

# MAXIMUM YIELD RESEARCH ON SOYBEANS IN THE USA

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**3<sup>o</sup>** SIMPÓSIO SOBRE ROTAÇÃO SOJA/MILHO NO PLANTIO DIRETO  
Piracicaba-SP, Julho 10-12, 2002



# 1966-68 National Soybean Contest Yield Records.

Year		kg/ha
1966	Pick, Chenoa, IL	6203
	Beason, Hamburg, IA	6203
	Van Dyke, Trenton, TN	5296
	Lefferdink, Firth, NE	5009
	Huser, Neodesha, KS	4809
1967	Chandler, Herrick, IL	6350
	Storeholder, Delta, OH	6283
	Kimmons, Ozark, MO	6170
	Harms, Allison, IA	6030
	Jacks, Thornton, MS	6010
1968	Kimmons, Ozark, MO	7310
	Tarnow, Rolling Prairie, IN	6890
	Pick, Chenoa, IL	6717
	Peeler, Union, NE	6710
	Glaser, Stewart, IL	6497

ten highest yields out of 77 Literature Citations on the yield response of soybeans to irrigation (from Van Doren and Reicosky, 1987).

Location	References	Irrigated	Non-Irrigated	Incr.
		------(kg/ha)-----		
Mississippi	Heatherly, 1984	4035	4022	13
Florida	Jones et al., 1982	3942	2008	1934
Mississippi	Heatherly, 1984	3909	3715	194
Nebraska	Al-Ithawi, et al., 1980	3869	3182	687
Georgia	Ashley & Ethridge, 1798	3649	2041	1608
Mississippi	Heatherly, 1984	3628	3508	120
Minnesota	Reicosky	3562	3035	527
Mississippi	Heatherly, 1984	3528	1334	2194
Arkansas	Jang and Scott, 1980	3455	907	2548
Minnesota	Reicosky	<u>3402</u>	<u>3422</u>	<u>20</u>
<b>Mean</b>		<b>3702</b>	<b>2721</b>	<b>980</b>

## Highest yields reported from maximum yield research, 1980-1987.

Location	Researcher	Year	Yield
			(kg/ha)
New Jersey	Flannery	1980	6270
		1981	6203
		1982	7270
		1983	7897
Ohio	Cooper	1982	6817
		1985	6710
		1986	6003
		1987	6803
Australia	Lawn, et al.	1984 I	8004
		1984 II	8604











# Effect of early lodging on yield of Wayne soybeans, Ashland, IL, 1969.

Row Spacing (cm)	Seeding Rate (seeds/ha)	Yield	
		Lodged (kg/ha)	Non-lodged (kg/ha)
50	375,000	3302	4255
	562,500	2975	4736
	750,000	<u>3695</u>	<u>4722</u>
	Mean	3322	4569
17	375,000	3869	5042
	562,500	4456	4842
	750,000	<u>3622</u>	<u>4422</u>
	Mean	3982	4769





**Yield response of the soybean cultivars, Corsoy and Williams,  
to 17 cm rows, Urbana and Saybrook, IL, 1973-75.**

		1973	1974		1975		1973-75
		Urbana <sup>1</sup>	Urbana <sup>1</sup>	Saybrook	Urbana <sup>1</sup>	Saybrook	Mean
No. of tests		3	6	2	4	5	20
------(kg/ha)-----							
Corsoy	76 cm	3288	4115	3802	3435	3122	3648
	17 cm	4055	5036	4282	5062	3808	4582
	Incr.	767	920	480	1627	687	934
Williams	76 cm	3662	3909	3575	3228	3428	3622
	17 cm	4055	4562	4009	3869	3775	4155
	Incr.	394	654	434	640	347	534

<sup>1</sup> Irrigated.















## Comparison of row spacing and planting equipment, Urbana, IL, 1975.<sup>1</sup>

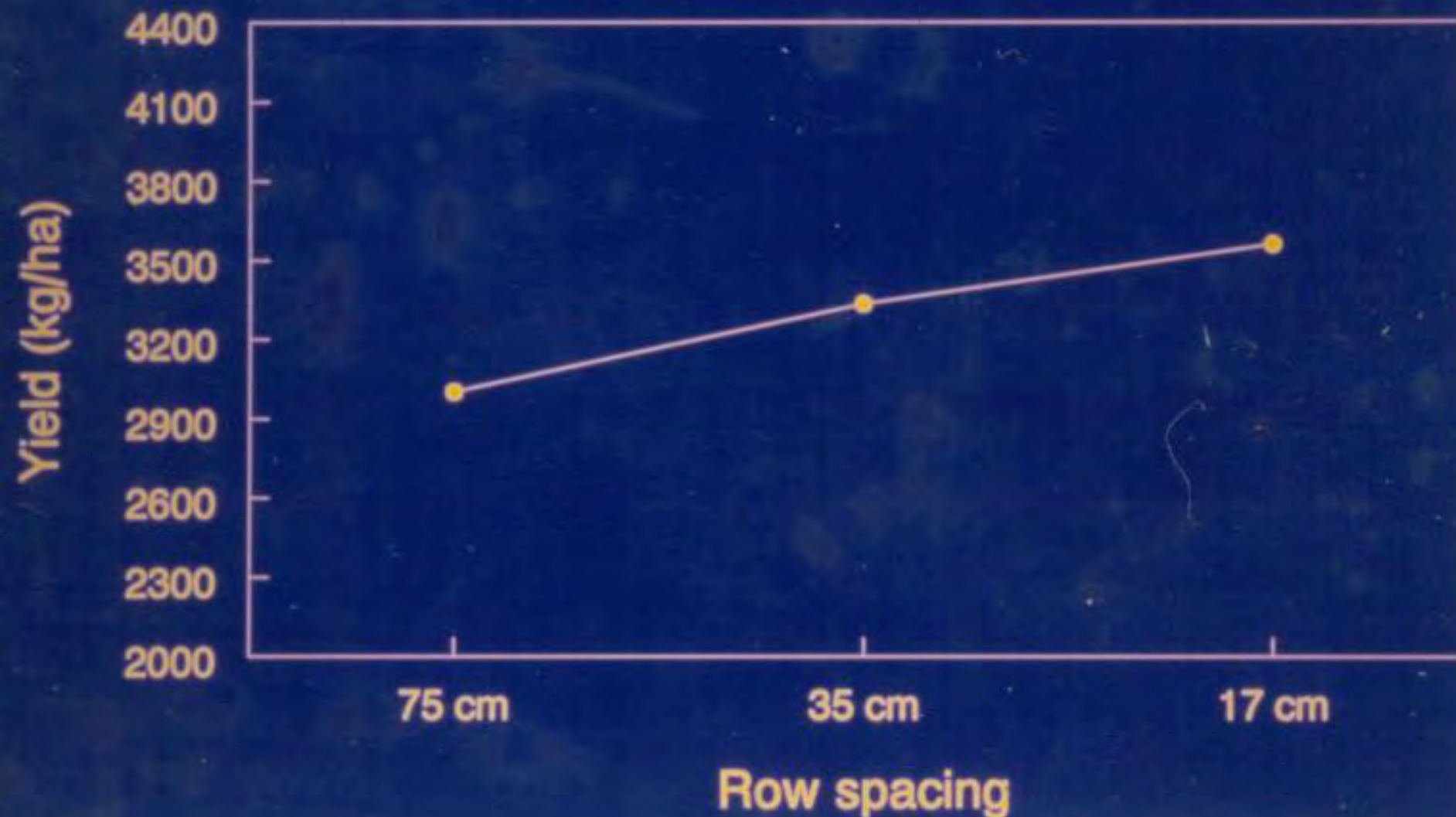
Method	Row Width	Corsoy		Williams	
		Yield	Incr.	Yield	Incr.
	(cm)	(kg/ha)		(kg/ha)	
End wheel drill + Cultipacker	17	4222	+794	-----	-----
Press drill + Cultipacker	17	3955	+527	3608	-127
Press drill + Harrowgator	17	3902	+474	3642	- 93
Unit planter	76	3428	-----	3735	-----

