

Table S1. Field operations for cropping system treatments over the course of the study.

	2007	2008	2009
Operation	----- Spring wheat – Fallow (Spring wheat phase) -----		
Pre-plant herbicide application	Gramoxone Max, 2.2 kg ha ⁻¹ (25 April) MSO, 2.2 kg ha ⁻¹ (25 April)	Roundup Ultra Max, 1.4 kg ha ⁻¹ (23 April) Aim EW, 0.03 kg ha ⁻¹ (23 April) AMS, 4.9 kg ha ⁻¹ (23 April) MSO, 1.1 kg ha ⁻¹ (23 April)	Roundup Weather Max, 1.4 kg ha ⁻¹ (11 May) Aim EW, 0.03 kg ha ⁻¹ (11 May) Request, 0.3 kg ha ⁻¹ (11 May)
Pre-plant herbicide application	Raxil MD, 3.2 g kg ⁻¹ seed (1 May)	Raxil MD, 3.2 g kg ⁻¹ seed (29 April)	Raxil MD, 3.2 g kg ⁻¹ seed (20 May)
Fertilization	33.6 kg N ha ⁻¹ [urea (46-0-0)] (1 May) 11.2 kg P ha ⁻¹ (0-44-0) (1 May)	33.6 kg N ha ⁻¹ [urea (46-0-0)] (29 April) 6.2 kg N ha ⁻¹ and 29.1 kg P ha ⁻¹ (11-52-0) (29 April)	33.6 kg N ha ⁻¹ [urea (46-0-0)] (20 May) 6.2 kg N ha ⁻¹ and 29.1 kg P ha ⁻¹ (11-52-0) (20 May)
Seeding	3.2 million viable seeds ha ⁻¹ (1 May)	3.2 million viable seeds ha ⁻¹ (29 April)	3.2 million viable seeds ha ⁻¹ (20 May)
Post-emergent herbicide application	Puma, 0.6 kg ha ⁻¹ (5 June) Bison, 1.1 kg ha ⁻¹ (5 June) Headline, 0.2 kg ha ⁻¹ (5 June)	Puma, 0.6 kg ha ⁻¹ (10 June) Bison, 1.1 kg ha ⁻¹ (10 June)	Puma, 0.6 kg ha ⁻¹ (20 June) Bison, 1.1 kg ha ⁻¹ (20 June)
Harvest	JD 4420 with chopper (3 August)	JD 4420 with chopper (18 August)	JD 4420 with chopper (10 September)
Post-harvest herbicide application	Roundup Ultra Max, 1.1 kg ha ⁻¹ (29 August) Brash, 1.1 kg ha ⁻¹ (29 August) AMS, 4.9 kg ha ⁻¹ (29 August) MSO, 1.1 kg ha ⁻¹ (29 August)		Gly Star Plus, 2.2 kg ha ⁻¹ (9 November) 2, 4-D LV6, 0.6 kg ha ⁻¹ (9 November) Induce, 0.3 kg ha ⁻¹ (9 November)
Post-harvest herbicide application	Roundup Ultra Max, 1.1 kg ha ⁻¹ (4 October) 2, 4-D LV6, 1.1 kg ha ⁻¹ (4 October) AMS, 4.9 kg ha ⁻¹ (4 October) MSO, 1.1 kg ha ⁻¹ (4 October)		

	2007	2008	2009
Operation	----- Spring wheat – Fallow (Fallow phase) -----		
Herbicide application	Gramoxone Max, 2.2 kg ha ⁻¹ (25 April) MSO, 2.2 kg ha ⁻¹ (25 April)	Roundup Ultra Max, 1.4 kg ha ⁻¹ (23 April) Aim EW, 0.03 kg ha ⁻¹ (23 April) AMS, 4.9 kg ha ⁻¹ (23 April) MSO, 1.1 kg ha ⁻¹ (23 April)	Roundup Weather Max, 1.4 kg ha ⁻¹ (11 May) Aim EW, 0.03 kg ha ⁻¹ (11 May) Request, 0.3 kg ha ⁻¹ (11 May)
