Getting started with no-till

This article has been written in an Australian context, but is likely to have world-wide relevance. Please consult your nearest department of agriculture or agronomy firm to get specific advice for your situation.

There are many potential benefits of no-till including:

- Increased water storage through better infiltration;
- Increased cropping opportunities through more stored soil water;
- Higher yields as a result of more plant available water;
- Less costs – typically chemical fallows cost less than cultivating;
- More efficient farming through faster operations (spraying is much quicker to complete than cultivating)

Many farmers believe that no-till starts with the planter/seeder, which is NOT the case. In some instances, we have seen no-till fail because people haven’t considered the whole system. Purchasing a new planter is not no-till.

We believe there are 7 steps to no-till:

1. Use a good no-till agronomist
2. Increased management knowledge and skills
3. Soil compaction from machinery
4. Dealing with harvest residues
5. Managing weeds
6. Nutrient tie-ups, especially Nitrogen
7. Planting through residues

1. Use a good no-till agronomist

As explained in point # 2 below, one of the first requirements is a higher level of knowledge and skill in chemical application and weed control. This is where a good no-till agronomist will be critical to success. They will know many of the chemical formulations that will work in your area, and they will also have a very good understanding of the available chemistry and tank mixes.
Another important point is herbicide resistance. Agronomists have a good understanding about mode of action, and can advise what products to use to minimise the chance of resistance developing in your area.

2. **Increased management knowledge and skills**

No-till requires a higher level of management in a range of areas. It is likely that the time spent farming will reduce with no-till; however timeliness is the most critical factor, especially with regards to weed control. Spraying must be done when weeds are small and fresh; otherwise failures are likely – in comparison to waiting for more weed flushes before cultivation.

Extra knowledge and skills will be required in the following areas:

- spraying set-up (primarily nozzle selection and operating pressures),
- identification of weeds, especially at early growth stages,
- selecting the right chemicals to do the job,
- chemical use – how products are applied, what conditions minimise drift, etc…,
- health and safety requirements for pesticides,
- record keeping, especially of spraying pesticides
- planting equipment in no-till needs more consideration and more adjustment due to the uneven nature of the seedbed

3. **Soil compaction**

Wheel tracks from machinery are a significant issue in no-till just as they are in minimum till or conventional tillage systems; the only difference being you cannot cultivate to remove them. Matching machinery to have all wheels driving on the same track (called Controlled Traffic Farming) will help with the move to no-till. We strongly recommend that you consider a CTF system, in combination with no-till conversion.

4. **Residues from harvesting**

Residue management starts with the harvester. We recommend to cut as tall as possible, thereby reducing the amount of material going through the header, and providing well anchored stubble. This may not be suitable in all situations, however, especially where stubble becomes brittle or decomposed at the base.
It is important to get the residue spread across the full width of the harvester front. Choppers and spreaders are required, and can be retro-fitted to older machines if required. The photo below shows very good spreading of the residue. You can see that the spread width is actually wider than the header front (which in this case was 12 metres or 40 feet).
Below is a photo of a ‘Cyclone’ chaff spreader retro-fitted to a JD tractor.
Below is a Claas header fitted with a very effective spreader.

After noticing some differences in the crop under poorly spread header trails, we took some simple measurements at harvest time to examine the impact of the header trails on crop yield (see below). This clearly shows the importance of stubble cover, where wheat yield was nearly doubled because of the extra moisture storage.
After proper spreading, the next step is to keep the residue standing – it is much easier to manage. Stock grazing and other farming operations (such as fertilising) will affect how well the stubble stands up. This is where GPS is important to maintain standing stubbles for as long as possible, thereby allow inter-row operations.

We are often asked about the longevity of stubble standing vs. on placed on the soil surface. The data below from the Queensland DPI shows that about 2/3 of cereal stubble weight has been lost within 6-8 months. The weight has basically been consumed by soil micro flora and fauna. Legume stubble is essentially gone by 5 months. By leaving stubble standing, the microbes are still consuming the bulk of the material, and incorporation is not required.

