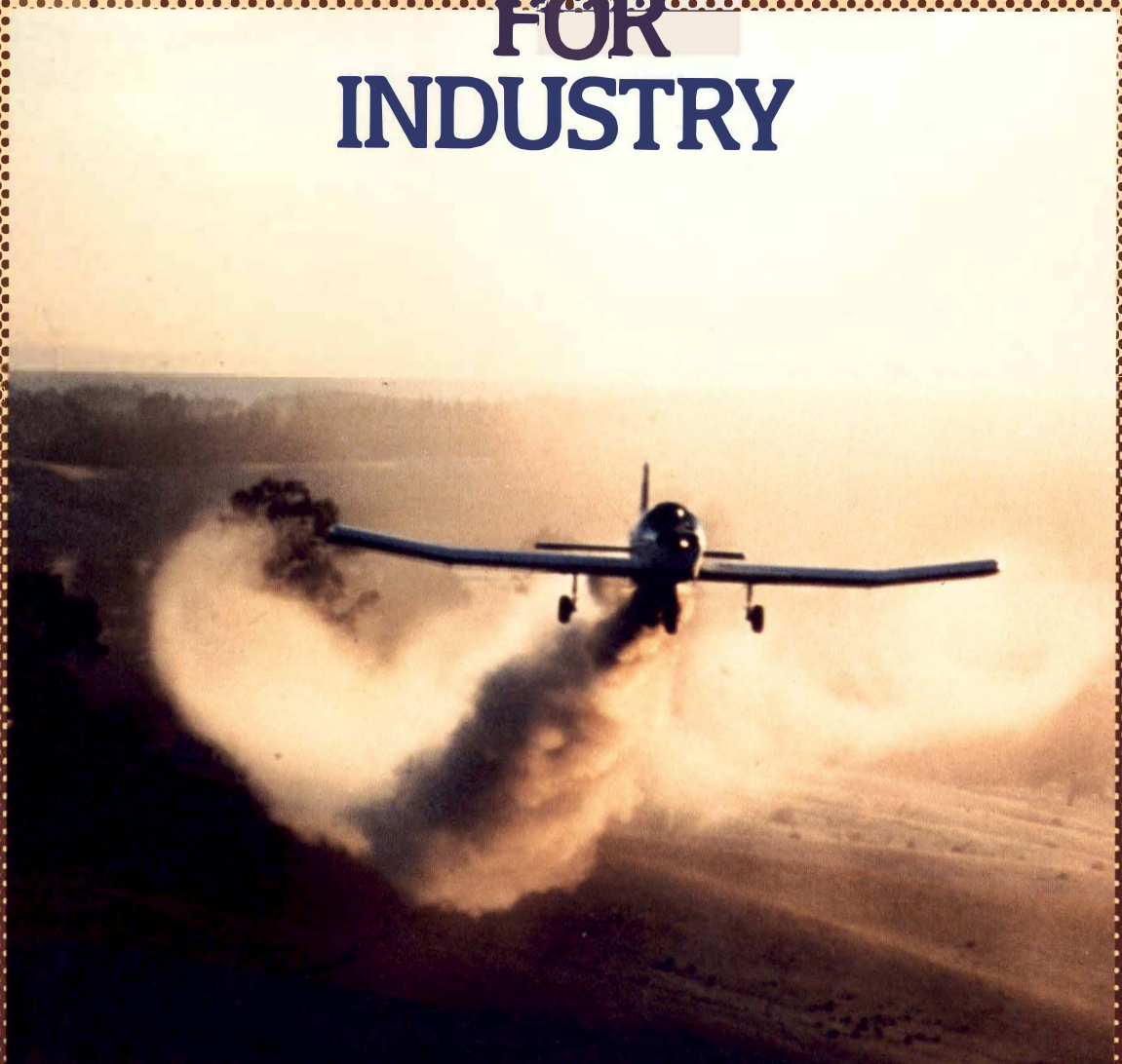
OPTIONS FOR INDUSTRY



N.Z. AGRICULTURAL ENGINEERING INSTITUTE

nzaei

NEW ZEALAND AGRICULTURAL ENGINEERING INSTITUTE
RUKUHIA RESEARCH STATION, HAMILTON, NEW ZEALAND
LINCOLN COLLEGE, CANTERBURY, NEW ZEALAND

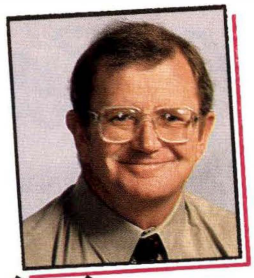
N.Z. AGRICULTURAL ENGINEERING INSTITUTE

nzaei

The New Zealand Agricultural Engineering Institute (NZAEI) carries out research, development, testing and consultancy projects involving the application of engineering skills to problems in the agricultural and horticultural industries of NZ — inside and outside the farm gate.

