Closing the nitrogen supply and demand gap using legume residue combined with fertiliser nitrogen input

Pilar Muschietti-Piana[1,2], Therese McBeath[1,2], Ann M. McNeill[1], Pablo A. Cipriotti[3], Vadakattu Gupta[2]

[1] School of Agriculture, Food & Wine, The University of Adelaide, SA 5005

[2] CSIRO Agriculture & Food, Waite Campus, PB 2, Glen Osmond, Adelaide SA 5064

[3] School of Agriculture, University of Buenos Aires, Av. San Martin 4453, Ciudad Autónoma de Buenos Aires, C1417DSE

AGRICULTURE & FOOD
www.csiro.au

Rationale

In dry environments, low wheat N uptake is attributed to asynchrony between soil mineral-N supply via mineralisation and crop N demand. Managing in-crop mineral-N relative to wheat N uptake using legume-N and fertiliser-N has the potential to close N-derived wheat yield gaps, especially on soils with low N-supply capacity

Aim

To measure the timing of N supply relative to crop N uptake for wheat following wheat-residues and wheat following lupin-residues under two N fertiliser rates in a low-rainfall sandy soil environment

Methods

Field experiments in 2015, South Australia. Treatments were:

- Crop residues: wheat vs. lupin
- N Fertiliser inputs: medium-N (20 kg N/ha) vs. high-N (55 kg N/ha)

Low-rainfall growing season (May-Nov) = 195 mm (20 % below average, decile 3)

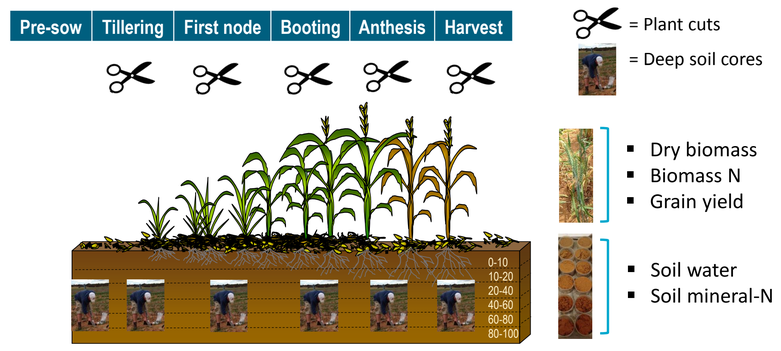

Figure 1: Plant and soil sampling prior to sowing and at key growth stages

Results

Figure 2: Wheat crop N uptake (a), and above-ground biomass (b), sum of soil mineral-N (**c),** and wheat grain yield as % of yield potential (d) following wheat residues with two different N fertiliser inputs measured at different growth stages. Sum of soil mineral-N up to 40 cm at tillering, first node and booting; and up to 60 cm at anthesis and harvest (soils sampled to rooting depth). For (a), (b) and (c) different letters indicate significant differences of the mean for interaction "growth stage x N rate" ($p<0.05$). For (d) different letters indicate significant differences of the mean (paired t test, $p<0.1$)

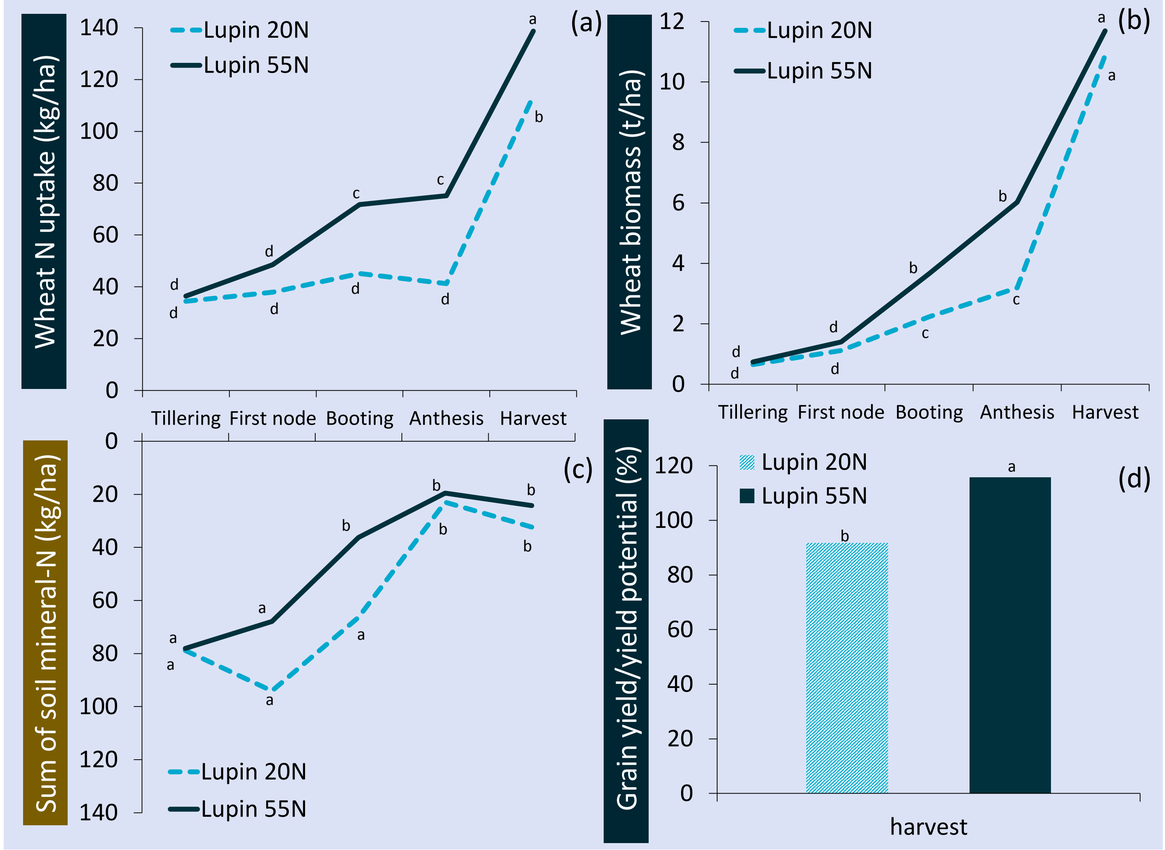

Figure 3: Wheat crop N uptake (a), and above-ground biomass (b), sum of soil mineral-N (c), and wheat grain yield as % of yield potential (d) following lupin residues with two different N fertiliser inputs measured at different growth stages. Sum of soil mineral-N up to 40 cm at tillering, first node and booting; and up to 60 cm at anthesis and harvest (soils sampled to rooting depth). For (a), (b) and (c) different letters indicate significant differences of the mean for the interaction "growth stage x N rate" ($p<0.05$). For (d) different letters indicate significant differences of the mean (paired t test, $p<0.1$)

Conclusions

- In a very dry season, the combination of lupin-N with a high fertiliser-N were key inputs for increasing soil mineral-N at the time of high demand, improving wheat N uptake and yield relative to potential in a low rainfall sandy soil environment

- Experiments in 2016 are also measuring the temporal changes in the soil N supply capacity (microbial biomass-N, mineralisable-N, dissolved organic-N) relative to N uptake to better assess the key functional drivers of N mineralisation

FOR FURTHER INFORMATION
Pilar Muschietti-Piana
e pilar.muschiettipiana@csiro.au

ACKNOWLEDGEMENTS
Loller family, Bill Davoren, Maxime Salot, Damian Mowat, William Shoobridge, Stasia Kroker, Ahsan Chowdhury, Thomas Carter & Bruce Hawke