

V Seminário

Desafios da Liderança Brasileira no Mercado Mundial da Soja

19 e 20 de setembro de 2023



TENDÊNCIAS E FERRAMENTAS TECNOLÓGICAS NO DESENVOLVIMENTO DE MODELOS AGRÍCOLAS SUSTENTÁVEIS NA CULTURA DA SOJA

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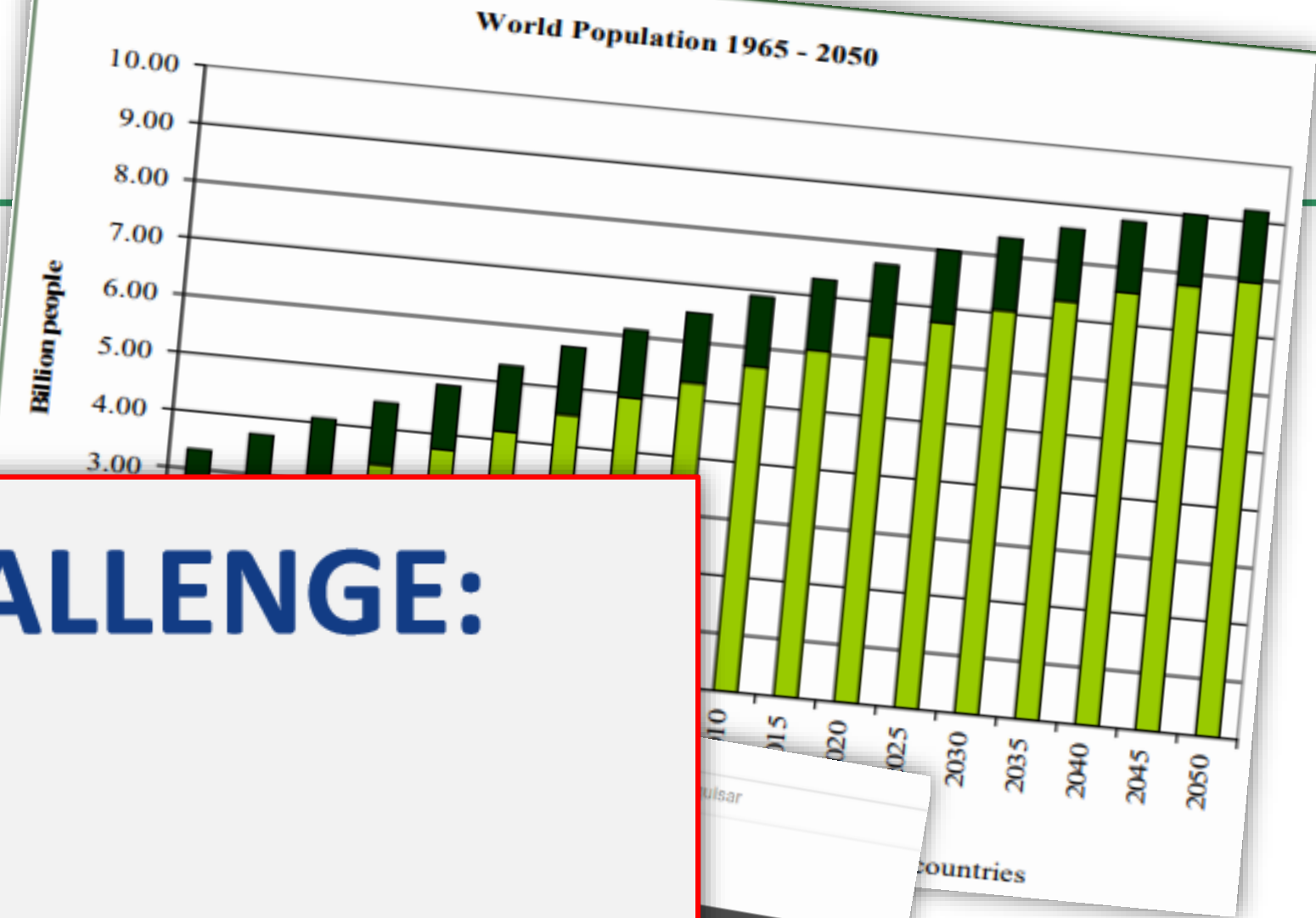
DESAFIO GLOBAL

SOMOS 8 BILHÕES

Planeta Terra atinge a marca de 8 bilhões de habitantes

Segundo projeção da ONU, na última terça-feira, 15, o planeta Terra atingiu a marca de 8 bilhões de habitantes. O crescimento vem de nações em desenvolvimento na África e na Ásia.

Agência Estado
Publicado em 15/11/2022 às 17:04
Atualizado em 15/11/2022 às 18:02



2050 GLOBAL CHALLENGE: FEED 9.5 BILLION PEOPLE

"IN THE NEXT 40 YEARS AGRIBIZ
WILL NEED TO GENERATE OUTPUTS EQUIVALENT TO
THE TOTAL PRODUCTION IN THE LAST 10,000 YEARS"

McKinsey CEO @ I3 Conference 2014

CIDADES

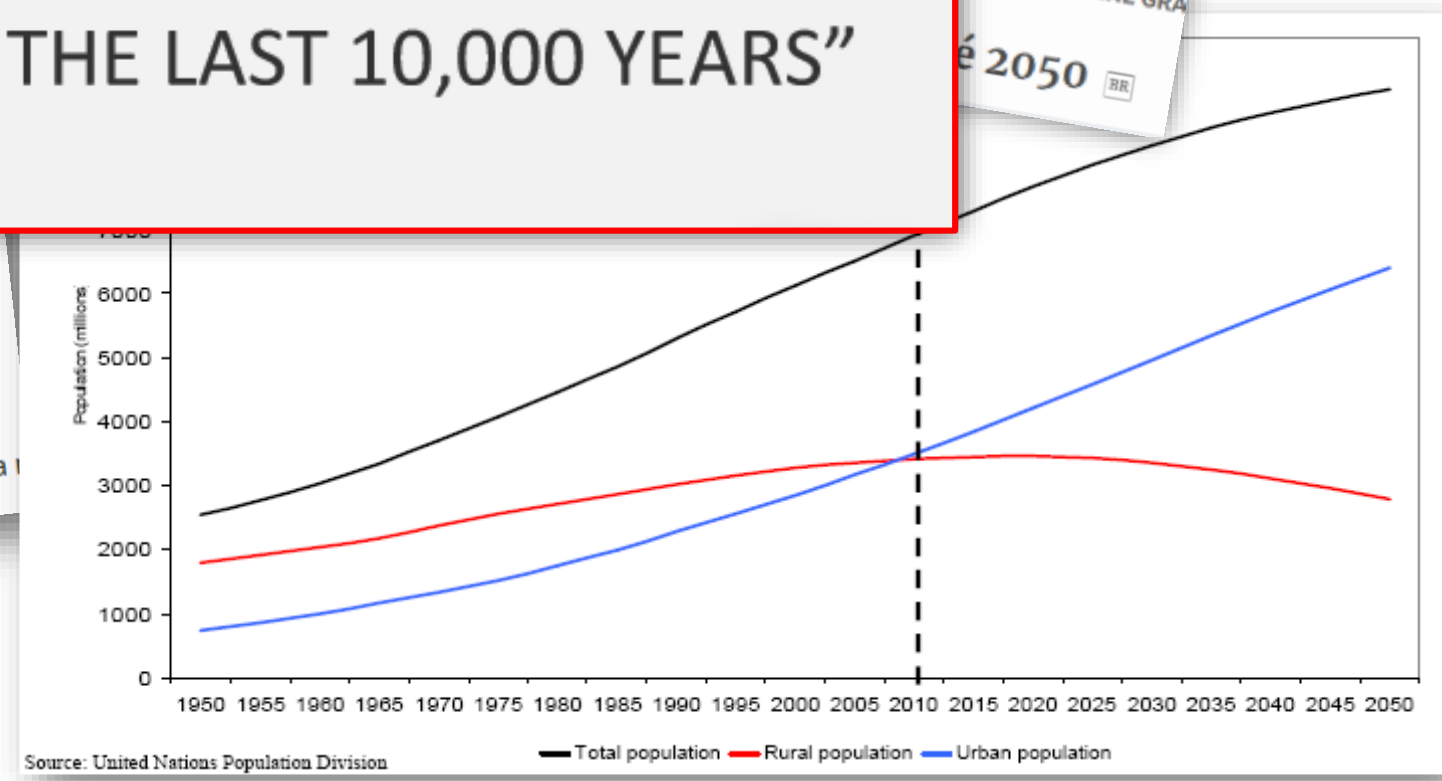
POPULAÇÃO

Planeta atinge marca de oito bilhões de habitantes

Relatório da ONU aponta que a expectativa de vida média deverá atingir 77,2 anos em 2050

Nos siga

15/11/2022 10h18 BEATRIZ FELDENS



Source: United Nations Population Division

— Total population — Rural population — Urban population



AUMENTO DA PRODUÇÃO AGRÍCOLA – Nível global

DESAFIO

Como produzir mais ?
Com menos...?

Insumos, Impactos...

Com menor...custo de produção

Com maior...retorno econômico

Uso racional e eficiente de insumos

Com...SUSTENTABILIDADE



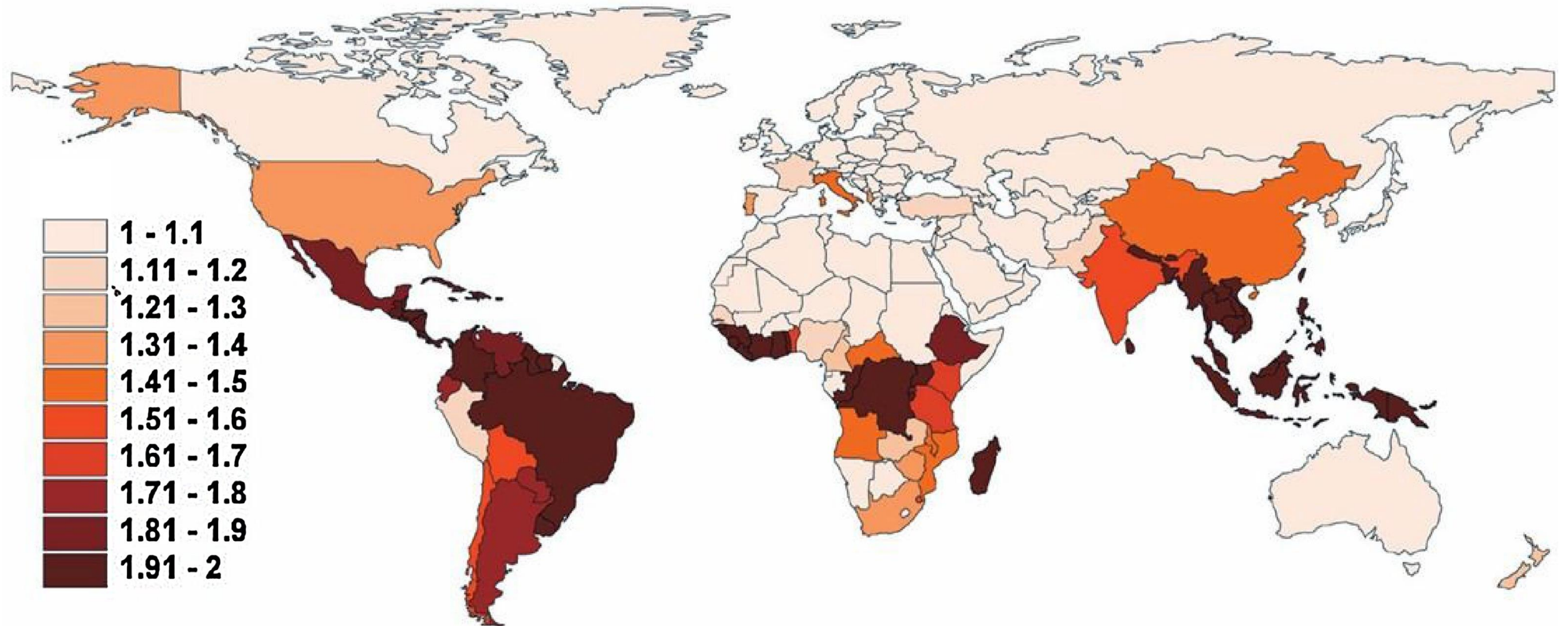
77% - Aumento de rendimento

14% - Intensificação

9% - Área



INTENSIFICAÇÃO DOS SISTEMAS PRODUTIVOS



Potencial de intensificação de cultivos, sob limitações de temperatura e precipitação.



INTENSIFICAÇÃO DOS SISTEMAS PRODUTIVOS

Plantio do milho
(Segunda safra)

Colheita
da soja



Plantio do milho
(Segunda safra)

Colheita da soja



INTENSIFICAÇÃO DOS SISTEMAS PRODUTIVOS

Arroz irrigado

Soja



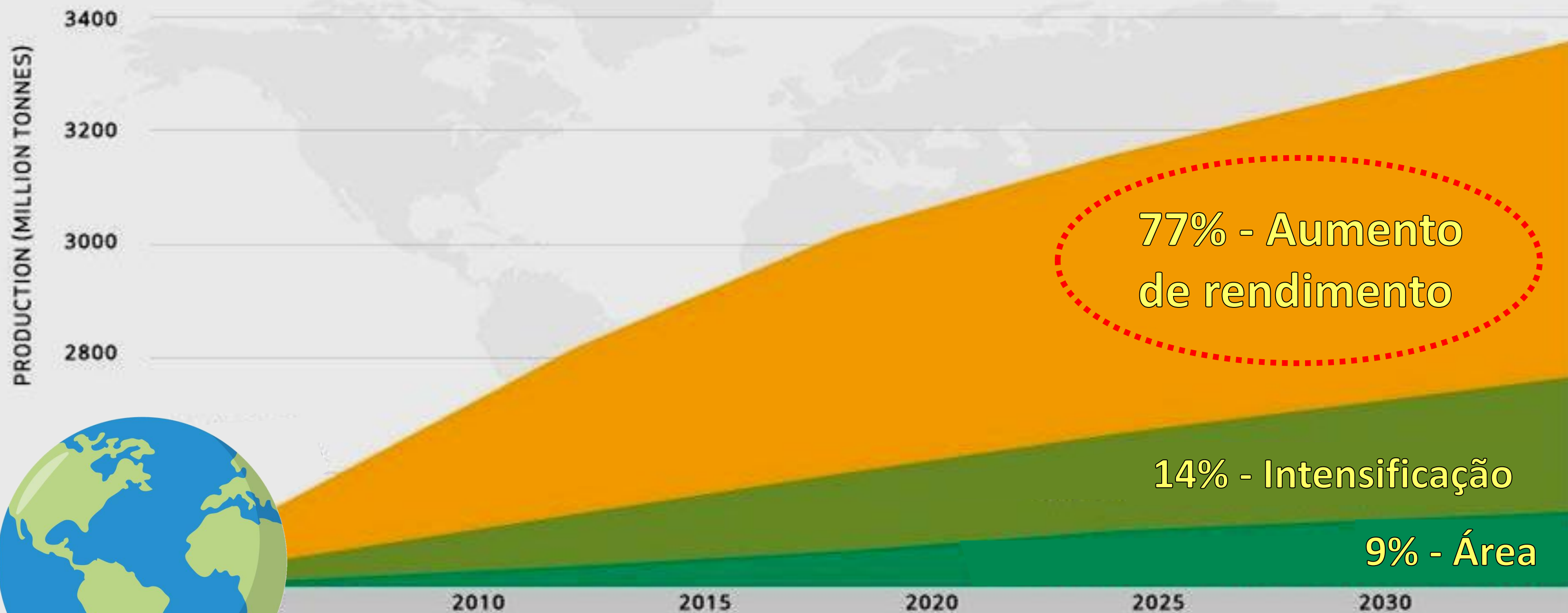
Pecuária



Nabo forrageiro (outono)

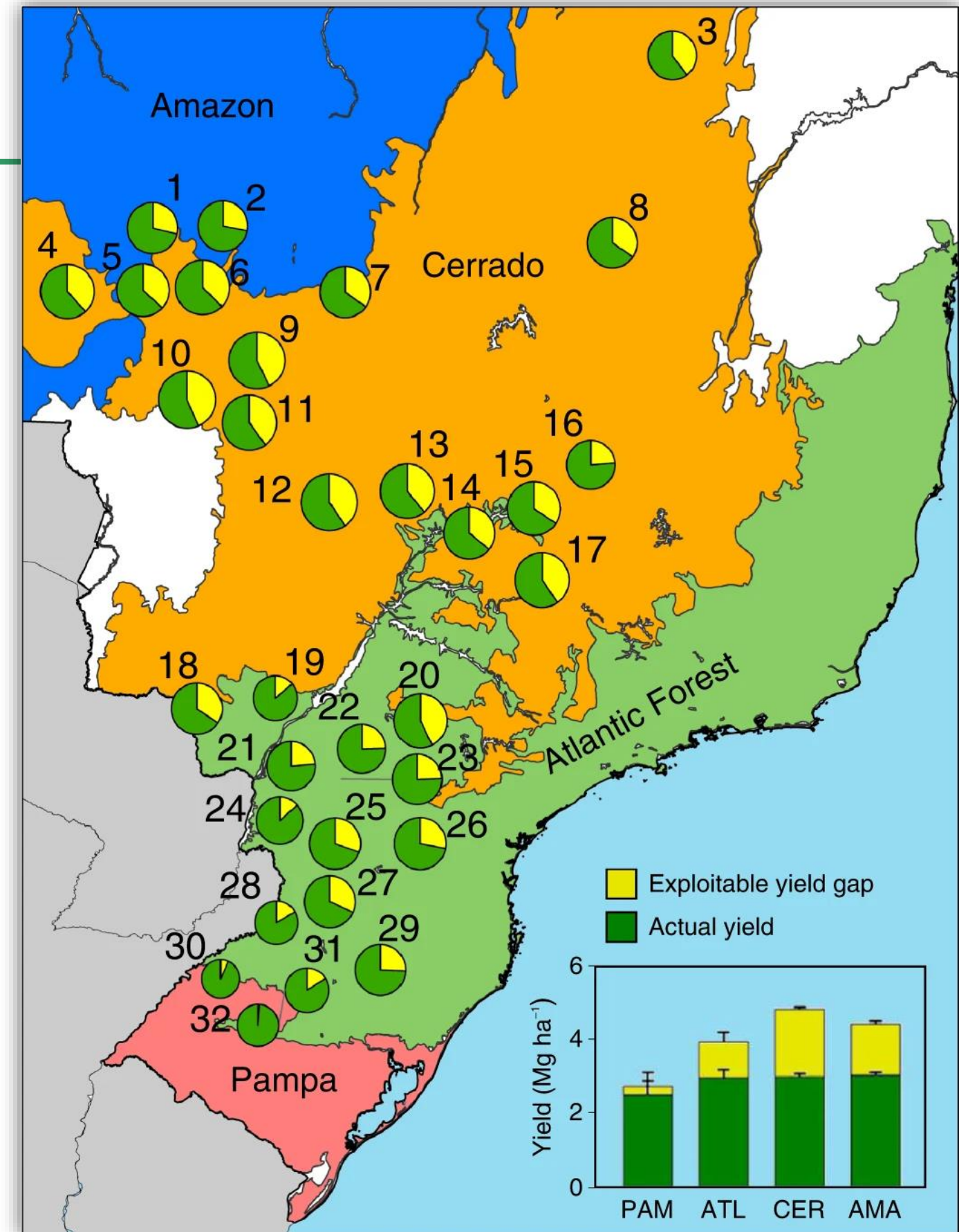


AUMENTO DA PRODUÇÃO AGRÍCOLA



LACUNAS DE PRODUTIVIDADE

Produtividade atingível e lacunas de produtividade no Brasil.



AGRICULTURA DIGITAL

A agricultura digital é uma estratégia de gestão que utiliza as tecnologias da informação para trazer os dados de múltiplas fontes e apoiar as decisões relacionadas ao sistema produtivo.

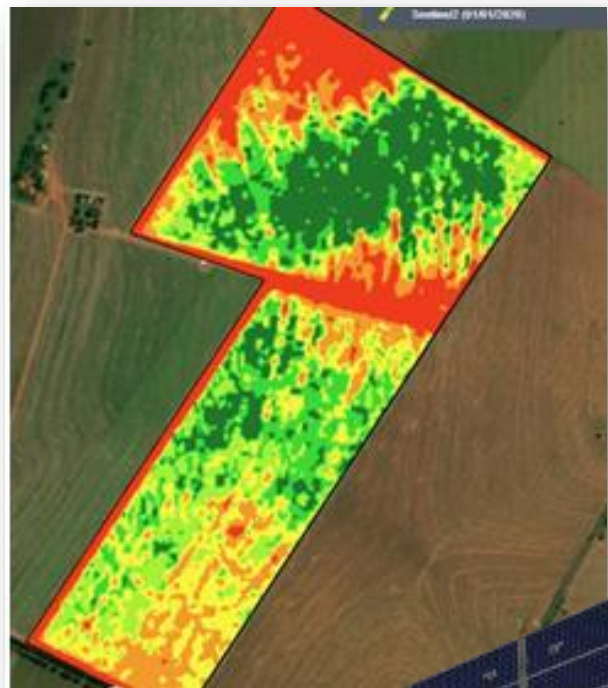
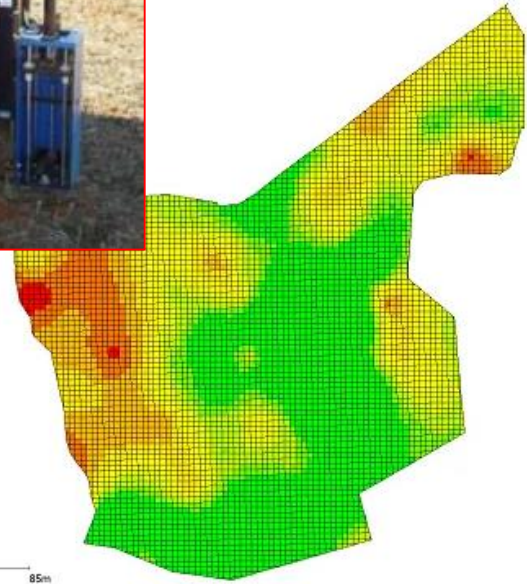


AGRICULTURA DIGITAL

A agricultura digital é uma estratégia de gestão que utiliza as tecnologias da informação para trazer os dados de múltiplas fontes e apoiar as decisões relacionadas ao sistema produtivo.