<sup>1</sup> Treflan + Sencor used for weed control.

## Yield response of soybeans to reduced row widths, Wooster, OH, 1977-82

Year	75 cm	35 cm	17 cm
	----- (kg/ha) -----		
1977	3275	3548	3802
1979	3115	3415	3588
1980	2621	3042	3402
1981	3188	3515	3655
1982	<u>2808</u>	<u>3162</u>	<u>3375</u>
5-yr. mean	3002	3335	3562

# Yield response of soybeans to reduced row widths, Wooster, OH, 1977-82



Yield response of soybeans to reduced row width, Wooster, OH , 1977-80.

Year	75 cm	35 cm	17 cm
	(kg/ha)	(kg/ha)	(kg/ha)
1977	3275	3548	3802
1978	2915	2788	2806
1979	3115	3415	3588
1980	2621	3042	3402

## Percentage of soybean acreage solid-seeded in Midwest states, 1989-96<sup>1</sup>

	1989	1990	1991	1992	1993	1994	1995	1996
OH	31.7	43.6	48.0	54.6	63.8	66.5	68.0	69.5
IN	19.5	25.3	32.4	35.7	56.0	58.0	68.0	69.4
MO	23.8	26.8	32.6	38.0	41.9	46.4	53.1	48.4
IL	18.8	25.4	23.6	33.5	38.0	45.6	57.1	53.2
MN	20.7	11.7	23.4	24.4	29.6	36.2	25.0	30.8
IA	-----	4.3	7.9	18.3	23.2	28.3	28.2	28.3
NE	11.8	14.3	11.1	13.7	18.3	21.6	23.6	21.0

<sup>1</sup> USDA - Agricultural Statistics Board - Crop Production, November 1996.





**POTAFOS - 3º Simpósio sobre Rotação Soja/Milho no Plantio Direto**





	30" ROWS		7" ROWS	
	YIELD	INC	YIELD	INC
WILLIAMS	49.1	—	58.5	—
L74D-609	54.4	+5.3	74.2	+15.7
L74D-611	54.8	+5.7	80.0	+21.5
L74D 615	53.5	+4.4	68.8	+9.5
L74D 618	47.5	-1.6	72.3	+13.8

WILLIAMS      L74D 609      L74D 611      L74D 615      L74D 618



**Yield advantage of semidwarf soybean varieties in high a yield environment, Saybrook, IL, 1976.**

Variety	<u>75 cm rows</u>		<u>17 cm rows</u>	
	Yield	Incr	Yield	Incr
	--- (kg/ha) ---		---(kg/ha)---	
Williams	3275	-----	3902	-----
Gnome	3168	- 107	4822	+ 920
Elf	3655	+380	5336	+1,434
Pixie	3628	+353	4949	+1,047

## Yield of semidwarf soybean varieties in three high-yield environments in Ohio in 1979.

Variety <sup>2</sup>	Wooster <sup>1</sup>		S. Charleston		Hoytville		3- yr. Mean	
	75 cm	17 cm	75 cm	17 cm	75 cm	17 cm	75 cm	17 cm
----- (kg/ha) -----								
Williams	2841	4362	3442	4536	3475	3962	3255	4289
Pixie	3195	5156	4099	5149	3715	4756	3662	5022
Sprite	3302	5269	4342	5549	3895	5610	3848	5476
Hobbit	3288	5263	4289	5650	3922	5423	3835	5443

<sup>1</sup> Irrigated.

<sup>2</sup> Seeding rate per hectare 375,000 in 75 cm and 562,500 in 17 cm for indeterminate varieties and 562,500 in 75 cm and 750,000 in 17 cm for determinate semidwarf varieties.

**Surface irrigated (sprinkler system) Soybean Maximum Yield  
Research, Wooster, OH 1985.<sup>1</sup>**

Variety	Yield		Maturity	Height	Lodging
	17 cm	75 cm			
	(kg/ha)	(kg/ha)	(date)	(cm)	(score) <sup>2</sup>
Sprite 87	6710	4376	10/8	62	1.8
Sprite	6236	4576	10/7	70	2.0
HC80-585	5983	4362	10/8	68	1.5
Hobbit	5783	4449	10/8	60	1.8
Asgrow 3127	5683	4069	10/9	95	3.5
Pella	5663	4602	10/3	100	4.5
Williams 82	5349	3568	10/12	98	5.0

<sup>1</sup> Weekly application of 5 cm of water.    <sup>2</sup> 1 = erect, 5 = prostrate.





