Determining N and C budgets for alternative cover crop mixtures and management in a conservation tillage, tomato-corn system

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Introduction

▶ Conventional California cropping systems utilize intensive tillage operations that keep production costs high, generate significant dust, increase wind and water erosion, and reduce soil organic matter contents.

▶ The resulting loss in soil C and N offsets gains in crop C and N sequestration and contributes to rising greenhouse gas levels.

▶ Recent efforts in conservation tillage (CT) research have been aimed at reducing tillage costs, protecting air, water, and soil quality, increasing the rate and duration of soil C storage, and tightening the N cycle.

▶ Little information exists on strategies to maximize cover crop contributions to soil fertility, C and N sequestration, and weed suppression in California CT systems.

Objectives

▶ To examine and compare the compatibility of novel inter-cover crop mixtures and management strategies with a low-input, irrigated, CT tomato-corn rotation.

▶ To determine the effect of seasonal differences in cover cropping on C sequestration, N-fixation, N turnover, and synchronization of N availability with corn N demands.

Experimental Site

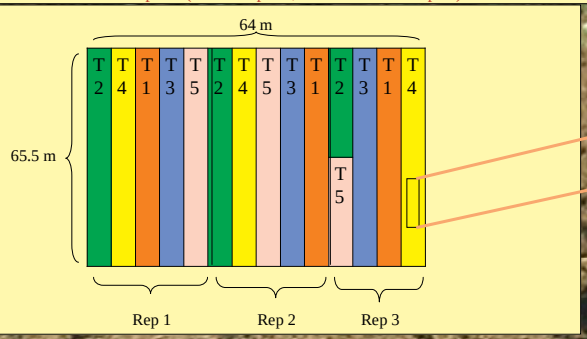
§ LTRAS/SAFS north plots – companion studies area

§ Site had 10 year oat/fallow history until tomatoes planted in 2003

§ 0.42 hectares (65.5m x 64m), 42 beds, 1.5m/bed

§ 5 treatments, 3 reps, 15 plots, 3 beds/plot

§ ^{15}N labeled microplots (24 microplots, 3m x 1.5m/microplot)



Treatments

- T1– Lana vetch seeded in mid-late October
- T2 – Sorghum-sudan, lablab, cowpea seeded in late August, minimal irrigation
- T3 – Sorghum-sudan, lablab, cowpea, lana vetch seeded in late August, minimal irrigation
- T4 – Sorghum-sudan, lablab, cowpea seeded in late August, minimal irrigation, and overseeding of lana vetch in mid-late October
- T5 – Fallow (no cover crop between the tomato and corn crops)

Plant Sampling

▶ Sample ^{15}N labeled cover crop microplots ($4.5m^2$) to measure N-fixation and total C and N input.

▶ Transfer labeled cover crop residue to uncontaminated microplot before corn planting (see Fig 1); destructively sample corn plants at 4 key points along corn N uptake curve to determine cover crop derived N content (see Fig 2)

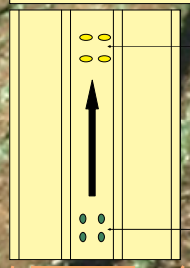


Figure 1

Soil Sampling

▶ 6 soil (0-15cm) sampling dates– 1 late-summer, 1 winter, 4 in spring to coincide with destructive corn and CO_2/N_2O sampling

▶ Measure microbial biomass C and ^{15}N

▶ Soil fractionation to determine the cycling of labile C and ^{15}N (e.g. particulate organic C and ^{15}N pools)

CO_2 and N_2O Sampling

▶ 6 sampling dates – 1 late-summer, 1 winter, 4 in spring to coincide with destructive corn and soil sampling

▶ Chambers will be set in soil to trap emissions for 30 minutes

▶ Head space samples will be analyzed for CO_2 and N_2O with a GC

Progress to Date

Pre-harvest tomato stand

Mowing tomato biomass and raking residue from furrows back onto bed tops

Cover crop stand 2 weeks after seeding

4.5m no-till John Deere drill seeding 7 rows of cover crop per bed

Integration of Plant, Soil, and Gas Data to Gain a Better Understanding of Complete C and N Cycling in Cover Crop CT Systems

Measure tomato biomass C and N, and soil C and N at harvest

In cover crop microplots measure cover crop N-fixation, ^{15}N, and C, soil C and N, and CO_2/N_2O emissions during cover crop growth and at winter kill

Plant growth

Soil organic matter

Microbial biomass

Emissions

In corn microplots samples of corn, soil, microbial biomass, and soil emissions will be taken simultaneously to determine their cover crop derived ^{15}N contents and C levels at 4 key points along a standard corn N uptake curve (see Fig 2 below)

4 Key Sampling Points

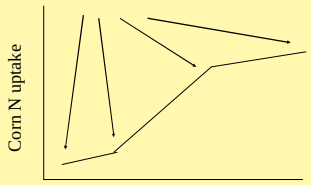


Figure 2