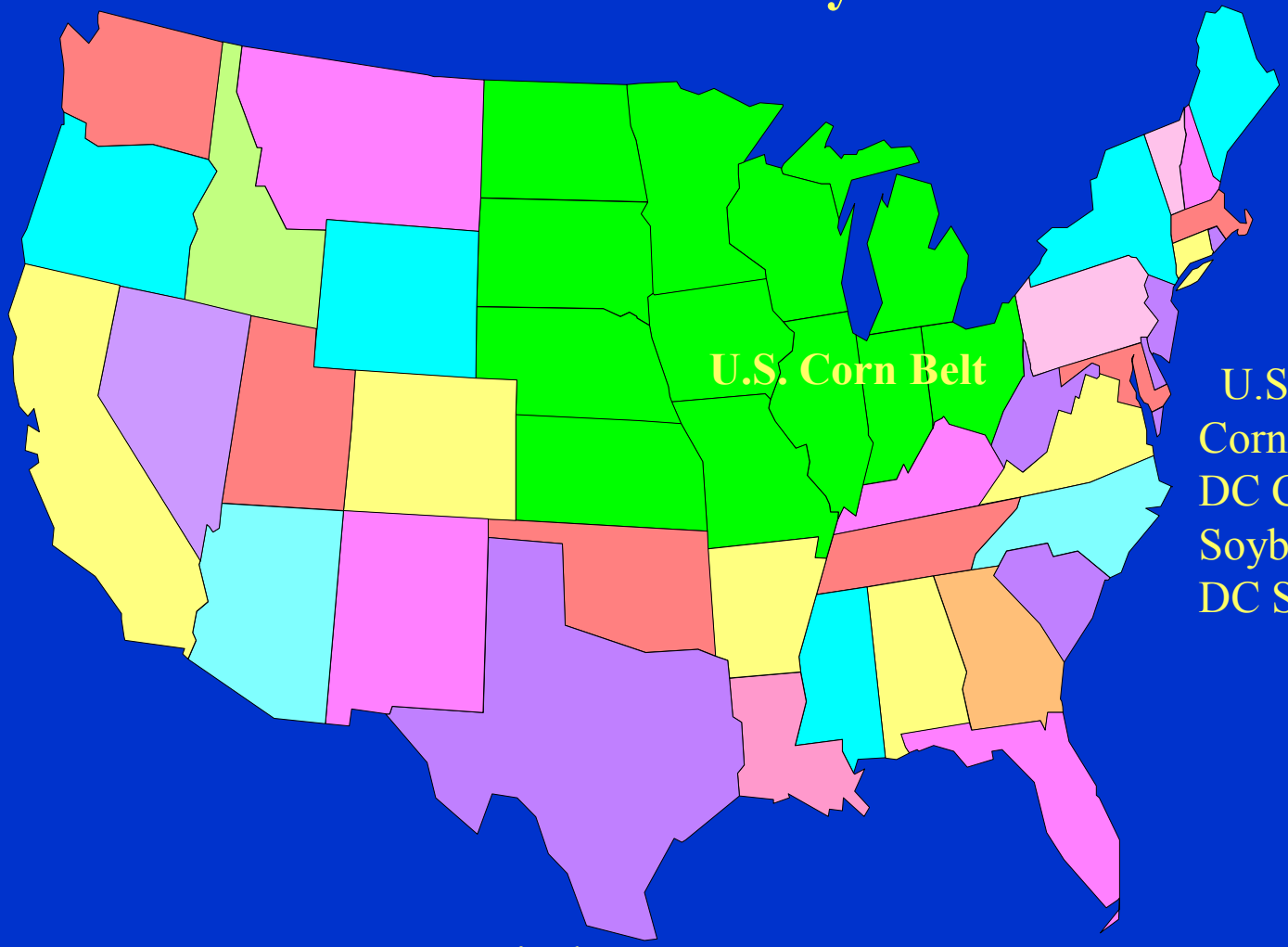
No-Till Corn and Soybean Production Systems in the United States

