INFOAG 2015

BRAZILIAN PRECISION AGRICULTURE IN PERSPECTIVE

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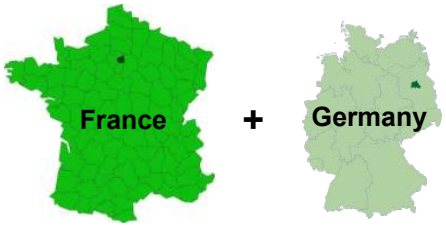
BRAZIL

✓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)

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.

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.

Brazilian Agriculture

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Setor Agro
Produção no Brasil enti

Soybean

safra 2010/2011
74,8 milhões de toneladas

Mato Grosso
maior estado produtor
20,4 milhões de toneladas

Fonte: CONAB

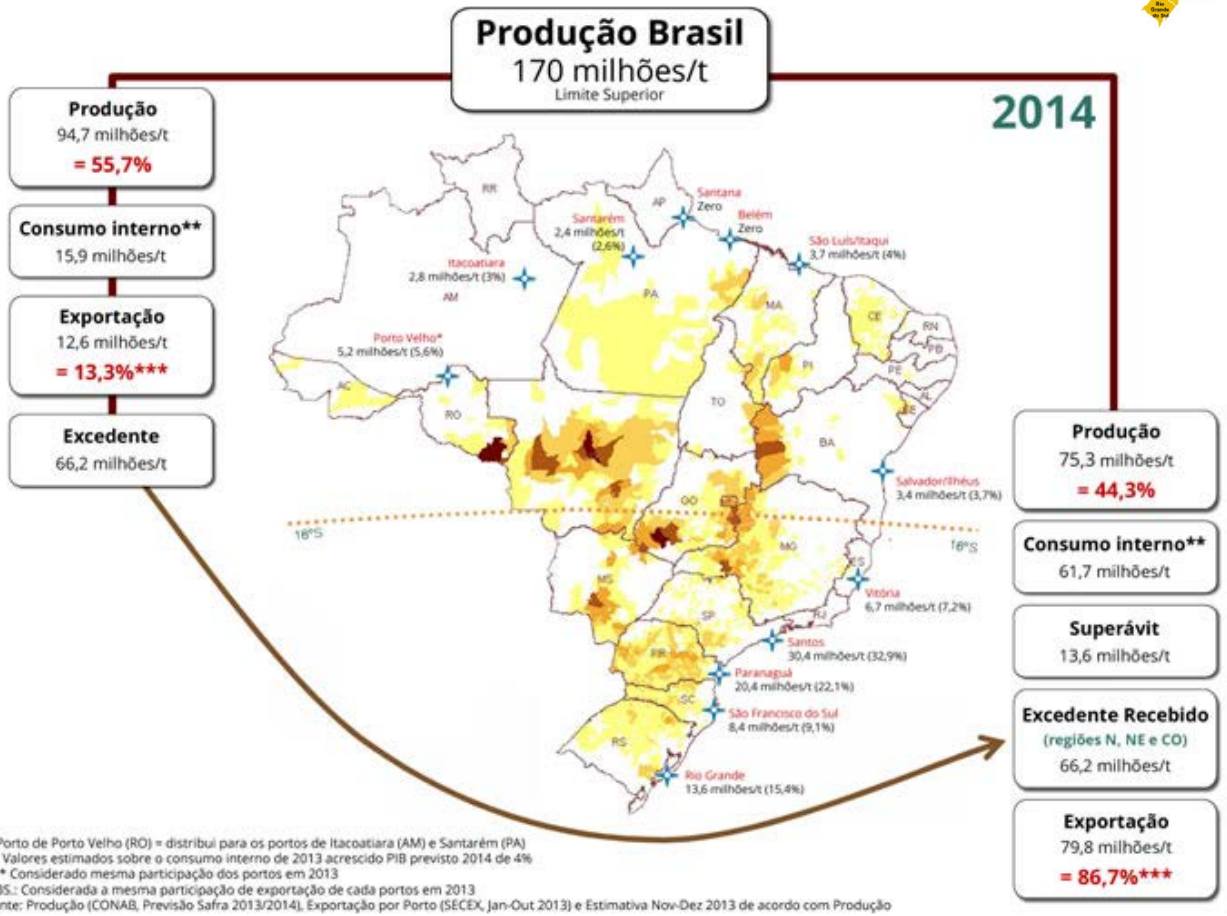
Cattle

safra 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

Soybean & Maize Production



* 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

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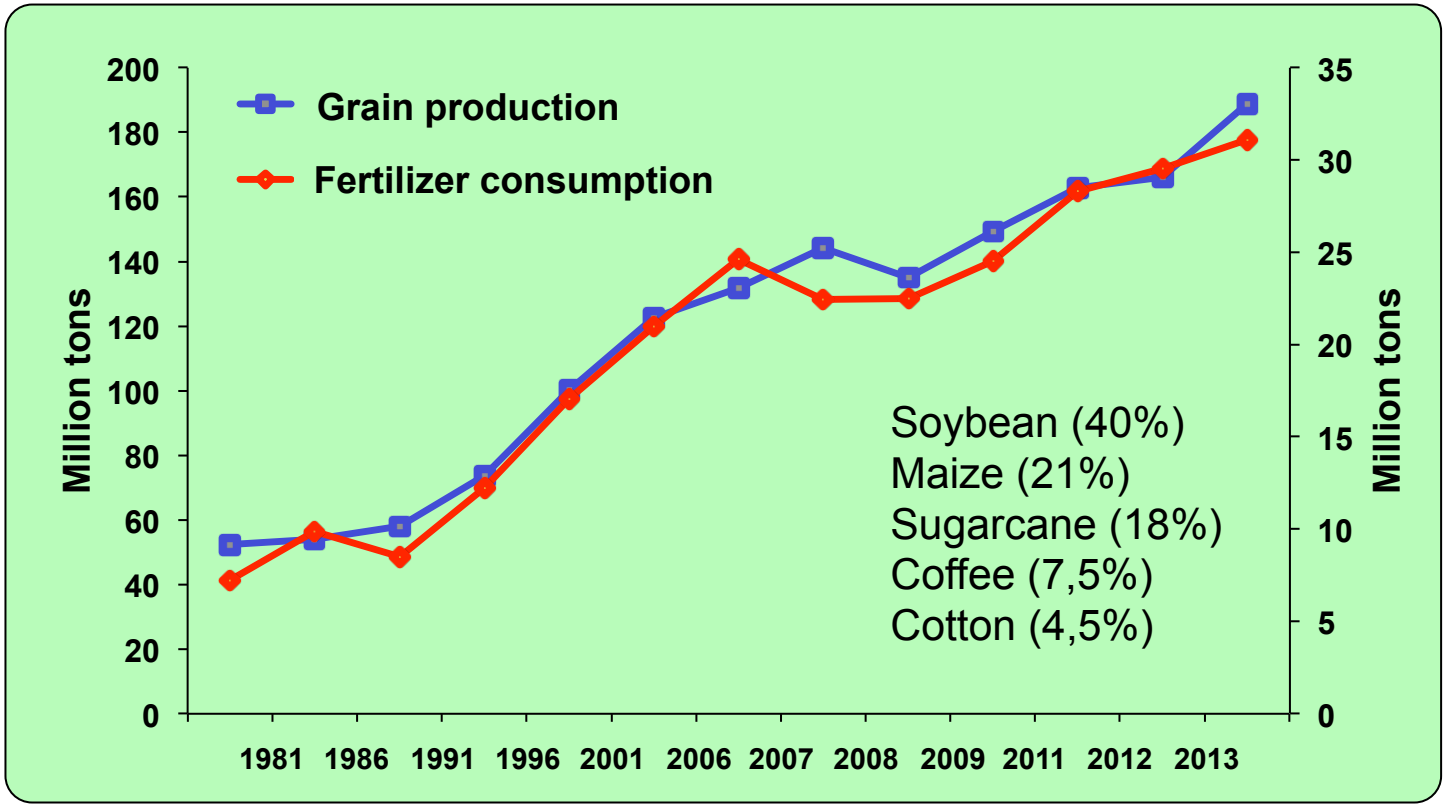
History of grain production and fertilizer consumption in Brazil



Sources: ANDA e CONAB (2014),

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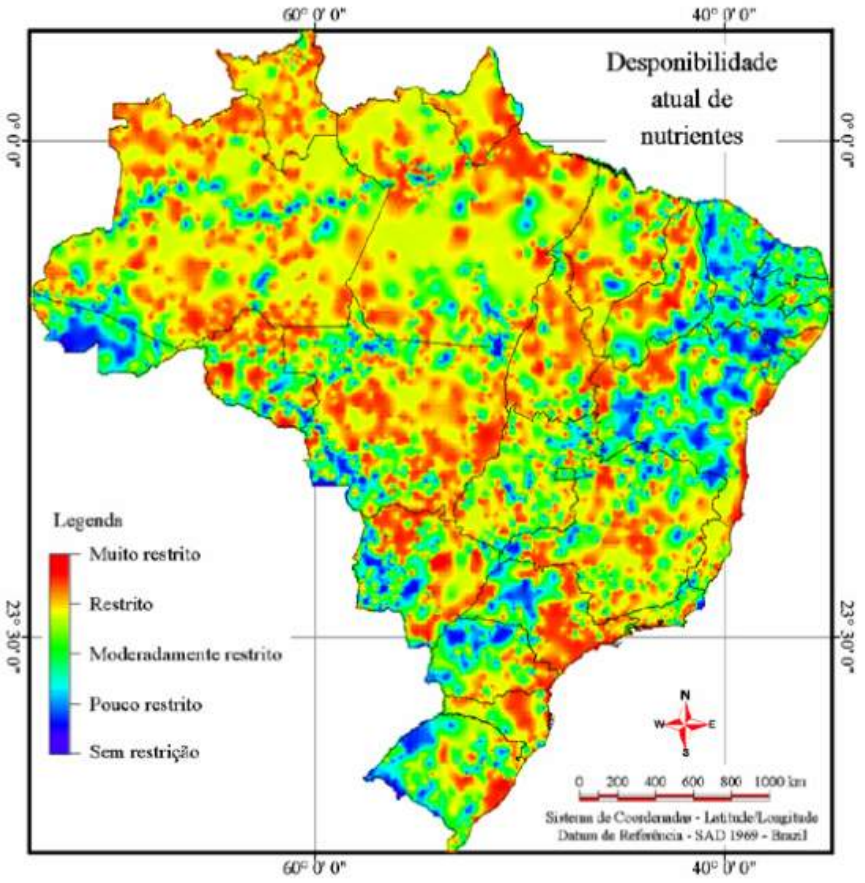
Soil fertility restrictions in Brazil



