NEW ZEALAND FARMING SCHOLARSHIP TRUST

REPORT OF A S WRIGHT

1996 SCHOLAR

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Introduction

This is the report of Stuart Wright on his Nuffield Scholarship awarded for the 1996 year, studying developments in seed potato production and disease management in arable crops. The scholarship included travel to the United Kingdom, Canada, Zimbabwe and Western Europe. It enabled the author to visit farms, researchers and people involved in both the arable and potato industries. The following report contains his personal conclusions and impressions following the discussions held with the above people.

Acknowledgements

It is fair to say that few people get the opportunity to travel the world for six months looking at topics of personal and business interest in the way that a Nuffield scholar can. To the New Zealand Nuffield Farming Scholarship Trust go my grateful thanks for your faith in selecting me to represent New Zealand as a Nuffield scholar in 1996.

I could not have undertaken this scholarship without the support of my family, especially Angela, my wife, who experienced a prolonged period of solo parenthood, and my brother and business partner, Quentin, who took over complete management of the farm in my absence.

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1. SEED POTATO PRODUCTION

1.1 Summary of Main Points

Improvement in potato seed quality have been driven by the requirements of the end user.

Major gains in quality have been made by reducing the number of generations between the initial cloned seed and the end user.

Virus testing of seed lines is being increasingly used to give an indication of the health status of those potatoes.

Aphid levels are monitored by field traps. If aphid numbers reach a set threshold the seed crop will be desiccated regardless of the tuber size.

An increasing number of seed lines are being sold by number rather than weight.

Controlled storage of seed potatoes from digging to planting can have a major effect on the seed vigour and quality.

Genetic engineering is more likely to be used to improve the processing or cooking quality of potatoes rather than disease and pest resistance.

1.2 The End User

Not surprisingly the vast majority of seed potato growers I visited in the UK and Europe considered that they were producing a product of the highest quality. When questioned, the buyers of the seed all wanted lines that had good vigour and health, but many were not happy with the product they were receiving, or the disease status of the resulting crops.

Therefore most buyers or their agents inspected crops of seed several times during the growing season, as well as in storage, before they would take delivery. If any problem was apparent then that line would be rejected.

A number of table producers visited were so disappointed with the seed quality they were receiving that they had decided to set up their own seed businesses - an extreme course of action, but they saw it as a way of improving their overall performance by improving their seed. The main reasoning behind this was, if they could get higher grade seed early and control its multiplication they knew exactly what they were using as a seed stock. Good hygiene and management were crucial to their production systems and if any seed crops showed problems of disease they would be killed and written off immediately. Often seed crops were being successfully grown in areas normally regarded as table producing regions. A natural progression for some was to expand and sell to other table growers which was being done successfully. One farming enterprise in particular emphasised its quality and attention to detail and prided itself on its service to table growers and could command a premium.

1.3 Virus Testing

In recent years the use of a test to establish if there is any viral or fungal infection in a line of seed has been developed. Each test is scored on an index ranging from 0-10; 0 being clean and 10 heavily infected. While not always 100% accurate, it does give a good guide to the status of the seed. Many purchasers made a zero test result a requirement of purchase. The cost per test was $160.00.

Experiments at the Cambridge University farms have shown that some plants may carry virus infection, but there are no visual signs on the leaves. As rouging is based on visual inspection this test can often detect a disease presence that otherwise may not show in the seed crop but could well surface in the next generation. More and more seed purchasers are now requesting this test as a standard part of their buying strategy.

1.4 Seed Stocks

As seed growers have moved to improve the quality of their product there has been a trend to reduce the number of generations grown between the initial cloned tubers and the final table crop. In some cases as many as nine generations were involved, but now this has been reduced to as low as three.

