

# **Comparison of Phase II and Phase III Crop Sequence Experiments**



## List of Crop Species in the Crop Sequence Experiments

There were four crops  
that were common  
to both experiments.

### Phase II

Cool-season dominant

Barley

**Canola**

Crambe

Dry bean

**Dry pea**

Flax

Safflower

**Spring wheat**

Soybean

**Sunflower**

### Phase III

Warm-season dominant

Buckwheat

**Canola**

Chickpea

Corn

**Dry pea**

Grain sorghum

Lentil

Proso millet

**Spring wheat**

**Sunflower**

# Crop Sequence Experiments Layout and Calendar

**10 crops seeded in strips the first year: the “residue” crops.**

1	2	3	4	5	6	7	8	9	10	3
11	12	13	14	15	16	17	18	19	20	10
21	22	23	24	25	26	27	28	29	30	8
31	32	33	34	35	36	37	38	39	40	5
41	42	43	44	45	46	47	48	49	50	4
51	52	53	54	55	56	57	58	59	60	1
61	62	63	64	65	66	67	68	69	70	9
71	72	73	74	75	76	77	78	79	80	7
81	82	83	84	85	86	87	88	89	90	2
91	92	93	94	95	96	97	98	99	100	6
7	4	1	5	9	6	10	3	8	2	

