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Long-term hydrologic effect of temporary cover crops in an olive orchard on a sandy-loamy soil

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Soil water erosion is one of the threats to sustainable soil use in Mediterranean countries, with tree crops (like olives) presenting areas severely degraded by this process.

Why?

There are a many studies in the last decades aimed to measure and modelling runoff and soil loss rates, and developing soil management to cope with this issue.

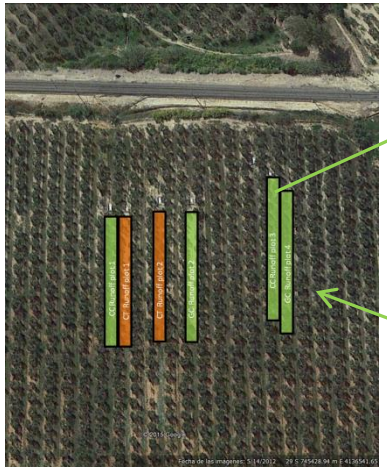
Most of these studies rely on a **relatively narrow experimental base**, particularly of long-term experiments.

What done?

Santa Marta is deficit irrigated table olive farm in Seville (Southern Spain) with a mean slope of 8 %. Textural class sand loamy and soil type is a **Petrocalcic Palexeralf.** Average annual precipitation is 534 mm.

From 2003, six closed **runoff plots** of 8x64 m were built with boundaries made by a combination of tree shoulders, masonry and beams on concrete foundation, with the longest dimension parallel to the maximum slope (11 %). Two soil managements have been evaluated: conventional tillage (CT) and temporary cover crops (CC) . **Plots are design to allow all the farm management operations, including machine traffic.**

Runoff water was collected in a systems of 3 consecutive **tanks separated with 1:13 splitters**. This is completed with a **weather station** and since **summer 2019 soil moisture sensors in two plots** (CC and CT), 12 at each plot monitoring the rooting depth (0-60 cm).

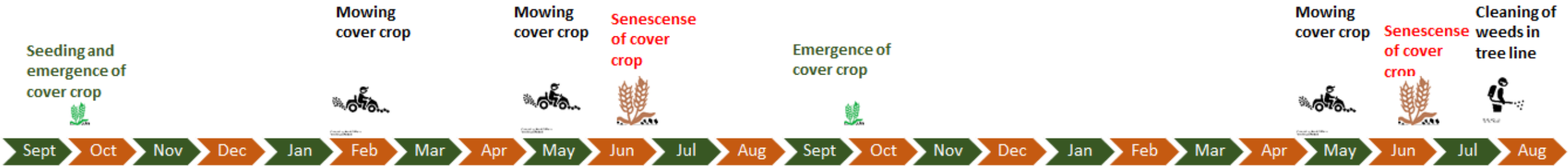


Rainy year

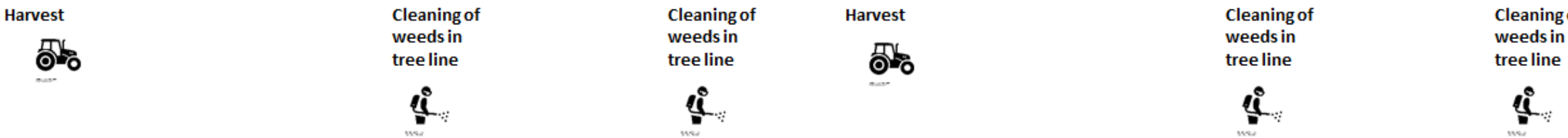
Dry year

A) Bare soil by tillage

B) Cover crop



All the plots



CC were seeded 5 times during these period. All grasses except 2 plots with a mix twice.

