

# TOTAL SOIL PHOSPHORUS IN PRAIRIE PROVINCE SOILS

by

Les Henry

Soils and Crops, March 6, 2017

Prairieland Park, Saskatoon

1. Why Total P – Why Now
2. The Old Phosphorus Story
3. The New Phosphorus Story
4. Total Soil P in the Soil Profile
5. Total Soil P in Prairie Provinces – Summary Table

# Why Total P ? Why Now ?

- \* Past 50 years we have data re: ' Available P' and endless P fractionations and mathematical models: we have no good database of total soil P
- \* The 'Old' P Story had no need for total P:  
The ' New' P Story will benefit for knowing total P
- \* Environmental Concerns Re: P in surface Waters needs total soil P to deal with particulate P ( eroded soil)

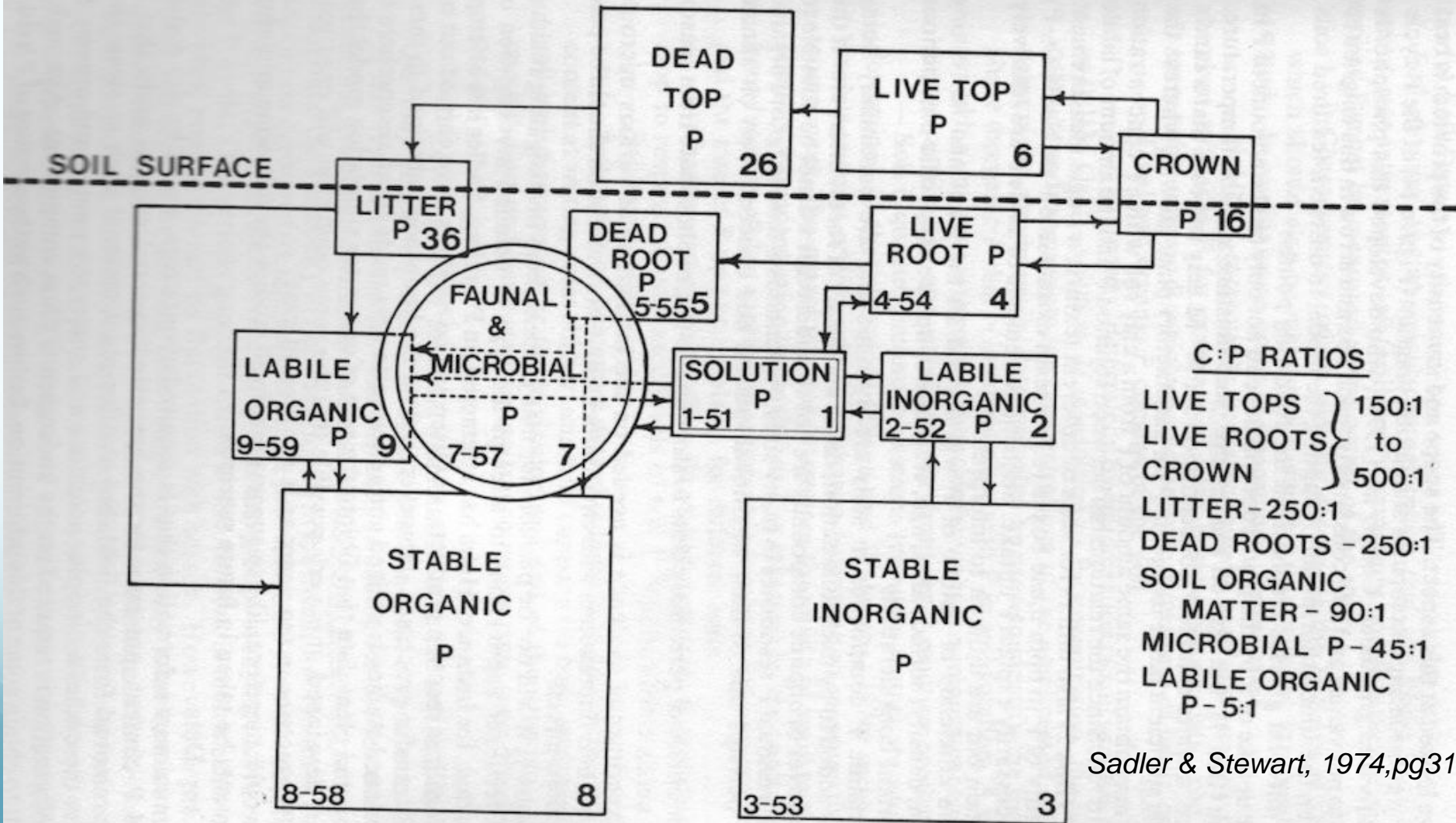
## 2. THE 'OLD' PHOSPHORUS STORY

- A 'little dab'll do ya' – with the seed
- Uptake efficiency of seed placed P is only about 30% and rest gets 'sucked up' by the soil
- With old cropping practices, P levels declined slowly and there was little use of higher P rates to build or maintain Soil P levels.

The 'old' story had complicated mathematical models as below:

Many papers published and many conferences .

