

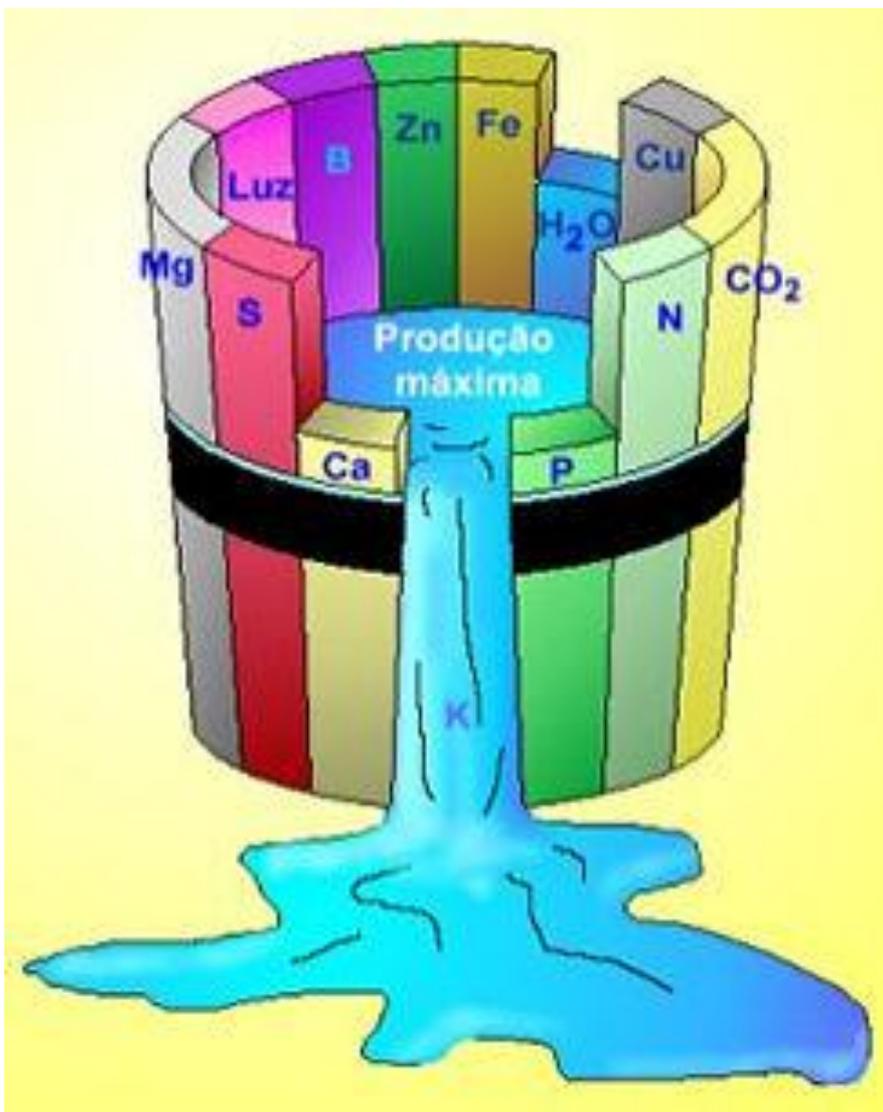
Amostragens georreferenciadas

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 **LAP**
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Objetivo

Abordar os temas relacionados às amostragens georreferenciadas em geral e em especial de solo, enfocando as técnicas e as limitações dos métodos atuais



Lei de Liebig (dos Mínimos)
ampliada e georreferenciada que
visa regularizar os teores no solo

...

Outros fatores de produção
devem ser lembrados:

compactação do solo
pragas
doenças

...

TEST YOUR SOIL FOR ACIDITY

BY C. M. LINSLEY AND
F. C. BAUER

THE
UNIVERSITY OF ILLINOIS
NOV 29 1929

UNIVERSITY OF ILLINOIS
LIBRARY-CHEMISTRY



University of Illinois
College of Agriculture and Agricultural Experiment Station
Circular 346

Linsley & Bauer (1929)

Levar o laboratório ao campo...



FIG. 5.—COLLECTING SAMPLES

If the envelopes or paper sacks are used, 1 tablespoonful of soil should be collected. If testing bottles are used, the bottles should be filled full. Surface samples should be collected from a depth of 4 to 2 inches, subsurface samples from a depth of 12 inches, and subsoil samples from 20 inches.

vided at the bottom of the map diagram. If carbonates are present, bubbling or effervescence will take place.

CAUTION: Do not handle hydrochloric acid or make any tests with it

The color chart on page 2 of this circular will be of assistance in reading the results.

2. Record results of *subsurface* and *subsoil* tests as shown in Fig. 8.

3. If subsurface and subsoil samples do not show acidity, they may be tested for carbonates (limestone) with hydrochloric acid and the results recorded in the blank spaces pro-



FIG. 6.—ADDING SOLUTION

When making the test the bottles should be filled one-third full of soil and enough testing solution added to fill the bottles two-thirds full. It is important to have equal volumes of soil and solution.



FIG. 7.—MAKING THE TEST

The soil and solution should be mixed by shaking the bottles vigorously for 2 or 3 minutes. The samples should then be allowed to stand for 10 minutes, after which they should be read.

Number of Samples to Collect

Twenty-three surface samples collected from a 40-acre field according to the systematic plan described below and 5 subsurface and 5 subsoil samples should locate the areas of sweet and acid soil fairly

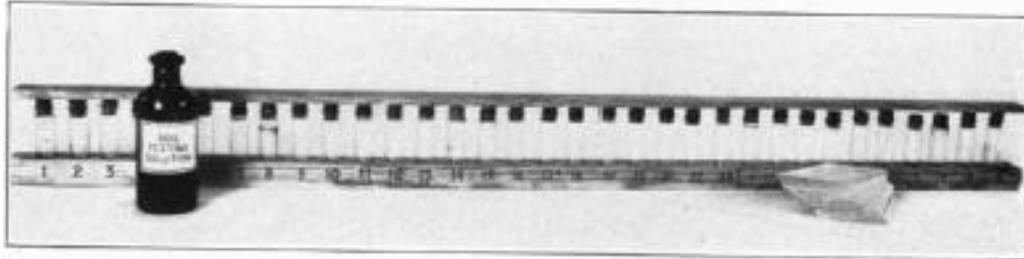
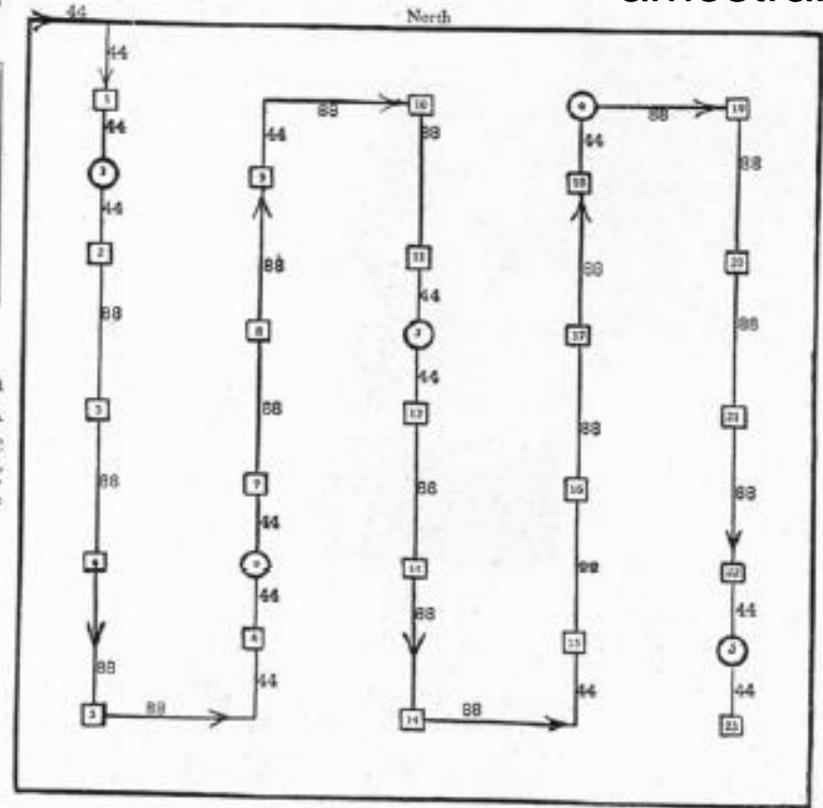


FIG. 3.—EQUIPMENT FOR MAKING SYSTEMATIC TEST OF SOIL FOR ACIDITY

Thirty-three small bottles are necessary in making the systematic test of a 40-acre field. A rack for holding the bottles will keep the samples in order. A thin strip of wood can be used over the tops of the bottles to hold them in place while shaking. Envelopes or small paper sacks are convenient for collecting samples, or the rack of bottles may be taken to the field and the soil samples placed in them as they are collected.

O planejamento da amostragem – a grade amostral



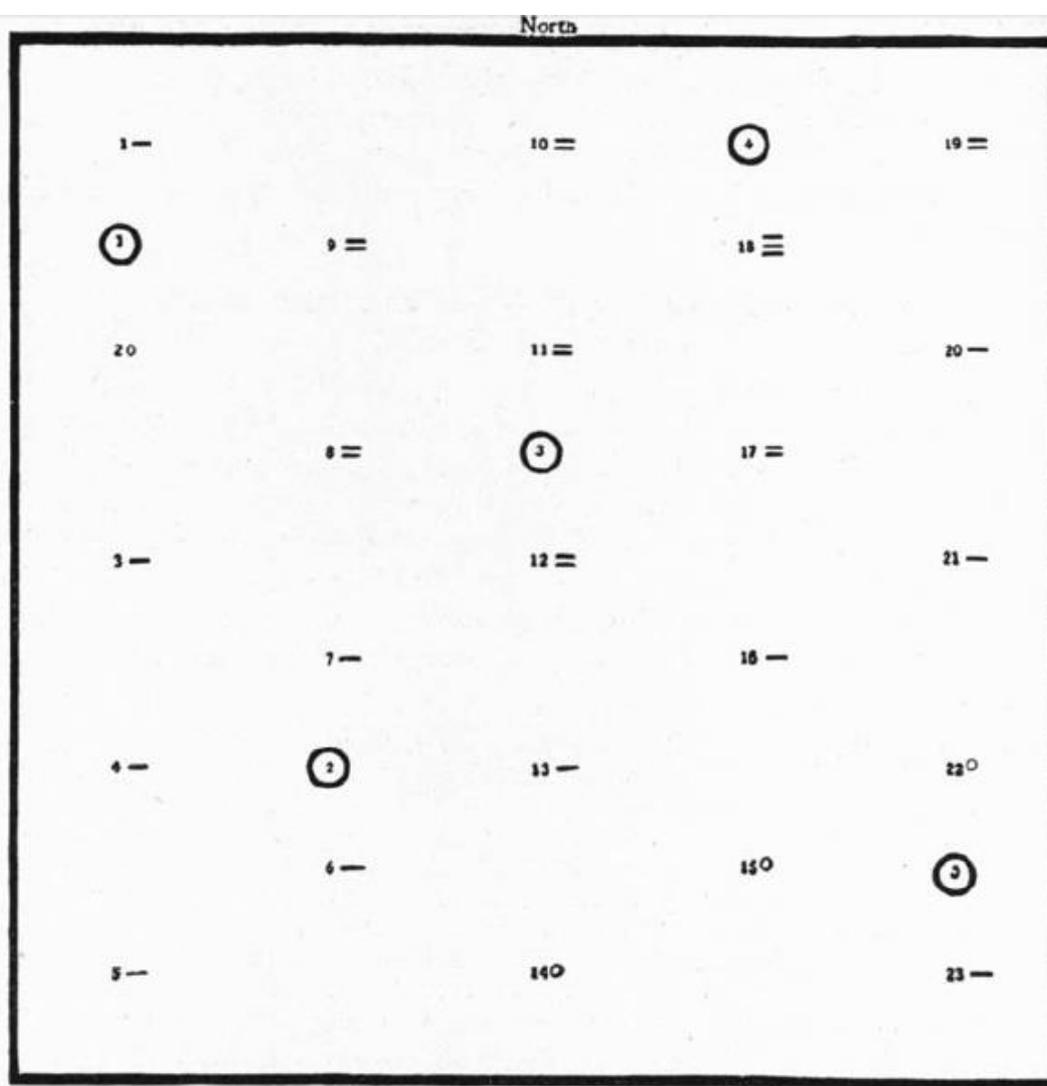
□ Take one surface sample. ○ Take one subsurface and one subsoil sample.

FIG. 4.—SOIL SAMPLING DIAGRAM FOR 40-ACRE FIELD

In taking samples, follow the lines in the direction of the arrows. The larger numbers along the lines indicate the number of 3-foot paces to take in locating the points where the samples are to be collected. The numbers in squares indicate where the 23 surface samples are taken, and the numbers in circles where the 5 subsurface and subsoil samples should be taken.

Linsley & Bauer (1929)

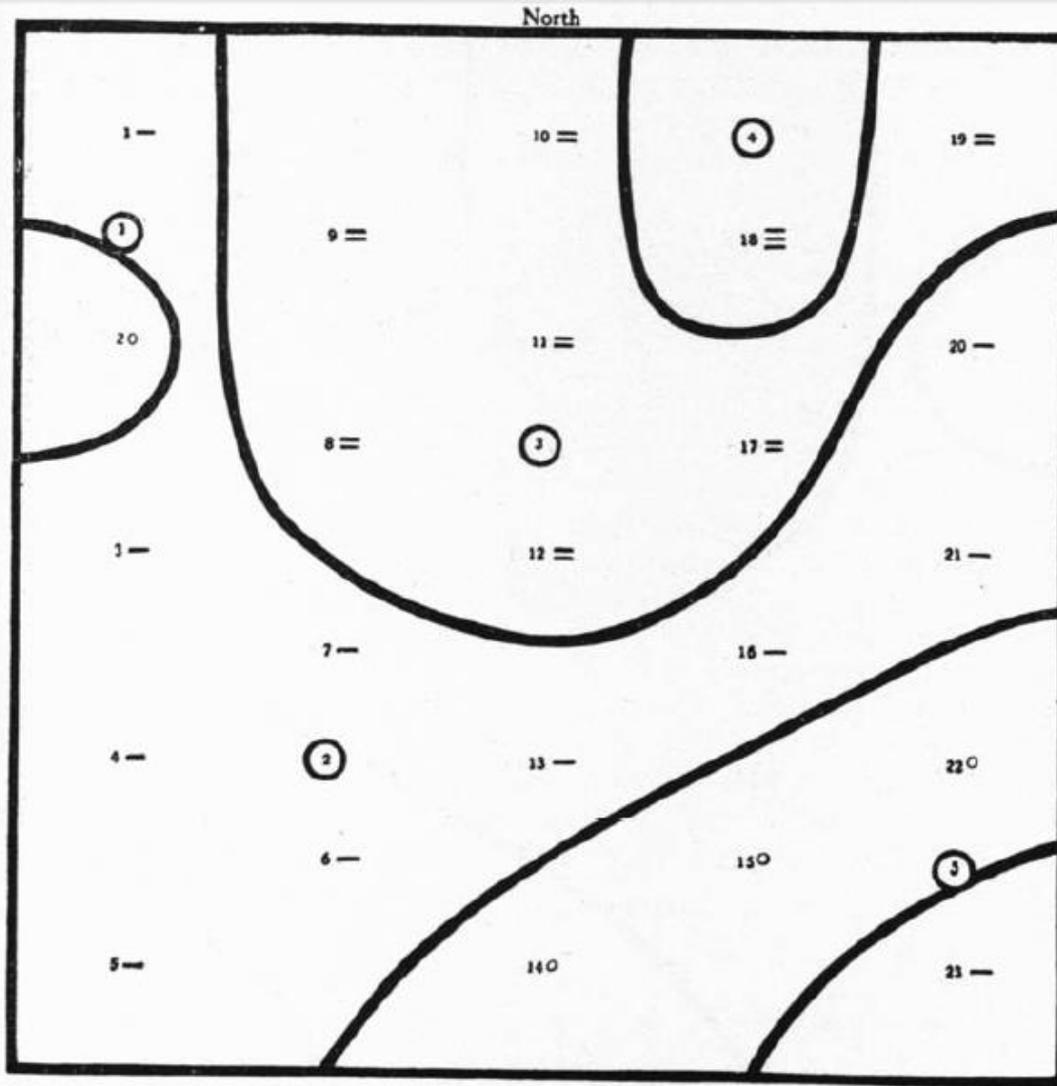
Os dados mapeados



No.	Acidity		Carbonate	
	Subsurface	Subsoil	Subsurface	Subsoil
1	-	-		
2	-	-		
3	=	=		
4	=	=		
5	-	-		

A legenda

Linsley & Bauer (1929)



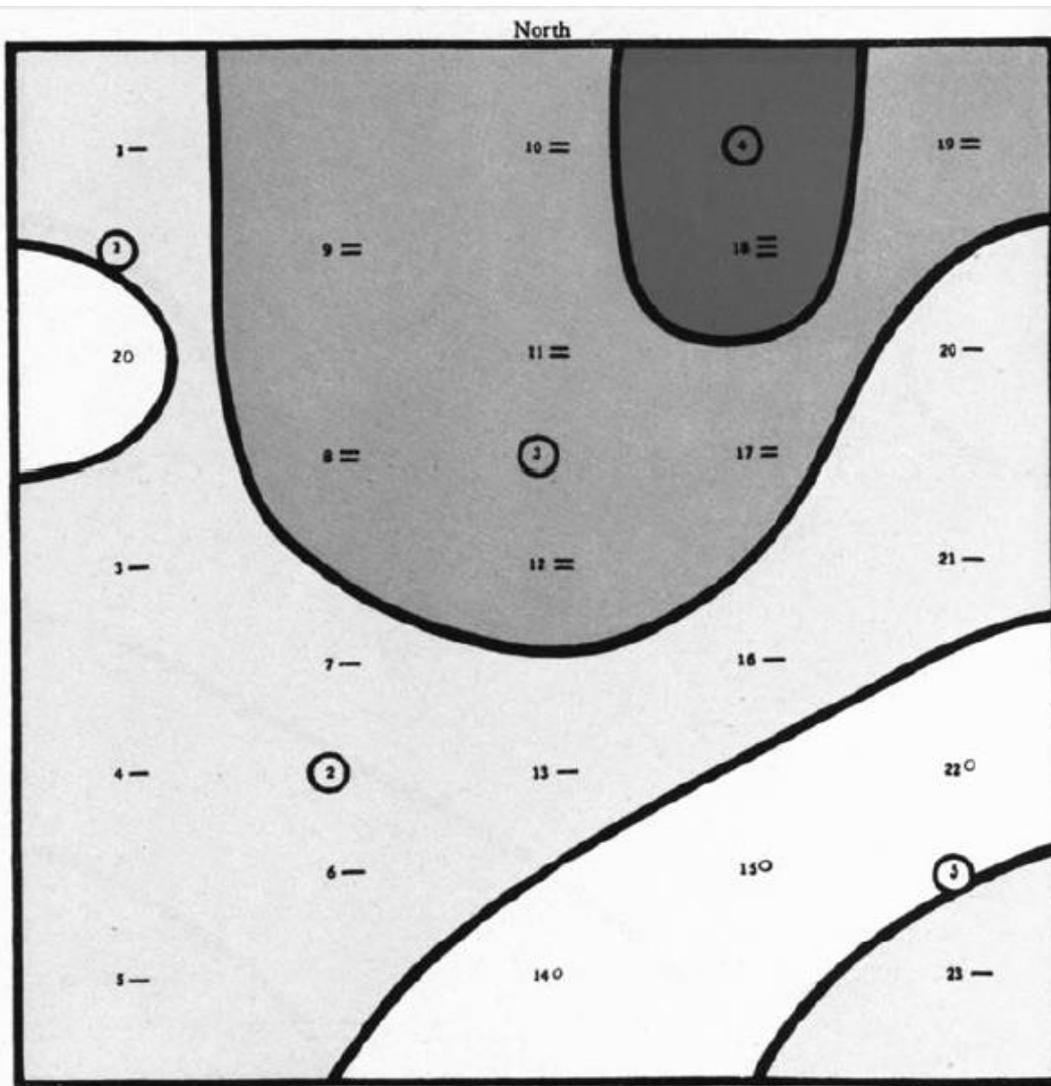
O mapa de dados interpolados – isolinhas

No.	Acidity		Carbonate	
	Subsurface	Subsoil	Subsurface	Subsoil
1	-	-		
2	-	-		
3	=	=		
4	=	=		
5	-	-		

A legenda

Linsley & Bauer (1929)

A prescrição de calcário



No.	Acidity		Carbonate	
	Subsurface	Subsoil	Subsurface	Subsoil
1	-	-		
2	-	-		
3	=	=		
4	=	=		
5	-	-		

A legenda

Linsley & Bauer (1929)

Outros estudos de casos

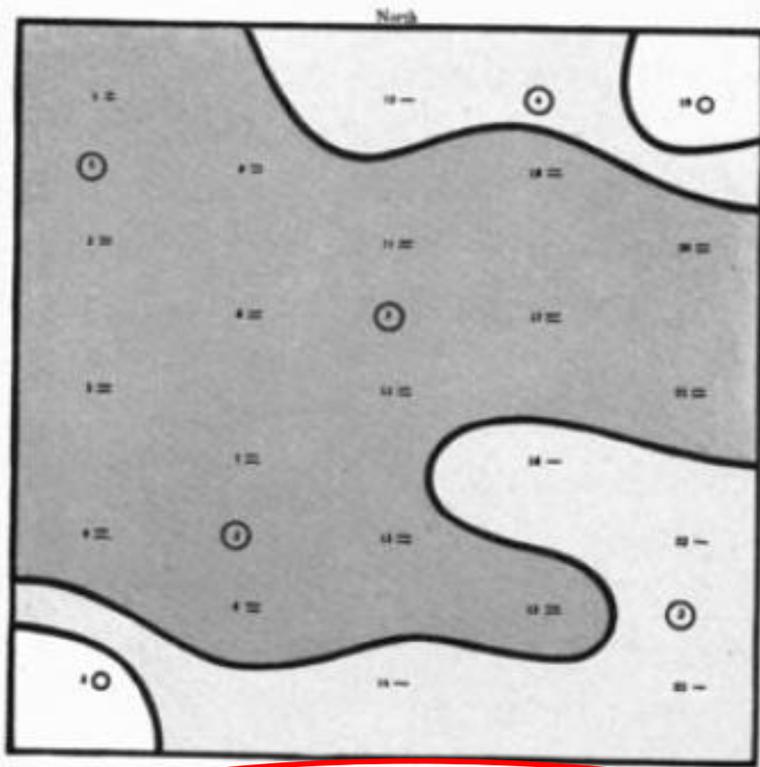


FIG. 11.—A FIELD ON WHICH THE SOIL WAS PRACTICALLY ALL ACID

Altho the systematic test of such a field does not mean much saving in limestone, it does show how much limestone should be applied on the areas of various degrees of acidity.

