Unidades de Gestão Diferenciada - UGD

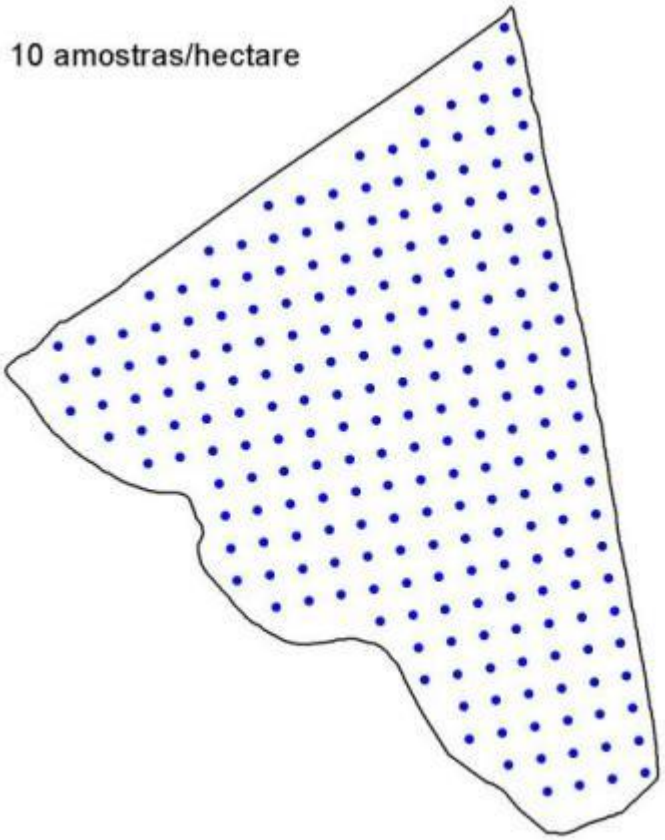
José P. Molin
ESALQ/USP
jpmolin@usp.br

Laboratório de Agricultura de Precisão

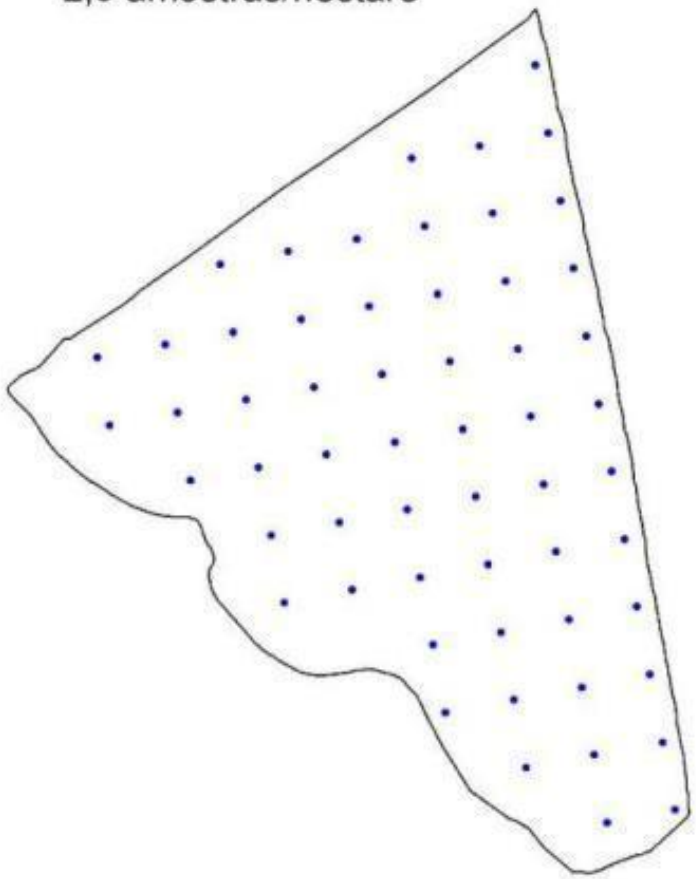
www.agriculturadeprecisao.org.br

Densidade amostral

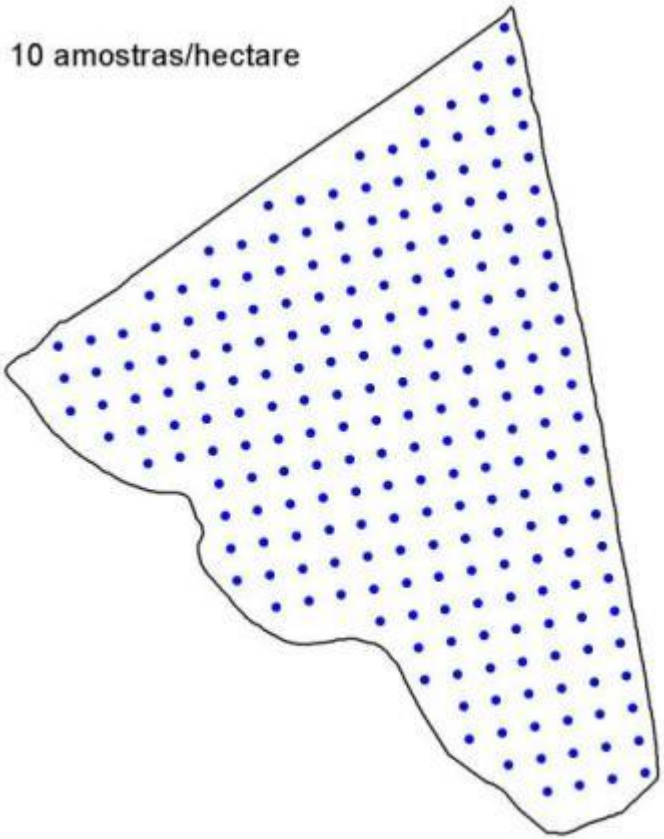
10 amostras/hectare

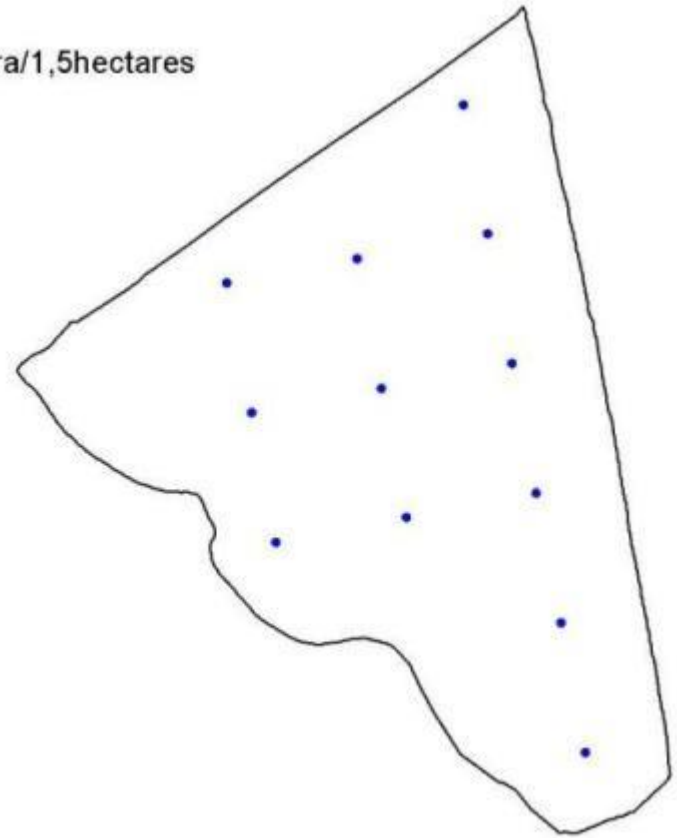


2,5 amostras/hectare

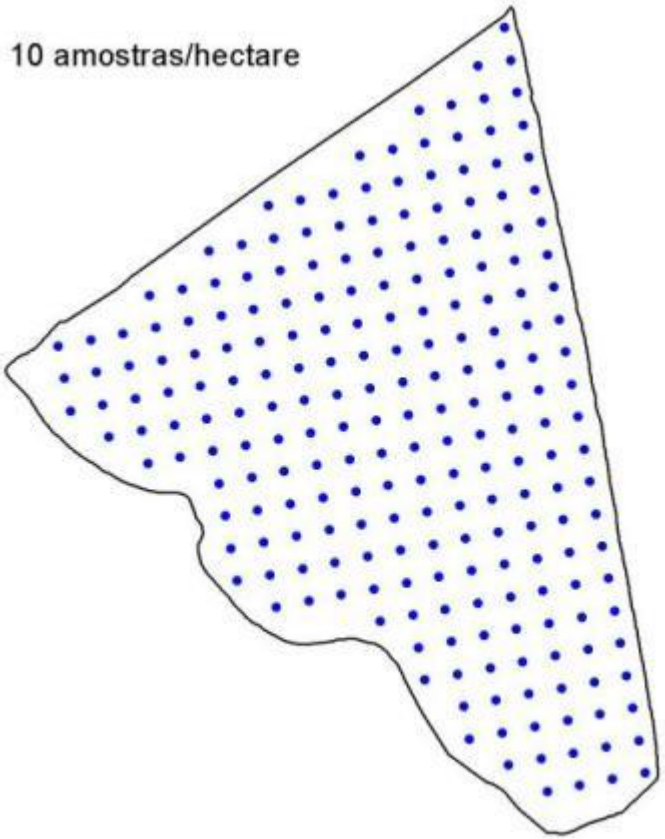


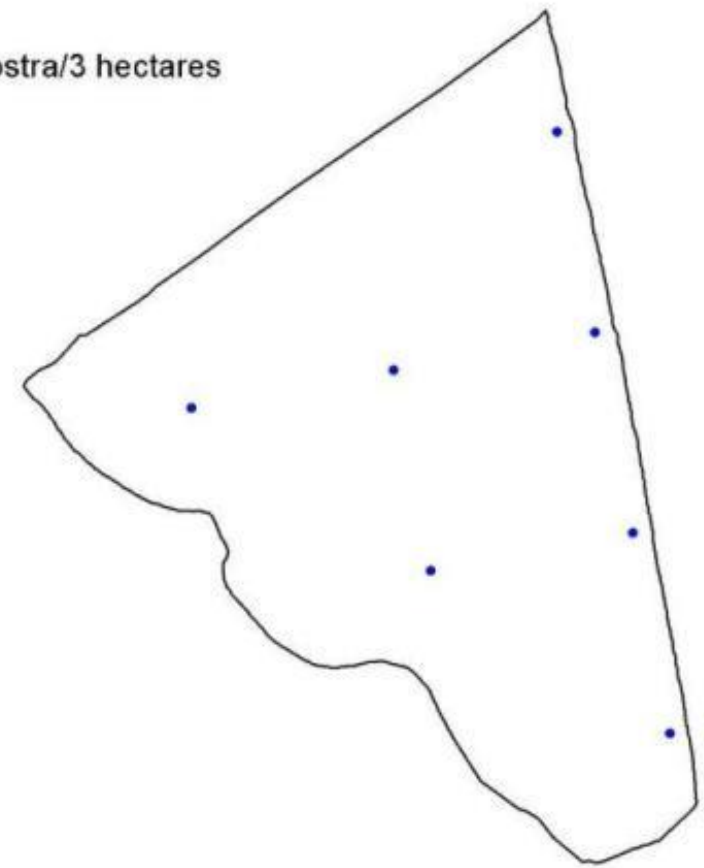
Densidade amostral



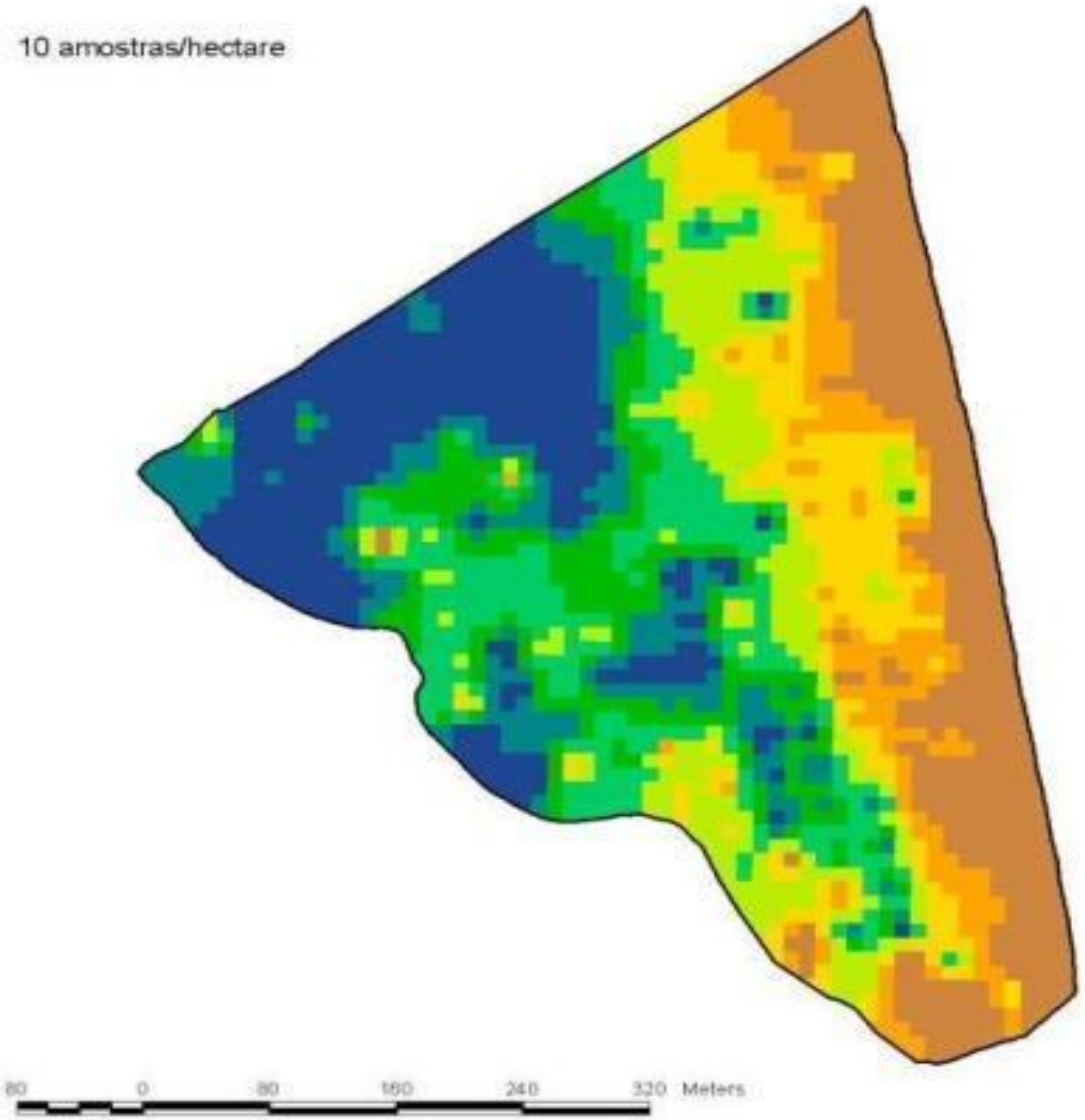


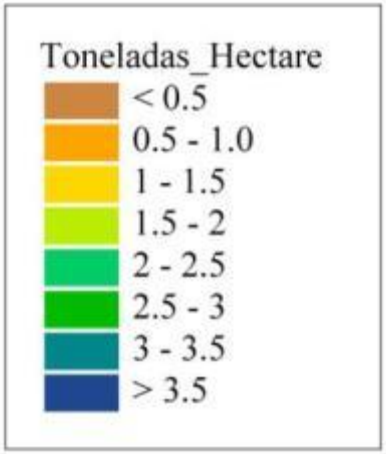
Densidade amostral