**POTAFOS - 3º Simpósio sobre Rotação Soja/Milho no Plantio Direto**

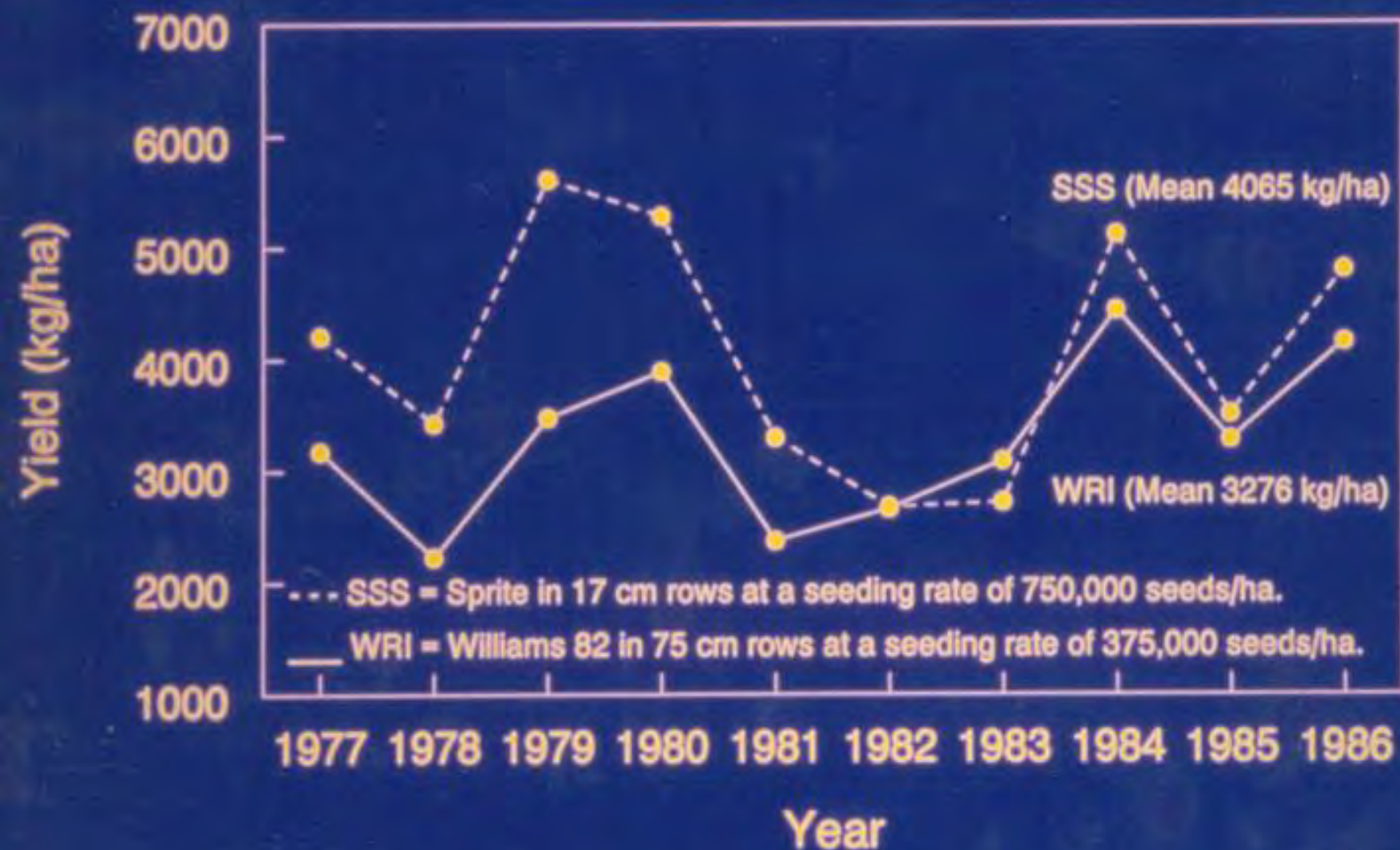
**Year effect on the yield advantage of a solid-seeded semidwarf (SSS) system over a wide-row indeterminate (WRI) system, Hoytville, OH, 1977-1986.<sup>1</sup>**

Year	75 cm	17 cm	Yield advantage	
	Williams (WRI)	Sprite (SSS)		
	------(kg/ha)-----			(%)
1977	3175	4209	1034	32.6
1978	2228	3428	1201	53.9
1979	3475	5610	2135	61.4
1980	3889	5283	1394	35.8
1981	2374	3295	921	38.8
1982	2661	2675	14	0.5
1983	3088	2721	-367	-11.9
1984	4436	5116	680	15.3
1985	3282	3508	226	6.9
1986	<u>4155</u>	<u>4802</u>	<u>647</u>	<u>15.6</u>
10-yr mean	3276	4065	789	24.0

<sup>1</sup> LSD (0.05) between systems within years = 467 kg/ha, LSD (0.05) between systems averaged over 10 yr = 147 kg/ha.



Year effect on the yield advantage of the solid-seeded-semidwarf (SSS) system over the wide-row indeterminate (WRI) system, Hoytville, OH, 1977-86.

