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# Spatial Variability of Soil Potassium

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Department of General Agronomy

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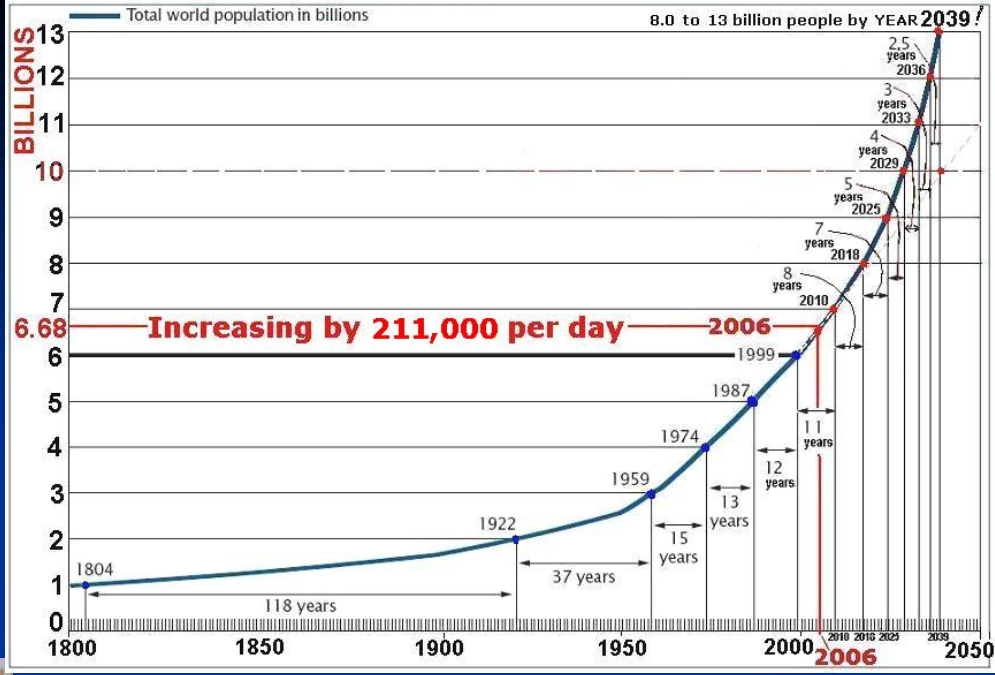
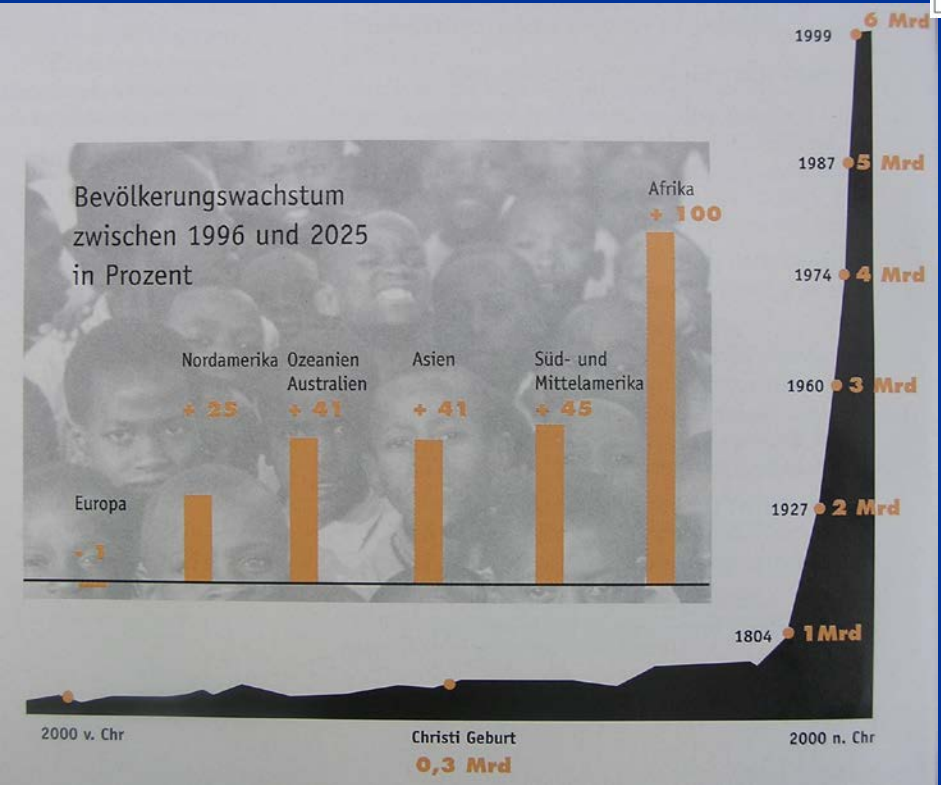
