

INFOAG 2015

BRAZILIAN PRECISION AGRICULTURE IN PERSPECTIVE

Dr. Eros Francisco, IPNI Brazil

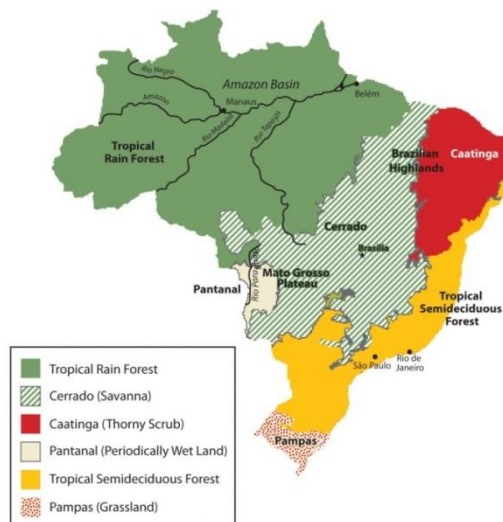
Dr. Leandro Gimenez, ESALQ/USP



BRAZIL



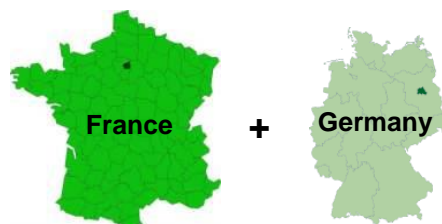
- ✓ Country continues to have enormous potential for agriculture and livestock production. Among other advantages we have: area, possibilities for yield increase, possibilities to increase # of crops per year, available water and the necessary labour.
- ✓ No need to interfere significantly with the Amazon forest.



Agriculture in Brazil



Actual Area not Yet Explored
100.000.000 ha



Actual Area with Forage
Grasses (220.000.000 ha)

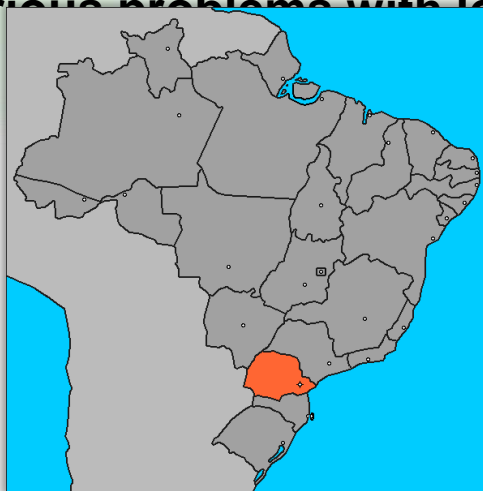


IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

BRAZIL



- ✓ Some concerns arising related to fertilizers and the environment (ex.: Parana state).
- ✓ Restrictions are growing because of environmental protection.
- ✓ Fastest growing country in terms of fertilizer consumption.
- ✓ Still serious problems with logistics.



Brazilian Agriculture



Main Crops Cultivated in Brazil Area, production, and yield information

Crops	Cropped land (ha)	Total Production (ton)	Yield (ton/ha)	World ranking (production)
Soybean (grains)	31,908,300	96,222,100	3.02	# 2
Corn (grains)	15,569,600	81,811,400	5.26	# 4
Sugarcane	9,462,556	678,298,386	71.7	# 1
Beans (grains)	2,977,500	3,151,200	1.06	# 3
Wheat (grains)	2,458,800	7,011,600	2.85	# 23
Rice (with rind)	2,292,300	12,499,900	5.45	# 7
Coffee (grains)	1,939,351	2,602,696	1.34	# 1
Cotton (seeds+lint)	976,200	2,320,400	2.38	# 5
Orange	614,467	13,809,684	22.5	# 2

Source: CONAB/IBGE - Systematic Survey of Brazilian Agricultural Production, Jun/2015.



IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

YIELD POTENCIAL IN THE CERRADO AREA OF BRAZIL

Crops	Area (Million ha)	Yield (t/ha/year)	Yield (Million t)
Rainfed	60,0	3,3	192
Irrigated	10,0	6,0	60
Beef Production	60,0	0,2	12
Perennial	6,0	15,0	90
Total	136,0		354

Assuming:

- a) 1/3 of area (71 million ha) for environmental preservation;
- b) availability of water to irrigate 10 million ha;
- c) increase in yield compatible with current available technology .

Extracted from Lopes, 2008

Source: Macedo, 1995



Brazilian Agriculture



Secondary Crops Cultivated in Brazil

Area, production, and yield information

Crops	Cropped land (ha)	Total Production (ton)	Yield (ton/ha)
Cassava	1,605,500	23,572,900	14.7
Cocoa (almond)	704,780	286,790	0.41
Sorghum (grains)	783,750	2,259,750	2.88
Oats (grains)	201,400	469,560	2.33
English Potatoes	132,100	3,739,400	28.3
Castor bean (grains)	63,000	37,820	0.60
Peanuts (grains)	109,000	318,000	2.91
Barley (grains)	91,170	329,820	3.62
Onion	57,700	1,654,300	28.6
Triticale (grains)	38,970	119,150	3.06

Source: CONAB/IBGE - Systematic Survey of Brazilian Agricultural Production, Nov/2014.



IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

Brazilian Agriculture



Soybean & Maize Production

Setor Agro

Produção no Brasil em

Soybean

Setor Agro

74,8 milhões de toneladas

Mato Grosso maior estado produtor
20,4 milhões de toneladas

Fonte: CONAB



Cattle

safr 2011

Brasil: 21,7 milhões de abates

MS (estado com maior número de abate)
4,3 milhões de abates

Fonte: Ministério da Agricultura, Pecuária e Abastecimento

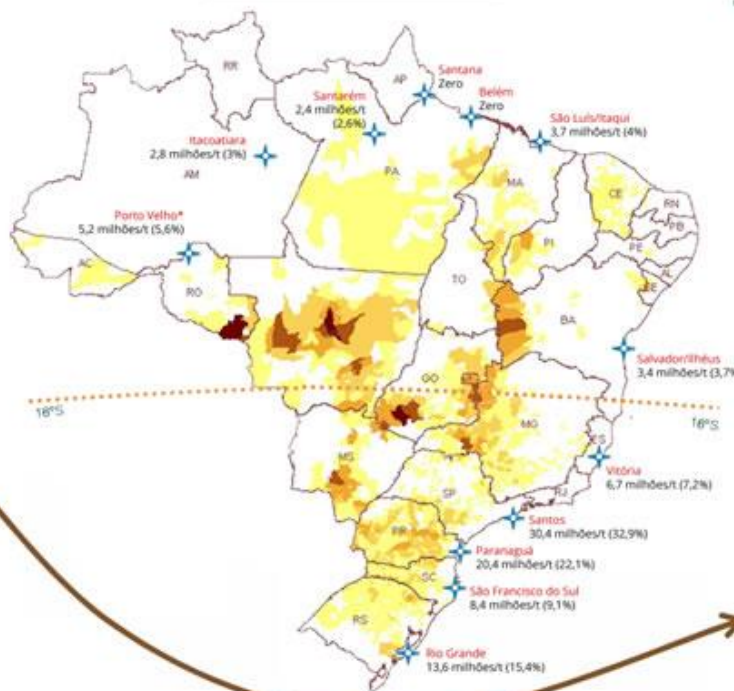


Produção Brasil

170 milhões/t

Limite Superior

2014



* Porto de Porto Velho (RO) = distribui para os portos de Itacoatiara (AM) e Santarém (PA)
** Valores estimados sobre o consumo interno de 2013 acrescido PIB previsto 2014 de 4%
*** Considerado mesma participação dos portos em 2013
OBS.: Considerada a mesma participação de exportação de cada portos em 2013
Fonte: Produção (CONAB, Previsão Safra 2013/2014), Exportação por Porto (SECEX, Jan-Out 2013) e Estimativa Nov-Dez 2013 de acordo com Produção

