Farming system effects on soil nitrogen dynamics

The Northern Farming System Research project is now commencing its sixth year at the Trangie Agricultural Research Station. In the February newsletter edition, the cumulative grain production over a five-year period (2015 to 2020) of six different farming systems showed clear differences between farming systems and how they performed on red and grey soil types (Trangie-Farming-Systems-research-write-up_March-newsletter.pdf (nsw.gov.au)).

Nitrogen (N) is an essential nutrient. It can be sourced from fertiliser, legume pasture, pulse crops and soil reserves. One aspect of this research investigates the legacy effects of six farming systems on the N dynamics, nutrient balance and N use efficiency. This article discusses the N dynamics over 5 years. The crop sequences of each farming system are shown in Figure 1.

System	2016	2017	2018	2019	2020
Baseline	wheat	wheat	barley	canola	wheat
Higher nutrient	wheat	wheat	barley	canola	wheat
Higher legume	wheat	chickpea	barley	fieldpea	wheat
Higher diversity	wheat	chickpea	fieldpea	wheat	canola
Low intensity	wheat	fallow	barley	fallow	canola
Ley pasture	lucerne	lucerne	lucerne	fallow	wheat

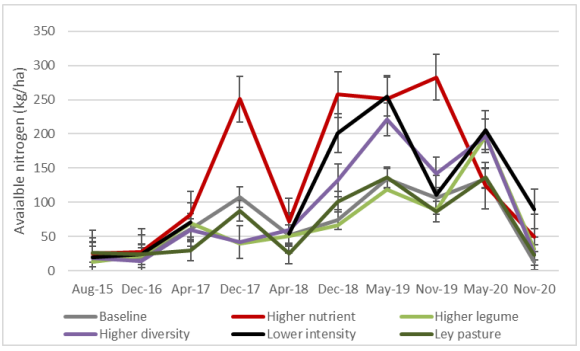
Red soil

System	2016	2017	2018	2019	2020
Baseline	wheat	wheat	barley	fallow	canola
Higher nutrient	wheat	wheat	barley	fallow	canola
Higher legume	wheat	chickpea	barley	fallow	faba bean
Higher diversity	wheat	chickpea	field pea	fallow	wheat
Low intensity	wheat	fallow	barley	fallow	canola
Ley pasture	lucerne	lucerne	fallow	fallow	wheat

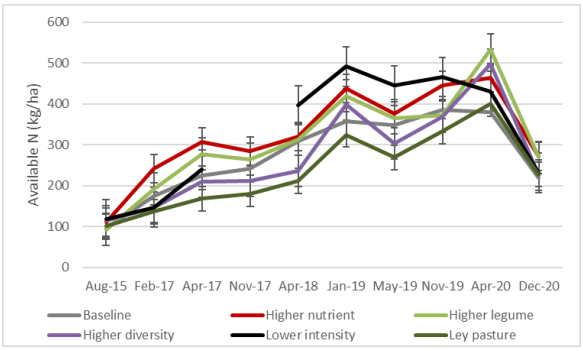
Grey soil

Figure 1: Farming Systems crop sequences on Red and Grey soil (2016–2020)

Figure 2 shows the changes in available soil N sampled immediately prior to sowing and immediately after harvest, from the start of the project to December 2020.



Red soil



Grey soil

Figure 2: Changes in soil available soil nitrogen (0–90 cm) (August 2015 to December 2020)

Key findings

Red soil

- Levels of available N increased in all farming systems up until the 2020 harvest.
- The levels of available N in the *Higher nutrient* system have exceeded all other systems throughout the dry cropping seasons. It indicates that much of the N is not being used within those seasons, a consequence of adding more N than water-limited plant requirements.
- In the dry 2017 season, total N levels declined after failed chickpea crops in the *Higher legume* and *Higher diversity* systems.
- Available N levels in the *Ley pasture* system are similar to the *Baseline* system, despite a 3-year lucerne phase (2016–2018) that produced an average of 16 t DM/ha. This is related to

the run of dry seasons, including the 2019 fallow which has delayed the breakdown of organic N to plant available N.

- High crop biomass and grain yields in 2020 have depleted soil N to between 13 kg/ha and 50 kg/ha in all systems except the *Low intensity* system which averaged 90 kg/ha.

Grey soil

- Levels of available N increased in all farming systems up until the 2020 harvest.
- The *Higher nutrient* and *Baseline* systems have shown a similar pattern of soil N changes from season-to-season. The *Higher nutrient* system has consistently maintained greater N levels.
- Despite poor pulse crop yields and low ground cover levels in the dry 2017 and 2018 winter crop seasons, total N levels increased as a result of the small rain events that stimulated N mineralisation.
- N levels in the *Ley pasture* system have tracked below the crop-only systems for most of the experiment. This reflects the rapid decline in plant numbers (Figure 3) and almost complete absence of ground cover until the 2020 wheat crop.
- Soil N levels dropped dramatically after the 2020 crop season in all farming systems. Despite this, there was in excess of 200 kg N/ha remaining at harvest. This is in sharp contrast with the red soil site (minimum of 13 kg N/ha) and highlights the differences in soil fertility of the two soil types.

Figure 3: Decline in lucerne pasture on grey soil.

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