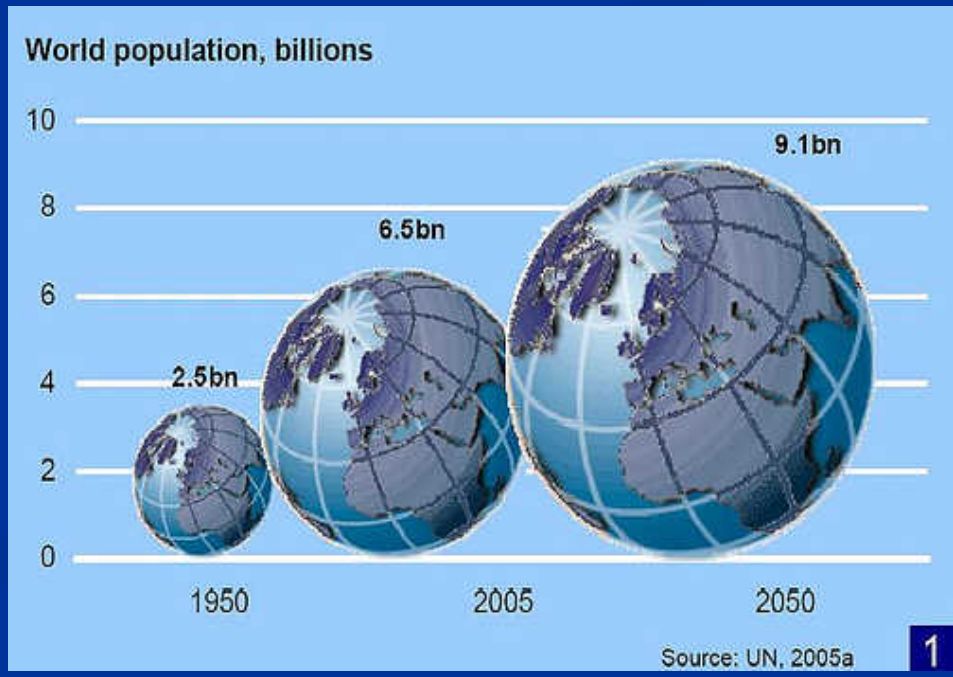
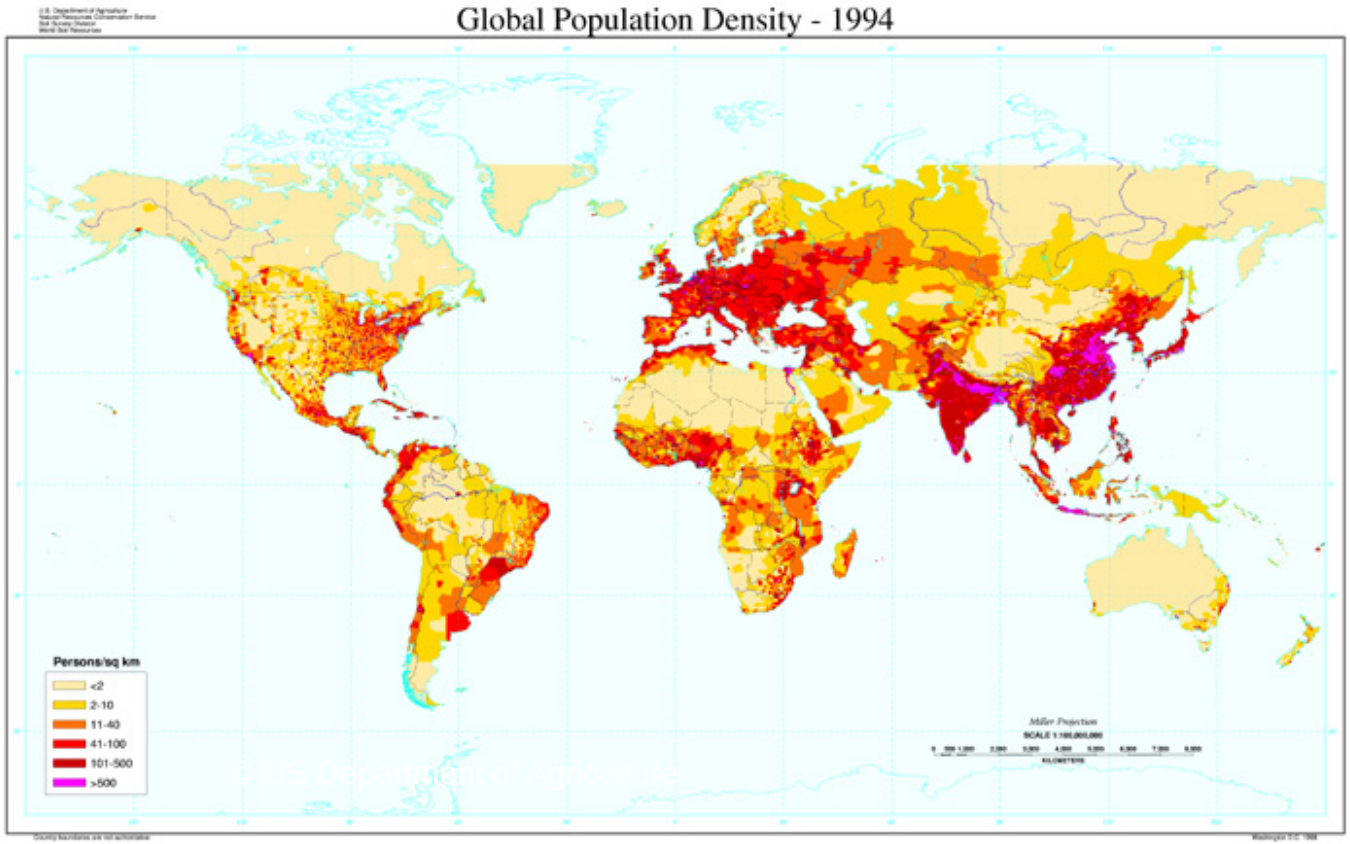
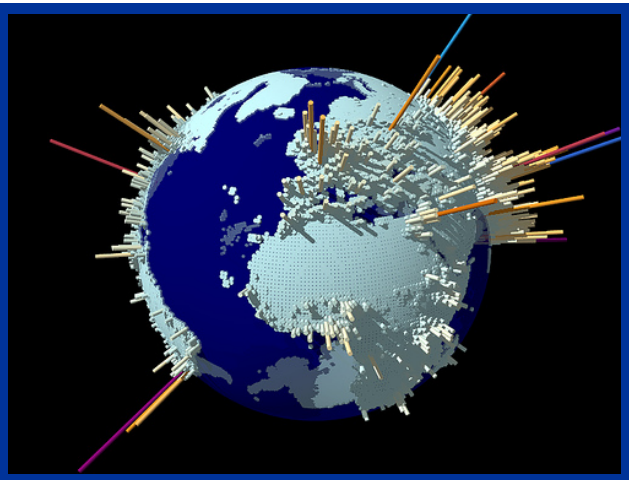
# Population

