this pest (Hoy, 16th Proc., 1963). In his paper on "Summation of grass grub research in New Zealand", Hoy outlined the need for

FIGURE 2: Number of papers published on chemical and biological (includes cultural measures) control of invertebrate pests in 11 Conference Proceedings spanning 50 years.

further research on these aspects but pointed to the difficulty of doing it with such a widespread use of insecticides. Subsequently it wasn't until the 1970s and beyond, after DDT use was banned, that much of the ecological work on grass grub was done. In the 1970's the discovery of sex attractants for grass grub was hailed as a breakthrough but proved to be impractical for field use. Other ecological work revealed the presence of several natural pathogens which have an important regulatory role in populations. One of these, *Serratia entomophila*, led to the development of a microbial insecticide for use against grass grub. Today grass grub receives relatively scant attention from researchers compared with its hey day in the 1970s and 80s. This situation is similar for other major pasture pests such as porina, black field cricket, black beetle and soldier fly, although a relatively large investment in Argentine stem weevil research is maintained because of its relationship with endophyte and the successful introduction of a parasitoid. In the crop field, aphids have received prominent attention, both for their role as virus vectors and for their damage to plants. Much has been written about mite control on fruit and vegetables and leafrollers on apples have become a 'hot topic' in recent years.

PATHOGENS

The first paper concerning pathogens was a review of potato blight presented to the 15th Conference. For the next few years plant pathology had a tentative relationship with the Society and papers on this subject appeared only sporadically until the 24th Conference in 1974 when four papers on *Sclerotinia* were presented. From then on plant pathology became a much more regular feature of conferences although papers have always been outnumbered by those on weeds and pests.

As with weeds, the majority of papers have been concerned with chemical control of pathogens (Fig. 3). Nevertheless the trend towards decreasing pesticide use is as evident in recent research on plant pathology as it is for other plant protection areas. Plant resistance to diseases has been a well researched topic in cereals over many years, and more recently papers have appeared on biological control of disease organisms. The control of the fireblight bacteria is probably the best example of this. The plant pathology area is the most advanced of the three disciplines in their use of computer technology, using it to predict infection periods in disease management systems, and thereby allowing more judicious use of fungicides.

Stripe rust in wheat has been the topic most reported on in papers on plant pathology. Others such as *Sclerotinia*, smut, botrytis, and powdery mildew have also been given

FIGURE 3: Number of papers published on chemical and biological (includes cultural measures) control of plant pathogens in 11 Conference Proceedings spanning 50 years.

considerable attention. Unlike weeds and pests, plant pathogens in pastures have received very little scrutiny whereas cereal, vegetable and fruit crops have been the main targets of pathogen research.

USE OF PESTICIDES

Perhaps the greatest changes in plant protection research in the last 50 years have taken place in the pesticides industry. Farmers and researchers alike took up the use of pesticides in the 1950s and 1960s with great enthusiasm and the consequent growth in the industry was enormous. In 1957 about 0.8% of the total superphosphate manufactured had agricultural chemicals added which amounted to 7,000 tons of DDT-superphosphate and 400 tons of superphosphate containing weedkillers, mainly 2,4-D. By 1961 these figures were 110,000 tons of DDT-superphosphate and 10,500 tons of superphosphate with weedkillers or 10% of the total super manufactured (Cunningham, 15th Proc., 1962). It was estimated that the amount of DDT superphosphate applied would rise to 160,000 tons, enough to topdress 1.5 million acres, the following year. Since then a vast armoury of different pesticides for use against every conceivable weed, pest and disease has been developed. Indeed the listing of pesticides in the Index outnumber those of the weeds, pests and pathogens, although many of these have “found their way to oblivion” as Doak (1st Proc., 1948) predicted.