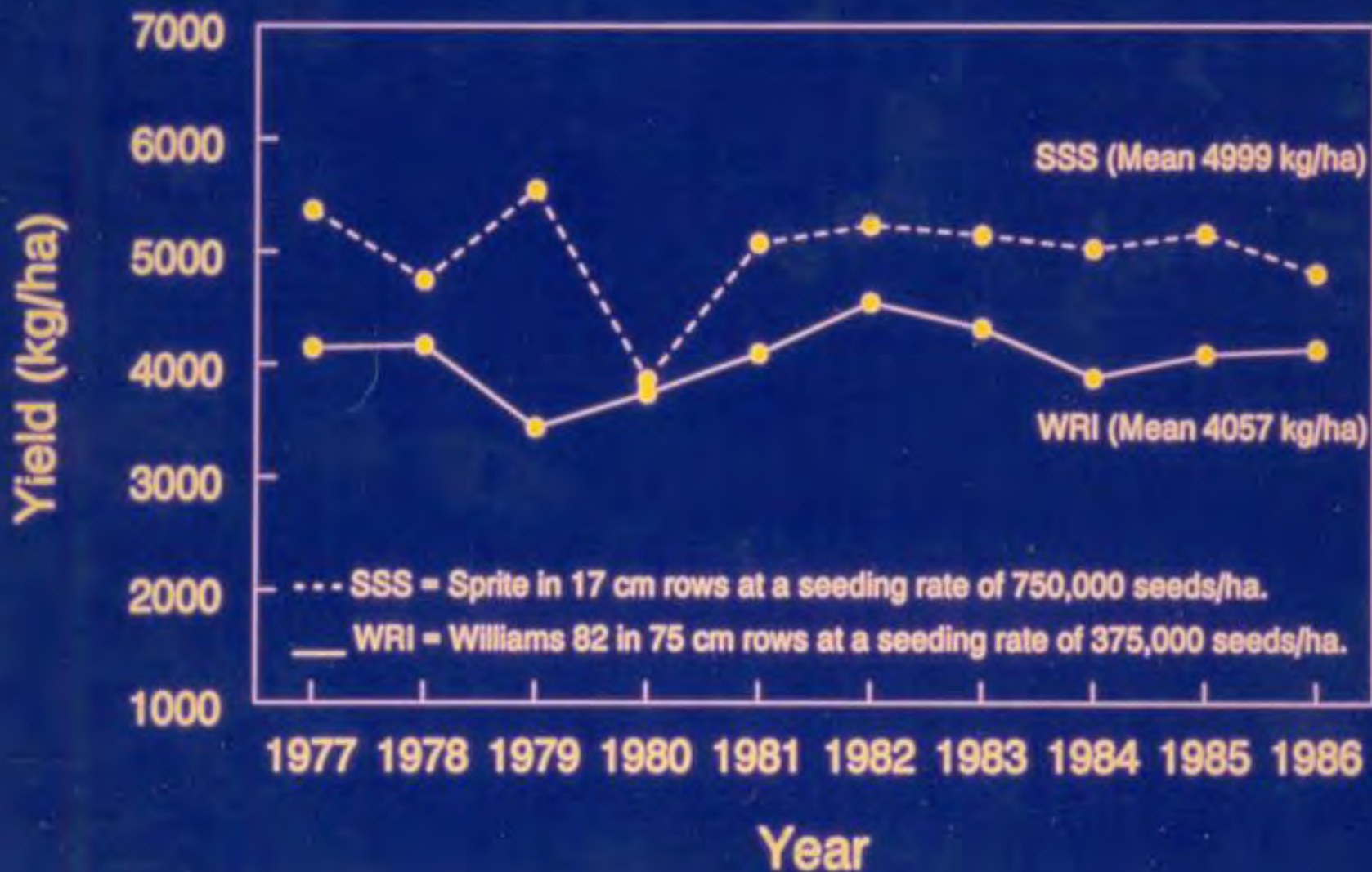


**Year effect on the yield advantage of a solid-seeded semidwarf (SSS) system over a wide-row indeterminate (WRI) system, S. Charleston, OH, 1977-1986.<sup>1</sup>**

Year	75 cm	17 cm	Yield advantage	
	Williams (WRI)	Sprite (SSS)		
	------(kg/ha)-----			(%)
1977	4149	5369	1220	29.4
1978	4169	4749	580	13.9
1979	3442	5549	2107	61.2
1980	3742	3862	120	3.2
1981	4095	5076	981	23.9
1982	4549	5236	687	15.1
1983	4322	5149	827	19.1
1984	3882	5029	1147	29.6
1985	4089	5163	1074	26.3
1986	<u>4135</u>	<u>4809</u>	<u>674</u>	<u>16.3</u>
10-yr mean	4057	4999	942	23.4

<sup>1</sup> LSD (0.05) between systems within years = 494 kg/ha, LSD (0.05) between systems averaged over 10 yr = 153 kg/ha

