Joys and Sorrows of No-Tillage Sowing in Western Australia

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ABSTRACT

The adoption of no-tillage in Western Australia has been a rapid revolution. The management flexibilities that no-till offers and the sharpening of farmers' skills has allowed farmers to realise the power of no-till to improve their agronomic performance and to understand their systems better.

RATE OF NO-TILL ADOPTION

The adoption of no-tillage in Western Australia (WA) has been a rapid revolution (Figure 1). The change from full tillage systems to knife-point seeding or zero-till disc seeding has been explosive. The adoption was farmer driven. Much of the scientific data being presented during the time of explosive change, during the early 1990s, was negative towards no-tillage.

It was the bigger systems issues and longer-term sustainable benefits that farmers observed that helped no-till to forge ahead. Information provided by, and shared among, the Western Australian No-Tillage Farmers Association's (WANTFA) network was, and still is, an important key to the large adoption of no-tillage. The WANTFA membership is now 1400, from the 50 who started the movement in September 1992. Our group was modelled on ManDak.

BACKGROUND

Climate

Southern Western Australia has a strong Mediterranean climate. The 44 million acres of land, with sufficient winter dominant rainfall (of 12–24 inches) capable of growing dryland crops, has a latitude similar to southern California (28–35˚S). It has a cool winter growing season from May to October, with hot and dry summers – when annuals do not survive (see Figure 2). A typical winter day would range from 40˚F to 60˚F, warmer by 5˚ in the north. Summer maximum temperatures can readily and regularly reach 115˚F in the northern and central regions.

Crops grown in southern WA are mostly wheat, barley, lupins, canola, oats, peas and other pulses and are mostly all sown in early May and harvested in November. Each day's delay in seeding reduces yields by about 1% – irrigation is not an option. Australian soils are cooling down and wetting up in May and the daylight hours are short (10.5 hours).

At seeding, farmers are not too concerned with drying soil as winter rains often occur weekly. Therefore, cultivating below the seed zone is not harmful to crop emergence. It is common to cultivate 4" deep with a knife-point (0.5" wide) to reduce rhizoctonia which is worse in zero-till initially. In deep sands that compact, a 30% tillage response can be achieved by no-tilling with a 10" deep knife point on 12" row spacings. This is common on the Wongan and Eradu sands.

Soils

The soils are mostly very infertile and sandy with little buffering capacity. About 60% of the soils are duplex, or sand over clay at 4-20 inches depth. There are large areas of deeper sands also. These duplex sands usually contain only 1-5% clay and in the natural state the soils grew Eucalyptus trees and contained almost no copper, zinc, molybdenum or phosphorus (1-5 ppm). The red loams, in the river flat systems, typically had enough nutrients to grow low-modest plant production.

Age of agriculture

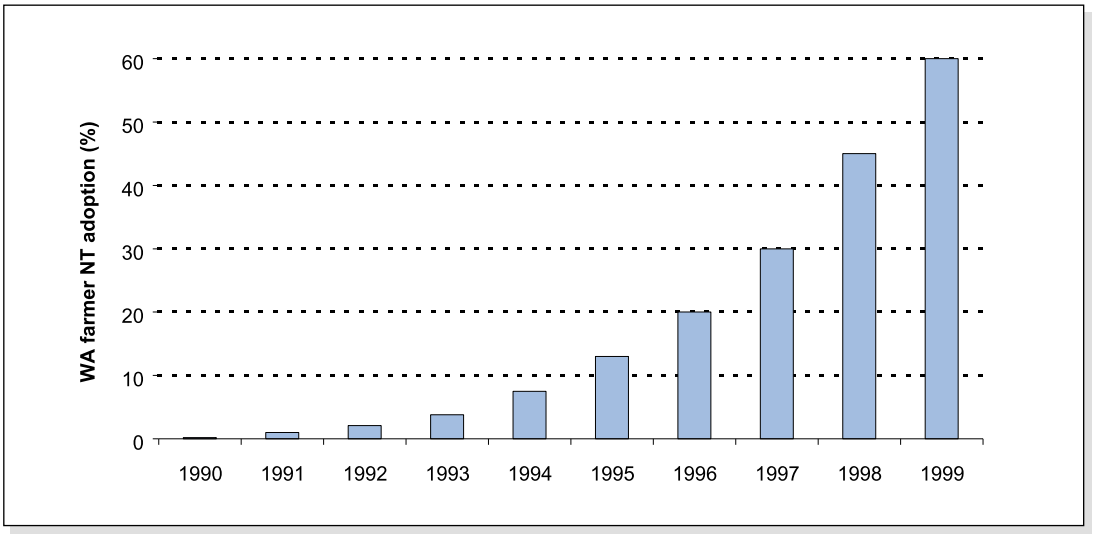
The somewhat fertile river loams were able to grow crops and pastures when first cleared of trees in the 1870s. The sandy soils were not used until in 1946 after they discovered the soils lacked trace elements. Then in a decade during the 1950s the government cleared more than a million acres a year. Now, 40 years later, 9% of this land is salt and they expect it will total 30% of the land by the year 2025. This is our crisis issue. More on this issue later. Many other crisis issues of the past in our agriculture have been solved by the widespread recent adoption of no-tillage.

