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Direct drilling comes to Australia via W.A.

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**DIRECT
DRILLING
COMES TO
AUSTRALIA
VIA W.A.**

Written by Geoff Pearce, M.Sc. Agric
Dated: 31 March 2017

DIRECT DRILLING COMES TO AUSTRALIA VIA W.A.

Geoff Pearce, M.Sc. Agric

The story which follows tells how Imperial Chemical Industries (ICI) from the U.K. changed the method of planting cereal crops used in W.A. for 40years, by replacing cultivation with a herbicide spray.

The main reason for cultivation is to prevent the growth of weeds in the crop. There are other benefits to be gained.

How Direct Drilling Works

Weeds have a dormancy capacity which requires a number of environmental conditions to operate before germination will occur. These include light, temperature, moisture and oxygen. To meet these conditions the weed seeds need to be close to the soil surface.

A plough turns over the top several centimetres of soil thus burying the surface weed seeds and killing seedlings which have emerged. Also weed seeds from below the surface will be exposed.

A scarifier stirs the soil surface killing any seedlings present, but at the same time bringing additional weed seeds to the surface. When they germinate further cultivation is required. This process is repeated several times before a high degree of control is obtained. Cultivations should be about 7 days apart and repeated as necessary. The use of herbicides instead of cultivation works differently. After rains the surface weed seeds germinate within about 7 days. A single herbicide application will kill these seedlings without any soil disturbance to induce a further germination of weeds. If 2 or 3 cultivations are required to obtain adequate weed control compared with a single herbicide spray, then the sprayed area could be planted 2 – 3 weeks earlier than where cultivation is used.

The theory is supported by the results of time of planting trials at three research stations, undertaken in 1928-1931. At a time when weeds were not present, planting in May gave a higher yield than planting in June which in turn out yielded planting in July. These results side-tracked W.A. researched for some years before they realised the benefits were actually elsewhere.

Areas to be cropped on today's farms are heavily infested with weeds. The first rains cause a germination of the surface weed seeds. These may represent about 20% of the total population in the soil and are killed with the weed spray, leaving the balance of 80% still below

the surface. However the tines on the combine planting the crop will bring a proportion of these weed seeds to the surface and establish a weed population in the crop. If there are several types of weeds present it may be necessary to delay spraying them until the tillering growth stage so that a mixture of herbicides can be used. This delay will cause some loss of yield. One of the next generations of researchers, Agricultural Scientist and farmer Bill Crabtree, in his outstanding 200-page book "Search for Sustainability with No-Till Bill" spends twenty pages discussing types of tine systems on Combines in an endeavour to reduce the weed seed germination. It is probably this weed growth that prevents any yield increase from earlier planting as obtained in the 1930 trials.

The Department of Agriculture in WA

From the beginning of settlement in WA the need to provide food for the growing population meant that farming quickly became the most important industry. In order to teach the new farmers how to grow cereal crops in a new climate and with basically poor soils, successive State Governments established demonstration farms. The first of these were at Geraldton (Chapman), Beverley (Avondale), Merredin and Wongan Hills. These were later called research stations and by the 1960's there were 18 established throughout the state, servicing the various branches of agriculture.

While successive State governments maintained a policy of releasing new areas of land for farming, a special effort was made after the two world wars and the great depression of the 1930's, to speed up the development.

At the end of the First World War the higher rainfall areas of the southwest were subdivided for returning soldiers to establish dairy farms and a timber industry. In the 1930's the government turned to the drier areas to establish wheat and sheep farms. The new farmers could visit the government demonstration farms to learn how to plant and grow cereal crops.

At the end of the Second World War the State Government set up the War Service Land Settlement Department. With the assistance of the Department of Agriculture new farms were developed and when they were self-supporting, they were allocated to ex-servicemen.

To diversify the operation, crops were planted every 2 or 3 years and in between sheep were grazed on the resting land. To provide food for the sheep, pasture seed usually sub-clover and rye grass was sown with the cereal for use in the following years.

Over the years research workers established the need for numerous minerals required by plants to grow in the different soil types. Tillage trials defined the most suitable type of machinery for preparing the seed bed for cereal crops. The establishment of sub-clover pastures gave a great boost to crop yields through nitrogen build up in the soil.