**10 crops seeded in perpendicular strips the second year: the “matrix” (or “expected”) crops.**

**There were two replications in time one year apart at two nearby sites**

## **Phase II Crop Sequence Experiment:**

**1997, 1998: Small grain preceeding crops (barley, winter wheat)**

**1998, 1999: 10 residue crops**

**1999, 2000: 10 matrix (expected) crops**

**2000.2001: Spring wheat follow crops**

## **Phase III Crop Sequence Experiment:**

**2001, 2002: Spring wheat preceeding crops**

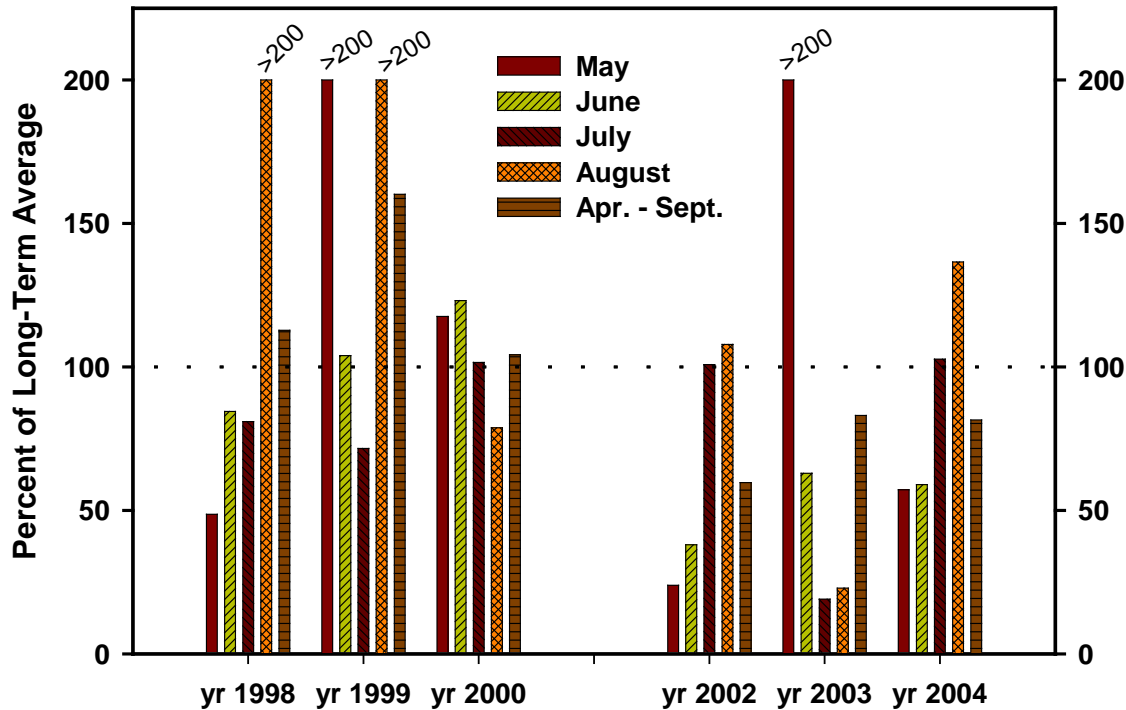
**2002, 2003: 10 residue crops**

**2003, 2004: 10 matrix (expected) crops**

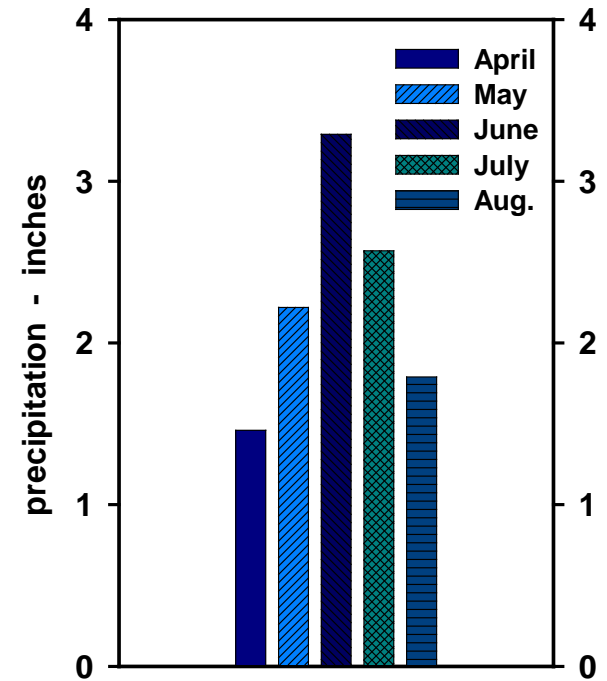
**2004, 2005: Spring wheat follow crops**

