# FARMING PRACTICE
# COVER AND CATCH CROPS

## IMPACT: NUTRIENT LEACHING AND RUN-OFF

### Reference 3

Liu, R; Thomas, B; Shi, XJ; Zhang, XL; Wang, ZC; Zhang, YT 2021 Effects of ground cover management on improving water and soil conservation in tree crop systems: A meta-analysis CATENA 199, 105085 10.1016/j.catena.2020.105085

### Background and objective

Tree crops are mainly planted on sloped farmland, which can lead to soil erosion caused by runoff. As an important tree crop management strategy, ground cover management has been effective in controlling runoff generation and soil loss. However, a global overview is needed to comprehensively quantify the effectiveness of ground cover on water and soil conservation. a) quantify the effectiveness of ground cover management in reducing runoff, soil loss and nutrient loss from tree crop systems; and (b) quantify the effectiveness of ground cover management according to the slope and climatic conditions of the tree crop system. The aim of this study is to provide evidence-based rationale for implementing more sustainable tree crop management practices.

### Search strategy and selection criteria

This study built a database that quantified the effect of ground cover management to reduce runoff, soil and nutrient losses in tree crop systems. Peer-reviewed articles from January 1990 to July 2020 were selected using Web of Science and China National Knowledge Infrastructure (CNKI) databases. Three fields were used for the search in the title, abstract or keywords of the articles. The first field was tree crop type, with the following search terms: "orchard" or "apple" or "citrus" or "vineyard" or "almond" or "olive". The second field was cover crop type, and the search terms were "cover crop" or "ground cover" or "catch crop" or "green manure". The third field was soil variable, with the search terms "runoff" or "soil loss" or "erosion" or "nutrient loss" or "soil and water conservation". The case studies were chosen following the strict quality criteria: (a) The experiments or observations were conducted under field conditions (i.e., no laboratory, rainfall simulation or runoff simulation experiments, etc.); (b) Both the ground cover and control (clean tillage or bare ground management) treatments were included in each case study, and the two treatments were exposed to the same environmental conditions; (c) the targeted article contained at least one response variable (runoff or soil loss or nutrients loss observations); (d) when the variable was measured at multiple time points, the average value was calculated to meet the accurate observation results; (e) multiple ground cover species in one study were considered as independent observations.

### Data and analysis

The mean percentage change and 95% confidential intervals were computed and compared with Sigmaplot V12.0 (Systat, San Jose, USA). Positive reduction percentages indicated significant reductions of runoff or soil loss or nutrient losses as a result of ground cover relative to clean tillage management. When the CI crossed the invalid line (including 0), the ground cover effectiveness was deemed not significant.

| Number of papers | Population | Intervention | Comparator | Outcome | Quality score |
|---|---|---|---|---|---|
| 85 | Tree crops (orchards) | 1) Cover crops; 2) Legume cover crops; 3) Non-legume cover crops | Clean tillage management | Metric: 1) Total nitrogen loss reduction; 2) Nitrate nitrogen loss reduction; 3) Ammonium nitrogen loss reduction; 4) Total phosphorus loss reduction; 5) Dissolved phosphorus loss reduction;; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control | 81.25 |

### Results

- 223 nitrogen loss and 152 phosphorus loss observations were collected from 85 articles.
- Cover crop significantly reduced TN losses.
- Losses of inorganic N forms ($NO_3^-$-N and $NH_4^+$-N) were significantly reduced by cover crops.
- Non-legume cover crops reduced TN, $NO_3^-$-N and $NH_4^+$-N losses more than legume cover crops.
- Cover crop significantly reduced total phosphorous and dissolved phosphorous loss.

### Factors influencing effect sizes

- Mean annual precipitation : When MAP exceeded 800 mm, ground cover reduced losses of TN by 56.4%, $NO_3^-$-N by 60.3%, and $NH_4^+$-N by 55.5%
- Slope gradient : Slope gradient (<10°, 10–15°, 15–20°, 20–25° or >25°), TN losses had the tendency to increase with steeper slopes.
- Mean annual temperature : When the MAT exceeded 20 °C, the ground cover was more effective in reducing TN and $NH_4^+$-N losses than at the lower MAT ranges.

### Conclusion

Cover cropping (either legumes or non-legumes) showed significant efficiency in reducing nutrient (Total nitrogen, inorganic nitrogen, total phosphorous and dissolved phosphorous) losses from tree-crops fields.