Effects of Rapeseed-Faba bean intercrop and litter mulch on soil Nitrogen

MOZA AL NAEMI

PATRICIA GARNIER, ALEXANDRA JULIEN, CELINE RICHARD-MOLARD

UMR ECOSYS, FRANCE

Context

- Agriculture is the largest consumer of chemical nitrogen fertilizer
- There is a need for alternatives to chemical fertiliser that can maintain agricultural productivity
- One alternative, is the growing associated crops like legumes with cash crops to supplement the cash crop's needs
- Rapeseed is a commercially important crop (France and Germany being the largest producers in Europe (Bouchet et al. 2016)
- Many studies have been in field conditions of Rapeseed intercrop with Lupine, Clover or Vetch, but its difficult to evaluate the impact of each plant on N dynamics, (Génard *et al.*, 2017)
  - Studies that did look at Rapeseed Faba bean intercrop in isolation, did not look into the soil Nitrogen dynamics and only took into account the plant (Jamont *et al.*, 2013)
- IMPULSE Project (20019-2022) was build to study the specific interaction between Rapeseed and Faba bean in mixed culture, *in isolated* soil columns taking into consideration the soil nitrogen and mulch mineralization.

Objectives

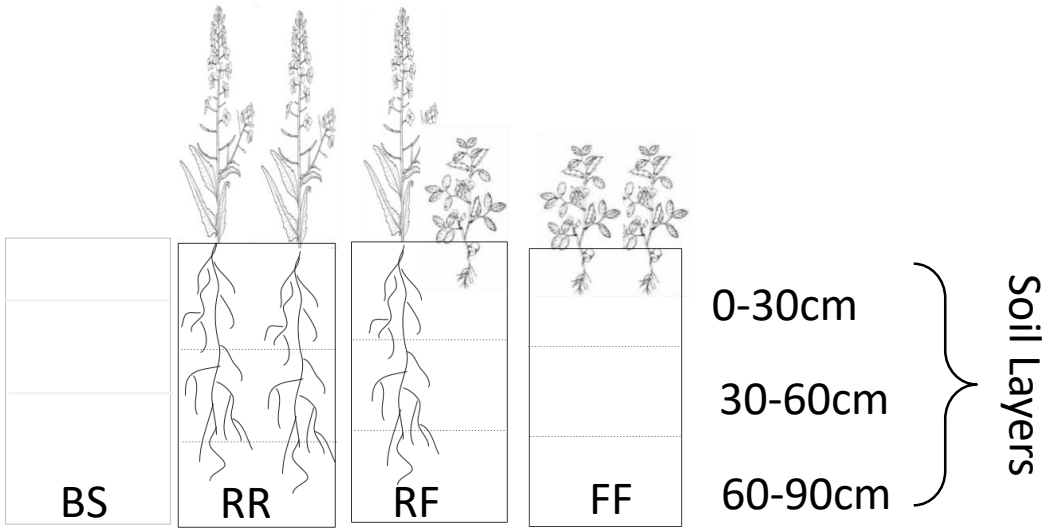
1. Identify if Faba bean in association with Rapeseed, as a companion crop has an effect on the growth of Rapeseed

2. Monitor and compare the soil nitrogen during the growing season in a mixed crop system (Rapeseed - Faba bean) and in monocrop systems (Rapeseed or Faba bean)

Experimental setup

- Out door experiments in Grignon (35Km west of Paris)
- September 2019 to June 2020
- 24 Boxes with 9 columns in each
- Recompacted Soil:
  - 15% Clay, 54% Loam, 31% Sand
  - pH 7.34 (±0.04)
  - Density was high at 1.35±0.06