This has been achieved by allowing more people to produce their own mini tubers, thus increasing the numbers of high quality seed available. With seed growers receiving higher grade seed earlier, and growing fewer generations to the final crop for sale, the risk of exposing that crop to disease infection is greatly reduced. The major issue with this approach is the ability of the owners of different cultivars to keep control of the quantity of production of those cultivars. There is no doubt that the best producers of seed all wanted to be able to access seed stocks of the highest quality and were therefore much more able to maintain minimal disease infection. In some cases this extended as far as farmer groups doing their own tissue culture work, which technically is not a difficult job.

1.5 Aphid Monitoring

Monitoring aphids in the field has also become a method of reducing infection of virus in crops. Traps are set and checked on a regular basis. As soon as aphid numbers trapped in a set period pass a threshold figure, the seed crop will be killed off regardless of tuber size. It is considered better to have a small crop than a virus-infected one. This regime was used extensively in areas where crops of potatoes, other than seed, were also grown, and, combined with using land not having grown potatoes before, these seed growers were able to produce crops equal to the quality of those from the more traditional seed-growing areas.

1.6 Beds Versus Rows

A number of seed growers were using a bed system, rather than the traditional method of rows, to grow their crops. It was used extensively by table growers, especially in the production of potatoes grown for the salad market, where small uniform size was critical and could be controlled to a degree by spacing in a bed. Using the same principles, the benefits for growing seed are that the mother seed pieces are spaced in

three rows in such a way that plant density has an effect on the size of the resulting crop. The theory is the same as that used by carrot growers to grow a certain crop size.

The advantages of beds seemed to be for the following situations regarding seed potatoes:

- In lighter soils. (Moisture loss was less from beds than rows).
- For early varieties. (The longer the beds were down, the more likely it was that the soil could settle and become hard to dig).

Most growers also agreed that in the centre row of the bed, the soil temperature was lower so the seed needed to be planted 20mm shallower and placed slightly further apart. Beds also committed growers to chemical rather than cultivation as a means of weed control. However, as soil conditioners or de-stoners were widely used, very little inter-row cultivation was done under either system.

1.7 Soil Conditioning Machines

As mentioned above, almost all the potato growers I visited used these machines. The great advantage to them was that the soil was free of stones and clods greater than 25mm-30mm in size, enabling them to dig at speed in less than ideal conditions. This greatly improved their chances of completing their digging within the limited period open to them.

There is no doubt that the quality of the seed beds produced by these machines was high. However questions remain on what effect they have on soil structure, especially on lighter or younger soils. Add to that the capital cost of this equipment, and it seems to me to be unlikely that such machines will be widely used in New Zealand in the near future, except by larger growers or in soils which are marginal for growing potatoes.

1.8 Seed Storage

The major point of note on my farm visits during this scholarship was that nearly all seed potato growers I visited had either built seed coolstores in the last few years, or were in the process of building them now. This has come about through the transfer of knowledge from the storage of table potatoes to seed. By controlling temperature and humidity of the air in which the potatoes are stored, seed health and vigour can be maintained at a very high level. As one noted advisor and researcher noted, *"Dry moving air is as good as any fungicide"*.

Traditionally potatoes have been stored in bulk, but in both table and seed industries there is a move towards bin storage.

- Bulk Storage

  All bulk stores by their nature require forced air moving through the stored potatoes. Most stores were of similar construction, insulated sheds featuring plenum chamber down one side with regularly spaced air ducts into the crop. As the crop is brought into store these ducts are put in place. The reverse

procedure is used as the store is emptied. This method is probably the most cost effective means of storing large amounts of potatoes.

- Bin Storage

  This was the most common form of controlled storage used by seed growers who I visited. Especially suited to situations where a number of smaller lines are grown and can be stored together, there were two distinct methods used in stores with bins. The first was the forced-air system which continuously moved air at speed through the bins, and the second a much less aggressive air circulation through the store rather than each individual bin. Each system had its proponents but the forced-air system was used by those in areas which were not traditionally seed producing regions, and was considered one of the most important factors in maintaining seed quality post harvest.

