

Do winter cover crops suppress weeds in Midwestern corn- and soybean-based systems? A meta-analysis

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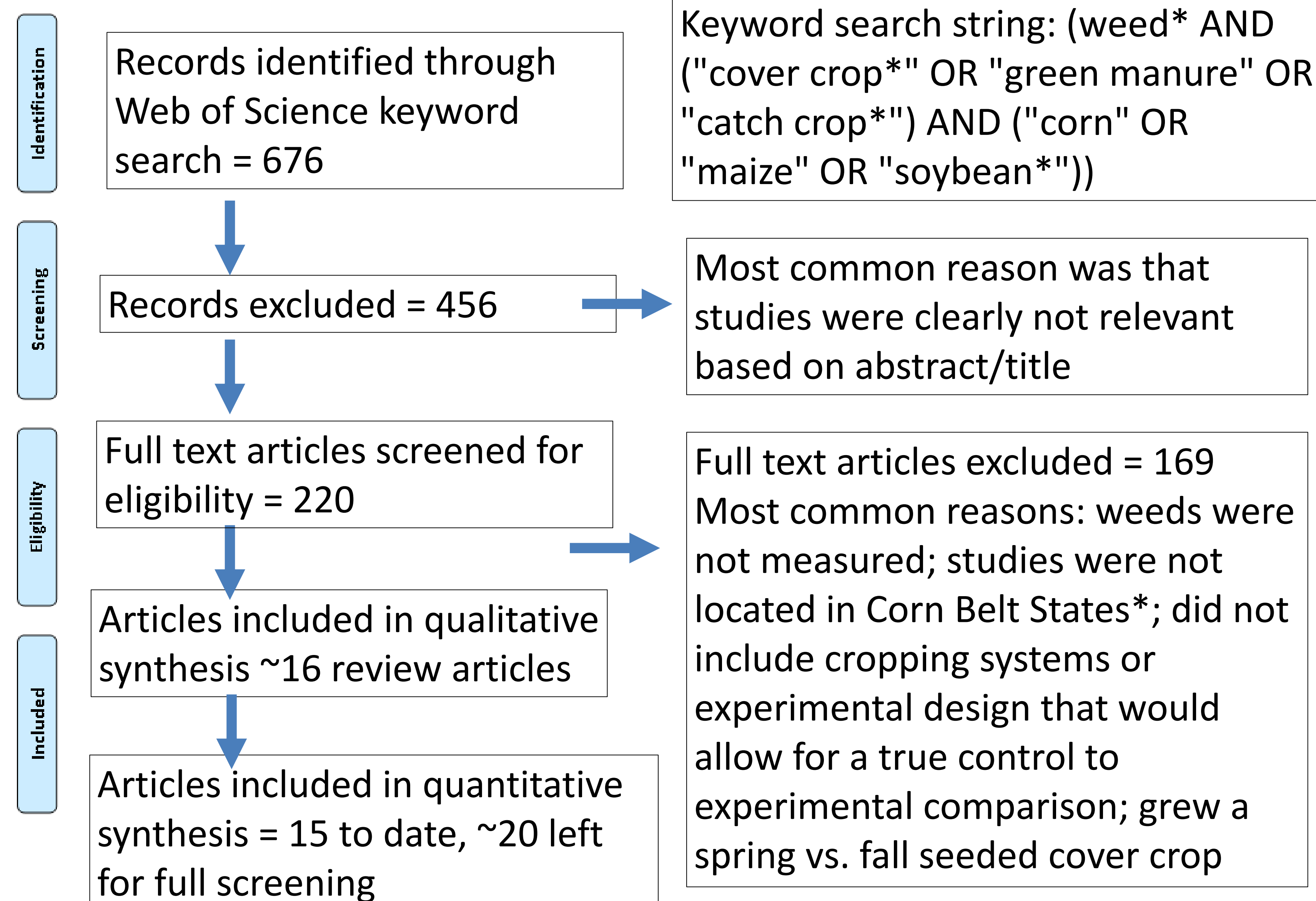
3. Practical Farmers of Iowa, Ames, IA

