Agrico Crop Care Meeting
Brampton, Ontario
26 January 2010

IPNI
INTERNATIONAL
PLANT NUTRITION
INSTITUTE

Consequences of Cutting Back on Fertilizer

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IPNI Mission

"to develop and promote scientific information about the responsible management of plant nutrition for the benefit of the human family."

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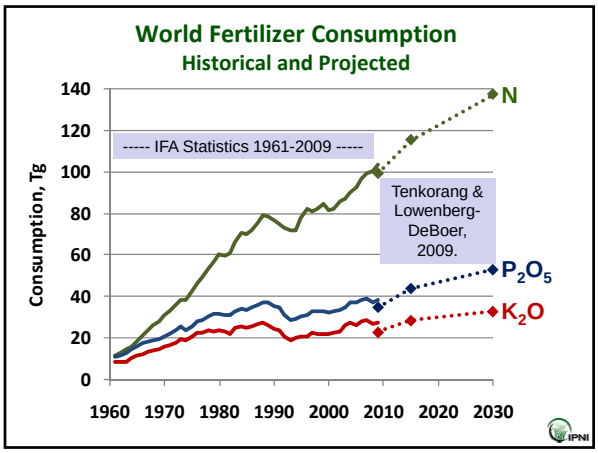
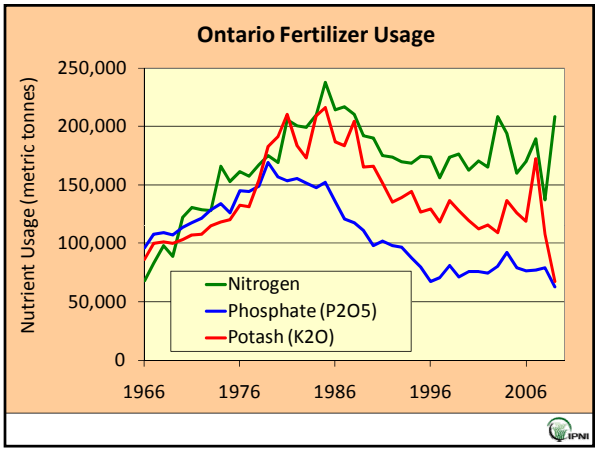
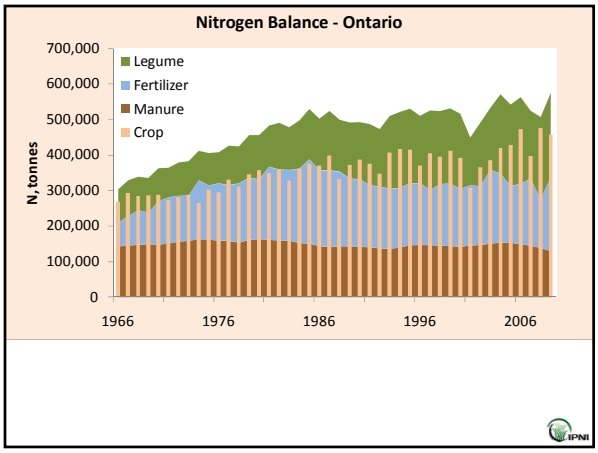
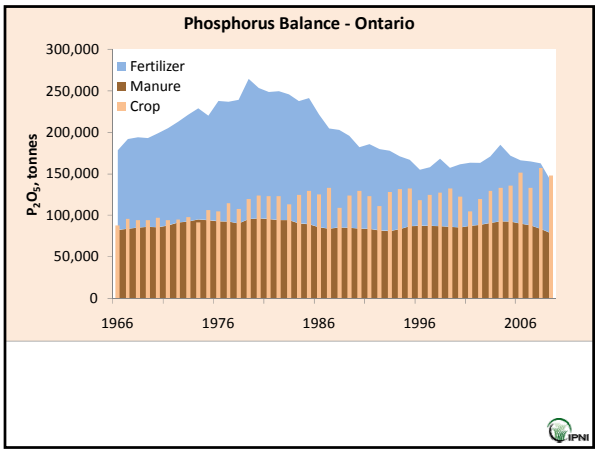
Outline

