Investigating the Water-related Impacts of Winter Cover Cropping and Residues on Specialty Crops in the Central Valley of California

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Context

Although the use of cover crops has become a common floor management practice in several agricultural production areas of California, information about major effects of winter cover cropping on water use and water productivity of orchards and vineyards is very limited, but is crucial to inform growers' decisions in water-limited areas.

Winter cover cropping is among the soil management practices that are being incentivized by public agencies to improve soil health and mitigate climate change via climate-smart incentives and programs.

Some studies have documented beneficial effects of cover crops on rhizosphere ecology, but little information is available on how winter cover cropping affects radiation dynamics and partition, actual evapotranspiration, soil-plant-water relations, water use efficiency, and water productivity in micro-irrigated wine-grape vineyards and nut orchards.

Most wine-grape growers seek more water-efficient production practices and techniques to monitor and manage vine health and water stress for the proper combination of grapes tonnage and quality under the prospect of increasingly limited and costly water supplies in the future, due to enviornmental regulations (SGMA) and to the increasing weather variability.

In the water-limited San Joaquin Valley, specific questions are raised by specialty crop growers about the water amounts necessary to establish and maintain winter cover crops, and whether cover cropping can lead to water productivity gains.

Objectives

Through this project, we will to collect, analyze, and outreach comparative bio-physical information to document the effects that winter cover cropping and inactive vegetation residues have on actual crop evapotranspiration, radiation dynamics, and soil-plant-water relations for micro-irrigated wine-grape vineyards and nut orchards.

Specifically, the project team will collect field measurements to:

1) determine the actual water use (ET) of the cover cropped area relative to the clean-cultivated area during the winter and early-spring months;
2) quantify the differences in actual ET, energy balance parameters, the partitioning of down-welling and up-welling radiation into photosynthetically active (PAR) and near-infrared (NIR) components in the cover-cropped and clean-cultivated vineyard block durings spring and summer;
3) appraise if the winter cover cropping leads to water productivity (Yield/ET) gains due to increase in grape production/quality versus evapotranspiration;
4) Evaluate the inaccuracy and errors of satellite remote sensing-based estimation of ET versus ground-based measurement of ET in cover-cropped and clean-cultivated vineyards during spring vs. summer.

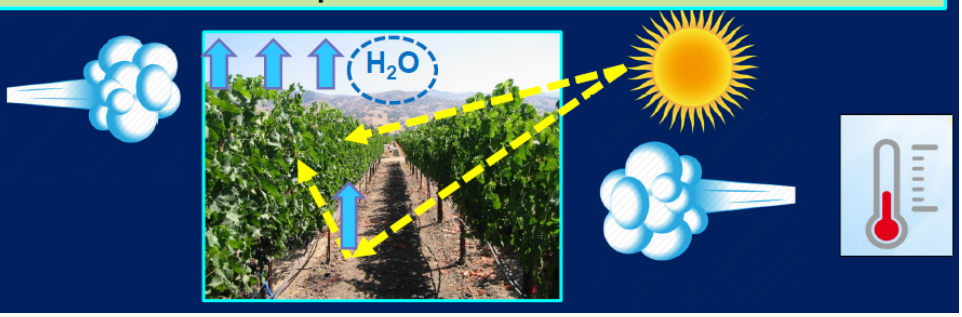
ET IS AN ENERGY-DEPENDENT PROCESS

Evapotranspiration (ET) is the transfer of water from the plant to the atmosphere