# Precipitation during the Experiments

Relative Precipitation during Crop Sequence Experiments

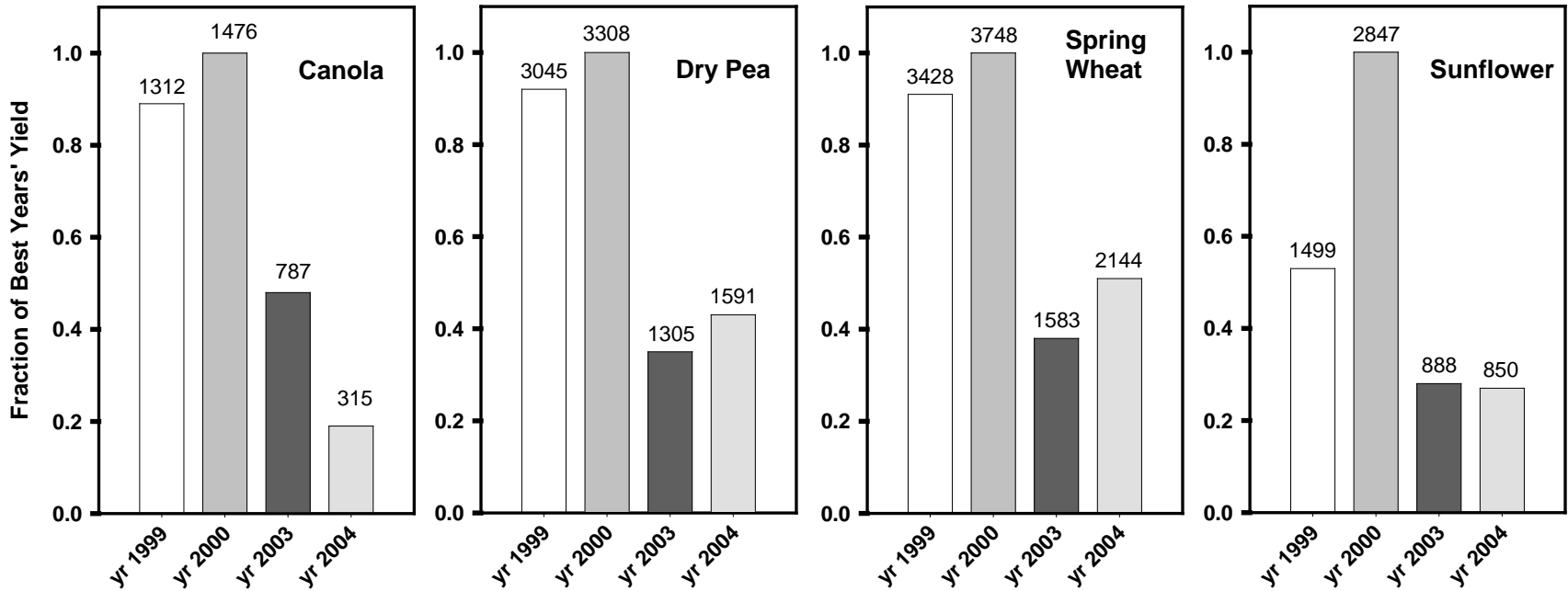


Long-term average, 1914 - 2006



Precipitation during the Phase II crop sequence experiment was either about average (2002, 2000) or above average (1999). Precipitation during the Phase III crop sequence experiment was below average for all three years 2002 through 2004, and was seriously maldistributed in 2003.

# Yields of Common 4 Crops Relative to Yield in Best Year (2000)



Seed yields of four crop species present in both Phase II (1999, 2000) and Phase III (2003, 2004) crop sequence experiments. Yield values shown by bars are relative to value for each crop in year of highest yields, 2000. Values above each bar are actual yields in kg/ha (1 lb/acre x 1.121 = 1 kg/ha).

# Crop Sequence Effects in Phase II Experiment

Units are percent increase or decrease in seed yield of expected crop caused by preceding residue crop.

Residue crops 1998, 1999	Phase II CSE: Percent Seed Yield Increment or Decrement: 1999 and 2000 Crops										
	Year	Dry pea	Barley	Crambe	Spring wheat	Canola	Dry bean	Flax	Soy-bean	Saf-flower	Sun-flower
Dry pea	1999	2	1	31	-7	11	13	-4	3	17	12
	2000	-13	3	-7	2	2	14	7	-4	17	28
Barley	1999	1	-3	12	1	7	24	10	2	24	12
	2000	1	-17	23	-1	9	-1	-77	11	18	0
Crambe	1999	-15	8	-2	-4	-6	-10	9	-1	-3	10
	2000	6	10	1	8	-2	-44	-1	-28	-12	-27
Spring wheat	1999	20	2	4	2	-5	-29	6	-10	15	-5
	2000	2	7	9	-14	2	9	19	-1	17	9
Canola	1999	-8	1	-6	7	2	16	10	-1	14	4
	2000	-10	-7	-77	0	-22	-17	-10	4	-41	-7
Dry bean	1999	1	-9	-13	-1	2	10	2	9	0	2
	2000	4	4	-12	6	15	2	20	-18	-16	29
Flax	1999	5	0	-1	9	12	5	-54	-3	-3	12
	2000	0	10	23	1	-1	7	-57	7	36	11
Soy-bean	1999	-9	-5	-8	3	-10	2	18	22	-1	-5
	2000	15	-3	7	-9	-10	9	33	18	-9	-1
Saf-flower	1999	0	-1	-16	-10	-12	-24	-7	-16	-49	-24
	2000	7	2	-13	11	9	4	37	-17	-25	-16
Sun-flower	1999	3	5	-2	1	-1	-8	9	-5	-15	-17
	2000	-11	-9	46	-3	-2	16	29	29	14	-26

Residue (left side) and expected (top) crops are listed in order of increasing average water use.

# Crop Sequence Effects in Phase III Experiment

Units are percent increase or decrease in seed yield of expected crop caused by preceding residue crop.