By the early 1960s concerns were starting to be raised about increasing DDT residues, and thus began a growing awareness, and indeed suspicion, of the safety of pesticides. Now in the 1990s pesticide use is a “topical area of environmental conflict” (Penman and Brunner, 44th Proc., 1991). These authors went on to say that pesticide use had become “an emotional issue, be it from the perspective of the farmer who fears the loss of pest management tools or the urban dweller who is concerned about food safety and environmental degradation”.

Developments in the pesticide industry, not only with regard to types of chemicals but also in the area of application techniques and timing, have improved immensely the selectivity and safety of pesticides since the days they were broadcast along with the fertiliser. While there has been much adverse publicity about the dangers of the hormone weedkillers and dioxin, there is no doubt that they were considerably safer than the few compounds they replaced, such as arsenic-based products which were highly effective at killing both humans and weeds unless great care was taken. Moreover, these products were used, not just as weedkillers, but also to desiccate potatoes prior to harvesting! Sulphuric acid, one of the few selective chemicals available 50 years ago, was another

highly dangerous chemical which was used for weed control in onions. It was very important when mixing it that the acid was added to water rather than vice versa. Otherwise the whole lot could blow up in ones face causing severe burns and blindness.

Much progress has also been made in the area of application technology. Aerial spraying was taken up very early on as an efficient method of application with one of the first papers on this topic being presented to the 4th Conference (1951) by R.N. Brodie a farmer in Hawkes Bay who was driven by "sheer desperation" to the use of aircraft. In 1948 he tried using low volume nozzles on Knapsack sprayers to control the 500 acres of variegated thistle on his property at Otane but the ones he had were of an American design and would not fit a New Zealand sprayer. He eventually got the nozzles to fit the pump but it was extremely slow work spraying the steep hill country. The following year he obtained twin nozzles which improved things, but not much. The job was described as a "real mankiller". One and a half hours per day were lost in the time it took one man to ride out to the back country which needed spraying. With six men on the job this meant over one man's time each day lost in travelling. Moreover the Jerry cans had to be filled from the creeks then carried by pack horse up the steep faces. Many a packhorse slipped and rolled down into the gorge. The spraying was started in early March and apart from breaks for crutching, docking etc. it carried on right through to a fortnight before Christmas. Much ordinary farm work was left undone. In such circumstances aerial spraying was a godsend but not without its problems as well. Calibration of aircraft machinery was no easy matter and neither was determination of flight paths to avoid overlapping. This particular farmer used flagmen to mark the path of the aircraft - the only problem being that the plane could travel at 80 m.p.h. while the flagmen could travel at a mere 4 m.p.h.. Despite the hassles aerial spraying in this case was judged to be highly successful and relatively cheap at an estimated total cost of £1.14.0d per acre compared with £6 per acre for hand application.

Even experimental work with pesticides in the early days could be an interesting experience. Mr M. Black reported in the 1st Proceedings (1948) how, in an effort to use herbicides for weed control in linen flax, they imported a chemical known as Sinox from California. Expecting a yellow sloppy paste they were rather surprised to receive a "bright yellow rubbly powder" and had to enlist the help of the Chemistry Department of Canterbury University to find out what it was that they had been sent. It turned out to be the parent material and for the next 3 or 4 years they had to hand prepare material for testing by mixing the powder they had received with caustic soda.

Apart from consumer concerns about the environment and the safety of their foodstuffs, probably the greatest problem facing the pesticide industry today is pesticide resistance. In this Society the issue was first raised in 1965 in two papers on resistance to DDT in insects. Since then 29 invertebrate pest papers, 26 plant pathogen papers and 16 weeds papers have been published on pesticide resistance, most of these in the last 15 years. So great is the problem that the Society has held two symposia on the issue.