Herbicide application	Roundup Ultra Max, 1.1 kg ha ⁻¹ (5 June) Bison, 1.1 kg ha ⁻¹ (5 June) AMS, 4.9 kg ha ⁻¹ (5 June)	RoundupMstr II, 1.1 kg ha ⁻¹ (4 June) Aim EW, 0.03 kg ha ⁻¹ (4 June) Request, 0.3 kg ha ⁻¹ (4 June)	Roundup Weather Max, 1.1 kg ha ⁻¹ (3 June) 2, 4-D LV6, 0.6 kg ha ⁻¹ (3 June) AMS, 9.8 kg ha ⁻¹ (3 June)
Herbicide application	Roundup Ultra Max, 1.1 kg ha ⁻¹ (29 August) Brash, 1.1 kg ha ⁻¹ (29 August) AMS, 4.9 kg ha ⁻¹ (29 August) MSO, 1.1 kg ha ⁻¹ (29 August)	Gly Star Plus, 1.1 kg ha ⁻¹ (11 July) 2, 4-D LV6, 1.1 kg ha ⁻¹ (11 July) Aim, 0.03 kg ha ⁻¹ (11 July) Request, 0.3 kg ha ⁻¹ (11 July)	Gly Star Plus, 1.4 kg ha ⁻¹ (30 June) 2, 4-D LV6, 0.6 kg ha ⁻¹ (30 June) Banvel, 0.03 kg ha ⁻¹ (30 June) Request, 0.3 kg ha ⁻¹ (30 June)
Herbicide application	Roundup Ultra Max, 1.1 kg ha ⁻¹ (4 October) 2, 4-D LV6, 1.1 kg ha ⁻¹ (4 October) AMS, 4.9 kg ha ⁻¹ (4 October) MSO, 1.1 kg ha ⁻¹ (4 October)	Gly Star Plus, 1.4 kg ha ⁻¹ (6 August) 2, 4-D LV6, 1.4 kg ha ⁻¹ (6 August) Aim, 0.03 kg ha ⁻¹ (6 August) AMS, 5.9 kg ha ⁻¹ (6 August) Request, 0.1 kg ha ⁻¹ (6 August)	Roundup Weather Max, 1.1 kg ha ⁻¹ (10 August) 2, 4-D LV6, 1.1 kg ha ⁻¹ (10 August) Request, 0.3 kg ha ⁻¹ (10 August)
Herbicide application		Gly Star Plus, 1.7 kg ha ⁻¹ (16 September) 2, 4-D LV6, 1.1 kg ha ⁻¹ (16 September) AMS, 5.9 kg ha ⁻¹ (16 September) Induce, 0.3 kg ha ⁻¹ (16 September)	Gly Star Plus, 2.2 kg ha ⁻¹ (9 November) 2, 4-D LV6, 0.6 kg ha ⁻¹ (9 November) Induce, 0.3 kg ha ⁻¹ (9 November)

	2007	2008	2009
Operation	----- Continuous spring wheat -----		
Pre-plant herbicide application	Gramoxone Max, 2.2 kg ha ⁻¹ (25 April) MSO, 2.2 kg ha ⁻¹ (25 April)	Roundup Ultra Max, 1.4 kg ha ⁻¹ (23 April) Aim EW, 0.03 kg ha ⁻¹ (23 April) AMS, 4.9 kg ha ⁻¹ (23 April) MSO, 1.1 kg ha ⁻¹ (23 April)	Roundup Weather Max, 1.4 kg ha ⁻¹ (11 May) Aim EW, 0.03 kg ha ⁻¹ (11 May) Request, 0.3 kg ha ⁻¹ (11 May)
Pre-plant herbicide application	Raxil MD, 3.2 g kg ⁻¹ seed (1 May)	Raxil MD, 3.2 g kg ⁻¹ seed (29 April)	Raxil MD, 3.2 g kg ⁻¹ seed (20 May)