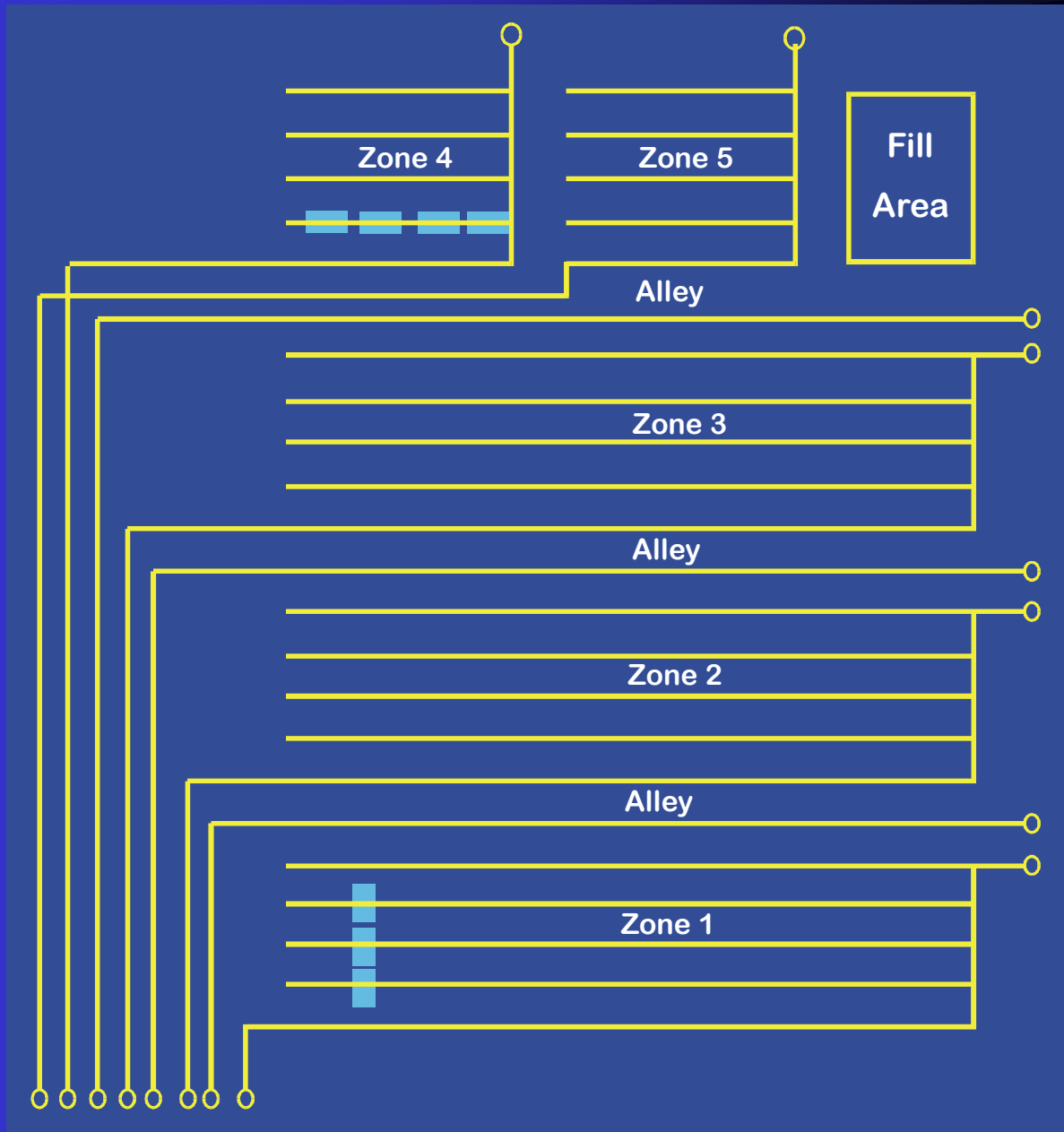
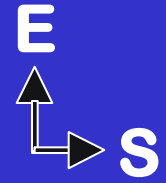
Year effect on the yield advantage of the solid-seeded-semidwarf (SSS) system over the wide-row indeterminate (WRI) system, S. Charleston, OH, 1977-86.



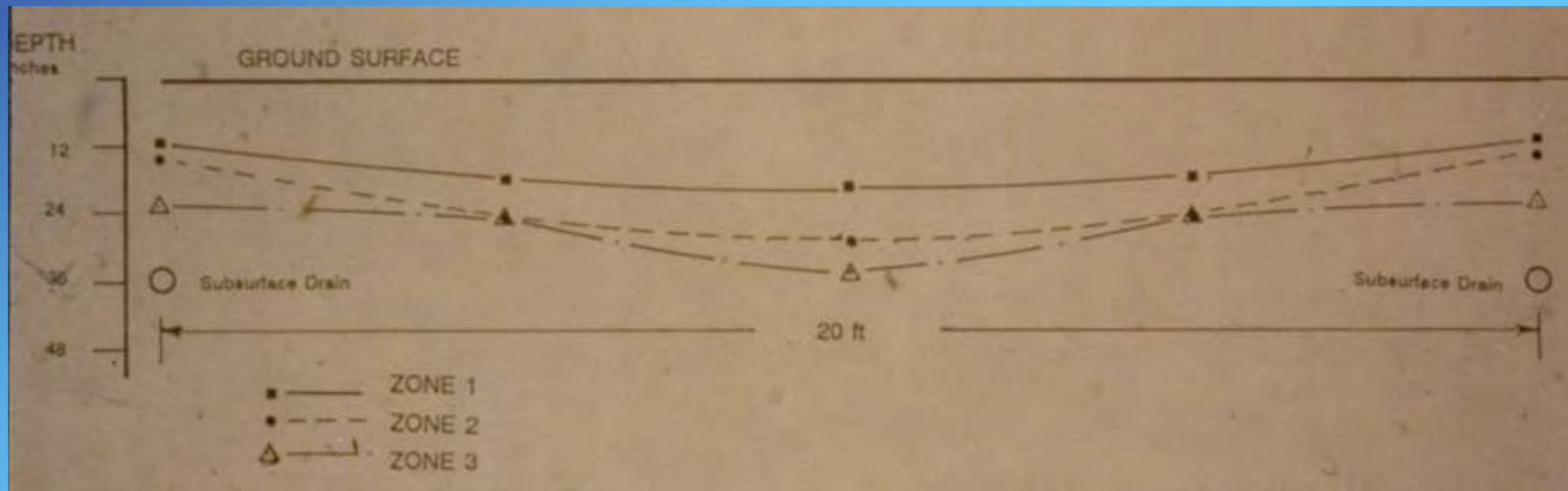
## The HYSIP Concept

In order to take advantage of favorable moisture years and long-term higher average yields, a grower must have a “high-yield-system-in-place” (HYSIP) every year.

# IRRI - DRAIN SYSTEM WOOSTER, OH













Effect of water table depth on the yield (kg/ha) response of soybeans to subirrigation/drainage system  
Wooster, OH 1985-88

Year	Average Water Table Depth		
	70 cm	55 cm	40 cm
1985	5027	5240	5294
1986	4254	4814	5520
1987	4387	4773	5740
1988	<u>4440</u>	<u>4647</u>	<u>4947</u>
Mean	4527	4868	5375

**Soybean yields from a subirrigation/drainage production system  
Wooster, OH, 1985-1987.<sup>1</sup>**

Cultivar	Year			3-yr Mean
	1985	1986	1987	
	----- (kg/ha) -----			(kg/ha)
Sprite	5656	5116	5176	5316
Sprite 87	5763	4922	5423	5369
Hobbit 87	5383	5143	5062	5196
Asgrow 3127	5123	5363	5896	5461
Williams 82	<u>4922</u>	<u>5670</u>	<u>6256</u>	<u>5616</u>
LSD (0.05) <sup>2</sup>	728	697	485	348
Mean	5369	5243	5563	5392

<sup>1</sup> 39 cm average water depth.

<sup>2</sup> LSD for cultivars.