Rationale

- Cover crop use may aid in reducing herbicide costs and in providing an alternative strategy for managing herbicide resistant weeds, both important cost savings that improve short-term economics for producers.
- The climate and cropping systems of the Midwestern Corn Belt constrain cover crop growth and adoption.
- The degree to which cover crop type, fall planting date and spring termination method affect weed management is not well understood.
- The quantity of cover crop biomass needed for a significant reduction in weeds is also uncertain.
- We conducted a meta-analysis to help answer these questions and to quantify the effects of winter cover crops, and their management, on weeds.

Objectives: 1) Quantify weed control from experiments in corn-soybean cropping systems in the Corn Belt using fall planted cover crops; 2) Identify cover crop management practices required to achieve optimal weed control

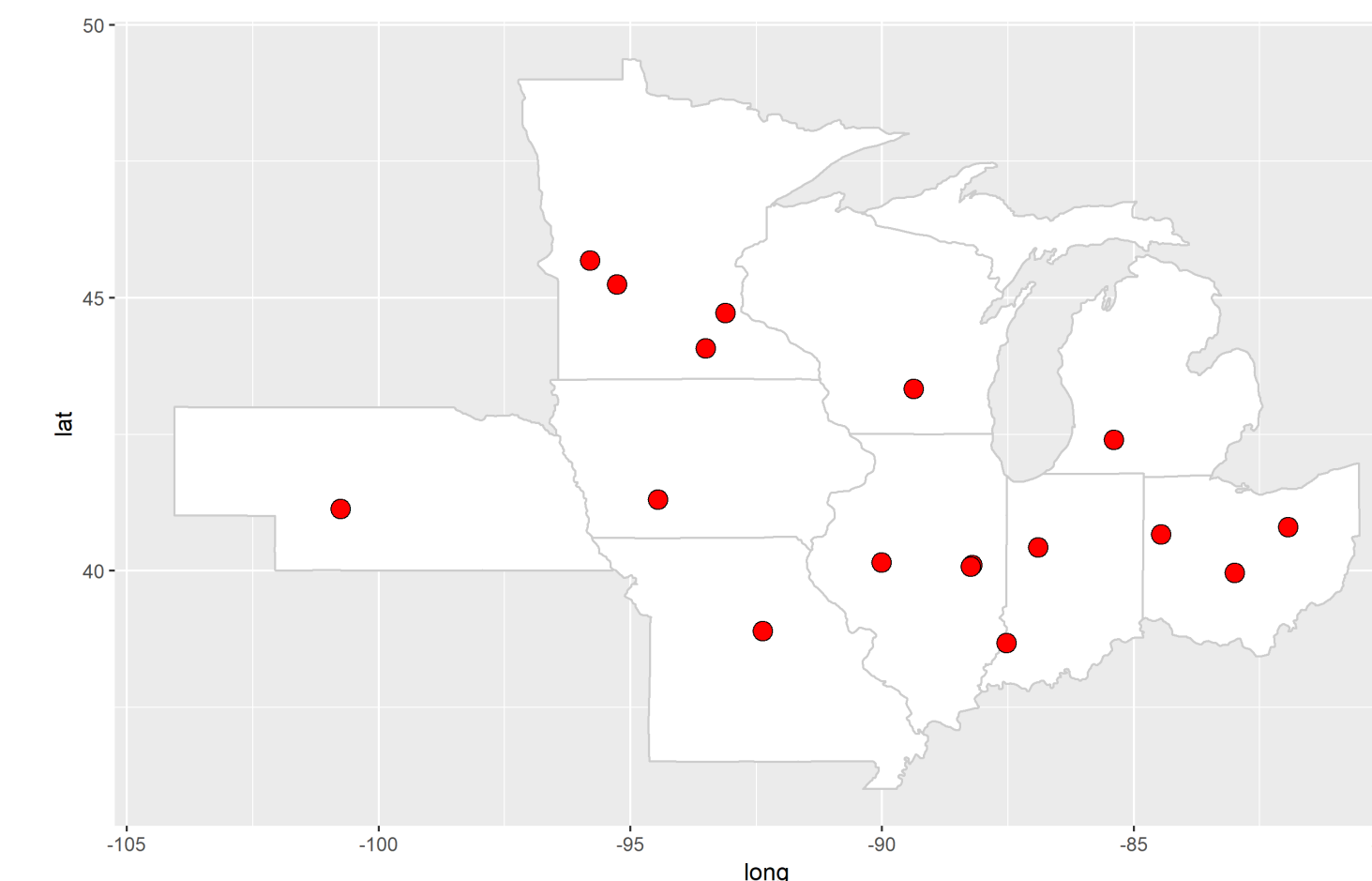
Literature search and database development