  Forced-air systems are recommended for crops harvested wet, to remove moisture, but circulating air stores were sufficient for crops harvested dry.

1.9 **Storage Management**

Both bulk and bin storage use the same approach in management of the humidity and temperature. During the first 8-15 days of storage temperature is maintained at 13°C - 16°C to enable wounds and bruises to heal. As tubers are respiring heavily during this period humidity is maintained at 90% - 95% ensuring that any moisture produced is removed. After this initial period the temperature is slowly lowered to between 2°C - 5°C and humidity maintained between 85% - 95%. At the end of the storage period the temperature is slowly raised to ambient level while keeping humidity at the same levels to ensure no moisture forms on the tubers.

Success in storing potatoes is through keeping a constant low temperature and therefore reducing the likelihood of disease activity and sprouting, as well as decreasing the respiration rate of the tubers, preserving their vigour and weight for longer. Maintaining a constant humidity reduces the formation of moisture on the tuber surface which in turn reduces the spread of any diseases associated with moisture, such as blackleg or rot.

1.10 **Seed Sales**

In recent years there has been a trend towards selling seed potatoes by number, or plantable hectare rather than weight. Depending on the end use or which variety is required, a recommendation is made to the table grower by his advisors on the number of tubers he requires, and at what density per hectare, of the preferred size range. The seed grower will then supply on a price per thousand.

The seed producer is required to grade his seed into much tighter bands, preferably 5mm, and to be able to accurately count the number of tubers in each tonne. This is often done by machine in larger operations or manually by taking 3kg from every 5 tonnes and counting the tubers.

The benefits to table growers are a better control of the size of seed tubers, meaning a greater control of plant densities per hectare and size of the resultant crop. When

ordering by number the seed required for each hectare is much more accurate, and reduces the chance of under or over ordering.

Seed growers have the advantage of pricing different sizes on a replantable hectarage basis to make them more attractive to purchasers, especially the out sizes (30mm - 35mm and 50mm - 55mm). In the UK these size ranges sold at a discount of 10% to 20% per plantable hectare including freight.

Yields of seed crops if measured in replantable hectares varied very little from year to year, thus making budgeting easier. If in a year a small number of tubers set the size was often larger therefore fewer were needed to plant a hectare. Of course the opposite applied when there were many smaller tubers - more are required to plant the same area. One firm I visited in Scotland used only this system to sell its seed and had very small variations in overall replantable area production each year, and with the aid of test digs, effectively had the majority of its crop sold before a potato had been dug.

There seemed to be a reluctance for UK growers to take this up as a way of purchasing their seed, however the growers using this system were definitely the more progressive. As more precision is required in the industry I have no doubt this will become commonplace.

1.11 Breeding

The number of new varieties produced each year for trialing does not seem to be reducing as potato plant breeders strive to produce a better cultivar for each niche market. I was concerned to see, at some trials, new cultivars which had very poor disease resistance, being promoted because of their end use qualities. As a rule their sponsors were large multinational processors, often with a vested interest in the breeding programme. Although, as stated earlier the end user will decide ultimately which cultivars are grown, it would be hoped that the increased resistance to disease is an important consideration when making those decisions.

Genetic engineering is becoming more widely used in plant breeding as a way of enhancing the performance of the resulting plant. Many seed growers may hope that this technology is used in the potato industry to overcome some of the major disease problems which are common to many worldwide. Genetic engineering is more likely to be directed at improving processing characteristics, however scientists have identified genes which give resistance to some of the common disease problems. Whether the funds are available to use this knowledge is yet to be seen, perhaps an accepted variety near the end of its licence may be genetically enhanced and re-released.

There is no doubt that much of the plant breeding of the future will be done this way, but it remains to be seen whether the public will find it acceptable to eat genetically-altered food. It is also worth bearing in mind that overcoming some of the major disease problems may make potatoes easier to grow, and as one grower said to me, *"If all the problems were taken out of growing potatoes and any one could grow them anywhere, we'd all be out of a job!"*.

