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

Bruce Lampinen, Greg Browne, Shrini Upadhyaya, Vasu Udompetaikul, David Slaughter, Sam Metcalf, Bill Stewart, Loreto Contador, Joe Connell, Carolyn DeBuse, Roger Duncan, John Edstrom, Elizabeth Fichtner, Brent Holtz, Bill Krueger, and Franz Neiderholtzer

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

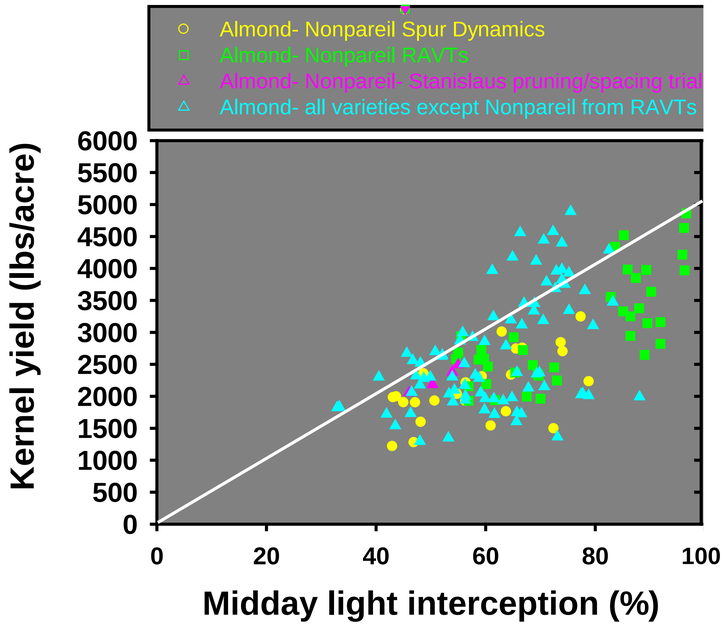

Fig. 1. Relationship between midday canopy light interception and yield for various almond trials. Data is from Mule light bar platform.

that was used to generate the upper limit line had limitations due to the difficulty in collecting light interception data with a hand lightbar.

We have outfitted a mobile platform (Kawaski Mule) with a light bar that is able to measure light across an entire row (up to 28 feet wide). The photo below shows the mobile platform and lists the equipment included. The data points in Fig. 1 are from the Mule lightbar and they appear to fit the same pattern as the data collected previously with the hand lightbar.

Objectives:

Objective 1) Retrofitting the mobile platform with sensors designed to develop the ability to detect water stress in trees.

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- This objective is currently being pursued as modification of the mobile platform is ongoing and should be completed over the winter of 2010 and 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.

Site #	County	Trial	Date mapped
1	Colusa	SCRI-Arbuckle	07/08/10
2	Colusa	Nickels almond rootstock	07/13/10
3	Colusa	Nickels organic almond	07/12/10
4	Colusa	Nickels almond pruning/training trial	07/12/10
5	Colusa	Shackel almond deficit trial	07/14/10
6	Glenn	Erickson	07/17/10
7	Kern	McFarland Variety trial	07/28/10
8	Kern	SCRI-Belridge	07/21/10
9	Kern	Spur Dynamics	07/24/10
10	Madera	Paramount New Columbia fumigation/irrigation trial	08/16/10
11	Madera	Paramount New Columbia main fumigation trial	08/13/10
12	Madera	Holtz almond Surround trial	08/03/10
13	Madera	Methyl bromide grower south orchard replant site	08/08/10
14	Madera	Agriland	08/05/10
15	Madera	SCRI-Madera	08/04/10
16	Stanislaus	SCRI-Salida	08/09/10
17	Stanislaus	Duncan almond pruning, spacing and training trial	08/22/10
18	Stanislaus	Duncan almond rootstock	08/17/10
19	Sutter	Dejong almond model site	08/24/10
20	Yolo	Martinez (no yield data)	09/14/10

Results

In 2010, the Mule mobile platform was used in the 20 almond orchards shown in the table above. The mobile platform performed well and allowed high resolution mapping of canopy light interception at speeds up to 10 km (6.2 mph). 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 SCRI Arbuckle trial in Colusa County (Site #1 in table above) are shown in Fig. 2 and 3. The mobile platform can be used to look at data from the left and right side of the light bar independently.

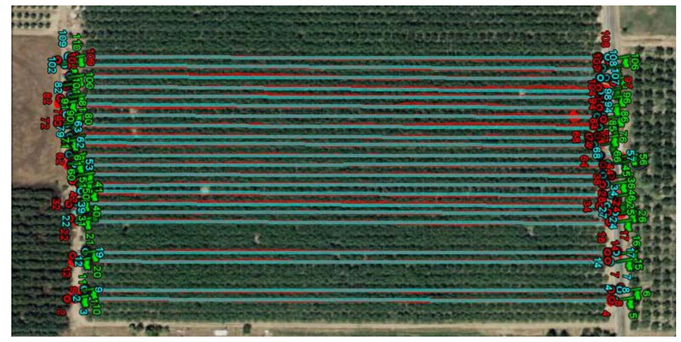

Fig. 2. Aerial image of SCRI Arbuckle almond trial mapped with the mobile lightbar. Numbers on image represent points at which full sun and GPS readings were taken. Blue lines are connecting two full sun reading done outside of orchard for each row and red line is actual GPS trace through orchard.

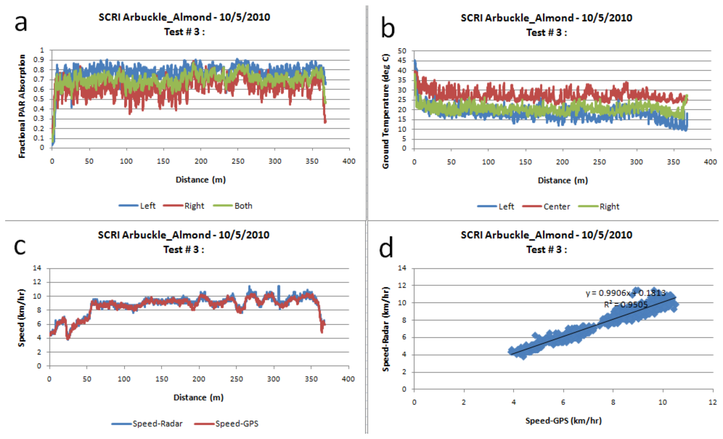

Fig. 3. Fractional photosynthetically active radiation interception (a), soil surface temperature (b), speed as measured by radar and GPS (c), and relationship between GPS and radar speed (d) for one row in the SCRI Arbuckle almond trial.

Uses of this technology in 2009 and 2010

- Investigated light interception/yield relationship
- Adjusted treatments for relative canopy area in studies such as pruning trials
- Evaluated performance of new cultivars- allows separation of effect of faster tree growth versus higher productivity per unit canopy light intercepted
- Investigated role of orchard floor temperature on food safety risk

2011 Goals

- Complete second generation Mule mobile platform (completion will be by spring 2011)
- Add LIDAR and/or 3d camera mapping ability for canopy shape/height measurements
- Adapt mobile platform for measuring canopy temperature for stress investigations (2011)

Acknowledgements

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