Dr. Kim Polizotto
Chief Agronomist
Potash Corporation of Saskatchewan

U.S. No-Till Corn and Soybean Production



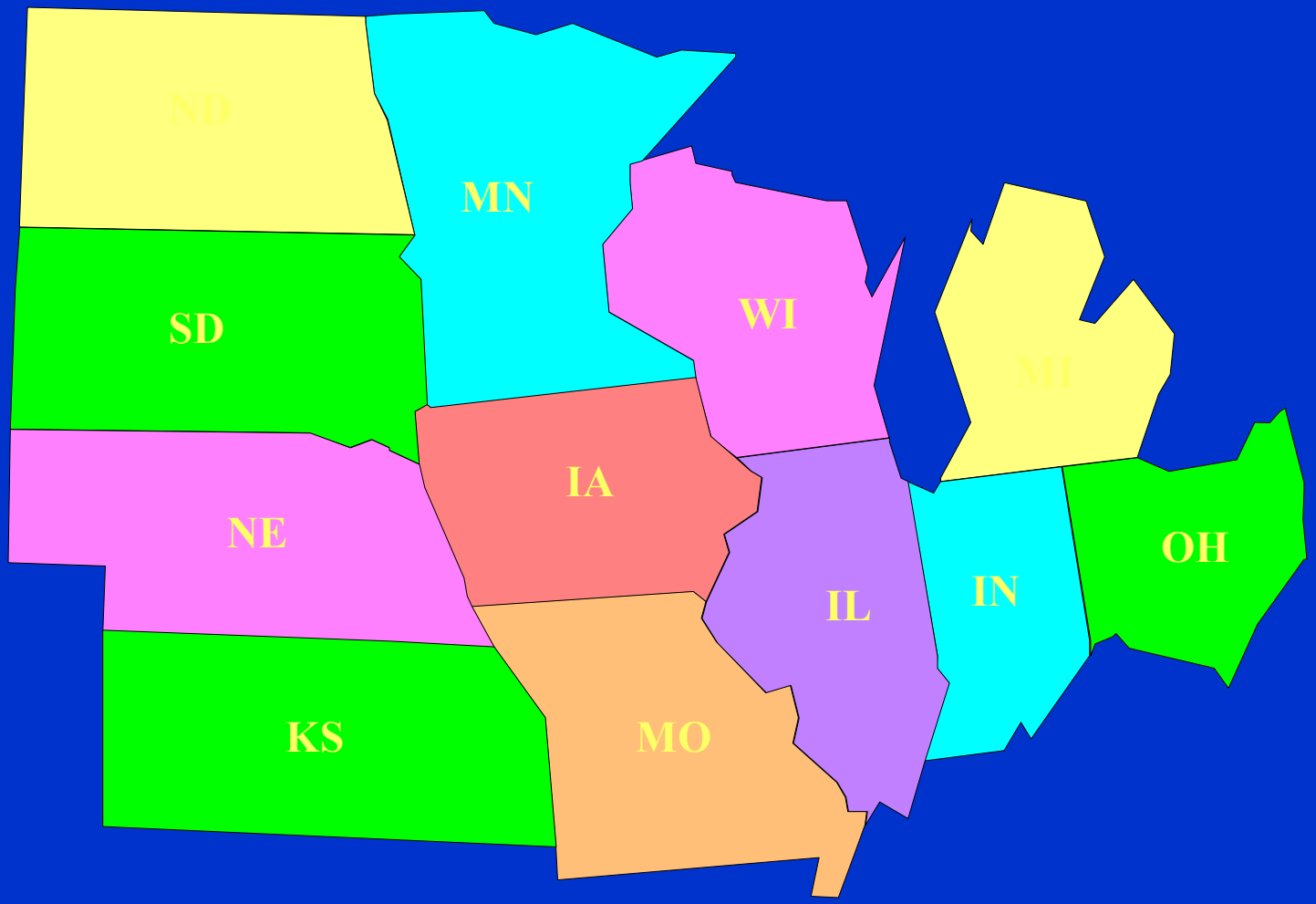
U.S. Midwest

Corn	81.49%
DC Corn	17%
Soybeans	82.80%
DC Soybeans	32.75%

United States

Corn	16.41% no-till
DC Corn	28.34%
Soybeans	28.66%
DC soybeans	66.32%

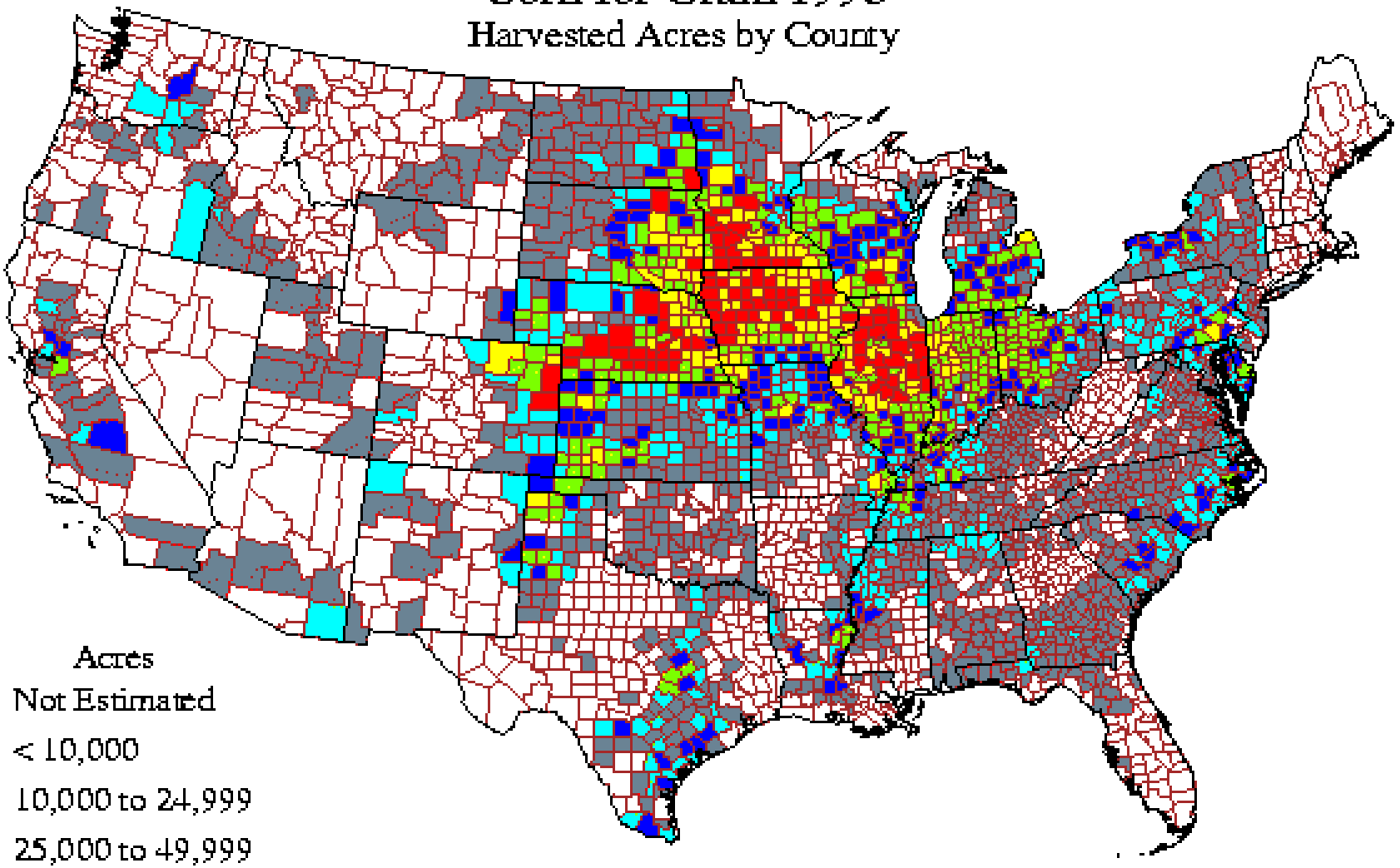
Midwest United States….“Corn Belt”



Corn	15.32% no-till
DC Corn	21.15%
Soybeans	30.41%
DC Soybeans	69.47%

Corn for Grain 1998

Harvested Acres by County



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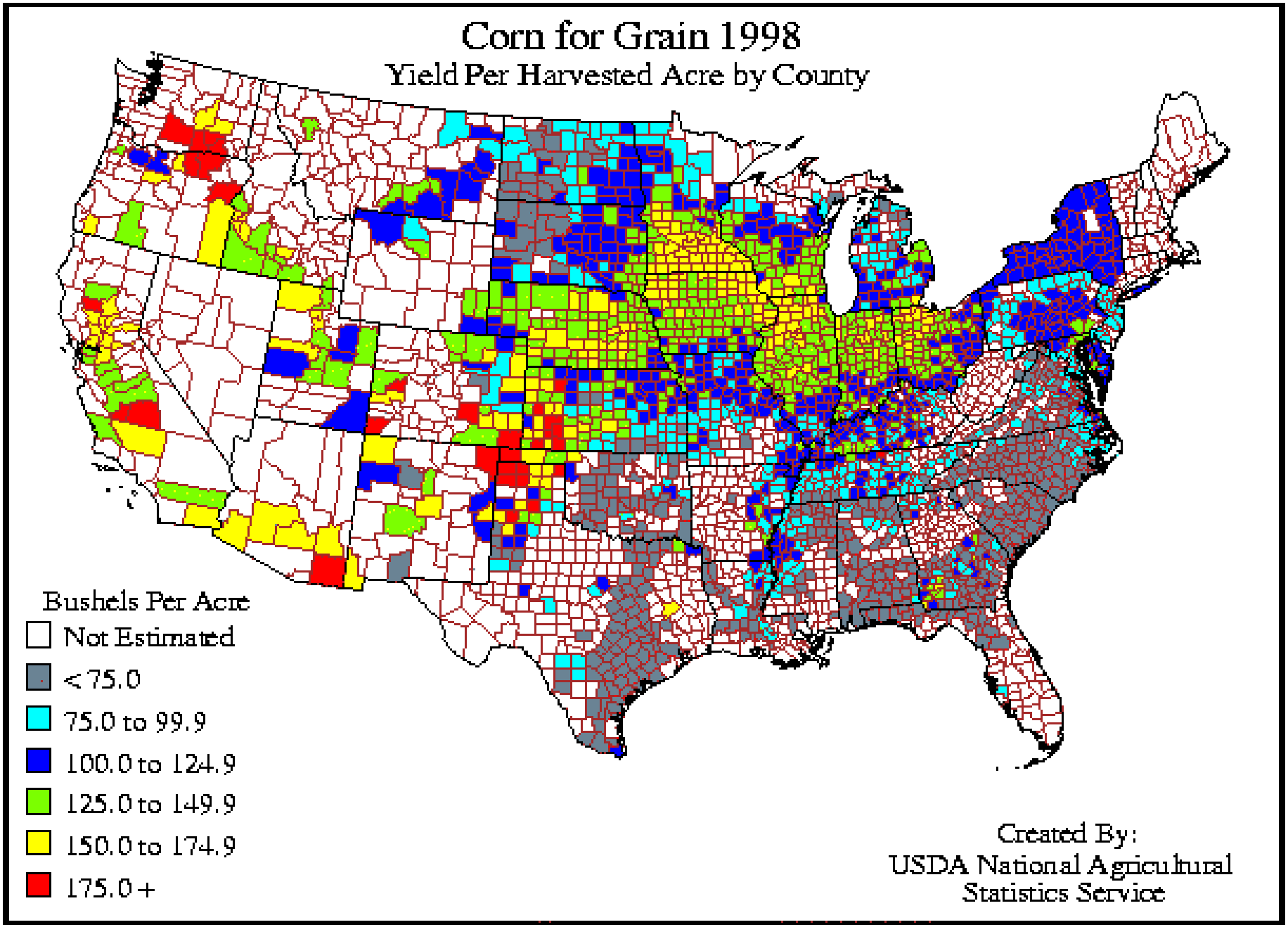
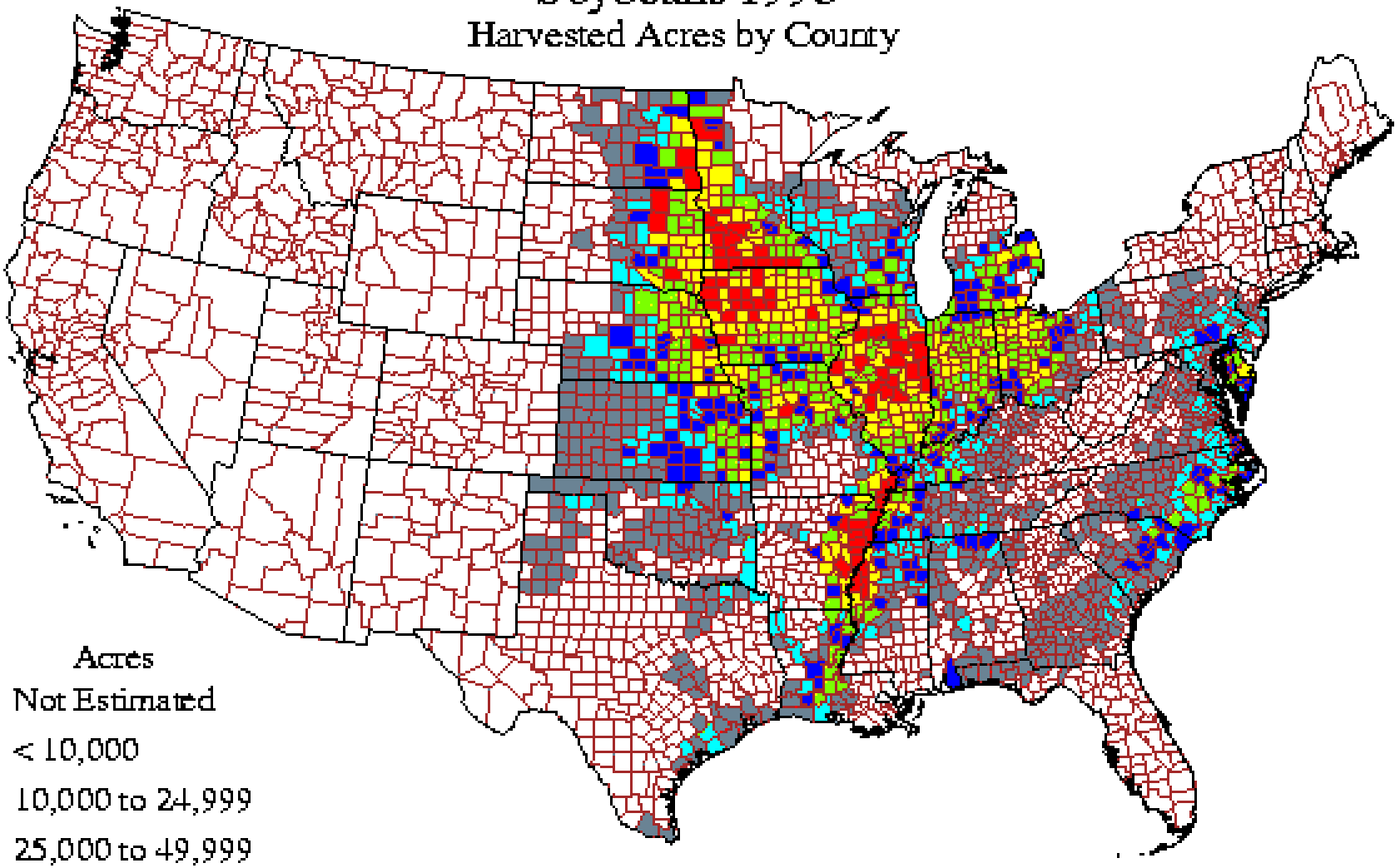
Statistics Service