Linsley & Bauer (1929)

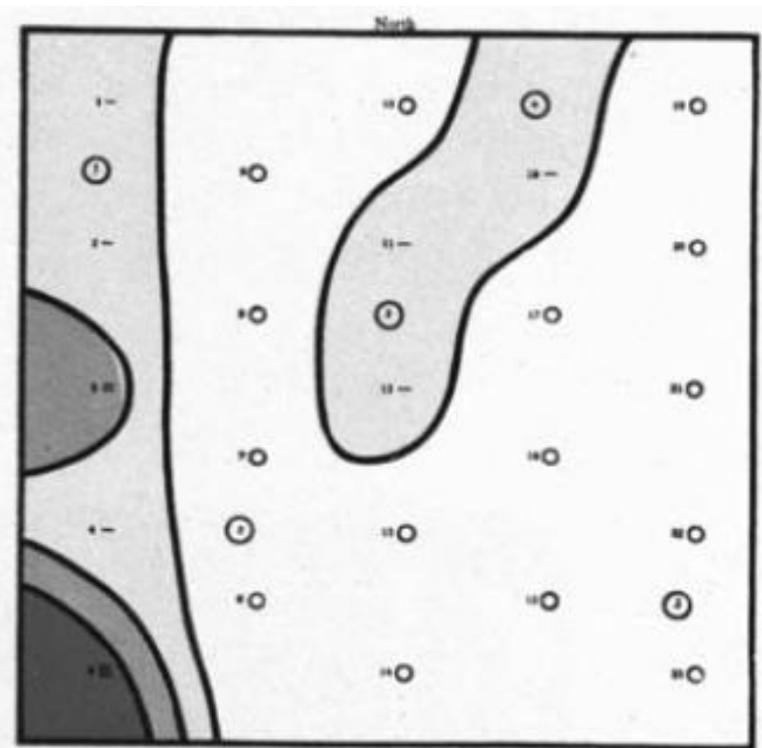


FIG. 12.—A FIELD ON WHICH THE SOIL TEST SAVED 90 TONS OF LIMESTONE

The owner of this 40-acre field had planned to apply 3 tons of limestone to the acre. The systematic test showed that approximately 30 acres were sweet. This knowledge meant a saving of 90 tons of limestone.

60 anos sem novidades...

... o próximo registro de **amostragem georreferenciada** para a geração de mapas de atributos químicos do solo (**usando geoestatística**) é de **1988**, pelo Prof. David Mulla, Minneapolis.

Amostragem georreferenciada

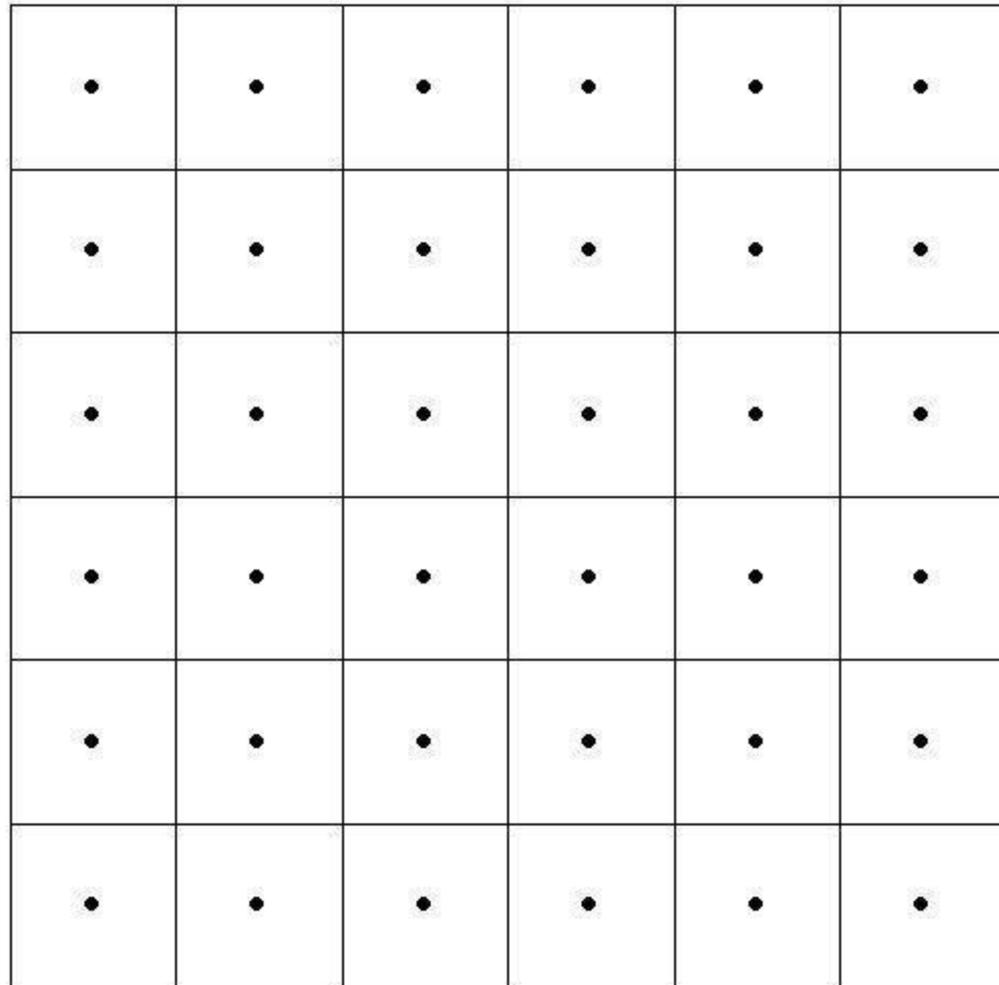
Destaque para a amostragem de solo

Métodos de Amostragem

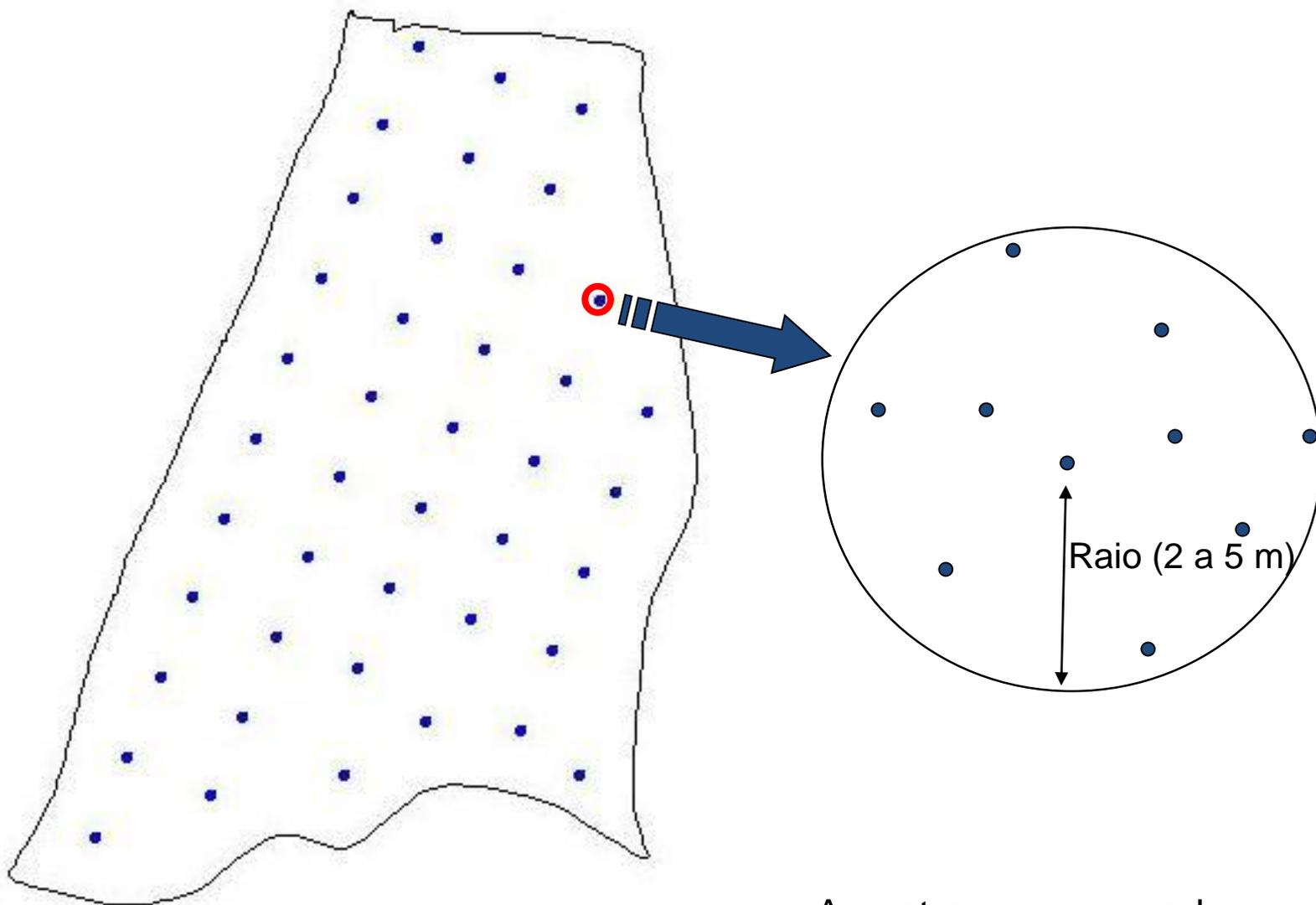
Sem conhecimento prévio da área

- Amostragem em grade
 - por ponto

Pontos normalmente gerados a partir de uma grade regular

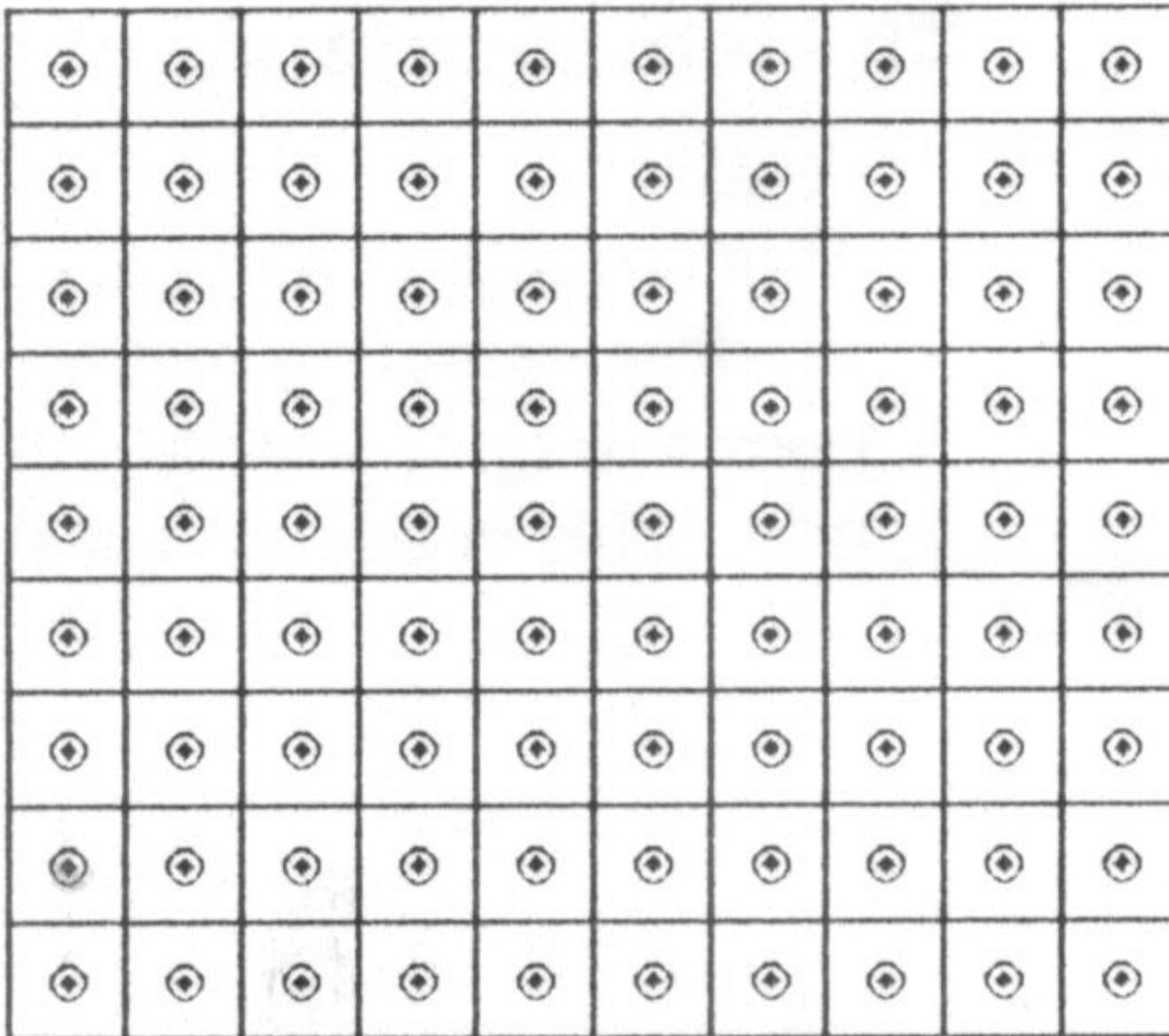


Amostragem em grade, por pontos

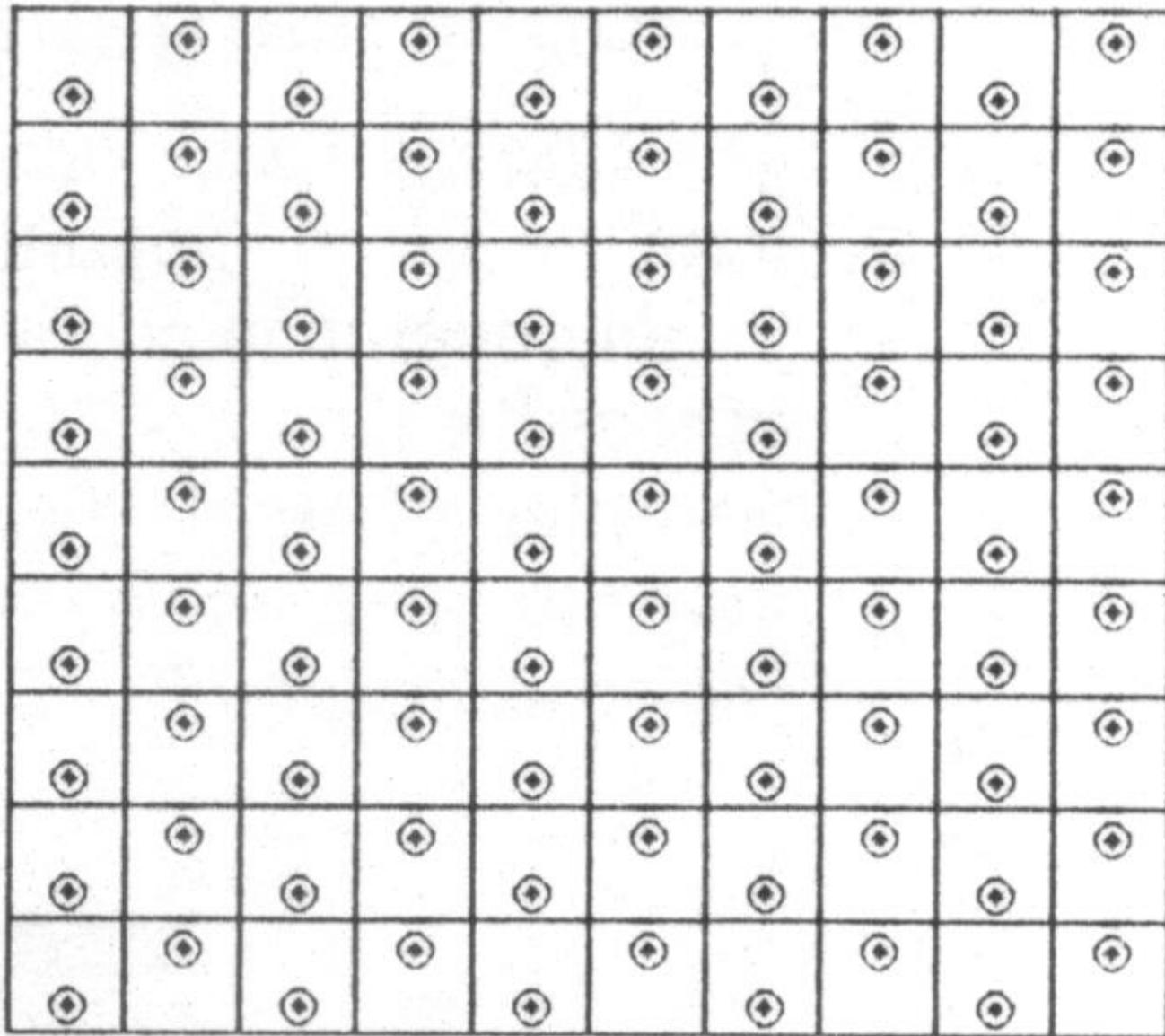


Amostragem em grade, por pontos

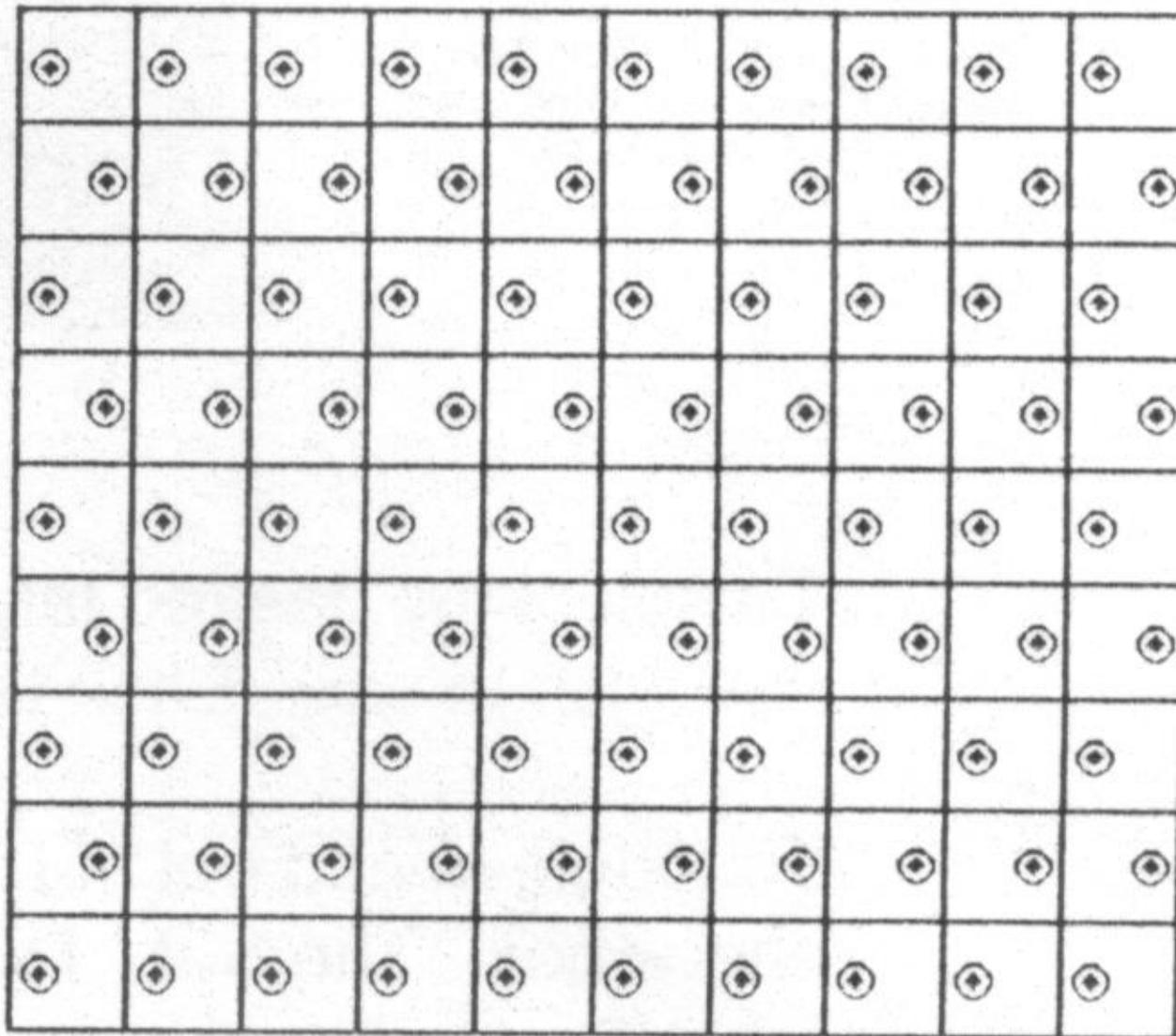




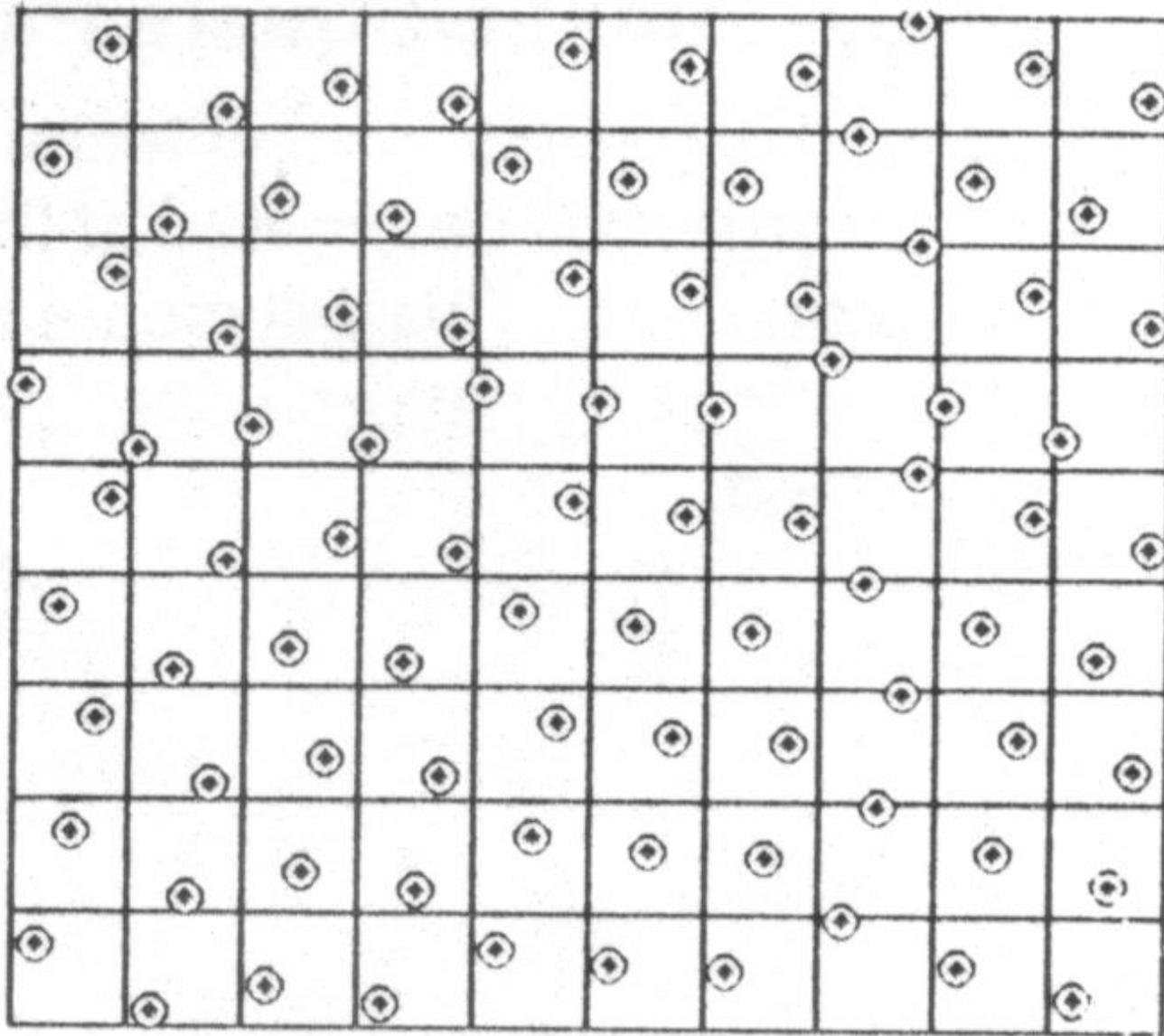
Amostragem em grade regular ou sistemática