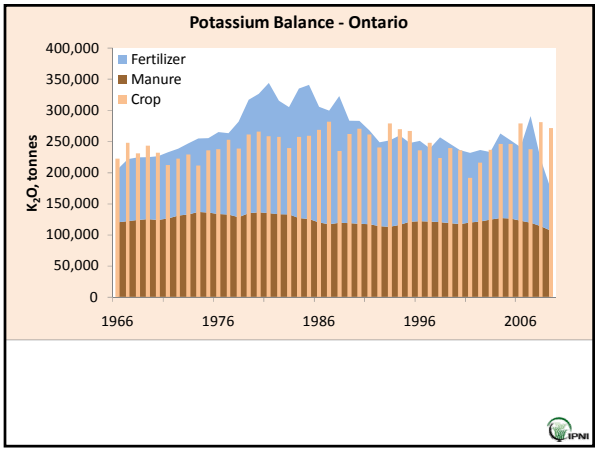
- Crop Nutrient Balances
- Consequences of Cutting Back
  - How fast do soil tests decline?
  - At what point will the soil test decline reduce yields?
  - How much will the soil test decline reduce yields?
  - Can profitability be improved with site-specific application?
- Starter responses
- 4R Nutrient Stewardship

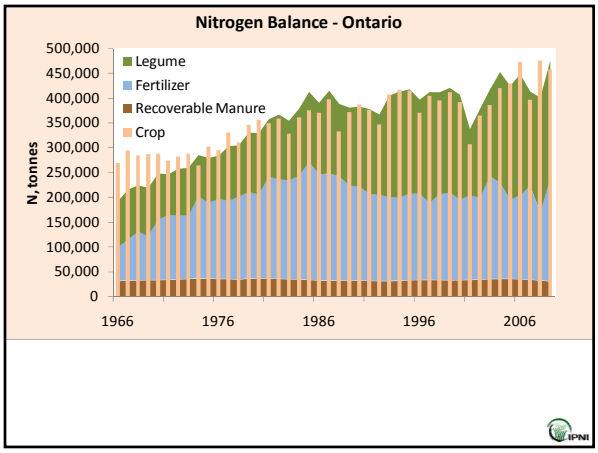

World Fertilizer Consumption
Historical and Projected
Consumption, Tg
140
120
100
80
60
40
20
0
1960 1970 1980 1990 2000 2010 2020 2030
----- IFA Statistics 1961-2009 -----
Tenkorang & Lowenberg-DeBoer, 2009.
N
P_2O_5
K_2O

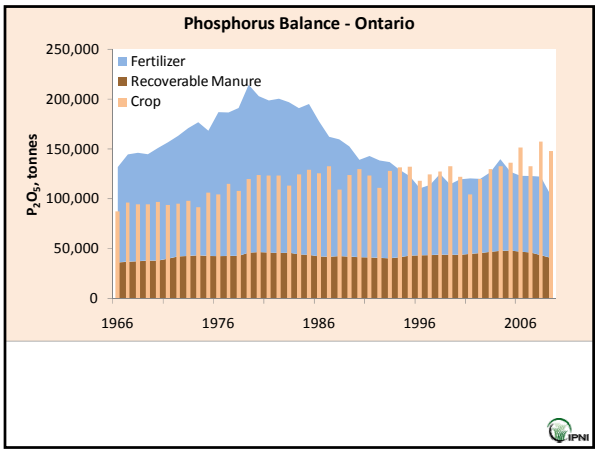

Ontario Fertilizer Usage
Nutrient Usage (metric tonnes)
250,000
200,000
150,000
100,000
50,000
0
1966 1976 1986 1996 2006
Nitrogen
Phosphate (P2O5)
Potash (K2O)

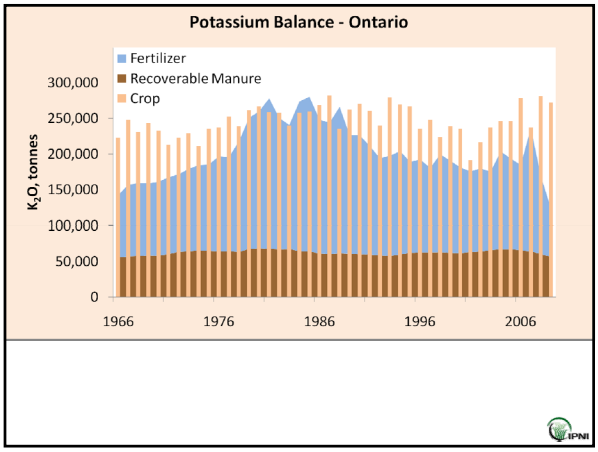

Nitrogen Balance - Ontario
N, tonnes
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
1966 1976 1986 1996 2006
Legume
Fertilizer
Manure
Crop


