The rotational sequence, with 3 years of grass-clover, as either hay or pasture (cut and mulched to simulate grazed land), as well as the addition of FYM on the root phase, has an impact on the soil nutrient status, particularly N due to the input from N fixation, and is represented by an approximation of likely nutrient availability in Table 3.

Table 3. Representation of soil fertility across the rotation

Crop (in rotation order)	Nutrient availability
Spring oats	High (Fig 2)
Root crop (potatoes)	Moderate - receives FYM (Fig 3)
Spring barley (undersown)	Low – Moderate (Fig 4)
Hay	Low - expected nitrogen deficiency, although some N fixation (Fig 5)
Pasture	Moderate (N fixation)
Pasture	Moderate - High (N fixation)

Spring Oats

- Yield increase over time (x3 for FYM and PK & FYM, but only x2 for NPK & FYM)
- Clear N response over first 7-8 cycles between treatments but less so in later cycles (Fig 2)

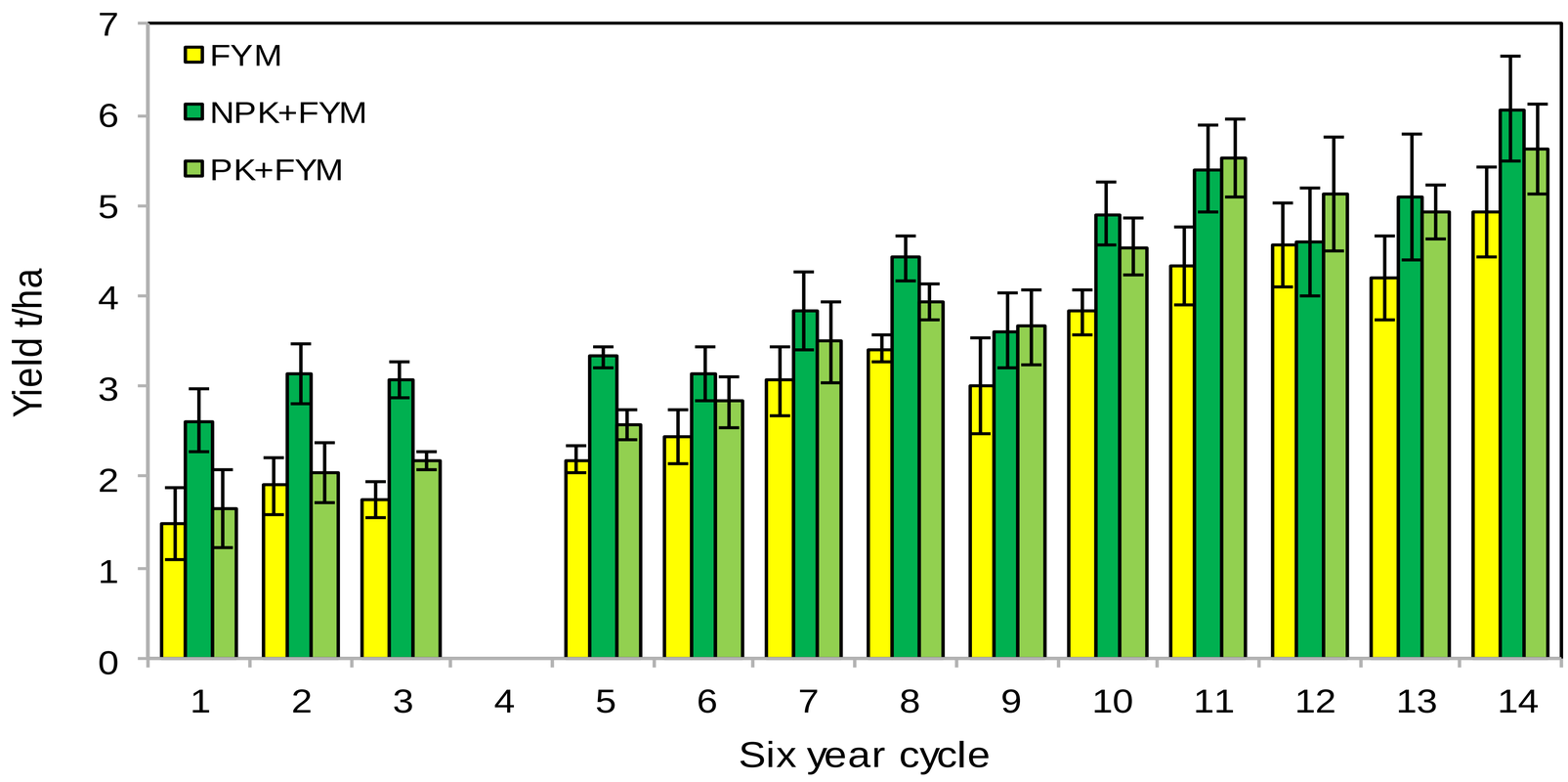

Figure 2. *Grain yield (85% DM) data (mean of 6 year cycle) for Spring Oat Crop at three different fertiliser regimes (1922-2010)*

Woodlands Old Rotation
SRUC Craibstone