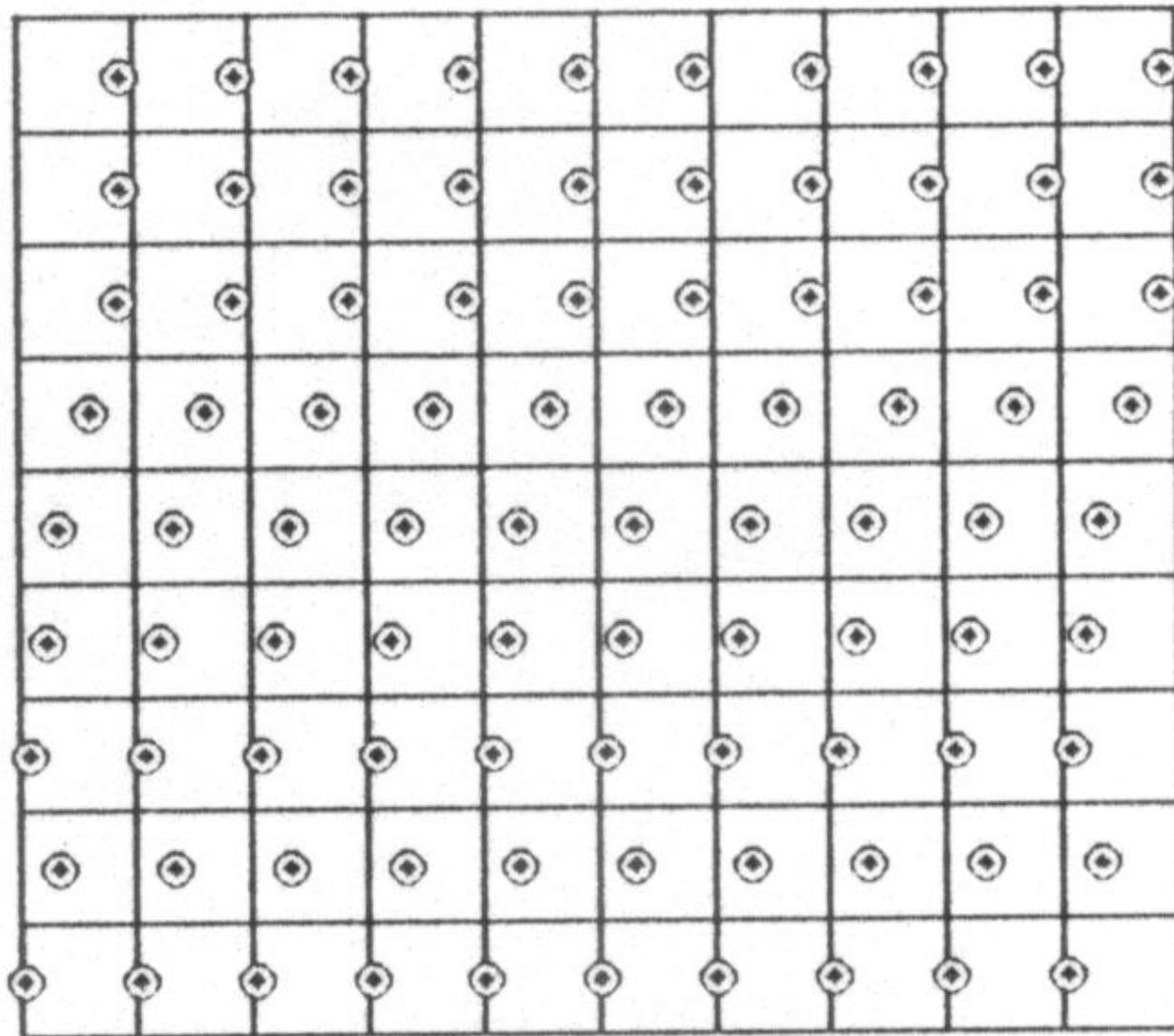
Amostragem em “diamante” fixo e “X”



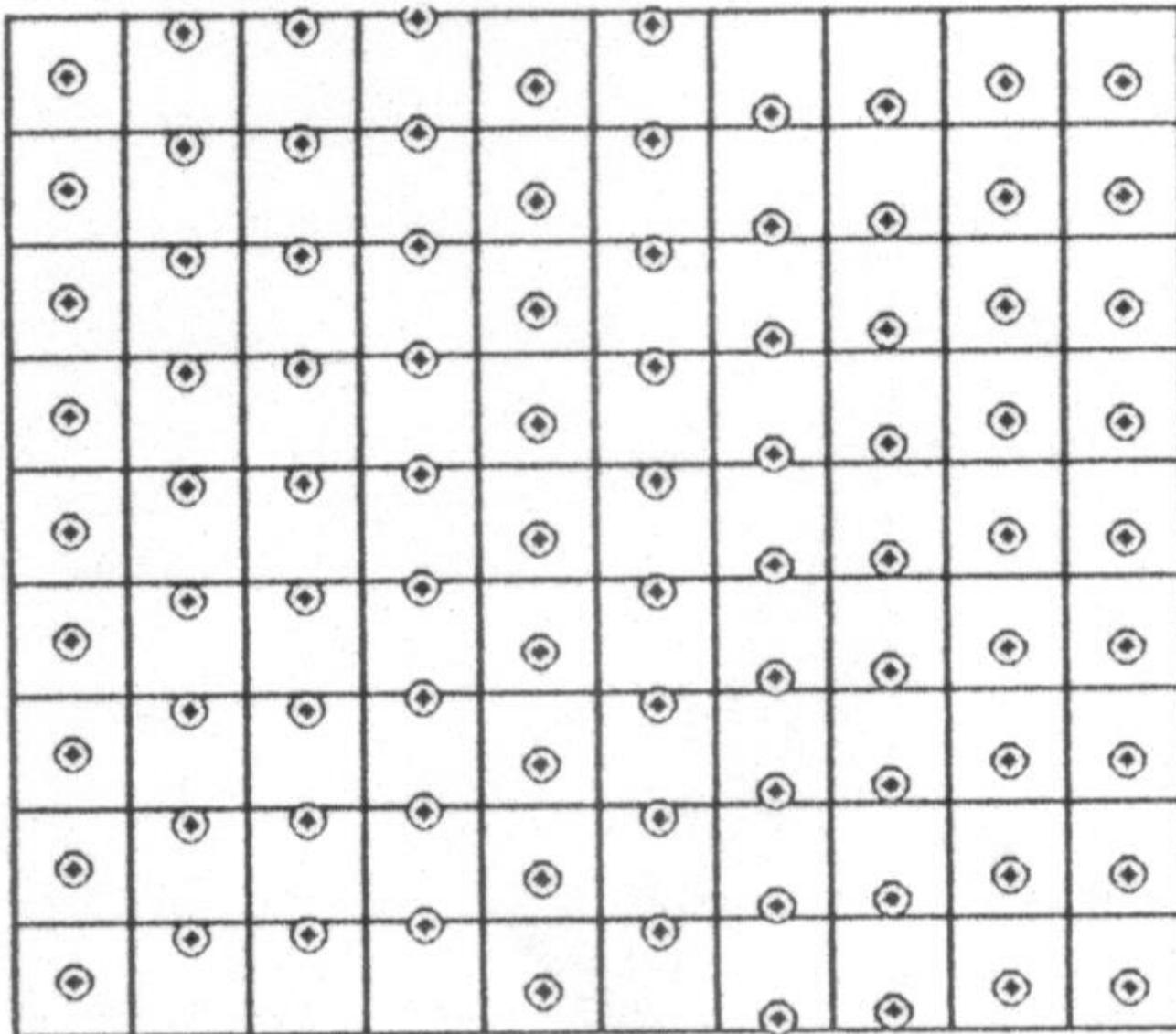
Amostragem em “diamante” fixo e “Y”



Amostragem randômica por célula



Amostragem randômica em “X”



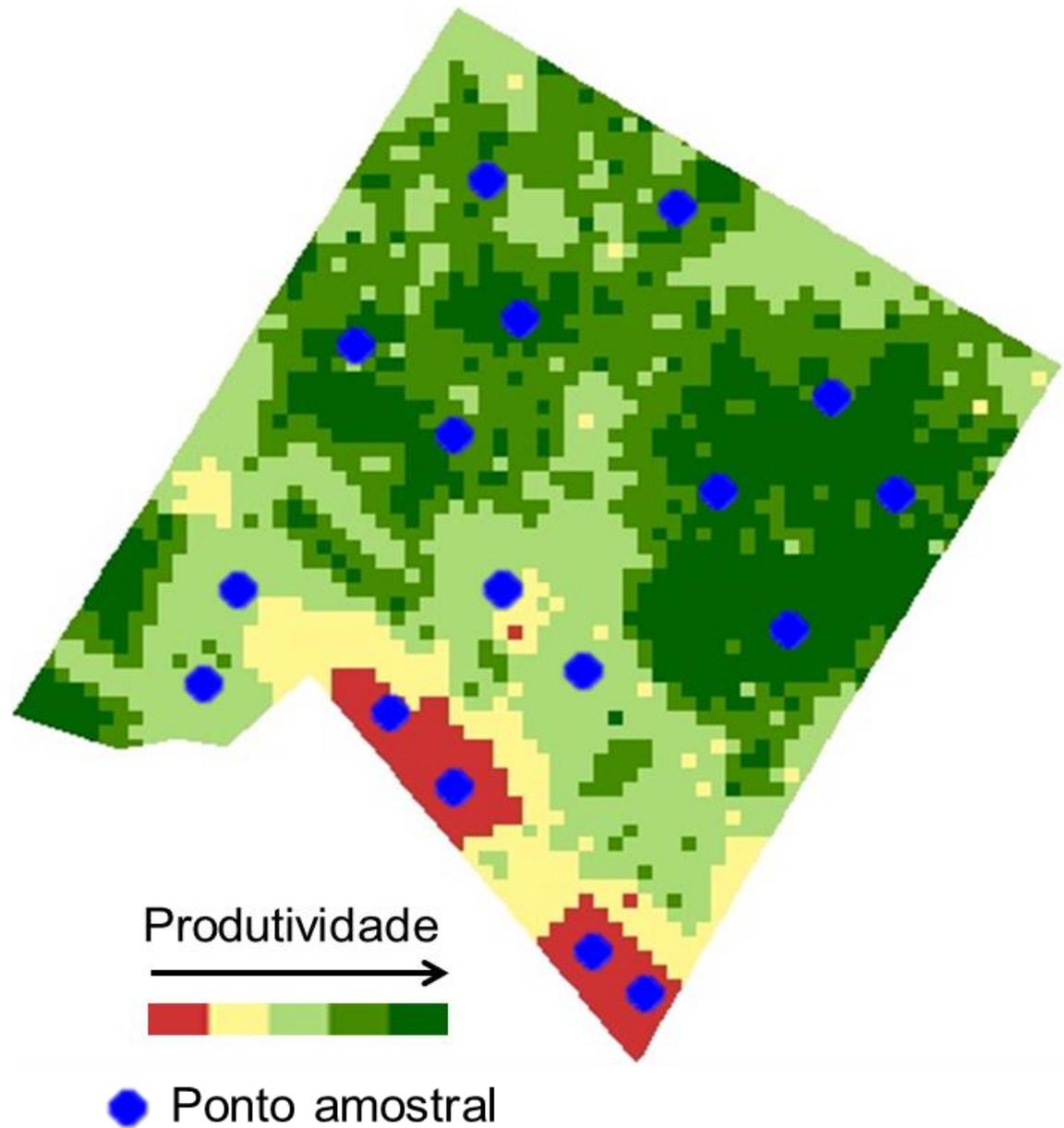
Amostragem randômica em "Y"

Métodos de Amostragem

Com algum conhecimento prévio da área

- Amostragem em grade
 - por ponto “guiado”

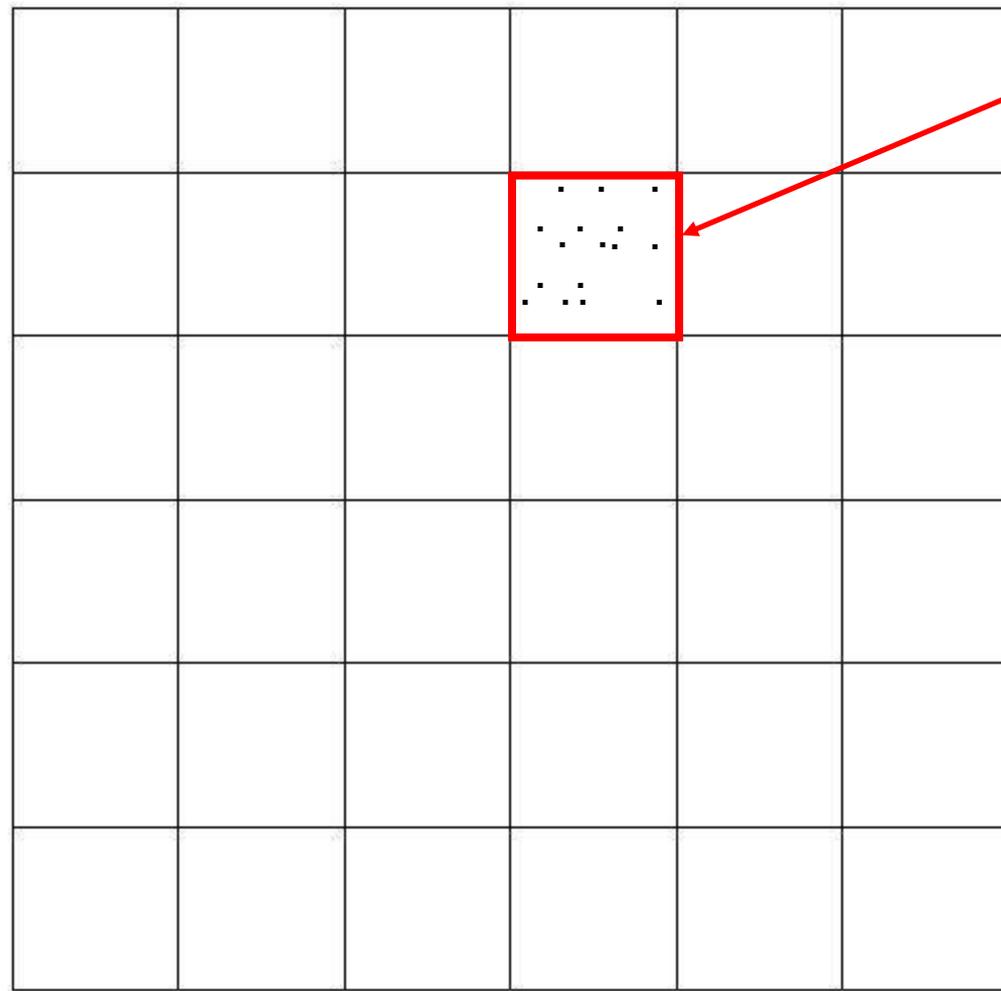
Ex.: amostragem
direcionada pelo
mapa de
produtividade



Métodos de Amostragem

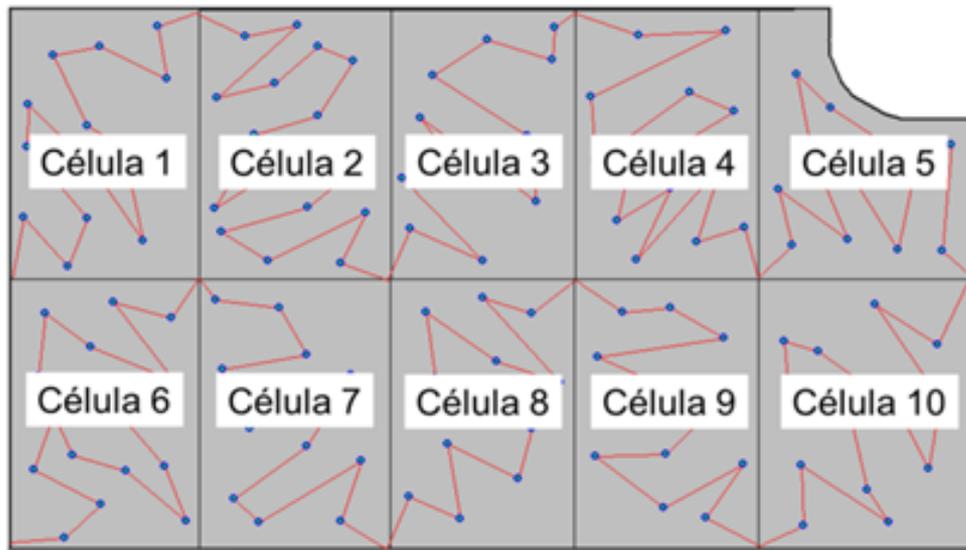
Sem conhecimento prévio da área

- Amostragem em grade
 - por ponto
 - por célula



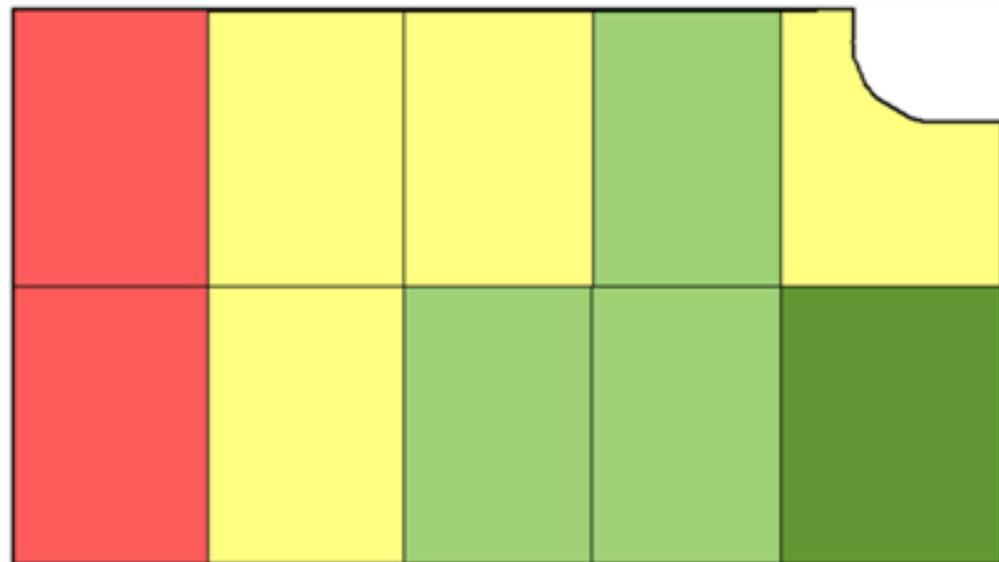
Célula amostral

Amostragem por célula



— Caminhamento em zigue-zague

● Subamostras

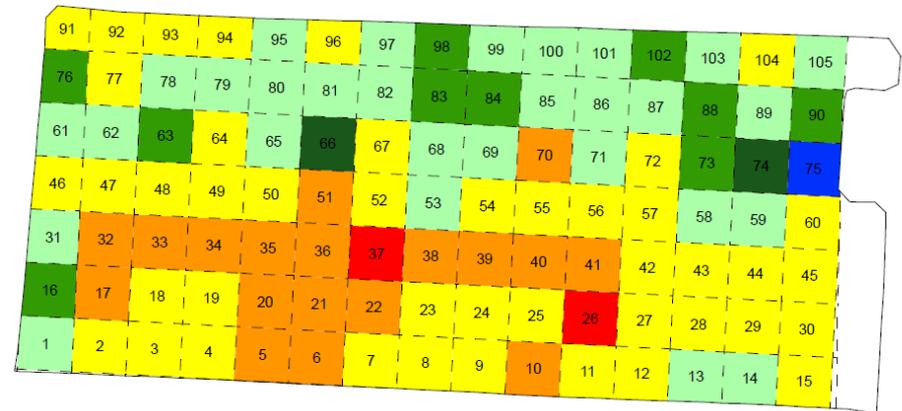
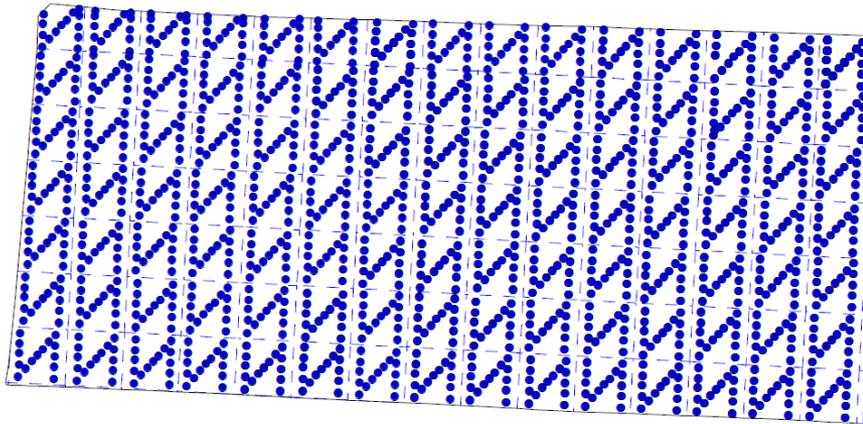
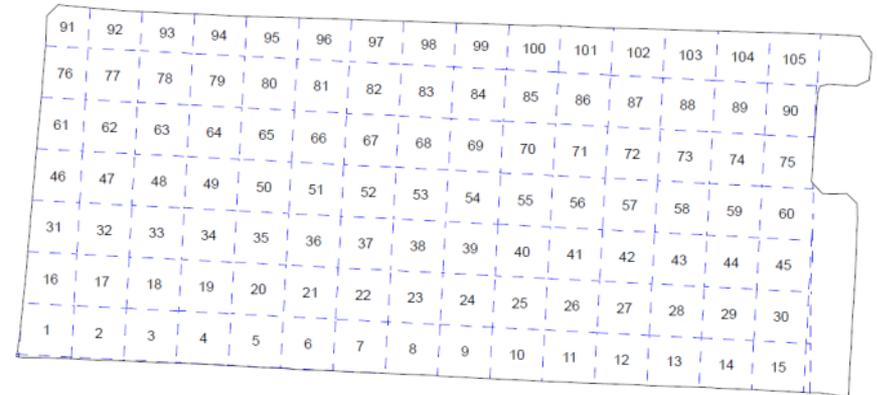


V (%)

- 40 a 50
- 50 a 60
- 60 a 70
- 70 a 80

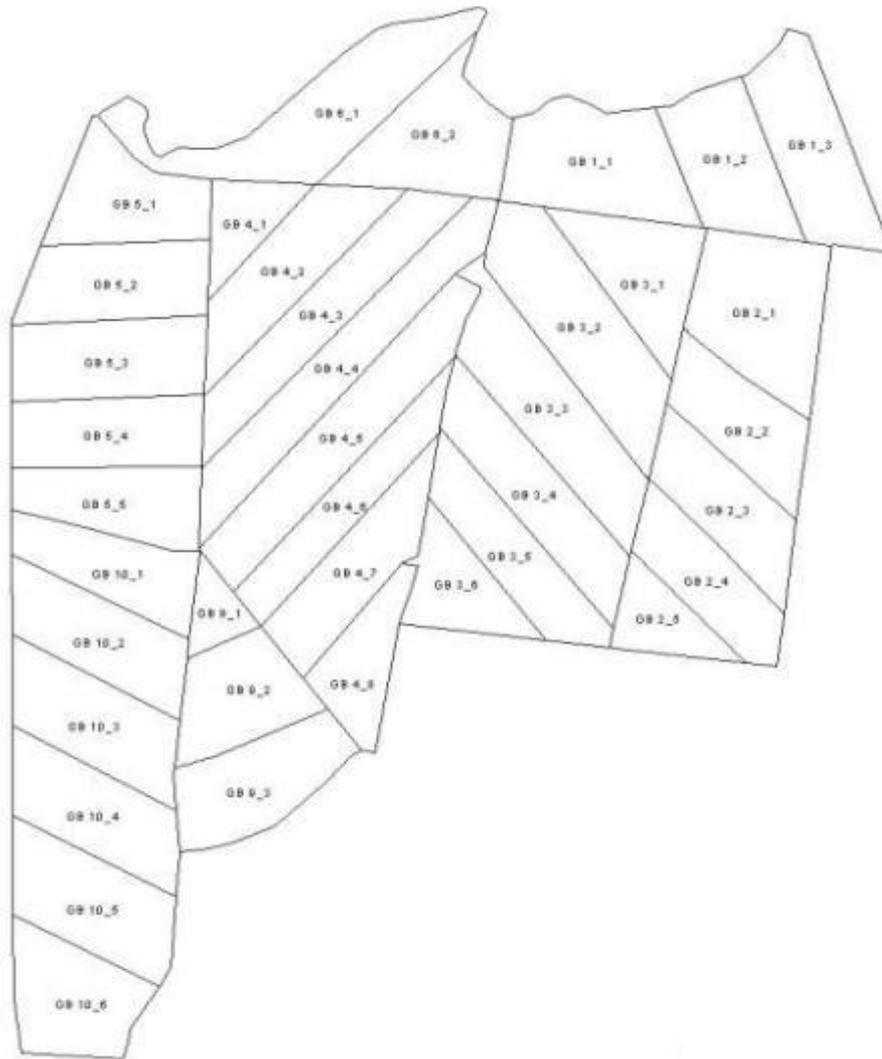
Amostragem em célula

- Maior número de subamostras
- Maior tempo de coleta
- Menor resolução
- Menor densidade
- Menor frequência