Royal Commission

At the end of the Second World War the WA state government held a Royal Commission into the problems of vermin and weeds. It recommended the formation of the Agriculture Protection Board within the DOA to be responsible for the control of Declared Vermin & Declared Weeds.

To provide the technical information on weed control required by farmers shire councils and other interested groups, a new branch was created in the Biological Services Division named The Weed Control and Seed Certification Branch. The Assistant Government Botanist, George Meadley was appointed Officer in Charge.

In 1949 Brian Quinlivan was appointed to the staff to work on the agricultural seed aspects of the branch. In 1952 Geoff Pearce was the second agricultural graduate to join the staff and allocated to work on weed control. Brian was eventually awarded a Doctorate for his work on clover seed dormancy while Geoff earned a master's degree for investigation of factors causing the sprouting of Cape Tulip. When George retired in 1974 the Branch was transferred to the Plant Research Division, Geoff was in charge of Weed Agronomy.

ICI Brings direct drilling to Australia

IN 1964 Diquat and Paraquat were registered in WA by ICI. They were recommended for the non-selective control of annual broad-leaved weeds and grasses respectively. In the UK ICI has developed a commercial market for their use with a number of crops including continuous planted wheat.

Demonstration plots were established by the Department of Agriculture at a number of sites using these herbicides to kill weeds growing around the base of cultivated plants. Included were grape vines, fruit trees and rose beds. Using a herbicide avoids causing damage to the root system which occurs with cultivation.

A local ICI representative in 1965 asked me to meet with some researchers from the UK to discuss the use of Paraquat and Diquat with cereals. This was the usual type of approach from Agricultural Chemical Companies seeking the endorsement of the Department of Agriculture for their products.

However on this occasion they were visiting Australia to decide in which state to launch the market development program for direct drilling wheat by replacing cultivation with herbicides. If this was successful many changes to present planting procedures would follow. The Department of Agriculture would be very interested in such a project and the advantages of starting their project in WA was presented and these included:

- Equipment and staff are available to undertake trials on five research stations in wheat growing districts
- Replicated plot trials could be repeated for several years
- The commencement of winter rains is fairly reliable

- Large summer weeds are not common
- The length of the growing season is only 4 – 5 months
- Trials could commence in 10966 and plots could be used at field days.

Before they left WA the ICI team had committed the company to commence their Australian Project in this state. Their official launch took place at Northam in October 1966.

In 1966 the WA weeds branch commenced a series of trials on five research stations to test replacing cultivation with a herbicide treatment. The results of these trials were presented for farmer’s information in articles in the WA Journal of Agriculture in 1969 – 1971.

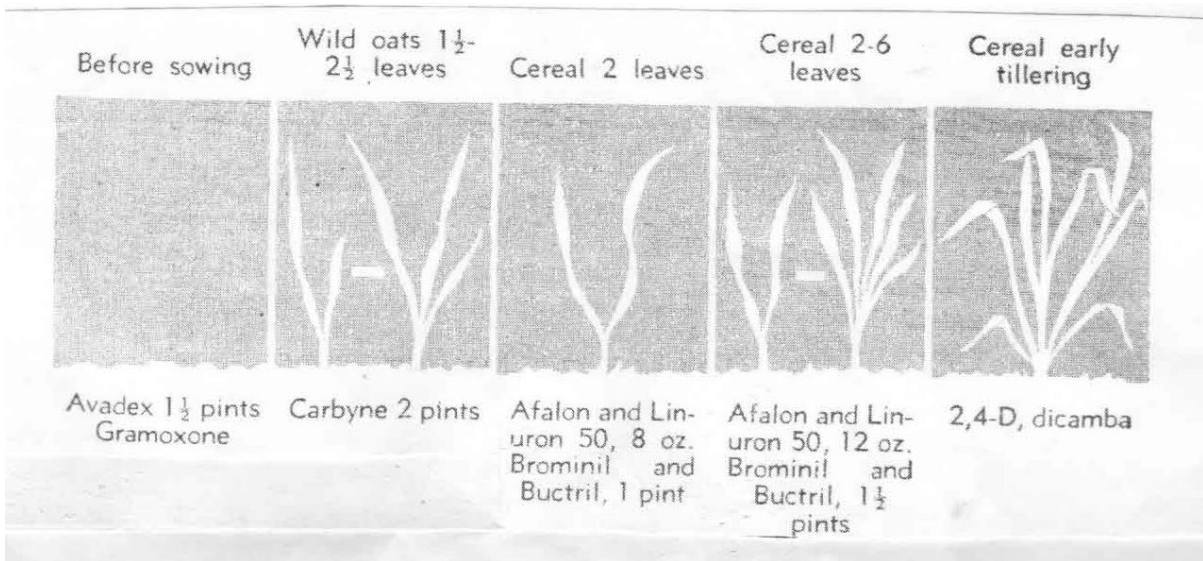
The team must have been greatly encouraged when they heard of the Department of Agriculture’s Time of Planting Trials back in the 1930’s, they showed that planting a crop earlier gave an increase in yield.