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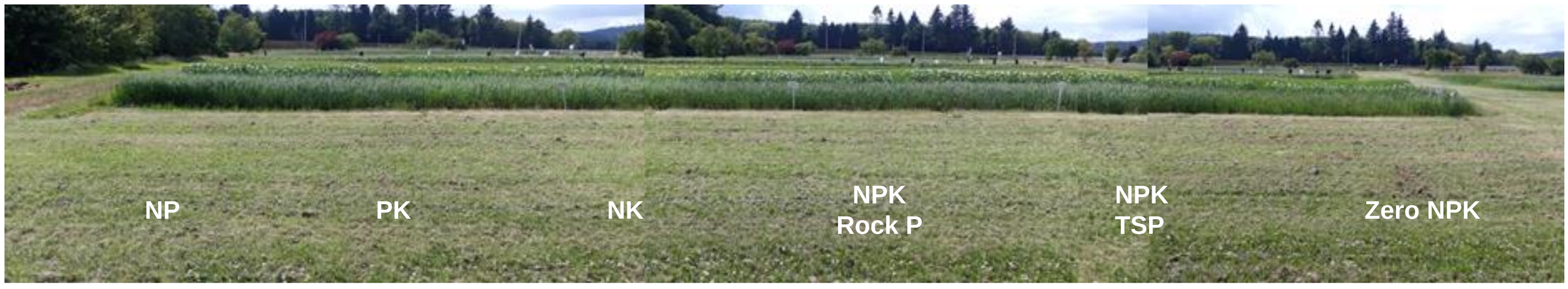
(video link: https://vimeo.com/242278226)

The Woodlands Old Rotation Experiment



Background

Management of soil fertility is a crucial part of a successful cropping system. Nitrogen, phosphorus and potassium in particular have a large impact on crop growth and yield, rooting behaviour, production of biomass residues and consequently soil organic matter.

The Woodlands Old Rotation, located at SRUC Aberdeen (Craibstone) which was started in 1922 is an excellent demonstration of this. Figure 1 gives a representation of the crop layout from 2017, with all 6 crops grown every year. Superimposed across all crops is a series of six different NPK and nutrient omission treatments. The soil is a sandy loam, Countesswells Association, Dess Series, with soil organic matter of approximately 8%, and pH is maintained at a target of around pH 6.0. The plots are managed with fertiliser (see table 1), and routine herbicide and fungicide typical for the region based on seasonal requirements. Changes in agronomic practice since 1922 until the present time are represented approximately in table 2.