There are currently 24 professional staff in a total complement of 50 located at the main centre at Lincoln College and the North Island Sub-Station at Hamilton.

The Institute is closely involved with private sector developments, with 20-30% of its annual budget coming from joint venture R&D and user pay activities.



A Message from the Director

As the Institute enters its third decade, new challenges have arisen in the organisation and direction of our research, changes which will prove to be of significant benefit to agricultural and industrial manufacturers.

A move away from complete Government funding has accentuated the application of research and opened up a much wider range of services that we can now offer private industry.

Much of our work in the past has been concerned with engineering inputs into agriculture. Research and extension went hand in hand and as a taxpayer the farmer was both client and customer. The farmer still remains the ultimate customer but in many situations our client will be those sections of the agricultural industry which supply goods and services to the farmer.

The benefits of applied technology which the Institute can offer to industry are the fruits of the more basic research that has been our lifeblood. It is an intellectual capital, developed and maintained over a period of 20 years by staff who numbered only three in 1964 but now number 50.

We will continue to do original research, some of which I have no hesitation in describing as world class, but in conjunction with this, 'Options for Industry' outlines some of the many services in research, development, testing and consultancy which we can undertake on your behalf.

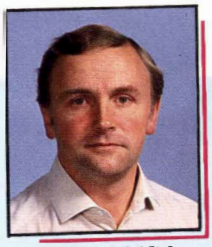
If your business, Government department or local authority is involved with agriculture or horticulture, we ask you to consider how the New Zealand Agricultural Engineering Institute can best assist you.



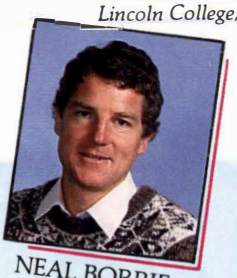
Terry Heiler
Director

Staff Selection

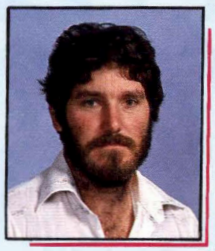
New Zealand Agricultural Engineering Institute
Lincoln College, Canterbury, New Zealand.



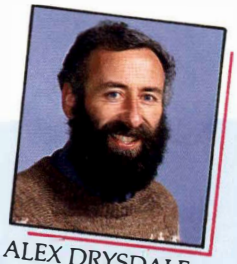
PETER JOHN
Section Leader — Soil & water engineering



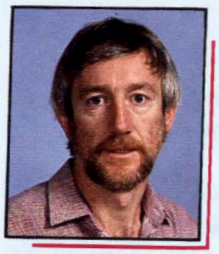
NEAL BORRIE
Water resources



JOHN BAIRD
Computer systems & modelling



ALEX DRYSDALE
Agricultural waste management



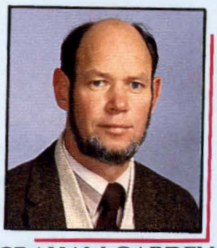
NEIL PASCO
Environmental physics



CARL HENDERSON
Chemical engineering



GEOFF WARREN
Fencing



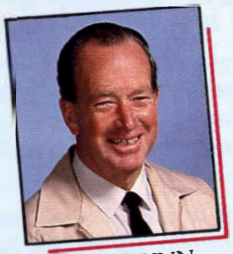
GRAHAM GARDEN
Section Leader — Instrumentation, Tractor safety frames



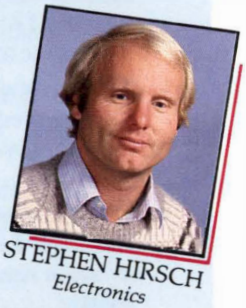
LINS KERR
Section Leader — mechanical design



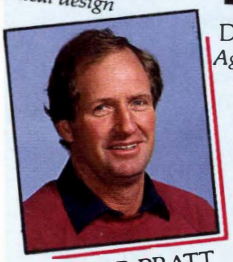
DICK HARWOOD
Agricultural machinery development



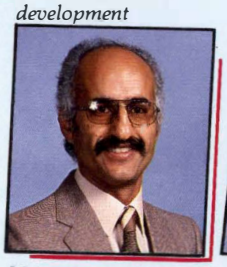
JOHN DUNN
Horticultural & agricultural machinery



