

**Supplemental Information: Additional information and data sources for dryland cropping experiment**

7 pages

GRAZING AND NO-TILL CROPPING IMPACTS ON N RETENTION IN DRYLAND AGROECOSYSTEMS

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The Stratton site was originally planted to the following crop rotation treatments: Grass (G), Wheat-Fallow (WF), Wheat-Sorghum-Fallow (WSF), and Wheat-Sorghum-Millet-Fallow (WSMF). In 1990, Stratton sorghum rotations were replaced with corn to match the Sterling site. At both sites, millet was replaced with sunflower in 1994, and with forage sorghum in 1995. In 1998, all WF treatments were changed to Wheat-Corn-Millet (WCM) treatments and all WCMF treatments were changed to Wheat-Wheat-Corn-Millet (WWCM). In 1999, soybeans were substituted for millet in WCM and WWCM treatments. Crops harvested in this study included: wheat, *Triticum aestivum* L.; corn, *Zea mays* L.; proso millet, *Panicum miliaceum* L.; forage sorghum, *Sorghum bicolor* (L.) Moench; soybean, *Glycine max* (L.) Merr.; sunflower, *Helianthus annuus* L. Annual inputs and removals by Site, Treatment, Crop Rotation, and Year, are presented in Table S1.

Table S1. Annual nitrogen inputs and removals (kg N ha<sup>-1</sup>), as well as the 15-year sums (kg N ha<sup>-1</sup> 15 y<sup>-1</sup>) and means (kg N ha<sup>-1</sup> y<sup>-1</sup>), by treatment and site at the dryland cropping experiment. Treatments include Planted Perennial Grass (PG), Wheat-Fallow (WF), Wheat-Corn-Fallow (WCF), Wheat-Corn-Millet-Fallow (WCMF). Crops harvested in a given year include: grass (G), fallow (F; no crop harvested), wheat (W), corn (C), soy (Sy), proso millet (M), sunflower (Su), wheat crop 1 of 2 successive rotations (W1), and wheat crop 2 of 2 successive rotations (W2).

Site	Treatment	Year	Crop	Fertilizer Inputs			Crop Removals				
				<i>Annual</i>	<i>15-y Sum</i>	<i>Annual Mean</i>	<i>Annual</i>	<i>15-y Sum</i>	<i>Annual Mean</i>		
Sterling	PG	1989	G	0.0	0.0	0.0	-6.0	-19.0	-1.3		
		1990	G	0.0			0.0				
		1991	G	0.0			0.0				
		1992	G	0.0			0.0				
		1993	G	0.0			0.0				
		1994	G	0.0			0.0				
		1995	G	0.0			-8.0				
		1996	G	0.0			-5.0				
		1997	G	0.0			0.0				
		1998	G	0.0			0.0				
		1999	G	0.0			0.0				
		2000	G	0.0			0.0				
		2001	G	0.0			0.0				
		2002	G	0.0			0.0				
		2003	G	0.0			0.0				
		WF	1989	F	0.0	550.8	36.7	0.0	-439.0	-29.3	
			1990	W	22.4			-50.0			
			1991	F	0.0			0.0			
			1992	W	39.2			-25.0			
			1993	F	0.0			0.0			
			1994	W	57.2			-46.0			
			1995	F	0.0			0.0			
			1996	W	74.0			-67.0			
			1997	F	0.0			0.0			
			1998	W	48.0			-61.0			
			1999	C	101.0			-71.0			
			2000	Sy	6.0			-29.0			
			2001	W	64.0			-46.0			
			2002	C	101.0			0.0			
			2003	M	38.0			-44.0			
			WCF	1989	C	56.0	660.6	44.0	-77.0	-600.0	-40.0
				1990	F	0.0			0.0		
				1991	W	44.8			-40.0		
	1992	C		0.0			-86.0				