1- Early fall

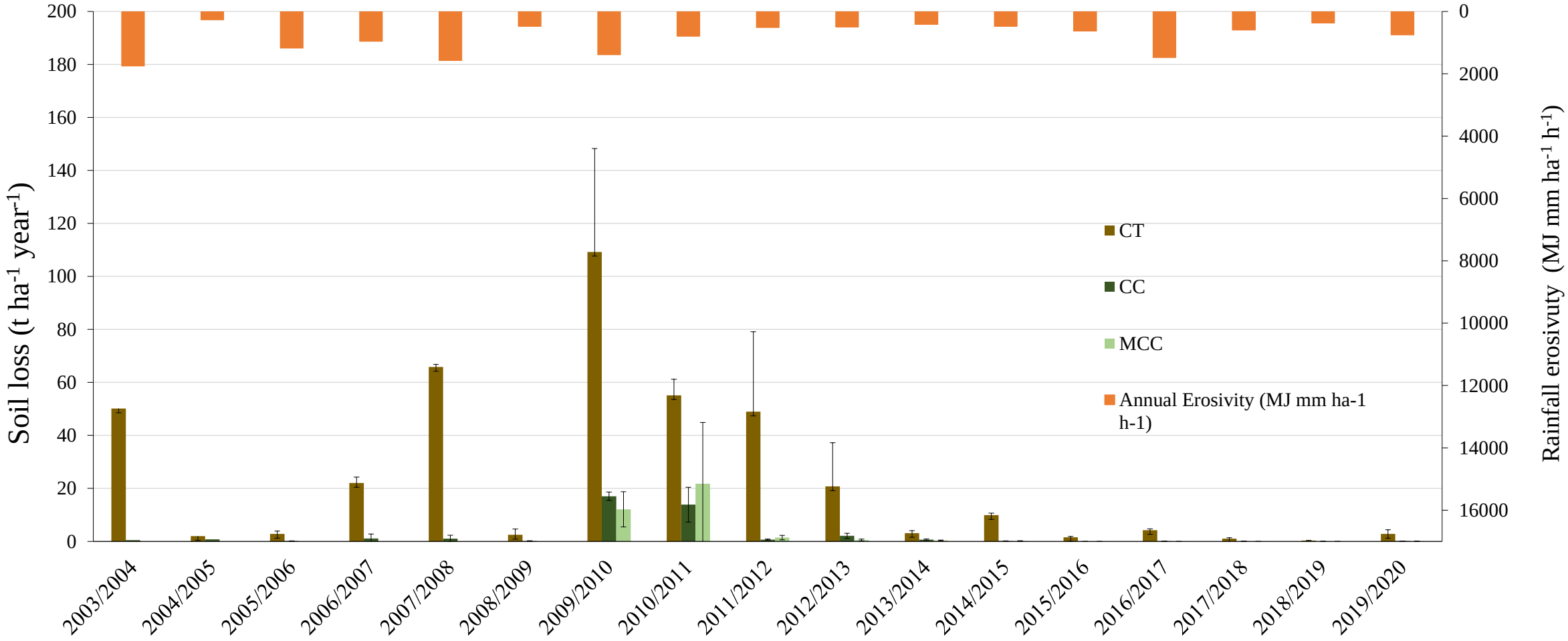
2- Fall

4- Late Spring-Summer

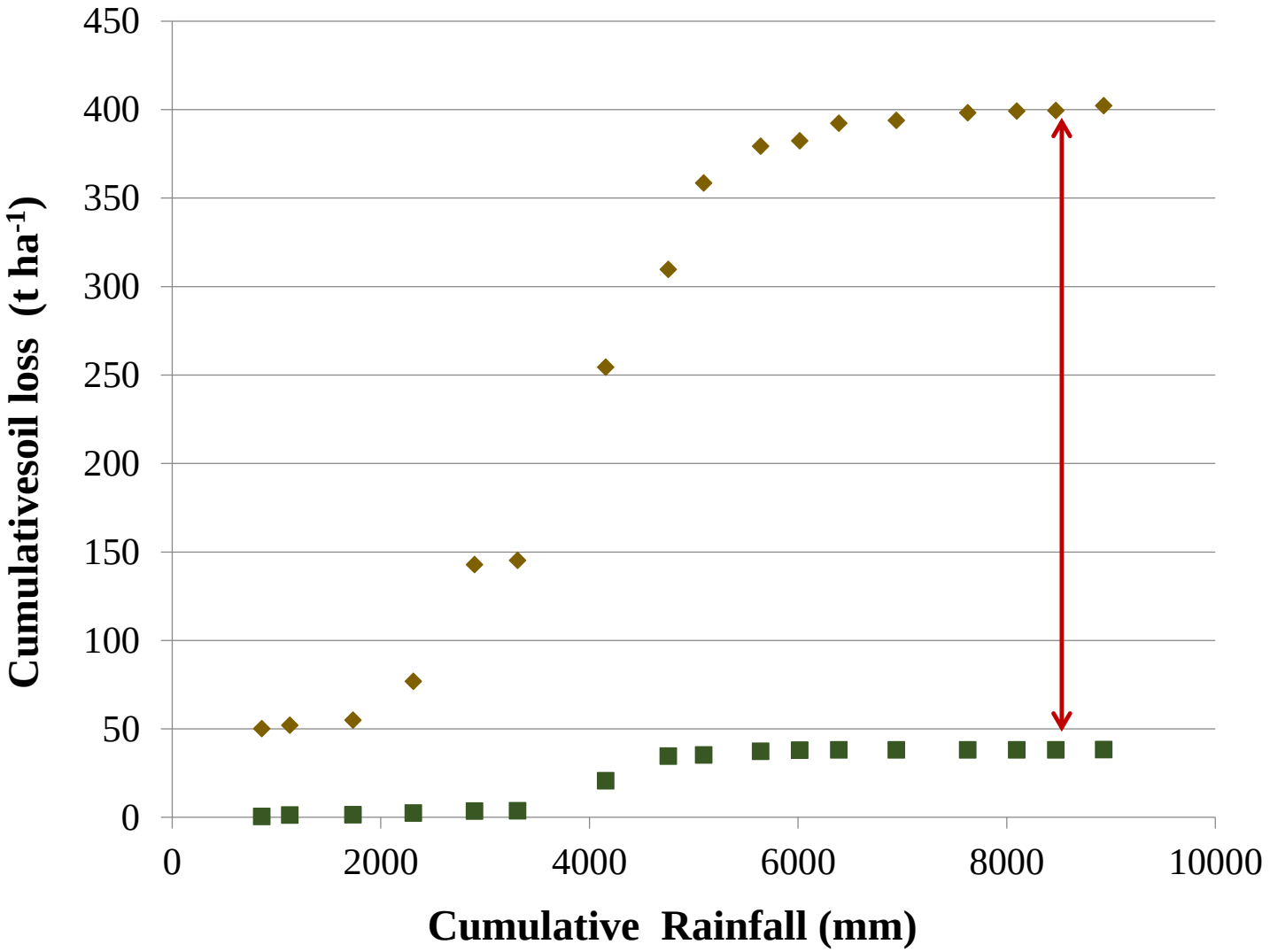
3- Winter

Soil losses

Trend to much lower soil losses in CC but not statistically in several individual years