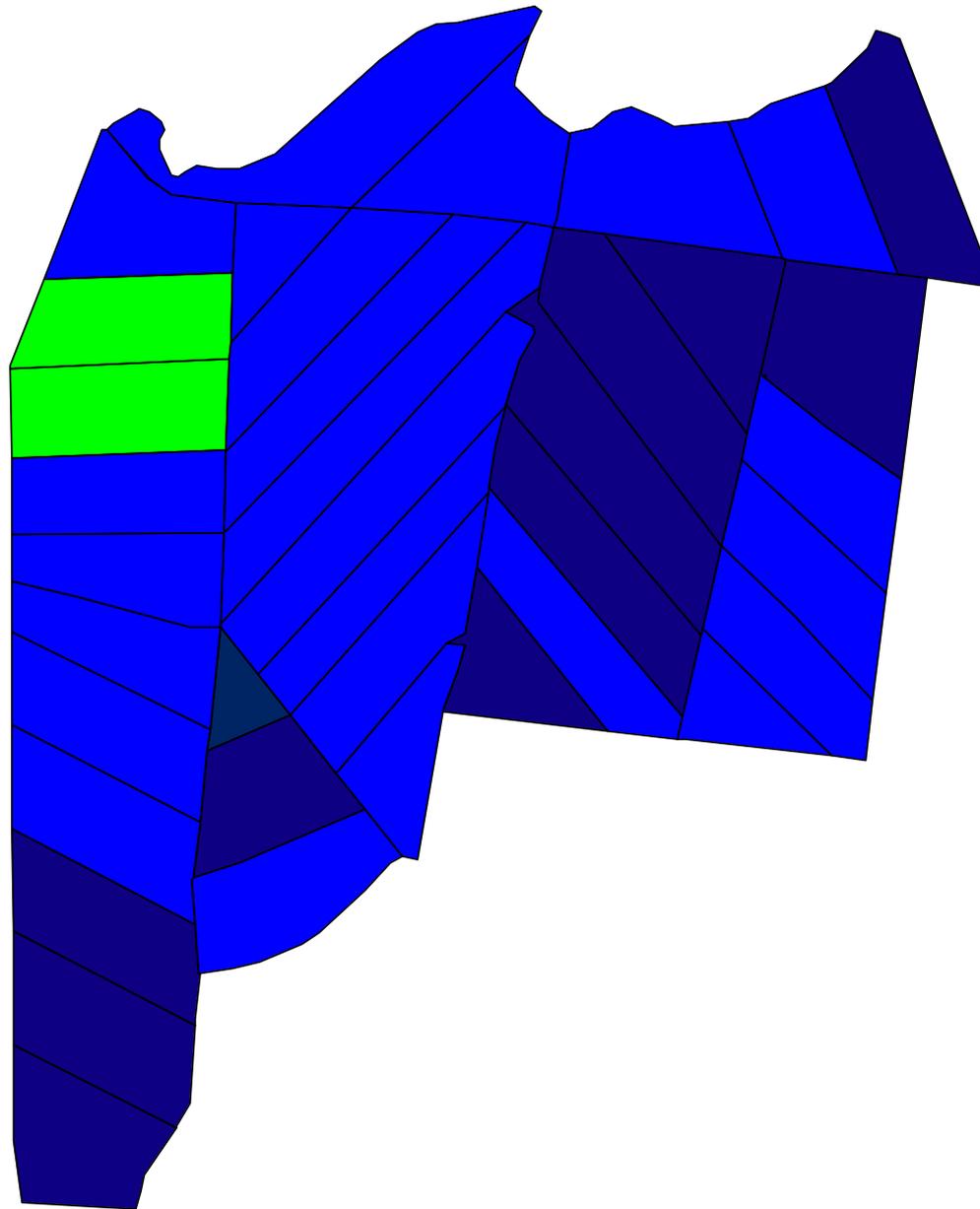
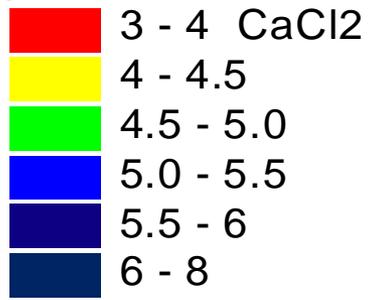


Gimenez, 2013

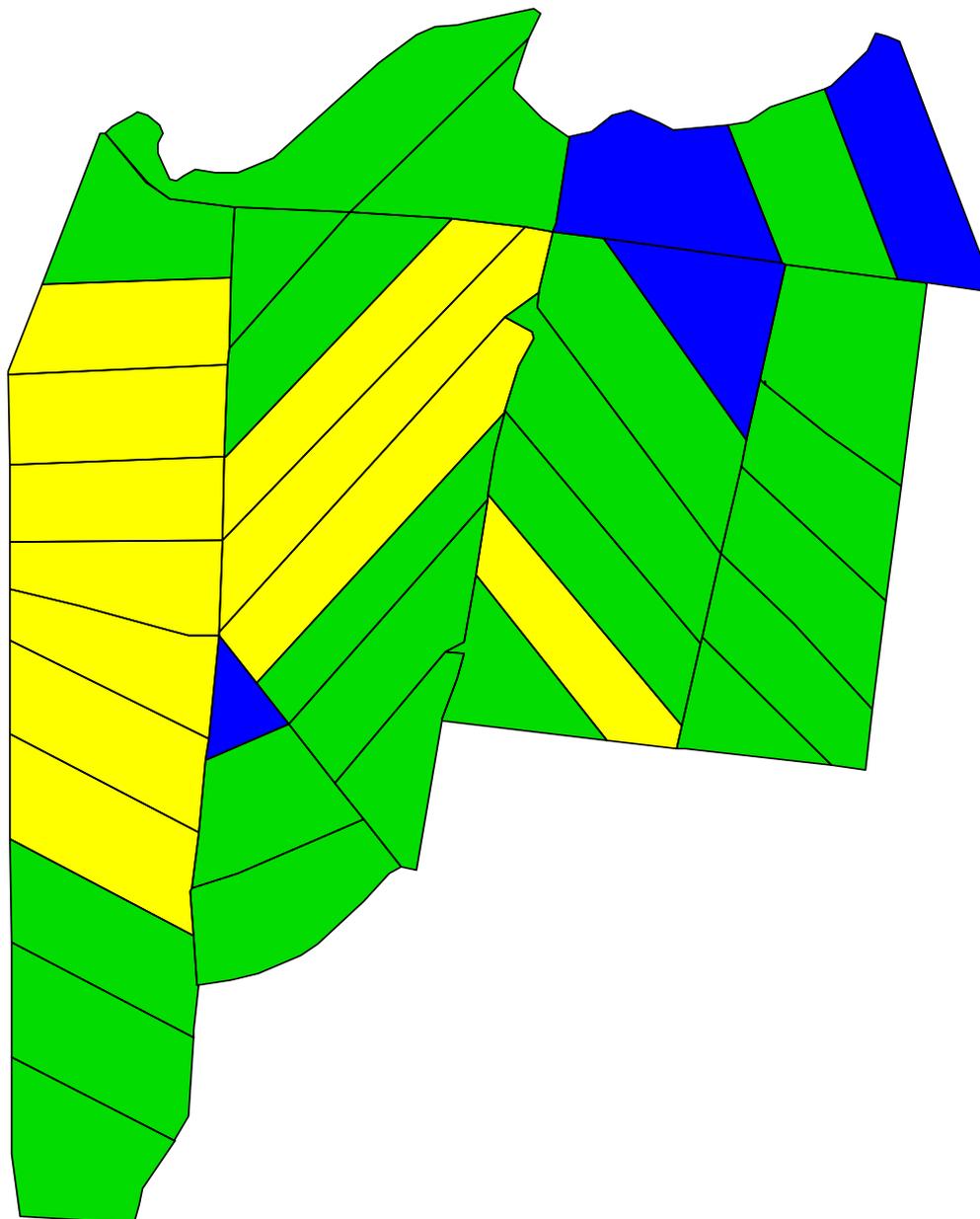
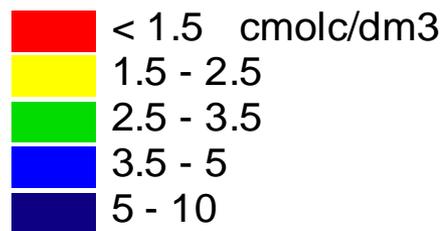
Amostragem em células



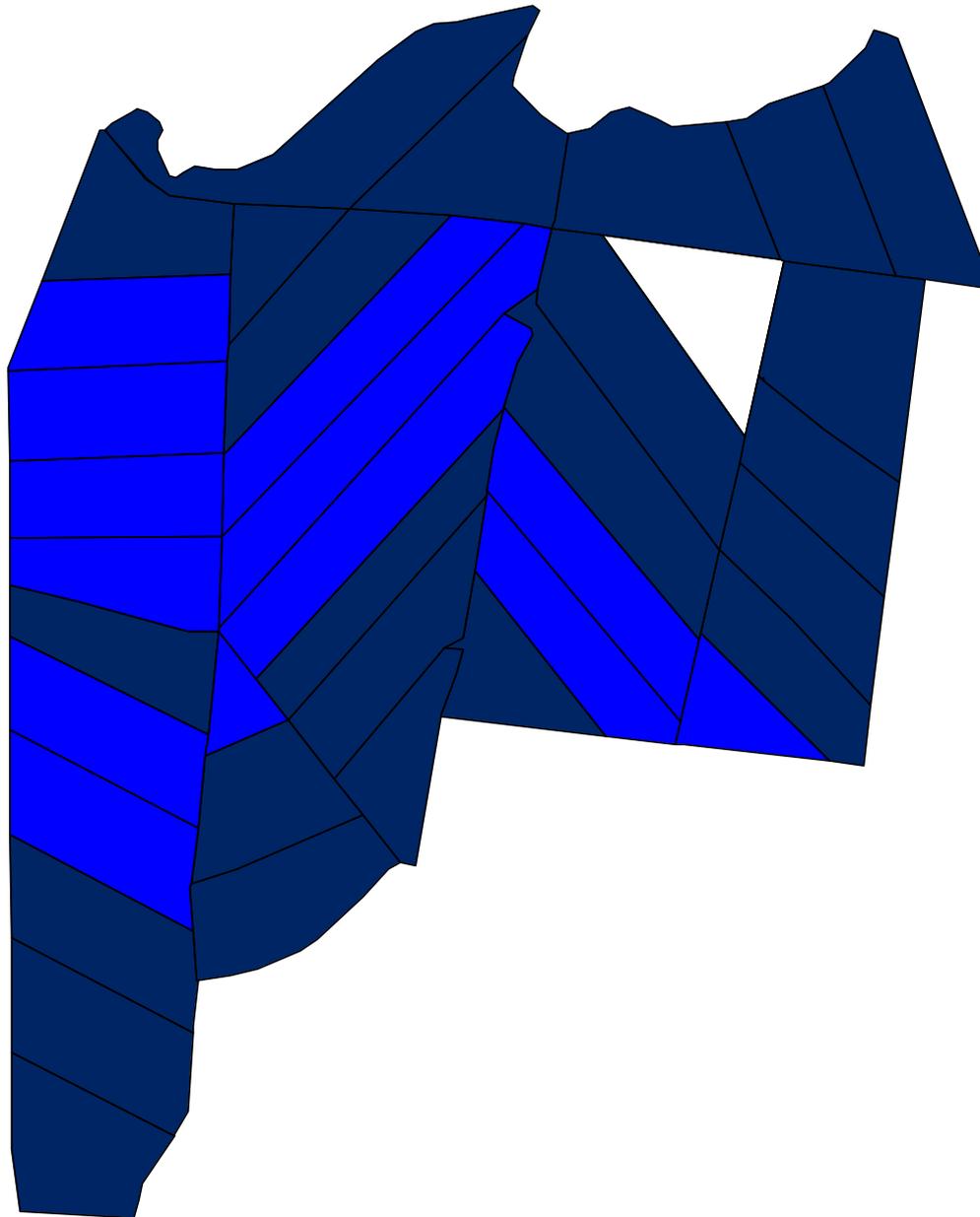
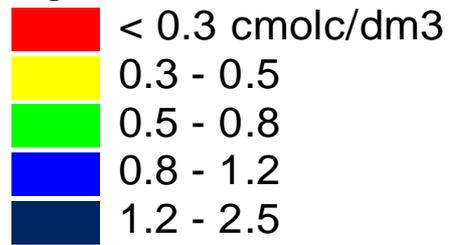
pH 0 20cm



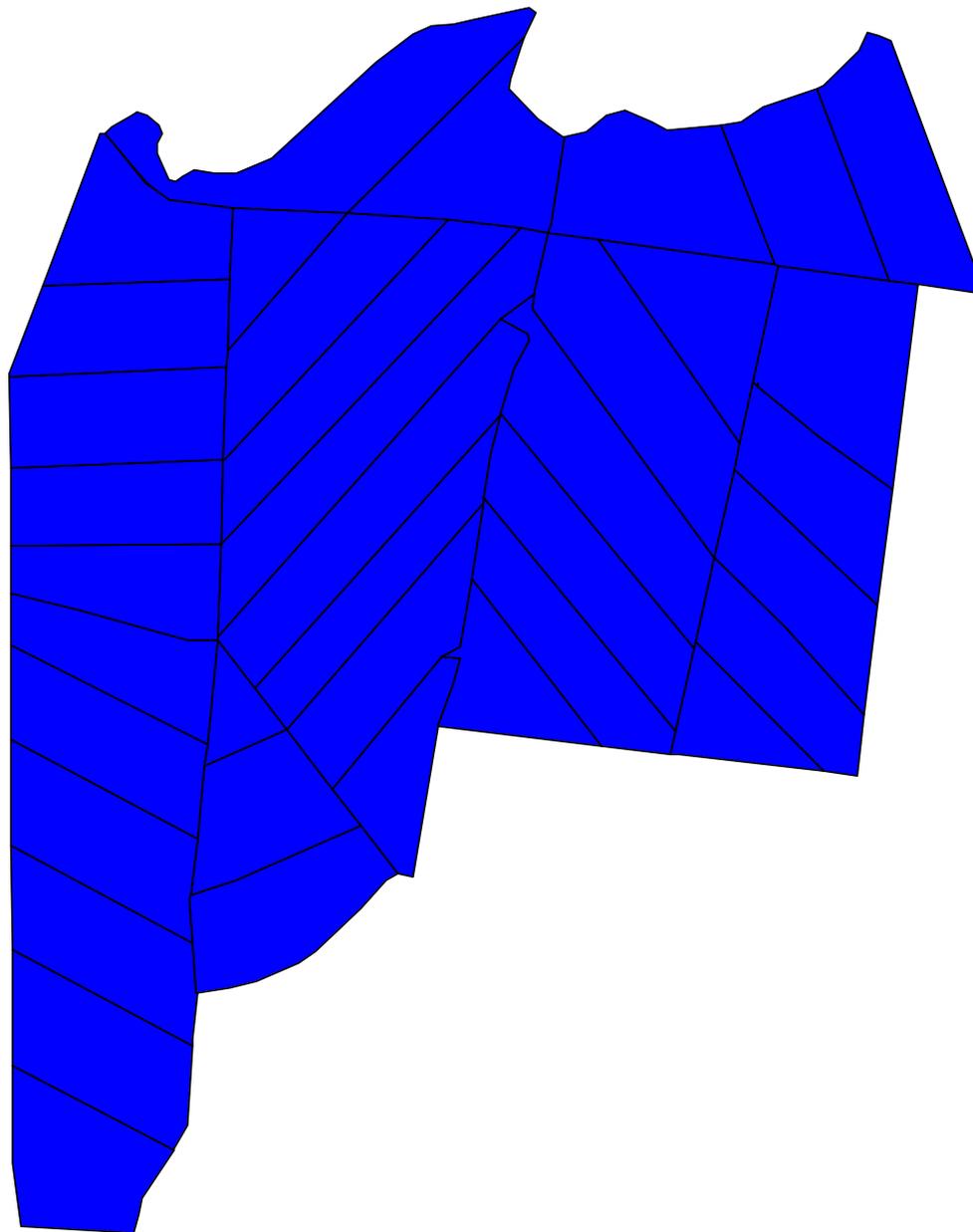
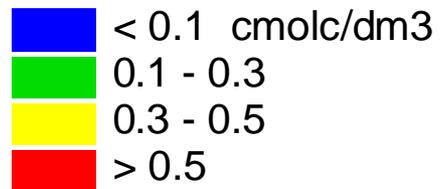
Ca 0 20cm



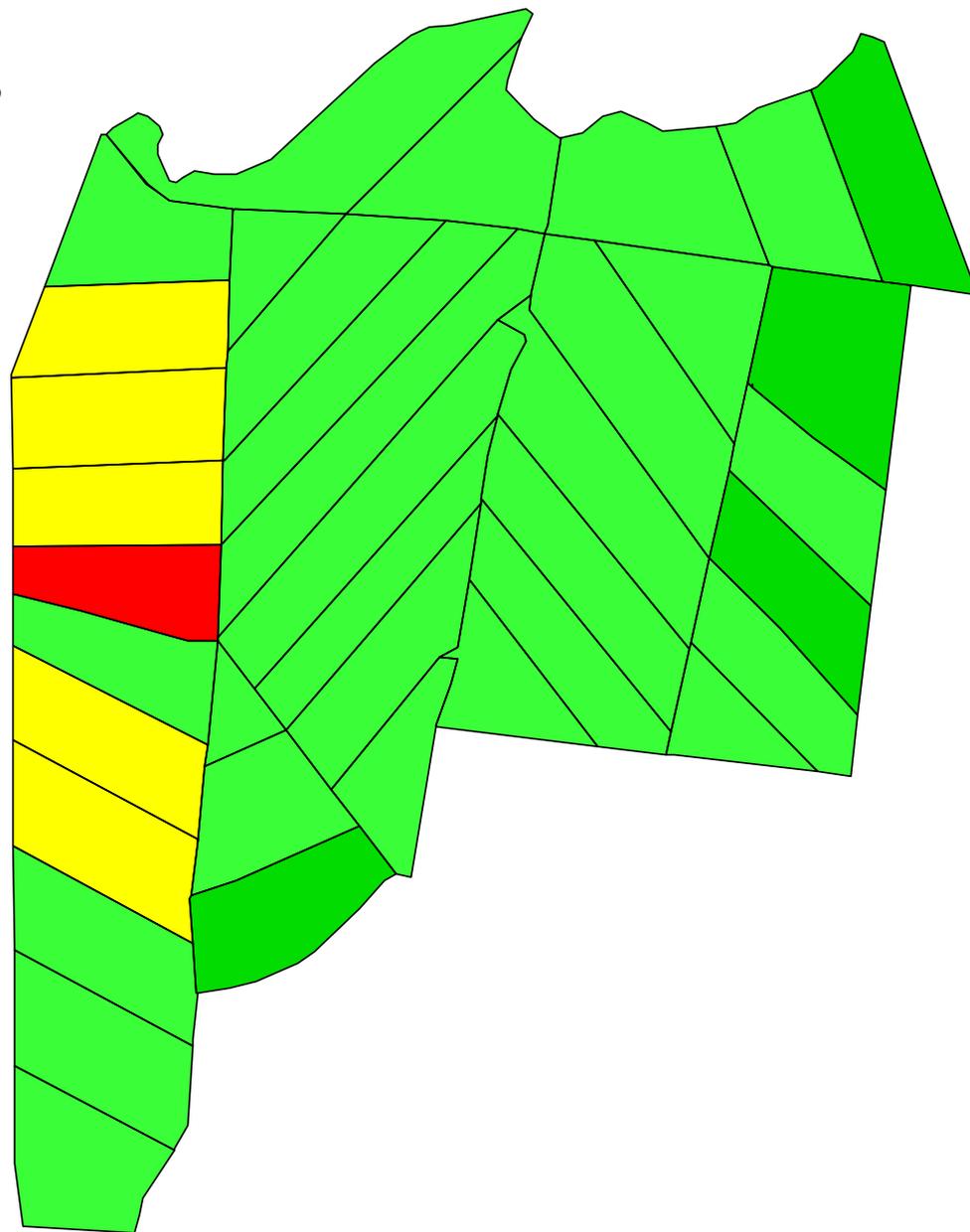
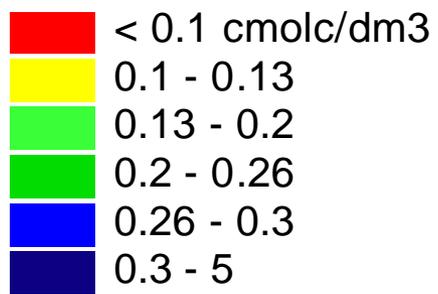
Mg 0 20cm