Fertilization	67.2 kg N ha ⁻¹ [urea (46-0-0)] (1 May) 11.2 kg P ha ⁻¹ (0-44-0) (1 May)	67.2 kg N ha ⁻¹ [urea (46-0-0)] (29 April) 6.2 kg N ha ⁻¹ and 29.1 kg P ha ⁻¹ (11-52-0) (29 April)	67.2 kg N ha ⁻¹ [urea (46-0-0)] (20 May) 6.2 kg N ha ⁻¹ and 29.1 kg P ha ⁻¹ (11-52-0) (20 May)
Seeding	3.2 million viable seeds ha ⁻¹ (1 May)	3.2 million viable seeds ha ⁻¹ (29 April)	3.2 million viable seeds ha ⁻¹ (20 May)
Post-emergent herbicide application	Puma, 0.6 kg ha ⁻¹ (5 June) Bison, 1.1 kg ha ⁻¹ (5 June) Headline, 0.2 kg ha ⁻¹ (5 June)	Puma, 0.6 kg ha ⁻¹ (10 June) Bison, 1.1 kg ha ⁻¹ (10 June)	Puma, 0.6 kg ha ⁻¹ (20 June) Bison, 1.1 kg ha ⁻¹ (20 June)
Harvest	JD 4420 with chopper (3 August)	JD 4420 with chopper (26 August)	JD 4420 with chopper (10 September)
Post-harvest herbicide application	Roundup Ultra Max, 1.1 kg ha ⁻¹ (29 August) Brash, 1.1 kg ha ⁻¹ (29 August) AMS, 4.9 kg ha ⁻¹ (29 August) MSO, 1.1 kg ha ⁻¹ (29 August)		Gly Star Plus, 2.2 kg ha ⁻¹ (9 November) 2, 4-D LV6, 0.6 kg ha ⁻¹ (9 November) Induce, 0.3 kg ha ⁻¹ (9 November)
Post-harvest herbicide application	Roundup Ultra Max, 1.1 kg ha ⁻¹ (4 October) 2, 4-D LV6, 1.1 kg ha ⁻¹ (4 October) AMS, 4.9 kg ha ⁻¹ (4 October) MSO, 1.1 kg ha ⁻¹ (4 October)		

	2007	2008	2009
Operation	----- Spring wheat – Safflower – Rye (Spring wheat phase) -----		
Pre-plant herbicide application	Gramoxone Max, 2.2 kg ha ⁻¹ (25 April) MSO, 2.2 kg ha ⁻¹ (25 April)	Roundup Ultra Max, 1.4 kg ha ⁻¹ (23 April) Aim EW, 0.03 kg ha ⁻¹ (23 April) AMS, 4.9 kg ha ⁻¹ (23 April) MSO, 1.1 kg ha ⁻¹ (23 April)	Roundup Weather Max, 1.4 kg ha ⁻¹ (11 May) Aim EW, 0.03 kg ha ⁻¹ (11 May) Request, 0.3 kg ha ⁻¹ (11 May)
Pre-plant herbicide application	Raxil MD, 3.2 g kg ⁻¹ seed (1 May)	Raxil MD, 3.2 g kg ⁻¹ seed (29 April)	Raxil MD, 3.2 g kg ⁻¹ seed (20 May)
Fertilization	67.2 kg N ha ⁻¹ [urea (46-0-0)] (1 May) 11.2 kg P ha ⁻¹ (0-44-0) (1 May)	67.2 kg N ha ⁻¹ [urea (46-0-0)] (29 April) 6.2 kg N ha ⁻¹ and 29.1 kg P ha ⁻¹ (11-52-0) (29 April)	67.2 kg N ha ⁻¹ [urea (46-0-0)] (20 May) 6.2 kg N ha ⁻¹ and 29.1 kg P ha ⁻¹ (11-52-0) (20 May)