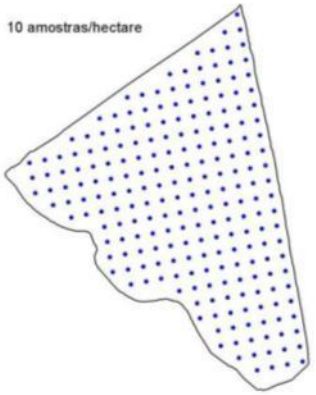




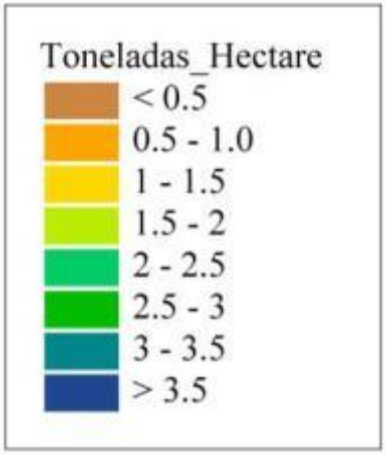
Aplicação de Calcário

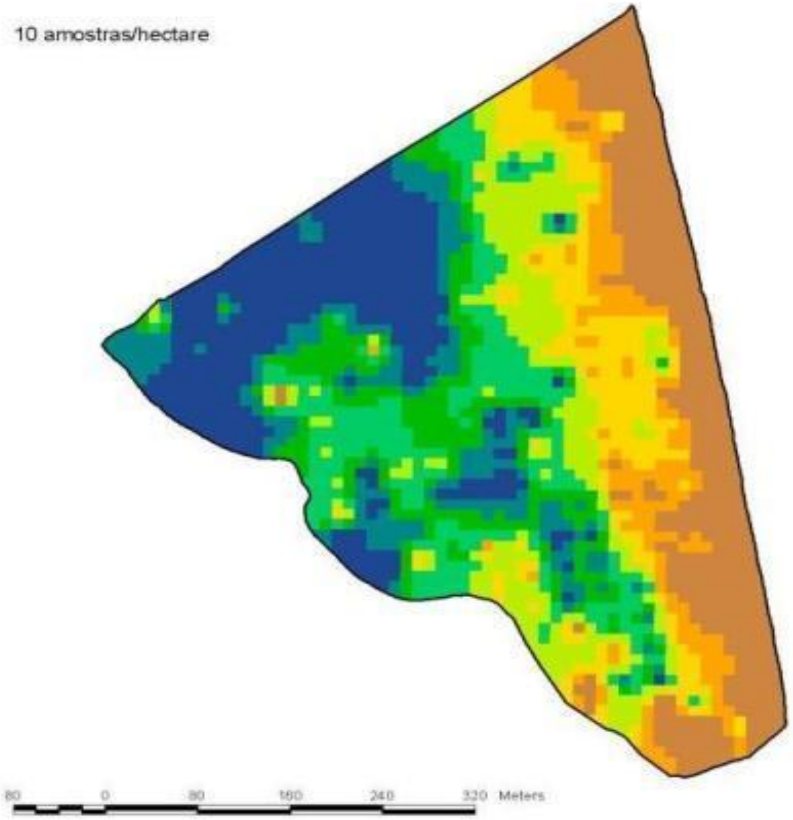


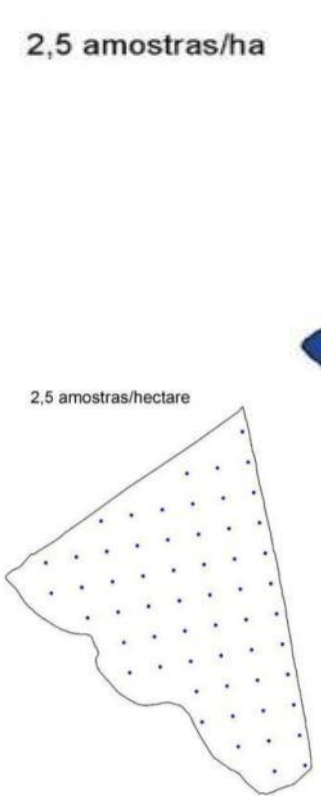


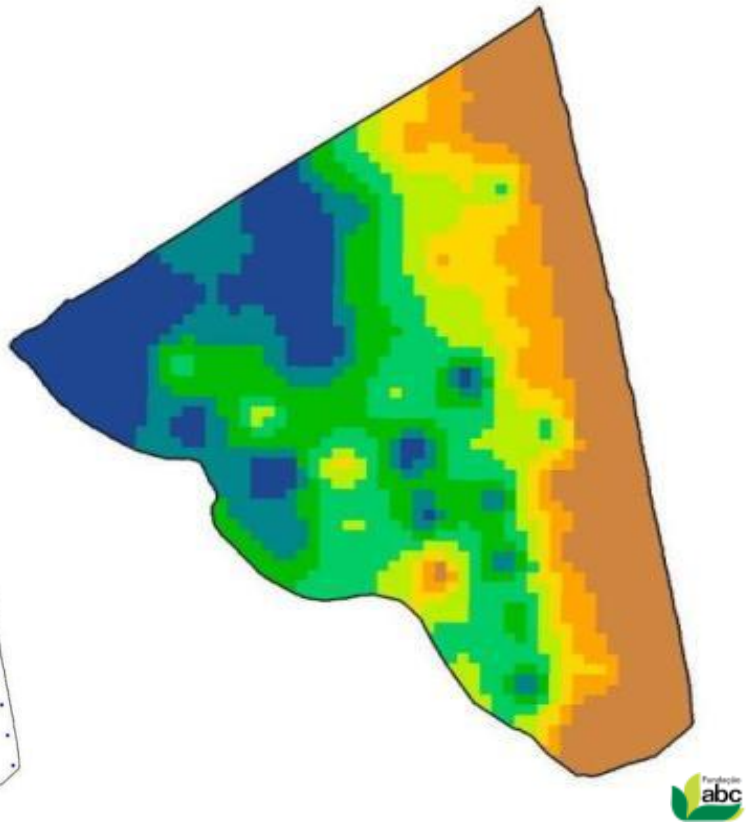


Aplicação de Calcário

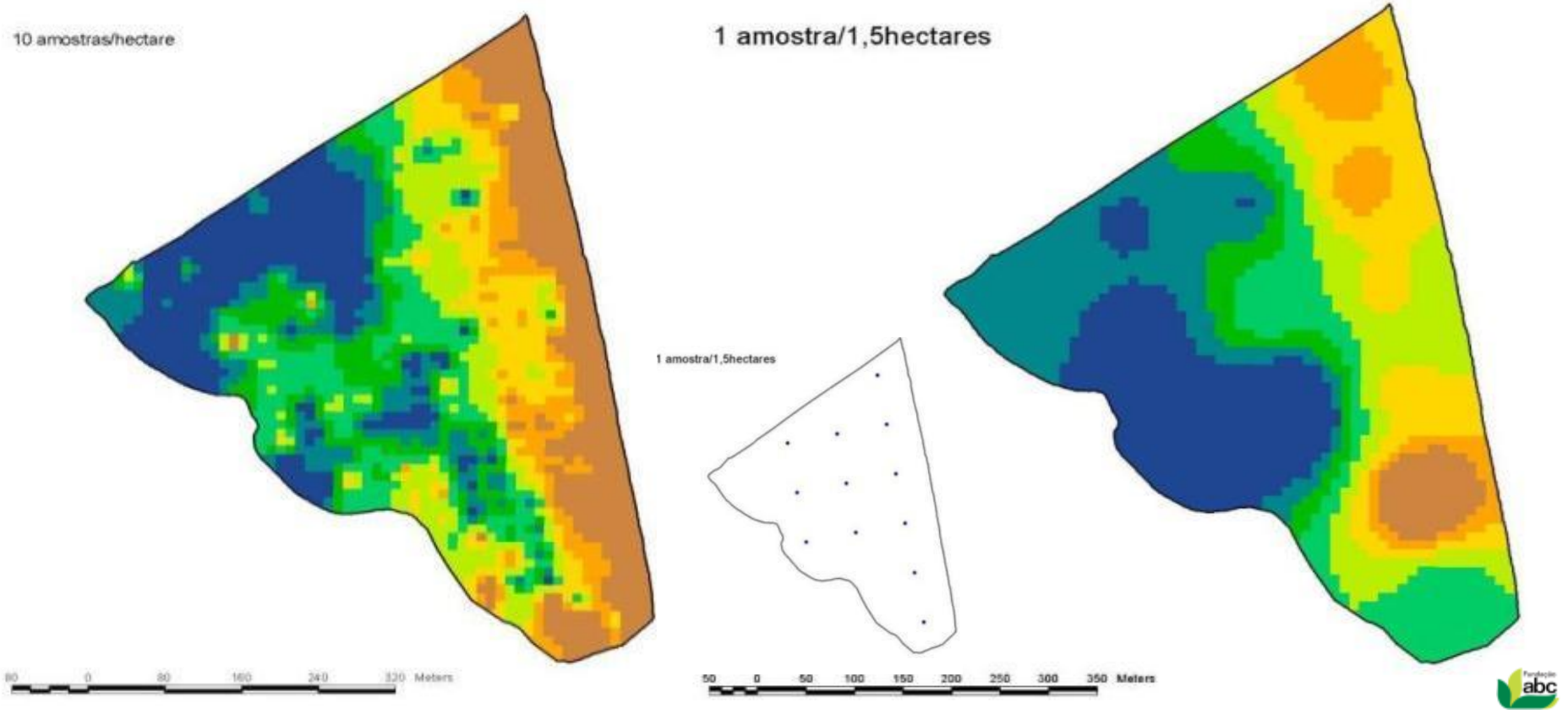




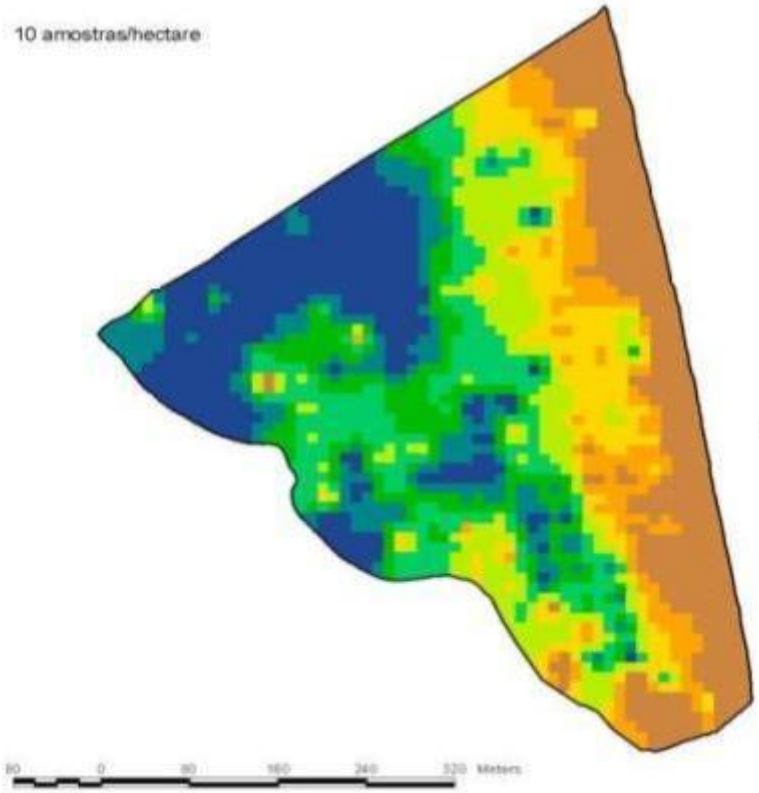


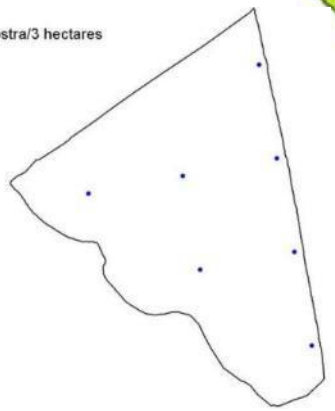


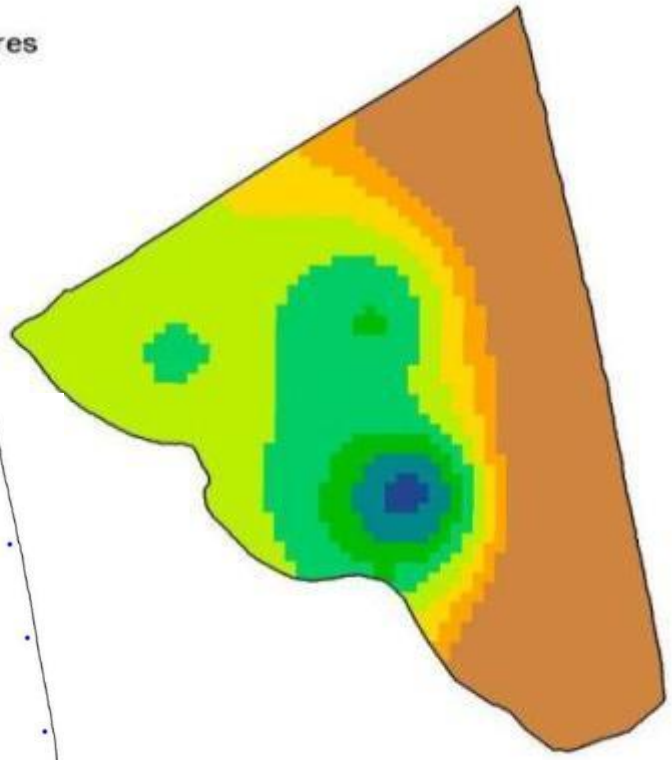
Aplicação de Calcário

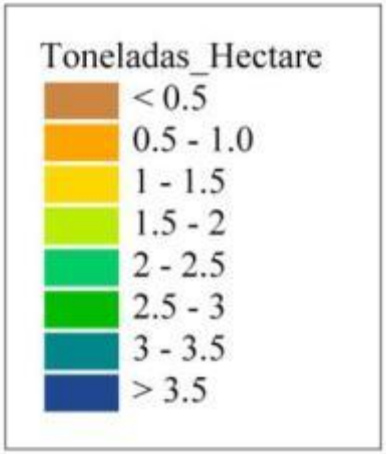


Aplicação de Calcário







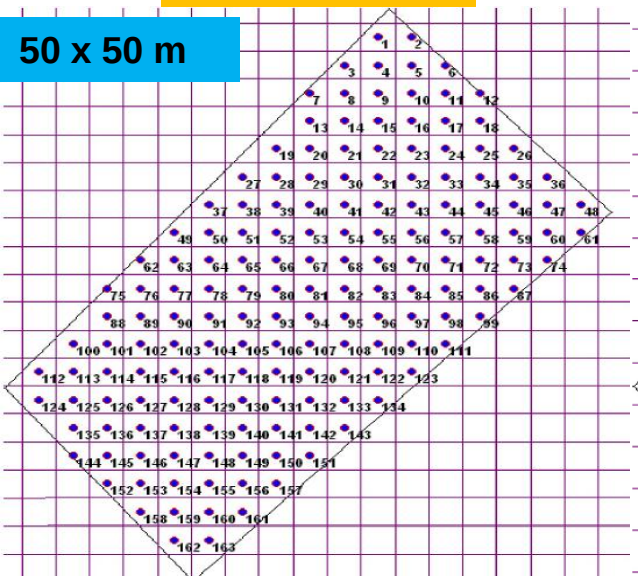


Cherubin et al. (2015)

Qual a dimensão ideal da grade amostral?

