CASE STUDY

Controlling soil erosion and improving soil conditions in field tree and hedging nursery stock production

Key points

- **Soil erosion increases the risks of water pollution and compromises the viability of farm businesses**
- **Soil loss from fields has been reduced by establishing wide grass margins, filter barriers and sediment ponds at the base of slopes**
- **Other measures to reduce erosion and soil loss include re-orientating rows across the slope and reducing slope length by establishing in-field grass buffer strips, although these measures can impact on the efficiency of operations**
- **Building soil organic matter can increase the soil's resistance to erosion and compaction**
- **The regular use of grass leys and green compost will help enhance soil organic matter content in the topsoil over time**
- **Subsoiling has been ineffective at improving soil conditions - reduced cultivations without subsoiling will be trialled on a small area of the nursery**
- **Where feasible, beds should be kept in place but levelled post-harvest and then re-planted without further cultivation**

Background

Wyevale Transplants (part of Wyevale Nurseries) is a horticultural business based in Herefordshire, which specialise in raising tree and hedging transplants at Russell's End Farm, managed by Ray Jenkins.

Plants are typically established in outdoor seedbeds until they are around 30 cm tall. Young plants are lifted between October and February and cold stored prior to being transplanted into beds in the spring (March-May). The plants are then grown on for 1 to 2 years before autumn-winter harvesting and selling on to various markets.

The main production site is 90 ha; soils are sandy (Bromsgrove association) and many of the fields are sloping. One of the greatest challenges for soil management is the harvesting in the autumn-winter period when soils are moist to wet; and in the absence of any mulch, soils are left bare over winter. The vigorous soil movement associated with harvesting destabilises the soil and erosion is therefore a significant issue at the site, resulting in loss of soil and organic matter along with topsoil nutrients, posing a major pollution risk for watercourses. Soil slumping, which results in compaction at the soil surface and capping were also an issue for production at the nursery.

Figure 1. Soil erosion on site

Soil conditions

Soil assessments and measurements indicated that the upper topsoil was generally well structured, with a firmer layer at 10-25 cm depth and a moderately-developed tillage pan (Figures 2 and 3).

Figure 2. Topsoil structure at Russell End's Farm with larger aggregates indicating a moderately-developed tillage pan

Figure 3. The knife indicates the depth of the firmer topsoil layer

The upper subsoil at around 30-45 cm depth was the firmest layer (probably associated with in-furrow ploughing) and during a visit in January 2018 the soil was saturated above this layer (Figure 5). Soil compaction generally extended to below the effective working depth of most agricultural subsoilers (c. 45 cm depth). When left bare, sandy soils with low organic matter content are particularly prone to soil erosion from raindrop impact and surface runoff. Sand content in topsoils ranged from 75% to 84% and organic matter content (Dumas method) from 0.9 to 1.3%.

Soil management strategy

Regular surface runoff, soil erosion and local flooding incidents led to Ray introducing a range of measures on field headlands and margins to slow down and capture surface-runoff. These included wide grass strips with the surface contoured to route surface water in meanders to sediment ponds and filter barriers. As a result, sediment loss from the fields and surface runoff and sediment load in local ditches and streams has reduced significantly.

In recent years, the nursery has adopted additional measures to try and improve soil conditions within the fields, thereby tackling the problem at source.

The principal measures are:

i) The introduction of 18 month grass leys into the rotation; and

ii) The application of green compost every two years.

Within a Nitrate Vulnerable Zone (NVZ), PAS100 certified compost can be applied at a nitrogen (N) loading rate of 500 kg N per hectare every two years; an application rate of approximately 60 t/ha (as applied) adding around 9 tonnes of organic matter per hectare. Increasing organic matter content over time will make topsoil more resistant to raindrop impact, capping and crusting (due to higher aggregate stability).

Other measures considered include the use of shallow tine cultivation to break up compacted wheelings, applying surface mulch (straw or compost) and the establishment of grass strips within track ways. Ray has also considered re-orientating rows across the slope and reducing slope length by establishing in-field grass buffer strips, however he concluded that these measures would significantly reduce the efficiency of operations.

A key challenge is to identify erosion control measures that will not impact on transplant growth and productivity. Growing cover or nurse crops within the beds competes with the transplants for water and nutrients and reduces plant size, which is directly related to the market price.