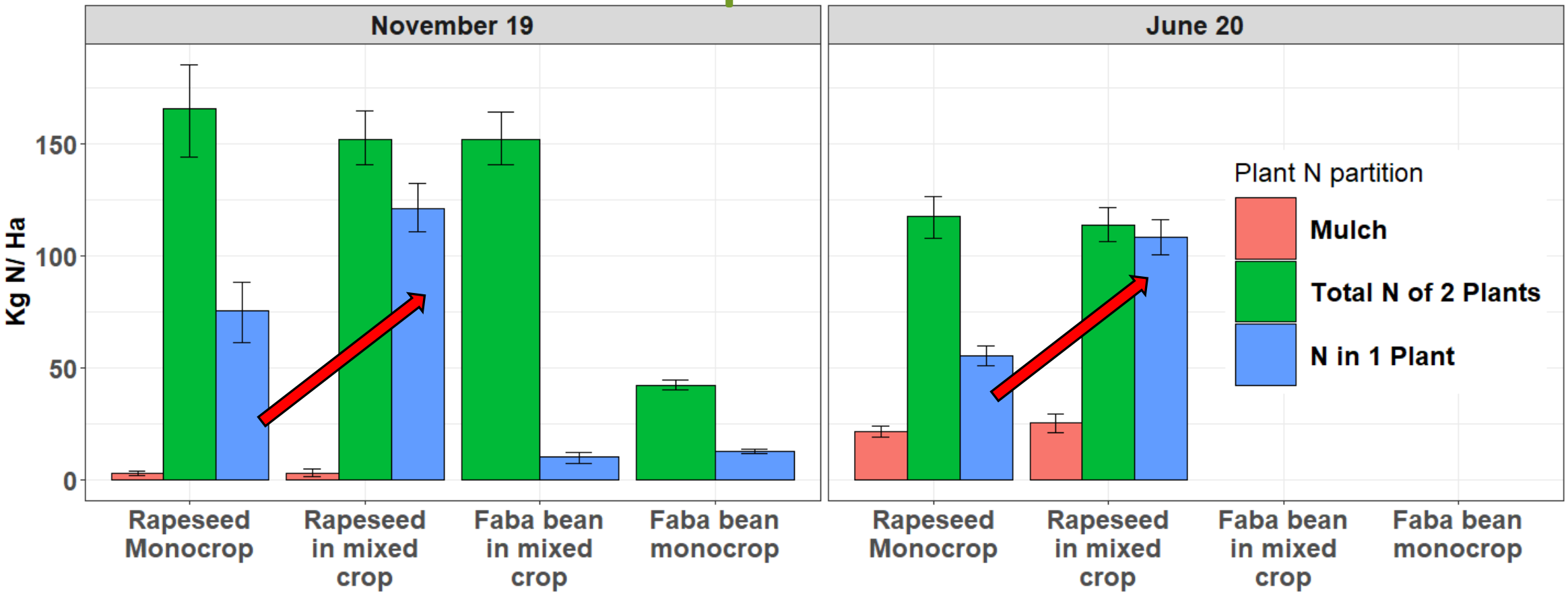
Experimental setup : 5 treatments



- BS: Bare soil
- RR: Rapeseed-Rapeseed monocrop
- RF: Rapeseed-Faba bean mixed-crop
- FF: Faba bean-Faba bean monocrop

