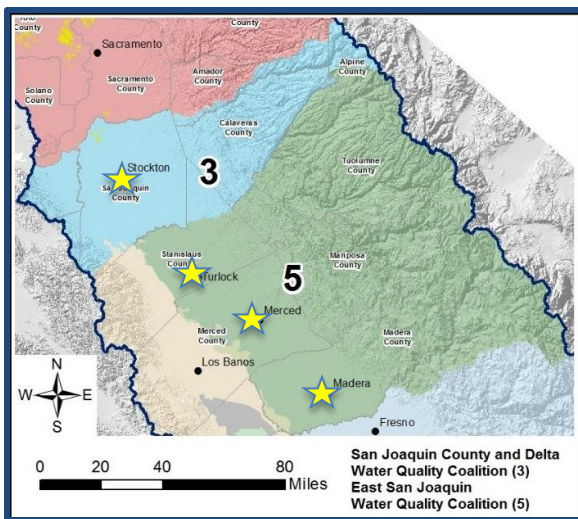


Adoption of Cover Crops in California

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Summary: We are broadening our understanding of the use of cover crops in California to address a necessary research gap related to conservation agriculture. Cover crop adoption rates remain relatively low, despite the multiple benefits cover crops bring to soil health, pest management, weed suppression, and soil-water retention. Thus, investigating what motivates or creates barriers to adoption is key to increasing the use of cover crops across the agricultural landscape. Our project investigated growers' decisions to adopt cover crops, taking into consideration farm characteristics, perceived challenges and benefits, and sources of information.



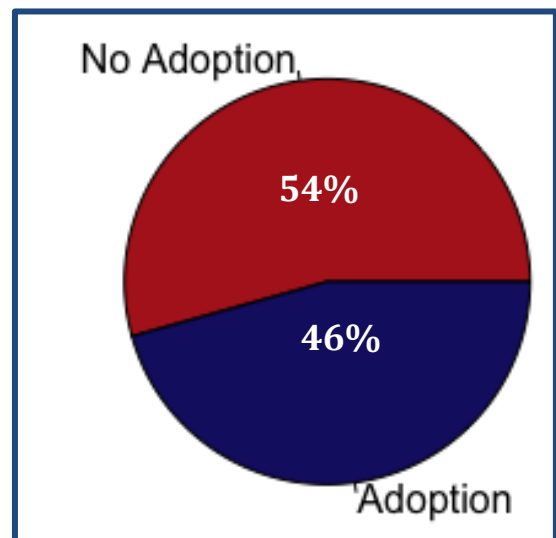
Surveys: We conducted in-person surveys at 7 grower education meetings (marked with stars on map) in the northern San Joaquin Valley during winter 2017. We had a 35% response rate from the growers who attended the meetings, for a total of 565 survey respondents.

- ❖ **Respondents:** 565 (~35% response rate, 461 responded to cover crop adoption question, 46% adopt cover crops)
- ❖ **Crop type:** 346 almond growers (42% adopt cover crops); 41 wine grape growers (49% adopt cover crops); 31 row crop growers (19% adopt cover crops)
- ❖ **Parcel size:** 296 growers have 0-50 acres (43% adopt cover crops); 107 growers have 51-250 acres (53% adopt cover crops)
- ❖ **Land tenure:** 370 land owners (40% adopt cover crops)
- ❖ **Irrigation:** 218 growers use micro-irrigation (36% adopt cover crops); 115 growers use flood (42% adopt cover crops); 41 growers use sprinklers (51% adopt cover crops).

