'Factors affecting Nitrogen Use Efficiency – identification, measurement and management'
2019 IFS Agronomic Conference, Cambridge (UK), December 11-12th

Leguminous Winter Cover Crops In Monoculture Maize Under Mediterranean Irrigated Conditions

Ramón Isla[1]*, Ignacio Clavería[1], José Cavero[2]

[1]Dpto. Suelos y Riegos, Centro de Investigación y Tecnología Agroalimentaria de Aragón, Avda. Montañana 930, 50059 Zaragoza, Spain

[2]Dpto. Suelo y Agua, Estación Experimental de Aula Dei (CSIC), Avda. Montañana 1005, 50059 Zaragoza, Spain

*risla@aragon.es

1. Introduction

Winter cover crops (CC) are proposed as a tool to decrease nitrate leaching during the intercrop period of maize with a potential reduction of nitrogen fertilizer rates to the following maize crop when leguminous species are used as CC. However, the species election, seeding rates, and soil tillage to plant CC are crucial aspects that are not fully optimised and must be assessed to increase their adoption.

Objective: Evaluation of different factors (plant species, sowing rate, and planting method) to optimize the use of winter cover crops preceding irrigated maize under Mediterranean conditions.

2. Materials and Methods

- Factorial experiment with 3 replicates (plots of 180 m^2) in a Deep soil (Typic Xerofluvent) under Mediterranean irrigated conditions (Zaragoza, NE Spain).
- CC planting method (2): **CT**: conventional tillage of maize residues and sowing of CC, and **NT** ; no tillage and direct sowing of CC.
- CC species (4): Common vetch (*Vicia sativa*), Hairy vetch (*Vicia villosa*), Peas (*Pisum sativum*), Winter fallow (no CC).
- CC sowing rate (2): **Normal rate** - **NR** (Common vetch - 96 kg/ha; Hairy vetch – 51 kg/ha; Peas: 202 kg/ha)
  Reduced rate – **RR** (Common vetch - 74 kg/ha; Hairy vetch – 36 kg/ha; Peas: 153 kg/ha)
- Aerial biomass of CC incorporated to the soil at 158 days after CC sowing and two weeks before maize planting.
- Reduced N fertilizer rate (150 kg N/ha) on subsequent maize crop cv. 'Pioneer cv. P0933Y' (FAO 600).
- Measurements: Soil mineral N (0-30 cm depth); CC aerial biomass (kg/ha); CC N uptake (kg N/ha); N derived from fixation (Ndfa) in CC; Maize grain yield (kg/ha).

3. Results

- The total aerial biomass of winter cover crops (CC) was affected by the plant species ($p<0.001$) but unaffected by the CC planting method and CC sowing rate ($p>0.05$) (Fig. 1). At the normal sowing rate peas produced higher aerial biomass than common and hairy vetch.
- The cover crop N uptake was mainly affected by the plant species (Table 1).
- The nitrogen derived from fixation (Ndfa) decreased as the soil mineral nitrogen increases (Fig. 2). Significant differences in Ndfa were found among CC species (Table 1).
- Grain yield of maize planted after CC was not significantly affected by any of the CC treatments.

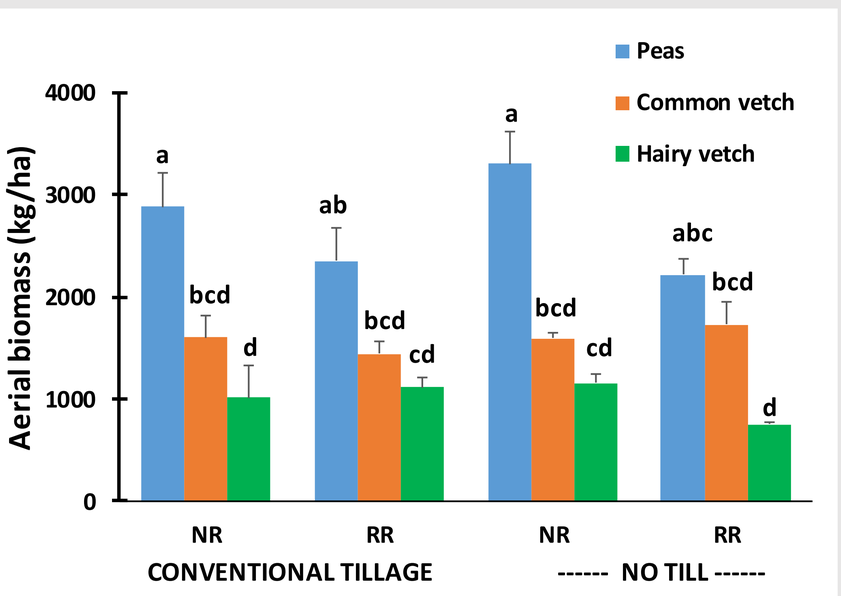

Figure 1. Cover crop aerial biomass obtained for the different treatments (Tukey's test; $p<0.05$).