1.12 Conclusion

In the northern hemisphere improvements in the quality of seed potatoes, demanded by the end users, have been achieved by reducing the number of generations during the production process, thus reducing the chance of exposure to viral diseases. Added to that is the increased use of cool storage of seed potatoes, from as soon as possible after digging to planting, thereby improving tuber vigour and decreasing the spread of common problems found under more traditional storage methods. The future holds a move towards selling tubers by number, thus meeting more precisely the buyer's requirements. There will also be genetic engineering of potatoes to give a better product to the end user, and hopefully better disease resistance for the producer.

2. DISEASE MANAGEMENT IN ARABLE CROPS

2.1 Summary of Main Points

- Individual disease forecasting models are being developed to predict seasonal disease pressure, but are some way from perfection.
- Disease forecasting systems will only be another tool for farmers to use in managing their crops.
- The use of independent specialist crop walkers to monitor arable crops is likely to become common in New Zealand.
- Precision farming is undoubtedly going to be widely used in arable crop management of the future.
- A future requirement of purchasers of arable produce will be the traceability of that product to its original producer and a record of the inputs into that growing crop.
- Farmers will come under increasing pressure to justify their management practices to their consumers.

2.2 Disease Forecasting

Work is being undertaken in this area but to date it is very difficult to predict specific disease patterns. There are two approaches:

(a) Using the amount of overwintering innoculum (primary) and environmental factors to predict disease pressure.

(b) To use a disease progress curve (secondary innoculum), and environmental factors within a season to predict the likely incident of a disease.

Some of the environmental factors which have a major effect are rainfall, frost days over winter, humidity, wind and sunshine. The future still requires a considerable amount of research, for both methods to reach the stage where a computer model can be assembled to predict the likely seasonal risk of a specific disease, and even then it will only be another tool to be used in the overall approach to crop management. The

aim will be to reduce chemical inputs but improve control, and move away from the present system of formula spraying.

Considerable work has been undertaken on several major diseases, notably blight in potatoes and septoria in wheat - both major problems in the UK in their respective industries. It is therefore logical that comprehensive forecasting of these diseases will be the first to appear.

2.3 Crop Walkers

One of the features of British arable farming was the key role specialist crop walkers played in the management of arable crops. These people were highly qualified and in most cases had wide experience of the crops they monitored. They regularly inspected the crops in their care from planting to harvest and made recommendations on weed and pest control as well as fertiliser requirements. Payment was either by per hectare rate, or their clients purchased their chemicals from them. They all survived on their performance, which was normally measured by the amount of cereal crop that lodged, and farmers as a rule had a very good relationship with them.

What impressed me most was the depth of knowledge that these people had in a wide variety of crops and their ability to keep abreast of research which directly affected a farmers profitability. They were also independent of other participants in the arable sector and therefore able to give good impartial advice, as well as being a link between research groups and farmers.

As the role of the traditional stock and station company in New Zealand is increasingly questioned, I feel there is a place for similar people to operate here as independent advisor to arable farmers whose crop management is becoming much more technical and precise. Most farmers would agree that this is perhaps the most difficult area of farm management, and also has the potential to markedly affect profitability. Already, in other areas of agriculture, there are people filling this role and I am sure before long it will become common place in the arable sector in New Zealand.

2.4 Research Organisations

The amount of arable research being undertaken in the UK was quite amazing even though (as in New Zealand) research funds were becoming increasingly difficult to access. The UK Government had taken the stance that it would not become involved in "near-market research", leaving this up to industries to fund themselves. This has led to a restructuring of the Government Agriculture Research and Advisory Group ("ADAS") and an increase in farmer-based groups funding their own research. Much of this research has relevance to New Zealand agriculture, and it is pleasing to see that our own Foundation of Arable Research ("FAR") has formed links with one of the UK's leading farmer subscription groups, Arable Research Centres ("ARC"). I am sure that long term this will have major benefits to our own arable industry.