![Graph showing the effects of stubble type on decomposition rate](image)

Another common question is whether stubble cover reduces evaporation. Unless it is extremely high amounts (similar to your garden at home) then stubble has little impact on soil evaporation amounts (see below – source Queensland DPI).

Cover will reduce evaporation rate by only a small amount, however the net result after about two months of no rain is that cover has no impact on the total evaporation of water from the soil. This data comes from dryland grain farming – in very high biomass crops or high rainfall areas that produce more crop bulk (such as sugarcane) the results are likely to be different.
Managing weeds

As mentioned previously, management knowledge and skill will need to be heightened in the area of weed management.

Weed spectrums often change under no-till – so you need to be vigilant and look for weeds that you may not normally see. There has been a higher presence of weeds such as sow thistle, fleabane, and Feathertop Rhodes grass in no-till areas of Australia. This weed spectrum change needs new ways to achieve good weed control. This may include using different herbicide modes of action, rotating crops, spot spraying (with technology like the Weedseeker™ [shown below], band spraying, and shielded spraying).

Fig. 4 The effect of stubble cover on evaporation from a red soil in mid-summer. Covered soil conserves slightly more water than bare soil.

5. Managing weeds
The photo below shows Fleabane seedlings. Spraying any plants larger than the plant on the far left will lead to many plants which have failed to be killed. This highlights the importance of good checking and a good agronomist to detect issues early.
The graph below shows the impact of seed depth on emergence of Feathertop Rhodes grass in Australia (courtesy Qld DPI). Feathertop has a very small seed; therefore any seed that is buried will not survive. With the removal of cultivation, weeds with smaller seeds appear to be taking a firmer hold in no-till systems.

Another very important factor that is far more likely under no-till is herbicide resistance. Mode of action refers to the way a chemical enters or works to kill or suppress the weed. By using chemicals from different mode of action categories herbicide resistance can be delayed or even avoided altogether. For more information, contact your local chemical reseller or Primary Industries Department or a website like www.hracglobal.com.

Aim for minimal disturbance of the seedbed when planting. We have seen many instances where disc planters have resulted in very little weed germination because they do not disturb the soil. If weed seeds don’t germinate, it allows more chance of the seed dying or being eaten by predators such as ants. After several years, you may see a gradual decline in germination of weeds due to the simple fact that weeds have not been setting seeds.

Don’t rely on sheep/cattle to kill weeds. Sheep and cattle play a critical role and many farming systems in Australia, but our advice is to control summer weeds by spraying the fallow. Fence lines are also great weed harbours – try and plan the property with minimum amount of fences in cropped areas. As part of property planning, we have helped many farmers to lay-out their properties more effectively, with one of the key outcomes being the reduction in weed harbours.

Boomsprays are a very important piece of machinery in the no-till system – it is the machine that a farmer will spend the most time on. Often many new no-till farmers start with a new planter and an old boomspray with the wrong, or worn, nozzles attached. Whilst the boom spray doesn’t need to be the best or most expensive on the market, it is needs to have at least some of the following:

- A tank size suitable for the size of your farm or what you need to spray in a given time period;
- Quality nozzles with no wear to maintain desired droplet spectrum and flow rate;
- A rate controller so that as ground speed changes the flow rate at the nozzle is maintained;
- Cabin on the tractor with a filtered air-conditioning system to reduce operator exposure to chemicals; and
- A pump of sufficient capacity to maintain desired pressures and flow at the required range of operating conditions.

Some other useful features of a boom spray include:

- Boom section controller, so that the sections automatically shut off when you travel over sprayed areas (we have witnessed savings of 25% of chemicals);
- Automatic boom height controller to maintain boom height at the desired level above the target – this is critical for drift reduction as a boom operating at 1m above the ground has almost 10 times the potential drift of that operating at 0.5m;
- Suspension for rough travelling at high speed in no-till systems

A designated refilling area will make the job a lot quicker and easier, and properly designed (check your local legislative requirements) can meet all health and safety requirements as well.