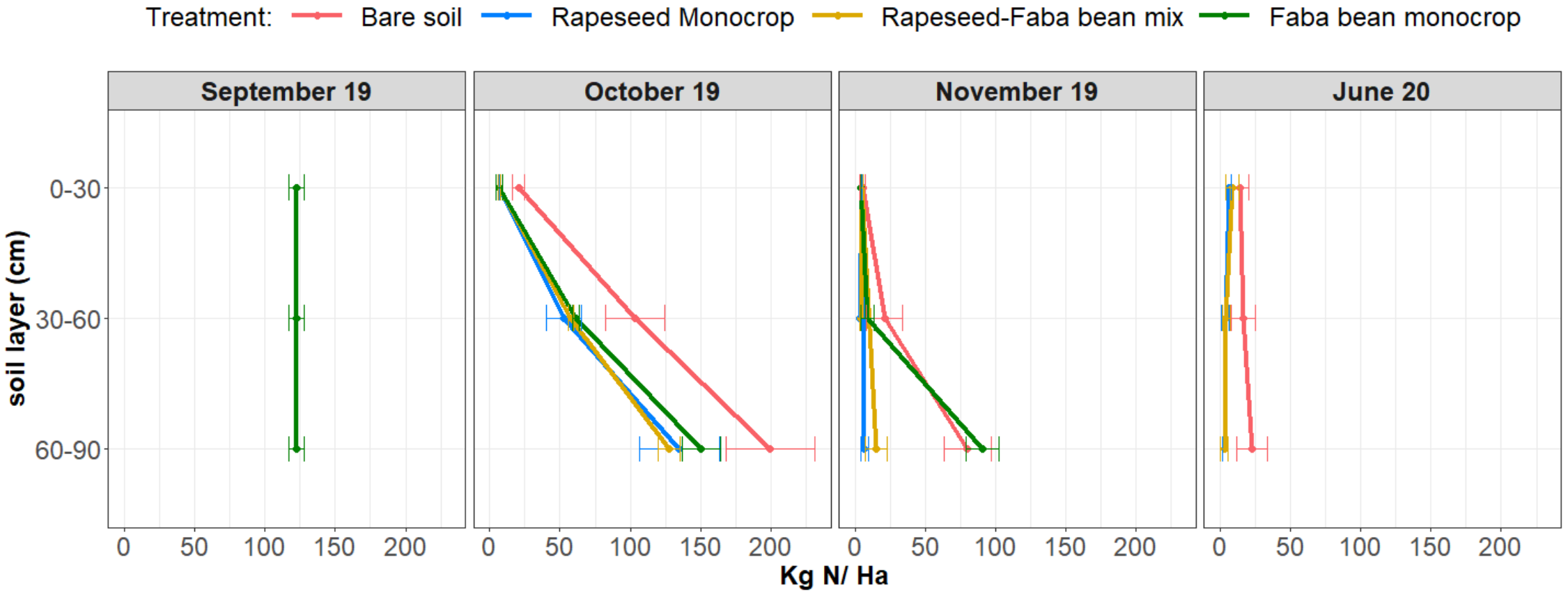
- Plant N analysis
- Soil Mineral N was monitored during the growing period
- Mulch was analysed
- Soil incubation of different mulch residues to measure soil mineralization rates