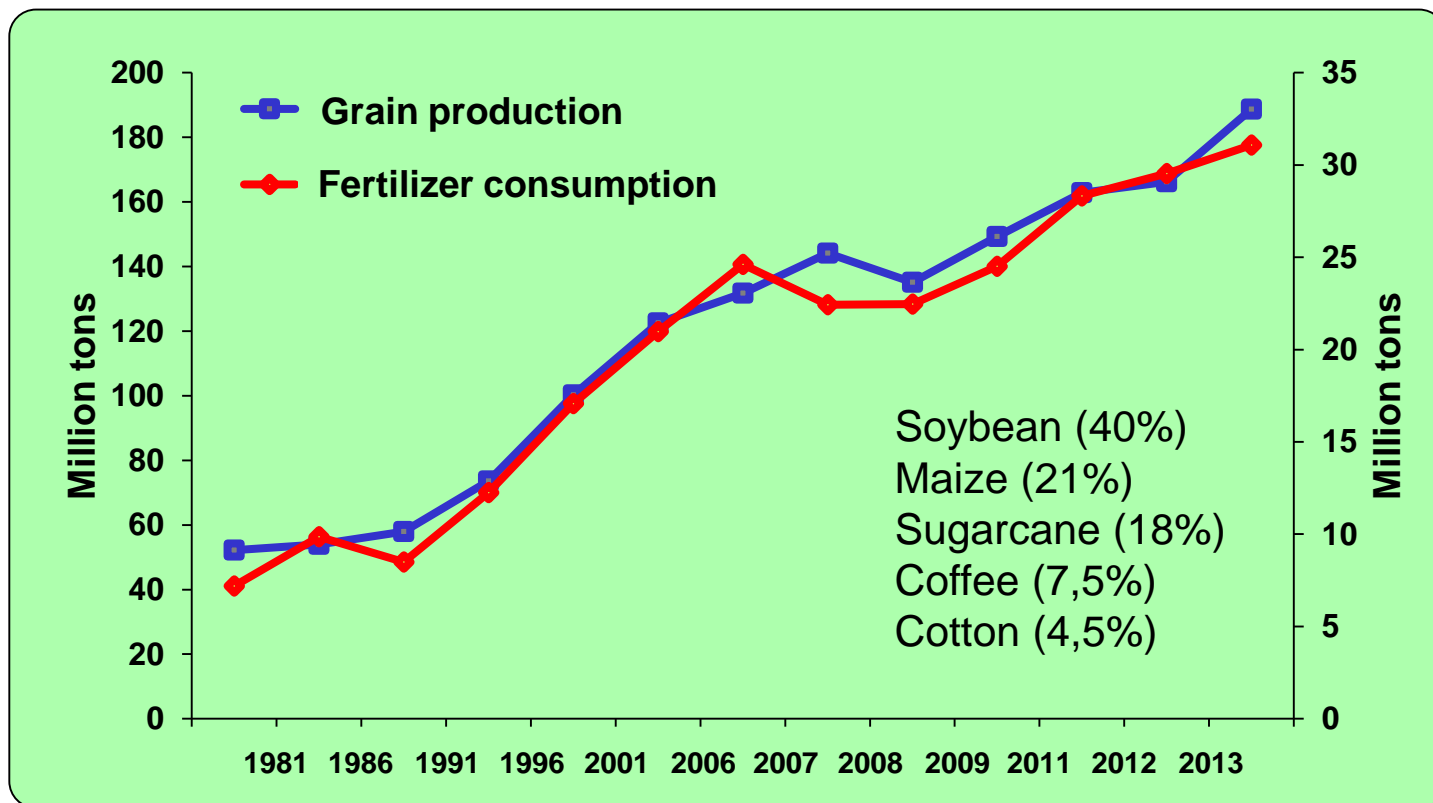


IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

Brazilian Agriculture



History of grain production and fertilizer consumption in Brazil



Sources: ANDA e CONAB (2014),

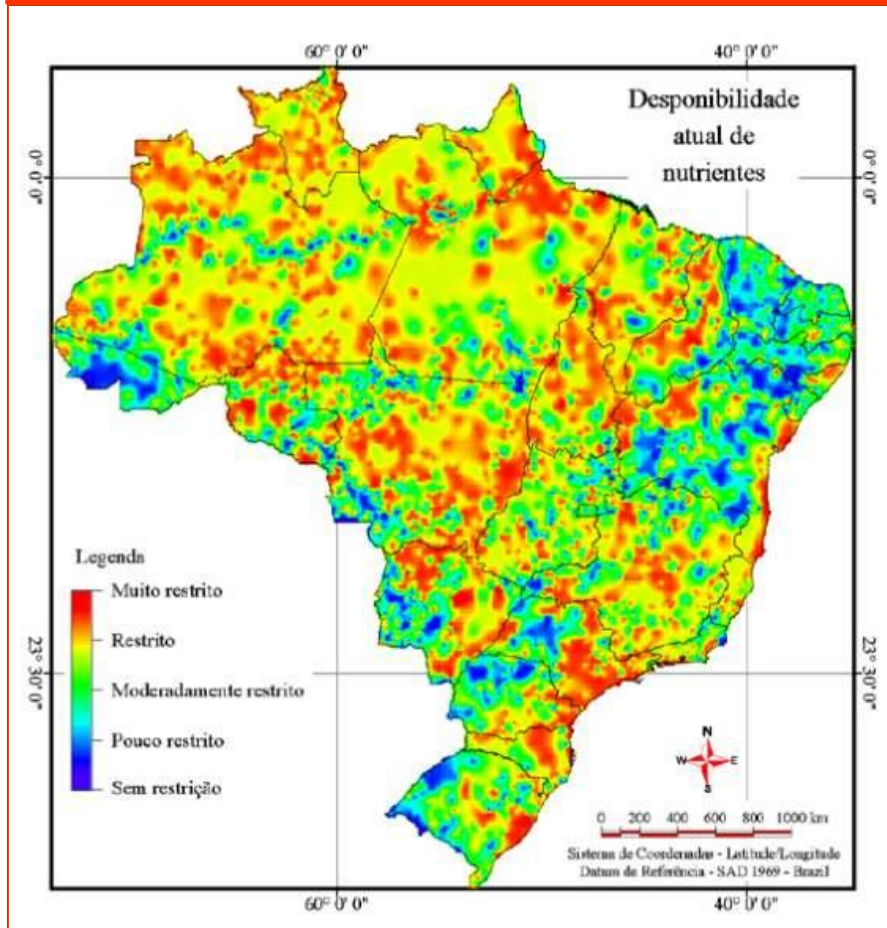


IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

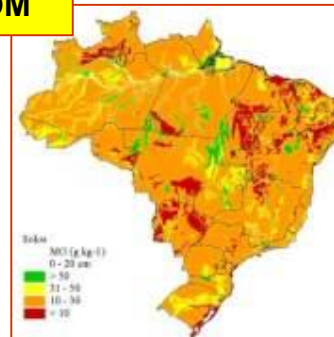
Brazilian Agriculture



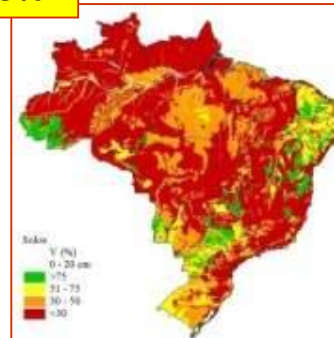
Soil fertility restrictions in Brazil



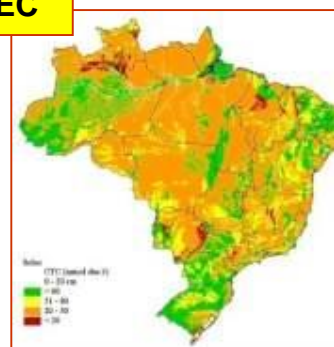
OM



BS%



CEC



IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

Fonte: Sparovek et al.

Brazilian Agriculture



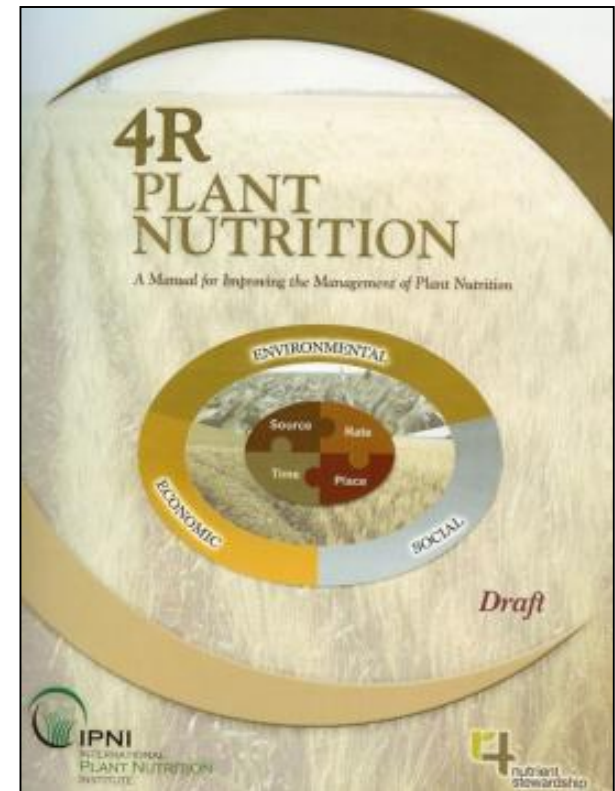
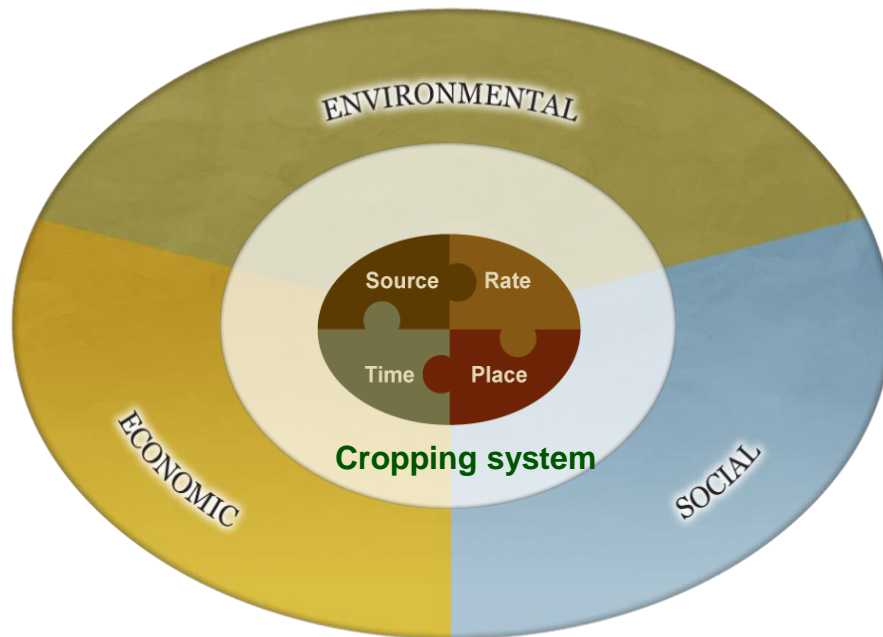
BRASIL
ESTADOS
DO BRASIL
AMAZONAS
RO RORAIMA
ACRE
PARÁ
MARANHÃO
PIAUI
CEARÁ
RIO GRANDE DO NORTE
PARAIBA
PERNAMBUCO
ALAGOAS
SERGIPE
BAHIA
ESPÍRITO SANTO
MINAS GERAIS
GOIÁS
MATO GROSSO DO SUL
MATO GROSSO
RONDÔNIA



Equipaments are changing affecting how we apply inputs (ex.: fertilizers). Should not be the opposite?