High clearance spray rigs are becoming very popular in many parts of Australia. A spra-coupe is shown below. There are many other options as well. These can travel at high speeds in comfort; however tank size can be limiting in some cases.
6. Nutrient tie-up, especially Nitrogen

The main nutritional issue with no-till is the tie up of Nitrogen by soil bacteria. Whilst the tied-up Nitrogen will cycle back to become available again, in the early stages no-till will almost certainly require higher Nitrogen rates to be used. The lack of cultivation will also lead to less N being released from the unavailable N pool in the soil.

The other issue is that with greater storage of soil water, no-till generally leads to higher yields; therefore there will be a higher demand for all nutrients.

Testing for Nitrogen should be done to at least 60cm, preferably 90cm into the soil profile. Knowing the depth of Nitrogen is also important – therefore testing at depths of 0-30, 30-60 an 60-90 (and even 90-120cm in deeper soils) will develop understanding of where the Nitrogen is positioned in the profile. This information will assist in the development of a fertiliser strategy, which we believe is critical to the success of no-till.

7. Planting through residues

There are an increasing number of no-till planters/seeders on the market. There is certainly a push towards single disc seeders for no-till seeding, tined machines still remain the dominant planter type in Australia.

Recommended components of a no-till planter:

- Independent depth control (in preference to frame depth control) which generally means parallelogram tine, walking beam or rocker arm (most single and double discs). This ensures the most consistent seeding depth in a no-till system given the inconsistent nature of the seedbed,
- Presswheels as close as possible to the planter unit. This will assist in assuring pressure is applied directly over the seed, and no too much dry soil falls into the trench prior to pressing the seed,
- Row spacing of min 10” (250mm), preferably wider. This will assist in inter-row sowing, clearance within the frame, and overall stubble flow,
- Under-frame clearance of min,
- In-frame/between bar clearance of min,
- Frame components to be bolted rather than welded – this will assist in moving planter units within the frame when required for inter-row sowing,
- Air diffusers (D-cup type shown below) on airseeder based planters to separate air and seed close to the planter unit (min 300-400mm above the seed drop),
Presswheels with simple, but consistent, pressure adjustment. Adjustment is critical in no-till depending on the soil conditions and the crop type being planted,

Depth control and 'lift assist' wheels of 3 point linkage planters should be located in the wheel track (if in Controlled Traffic Farming). Depth control will then be achieved by each unit,

Depth control wheels of tined planters with frame depth control should be out of the CTF wheeltracks. This is because wheeltracks are generally not a consistent depth,

A coulter can assist with cutting through stubble, as well as assist with minimising soil throw on tined planters. Most planters in Australia have a straight/flat coulter; however fluted/wavy coulters may also be useful in some areas. Testing on your own farm is suggested,

Presswheel shape and width should match the point on tined planters. This is important to ensure proper seed press in the trench – see information below

Tine width should be as narrow as possible. Our experience suggests that 2 different types are required for most situations; a beak/chisel point (below right) and a snub nose/flat (below left) at the least.
Important factors to consider between single discs and tined planters for no-till:

- Tined machines can generally operate in a wider range of moisture conditions,
- Tined machines can achieve deep sowing (>4”),
- Single discs generally relate in lower weed germination,
- Single discs will generally plant quicker than tined machines,
- Disc machines will generally have more moving parts therefore higher maintenance costs,
- Soil compaction can cause issues with disc seeders not closing the trench fully,
- Seed depth placement with single discs can be sometimes be inconsistent due to the nature of the disc rotation and angle,
- Tined machines may lead to the release of more Nitrogen from the soil, which has been shown in some cases to lead to lower yields as a result of the crop outgrowing moisture supply.

Covering chains have been found to be useful (below). The aim is to bring some dry soil over the pressed wet soil to prevent baking of the seed trench. About 1.5 metres of heavy chain is needed following each presswheel.