Table 1: Results of time of planting trials at three research stations			
Year & Site	Yields (Bushels per acre)		
	May	June	July
1928: Merredin	20.3	18.9	12.9
1928: Wongan	23.2	11.3	10.5
1928: Chapman	15.5	12.8	7.3
1929: Merredin	28.2	19.7	11.2
1929: Wongan	7.3	3.2	1.5
1929: Chapman	19.1	14.5	7.2
1930: Merredin	34.2	28.2	13.5
1930: Wongan	13.5	8.9	3.8
1930: Chapman	11.4	12.8	6.2
1931: Merredin	25.3	25.5	19.5
1931: Wongan	19.5	18.3	10.5
1931: Chapman	13.7	8.2	6.8

Table 2: Yields obtained when weeds were killed at different growth stages in 1966
(bushels per acre)

WEED	Not Sprayed	Sprayed Two Leaf Stage	Sprayed Tillering Stage
Doublegee	30.2	40.2	35.5
Capeweed	7.6	16.3	14.7

The Correct Growth Stages at which to apply the Herbicides



While the Research Station trials were being undertaken ICI gained public support for Direct Drilling in WA by persuading leading farmers to use direct drilling on whole paddock size sites for public display along with ICI's own demonstration trials. This was in preparation to launch the project in WA at Northam in October 1969.

The results of the 1966-70 trials (WA)

From 1966 to 1970 five trials were carried out requiring 200 plots at 5 Research Stations to test 30 treatments. Killing the first germination of weeds by spraying with a herbicide 7 days after the opening rains was always successful. However this leaves dormant weed seeds below the soil surface which germinate when they are disturbed and brought to the surface by the machine sowing the crop.

Where a farmer has found it necessary to undertake a weed spray program in previous years, the same problems will still be present after direct drilling in following years. The spectacular yield increases seen in the 1930's trials did not occur in these later trials because of the weed problems in modern crops. Native plants do not become weeds after being cleared for farming and so all the 1930 sites were weed free. As a result of the disappointment the trials

were not reported in the Journal of Agriculture until 1969 or 1970. It was 1977 before any more direct drilling trials were undertaken by the Department of Agriculture.

Direct Drilling Promotion Begins

The DOA Time of Planting Trials in the years 1928-1931 were highlighted in the Journal of Agriculture in 1969. This was before ICI's launch of Spray Seed in October 1969. On its first page (see over – chemical ploughing) it points out that to gain similar yield increases complete control of weeds is needed.

Event though ICI were not claiming higher yields would necessarily result these trials certainly meant there would not be a loss of crop yield. ICI were delighted.

In Table 3 the trials show the results of a very dry year. No matter when or how the crop is planted the results are disappointing. Salmon Gums results should be ignored.

At Merredin with Spray Seed the earlier the planting the higher the yield. With conventional the opposite effect is seen.

At Lake Grace the results were reversed.

