

Maize Residue Removal and Cover Crop Effects on Subsequent Soybean Crops

This poster reports on a long-term field study that addressed the impact of maize residue removal and cover crop cultivation on the subsequent soybean crop yield, seed moisture, and mineral nutrients under no-till soil management.

A Call to Action:

- Maize residue removal for silage or biofuel feedstocks reduces soil quality and has unknown effect on yield of subsequent soybean crops.
- Cover crops, which maintain soil quality when maize crop residues are removed from the field, have unknown effect on subsequent soybean crops.
- Objectives were to measure maize residue removal and cover crop treatment effects on the subsequent soybean crop in terms of grain yield, seed moisture at harvest, and essential mineral elements.

Residue Removal



Cover Crops



Residue removal effects on soybean yield

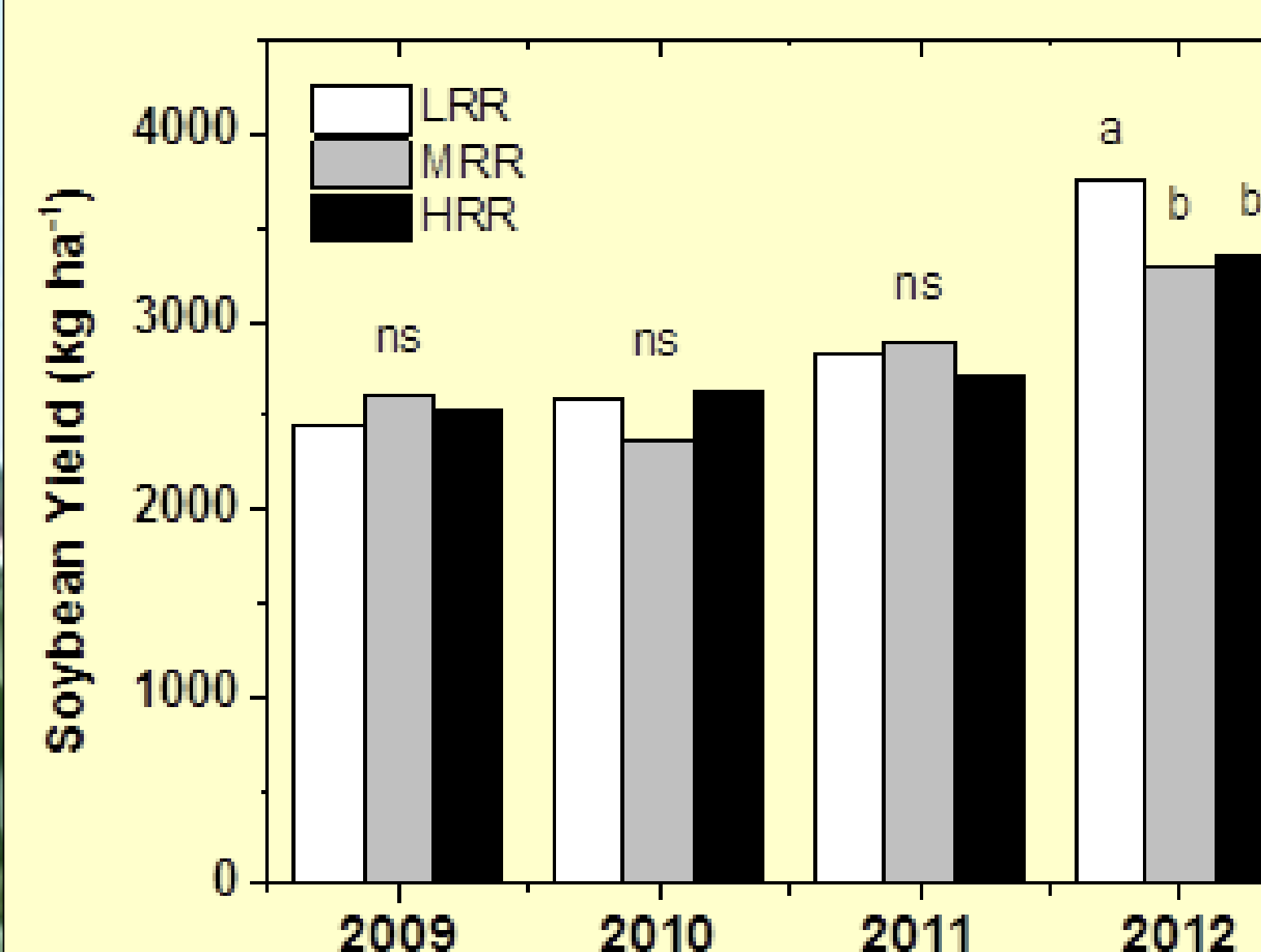


Figure 2. The significant 2-way interaction for year by residue removal treatments for grain yield of the soybean phase of the maize-soybean rotation. Partitioned analysis of the LS-means for the interaction was conducted using the SLICE statement.