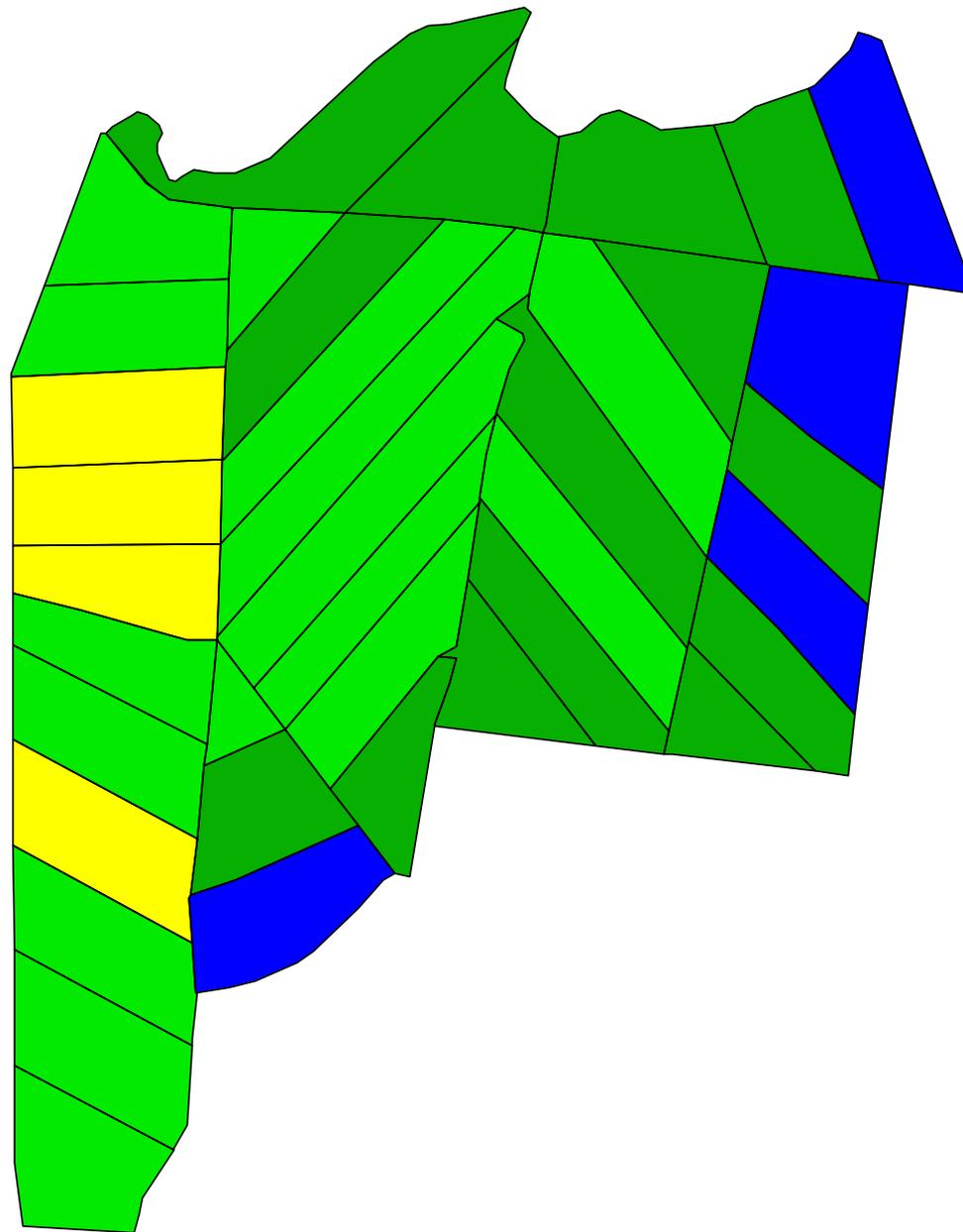
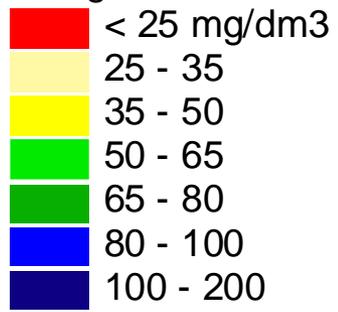
AI 0 20cm



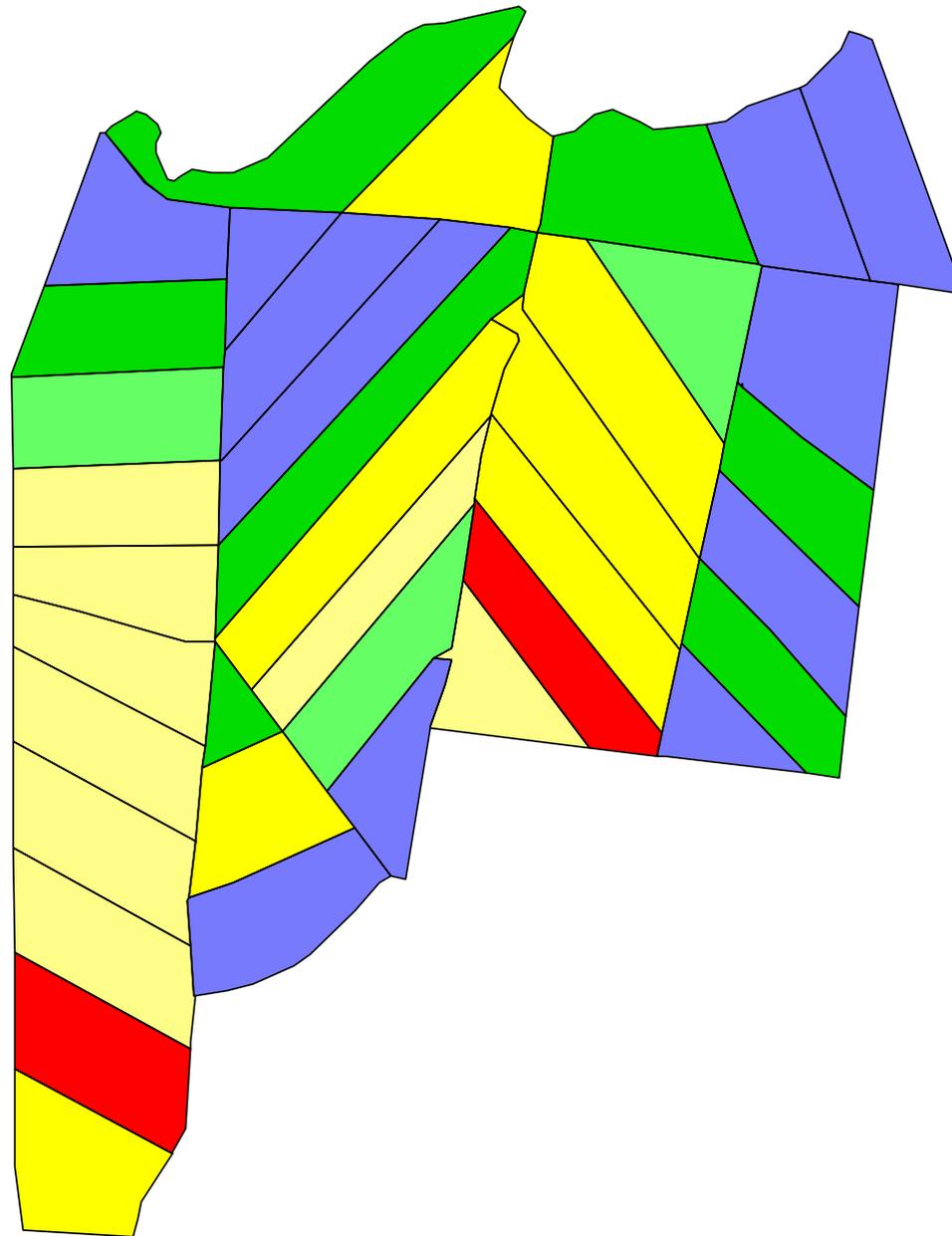
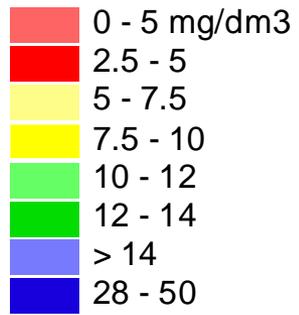
K 0 20cm



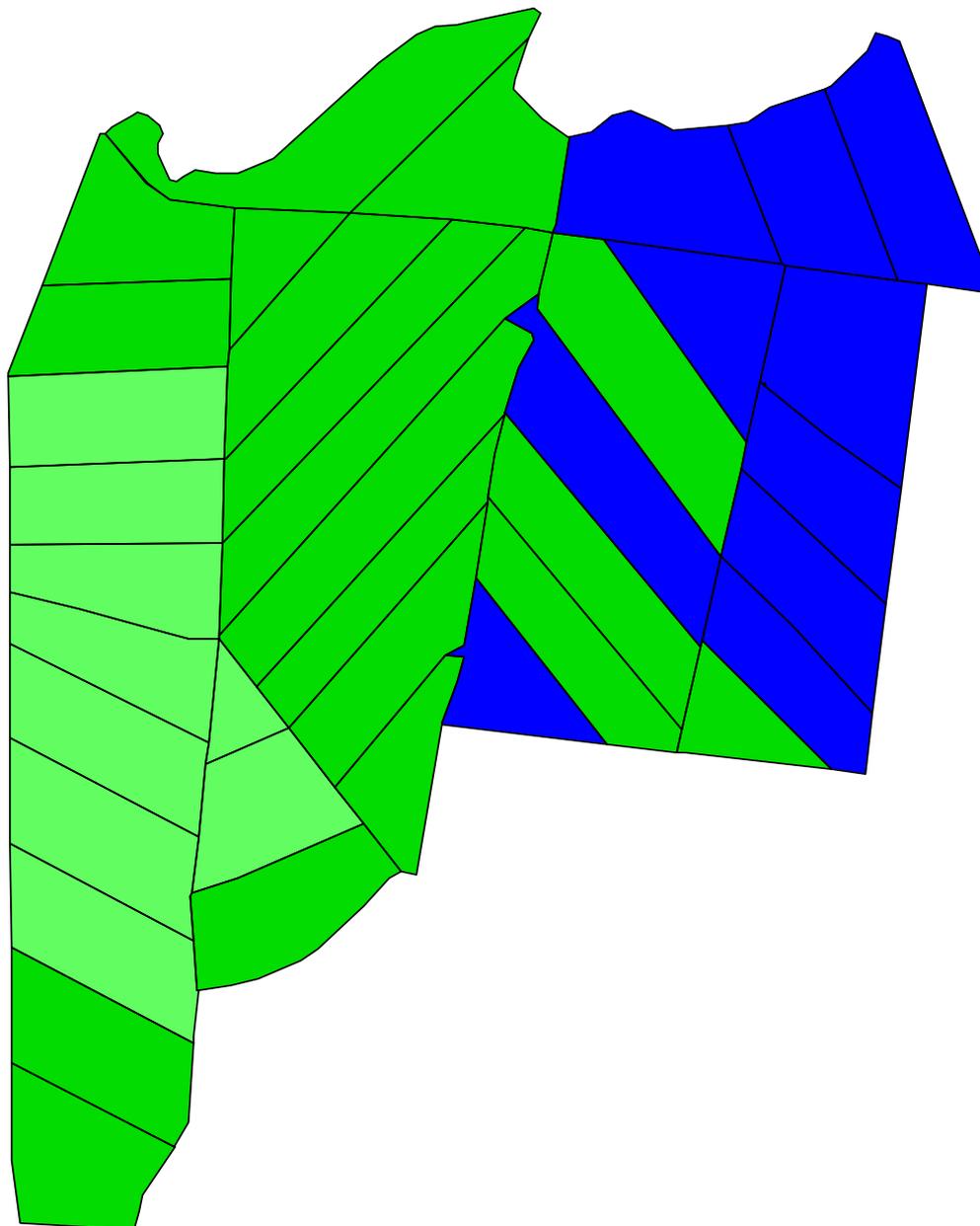
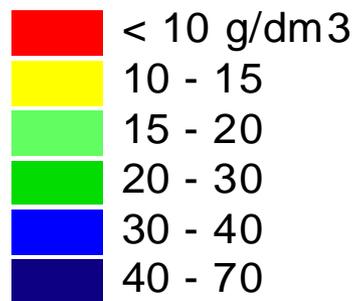
K_mg 0 20cm



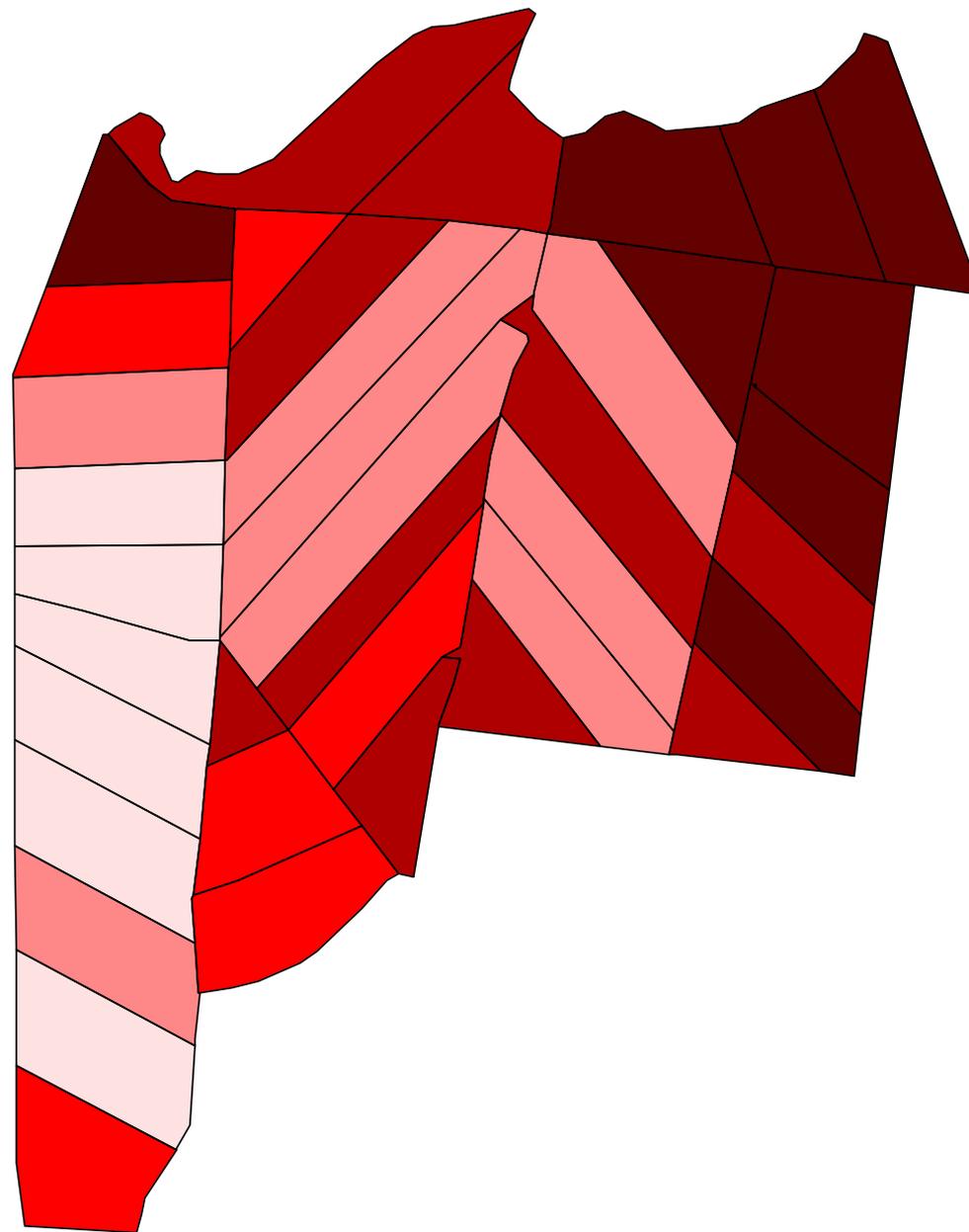
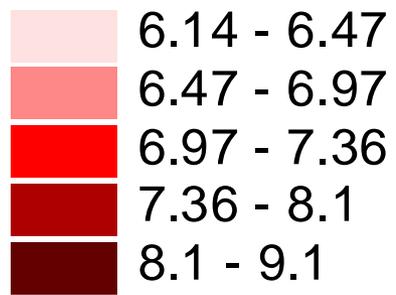
P_mel 0 20cm



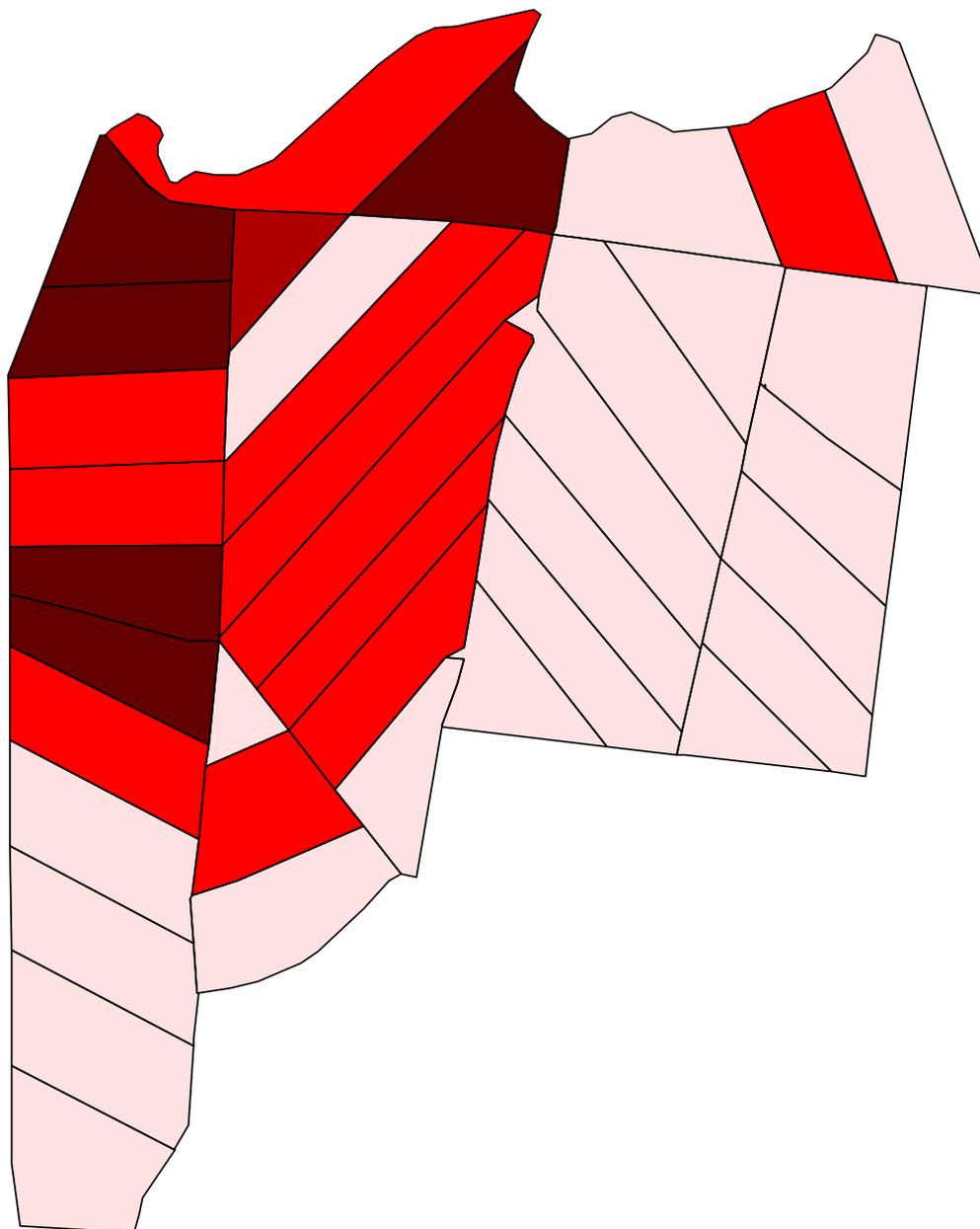
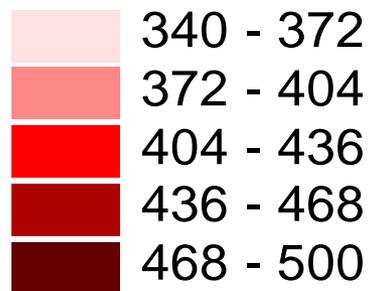
Mos 0 20cm



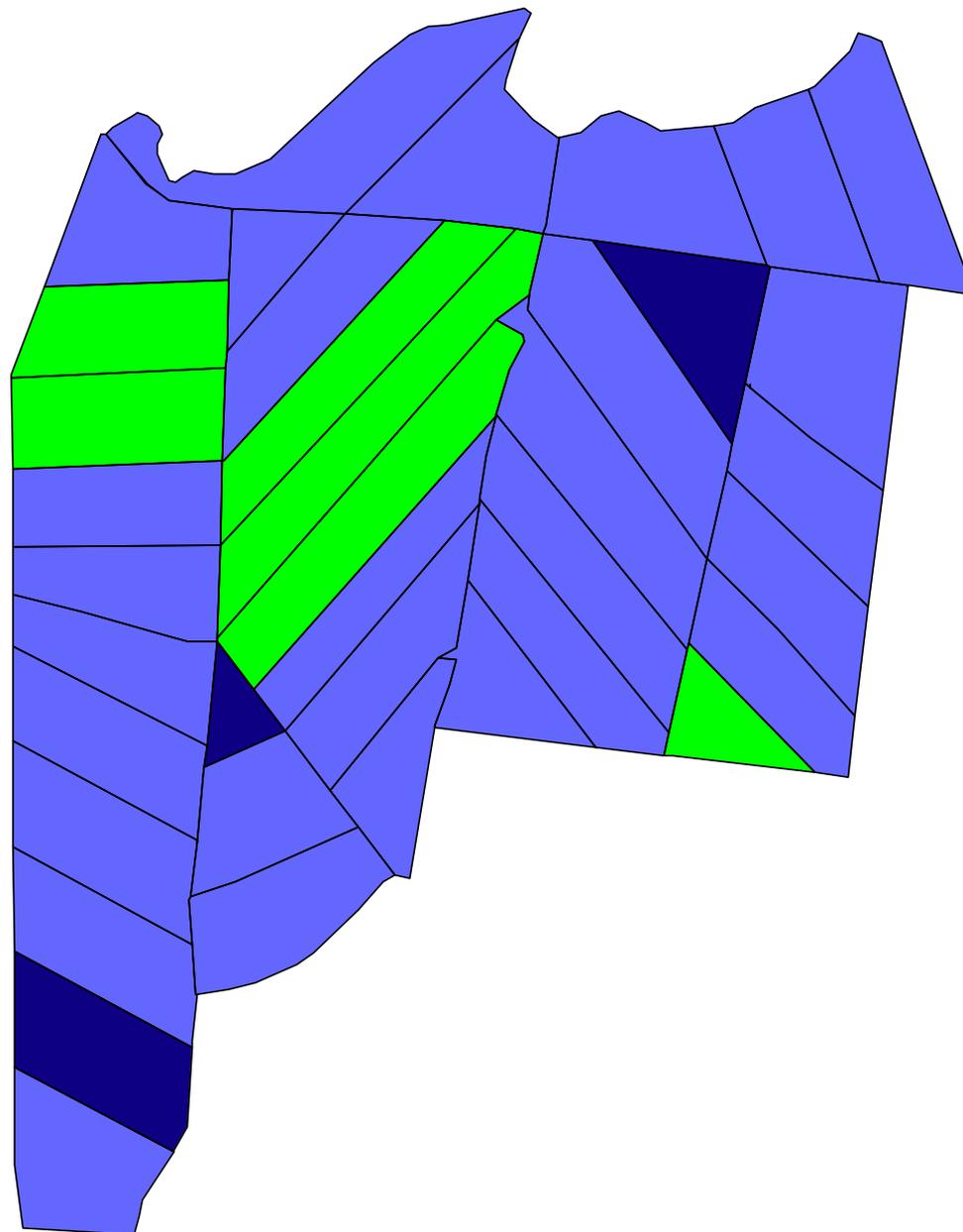
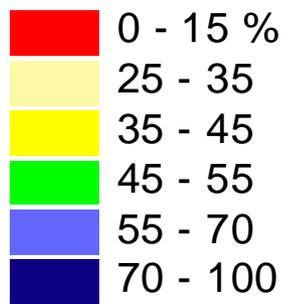
CTC 0 20cm