Sheep and pasture

During the hot summers merino sheep roam inefficiently in search of food and water. Their roaming loosens the dry soil and predisposes it to wind and water erosion and structural damage on heavy soils. However, sheep have been an important part of Australian farming. The sheep require fences, forages (pastures) and a dam in each paddock. Paddocks are often 150-300 acres in size and farms are often 2000-10 000 acres in size and each farm has a large shearing shed and pens for shearing and pest management.

Pastures naturally regenerate in April-May after enough rain falls and the temperature drops. This is called the break to the season. Annual germinating pastures are weeds in crops, but since there are no perennial weeds to kill (dry summers) low rates of glyphosate (120 ml/ha) often work effectively. Pastures produce a lot of nitrogen. Some cereal crops would only get 25 lbs

Figure 1
Estimated farmer adoption of no-till in Western Australia



N/acre while canola might get 80 lbs. The cool and raining conditions after seeding make urea 4 weeks after seeding a sensible option in WA.

WHY WAS NO-TILL ADOPTED? – THE JOYS!

The massive amount of wind erosion that occurred in WA, and in particular along the south coast, in the early 1980s and early 1990s, created a fertile atmosphere for change. Farmers – and their wives – were tired of severe wind erosion and dust problems. Not to mention the loss of a very useful sandy soil that was often shallow and overlying an inhospitable sodic clay subsoil. These soils are called duplex and are not common (existent?) in North America.

Once farmers experimented with no-till they discovered lots of unexpected benefits. They could not only stop wind and water erosion, but they could seed into drier soil, they had improved earthworm activity and yields were not decreased (when put into the right part of the rotation). Farmers also found they could spend more time with their families at seeding, trafficability was improved, they could sell excess equipment, they had more seeding management flexibility and they found their over-all agronomic knowledge improved. This was because mistakes are more obvious with no-till and better monitoring was essential and more possible with no-tillage.

Farmers also discovered, within a few years, that weeds could be more effectively controlled if they were left on the soil's surface with no-tillage. This was particularly so when using trifluralin with knife-points on wide row spacings (9-11"). In fact, all soil active herbicides were more effective in the no-till systems, compared to full cultivation systems. With the widespread severity of herbicide resistance to many herbicides, particularly to the fops, dim and SUs, this better weed control has been a driving force for no-till adoption in recent years.

Another most powerful observation has been the better crop yields in drought years. Each cultivation encourages about 8/10"of an inch of rainfall to evaporate. Not only does no-till conserve soil moisture, it allows farmers to seed into dry conditions and ensures that water harvesting into the furrows occurs at the beginning and the end of the season. This extra moisture is channelled to where the crop roots and fertiliser are placed, making it more difficult for weeds to compete with the crop.

WHAT ARE THE CURRENT NO-TILL ISSUES?

We are at a time of continued great change in our cropping systems in Western Australia. Some of these include; the diminishing role of sheep over the last 10 years (poor wool prices), trying to find more diverse and appropriate rotations, and trying to survive with increasing herbicide resistance.

The fading of sheep has created a niche for other options. Without sheep there have been improved crop grain yields from retaining stubble and better time of sowing and not allowing sheep to spread weeds over the whole farm. Conversely, not having pasture in the farming system removes grazing as a management tool for herbicide resistant weeds.

