Best practices in organic Citriculture: the Palap9 long-term experiment

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Palap9 is a field study started in 1995 on 'Valencia late' orange [*Citrus sinensis* (L.) Osbeck)] trees grafted on sour orange (*C. aurantium* L.) in CREA "Palazzelli" experimental farm [Lentini, SR (IT)]. During 15 years, the effects of three organic fertilizers have been compared to a control (mineral fertilizer) after yearly application at the same N input level (Fig. 1). The system comparison showed the increase of soil organic C stock in the organic treatments, of nutrient use efficiency (P, K, and micronutrients), and of some key fruit quality parameters, being the yield equal (Canali *et al.*, 2012; Roccuzzo *et al.*, 2012).

The mature orchard in 2012 was replaced in the same plots with 'Tarocco Rosso' orange seedlings, grafted on Carrizo citrange [*Poncirus trifoliata* (L.) Raf. × *C. sinensis* (L.) Osbeck], with and without soil disturbance. Fig. 2 shows the effect of heavy soil tillage (up to 150 cm depth) on soil organic carbon content.

Fig. 1 – Aerial photo of the new Palap9 experimental design.
Block I refers to no tillage, blocks II and III refer to tillage in fig. 2

In order to design and to evaluate resilient organic citrus systems, studies on cover crop introduction and soil management techniques are currently carried out.
The old experimental design was mantained in blocks I and II (Fig. 1). Cover crop aboveground biomasses need on-site adjustments of traditional soil management techniques, realized in block III.

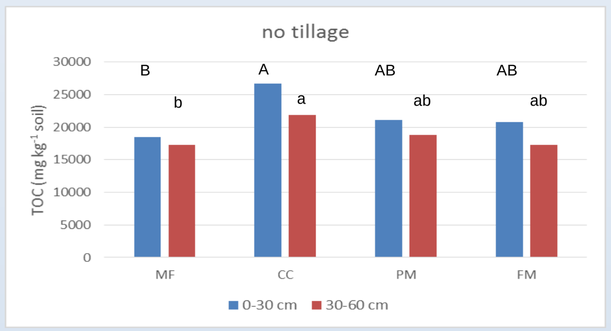


Fig. 2 – Effect of soil tillage at the replanting date (2012) on total organic carbon

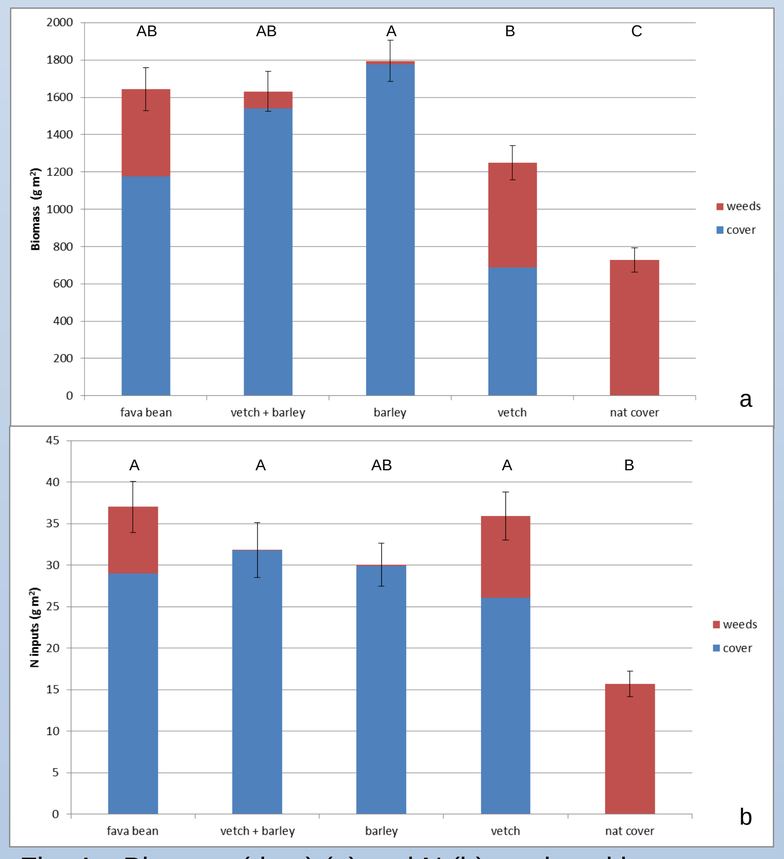


Fig. 4 – Biomass (d.m.) (a) and N (b) produced by cover-crops and natural cover (mean of 3 years ± se)

Fava bean (*Vicia faba* var. *minor* Beck), common vetch (*Vicia sativa* L.), barley (*Hordeum vulgare* L.), and a vetch-barley mixture showed to be well adapted to local conditions. Cover crops are an essential part of conservation agriculture, but they must be managed properly to obtain their full benefit (Fig. 4).