Effect of row width on soybean yields from a subirrigation/drainage production system, Wooster, OH, 1985-1986.<sup>1</sup>

Cultivar	1985		1986		2-yr Mean	
	17 cm	75 cm	17 cm	75 cm	17 cm	75 cm
	(kg/ha)		(kg/ha)		(kg/ha)	
Sprite	5656	4362	5116	4209	5386	4286
Sprite 87	5763	4742	4922	4436	5342	4589
Hobbit 87	5383	4182	5143	4162	5263	4172
Asgrow 3127	5123	4336	5363	4242	5243	4289
Williams 82	4922	4189	5670	4296	5296	4242
LSD (0.05) <sup>2</sup>	543		494		352	
Mean	5369	4362	5243	4269	5306	4316
LSD (0.05) <sup>3</sup>	242		220		160	

<sup>1</sup> 39 cm average water table depth.

<sup>2</sup> LSD for row width effect within cultivars.

<sup>3</sup> LSD for row width effect averaged across cultivars.











# Soybean Maximum Yield Production System, Wooster, Ohio

1. Use a well drained soil with good surface drainage to avoid possible flooding injury from a heavy rainfall event, especially if it occurs just after an irrigation application (Wooster silt loam).
2. Maintain a high fertility level in the soil with annual applications of 1,120 kg/ha of 0-18-36 fertilizer plus 672 kg/ha of 33-0-0 broadcast and incorporated prior to planting.

3. Use a 2 year corn/soybean rotation to minimize disease and insect build up.
4. Plant early to take advantage of the longer days and higher light intensity earlier in the growing season (the last week of April or the first week of May at Wooster, OH)
5. Use soybean cultivars with known high yield potential and excellent lodging resistance (determinate semidwarf cultivars or shorter indeterminate cultivars)

6. Use solid-seeding, 17 cm row spacing with a seeding rate of 750,000 seeds/ha for semidwarf cultivars and 562,500 seeds/ha for indeterminate cultivars.
7. Irrigate with a goal of 5 cm/week (rainfall + irrigation), beginning at the V-3 (2<sup>nd</sup> trifoliate) or V-4 (3<sup>rd</sup> trifoliate) growth stage, depending on natural rainfall (approx. 2 weeks prior flowering, June 15 at Wooster, OH)

8. Use fungicide application as needed to prevent or minimize foliar diseases.
9. Use insecticides to minimize insect feeding.

**Ten Highest Yielding Lines Under a Maximum  
Yield Soybean Production System  
Wooster, Ohio, 1982**

<b>Entry</b>	<b>Yield (kg/ha)</b>	<b>Entry</b>	<b>Yield (kg/ha)</b>
<b>HC78-1931</b>	<b>7050</b>	<b>Pixie</b>	<b>6603</b>
<b>HC78-1884</b>	<b>6823</b>	<b>HC79-1737</b>	<b>6590</b>
<b>HC79-1644</b>	<b>6770</b>	<b>HC78-349</b>	<b>6530</b>
<b>HC78-352</b>	<b>6677</b>	<b>Sprite</b>	<b>6510</b>
<b>HC78-1318</b>	<b>6643</b>	<b>HC78-354</b>	<b>6503</b>
<b>Mean yield of 54 entries: 5963 (kg/ha)</b>			

# Ten Highest Yielding Lines Under a Maximum Yield Soybean Production System Wooster, Ohio, 1983

Entry	Yield (kg/ha)	Entry	Yield (kg/ha)
HC78-350	5316	Asgrow 3127	4869
HC78-279	4989	HC78-353	4816
Sprite	4949	HC78-352	4729
Williams 82	4949	HC78-349	4722
HC78-265	4889	HC76-1391	4662
Mean yield of 24 entries: 4549 kg/ha			

# Ten Highest Yielding Lines Under a Maximum Yield Soybean Production System Wooster, Ohio, 1984

Entry	Yield (kg/ha)	Entry	Yield (kg/ha)
HC80-1944	5516	HC78-352	4989
HC78-353	5483	HC78-350	4896
Asgrow 3127	5229	Pixie	4836
HC78-354	5136	Williams 82	4696
Sprite	5102	HC78-1884	4642
Mean yield of 24 entries: 4602 kg/ha			

# Ten Highest Yielding Lines Under a Maximum Yield Soybean Production System Wooster, Ohio, 1990

Entry	Yield (kg/ha)	Entry	Yield (kg/ha)
HC85-276	4802	HC85-275	4649
HC85-1248	4756	HC85-5847	4622
HC84-2612	4736	Resnik	4482
HC85-1440	4696	HC85-767	4462
HC85-279	4696	HC85-618	4462
Mean yield of 72 entries: 4122 kg/ha			



# Ten Highest Yielding Lines Under a Maximum Yield Soybean Production System Wooster, Ohio, 1996

Entry	Yield (kg/ha)	Entry	Yield (kg/ha)
HC90-196	5189	HC92-89PR	5016
HC92-79PR	5149	HC92-465	5009
HC89-82PR	5096	HC92-84PR	4996
HC92-151	5042	HC92-218	4956
HC92-984	5029	HC92-1013	4949

Mean yield of 37 entries: 4642 kg/ha

# *Ten Highest Yielding Lines Under a Maximum Yield Soybean Production System Wooster, Ohio, 1997*

<b>Entry</b>	<b>Yield (kg/ha)</b>	<b>Entry</b>	<b>Yield (kg/ha)</b>
<b>HC94-422</b>	<b>5323</b>	<b>HC94-421</b>	<b>5042</b>
<b>PR94-96</b>	<b>5236</b>	<b>HC91-1662</b>	<b>4976</b>
<b>HC90-196</b>	<b>5143</b>	<b>H93-1086</b>	<b>4969</b>
<b>H93-868</b>	<b>5129</b>	<b>H93-1584</b>	<b>4962</b>
<b>H93-2084</b>	<b>5089</b>	<b>PR94-81</b>	<b>4956</b>
<b>Mean yield of 32 entries: 4756 kg/ha</b>			