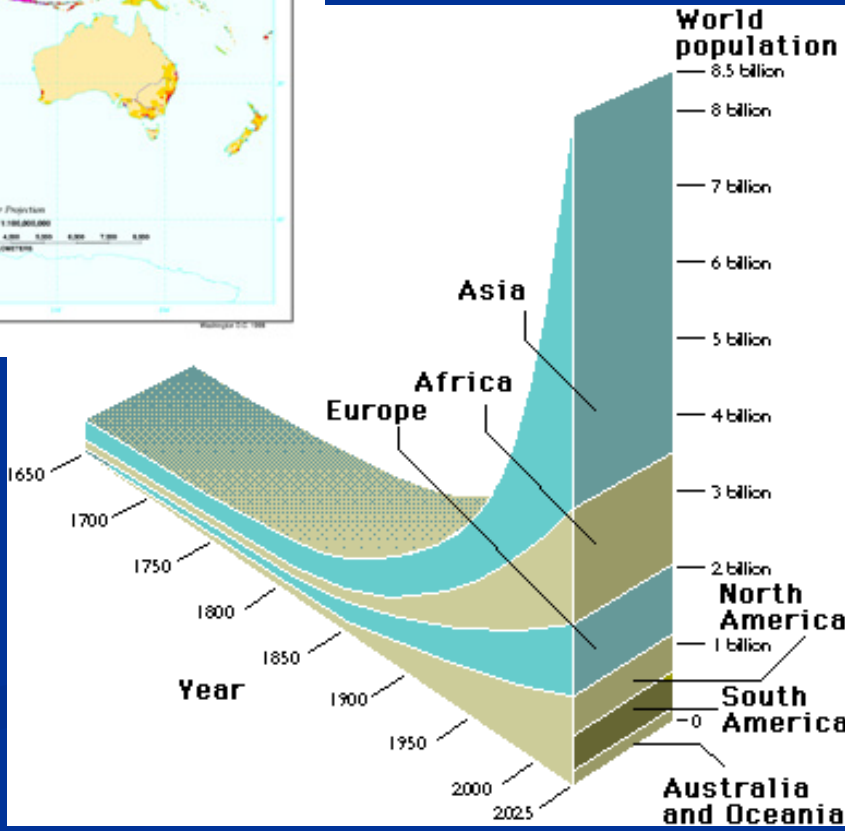

Total world population in billions
8.0 to 13 billion people by YEAR 2039 !
BILLIONS
13
12
11
10
9
8
7
6.68
6
5
4
3
2
1
0
Increasing by 211,000 per day
2006
1999
1987
1974
1959
1922
1804
118 years
37 years
15 years
13 years
12 years
11 years
8 years 2010
7 years 2018
5 years 2025
4 years 2029
3 years 2033
2.5 years 2036
1800
1850
1900
1950
2000
2050


Bevölkerungswachstum
zwischen 1996 und 2025
in Prozent
Europa
+ 1
Nordamerika
+ 25
Ozeanien
Australien
+ 41
Asien
+ 41
Süd- und
Mittelamerika
+ 45
Afrika
+ 100
6 Mrd
1999
5 Mrd
1987
4 Mrd
1974
3 Mrd
1960
2 Mrd
1927
1 Mrd
1804
2000 v. Chr
Christi Geburt
0,3 Mrd
2000 n. Chr


World population, billions
10
8
6
4
2
0
9.1bn
6.5bn
2.5bn
1950
2005
2050
Source: UN, 2005a
1