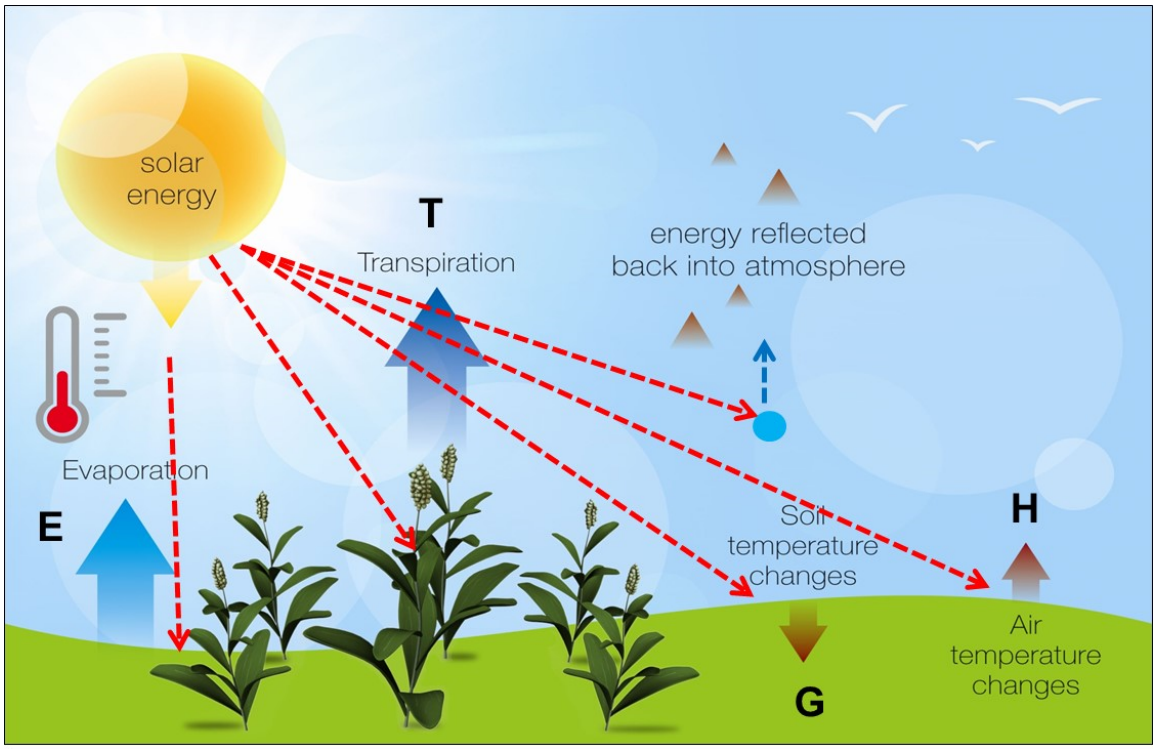
This water transfer brings nutrients & CO_2 to plant tissues and regulates the Temp.

- ✓ **ET is driven by the amount of energy intercepted by plants' canopy**
- ✓ **The canopy encounters this energy as direct radiation from the sun, and indirect energy sources** (reflected/scattered radiation, warm air, wind, advection)

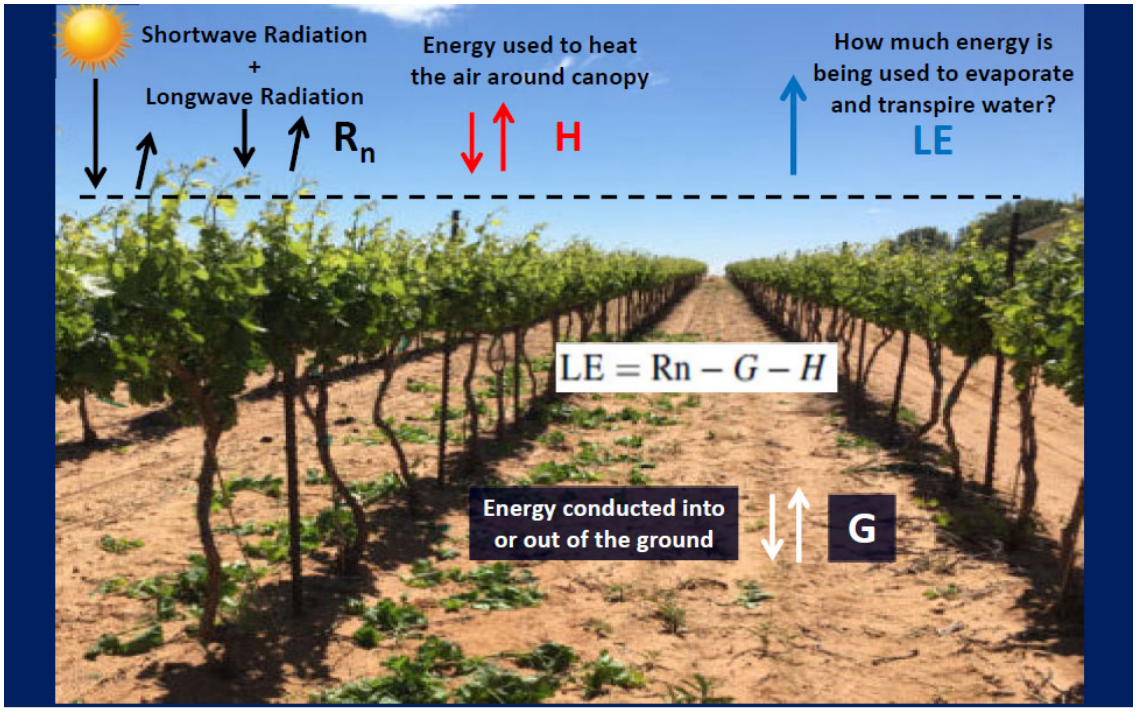
The combined effect of these direct & indirect energy sources on the plants' canopy determines soil Ev. and plant Tr. when soil moisture is not limited.