Corn for Grain 1998
Yield Per Harvested Acre by County
Bushels Per Acre
Not Estimated
< 75.0
75.0 to 99.9
100.0 to 124.9
125.0 to 149.9
150.0 to 174.9
175.0 +
Created By:
USDA National Agricultural
Statistics Service

Soybeans 1998

Harvested Acres by County



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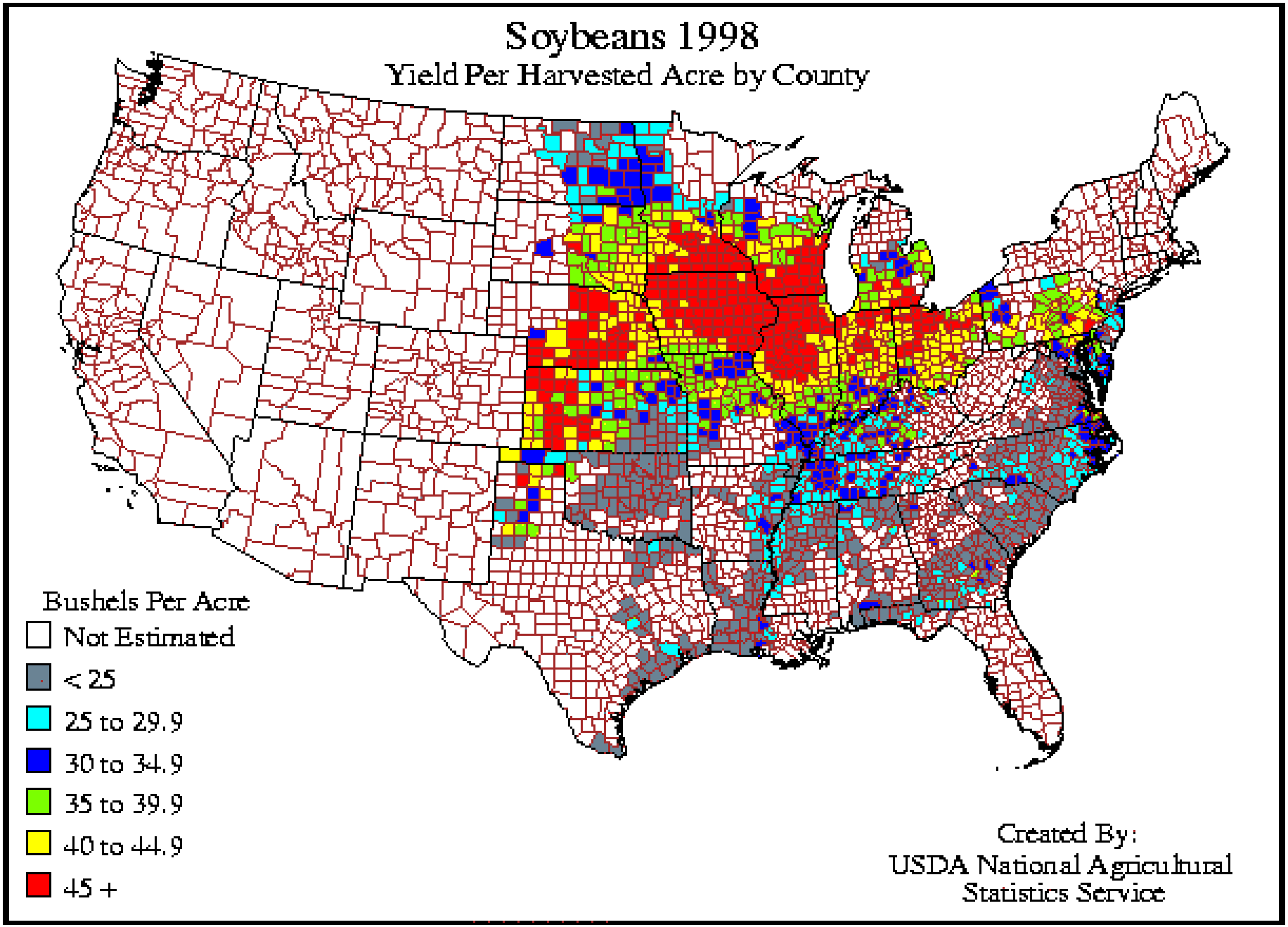

Soybeans 1998
Yield Per Harvested Acre by County
Bushels Per Acre
Not Estimated
< 25
25 to 29.9
30 to 34.9
35 to 39.9
40 to 44.9
45 +
Created By:
USDA National Agricultural
Statistics Service