2.5 Precision Farming

Much has been made of the future of high-tech farming, especially in the agricultural media and there is no doubt that it will play a major part in the methods of farming in

the future. The basis of precision farming is the use of American military global positioning satellites to accurately pinpoint a position any where on the plant. This is commonly referred to as "global positioning systems" ("GPS"). With the right equipment, a farmer can accurately pinpoint the position on a farm, where he can measure anything from yield, soil depth, and fertiliser applied, to rainfall. By using GPS he can return to the same point over and over again enabling a picture of what is happening at that exact spot to be built up. When combined with technology that can repeat that measurement every five metres, an accurate picture of a whole farm or field can be built up very quickly. This is particularly evident through yield mapping, where combines can record the variations in crop yield as they harvest, and build a map which shows the variations in yield across the field.

In the northern hemisphere GPS is being widely used in the precision application of chemicals, fertiliser and yield mapping. The challenge ahead is being able to either use historical data from yield maps and manipulate inputs to improve overall field production (not always yield), or use GPS to monitor the growing crop and make decisions on which inputs to use as the season progresses. To date, using historical yield mapping to predict crop performance is the only viable option, but with further research and new technology this could change rapidly.

At present in the UK there is a major research programme under way, funded by the Government, to measure the gains made in crop gross margins by using the information from historical yield mapping. The first step is to identify areas of farms which are under performing. This requires at least five years of yield mapping, and if there is a physical problem, such as shading, drainage, compaction or soil type, the management is adjusted accordingly (to British farmers this often meant putting these areas into their 10% EU set aside and claiming a subsidy on them). Once those areas have been discarded researchers hope to be able to identify what makes the high performance areas of farms high performing. At the time of my visit the answer seemed elusive and was certainly not as simple as applying more fertiliser to the less productive areas. The research programme is planned to last five years and they hope to have some interim results by three years.

Until then their advice is to be extremely wary of people promoting precision farming as a way of minimising inputs while maximising returns. What is promised has not always been delivered in the UK much to some farmers cost. However, this technology will be sold in the future as a way of accurately matching crop inputs to crop requirements, and the obvious cash and environmental benefits that that will produce. There is no doubt that this is an exciting area of agricultural research, and has the potential to dramatically alter the way we farm. At this point we have the technology but not the information to make sound management decisions. That seems to be at least five to ten years away.

Watch this space!

2.6 Traceability

As a result of the BSE scare and the resultant public pressure on the major retailers of food in the UK, traceability has become very much the buzzword of the moment. Almost all food buyers are requiring a full record of inputs into both crops and animals

as well as proof of due diligence in the use of those inputs. Care of the environment featured highly on that list.

The retailers wanted to be able to supply the highest quality product to the consumer and be able to assure them that it had been produced with the utmost care. This meant a premium on price in many cases. There is a definite move to accredited suppliers who will meet the standards laid down by the purchaser and back that up with an audit trail if requested. That audit may not only check crop husbandry but also farm safety standards, farm employees qualifications to operate farm machinery, and farm care of the environment.

There is no doubt in my mind that this will become a requirement for New Zealand farmers if they wish to supply high value overseas markets. If farmers are not maintaining detailed records of their farm operation now they should start immediately!

2.7 Environmental Farming Groups

As the consumers in the northern hemisphere have become more conscious of what they are buying in supermarkets, pressure has been applied to farmers to justify how they produce their products. Because they are mainly main-high input producers, this has often been difficult, especially regarding the effect farming practices are having on the environment. This has led to a number of organisations being formed to promote so-called integrated crop management, and taking a proactive stance in informing the public on how and why certain farming practices are carried out.