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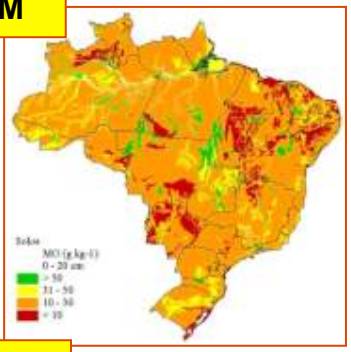
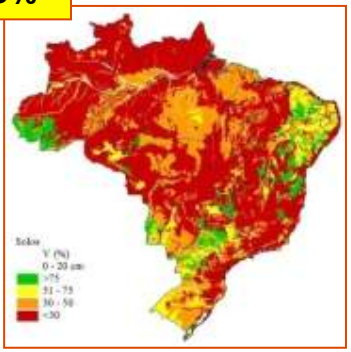


BS%



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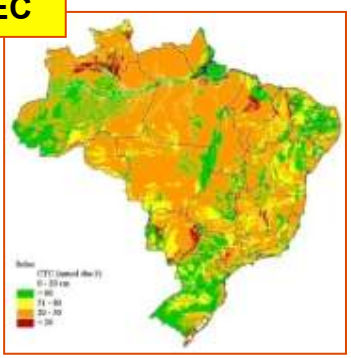

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Fonte: Sparovek et al.

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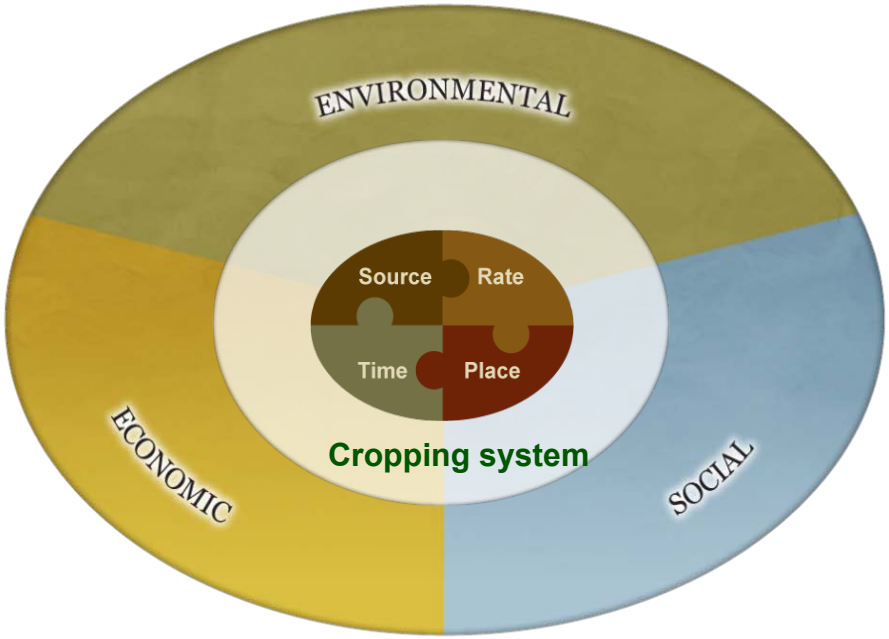
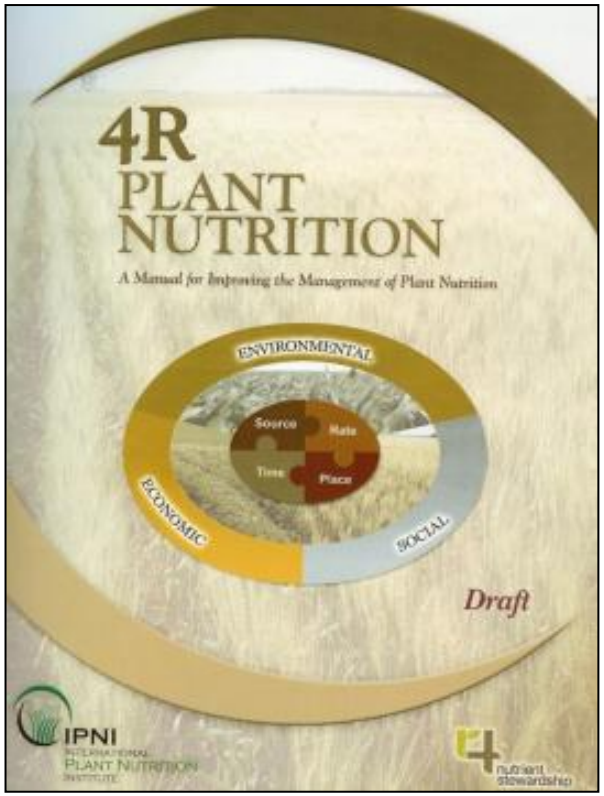
Equipaments are changing affecting how we apply inputs (ex.: fertilizers). Should not be the opposite?