Figure 1. Woodlands Old Rotation plot layout in 2017 (a) shows the crop rotational sequence which moves across to an adjacent "bed" each year and (b) indicates the different fertiliser treatments. 25t/ha Farm Yard Manure (FYM) is applied across all roots (currently potatoes), irrespective of the fertiliser treatment. TSP = triple superphosphate; u/s = undersown grass & white clover

(a)

(b)

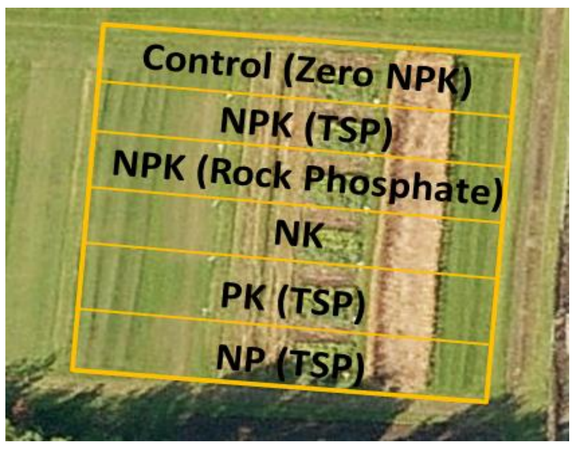
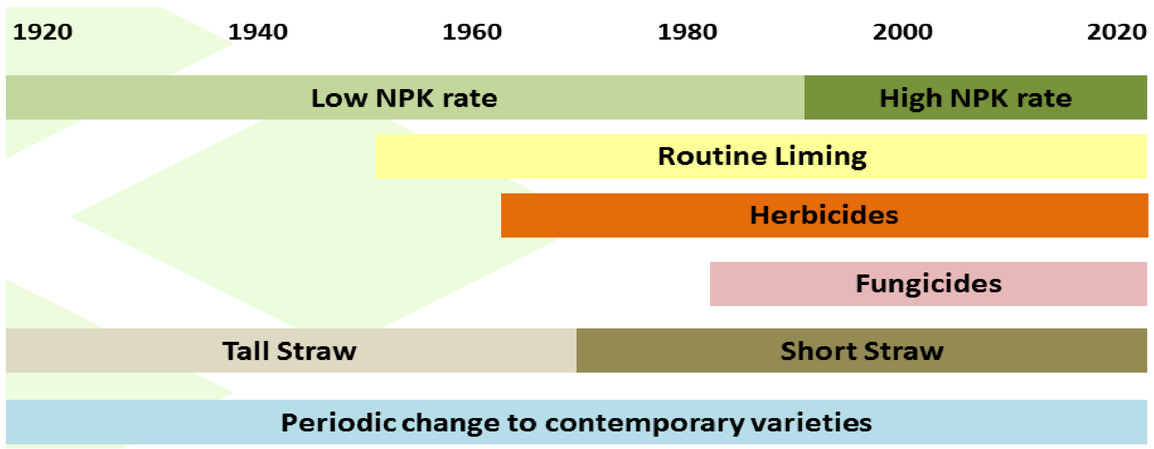


Table 1: Fertiliser inputs

Fertiliser Source	Pre-1991 kg/ha	Post- 1991 kg/ha
Nitrogen (N)	26	80
Phosphorus (P)		
Roots	39 (90)	66 (150)
Cereals & hay	20 (45)	26 (60)
Potassium (K)		
Roots	62 (75)	83 (100)
Cereals & hay	32 (38)	58 (70)