One such organisation was LEAF. (Linking Environment And Farming). Its mission statement was as follows:

> *"Leaf is committed to the concept of a viable agriculture which is an environmentally and socially acceptable means of ensuring continuity of supply of wholesome, affordable food while conserving and enhancing the fabric and wildlife of the British countryside for future generations'.*

LEAF had a number of approaches to meeting the aims of the above statement:

(a) An environmental audit for new farming members which covered such topics as on farm conservation plans, soil management, waste management plans and staff training.

(b) Demonstration farms which were opened regularly to the public to explain what they do and why they do it.

(c) A media presence maintaining a caring image to the public.

(d) Collaboration with other groups of a similar nature throughout Europe, all promoting responsible agriculture.

It could be said that organisations such as LEAF are nothing more than a public relations effort by farmers to justify what they do. To a certain extent this is true, but there is no doubt that they are filling an important role in not only educating a generally ignorant public but also promoting a more responsible environmental

approach amongst farmers. I felt many New Zealand farming systems would sit comfortably in an organisation such as this and as a more vocal green movement mobiles itself, we here should be taking a much more proactive role and promote what we are doing and why we do it to the general public.

2.8 Conclusion

The pressure of public concern as to how farmers grow their crops and what they use in growing them will increase as consumers become more aware of what they are eating. This will mean farmers will have to adapt to justifying their inputs and keeping detailed records of them. By using new technology and research, the future will mean applying inputs at the rates required to do the job and no more, and targeting those inputs to the areas of the crop where they are required. Meeting these requirements is going to be closely linked to profitability and competitiveness.

3. THE BSE SCARE

This was probably the most significant agricultural event which occurred during my scholarship. Much has been written about the circumstances that led to this crisis, but I would only like to comment briefly on impressions it left with me.

Consumer confidence in beef as a safe food was almost destroyed through no fault of the producers of that beef. The power of the press was such that no sound argument as to the integrity of the production of beef could be communicated to the public. To me this reinforced my belief that farmers have to explain how their production systems work and be prepared to document all their inputs so that an audit trail is available to consumers as a check as to what is happening on farms. As a result of this food scare most retailers have tightened up their traceability requirements for their produce. In reality this means if a producer does not meet a certain standard of production, or cannot prove he has met that standard he does not supply that retailer.

A healthy and vibrant farming organisation is vital to protect farmers interests in a crisis. The British Government seemed unable to act and it was only the advice coming from the British Farmers Union that adverted a major disaster. It would be fair to say, that at times it was the Farmers Union which was driving Government policy, while at the same time brining some sanity to the BSE debate.

No doubt we have not heard the last of the BSE scare, but the number of new cases in cattle was dropping rapidly as predicted by those who have monitored this disease. At the time of my departure from the UK, the feed supply industry would still not disclose what they were putting in their animal feeds, stating that it was commercially sensitive.

4. EUROPE

Until spending two days in Brussels, at the headquarters of the European Union (EU), I had no real understanding of the politics which surround it. I think it is important to record my impressions of what I learned in those two days.

The EU was set up after the Second World War to provide a constant supply of quality food produced within Europe. A well-fed Europe was less likely to be at war.

That philosophy has been extended to include keeping people living in rural communities. To do this they have to be paid well for what they produce, even though the farming units on which they live may be small.

Both the above policies have been achieved by subsidies, and regardless of what is said the political reality is that this will not change.

With the lifting of the iron curtain Eastern Europe is now positioning itself to join the EU over the next 10 to 20 years. It is not a matter of "if", but of "when".

At present of all the member countries of the EU, only four are net contributors to the common agricultural policy. When Eastern Europe joins, that will dramatically change and countries like Greece and Portugal will have to become contributors rather than receivers. This may well affect the level of subsidy on agricultural produce.

With the improvement in infrastructure and technology, Eastern Europe has huge potential as a food producer.

In conclusion, it seems unlikely in the medium to long term that Europe will abandon its policy of subsidising its agricultural producers. The volumes of food produced in greater Europe are likely to dramatically increase in the next ten years.