Seeding	3.2 million viable seeds ha ⁻¹ (1 May)	3.2 million viable seeds ha ⁻¹ (29 April)	3.2 million viable seeds ha ⁻¹ (20 May)
Post-emergent herbicide application	Puma, 0.6 kg ha ⁻¹ (5 June) Bison, 1.1 kg ha ⁻¹ (5 June) Headline, 0.2 kg ha ⁻¹ (5 June)	Puma, 0.6 kg ha ⁻¹ (10 June) Bison, 1.1 kg ha ⁻¹ (10 June)	Puma, 0.6 kg ha ⁻¹ (20 June) Bison, 1.1 kg ha ⁻¹ (20 June)
Harvest	JD 4420 with chopper (3 August)	JD 4420 with chopper (18 August)	JD 4420 with chopper (10 September)
Post-harvest herbicide application	Roundup Ultra Max, 1.1 kg ha ⁻¹ (29 August) Brash, 1.1 kg ha ⁻¹ (29 August) AMS, 4.9 kg ha ⁻¹ (29 August) MSO, 1.1 kg ha ⁻¹ (29 August)	Gly Star Plus, 2.2 kg ha ⁻¹ (9 November) 2, 4-D LV6, 0.6 kg ha ⁻¹ (9 November) Induce, 0.3 kg ha ⁻¹ (9 November)	Roundup Ultra Max, 1.1 kg ha ⁻¹ (29 August) Brash, 1.1 kg ha ⁻¹ (29 August) AMS, 4.9 kg ha ⁻¹ (29 August) MSO, 1.1 kg ha ⁻¹ (29 August)
Post-harvest herbicide application	Roundup Ultra Max, 1.1 kg ha ⁻¹ (4 October) 2, 4-D LV6, 1.1 kg ha ⁻¹ (4 October) AMS, 4.9 kg ha ⁻¹ (4 October) MSO, 1.1 kg ha ⁻¹ (4 October)		

	2007	2008	2009
Operation	----- Spring wheat – Safflower – Rye (Safflower phase) -----		
Pre-plant herbicide application	Sonolan 10Gm, 12.2 kg ha ⁻¹ (22 March)		
Pre-plant herbicide application	Gramoxone Max, 2.2 kg ha ⁻¹ (25 April) MSO, 2.2 kg ha ⁻¹ (25 April)	Roundup Ultra Max, 1.4 kg ha ⁻¹ (23 April) Aim EW, 0.03 kg ha ⁻¹ (23 April) AMS, 4.9 kg ha ⁻¹ (23 April) MSO, 1.1 kg ha ⁻¹ (23 April)	Roundup Weather Max, 1.4 kg ha ⁻¹ (11 May) Aim EW, 0.03 kg ha ⁻¹ (11 May) Request, 0.3 kg ha ⁻¹ (11 May)
Pre-plant herbicide application	Raxil MD, 3.2 g kg ⁻¹ seed (1 May)	Raxil MD, 3.2 g kg ⁻¹ seed (29 April)	Raxil MD, 3.2 g kg ⁻¹ seed (20 May)
Fertilization	67.2 kg N ha ⁻¹ [urea (46-0-0)] (1 May) 11.2 kg P ha ⁻¹ (0-44-0) (1 May)	67.2 kg N ha ⁻¹ [urea (46-0-0)] (29 April) 6.2 kg N ha ⁻¹ and 29.1 kg P ha ⁻¹ (11-52-0) (29 April)	67.2 kg N ha ⁻¹ [urea (46-0-0)] (20 May) 6.2 kg N ha ⁻¹ and 29.1 kg P ha ⁻¹ (11-52-0) (20 May)
Seeding	741,000 viable seeds ha ⁻¹ (1 May)	741,000 viable seeds ha ⁻¹ (29 April)	741,000 viable seeds ha ⁻¹ (20 May)
Seeding (replanted)		741,000 viable seeds ha ⁻¹ (10 June)	
