**Materials and methods**

*Literature search and data extraction*

A systematic search of the literature was conducted using Web of Science Core Collection, CAB Abstracts, and BIOSIS databases. The search was conducted from June through August of 2020 using the following Boolean string: ("weed management" OR "weed control" OR "weed science" OR "weed suppression") AND "cover crop" OR "catch crop" OR "green manure”. An initial selection criterion required that all peer-reviewed journals were conducted in the following US states: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee. Together, these comprise all the states with the USDA ARS Southeast Region. Subsequent filtering was based on identifying journal articles that i.) measured the response variable weed biomass (WBIO) or weed density (WDEN) and ii.) measured said response variables in the same crop, at the same time point, and with all management activities being identical save for the presence of a fall-planted CC. After removal of duplicates and application of the filtering criteria described above, 29 papers were used for data extraction and analysis. The specifics of the literature search are documented in a PRISMA flow chart (Supplemental 1).

Paired comparisons of WBIO or WDEN were extracted from tables and/or figures within our selected journal articles. When data were presented solely in figure-format, the GetData graph digitizer (http://getdata-graph-digitizer. com/) was used to extract relevant data. For WDEN, if measurements were taken at multiple time points in a given season, we either extracted data from the final WDEN measurement, if that value represented a cumulative seasonal total, or summed all values in order to generate a value for the cumulative seasonal total. For each comparison, we also extracted cash crop yield (CY) data if provided. Relevant information was extracted and assessed as potential moderator variables. Examples include information about how and where the study was conducted, geographical and pedological information, cover crop management and weeds present in a given study. The complete dataset with metadata describing both response and moderator variable information is available at YOUR GITHUB.

*Data analysis*

The response variables WBIO, WDEN, and CY were first transformed into the log response ratio (LRR) i.e., natural log of the ratio between response value with cover crop and response value without cover crop. The overall effect of cover crop on each of the three response variables LRR was assessed using random-effect models with paper as the random effect and testing whether the overall mean was different than zero. Since cover crops had a significant effect only on WDEN LRR, conditional inference tree was used to dissect the main moderator drivers of WDEN LRR. Tree terminal node means were further compared using a mixed-effect model with WDEN LRR as the response variable and terminal node membership (fixed-effect) and paper (random effect) as the explanatory variables. The tree analysis identified cover crop biomass as an important moderator of WDEN LRR, thus we further explored this relationship by regressing WDEN LRR against cover crop biomass. Finally, all WDEN-CY and WBIO-CY LRR paired values were categorized as win (when cover crop either decreased weed density/biomass or increased grain yield) or lose (when cover crop either increased weed density/biomass or decreased grain yield) creating four quadrants. The number of observations in each win-lose quadrant was counted to assess the frequency of the concurrent effects of cover crop on weed suppression and crop yield.

Data wrangling, statistical analysis and graphs were performed in R (citation). Random- and mixed-effect models were ran using function lmer from package lme4 (citation). Fixed-effect models were run using function lm from package stats (citation). Conditional inference tree was ran using function ctree from package partykit (citation). Statistical significance of all model results was evaluated using alpha = 0.05.