

INCIDENCE OF NITROGEN FERTILIZATION ON THE ECOLOGICAL SERVICES PROVIDED BY RELAY-INTERCROPPED FORAGE LEGUME.

S. VRIGNON-BRENAS, F. CELETTE, C. DAVID.

ISARA-Lyon, Unité AGE (Agroecology & Environment), Université de Lyon, 23 rue Jean Baldassini - 69364 Lyon 07, France
[celette@isara.fr]



In organic stockless systems, forage legume can be used to provide ecological services like nitrogen provision and weed infestation mitigation. Intercropping may be a strategic way to extend the legume growth period and ensure better development than a cover crop sown after the winter wheat harvest [1]. It permits to limit resource competition but does not improve wheat production, leading farmers to apply nitrogen fertilization to insure cash crop production. Due to better cereal soil nitrogen competitiveness, forages legume dry matter production may decrease, potentially impairing its ability to provide expected ecological services. The effect of spring organic fertilization on the performances of intercropped wheat and the services provided by the forage legume has to be evaluated to think to the better compromise between wheat performances and services provided by the legume cover crop.

MATERIAL AND METHODS

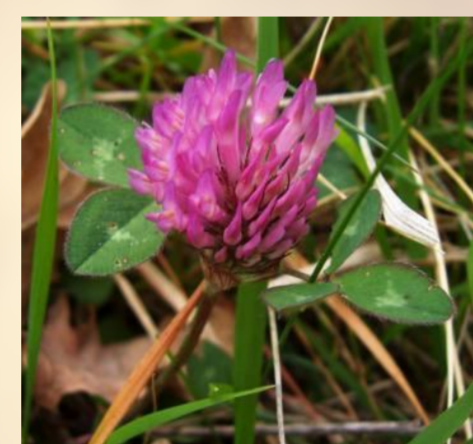
Study sites

- 5 on-farm experimental fields in south-eastern France in 2009 or 2010 :
 - Soil textures ranged from sandy loam to Silty Clay
 - Climate conditions were typical from a temperate climate with mediterranean influence
 - Rainfall ranged from 190 to 340mm during intercropping phase and 640 to 850mm between wheat harvest and cover crop destruction

Cropping systems



- 6 studied treatments:
 - Sole wheat crop (cv. Lona) sown with a density of 200kg.ha⁻¹ i.e. about 500 seeds.m⁻² (T0)
 - Wheat crop associated with cover crops undersown at the end of winter at a density of 800 plants.m⁻². 2 species: *Trifolium repens* (Tr), *Trifolium pratense* (Tp).
- A spring fertilization (100kg N.ha⁻¹ with feather meal) was added on each treatment on february (100 N_{org}).
- 3 complete and randomised blocks in each experimental fields.