But what about the FARMER

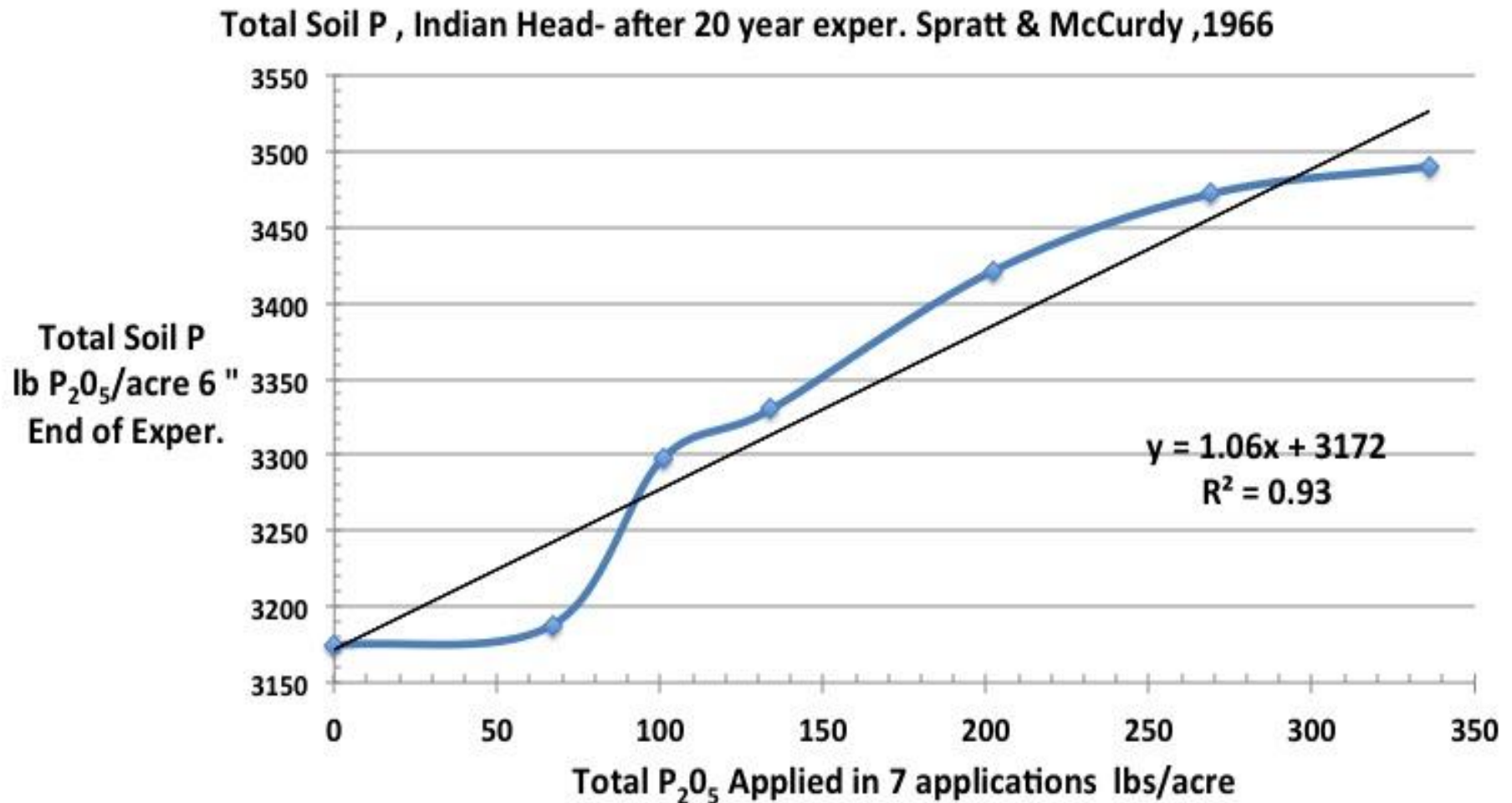


The long term residual P effects were  
staring us in the face