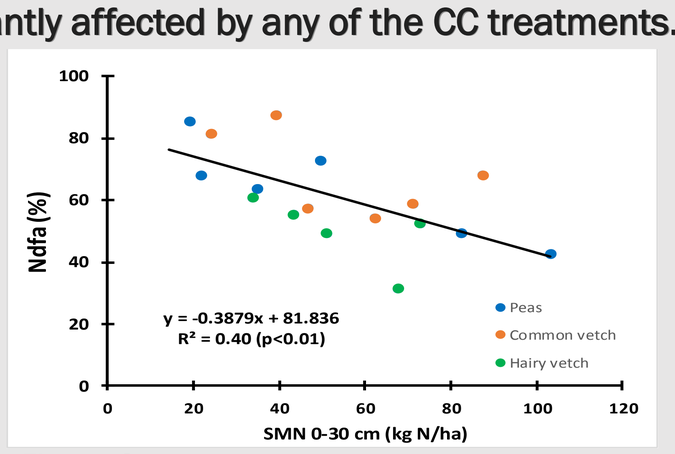

Figure 2. *Relationship between the N derived from fixation (Ndfa, %) and the soil mineral N (kg N/ha) in the different plots.*

Table 1. *N content, N uptake and nitrogen derived from fixation (Ndfa) for the 3 cover crop species (Tukey's test) at normal seeding rate (NR). Average of the 2 planting methods.*

Species	N content (%)	N uptake (kg N/ha)	Ndfa (%)
Peas	2.95 b	91.5 a	63.0 ab
Common vetch	3.81 a	60.9 b	68.5 a
Hairy vetch	3.82 a	41.2 c	48.7 b

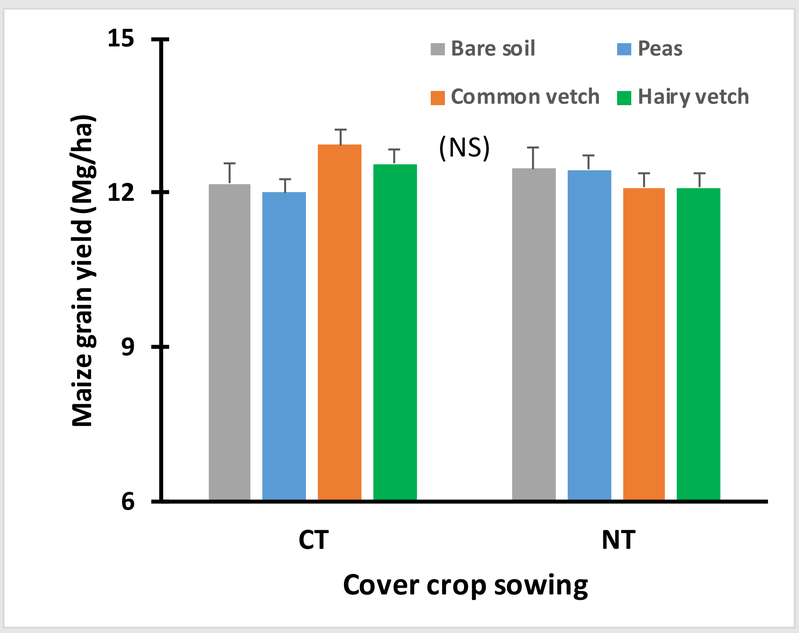

Figure 3. *Grain yield (Mg/ha) of maize grown after the different CC species and the two CC planting methods.*

4. Conclusions

- Peas are a good alternative as winter cover crop compared to vetch under mediterranean conditions, presenting higher aerial biomass and N uptake in early spring. The direct sowing of CC allows similar final CC growth than using conventional tillage.
- The leguminous species are able to modulate the microbial N fixation according to the abundance of mineral N in the soil.
- The use of winter cover crops does not affect negatively the yield of the subsequent maize crop.

Funding: Spanish Ministry of Economy, Industry and Competitiveness – Project AGL2017-84529-C3-2-R