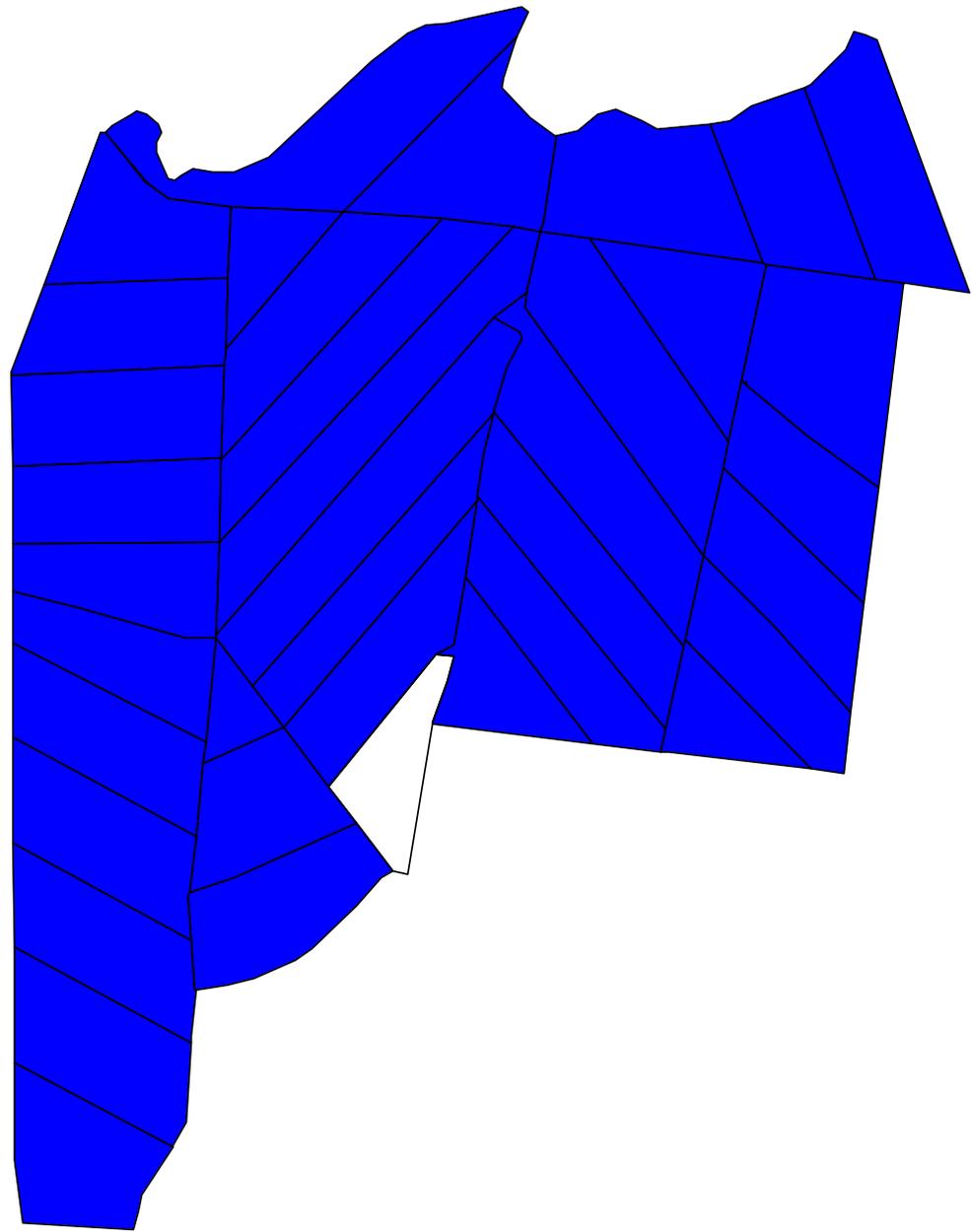
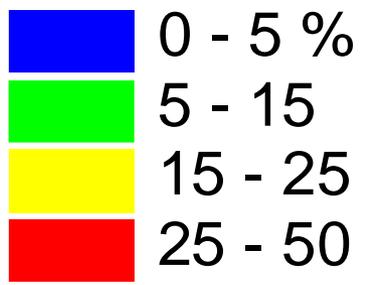
Argila 0 20cm



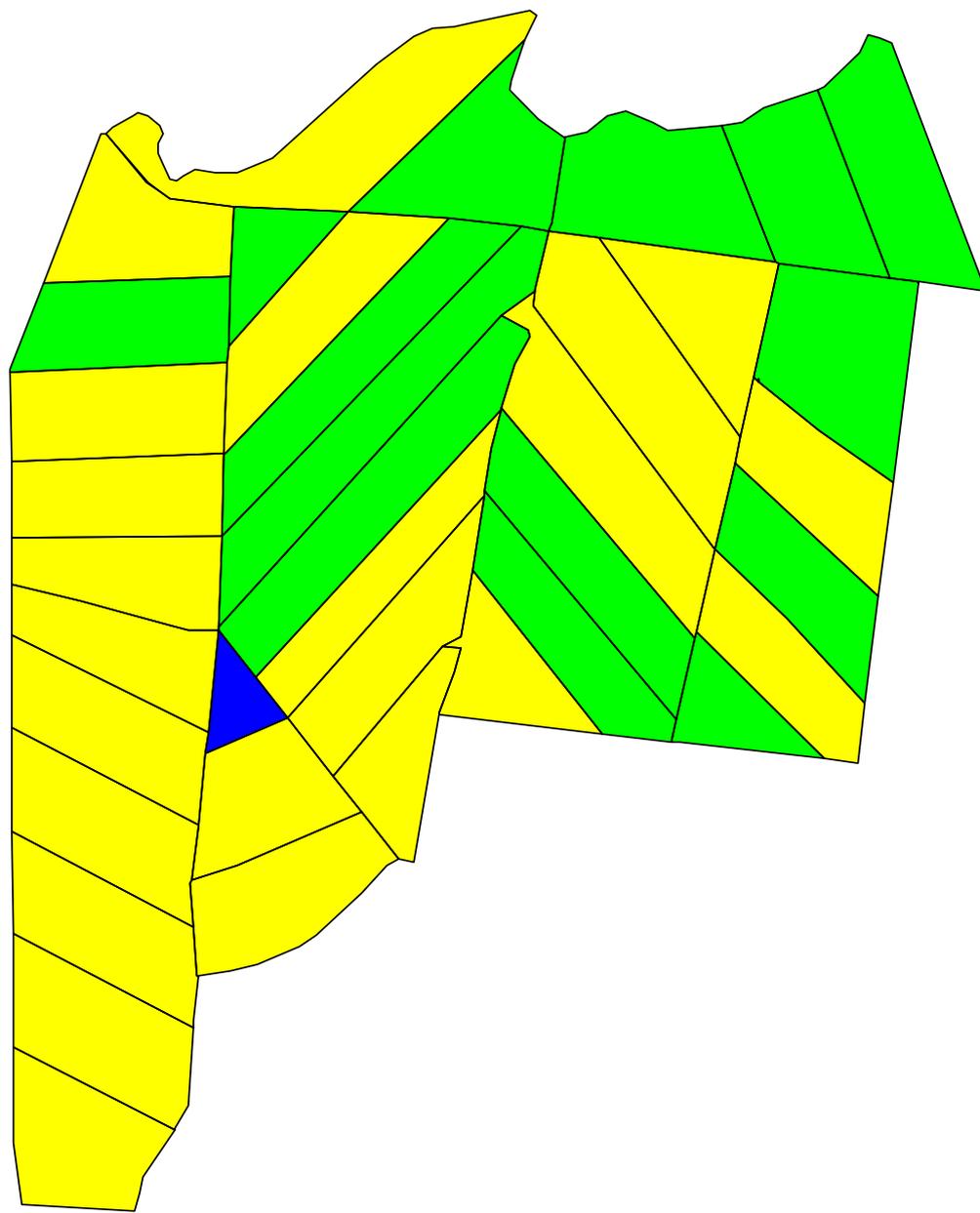
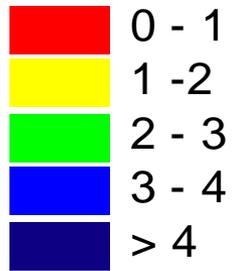
V 0 20cm



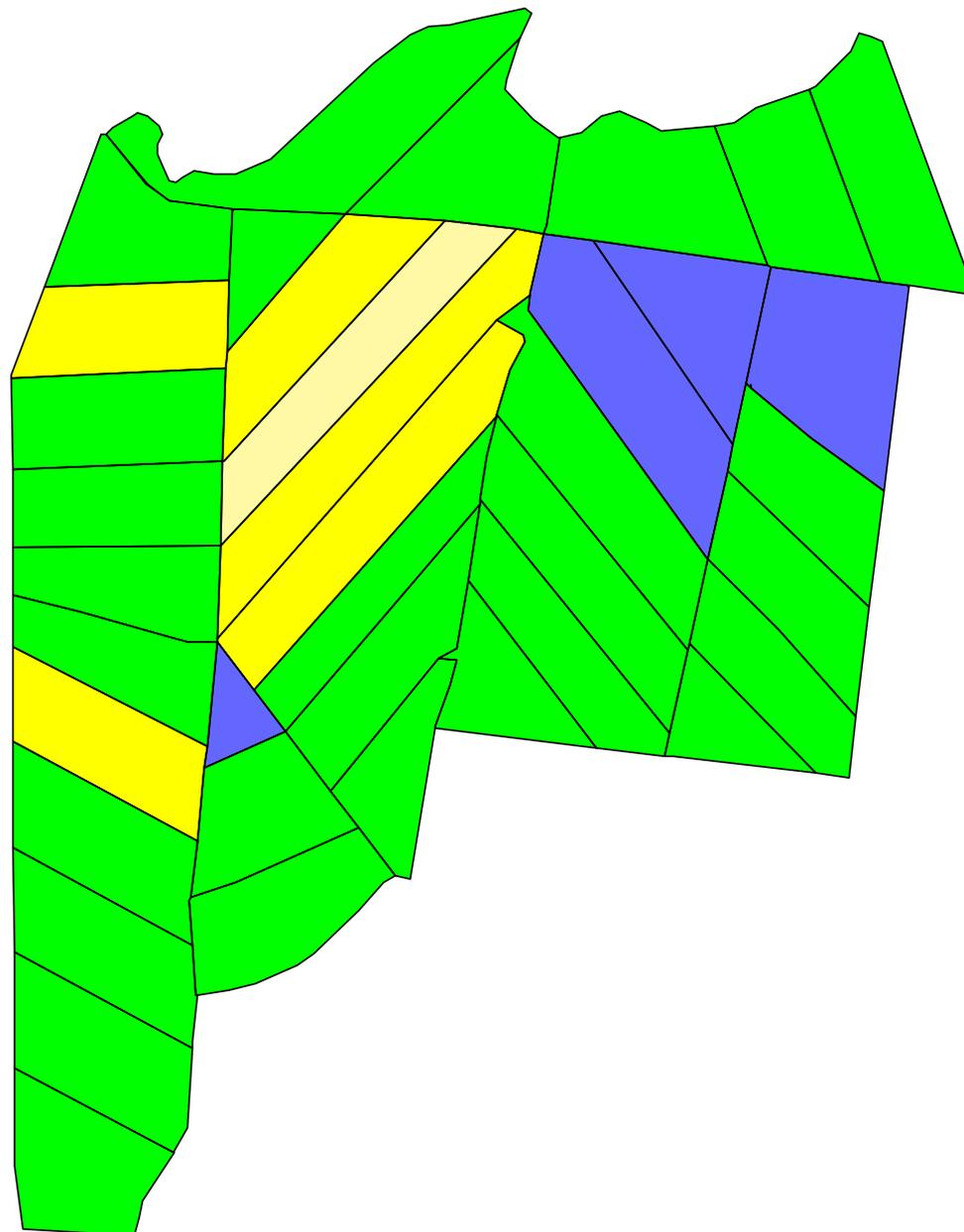
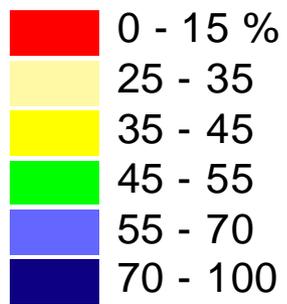
Sat_AI0 20cm



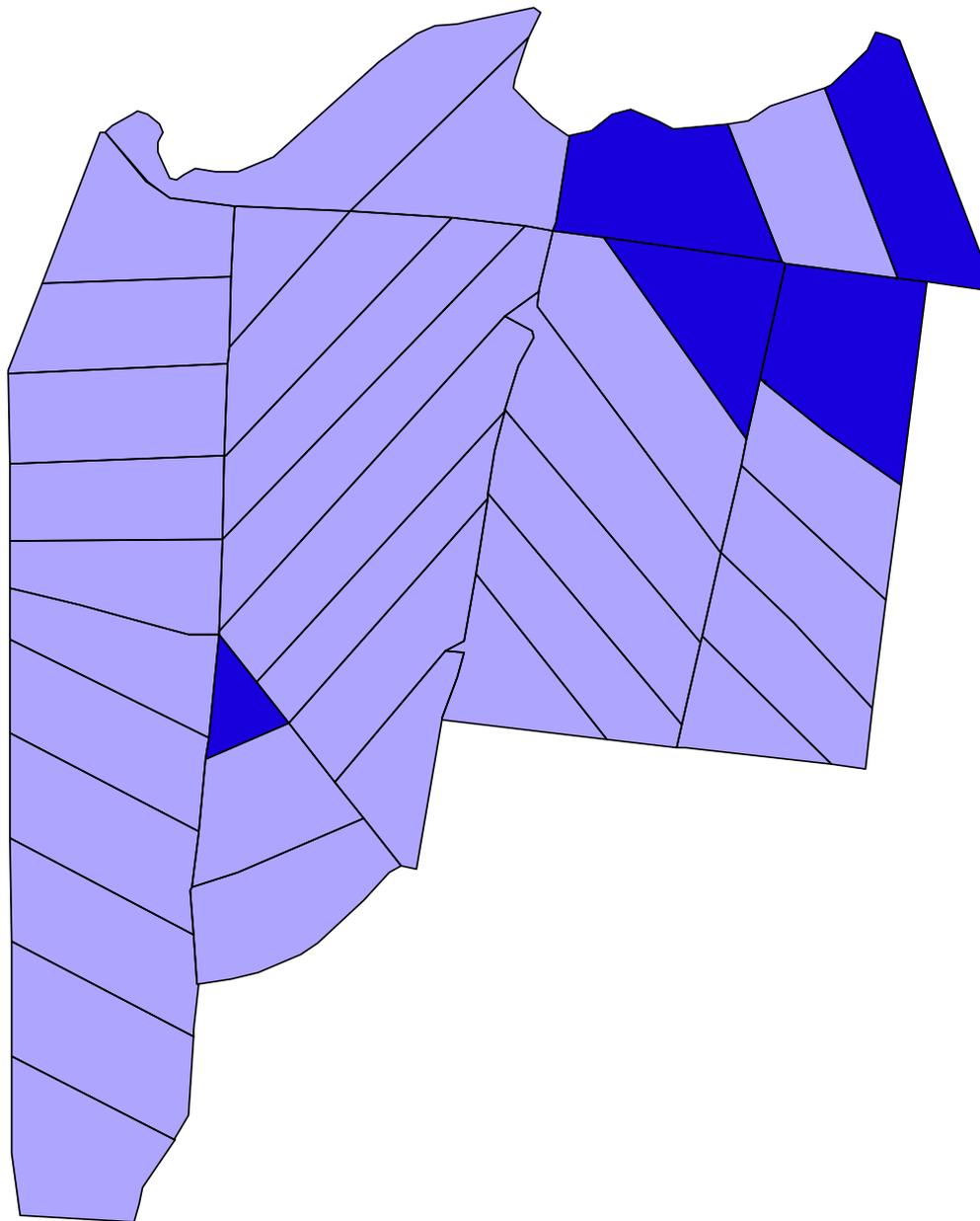
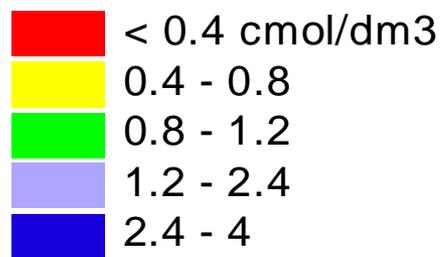
Rel_Ca_Mg 0 20cm



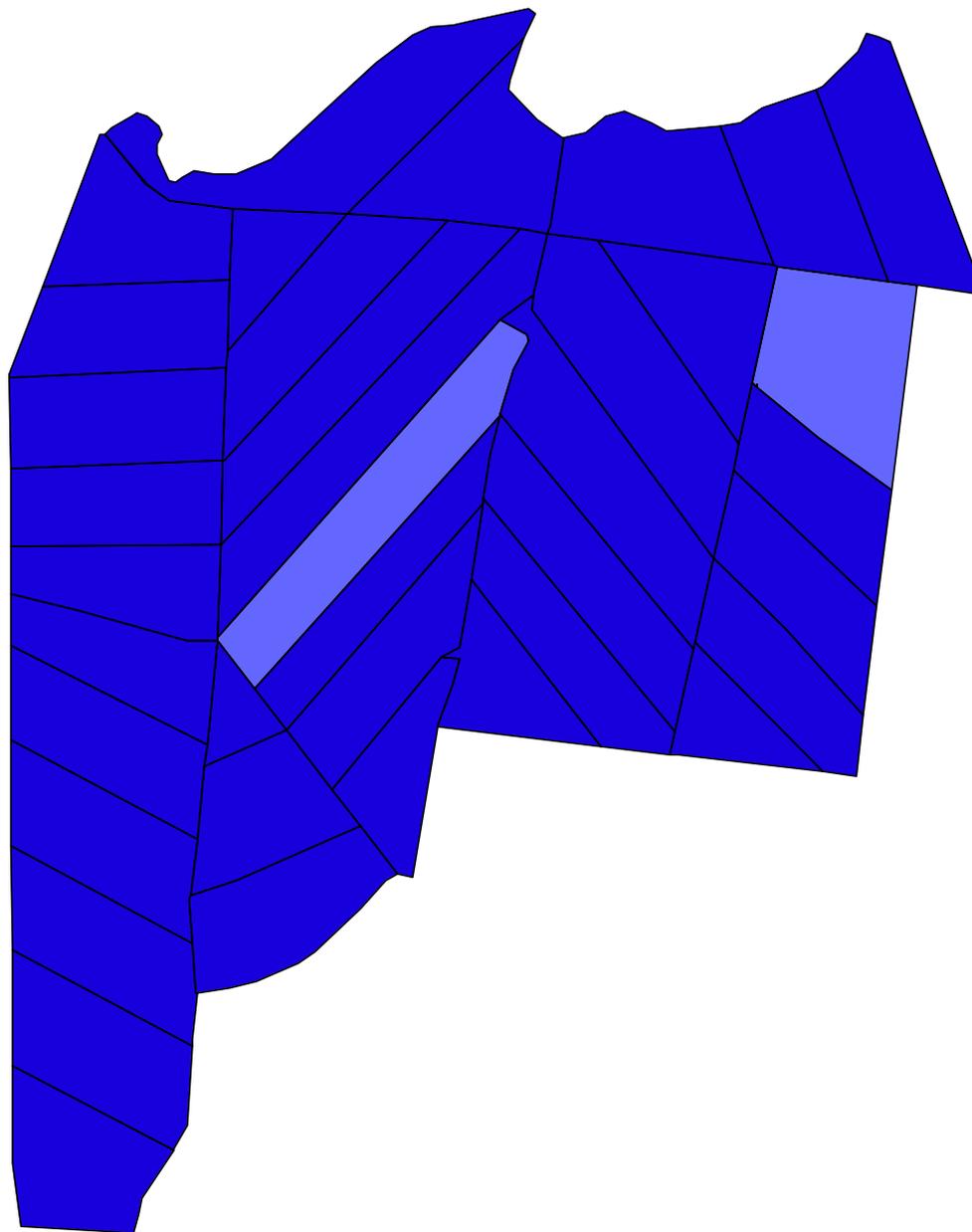
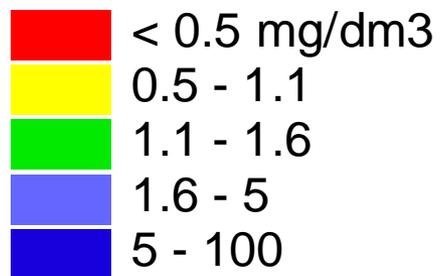
V 0 40cm



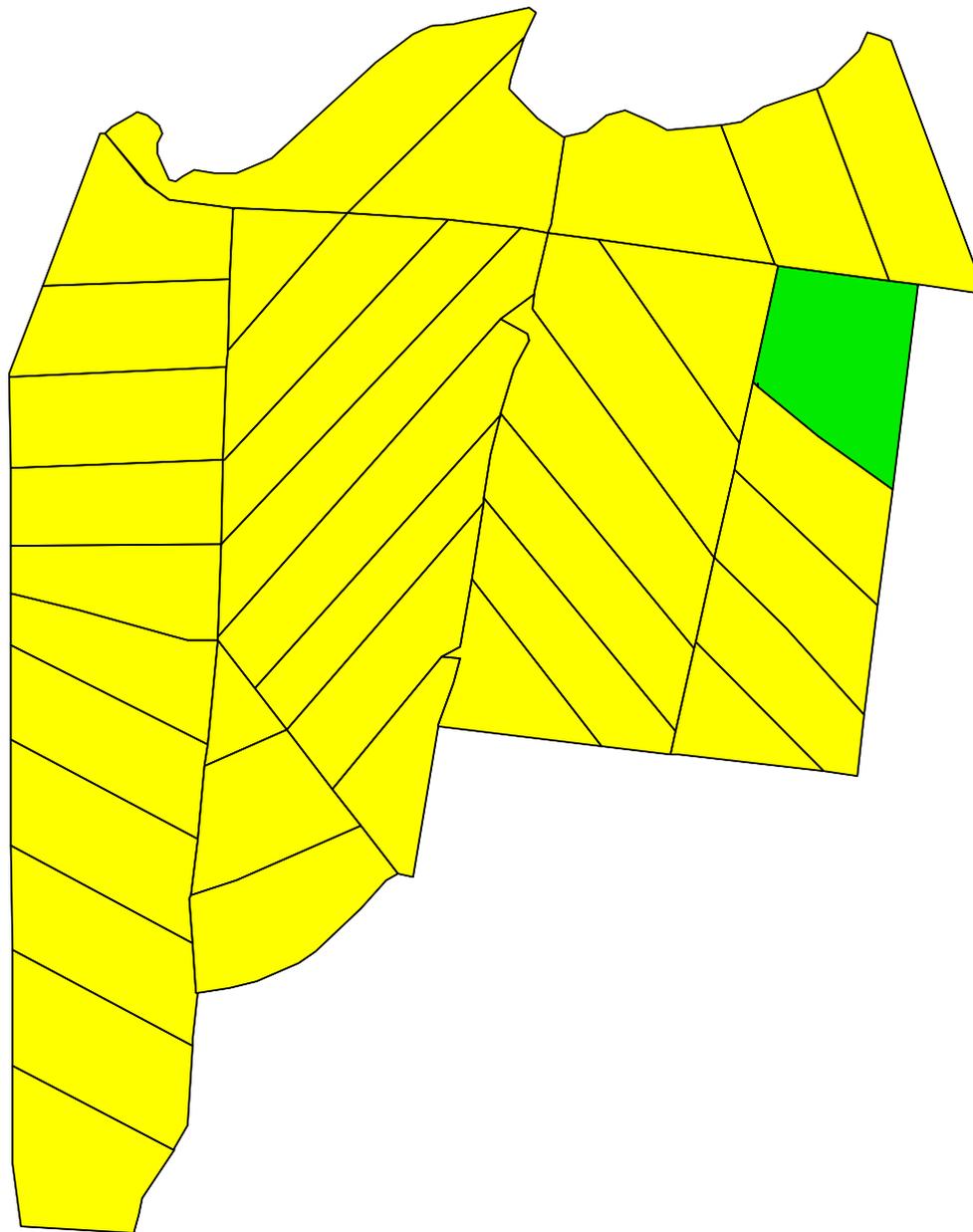
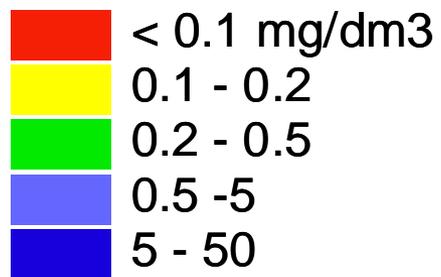
Ca 0 40cm