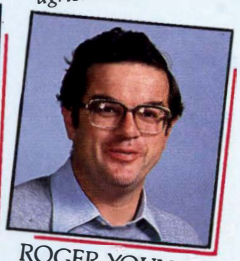
STEPHEN HIRSCH
Electronics



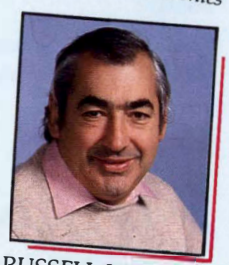
TREVOR PRATT
Agricultural machinery, spraying systems



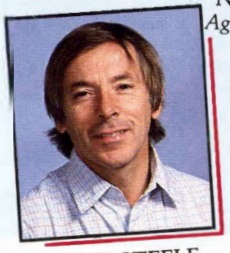
NASSER KAVIANI
Agronomic investigation



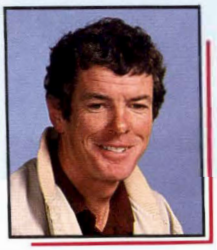
ROGER YOUNG
Agricultural tractor technology



RUSSELL HORRELL
Agricultural machinery, fertiliser application



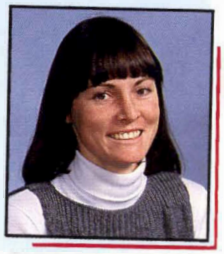
PETER STEELE
Information systems



JOHN MABER
Officer in charge, Hamilton station



BETTY SULLIVAN
NZAEI secretarial services



LYNETTE ROCHE
Publications, drafting and layout

NO LONGER 'DROWNING' AND 'DRENCHING' THE KIWIFRUIT



Kiwifruit has been the undoubted glamour boy of the New Zealand farming scene over the past five years, but it is a very demanding product to produce, requiring a comprehensive spraying programme to meet very high export standards.

The valuable contribution of the Institute to the kiwifruit concept has been to design and develop a machine which applies these chemicals at the same rate and with the same results as a conventional machine, but requiring 37 times less water to do so.

The traditional method of applying chemicals has been first to 'drown' them in water and then 'drench' them all over the kiwifruit.

To do this required over 2250 litres of water for a single hectare and this leant more impetus to finding a more efficient application method.

In 1981 Institute research officer John Maber undertook a study (underwritten by the New Zealand Kiwifruit Authority) to look at the possibility of using Controlled Droplet Application techniques on kiwifruit. CDA emphasises spray droplet size rather than spray volume to get good spray coverage. So instead of pouring on vast volumes of water, this technique had the potential for considerable cost savings.

But there was nothing designed for kiwifruit, so John Maber and his team set about building a CDA unit for kiwifruit.

This was completed within six months and then an exhaustive series of trials were conducted over two years. "They were conducted under the toughest possible conditions, on a commercial orchard with the orchardist keeping a very close eye on us", recalls Maber, with a grin.

The prototype CDA machine which was refined as the trials progressed, involved modifying and redesigning the nozzles which are a key component in a CDA unit. A water flushing system to keep the nozzles clean was patented by the Institute.

The sprays are in wettable powder form and unless washed out immediately after spraying, they can clog the system very quickly.

A new tank agitation system to ensure the right mix of chemicals was built, as were an electronic instrumentation panel located near the steering wheel which enabled the operator to be fully informed on what was happening behind him.

And if that wasn't enough, they also designed a special safety cab so that the operator could do the job much more safely.

The trials showed clearly that the Institute's CDA sprayer could do the same job, just as well as the conventional airblast sprayer, but requiring only 60 litres of water to do so.

Indeed, so successful was the prototype that before the Institute had finished developing it, a commercial firm took over the rights to do it and completed the design themselves.

The major benefit to the grower lies in the tremendous amount of time saved. With far less water being required, the orchard can be sprayed more quickly and if the safety cab is used, the grower doesn't have to get all dressed up to do so. Significant savings in water charges arise not just because of using so much less, but because the structure needed to supply the water is far smaller than for a conventional system. And a much smaller tractor can be used because of the lighter loads.

Not a bad effort when the selling price is the same as its more cumbersome competitors.

"STILL THERE AT FIVE O'CLOCK"



"It is the only fielday I can remember where there were as many farmers still there at five o'clock as there had been at lunchtime," said the owner of the property after a most successful fielday on 'Tractor Economy' run jointly by the Agricultural Engineering Institute and Ministry of Agriculture and Fisheries.

These seminars grew out of a highly successful display at the 1982 Agricultural fieldays and have been held at locations from Southland to the Manawatu as part of a programme supported by the Ministry of Energy and the New Zealand Energy Research and Development Committee.