Education – 4R NUTRIENT STEWARDSHIP PROGRAM





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

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

Available Tools for PA

➢ 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 Aplication Quality

Gimenez, L.M. (2012) – Fundação MT

CENTER 5 m 10 m 15 m

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Broadcast Fertilizer Aplication Quality

Creating more variability…

Available Tools for PA

Responsive machinery industry but not always technical sounding...

2 tanks/rate controlers

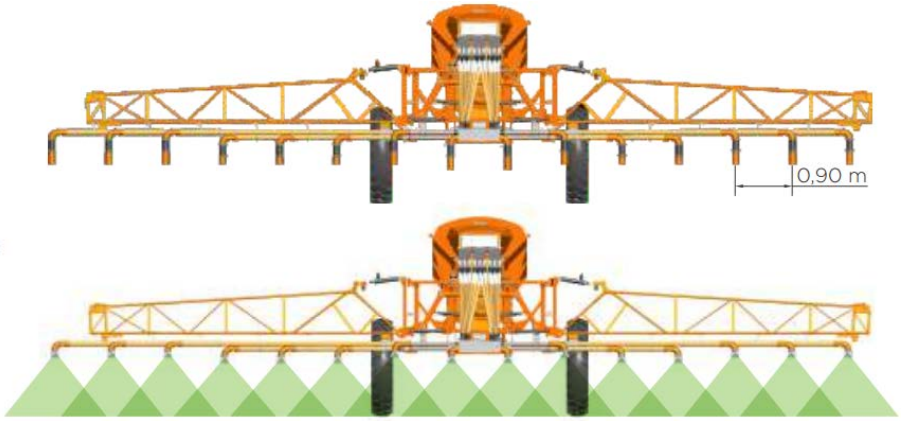
1 spreading mechanism

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

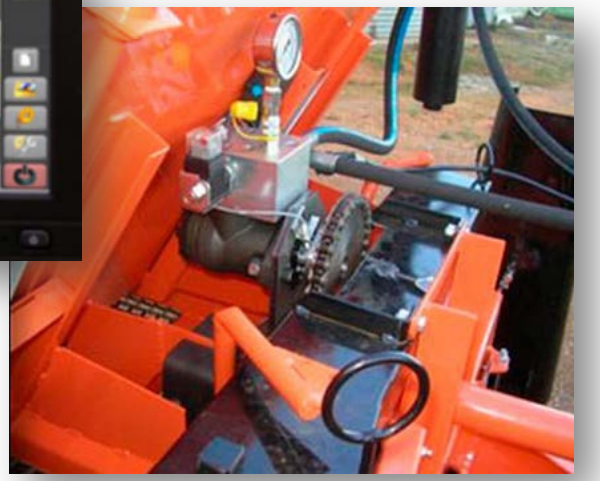
Available Tools for PA

Machinery industry

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

Available Tools for PA

Machinery industry



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

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 recomendation to maize in this case would be 100 kg ha^{-1} of P_2O_5. 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 ?

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

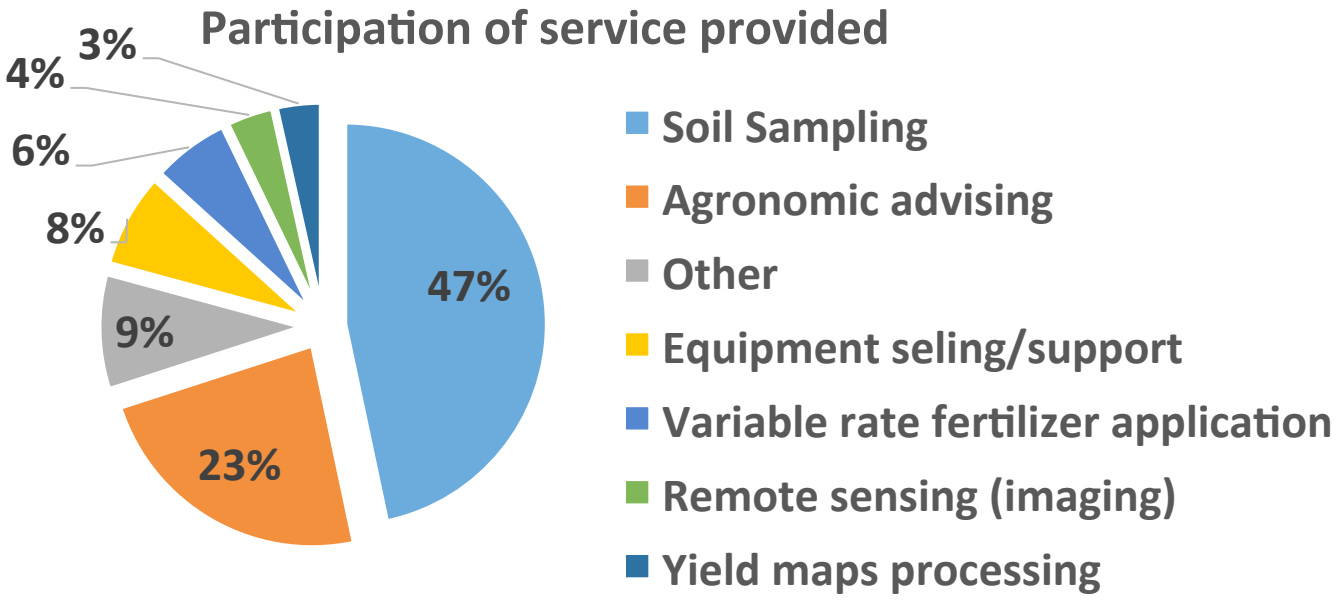
Source: ***Brazilian Association of Precision Agriculture Service Providers, Mr. Pedro Magalhães***