Residue crops 2002, 2003	Phase III CSE: Percent Seed Yield Increment or Decrement: 2003 and 2004 Crops										
	Year	Dry pea	Lentil	Chick- pea	Buck- wheat	Proso millet	Canola	Spring wheat	Grain sorghum	Corn	Sun- flower
Dry pea	2003	-14	9	0	58	27	-4	5	64	55	10
	2004	-13	26	36	31	26	41	23	x x x	29	43
Lentil	2003	19	-9	6	7	24	-12	6	67	41	34
	2004	-12	-27	-42	-1	10	46	13	x x x	19	-15
Chick- pea	2003	19	-6	3	17	18	9	-1	22	58	-17
	2004	-28	-39	-61	-12	4	6	3	x x x	17	34
Buck- wheat	2003	-14	2	-14	-17	9	19	3	-13	-40	20
	2004	-2	-13	23	-1	-7	-3	-8	x x x	-48	-93
Proso millet	2003	6	20	12	10	-23	9	-1	-60	-58	-5
	2004	51	9	15	-13	-6	-7	0	x x x	23	37
Canola	2003	-2	3	-2	-13	8	-6	2	29	44	28
	2004	-13	14	30	10	4	9	-6	x x x	-23	-14
Spring wheat	2003	3	17	11	-15	-13	-2	-3	25	-8	27
	2004	37	63	29	18	3	-9	19	x x x	31	26
Grain sorghum	2003	-17	-22	4	-16	-32	11	-2	-58	-8	2
	2004	-21	-21	-15	-24	-12	-56	-15	x x x	-12	-11
Corn	2003	-6	9	-4	-7	-21	-1	5	-35	-58	-35
	2004	-7	-13	2	-3	-14	3	-25	x x x	-20	4
Sun- flower	2003	4	-24	-16	-23	2	-23	-14	-42	-26	-64
	2004	11	1	-17	-3	-11	-28	-3	x x x	-17	-11

Residue (left side) and expected (top) crops are listed in order of increasing average water use.

## Average Crop Sequence Effect of Residue Crops on Expected Crops

Units are percent increase of decrease in seed yield of expected crop caused on average by preceding residue crop.

Residue crop	Phase II Crop Seq. Expt.				Phase III Crop Seq. Expt.		
	1999	2000	2 year avg.		2003	2004	2 year avg.
Dry bean	+0.1	+3.5	+1.8				
Dry pea	+8.0	+5.0	+6.5		+21.2	+29.8	+25.5
Soybean	+0.7	+5.0	+2.9				
Lentil					+18.5	-1.1	+8.7
Spring wheat	+0.1	+5.8	+3.0		+4.0	+27.0	+15.5
Barley	+9.1	-3.4	+2.9				
Canola	+3.7	-18.7	-7.5		+9.2	+1.4	+5.3
Corn					-15.3	-9.1	-12.2
Sunflower	-2.9	+8.3	+2.7		-22.6	-9.7	-16.2
Crop-on-same crop	-8.6	-15.3	-12.0		-24.9	-13.1	-19.0