Forecast for soybean: area increase mainly in Brazil and India

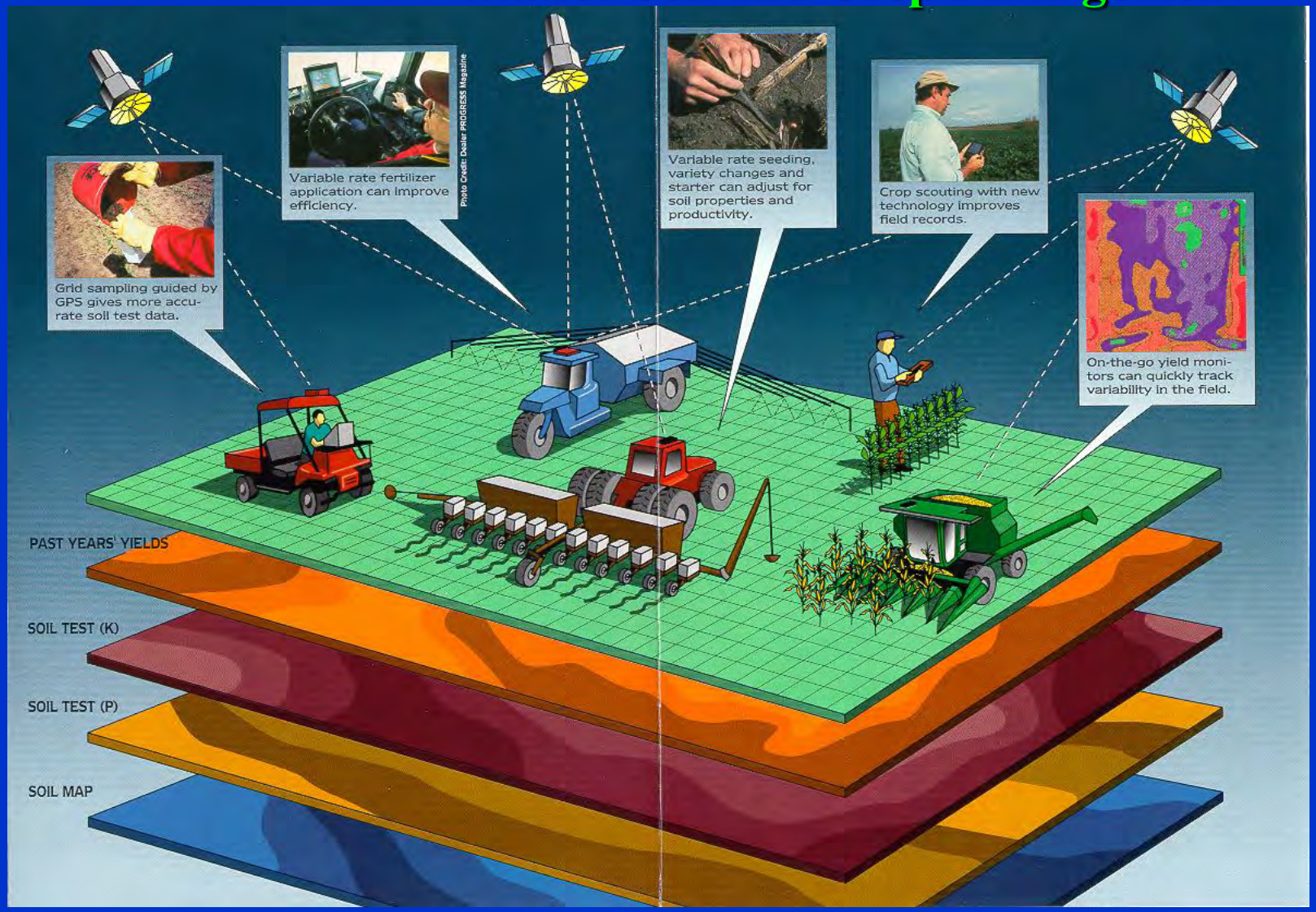
Countries	production (10^6 ton)			area (10^6 ha)		
	1998	2010	2020	1998	2010	2020
USA	75	84	97	28.0	28.0	27.0
Brazil	31	45	55	12.9	18.0	20.0
China	14	20	24	8.0	9.5	9.5
Argentina	18	17	20	7.4	8.2	9.0
India	6	15	24	6.3	10.0	12.0

Source: Paroda, R.S. (1999). In: VI World Soybean Research Conference, Chicago

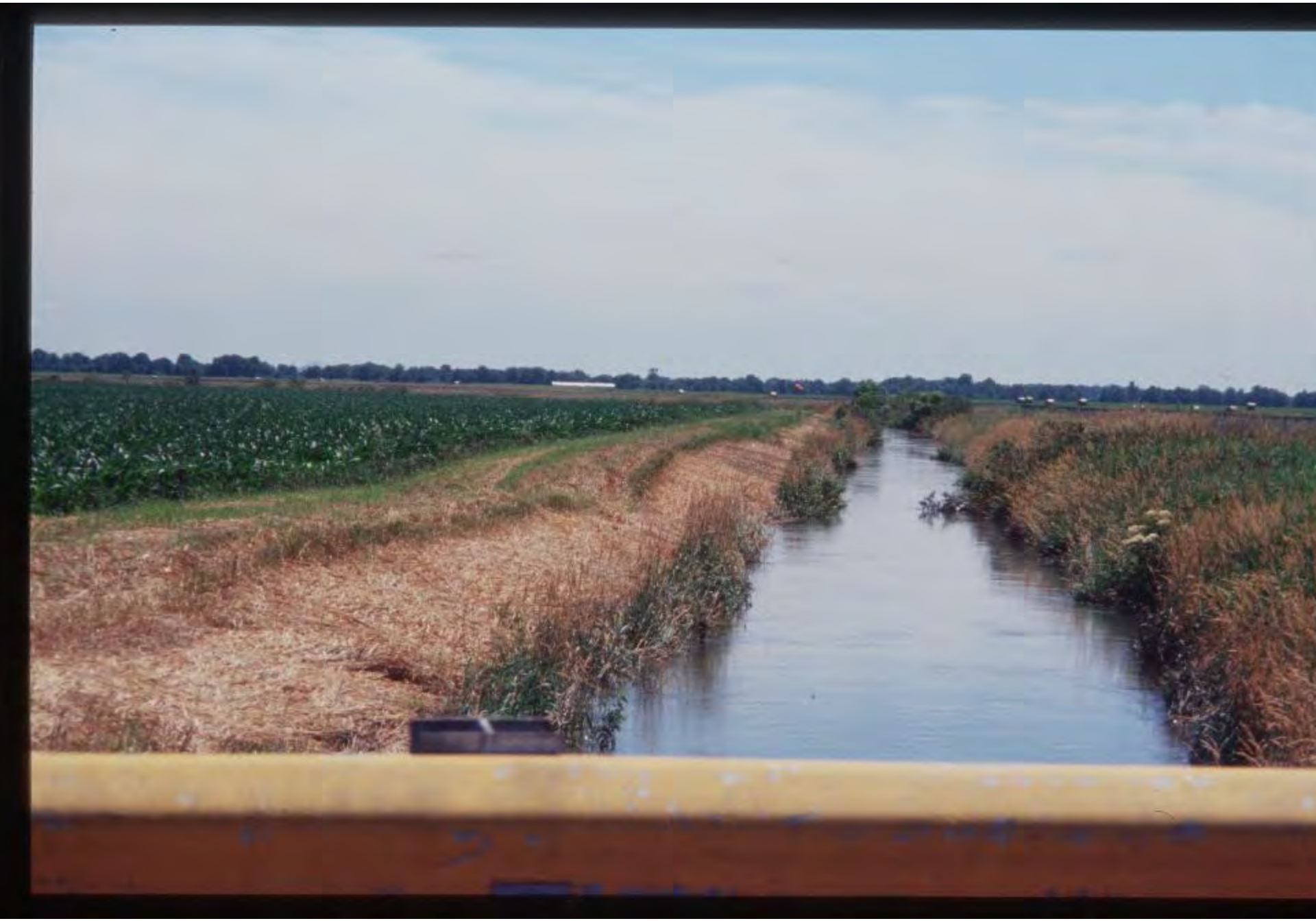
Midwest Soils and Climate

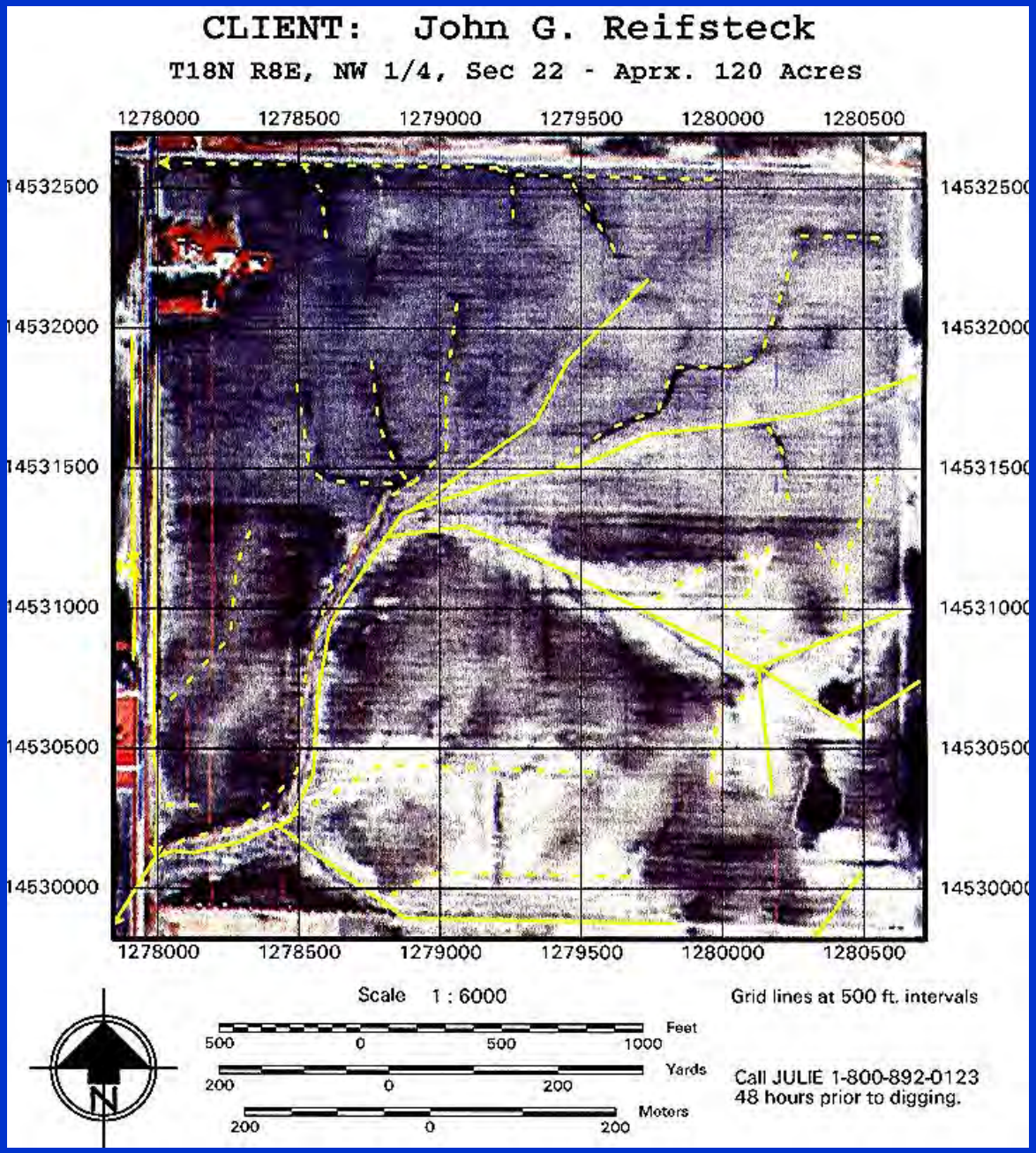
Primarily, silt loam, silty clay loam
Poorly/somewhat poorly drained
CEC= 15-30
OM=2-5%
Naturally fertile
85 to 140 day growing season
650 to 1150 mm rainfall