Table 3 shows the results of some trials in 1970			
Table 3 – Wheat yields following “Spray Seeding” and conventional weed control techniques – 1970”			
All crops were sown with a combine			
Treatment	Yield – bushels per acre		
	Salmon Gums	Merredin	Lake Grace
Spray Seed			
21 days	3.0	17.1	4.0
28 days	NIL	15.7	6.8
35 days	NIL	11.2	6.3
Conventional			
21 days	14.0	14.1	10.8
28 days	-*	15.5	6.1
35 days	20.1	16.3	8.1
Difference for significance between treatments P < 0.05	6.8	6.2	3.4
-* Treatment not included			

On the next page is show page 1 of a Journal Article published in 1969 titled Chemical Ploughing. This expressed the conclusions from the trias undertaken in the previous 3 years.

Later in October 1969 ICI launched the “Spray Seeding” concept for the first time.

CHEMICAL PLOUGHING

it is possible, and in many situations highly desirable, to replace some cultivation with a herbicide spray.

Importance of early planting

One of the most obvious ways of increasing wheat yields in Western Australia is to develop techniques which will enable crops to be planted earlier. In a normal growing season it is standard practice to plant as soon as adequate weed control has been obtained.

Table 1.—Results of time of planting trials at three research stations

Year and site	Yield (bushels per acre)		
	May	June	July
1928—Merredin	20.3	18.9	12.9
Wongan	23.2	11.3	10.5
Chapman	15.5	12.8	7.3
1929—Merredin	28.2	19.7	11.2
Wongan	7.3	3.2	1.5
Chapman	19.1	14.5	7.2
1930—Merredin	34.2	28.2	13.5
Wongan	13.5	8.9	3.8
Chapman	11.4	12.8	6.2
1931—Merredin	25.3	25.5	19.5
Wongan	19.5	18.3	10.5
Chapman	13.7	8.2	6.8

Table 2.—The average break of the season and rainfall details of the growing season for ten centres in Western Australia

Centre	Break of season	Length of growing season (months)	Rainfall in growing season (points)	Proportion of rain in first 6 weeks (estimated)
Bruce Rock	early May	4.2	774	37
Doodlakine	mid May	3.6	577	47
Goomalling	early May	4.1	895	34
Katanning	mid April	6.4	1,568	23
Northampton	early May	4.6	1,634	30
Ongerup	late April	5.9	1,022	30
Perenjori	early May	3.7	819	36
Southern	mid May	3.1	530	40
Cross				
Wickepin	late April	4.9	1,278	26
Wyalkatchem	early May	3.8	790	35

Table 3.—The effects of cultural treatment on wheat yield. Average yields obtained with various cultural treatments where sowing was carried out with a non-disturbance drill (sod-seeder). The number of days refer to time after the opening rains

Treatment (Merredin Research Station) 1966	Yield
Sod seeded 7 days	12.1
Scarified dry, sod seeded 7 days	21.9
Sod seeded 7 days + urea	14.4
Scarified dry, sod seeded 7 days + urea	22.2
Ploughed 7 days, scarify and combine 21 days	25.1

Replacement of a cultivation with a herbicide

With a conventional planting programme there is no reason why a cultivation cannot be replaced with a herbicide treatment. This may not allow earlier planting but could provide better weed control.

An initial cultivation appears necessary but provided good tilth is obtained no further cultivation would be required. However, with heavy soil it is often necessary to work the ground several times in order to break up the clods.

A trial was undertaken in 1966 at three Department of Agriculture research stations where a cultivation was replaced with a herbicide spray. Table 4 lists the results obtained.

Good weed control was obtained where herbicides were used.

Table 4.—The yields obtained at three research stations where a cultivation was replaced with a herbicide treatment 1966

Treatment	Yield (bushels per acre)		
	Chapman	Wongan	Merredin
Scarify only	19.0	33.5	24.6
Scarify + scarify	24.2	36.5	27.6
Plough only	24.3	39.2	25.1
Plough + scarify	23.0	40.0	25.7
Scarify + herbicides	24.3	40.0	28.4
Plough + herbicides	23.7	41.1	27.8

The ICI Story by the team leader: Mr John Thompson

The establishment of a commercial market for the sale of Diquat and Paraquat in Australia is described by John Thompson in his article "Unsung Heroes who broke the mould". He was an Australian with an Agricultural Science degree from Melbourne University and had been working in the UK with ICI for several years.

A slightly abridged copy follows.

"July 21st, 1969 is memorable for me because the first man set foot on the moon and I became the first person responsible for the market development of the bipyridyls in Western Australia, nearly half a century later.