Values in brackets are P_2O_5 and K_2O

Table 2: Changes in agronomic practice



Acknowledgements

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Potatoes

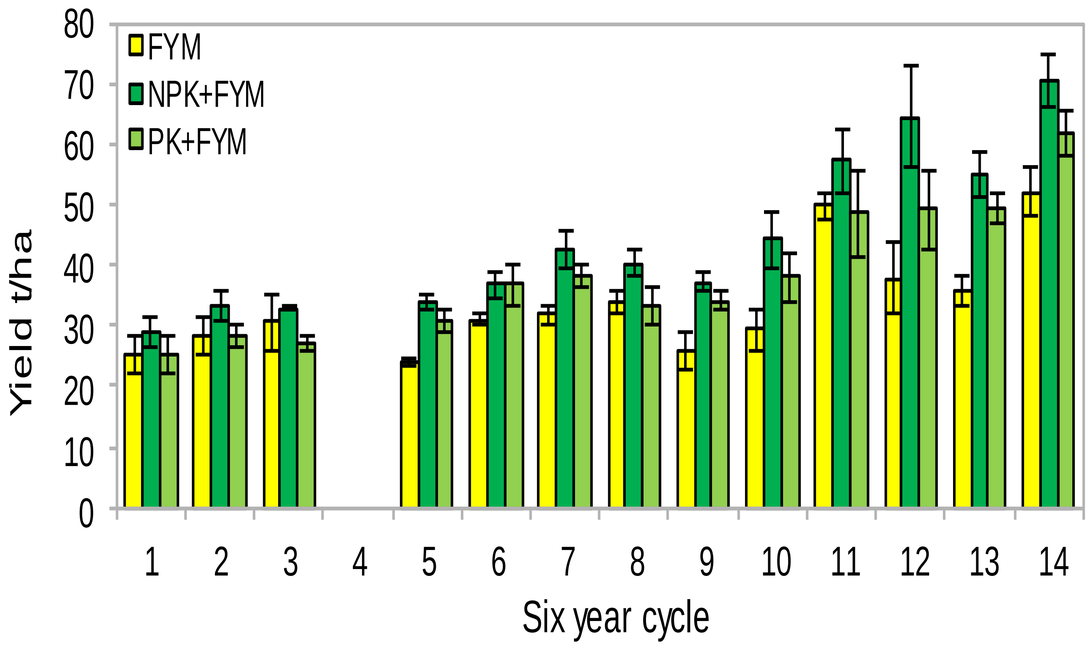
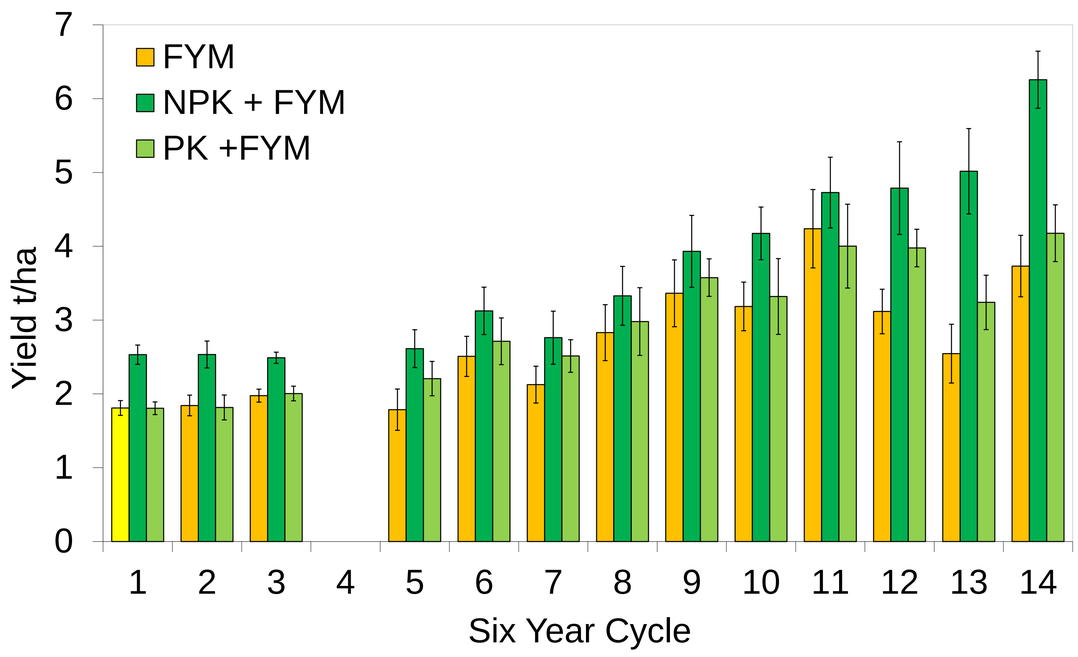