Monitoring

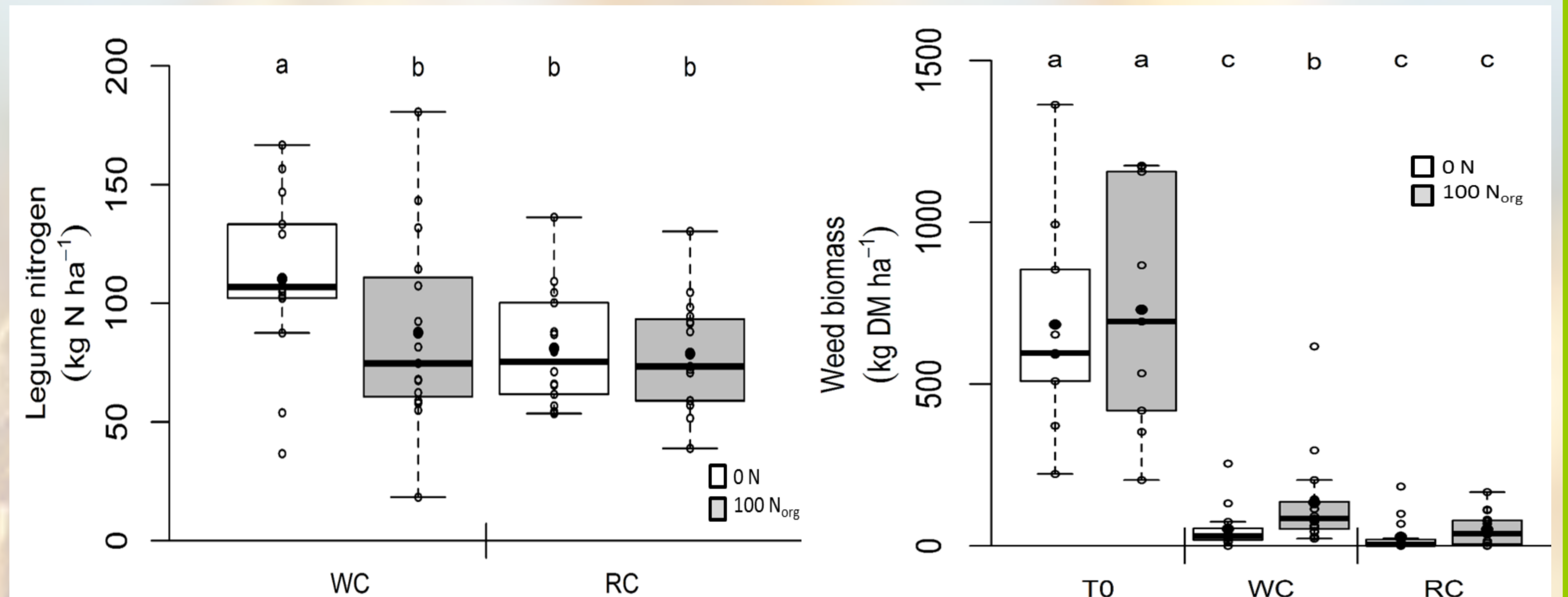
- Wheat crop: biomass and nitrogen content (at crop flowering and harvest) yield components & protein content
- Legumes: biomass and nitrogen (at crop flowering and harvest)
- Weeds: Biomass and nitrogen content (at crop flowering and harvest)

RESULTS & DISCUSSION

N impact on wheat performances and legume growth

- Addition of nitrogen fertilizer increased both wheat grain yield (+1 t.ha⁻¹ – p<0.001) and protein content (+6g N.gDM⁻¹; p<0.001)
- But fertilization also decreased clover biomass for both *T. pratense* and *repens* (-28 and -50% respectively) at wheat harvest
- The gap of clover biomass between fertilized and unfertilized conditions is reduced at clover destruction thanks to a higher growth of fertilized clover after wheat harvest.

Figures 1 & 2. 1) Nitrogen accumulated in aboveground legume biomass and 2) weed aboveground biomass at cover crop destruction as affected by the presence of a white (WC) or red (RC) clovers and the addition of N fertilization (100 N_{org}). Similar letters indicate homogenous groups after Tukey's test (P=0.05).



N impact on ecological services expected from the cover crop

- Both nitrogen accumulation and weed control by the cover crop were impaired (figures 1&2)
- Reduced nitrogen accumulation was the direct consequence of lower biomass for both clovers
- Weeds were less controlled as they benefited from this additional nitrogen and legumes lost their competitive advantage (ability to fix nitrogen) [2].

T. repens sensitivity to this addition of nitrogen is higher

- T. repens* reduction of biomass because of fertilization was more important than for *T. pratense*.
- This directly reduced the ability of *T. repens* to control weeds (figure 2)
- T. repens* accumulation of nitrogen was significantly reduced in fertilized conditions by contrast to *T. pratense* (figure 1).
- This reduction was the only consequence of biomass reduction as nitrogen content and the part of nitrogen fixed from the atmosphere were comparable in fertilized and unfertilized conditions (Ndfa = 80.9 ± 1.9%)

CONCLUSION

Spring nitrogen fertilization disturbed relay intercropped legume growth until wheat harvest. Then, legume growth was no longer affected, regardless of the species [3]. If red clover ensured better weed control, it provided less nitrogen to the subsequent crop than white clover. However the latter appeared to be more sensitive to the fertilization. The clovers' resilience to this addition of nitrogen, observed after wheat harvest, suggests that such practice may be of limited impact if the period between intercropping and cover crop destruction is long enough.

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