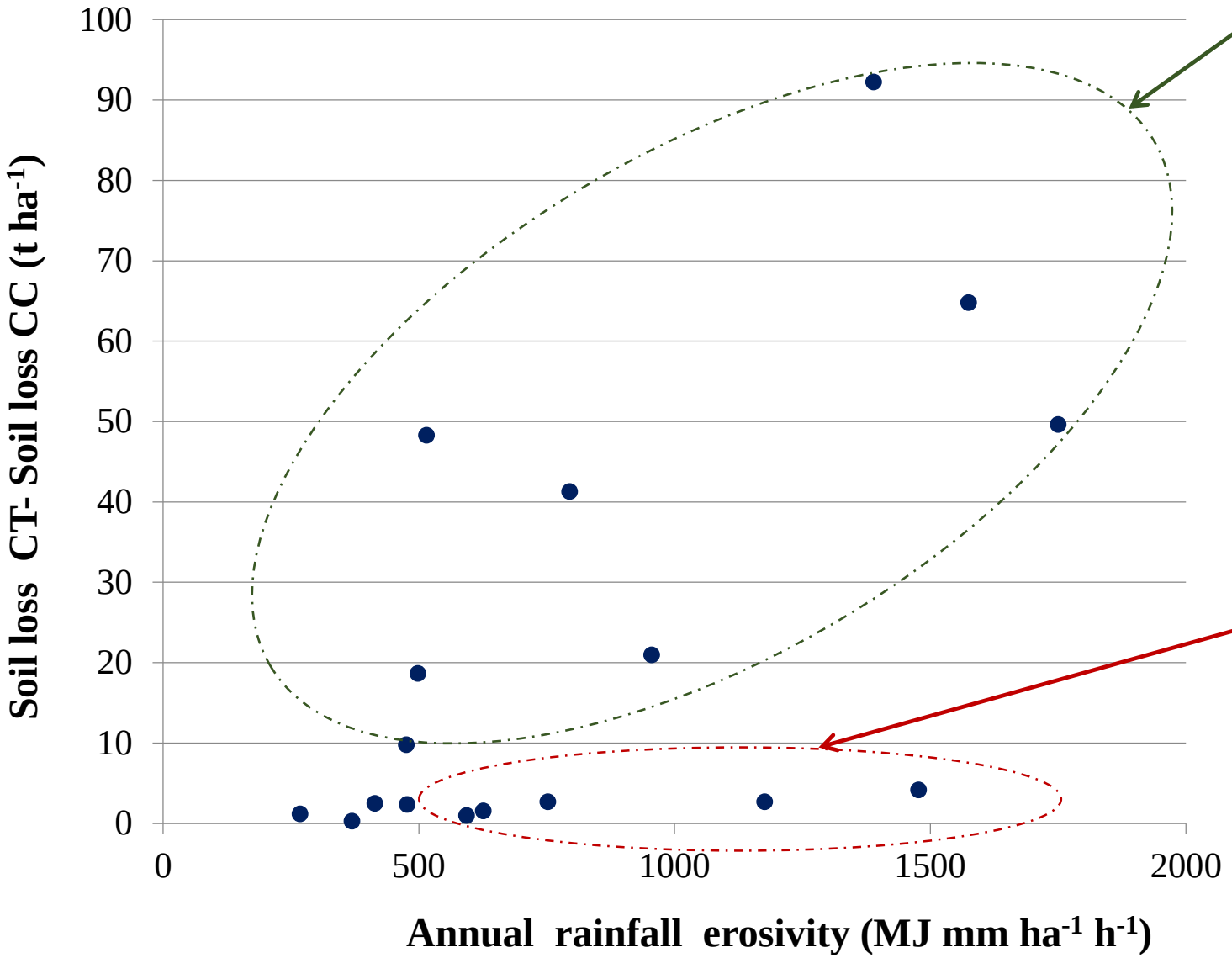
Soil losses



This a 363 t ha^{-1} difference in 17 years

Average:
23.6 vs. 2.5 t ha^{-1} $year^{-1}$

Soil losses

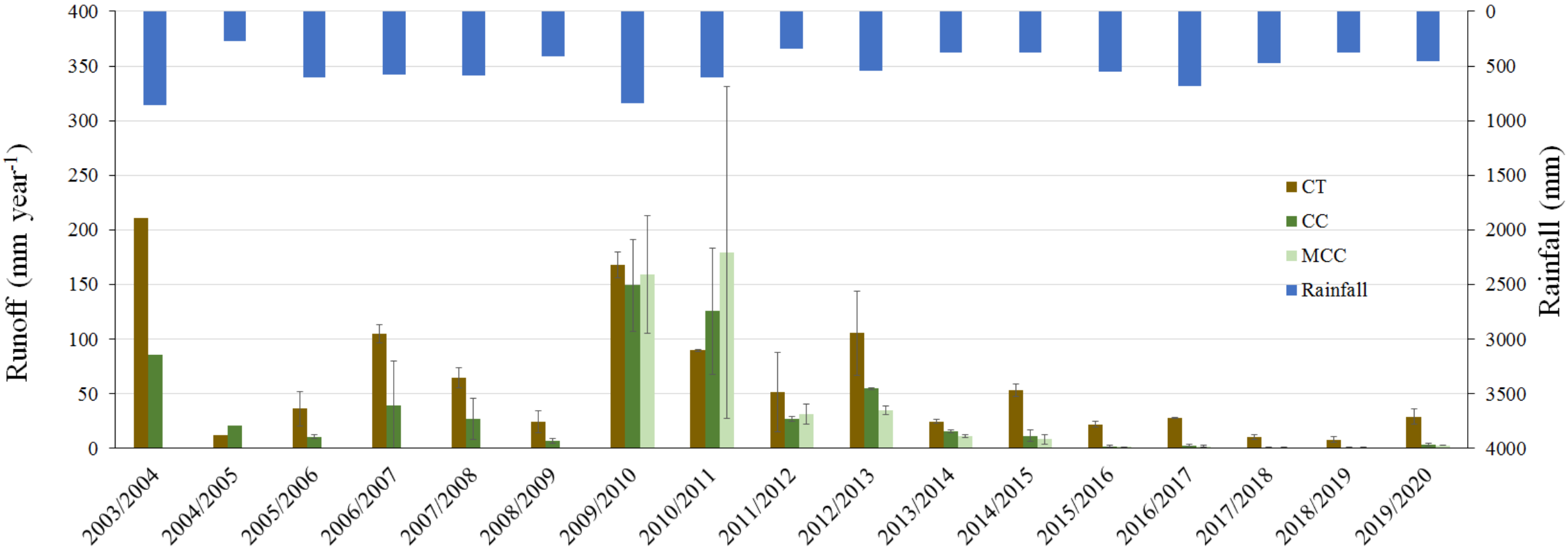


Years with intense precipitation on freshly tilled CT plot.