Phosphorus Balance - Ontario
300,000
250,000
200,000
150,000
100,000
50,000
0
P_2O_5, tonnes
Fertilizer
Manure
Crop
1966
1976
1986
1996
2006


Potassium Balance - Ontario
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
K_2O, tonnes
Fertilizer
Manure
Crop
1966
1976
1986
1996
2006


Nitrogen Balance - Ontario
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
N, tonnes
Legume
Fertilizer
Recoverable Manure
Crop
1966
1976
1986
1996
2006





IPNI INSIGHTS
INTERNATIONAL PLANT NUTRITION INSTITUTE

What Are the Consequences of Not Maintaining Soil Potassium?

May 2009

1. How fast do soil tests decline?
2. At what point will the soil test decline reduce yields?
3. How much will the soil test decline reduce yields?
4. Can profitability be improved with site-specific application?

How fast does soil test P decline?

- 1 ppm for each 28 lb/A of P_2O_5 – rule of thumb

Management Treatment	P_2O_5 input, lb/A/y	STP, ppm	Balance, lb P_2O_5/A[1]	ΔSTP, lb P_2O_5 /ppm
Control	63	10	50	14
Grower	63	9	50	19
Grower	63	7	20	29
Intensive (high NP, pop)	180	26	470	24
Intensive (high NP, pop)	180	22	460	29
Intensive zone-till	180	21	490	33
Intensive zone-till	180	17	490	46

[1] P_2O_5 applied over 5 years minus P_2O_5 removed in grain from 3 corn and 2 soybean harvests.

Initial soil test P 6 ppm. Corn-soybean rotation, 2002-2006, well-drained London loam, pH 7.5, Embro, ON. Adapted from Deen et al., 2007

How fast does soil test K decline?

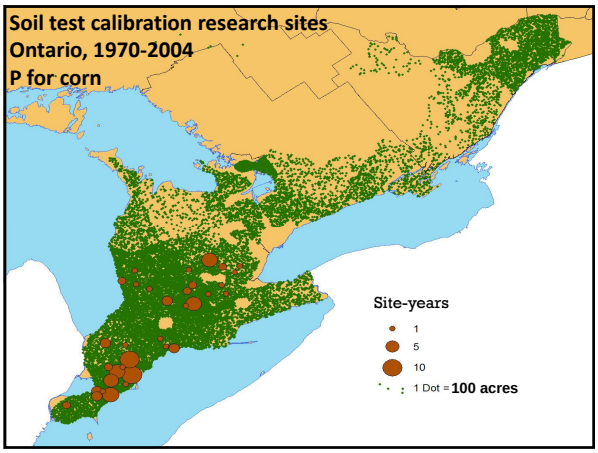
- 1 ppm for each 8 lb/A of K_2O – rule of thumb

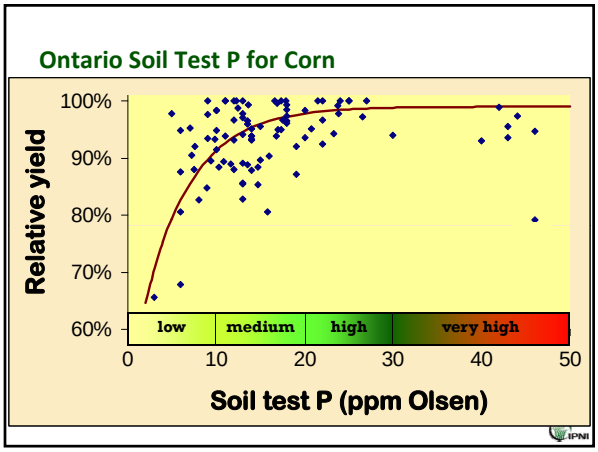
Management Treatment	K_2O input, lb/A/y	STK, ppm	Balance, lb K_2O/A[1]	ΔSTK, lb K_2O /ppm
Control	3	76	-190	48
Grower	30	77	-70	23
Grower	180	140	500	8
Intensive (high NP, pop)	30	91	-110	-10
Intensive (high NP, pop)	180	145	490	8
Intensive zone-till	30	80	-100	∞
Intensive zone-till	180	119	500	13

[1] K_2O applied over 5 years minus K_2O removed in grain from 3 corn and 2 soybean harvests.