The 2012 growing season was hot and dry. The presence of greater residue amounts in LRR likely shielded the soil surface, keeping it cooler and reducing water evaporation from the soil surface. This likely allowed soybeans to produce greater yields than when greater residue amounts were removed under MRR and HRR.

Cover crop effects on soybean yield

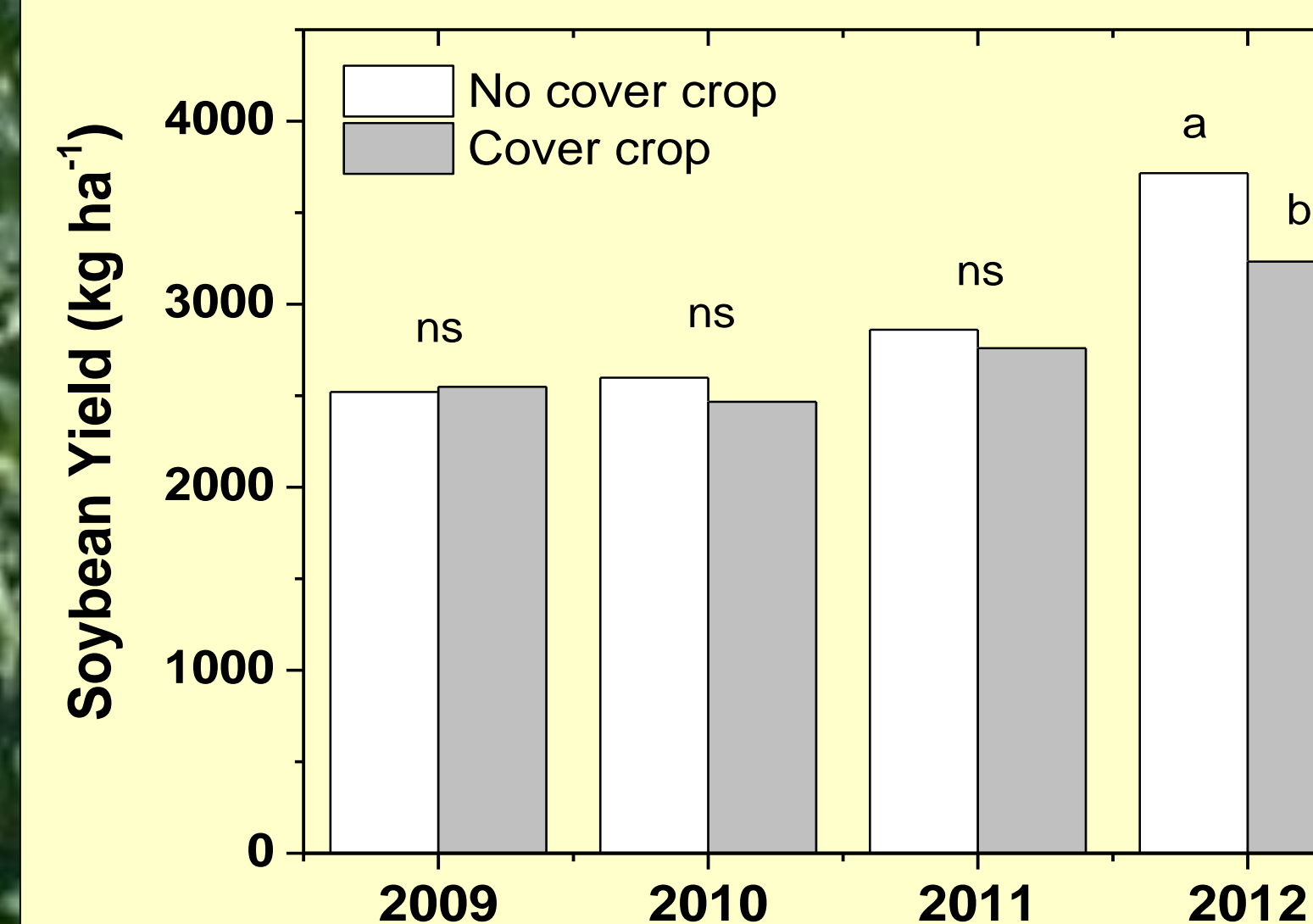


Figure 3. The significant 2-way interaction for year by cover crop treatments for grain yield of the soybean phase of the maize-soybean rotation. Partitioned analysis of the LS-means for the interaction was conducted using the SLICE statement.

The 2012 growing season was hot and dry. The presence of cover crops in the spring likely used soil water to a greater extent than the no cover crop treatment. Soil water likely was not replenished due to the dry conditions, leading to decreased soybean yields in this hot and dry season.

Materials and Methods

- No-till experiment established in 2000.
- Corn (C) and soybeans (S) were grown in 2-year rotation.
- Maize residue removal treatments imposed in the fall of each year.

Residue Removal Treatments

- LRR = maize grain harvest only.
- MRR = residue windrowed, baled and removed after grain harvest.
- HRR = fodder harvested as silage.

Cover Crop Treatments

- Slender wheatgrass was drilled into maize plots.