Figure 3. *Fresh tuber yield data (mean of 6 year cycle) for Root Crop (Potatoes) at three different fertiliser regimes (1922-2010)*

- Yields similar across treatments for first 10 cycles then progressively diverging, with NPK & FYM highest and FYM only lowest
- Indication of N and possibly P / K deficiency associated with increasing offtake (Fig. 3)

Spring Barley

Figure 4. *Grain yield (85% DM) data (mean of 6 year cycle) for Spring Barley Crop (undersown)at three different fertiliser regimes (1922-2010)*



- NPK & FYM treatment generally produced the greatest grain yield – more pronounced in later cycles (Fig 4)
- PK & FYM treatment also had a tendency to produce more grain than the FYM only treatment in these later cycles.

Grass-clover (Hay)

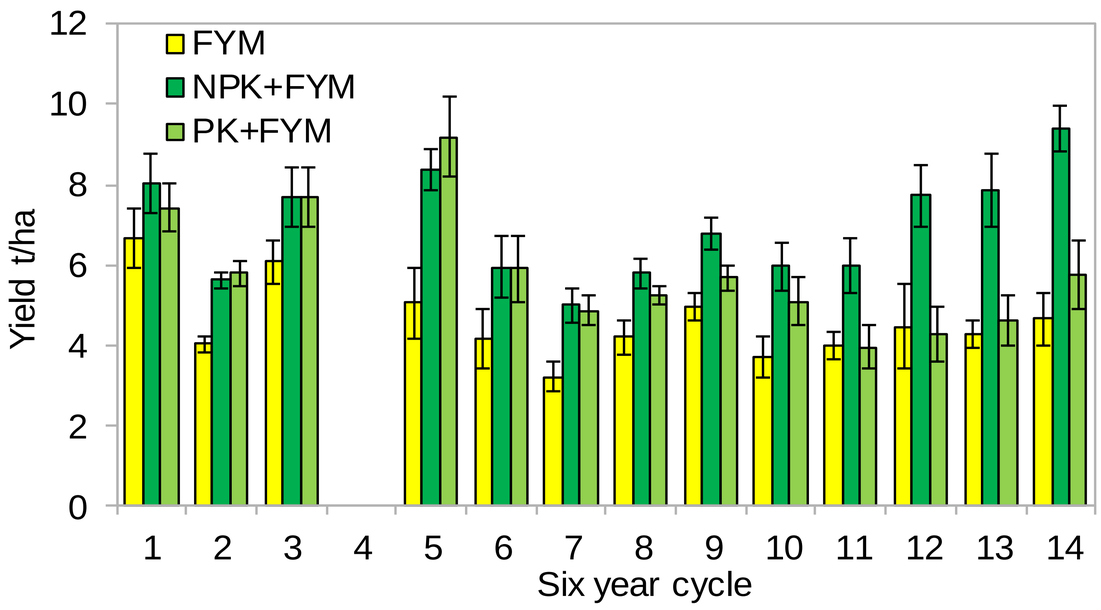


Figure 5. *Woodlands long-term rotation yield (85% DM) data (mean of 6 year cycle) for Hay at three different fertiliser regimes (1922-2010)*

- Yields for FYM only and PK & FYM treatments, declined after 5-6 cycles to a consistent level
- Clear N response shown, with P / K response gradually showing in later cycles (Fig. 5)

Summary

The crop yields for selected fertiliser treatments (FYM only, NPK & FYM, PK & FYM) highlight both the increase in yield across all fertiliser treatments over time, and with the exception of the oat crop (located immediately after the grass clover ley), an increasing divergence between the fertiliser treatments as the NPK & FYM treatment produced increasingly better yields as the various agronomic practices over the time period became routine.