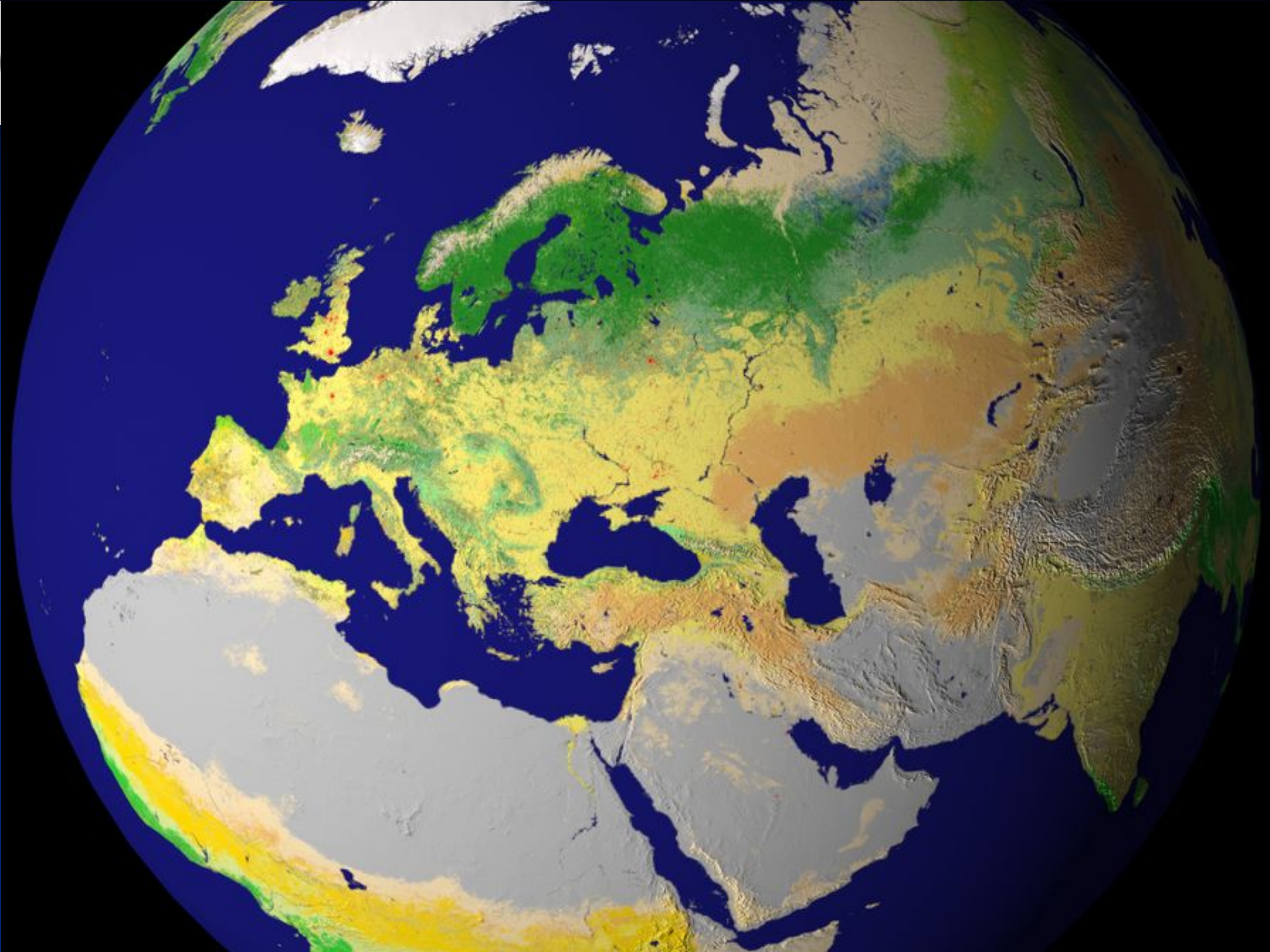






Source: The Nystrom Desk Atlas, Chicago 1994

# Green revolution is over?

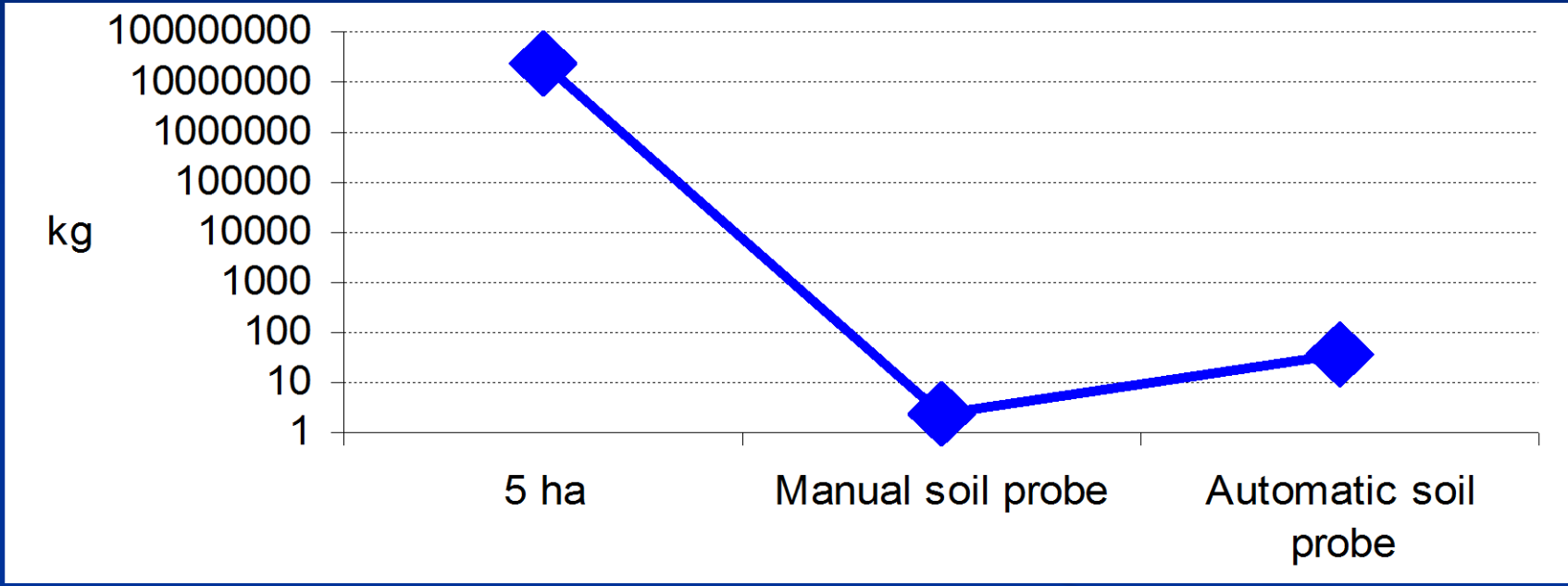
- “Unless progress with agricultural yields remains very strong, the next century will experience sheer human misery that, on a numerical scale, will exceed the worst of everything that has come before".