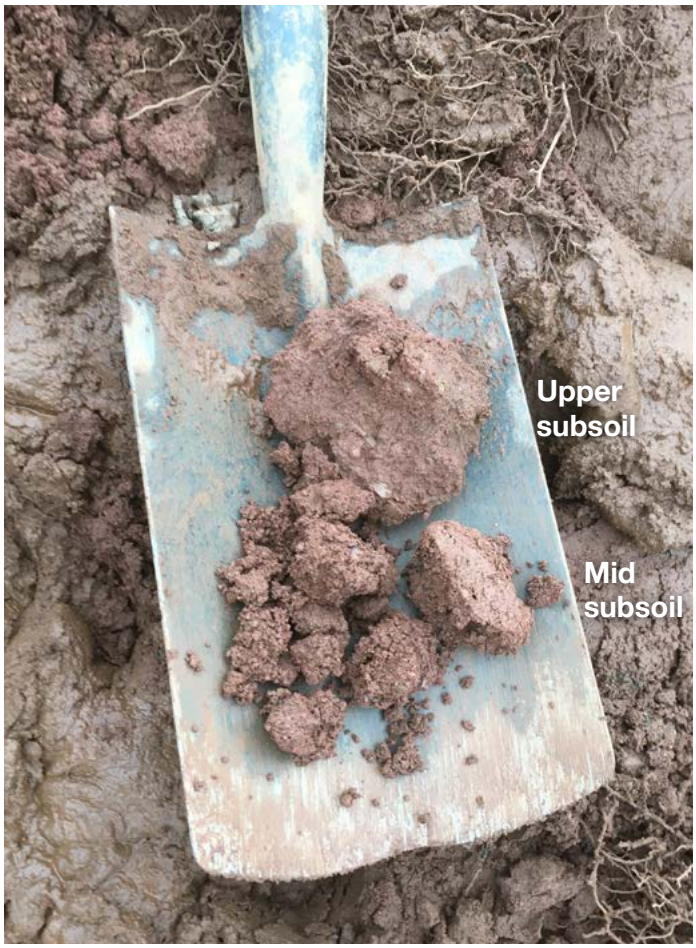

Figure 4. Larger, firmer soil aggregates in the upper subsoil with smaller aggregates below

Figure 5. Water seeping into a soil pit above the firmer layer at 30-45 cm depth

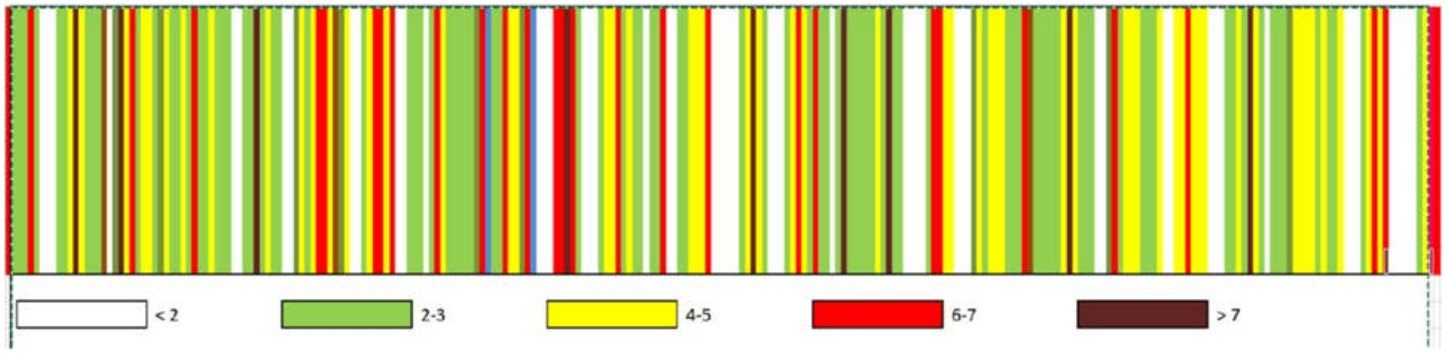

Figure 6. Tracking on grass leys by a single pass of the topper followed by manure spreading and seedbed preparation before bed forming. The colours denote the number of coincident passes, with white representing areas of no tracking, and blue, the path of spraying operations

Finally, Ray is considering ways of reducing the number of cultivations to reduce soil instability. Bed establishment usually involves subsoiling 2 or 3 times before ploughing (in the furrow), power harrowing, bed forming, sterilisation and drilling/transplanting. However, soil assessments carried out in January 2018 indicated that the subsoiling had not been effective. As a result, Ray is considering a trial in one part of a field where subsoiling will not be carried out to identify whether savings in cultivation costs do not lead to reductions in crop yields and quality.

