Organic carbon storage in native and irrigated cropland soils in California

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Introduction

v Irrigated cropland in California accounted for about 9 million acres in 1995.

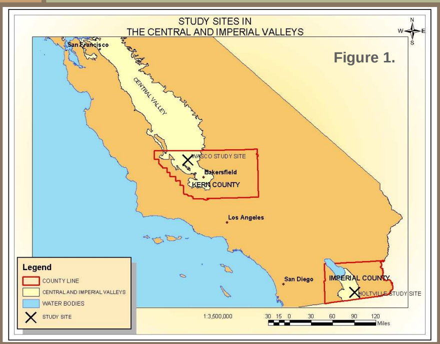
v The conversion of native lands to irrigated cropland affects organic matter dynamics and storage by changing the vegetative cover, inputs of organic materials, and soil moisture and nutrient content.

v Irrigated soils have been shown to both increase and decrease the total soil organic carbon content compared to the native soil (pre-cultivated conditions).

v It is not clear how the conversion of native land to irrigated cropland has affected organic carbon storage and dynamics in arid-zone soils within California.

Study sites

v Two areas were chosen for sampling: near Wasco in the San Joaquin Valley and near Holtville in the Imperial Valley (Figure 1).



v San Joaquin Valley Soil samples were from 4 sites: a native site and 3 sites that were cultivated for either 10, 20, or 30 yrs.

v Imperial Valley Soil samples were from 3 sites: a native site and 2 sites that were cultivated for either 50 or 90 yrs.

v Within each site, samples were taken from 5 locations (replicates) at four depths.

v Climate data for the study areas:

Site Location	Mean annual Precipitation	ET	Temp (max,min)
Wasco, San Joaquin Valley	172 mm	147 mm	26, 9.7 °C
Holtville, Imperial Valley	65 mm	182 mm	31, 15 °C

Figure 2. Native site near Holtville, Imperial Valley, CA.

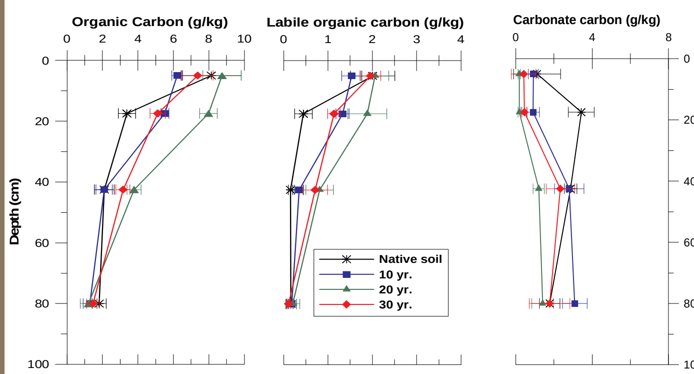
Figure 3. Cropland site that has been cultivated/irrigated for approximately 50 years near Holtville, Imperial Valley, CA.

Objective

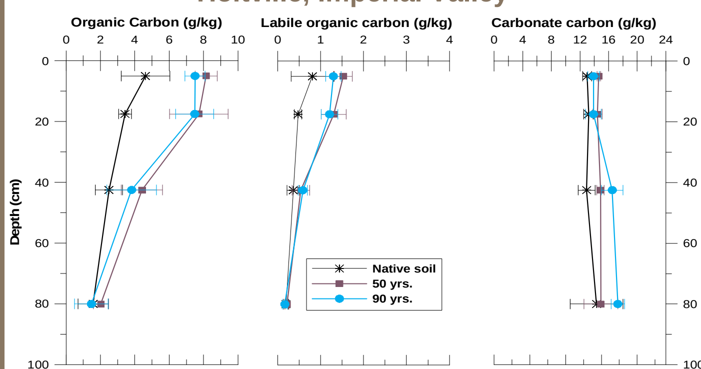
To gain insight into changes in carbon storage in native soils and cropland soils under various management systems

Results

Wasco, San Joaquin Valley



Holtville, Imperial Valley



Results

v San Joaquin Valley sites:

w Conversion from native to irrigated agriculture (10 to 30 yrs) does not appear to affect the organic carbon (OC) and labile organic carbon (LOC) contents of the 0-10 cm and 60-100 cm depths

w An increase in OC and LOC content is observed in the cropland soil samples compared to the native soil samples at the 10-25 and 25-60 cm depths

w The 20 yr site contains the greatest content of OC at the 10-25 cm depth and the highest OC content average from 0-60 cm compared to the other sites.

v Imperial Valley sites:

w No significant differences between OC and LOC content of soil samples from 50 and 90 yrs sites throughout 0 to 100 cm depths

w Conversion from native to irrigated agriculture appears to increase the OC content of the cropland soils from 0 to 60 cm and the LOC content from 10 to 25 cm.

v Both sites:

w Greatest change in OC and LOC content from native to irrigated agriculture sites is at the 10-25 cm depth

w Soil samples from Imperial Valley have a higher content of carbonates than the soils from the San Joaquin Valley.

Conclusions

v Preliminary research indicates that irrigated agriculture increases the soil OC content in the upper soils profiles (0 to 60 cm). Deeper in the soil profile, however, the total OC content is essentially the same in native and in irrigated soils for both sites.

v Irrigated agriculture also increases the labile OC in the upper soil profiles for both sites. Cultivation length does not seem to have a significant effect on labile OC content.

v Future research is needed to compare OC dynamics in native and irrigated soils.

Research in Progress

v To gain insight into OC dynamics we will use:

w carbon-13 nuclear magnetic resonance (C^{13} NMR) spectroscopy analyses of bulk soil samples to understand organic matter transformation process with soil depth and with increasing time of cultivation; and

w total OC and ^{13}C isotopic measurements on soil physical fractions (i.e. sand, silt, and clay size fractions) to understand mechanisms of OC storage.