# Leguminous Winter Cover Crops In Monoculture Maize Under Mediterranean Irrigated Conditions

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## Abstract

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 under Mediterranean irrigated conditions. The objective of the study was the evaluation of different factors (species, sowing rate, and planting method) to optimise the use of winter cover crops preceding maize under Mediterranean irrigated conditions. The experiment was performed in a deep soil (Typic Xerofluvent) located in Zaragoza (NE Spain). A factorial experiment including 2 CC sowing methods (CT: conventional tillage of maize residues and sowing of CC, and NT: no tillage of maize residues and direct sowing of CC), 4 CC species (peas, common vetch, hairy vetch, and control without cover crop), and 2 CC sowing densities (NR: normal rate, common vetch - 96 kg/ha; hairy vetch – 51 kg/ha; peas: 202 kg/ha; RR: reduced rate, common vetch - 74 kg/ha; hairy vetch – 36 kg/ha; peas: 153 kg/ha). The design was a Strip-Split plot where CC species are laid out in vertical strips, which are then split into subplots with the two densities. CC sowing method is stripped across the split-plot experiment, and the experiment is replicated three times. Each experimental plot comprised an area of 60 m x 3 m (4 maize rows spaced 0.75 m) and the evaluated variables were analysed in different specific sampling areas to manage the spatial variability. The CC grew during 158 day before they were chopped and incorporated into the soil by a disk harrow two weeks prior to maize (cv. P0933Y) planting. A reduced rate of 150 kg N/ha was used in all the plots to grow maize. The variables analysed were soil mineral nitrogen (SMN 0-30 cm soil depth, kg N/ha), CC aerial biomass (kg/ha), CC N uptake (kg N/ha), nitrogen derived from fixation (Ndfa %; $^{15}N$ natural abundance method), and maize grain yield (Mg/ha at 14% humidity).

The total aerial biomass of CC (Fig. 1) was affected by specie ($p<0.001$) but unaffected by the CC sowing method and sowing rate ($p>0.05$). At the normal seeding rate, common peas presented higher aerial biomass than common and hairy vetch. No significant differences in aerial biomass were found between the two vetch species, although common vetch tended to present higher aerial biomass. For the normal seeding rate (NR), the N uptake on aerial biomass was higher for peas (91.5 kg N/ha) than for common vetch (60.9 kg N/ha) and hairy vetch (41.2 kg N/ha) due to its higher aerial biomass, although its N content was lower than for vetches. The N derived from fixation (Ndfa; Fig.2) decreased as the soil mineral nitrogen increased indicating the ability of these leguminous species to regulate fixation depending on the amount of soil mineral nitrogen. Hairy vetch showed lower fixation capacity (48.7%)

compared to peas (63%) and common vetch (68.9%). The grain yield of maize planted after the CC was not significantly affected by any of the evaluated CC treatments.

Peas are a good alternative as winter cover crop compared to the traditional vetch under Mediterranean conditions, presenting higher aerial biomass and N uptake in early spring, probably because its better early growth at low temperatures typical of the end of October after maize harvest. The lack of a positive effect of the cover crops on subsequent maize grain yield, as compared with the control without cover crop, suggest that N availability for maize was not the main limiting factor in this experiment. Further studies under more N limiting conditions must be performed to evaluate the feasibility of decreasing N fertilizer rates in maize after leguminous winter cover crops.

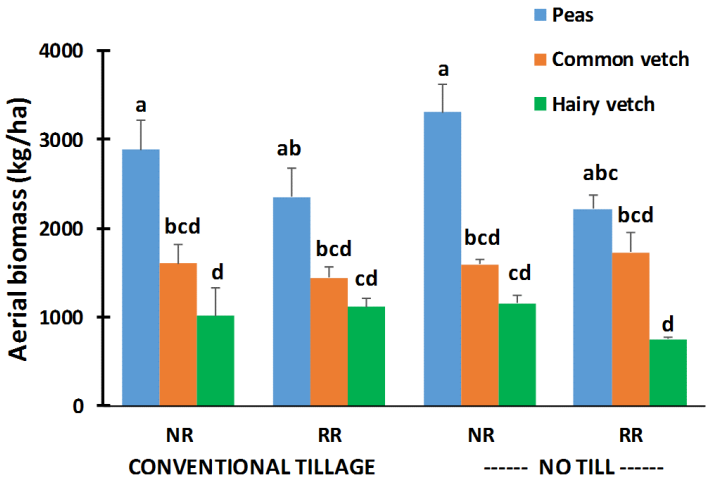


**Fig. 1.** Cover crop aerial biomass obtained for the different treatments (Tukey's test; $p<0.05$).

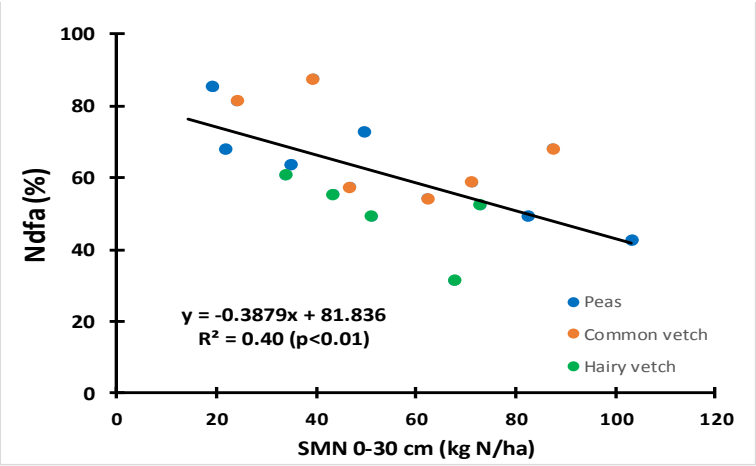


**Fig. 2.** Relationship between the N derived from fixation (Ndfa, %) and the soil mineral N (kg N/ha) in the different plots.