Effects of Cover Cropping and Conservation Tillage on Sediment and Nutrient Losses to Runoff in Conventional and Alternative Farming Systems

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OBJECTIVES

1. Quantify discharge from research plots and grower fields to compare alternative management practices with conventional ones.
2. Quantify non-point source pollutions (NPSP) concentrations and loads in discharge.
3. Inform farmers, policymakers, and the general public about the usefulness of cover crops (CC) and conservation tillage (CT) in addressing nutrients losses.

Executive Summary

Our research quantified non-point source pollution (NPSP) in discharge from conventional and alternative management practices using long-term UC Davis research plots and grower fields. We have placed a network of automated water samplers in the surrounding Sacramento Valley (Yolo County) to monitor storm season and irrigation tail water discharge. We compared the alternative practices of winter cover cropping and conservation tillage, known to reduce runoff in other areas of the US, on the amount of nutrients and sediment in agricultural runoff. Targeted constituents affecting water quality parameters (CAWQP) include total suspended sediment (TSS), turbidity, inorganic phosphate (PO_4-P) and nitrogen (NO_3-N, NH_4-N), total dissolved nitrogen and phosphorous (DON, DOP), dissolved organic carbon (DOC), and pesticides were

examined. Finally, we assessed crop yields under alternative practices to provide information on the sustainability of these practices in California row crop agriculture. The following are the major findings of our research.

1. On fields prone to winter runoff cover crops significantly reduced runoff. Cover crops had little affect on fields with a tendency to produce low runoff.
2. The effect conservation tillage was not uniform and produced mixed results. The reason for mixed results is that conservation tillage was broadly defined being implemented either as leaving 30% or greater residue cover on the soil surface or a 40% reduction in tillage passes. Therefore, conservation tillage either increased or decreased winter runoff with no clear trend attributed to soil type.
3. The quality of water in runoff was generally within EPA drinking water guidelines for both winter and summer runoff except total suspended solids. Generally, less than 1% of applied fertilizers were found as inorganic or organic constituents in runoff annually.
4. Conservation tillage had comparable yields to conventional tillage using the same fertilization practices within the same farming system (i.e., conventional, organic). The main exception was for organic management where we found conservation tillage to be incompatible with manure amendments that are required to be soil incorporated to provide nitrogen to crops.
5. Conventionally managed systems generally had higher yields of corn compared to low-input or organic management. Tomatoes yields were similar among all systems regardless of source of fertilizer nitrogen, tillage or cover crop management

In conclusion, there is no universal prescription to reduce winter runoff except for the use of cover cropping on fields prone to winter runoff. We therefore recommend that a system of classification that scores fields based on runoff vulnerability be implemented to target fields prone to winter runoff. However, timing is a serious issue where planting cover crops before fall rains is generally a constraint facing farmers. In addition, farmers who cover crop may experience significant delays in spring field entry due to managing the cover crop putting them at a competitive disadvantage compared to growers who do not cover crop.