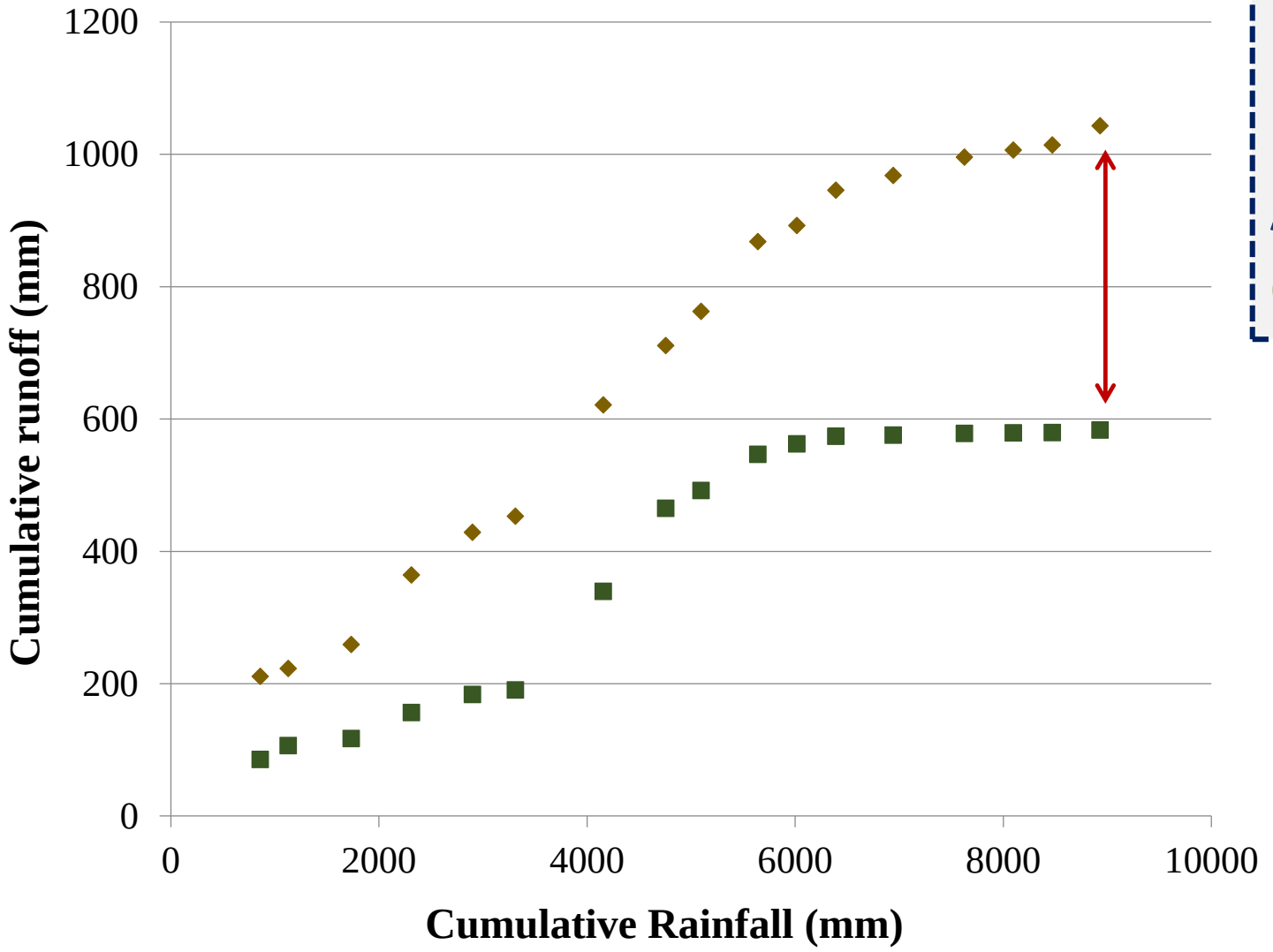
Years with intense precipitation with vegetation cover in the CT treatment, or freshly seeded in the CC.

Runoff losses

Tend to lower values in CC but not statistically significant differences (high variability, limited replications).