# Ten Highest Yielding Lines Under a Maximum Yield Soybean Production System Wooster, Ohio, 1998

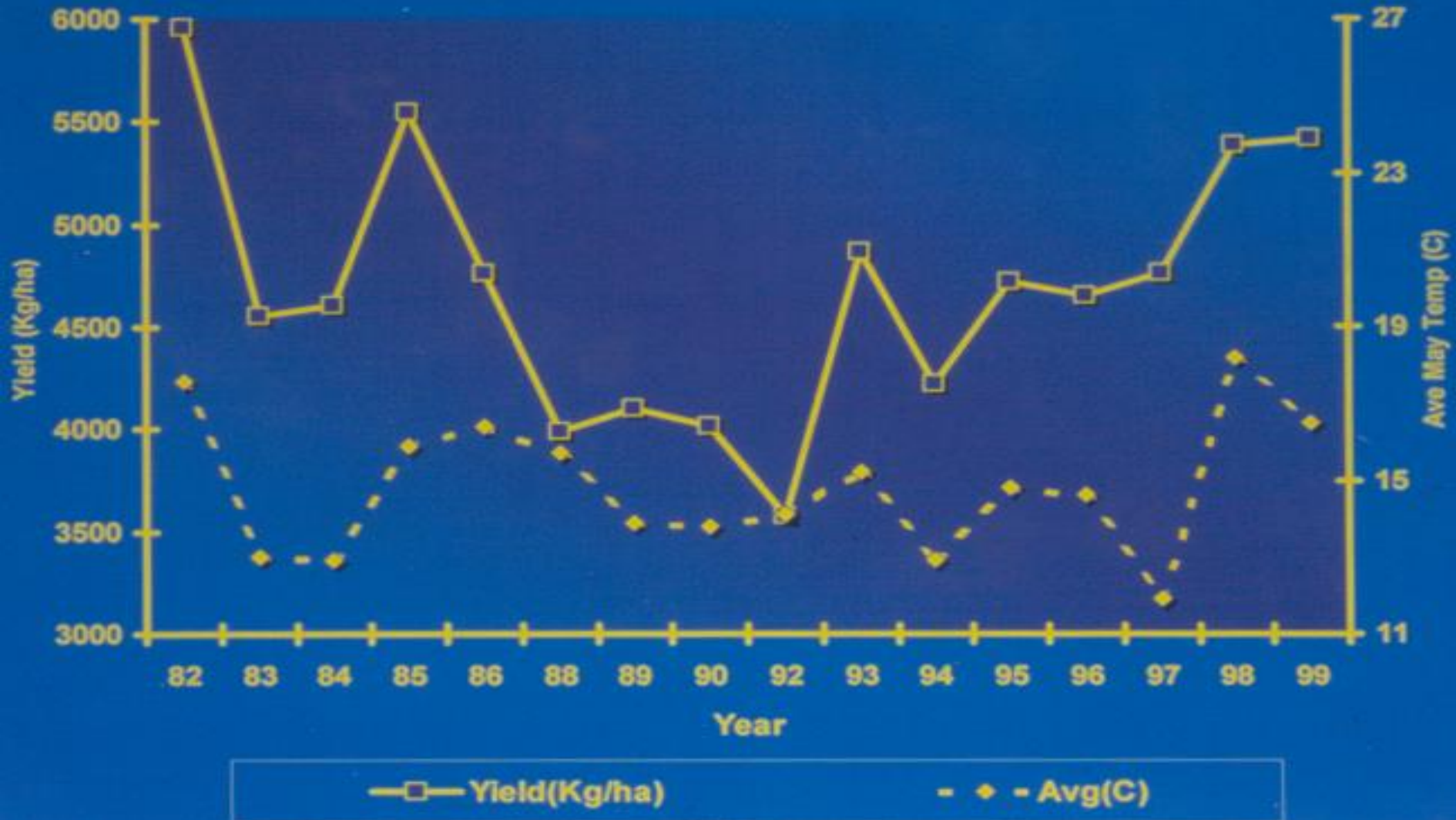
Entry	Yield (kg/ha)	Entry	Yield (kg/ha)
HC94-96PR	6050	HC94-422	5930
HC95-261PR	6043	HC95-259PR	5870
HC94-380-4	5956	HC94-419-6	5830
HC94-1946-19	5956	Charleston	5816
HC94-168	5943	HC94-421	5790