- ✓ 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

PA through SP perspective

Overview

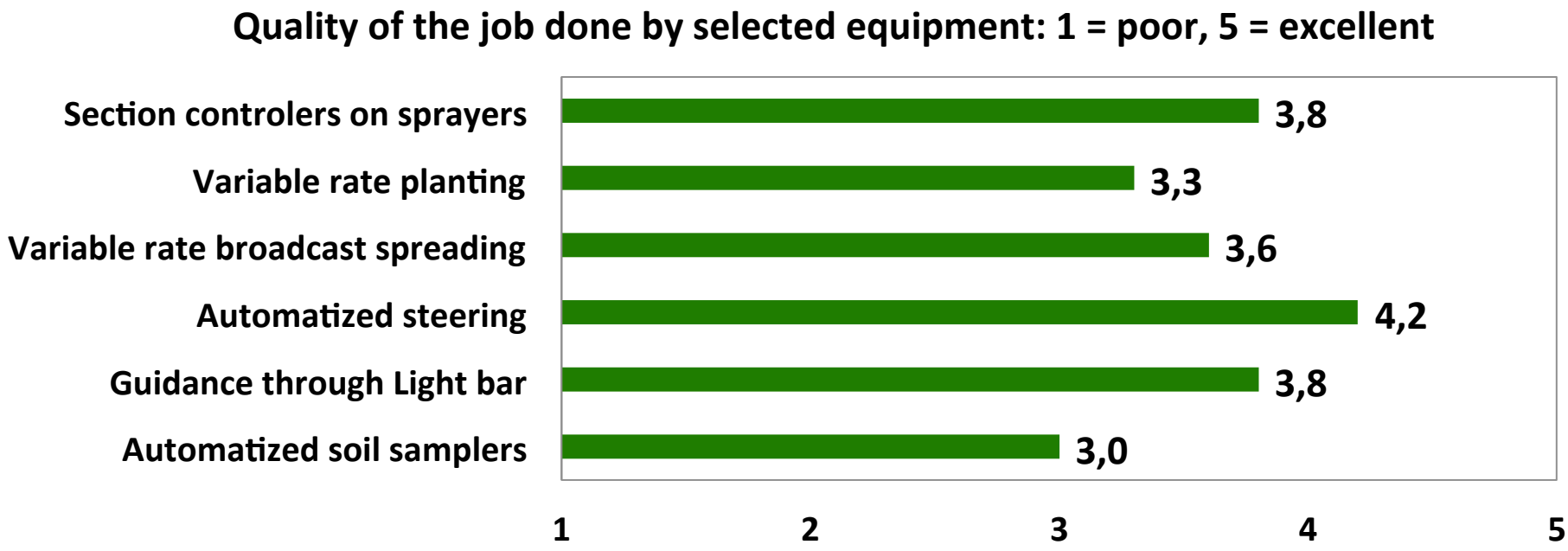
- ✓ Areas mainly in soybeans (80%) and corn (20%) cultivation,
- ✓ Major part of services are provided for farmers which already used the technology and keep using it,