- Criteria: Studies were (1) located within the “Corn Belt”*; (2) grew a fall seeded cover crop before corn or soybean; and (3) measured and reported weed biomass/density.
- Data was extracted systematically from comparisons of CC vs. no CC treatments
- Comparisons were used to create “response ratios” (RR) for statistical analysis
- RR = $\ln(\text{weeds in CC treatment} \div \text{weeds in no CC treatment})$**
- Multiple RRs were present for certain studies e.g. different termination methods or cover crop species

Database Overview

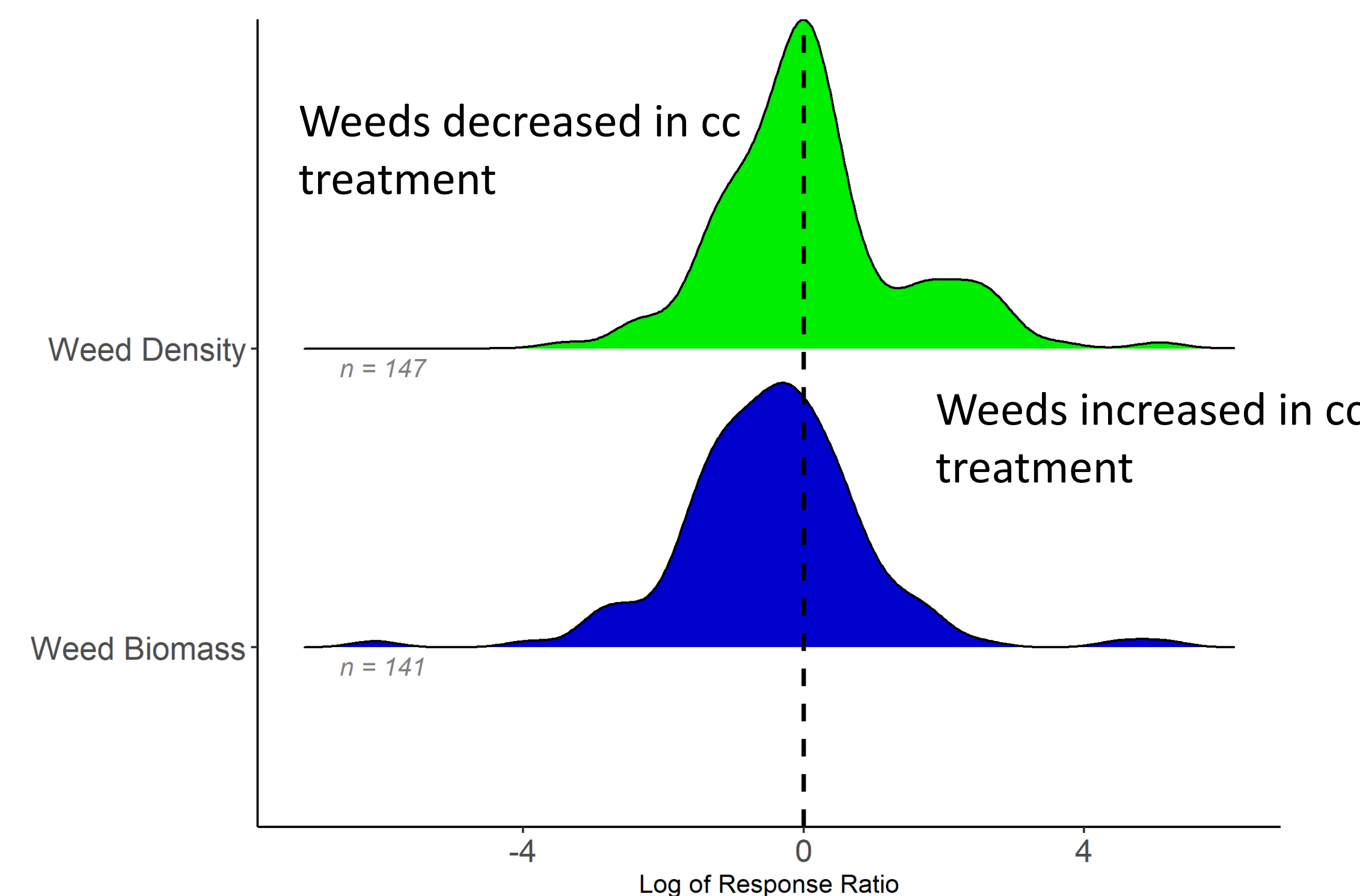
State	Year	Cover crop species	Corn or soybean following cover crop	Authors
OH	1993	vetch	corn	Hoffman et al.
MI	2001	clover, medic	corn	Fisk et al.
IL	2002	vetch	corn	Czapar et al.
OH	2003	wheat, vetch	corn, soybean	Gallagher et al.
MN	2005	rye	soybean	DeBruin et al.
IL	2010	rye, vetch	soybean	Davis et al.
WI	2011	rye	soybean	Bernstein et al.
IA	2012	mixes	corn, soybean	Delate et al.
MI	2012	rye/vetch, vetch, rye	-	Hayden et al.
IN	2012	wheat, ryegrass	corn, soybean	Mock et al.
MN	2013	rye	soybean	Forcella et al.
MN	2016	radish	corn	Gieske et al.
MO	2017	pea, vetch, clover, radish, oat, ryegrass, rye, wheat	soybean	Cornelius and Bradley
IL	2017	radish, canola, rye	soybean	Crawford et al.
NE	2018	rye	corn	Werle et al.



