Grower Summary

TF 214

Improving nitrogen use efficiency, sustainability and fruit quality in high-density apple orchards

Annual 2015

Disclaimer

While the Agriculture and Horticulture Development Board seeks to ensure that the information contained within this document is accurate at the time of printing, no warranty is given in respect thereof and, to the maximum extent permitted by law the Agriculture and Horticulture Development Board accepts no liability for loss, damage or injury howsoever caused (including that caused by negligence) or suffered directly or indirectly in relation to information and opinions contained in or omitted from this document.

The results and conclusions in this report may be based on an investigation conducted over one year. Therefore, care must be taken with the interpretation of the results.

Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.

Before using all pesticides check the approval status and conditions of use.

Read the label before use: use pesticides safely.

Further information

If you would like a copy of this report, please email the AHDB Horticulture office (hort.info.@ahdb.org.uk), quoting your AHDB Horticulture number, alternatively contact AHDB Horticulture at the address below.

AHDB Horticulture,

AHDB

Stoneleigh Park

Kenilworth

Warwickshire

CV8 2TL

Tel – 0247 669 2051

AHDB Horticulture is a Division of the Agriculture and Horticulture Development Board.

Project Number:	TF 214
Project Title:	Improving nitrogen use efficiency, sustainability and fruit quality in high-density apple orchards
Project Leader:	Dr Eleftheria Stavridou, East Malling Research
Contractor:	
Industry Representative:	Nigel Kitney, Hutchinsons Ltd
Report:	Annual 2015
Publication Date:	September 2015
Previous report/(s):	April 2014
Start Date:	01 April 2014
End Date:	31 March 2017
Project Cost:	£94,599.00

GROWER SUMMARY

Headline

- In this nutrition project, there were no significant yield and quality differences between fertiliser treatments, in spite of large differences in the quantity of nutrients (i.e. nitrogen and potassium) applied.

Background and expected deliverables

The adoption of high density planting systems for apple trees in the UK will increase the use of irrigation in order to maintain or increase yields against a backdrop of increasing summer temperatures and decreasing water supplies. Broadcast or foliar fertilizer applications have been traditionally used to improve or sustain the nutrition of deciduous fruit tree orchards in the UK. Broadcast and foliar fertilisers are often replaced by fertigation in high density irrigated orchards. However to meet governmental demands for greater environmental protection and comply with legislation, new production methods that improve water and nutrient use efficiency and utilise 'best practice' are needed. Application of nutrients with fertigation is the most efficient method of nutrient delivery as it offers increased flexibility in managing orchard nutrition programmes because of the potential for more closely synchronizing nutrient application with plant demand.

Nitrogen is often applied in excess of that required to support optimum productivity and eventually it accumulates in the soil and becomes vulnerable to leaching. The major apple growing regions are in areas designated as Nitrate Vulnerable Zones (NVZ's) and growers must reduce their inputs to comply with legislation (The Nitrates Directive Action Programme). As part of the Rural Payments Agency audit, growers in NVZ's have to justify N applications, relationship between yield and N applications, and prove that industry good practices are followed. Fruit trees recover only about 20% of the applied N fertiliser (Neilsen et al., 2001). The effective rate of N fertigation in apple orchards is also influenced by the amount of irrigation, as excess water can leach N below the root zone. Apple trees grown on dwarfing rootstocks have low rooting densities and under daily irrigation, the roots congregate close to the surface and irrigation emitter (Neilsen et al., 1997). Thus, N supply

should be targeted to remain in the root zone and allow root interception; effective irrigation scheduling, particularly in coarse-texture soils, will help reduce the deep percolation of N.