Drawing very good attendances, they have shown farmers how to get the best from their tractors and given very useful guidelines as to what to look for when purchasing a tractor. "Everybody's pretty competent at actually driving their tractors," says engineer Roger Young, "but there is a lot more to it than this.

"The thing that makes our fieldays different from conventional ones is that we try and stick to tractor adjustments we can actually demonstrate and thus give farmers a chance to see things in practice for themselves."

Another difference is that they have attracted the attention of the trade and a series of successful seminars have been held for dealers.

Big names in the tractor industry, such as Ford, Massey Fergusson and John Deere have sent sales reps along for technical training, enabling them to become much more proficient through a greater understanding of what they are trying to sell.

The demands for this sort of service both from the trade and farmers is growing, and having independent but authoritative engineers demonstrate the performance qualities of the product must count as an invaluable selling tool.

But the Institute's work in this field is not confined to tractors.

Following the success of an electric fencing presentation at the National Fieldays in 1983, engineer Graham Garden found that the demand for the sort of easy-to-understand, but very accurate information on electric fencing, was growing.

As well as speaking directly to farmers, Graham reasoned that an equally effective way to get the message across was to train industry people.

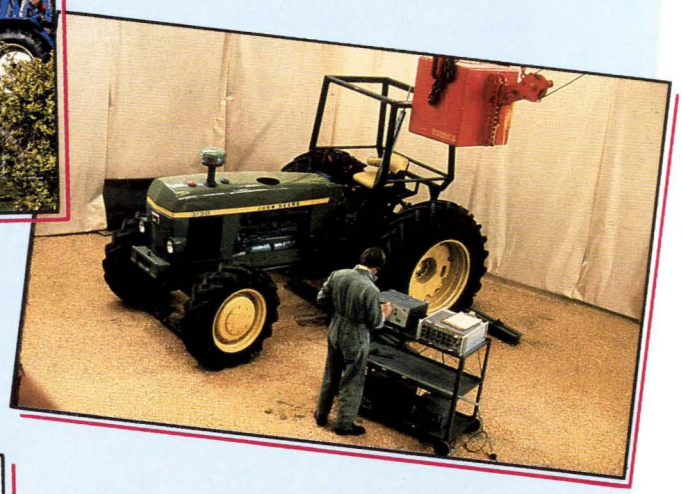
So he and his team were receptive to the request when New Zealand Wire Industries asked for help in providing electric fencing instruction to a training course for fencing instructors. He is also planning training courses for stock and station agent staff. John Maber took a similar approach in conveying the 'secrets' of efficient boom spraying to the farming community. He and Trevor Pratt have run some user-pay training sessions in locations from Gore to the Manawatu for farmers in the "Spray '83" and "Spray '84" courses.

This technique of technical seminars for the trade, which the Institute categories as 'Information for Profit' is meeting an increasing demand and is well worth considering by companies selling agricultural equipment. As Roger Young concludes: "The only criticism that we have had about the seminars has come from those who haven't been there."






nzaei
Electric
Fencing







WATER HARVESTING BENEFITS SPILL OVER

The water harvesting techniques which have been developed and refined by the New Zealand Agricultural Engineering Institute may provide one of the few effective countermeasures to the continuing and widespread drought problems that regularly devastate the farming economies of regions like South Canterbury and North Otago.

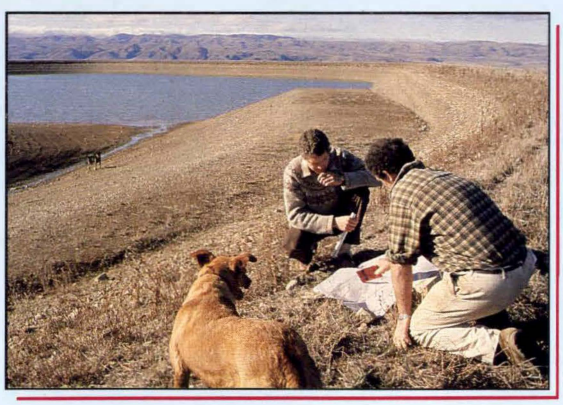
Water harvesting is the concept of capturing water in the winter and spring time when it is largely going to waste, storing it in large well-sealed earth dams, and then using it during the summertime for irrigation.

Certainly the successful project which the Institute has undertaken on the Hakataramea sheep property of Allan Kelly, shows the value of water harvesting in this dry river valley where summer river flows are very low.

The project arose in response to a request from farmers in the Haka valley for the Ministry of Works and Development to investigate a community irrigation scheme. This led to the Institute (with MWD backing) looking at the valley-wide prospects for an irrigation scheme based on water harvesting. Allan Kelly liked the idea, and asked the Institute for assistance to design and build a suitable scheme on his property.