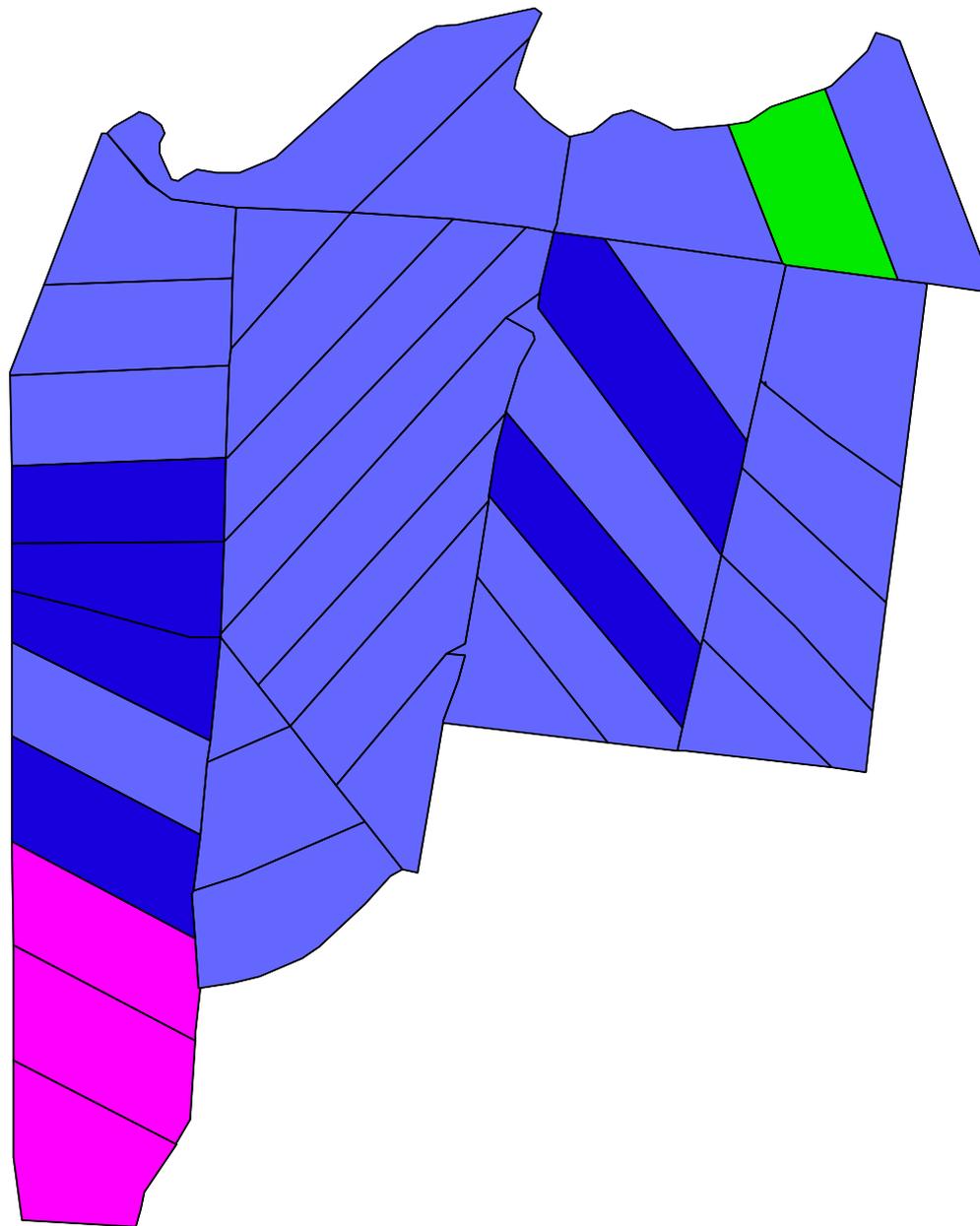
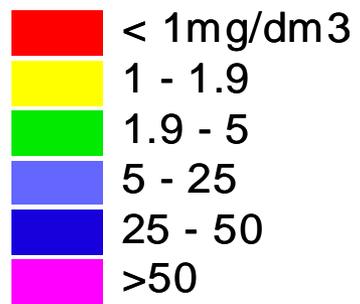
Zn 0 20cm



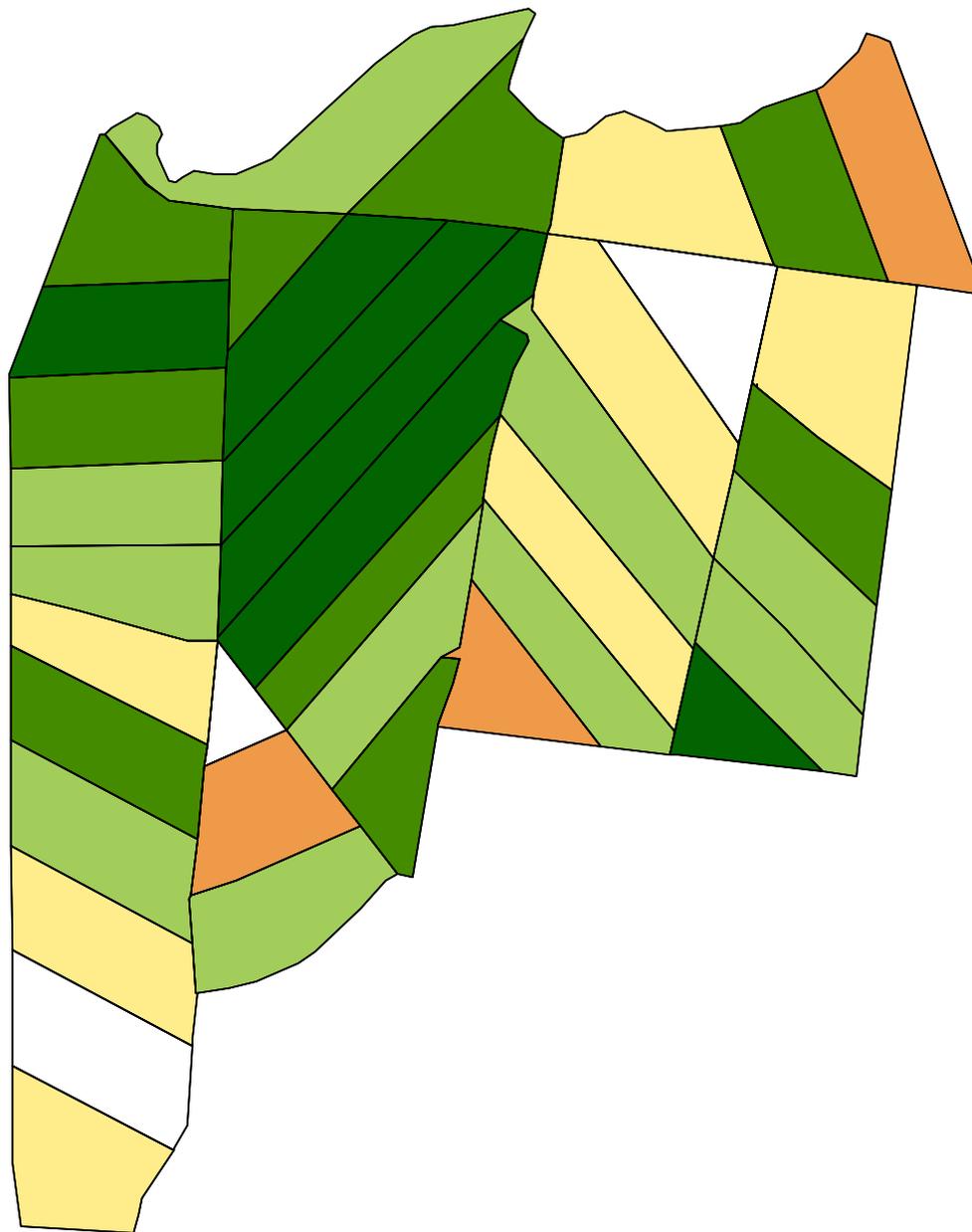
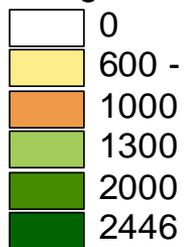
B 0 20cm



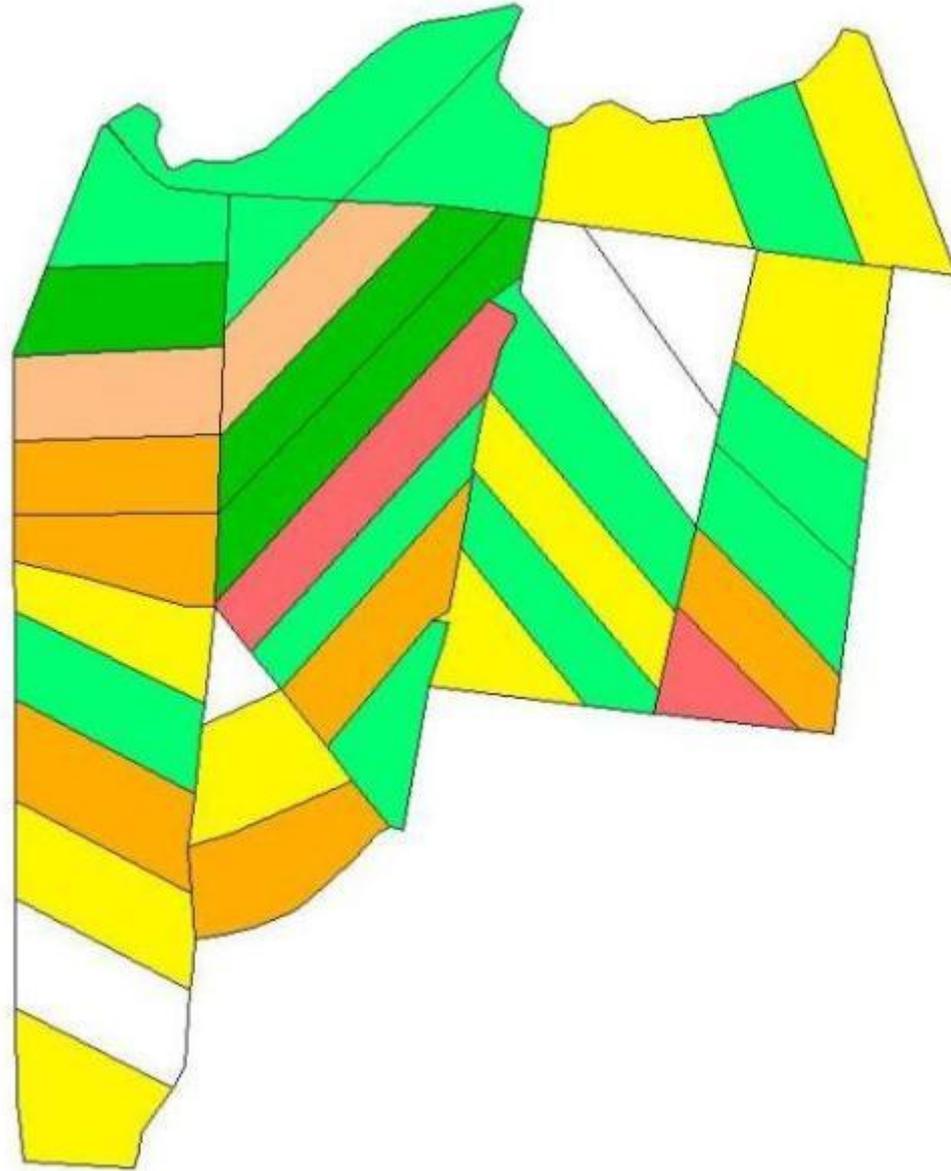
Mn 0 20cm

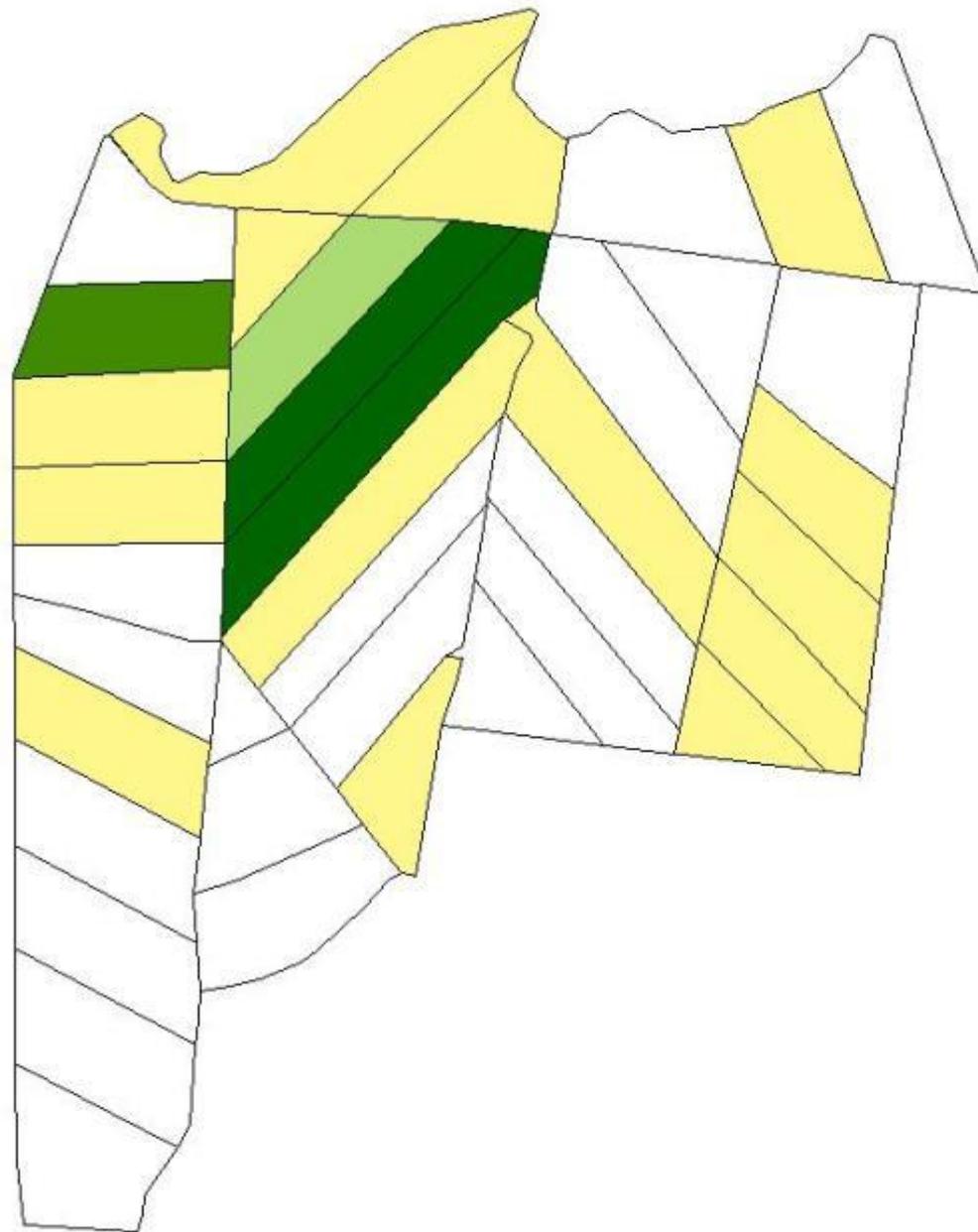


Calagem



Calcario Ajustado

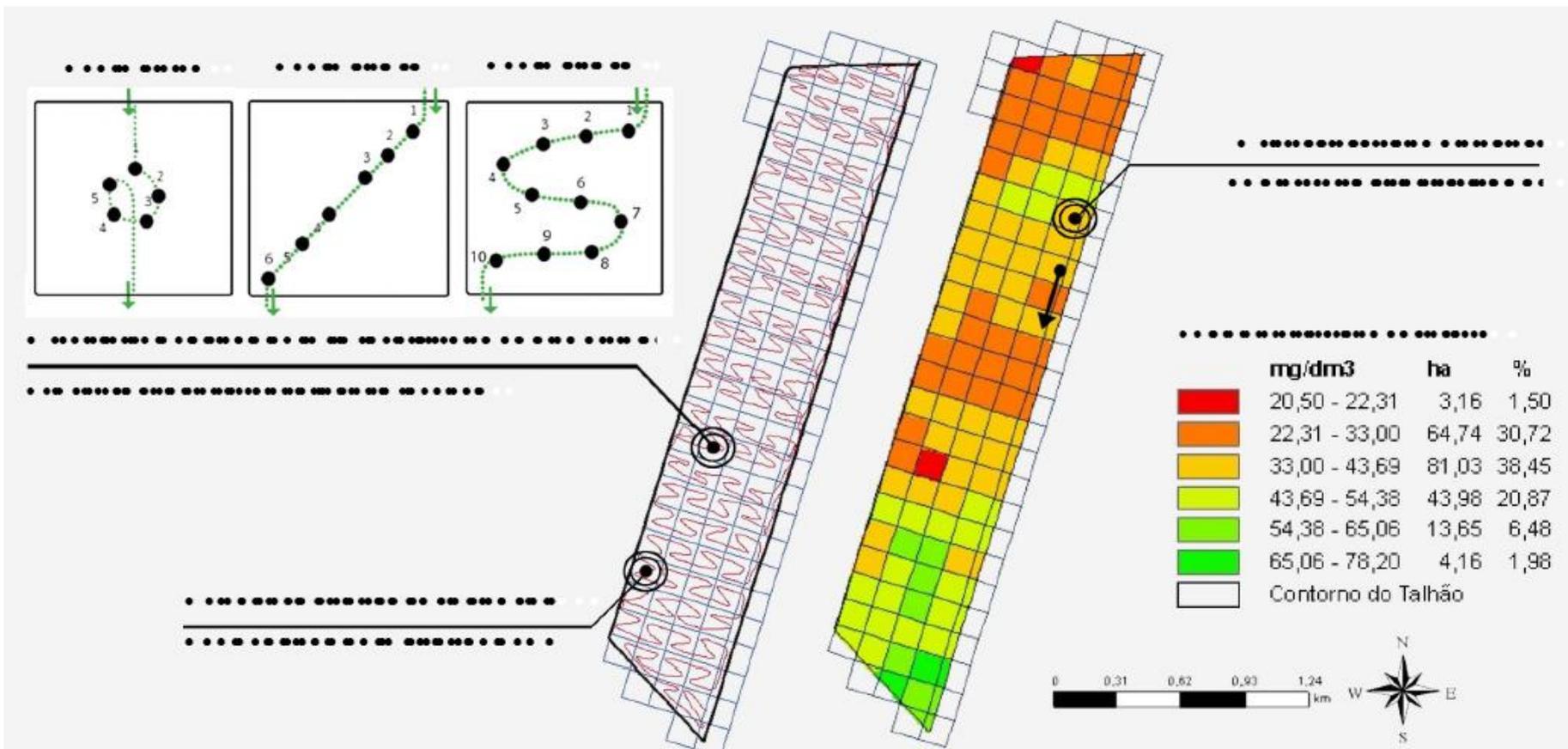




Necessida de Gesso

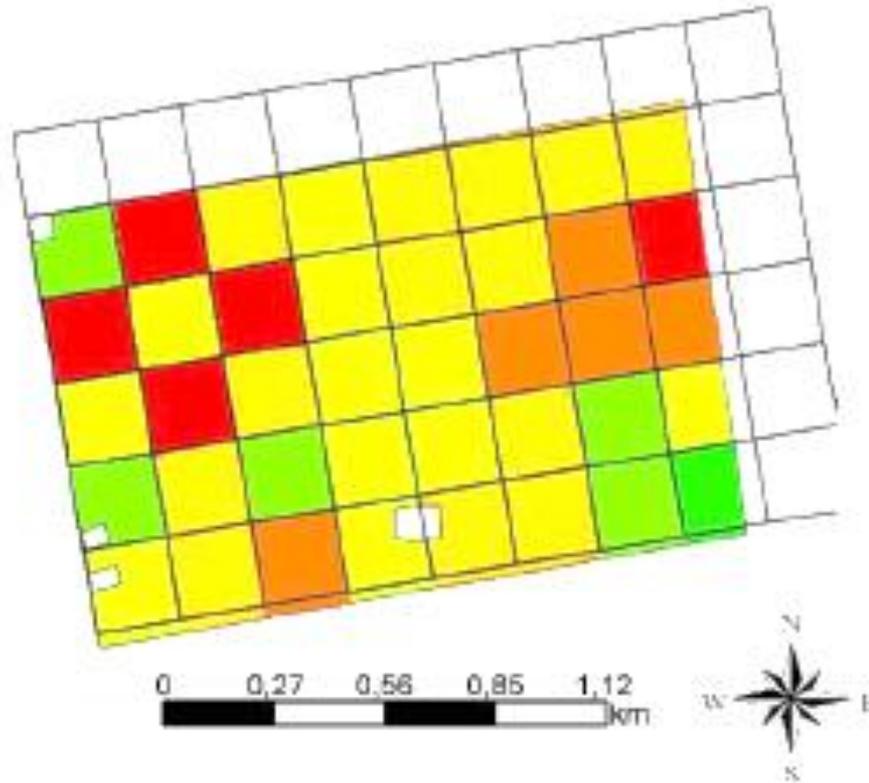
-  0
-  130
-  680
-  1020
-  1360

Amostragem por células (sem interpolação)



Radin (2016)

Amostragem por células (sem interpolação)



Análise de solo - M.O. (%)

%	ha	%
2,6 - 2,8	19,44	12,10
2,8 - 2,9	19,64	12,22
2,9 - 3,0	54,16	33,70
3,0 - 3,2	43,79	27,25
3,2 - 3,3	20,40	12,69
3,3 - 3,4	3,28	2,04
Contorno do Talhão		

Área de Contorno: 159,38 ha
Mínima: 2,6 %
Média: 3,0 %
Máxima: 3,4 %
CV: 6,6 %

Radin (2016)

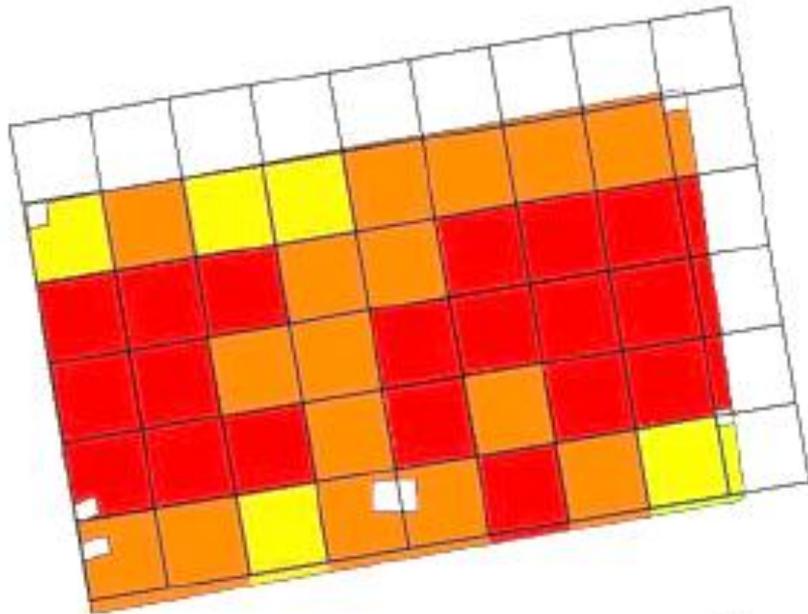
Grade de 4 ha

Análise de solo - Potássio (Mehlich I)

