

## THE CHALLENGES OF MINIMUM TILLAGE

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Summary. Australian agriculture is undergoing dramatic and accelerating change. The economic pressure on farmers is to crop more intensively. If they do so with conventional cultivation they put already degraded soils into further jeopardy. The means of providing efficient weed control with the minimum of cultivation have been available for more than two decades and the trend towards minimum tillage is quickening. But there are three nagging questions for the scientific community to answer: Have research and extension met the challenges of change? Is it necessary to keep on repeating trials that have shown already that minimum tillage works? Can we waste time on refinements when the urgent need is to see that the principles of minimum tillage are applied in farming generally?

## INTRODUCTION

Agriculture in Australia has been dominated by three major phases that have developed from independent ideas.

The first began in 1876 with the invention of the stump-jump plough by Robert Bowyer Smith in South Australia.

The quest for better machines for general or specific purposes continues. So it could be said that we are still in the throes of the machinery revolution.

The second phase came with the availability of artificial fertiliser — superphosphate — about the turn of the century. This compensated for the generally low fertility of Australian wheatbelt soils, and we continue to be concerned with the nutritional requirements of our crops.

The third phase began with the adoption in the 1940s of the clover-ley as the basis of a stable farming "system" in the winter-rainfall areas.

For various reasons — but mainly because of economic pressure to crop more intensively — the clover-ley system has broken down, as have traditional methods in the summer-rainfall areas. So we are still engaged in the search for stable agricultural systems.

It is at this point that herbicides have emerged to put back the clock on one hand — and to take us into a fourth stage of agricultural development on the other.

When man first started planting crops he poked a stick into the ground, dropped a seed in the hole and hoped for the best.

Later on, he began to worry about providing nutrients and moisture and reducing the competition of weeds for those resources.

It became part of the folk-lore of farming that cultivation was essential not only to kill weeds and provide a seedbed but also to aerate the soil and improve its moisture characteristics.

We know today, when most of our agricultural land has been seriously degraded by cultivation, that the folk-lore had no basis in scientific fact.

The overwhelming evidence is that crops will grow as well (or better) without cultivation as they grow with cultivation — provided there is good control of weeds and the physical planting of the seed is done properly.

#### BEGINNINGS OF NO-TILL

The first work into no-till or direct drilling was carried out by E.W. Russell in England in the 1930s.

But it was not till the early 1950s — when 2,4-D became available — that we began to think about controlling weeds with chemicals, rather than the plough.

The chemical revolution in farming really got under way in the late 1950s with the development by ICI of the bipyridyl herbicides, paraquat and diquat, which are used separately in most of the world but are marketed in mixture (as Spray.Seed) in Australia.

As with most of these things the discovery came first and it was then a matter of finding how to use it.

But the potential of the bipyridyls was apparent from the start:

- \* They killed on contact — and had no residual activity — which overcame one of the drawbacks of earlier herbicides.
- \* They were rainfast and acted very quickly.
- \* They became locked almost immediately on to clay particles in the soil and were safe to the environment and to stock after spraying.
- \* From those attributes came the proposition that the whole farm could be kept in production — either in growing crops or in pasture.

ICI's early work with the bipyridyls in Australia was carried out in the late 1960s and Spray.Seed became fully available to farmers in Western Australia in 1970.

But farmers who had looked on Spray.Seed as a kind of miracle cure for weeds faced serious problems in 1974.

The early, wet season brought weed growth with which the chemical could not cope — given the techniques with which it was applied.

## CHANGE TO TECHNIQUE

This brought a fundamental change in ICI's approach to the bipyridyls.

Their potential — in terms of soil preservation and more flexible farm management — was obvious. But it was equally obvious that we would have to pioneer a new farming technique if farmers were to use the chemicals efficiently.

A lot of field work was done by ICI in close co-operation with the departments of agriculture from 1974 till 1978, when we took the first steps into selling the direct-drilling technique rather than the chemical Spray.Seed.

The mechanics of this approach involved a great many challenges:

- \* To ensure a high level of technical expertise in the ICI field staff.
- \* To test whether the results of trial work were reflected in the experiences of the farmer pioneers of direct drilling.
- \* To interest the media in the implications of direct drilling and to have the results achieved by the farmer pioneers reported.
- \* To ensure that ICI itself recognised the implications of what farmers were doing — and learnt the lessons well.