AUMENTO NA EFICIÊNCIA DE USO DE INSUMOS COM TECNOLOGIAS DA AGRICULTURA DE PRECISÃO/DIGITAL



APLICAÇÕES DE INSUMOS EM TAXA VARIÁVEL



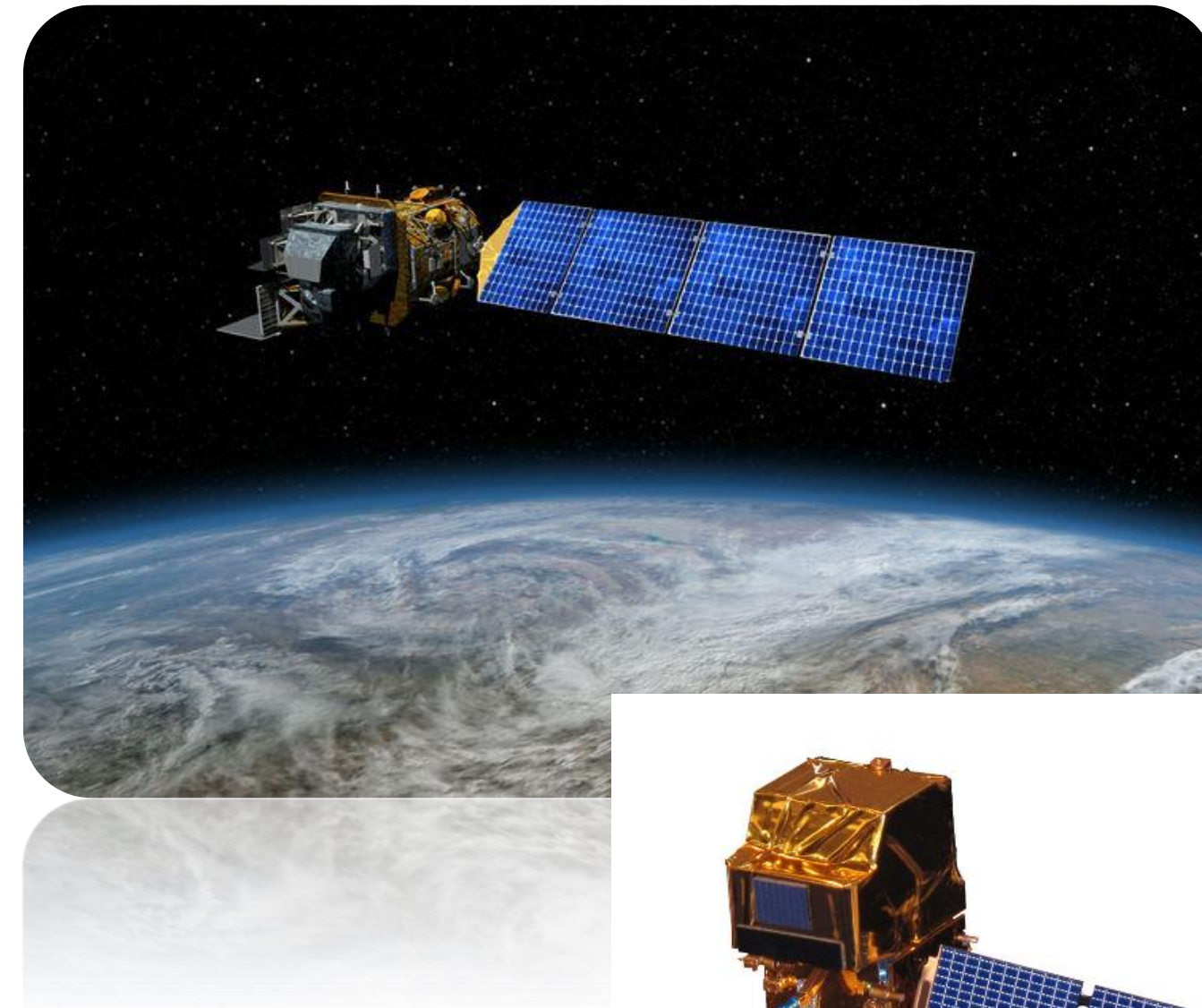
Amostragem
em grid



SENSORIAMENTO REMOTO



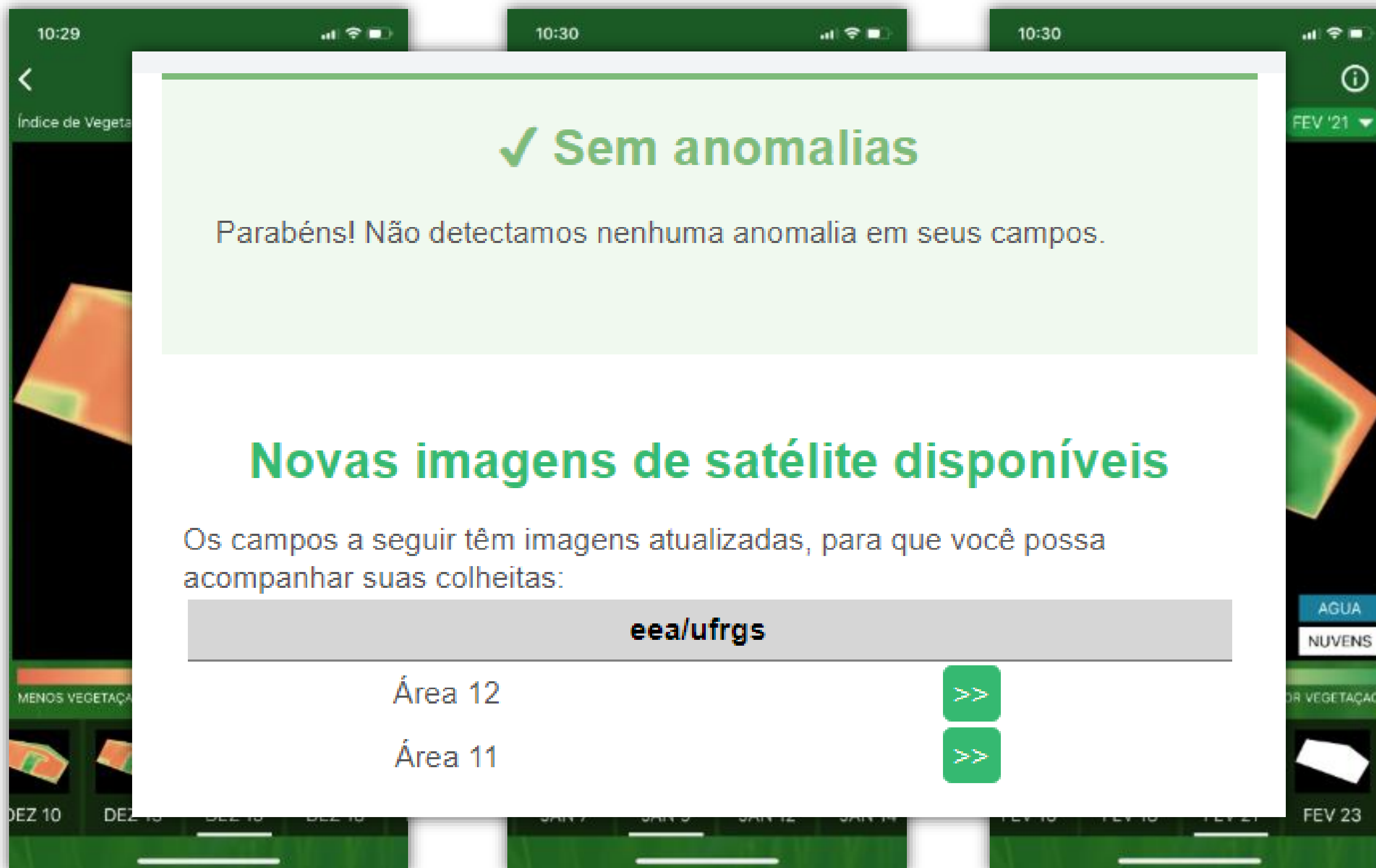
**Veículos aéreos
não tripulados**



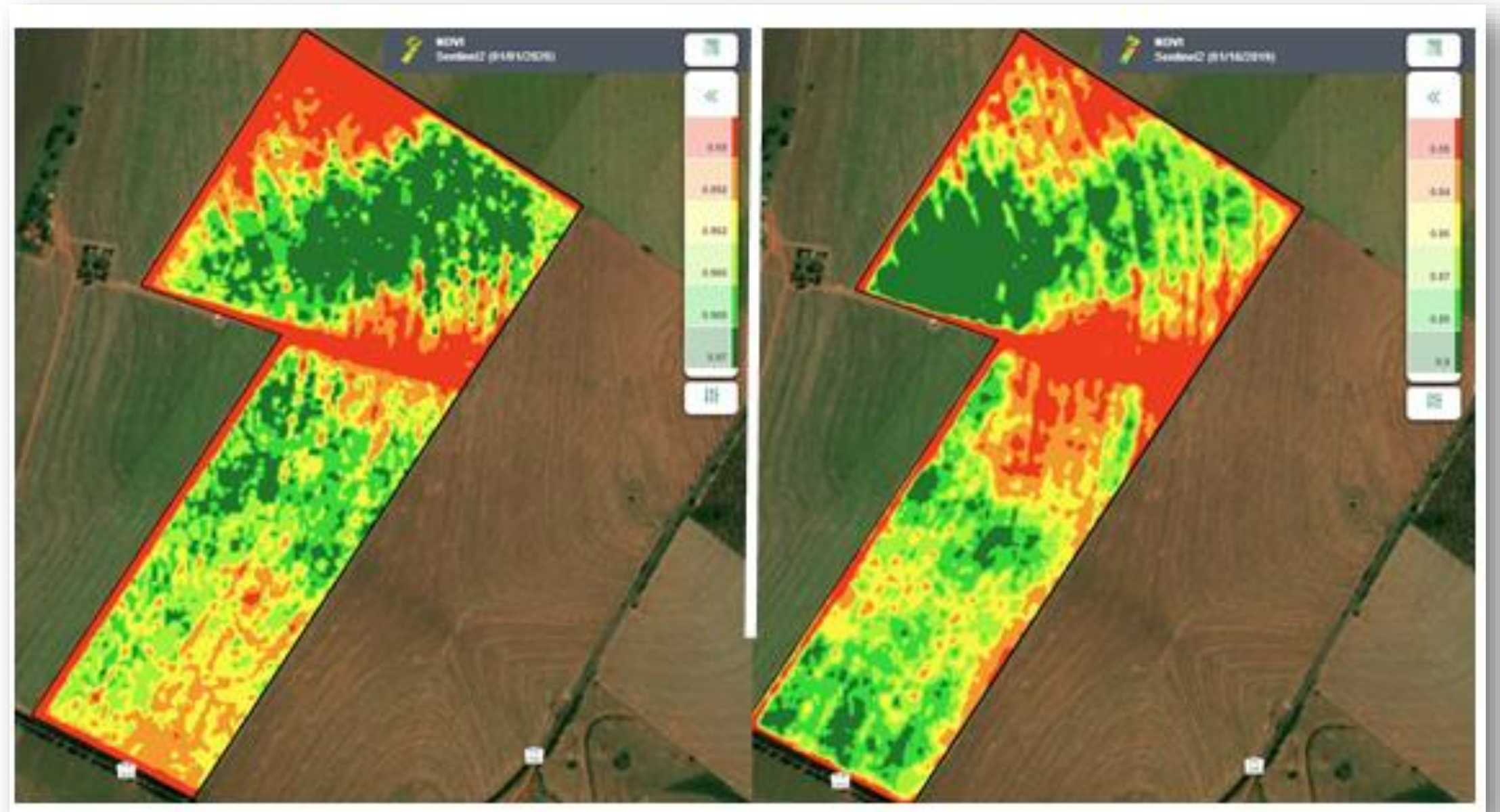
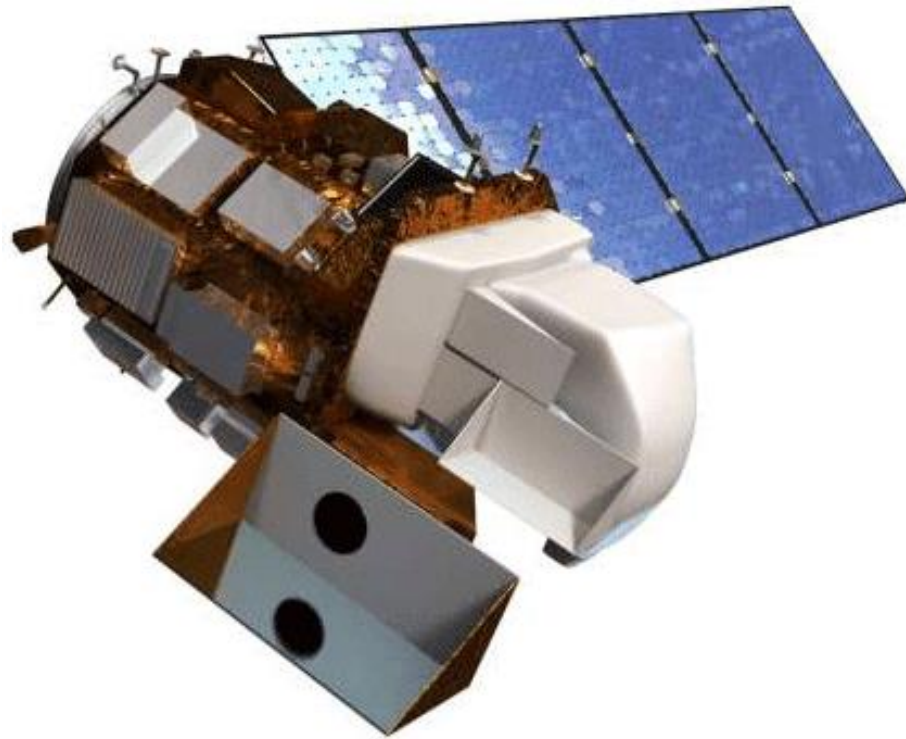
Satélites



MONITORAMENTO DE LAVOURAS



MONITORAMENTO DE LAVOURAS



Janeiro de 2019

Janeiro de 2020



MONITORAMENTO DE LAVOURAS

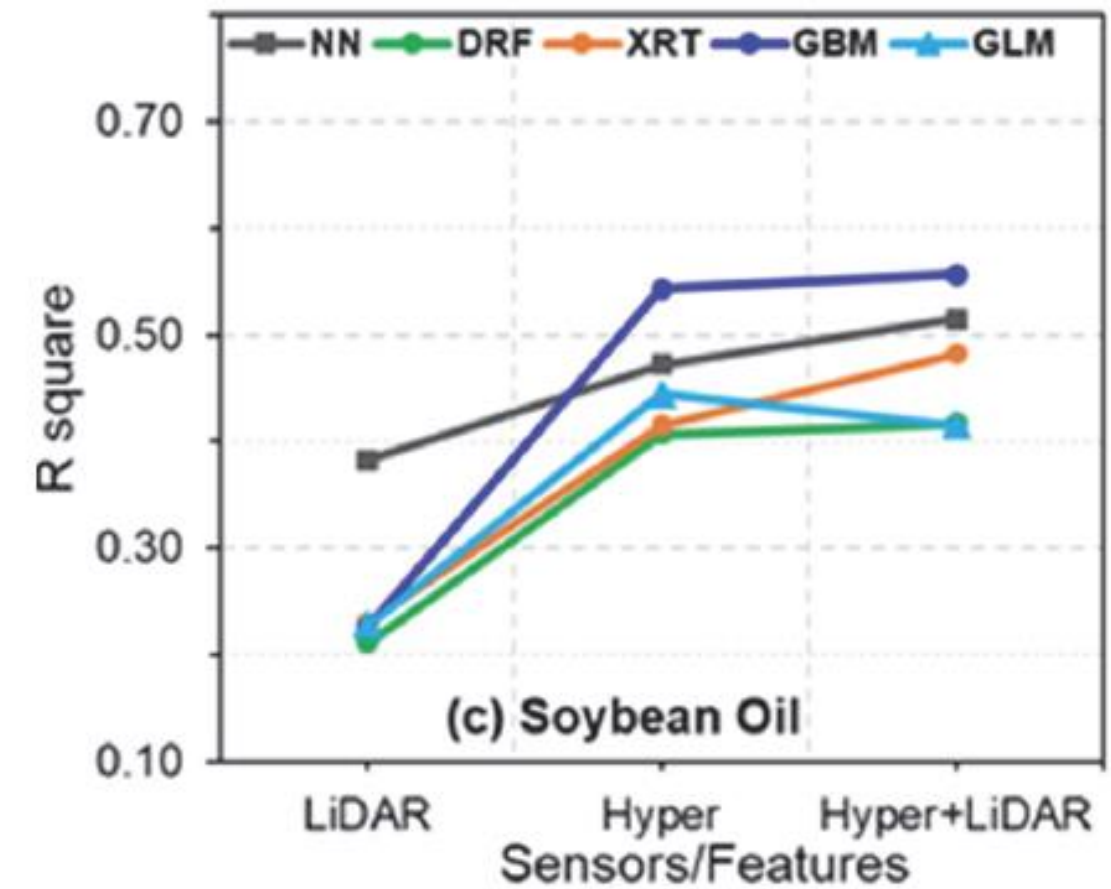
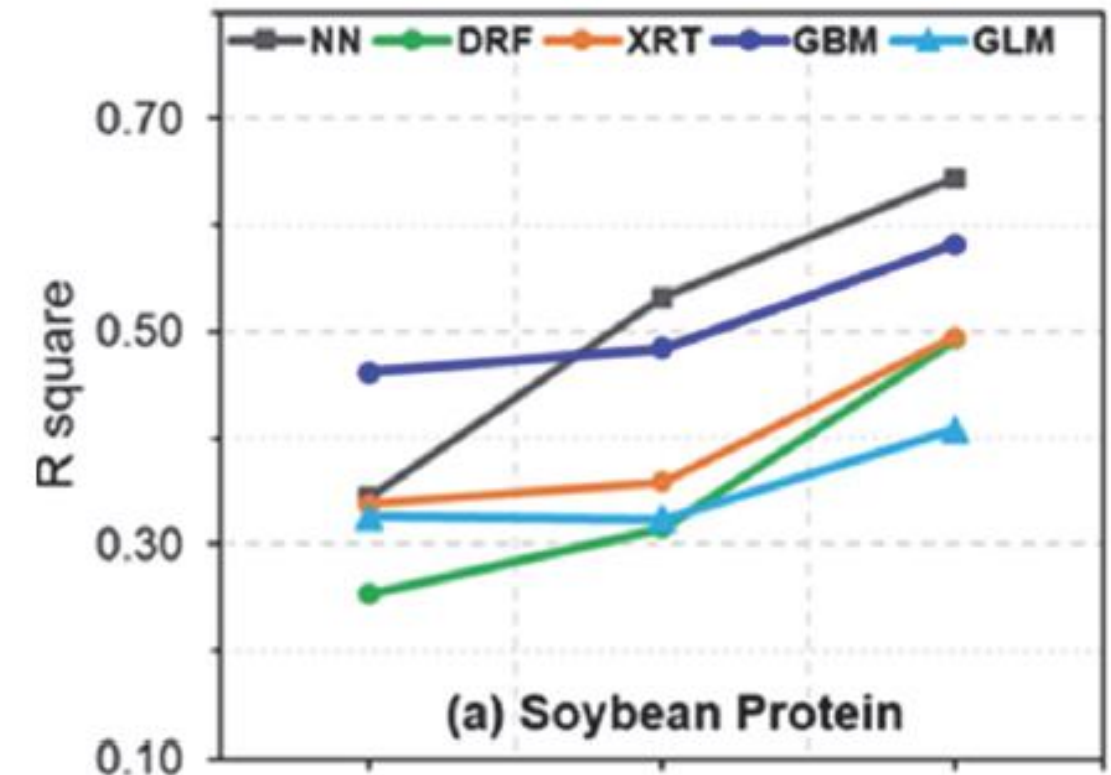
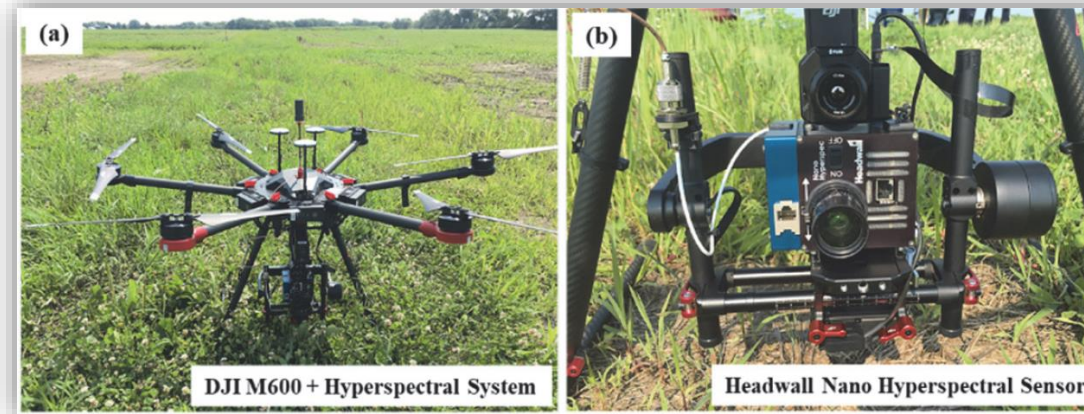
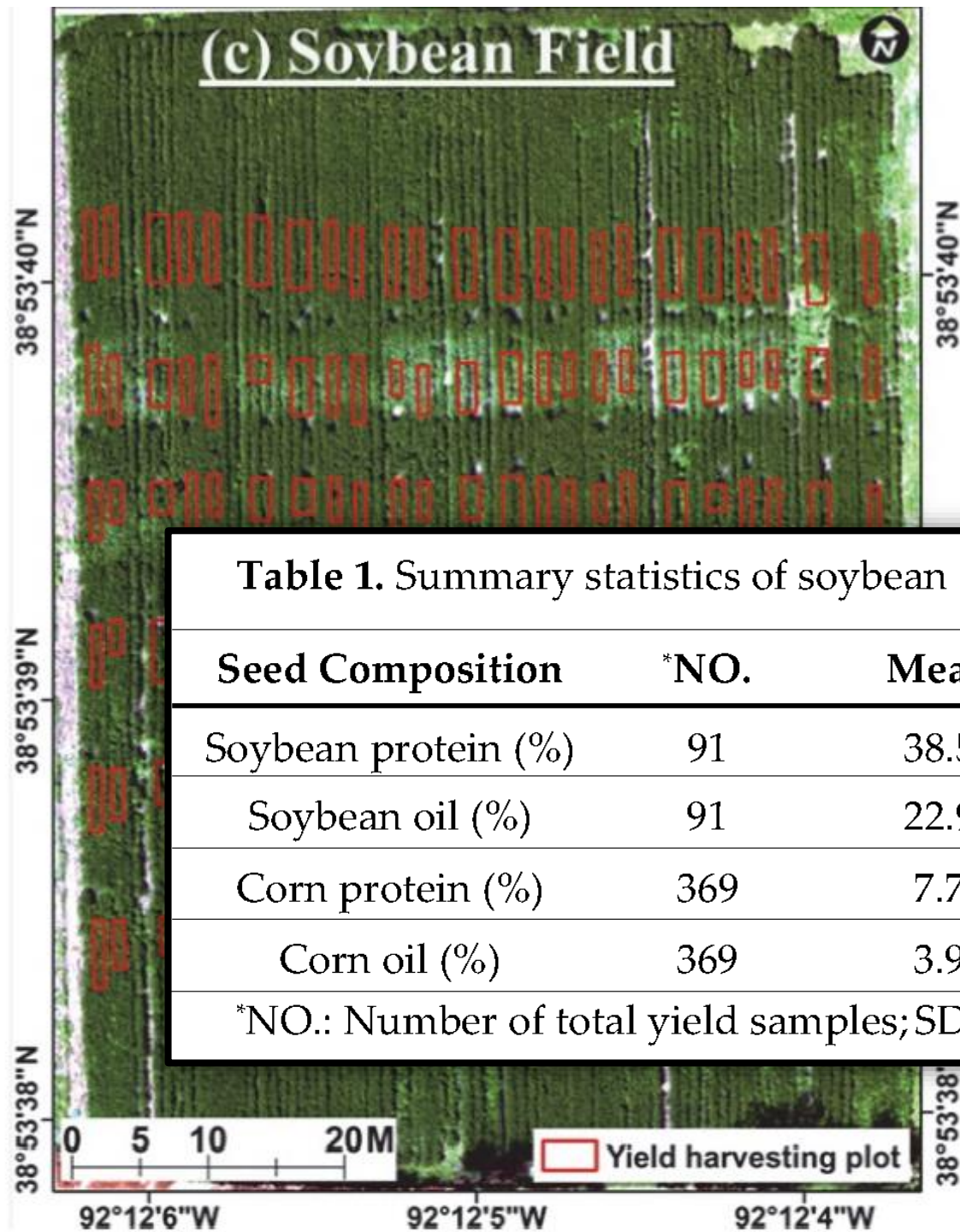


Table 1. Summary statistics of soybean and corn seed composition datasets.

Seed Composition	*NO.	Mean	Max.	Min.	SD	CV (%)
Soybean protein (%)	91	38.5	41.2	36.7	0.87	2.3%
Soybean oil (%)	91	22.9	24.5	21.0	0.83	3.6%
Corn protein (%)	369	7.7	15.3	5.7	1.45	18.9%
Corn oil (%)	369	3.9	5.3	2.1	0.57	14.5%

*NO.: Number of total yield samples; SD: standard deviation; CV: coefficient of variation.