Key Research Findings

- ❖ **46% of survey respondents adopt cover crops. Most adopters perceive no challenges with the practice.**
- ❖ **Growers who choose not to adopt name cost, labor, practice efficacy, and uncertainty as common challenges.**
- ❖ **The most commonly perceived benefits include agronomic benefits to crop yield and quality. Meanwhile, benefits to water use, including water savings and adaptation to drought, were least cited.**
- ❖ **Growers who adopt cover crops more often use multiple information sources, as compared to growers who do not adopt cover crops.**

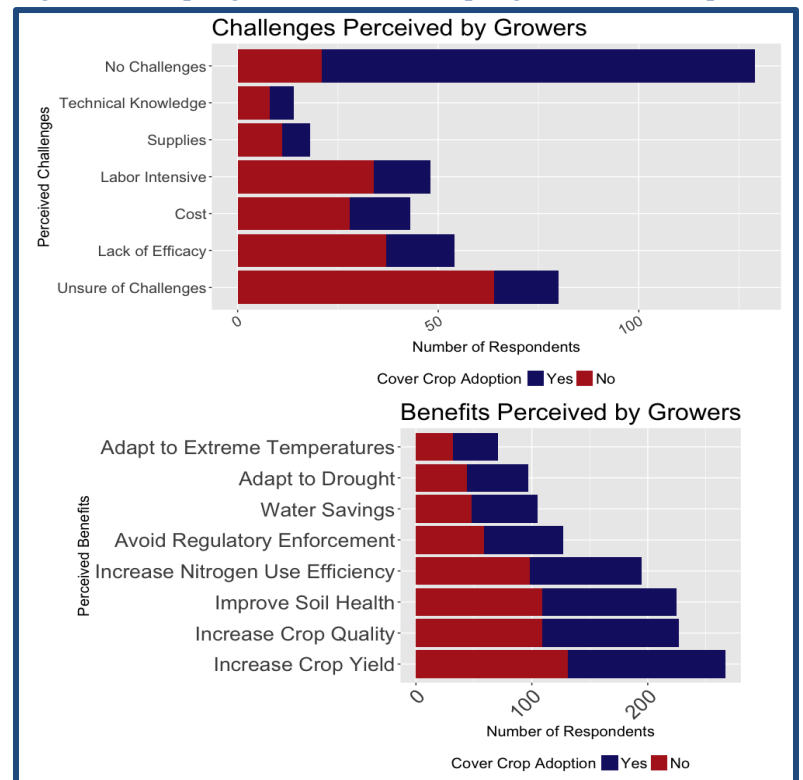
Figure 1: Cover crop adoption of survey respondents



❖ Uncertainty of the challenges is an important barrier to cover crop adoption

59% of growers who adopt cover crop perceive no challenges. In general, respondents that do *not* adopt cover crops perceive a greater number of challenges associated with the practice. These non-adopters make up 58% of those who saw cost as a challenge, 67% of those who saw efficacy as a challenge, and 68% of those who saw labor as a challenge. Interestingly, 77% of those who were unsure of the challenges do not adopt cover crops. This is perhaps the most important perceived challenge. We hypothesize that this uncertainty may stem from multiple sources, including: growers thinking cover crops will affect their cash crop, a perceived lack of efficacy in that cover crops may not bring the expected benefits, and the potential impacts of cover crops on the farm's water budget. If growers are uncertain regarding the true costs and benefits of cover crops, they will be less likely to adopt the practice.

Figure 2: Challenges (top) and benefits (bottom) perceived by growers adopting (blue) and not adopting (red) cover crops.



❖ Respondents are most motivated by agronomic benefits such as crop quality and yield, while benefits to water use are largely overlooked

The most cited benefits to cover cropping are crop yield and crop quality, followed by benefits to nitrogen use efficiency and improved soil health. Meanwhile, benefits related to water use are overlooked; only 11.9% of respondents cited water savings as a benefit and only 10.9% of respondents cited adaptation to drought as a benefit. As discussed above, we interpret that these findings may suggest an uncertainty around water. At the time the survey was conducted, California was just getting out of a severe drought, and much of the research around cover crops is still undecided about the water benefits of cover crops in arid areas like California¹. Thus, addressing this information gap in our understanding of the effect of cover crops on farm water management may be particularly important to motivating widespread cover crop adoption. From another perspective, we emphasize the importance of discussing agronomic benefits when conducting education and outreach efforts. The majority of all growers (both adopters and non-adopters) perceive the agronomic benefits to cover crops, but additional research is needed to understand *when* this perceived benefit drives adoption or not.