Even before the 1970s/80s high rate  
residual plots

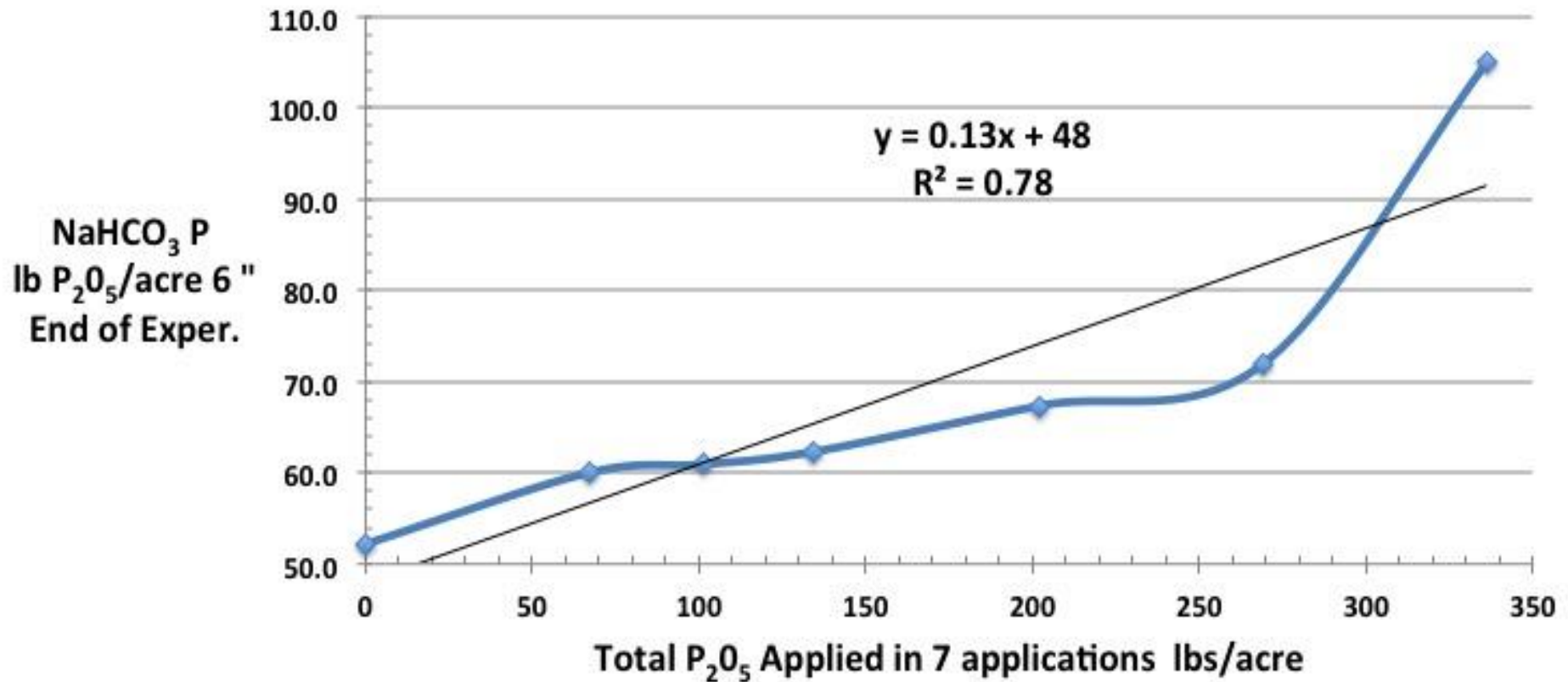
Why did it take us so long to figure it  
out???????