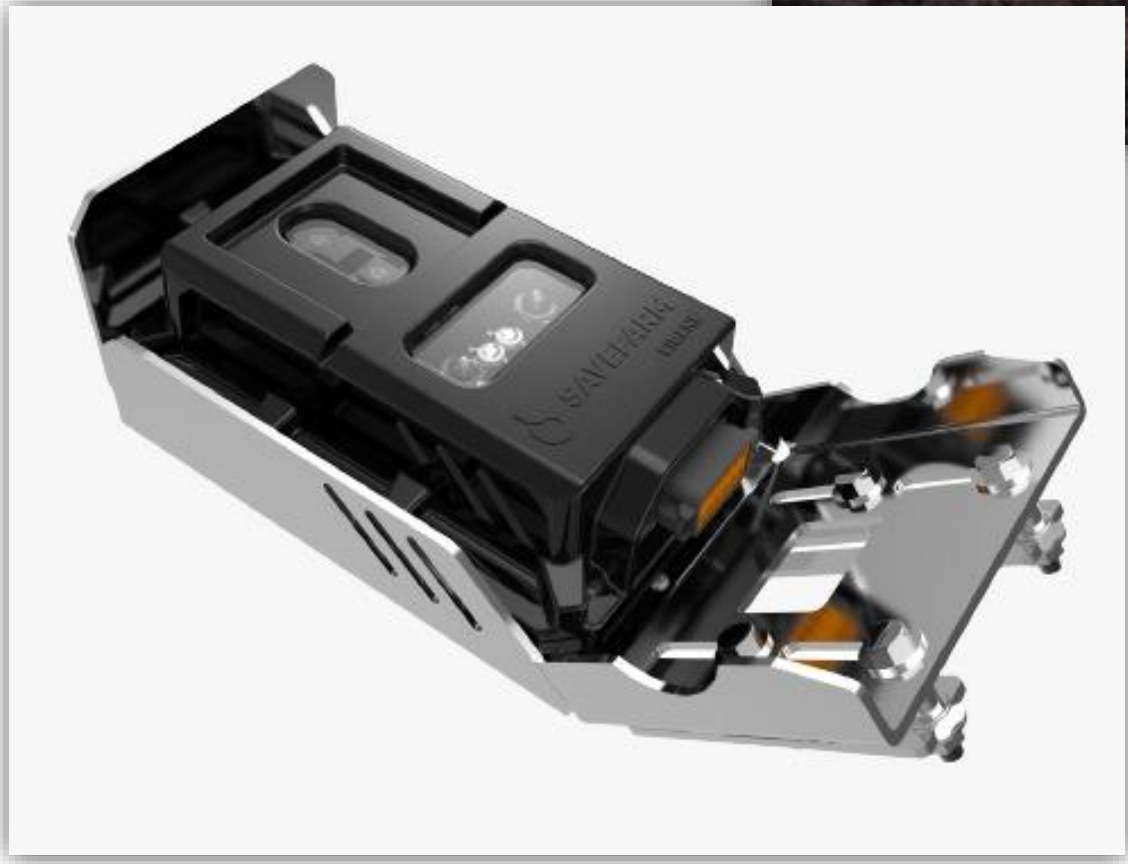
SENSORES PARA APLICAÇÃO LOCALIZADA DE HERBICIDAS



WeedSeeker



SaveFarm



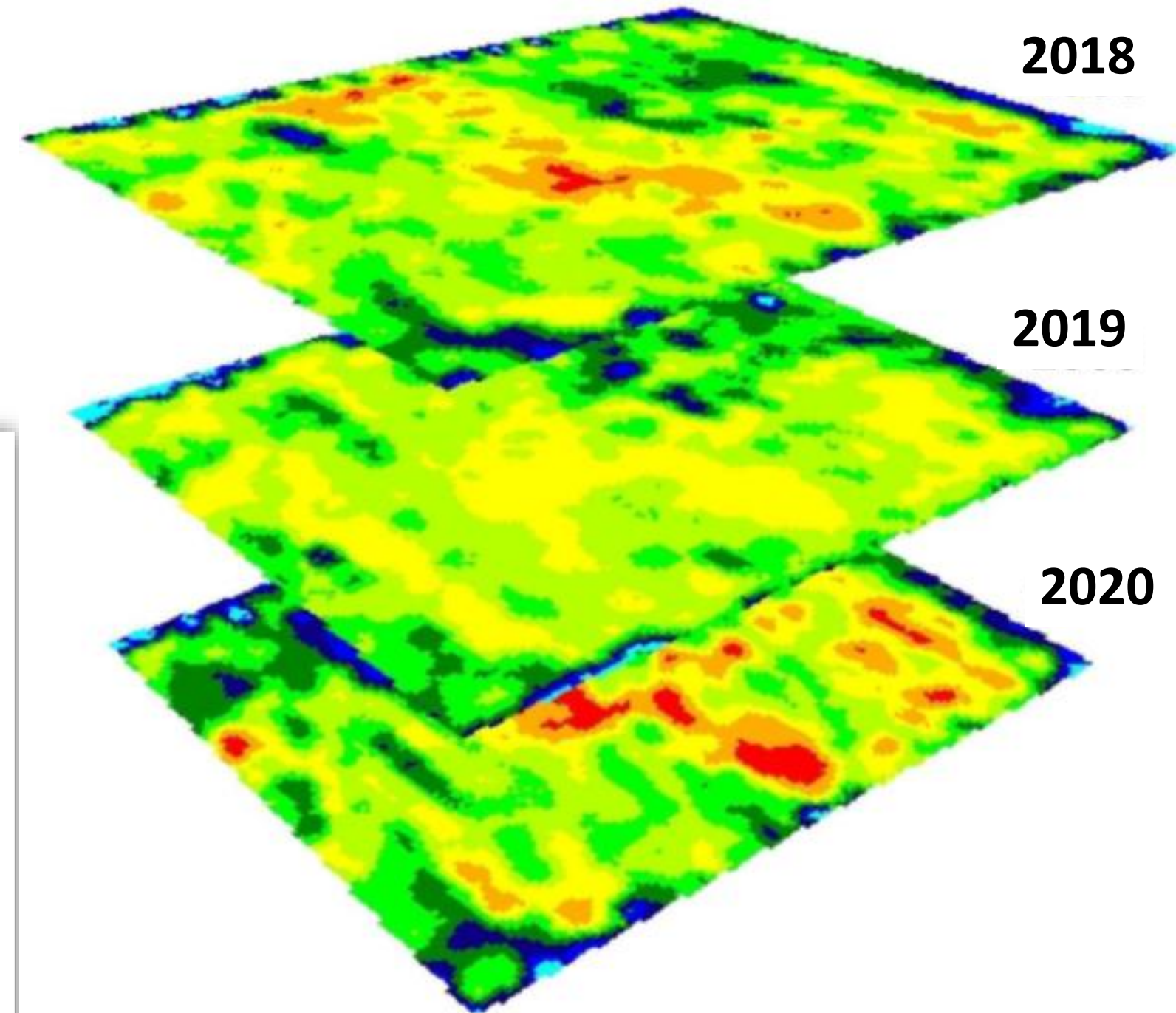
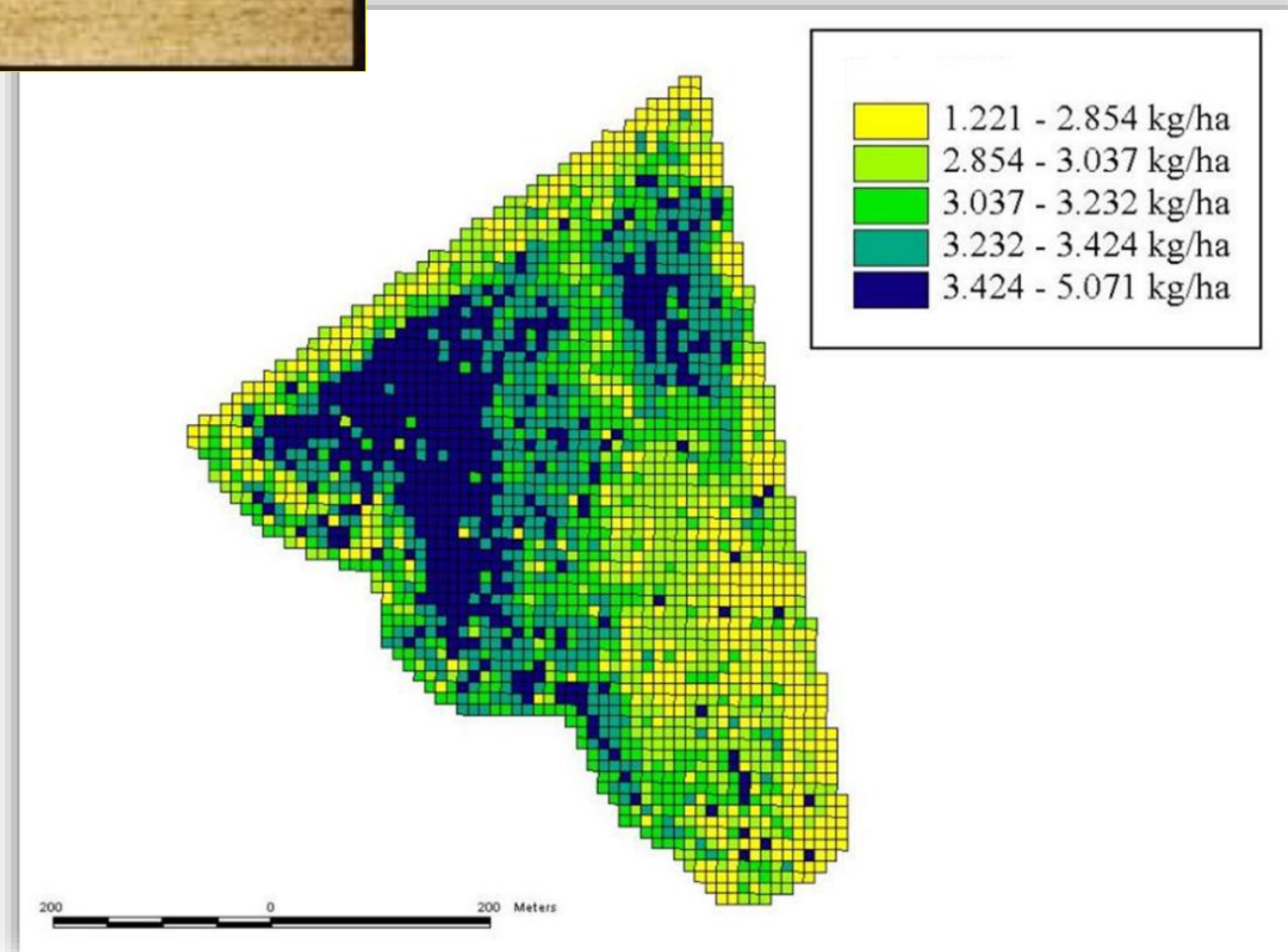
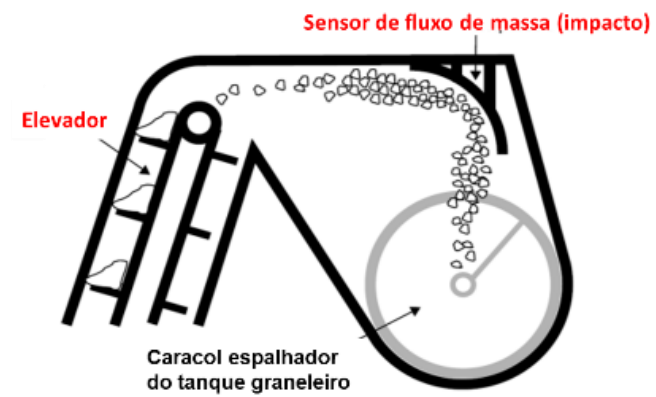
Weedit



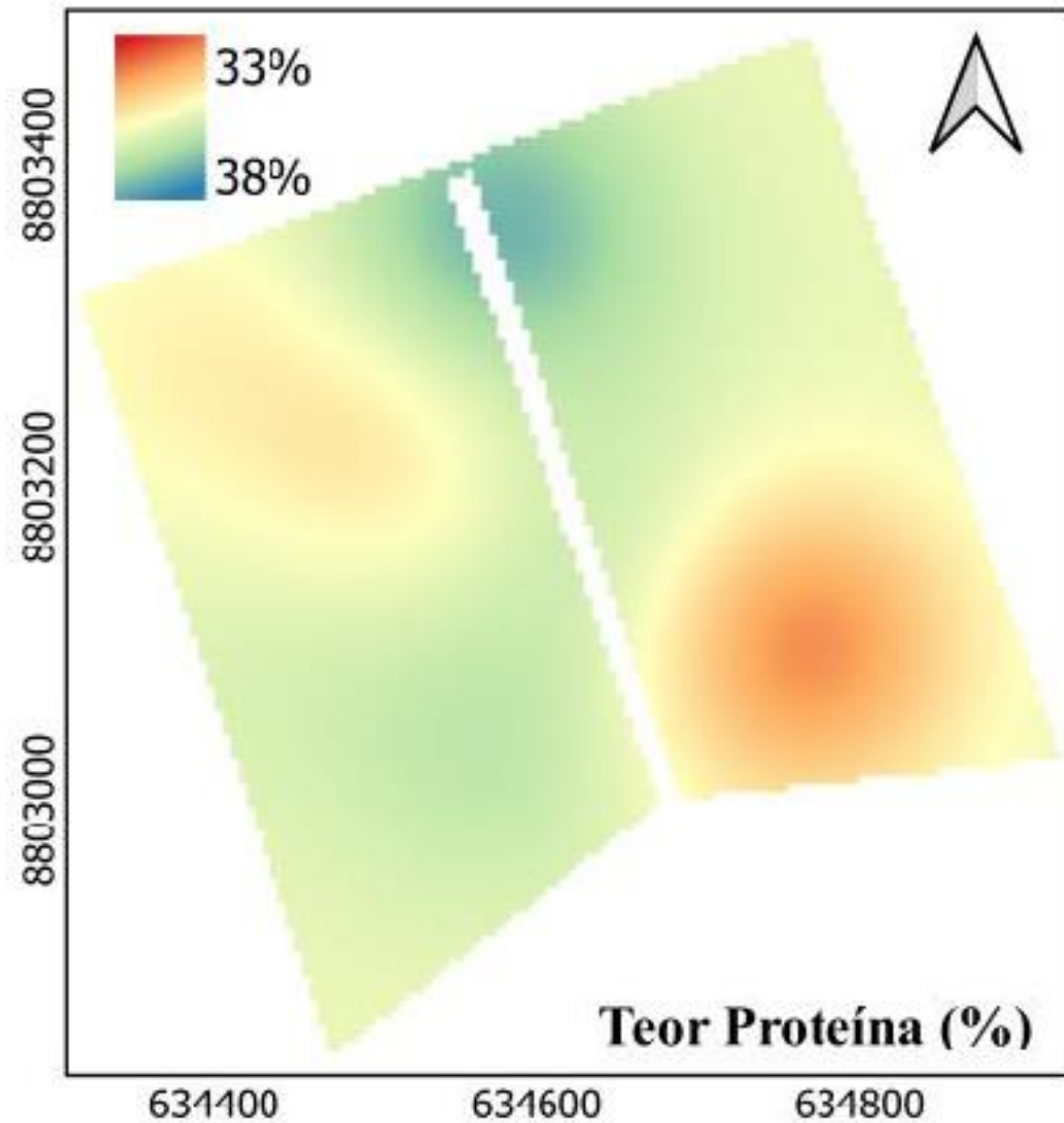
SENSORES PARA APLICAÇÃO LOCALIZADA DE HERBICIDAS



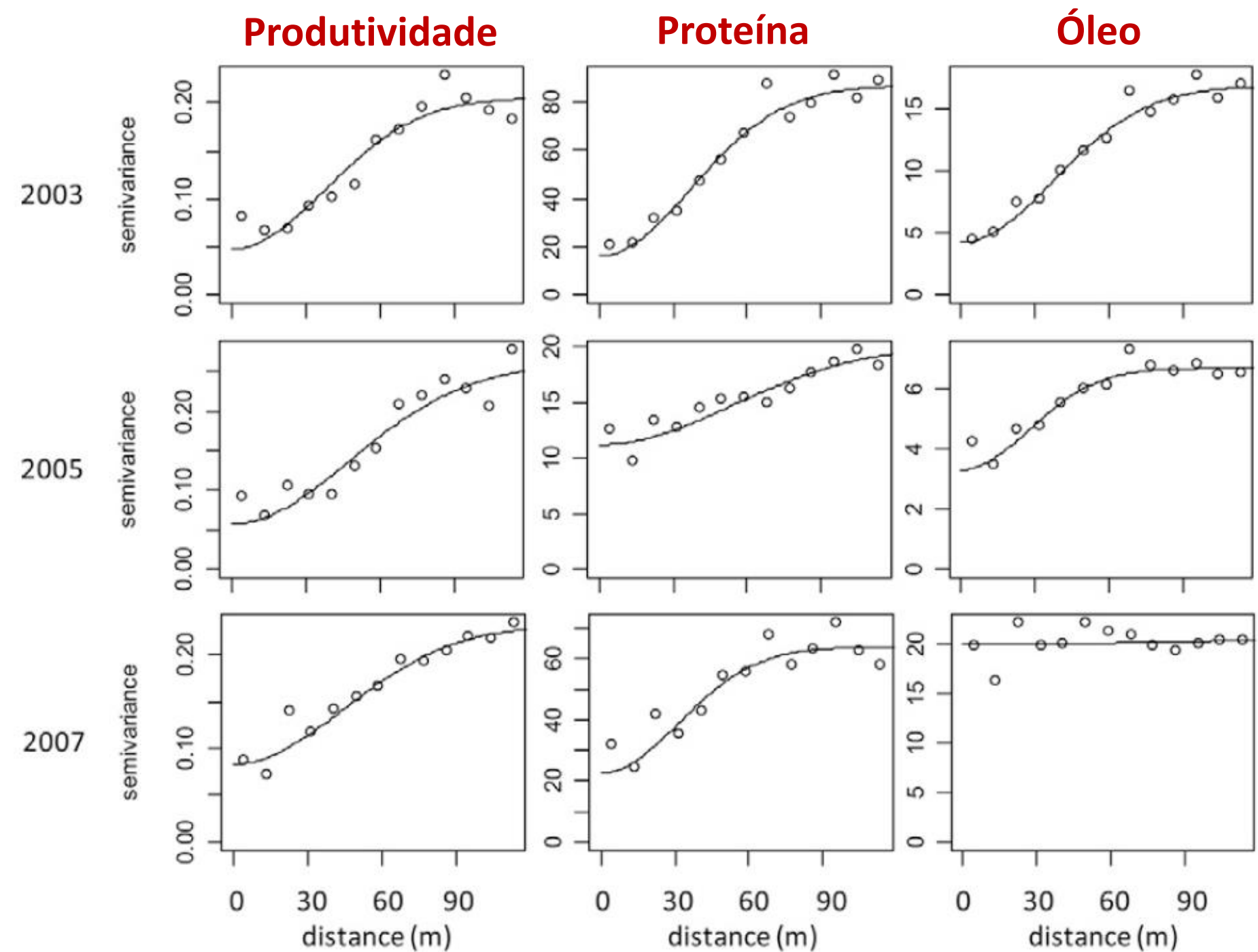
MAPAS DE PRODUTIVIDADE



VARIABILIDADE ESPACIAL – QUALIDADE DA SOJA



Carvalho, S. *et al.* 2022. Spatial distribution for yield, quality, and storage of soybean seeds obtained in the tropical lowlands. DOI: 10.5965/223811712122022093



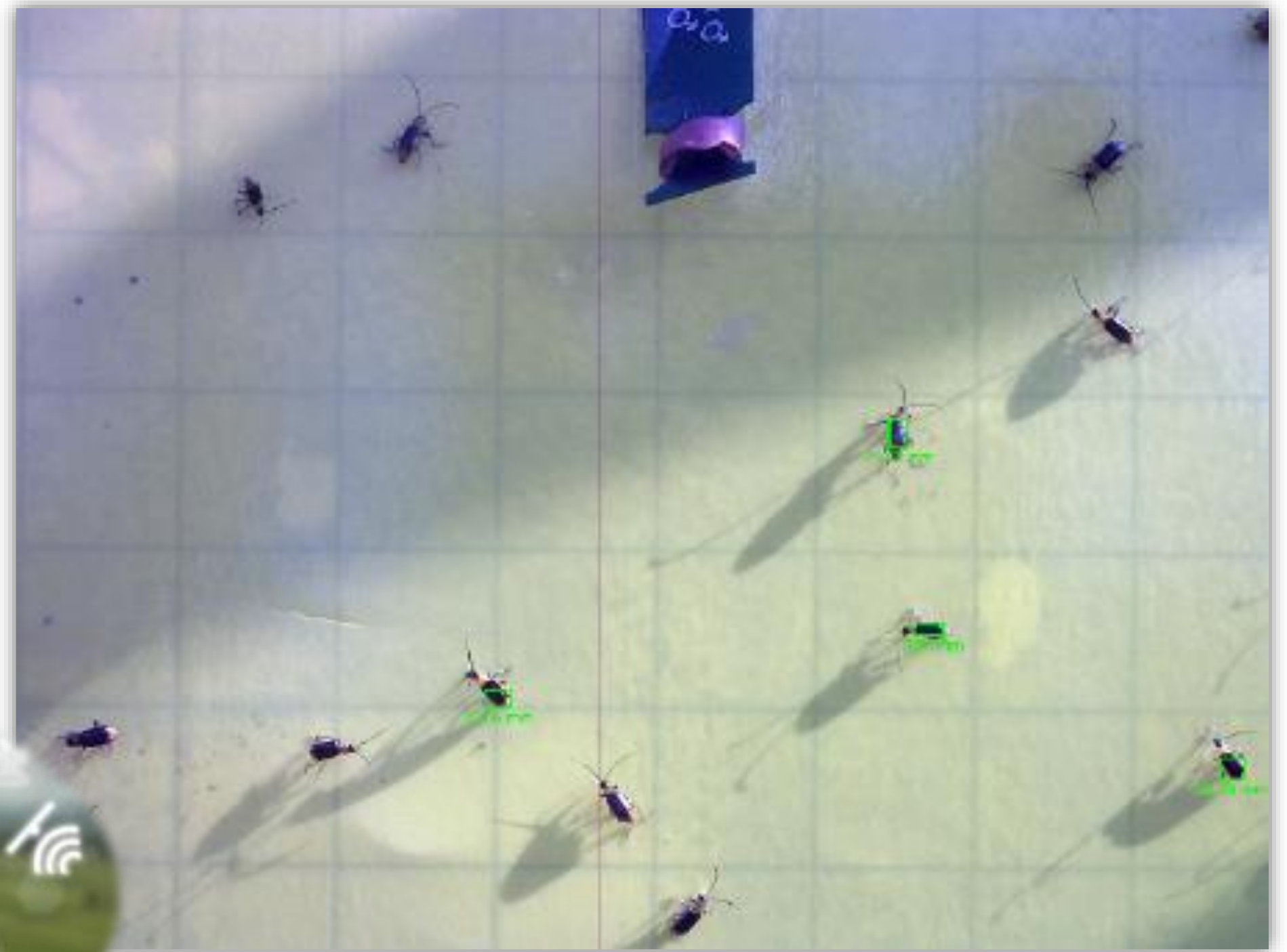
Anthony, P. *et al.* 2012. Soybean Yield and Quality in Relation to Soil Properties. *Agronomy Journal*, 104: 1443–1458. DOI: 10.2134/agronj2012.0095.