- Oats and hairy vetch were direct seeded into soybean.

Walter Riedell, Shannon Osborne, Kurt Dagel

USDA Agricultural Research Service
Brookings SD, USA

Results

Table 1. The ANOVA significance levels for treatments and interactions of cover crop, maize residue removal, cover crop x residue removal, year, year x cover crop, year x residue removal, and year x cover crop x residue removal for pre-season residue, soybean seed yield, seed moisture, and soybean seed mineral nutrient concentrations. Data were collected from the soybean phase of a maize/soybean rotation under maize residue removal and cover crop treatments near Brookings SD in the 2009 through 2012 seasons.

Effect	df	Residue	Yield	Moisture	N	P	K	Ca	Mg	S	Fe	Zn
Cover crop (CC)	1	0.0471	0.0100	0.0055	0.1119	0.9329	0.2218	0.4256	0.4682	0.0655	0.7084	0.4859
Res. removal (RR)	2	0.0001	0.4716	0.0342	0.0400	0.5355	0.3710	0.0755	0.1740	0.0218	0.3249	0.1491
CC x RR	2	0.7422	0.9717	0.2933	0.2196	0.5785	0.7911	0.8957	0.5879	0.1552	0.4902	0.4064
Year (YR)	3	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0063	0.0001	0.0001	0.0001
YR x CC	3	0.3033	0.0361	0.0057	0.1700	0.9829	0.9780	0.7591	0.6327	0.7387	0.8963	0.6138
YR x RR	6	0.0003	0.0406	0.1422	0.0826	0.8449	0.4229	0.6561	0.7065	0.7858	0.6814	0.5644
YR x CC x RR	6	0.1316	0.2755	0.6465	0.3294	0.9954	0.9750	0.9841	0.9195	0.6796	0.4126	0.3224