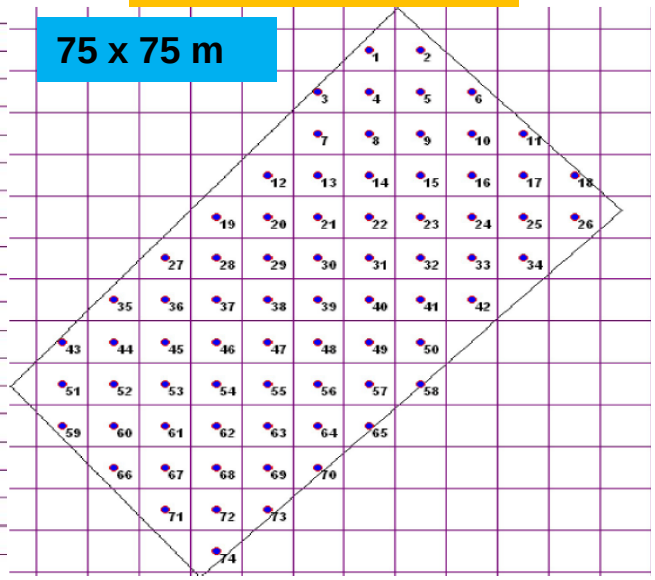
4 amostras ha^{-1}

50 x 50 m



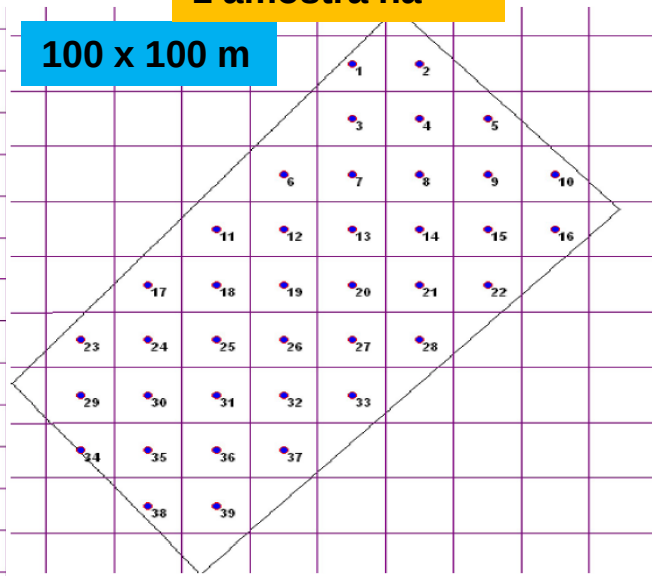
1,77 amostras ha^{-1}

75 x 75 m



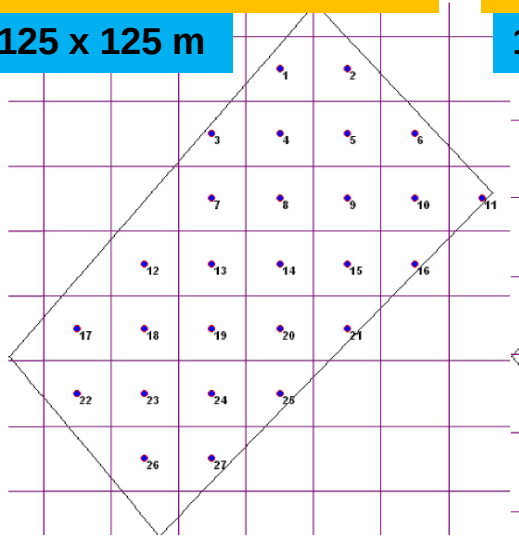
1 amostra ha^{-1}

100 x 100 m



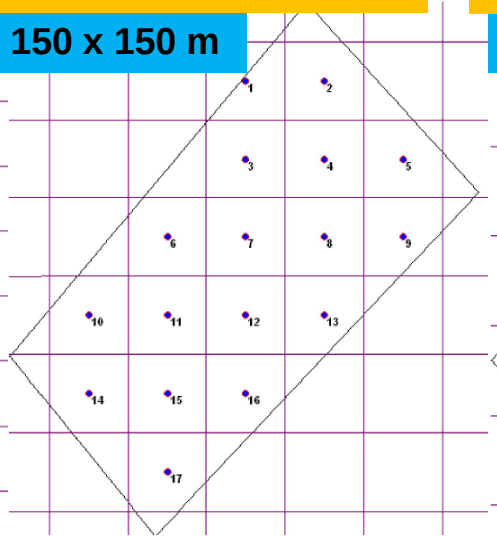
1 amostra cada1,56 ha

125 x 125 m



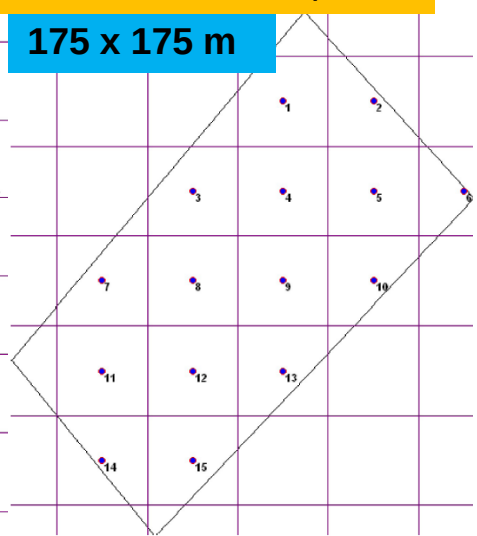
1 amostra cada 2,25 ha

150 x 150 m



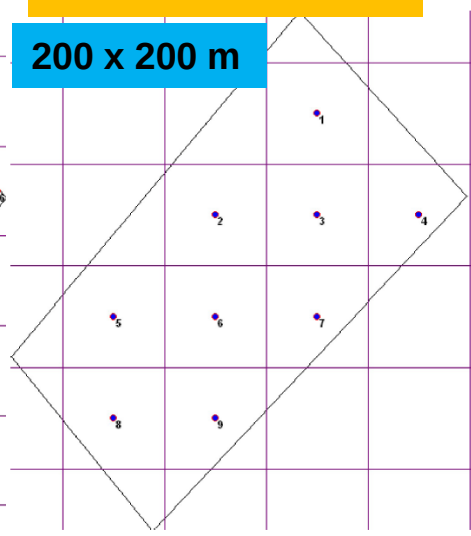
1 amostra cada 3,06 ha

175 x 175 m

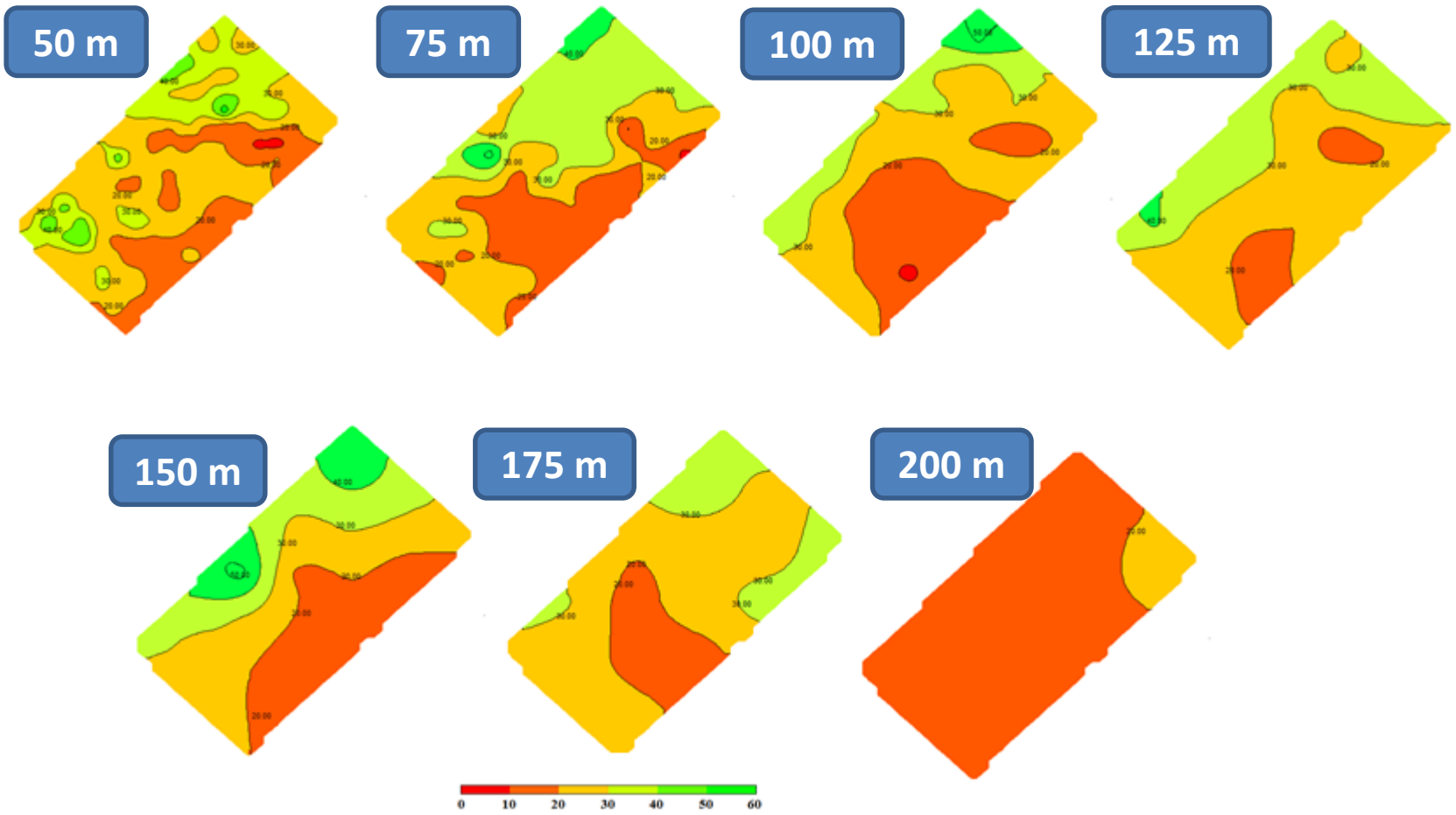


1 amostra cada 4 ha

200 x 200 m

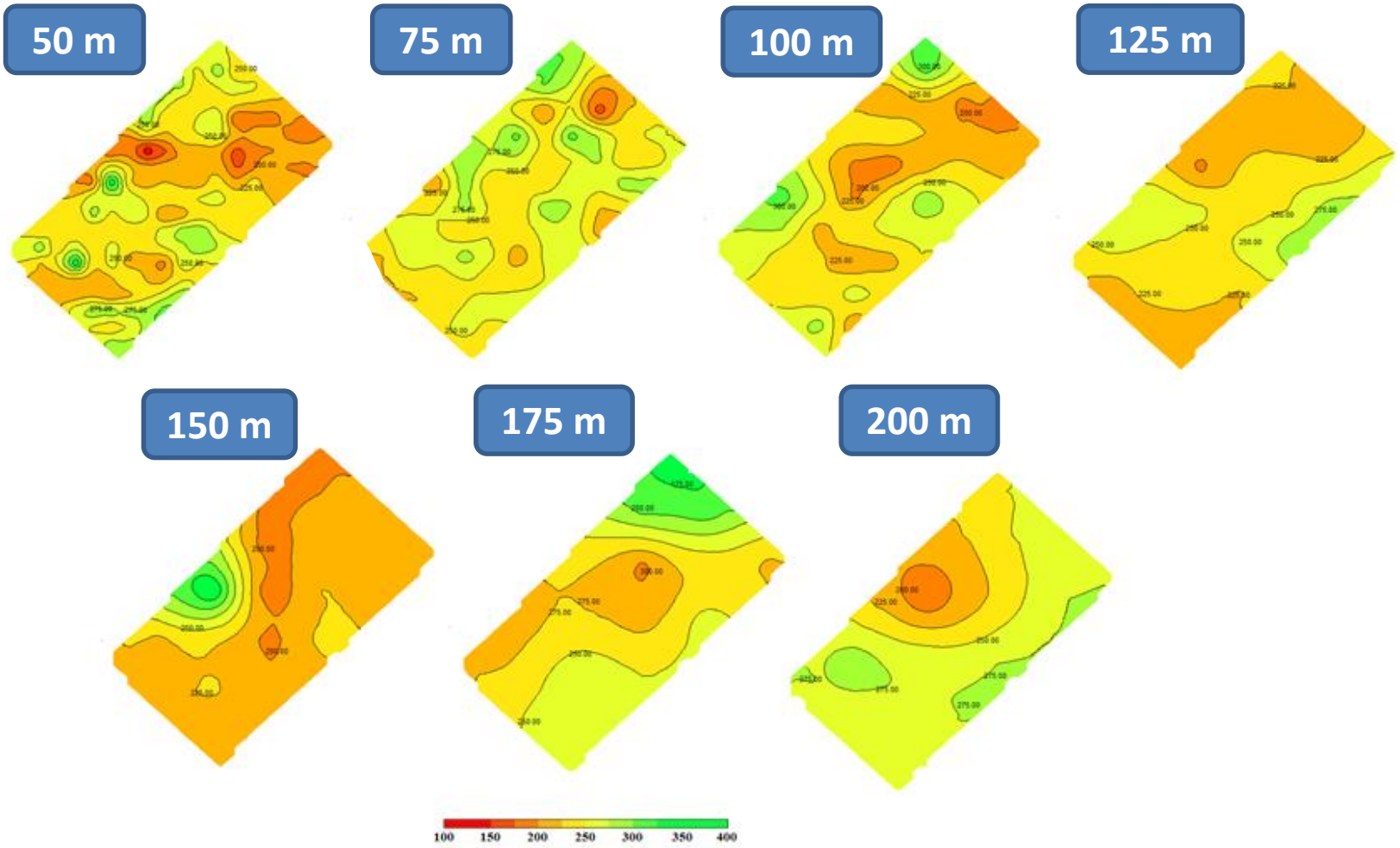


Fósforo



Cherubin et al. (2015)

Potássio



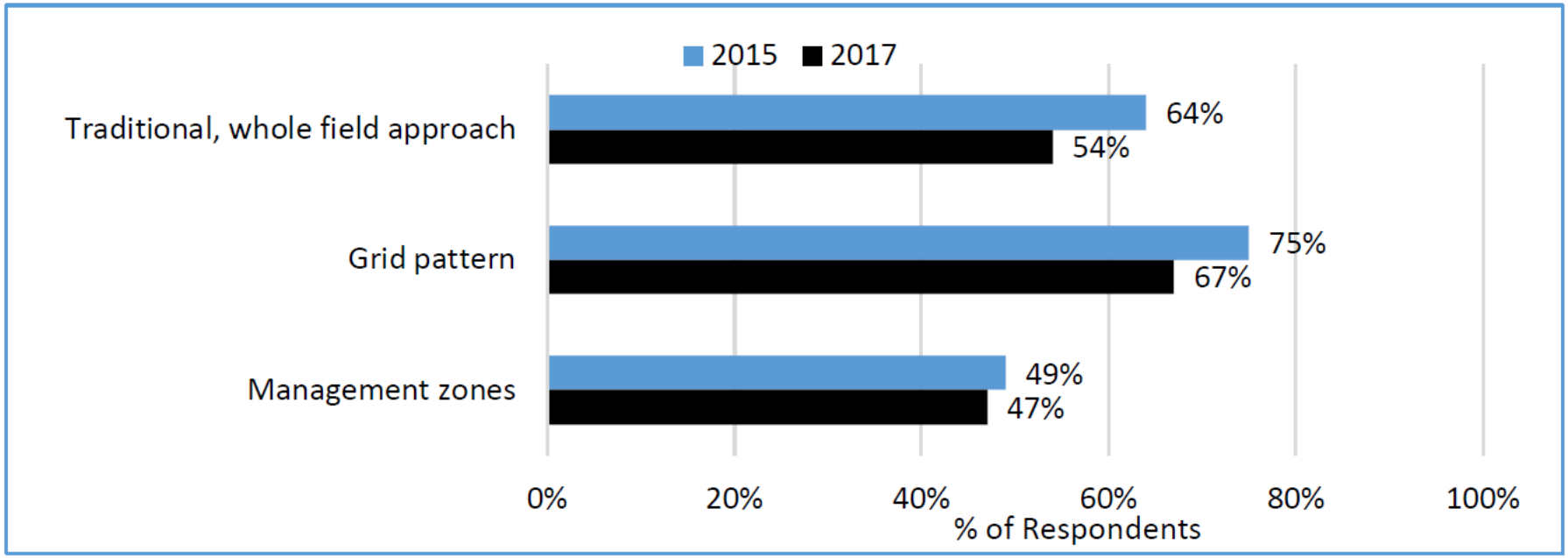
Cherubin et al. (2015)

A qualidade (exatidão) do mapa

Atributo do solo	Variabilidade espacial (amplitude)	Variabilidade temporal
Textura	Média – alta (entre 20 e 98 m)	Baixa
Carbono orgânico	Alta (entre 22 e 78 m)	Média (entre 5 e 10 anos)
CTC	Média – alta	Média
pH	Média – alta (entre 30 e 100 m)	Média – alta (entre safras)
P disponível	Alta (entre <10 e 31 m)	Alta (dentro e entre safras)
K disponível	Alta (entre 18 e 68 m)	Média – alta (dentro e entre safras)

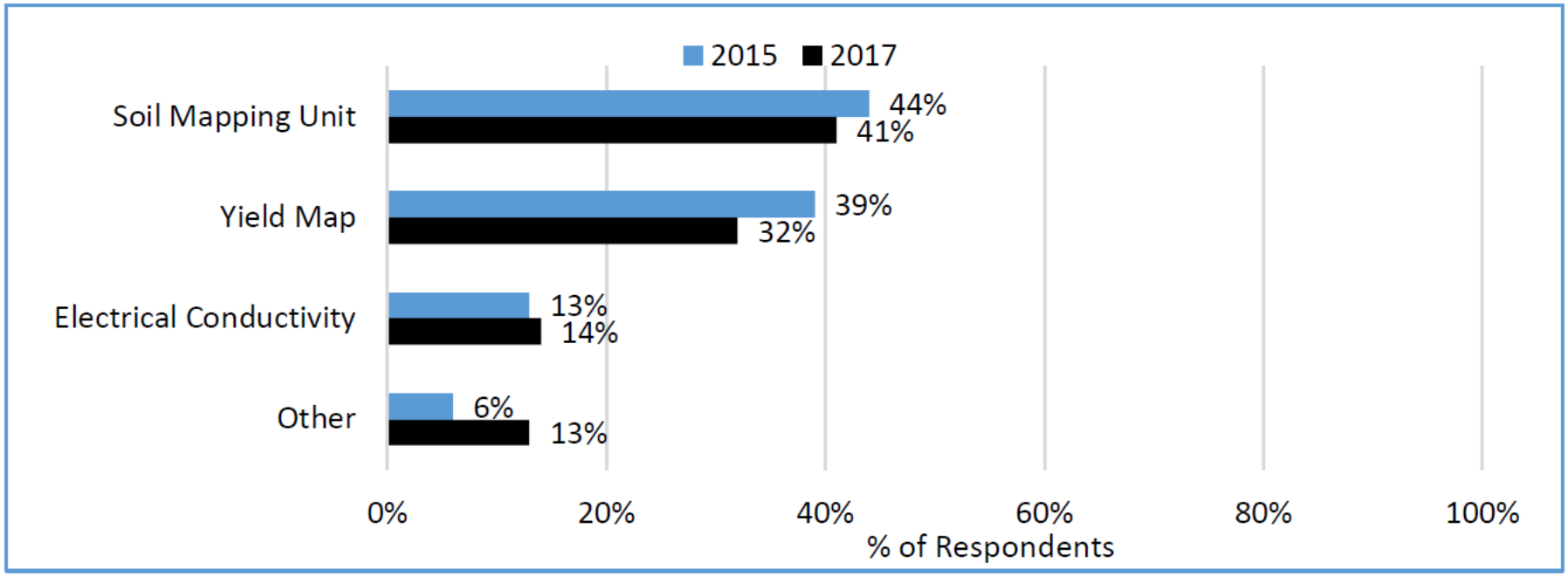
TAVARES, T (de Viscarra Rossel e Lobsey 2016)

Tipos de amostragem de solo oferecida nos EUA



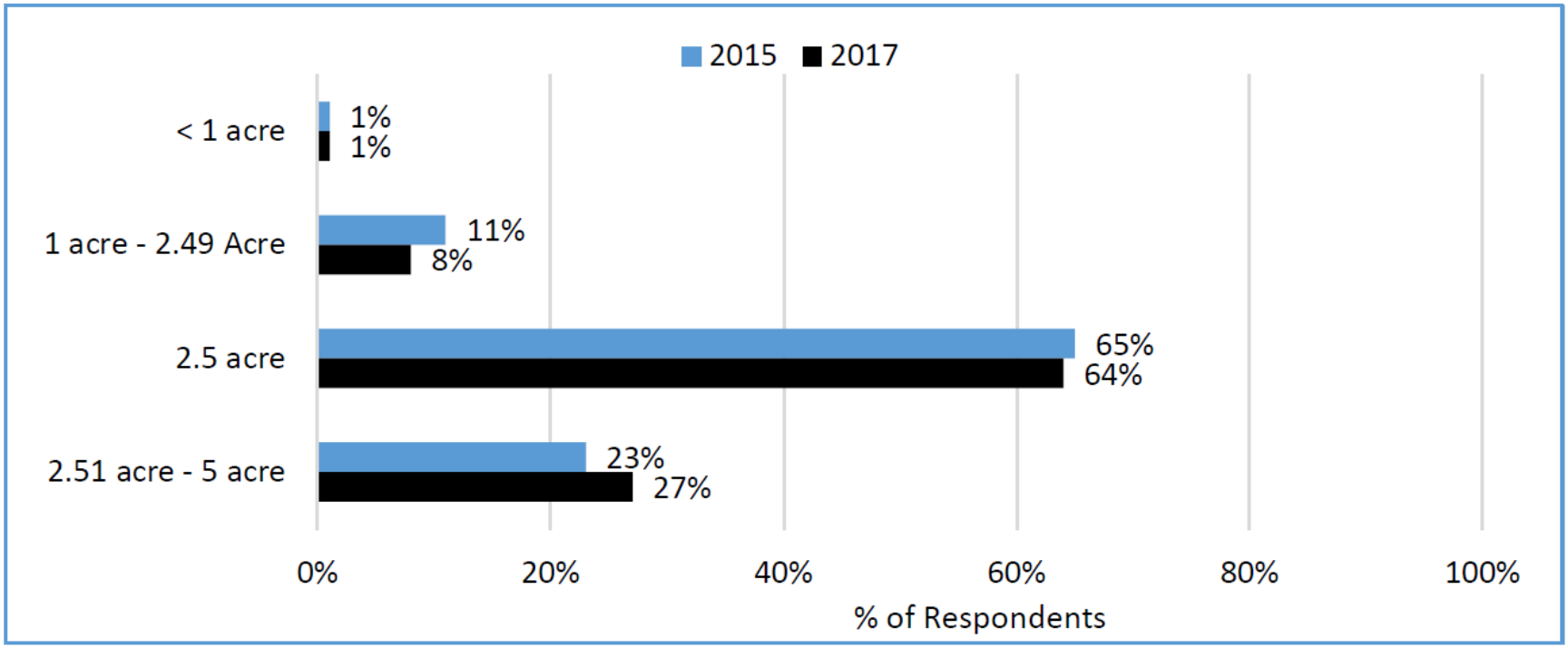
B.Erickson, J. L. Lowenberg-DeBoer & J. Bradford (2017)

Fatores usados para determinar UGD ("zonas de manejo")



B.Erickson, J. L. Lowenberg-DeBoer & J. Bradford (2017)

Tamanhos de grades amostrais praticadas



B.Erickson, J. L. Lowenberg-DeBoer & J. Bradford (2017)