Education – 4R NUTRIENT STEWARSHIP PROGRAM



APPLICATION OF THE RIGHT NUTRIENT SOURCE AT THE RIGHT RATE, TIME, AND PLACE



IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

Precision Ag by Region



➤ Southern region – Paraná and Rio Grande do Sul

- Small to medium farms, family operated, no-tillage and crop rotation
- Skilled farm machinery operators
- Cooperatives selling “applied fertilizer” – grid sampling + VRT broadcast

➤ Sugarcane region – São Paulo

- Mills sold for worldwide companies (shell, raizen)
- Large mills usually growing many small fields
- Precision ag tools as ancillary tool for managing assets, not much on variability management

➤ Central/Southern region – Mato Grosso do Sul, Goiás, Minas Gerais

- Medium to large farms, family management and hired labor
- Grains, Pastures and integration: grains in rotation with pasture
- Specialized companies selling grid sampling and prescription maps for fertilizer application

➤ Central/Northern region – Mato Grosso, Bahia, Maranhão

- Medium to huge farms, family and investors (large groups with thousands ha)
- Less skilled operators
- Soybeans and second season corn
- Specialized companies selling grid sampling and prescription maps for fertilizer application
- Investors developing their own team for grid sampling aiming variable rate fertilizer application





➤ Machinery guidance

- Guidance is used by the majority of sprayers
- Broad range of technological solutions from U\$5.000 to U\$50.000
- ✓ **Light bars with autonomous GPS** – small farms (50ha and larger), for spraying and broadcast fertilizer application
- ✓ **Electric steering with correction through algorithm** – medium farms (200 ha and larger) for spraying and planting
- ✓ **Hydraulic steering with satellite DGPS** – medium to large farms (300 ha and larger) for planting, spraying and broadcast fertilizer application
- ✓ **Autopilot with satellite DGPS and RTK**– large farms (1000 ha and larger) for planting, harvesting, sugarcane is a big client
- ✓ **GPS signal correction** through local towers and radio are becoming common in region with intensive agriculture



Available Tools for PA



➤ Rate controllers

- For uniform application – sprayers
- Variable rate
- Broadcast fertilizer and lime
- Fertilizer and seeds for planters

➤ Yield monitors

- Available for medium to large combines from the industry dealer
- Available for almost any machinery from accessories dealers
- Few farmers are using yield maps, less than 5% for grains

➤ **Key machinery companies:** Stara, John Deere, Jacto, CASE, AGCO

➤ **Key accessories companies:** Trimble, Arvus, Verion,



Available Tools for PA



- Worldwide companies are implementing electronics right after their release outside Brazil
- Local implement companies have partnership with local providers for replacing gearboxes by electro hydraulic mechanism
- Equipment is available, the cost is still high but the main restriction for its adoption is the lack of specialized labor and maintenance



Available Tools for PA



Broadcast Fertilizer Application Quality



Gimenez, L.M. (2012) – Fundação MT

CENTER

5 m



10 m

15 m

IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

Broadcast Fertilizer Application Quality



Creating more variability...



IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

Available Tools for PA



Responsive machinery industry but not always technical sounding...



2 tanks/rate controllers

1 spreading mechanism

Powders (Lime + Gypsum) → 😊

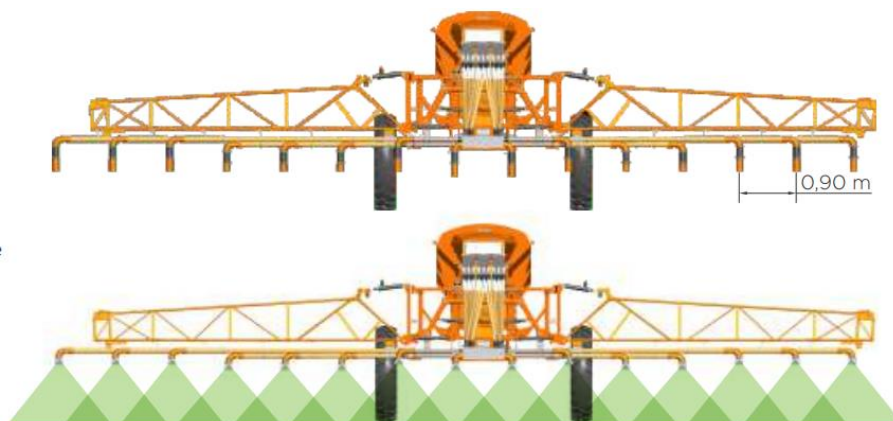
Ganulated fertilizers → ☹



Available Tools for PA



Pneumatic option for fertilizers and seeds



13 m boom for sugar cane

32 m boom under development for cereals

Sprayers with nozzle/nozzle control

Coffee harvester with yield monitor



Available Tools for PA

Machinery industry



Complete line of implements with VRT capability: planters, sprayers, fertilizer applicators, guidance, yield monitor, electrical conductivity



IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

Available Tools for PA



Machinery industry



Electrical and hydraulic components that allow VRT in a large range of existing machinery, telemetry, guidance, yield monitor



IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

Available Tools for PA

Soil Sampling



X
Soil sampling,
penetrometer, software,
chlorophyll meter, soil
moisture sensors

Y
Soil sampling,
mechanical or
handheld
versions

EXERCISE

The determination of P in a soil sample, using methodology “A”, revealed an amount of 4 mg Kg (very low). the fertilizer recommendation to maize in this case would be 100 kg ha⁻¹ of P₂O₅. An experiment under this field site showed that the crop did not respond to P (12.5 t ha⁻¹).
Make comments regarding the effectiveness of methodology “A”.

A GOOD PROGRAM UNDER AGRICULTURE
NUTRIENT MANAGEMENT SHOULD INITIALLY, AND
ABOVE ALL, HAVE AN EFFICIENT METHOD TO
PROPERLY EVALUATE THE SOIL AVAILABILITY OF
PLANT NUTRIENTS

WE SHOULD NOT MAKE OURSELVES
CONFORTABLE. NEW AND BETTER POSSIBILITIES
MAY EXIST.

TEST THE EFFECTIVENESS OF CURRENT
METHODS UNDER SITE FIELD CONDITIONS

HOW ARE THE METHODS FOR SOIL ANALYSIS
EVALUATING THE AVAILABILITY OF NUTRIENTS IN
YOUR REGION ?



IPNI INTERNATIONAL PLANT NUTRITION

Precision Ag by Crop



➤ Soybean

- Variable rate fertilizer and lime based on grid soil sampling.
- Sampling density varying from 1 to 5 ha

➤ Sugarcane

- Autopilot for planting and harvesting – avoid damaging shoots
- Variable rate fertilizer and lime based on grid soil sampling

➤ Corn and Wheat

- Variable rate fertilizer and lime based on grid soil sampling
- Starting on the usage of reflectance sensors for nitrogen sidedressing





Precision Agriculture through Service Providers perspective

*Source: Brazilian Association of Precision Agriculture Service Providers,
Mr. Pedro Magalhães*