SORROWS OF NO-TILLAGE SOWING

Herbicide resistance

Increasing reports of glyphosate resistant weeds is the biggest threat to no-tillage seeding. Without an effective and cheap broad spectrum burn-down (knockdown) herbicide, and tillage (with all the damage it does) – how else can we no-till? Most of our problem weeds have demonstrated resistance to most herbicide groups. There is glyphosate resistance in two confirmed cases in Australia, and several more are highly suspected. At least two glyphosate resistant weed populations have been identified in California, and Malaysia has recently reported several populations of glyphosate resistant weeds. We desperately need another glyphosate herbicide soon.

A strategy developed in Western Australia to extend the life of glyphosate is the "double knock" technique with Spray•Seed™ (paraquat 135 g ai/l + diquat 115 g ai/l) use. Most no-tillage farmers now apply Spray•Seed™ onto weeds that are still dying from glyphosate uptake. The Spray•Seed™ is applied within 1-10 days of the glyphosate application. This double knock technique has become the normal practice with most no-tillage farmers in Western Australia over the last ten years. Apart from delaying the occurrence of knockdown resistance, the technique also ensures quicker weed root release, improves herbicide mix options, can achieve an extra kill of new weeds, ensures barer ground for longer and can clean up areas that may have been missed with the first knockdown.

Farmers have been making significant changes to their weed management strategies over the last 10 years. Resistance to all herbicides is well understood in our farming communities. Farmers are swathing, manuring, cutting hay, using chaff carts, mixing up rotations, changing seeding time, burning header rows, adopting no-till, using the Chaff Top, growing short season crops and ensuring

a weed emergence flush occurs before spraying and then seeding with minimal disturbance. Some have even brought sheep back in (though the sheep may not be profitable alone) and many are experimenting with warm season crops.

It is clear that we must develop more diverse ways of killing all weeds. In Western Australia, this is particularly important for ryegrass and radish. No-tillage has provided significant biological weed management tools – with allopathy and surface placement rotting and predation (by ants, in particular). However, these must be complimented with other physical tools, particularly those tools that are still to be developed, like crushing the seed.

Insects and diseases

Obviously these pest problems are best managed with diverse three crop-type rotations – as Dwayne Beck would say. But the search for finding these profitable and diverse rotations in our environment is very challenging and has only recently begun in earnest. This search for diversity is ridiculed by most experienced researchers. The other option, which many researchers keep coming back to is – plough and burn! Neither of these excite many WANTFA members, who are keen to go forward – not back to the problems this approach offers.

There are only two crop types used in WA; they are cool season grasses and cool season broadleaves. Three years of farmer experiments suggest that sunflowers and grain sorghum may have some potential, with likely poor yields. Our hot and dry weather soon after seeding in September in sandy soils (holding only 10% moisture) is evidence for scepticism of their potential.

However, without this desperately needed diversity our cropping systems need modest pesticide inputs (low compared to European agriculture). Our hot-dry summers do not kill many crop disease problems, while our long-cool winters give many diseases ample time to build up and move on the wind throughout the state.

Most of our pests are protected by stubble retention and are worse with no-tillage with our limited cool season crop diversity. Some of these pests include falsewireworm, slugs, red legged earth mite, various grubs, snails (in patches of alkaline soils), mice, Rutherglen bug, septoria in wheat, various barley leaf diseases, blackleg in canola, Ascochyta in chickpeas, blackspot in peas. It is a rare plant pathologist who does not recommend burning and tillage to manage these problems.

Too few progressive researchers

While no-till has been rapidly adopted by farmers, many researchers are still negative about no-tillage. This has restricted the amount of useful research that has been done. Many researchers are very quick to say 'we told you so' when problems emerge. It would be great if they said 'let's push on and refine the system to cope with the new challenges'. One thing is for sure, the farmers are not keen to go back!

It makes water repellence worse

With very little surface area in our sands, they easily become coated with waxy material from retained organic matter. No-tillage makes this problem worse and now many farmers are applying 250 t/ha of clay on the surface and mixing it in to raise the clay levels to 5%. Water repellent soils severely exacerbate crop production – reducing yields by 20–60%

BRIEF NO-TILL HISTORY IN WA

Interestingly, the Agricultural Department's early trial work showed lower yields with no-till. The advent of severe wind erosion, fops, better legume crops, clean break crops, tungsten carbide, press wheels and better crop agronomy made for better no-till yields. Wheat crops of 18 bush/acre were common in the late 1970s with conventional tillage.