Spratt & McCurdy, 1966: Can.J. Soil Sci. 46: 29-36: Indian Head Clay  
Wheat, Wheat, Fallow: 0, 9.6, 14.4, 19.2, 28.8, 38.4, 48 lbs  $P_2O_5$ /acre  
to fallow wheat only. Experiment ran for 20 years.





NaHCO<sub>3</sub> P , Indian Head- after 20 year exper. Spratt & McCurdy ,1966





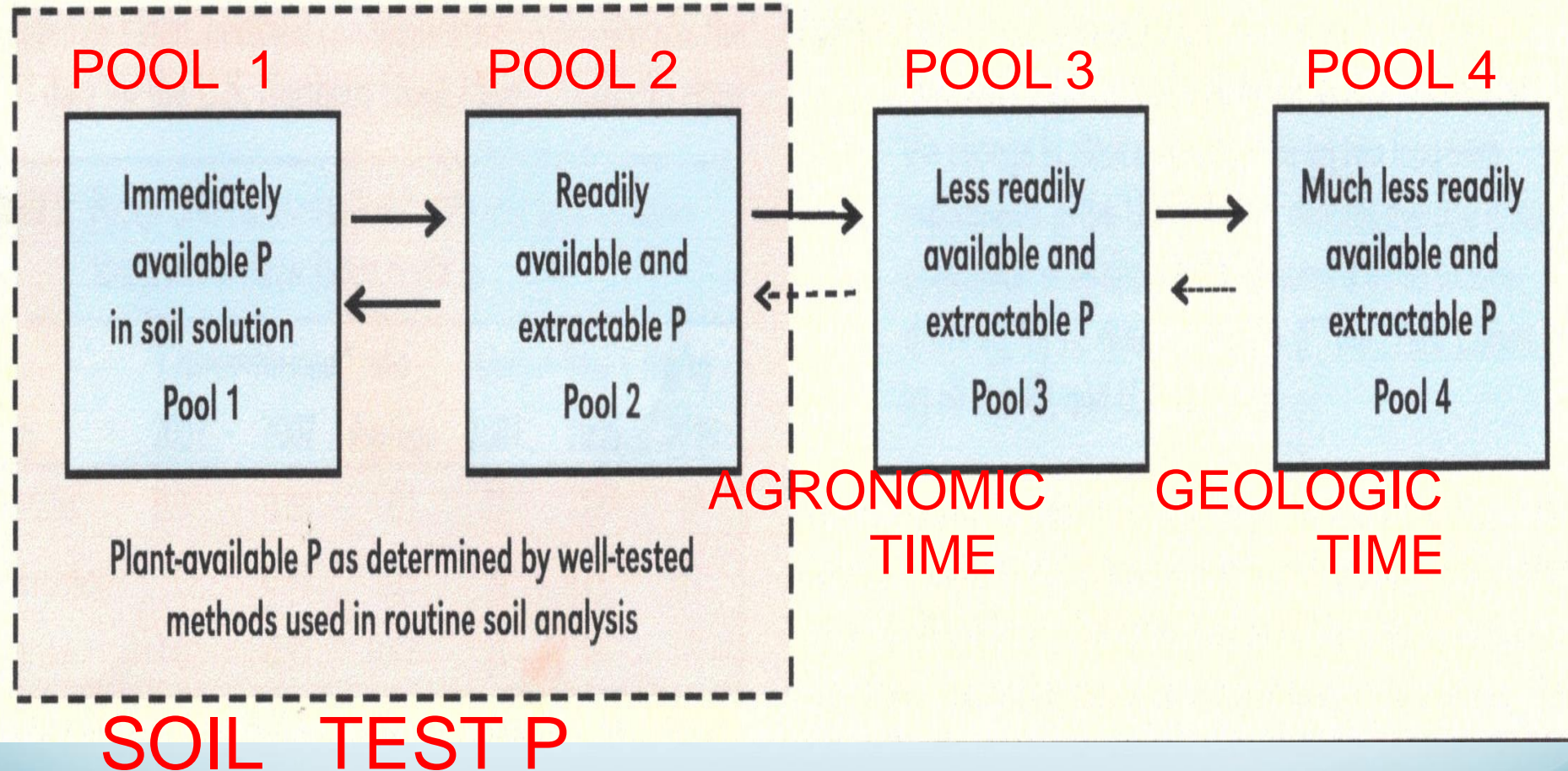
### 3. THE 'NEW' PHOSPHORUS STORY

\* Renaud Lemke , AAFC , Swift C/Saskatoon analyzed long term NP fertilizer experiments from Swift C and found that 98% of fertilizer added could be accounted for by the extra P the farmer hauled to the elevator in the extra grain grown.

“ Data from ....controlled experiments in England and .. state-wide ..data in the U.S. ....suggest ... ‘simple rule’ ... of plant-available soil P... related to a four-pools concept..”