Potential to introduce Controlled Traffic

Controlled traffic farming (CTF) aims to reduce the proportion of each field area that is wheeled by machinery to avoid widespread soil compaction. CTF involves confining compaction to the least possible area of permanent traffic lanes. Maximising the unwheeled area should retain good soil structural condition in the growing bed, with the aim of improving crop yield and soil drainage. Machinery technical data was used to determine the extent of tracking within the current system, from the growing of leys to bed forming, and the potential for introducing some form of CTF system.

Tracking on grass leys, including one topping pass and seedbed operations up to bed forming cover 78% of the field area, assuming that all operations are parallel to each other (Figure 6). An additional subsoiling operation at an angle to the other operations increases tracking on another 39%, although some of this is on the previously tracked area. Around 80% of compaction occurs in the first pass, but additional passes can extend compaction to deeper in the soil profile.

Once the 1.65 m wide beds have been formed, all machinery up to and including harvest (other than boom spraying) runs on tyres with a maximum section width of 400 mm, and a tracked area of about 25% - assuming perfect tracking is maintained!

Figure 7. Harvesting hawthorn *(Crataegus monogyna)* transplants in good field conditions

Partial CTF scenario

At harvest, the established tracking at 1.65 m centres is often obscured due to harvest machinery occasionally slipping off trackways and soil spillage from the beds. As a result, the location of the wheelings is lost and the whole field is then subsoiled and ploughed, even though the soil in the beds has not been tracked over. Where a grass ley is not being introduced, these beds could be reformed on the occasions when the existing wheel tracks can be located and used again.

Wyevale Transplants have investigated the use of a global navigation satellite system with auto-steer, but consider them too costly for the business. The alternative is to introduce a manual means of guiding vehicles. Once the growing beds have been installed, this simply means following the pronounced traffic lanes but, when these have been obscured by harvesting, their re-establishment is difficult.

The simplest manual guidance system would be to have a centre mark put in during the harvesting operation that could be followed during the next pass. Alternatively, two wheel marks centred on the existing marks could be established. Nevertheless, Wyevale insist that keeping harvest machinery on the traffic lanes is challenging in wet field conditions, particularly on slopes, making an efficient controlled traffic system difficult to achieve.

Tracking reduction within the partial CTF scenario

Further tracking reduction could be achieved by exploring the potential of ultra-flex (VF) rather than cross-ply or conventional radial-ply tyres. VF tyres can run in the field and on the road at a uniform low inflation pressure of less than 1.0 bar. These and other low ground pressure tyres increase the tyre footprint (or contact) area, which can improve traction and fuel economy and reduce the degree of topsoil compaction. VF tyres can also reduce the width of the impacted area through increasing lengthways contact and potentially eliminating the need for dual wheels.

Tyre widths could be reduced to a maximum of approximately 300 mm by using VF tyres, which have additional benefits of reducing ground pressure by 40% for a given load. With a tyre section width of 300 mm, tracking post-seedbed preparation would be reduced to just 18%.

Conclusions

- The nature of the production and (winter) harvesting operations at Wyevale Nurseries means that soil erosion and compaction are significant issues that could compromise business viability
- The nursery has reduced off-site impacts of soil erosion by establishing wide grass field margins, sediment ponds and filter barriers
- Within-field soil erosion is being tackled by growing 18-month grass leys and applying green compost, to increase soil organic matter content. The use of mulches to protect the soil surface and grass strips in wheelings is also being considered
- The nursery is investigating ways to reduce cultivation and the degree of soil disturbance to alleviate compaction and increase soil aggregate stability. A small trial is being carried out to assess the need for subsoiling
- There may be some potential to reduce the extent of compaction using controlled traffic, but establishing permanent trackways is challenging with machinery harvesting on sloping land in wet conditions over winter. The first ‘quick win’ to reduce compaction could be to upgrade tyres to one of the latest designs to reduce tracking and ground contact pressure

Authors

Paul Newell Price, David Talbot and Lizzie Sagoo (ADAS); and Tim Chamen (CTF Europe)

Produced for you by:

AHDB Horticulture
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

T 024 7669 2051
E comms@ahdb.org.uk
W ahdb.org.uk
@AHDB_Hort

If you no longer wish to receive this information, please email us on **comms@ahdb.org.uk**

30013 0922