INFORMAÇÕES METEOROLÓGICAS EM TEMPO REAL



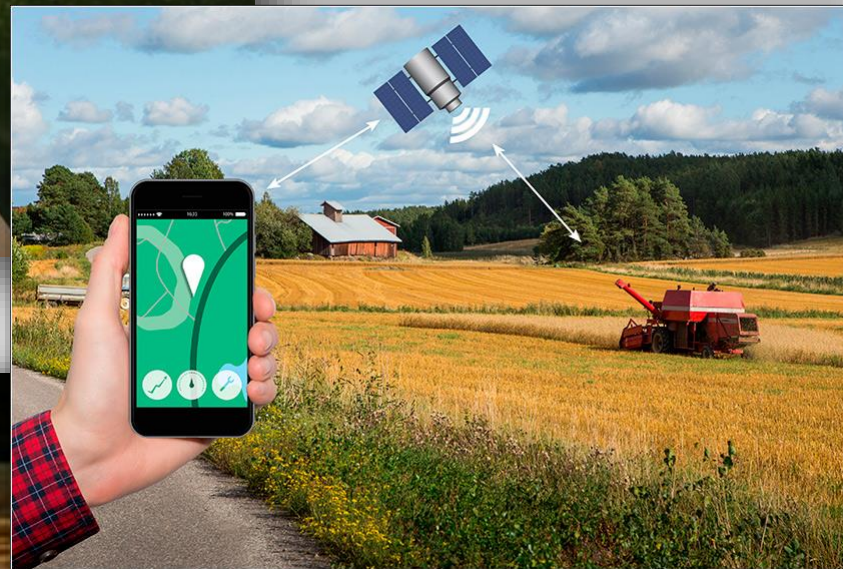
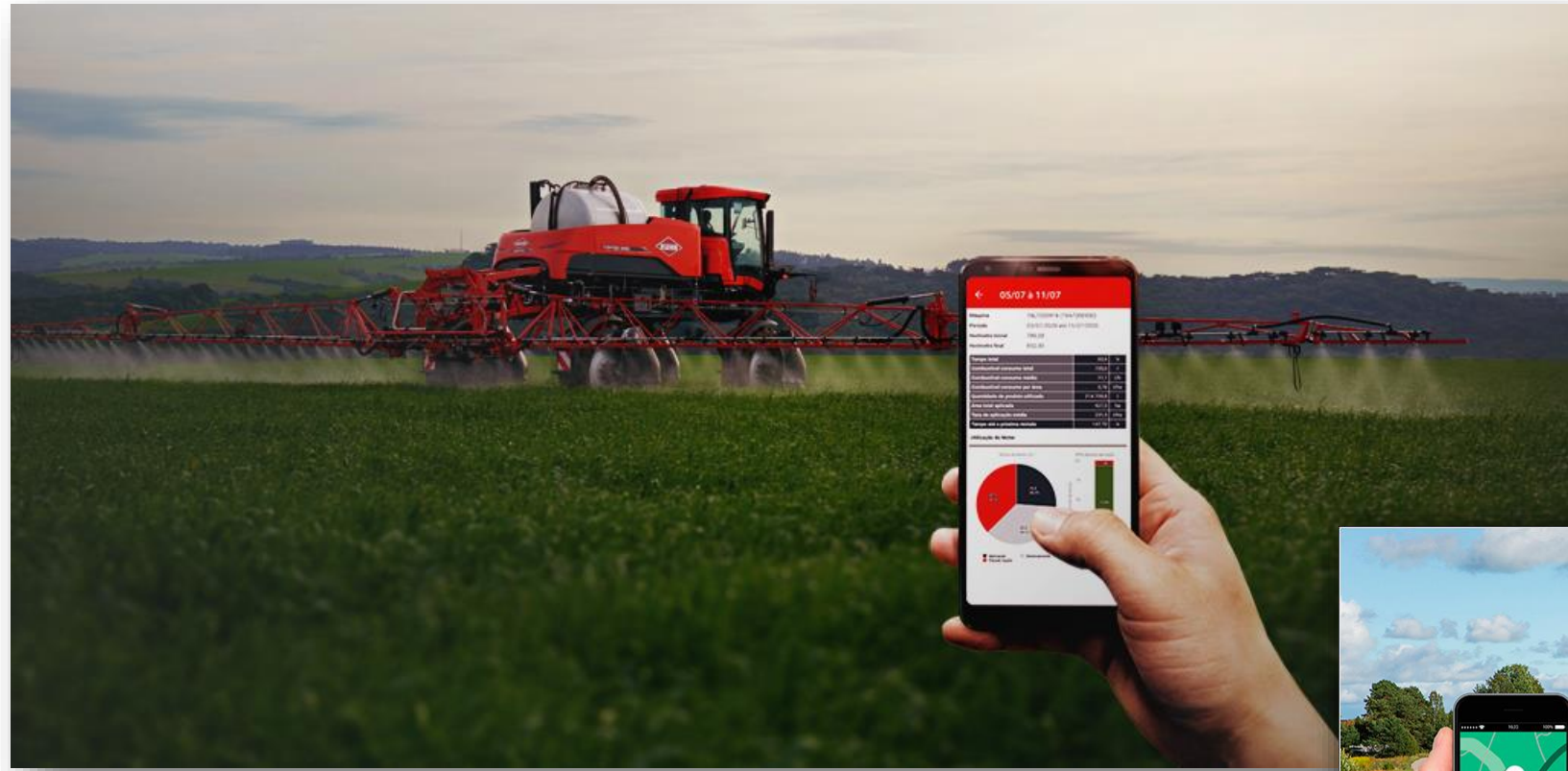
MONITORAMENTO AUTOMATIZADO DE PRAGAS



MONITORAMENTO AUTOMATIZADO DE DOENÇAS



MONITORAMENTO DE MÁQUINAS



Fonte: G. Nichel



**Nunca antes na agricultura houve tantas
oportunidades e ferramentas
para obtenção de dados sobre as áreas e
as operações agrícolas.**



BIG DATA AGRÍCOLA

Computers and Electronics in
Agriculture

Volume 198, July 2022, 107080

How many gigabytes per hectare are available in the digital agriculture era? A digitization footprint estimation

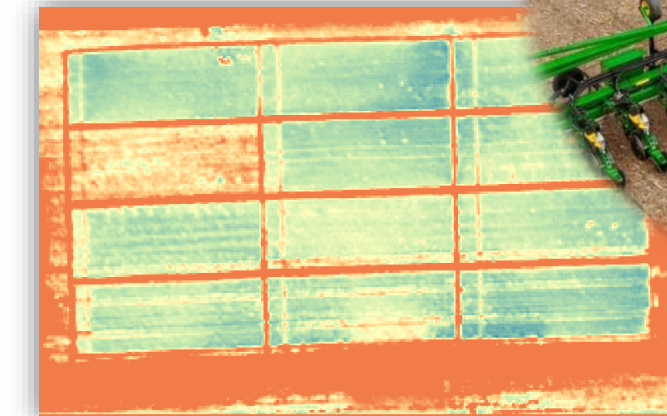
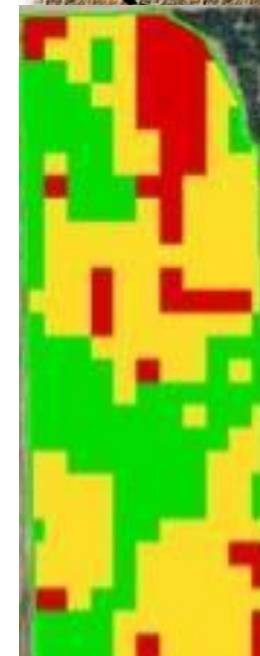
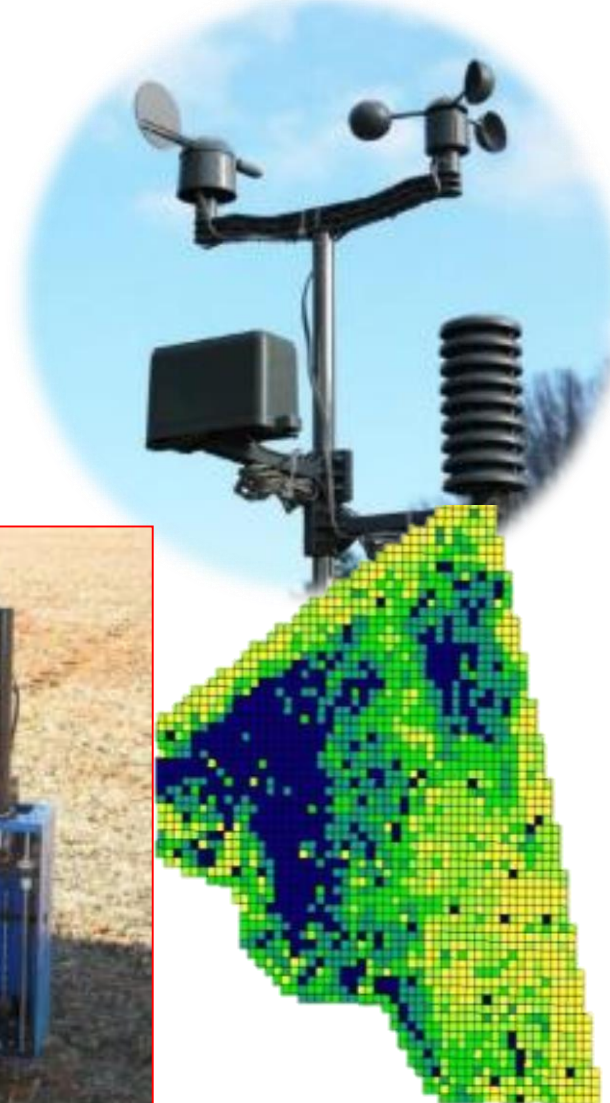
Ahmed Kayad ^{a, b} ... Francesco Marinello ^a

Em 22 hectares e 22 anos:

18.6 Gb (2020)

40.5 Gb (2025)

Entre 2020 e 2025: 165 Mb/ha/ano



CONEXÃO E INTEGRAÇÃO DE INFORMAÇÕES PARA MELHORIA DO PROCESSO DE GESTÃO

“Agricultura Digital”

“Agricultura
de Dados”

“Fazenda conectada”

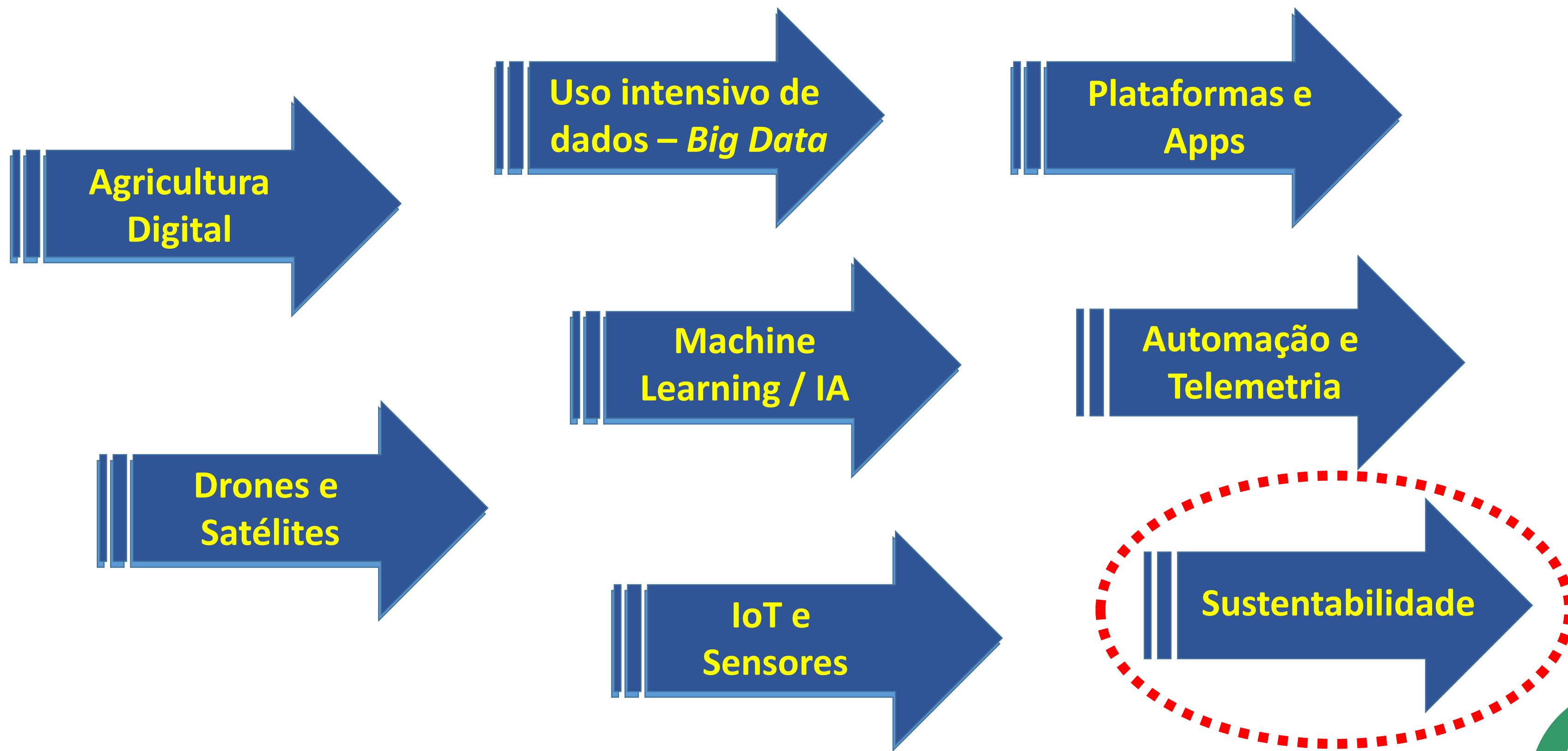
“Agricultura
preditiva”

“Agricultura 4.0”

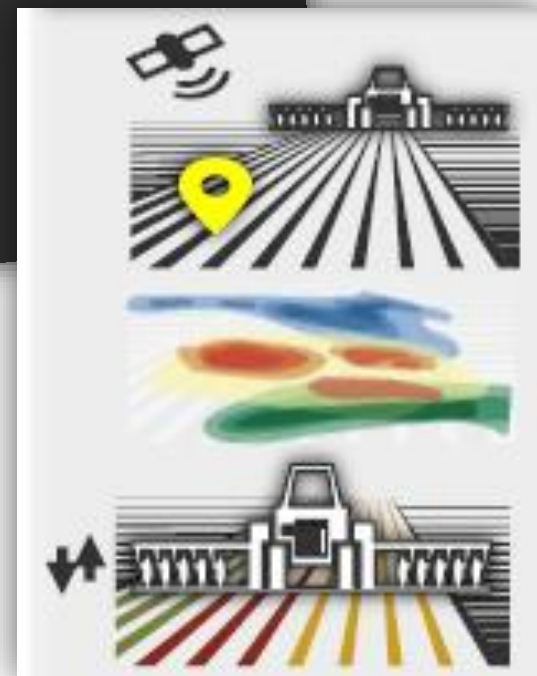
“Agricultura 5.0”



TENDÊNCIAS – TECNOLOGIA E INOVAÇÃO



INOVAÇÃO E SUSTENTABILIDADE



Piloto automático

Taxa variável

Controle de seção



INOVAÇÃO E SUSTENTABILIDADE



+14%



-15%



-16%



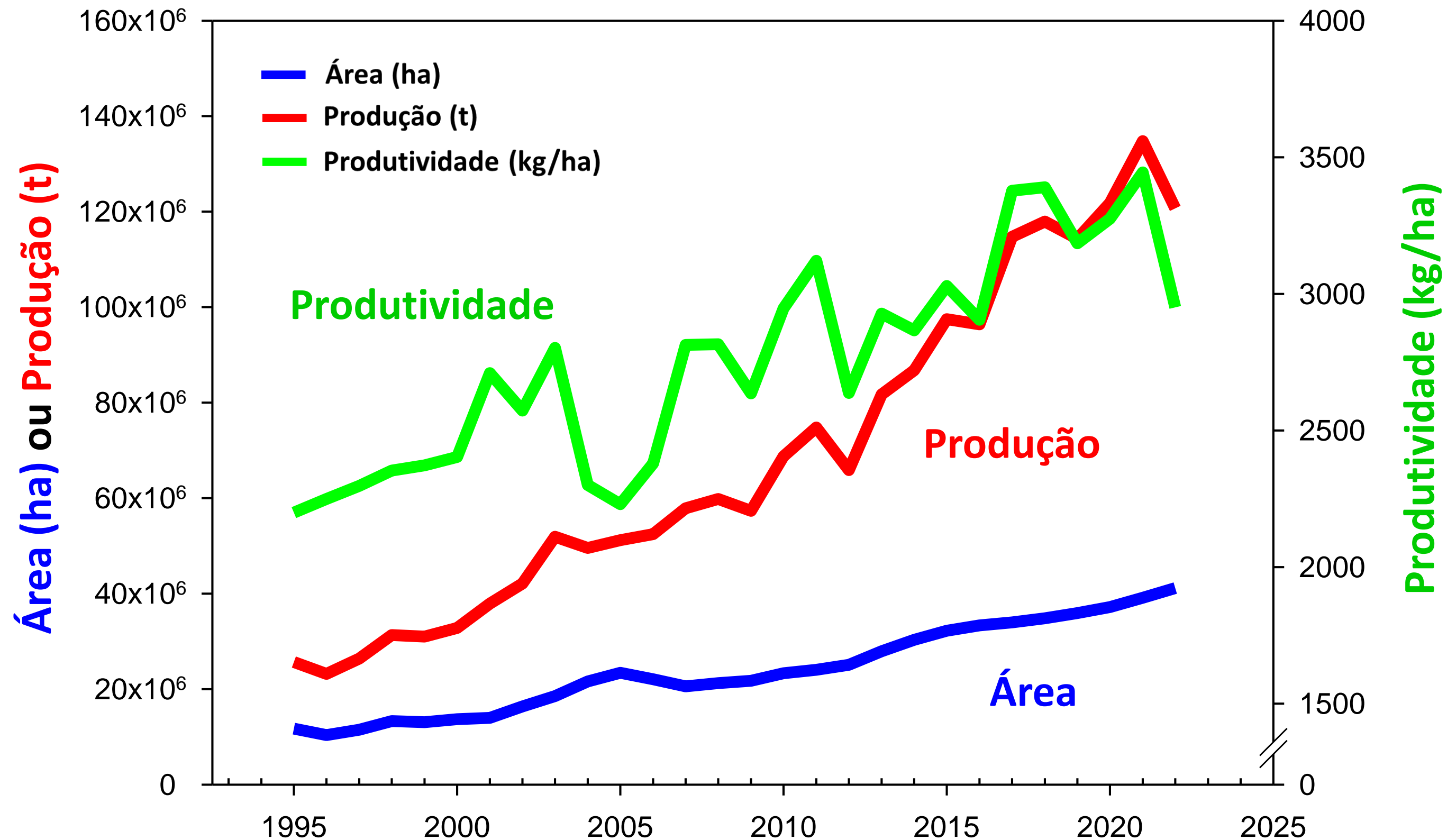
-21%



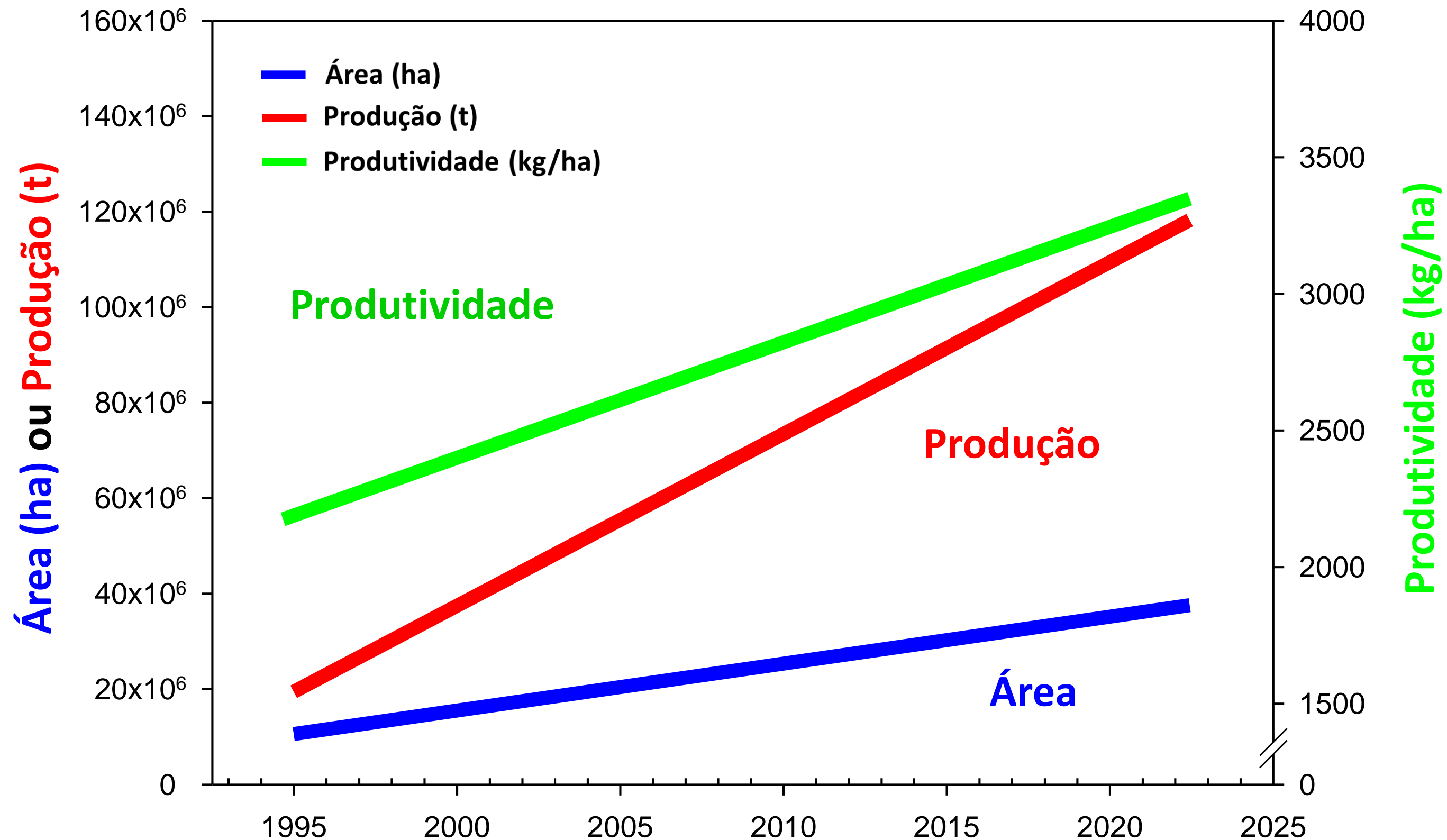
Cultivo em área equivalente a 4,5x a área do YELLOWSTONE seria evitado (~ 10,2 milhões de acres)



SOJA – Produção, produtividade e área



SOJA – PRODUÇÃO, PRODUTIVIDADE E ÁREA



V Seminário
Desafios da Liderança Brasileira no Mercado Mundial da Soja
19 e 20 de setembro de 2023



OBRIGADO !

Christian Bredemeier
bredemeier@ufrgs.br

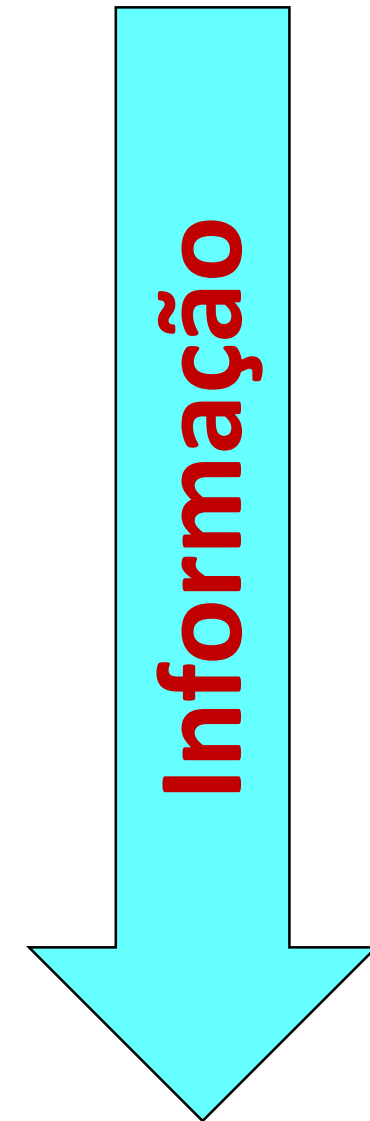
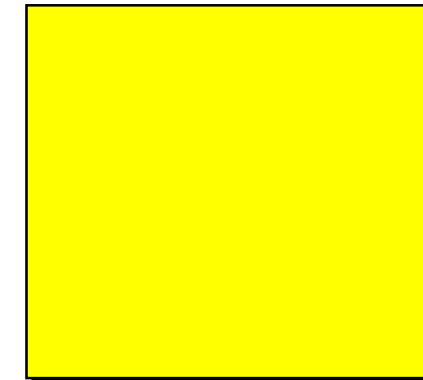


DESAFIO GLOBAL – Objetivos de Desenvolvimento Sustentável



MANEJO COM REDUÇÃO DE ESCALA

- Agricultura convencional **Talhão**
Tratamento
uniforme



INTENSIFICAÇÃO DOS SISTEMAS PRODUTIVOS

Average, percentile 5 (5%), and percentile 95 (95%) for seed protein concentration, seed yield, and seed N for individual fields in central Argentina between 2012 and 2016 growing seasons.