Integrated, Intensive, Site-Specific Systems…..
……for Soil and Crop Management



Stand Establishment in No-till Corn Production





Tile Drainage Maps

Champaign Country Soil and Water Conservation District

Soil Temperature as Affected by Tillage in Wisconsin

Date	Temperature - 5 cm		
	No-Till	Chisel	Zone Till
	C		
4-17	8.7	13.6	13.9
4-25	7.5	11.7	11.0
5-2	9.4	12.7	11.5
5-8	9.3	9.8	9.7
5-15	14.4	20.9	19.2
5-24	12.9	17.2	16.5
6-2	21.0	24.7	22.5

R.P. Wolkowski, U. of Wisconsin


MaxEmergePlus
VacuMeter
REYNOLDS
FARM EQUIP.
Lafayette, In.

Effects of tillage and fertilizer treatment on corn emergence, nutrient concentration and early growth (V-6)

Treatment	Emergence plts./ft	Wt. g/plt	P %	K %
Tillage				
Fall Zone	1.5	1.2	.57	4.91
Spring Zone	1.6	1.0	.49	3.74
Chisel	1.8	1.1	.53	4.31
No-till	0.4	0.6	.54	4.61
Fertilizer				
None	1.3	0.8	.48	3.87
Fall Surface	1.3	1.3	.56	4.55
Fall Inject	1.4	1.0	.55	4.41
2X2 starter	1.4	1.1	.54	4.79

Wolkowski, U. of Wisconsin
Fertilizer rate=7+20+7 lbs/A

Fertilizer Programs for High Yield Corn Production

Annual and biennial fertilizer application and custom application is very common and unique to U.S.


Broadcast application of K

Soil test interpretation ranges for phosphorus (corn)

Soil	Soil test category			
	Very Low	Low	Medium	High
	soil P, ppm			
A	<5	5-10	11-15	16-25
C	<10	10-15	16-20	21-30
E	<12	12-22	23-32	33-42

Wisconsin

Soil test interpretation ranges for potassium (corn)

Soil	Soil test category			
	Very Low	Low	Medium	High
	soil P, ppm			
A	<60	60-80	81-100	101-140
B	<70	70-90	91-110	111-150
D	<70	70-100	101-130	131-160

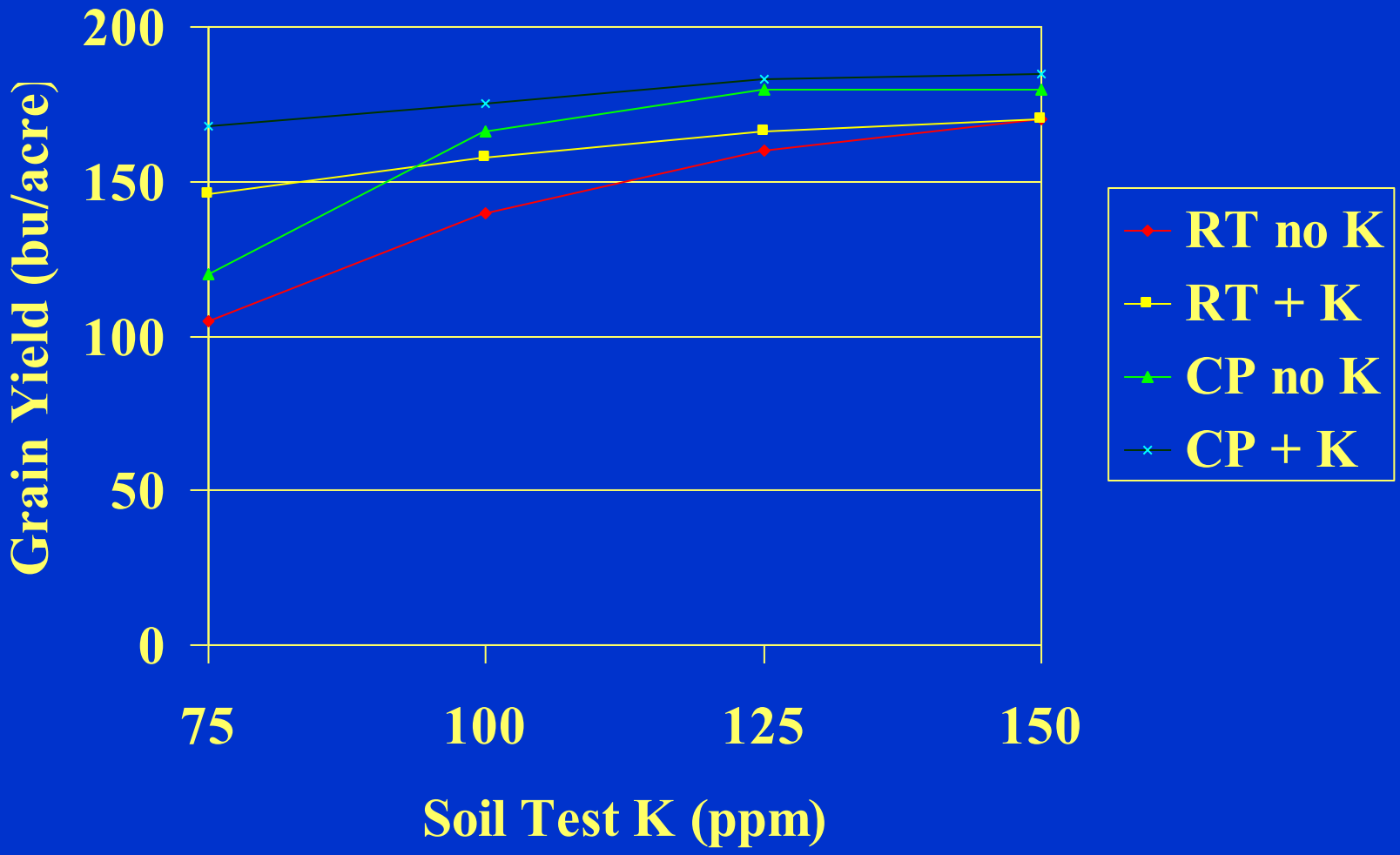
Wisconsin

Phosphorus on No-till Corn in Ohio

Bray P_1	check	34 kg P_2O_5		68 kg P_2O_5	
		B'cast	Row	B'cast	Row
ppm			kg/ha		
15	9388	9388	10258	9947	10320
26	9823	9574	10320	10320	10258
34	10072	10009	10320	10072	11315
Ave.	9761	9636	10134	10134	10631

