FARMING PRACTICE
COVER AND CATCH CROPS

IMPACT: CROP YIELD

Reference 34

Marcillo GS, Miguez FE 2017 Corn yield response to winter cover crops: An updated meta-analysis JOURNAL OF SOIL AND WATER CONSERVATION 72, 3, 226 - 239 10.2489/jswc.72.3.226

Background and objective

Winter cover crops (WCCs) provide agronomic and environmental benefits, although their impacts on subsequent crop yields have been reported to vary across regions, soils, or under different farm practices. To address the variability in response, previous qualitative and quantitative reviews have summarized the overall yield effects of WCCs. However, the results from such reviews need constant revision as new research is published and interest in the conservation benefits of WCCs increases. 1) estimate mean corn yields comparing systems with and without WCCs, (2) assess variability in corn yield response to WCCs affected by management conditions (e.g., N fertilization, WCC species, WCC planting and termination dates, tillage, etc.), and (3) assess temporal changes in corn yield response to WCCs depending on evidence accumulated over time.

Search strategy and selection criteria

We updated a previous database of 37 peer-reviewed publications, which included studies from 1965 to 2004. We used Institute for Scientific Information (ISI) Web of Science (Thomson Reuters, New York, New York) and Google scholar (Google Inc., Mountain View, California) to search for studies in the 2004 to 2015 period that matched the following Boolean expressions: "Corn yield and winter cover crops or cover crops." 1. Yield records came from corn following a cover crop treatment, and corn following no cover (NC). 2. Yields were reported in more than one year or location. 3. Enough information was provided to compute study variances. 4. The studies were conducted in the United States or Canada.

Data and analysis

Homogeneity in the distribution of log-RR (i.e., null hypothesis that WCC had similar effects on corn yield across studies) was tested by computing total variance, or weighted total sum of squares for log-RR (Q-statistic). Weights in the calculation of Q equaled to the inverse of within-study variances (Viechtbauer 2010). The Q-statistic follows a chi-square distribution with (n – 1) degrees of freedom; therefore, a Q estimate whose p-value is less than 0.05 led to reject the null hypothesis and conclude that studies did not share a common effect size (i.e., WCC effects differed across studies). Further, we used the I-square (I2 index to determine the presence of heterogeneity in our data set. Weighted mean log-RR and 95% CI were estimated using weights equal to the reciprocal of total variance (i.e., within-study variance computed with equation 2 plus between-studies variance estimated in the homogeneity analysis). For ease of interpretation, weighted mean log-RRs were back transformed to ratio form by applying anti-logs.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
65	Corn fields in north america (US and Canada)	Winter cover crops (legumes, grass, mixture)	No cover crops	Metric: Maize yield; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	87.5

Results

- Grass winter cover crops showed neutral effects on corn yields. The weighted mean response was 1 (0.98 to 1.02), which means that corn yields following a grass winter cover crops were not significantly different than no cover crops.
- Legume winter cover crops showed overall positive effects on corn yields. The weighted mean response was 1.21 (1.17 to 1.29), which means that corn that followed a legume winter cover crop yielded 21% more than without a cover. Legume cover crops resulted in subsequent higher corn yields by 30% to 33% when N fertilizer rates were low or the tillage system shifted from conventional tillage (CT) to no-tillage (NT).
- The weighted mean response for the mixture group was 1.13, with a 95% CI not including 1, which means that corn following a mixture winter cover crops treatment showed 13% higher average yields than no cover. Mixture cover crops increased corn yields by 30% when the cover crop was late terminated (zero to six days before subsequent corn).
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Factors influencing effect sizes

- Nitrogen fertilisation rates : Within legume winter cover crops, the response ratio (yield difference) decreased with increasing exogenous) nitrogen fertilisation rates. For low N rates (0 to 99 kg ha–1 [0 to 88.3 lb ac–1]), corn yields were significantly higher following a legume winter cover crops than following no cover. As N rates increased from 100 to 199 kg ha–1 (89.2 to 177.5 lb ac–1), yield increases following a legume winter cover crops were only 9%. Yields for legume winter cover crops and NC were not significantly different when N fertilizer was 200 kg ha–1 (178.4 lb ac–1) or higher.
- Termination of cover crop before main crop : Mixture cover crops increased corn yields by 30% when the cover crop was late terminated (zero to six days before subsequent corn).

Conclusion

Grass winter cover crops neither increased nor decreased corn yields. Corn that followed a legume winter cover crop yielded 21% more than without a cover. Mixture cover crops increased corn yields by 13%.