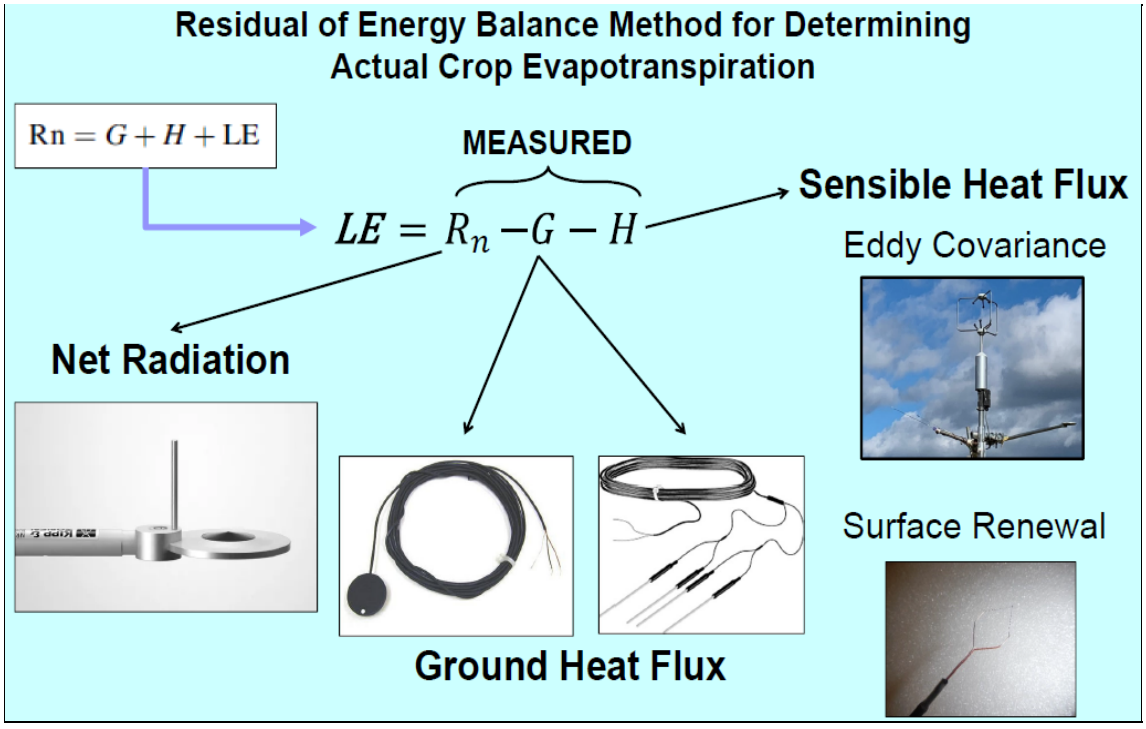
SOLAR RADIATION IS THE MAIN ENERGY SOURCE FOR CROP ET



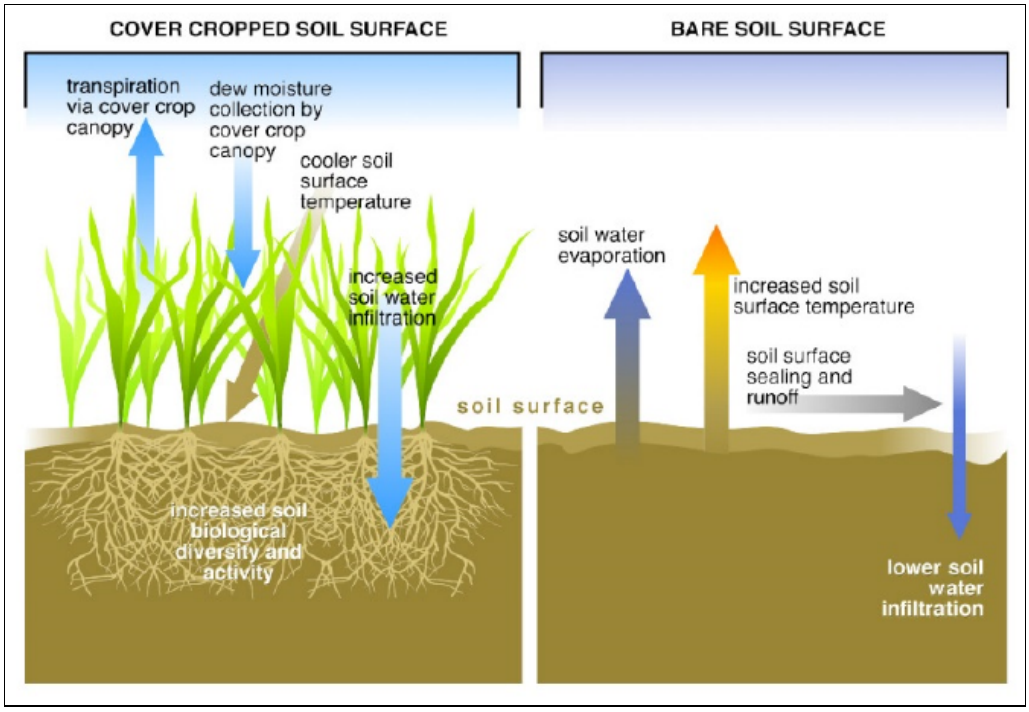
HOW WE DETERMINE FIELD-SPECIFIC ET?