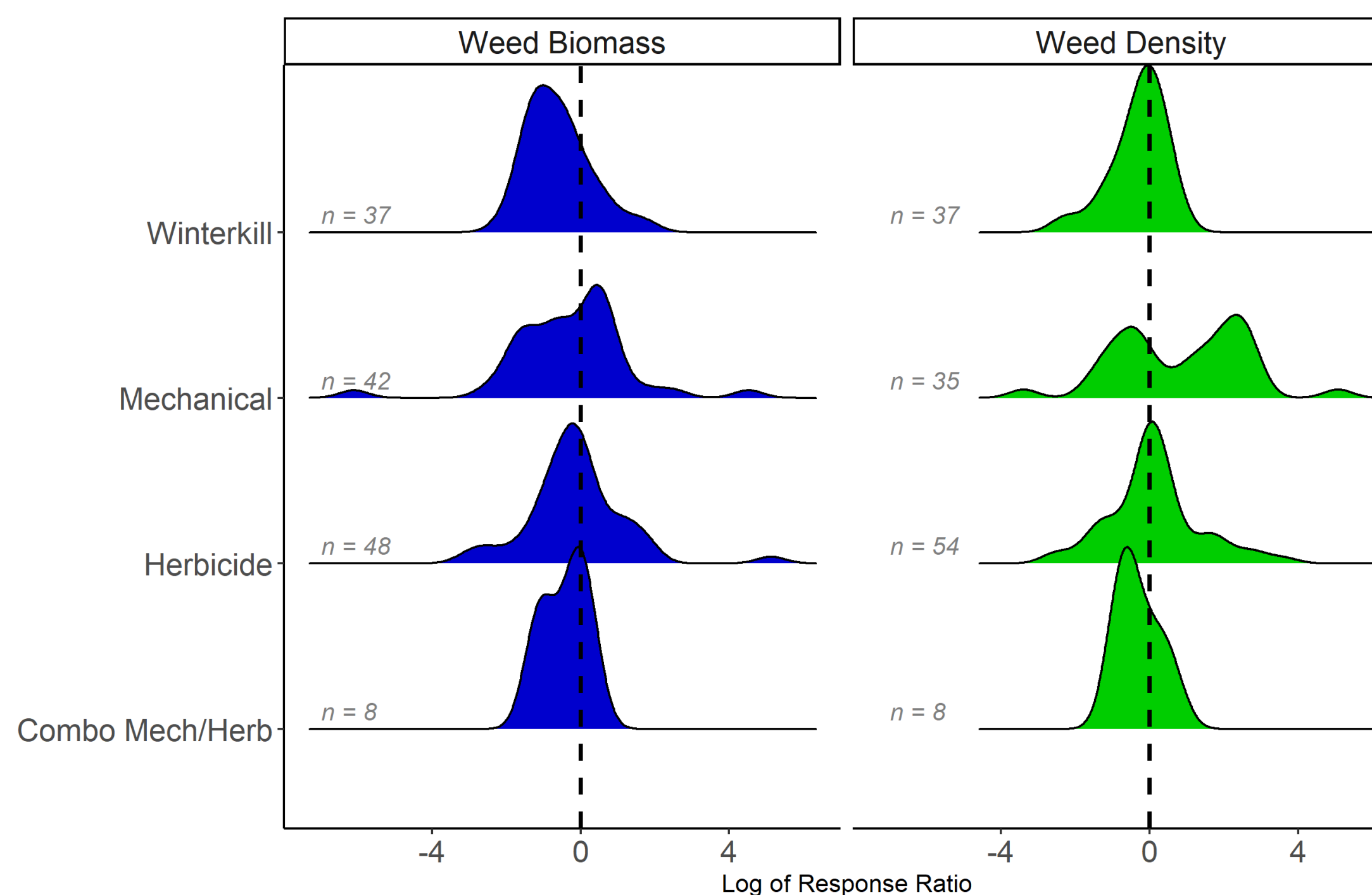
Locations of experiments (above) and meta-data (left). *Only Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin were potentially included because we were concerned with the continuous Corn Belt states in the Midwest with the greatest number of corn and soybean acres.



