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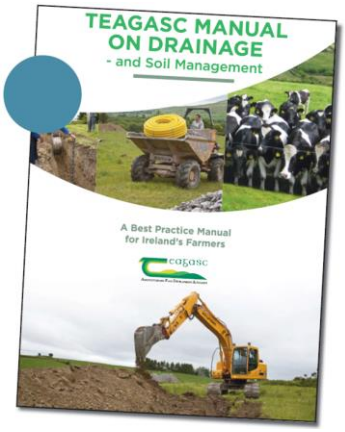
Drainage and compaction issues on poorly drained soils



Key external stakeholders:

All farmers
Teagasc Advisors
Department of Agriculture, Food & Marine
Environmental Protection Agency
Industry

Practical implications for stakeholders:

This project brought together knowledge gained within Teagasc on drainage and soil compaction and disseminated this knowledge through a series of open days and training events. In particular a comprehensive collaborative publication: The Teagasc Manual on Drainage and Soil Management was developed and is a best-practice manual for any farmer seeking information on drainage and compaction issues. It is an essential handbook for all stakeholders with an interest in the soil and drainage.

Main points

- **Farmers:** There is no one size fits all solution to drainage or compaction. Soil test pits are key to diagnosing and solving such problems. The Teagasc Manual on Drainage and Soil Management contains l the key information needed.
- **Policymakers:** The site-specific drainage design approach now being researched will have a smaller environmental impact than previously one size fits all schemes.
- **Scientific:** Achieving environmental sustainability in drained grassland requires a holistic understanding of the linkages between hydrologic, biogeochemical and adsorption processes controlling the fate of nutrients in in-field and open drain systems.

Main results:

- Drainage: The way forward with respect to land drainage design is to retro-fit drainage solutions to particular problems. A clear message is that there is no one size fits all solution to drainage. Digging a soil test pit and elucidating permeable and impermeable layers is paramount to a successful project. The environmental sustainability of drainage systems should be characterised from a holistic perspective and the means to negate negative losses investigated at farm and landscape scales.

- Compaction: Modern machinery and intensive production systems pose a significant threat to the soils structure with consequences for grass and crop yields. Traffic management and the use of appropriately sized tyres to reduce ground pressure can prevent damage. Dealing with existing compaction can be difficult. Soil examination followed by cautious consideration of alleviation options is warranted. However the emphasis must be on preventing compaction.

Opportunity / Benefit:

Contact Dr Owen Fenton Email: owen.fenton@teagasc.ie.

- With the publication of the Teagasc Drainage and Soil Management manual the necessary information on all aspects of drainage and compaction is available for the first time in Ireland. This is the definitive guide for farmers bringing together all the necessary information that Teagasc has accumulated over the years.

Teagasc project team: Dr. Owen Fenton
Dr. Rachel Creamer
Mr Dermot Forristal
Dr Tristan Ibrahim
Dr. Pat Tuohy

1. Project background:

Food Harvest 2020, the industry-led initiative, supported by Government, has set ambitious goals for Irish agriculture by targeting an increase in productivity while maintaining the protection and enhancement of the natural environment. It is expected that milk supply will increase by 57%, or an extra 540 million litres of milk will be produced by 2020 from the 2011 base. This increase in intensification requires actions to enhance the soils ability to support production without incurring structure or productivity damage. Knowledge transfer and providing stakeholders with clear information on drainage and soil management are integral parts of achieving such targets.

2. Questions addressed by the project:

- What information is available in an Irish context on land drainage?
- What information is available in an Irish context on soil compaction?
- How best to deliver this information to relevant stakeholders

3. The experimental studies:

This was a desk based study with associated open day and training events, which culminated in the publication of the Teagasc manual on drainage and soil management.