Variable	Soybean crop	Average	5%	95%
Seed protein concentration (%)	Soybean as single crop	36.6	34.2	39.4
	Soybean as second crop	37.6	34.8	40.4
Seed yield (kg ha ⁻¹)	Soybean as single crop	3648	2157	4785
	Soybean as second crop	3154	1915	4019
Seed N (kg N ha ⁻¹)	Soybean as single crop	213	128	280
	Soybean as second crop	190	109	242

Management and environmental factors explaining soybean seed protein variability in central Argentina

Lina B. Bosaza, Jos  A. Gerdea, Lucas Borr sa, Pablo A. Cipriottib, Luciano Ascheric, Mat as Camposc, Santiago Galloc, Jos  L. Rotundoa, 2019

Tabela 1. Produtividade, umidade de solo e teores de  leo e prote na para sementes de soja obtidas em campos de sementes em Lagoa da Confus o/TO, safra 2020.

Table 1. Yield, soil and seed moisture and oil and protein contents of soybean in seed fields in Lagoa da Confus o (Tocantins state, Northern Brazil), 2020 season.

Caracter�stica	M�x.	M�n.	M�dia	S	CV	Assimetria	Curtose
Prod.	342,32	195,10	275,55	35,89	13,03	-0,17	-0,20
U. Semente	21,90	8,30	14,66	3,20	14,61	0,19	-0,04
U. Solo	40,20	24,30	30,56	3,78	9,40	0,69	0,45
�leo	23,13	20,37	21,82	0,70	3,21	-0,25	-0,56
Prote�na	38,06	34,00	35,79	1,07	2,99	0,22	-0,58

Prod = produtividade de gr os em g.m⁻². U. Semente = umidade da semente na colheita, em %. U. Solo = umidade do solo na colheita, em %.  leo e Prote na = teor de  leo e de prote na, respectivamente, nas sementes, em %. S = desvio padr o. CV = coeficiente de varia o, em %.

Spatial distribution for yield, quality, and storage of soybean seeds obtained in the tropical lowlands
Carvalho et al. 2022

DOI: 10.5965/223811712122022093



Table 3. Correlation coefficients for relationships between soybean yield, protein concentration, oil concentration, protein + oil (P+O) concentration, and protein/oil (P/O) ratio within site-years.

Site†	Plant variable	2003				2005				2007			
		Protein	Oil	P+O	P/O	Protein	Oil	P+O	P/O	Protein	Oil	P+O	P/O
AN	Yield	0.49***	-0.38***	0.53***	0.45***	ns‡	-0.47***	-0.37***	0.21***	-0.29***	0.12*	-0.23***	-0.25***
	Protein		-0.94***				-0.38***				-0.31***		
WB	Yield	0.41***	-0.43***	0.33***	0.43***	ns	-0.57***	-0.53***	0.35***	-0.14***	-0.06	-0.32***	-0.10**
	Protein		-0.95***				-0.67***				-0.21***		

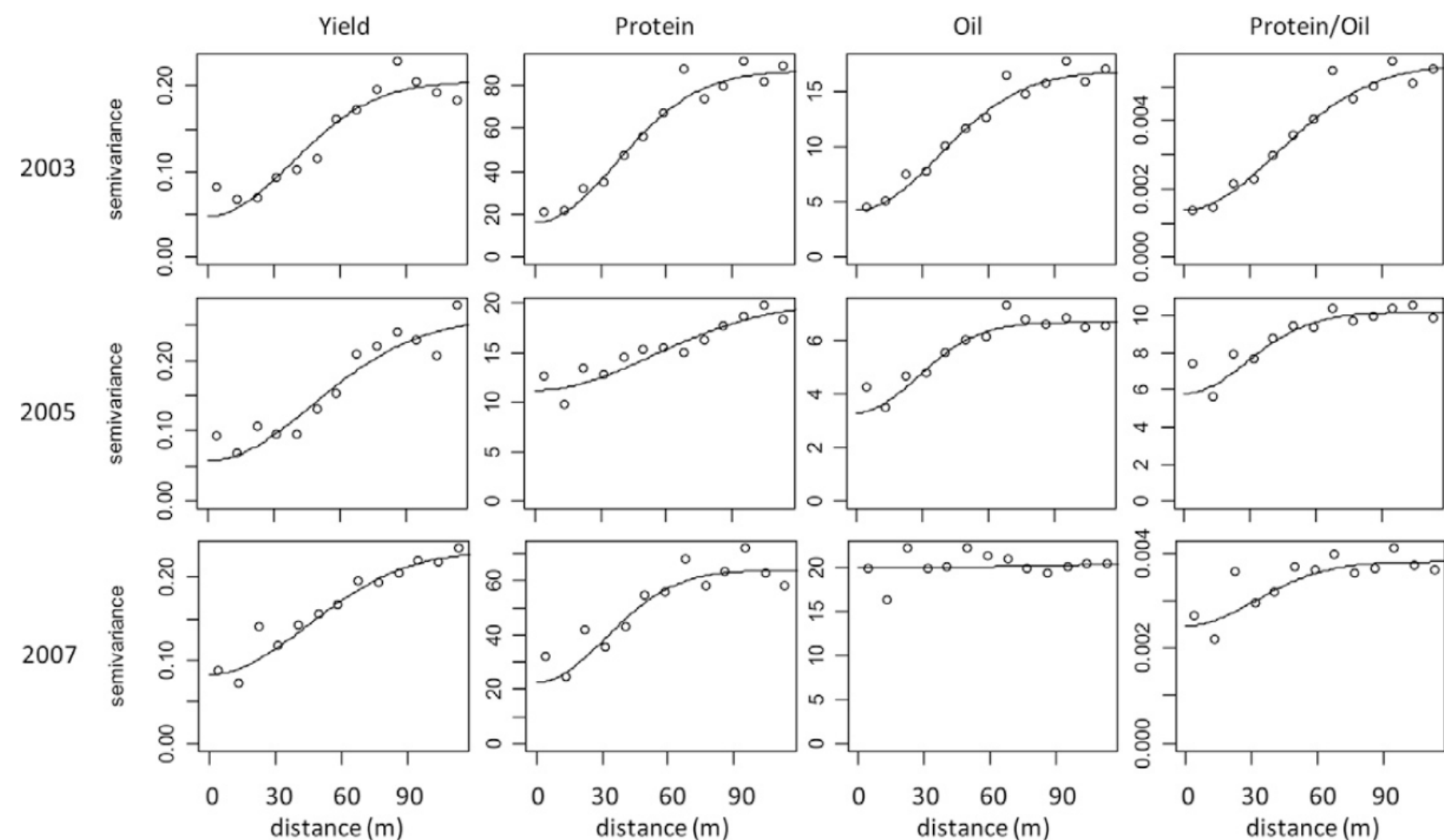


Fig. 3. Sample variograms and variogram models for soybean yield, protein concentration, oil concentration, and protein/oil ratio at site AN.

Published in Agron. J. 104:1443–1458 (2012)

Posted online 3 Aug. 2012

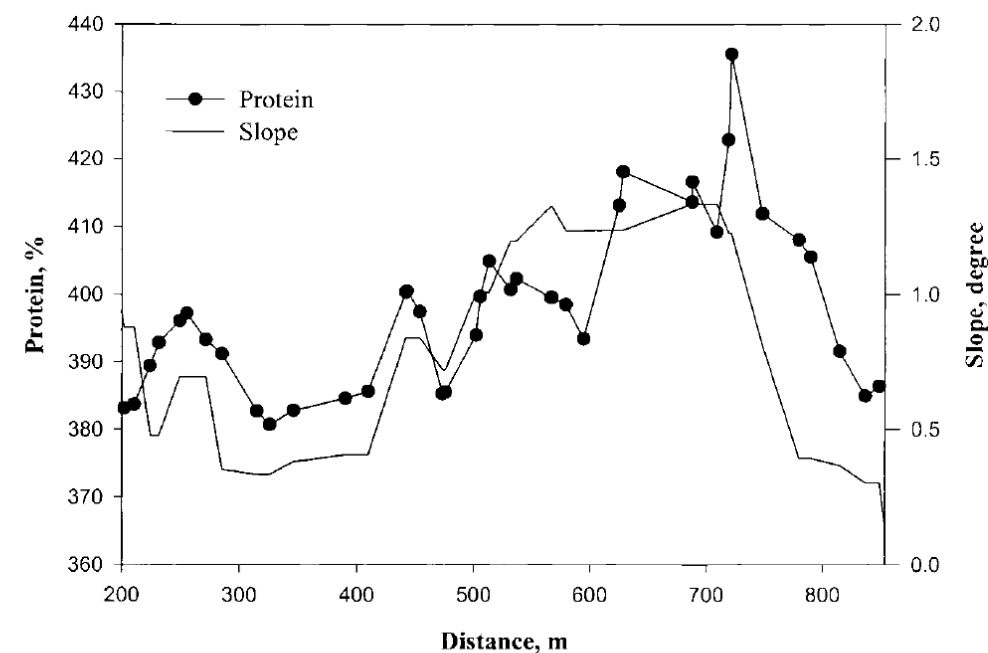
doi:10.2134/agronj2012.0095

Soybean Yield and Quality in Relation to Soil Properties

P. Anthony,* G. Malzer, S. Sparrow, and M. Zhang

Table 2. Mean and variance for soybean protein and oil concentrations along with parameters of the best fitted variogram model, cross-validation criteria including reduced kriging error (RKE), and coefficient of determination between measured and estimated values (r^2), and the number of closest samples used for kriging estimation (N).

Field	Mean	Min.	Max.	Variance	Variogram model parameters			Cross-validation criteria		N	
					Model	c_0	$c_0/(c_0 + c)$	a	RKE		r^2
	g kg^{-1}			$\text{g}^2 \text{kg}^{-2}$			m				
					<u>Protein</u>						
DL98	405	358	442	163	Exponential	85	0.55	90	0.966	0.197	10
RF98	402	366	433	157	Spherical	30	0.19	73	1.104	0.162	11
WL198	392	337	462	246	Spherical	145	0.73	120	1.117	0.261	15
KN99	446	420	469	60	Spherical	50	0.72	219	0.927	0.096	5
WL299	444	406	487	221	Spherical	100	0.41	73	1.010	0.220	5
					<u>Oil</u>						
DL98	185	166	202	33	Spherical	26	0.81	82	0.965	0.063	7
RF98	184	171	194	24	Spherical	14	0.56	22	1.028	0.051	5
WL198	180	138	198	60	Exponential	32	0.54	59	1.106	0.093	17
KN99	187	173	211	22	Spherical	17	0.65	198	1.004	0.112	8
WL299	190	168	207	43	Spherical	26	0.58	96	0.988	0.213	8



A. N. Kravchenko and D. G. Bullock
Crop Sci. 42:804–815 (2002).

Fig. 5. Protein concentration values plotted along with terrain slope for the transect drawn in the north-south direction in the central part of the WL198 field.

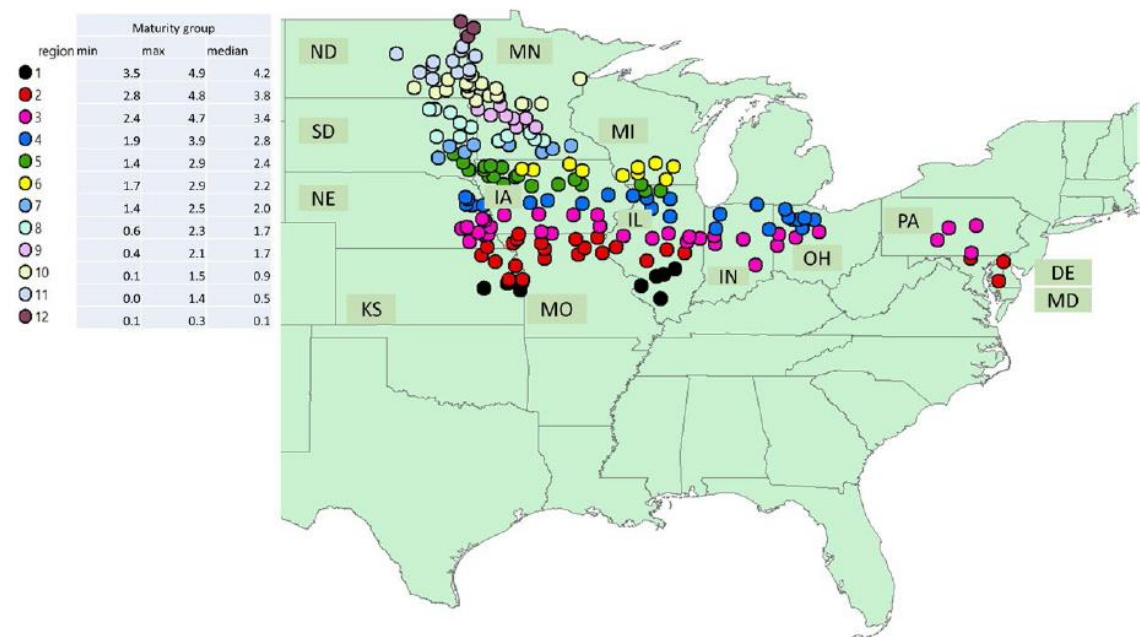


Figure 1. Locations of soybean testing programs within the 14 United States (US) states where experiments were conducted from 2012 to 2016 period. Dots represent city locations and colors represent regions with similar soybean maturity group in test. The minimum, maximum, and median maturity groups for the region are indicated in the legend.

SCIENTIFIC REPORTS

OPEN

Spatial Characterization of Soybean Yield and Quality (Amino Acids, Oil, and Protein) for United States

Y. Assefa¹, N. Bajjalieh², S. Archontoulis³, S. Casteel⁴, D. Davidson⁵, P. Kovács⁶, S. Naeve⁷ & Ignacio A. Ciampitti¹

Continued economic relevancy of soybean is a function of seed quality. The objectives of this study were to: (i) assess the spatial association between soybean yield and quality across major US soybean producing regions, (ii) investigate the relationship between protein, oil, and yield with amino acids (AAs) composition, and (iii) study interrelationship among essential AAs in soybean seed. Data from soybean testing programs conducted across 14 US states from 2012 to 2016 period ($n = 35,101$ data points) were analyzed. Results indicate that for each Mg ha^{-1} yield increase, protein yield increased by $0.35 \text{ Mg protein ha}^{-1}$ and oil yield improved by $0.20 \text{ Mg oil ha}^{-1}$. Essential AA concentrations exhibit a spatial autocorrelation and there was a negative relationship between concentration of AA, protein, and oil, with latitude. There was a positive interrelationship with different degree of strength among all AAs, and the correlation between Isoleucine and Valine was the strongest ($r = 0.93$) followed by the correlation among Arginine, Leucine, Lysine, and Threonine ($0.71 < r < 0.88$). We concluded that the variability in genotype (G) x management (M) x environment (E) across latitudes influencing yield also affected soybean quality; AA, protein, and oil content in a similar manner.

Received: 15 March 2018
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Published online: 02 October 2018

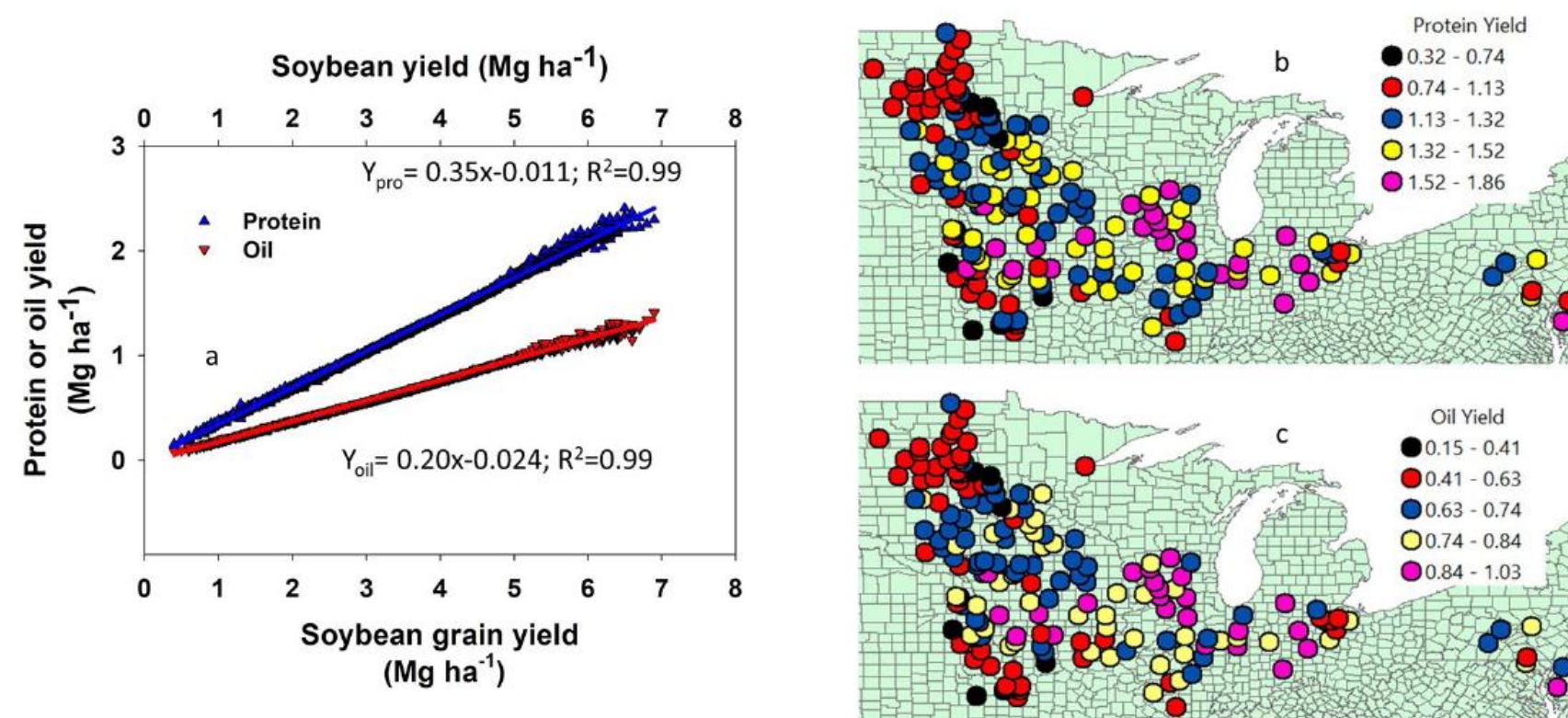
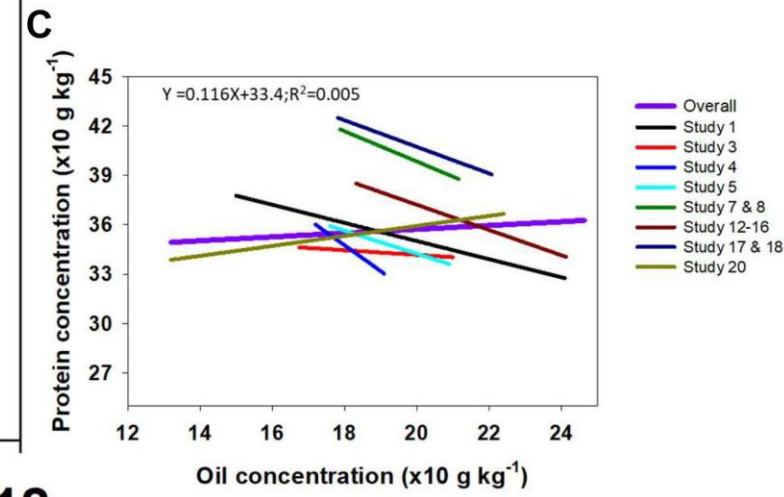
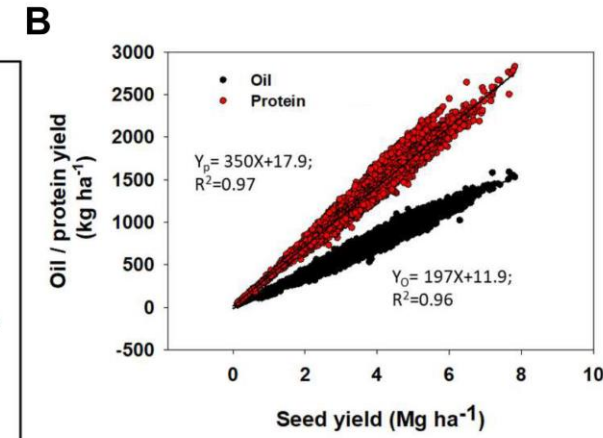
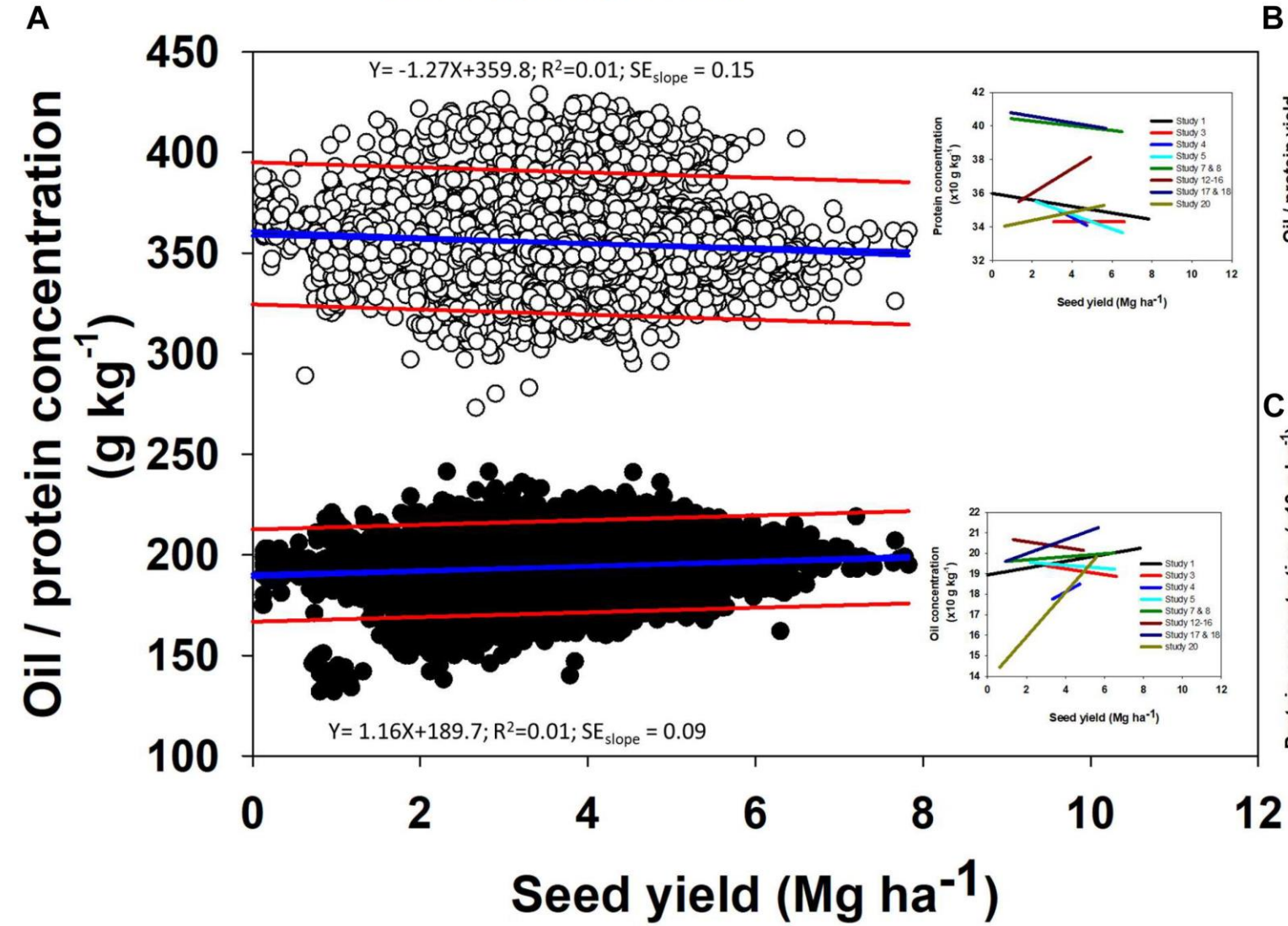


Figure 9. Relationship between soybean grain yield with protein and oil yields (a) spatial trend for protein yield (b) and oil yield (c) across 14 major soybean producing states in the USA average for the years 2012 through 2016.