One spin-off of the work at Hakataramea has been the development of a comprehensive package of computer simulation models that take account of local river flow and climate data and allow correct sizing of storage volumes for any irrigated situation.

In just six months from the finish of planning, the system was up and running, with benefits that have been both specific and gratifying.



"The results have been fantastic", says Allan Kelly. "We're carrying an extra 500 ewes, our wool weights are up, and we've got 4500 bales of hay off watered pastures. Without water we would have had to sell most of our lambs as stores. But this year, with the feed, we are making an extra $5 a lamb. And the benefits will really show up next year when the two-tooths, which have the best-ever body weights, come through. I'm very grateful to the Institute."

But the benefits range far beyond this farmer's fence line. What engineer Neal Borrie and Institute Director Terry Heiler have managed to do, is develop a very detailed and comprehensive computer package that allows the systematic design of water harvesting schemes in any area.

"By combining the computer models of stream flow, storage behaviour and irrigation demand with models of crop growth, we have a new design tool," relates Heiler, "and irrigation planning in New Zealand will be the better for its development."

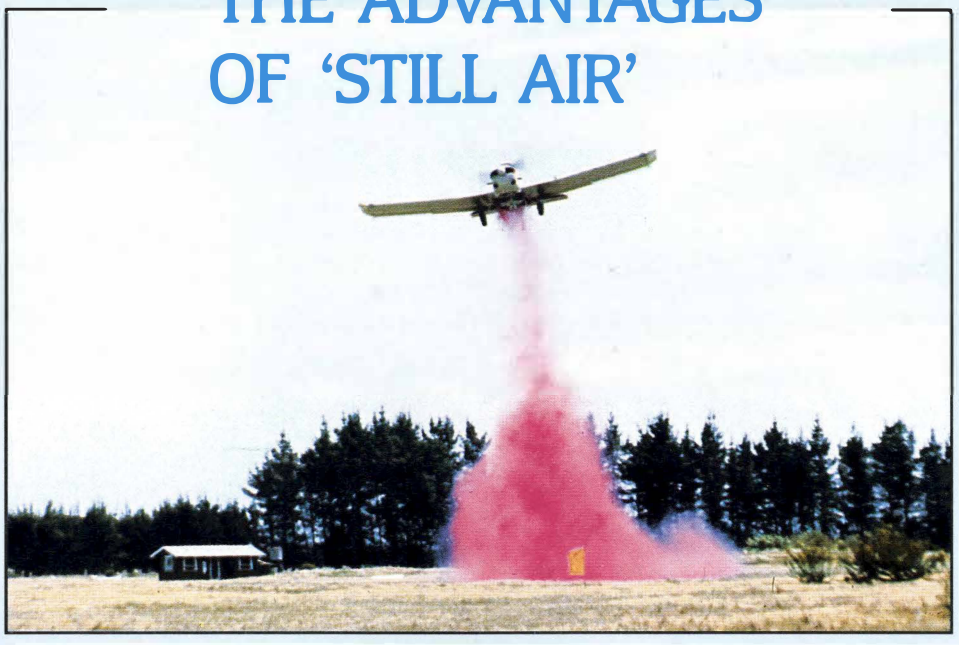
Already, Government departments have been using these programmes to assess the Central Plains irrigation scheme and the North Canterbury Catchment Board have found them invaluable in their work in assessing the resource potential of the Rakaia.

"What we have developed is a technique which is a lot more sophisticated and accurate than anything else currently on offer. At the moment it has been confined to the east coast of the South Island, but there is no reason why it cannot be used over the rest of the country," says Terry Heiler



DIRECT CONSULTANCY FOR INDUSTRY
INDUSTRY DIRECT CONSULTANCY FOR INDUS

THE ADVANTAGES OF 'STILL AIR'



"In my view the still air testing facility at NZAEI is grossly underutilised by the fertiliser industry. For the type of work which I wanted done, I wouldn't have considered going anywhere else," says Petrochem's technical manager, John Scott.

"I think they have a very valuable service to perform in terms of testing a wide range of machines to check their calibration and ensure they meet the required standards, because it is surprising how many of them don't."

John Scott has commissioned the Institute to look at fertiliser spreaders because results that had filtered through from a series of English trials showed that there tended to be wide variations among distribution patterns.

"There was nothing wrong with our urea and it came through with a clean bill of health, but the tests did confirm a wide range of swath patterns.

"None of the four machines stood up to the calibration tests and Petrochem is now using the results and the computer analysis supplied by the Institute as part of its testing package, to suggest possible areas of improvement" says Scott.