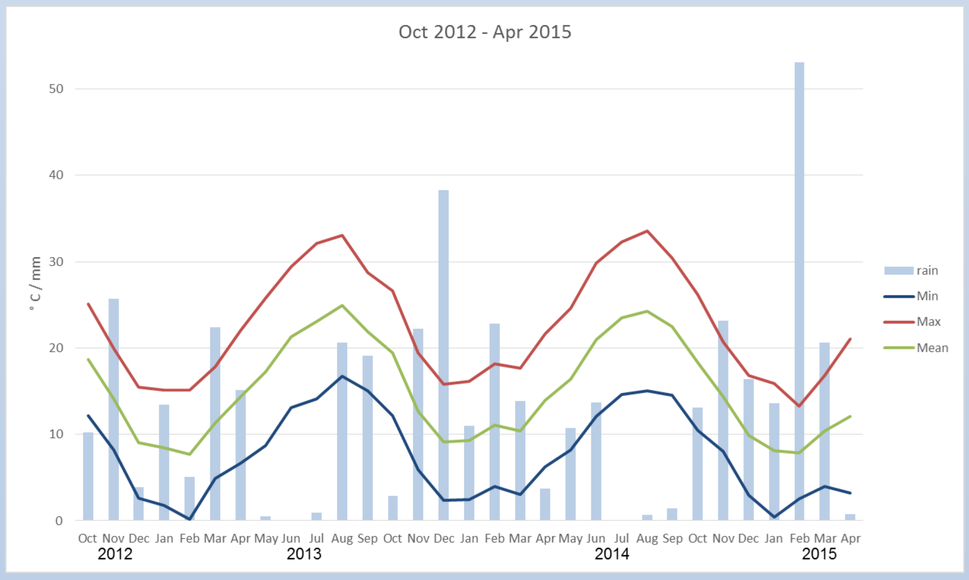


Fig. 3 – Air temperature and rainfall during the experiment

The roller-crimper was used in block III (Figg. 1 and 5).
The different treat-ments showed to have an influence on weed dynamics and coverage (Fig.6).

Fig. 5 – Roller crimper (right) and its effects (left) on the ground cover (April 2015, block III)

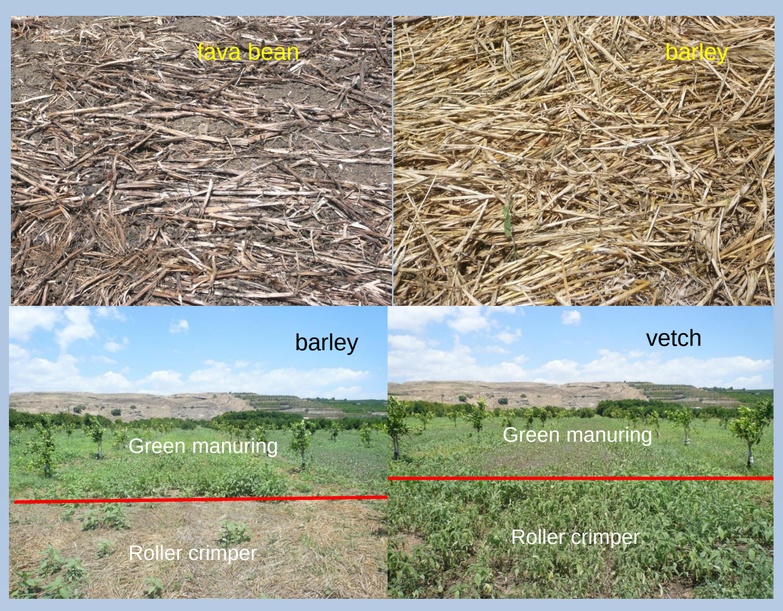
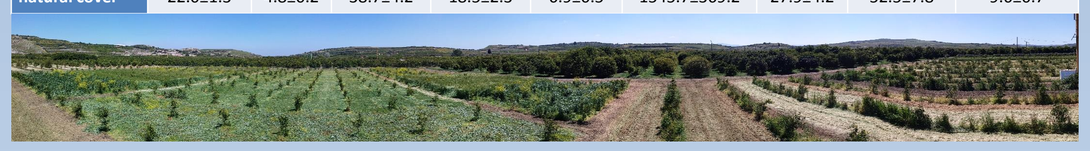


Fig. 6 – Effects of roller-crimper on different species (above), and on weeds (below) @45 DAT (June 2014)

The amount of nutrients mobilized by either the cover crops and the natural cover are showed in fig. 4b and in tab. 1.

Tab. 1 – Biomass nutrient concentration (d.m.) of some cover crop species

2013	N	P	K	Ca	Mg	Fe	Zn	Mn	Cu
	g kg^{-1}					mg kg^{-1}			
fava bean	21.1±2.0	2.8±0.2	22.2±1.7	8.8±0.8	4.3±0.4	479.6±63.8	14.4±3.2	30.0±2.5	6.5±1.0
barley	18.5±1.6	3.7±0.3	25.4±2.0	4.4±0.4	3.5±1.0	1240.7±624.1	10.7±3.2	36.4±5.3	4.4±0.5
vetch + barley	18.0±1.2	3.6±0.2	21.7±2.3	4.3±0.3	2.3±0.2	431.5±144.8	12.7±3.3	34.1±3.1	6.1±0.4
vetch	28.0±1.6	3.8±0.3	26.1±1.5	12.6±0.6	4.1±0.6	521.5±70.2	19.5±5.4	27.8±2.0	8.3±0.7
natural cover	22.0±1.3	4.8±0.2	38.7±4.2	18.5±2.3	6.9±0.5	1545.7±369.2	27.9±4.2	52.5±7.8	9.6±0.7



A key issue of organic agroecosystems is to maintain or increase the soil organic matter content over time. By means of composting of residues is possible to recycle a relevant part of organic outputs in fruit tree systems in arid environments. The combined action of cover-cropping and conservative soil management techniques can act to increase the economic and environmental sustainability of organic Citriculture.

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