AGRICULTURA DE PRECISÃO

Boletim Técnico 03

AGRICULTURA DE PRECISÃO: NÚMEROS DO MERCADO BRASILEIRO

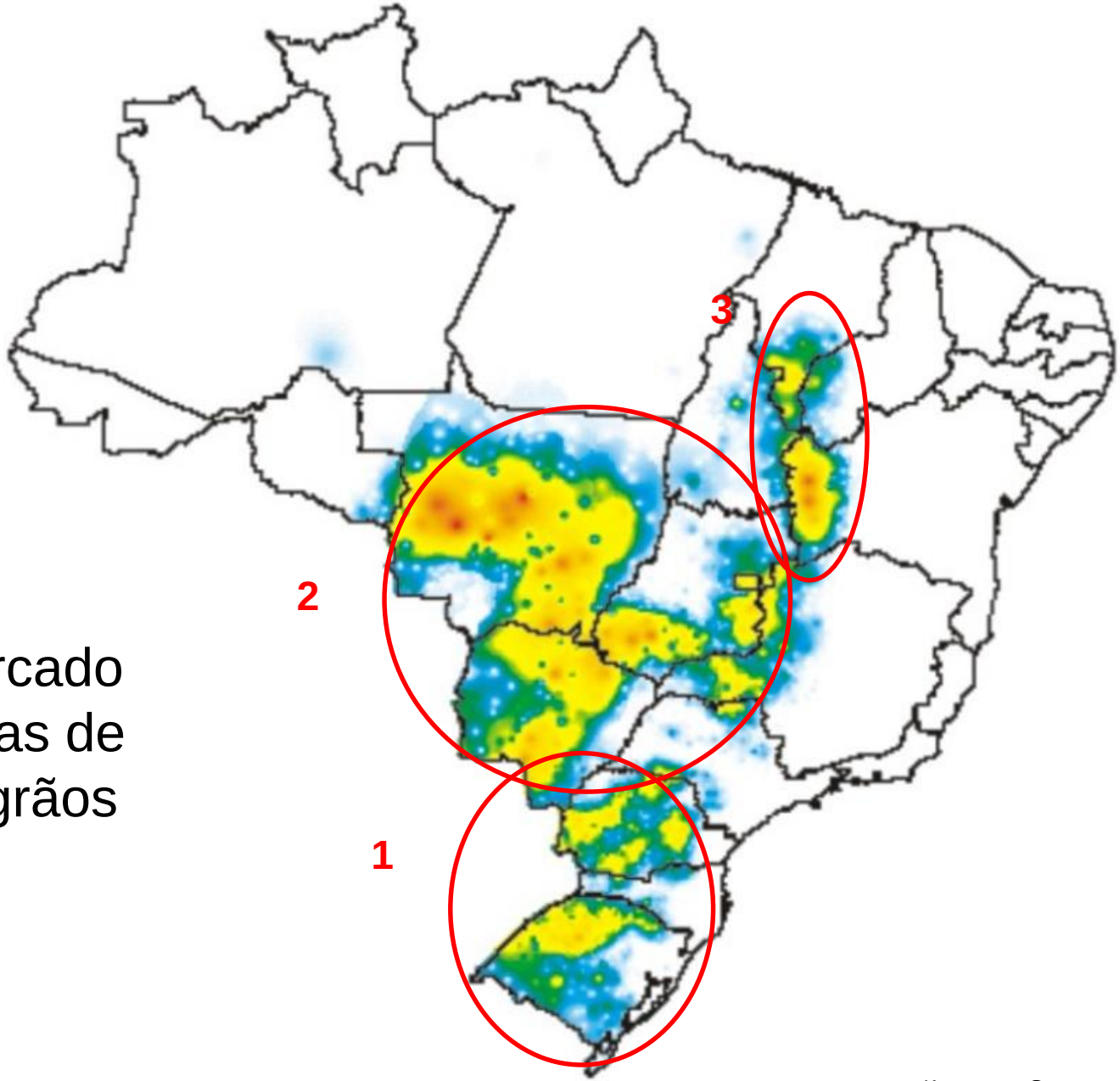
José P. Molin[1]

[1]Professor e Coordenador do Laboratório de Agricultura de Precisão (USP-ESALQ).

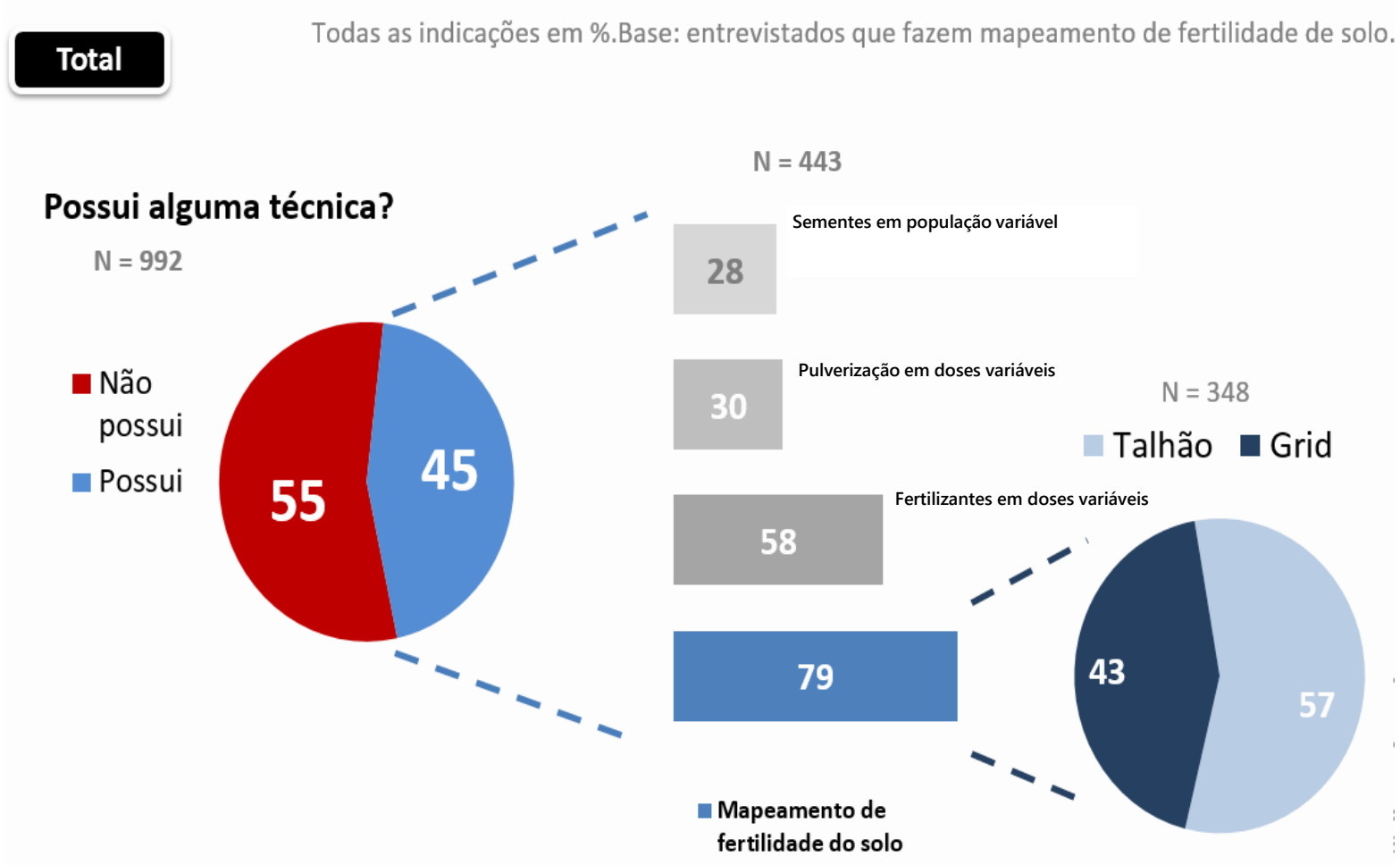
04/2017

A agricultura de precisão (AP) tem sua origem na gestão da variabilidade espacial das lavouras, dados de produtividade expressos por mapas são fundamentais. A interpretação da variabilidade

Dados do Mercado de AP em áreas de produção de grãos

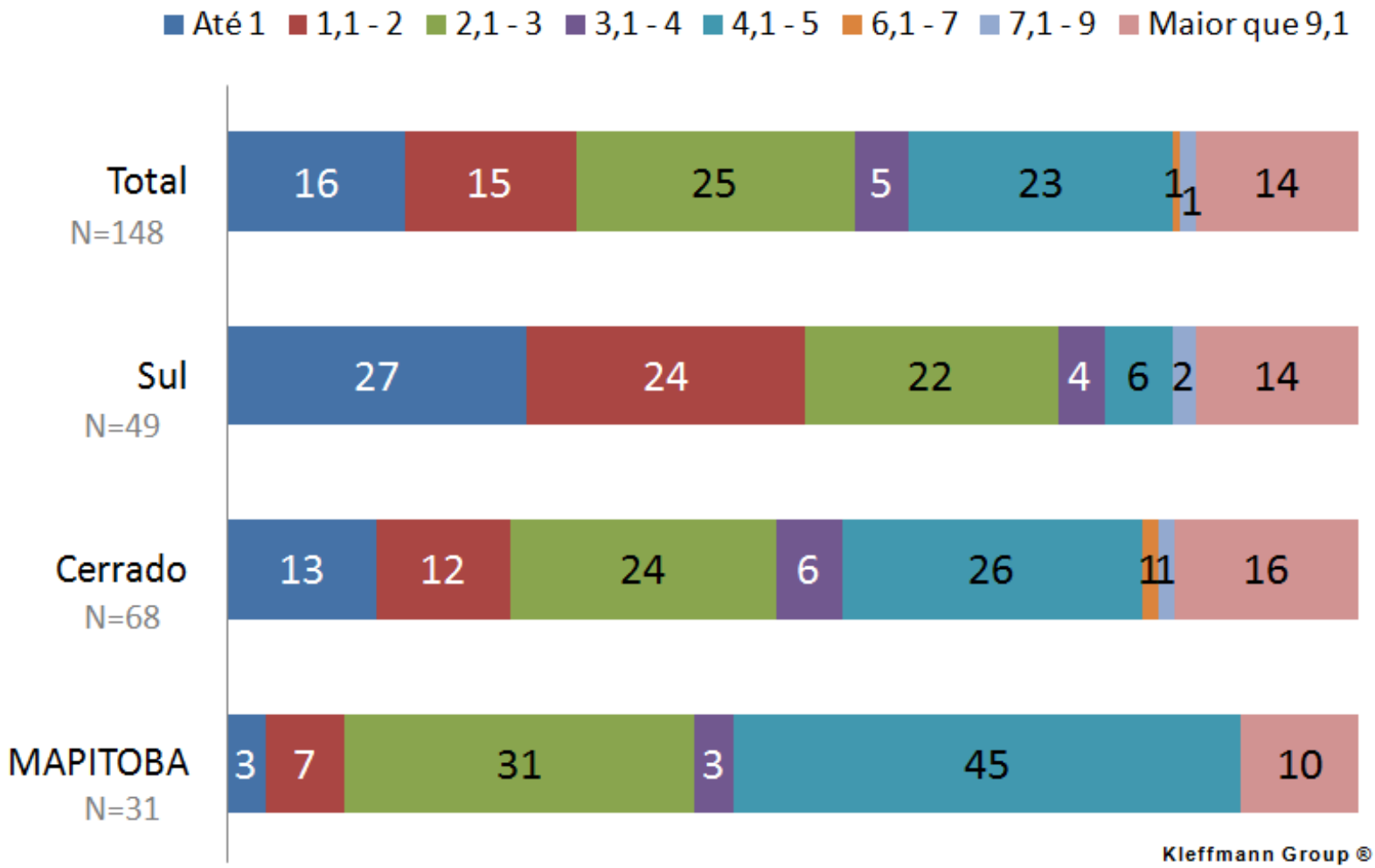


Nível de adoção de técnicas de AP relacionadas com a variabilidade espacial das lavouras e de amostragem de solo em grade

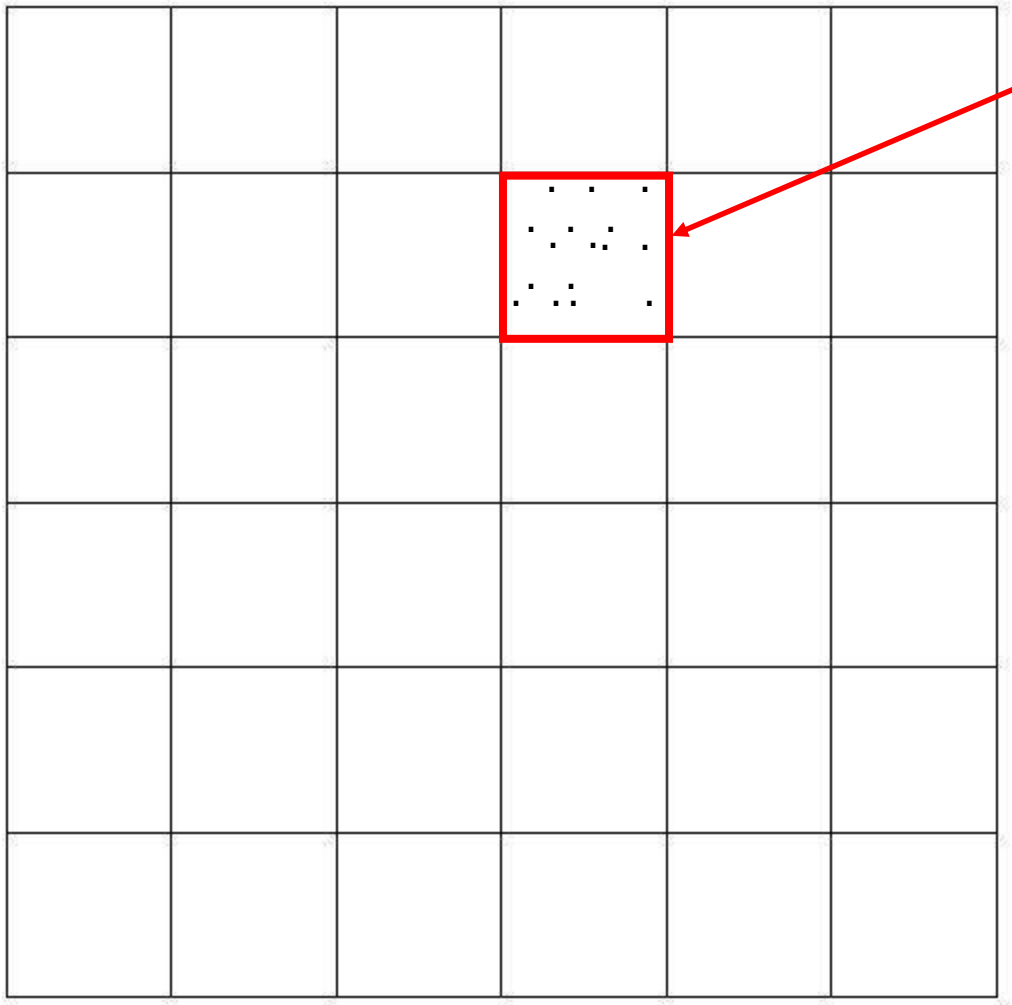


Tamanho das grades amostrais, em hectares, praticadas em cada região do Brasil

Todas as indicações em %. Base: Entrevistados que realizam o mapeamento da fertilidade do solo por grades N = 148

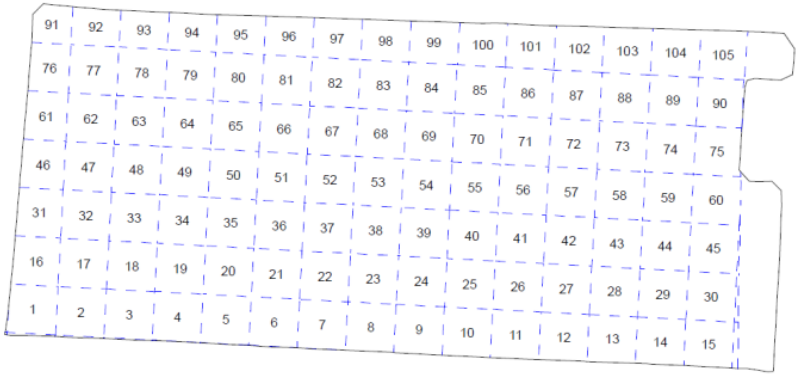


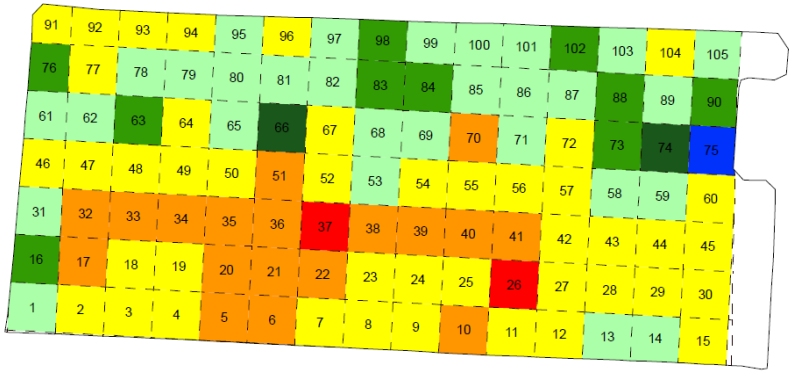
J. P. Molin (2017)

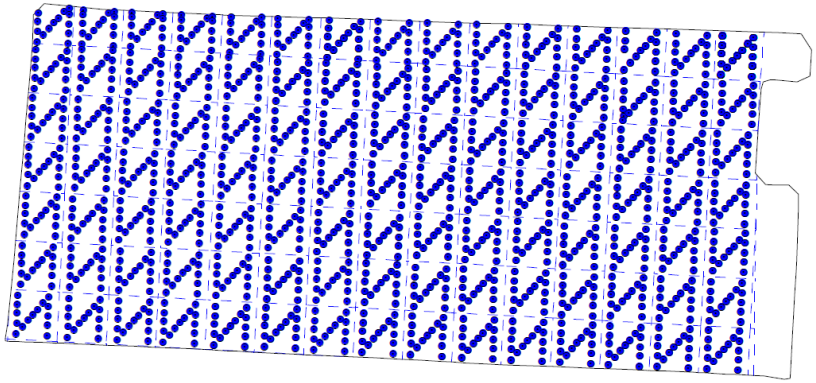


Amostragem por célula

Amostragem por célula







- Maior número de subamostras
- Maior tempo de coleta
- Menor resolução
- Menor densidade (menos amostras)
- Menor frequência

Gimenez, 2013 - FMT

Métodos de Amostragem

Sem conhecimento prévio da área

- Amostragem em grade
  - por ponto
  - por célula

Com conhecimento pleno da área

- Amostragem por unidades de gestão (UGD)

Unidades de gestão diferenciada (UGD) ou “zonas de manejo”

São áreas delimitadas, dentro de um talhão, com mínima variabilidade interna.