Initial soil test K 80 ppm. Corn-soybean rotation, 2002-2006, well-drained London loam, pH 7.5, Embro, ON. Adapted from Deen et al., 2007

At what point will the soil test decline reduce yields?





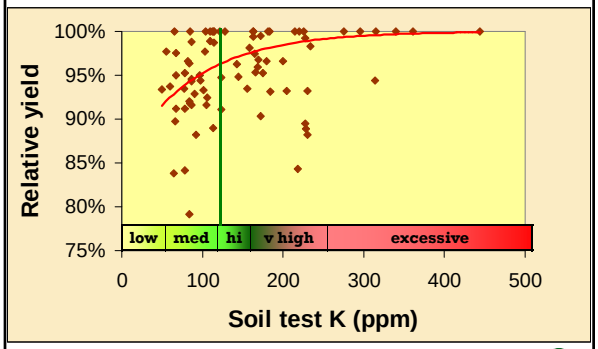
Corn Response to P

Soil Test Class	Frequency of response, %	Most economic rate (kg P_2O_5 ha^{-1})	
		mean	range
Low (0-9)	85	51	0-130
Medium (10-20)	59	28	0-110
High (20-30)	19	8	0-50
Very high (>30)	25	8	0-50

99 site-years; L<9 M<20 H<30 ppm Olsen-P

Better Crops/Vol. 88 (2004, No. 3)

Ontario Soil Test K for Corn



Corn Response to K

Soil Test Class	Frequency of response, %	Most economic rate (kg K_2O ha^{-1})	
		mean	range
Low (0-60)	67	49	0-190
Medium (61-120)	64	45	0-270
High (121-150)	49	30	0-95
Very high (>150)	12	7	0-80

113 site-years; L<60 M<120 H<150 ppm ammonium acetate K

Better Crops/Vol. 88 (2004, No. 3)

New Soil Test Categories

Probability of response to applied nutrients at different soil test levels

Old	New Response Category	Probability of profitable response to applied nutrients
L	High Response (HR)	High (most of the cases)
M	Medium Response (MR)	Medium (about half the cases)
H	Low Response (LR)	Low (few of the cases)
VH	Rare Response (RR)	Rare (very few of the cases)
E	No or Negative Response (NR)*	Not profitable to apply nutrients*

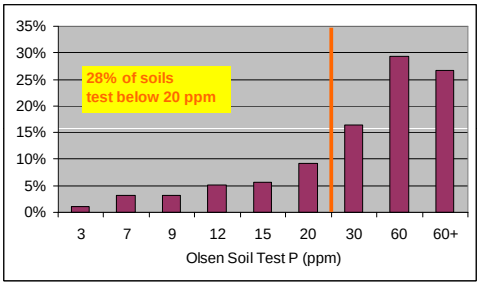
*adding nutrients to soils with these levels of nutrients may reduce crop yields or quality by interfering with the uptake of other nutrients.

Adapted from OMAFRA publication 811

Crop response to applied P
—at a given level of soil test P—
can depend on:

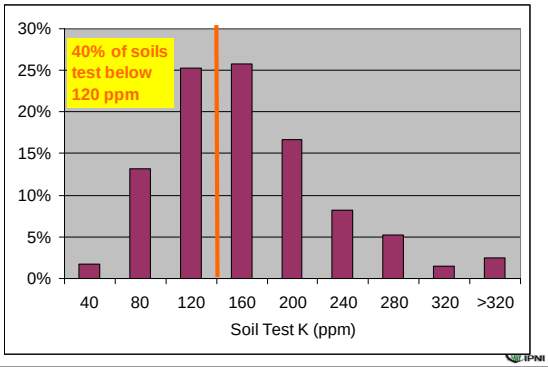
Amount & type of clay	Soil compaction
Application timing	Soil moisture
Crop cultivar	Soil organic matter
Other nutrients	Soil pH
Soil aeration	Tillage & weather

Soil Test P in Ontario



PPI Soil Test Summary, 2005. 92,000 samples.

