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Heithem Bahri, Mohamed Annabi, Khadija Ouerghi, Cornelia Rumpel, Laurent Bedoussac, et al.. Intercropping, a system allowing to increase durum wheat production and to maintain soil fertility in Northern Tunisia?. Ecological Engineering : from concepts to applications - EECA, Dec 2009, Paris, France. , 1 p., 2009. hal-02823824

HAL Id: hal-02823824

<https://hal.inrae.fr/hal-02823824v1>

Submitted on 20 Jun 2023

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Intercropping, a system allowing to increase durum wheat production and to maintain soil fertility in Northern Tunisia?

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Introduction

In the mountainous regions of Northern Tunisia, soils are increasingly exposed to erosion and degradation due to crop rotations and the intensification of agricultural practices, including the use of fertilizers and pesticides. Intercropping is known to increase global yield and the efficiency in the use of natural resources in low input systems.

Objective

The objective of the study was to evaluate the effect of durum wheat and grain legume intercrops i) on increasing the plant nitrogen use efficiency, ii) on maintaining the organic matter content of the soils, and iii) and on decreasing soil erosion.

Matériel et méthodes

- The field experiment was carried out in 2008-2009, on a sandy loam soil with a pH of 6.1 containing 0.54% total C and 0.29% total N in the 0–20 cm soil layer.
- The site was located 60 km north of Tunis, Tunisia (Sidi Nsir: 37°03'49.40"N; 09°24'25.55"E).
- The climate is sub humid, the average annual precipitation and air temperature were 737 mm and 12.6°C respectively
- The experimental plots (6 m x 15 m) were laid out with 3 replicates (Fig. 1). Seeds of durum wheat (Wd), faba bean (Fb) and fenugreek (Fn) were sown as sole- (SC) and intercrops (IC) : Wd-Fb and Wd-Fn). Sole crop densities are about : 160, 140 and 80 kg.ha⁻¹ for Wd, Fb and Fn respectively. In intercrop plots, crop density was half the one without intercrop expect for Fn which was sown with the same density as in the sole crop plot.

Calculation

- The land equivalent ratio (LER): calculated on the basis of grain yields (Y) and of dry matter (LER_b) as in De Wit and Van den Bergh (1965): (example : $LER_y = Y_{IC}/Y_{SC}$)

LER > 1 → an advantage from intercropping, in terms of the use of environmental resources
LER < 1 → resources are used more efficiently by sole crops than by intercrops.

- Legume N-derived from fixation air (%Ndfa) is calculated using ¹⁵N data which are measured by CHN auto-analyser (CHN NA 1500,4 Carlo Elba) coupled to an isotope ratio mass spectrometer

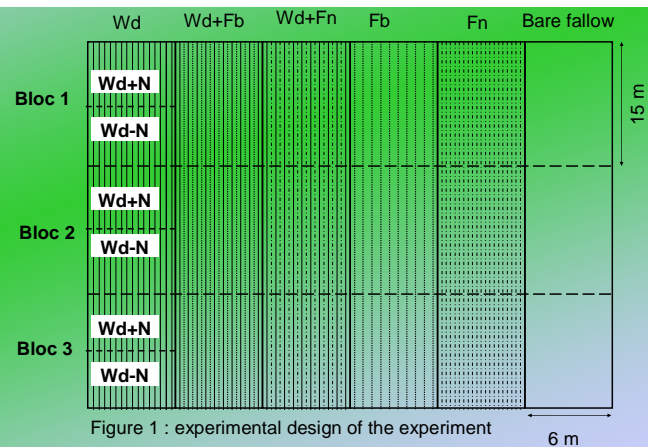


Figure 1 : experimental design of the experiment

Wd: durum wheat; Fb: faba bean; Fn: fenugreek
Wd+N and Wd-N: durum wheat with and without nitrogen fertilization
Bare fallow: control treatment

Results et discussion

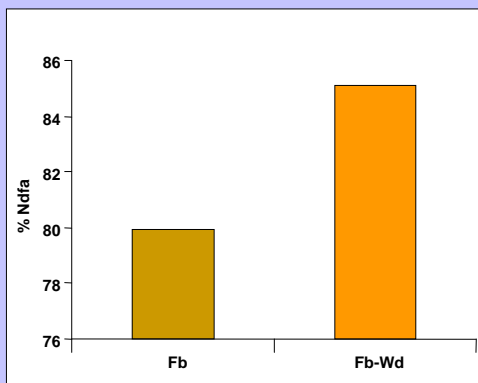


Figure 2: %Ndfa of Fb in sole and as intercrop

- ✓ Faba bean symbiotic N-fixation was higher in intercrop than in sole crop faba bean (figure 2) → soil nitrogen is more available to Wd
- ✓ %Ndfa in fababeans was greatly increased when intercropped with Wheat illustrating a greater ability of fababeans plants in intercrop to fix N₂

Conclusion

- ❖ This study indicated a potential for intercrops in terms of yield, nutrient use efficiency and soil stability compared to sole crops and could be used to increase efficiency and production in some parts of Northern Tunisia. An intercrop gain in yield of about 21 % and 41 % resp. for Wd-Fn and Wd-Fb was observed.
- ❖ Increased N legume fixation may result in less soil N uptake, which farther enhances the value of the legume in an intercrop.

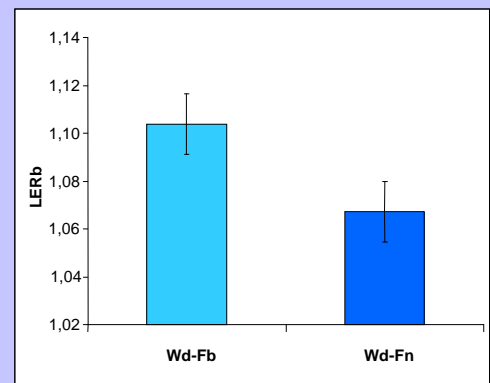


Figure 3: LER_b of intercrops Wd-Fb and Wd-Fn

- ✓ LER_b, indicated that growth resources were used 7 to 10% more efficiently in intercrops than sole crops (Fig. 3)

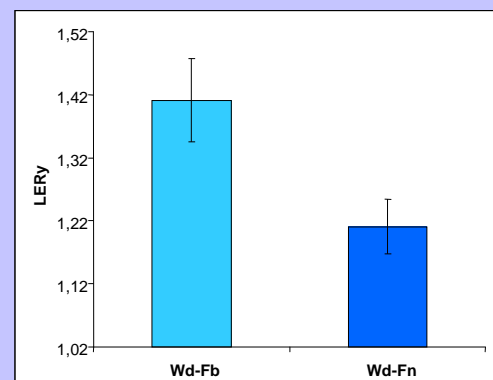


Figure 4: LER_y of intercrops Wd-Fb and Wd-Fn

- ✓ The higher efficiency of Wd-Fb intercrop compared to Wd-Fn (Fig. 4) could be partly explained by the complementarities for natural resources .