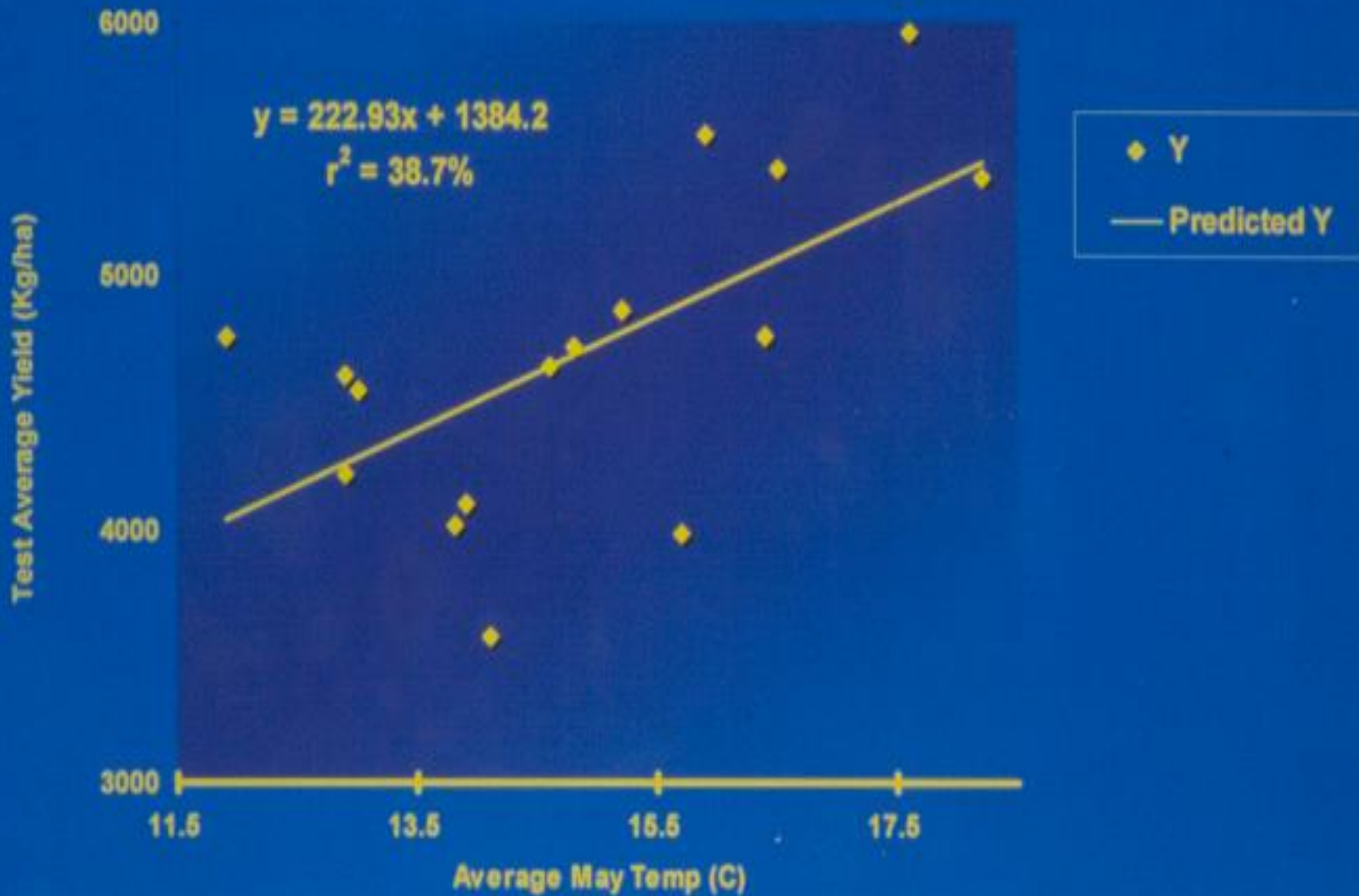
Mean yield of 64 entries: 5383 kg/ha

Ten highest yielding lines under a maximum yield soybean production system, Wooster, OH 1999

Entry	Yield	Entry	Yield
	(kg/ha)		(kg/ha)
Stout	6440	HC95-1597	6000
HC94-1382	6267	Stalwart	5980
HC95-634	6207	Apex	5960
HC92-984	6207	HC95-4337	5900
HC95-2137	6200	HC95-2005	5840

# Comparison of Test Average Soybean Yield and Average May Temperatures Maximum Yield Field, Wooster, OH, 1982-1999





Yield response (kg/ha) of soybeans to subirrigation/drainage  
Wooster, OH 1999

Entry	Drainage Only	Subirrigation/ Drainage	Increase
Stout	4700	6480	1780
Strong	3467	6160	2693
Stalwart	4987	6674	1687
HC96-261 PR	3467	6860	3393
HC94-1946	5547	6607	1060
Kottman	4580	6847	2267
General	<u>4220</u>	<u>6560</u>	<u>2340</u>
Mean	4424	6598	2174



**POTAFOS - 3º Simpósio sobre Rotação Soja/Milho no Plantio Direto**



**Yield of HC94-1065 and semidwarf check varieties under a subirrigation/drainage management system, Wooster, OH, 2000-01.**

<b>Entry</b>	<b>Yield (Kg/ha)</b>		
	<b>2000</b>	<b>2001</b>	<b>Mean</b>
<b>Stout</b>	<b>4022</b>	<b>4896</b>	<b>4456</b>
<b>Stalwart</b>	<b>4909</b>	<b>6083</b>	<b>5496</b>
<b>HC94-1065</b>	<b>5136</b>	<b>6477</b>	<b>5803</b>
<b>Kottman</b>	<b>4722</b>	<b>5352</b>	<b>5042</b>
<b>General</b>	<b>4882</b>	<b>--</b>	<b>--</b>
<b>Strong</b>	<b>4516</b>	<b>5376</b>	<b>4942</b>

**Yield of HC94-1065 and semidwarf check varieties under maximum yield management, Wooster, OH, 1999-01.**

Entry	Yield (Kg /ha)			
	1999	2000	2001	Mean
Stout	6443	4849	6230	5843
Charleston	5556	4876	5983	5469
Stalwart	5983	5136	6110	5743
HC94-1065	5963	4989	6984	5976
Strong	5203	4876	5923	5203
Troll	5710	--	5830	--

Relative yield (kg/ha) of the determinate semidwarf cultivar, Apex, and the tall indeterminate cultivar, Macon in the five highest yielding location in the 2001 Northern Uniform Regional Trials.

Location	Apex	Macon
1	5076	4602
2	4502	4155
3	5983	5429
4	5483	4936
5	<u>5496</u>	<u>4722</u>
5 Loc Mean	5308	4769

Relative yield (kg/ha) of the determinate semidwarf cultivar, Apex, and the tall indeterminate cultivar, Macon, in the five lowest yielding locations in the 2001 Northern Uniform Regional Trials.

Location	Apex	Macon
6	2795	3388
7	3062	3462
8	3368	3909
9	2374	3468
10	<u>2415</u>	<u>3655</u>
5 Loc Mean	2803	3576

**The potential yield (Kg/ha) advantage from matching soybean cultivars with specific adaptation to different productivity levels within a field, Northern Uniform Test III, 2001.**

	Loc.	HC94-1065 ( <i>dt<sub>1</sub></i> )	Macon ( <i>Dt<sub>1</sub></i> )	HC94-1065 & Macon
		(Kg/ha)	(Kg/ha)	(Kg/ha)
<b>High Yield</b>	1	5076	4602	5076
	2	4502	4155	4502
	3	5983	5429	5983
	4	5483	4936	5483
	5	5496	4722	5496
<b>Low Yield</b>	6	2795	3388	3388
	7	3062	3462	3462
	8	3368	3909	3909
	9	2374	3468	3468
	10	2415	3655	3655
<b>10 Loc. Average</b>		4055	4169	4482

# SUMMARY

- 1. Maximum yield research helps in identifying yield limiting factors in soybeans without the confounding effect of other yield limiting factors in the system.**
- 2. You must first identify a problem before you can solve it.  
Once yield limiting factors are identified, steps can be taken to overcome these limitations.**