Plant N distribution per treatment



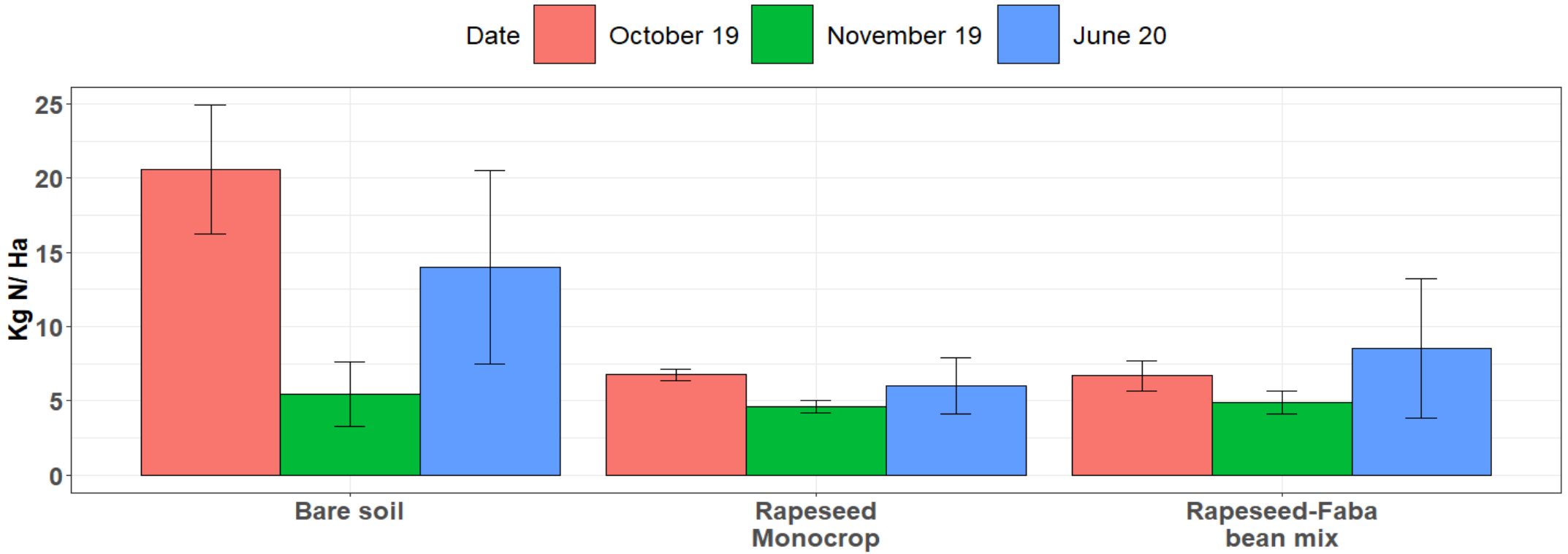
- The quantity of N in plants is equal in Rapeseed monocrop and in Rapeseed/Faba-bean mixed crop
- Because one Rapeseed plant in mixed crop has double the quantity of N compare to one plant in Rapeseed monocrop

Soil Mineral N Profile



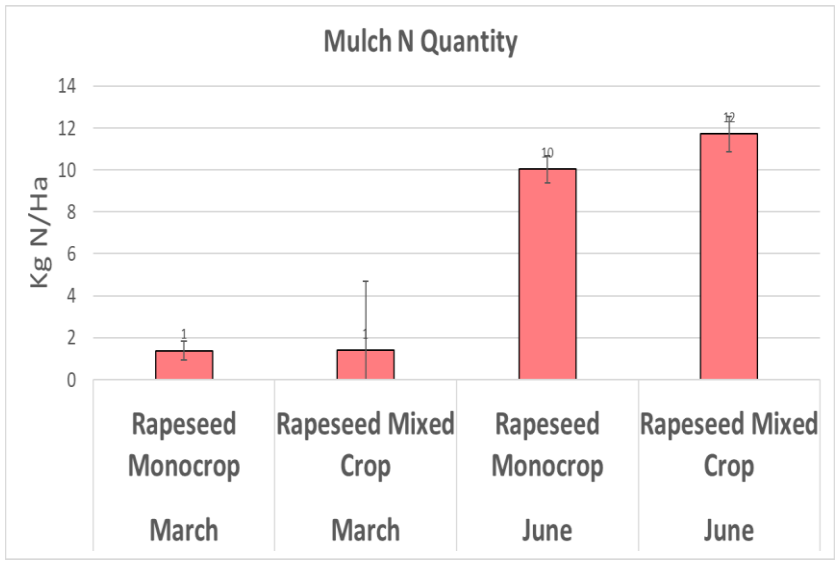
- Sept-Oct : Nitrates leach to the lower horizons for all treatments
- Oct - Nov : N lower in RR and RF because of rapeseed roots uptake until 100 cm,
- Nov : N higher in FF in 60-90 because Faba bean has shallow roots (60 cm) and use less N
- Jun : N decreased in all soil columns because of N leaching in bare soil and N plant uptake for the other treatments