*Johnny Johnston et al., 2014*

# 4 Pools of Soil Phosphorus

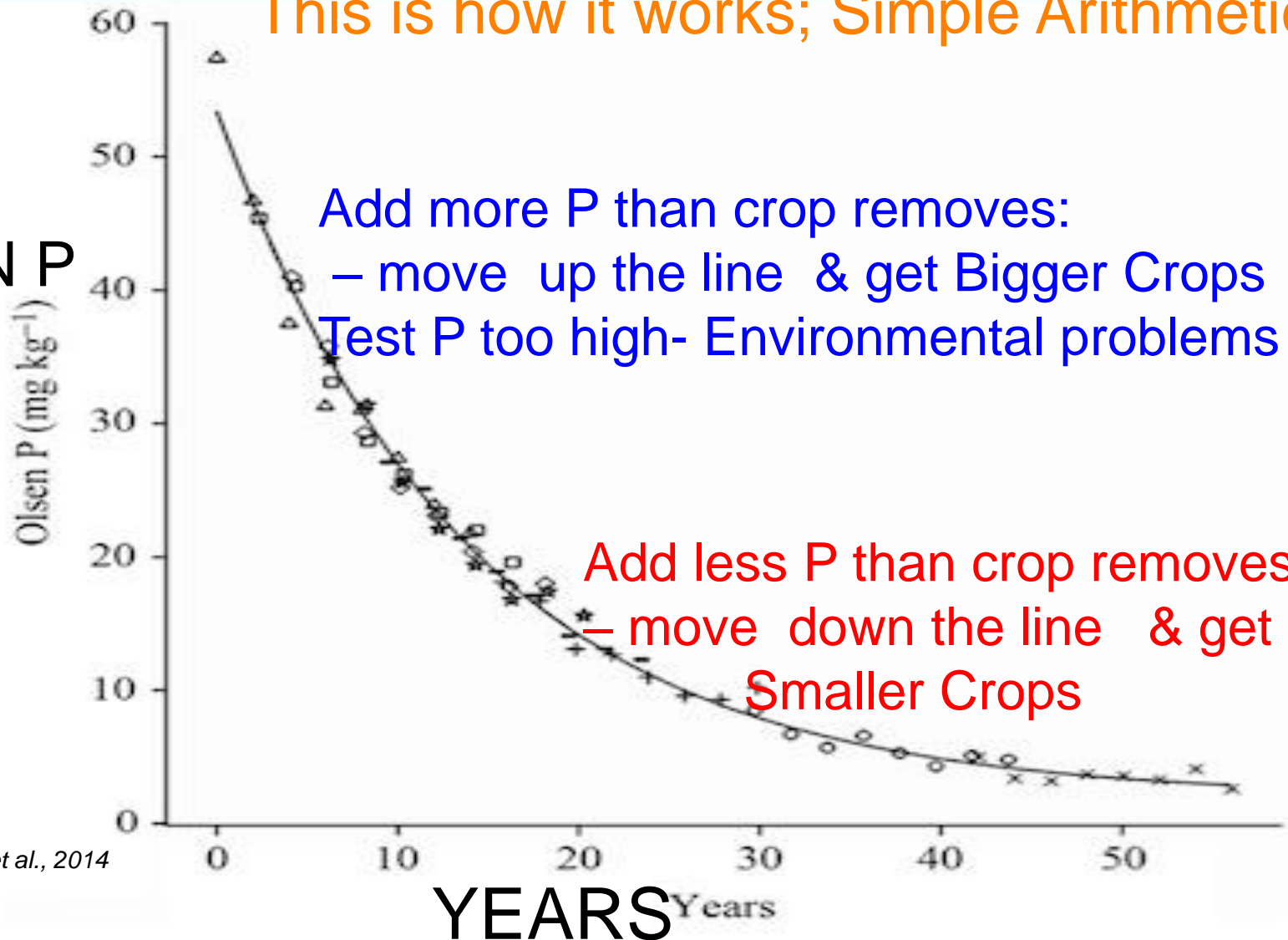


From : Johnson et al. , 2014  
Better Crops... Vol. 98 No.4 Page 22

This is how it works; Simple Arithmetic:

Add more P than crop removes:  
– move up the line & get Bigger Crops  
Test P too high- Environmental problems

Add less P than crop removes:  
– move down the line & get  
Smaller Crops



from Johnston et al., 2014  
Adv Agron

## 4. TOTAL SOIL P IN THE SOIL PROFILE

$$P \times 2.29 = P_2O_5$$

$$P_2O_5 / 2.29 = P$$

$$\text{ppm} \times 2 = \text{lb/acre 6 inches}$$

*but to be accurate must use bulk density*

$$\text{ppm} \times 4.58 = \text{lb/acre 6 inches}$$

# Sources of Total Soil P data

Alberta – Soil survey Reports – until 1961- profiles

Saskatchewan – Soil Survey Reports until 1950

# 12 and # 13 and special surveys of Fed stations

# 13 Topsoil only

Research Papers and theses-

Especially Lorne Letkeman U of S Soil Science, 1993

& Bob McKercher , U of S – PhD in Scotland but soils from Sask.