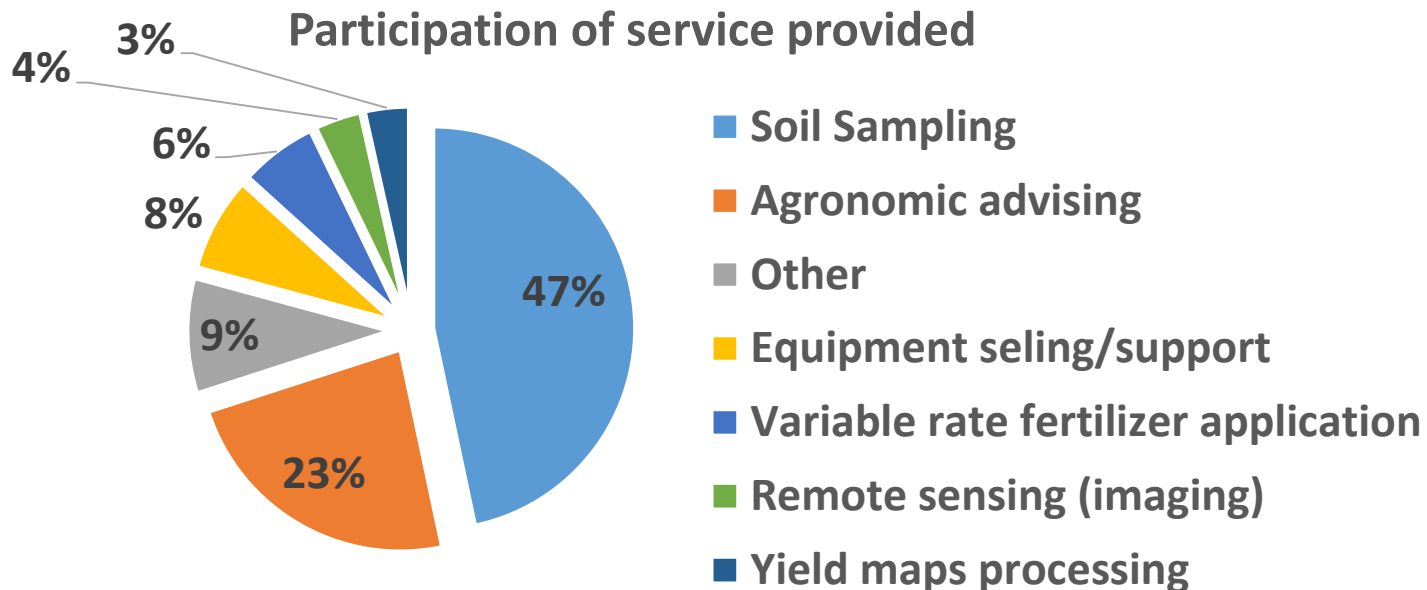
- ✓ Specialized companies/contractors are responsible for the majority of PA operationalization in Brazil
- ✓ Questionnaires answered by several companies
- ✓ Average of 8 years in the market, 12 Brazilian states
- ✓ 280.000 ha/year of sampled/assisted area





Overview

- ✓ Areas mainly in soybeans (80%) and corn (20%) cultivation,
- ✓ Major part of services are provided for farmers which already used the technology and keep using it,

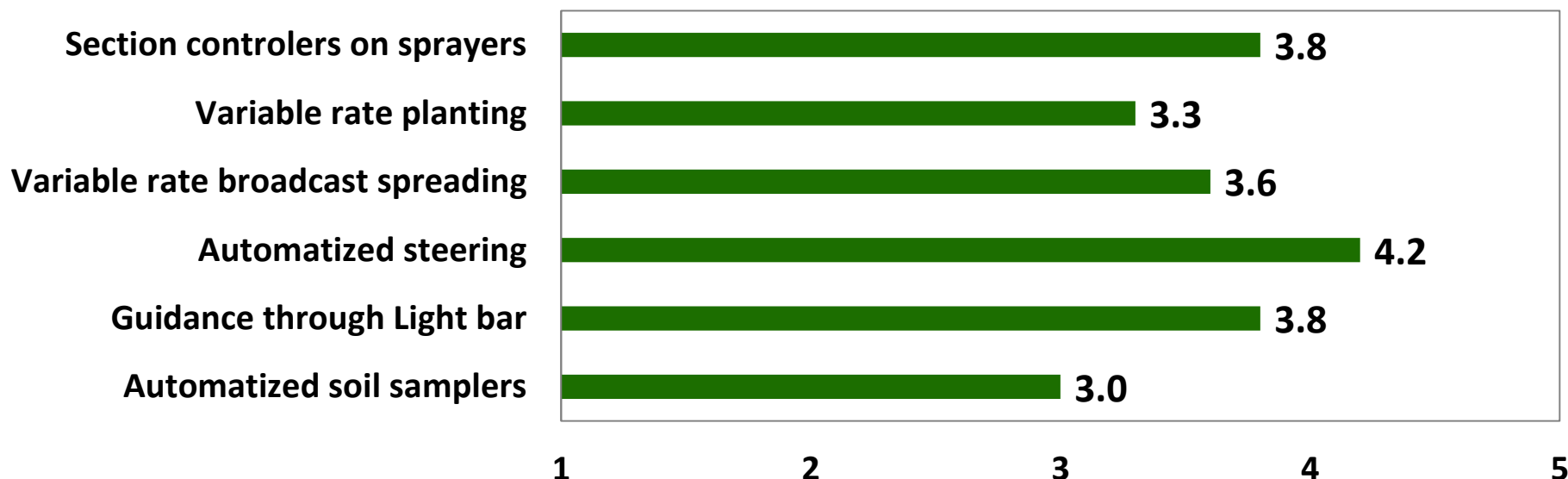




Quality of equipment

- ✓ Overall perception: broadcast fertilizer and amendments application is improving but still an issue

Quality of the job done by selected equipment: 1 = poor, 5 = excellent





Quality of equipment

- ✓ Main difficulties when providing soil sampling services are:
 - ✓ 1st Human resources/Labor issues
 - ✓ 2nd Seasonality
 - ✓ 3rd Equipment can't adjust to varying soil conditions