PA through SP perspective

Quality of equipment

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



PA through SP perspective

Quality of equipment

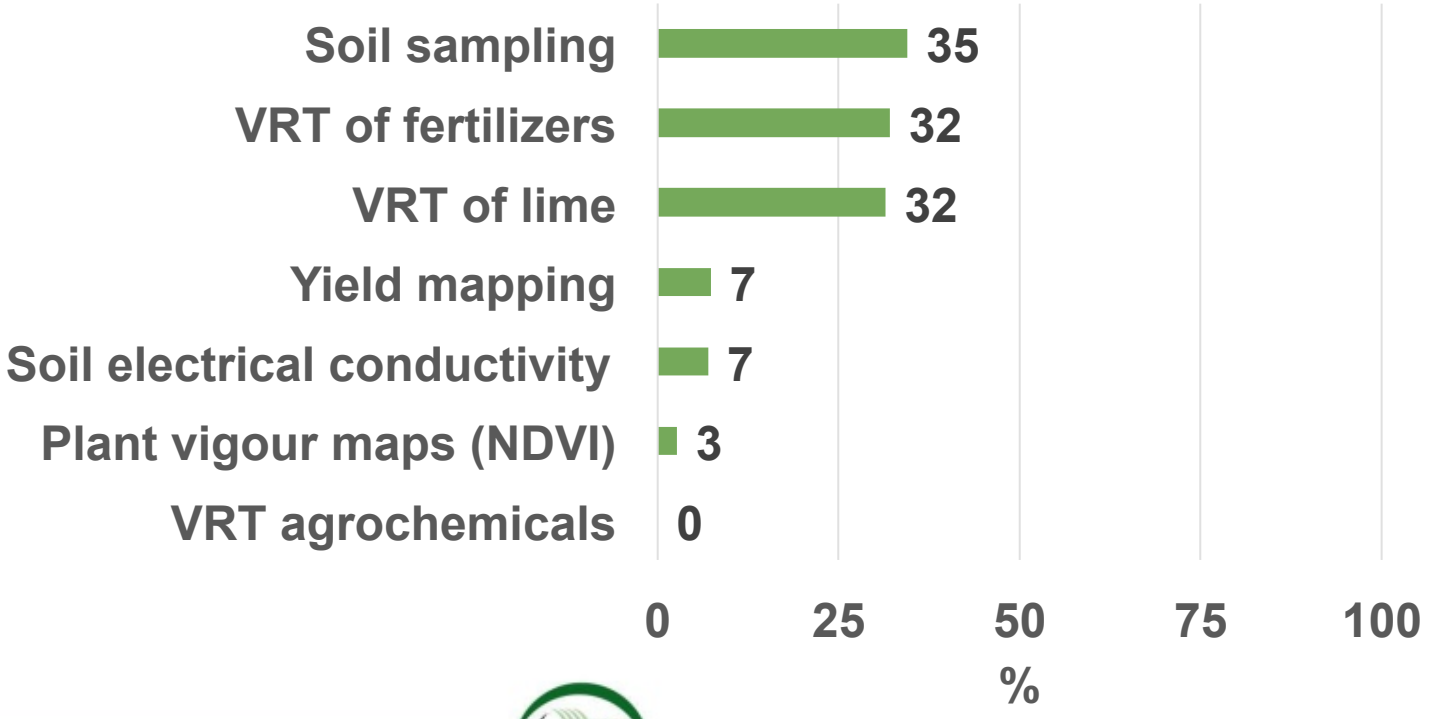
- ✓ Main difficulties when providing soil sampling services are:
  - ✓ 1st Human resources/Labor issues
  - ✓ 2nd Seasonality
  - ✓ 3rd Equipment can't adjust to varying soil conditions

- ✓ 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

PA through SP perspective

Quality of equipment

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



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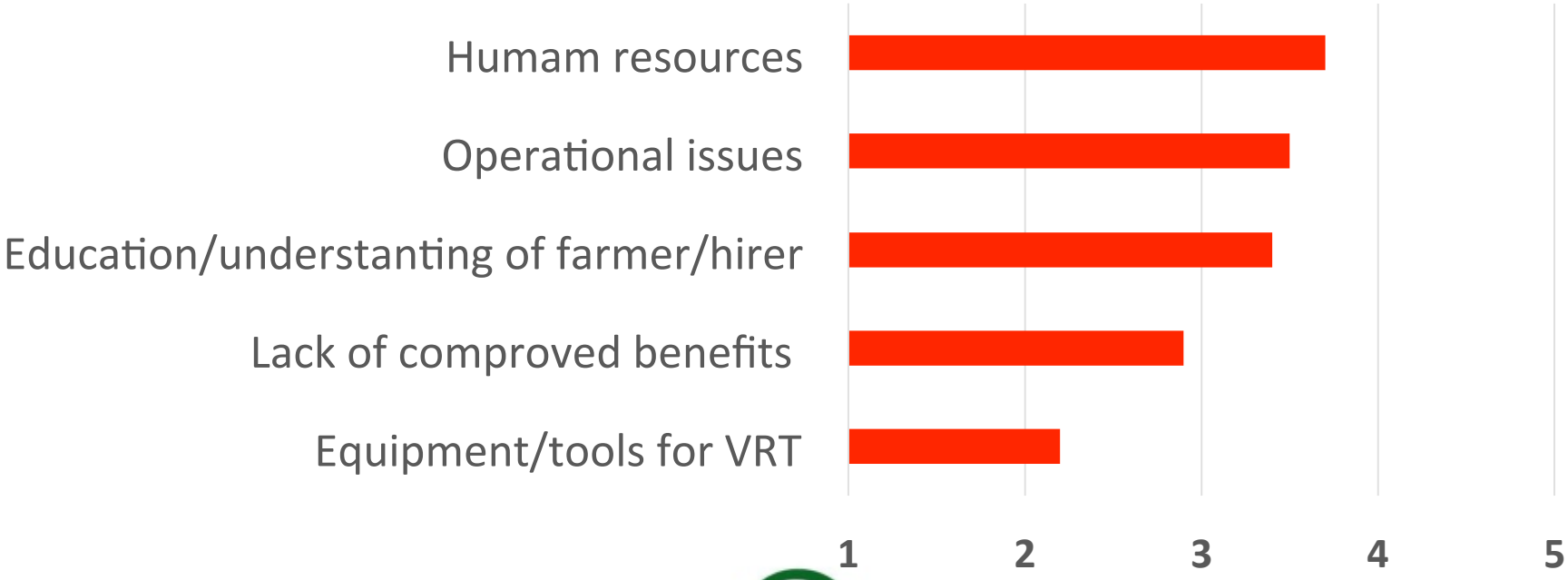
PA through SP perspective