- Oil
- Protein
- 95% Confidence Band
- 95% Prediction Band



ORIGINAL RESEARCH article

Front. Plant Sci., 11 March 2019
 Sec. Crop and Product Physiology
 Volume 10 - 2019 | <https://doi.org/10.3389/fpls.2019.00298>

Assessing Variation in US Soybean Seed Composition (Protein and Oil)

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- John M. Orlowski¹³
- Bobby R. Golden¹³
- Gurpreet Kaur¹³
- Maninderpal Singh¹⁴
- Kurt Thelen¹⁴
- Randall Laurenz¹⁴
- Dan Davidson¹⁵
- Ignacio A. Ciampitti^{1*}

Nebraska Growers Help Estimate Field Variability in Soybean Protein and Oil Content

JUNE 14, 2023

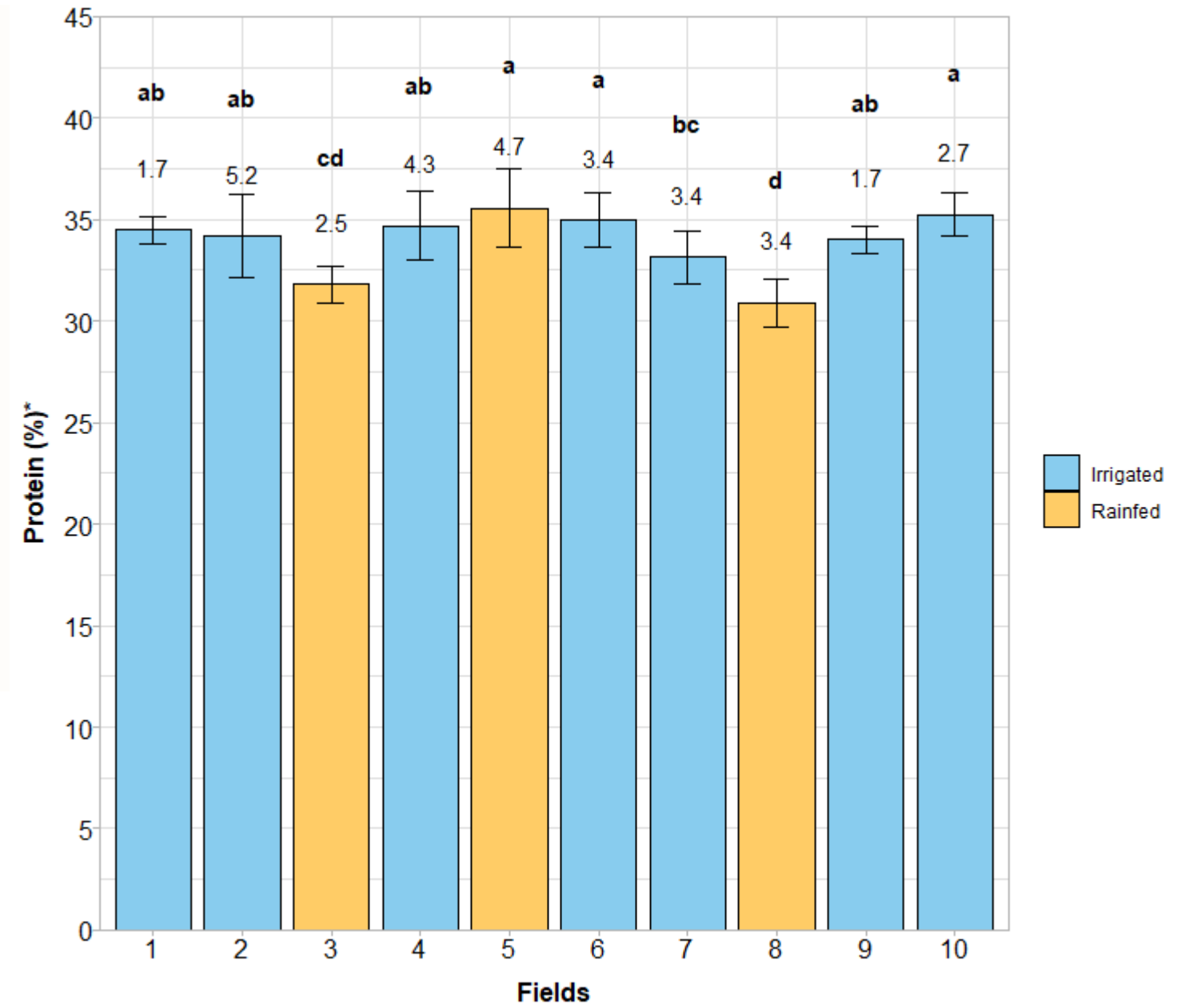
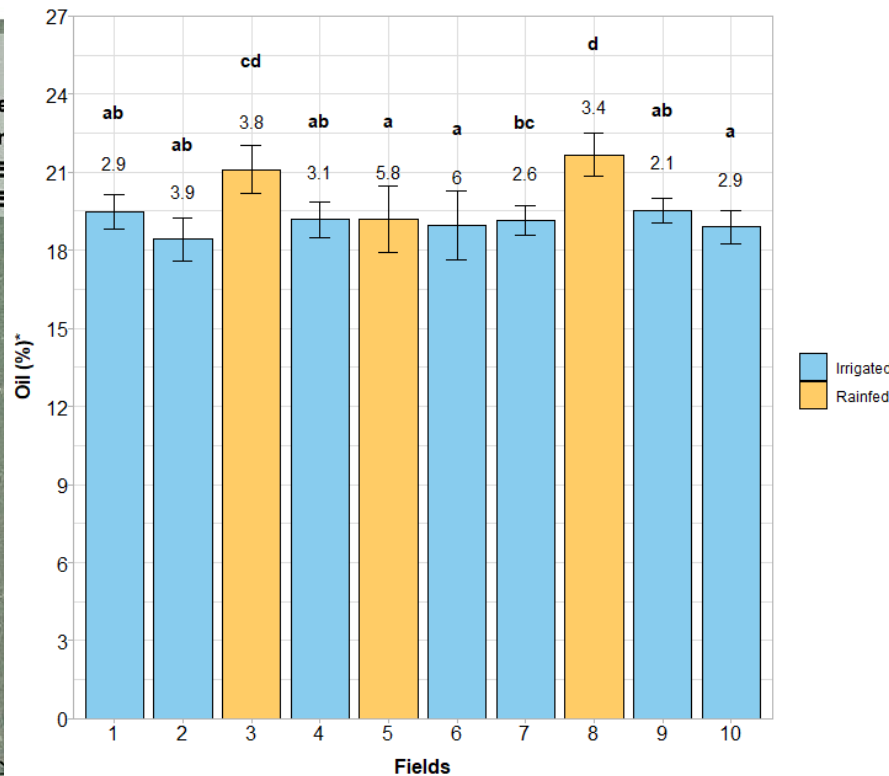
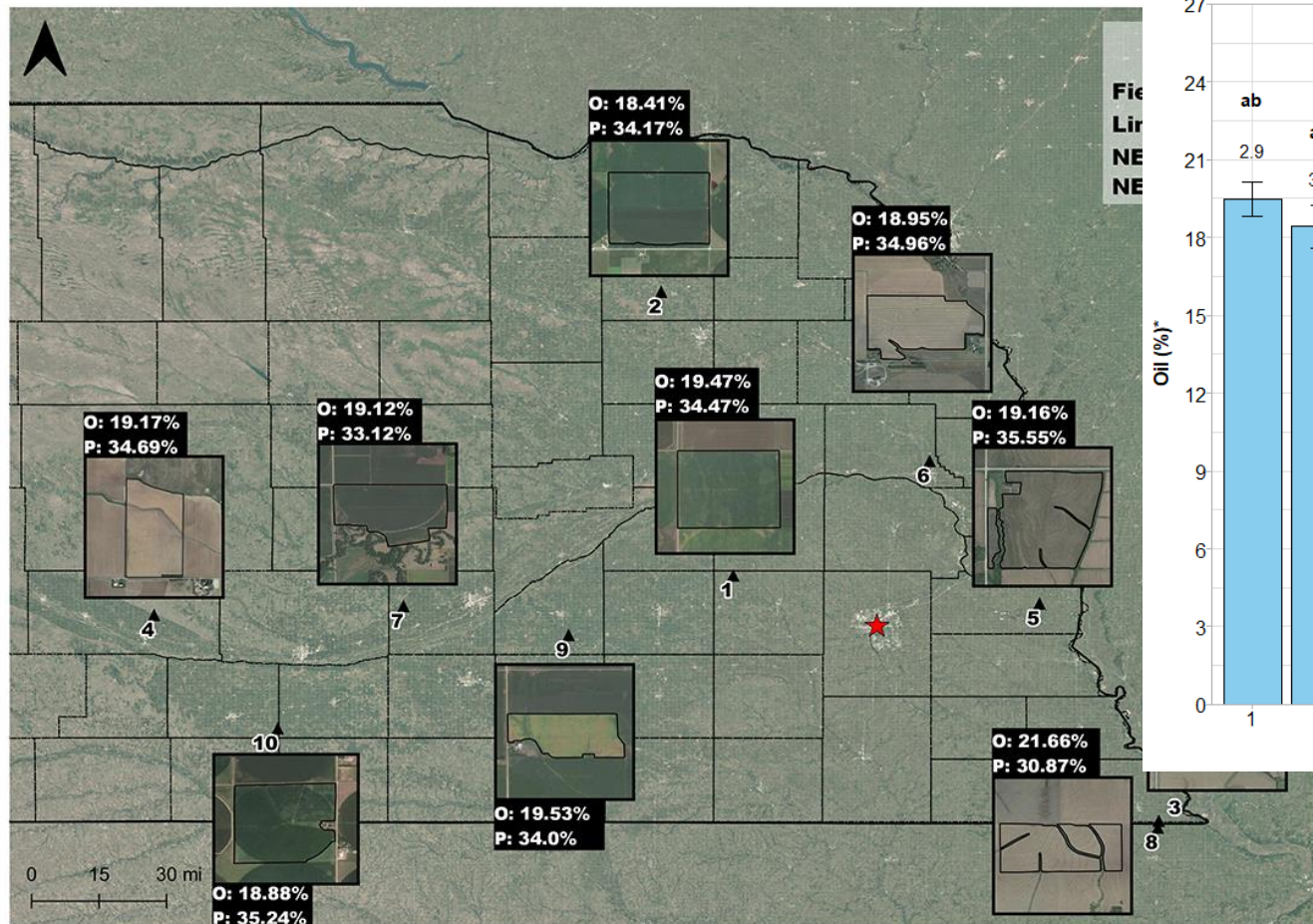
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Sixty percent of the value of soybeans comes from its protein meal, and 40% comes from its oil, making soybean seed's protein and oil content relevant to production. Nebraska ranks fourth in U.S. soybean production, with an average protein content of 33% and an oil content of 20% (Annual Report U.S. Soybean Quality, 2021).

From a farmer's perspective, several important reasons exist to consider soybean protein and oil content, including potential market value. Buyers such as animal feed manufacturers, food processors and biodiesel producers are willing to pay a premium for soybeans with higher protein and oil content. In order to get a premium price for their crop, these farmers must produce soybeans with higher levels of protein and oil content. Farmers have been interested in learning more about soybean protein and oil content, as shown by a recent survey conducted by Kansas State University. This survey showed that 100% of Midwest growers would be willing to invest in technology to map soybean protein variability if they could obtain a protein premium, and 75% would like to learn more about quality and how to manage protein and oil within their fields (Ciampitti, 2021).

While some studies have evaluated variability in protein and oil content between fields, research has not been done to understand how protein and oil content varies within fields. Soybean seed quality is a function of environment, genetics and management; however, the contribution of each factor to seed



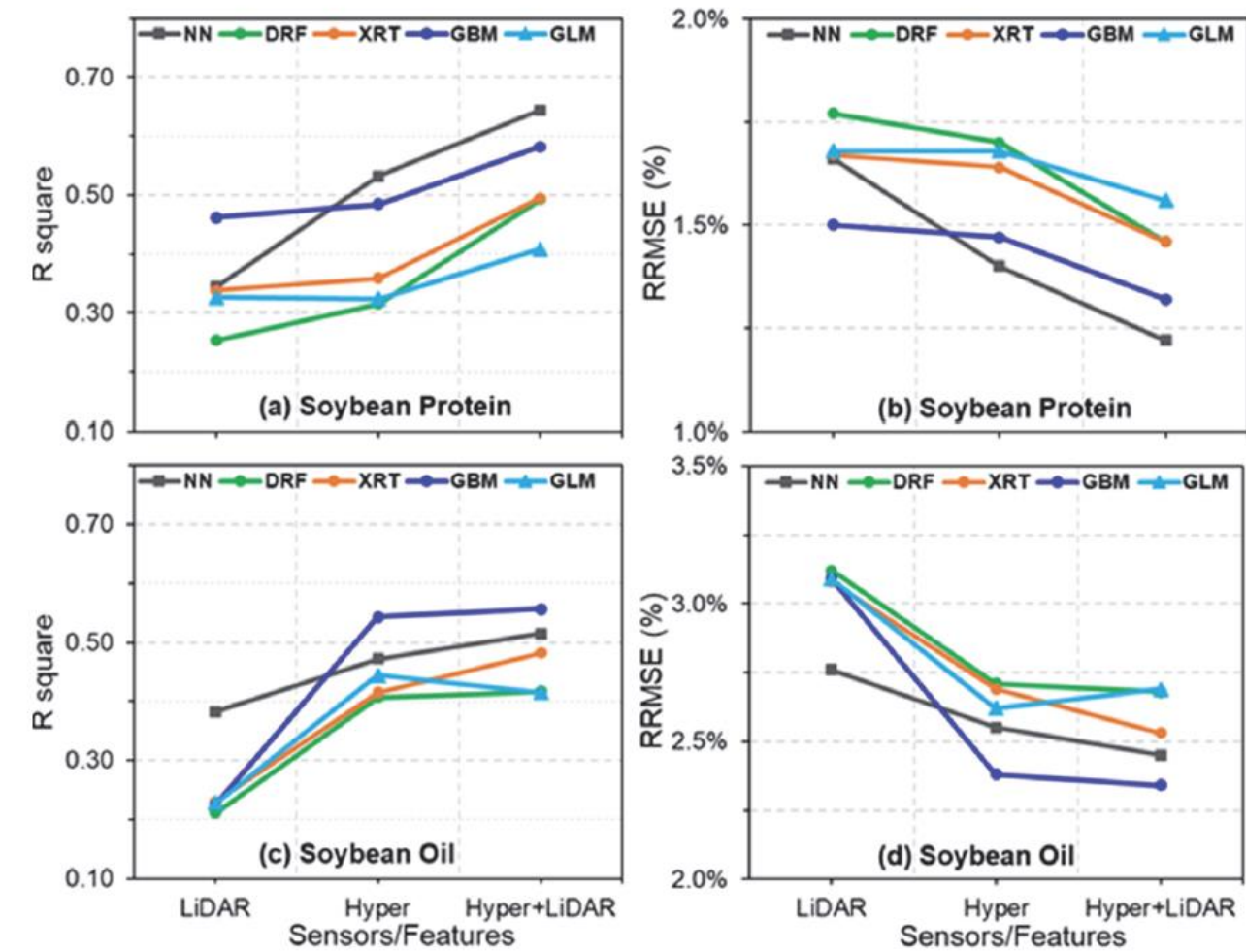
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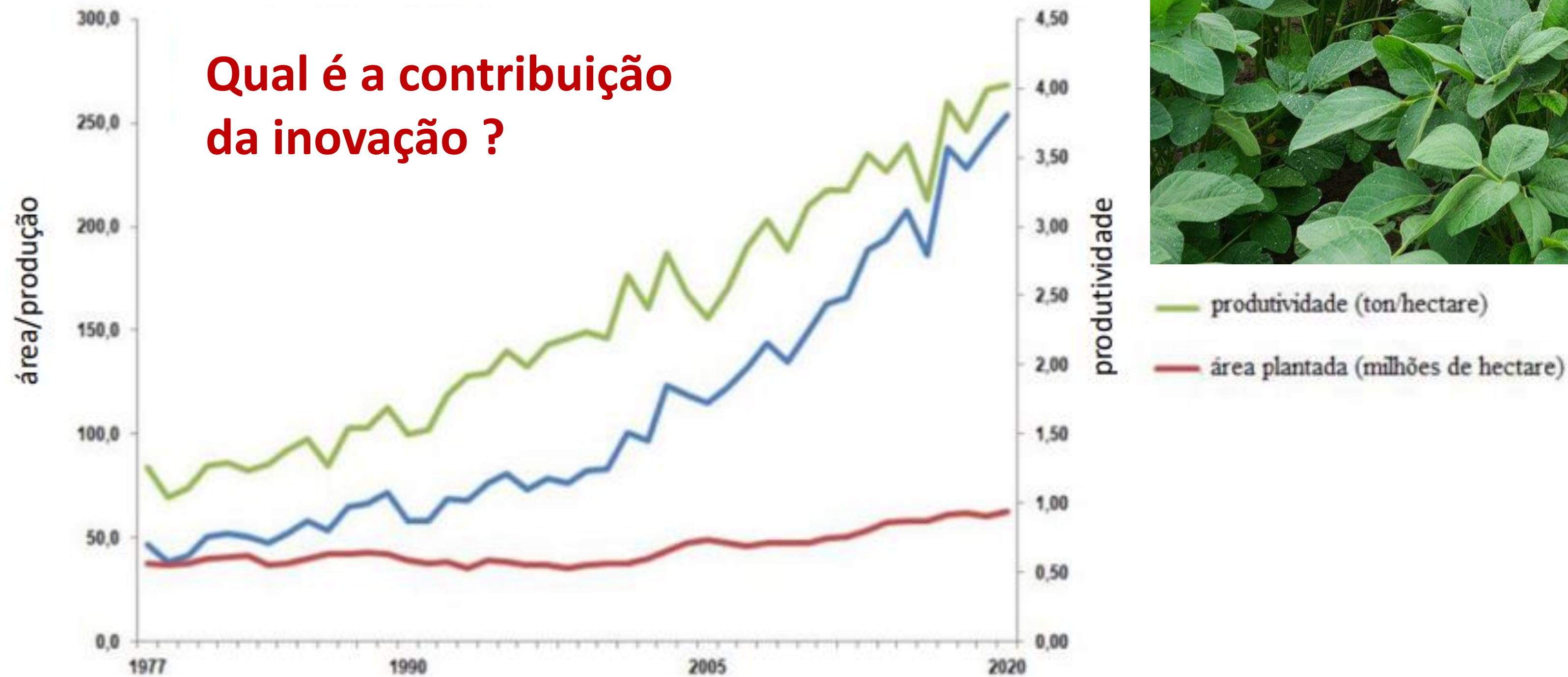
Table 1. Summary statistics of soybean and corn seed composition datasets.

Seed Composition	*NO.	Mean	Max.	Min.	SD	CV (%)
Soybean protein (%)	91	38.5	41.2	36.7	0.87	2.3%
Soybean oil (%)	91	22.9	24.5	21.0	0.83	3.6%
Corn protein (%)	369	7.7	15.3	5.7	1.45	18.9%
Corn oil (%)	369	3.9	5.3	2.1	0.57	14.5%

*NO.: Number of total yield samples; SD: standard deviation; CV: coefficient of variation.

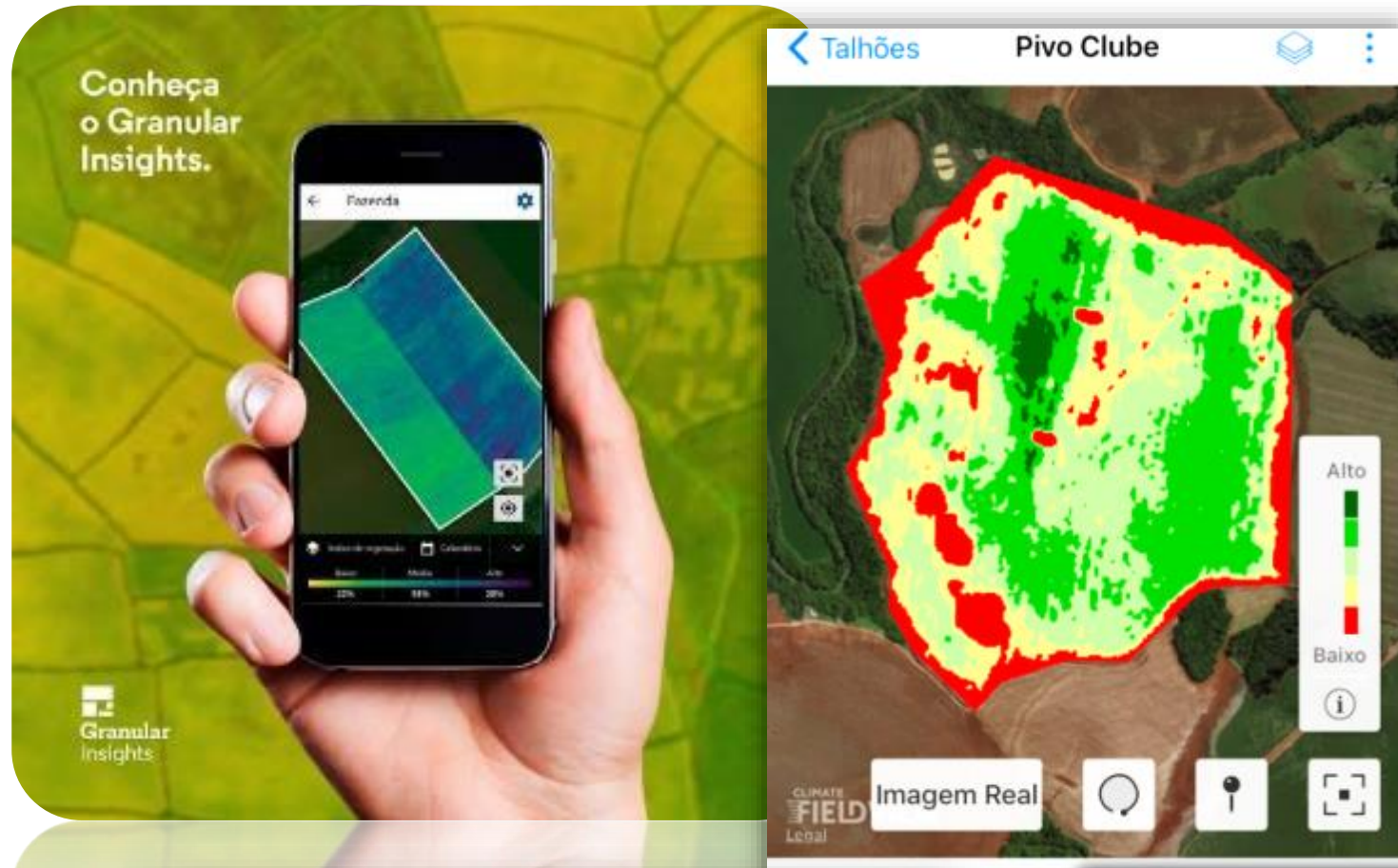


Qual é a contribuição da inovação ?