Uneven spreading of urea causes losses in pasture and crop production and can be minimised by correct machine calibration and setting. The Institute trials showed that not enough attention is being paid by machinery manufacturers in checking that the machines they use and sell are properly calibrated and are meeting specifications, and that farmers are not generally aware of this.

"Too many farmers in the past have assumed that they can set up their spreaders by making an informed guess as to how much fertiliser is going on to the paddocks in relation to how much should be going on and they are not looking at bout widths and distribution patterns to guarantee an even spread.

"You may get away with it in pastoral farming but you definitely won't in arable farming, where the machines must be very carefully calibrated or crop production may suffer." John Scott is convinced that much greater use should be being made of the Agricultural Engineering Institute's facilities for doing more performance tests and allowing the manufacturer to quietly improve his product if it is performing poorly. The guarantee of confidentiality means that clients remain in control of the results, the only caveat being that if used in advertising they must be reported correctly and not misinterpreted.

Senior technical officer Russell Horrell says one of the main advantages of the laboratory is that it can guarantee repeatable conditions for testing. The lab has an elaborate array of catching trays and with no bounce-in or bounce-out, they are more accurate than any other facility in the country. The testing facilities can handle a wide range of fertiliser flow rates and bout widths, and will back up the work with computer programmes and statistical analysis as part of the overall service to the clients.

The fertiliser calibration system is not restricted to the full range of fertilisers but can also be used to calibrate for even spreading of seeds, trace elements and granular pesticide or herbicides. The equipment is also used for calibration of fixed wing aircraft and helicopters.

The still air lab is probably used as much for the testing of irrigation equipment for the industry as it is for the fertiliser work, and has just been doubled in size to cater for increasing demands.

QUALITY FRUIT DEMANDS QUALITY PICKER

The Institute's raspberry picker really came about because of a decision by the Ministry of Agriculture and Fisheries to look at the possibility of planting better quality raspberries.

'March', the standard, somewhat insipid variety is a soft floppy fruit which doesn't really lend itself to mechanical harvesting and is basically a processing variety, not a dessert top-of-the-table fruit.

The best of the new varieties that has come on-stream is 'Fairview', an excellent quality fruit with an exquisite flavour and a big, firm berry that is resistant to damage.

Both in hand-picking and conventional mechanical methods of harvesting raspberries, a lot of fruit may be lost because it is difficult to separate out the fruiting canes from the newly emerging ones.

When the usual mechanical methods were being used and fruiting canes being 'beaten', it meant that because of the delicate nature and close proximity of the new canes, considerable damage to them was likely. New canes growing with the fruiting canes also had a blanketing effect, so the efficiency of the beaters on the fruiting canes was reduced; ripe fruits were not always removed. Other fruit which was released was often trapped within the mass of vertical canes and was lost onto the ground. Up to a third of the crop could be lost.

So there were two tasks for scientist John Dunn and technical officer Dick Harwood. One was to produce a canopy that kept the fruiting canes and the newly emerging canes separate from each other and the other to design a raspberry harvester that could pick the fruit. The secret of the new canopy system devised by John Dunn is that the one year canes which will bear the fruit in the next season are tied down on either side of the row to form a horizontal canopy which is kept in place by a wire and wooden frame.



When the new canes appear in the spring they grow straight up and do not interfere with the fruiting canes. There is nothing quite like Dick Harwood's raspberry harvester. It is one of the most advanced of its type in the world and is an impressive technical achievement — that also works! One machine has been exported to Britain.

The fingerwheels vibrate the horizontal canes and release ripe fruit onto a conveyor. A gentle airblast can remove any unwanted green leaf material and the fruit then goes onto a conveyor sorter, which is the first time any human hand goes near it. Sorting then takes place.

Gentle persuasion is the aim of the exercise. One pass of the machine removes the ripe fruit and leaves unripe berries for removal at a later pass.

The machine-harvested raspberries grown on the horizontal canopy system are in A-1 condition and suitable for many purposes, including the export markets.

Two commercial raspberry growers are now producing top quality fruit from the Lincoln canopy system and raspberry picker. One of the growers is marketing his fruit in punnets which are filled on the harvester and sold fresh for dessert without any further sorting, while the other grower blast freezes most of his crop for sale and export in free-flow form.

SUBSTANTIAL BENEFITS FOR STONEFRUIT FROST PROTECTION RESEARCH



The South Island's booming stonefruit industry could gain substantial benefits from the recent trials on sprinkler systems for frost protection, carried out by Institute researchers Peter John and Peter Carran.