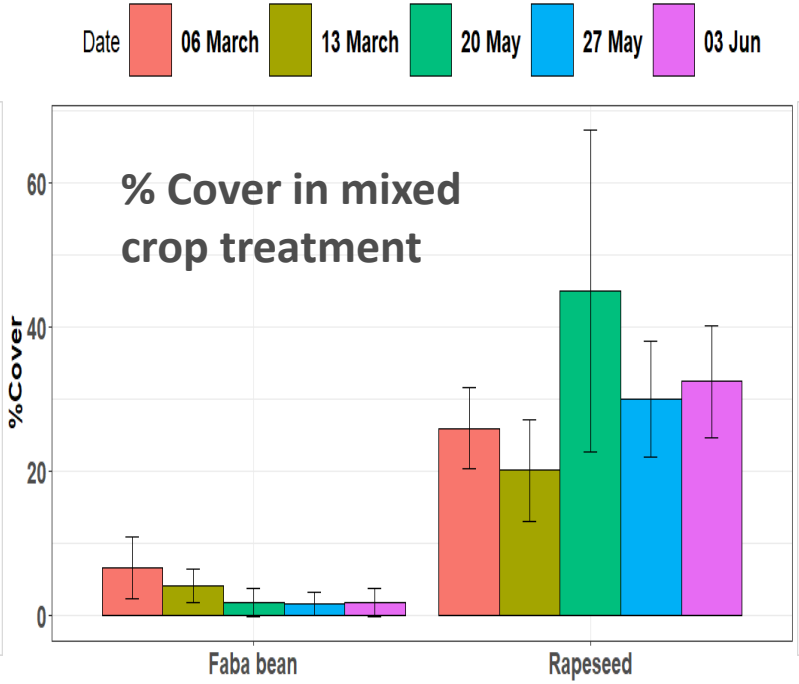
Soil Nitrogen: Horizon 0-30 cm

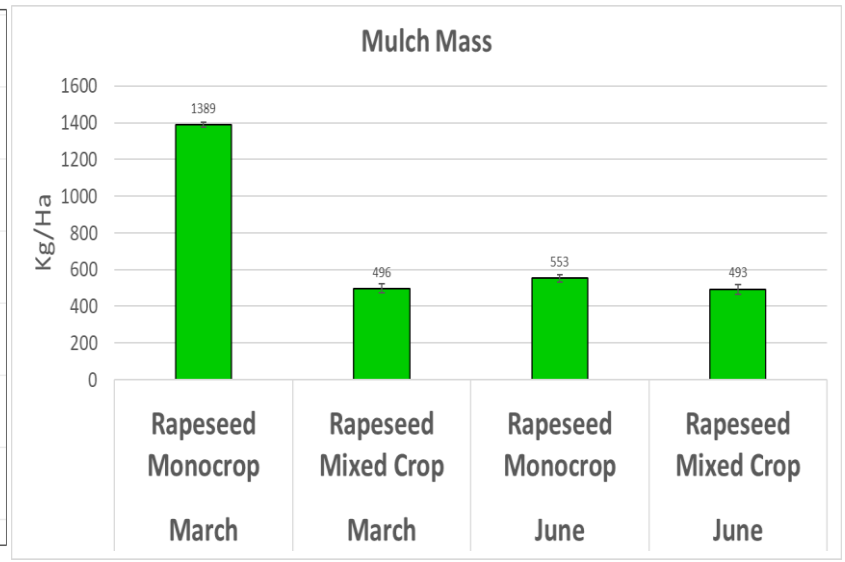


- Bare Soil : N leaching from the column and soil N mineralisation
- Crop system: mostly plant N uptake, N leaching to lower layers, and soil N mineralisation
- June : Higher N in crop mixture than in rapeseed monocrop but no significate differences