— produtividade (ton/hectare)
— área plantada (milhões de hectare)

PLATAFORMAS DIGITAIS



✓ **Sem anomalias**

Parabéns! Não detectamos nenhuma anomalia em seus campos.

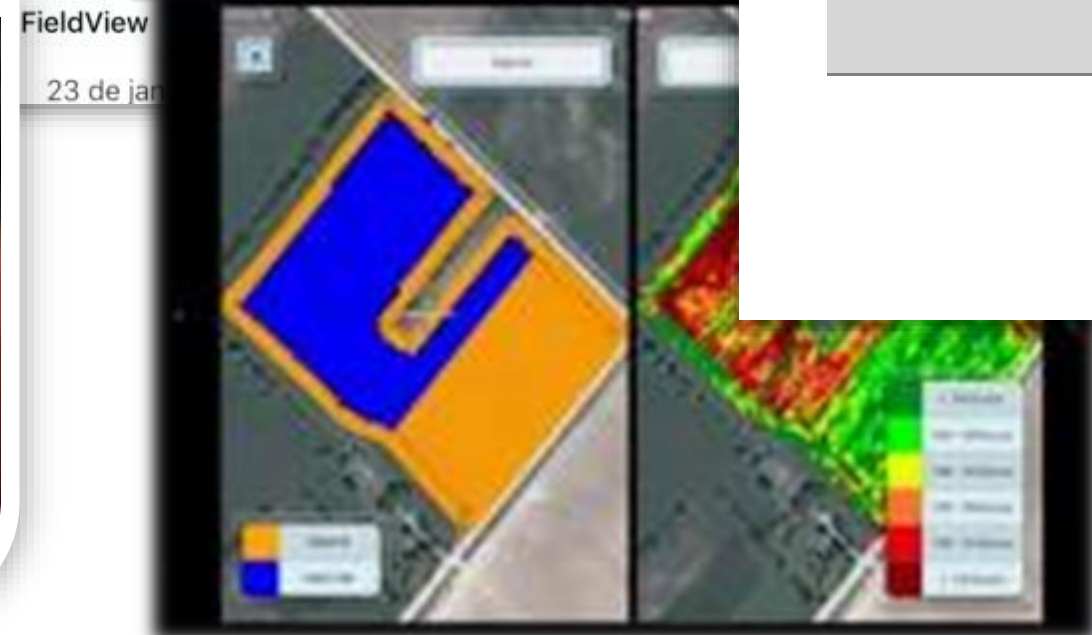
Novas imagens de satélite disponíveis

Os campos a seguir têm imagens atualizadas, para que você possa acompanhar suas colheitas:

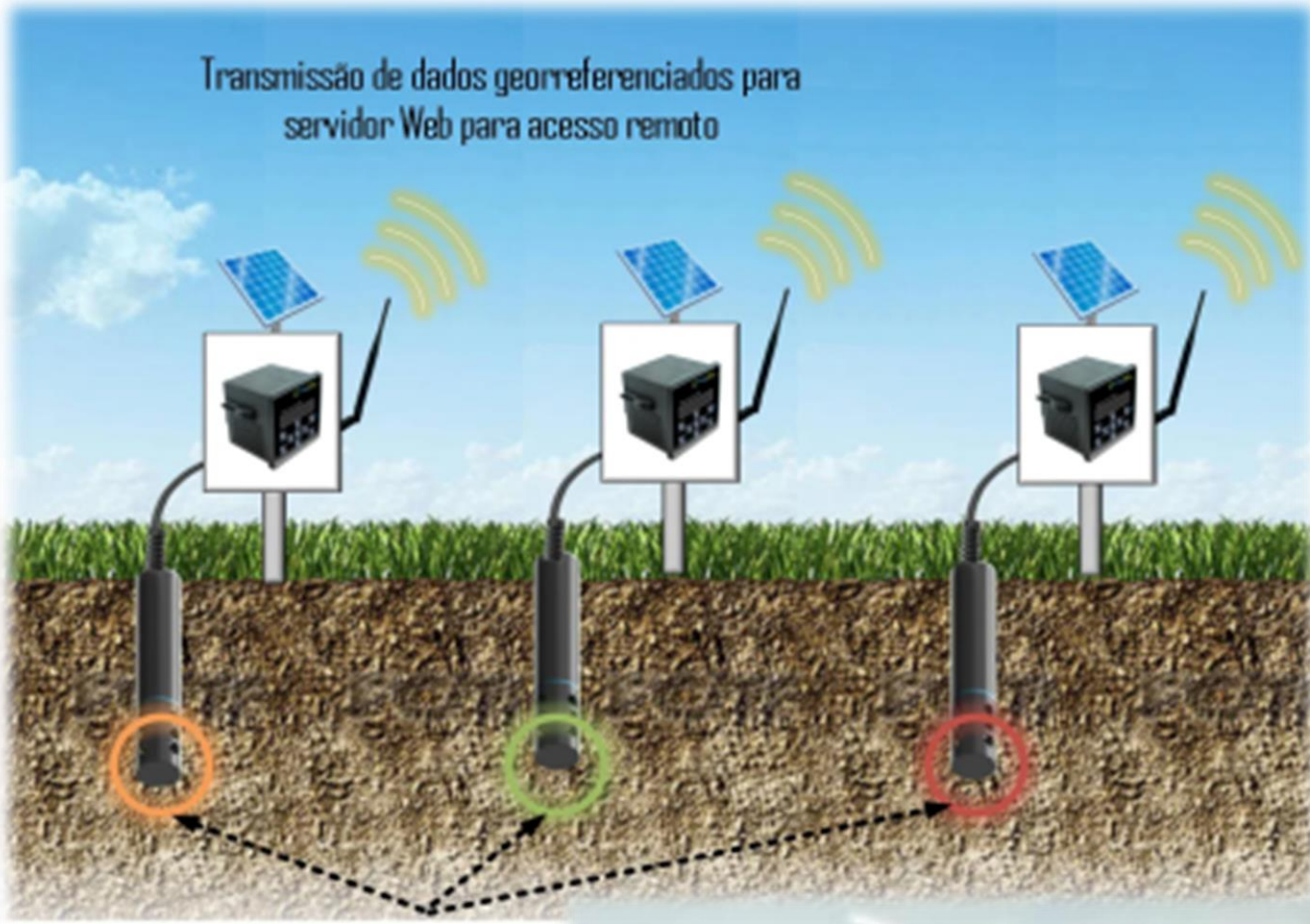
eea/ufrgs

Área 12 >>

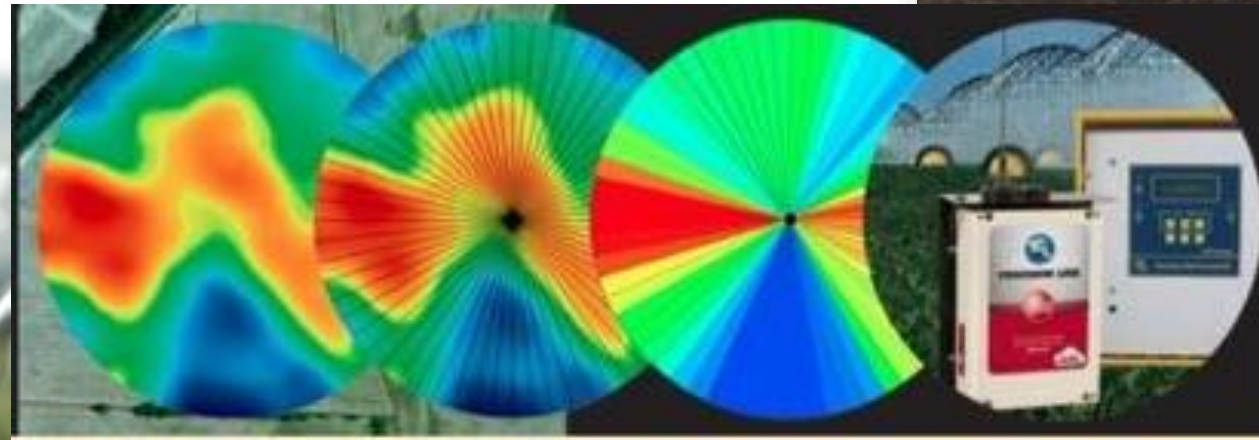
Área 11 >>



SENSORES DE SOLO - UMIDADE



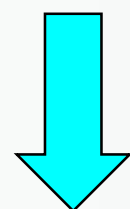
Identificação de regiões com ma



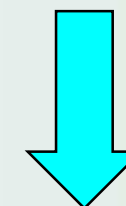
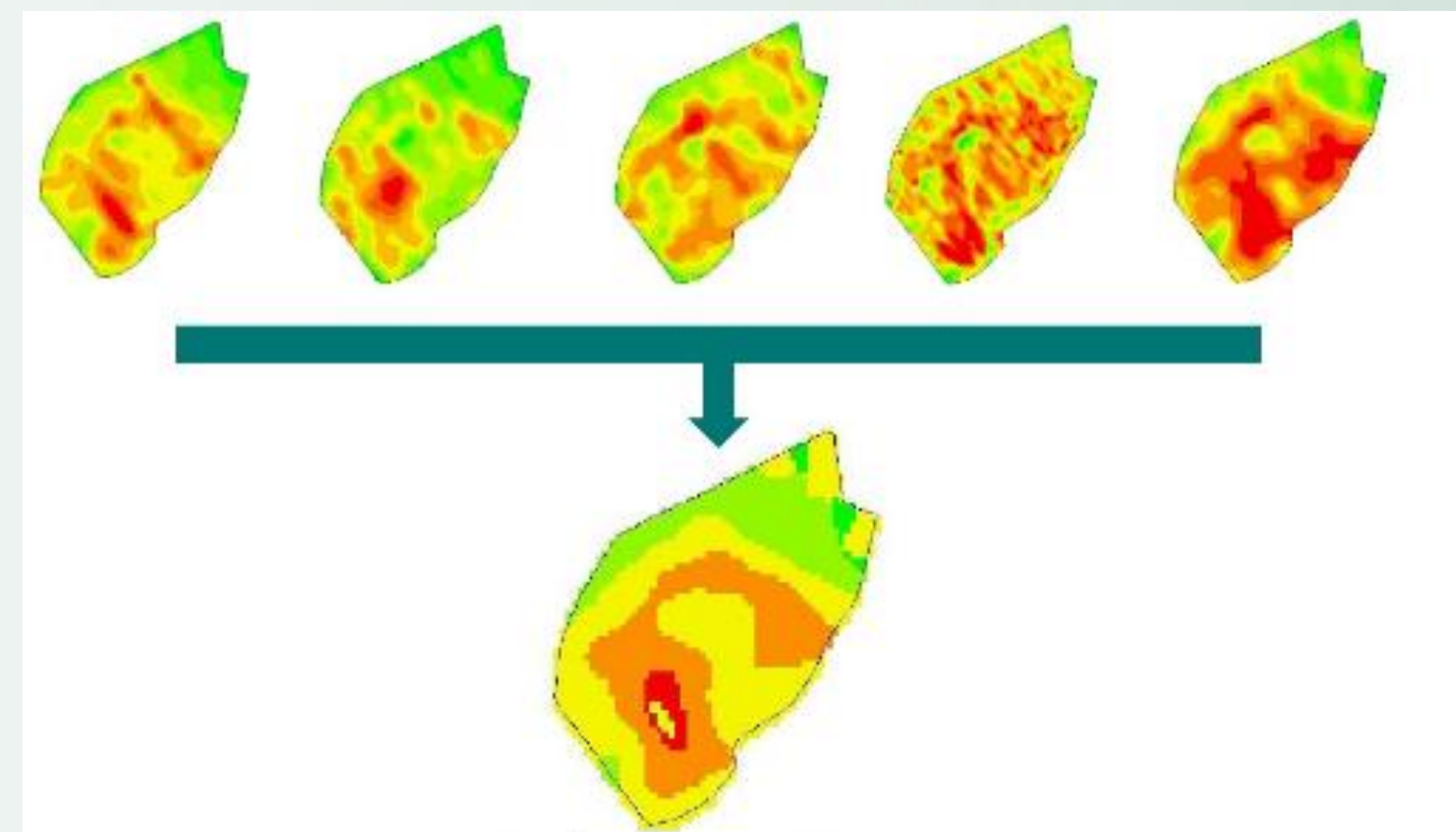
Ciência de dados



Imagens
Sons
Tempo de atenção
Palavras
Ações
Perfil de consumo
...



Estratégias de marketing e produtos que seriam de nosso interesse



Melhores recomendações para cada parte do talhão
Recomendação de intervenções
Agricultura preditiva

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Article | [Published: 10 October 2022](#)

Protecting the Amazon forest and reducing global warming via agricultural intensification

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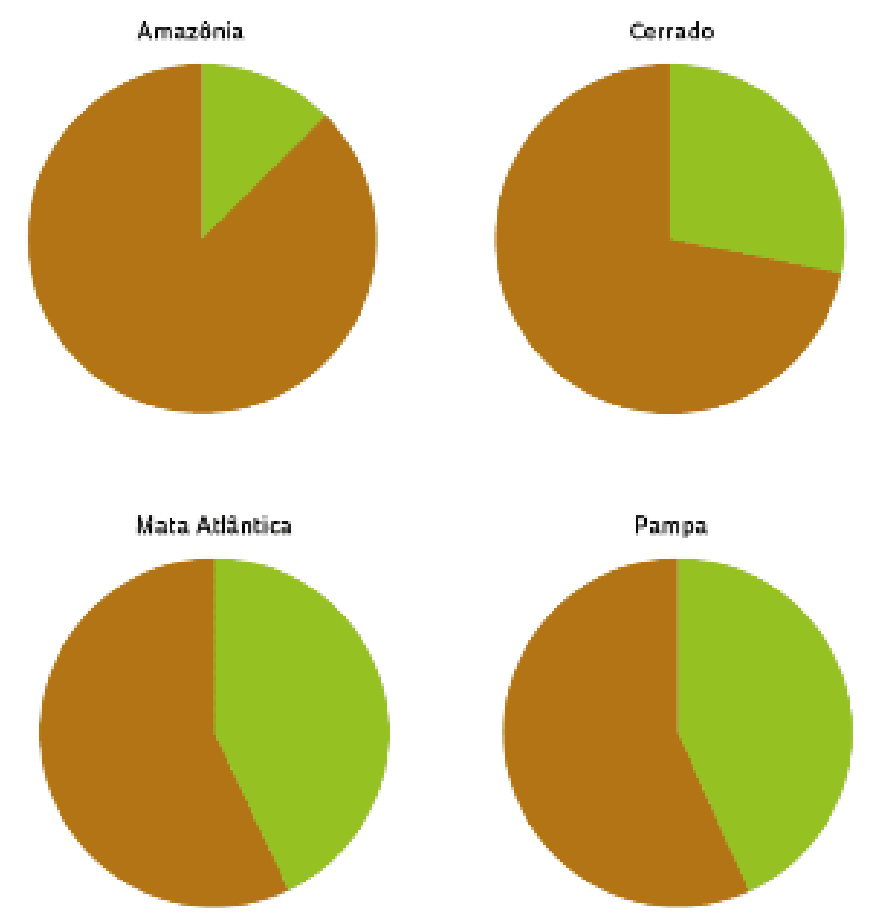
Abstract

The Amazon basin includes 550 Mha covered with rainforests, and 60% of this area is in Brazil. The conversion of rainforest for soybean production raises concerns about how Brazil can reconcile production and environmental goals. Here we investigated the degree to which intensification could help Brazil produce

POR QUE A SAFRA DE SOJA AUMENTA

Proporção do crescimento da produção do grão atribuída à expansão da área de plantio e a ganhos de produtividade na lavoura

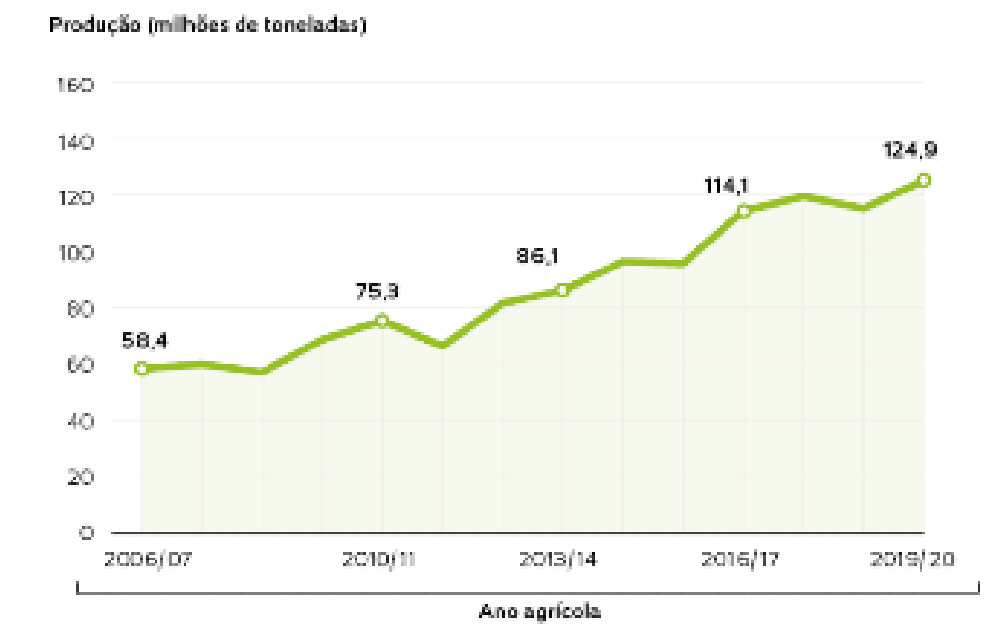
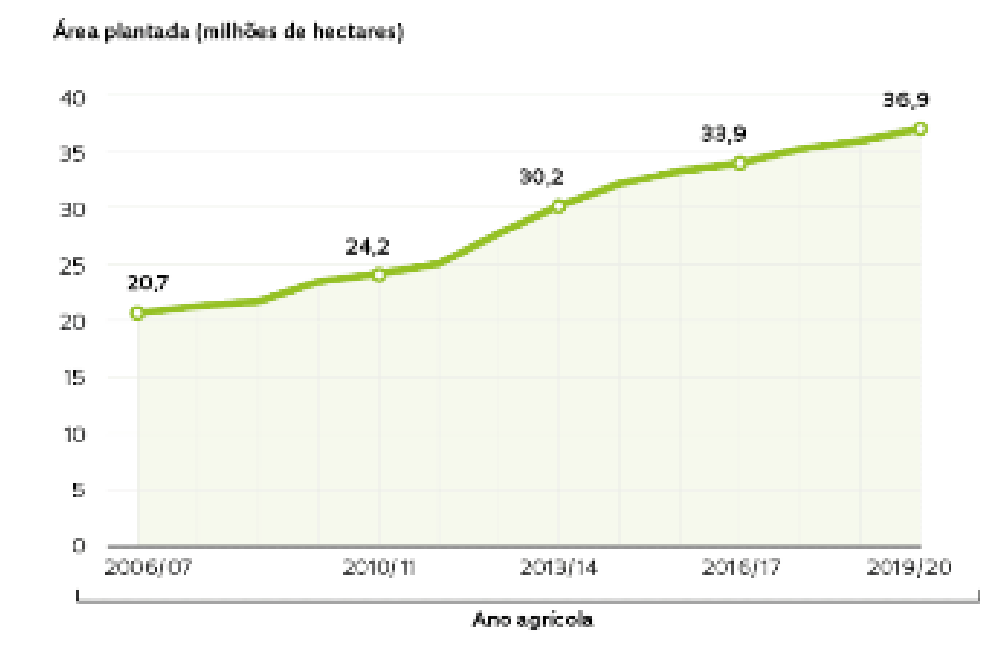
■ Expansão da área de plantio ■ Ganhos de produtividade