The trials showed that energy savings of 60-80% and water savings of 25-40% were possible using an overhead targeted mini sprinkler system being developed at NZAEI.

The concept of overhead sprinklers is nothing new, but conventional medium drive overhead systems use large amounts of water and have high operating pressures. While this system has proved successful, it can lead to ground saturation and consequent disease of the tree crop. The expensive water storage system required to service it can be a wasteful use of resources.

"Any reduction in water requirements for frost protection is an attractive proposition for reasons of tree health, orchard floor condition and storage cost", says Peter John. The reason for the success of these sprinkler systems is their ability to capitalise on latent heat.

When liquid water changes to ice, sufficient energy in the form of latent heat, is released from one cubic metre of water to run a one kilowatt heater for 90 hours!

As the ice forms on the tree, this energy is available to keep the encased tissue above surrounding air temperature. If sufficient water is applied, then the temperature should stay at about 0°C; this is necessary because buds, fruit etc. can be seriously damaged or killed if they are allowed to get too cold. The latent heat energy is only available while the water is turning to ice as part of a continuous process. As soon as the ice is allowed to dry, then the tissue temperature will drop.

The problem with conventional systems is that they spread water over the whole orchard plus some areas outside, and water falling anywhere but on the trees is wasted. With the targeted system, mini sprinklers suspended on overhead irrigation pipes spray water directly at the trees. Therefore, although the amounts of water falling on the trees is no less than for a conventional system, the area of application can be significantly reduced. The mini sprinklers also have the advantage of running at less than half the pressure of conventionally used impact-drive sprinklers.

The initial work was funded by the Ministry of Works and Development, New Zealand Fruitgrowers Federation, DSIR and MAF. The Institute frost protection team are now involved in a full scale orchard study at Clyde. The MWD have provided substantial funding for this work while DSIR and MAF are also making significant contributions.

If the flow of enquiries is anything to go by, the targeted method could also prove to be a valuable addition to the frost protection armoury on a wide range of crops on both Islands.

These findings provide an interesting contrast to the conclusions which these two researchers also derived from trials on the effects of undertree sprinklers on frost protection.

These trials were some of the most detailed and precise carried out anywhere in the world and the conclusions were that undertree sprinklers were likely to raise orchard temperatures by only 1°C or so, and often less than this. "Consequently", says Peter Carran, "we are able to advise that, in most cases, the level of protection to be expected from undertree sprinklers are unlikely to be sufficient to avoid frost damage". The undertree work was funded by the MWD, New Zealand Fruitgrowers Federation, DSIR and MAF.

The targeted work was designed to solve a specific problem — that of the large amounts of water necessary for conventional sprinkler frost protection. The undertree study sought to provide information on a method, the introduction of which was causing concern among scientists and engineers. Both research projects are proving of immense practical value to the horticultural industry.

KEEPING THEM OUT OF A BAD ODOUR

Meadow Mushrooms have rightly earned themselves recognition as one of New Zealand's most innovative small companies, pioneering the production of artificial mushrooms on a large scale and growing to a multi million dollar product.

When they first came to Prebbleton there were fewer residents and little complaint about the odours involved in their production process. But as the little village has grown, so have the number of complaints. So in late 1983 they approached the Institute to see if studies could be carried out on how to remove or at least reduce these problems.

Institute technical officer Alex Drysdale has been working for 18 months on this project and has had considerable success in reducing the odours right down to a bare minimum.

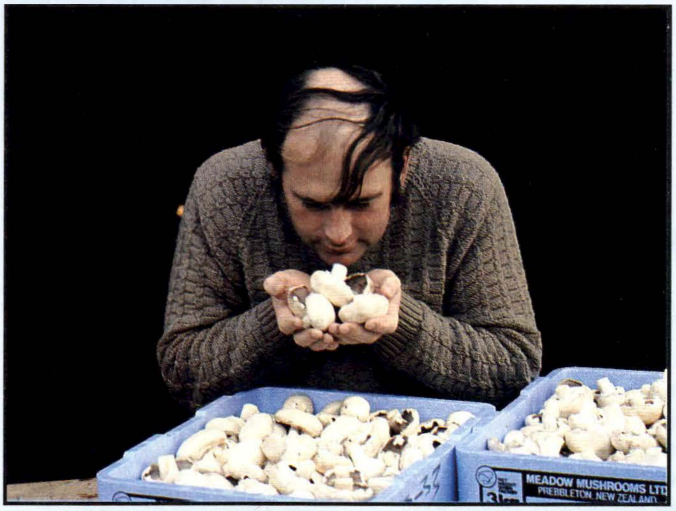
Part of the composting process was soon identified as the main 'villain' but care had to be taken in finding the right remedy, because whatever steps were taken must not involve the loss of actual production. The company did not want to end up in a situation of no smell but no mushrooms either!