Eckert, Ohio State University

Effect of tillage on corn response to row applied K and soil test K

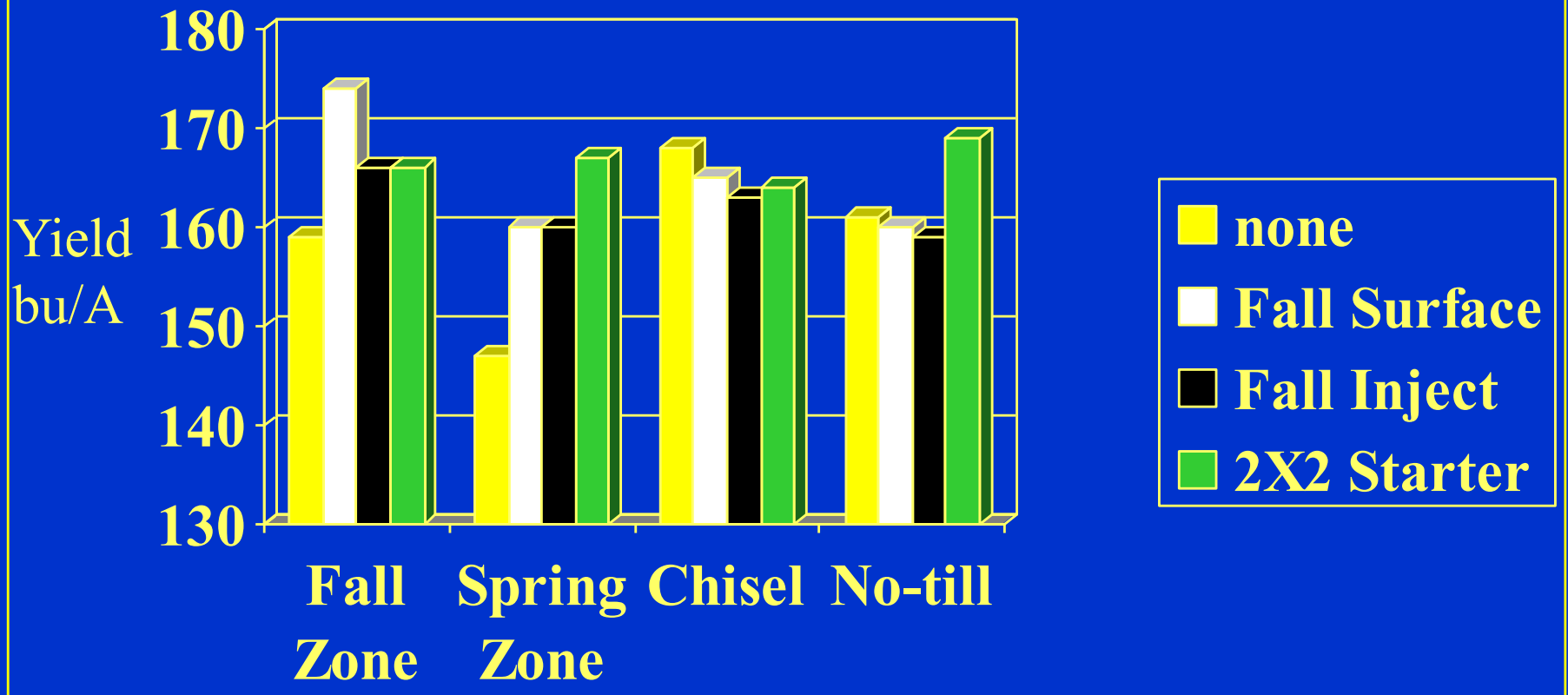


Effect of soil test K and K rate and method of placement on corn yield

Soil Test K	K_2O added	Method	Yield	Leaf %K
kg/ha	kg/ha		kg/ha	
388	0	------	8278	2.16
361	34	broadcast	8842	2.12
361	34	row	8403	2.15
412	68	broadcast	7964	2.27
412	68	row	8340	2.27
408	102	broadcast	8717	2.28
408	102	row	8591	2.33

Eckert, Ohio State University

Effect of tillage and row placed fertilizer on corn yeild



Wolkowski, U. of Wisconsin, 9 gal 7-21-7

Evaluation of starter fertilizer placed on dryland no-till corn production, Manhattan, KS 1999

C'cast N	Starter Fertilizer N	P_2O_5	K_2O	S	Plant Pop.	V-6 . Dry wt.	Yield
kg/ha	kg/ha				1000X	lb/z	kg/ha
168	0	0	0	0	26	256	5142
134	33	33	11	0	26	320	5456
134	33	33	11	11	26	448	6835
101	67	33	11	0	26	326	6710
67	101	33	11	0	26	377	6396
33	134	33	11	0	26	403	8152
LSD (0.01)					NS	160	14

Broadcast N applied as ammonium nitrate after planting

Lamond et al., Kansas State U.

Prices and field capacity of no-till planters

Attachments on 8-row planter	1996 total planter list price (U.S. $)	Field capacity (ha/hr)
No attachments	26,400	3.8
Surface-applied fertilizer attachments	31,050	3.4
2”X2” banded fertilizer attachments	34,700	3.2

J.D.Hibbard, U. of Illinois

Corn yield and net return increases for 2X2 banded fertilizer in IL

Starter	Average yield increase	Average net return increase above fertilizer cost	"Worst Case" scenario net return increase
kg/ha	bu/a	$/a	$/a
0-0-0	0	0.00	0.00
25-0-0	8.5	11.68	2.12
25-30-0	15.8	19.24	9.68
25-30-20	15.1	3.93	-5.63

J.D.Hibbard, U. of Illinois

Nitrogen Management

Nitrogen source and crop rotation effects on no-till corn yields in Missouri

N Source*	Yield	
	C/C	C/S
	(kg/ha)	
Am. Nitrate	7337	9469
Urea	6522	9093
UAN	6020	8403
UAN+ATS	6020	8654

All treatments broadcast at planting, 134 kg/ha N
Buchholz, U. of Missouri

Ammonia volatilization losses and corn yields from surface applied N fertilizers

N source & method	3 year average N loss (%)	3 year average yield (kg/ha)
Control	---	5581
Urea-surface	29.5	7776
UAN-surface	16.1	8904
UAN-dribble	12.9	8403
Am. Nitrate-surface	----	9218

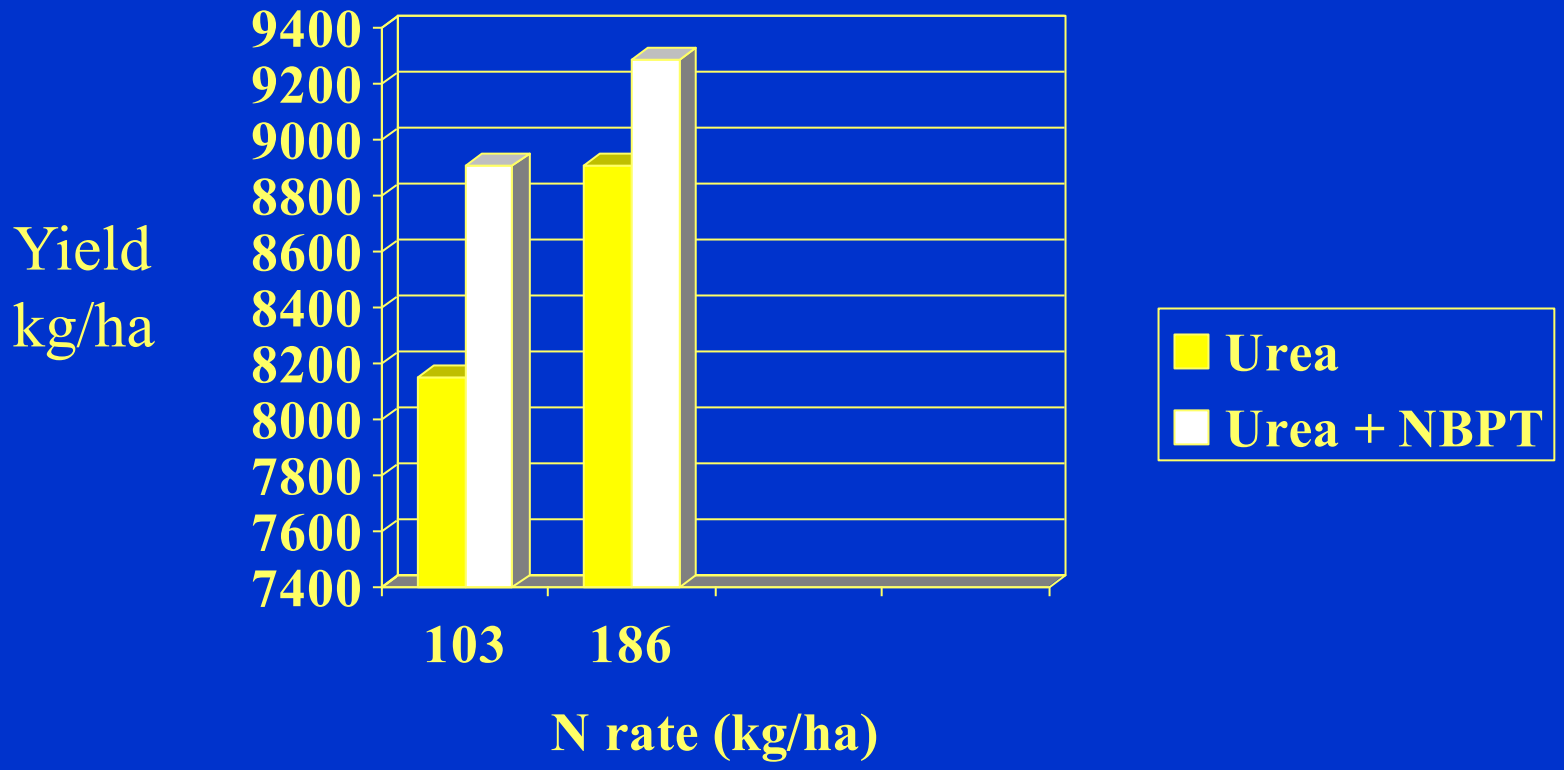
134 kg/ha N applied
Fox, Penn State U.