Mínima variabilidade dentro das UGDs

Diferenças (variabilidade) entre UGDs

Os indicadores podem ser únicos ou, preferencialmente, compostos:

Plantas

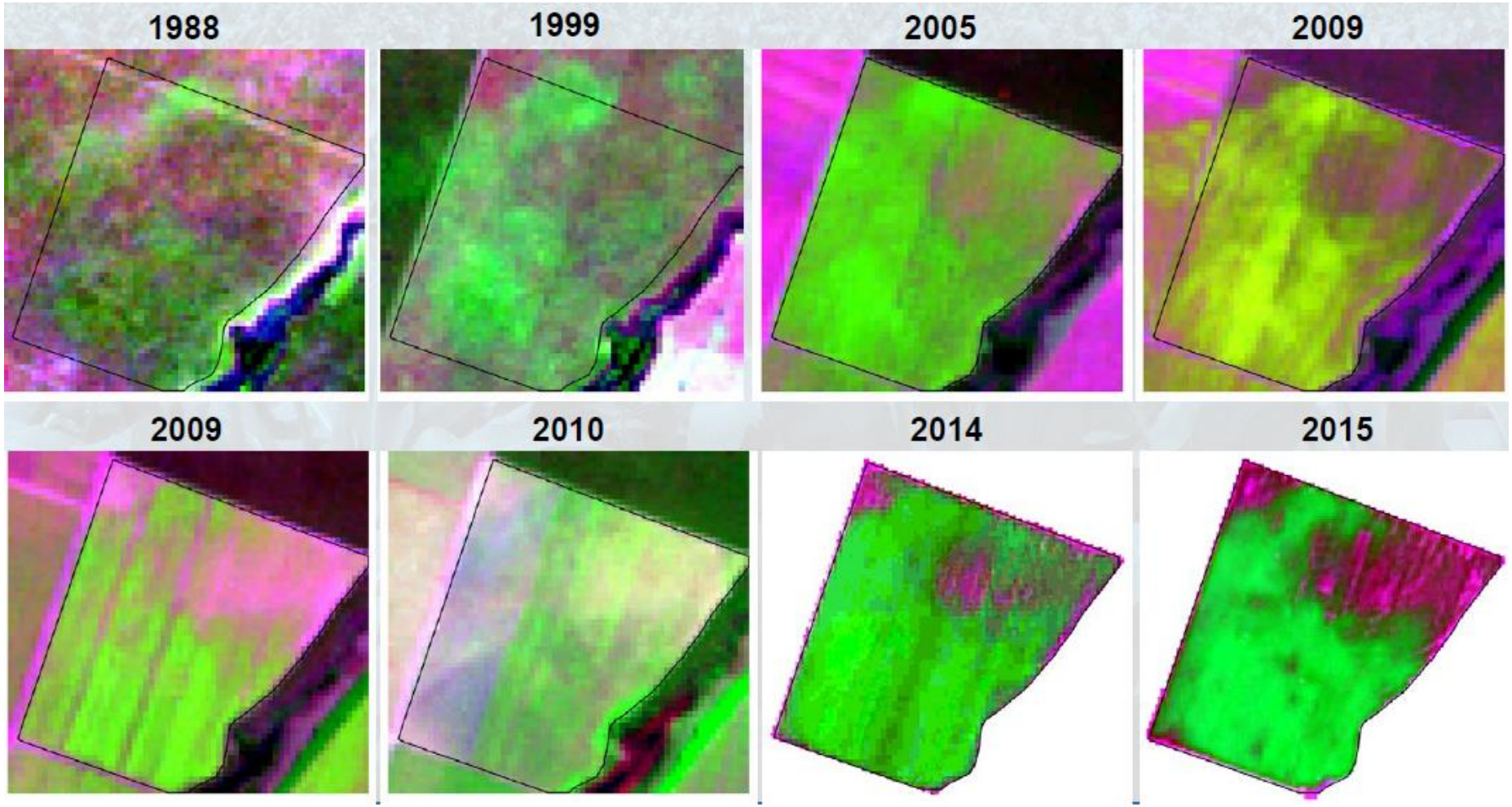
- produtividades
- vigor das culturas (biomassa) a partir de Índices de Vegetação

Solo

- condutividade elétrica do solo
- relevo
- pedologia

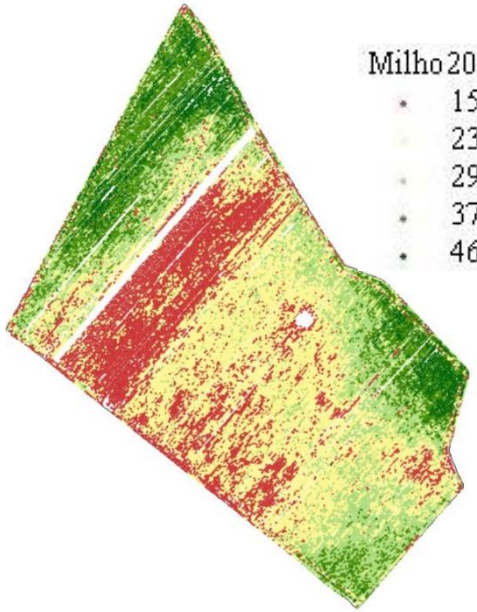
- conhecimento intrínseco (do agricultor ou...)

Estabilidade temporal

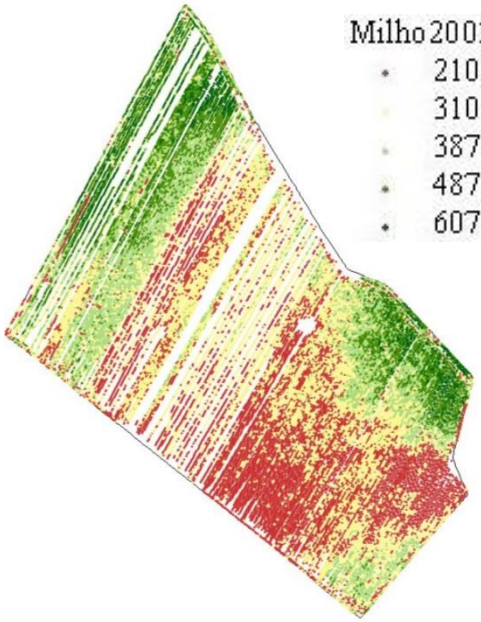


Trevisam, R. (2018)

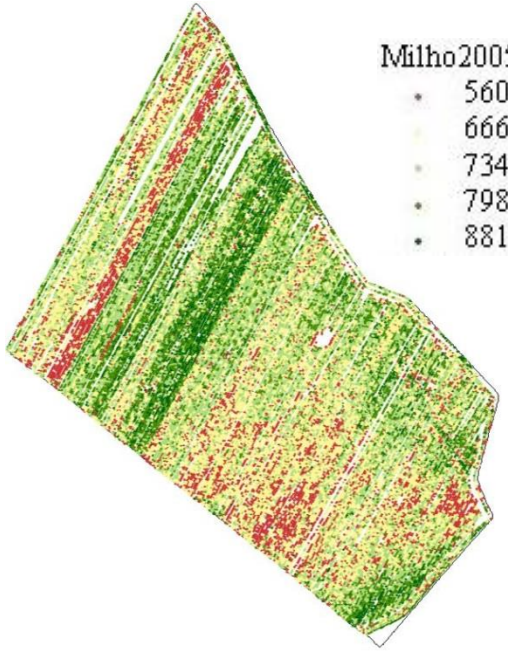
Unidades de Gestão Diferenciada (UGD)



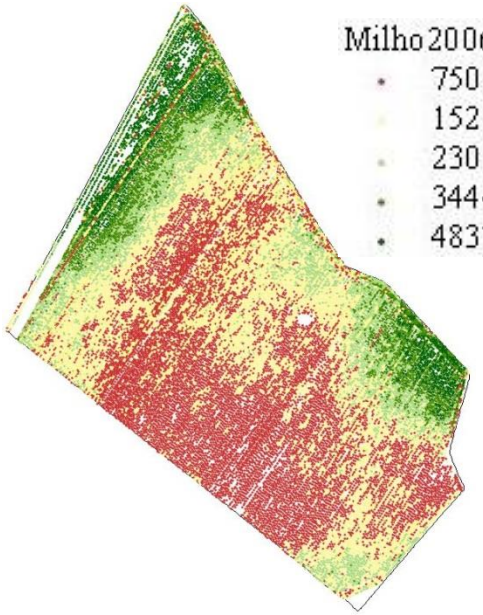
Milho 2002b
- 1500.17 - 2369.13
- 2369.13 - 2970.62
- 2970.62 - 3728.42
- 3728.42 - 4692.63
- 4692.63 - 6794.93



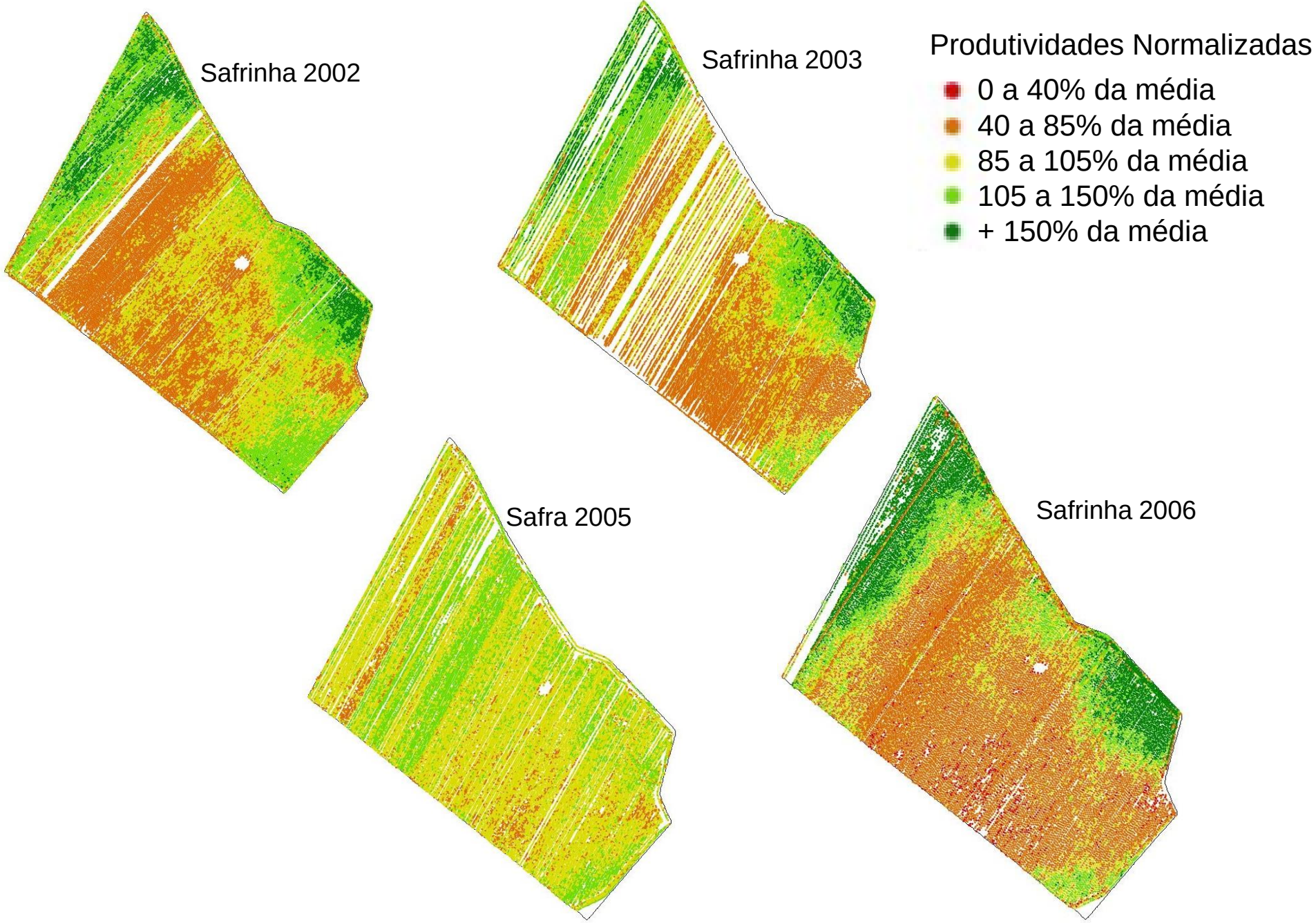
Milho 2003b
- 2101.13 - 3108.84
- 3108.84 - 3874.79
- 3874.79 - 4879.6
- 4879.6 - 6072.77
- 6072.77 - 8493.56



Milho 2005a
- 5600.24 - 6669.72
- 6669.72 - 7343.13
- 7343.13 - 7989.91
- 7989.91 - 8812.51
- 8812.51 - 10496.52



Milho 2006b
- 750.23 - 1521.29
- 1521.29 - 2305.03
- 2305.03 - 3444.3
- 3444.3 - 4837.29
- 4837.29 - 6699.78

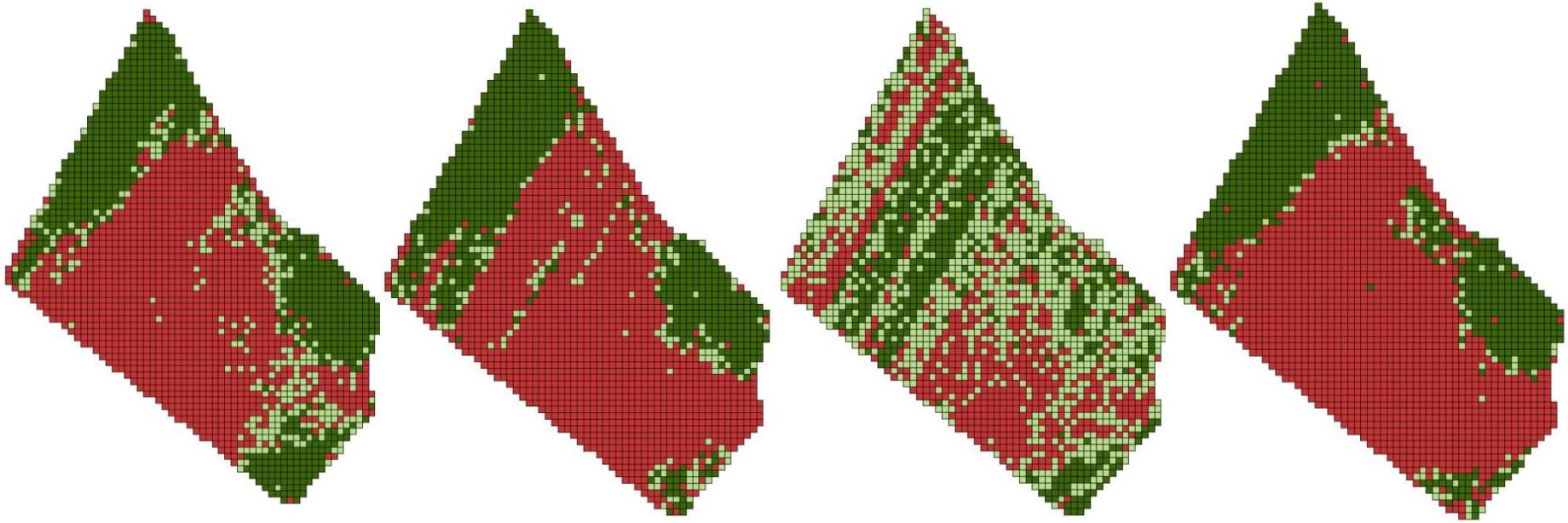

Safrinha 2002
Safrinha 2003
Produtividades Normalizadas
0 a 40% da média
40 a 85% da média
85 a 105% da média
105 a 150% da média
+ 150% da média
Safra 2005
Safrinha 2006