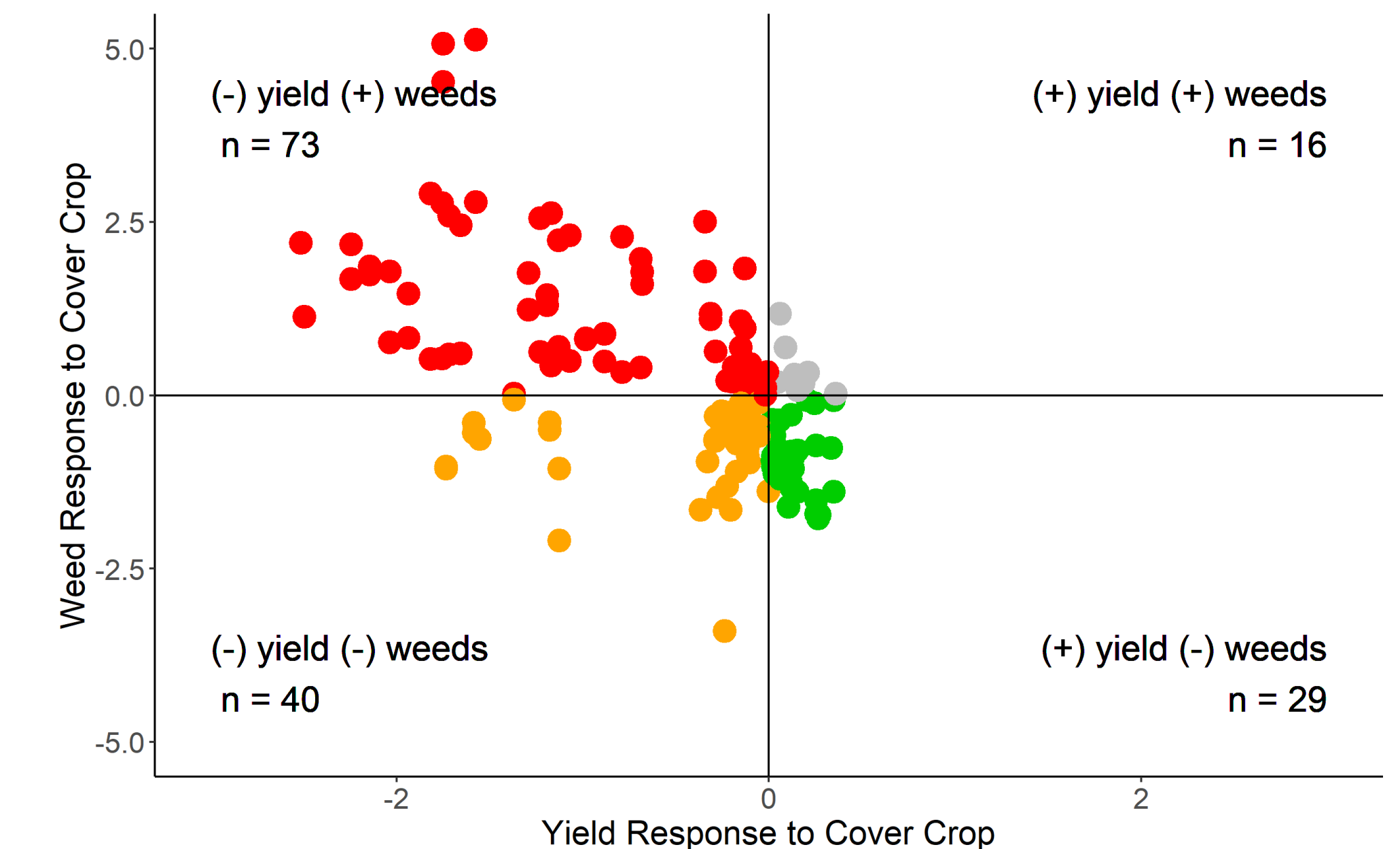
Results



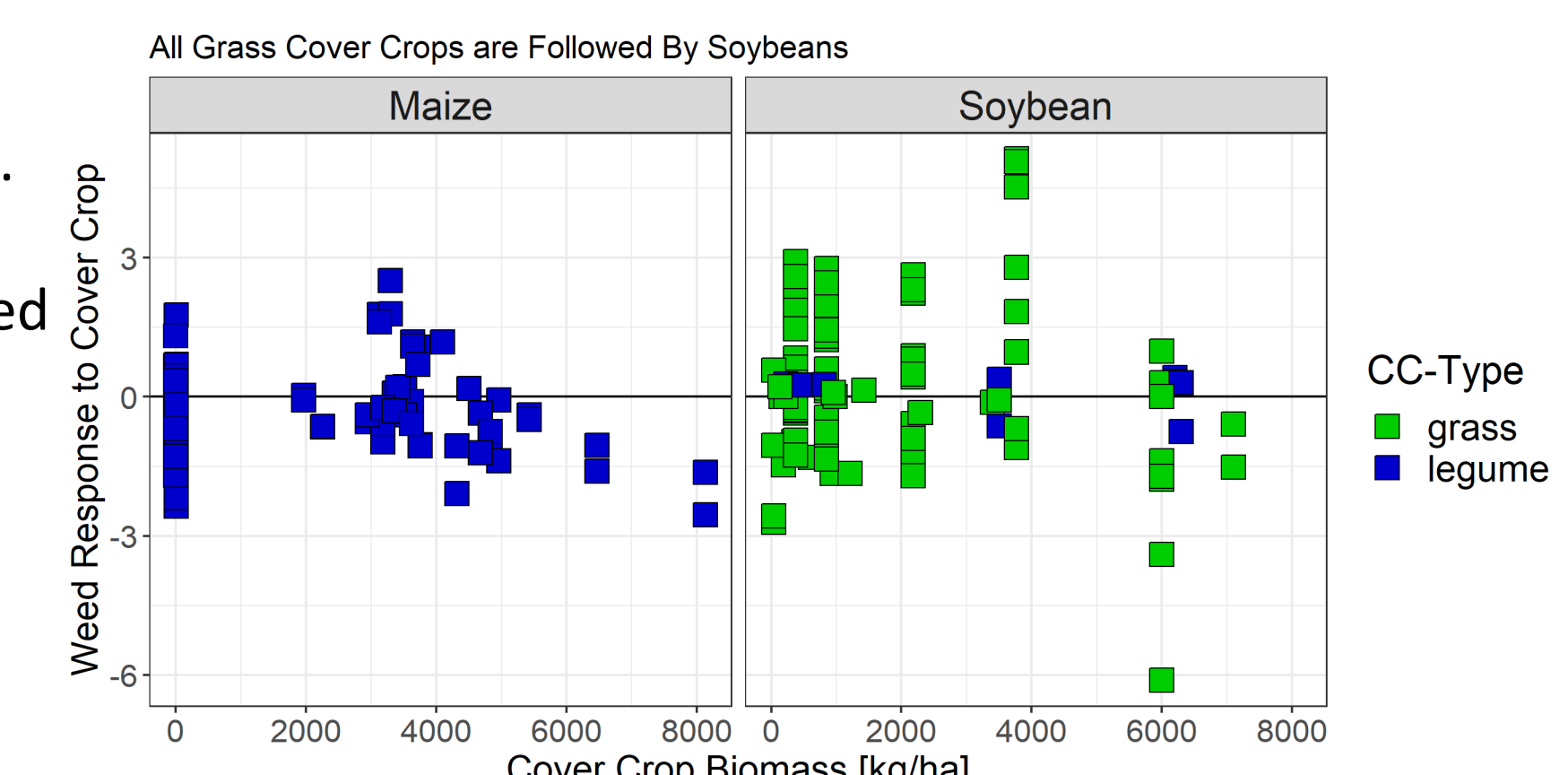
Below: Termination methods. Winterkill, herbicide and dual methods of cover crop termination were more effective at suppressing weeds with cover crops, and our preliminary statistical analysis suggests that there are significant differences between these groups for both weed biomass and weed density. There was one notable study (DeBruin et al. 2005) where weed density was continually increased in the cover crop treatment when rye before soybean was mowed.



(Right): Yield and weed responses. When experiments included yields we found that cover crops represented “win-win” scenarios 18% of the time, where weeds were reduced and yields were increased. These data are represented by the green points in the figure to the right. “Lose-lose” situations (weeds increased and yield decreased) are in red.



(Left, top): Overall results. Response ratios represent the natural log of weeds (biomass or density), where a negative value represents experiments where cover crops reduced weeds. Cover crops decreased weed density in 48% of response ratios, and cover crops decreased weed biomass in 64% of response ratios.



(Right) Cover crop biomass and crop following the cover crop. Greater levels of cover crop biomass tended to have a greater impact on weed control, particularly before corn.

Additional Questions Generated

- Are there interactions with cover crops and herbicides that make herbicides more or less effective?
- How much biomass is needed to consistently reduce weeds?
- How might a cover crop be creating a more favorable environment for weeds?
- What is the difference in weed control in overwintering or winter killed cover crops?
- How does a cover crop impact weed germination and emergence?