

Conservation Agriculture in Mediterranean areas enhances water use efficiency



CONTEXT

Mediterranean agriculture suffers frequent droughts. Water limitations imposed by climate have an impact in the crop yields and its stability. Poor soil cover by vegetation exacerbates the soil erosion problems and reduces fertility of the soil. In these conditions, agricultural practices as the Conservation Agriculture (CA) production system enhance soil protection, water conservation and biodiversity, improving crop yield by enhancing the water productivity.

WORK DONE IN CAMA

Due to high diversity of pedo-climatic conditions in the Mediterranean area and the diversity of crop production systems, CAMA project objectives included to demonstrate that in such different conditions the implementation of CA did not produce a crop yield limitation. For that, a set of 11 experiments in 10 field controlled commercial conditions was used during 3 growing seasons from 2020 until 2023 in the different countries, with a diversity of climate and production system conditions, and with different agricultural practices adjusted to the implementation of CA.

The network of experiments gives us a main assessment of the soil management system comparison (effect of reduction of tillage). The network of experiments allowed us an assessment and comparisons of soil management systems (effect of reduction of tillage: conventional - reduced - no till). Other factors as water regime, crop and varieties types, cropping system (crop rotation - intercropping), fertilizer application were also studied. The impact of CA on water productivity as water use efficiency (WUE) was evaluated in these experiments.



Fig. 1. As examples of the field network, field experiments conducted in Foggia, Drimos, Greece (left- Residue management) and in Senes de Alcubierre, Spain (right- Pea crop under rotation).

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RESULTS

Table 1 resumes average **water use efficiency** obtained as average comparing different soil management systems (Conventional/Intensive, Minimum and No tillage) in field experiments under different conditions and particular cropping systems. In general values of WUE are quite low because the limited water conditions, however and despite the heterogeneity of the different locations and pedo-climatic conditions **CA options (Minimum and No tillage) obtained a better or equal yield as intensive tillage**. In the experiments as in Italy (CREA) and Greece (HAO), representing more humid conditions, minimum tillage use to be optimum strategy. However in dryer situations no tillage use to obtained higher levels of WUE showing that is the optimal and recommended strategy for soil management. Table 2 indicated, as example, the **interest of adjusting dose of N fertilization when implementing CA**.

Table 1. General Water use efficiency (kg/mm/ha) of field crops comparing tillage systems under the different conditions of the field experiments and including different practices (Greece included rotation of different crops; Spain included comparison with fertilizer type and dose; Morocco included different tested pant material and Tunisia included different duration of a crop rotation).

Tillage system	Foggia Italy	Drimos Greece	Senes Spain	Merchouch Morroco	Kef Tunisia
Conventional intensive tillage		8-22	0.97-6.5	0.40	0.45-0.77
Minimum tillage	3-20	13-22			0.44-0.89
No tillage	3-17		2-13	1-3	0.5-1.08

Table 2. Water use efficiency (kg/mm/ha) in wheat, pea crop and barley under different tillage, fertilization N dose from 2020 to 2023 growing seasons in Senes de Alcubeire (Huesca, Spain). The data were subjected to analysis of variance according to the randomized block design. The means separation test was the Student-Newman-Keuls at 0.5 probability level. GLM procedure of the JMP program was used in the analysis of variance and mean separation test. Mean values labelled with the same letter were not significantly different at $p < 0.05$ in the ANOVA and t-student test.

Growing season	2020-21		2021-22		2022-23	
Crop	Wheat Crop		Pea crop		Barley crop	
Tillage system						
CT	5.19	a	6.36	b	0.97	b
NT	7.37	a	13.29	a	2.15	a
N fertilization dose						
0	5.24	b	4.53	b	1.52	a
75	6.90	a	10.17	a	1.60	a
150	6.18	ab	12.13	a	1.59	a

CAMA PROJECT FACTSHEET



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CONCLUSIONS AND RECOMMENDATIONS

Soil management options (main factor, tillage options). In general we could conclude that the reduction of the intensity of de tillage enhances water productivity of the crops.

Fertilization options. All the scenarios where N fertilization is considered demonstrate that there is an interactive effect through the water response. N application produces better response of the reduction of the tillage system enhancing water use efficiency. However it is important adjusting the N dose. The abuse of N fertilization does not increase water productivity.

References

Deliverable 5.2 CAMA project- Set of suggested technical improvements

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