Safrinha 2002

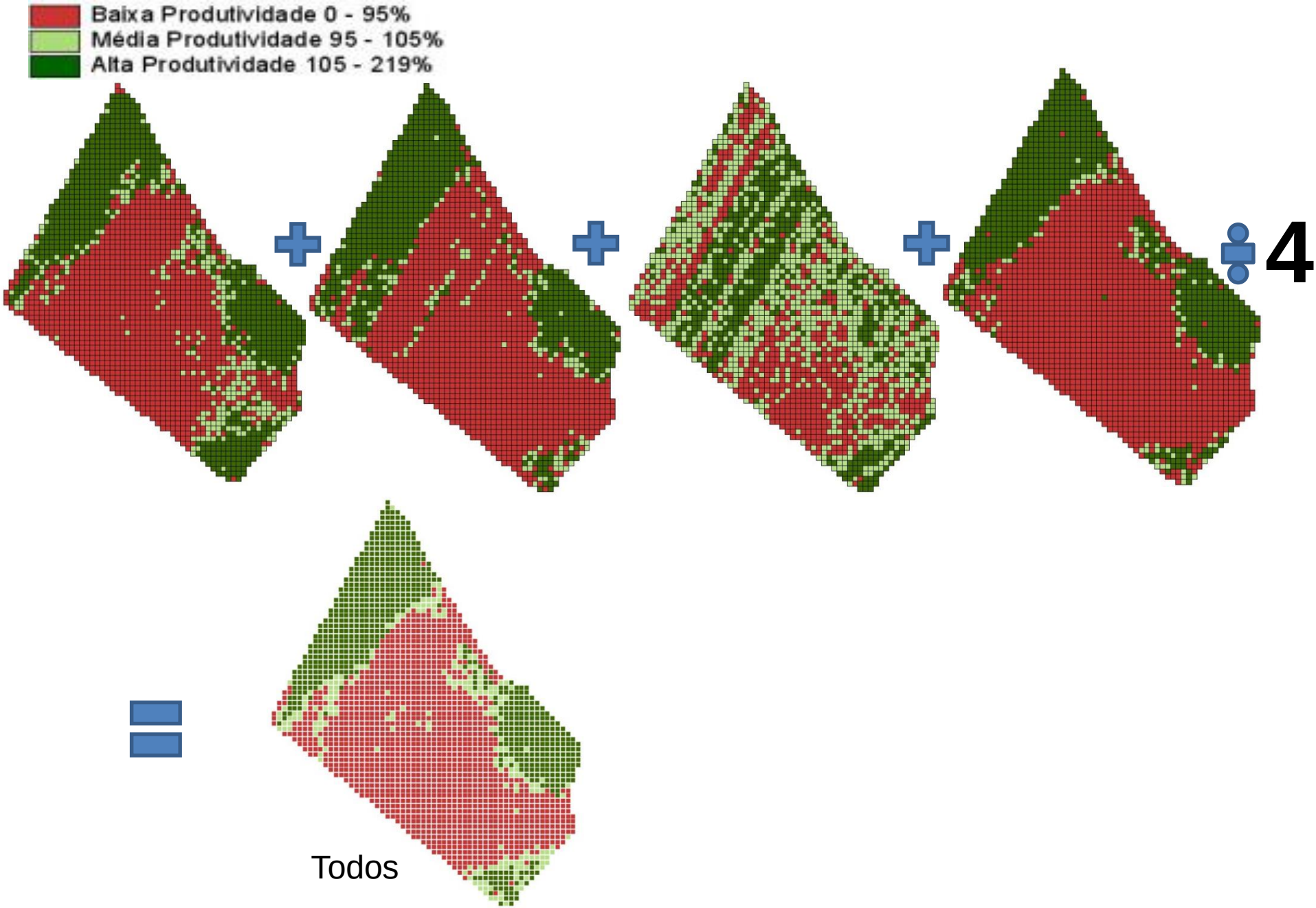
Safrinha 2003

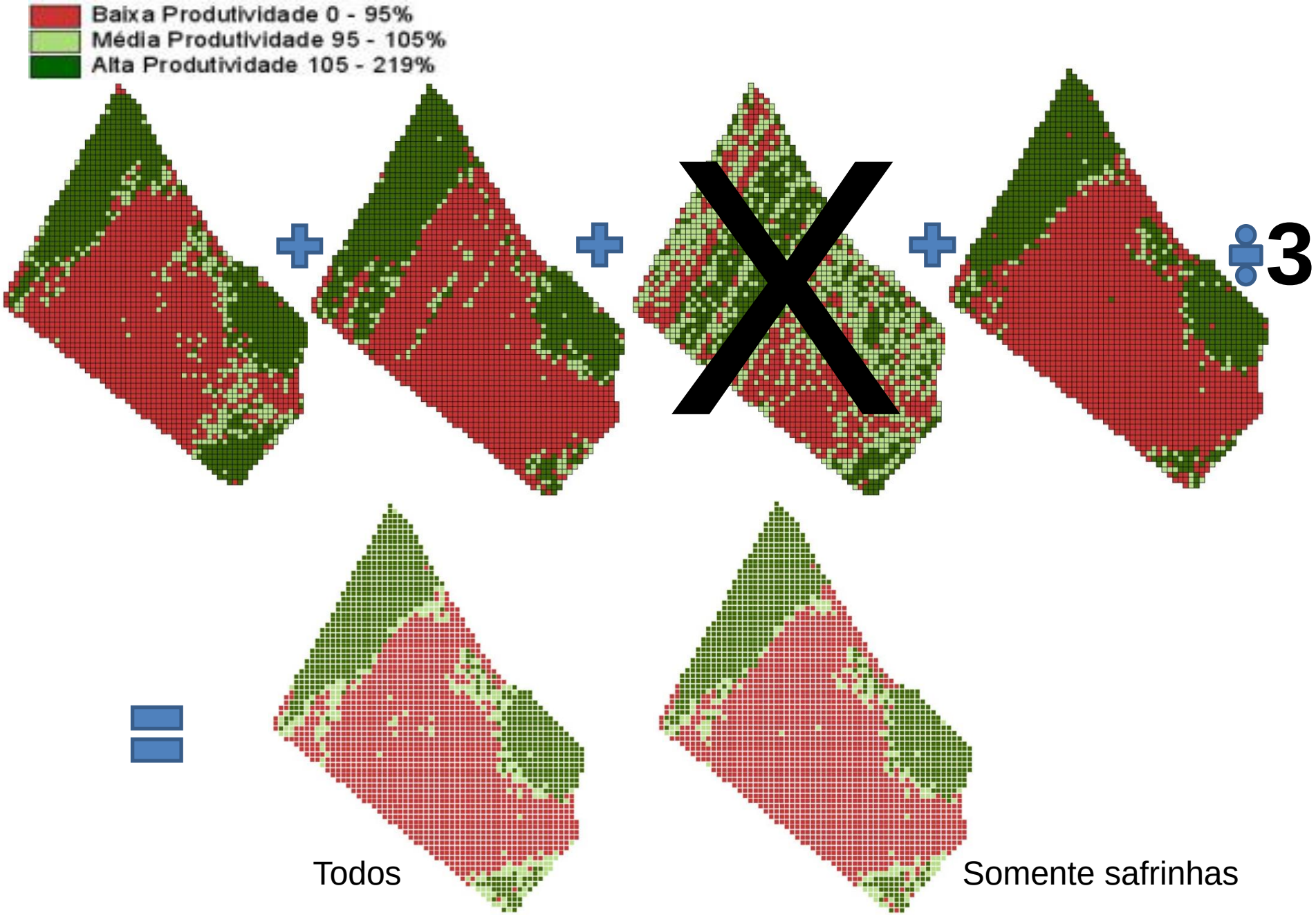
Safra 2005

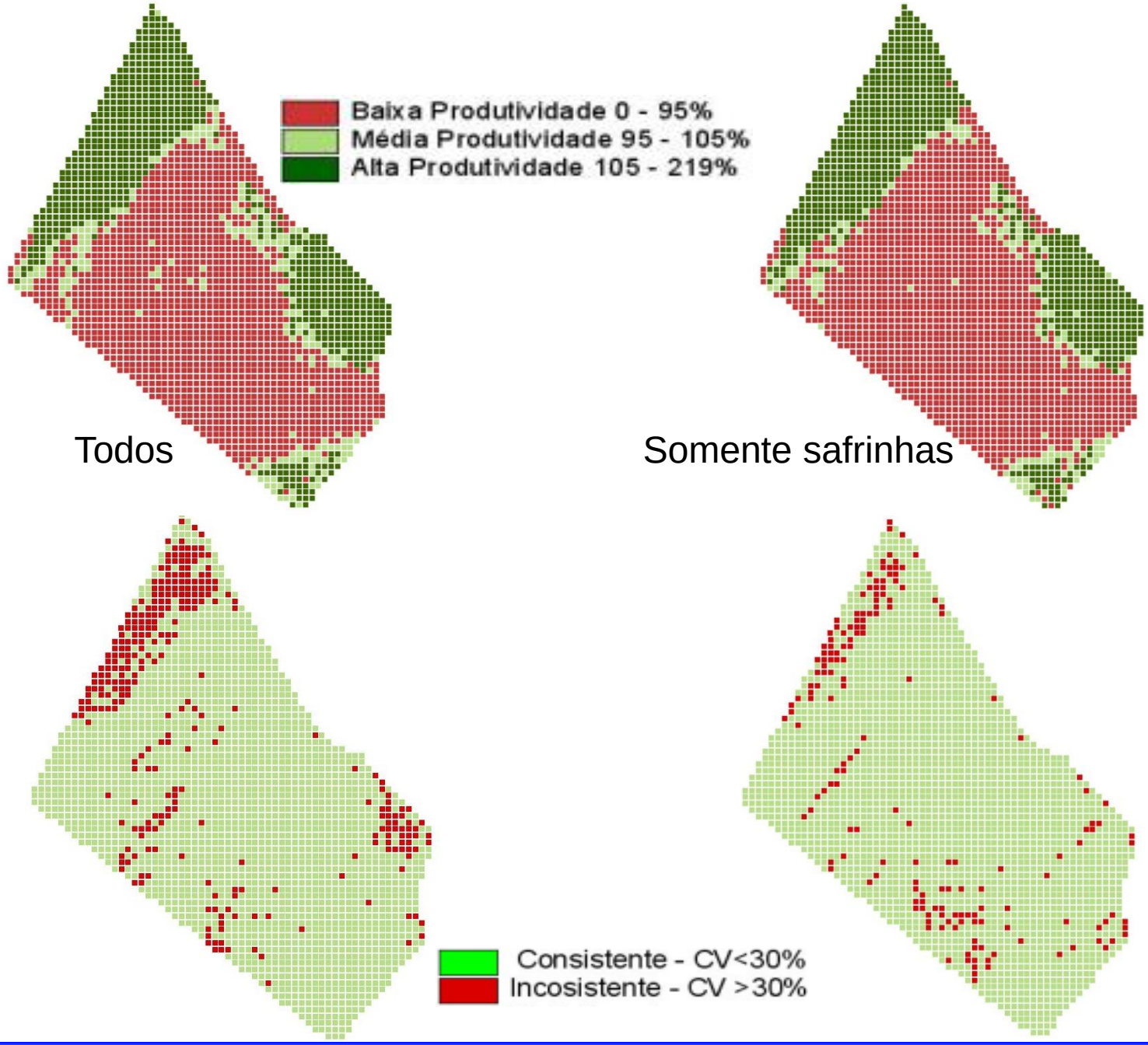
Safrinha 2006



Baixa Produtividade 0 - 95%
Média Produtividade 95 - 105%
Alta Produtividade 105 - 219%


Baixa Produtividade 0 - 95%
Média Produtividade 95 - 105%
Alta Produtividade 105 - 219%
4
Todos


Baixa Produtividade 0 - 95%
Média Produtividade 95 - 105%
Alta Produtividade 105 - 219%
3
Todos
Somente safrinhas


Baixa Produtividade 0 - 95%
Média Produtividade 95 - 105%
Alta Produtividade 105 - 219%
Todos
Somente safrinhas
Consistente - CV<30%
Incosistente - CV >30%

Unidades de gestão diferenciada em função das produtividades médias normalizadas:



1, 2 e 3 – alta produtividade
4 – baixa produtividade

Formas de demarcar UGD

Método supervisionado: álgebra de mapas - empilhamento e operações entre mapas

Análise de agrupamentos: algoritmos para classificação, normalmente não supervisionada, de um conjunto de dados

visa:

- redução da variabilidade dentro da classe e
- maximização das diferenças entre as classes

Análise de Agrupamento

Análise de Agrupamento (“Clustering”; “Fuzzy Clustering”); algoritmos para classificação, supervisionada ou não, de um conjunto de dados.

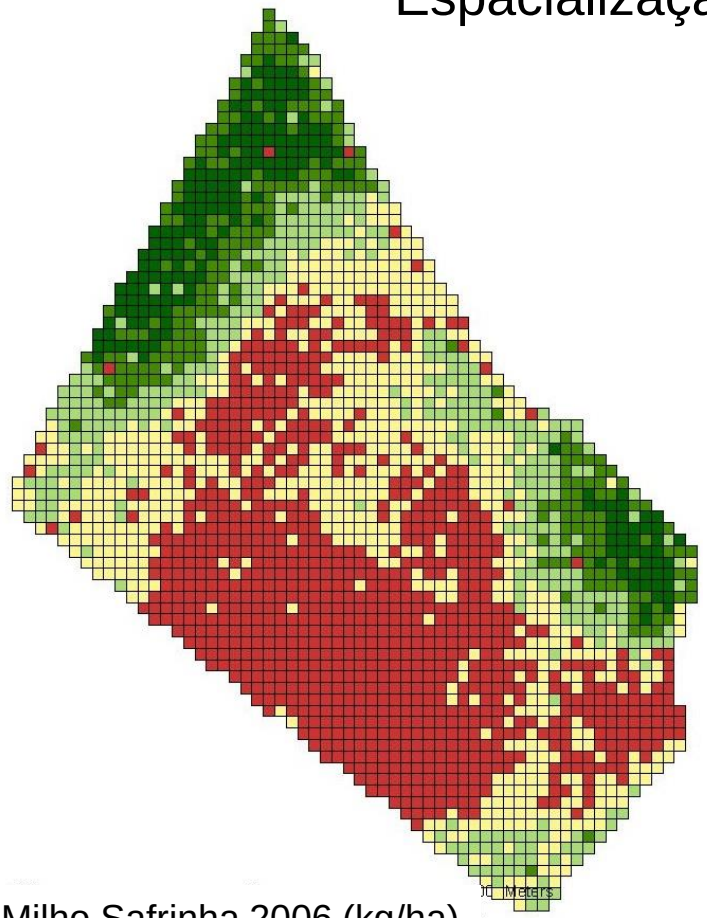
Usam como técnica a redução da variabilidade dentro da classe e maximização das diferenças entre as classes.

Análise de Agrupamento

FuzME - Australian Centre for Precision Agriculture (ACPA)
http://sydney.edu.au/agriculture/pal/software/fuzme.shtml

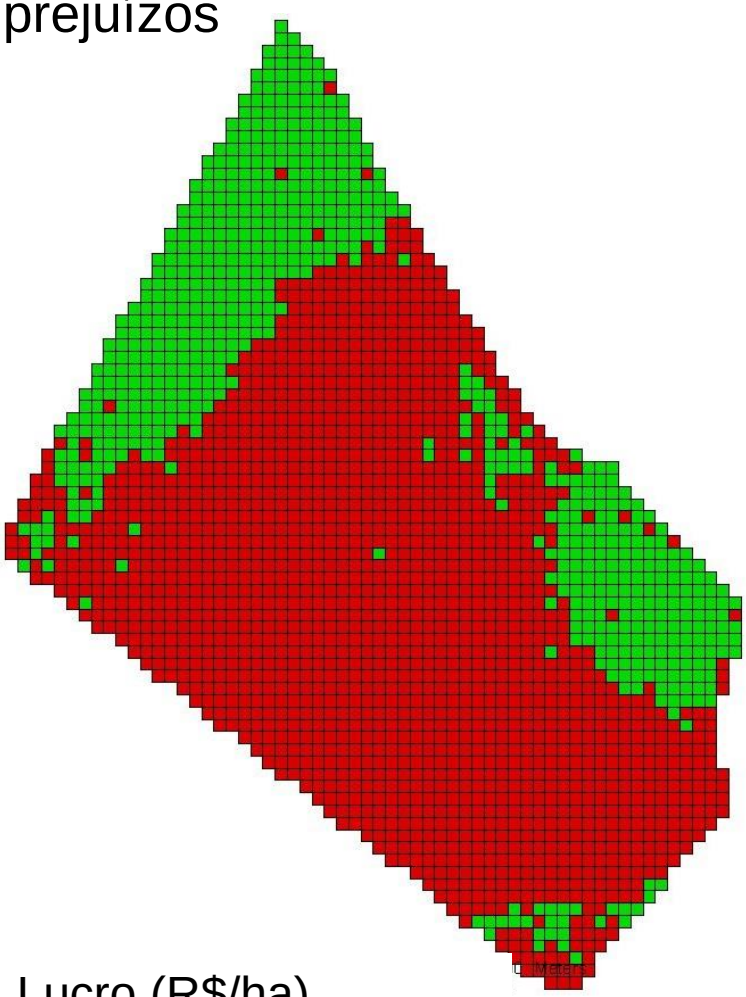
MZA - USDA
http://www.ars.usda.gov/services/software/download.htm?softwareid=24

Espacialização dos lucros e prejuízos



Milho Safrinha 2006 (kg/ha)

- 794.2 - 1512.8
- 1512.8 - 2224.3
- 2224.3 - 3275.6
- 3275.6 - 4547.3
- 4547.3 - 6408.4

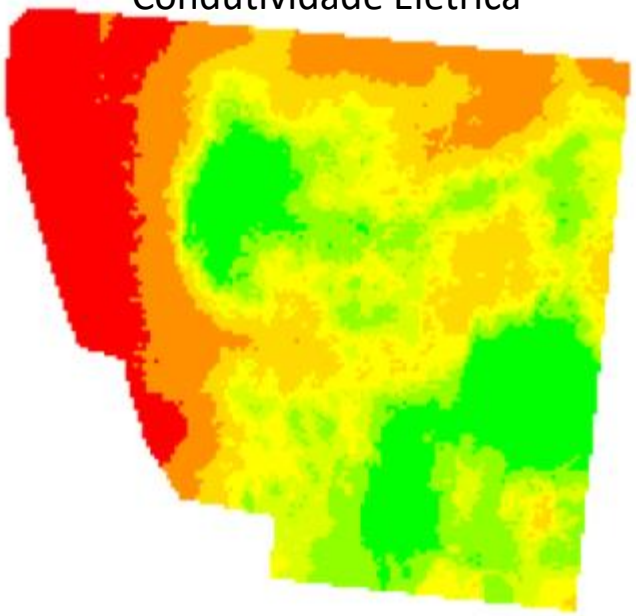


Lucro (R$/ha)