Runoff losses



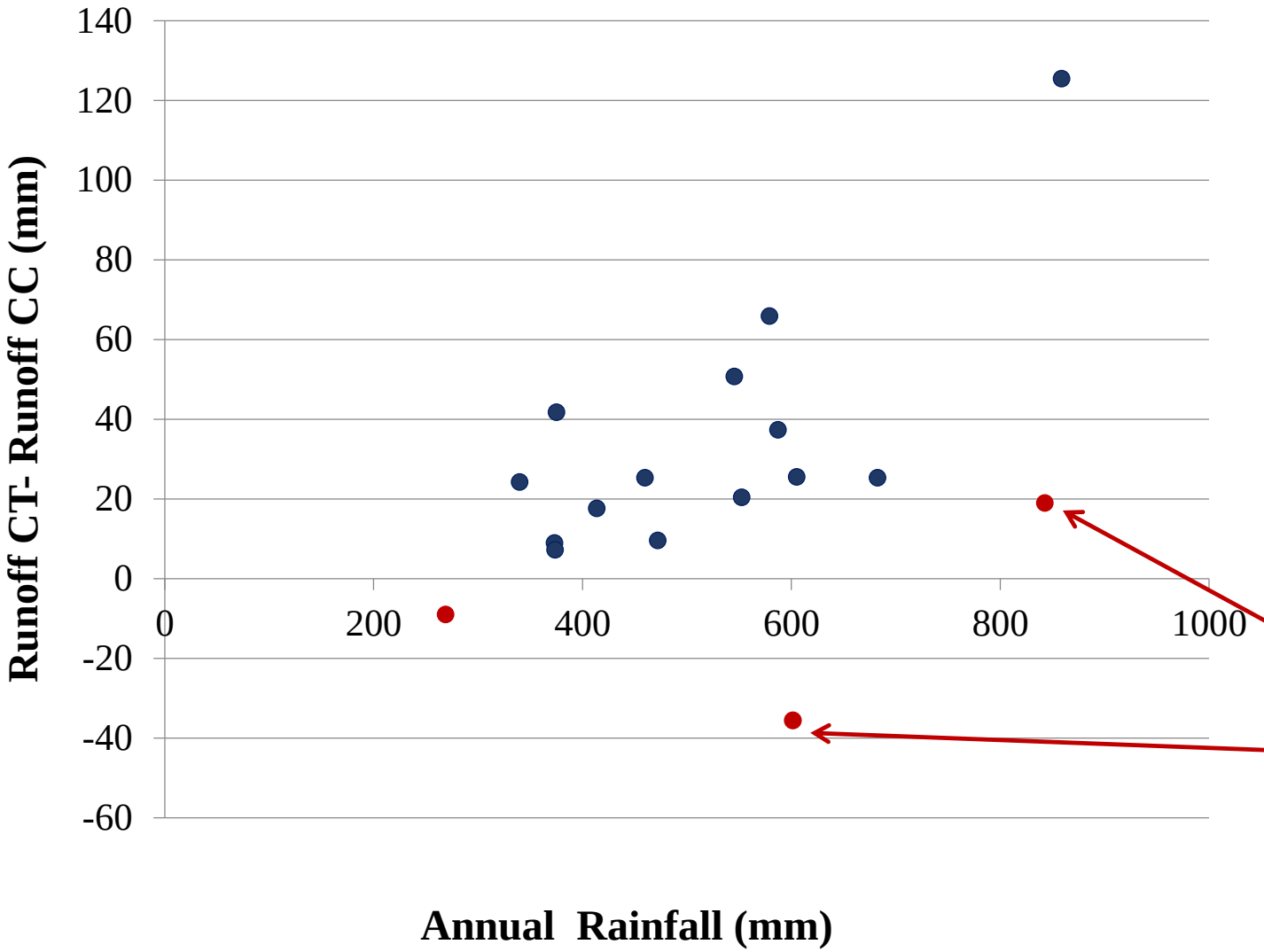
459 mm difference in 17 years, 27 mm year^{-1}

Average.
61.3 vs. 34.3 mm year^{-1}

Average runoff coeff.
10.5 vs. 5.2 %.