4. Main results:

For drainage:

No drainage work should be carried out before the drainage characteristics of the soil are established by a site and soil test pit investigation. Two types of drainage system exist: a groundwater drainage system and a shallow drainage system. The design of the system depends entirely on the drainage characteristics of the soil. Distinguishing between the two types of drainage systems essentially comes down to whether or not a permeable layer is present (at a workable depth) that will allow the flow of water with relative ease. If such a layer is evident, a piped drain system at that depth is likely to be effective. If no such layer is found during soil test pit investigations, it will be necessary to improve the drainage capacity of the soil. This involves a disruption technique such as moling, gravel moling or subsoiling in tandem with collector drains. Drains are not effective unless they are placed in a free draining soil layer or complimentary measures (mole drainage, subsoiling) are used to improve soil drainage capacity. If water is not moving through the soil in one or other of these two ways, the water table will not be lowered. Outfall level must not dictate the drainage system depth. If a free draining layer is present, it must be utilised. Drain pipes should always be used for drains longer than 30 m. If these get blocked it is a drainage stone and not a drainage pipe issue. Drainage stone should not be filled to the top of the field trench except for very limited conditions (the bottom of an obvious hollow). Otherwise it is an extremely expensive way of collecting little water. Most of the stone being used for land drainage today is too big. Clean aggregate in the 10–40 mm (0.4 to 1.5 inch approx.) grading band should be used. Generally you get what you pay for. Subsoiling is not effective unless a shallow impermeable layer is being broken or field drains have been installed prior to the operation. Otherwise it will not have any long-term effect and may do more harm than good. Most land drainage systems are poorly maintained. Open drains should be clean and as deep as possible and field drains feeding into them should be regularly rodded or jetted.

For Compaction:

The increasing weight of farm machinery and intensification of livestock production, coupled with our climate and soils, pose a particular threat to soil structure. This creates trafficability problems for machinery and animals and can result in severe sward damage and soil structure damage, which can be expensive and difficult to remedy. All soils are prone to damage, but wetter soils present greater challenges. While drainage can improve trafficability and reduce the risk of compaction, drained soils are still prone to

Contact Dr Owen Fenton Email: owen.fenton@teagasc.ie.

damage. Prevention of compaction is better than trying to alleviate the problem subsequently. Restricting both animal and machinery traffic when the soil is vulnerable is effective, but is not always possible. Where time-critical machinery operations are involved, lowering the ground pressure of the equipment by increasing tyre sizes and/or reducing axle loads can help protect the soil. Baled silage systems for example can have axle loads of less than one third those of conventional clamp silage, making the achievement of low ground pressures of less than 1.0 bar possible with appropriate tyre selection. Appropriate tyre types and sizes need to be selected to reduce ground pressure on larger machines on grassland and tillage farms. While this is expensive, there is a payback in crop performance and nutrient use efficiency.

Compaction can reduce grass/crop yields by reducing the plants access to water and nutrients. Irish research indicates yield reductions from silage machinery compaction in grassland of from 8 to 31%. Dealing with existing compaction requires a methodical approach as alleviation methods can be counter-productive in some situations. Visual soil assessment techniques, where spade samples of soil are examined, can be useful in determining damage, in conjunction with crop evidence such as poor yield or ponding associated with traffic patterns. If the soil structure is damaged, the steps to consider are: 1) ensure future damage can be prevented by traffic management and use of lower ground pressure; 2) consider letting the soil recover without further intervention; 3) if discrete, very shallow compaction layers are present, spiking or aerating (to 150mm) may have a role and: 4) if damage is deep and severe, deeper loosening (200-400mm) may be cautiously considered but this may temporarily check yields and great care is needed to avoid re-compacting to a deeper depth subsequently.

5. Opportunity/Benefit:

The Teagasc Drainage and Soil Management manual now is the definitive guide for farmers bringing together all the necessary information that Teagasc has accumulated over the years.

6. Dissemination:

Throughout the project there was a comprehensive series of open days and training days for a variety of stakeholders on drainage and compaction issues.

Main publications:

Anon, 2013. Teagasc manual on drainage and soil management. A best practice manual for Ireland's farmers. Editors: Moore, Fenton, Tuohy, Creamer, Forristal and Ibrahim.

Popular publications:

Forristal et al., Dealing with soil damage in silage fields. Forage and Nutrition Guide
Forristal et al., Compaction – prevention better than cure. Today's Farm.
Ibrahim & Fenton. Drain, drain, sustain. Tresearch (Winter)
Tuohy & Fenton – Irish Farmer Journal Article on Land Drainage
Tuohy et al., Dig into the figures before breaking ground. Today's Farm

7. Compiled by: Dr. Owen Fenton, Dr. Rachel Creamer, Mr. Dermot Forristal, Dr Pat Tuohy

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