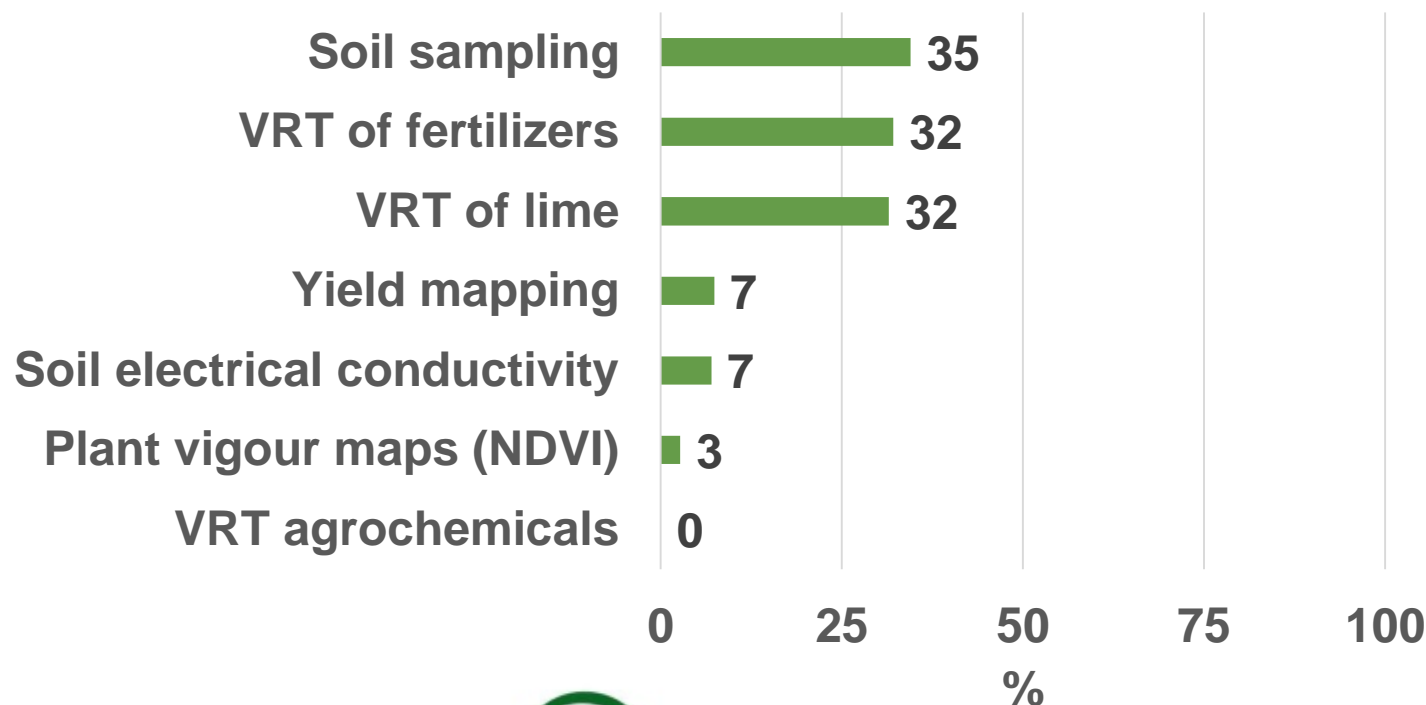
- ✓ Sampling details:
 - ✓ Point grid sampling, 8 sub-samples/point
 - ✓ 1 sample for each 2,0 ha (range:1 to 5 ha/sample)
 - ✓ 0 to 0,2 m layer (0-8 inch) majority, 0,2 to 0,4 m in some fields





Quality of equipment

- ✓ In your influence region what is the participation of the following precision ag tools in the farms?

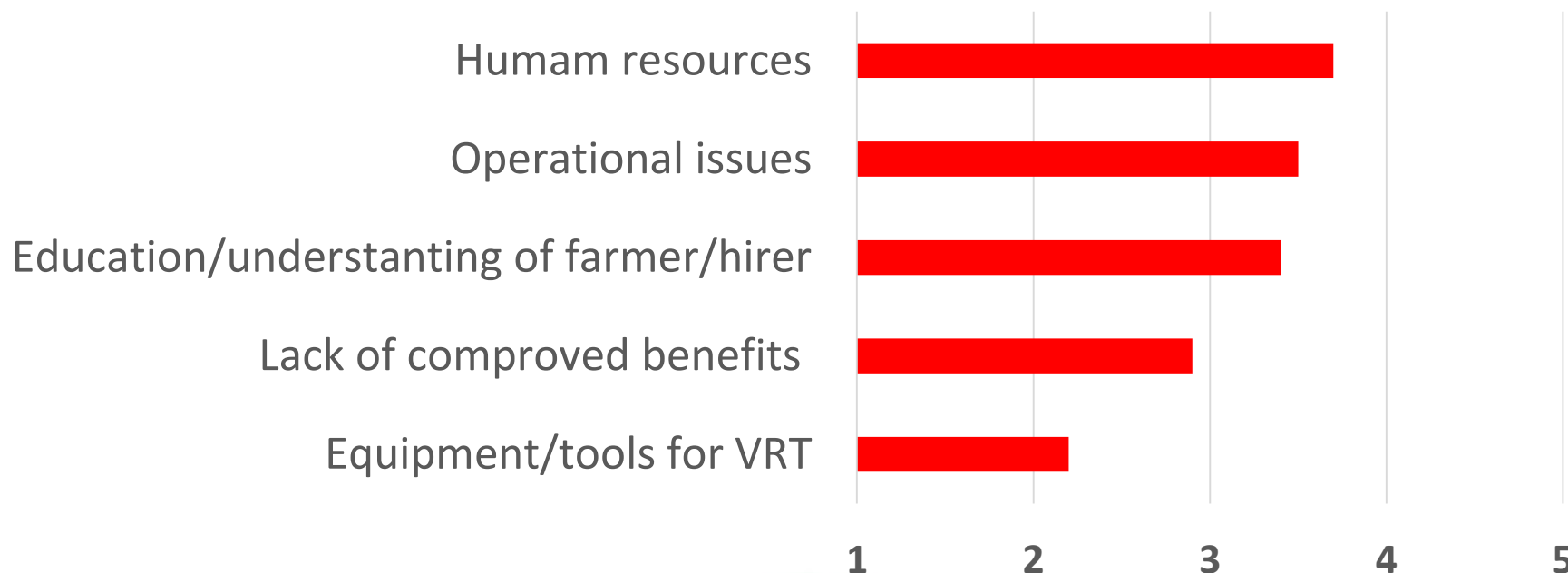




Quality of equipment

- ✓ In your experience, which are the main constraints for the proper use of precision agriculture?

1 = not restrictive, 5 = very restrictive





Future...

- What do you think will be good opportunities for service providers within the next 5 years?
 - ✓ Plant vigor mapping, UAVs or active sensors
 - ✓ Management unit/directed sampling
 - ✓ Variable rate plant population
 - ✓ Soil Electrical conductivity





Precision Agriculture Use in Selected Agricultural Regions in Brazil

By Bernardi & Inamasu

*12th International Conference on Precision Agriculture
Sacramento/CA, 2014*

- ✓ 301 questionnaires
- ✓ Sep to Nov, 2012
- ✓ Main agricultural regions in Brazil: 9 states
- ✓ Public: farmers, extension agents, consultants, employees of agricultural enterprises, teachers, and students



IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

PA Use in Selected Agricultural Regions



Farmers and managers (%)

	N	Age	Gender		Education					
			Female	Male	Elem/ middle	High school	Under Graduate	Graduate		
Conv	141	39	11	83	11	32	42	11		
PA	160	35	9	82	9	27	43	19		