Average annual rainfall:
530 mm

Runoff losses

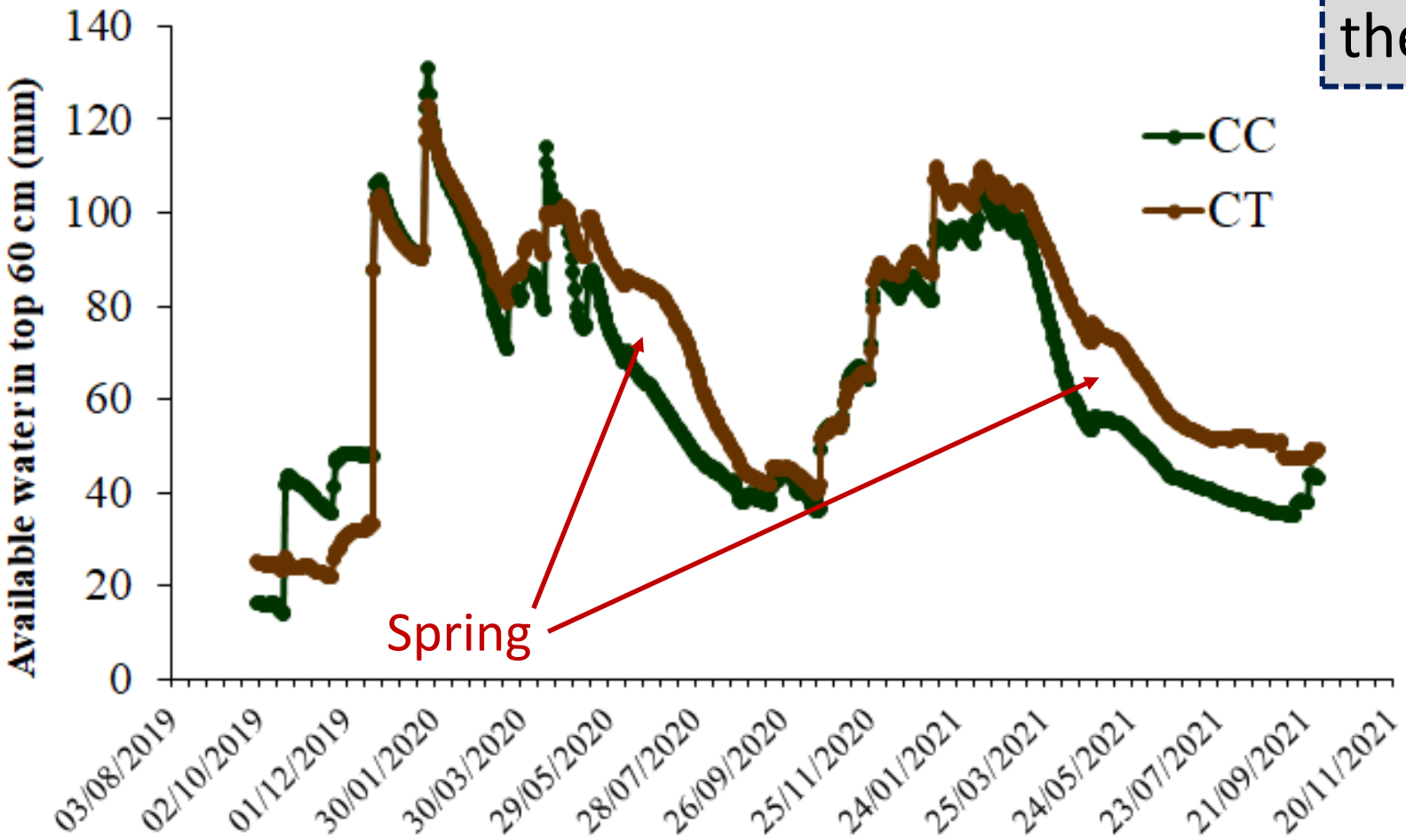


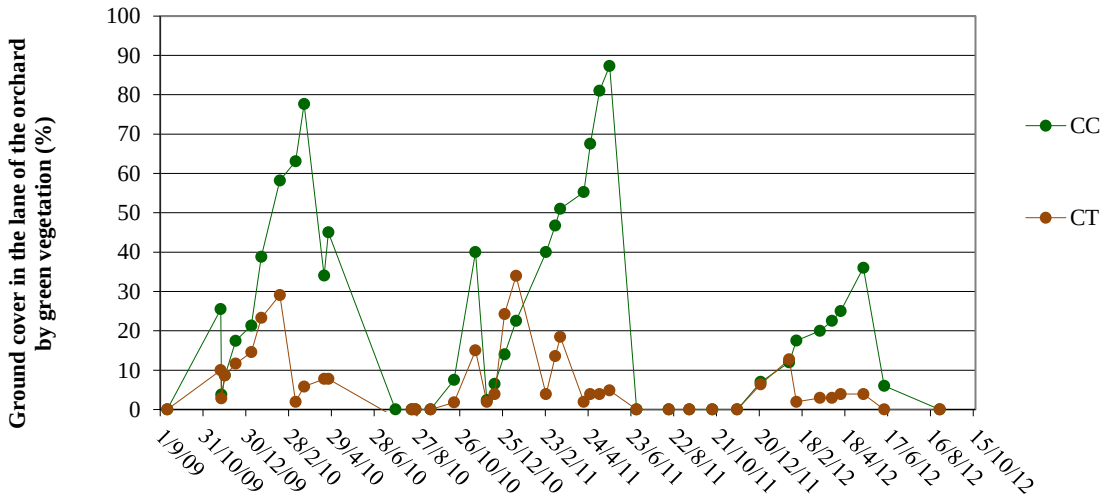
Average of “optimum” 14 year, this is 34.6 mm/year in average.