# Ardill : Brown soil on Glacial till (North of Swift C)

## Orthic Profile

## Native Prairie

## Eluviated profile

Horizon	Total P, ppm	Thickness cm
Ah	672	7
Bm	587	16
BC	766	9
Cca	692	56
Ck	686	62 Total 1.5m

Horizon	Total P, ppm	Thickness cm
Ah	1521	7
Aeg	918	15
Bt	536	68
BC	727	10
Cca	825	51
Ck	738	35 total 1.9m

# Weyburn: Dark Brown soil on Glacial till ( at Aberdeen)

## Native Prairie

### Rego Profile no B

Horizon	Total P, ppm	Thicknes s cm
Ah	942	20
Ahk	818	10
Cca	600	40
Ck	601	60
Total 1.2m		

### Eluviated profile

Horizon	Total P, ppm	Thickness cm
Ah	1337	13
Ahe	642	17
Ae	371	25
Bt1	535	10
Bt2	722	30
BC	772	76
Cca	662	81
Total 2.9m		

*From Letkeman MSc Thesis U of S*



# Killam Loam :Black on till

# Elnora Loam: Thin Black on till

## Alberta Soil Report # 16 Red Deer

Horizon	Total P, ppm	Thickness inches
Ah <sub>1</sub>	920	3
Ah <sub>2</sub>	650	3
Ae	360	2
B <sub>1</sub>	520	6
B <sub>2</sub>	670	6
C	930	10 Total =30 in.

Horizon	Total P, ppm	Thickness inches
Ah	850	5
B <sub>1</sub>	390	6
B <sub>2</sub>	500	13
Cca	500	6 Total =30 in.