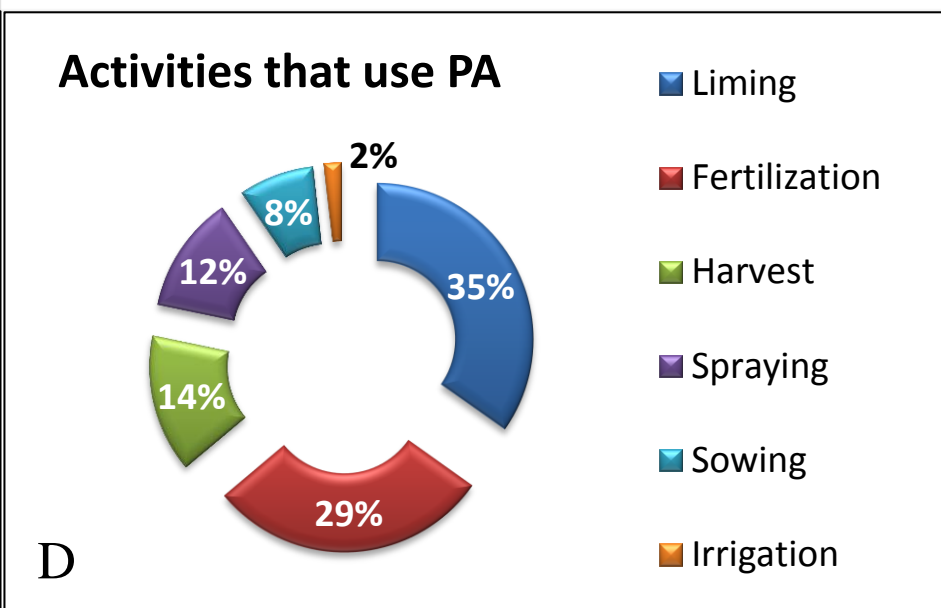
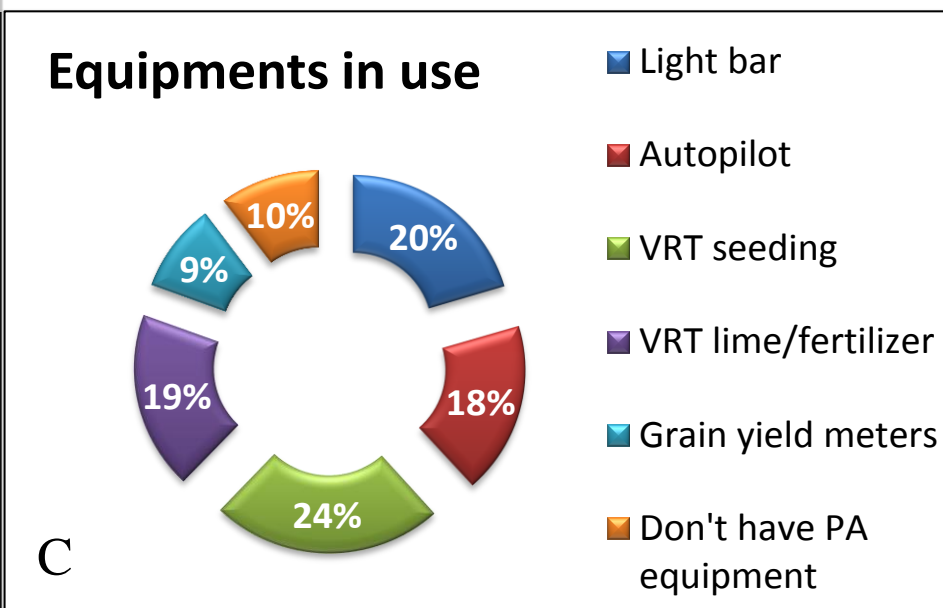
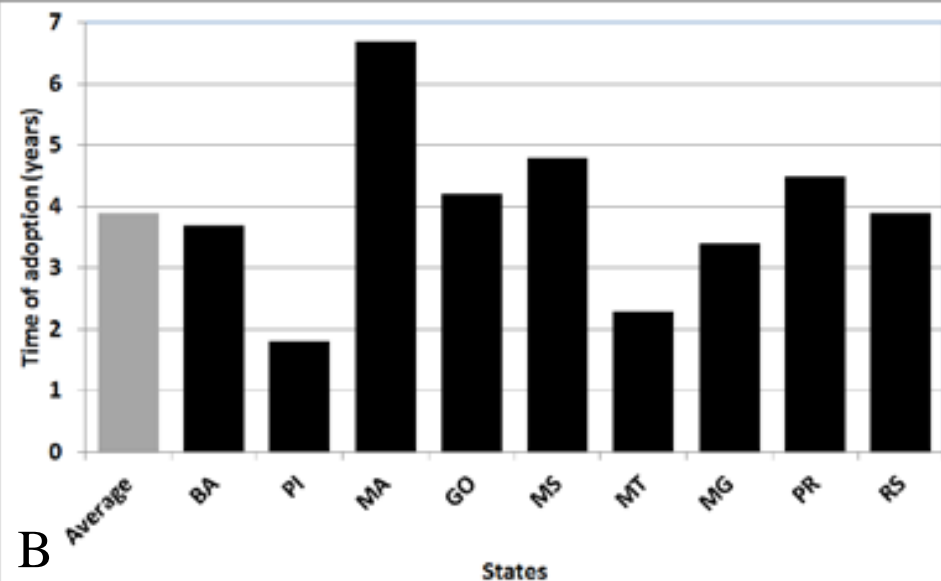
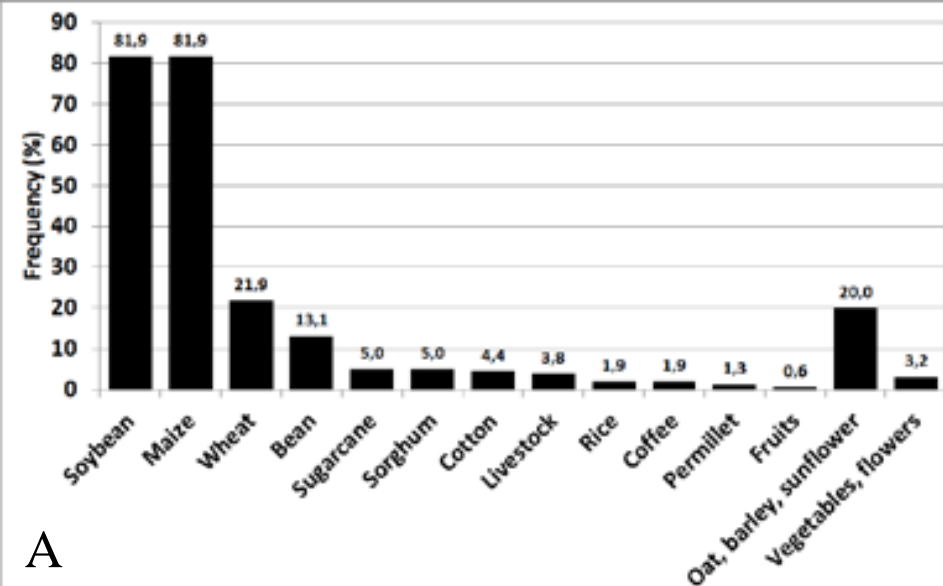
Farms and agricultural systems (%)