Effect of application method and N source on corn yield in Kansas

Treatment	5 year average (kg/ha)
0 N check	5895
AA preplant, knife	9845
UAN, preplant, knife	9783
UAN, preplant, brdcast	8968
UAN, preplant, dribble	9093
UAN, split, knife	9720
UAN, split dribble	9407
LSD (0.05)	250

Average N rate 130 kg/ha
Gordon, U. of Kansas

Effect of a urease inhibitor on corn yield



Surface applied urea, average of 21 experiments

Corn yield as influenced by the use of a nitrification inhibitor

N treatment	4 year average yield (kg/ha)
Fall AA	8026
Fall AA+Nitrapyrn	8591
Spring AA	8591
Split AA	9030

Randall, U. of Minnesota

Soil pH of two sampling depths as influenced by 5 years of surface application of several rates and sources of N fertilizer

Source	Annual N rate (kg/ha) 0	50	100	150
	pH			
	0-2.5 cm			
Check	6.73			
NH_4NO_3		6.30	6.23	5.45
Urea		6.52	6.20	5.90
UAN		6.52	6.44	5.84
$(NH_4)_2SO_4$		6.40	5.77	4.70
	0-5.0 cm			
Check	6.46			
NH_4NO_3		6.52	6.53	5.94
Urea		6.52	6.22	6.23
UAN		6.58	6.49	6.20
$(NH_4)_2SO_4$		6.59	6.04	5.20

Eckert, Ohio State University

High yield no-till corn production in the U.S.

1. Select hybrids suitable for no-till
2. Successful stand establishment
3. High populations
4. High P and K soil test levels and annual/biennial applications of P and K at removal rates
5. Starter fertilizer, 1:1 N:P ratio
6. Split applications and high rates of N fertilizer, with nitrification or urease inhibitors. Injected or strip applied.
7. Excellent weed and insect control
8. Rotation with soybeans

No-Till Soybean Production


JOHN DEERE
750

Yield of soybeans planted in three systems in Wisconsin

Cultivar/Herbicide system	ave. yield (3 year) kg/ha
conventional variety conventional herbicides	3897
Glyphosate resistant conventional herbicides	3662
Glyphosate resistant Glyphosate herbicide	3823
LSD (0.01) 100kg/ha	

Oplinger, U. of Wisconsin

Soybean Yield as affected by tillage system and row width

Tillage System	Row Width (cm)	Average Yield (kg/ha)
Fall Chisel	17.8	3,554
	76.2	2,506
No-till	17.8	3,366
	76.2	2,372

Purdue University

The effect of row spacing and seeding rate on yield of no-till soybeans in Wisconsin

Row Spacing cm	Seeding rate seeds/ha	Yield kg/ha
19	432,250	3857
	555,750	3998
	679,250	4038
38	308,750	4025
	432.250	4132
	555,750	4172
76	185,250	3454
	308,750	3689
	432,250	3702

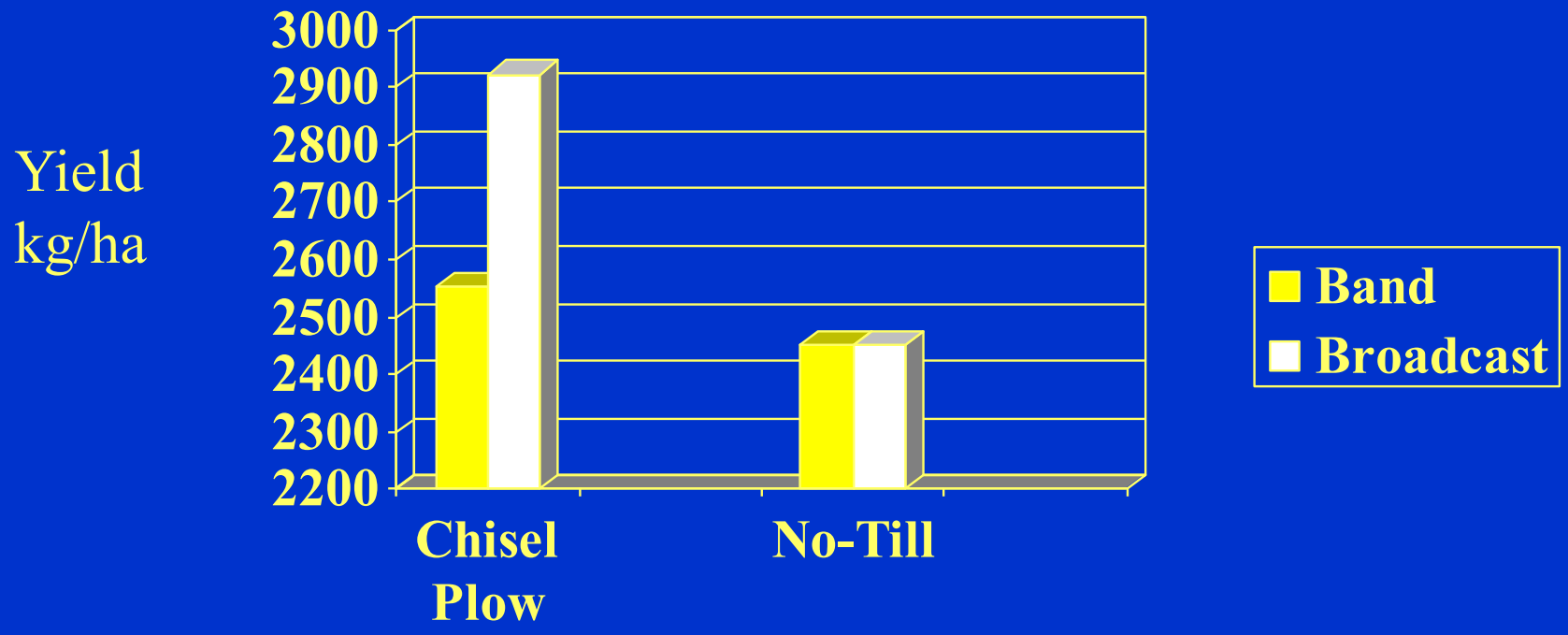
Average of 6 locations per year for 3 years with 2 varieties
Oplinger, Wisconsin

Soybean Fertilization Programs

Soybean yield as affected by tillage system, row spacing, and rate of phosphate in Minnesota

Tillage System	Row Spacing		P2O5 Applied (kg/ha) 0	26	52	78	104	ave.
	(cm)				(kg/ha)			
fall chisel	17.8		2956	3440	3667	3702	4018	3554
"	76.2		2009	2533	2278	2768	2943	2506
		ave.	2486	2990	2976	3839	3480	
no-till	17.8		2956	3137	3581	3669	3501	3366
"	76.2		1167	2318	2405	2479	2681	2372
		ave.	2466	2728	2997	3077	3091	

Effect of Tillage and Placement of P on soybean yield



The effect of tillage system on soybean yield in Minnesota

Tillage System	Frequency of Phosphate Application	
	Annual	Biennial
	(kg/ha)	
no-till	2607	2466
fall Chisel	2701	2788

Yields averaged over P rates, P placement, and row spacing
Rehm, U. of Minnesota

The effect of phosphate placement on soybean yield in Minnesota

Placement	Frequency of Phosphate Application	
	Annual	Biennial
	(kg/ha)	
Band	2641	2593
Broadcast	2667	2661

Yields averaged across row spacing, phosphate rate and row spacing
Rehm, U. of Minnesota

Effect of K fertilization on no-till soybean yield in Ohio

Soil Test	K_2O added	Yield	
		Broadcast	Band
kg/ha		kg/ha	
438	0	3346	
378	34	3427	3212
413	68	3306	3198
438	102	3501	3198

Eckert, Ohio State University

Stratification of K fertilizer after repeated application over 3 years

Soil profile depth (cm)	No-till no K added	No-till K added	Conventional K added
		(ppm)	
0-2.5	120	235	130
2.5-5.0	115	168	120
5.0-7.5	105	192	170
7.5-10	145	175	160

95 kg of K added each year
Eckert, Ohio State University

Nitrogen Fertilization of Soybeans

Effects of seed inoculation and nitrogen fertilizer on soybean yield

Treatment			Yield	leaf N
Inoculation	N	time	kg/ha	%
	kg/ha			
+	0	-	3541	2.9
+	40	June 6	3501	3.0
+	40	July 2	3971	3.0
-	0		3440	2.9
-	40	June 6	3480	2.9
-	40	July 2	3520	2.9

Vitosh, Michigan State U.