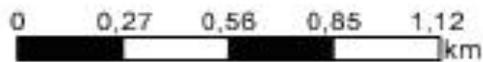
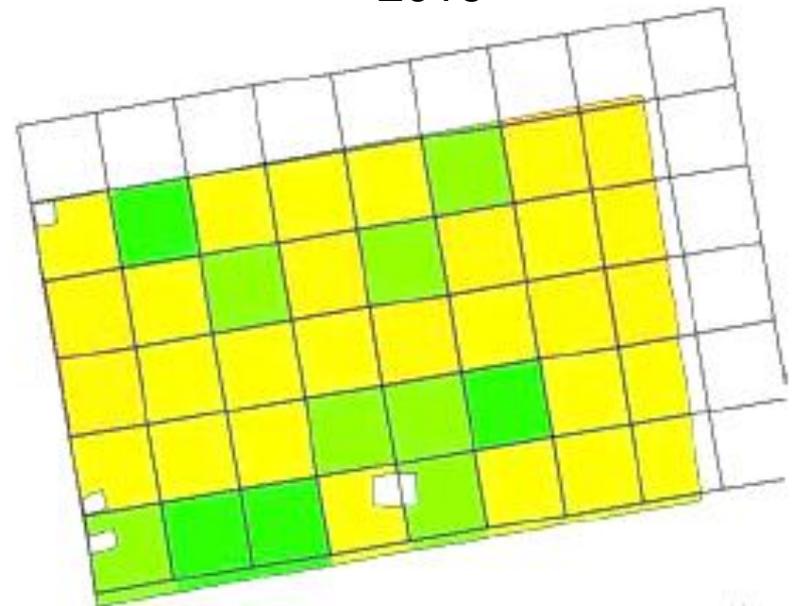
mg/dm ³	2013		2016	
	ha	%	ha	%
35,20 - 44,17	79,64	46,96	-	-
44,17 - 53,13	68,06	40,13	-	-
53,13 - 62,10	16,64	9,81	38,59	24,01
62,10 - 71,07	5,24	3,09	75,72	47,11
71,07 - 80,03	-	-	29,17	18,15
80,03 - 89,00	-	-	17,23	10,72
Contorno do Talhão				

Área de Contorno: 168,22 ha 159,38 ha
 Mínima: 35,20 mg/dm³ 53,80 mg/dm³
 Média: 46,12 mg/dm³ 67,84 mg/dm³
 Máxima: 62,60 mg/dm³ 89,00 mg/dm³
 CV: 14,85 % 12,13 %

2013



2016



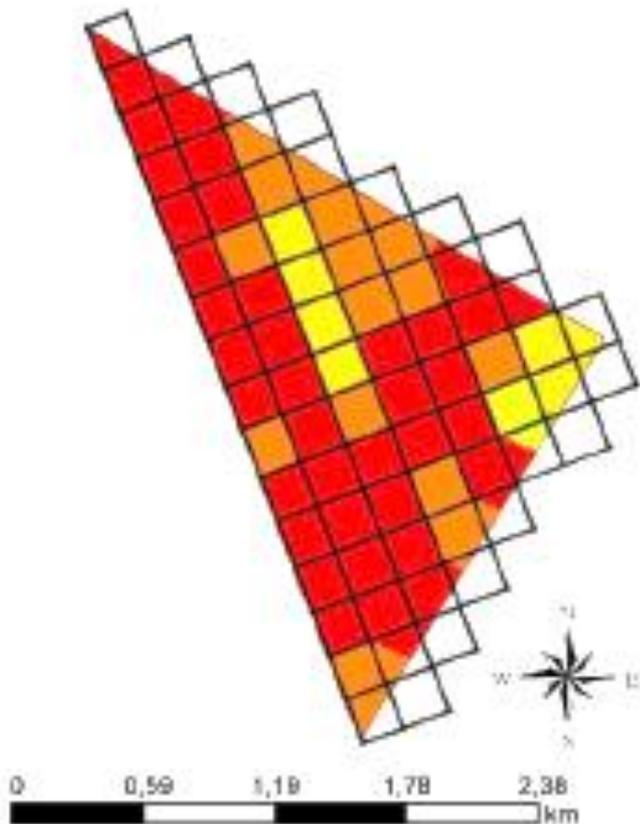
Radin (2016)

Análise de solo - Potássio (Mehlich I)

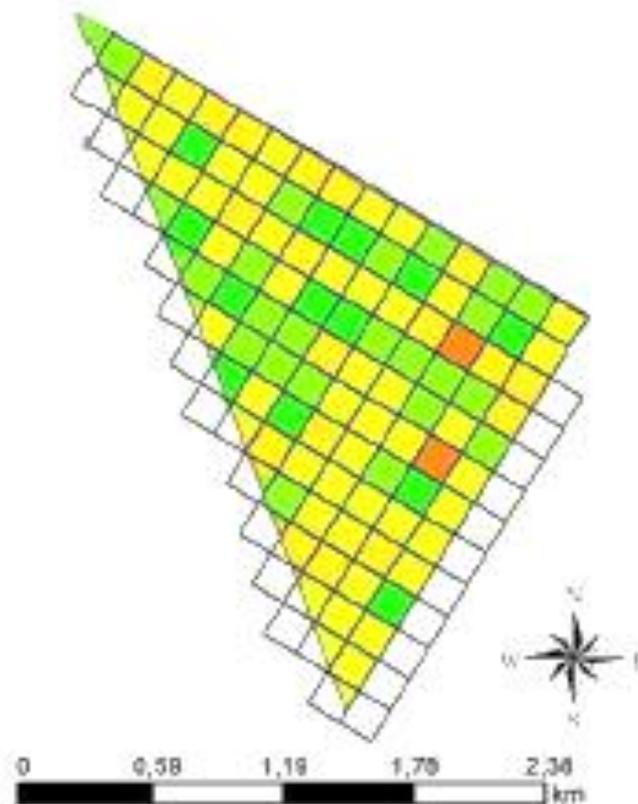
mg/dm ³	2013		2016	
	ha	%	ha	%
21,50 - 35,02	187,8	61,29	-	-
35,02 - 48,53	79,49	25,93	6,08	1,97
48,53 - 62,05	32,36	10,56	55,50	17,95
62,05 - 75,57	6,82	2,22	136,7	44,23
75,57 - 89,00	-	-	71,45	23,11
89,00 - 102,6	-	-	39,37	12,74
Contorno do Talhão				

Área de Contorno:	301,34 ha	301,34 ha
Mínima:	21,50 mg/dm ³	45,00 mg/dm ³
Média:	35,20 mg/dm ³	71,91 mg/dm ³
Máxima:	75,30 mg/dm ³	102,6 mg/dm ³
CV:	29,35 %	18,87 %

2013 (grade de 5 ha)

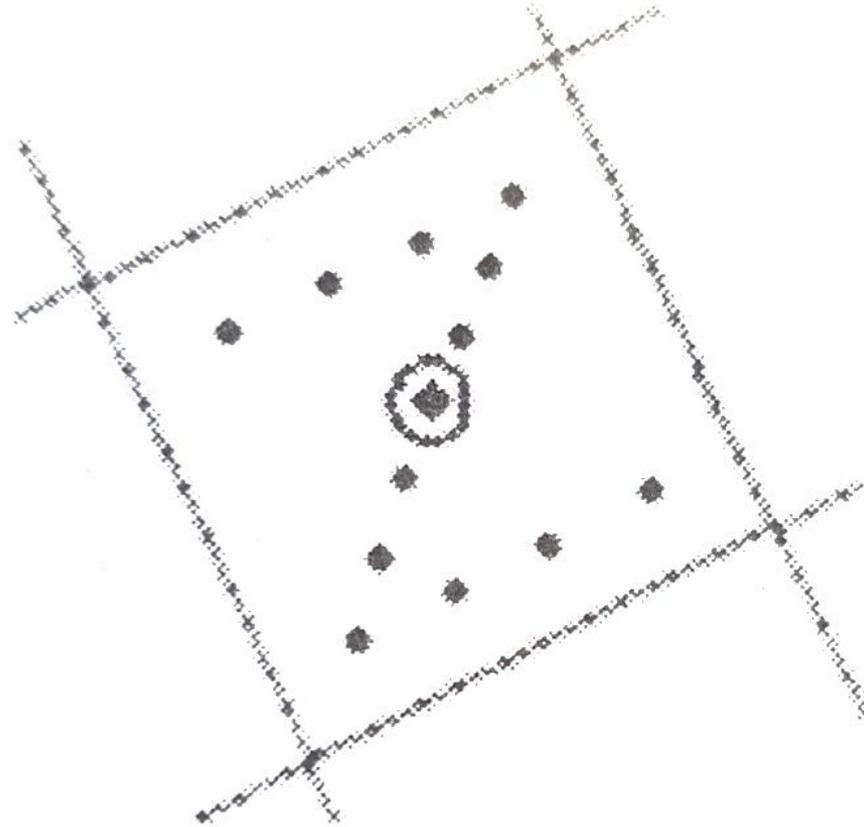


2016 (grade de 3 ha)



Radin (2016)

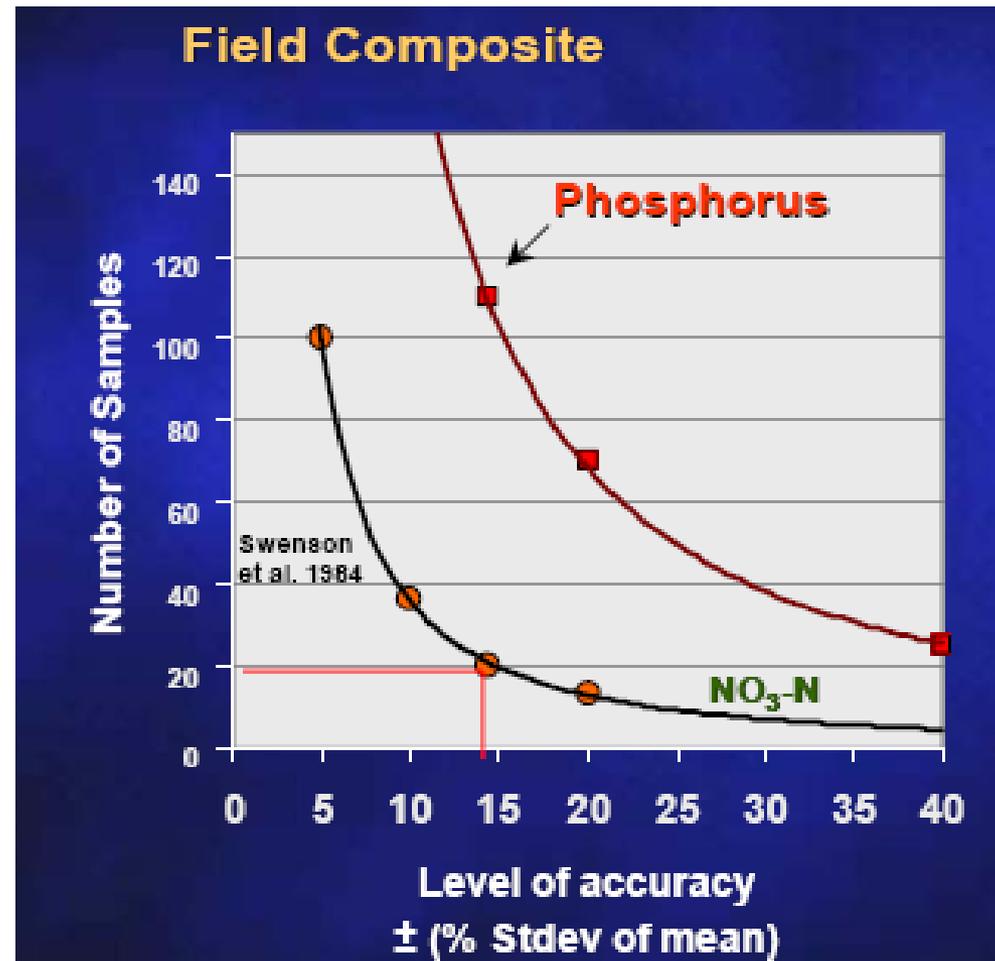
O que tem de errado aqui?



Folder de prestador de serviços de AP

Uma amostra composta deve ser formada por quantas unidades de amostra?

Exemplo de um conjunto de sub-amostras para nitrato



Miller, 2007

Retirada das amostras



Navegar até o ponto...



... e coletar a amostra

Amostradores de solo

O que é necessário:

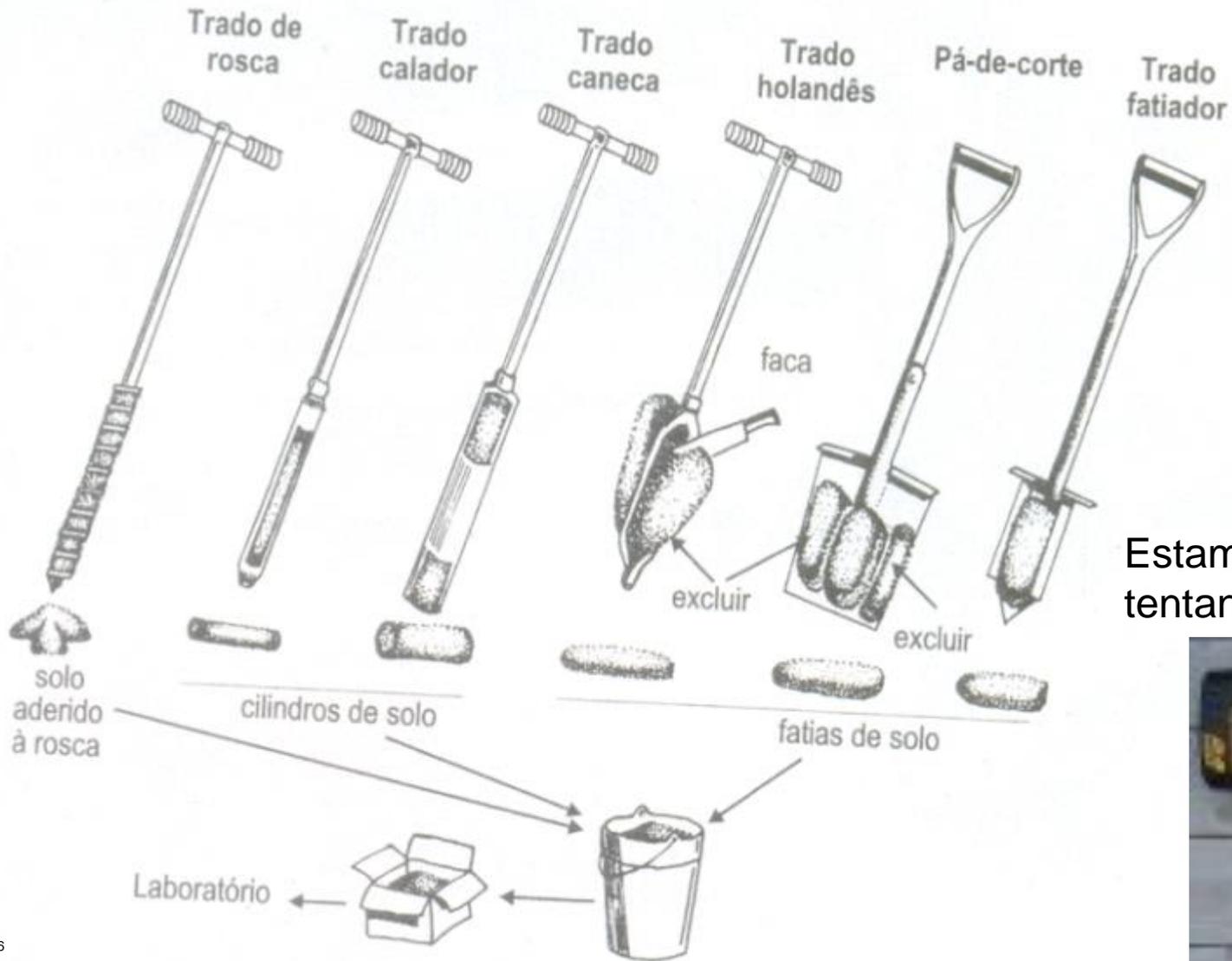
- **fonte de potência** – quem aciona o sacador
- **sacador de amostras** – quem retira a amostra do solo
- **operador** – quem executa a amostragem

A fonte de potência para o amostrador pode ser:

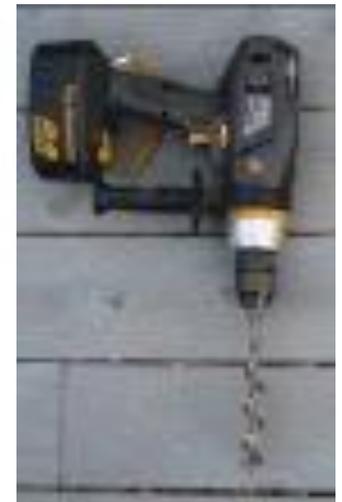
- humana
- elétrica
- hidráulica
 - de giro
 - de deslocamento linear
- motor de combustão interna
- pneumática

Os sacadores de amostras podem ser:

- pá-de-corte e enxadão
- trados
 - tipo rosca
 - tipo holandês
 - tipo caneca
- caladores



Estamos apenas tentando mecanizar...



Lopes, 2006

Amostradores de solo tradicionais, operados manualmente

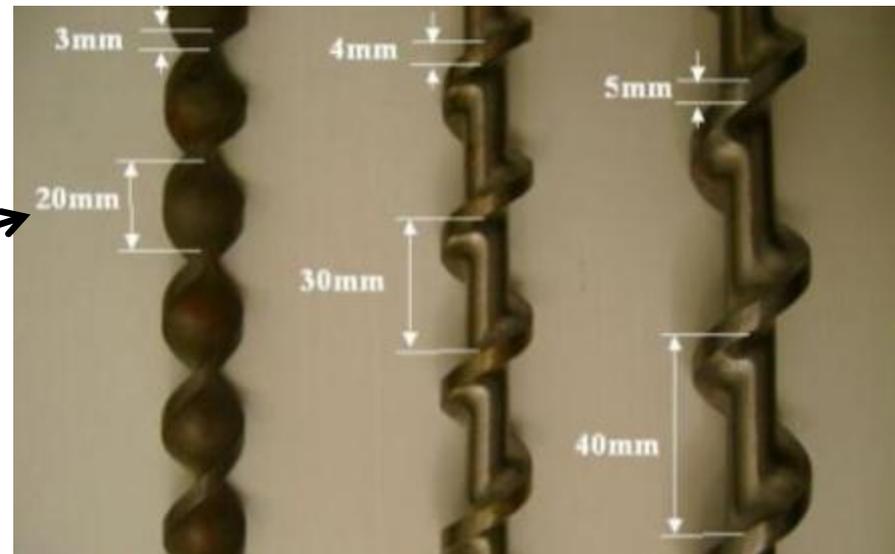


O conjunto amostrador pode ser:

- transportado em
 - quadriciclo
 - motocicleta
 - trator
 - pick-up
 - veículo adaptado
 - cavalo
- carregado pelo próprio operador

Com relação ao desempenho do conjunto amostrador, as variáveis envolvidas, normalmente são:

- textura do solo
- teor de água no solo
- no caso de roscas:
 - rotação
 - passo
 - diâmetro



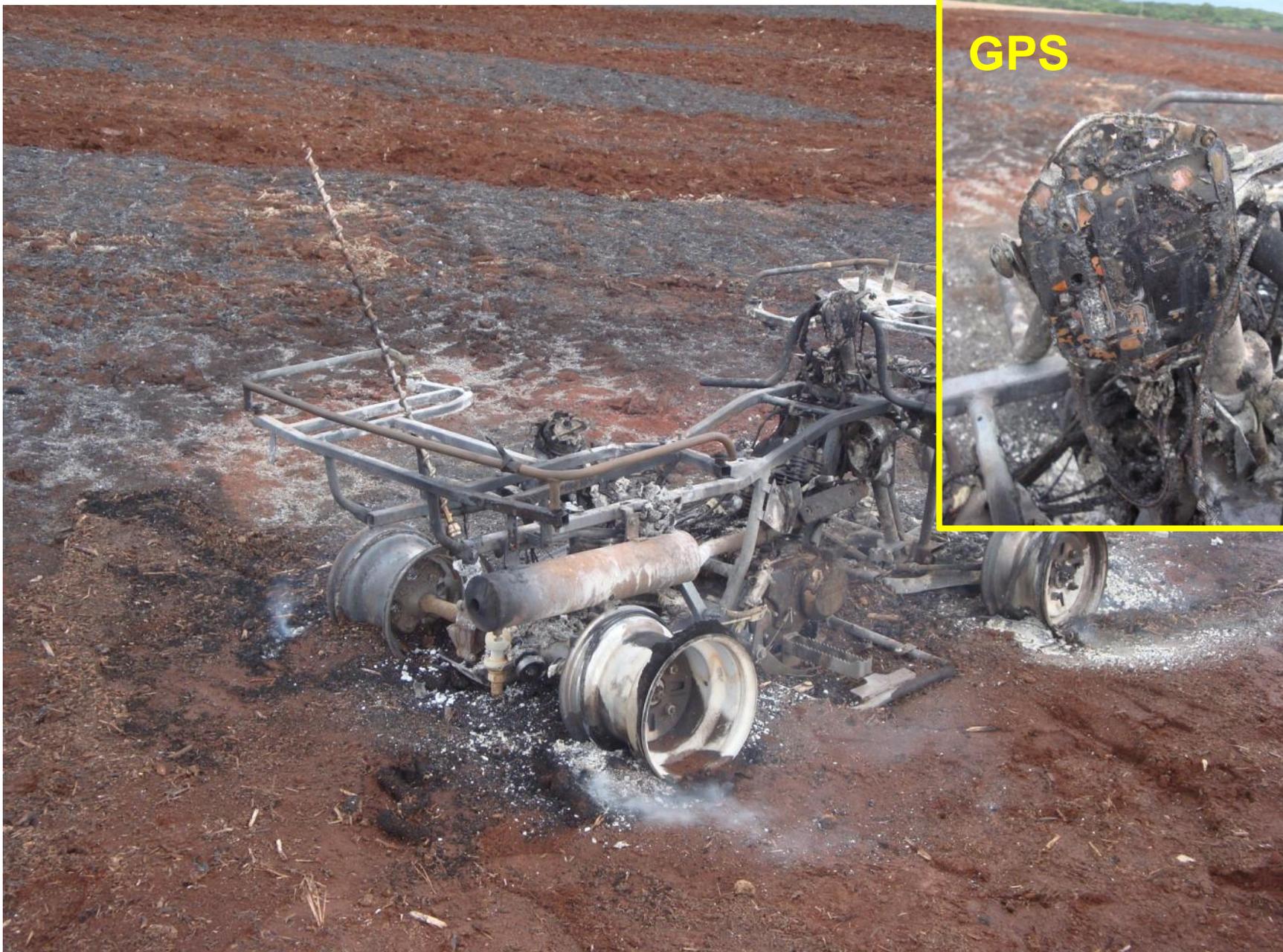
As preocupações são:

- quantidade de material retirado em cada sub-amostra
- condição desse material para compor uma amostra uniforme
- risco de contaminação no caso de amostragem em sub-superfície
- rendimento operacional

O rendimento operacional é função de:

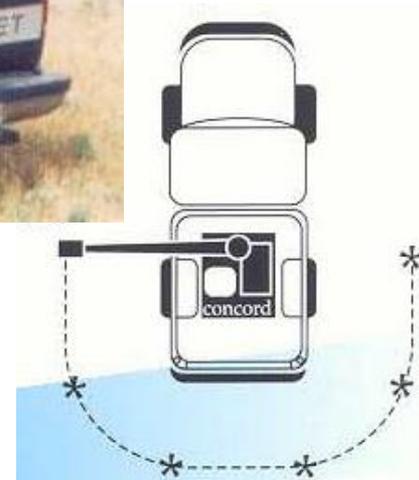
- tipo de amostrador
- quantidade de pessoas envolvidas
- número de sub-amostras
- densidade amostral e raio de busca
- relevo do terreno
- vegetação ou cobertura do terreno
- textura e teor de água do solo
- forma de deslocamento no campo





GPS

Os pioneiros



Amostrador tipo rosca, de acionamento por motor hidráulico, sobre um veículo

Algumas composições comuns



Amostrador tipo rosca, de acionamento por motor hidráulico, sobre um quadriciclo







... mas o quadriciclo nem sempre é o “amostrador”



Amostragem de solo com trado calador, operado manualmente



Amostrador tipo rosca, de acionamento por motor de combustão interna (furadeira), operado manualmente





Veículo dedicado com amostrador hidráulico





http://www.baseap.com.br/website/index.php?option=com_content&task=view&id=16&Itemid=32

Amostrador tipo rosca, de acionamento por motor elétrico, sobre um quadriciclo



Amostragem em duas profundidades com brocas separadas, na mesma posição

Agrishow, 2014