PEOPLE

The late 40s and early 50s was the dawning of not only the herbicidal era but apparently also the weedologist era. As Mr R.K. Ward, a research officer with the Soil Fertility Station at Ruakura pointed out in his address to the 2nd Conference in 1949, after he was instructed in 1945 to immerse himself in the literature on weed control - "When struggling to keep abreast of the endless spate of papers appearing in the chemical, botanical, agricultural, engineering, manufacturing and general scientific journals which we receive from various countries, dealing with new weedkillers, new methods, new nozzles and machinery, new wetting agents and emulsifiers, adjuvants, sequestering agents, and new this and that and something else, I often smile a trifle grimly at recollections I have sometimes of poring over lengthy and detailed articles on such matters as how many years it took to eradicate Californian thistle, couch grass and convolvulus by means of continuous hoeings and such like. At those times, also, one is inclined, regretfully, to the view that for every weed control specialist of ten years ago, there seem to be 5,000 today, each as voluble as a football fan on a Saturday afternoon".

If the 1950s was the weedologists era the next decade or two belonged to the

entomologists. There are more than a few scientists still employed today who were hired on the back of the banning of DDT in 1970 and the insect epidemics which followed. For both weeds and insect pests the early research was scattered through many different government departments. For instance people engaged in grass grub research within DSIR in the 1960s, detailed by Hoy (16th Proc., 1963), were from the Entomology Division, Soil Bureau, Dominion Laboratory and Fats Research Laboratory, while the New Zealand Fertiliser Manufacturers Research Association, the Department Of Agriculture's Wallaceville Animal Research Station and Farm Advisory Division, plus chemical manufacturers were all involved as well. Now most weed, pest and disease research is concentrated in specialist groups within Crown Research Institutes.

Government personnel have been the major contributors to Conferences throughout the last 50 years (Fig. 4). For two decades from the early 1960s to the early 1980s significant contributions of papers have also come from pesticide industry representatives but in recent years the numbers of papers from this source has abruptly declined as a result of major restructuring within the industry. University personnel, both students and academic staff are also regular contributors to Conferences. In the first five conferences farmers were invited to give papers and they brought an enlightening perspective to practical aspects of weed control on farms. Some, such as W.J. Tripe and R.N. Brodie at the 4th Conference (1951) could be considered to be pioneers in weed control.

CONCLUSION

This paper has merely skimmed the surface of a vast store of knowledge on plant protection which has been printed in successive Conference Proceedings over the last 50 years. Some recent developments such as the use of organic materials and genetic engineering to control pests, have not even been mentioned and yet both these may well be important issues in pest control in the future. What is apparent from this brief survey

FIGURE 4: Number of papers published by government, pesticide industry and university personnel in 11 Conference Proceedings spanning 50 years.

is that blanket pesticide use is a thing of the past and research is now focused on development of more environmentally sustainable methods of pest control. We should not, however, dismiss the contribution of pesticides to plant protection. They have had an immeasurable impact on New Zealand's agriculturally based economy over the last 50 years and they will continue to be an integral part of it for the foreseeable future.

With all the information that has been presented to Conferences over the years the question has to be asked - have we made progress in defending agriculture from the incursions of weeds, pests and pathogens over this last half century? If we looked at a list of weeds, invertebrate pests and pathogens causing problems in agriculture 50 years ago and compared that with a similar list prepared today we would find that many of the same problems still exist. If this then was the measure of our success, we would have to conclude that we have made little progress. That would, however, ignore the enormous advances which have been made in providing effective tools for plant protection in New Zealand. Research is showing the way to more strategic use of pesticides, continually developing biological and cultural control methods and extending our basic ecological knowledge and understanding. But perhaps the greatest advance that we have made is to learn that it is seldom possible to eliminate a pest with a single control measure. Each paper published has contributed to an array of knowledge on a particular problem and it is this which can now be used to reduce, if not eliminate, the damage that problem causes. What was once a question of finding a control is now a case of providing a management strategy. For many weeds, pests and pathogens this is now a reality after 50 years of research.

REFERENCES

- Proceedings of N.Z. Weed Control Conferences, Vols 1 - 16.
- N.Z. Weed and Pest Control Conferences, Vols. 17 - 44.
- N.Z. Plant Protection Conferences, Vols. 45 - 49.