55.2 vs. 20.5 mm

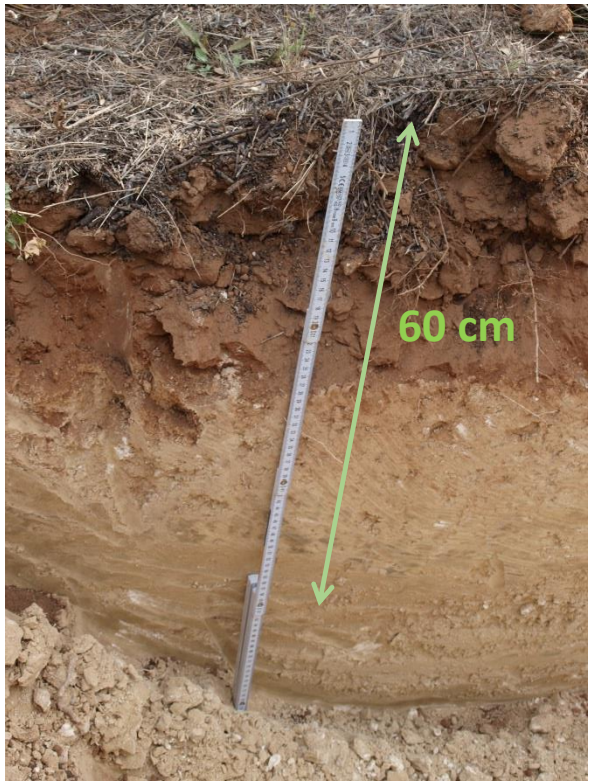
Years with wet fall after seeding CC saturating the soil profile on relatively bare soil.

