

Reference 14

Nicholas, V; Martinez-Feria, R; Weisberger, D; Carlson, S; Basso, B; Basche, A 2020 Cover crops and weed suppression in the US Midwest: A meta-analysis and modeling study AGR ENV LETT 2020;5, e20022 10.1002/ael2.20022

Background and objective

Winter annual cover crops (CCs) have been heavily promoted in the midwestern Corn Belt region of the United States. In addition to soil health and conservation benefits, cover crops (CCs) may offer weed control in the midwestern United States, but individual studies report varying effects. (a) to quantify how environmental conditions and management practices affect weed responses to CCs, (b) to identify Midwest-specific CCBIO targets for providing significant weed suppression, and (c) to evaluate the feasibility of achieving these targets under different CC planting and termination scenarios.

Search strategy and selection criteria

The authors conducted a systematic search of the literature using Web of Science Core Collection (Clarivate Analytics) and CAB Direct (CAB International) databases. Search details, including a PRISMA diagram and list of included publications, are in the supplementary material of the original paper (Supplemental Material S1). The authors included weed biomass (WBIO), weed density (WDEN), and cash-crop yield as response variables. They recorded values in a paired format, requiring each pair of response variables to be measured in the same crop at the same time with all aspects of management held constant except for a treatment of a fall-planted CC. Ancillary data included geographical location, climate, and soil characteristics of the study site; cashcrop and CC management including species, tillage system, planting and termination methods and dates; and experimental information such as timing of weed measurements and type of weed. The complete database is published and available on Iowa State University's DataShare platform. Fifteen articles fit our criteria, producing 123 response ratios for WBIO and 119 response ratios for WDEN.

Data and analysis

Mixed-effect models were used with the modifier of interest as a fixed effect and a random intercept for each study using nonparametric weighting based on the number of replicates. All linear models were fit using the lme4 package, and results were analyzed using lmerTest and emmeans. Means and 95% confidence intervals were back-transformed for reporting purposes. To identify suites of practices predictive of achieving both a reduction in weeds and an increase in cash-crop yield with CCs, we fit random forest models (Kuhn & Johnson, 2013) using several R packages.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
15	Maize	Winter cover crops	no cover crop (fallow) . all other aspects of management held constant like in the intervention.	Metric: 1) Weed biomass; 2) Weed density;; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	100

Results

- 123 response ratios for WBIO and 119 response ratios for WDEN. Overall, cover crops significantly reduced WBIO ($p = .02$), which was robust against publication bias (>3,000 unpublished null studies needed) and the removal of individual studies (p values ranged from .01 to .04). There was no evidence CCs reduced WDEN ($p = .98$).
- Grass (non-leguminous) monoculture cover crops reduced WBIO by 68% (confidence interval [CI] :41–82%) compared with a nonsignificant reduction of 33% for mixtures and other types of CCs ($p < .01$).
- NULL
- NULL
- NULL

Factors influencing effect sizes

- Time after cover crop : Measurements taken before cash-crop planting showed a 74% (CI: 51–85%) reduction in WBIO, compared with only 44% (CI: 12–64%) in measurements taken after planting ($p < .01$).
- Type of weed : Winter annual weeds showed the largest reductions (65%; CI: 27–83%), followed by summer annuals (47%; CI: 10–68%), with perennial weeds being unaffected by CCs.
- Cover crop biomass production : Weed suppression was significantly affected by cover crop biomass for both weed biomass ($p = .03$) and weed density ($p < .01$). An estimated 5 Mg ha⁻¹ of CCBIO at termination reduced WBIO by 75% for grass CCs, but only 40% for other CCs.

Conclusion

Cover crops significantly reduced weed biomass. There was no evidence cover crops reduced weed density.