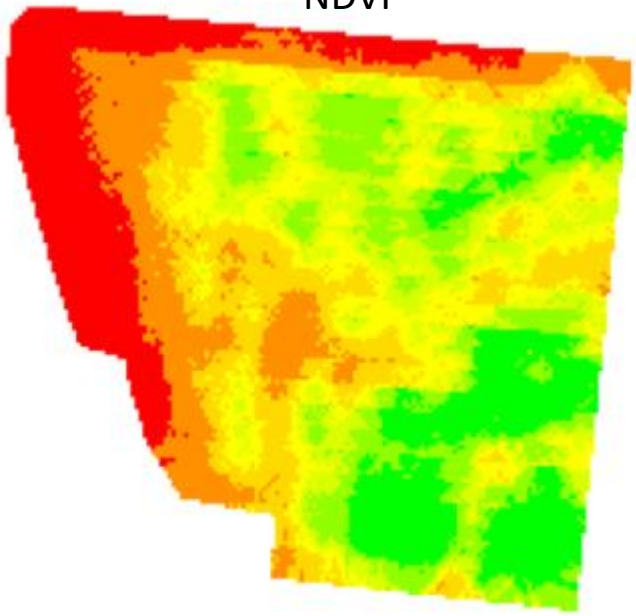
- -535 - 0
- 1 - 1350

Valores atualizados para 2014:
R$ 20,00/saco
Custo: R$ 750,00/ha

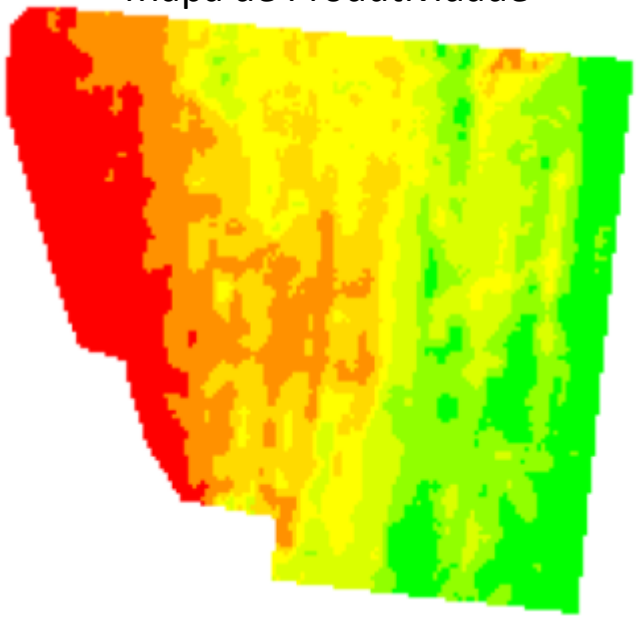
Condutividade Elétrica



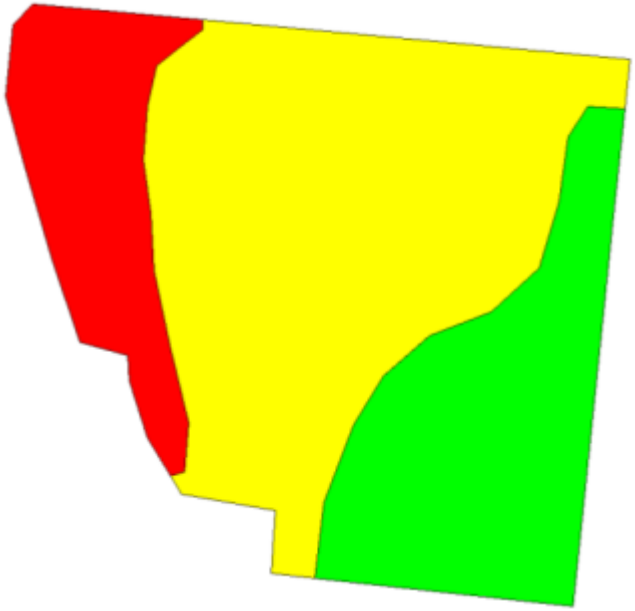
NDVI



Mapa de Produtividade

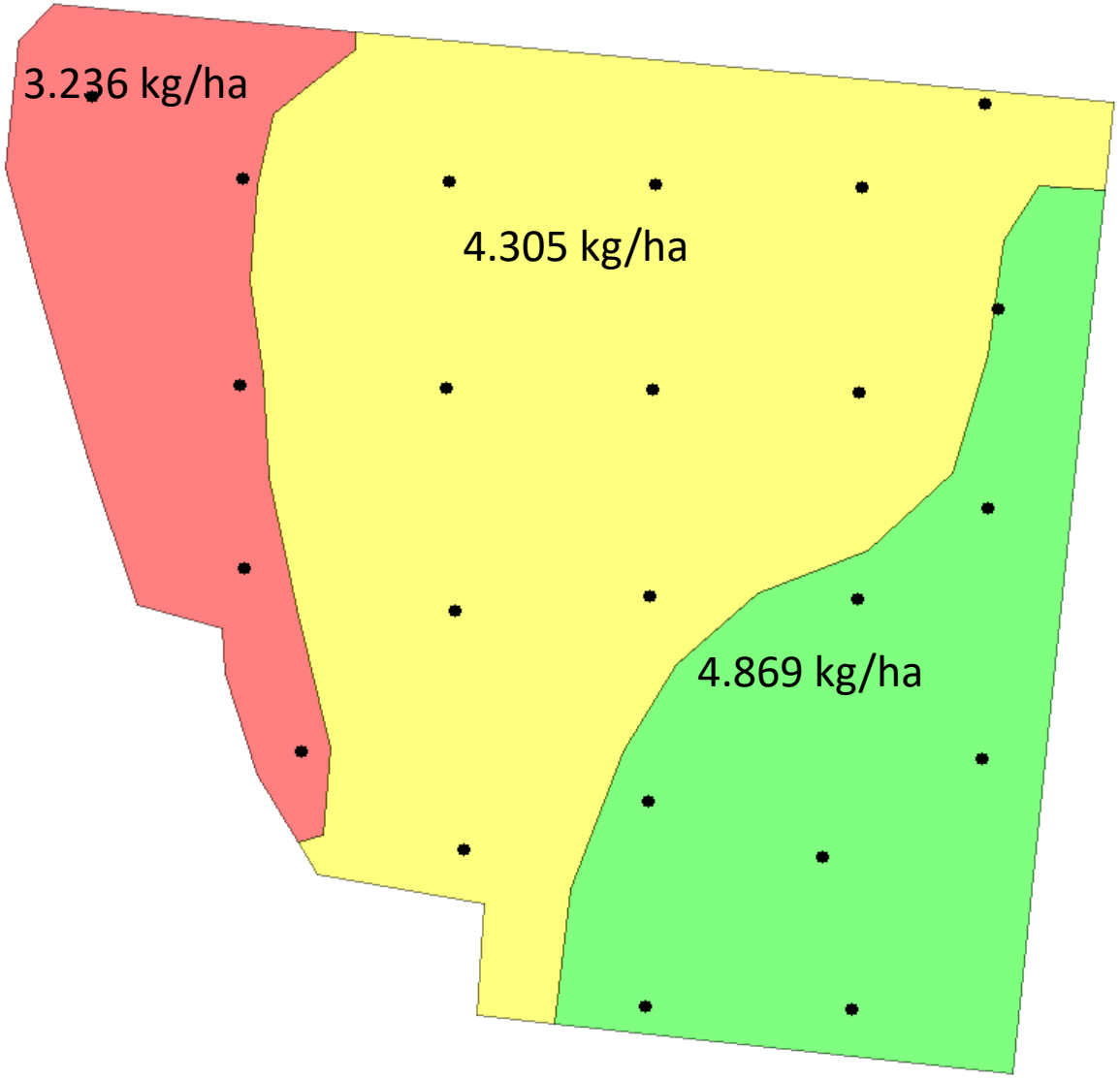


Clusters



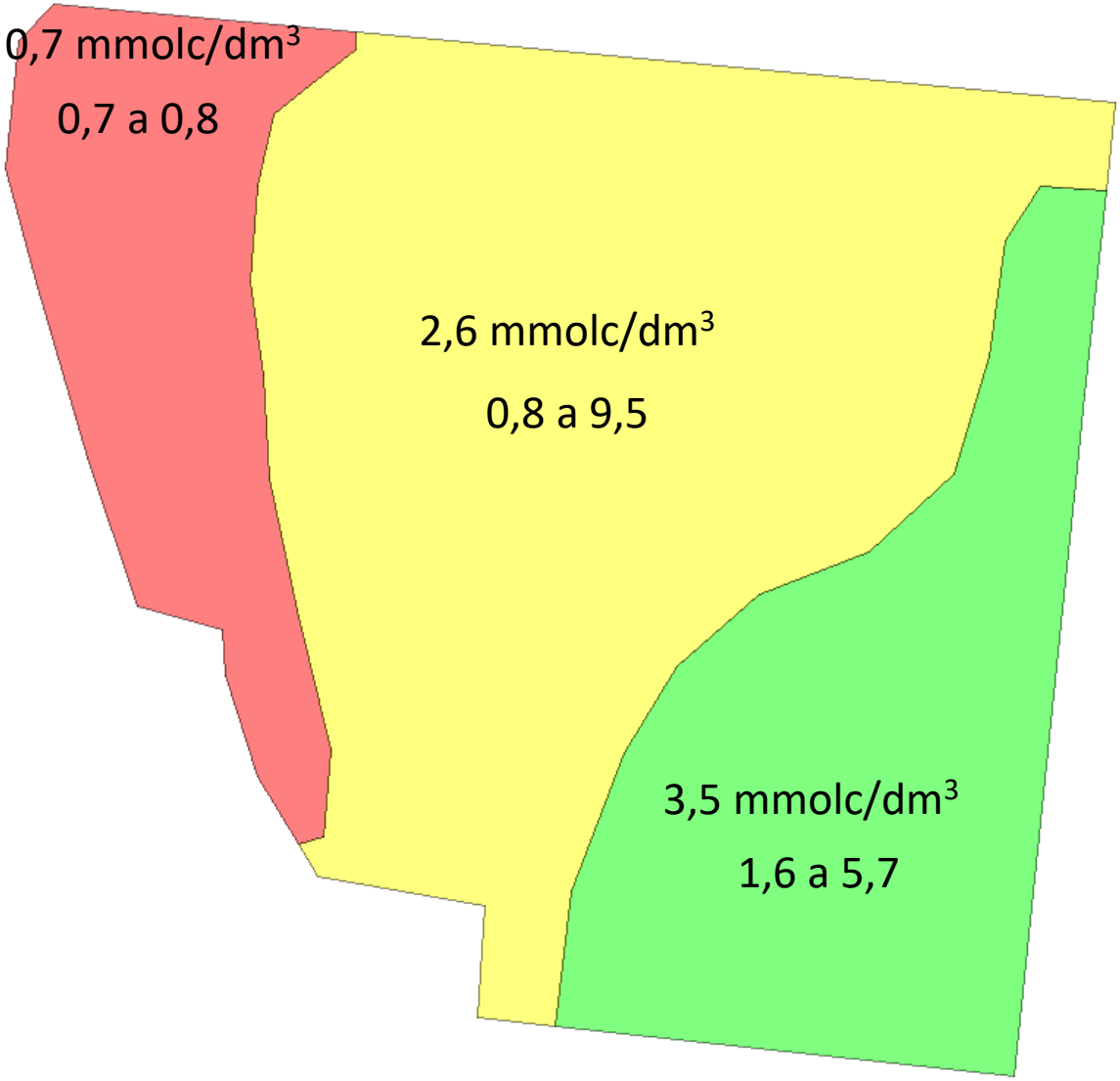
POVH, 2011

Produtividade de Trigo (safra 10/10) – 41,36 ha



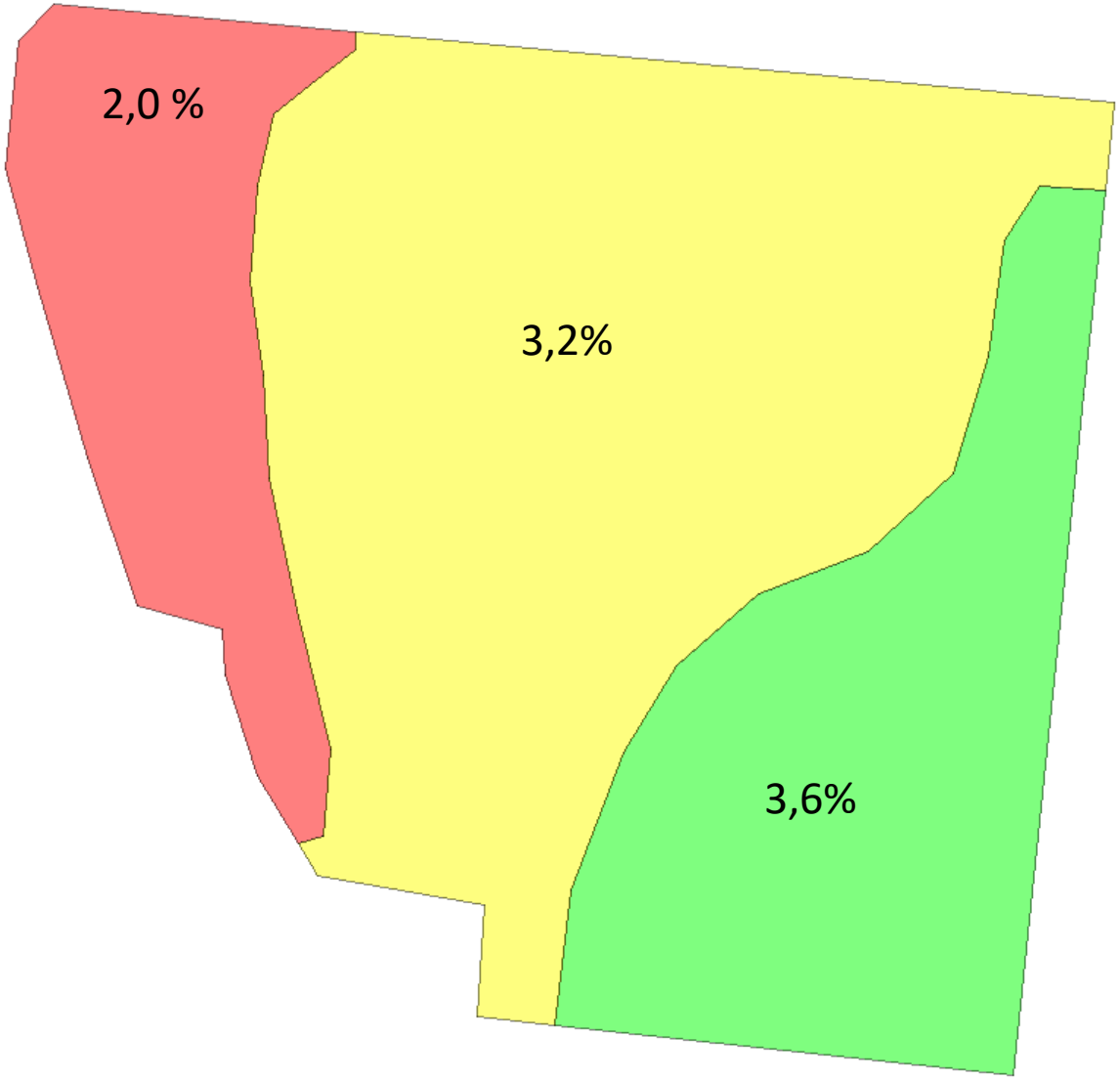
POVH, 2011

Potássio (0 – 20 cm)



POVH, 2011

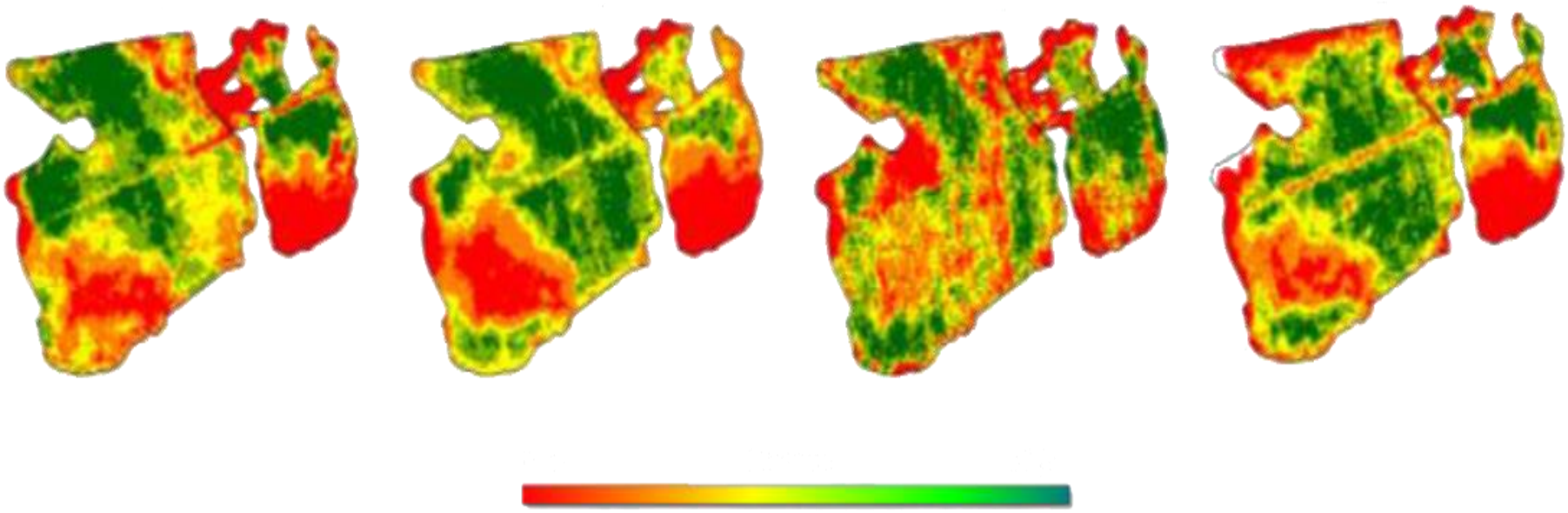
Matéria Orgânica (0 – 20 cm)



POVH, 2011

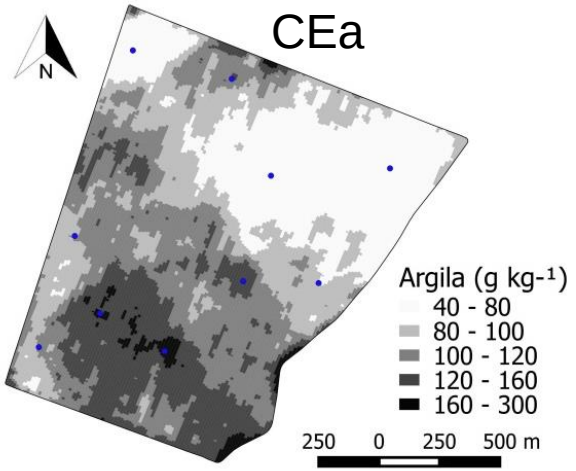
Estabilidade temporal

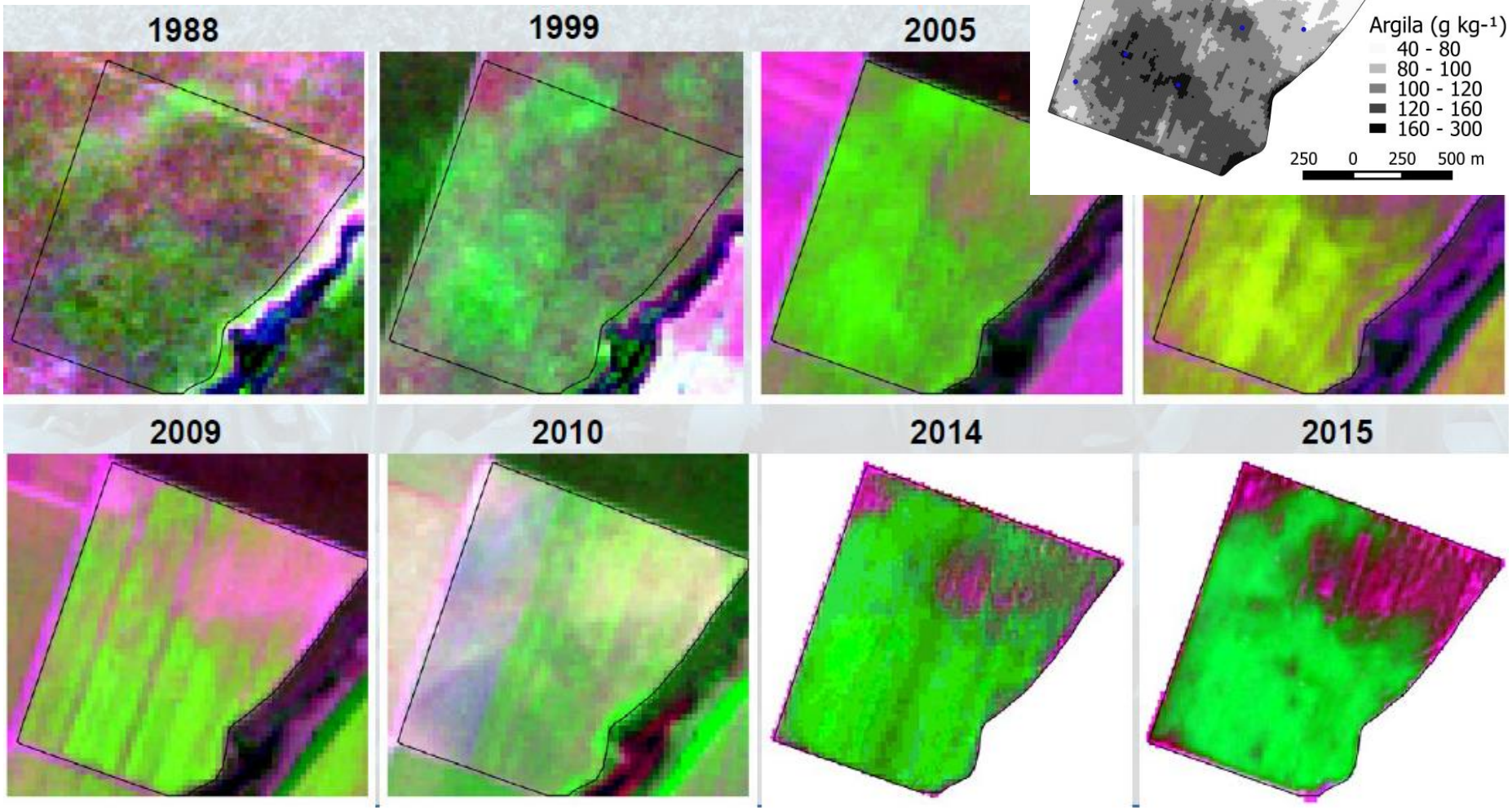
Corn 2007 | Corn 2009 | Soybeans 2010 | Corn 2010