# Waitville loam : Grey wooded on till Native bush

(at Spiritwood)  
Cultivated

Horizon	Total P, ppm	Thickness cm
L-H	554	5
Ah/Ae	256	7
Ae	149	9
Bt <sub>1</sub>	250	5
Bt <sub>2</sub>	709	36
Cca	667	60
Ck <sub>1</sub>	656	52
Ck <sub>2</sub>	651	610



Photo  
Beaverlodge soil report 1961  
Orthic Grey Wooded

Horizon	Total P, ppm	Thickness cm
Ap	286	10
Ae	224	7
Bt <sub>1</sub>	302	5
Bt <sub>2</sub>	432	15
Bt <sub>3</sub>	561	13
Bt <sub>4</sub>	672	20
BC/CB	649	14
Cca	634	23
Ck	665	163

Total 2.7 m

**Total 10.05m**

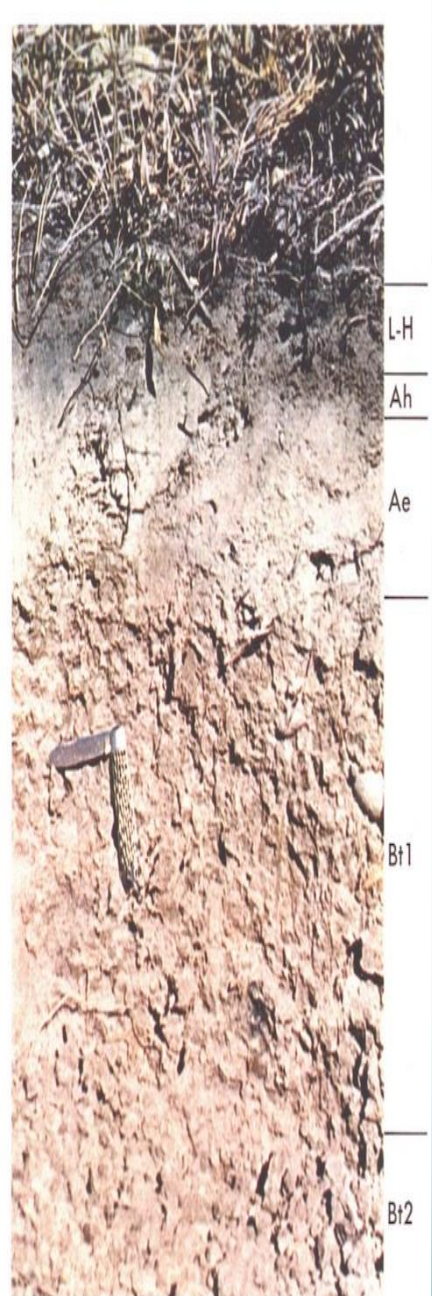
Soil Total P by Les Henry

Data from Letkeman MSc Thesis U of S

March 6 2017

# Braeburn Series, Grey Wooded on glacial till, Beaverlodge soil report 1961

HORIZON	TOTAL P, ppm	Thickness, inches
L-H	800	1
Ae	300	2
AB	300	9
Bt <sub>1</sub>	300	6
Bt <sub>2</sub>	400	6
BC	600	8
C	600	at 32"



Orthic Grey Wooded



## IT IS ALL ABOUT TOPSOIL

Topsoil P will reflect what Mother Nature moved from subsoil to topsoil over 10,000 years

AND

What we have done in cropping over last 100 years

Haul away more crop P than we add – soil P and Crop Yield down

Add more P than crops remove – soil P and Crop Yield goes up



Haul away more crop P than we add: soil P & Crop Yield down

Add more P than crops remove: soil P and Crop Yield goes up

THE SOIL TEST IS THE EXAM re: SOIL P

Soil P test is to the farmer as  
Hemoglobin A1C test is to diabetic

## 5. Total P -Prairie Soils – Summary Table

(Approximate benchmark data only – from many sources)

	<u>lbs <math>P_2O_5</math>/acre 6 inches</u>
Brown and Dark Brown Soils	
Sandy Texture	1600
Medium and Fine texture	2300
Black – Medium Texture	3400
Thick Black – Clay Texture	4100
Grey Wooded – Medium Texture	1200

Note: Feedlot alley in Alberta has quarter sections with 2200 lbs  $P_2O_5$ /acre 6 inches of SOIL TEST P ??? TOTAL???

## MORE INFORMATION ON 'THE NEW PHOSPHORUS STORY

Stu Brandt - at Agri-Arm Update January 2017 –  
on website

Manitoba Agriculture – Heard, Flaten, Grant



# THE END

??????????

????????