The effort to meet those challenges has involved a massive two-way extension programme that continues to grow and change as different situations are encountered by farm (and paddock) and by season.

We have found, for instance, that the break-graze-spray-sow technique that we adopted initially is not suited to a good many farming situations, especially in south-eastern Australia.

For that reason we talk nowadays about minimum-tillage, with direct drilling and no-till as the ultimate goals of the practice.

We were aware from the beginning that farmers would take any technique we recommended and modify it to what they saw as their individual needs and challenges.

But the extent to which they have modified chemical weed control under minimum-tillage practices has been surprising and — to a technically oriented company such as ICI — most satisfying.

West Australian farmers increased the area sown with minimum tillage from 160,000 ha in 1979 to 2.34 million hectares in 1983.

But nearly half of the 2.34 million hectares last year was sown without chemical. Those farmers were confident enough in their versions of the technique to bend the rules. The other side of that coin was seen this year when farmers' assessments of seasonal conditions and weed growth brought an unprecedented demand for chemicals.

Indeed, the most fascinating challenge of all, in ICI's experience in the past few years, is the challenge to explore all the new avenues that are signposted by farmers' needs and aspirations.

We have had to develop the chemical and the technique against a background of whole-farm performance and in the light of all the economic problems that confront the farmer in 1984 and beyond.

This has meant that our field staff need to be as familiar with farm budgeting as the farmer is.

We have had to keep abreast of boomspraying technology — and in the development of the ICI Electrobyn we are leaders in that technology.

We have had to tailor broad techniques to regions — as in the big difference between spray-fallow in the summer and winter rainfall areas.

Today we are confronting the twin challenges of soil conservation, which means drastically reducing cultivation, and curbing the costs of producing weed-free crops — which means thinking of weed management, rather than weed control.

The ramifications of those two approaches have an awesome bearing on the future well-being of Australian agriculture and of the Australian community.

The need to preserve our fragile soils is recognised universally.

But weed management is in its infancy, scientifically as well as in practice, and ICI will doubtless play a significant role in the development of weed-management practices on the farm.

Contrary to belief in some quarters there is underlying altruism in many of the things that the great multinational companies do in pursuit of their commercial goals.

We at ICI care about the environment and about the financial well-being of farmers through better methods of farming.

We share with individual officers of agriculture departments and soil conservation services an immense personal satisfaction in seeing the spread of minimum tillage so far.

We will have the same feeling about the adoption of planned weed management.

#### TOWARDS 2000

The commercial reality of all the challenges we face in the paddocks of Australian farms is that we are sellers of tools in farming. If we are able to contribute to the techniques for using them — and hence to the profitability of the farm — we have taken out the best insurance available to us.

But we can't leave it at that.

The changes we are witnessing today have occurred in the space of two decades.

If we let our minds embrace all the implications of weed management with virtually no cultivation the prospects for the next two decades are spine-tingling.

For thousands of years societies that could claim to be agriculturally advanced have seen the plough as the fundamental tool in crop husbandry.

In our efforts to feed ourselves we have produced vast deserts and seriously degraded the rest of our arable land.

A report to the World Conservation Strategy a few years ago estimated that the world is losing 80 ha a minute of its 11 per cent of arable area. At that rate we would lose by the end of the century more than a third of what we have today.

An American estimate in 1981 put it differently — it saw the U.S. loss of 6500 ha a day to erosion and urban development as the daily loss of a sustenance diet for 250,000 people.

These are horrifying estimates, the more so because they could be underestimates.

Yet we have still not got our act together.

In the United States farmers are being paid not to grow crops on land that past practices have put to unacceptable risk.

At the same time the advanced countries are trying to help the Third World to feed itself — by exporting those discredited practices.

We have all had a hand in the immense and exciting changes that have taken place in Australian agriculture in the past 20 years — scientists and extension workers, progressive farmers and industry representatives.

We have provided tools and techniques that would allow farmers to preserve the national heritage on economically attractive terms and we have seen Australia become a world leader in dryland conservation tillage.

We can contemplate — without being fanciful — the return of earthworms and other soil creatures to our paddocks, our rivers running clear and summers without dust storms.

But in practical terms what we have done so far is fashion the pieces of a jigsaw.

A lot of work has been done to prove some point to somebody's satisfaction. Too little has been done to identify the picture that the jigsaw pieces form.

The transcending challenge to all of us is to share a vision.