Quality of equipment

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

1 = not restrictive, 5 = very restrictive



PA through SP perspective

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

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Precision Agriculture Use in Selected Agricultural Regions in Brazil

By Bernardi & Inamasu

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

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

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PA Use in Selected Agricultural Regions

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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 acess (%)					
	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

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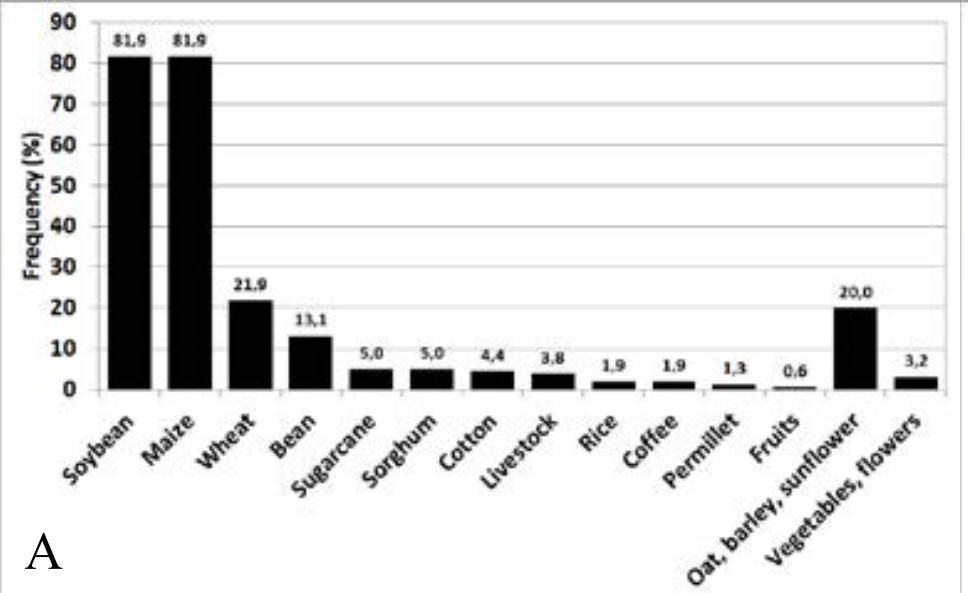
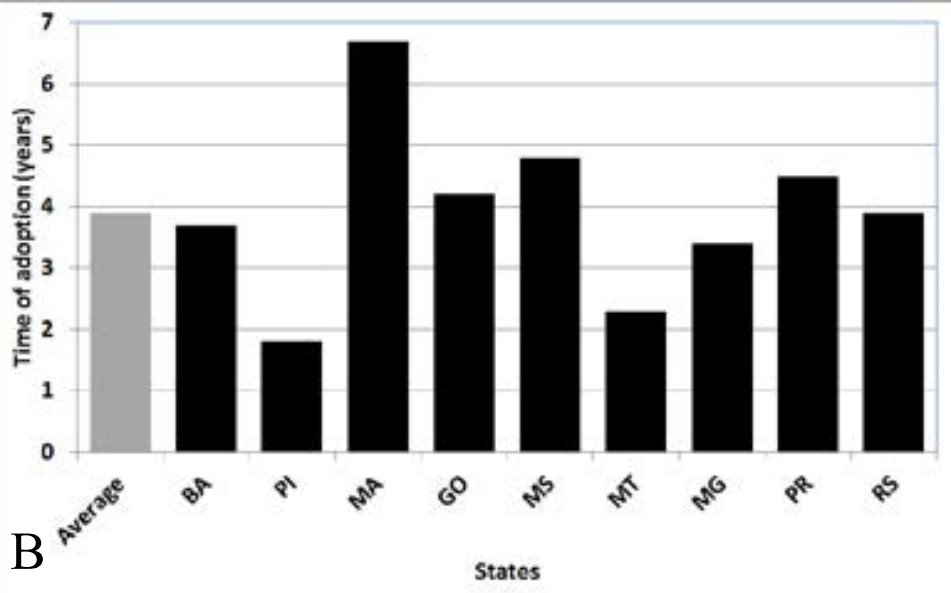