Geoff Ireland, my Melbourne boss, taught me, largely by example, an invincible 25-year-old, what it meant to combine commercial acumen with personal technical integrity.

The vexing question was How to get some payback for the money and resources the company had invested in WA. The local team were three Poms in Northam, a Scotsman from Lake Valley, a lone eastern-stater down at Katanning, and the state sales manager.

Dr David Barrett led the ICI Plant Protection team of Terry Wiles, Mike Barker and Ian Fletcher. However only an adventurous Scott travelled 400km inland to advise the locals on how to be better farmers. Bill Roy and myself established a fantastic working relationship.

From the outset I had been convinced that we should go with a strong single, clear proposition, rather than confusing everyone with belts and braces options to minimise risk, including direct drilling with a triple disc drill, the use of a modified combine, and several programmes that combined cultivation, spray and seeding. Unfortunately there did not seem to be a clear technical winner, and to complicate things, 1969 was a very dry year. We eventually decide to go for the radical alternative to cultivation, using a boom spray and standard combine. With great excitement the "Spray-seeding" concept was launched in October 1969 at Northam.

Back in WA the cost of chemical was a real sticking point. Bill Roy did the numbers and the target was to come in under the magic \$2 per acre level, a mere 40% reduction from around \$3.30. Bill took time out from a trip to Scotland to visit Fernhurst, which lead to an economist being sent out to do an appraisal several weeks later. Then, after much pleading they permitted me to fly over and seal the deal. A lower priced specially formulated combination for brad acre use only was introduced. In 1971 we re-launched a combination product priced \$1.99 per acre, called ICI Spray-Seed."

The ICI story is continued by Neil Clark who had worked his way up through the ranks to become State Sales Manager. The following is taken from his article "The Direct Drilling Revolution" printed in 2014. He does not mention the period from 1969 to 1971 described by John Thompson.

Neil Clark writes;

“It all started in 1971 with ICI’s introduction of its knockdown herbicide, Spray-seed. Western Australia was chosen for the launch of the company’s direct drilling initiative due to the presence of larger farms, innovative management and lighter soils. The first three years saw good sales of Spray-seed and widespread interest in adopting direct drilling, led by a group of salesmen and farmers. But that all came to a halt in 1975 with a dramatic slump in sales due to a combination of adverse season conditions, system management problems, staff shortage at ICI and inexperienced new users. The project almost collapsed.

Sadly, lack of support from the Department of Agriculture was another factor, he said. They weren’t in favour of direct drilling. This proved very challenging for early adopters and our sales team. Something had to be done and ICI in their wisdom recognised their extension programme would have to be increased for the system to succeed. This led to the setting up in 1976 of the Direct Drilling Project team. We set up a series of farm discussion groups and also appointed successful farmers as advisers. This gave rise to the establishment of ICI Crop Production Groups and other private extension programmes such as “Farm Management 500.” Mr Clark said another ICI initiative at the time was the establishment of private/public partnership with departments of agriculture, the CSIRO and universities.

Eastern States

Collaboration was further widened to include banks and manufacturers of spraying and tillage equipment. With these relationships in place the market development programme was rolled out in the eastern states. In 1979, ICI convened a high-profile National Direct Conference in Adelaide and then another two years later in Albury.

Million litre mark

In 1981, sales of spray-seed in WA reached the million-litre mark. Research, development and extension were stepped up at research stations, universities, CSIRO and state departments of agriculture. Further GRDC supported research was conducted by farmer-led groups such as WANTFA and Birchip Cropping Group. Adoption rates accelerated and the rest is history. Mr Clark said while the raw numbers were very impressive, there was far more to the direct drilling revolution than was often recognised. Benefits such as savings in labour and fuel were readily apparent early on. Lower machinery depreciation is another benefit that was fairly self-evident.”

The 1975 incentives by ICI were seen differently by the Department of Agriculture.

1. More experienced advisory staff were appointed to provide a state-wide extension service led by Roger Crook.
2. In 1975 a group tour was planned by ICI for researchers around Australia to visit research projects in UK, USA & Canada in 1976. Geoff Pearce was the only applicant so the trip was cancelled. However, the Department of Agriculture met the cost for him to visit the same places in 1976 hosted by ICI.