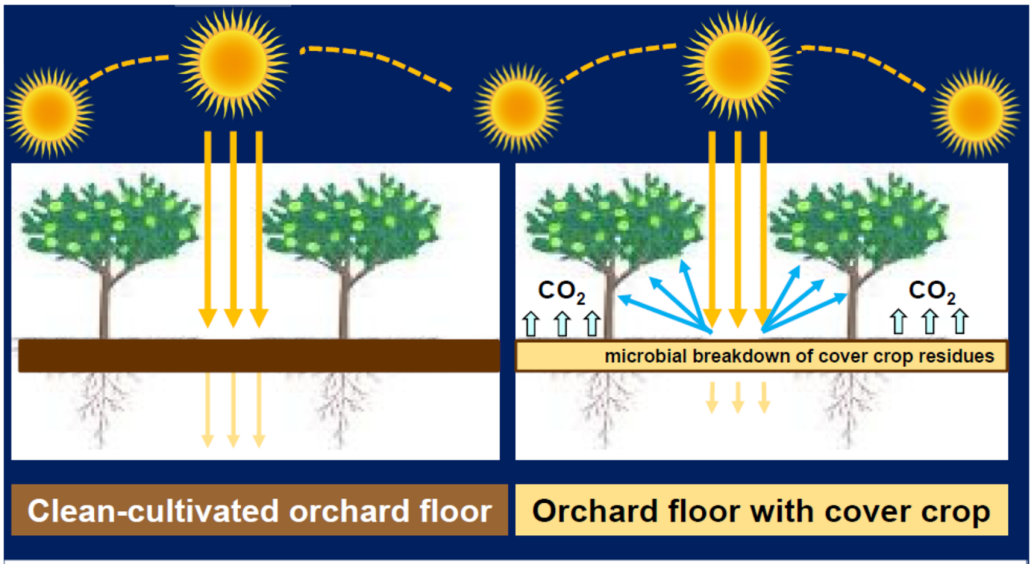
FIEL EQUIPMENT TO MEASURE ACTUAL ET



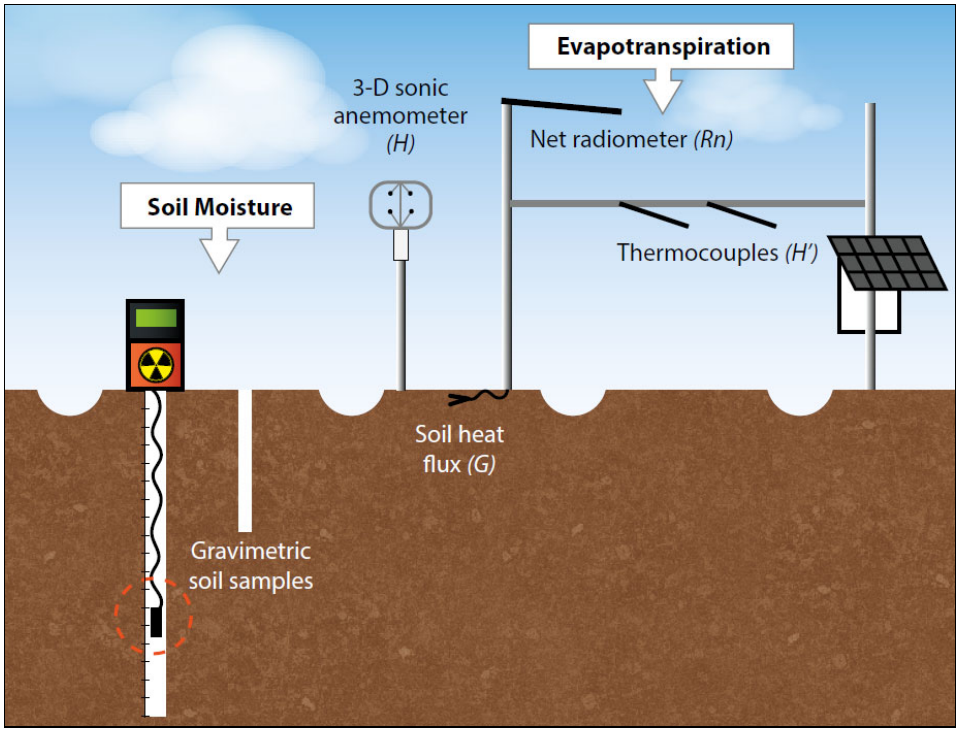
POSSIBLE MECHANISMS FOR ENHANCED SOIL-WATER DYNAMICS IN COVER CROPPED VS. FALLOW SYSTEMS



RESULTS OBTAINIED MEASURING INCOMING AND OUTCOING ENERGY IN PISTACHIO ORCHARDS WITH COVER CROPS AND CLEAN-CULTIVATED FLOOR



Study orchard	Orchard floor management	Incoming short-wave radiation	Outgoing short-wave radiation	Incoming long-wave radiation	Outgoing long-wave radiation	Net radiation	Albedo
Coalinga	Cover crop	60,953	9,620	105,231	137,640	18,924	0.16
Hanford	Clean-cultivated	54,682	7,187	111,838	142,289	17,044	0.13



RESEARCH ARTICLE

Impacts of winter cover cropping on soil moisture and evapotranspiration in California's specialty crop fields may be minimal during winter months

Results from a 3-year study suggest that processing tomato and almond growers can adopt winter cover cropping without changing irrigation practices.

by Alyssa DeVincentis, Samuel Sandoval Solis, Sloane Rice, Daniele Zaccaria, Richard Snyder, Mahesh Maskey, Anna Gomes, Amélie Gaudin and Jeffrey Mitchell

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Research article

Using cost-benefit analysis to understand adoption of winter cover cropping in California's specialty crop systems

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TAKE-HOME MESSAGES

- ✓ The water-related impact of winter cover cropping on soil moisture may be insignificant during winter months
- ✓ Results from earlier studies suggest that winter cover crops in the Central and San Joaquin valleys may break even in terms of actual consumptive water use.
- ✓ The evapo-transpirative losses due to winter cover crops were negligible relative to clean-cultivated soil (< 1 in. and < 10% of seasonal ETc)
- ✓ Water infiltration and storage in the soil root zone in cover cropped grounds are usually larger than in clean-cultivated grounds
- ✓ Soil oxygen concentration and diffusion rate in cover cropped grounds may be higher than in clean-cultivated grounds
- ✓ The soil-water benefits resulting from cover crops usually offset the extra water losses due to increased ET (in dry winters).