A



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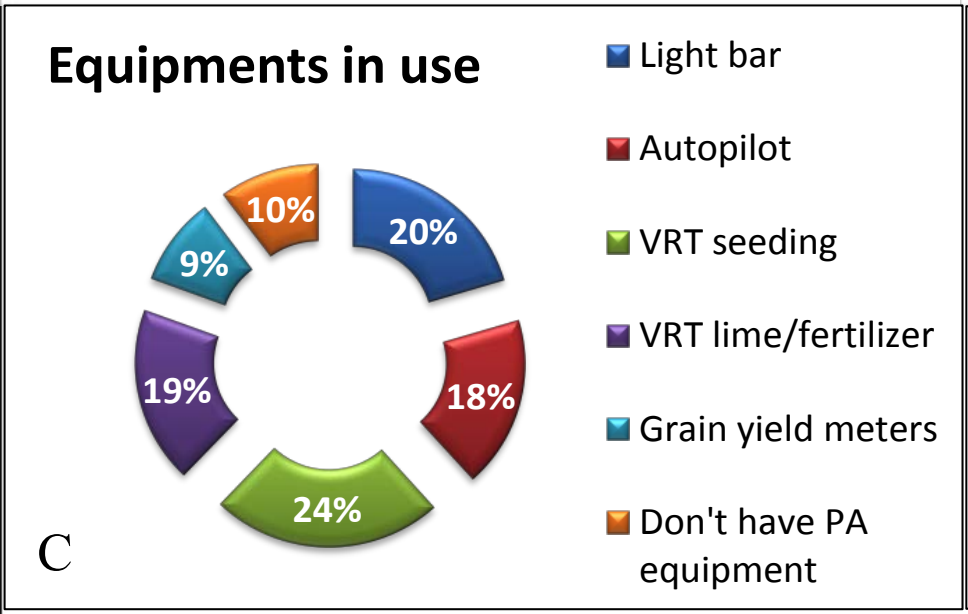

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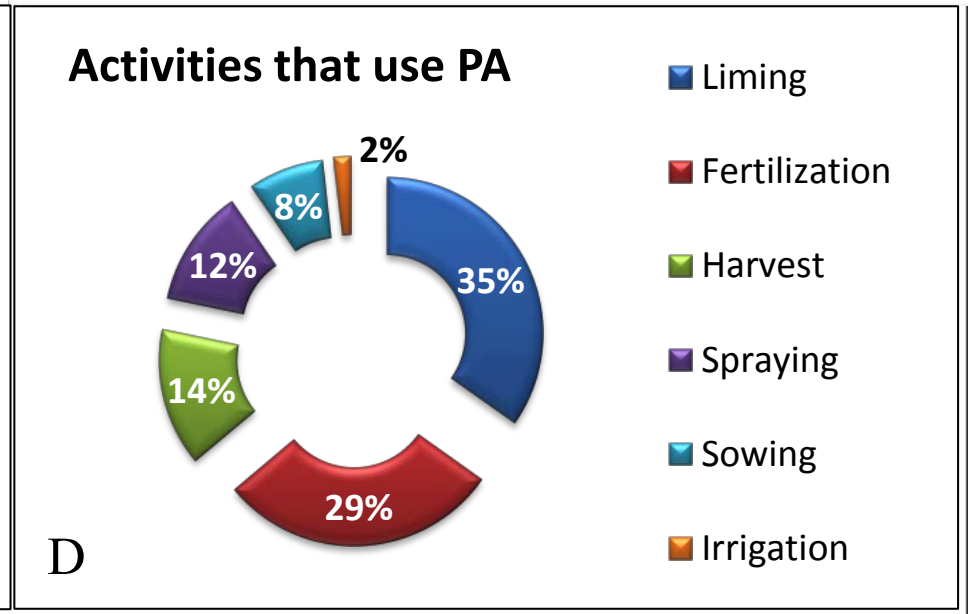

D

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.

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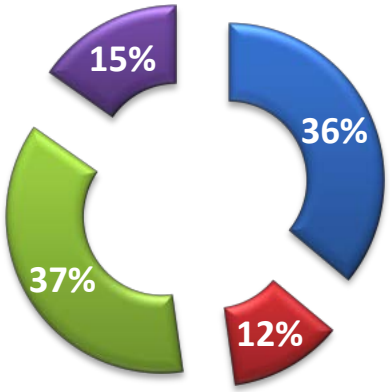
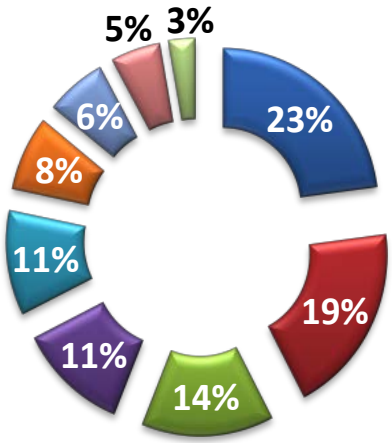
Implemention of PA services



- Contractors
- Maps by contractors, PA activities done with own team and equipment
- Contractors with their own equipment
- Speciallized team with own equipment

E

Information sources



- Consultants
- Trainning courses
- Fair and expositions
- Dealers
- Internet
- Publications
- Magazines
- Neighbor
- Extension agents

F

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 stablish 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

Thank you for your attention!

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