Conservation Agriculture for sustainable cropping and environmental protection

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Following the success of the joint TAA/IAgrE seminar on conservation cropping held at Cranfield University on 8 March this year (www.iagre.org/conservecrop.shtml), TAA organized a visit to a no-till farm in the UK. This was hosted by Tony Reynolds on 4 June at Thurlby Grange farm at Thurlby, Bourne, Lincolnshire, where the evidence for the success of no-till agriculture was on display.

Conservation agriculture (CA) is now practised on some 120 million hectares worldwide and it consists of the synergistic application of minimum soil disturbance (preferably no-till), permanent organic soil cover and rotations of main and cover crops (www.fao.org/ag/ca). Adoption of no-till (an essential CA ingredient) in the UK has faltered since the banning of crop residue burning, but with the imminent convergent storm of environmental damage, climate change, population increase and rising food and fuel prices, people are taking a serious new look at its potential.

No-till oats sown into wheat residue

Thurlby Grange farm covers 243 hectares and is principally an arable farm with important complementary enterprises. The main soils range from organic black peat fen soils to silt and clay loams; with an annual rainfall of about 673 mm. The main crops sown are first and second wheat, oil seed rape and spring crops including peas, beans, linseed and canary grass (*Phalaris* spp.), there is a small area of oats. Crucially the farm fattens store cattle on pasture which is undersown in winter sown crops. There is also a 16 000 hen egg-production unit, which produces a vital 10 tonnes per week of manure rich in P and K. This integration of crop and livestock enterprises, in parallel with good crop rotations, is an important key to the success of CA. The farm started to experiment with no-till in 2003 and was 100% converted in 2006 when all the conventional tillage equipment was sold off. This was a brave move and aroused a suspicion in the neighbourhood that the owners had either lost their marbles or gone bust. They certainly were not in danger of going bust.

Wheat yields and production costs

It is to be expected that soils damaged by mechanical tillage will take some time to recover their vitality under a no-till regime. And this has proven to be the case at Thurlby Grange. Wheat yields under conventional tillage were 8.75 t/ha and these

[1] www.engineering4development.co.uk

declined to 8 t/ha after the first year and 7.5 t/ha after two years. Thereafter yields started to improve, back to 8 t/ha in year 3, 8.5 in year 4 and 10 t/ha 5 years after switching to no-till. So yields are improved over time, but what about production costs? Well, as would be expected, the elimination of power-intensive soil tillage has meant that production costs have plummeted from £245/ha to £36/ha. And this includes the very important reduction in total annual farm fuel consumption from 96 litres/ha to 43 litres/ha. The only machinery that the farm now requires is a no-till seed drill, a sprayer, a fertilizer distributor, a combine and tractors for farm transport and maintenance.

No-till planting

The farm has a four metre Argentinean Bertini 22000 no-till seed drill which is capable of cutting through the surface residue of the previous crop, depositing seed and slug pellets (when required) in a slot formed by two offset discs and covering and compacting the soil over the sown seeds with inclined packer wheels.

Planting line of the Bertini no-till seed drill

The combine has a stripper header which strips the grain from the crop and leaves the straw standing in the field. The header can be equipped with an Autocast pneumatic broadcaster which spreads oil seed rape seed and slug pellets behind the header so that they are covered by the straw and chaff discharged from the back of the combine. So the rape is 'sown' with no soil movement at all and establishes itself on the ground surface beneath the protective cover of the previous cop residues.

◄ Autocast oil seed rape seed broadcaster mounted on the rear of the Shelbourne Reynolds stripper header

► Tony Reynolds in an oil seed rape crop broadcast during the harvest of the previous crop with the Autocast

Weed control

Weed control is achieved by the judicious use of herbicides. Glyphosate is a broad spectrum systemic herbicide used to control all weeds at seed drilling time.

Subsequent treatments are applied as required: for example, Atlantis has controlled black grass to the point where there is hardly any of the weed on the farm, and Kerb is used as a post-emergence treatment in oil seed rape.

Benefits to the soil

This year has experienced the driest spring on record and Thurlby Grange farm has received only 11mm since February. However there is no evidence of water stress and the soils are still moist to the touch. They are also well structured thanks to the action of crop roots and earthworms. The rape roots can reach over 1.2 m deep and when they rot they leave ready made channels for precipitation to infiltrate.

Tony Reynolds extracts a soil sample from a no-till wheat crop flourishing in spite of 2011 having the driest spring on record

The population of earthworms has multiplied many fold as a result of not disturbing the soil. They have also increased in size and Tony thinks that there may now be a subspecies: *Lumbricus terrestris* sspp. *Rattlesnakeensii,* loose in his no-till fields.

An earthworm channel. Made by: *Lumbricus terrestris* sspp. *Rattlesnakeensii*? The soil is well structured with good porosity and an increasing organic matter content

With the annual addition of organic matter and the elimination of soil erosion the soils are increasingly more friable, moist and porous – in complete contrast to ploughed and harrowed soils which have their structure destroyed each year. Many fen soils are now below sea level due to the oxidation of organic matter as a result of traditional tillage, and the catastrophic wind erosion that occurs when tilled soils are left unprotected by surface residues. Tony now believes that his soils may even be increasing as wind blown soil from his neighbours is deposited on his land.

With the natural increases in soil fertility and the application of the poultry enterprise manure, inorganic fertilizer application on the farm has been reduced by up to 80%.

Environmental benefits

Improvements in soil structure, fertility and fauna such as the earthworms are one thing, but there are other environmental benefits associated with no-till. Carbon emissions are drastically reduced with the savings in fuel use per hectare and soil organic matter is increasing as crop residues are retained (some are incorporated by the earthworms) and carbon is sequestered. The reduction in use of inorganic fertilizers also adds to the reduction in carbon emissions as large amounts of fossil fuel are used in their manufacture. Wildlife, too, can benefit from the improved conditions, brown hares have multiplied, lapwings and skylarks are on the increase and the generally greater numbers of mammals means that raptors such as the buzzard and marsh harrier are starting to visit. And of course kestrels are particularly fond of snake-sized earthworms.

These environmental services may well become important economically as we move to the reform of the European CAP in 2013 when ecosystem services in the areas of water retention, carbon sequestration and biodiversity increase are likely to be rewarded.

There is a strong possibility though, that more field hedges would not only act as windbreaks and so protect both crop and soil, but would also offer a haven for wildlife and so increase still further the improvements in biodiversity.

Conclusion

The visit to Thurlby Grange farm demonstrated, in very certain terms, that no-till agriculture in the UK is economically feasible and can lead to sustainable crop intensification and environmental protection. These results are equally valid in the tropics where CA has a remarkably attractive future. Both smallholder and large scale farmers in many countries have now adopted CA (see the FAO website) and the frontier is steadily advancing worldwide. There is much for European would-be CA farmers to learn from colleagues in other countries, including developing countries. And it is also the case that pioneers like Tony Reynolds have rich experiences to share with other farmers world wide.