Post-emergent herbicide application	Assure II, 1.1 kg ha ⁻¹ (11 June)	Harmony GT, 0.01 kg ha ⁻¹ (9 July) APM28, 4.4 kg ha ⁻¹ (9 July)	Poast, 1.1 kg ha ⁻¹ (10 July) Super B, 1.7 kg ha ⁻¹ (10 July)
Post-emergent herbicide application	Quadris, 0.4 kg ha ⁻¹ (27 July)	Poast, 1.7 kg ha ⁻¹ (15 July) Super B, 1.7 kg ha ⁻¹ (15 July)	Quadris, 1.1 kg ha ⁻¹ (10 August)
Post-emergent herbicide application	Roundup Ultra Max, 1.1 kg ha ⁻¹ (29 August) Brash, 1.1 kg ha ⁻¹ (29 August) AMS, 4.9 kg ha ⁻¹ (29 August) MSO, 1.1 kg ha ⁻¹ (29 August)		
Harvest	JD 4420 with chopper (19 September)	JD 4420 with chopper (8 October)	JD 4420 with chopper (6 November)
Post-harvest herbicide application	Roundup Ultra Max, 1.1 kg ha ⁻¹ (4 October) 2, 4-D LV6, 1.1 kg ha ⁻¹ (4 October) AMS, 4.9 kg ha ⁻¹ (4 October) MSO, 1.1 kg ha ⁻¹ (4 October)		Gly Star Plus, 2.2 kg ha ⁻¹ (9 November) 2, 4-D LV6, 0.6 kg ha ⁻¹ (9 November) Induce, 0.3 kg ha ⁻¹ (9 November)

	2007	2008	2009
Operation	----- Spring wheat – Safflower – Rye (Rye phase) -----		
Pre-plant herbicide application	VitaVax, 2.2 g kg ⁻¹ seed (29 September)	VitaVax, 2.2 g kg ⁻¹ seed (28 September)	VitaVax, 2.2 g kg ⁻¹ seed (4 November)
Fertilization	6.2 kg N ha ⁻¹ and 29.1 kg P ha ⁻¹ (11-52-0) (29 September)	6.2 kg N ha ⁻¹ and 29.1 kg P ha ⁻¹ (11-52-0) (28 September)	6.2 kg N ha ⁻¹ and 29.1 kg P ha ⁻¹ (11-52-0) (4 November)
Seeding	3.2 million viable seeds ha ⁻¹ (29 September)	3.2 million viable seeds ha ⁻¹ (28 September)	3.2 million viable seeds ha ⁻¹ (4 November)
Post-emergent herbicide application	Bison, 1.1 kg ha ⁻¹ (11 May)	Roundup Ultra Max, 1.1 kg ha ⁻¹ (16 June) Sterling, 0.3 kg ha ⁻¹ (16 June) Request, 0.3 kg ha ⁻¹ (16 June)	Gly Star Plus, 1.4 kg ha ⁻¹ (30 June) 2, 4-D LV6, 0.6 kg ha ⁻¹ (30 June) Banvel, 0.3 kg ha ⁻¹ (30 June) Request, 0.3 kg ha ⁻¹ (30 June)
Fall herbicide application			Roundup Weather Max, 1.1 kg ha ⁻¹ (10 August) 2, 4-D LV6, 1.1 kg ha ⁻¹ (10 August) Request, 0.3 kg ha ⁻¹ (10 August)
Fall herbicide application	Bison, 1.1 kg ha ⁻¹ (25 October)		Gly Star Plus, 2.2 kg ha ⁻¹ (9 November) 2, 4-D LV6, 0.6 kg ha ⁻¹ (9 November) Induce, 0.3 kg ha ⁻¹ (9 November)