Soil Test K in Ontario



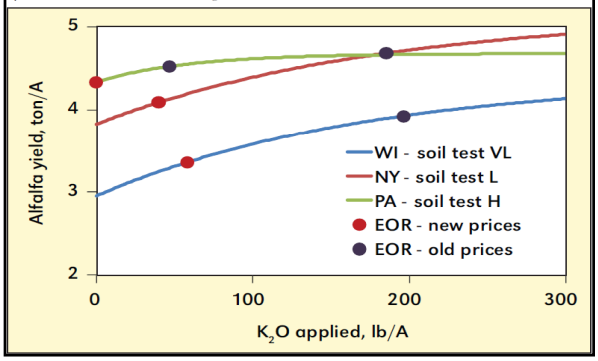
How much will the soil test decline reduce yields?

Table 1. Response to applied K (or, expected yield reduction when no K is applied).

Soil test K	Corn, bu/A n=96		Soybeans, bu/A n=128		Alfalfa, ton/A n=53	
ppm	median	maximum	median	maximum	median	maximum
< 80	10	49	1.3	14	1.1	2.0
80-120	4	22	1.0	11	0.4	1.3
> 120	1	15	0.5	14	0.1	0.7

Forage Fertilizer Decisions in an Uncertain Market

By Tom Bruulsema and Gilles Bélanger



Can profitability be improved with site-specific application?

- Yes!
- Sample management zones
- Scout for deficient areas

P Deficiency in Corn Seedlings

Starter fertilizers and corn yields 2008-9

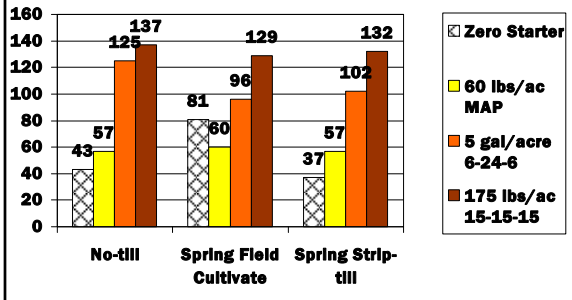
Site:	Elora		Alma	Bornholm
Year:	2008	2009	2009	2009
Soil Test Values:	P:11 K:61	P:8 K:68	P:35 K:77	P:18 K: 80
Starter Fertilizer Treatments	Corn Yields (bu/A)			
Control (no starter)	188	168	179	125
10-34-0 @ 5 gal/A (in furrow)	195	169	180	116
11-52-0 @ 75 lb/A (2x2)	198	165	180	114
11-52-0 @ 75 lb/A + UAN @ 10 gal/A (2x2)	199	163	171	114
6-24-6 @ 5.0 gal/A (in furrow)	204	177	181	128
5-20-20 @ 200 lb/A (2x2)	220	184	183	150

In Elora both 2008 and 2009, 200 lb/A of 0-0-60 was broadcast in addition to starter treatments.

Source: Greg Stewart, OMAFRA

Starter Fertilizer 2009

Elora (P = 9 PPM; K = 66 PPM)



Source: Greg Stewart, OMAFRA

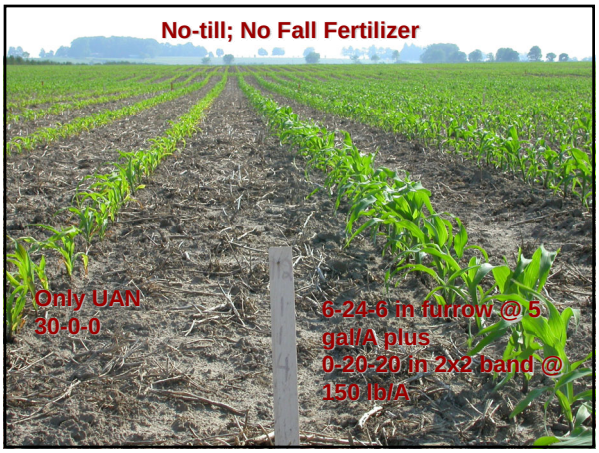
Ontario Tillage x Starter Fertilizer Studies

Alma, Ancaster, Wellington, 2001-2003
Loam to silt loam soils

Bill Deen, Greg Stewart, John Lauzon
Tillage x Fall Fertilizer x Spring Starter Experiment
4 x 4 x 5 factorial