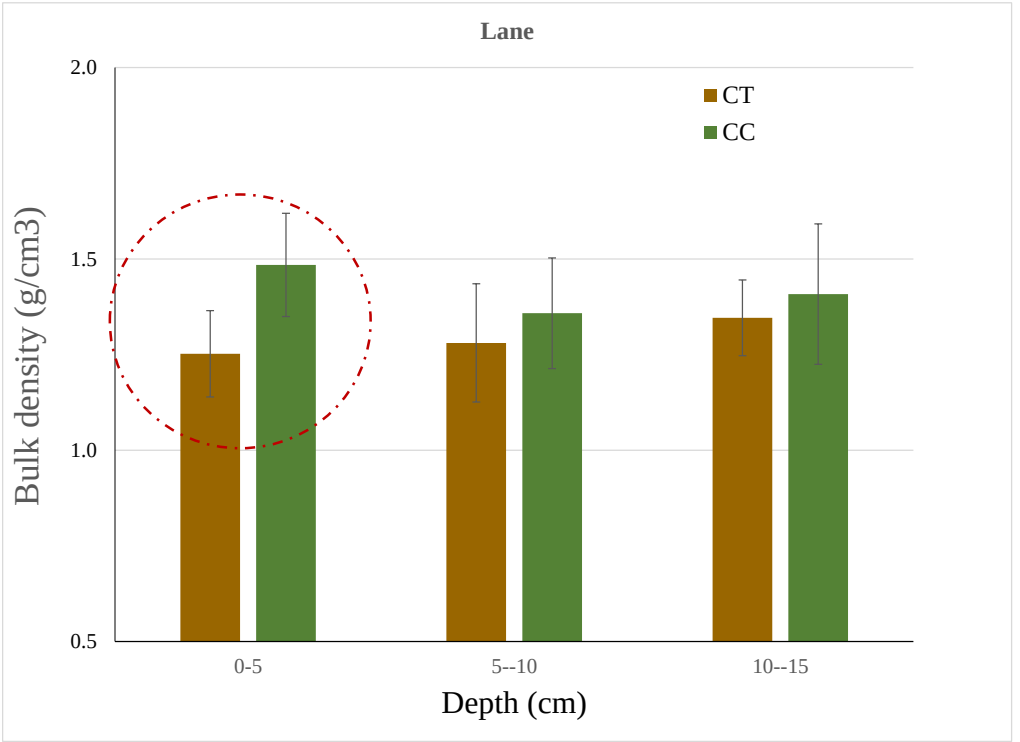
Soil water

Higher water (not much) in some rainy period, differences (CC < CT) after the onset of Spring




Ground cover in the lane of the orchard by green vegetation (%)
100
90
80
70
60
50
40
30
20
10
0
1/9/09
31/10/09
30/12/09
28/2/10
29/4/10
28/6/10
27/8/10
26/10/10
25/12/10
23/2/11
24/4/11
23/6/11
22/8/11
21/10/11
20/12/11
18/2/12
18/4/12
17/6/12
16/8/12
15/10/12
CC
CT


60 cm


Lane
2.0
1.5
1.0
0.5
Bulk density (g/cm3)
CT
CC
0-5
5--10
10--15
Depth (cm)

Conclusions

Impact of **CC** vs **CT** on differences runoff and soil losses at plot scale:

1- **Drastic reduction in soil losses**: 23.6 vs. 2.5 t ha^{-1} $year^{-1}$.

2- **Moderate reduction in runoff losses**: 61.3 vs. 34.3 mm $year^{-1}$.

Consistent with processes at the orchard: evolution of ground cover, soil roughness, infiltration plus shallow soil depth and mosaic pattern distribution of soil properties.

CC shows a decrease in water as compared to **CT** as Spring progress. *Which it **not relevant for this farm** because is (deficit) irrigated, and oriented for high caliber table olives (they induce lower yields by pruning), but a* **key point for dissemination among farms**.

The **scale, duration, and possibility of accommodating farm operations** into the farm (particularly traffic) provided some insight, and allowed a fair evaluation similar to situation in commercial farms.

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Thank you!

SHui

Judi

Open Data Platforms for sharing long-term data on agricultural production, crop yield, soil properties, soil quality, water quality, and weather reflecting the climatic and cropping diversity within both Europe and China.

Sharing is encouraged

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