There is a paucity of information on the effects of fertigation on the yield, quality and storability of ‘Gala’ and ‘Braeburn’ (HDC, Apple Best Practice Guide). Daily irrigation decreases leaf N concentration in ‘Gala’ apple, which implies greater N leaching compared to the intermediate or low irrigation frequencies (Neilsen et al., 1995). Research conducted in the Concept Pear Orchard at EMR (TF 198), in which the Project Leader was involved, has delivered water and fertiliser savings of over 50% by scheduled irrigation without reducing productivity or fruit quality. Preliminary data (TF210) indicate that scheduled irrigation can be used to improve water use efficiency in apple production. There is a need, however, to assess the effectiveness of any new fertilisation strategy relative to traditional methods and optimise them to ensure yield consistency and quality.

Summary of the project and main conclusions

A pilot experiment was carried out on a five-year old orchard at EMR (‘Gala’/M.9 and ‘Braeburn’/M.9) with a distance of 3.5 m between rows and 1 m between trees within rows. Two fertiliser treatments were applied in order to assess the risk of N leaching (1) broadcast fertiliser (BF) and (2) commercial fertigation/irrigation (FR).

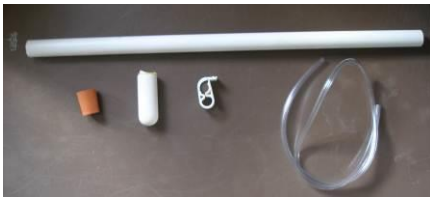

Figure 1. Parts used to build a lysimeter; PVC conduit tube (15mm I.D.), rubber bung, 24mm round end ceramic cup, polycarbonate clamp

Soil solution sampling was undertaken using soil suction lysimeters buried at two different depths within the rooting zone beneath the emitter and 0.25 m from the emitter and then analysed for nitrate nitrogen. The lysimeter tubes are simple and inexpensive and can be used in a variety of ways. The lysimeter consisted of a porous ceramic cup, a PVC body tube, a rubber bung and rubber tube as shown in Figure 1. The PVC tubes were cut to 30 cm and 60 cm sections and the ceramic-cup was inserted into one end of the tube and glued into it. For the upper end of the lysimeter, a removable, yet airtight cap is required. For this, large rubber stoppers (No. 19) were used. Tubing from the reservoir to the soil surface was used to apply partial vacuum (suction) in the lysimeter using a vacuum pump (with a suction range of 0–100 kPa). Once a vacuum was drawn, the tubes could be sealed off by folding and clamping the rubber tubes using tube clamps. Water in the soil is drawn into the

collector through the porous ceramic cup in response to the negative pressure (vacuum) inside the lysimeter.

Nitrate concentration in soil solution was measured weekly with a portable ion-selective nitrate meter. Soil samples were taken after harvest and analysed for nutrient concentration and soil acidification. Foliar nutrient concentration was monitored during the growing season.

Total and marketable yields from treatment were determined. Fruit quality was evaluated at harvest. Quality factors evaluated were firmness, percentage and intensity of colour, elemental and sugar (%, BRIX) concentrations and disorders.

Main findings so far

- Samples were unable to be taken when soil water content fell too low. Therefore, during these periods, nitrogen leaching risk was reduced.
- Nitrate concentrations in the soil solution at 50 cm depth were similar or higher to the concentrations in the fertigation solution.
- The results indicate that the extent of nitrate leaching differs between apple varieties.
- At the end of the growing season, soil N content in the 0-50 cm horizon ranged from from 37 to 82 kg N ha^{-1}.
- Leaching of other mobile nutrients such as P may occur over winter.
- There were no significant yield and quality differences between fertiliser treatments, in spite of large differences in the quantity of nutrients (i.e. nitrogen and potassium) applied.
- Nutrient analysis of harvested fruit showed that K+Mg/Ca and N/Ca ratios were within the recommended range for Gala, but N/Ca ratio for Braeburn was high which may affect storage potential.
- Environmental (i.e. leaching beyond the root zone) and economic (i.e. money spent on fertiliser) considerations highlighted the need to further understand the fate of applied nutrients.

Financial benefits

No financial benefits have been identified from this project to date.

Action points for growers

- There are no action points for growers at present as the project is at an early stage.