The Agriculture Chemical Industry

Government organisations working alongside international chemical companies' research centres, receive a lot of advance information on products compared with faraway places like Australia.

ICI's Jealott Hills Research Centre in England has about 800 people involved in Pesticide Research. Of these, 100 are working on environmental studies. Other companies have similar establishments. The English Agricultural Development and Advisory Service is a government body which tests and approves new products as they become available.

European Companies are much larger. Recently Bayer's Kemal Malik said "Bayer spends about four billion Euros a year on research and development and has long standing collaborations with CSIRO in Australia." Speaking from Frankfurt, Bayer's Head of Weed Control Research Hermamann Stuebler said "Bayer has added nine Australians and two New Zealand Chemists to its team of about 4700 scientists and technical staff working in crop science, research and developments." Other large chemical companies include BASF, Dow, Elalco Dupont, Monsato and Shell.

After seeing a plot of wheat which has been planted every year for 90 years, ICI were asked to provide the DOA with two Bettinson Drills so that plots could be planted without any cultivation. They readily agreed and supplied one drill for use at Avondale and Mt Barker research stations and another one for use at Wongan Hills and Merredin research stations. The Bettinson drill cuts a slot into which the seed and fertiliser is dropped.

Also in 1976 ICI organised at El Caballo Resort a meeting between ICI staff, a number of successful farmers, Noel Fitzpatrick the Director of Agriculture, Norman Halse Chief of Plan Research Division and several other officers. When challenged to give more positive support to the spray seed concept, the Director and Chief said more research trials were needed to support claims about yield increases from direct drilling. They would consider how this could be done. The Director and Chief later decided that the Weeds Branch should undertake their trials planned for 1977 & 1978 which included a time of planting treatment. A group of specialist officers would then take over the trials making any necessary changes.

This proved to be a very wise decision as after the trials had run for five years there was no evidence that an increase in yield would automatically follow a one pass sowing systems. Recommendations for particular areas were needed if direct drilling was to be promoted. The weed seed population left after the one germination killed by spraying would lead to a further emergence of weeds caused by the combine planting the crop.

In the meantime Ron Jarvis an experienced district adviser was transferred to Perth to co-ordinate the results of the various trials.

Continuous Cereal Cropping with Alternative Tillage Systems

The cropping trials promised at the meeting in 1976 were commenced in 1977. The full results of the trials are reported in Department of Agriculture Technical Bulletin no 71. The trial sites were located on Research Stations Avondale, Esperance Downs, Merredin, Mt Barker and Wongan Hills. Spread over such a wide area of the State the results showed considerable variation.

Summary of conclusions – Technical Bulletin no. 27 WA Department of Agriculture. Continuous Cereal Cropping with alternative Tillage Systems in WA over 5 years.

1. No one tillage method gave consistently higher yields at all sites. What can be said about one pass direct drilling is that if the time usually spent cultivating to kill weeds is spent planting extra crop, then the total yield of grain harvested will be increased by the amount of wheat harvested from the extra planting.
2. Spread over a distance of about 500kms and from 290 to 650mm annual rainfall, the trials displayed a considerable range of grain yield responses to tillage and yield responses to tillage and fertilisers interactions.
3. The interaction of tillage systems with rainfall and water use has widespread significance for semi-arid agricultural areas. There is an initial tendency for direct drilled crops to grow more slowly. Direct drilling tends to reduce yields. This is typified by the lower yields of direct drilled crops at Wongan Hills.
4. Where correct spray technology is applied direct drilling should give as high or sometimes higher yield as with cultivation on most soils. Lower yields from direct drilling with currently available machinery are common on yellow loamy soils where high soil strength reduces early vigour and total dry matter production.

In these 3 long term continuous cropping trials the two years 1977-78 were the only years when the District Practice treatments were planted 21 days after the minimum tillage treatments. This meant the crop growing period was increased by 21 days. In 1977 this resulted in an increase in yields. In 1978 the district practice gave a slight increase in yield over minimum tillage plots.