Speken, et. al. 2015

Estabilidade temporal

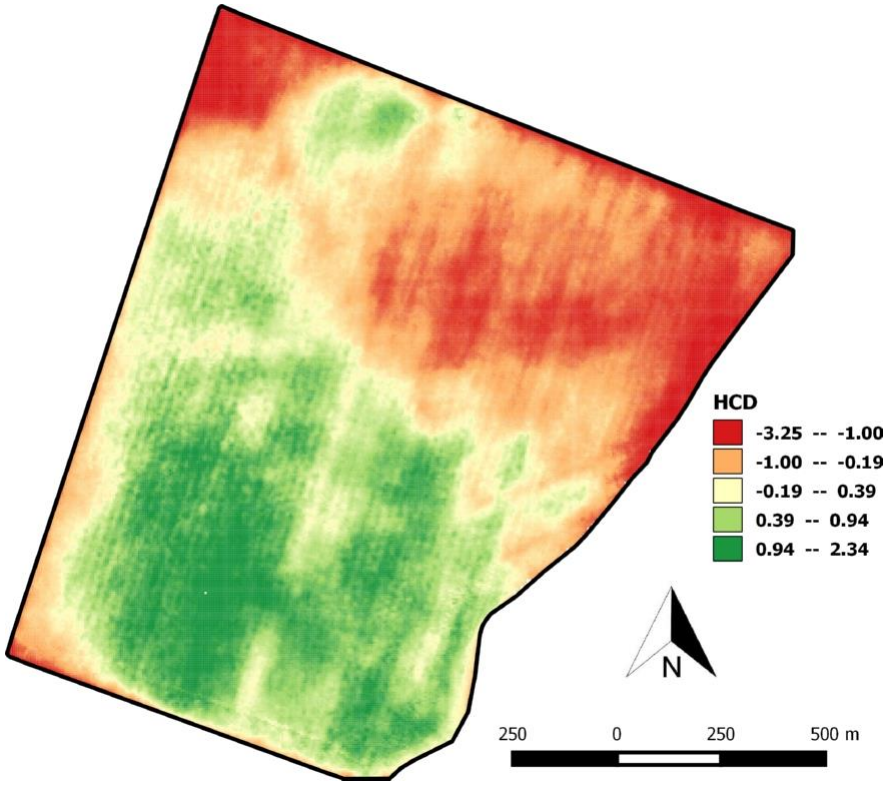


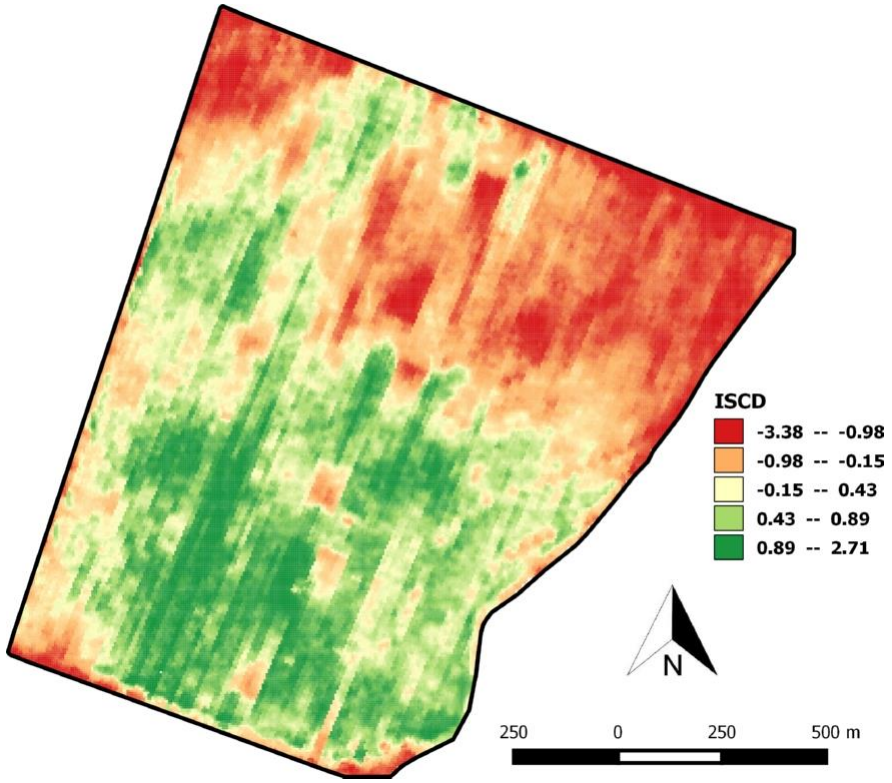


Trevisam, R. (2018)

12 historical NDVI maps

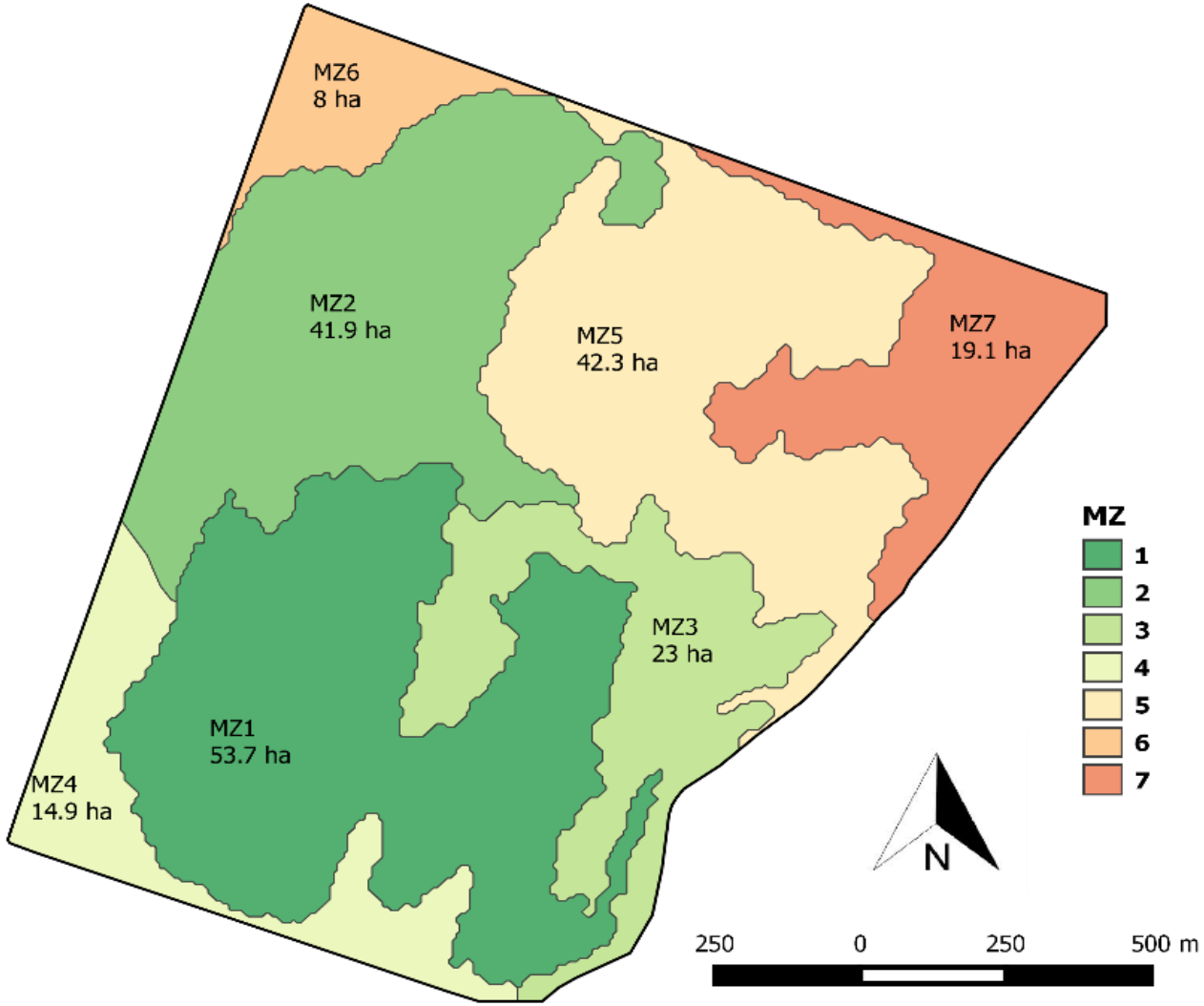
N-Sensor, satellite derived NDVI and ultrasonic measured crop height at mid-season and pre-harvest





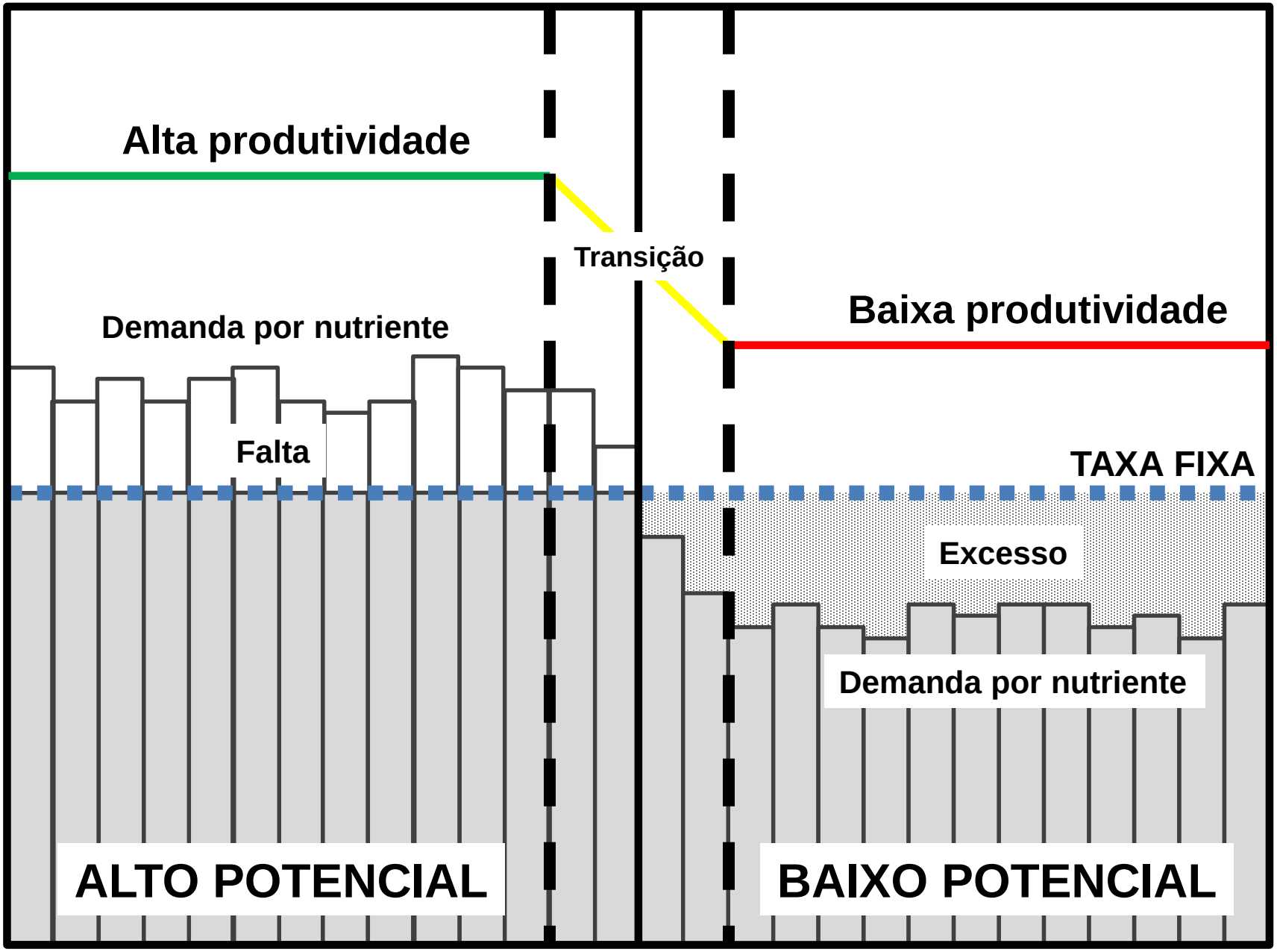
Maps of the first pair of latent variables from the canonical correlation analysis, representing historical crop development (HCD) and in season crop development (ISCD) for a cotton field in Campo Verde – Mato Grosso – Brazil

Trevisam, R. (2016)

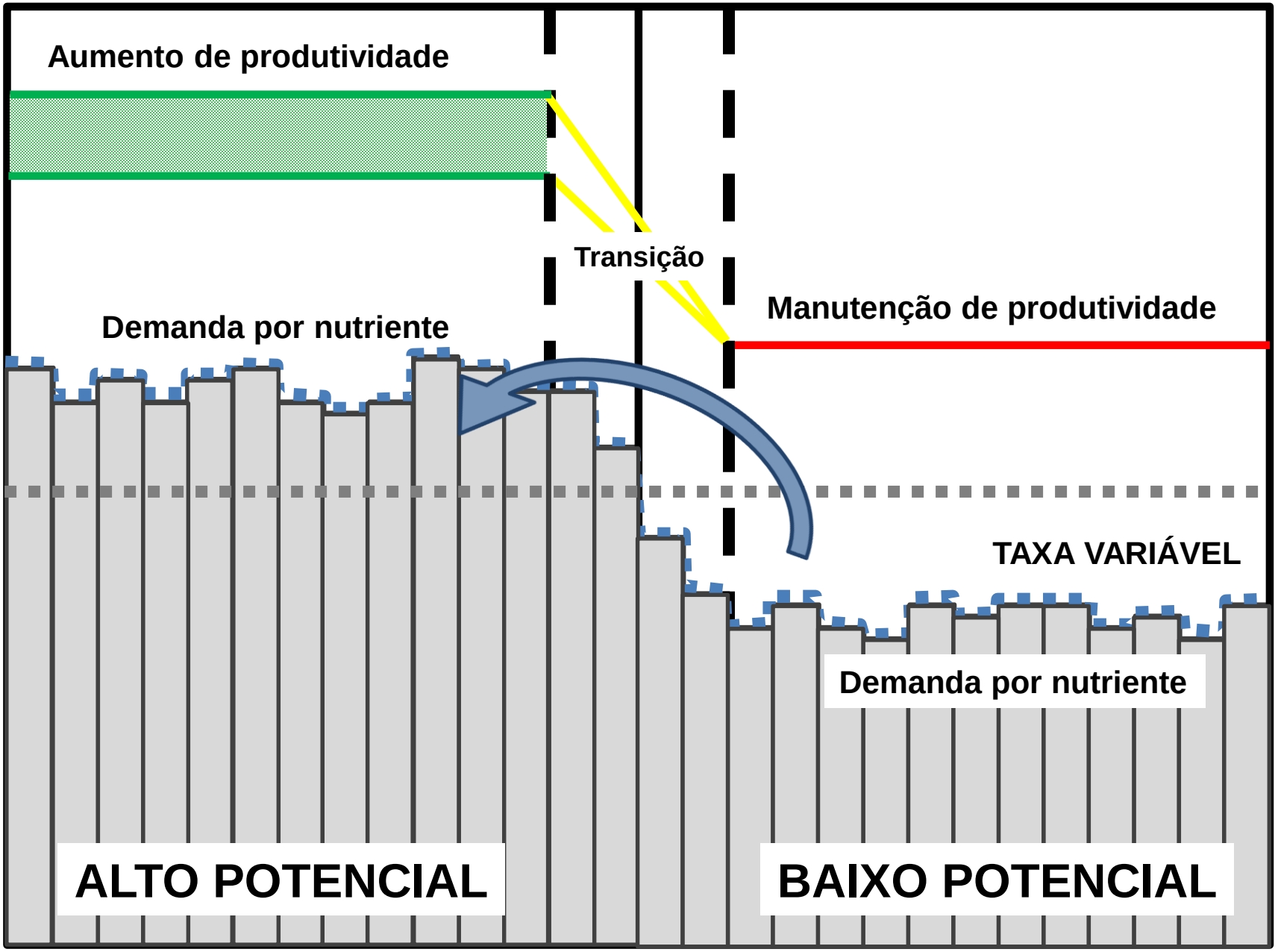


Map of the management zones delineated for a cotton field in Campo Verde – Mato Grosso – Brazil

Trevisam, R. (2016)


Alta produtividade
Transição
Baixa produtividade
Demanda por nutriente
Falta
TAXA FIXA
Excesso
Demanda por nutriente
ALTO POTENCIAL
BAIXO POTENCIAL

COLAÇO (2015)


Aumento de produtividade
Transição
Manutenção de produtividade
Demanda por nutriente
TAXA VARIÁVEL
Demanda por nutriente
ALTO POTENCIAL
BAIXO POTENCIAL

COLAÇO (2015)

Amostragem por células (sem interpolação)

