FARMING PRACTICE
COVER AND CATCH CROPS

IMPACT: PESTS AND DISEASES

Reference 23

Osipitan OA, Dille JA, Assefa Y, Radicetti E, Ayeni A, Knezevic SZ 2019 Impact of cover crop management on level of weed suppression: A meta-analysis Crop Science 59, 3, 833-842 10.2135/cropsci2018.09.0589

Background and objective

The authors conducted a previous systematic and meta-analysis review that showed differences in results from studies that evaluated the effectiveness of cover crops for weed suppression in cropping systems; these differences were largely due to management approaches used in growing the cover crop and main crop. The current meta-analysis provides a quantitative review on how cover crop and main crop management practices influence the impact of cover crops on weed suppression. The current study uses meta-analysis to ask the following questions: 1. How does choice of cover crop species affect weed suppression? 2. How do cover crop management practices, such as sowing season or date, seeding rate, termination method, termination date, integrating cover crops with other weed control inputs, and tillage or cropping system adopted for cover crop production affect weed suppression at (i) cover crop termination or (ii) after main crop planting?

Search strategy and selection criteria

Data from previously published studies were used in the meta-analysis. Studies were identified in the Institute for Scientific Information (ISI) Web of Science database using search terms for nine different topics regarding weed suppression by using cover crops. Terms used referred to (i) cover crop species, (ii) weed suppression or control as measured by weed biomass, density, and percentage control, (iii) cover crop termination method, (iv) cover crop termination timing, (v) tillage system in which cover cropping was practiced, (vi) cropping system in which cover cropping was practiced, (vii) cover crop seeding rate, (viii) season in which the cover crop was sowed, and (ix) whether cover crop was part of an integrated weed management program. (i) study was conducted in the field, (ii) treatments were randomized with replications, (iii) results reported weed biomass, density, or percentage weed control after cover crop and no cover crop treatments, (iv) time of collecting weed data was specified, and (v) sufficient information was provided to estimate variance of mean values for weed biomass or density.

Data and analysis

A response ratio with CI ≥1 indicates that an intervention did not provide weed suppression (or resulted in increased weed presence), whereas a response ratio with CI <1 indicates that weeds were suppressed. Depending on the CI, the lower the response ratio, the greater the level of weed suppression. The difference in response ratio (or weed suppression) among interventions was evaluated using the bias-corrected 95% CI with random effect model: differences exist among interventions if $p < 0.05$. Meta-regression analysis was used to test the relationship between cover crop biomass and weed suppression as measured by weed biomass and density.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
53	Cereals and vegetables	Cover crops	no cover crop	Metric: Weed suppression (i.e., weed biomass, density, and percentage of weed control); Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	68.75

Results

- The meta-analysis showed that there were differences in level of weed suppression at termination among cover crop species. In most cases, the grass cover crop species provided greater weed suppression than the broadleaf cover crop species. The response ratio provided by cover crop species ranged from 0.06 (95% CI = 0.03–0.15) in cereal rye to 0.71 (95% CI = 0.48–1.09 and 0.34–1.11) in radish (Raphanus raphanistrum L.) and buckwheat (Fagopyrum esculentum Moench), respectively.
- All cover crops suppressed weeds at termination except blackmedic (Medicago lupulina L.), buckwheat, mustard (Sinapis alba L.), pea, radish, and sunflower (Helianthus annuus L).
- Incorporating the terminated cover crop into the soil had a response ratio of 0.45 (95% CI = 0.38–0.54) vs. placing it on the soil with a response ratio of 0.49 (95% CI = 0.31–0.76).
- There was no difference in early weed suppression (up to 5 wk after main crop planting) by cover crops when intercropped or in sequence with main crop.
- NULL

Factors influencing effect sizes

- Cover crop biomass production : Cover crop biomass was inversely related to the level of weed biomass ($r2 = 0.67$) and weed density ($r2 = 0.64$); increase in cover crop biomass provided greater weed suppression.
- Sowing season : Fall-sown cover crops provided greater weed suppression in the summer ($R^* = 0.19$, 95% CI = 0.09–0.38) than spring-sown cover crops ($R^* = 0.48$, 95% CI = 0.47–0.64).
- Seeding rate : Cover crop seeding rate affected ($P < 0.01$) weed suppression, such that weed biomass and density were reduced by increasing seeding rate of cover crops from the 1× seeding rate ($R^* = 0.50$, 95% CI = 0.35–0.62) to 2× ($R^* = 0.27$, 95% CI = 0.25–0.32) or 3× ($R^* = 0.10$, 95% CI = 0.25–0.29).
- Ternination period : Weed suppression by cover crops terminated late was greater ($R^* = 0.29$, 95% CI = 0.21–0.45) than for those terminated early (2-wk interval; $R^* = 0.74$, 95% CI = 0.48–1.02) in spring.

- Cash crop seeding time : Delayed crop planting by 1 to 4 wk after termination of cover crop increased the response ratio (i.e., less weed suppression) from 0.13 (95% CI = 0.06–0.27) to 0.74 (95% CI = 0.62–0.88)

Conclusion

Cover crops provided a range of weed suppression (all statistically significant), depending on management decisions such as choice of cover crop species, cover crop sowing season (fall or spring), sowing dates within seasons, seeding rate, termination date, delay in main crop planting date after cover crop termination, tillage system under which the cover crop was produced, and integrating the cover crop with other weed control inputs.