The Department of Agriculture's Policy

In 1991 the Department of Agriculture published "The Wheat Book," a technical manual for wheat producers. This was funded by the Wheat Research Committee of Western Australian and distributed by the Australian Wheat Board to the wheat growers of WA. It covers all aspects of wheat cropping and summarises the result of much research carried out over many years. It is an excellent publication.

In chapter 7 of the book on tillage and on page 120, reduced or direct drilling is recommended on 5 of the 6 soil types listed. However, on page 121 it states that 'the advantage of cultivation over direct drilling with a direct combine has averaged 0.27ha over 10 years from more than 200 Department of Agriculture trials.' On the two tables shows, 7.1 and 7.4, it states that all treatments were sown on the same day. (It is probable that the single time of planting applied to most of the 200 trials mentioned.)

In 2008, Mr Noel Fitzpatrick, ex Director of Agriculture and generally regarded as the most outstanding occupant of that position since the Second World War, published a book on the history of the Western Australian Department of Agriculture from 1894 to 2008. Being a farmer himself, he appreciated how valuable agriculture research was to the farming industry.

In Part 13 (1970 – 1994) he describes the changes in the methods of planting as follows;

“In the early 1970’s drought and reduced stock numbers, coupled with better returns from continuous cropping resulted in a move away from the clover ley system of farming. Progressively, the industry moved to continuous cropping without a pasture phase.”

“In the mid 1970’s it became commercial possible to selectively, or totally control weeds by spraying with herbicides, and this progressively changed the method of planting crops. While this achieved effective weed control, there remained issues such as how much cultivation was needed to provide the necessary seed bed. Within this new framework developments took place which totally changed the cropping process and the potential for yield, particular in the medium rainfall districts.”

“From a research and development aspect there were new challenges. New varieties had to suit the longer season, the new nutrient cycle needed to be understood, the level of cultivation for seedbed preparation and nutrient mobilisation needed study and the appropriate rotation to establish a sustainable agriculture had to be defined. Experimental work and form innovation resulted in further changes to the cropping system.”

Page 104-105 “The new cropping industry”

“The clear advantage of the new approach was that even if the farmer waited for the first rain, he sowed his crop with one pass, considerably earlier than was possible when weeds had to be killed by cultivation.”

“This meant that the growing season could be extended by up to three weeks. Moisture loss due to cultivation was avoided and more moisture was available for crop growth.”

The Principal Dividend from Direct Drilling

After 10 years in WA the ICI research and marketing teams were disappointed with the results of their endeavours. Their technical knowledge, experience and presentation deserved better.

After 1977 sales began to accelerate and in 1980 sales reached one million litres for the year. Not only were farmers gaining experience but their results were interpreted differently.

ICI and the Department of Agriculture were saying “direct drilling allows you to commence planting 2 – 3 weeks earlier with better growing conditions and perhaps some increase in yield.”

However the farmers recognised that direct drilling would allow them to plant extra crops. This was true but why hadn’t the researchers carried out trials to measure the increase?

In over 200 trials by the Department of Agriculture only the 10 trials undertaken in 1977 and 1978 had a time of planting treatment included, the yield from the extra crop which could be planted was never included. Below is shown how 27% is the increase in yield if 3 weekly cultivations are replaced by a single spray-seed treatment. In a direct drilling trial the direct drilling treatment plots should be made 27% wider than the district practice plots to reflect the conditions in a farmers' cropping situation.

The Weather Bureau has provided the data in Table 2. Averages are used to calculate the following:

Break of Season	May 7
Growing Season	4 ½ months
Planting no later than	July 15
Planting time available	70 days
Area of extra crop sown-	
Replace 2 cultivations	17%
Replace 3 cultivations	27%

Centre	Break of Season	Length of growing seasons (months)	Rainfall in growing season (points)	Proportion of rain in first 6 weeks (estimated) %
Bruce Rock	Early May	4.2	774	37
Doodlakine	Mid May	3.6	577	47
Goomalling	Early May	-4.1	895	34
Katanning	Mid April	6.4	1,598	23
Northhampton	Early May	4.6	1,634	30
Ongerup	Late April	5.9	1,022	30
Perenjori	Early May	3.7	819	36
Southern Cross	Mid May	3.1	530	40
Wickepin	Late April	4.9	1,278	26
Wyalkatchem	Early May	3.8	790	35

When direct drilling the actual increases in area of crop sown can be calculated as a percentage of the total crop planted. If replacing 3 cultivations with a single application of Spray-seed, the increase will be 27%. If only 2 cultivations are replaced then the increase will be close to 17%.

