Development and Testing of a Mobile Platform for Measuring Canopy Light Interception and Water Stress in Almond

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Introduction:

Data collected by the authors over the past several years has provided a rough upper limit to productivity in walnut and almond based on the percentage of the available midday canopy photosynthetically active radiation (PAR) that is intercepted (Fig. 1). However, most of the data

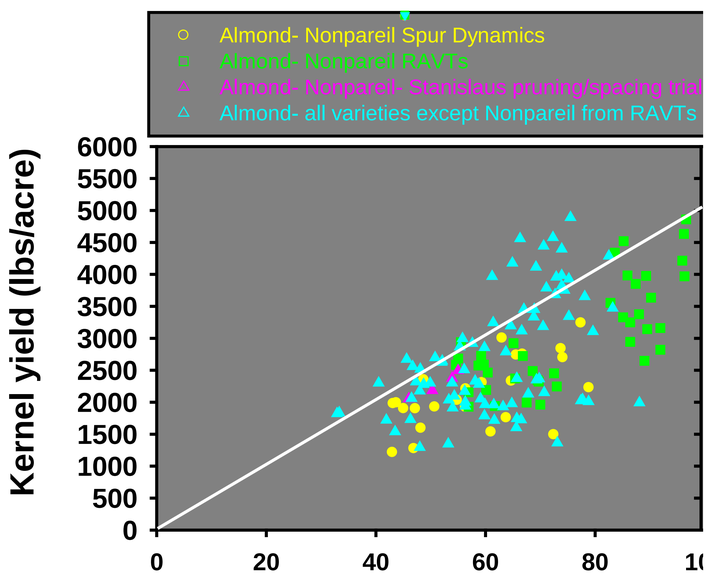

Fig. 1. Relationship between midday canopy light interception and yield for various almond trials.

that was collected previously had limitations due to the difficulty in collecting light interception data with a hand lightbar. The accuracy of the data in the above figure is variable since the area for the yield and PAR interception data often did not match (i.e. PAR data from 5 trees and yield data from either one tree or from an entire row).

We have recently outfitted a mobile platform (Kawasaki Mule) with the 2nd generation light bar that is able to measure light across an entire row (up to 32 feet wide). The photo below shows the 2nd generation mobile platform and lists some of the equipment included.

Objectives:

Objective 1) Updating the second generation mobile platform with a more secure and adjustable structure, updating positioning system (with improved GPS) and working with sensors designed to detect water stress.

Objective 2) Use the mobile platform mounted lightbar to measure light interception and relate that to yield data from the same area in almond orchards throughout the almond growing area of California. The goal of this aspect of the work is to help establish the upper limit to the light interception/yield relationship for almond (shown in **Fig. 1**).

Materials and methods

Objective 1- Retrofitting of the Kawasaki mule with the 2nd generation of the lightbar set up was completed in the spring of 2011.

Objective 2- Sites were selected across the almond growing area of California for studying the light interception yield relationship. An attempt was made to get sites that were relatively productive for their age and where ever possible, sites were utilized that were parts of other ongoing studies where yield data was already being collected as part of the original study. The sites where the mobile platform was used to collect PAR data are listed in the table below.

Site #	County	Trial	Date mapped
1	Kern	Spur Dynamics	06/08/11
2	Kern	McFarland Variety trial	06/10/11
3	Madera	Paramount New Columbia main fumigation trial	06/18/11
4	Madera	Madera Growers South	06/19/11
5	Madera	Agriland irrigation trial	06/20/11
6	Colusa	Nickels almond pruning/training trial	06/25/11
7	Madera	Agriland fumigation trial	06/26/11
8	Kern	Belridge spur survival	06/27/11
9	Kern	SCRI-Belridge continuous fertigation	08/28/11
10	Kern	SCRI-Belridge	06/30/11

Site #	County	Trial	Date mapped
11	Madera	Paramount New Columbia fumigation/irrigation trial	07/04/11
12	Colusa	Nickels organic almond	07/07/11
13	Colusa	Nickels almond rootstock	07/08/11
14	Colusa	Shackel almond deficit trial	07/18/11
15	Stanislaus	Duncan almond pruning, spacing and training trial	07/22/11
16	Glenn	Erickson	07/31/11
17	Colusa	LeGrande Freshwater orchard	08/08/11
18	Colusa	LeGrande	08/09/11
19	Merced	Browne Frago trial	08/31/11

Preliminary results

The program for processing the mobile platform data generates an aerial image of the site showing the rows where data was taken. Data from the Shackel deficit irrigation trial at Nickels Soil Laboratory (Site #14 in table above) are shown in Fig. 2 and 3. Data for the left and right side of the mobile platform light bar can be separated to look at data for the Nonpareil and pollenizer rows separately.

Fig. 2. Aerial image of Shackel deficit irrigation trial mapped with the mobile lightbar. Numbers on image represent points at which full sun and GPS readings were taken.

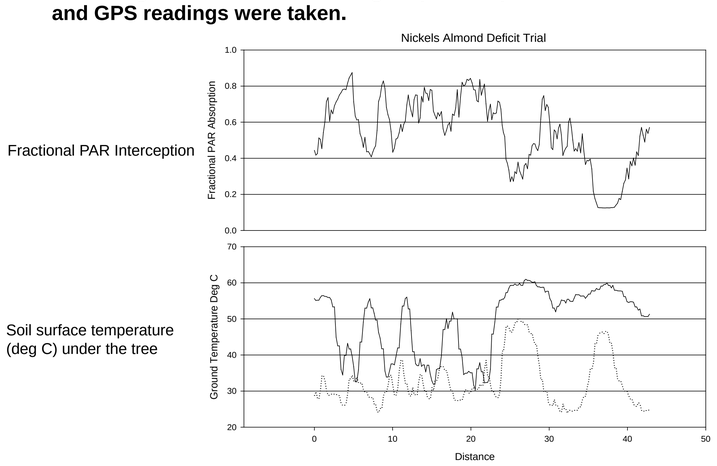

Fig. 3. Fractional photosynthetically active radiation interception for one Nonpareil row in the Nickels deficit irrigation trial (top) and soil surface temperature under the tree row (bottom). Note high soil temperatures where fractional PAR interception is low.

Current and future uses of this technology:

- Investigate light interception/yield relationship (ongoing)
- Adjust treatments for relative canopy area in any type of study such as pruning trials (ongoing)
- Evaluate performance of new cultivars- separate out effect of faster tree growth versus higher productivity per unit canopy light interception (ongoing)
- Investigate role of orchard floor temperature on food safety risk (ongoing)
- Adapt mobile platform for canopy shape/height measurements using LIDAR (ongoing)- preliminary data was collected with the system shown in the photo at lower left
- Adapt mobile platform for measuring canopy temperature for stress investigations (near future)- work on this aspect of the project was reported in the annual project report.

Acknowledgements

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