	Area	Soil texture			Relief				No-till	Crop rotation
		Sandy	Loam	Clay	Plane	Slightly undulating	Undulating	Sloping		
Conv	977	9	43	45	25	52	20	3	70	33
PA	2357	14	46	39	28	58	16	3	89	51

Technology access (%)

	Computer for farm management	Laptop in the field		Internet access	Mobile	Smart phone
Conv	47	20		46	90	28
PA	74	37		67	90	46

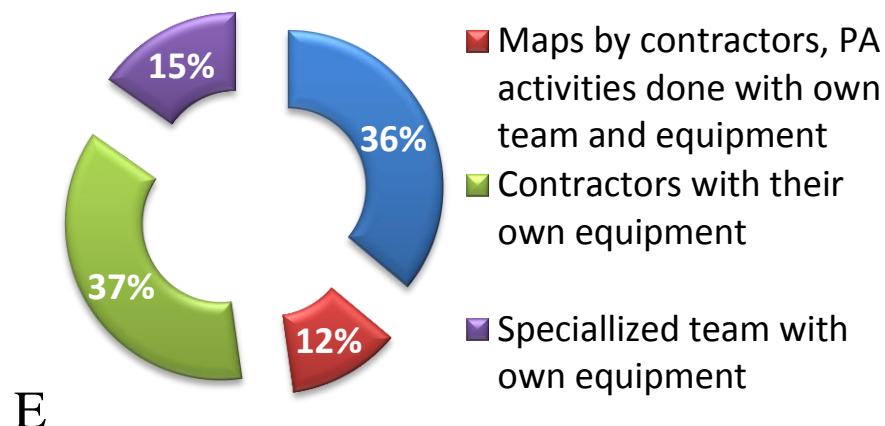




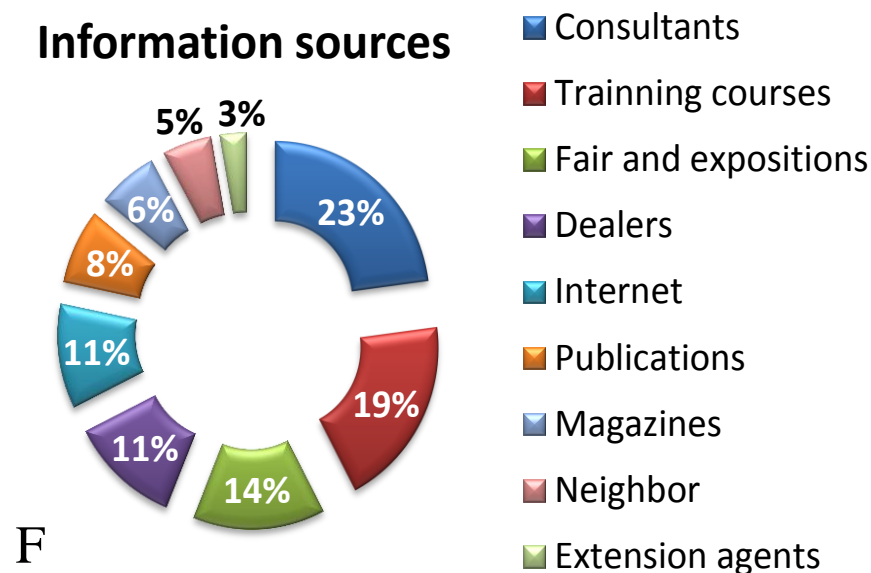
Main crops (A), adoption time (B), equipment (C) and activities in which the PA is used (D) implementation of PA services (E) and information sources (F) in the farms that adopt PA.



Implementation of PA services



Information sources



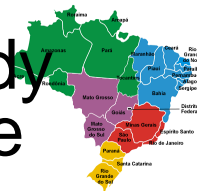


What the Brazilian researchers are looking for...

- Development of models for variable rate nitrogen through active sensors
 - Wheat, Corn, Cotton
- Soil sensors validation/testing
 - VIS/NIR, pH, OM, K
- Management units creation
 - Through sensing: remote + soil
 - Though sampling: soil chemical parameters



Some important additional comments



- Electronics for improving machinery efficiency already accepted and growing year after year: guidance, rate controllers, section controllers
- Management of variability partially accomplished:
 - Mainly focused on variable rate application of fertilizers – with inadequate sampling and machinery, poor broadcast spreaders
- In the last two years remote sensing satellite and UAVs data is provoking dealers and customers to establish relations and better analyze their management actions like VRT
- Some movements on variable rate corn plant population
- Some movements on reflectance sensors
- Industry focused on telemetry – allow better management of machinery/fleet



--- REINALDO AZEVEDO ---

“Farmers are very generally not well considered by several minority and noisy sectors of society. They are criticized by many: the left, the greens, the indians, the media, famous “progressive” actors and actresses, from radicals of global warming, Bono Vox, Sting

In summary this is a country where those that produce wealth are targeted by the fury of those that basically produce speech”

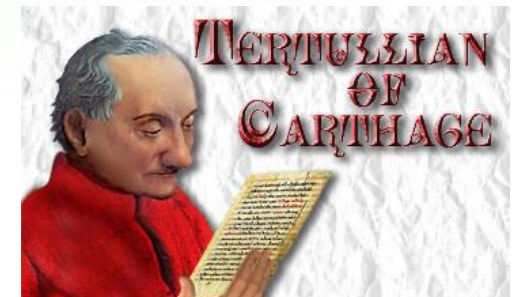


The Future

“One thing is sure: The Earth is more cultivated and developed now than ever before. There is more farming, but fewer forests. Swamps are drying up and cities springing up on an unprecedented scale. We have become a burden to our planet. Resources are becoming scarce and soon Nature will no longer be able to satisfy our needs. It will come to pass that disease, hunger, flood and war will reduce the excessively large numbers of the human species”.

Quintus Septimus Tertullianus, 200 BC

(by D. G. Johnson, Univ. of Chicago, 22 August 1998)



GOOD SERVICE/KNOWLEDGE VALUE: HOW TO EVALUATE?

- ✓ A computer technician is called by a company to evaluate a problem in a valuable computer.
- ✓ After carefully studying the situation he turns off the machine, opens a specific part and turns a screw one and a half times.
- ✓ Turns the computer on, which starts to work perfectly.
- ✓ The company owner congratulates the technician and asks for the price.
- ✓ He becomes very angry in finding out that the price is US\$ 10,000 Says he will not pay unless an invoice is sent specifying everything done.
- ✓ The next day the invoice arrives at the office and the company owner decides to pay immediately.
- ✓ The invoice simply specified:
 - Tigthen a screw US\$ 20
 - **Know which screw to tighten US\$ 9,980**



**Thank you for your
attention!**



Website:

<http://brasil.ipni.net>
efrancisco@ipni.net

Phone:

(55) 66-3023-1517



Escola Superior de Agricultura "Luiz de
Queiroz"
Universidade de São Paulo

Website:

www.esalq.usp.br
Imgimenez@usp.br

Phone:

(55) 19-3447-8524