Plots 10' wide by 70' long
All plots received 30 lb/A starter N as UAN

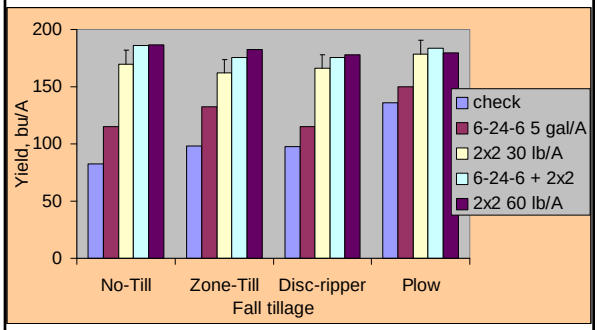
No-till; No Fall Fertilizer



Only UAN
30-0-0

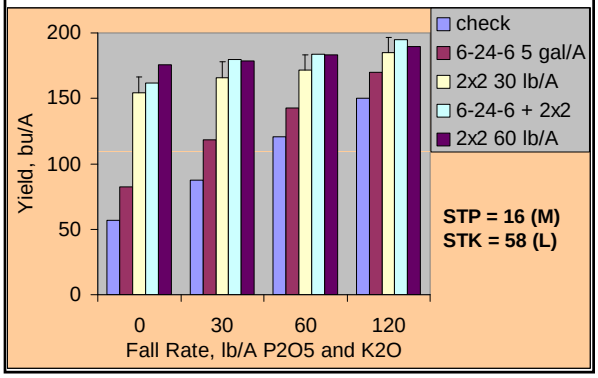
6-24-6 in furrow @ 5 gal/A plus
0-20-20 in 2x2 band @ 150 lb/A

Alma 2003



STP = 16 (M); STK = 58 (L)

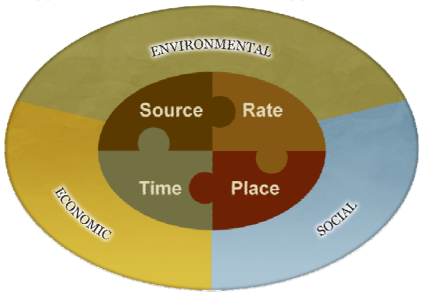
Alma 2003

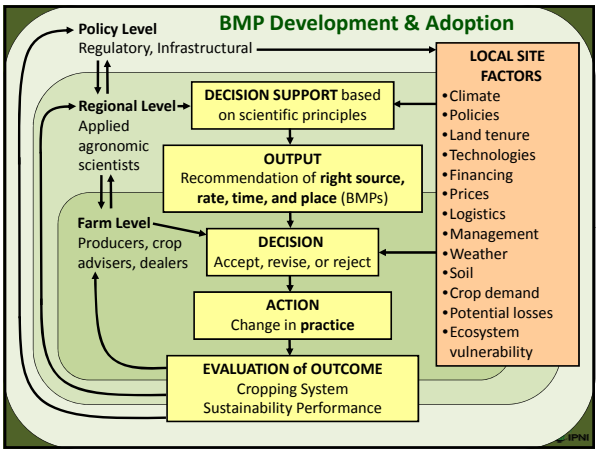


STP = 16 (M)
STK = 58 (L)

4R Nutrient Stewardship

- **Right Source, Right Rate, Right Time & Right Place**
  - **Linking practices to science for sustainability performance**

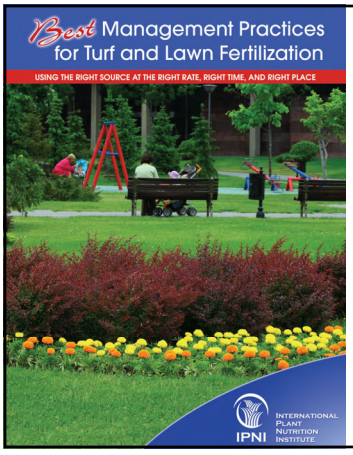




Fertilizer can reduce P loss from turf

Fertilizer	Total losses in runoff July 2000 – November 2001 (33 runoff events)
	Phosphate-P, pounds per acre
Controlled-release 24-5-11	0.9
Soluble 35-3-5	0.7
Control 0-0-0	1.4

Easton and Petrovic, 2004



Following the principles of the "4 R's"

— right source at the right rate, right time, and right place —

is the foundation of fertilizer BMPs for turf.

Summary

- Crop nutrient balances moving toward deficit
- Consequences of cutting back on fertilizer
  - Soil test decline
  - Reduced yields when soil tests decline to responsive range
  - Need specific data to estimate size of yield reduction
  - Need for site-specific application
- Starter responses also depend on soil test levels
- 4R Nutrient Stewardship seeks the right source, rate, timing and placement for sustainable production

Comments Welcome

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