		1993	F	0.0			0.0	
		1994	W	74.0			-42.0	
		1995	C	93.0			-18.0	
		1996	F	0.0			0.0	
		1997	W	51.6			-51.0	
		1998	C	113.2			-57.0	
		1999	F	0.0			0.0	
		2000	W	63.0			-88.0	
		2001	C	101.0			-49.0	
		2002	F	0.0			0.0	
		2003	W	64.0			-92.0	
	WCMF	1989	C	56.0	744.7	49.6	-81.0	-637.0 -42.5
		1990	M	0.0			-31.0	
		1991	F	0.0			0.0	
		1992	W	56.0			-26.0	
		1993	C	67.2			-59.0	
		1994	Su	34.7			0.0	
		1995	F	0.0			0.0	
		1996	W	46.0			-83.0	
		1997	C	112.1			-88.0	
		1998	M	34.7			0.0	
		1999	W1	72.0			-47.0	
		2000	W2	63.0			-78.0	
		2001	C	101.0			-51.0	
		2002	Sy	38.0			0.0	
		2003	W1	64.0			-93.0	
	Stratton PG	1989	G	0.0	0.0	0.0	-2.0	-12.0 -0.8
		1990	G	0.0			0.0	
		1991	G	0.0			0.0	
		1992	G	0.0			0.0	
		1993	G	0.0			0.0	
		1994	G	0.0			0.0	
		1995	G	0.0			-5.0	
		1996	G	0.0			-5.0	
		1997	G	0.0			0.0	
		1998	G	0.0			0.0	
		1999	G	0.0			0.0	
		2000	G	0.0			0.0	
		2001	G	0.0			0.0	
		2002	G	0.0			0.0	
		2003	G	0.0			0.0	
	WF	1989	F	0.0	572.1	38.1	0.0	-515.0 -34.3
		1990	W	44.8			-81.0	

	1991	F	0.0			0.0		
	1992	W	54.9			-68.0		
	1993	F	0.0			0.0		
	1994	W	57.2			-65.0		
	1995	F	0.0			0.0		
	1996	W	57.2			-67.0		
	1997	F	0.0			0.0		
	1998	W	48.0			-54.0		
	1999	C	101.0			-72.0		
	2000	Sy	6.0			-26.0		
	2001	W	64.0			-59.0		
	2002	C	101.0			0.0		
	2003	M	38.0			-23.0		
WCF	1989	S	44.8	755.9	50.4	-33.0	-568.0	-37.9
	1990	F	0.0			0.0		
	1991	W	67.2			-72.0		
	1992	C	84.1			-73.0		
	1993	F	0.0			0.0		
	1994	W	74.0			-51.0		
	1995	C	93.0			-35.0		
	1996	F	0.0			0.0		
	1997	W	51.6			-63.0		
	1998	C	113.2			-117.0		
	1999	F	0.0			0.0		
	2000	W	63.0			-48.0		
	2001	C	101.0			-7.0		
	2002	F	0.0			0.0		
	2003	W	64.0			-69.0		
WCMF	1989	S	44.8	782.5	52.2	-45.0	-498.0	-33.2
	1990	M	44.8			-37.0		
	1991	F	0.0			0.0		
	1992	W	56.0			-57.0		
	1993	C	67.2			-67.0		
	1994	Su	34.7			0.0		
	1995	F	0.0			0.0		
	1996	W	57.2			-69.0		
	1997	C	112.1			-31.0		
	1998	M	34.7			-46.0		
	1999	W1	65.0			-55.0		
	2000	W2	63.0			-34.0		
	2001	C	101.0			-11.0		
	2002	Sy	38.0			0.0		
	2003	W1	64.0			-46.0		

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Table S2. Soil bulk density ( $D_b$ ) values by site, treatment, and soil depth.

Site	Treatment	Topographic Position	Soil Depth (cm)	$D_b$ ( $\text{g cm}^{-3}$ )	
SGS-LTER	G	Ridge	0-10	1.42	
			10-30	1.38	
		Swale	0-10	1.1	
			10-30	0.95	
	U	Ridge	0-10	1.42	
			10-30	1.38	
		Swale	0-10	1.1	
			10-30	0.95	
Sterling	PG	Ridge	0-10	1.4	
			10-30	1.35	
	WCF	Ridge	0-10	1.44	
			10-30	1.35	
	WCMF	Ridge	0-10	1.35	
			10-30	1.35	
	WF	Ridge	0-10	1.39	
			10-30	1.35	
	Stratton	PG	Ridge	0-10	1
				10-30	0.95
WCF		Ridge	0-10	1.11	
			10-30	0.95	
WCMF		Ridge	0-10	0.95	
			10-30	0.95	
WF		Ridge	0-10	1.18	
			10-30	0.95	