Yield and brown stem rot response of soybean to early season nitrogen (V-2)

Tillage	Yield		BSR severity	
N rate	0	30	0	30
	kg/ha		(disease rating)	
No-till	3769	3978	49.6	34.5
Conventional	4280	4401	44.0	31.3

Oplinger, U. of Wisconsin

Effects of N application on dryland and irrigated soybeans in Georgia

N treatment kg/ha	Yield kg/ha	Bean wt. g/100
	non-irrigated	
0	2426	13.0
45	2459	13.5
	irrigated	
0	3400	14.2
45	3581	14.5

Application at R-3-5 stage
Gasho, U. of Georgia

What are top no-till soybean producers doing to increase yield and profitability?

1. Select varieties based on yield potential, maturity, disease resistance, SCN resistance, and weed control options.
2. Plant in narrow rows, 17.8-38 cm
3. Maintain high P and K soil test levels. Apply P in bands or strips at removal rates, every year. Apply K broadcast as needed for rotation at removal rates.
4. Apply K in Fall or before corn in 2 year rotation
5. Excellent insect and weed control


Thank You

Extra Slides

Soybean Production Costs, 1997

Factor	Cost, $/ha
Fertilizer	54
Herbicide	86
Seed	44
Machinery	69
Total variable	253
Other non-land costs	299
Land costs	371

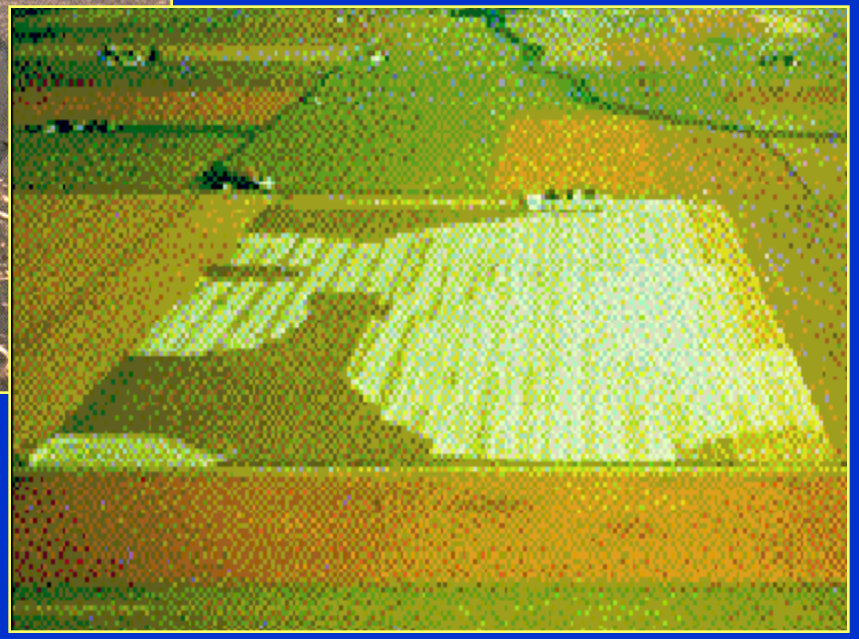
Source: Illinois FBFM Records

The effect of row spacing on soybean yield in Minnesota

Row Spacing	Frequency of phosphate application	
	Annual	Biennial
(cm)	(kg/ha)	
17.8	2788	2600
76.2	2513	2647

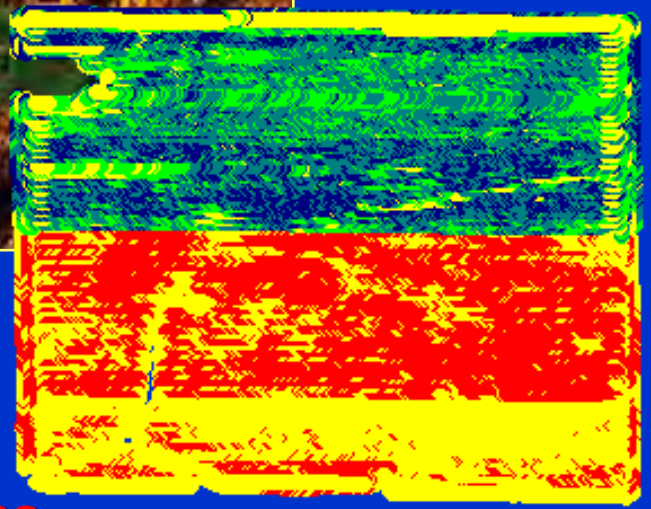
Yields averaged over tillage, phosphate, rate and placement
Rehm, U. of Minnesota

VRT - Variable Rate Technology



- Uses GPS
- Applies appropriate rates
- Maximize efficiency of fertilizer dollar

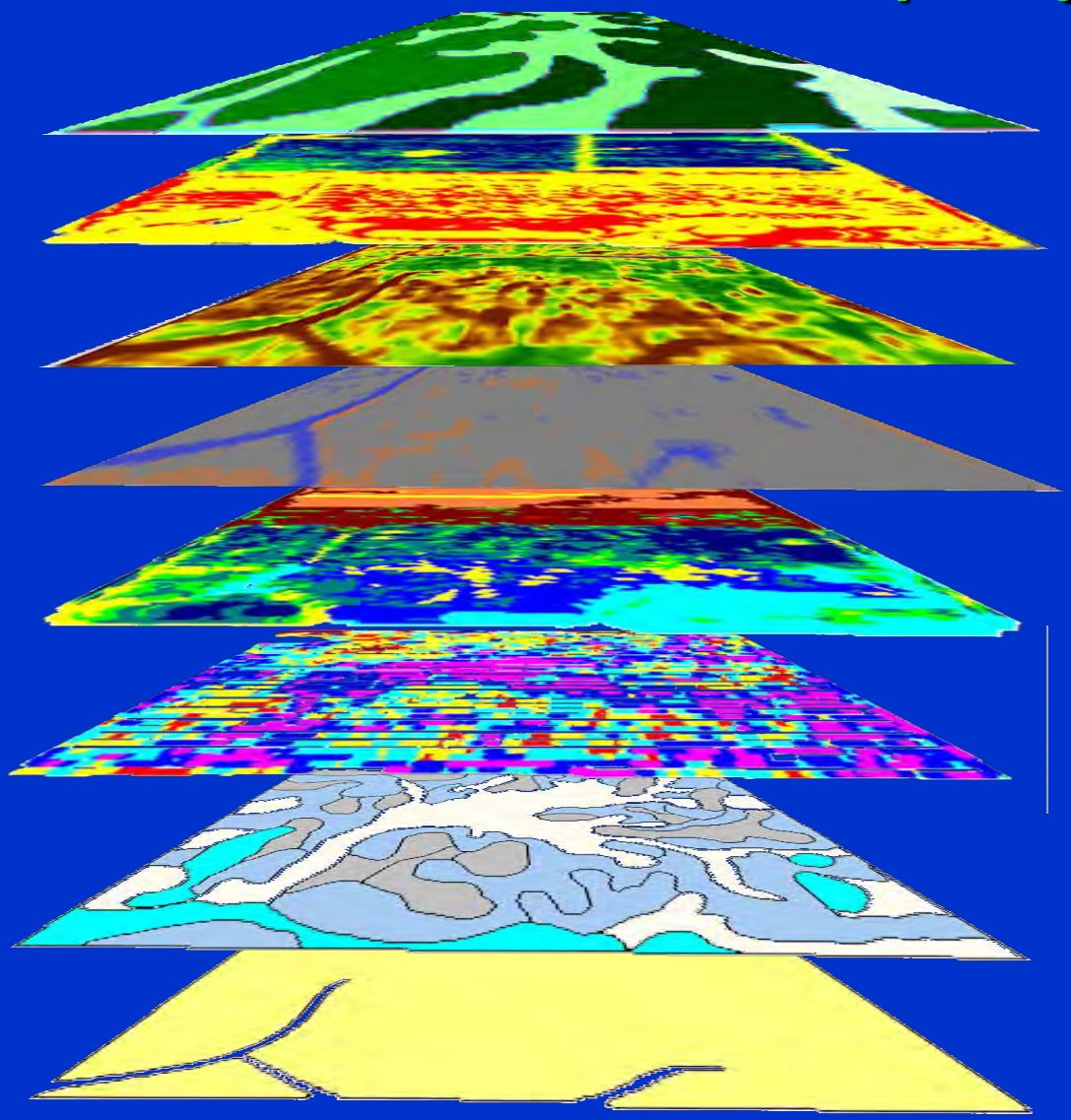
Yield Monitoring Systems



- Records yield and moisture
- Use with GPS to generate yield maps
- Maps help determine and manage field variability

GIS - Geographic Information System

Multiple layers of each!



Profitability Map

Yield Map

Remote Sensing Imagery

Weed Map

Nutrient Application Map

Soil Test Data

Digital Soil Survey

Field Boundaries