To actually measure this increase in a proper replicated trial it only requires the width of the direct drilled plots to be 27% or 17% wider respectively. Wider plots were never used by the Department of Agriculture after 1978. All treatments were sown on the same day. The advantage of early planting was ignored, so that there was very little difference in treatment yields.

Table 3

These figures are taken from the 1977-1981 trials where the district practice plots (DP) were sown at the same time as the direct drilled plots (DDC). They are the average of 2 of the 4 treatments with 4 replications at 5 research stations, a total of 80 plots each year. A third column has been added for each year which presents the yield obtained when the increase of 27% from direct drilling has been added to the plot yield of DDC to represent the extra crop which could have been planted.

Table 3			
Treatment	DDC	DP	DDC + 27%
Year 1977	1,852	1,682	2,352
1978	2,151	2,282	2,733
1979	2,003	1,915	2,544
1980	1,323	1,178	1,680
1981	1,572	1,535	1,996
Total	8,901	8,592	11,304
Mean	1,780	1,718	2,261
Plus 27%	2,260		

DDC = Direct Drill – Combine

DP = District practice

Each figure is the average of 5 stations yield for each treatment for that particular year

The mean represents 400 plots of each treatment

Discussion

The mean yields per hectare of 1780 and 1718 kilograms per hectare for the two treatments, Direct Drill with a Combine and District Practice are quite remarkable. At the five Research Stations, Merredin, Wongan Hills, Avondale, Esperance and Mt Barker, each of the two treatments were planted on 50 plots and reported each year for 5 years. As expected there was considerable variation amongst the 400 plots and yet when brought together as just two treatments they could be said to be the same!

If an extra 27% of land was added to the DDC plots and planted the mean yield increased to 2261 k/h.

Farmers quickly realised the opportunity they had to plant larger areas to crop each year. After 1978 with the improvement to their marketing strategy and the support of the Department of Agriculture the use of Direct Drilling expanded rapidly and by the turn of the century the system was almost universal.

The WA Wheat Crop for 2016

CBH reported that the wheat crop for the year totalled more than 18 million tonnes, a new State record.

In 2008, CBH handled 8.5 mt and in between 2008 and 2016 the annual crop handled has seen upwards depending on the season. During that time there has been a decline in the annual average rainfall. The number of farmers has dropped to 4300, but the average farm size has increased. The most important change in farming began in 1969 when ICI promoted Spray-seed for direct drilling crops.

In the 1960's Eric Smart the state's biggest wheat producer, in one season planted 1000 acres to wheat – a record. Today however individual crops of more than 1000 hectares are common.

Also the skill of farmers in handling 30 metre spray booms travelling at 15-20km/hr along with huge tractors to handle the large sowing and harvesting equipment helped to make it possible.

With proper weed control the gain from using direct drilling is the main reason for the continuing increase in growth of cropping in WA. The problems of frost and hail are still to be solved. Yet another dimension can be added, that of the professional contractors who have still bigger equipment to plant for a number of farmers.

A tribute to Imperial Chemical Industries

ICI are to be congratulated for their success.

They changed the method of planting cereal crops used in WA for over 40 years by replacing cultivation with a herbicide spray.

The UK Plant Protection team came to Australia having established Direct Drilling as a commercial success in England. In addition to the local research and development staff they added an experienced Private Farm Consultant Bill Roy to their group. A very wise decision.

The "Spray-Seeding" concept was launched at Northam in October 1969. The ICI Spray-Seed formulation was launched in 1971. However in 1975 the state sales manager wrote 'the project almost collapsed'. With confidence in their own experience ICI made further changes to their marketing program. They persuaded the Department of Agriculture to commence long term tillage research trials. Most important of all farmers realised and put into practice the opportunity to plant additional crop.

The rate of acceptance of direct drilling accelerated and within a few years there were very few farmers who didn't practice direct drilling.

Well done ICI WA owes you!