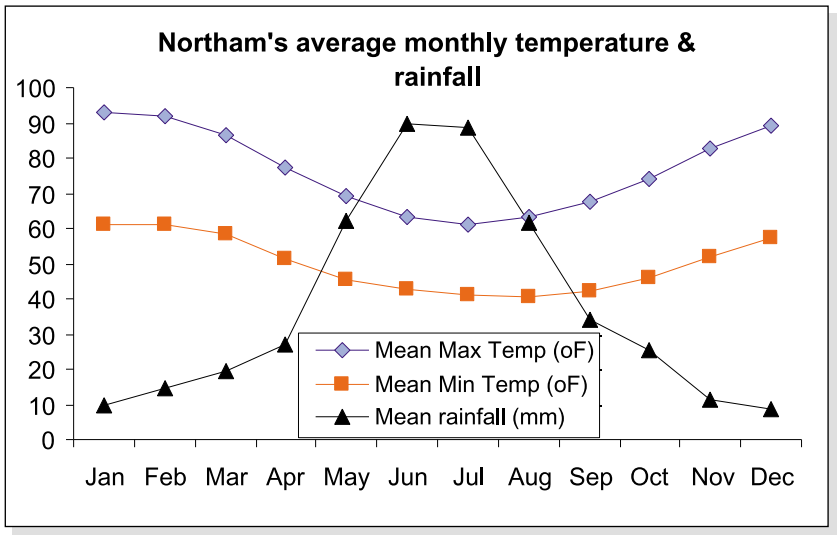


Figure 2
Typical climatic data for Western Australia

By the late 1980s high yielding (50 bush/ac) crops were common, leaving high levels of trash. This easily blocks seeders on our sandy soils and farmers attempted to selectively burn while others burnt whole fields prior to seeding. However, strong winds and a poor 'break' caused severe soil erosion. The loss of valuable topsoil was a powerful incentive for change. Those farmers that no-tilled did not lose paddocks and they produced a crop.

SEEDING MACHINES

Which type of no-till machine farmers should buy is not clear cut. Some environments favour zero-till discs while others no-till knife-points. Press wheels are always favoured. Trash flow is best with the discs and they ride over rocks better. The wear rates on either machine type are high and changing tips every 300-500 acres occurs often in Australia. Tungsten carbide tips are now common. Australian farmers can zero till with some very cheap machines although many of the expensive Canadian seeders are commonly bought.

SUMMER MANAGEMENT ISSUES

The 2-3 thunderstorms that might occur during summer may drop some rain before the true break and this will allow weeds and insects to grow. Some of these will not drought prior to the break, and if these weeds are not quickly controlled they are hard to kill before seeding. Their growth allows insects to grow – which damage emerging crops. Without early weed control no-till can fail; with it, the extra moisture conserved allows early crop establishment, but increases the threat of the rising groundwater.

CONCLUSIONS

Farmers continue to be enthusiastic about the benefits of no-tillage. This is despite many of the pest management issues that have arrived since no-till. The management flexibilities that no-till offers and the sharpening of farmers' skills has many farmers realising the power of no-till to improve their agronomic performance and to understand their systems better.

There is a continuing need for farmers to take control of their own agronomic destiny. Researchers tend not to be leaders, but followers, and the lag phase is often very frustrating – especially when you are on the edge.

Keep up your good work, and on behalf of WANTFA President Mr Geoffrey Marshall and myself, many thanks for your willingness to share freely with us! All the best!

ABOUT THE AUTHOR

Bill grew up on a wind erosion stricken farm at Jerramungup (where there are some of the most severe erosive winds in world agriculture) on very sandy surface soil. He obtained a B. Ag. Sci. from the University of Western Australia in 1985. He worked as a researcher/ extension worker on a project called 'minimum tillage for wind erodible sandplain soils' from the Jerramungup Department of Agriculture from 1985-1987 before becoming general extension officer at Esperance and Jerramungup from 1987-1990 and 1992-1995 (working on a Masters degree in 1990-91). In 1996 he had a one year job exchange to Canada where he worked closely with the big farmer group 'Manitoba North Dakota Zero Tillage Farmers Association' and co-edited their book called 'Advancing the Art of Zero-Tillage'. Since returning in April 1997, he has been employed by the Western Australian No-Tillage Farmers Association (WANTFA) as their Scientific Officer.

IF YOU HAVE ANY ENQUIRIES REGARDING THE CONTENT OF THIS ARTICLE, PLEASE CONTACT:

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