# 1. Introduction

- Average soil sample of 2 kg represents 22,500,000 kg of soil on 5 ha area up to 30 cm depth
- Soil sampling need to be reliable, repeatable and simple

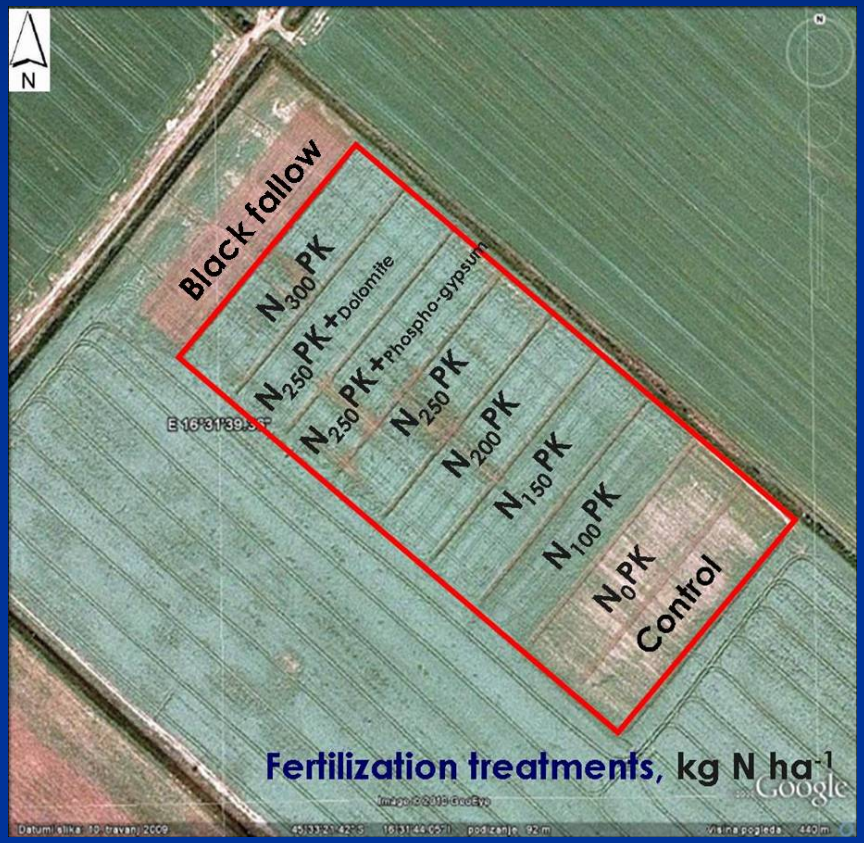
# 1. Introduction




Soil bulk sampled on 5 ha area with conventional and new soil probe

(depth of 30 cm, kg)

