USE OF COVER CROPS TO MITIGATE HEAT AT BLOOM

Dani Lightle & Franz Niederholzer

INTRODUCTION

Ongoing production problems related to excessive temperatures during prune bloom have been documented in recent years by Niederholzer and Buchner. Research shows that temperatures greater than 75˚F affect pollen tube growth and viability of a given fertilized flower. Options for protecting against heat are limited, with growers relying on evaporative cooling from sprinkler irrigation (where available) during hot spells to reduce the temperature a degree or two.

In orchards, cover crops are associated with lower temperatures. Sunlight radiating onto bare soil transfers heat into the soil, resulting in higher heat storage during the day and increased heat transfer. However, where cover crops are present, the heat is reflected back upwards, keeping soil temperatures, and consequently air temperatures, cool. The difference in temperature can be striking – comparisons between a 30" cover cropped and bare-ground citrus orchard in the San Joaquin Valley showed that at 5 feet above the orchard floor, cover cropped orchards were measuring 3-4˚C (or 5-7˚F) cooler than the bare-ground control (O'Connell & Snyder 1999).

OBJECTIVE

Evaluate potential of cover crops for reduction of orchard temperatures during bloom and increasing fruit set.

PROCEDURE

Temperatures were measured in two prune orchards in the Sacramento Valley: near Orland, CA (Glenn County) and Yuba City, CA (Sutter County). Both sites were seeded with a mustard mix cover crop seed provided by Project Apis m; however, because of uneven stand development at both sites, the study was moved to sites with tall resident vegetation.

At the Orland site, the study was replicated 3 times. Plots were approximately ¼ acre in size, encompassing 4 middles and a length 15 trees. The resident vegetation was approximately 13"-16" tall. The vegetation in the mowed control was 3" tall. In the center of the plot, a hobo temperature logger with UV shield was installed in the tree row at a height of 5 feet in each mowed and resident vegetation plot. An additional hobo was placed in an adjacent young almond orchard with an established cover crop that measured 5.5' tall. Hobo loggers were set on March 12, 2017 and removed March 28, 2017, and recorded ambient temperature and relative humidity every 5 minutes.

At the Yuba City site, the study was replicated 4 times. Plots were approximately ¼ acre in size, encompassing 4 middles and a length 15 trees. Resident vegetation measured approximately 12-

18 in. tall, while the vegetation in the mowed control was 3 in. tall. In the center of the plot, two hobo temperature loggers with UV shields were installed in the tree row in each plot. One measured temperature at 5 ft and a second measured the temperature at 10 ft above the orchard floor. Hobo loggers were set on March 14, 2017, removed April 7, 2017, and recorded ambient temperature and relative humidity every 5 minutes.

Percent fruit set was measured at both sites. Two branches on trees adjacent to each Hobo temperature logger were selected and the blossoms counted just prior to bloom. In early May, the number of developing fruit was counted. The percent fruit set was calculated by dividing the number of developing fruit by the number of blossoms.

RESULTS AND CONCLUSIONS

At the Yuba City site, there was no difference in temperature or relative humidity measured at 5 ft versus 10 ft (data not shown). There was no difference in temperatures in resident vegetation plots compared to mowed plots at either location (data shown for the Orland site, Figure 1). Lastly, there was no difference in the percent fruit set between resident vegetation and mowed plots in either location (Table 1).