There are three methods of odour control. The first is to find techniques of preventing the actual odour generation, the second to rely on chemical suppression and third one to physically contain the odours within a building.

Drysdale opted for the first method as being the only practical long term solution, because chemical suppression is expensive and often unsuccessful, whereas 'locking up' the smells can prove impractical for a number of reasons.

The major change was to switch the pre-assembly of composting from an anaerobic system to an aerobic one.

"Management techniques that increase the oxygen levels do eliminate odour production in composting," says Drysdale.



So natural aeration has proved the key to the subsequent composting carried out by Meadow Mushrooms, and the company has not progressed to the stage of doing without the pre-assembly stage altogether. Once this is refined the only smell left, and it is one that is quite acceptable, is a slight trace of ammonia given off by the aerobic decomposition process.

As well as drastically reducing both the smell and the neighbours' complaints, the improved method of composting has had major economic benefits, according to Meadow Mushrooms company secretary, Richard Calvert.

"We have reduced our composting cycle from 28 days to 14, we are using much less material for the same end results and the process is taking up much less space in our yards, so the redesigning has had unexpected and welcome effects.

"We have found the Institute and technical officer Alex Drysdale to be most co-operative and are very pleased with the results.

"Yes, it definitely paid off hiring them as our consultants."

What we can do for you

In the past the public image of the Institute has largely centred on "tractors, tinkering and fruit trees", and of course machinery and its on-farm application has been central to a lot of our work.

But our versatility extends far beyond this. Indeed we have successfully coped with such diverse client problems as the effect of road dust on agricultural production and the need for an improved sausage skin grading system! We took the smell out of mushroom growing, much to the relief of those within a five mile radius of the factory (especially the growers) and we have revolutionised apple production by training them to grow on canopies, thus making picking almost a pleasure (and much more profitable).

We have acquired an enviable international reputation through the successful completion of contracts with such prestigious clients as the World Bank, the United Nations and the Asian Development Bank.

As part of our more commercial approach there are now a very wide range of services which we can offer both the public and the private sector.

NZAEI will:

- © **Undertake fully confidential research and development contracts in the fields of:**
  - **— soil and water**
  - **— agricultural machinery and mechanisation**
  - **— farm structures and services (including horticulture)**
  - **— processing and handling of produce**
- © **Carry out a wide range of performance measurement and evaluations to assist manufacturers in the development and promotion of their products.**
- © **Investigate and advise on technical problems. Run in-house training sessions for staff (seminars on tractors and fencing techniques for sales personnel have already been successfully held).**
- © **Advise on the application of all kinds of electronic and computer developments. Maintain a world wide computer search of information relevant to your company.**
- © **Participate with industry in joint ventures where appropriate.**
- © **"Rent a man" — individual staff members may be hired under contract.**

List of jobs done

New Inspection Window for Food Vessels
Earth Voltage Monitor for Commercial Manufacturer
Application Performance of Broad-Acre Travelling Irrigators
New Methods of Harvesting Small Seeds

Overhead Targeted Frost Protection
Seeding Prairie Grass
Rain Out Shelter of Agricultural Experiments
Emitter Wetting Patterns at Te Kauwhata
Wire Tie Offs and Screw Anchors for Horticultural Structures
Evaluation of a Mechanical Harvester for Kiwifruit
A Membrane Grape Press Development
Development of an Apple Harvester
Evaluation of a Pesticide Sprayer
Evaluation of a Conditioner-Mower
Whole Crop Harvesting
Evaluation of a Milk Lifter
Evaluation of Permanent Wire Strainers
Fertiliser Distribution with Urea
Feasibility of On-farm Drying of Stone Fruit
Disposal of Dairy Effluent
Tractor Draw-bar Pull Tests
Evening Primrose Oil Extraction
The Effects of Road Dust on Agricultural Production
Fencing Role of Aluminium Clad Steel Wire
Effluent Disposal from a Timber Processing Plant
Tractor Economy
Design of Electronic Stock Weighing Equipment
Odour Control for Mushroom Composting
Harvesting and Storage of Beet
Ethanol Production from Beet
Testing of Plastic Drainage Pipe
Investigation of Fungicide Coating of Cereal Grains
Calibration Procedures for Boom Sprayers
Wind-Affected Sprinkler Performance
Design of Water Harvesting Systems
Application of Rock Phosphate by Air
Controlled Droplet Application of Sprays
Flip Over Canopy for Boysenberries

Designed by Wendy Murphy