FONTE MARIN, F. NATURE SUSTAINABILITY. 2022

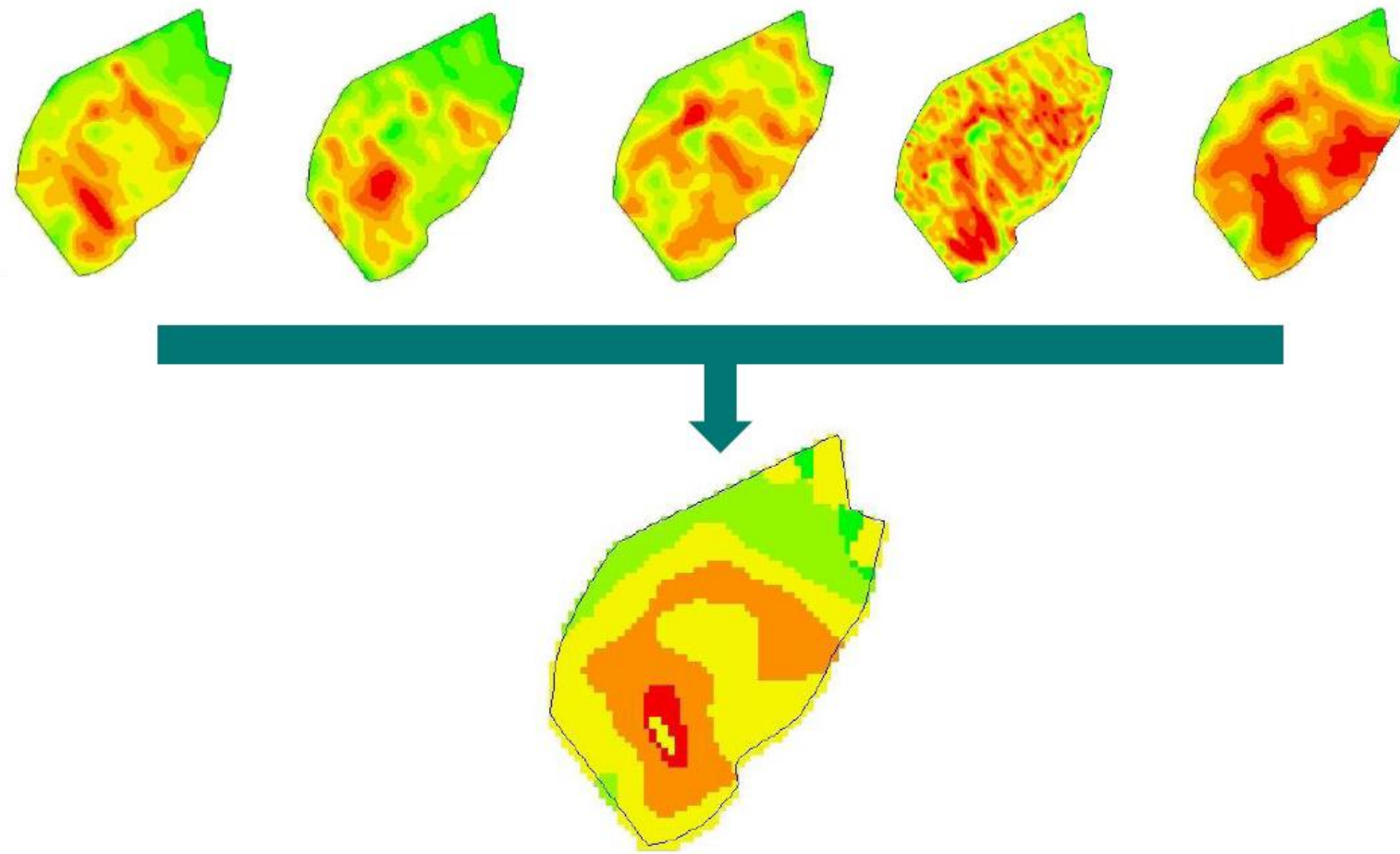
MAIS TERRAS CULTIVADAS, MAIS GRÃOS COLHIDOS

Evolução da área plantada e do volume da safra de soja

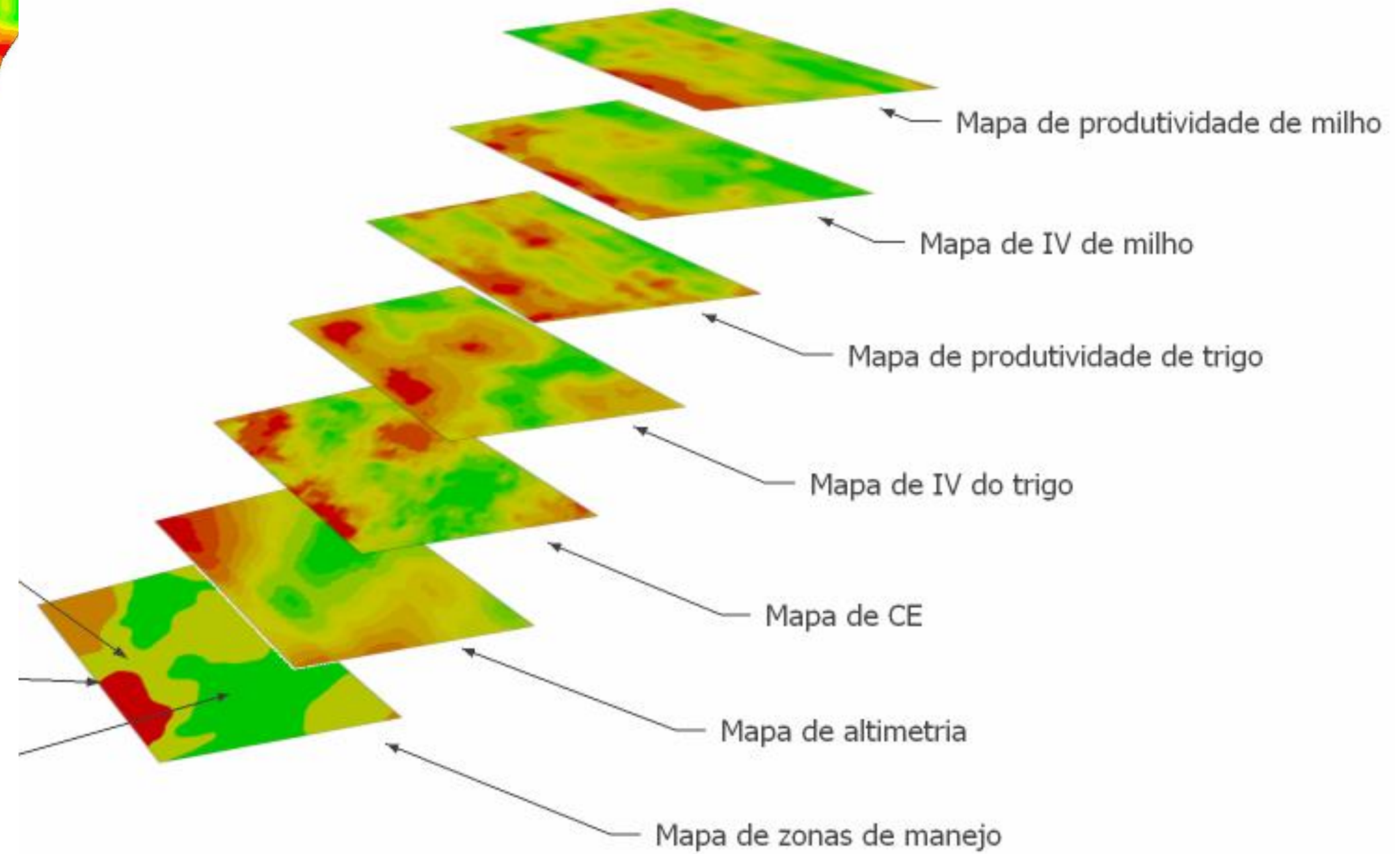


FONTE CONAB

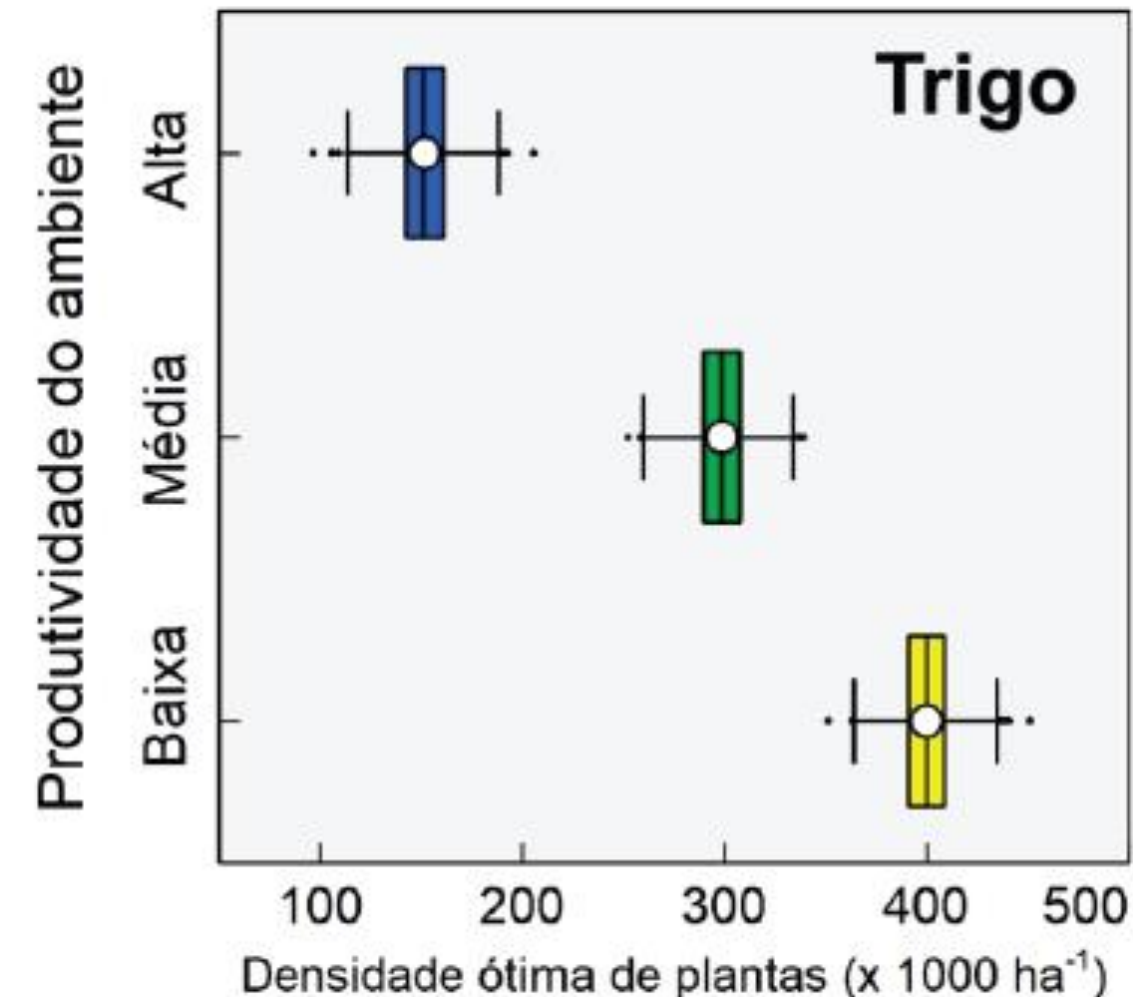
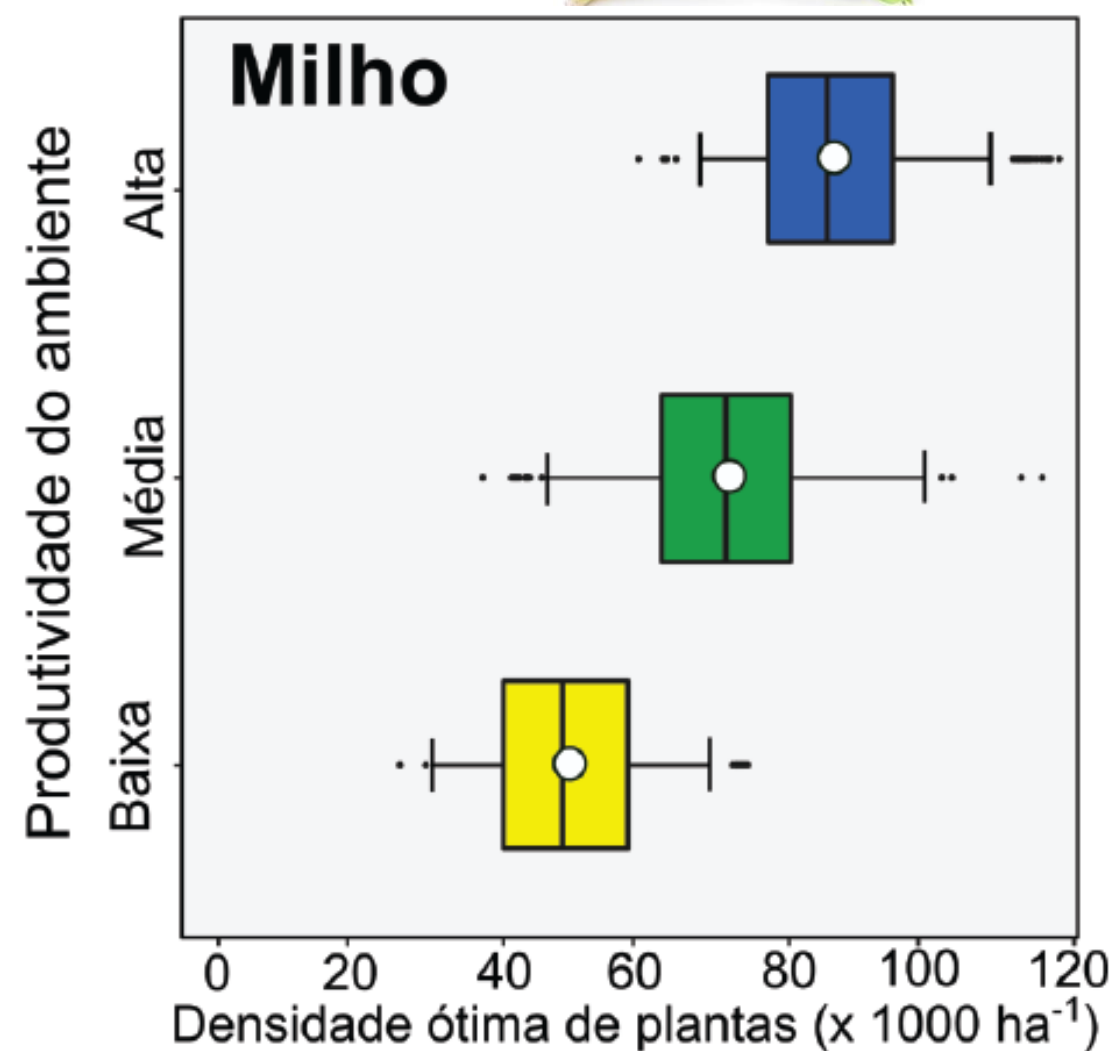
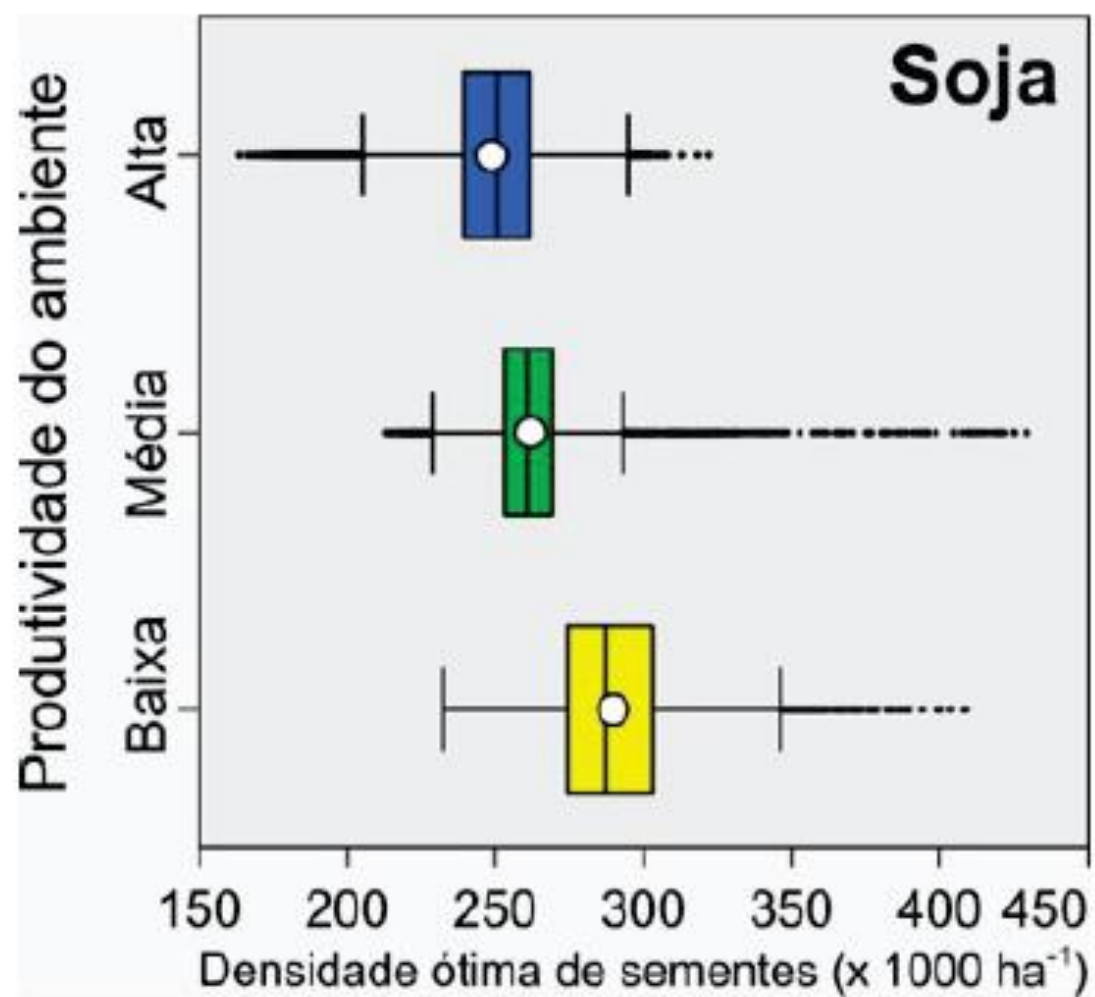
Mapas de colheita



“Ambientes de Produção”

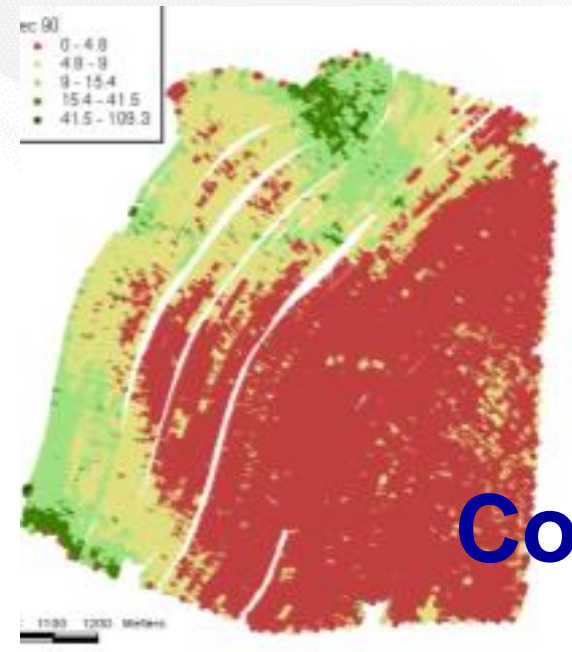


Ajuste de população de plantas em função de zonas de potencial produtivo de zonas de potencial produtivo



Corassa et al. (2020)

Sensores de solo



Condutividade elétrica

pH
Matéria Orgânica



Compactação



Aumento na eficiência de uso de insumos

**Momento
correto**

**Local
correto**

4 C's

**Produto
correto**

**Dose/taxa
correta**

Aumento da eficiência de uso de insumos nas culturas produtoras de grãos

Inovações tecnológicas - Máquinas



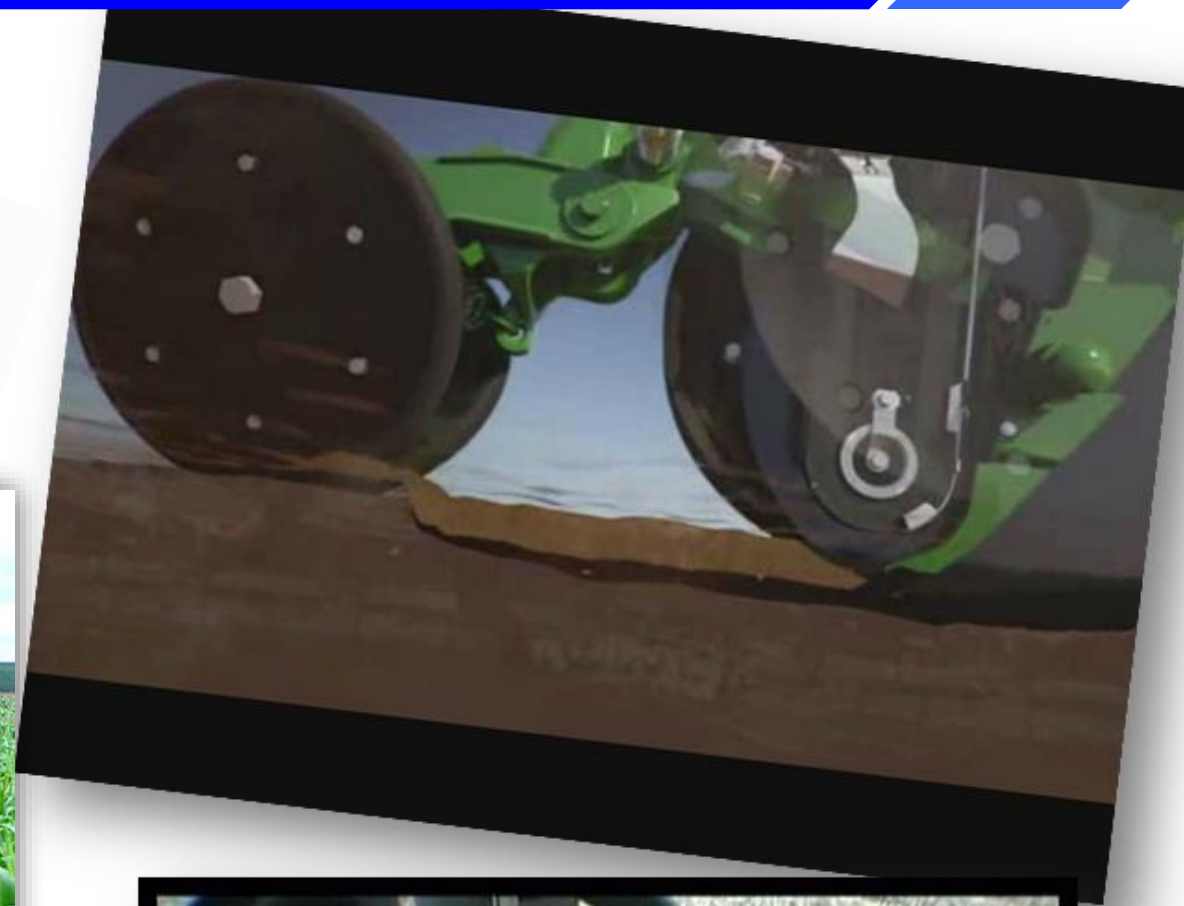
Aplicações em taxa variável



Sensores



Controle de seção



Piloto automático



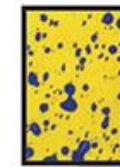
Aplicações em taxa variável



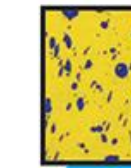
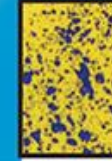
Sistema de controle de linhas de plantio ou bicos de pulverização



Menor Volume por área



Maior Volume por área




Aplicação Uniforme





TECNOLOGIA E INFRAESTRUTURA

Inteligência artificial identifica plantas doentes por captura de estímulos cerebrais

 Tatiane Bertolino
12 de fevereiro de 2023 às 18:00

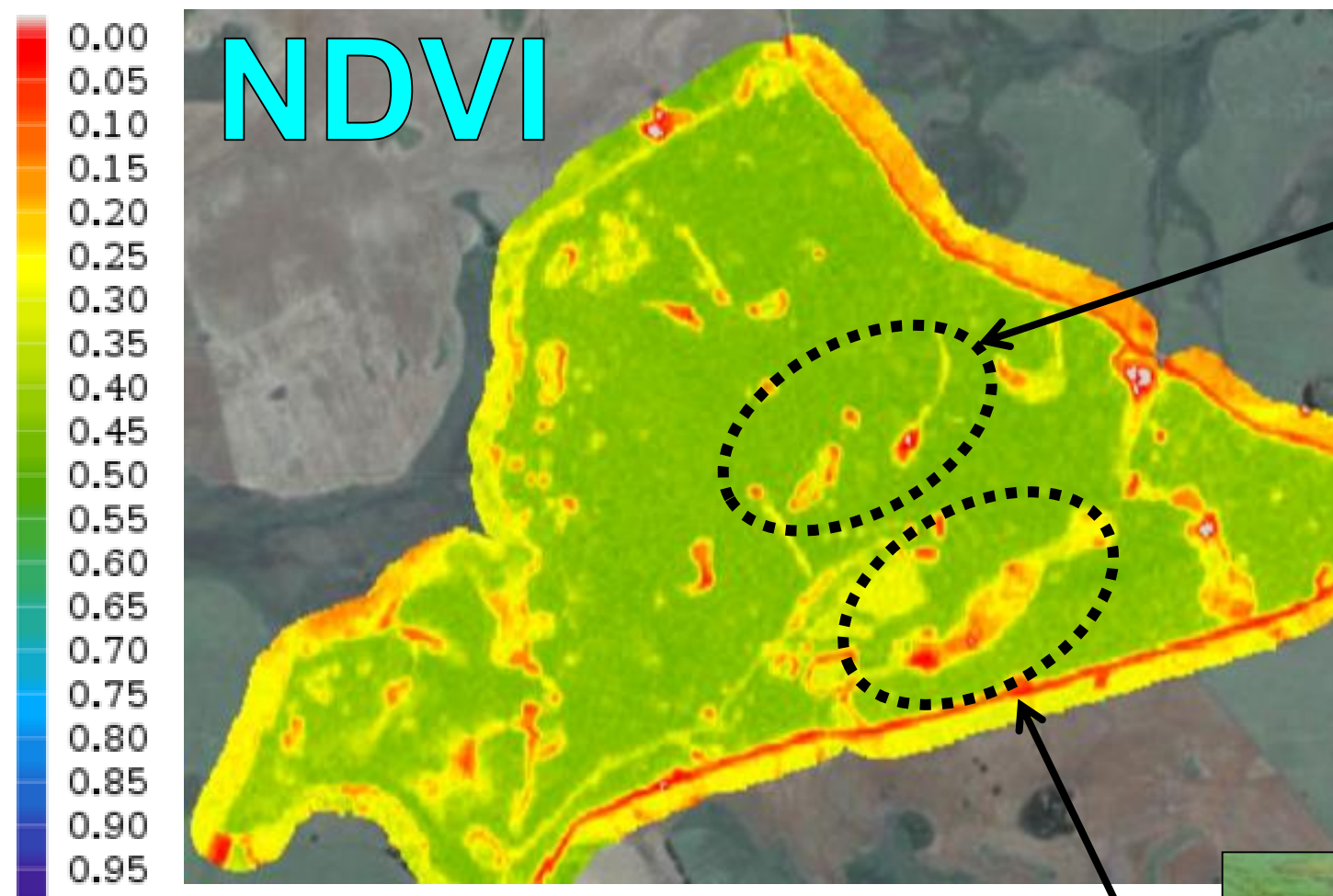


ENTRE EM UM DOS GRUPOS!

WHATSAPP

INSTAGRAM

Uso de imagens multiespectrais



Baixo vigor e morte de plantas causadas por *Rhizoctonia solani*