People are thinking cover crops mean we have more cost, and they don't see the benefits.

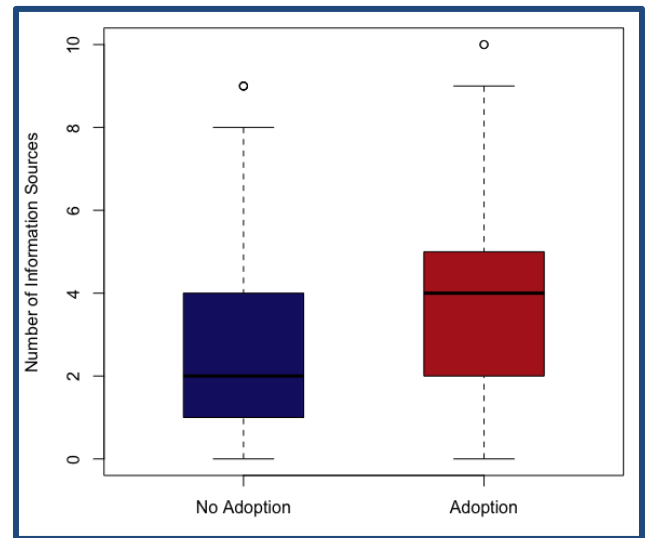
- Cover crop adopter in the Sacramento- San Joaquin Delta

¹ Dabney, S. M., J. A. Delgado, and D. W. Reeves. "Using winter cover crops to improve soil and water quality." *Communications in Soil Science and Plant Analysis* 32.7-8 (2001): 1221-1250.

❖ Growers who adopt cover crops more often use multiple information sources

There is substantial research that shows agricultural information networks are important influences on growers' decisions to adopt conservation agriculture practices. In the case of cover crop adoption in California, there is a significant difference between the average number of information sources utilized by growers who adopt cover crops and those who do not. On average, adopters cite approximately four information sources, while non-adopters cite less than three information sources ($p < 0.001$)². This points to the idea that a broader knowledge network and access to a greater number of informational resources may be influential to cover crop adoption. The most widely used information sources were Pesticide Control Advisors (PCA) and Certified Crop Advisors (CCA), both of whom are private consultants who often make on-farm visits and meet one-on-one with growers to consult on their farm management. We hypothesize that in California's diverse agricultural systems, growers may hold higher trust in the information they receive from people who understand their unique farm characteristics. Thus, working with these PCA and CCA on-farm advisors to promote cover cropping as a multi-benefit practice may be a strong strategy to increase widespread adoption.

Figure 3: Number of information sources adopters (red) and non-adopters (blue) reference.



❖ Implications & Future Research Directions

We have to [relay] to the next generation of farmers, how important cover cropping and composting ... [is for] helping our soil.

- Cover Crop Adopter in the San Joaquin Valley

This Summary reviews an in-depth look at cover crop adoption and shows that adoption decisions are multi-faceted and complex. As conservation agricultural researchers, we need to increase our understanding of the relationship between water and cover crops in California. A better understanding of water use and cover crops in arid areas could help growers predict what impacts cover cropping may have on their water management, bridging the uncertainty gap that appears to be a significant factor influencing cover crop adoption. Providing resources, especially through trusted information sources like private on-farm farm advisors, to increase growers' understandings of the challenges and benefits associated with cover crops can decrease uncertainty and motivate widespread adoption. Finally, in encouraging growers to use cover crops, the conversations must focus on the agronomic benefits that growers achieve from cover cropping.

This research summary was produced as part of a senior honors research thesis in Environmental Science and Management. For questions, comments or more information, contact Kennedy Gould at kennedygould@gmail.com.

² Significance based at 0.001 level based on both a t-test and a non-parametric Wilcoxon Rank-Sum test.