

Supplemental Material
**Harvesting fertilized rye cover crop: Simulated revenue, net energy,
and drainage nitrogen loss**

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Supplemental Table S1. Observed and/or RZWQM simulated winter wheat or rye above ground biomass and N uptake for selected studies that included different N fertilizer rates to winter rye/wheat as treatments.

Planting-harvest (years)	Fertilizer (kg N ha ⁻¹)†	Observed/Simulated‡		Comments
		Biomass (Mg ha ⁻¹)	N uptake (kg N ha ⁻¹)	
<i>Fang et al. (2008) Winter wheat and maize double cropping system in the North China Plain</i>				
2000-2001	0	10.0/10.9	150/162	Correlation between measured and simulated aboveground N uptake was high for wheat and despite some simulation errors, RZWQM can be used to simulate N management effects. #
	100	12.7/11.1	222/183	
2001-2002	0	5.7/7.3	59/73	
	100	11.2/12.7	162/195	
<i>Hu et al. (2006) Winter wheat and maize double cropping system in the North China Plain</i>				
2001-2002	100	12.6/9.2	150/140	Demonstrated potential of RZWQM for evaluating N management practices.
	200	13.0/11.0¶	181/177¶	
2002-2003	100	8.2/8.6	95/117	
	200	9.8/8.3¶	112/121¶	
<i>Saseendran (2004) Continuous winter wheat in Akron Colorado</i>				
1987-1988	0	5.4/5.0¶	nr††/147	RZWQM biomass simulations responded to N application rates compared to field measurements.
	84	9.6/6.7¶	nr/185	
1988-1989	0	4.6/4.6¶	nr/98	
	84	5.7/4.9¶	nr/159	
1989-1990	0	4.0/4.9¶	nr/81	
	84	7.1/5.4¶	nr/144	
<i>Gu et al. (2016) Winter wheat in the Huang Huai Hai Plains of northern China</i>				
2010-2011	0	nr/nr	145.8/nr	Investigated N fertilization management practices on N loss and use efficiencies using lysimeters.
	90	nr/nr	233.1/nr	
	180	nr/nr	301.0/nr	
2011-2012	0	nr/nr	145.3/nr	
	90	nr/nr	242.5/nr	
	180	nr/nr	273.1/nr	
<i>Shao et al. (2015) Winter rye in Rock Springs, Pennsylvania</i>				
2011-2012	0	5.9/nr	nr/nr	Investigated the trends in rye biomass yield and composition. Fall applied N at rye planting.
2011-2012	60	8.5/nr	nr/nr	
<i>Read et al. (2011) Winter rye in Pheba Mississippi</i>				
1999-2000	0	5.9/nr §	70/nr ¶	Investigated dry matter and nutrient uptake responses of cover crops including cereal rye to fertilizer rates applied approximately 2 months before spring harvest.
	100		97/nr ¶	
2000-2001	0	6.9/nr	130/nr ¶	
	100		172/nr ¶	

† N applied to winter wheat or rye

‡ observed value to left of hash; RZWQM-simulated value to right of hash

§ the biomass was not affected by N rate and is the average of the different rates.

¶ estimated from figures and/or regression equations

Fang et al. (2008) only reported average values for biomass and N uptake for wheat at different rates and years, therefore the specific values summarized here were provided by Q. Fang and the simulated values are slightly different than those used by Fang et al. (2008) because of different model versions (personal communication).

†† “nr” indicates not reported.

Supplemental Table S2. RZWQM scenarios for 2001-2010. †

Treatment	Rye fertilizer rate on 6-Apr prior to soybean planting (kg N ha ⁻¹)	Soybean planting date	Rye harvest amount	Rye termination or harvest date	
				Pre-corn	Pre-soybean
NCC‡	0	15-May	0%	n/a	n/a
CC	0	15-May	0%	20-April	10-May
CCH	0	15-May	90%	20-April	10-May
CCH_L_x	0, 30, 60, 90 120,140, 160	5-Jun	90%	20-April	30-May

†Corn was fertilized at 200 kg N ha⁻¹ five days prior to planting. Corn was planted in even years on 1-May while soybean was planted in odd years on either 15-May or 5-Jun depending on treatment. Late harvest of winter rye on 30-May (after rye anthesis) reduces regrowth and the need for herbicides (Mirsky et al., 2009). Both corn and soybean were harvested on 1-Oct. Rye was planted 5-Oct.

‡Treatment abbreviations: control treatment with no cover crop (NCC); unharvested winter rye planted on 5-Oct after corn and soybean harvest on 1-Oct (CC); same as CC except with winter rye harvest (CCH); late harvest of fertilized winter rye prior to late soybean planting (CCH_L_x; “x” indicates the fertilizer rate applied on 6-Apr, kg N ha⁻¹).

References

- Fang, Q., L. Ma, Q. Yu, R.W. Malone, S.A. Saseendran, and L.R. Ahuja. 2008. Modeling nitrogen and water management effects in a wheat–maize double-cropping system. *J. Environ. Qual.* 37:2232–2242. doi:10.2134/jeq2007.0601
- Mirsky, S.B., W.S. Curran, D.A. Mortensen, et al. 2009. Control of cereal rye with a roller/crimper as influenced by cover crop phenology. *Agron. J.* 101:1589–1596. doi:10.2134/agronj2009.0130