Cash crop residues in spring prior to soybean

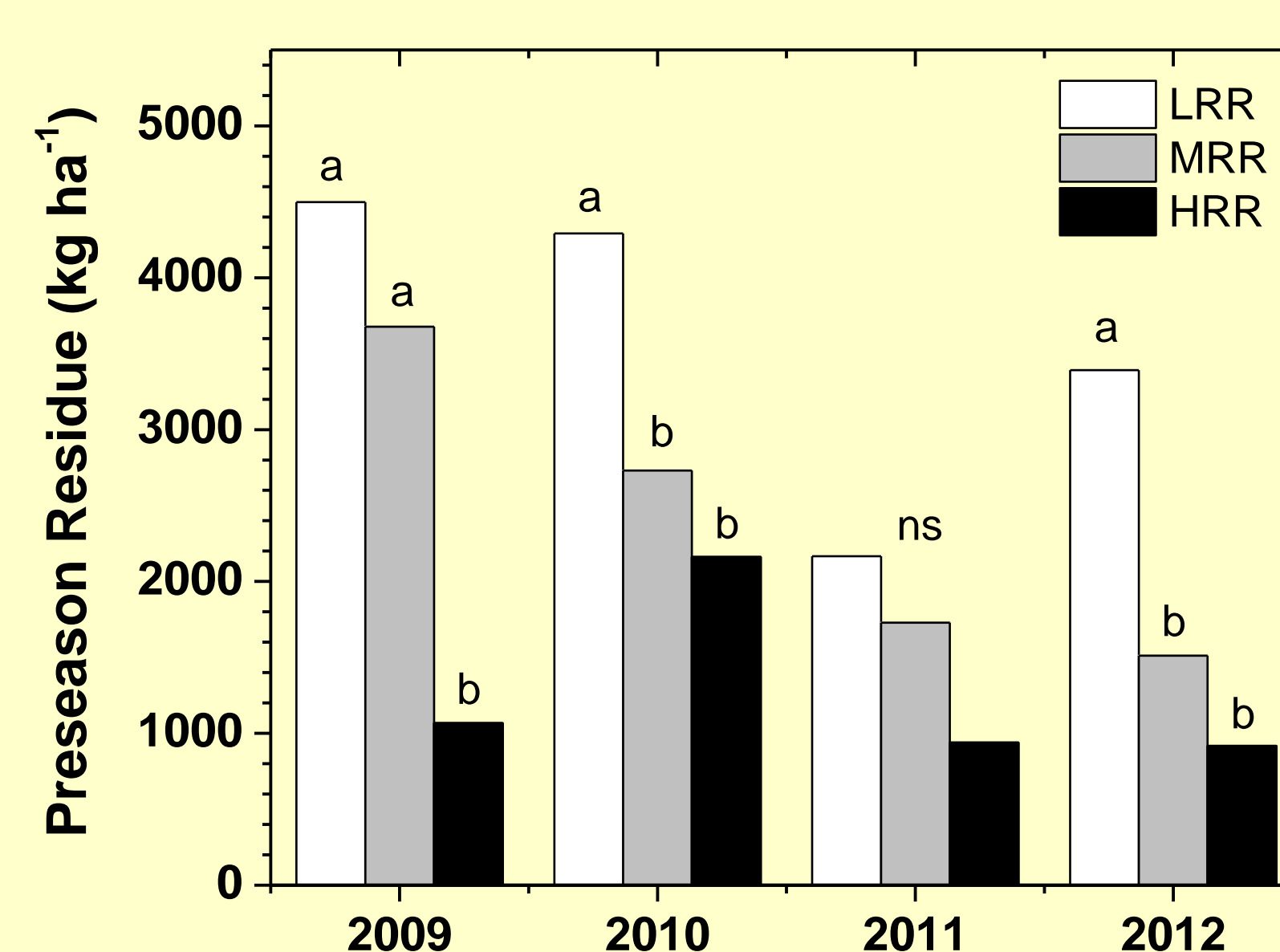


Figure 1. The significant 2-way interaction for year by residue removal treatments for pre-season residue present on the soil surface prior to the soybean phase of the maize-soybean rotation. Partitioned analysis of the LS-means for the interaction was conducted using the SLICE statement.

The 2010 growing season was wet and cold, which reduced maize growth and residue production. Residue remaining in 2011 was therefore reduced.

Table 2. Residue removal treatment effects on seed moisture, grain N, and grain S at harvest for the soybean phase of the maize-soybean rotation. Values represent data combined over cover crop treatments across all years of the study.

Residue removal treatment	Grain moisture (g kg ⁻¹)	Grain N (g kg ⁻¹)	Grain S (g kg ⁻¹)
LRR [†]	119.6 a	62.4 b	3.37 b
MRR	114.0 b	63.4 a	3.47 a
HRR	114.7 b	63.8 a	3.52 a

[†] LRR, low residue removal; MRR, medium residue removal; HRR, high residue removal treatment.

[‡] Values followed by the same letter are not significantly different (Tukey option in LSMEANS, $\alpha = 0.05$).

Conclusions

- Only during the hot and dry 2012 season did the MRR and HRR treatments result in less grain yield than LRR.
- Seed moisture was less while seed N and S concentrations were greater under MRR or HRR than under LRR.
- Warmer soil temperatures under MRR and HRR likely increased plant development and reduced seed moisture at harvest.
- Negative effects of maize residue removal or cover crop cultivation on soybean grain yield were mitigated during seasons characterized by moderate temperature and rainfall.