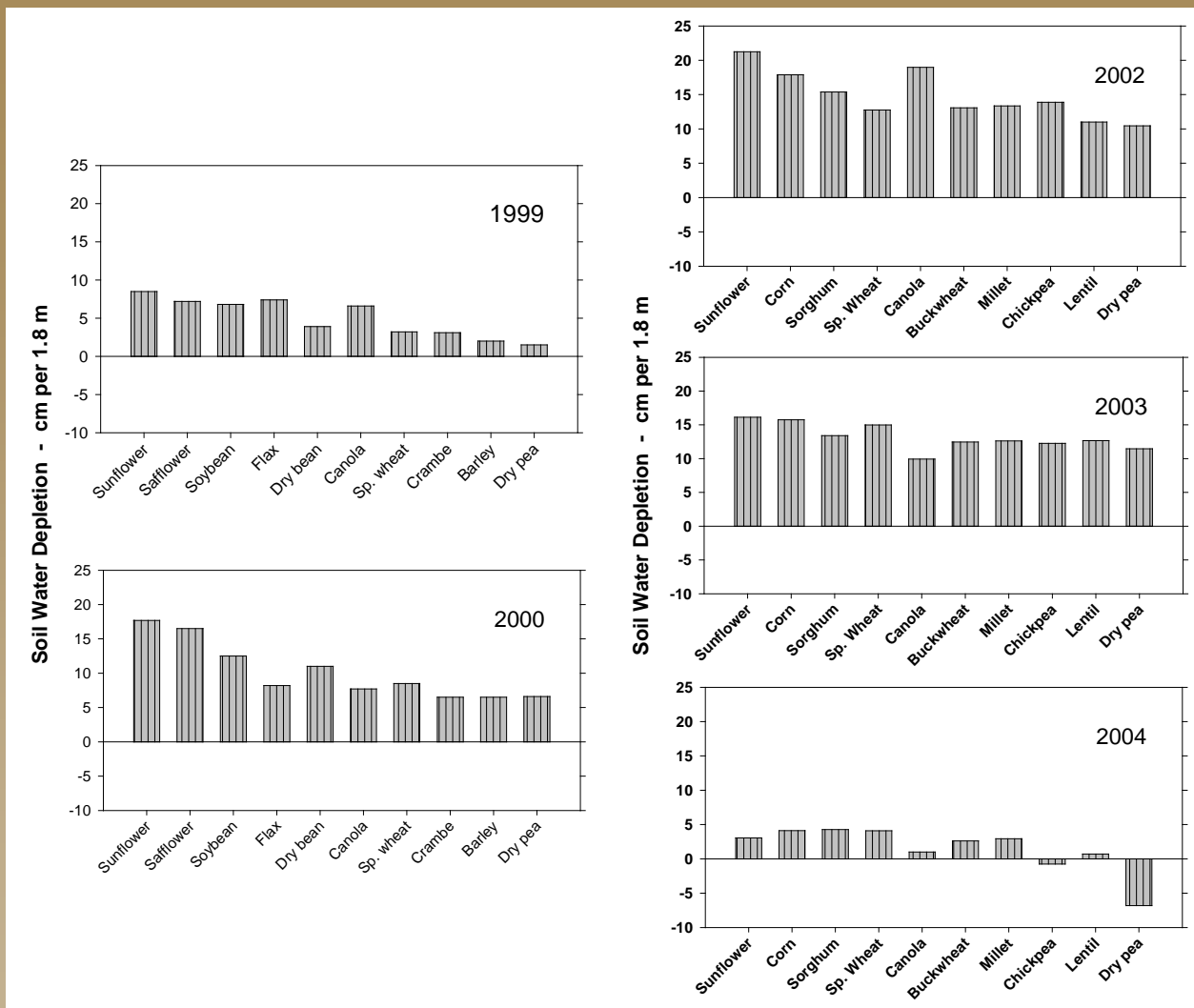


## Summary of Crop Sequential Effects Observed in the Experiments

1. Crop sequence effects were generally double or greater in the Phase III experiment compared with the Phase II experiment due to considerably drier conditions during the former experiment.
2. Legume crops had positive effects on succeeding crops in most cases. Low water-using dry pea had very positive effects on succeeding crops, especially under the drier conditions of the Phase III experiment.
3. Crops growing on their own residues (stacked crops) had reduced yields in the majority of cases during both experiments.
4. The heavy water-using crops sunflower and corn exhibited considerably negative effects on following crops during the drier conditions of the Phase III experiment. However, sunflower exhibited positive crop sequential effects during one year of wetter conditions in the Phase II experiment.
5. On average, spring wheat (both experiments) and barley (only present in Phase II) exhibited positive effects on following crops.

# Comparison of Soil Water Depletion for Crop Sequence Experiments

**Phase II  
Experiment**



**Phase III  
Experiment**

Average soil water depletion (SWD) as a percentage of water use varied considerably from year to year. SWD was low in 1999 because higher than average precipitation met much of water use. SWD was low in 2004 because of depleted springtime soil water followed by midseason rainfall. Crops are arranged in order of experiment-wide average soil water depletion.

# Relative Soil Water Depletion for Major Crops

**Relative scale:**

**Sunflower = 10**

**Dry Pea = 0**

Soil water depletion (SWD) differences indicate differences in water use ( $WU = SWD + \text{seasonal precip.}$ , where precip. is same for all crops.). Sunflower was the heaviest water user followed by corn and soybean. Dry pea had the lowest relative water use followed by barley and lentil. Spring wheat had the best overwinter snowcapture, which increased its soil water status in spring. Canola had notably variable SWD and hence, water use.

	Phase II	Phase III
Sunflower	10.0	10.0
Corn	---	8.1
Soybean	6.3	---
Flax	4.3	---
Canola	3.6	6.4
Sp. Wheat	2.2	4.1
Chickpea	---	2.9
Proso Millet	---	2.8
Barley	0.5	---
Lentil	---	1.2
Dry Pea	0	0