Mulch





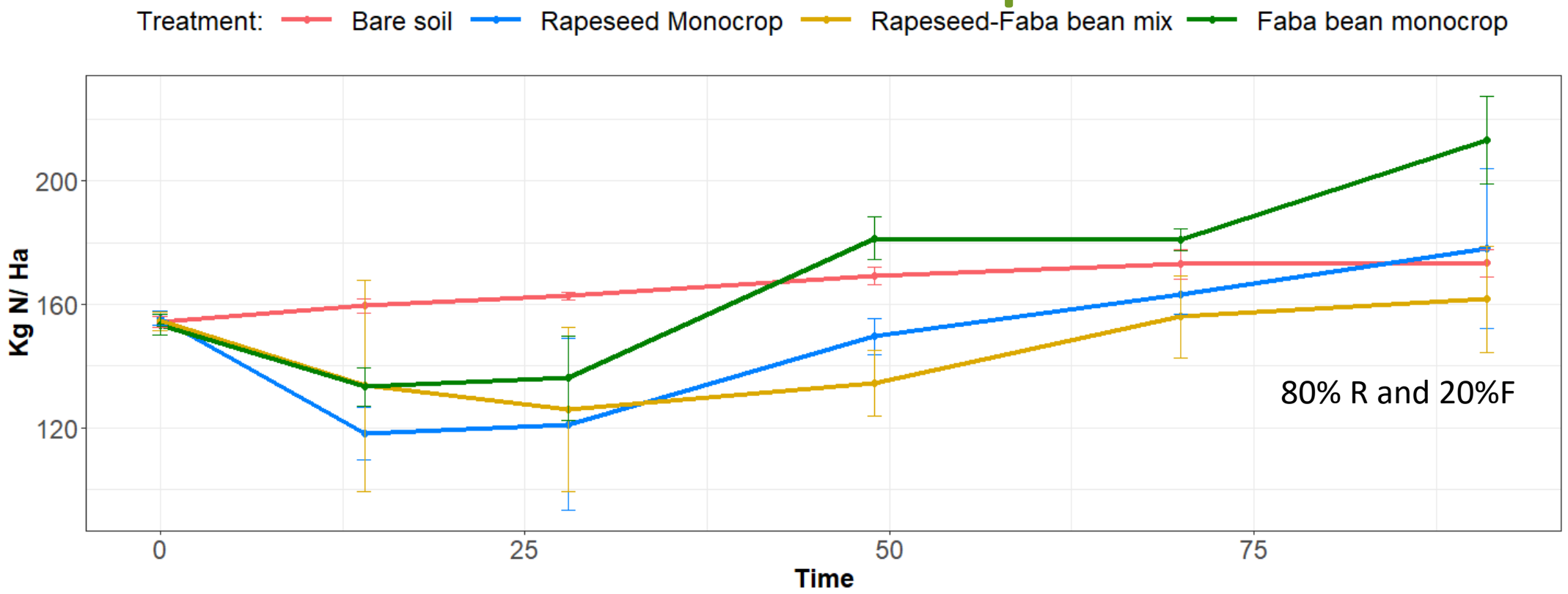


- N quantity in mulch similar between Monocrop RR and Mixed crop RF rapeseed

Even if %N Faba bean mulch (C:N=10) is much higher than rapeseed mulch (C:N=25), because:

- The % cover of Rapeseed is much higher than the % of Faba bean in the mulch of mixed crop
- The mass of mulch is higher in Rapeseed monocrop RR than Rapeseed mixed crop in march