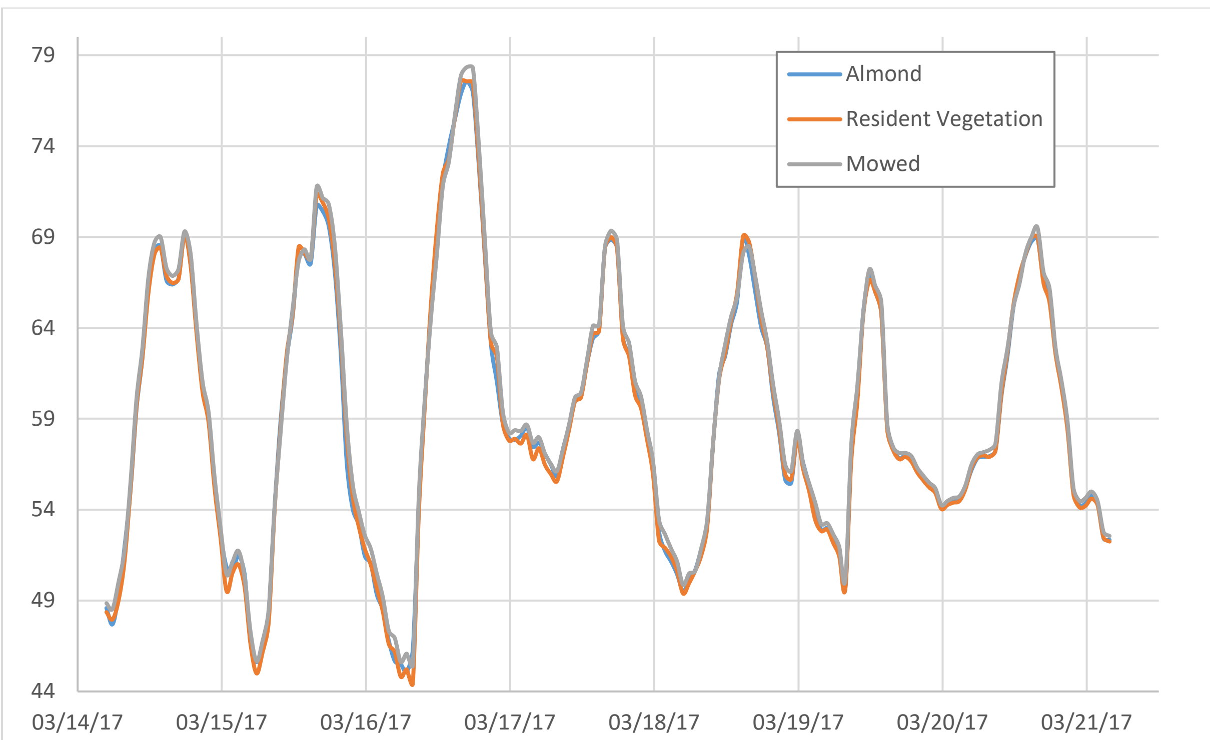

Figure 1. Temperature trace at the Orland site measured at 5 ft height in the tree row. Mowed vegetation was approximately 3 in. tall; resident vegetation was approximately 16 in. tall, and the cover crop in the adjacent almonds was approximately 5.5 ft tall.

Table 1. Percent fruit set at the Orland and Yuba City sites in mowed plots or plots with tall resident vegetation.

Site	Treatment	
	Mowed	Resident Vegetation
Orland	37.1 ± 0.01	38.2 ± 0.03
Yuba City	14.1 ± 2.6	12.3 ± 2.5

One factor that may influence the ambient temperature is the height of the cover crop. This study did not directly look at cover crop height, though in Orland, a Hobo datalogger was placed in an adjacent almond orchard with a 5.5 ft cover crop. The temperatures measured in the almonds were not different from those recorded in the prune orchard (Figure 1). Although the almond temperature data were not replicated, they do provide indirect evidence that a taller cover crop may not have had an effect in this study.

Much of the research on ambient temperature effects in orchards with cover crops has focused on winter night time temperatures and temperature lows. For example, a study conducted in almonds in Chico found that pre-dawn temperatures were colder in orchards with a 2 in. or greater cover crop than in orchards with (chemically mowed) bare soil (Snyder and Connell, 1993). Interestingly, they found that a taller cover crop of 4 in. or 12 in. did not reduce the pre-dawn lows any further than the 2 in. long ground cover did. This further supports our hypothesis that a taller cover crop would not have had an effect on temperatures in this study.

One reason for undertaking this study was the striking decrease in daytime temperatures recorded in a citrus orchard in the San Joaquin valley (O'Connell and Synder 1999). In that study, temperature traces showed that a 30 in. cover cropped orchard had daytime temperatures that were 5-7˚F cooler than the bare-ground control. The main difference between the citrus/almond orchards and our study was the inclusion of a chemically mowed – bare soil control. It may be that having any type of ground cover lowers the daytime orchard temperatures, with no additional cooling associated with a taller ground cover. Consequently, the vast majority of prune growers are already receiving the cooling benefit from their orchard floor management practices and there is little to no additional cooling to be gained.

While there may be many reasons a prune operation may decide to plant a cover crop during the winter and maintain it up to or through the bloom period, we did not record evidence that a taller cover crop will help to mitigate temperatures during the bloom period. Additionally, we did not find evidence that the microclimate within an orchard associated with taller resident vegetation affected fruit set.

BUDGET SUMMARY

Funds for this project were used to purchase Hobo temperature datalogger units, travel to field sites, and salary costs for time spent on the project.