Soil N Mineralization of crop residues



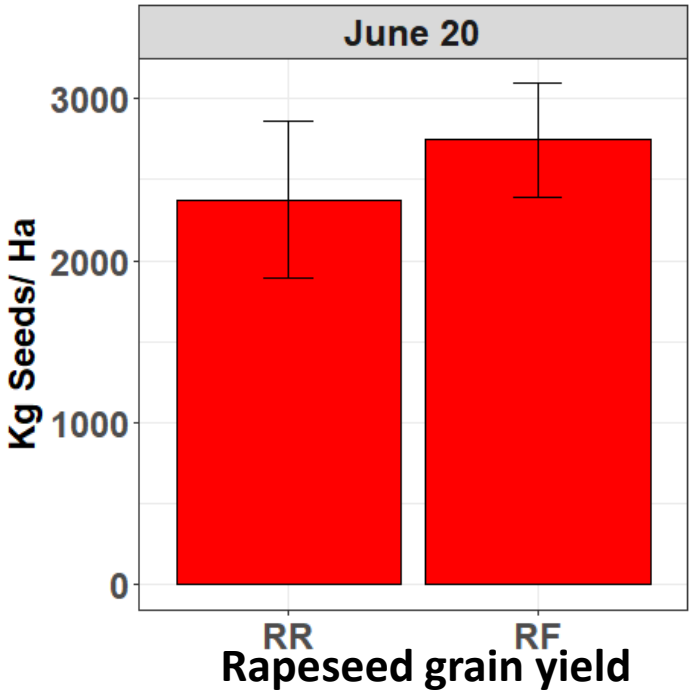
- Initial N immobilization : Rapeseed> Rapeseed-Faba bean mixture = Faba bean
  - due to the higher C:N of Rapeseed (25) than Faba bean (10)
- Final N Mineralization : Rapeseed = Rapeseed-Faba bean mixture<Faba bean
  - Due to the higher content of Rapeseed than Faba bean in the mixture (80%/20%)

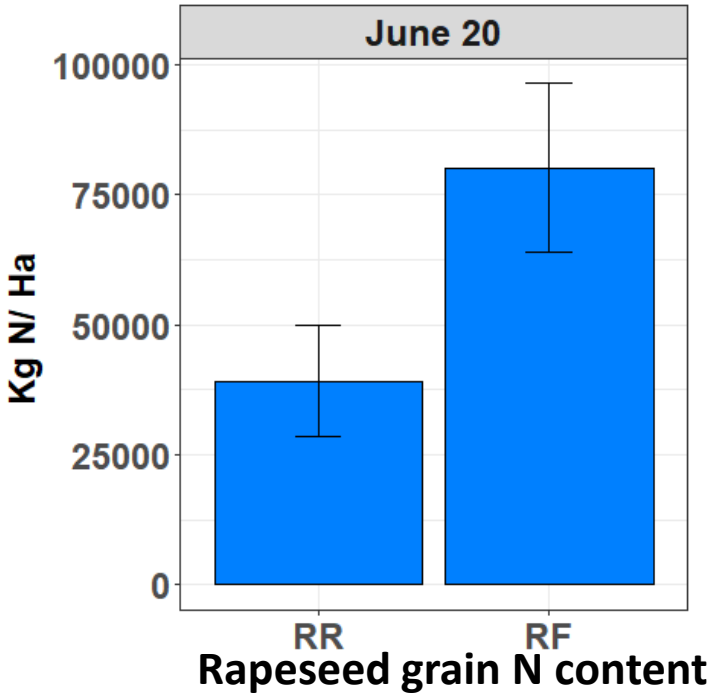
Conclusion

- Rapeseed in mixed crop RF had double the N content compare to Rapeseed monocrop RR

➡ The addition of legume the Faba bean in mixed crop does not disadvantage the rapeseed growth

- More N was reallocated to newer growing parts of the plant and for pod filling (Malagoli et al., 2005)
- Less competition for soil N from the Faba bean than between the two rapeseeds in proximity (Génard et al., 2017; Lupwayi & Soon, 2015).





Conclusion

- Mixed crop rapeseed/Faba bean and rapeseed monocrop :
  - have similar soil mineral N quantity
  - have similar mulch mineral N quantity
  - Mineralized the same amount of N from mulch

⇨ The addition of legume in the mixed crop has no effect on the soil N dynamic compare to the monocrop during the rapeseed growing season

Perspective :

- The legume addition may be beneficial for the plants in the next cropping rotation
- We should extended the experiment for a second crop growth

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Thank you!