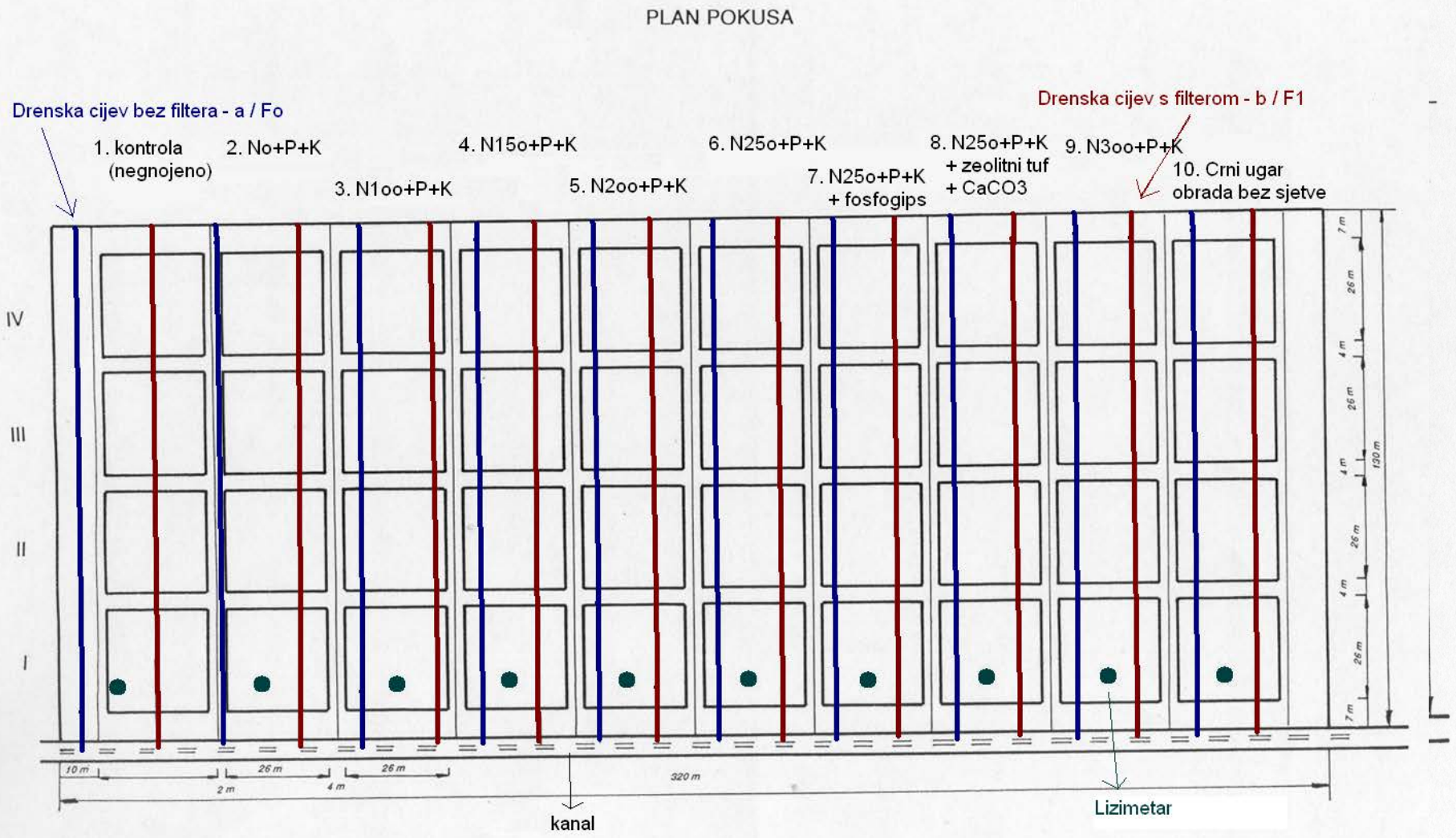
# 2. Background




1. Check
2. $N_0$ PK,
3. $N_{100}$ PK,
4. $N_{150}$ PK ,
5. $N_{200}$ PK,
6. $N_{250}$ PK,
7. $N_{250}$ PK+ PG,
8. $N_{250}$ PK+ Dolomite
9. $N_{300}$ PK
10. Black fallow

Field experiment with 10 treatments *(Source: Google Earth, 2010).*

# Plan of the field trial:



# From 1996

- 10 pan lysimeters
- 20 drainage pipes
- Lot of field and laboratory work

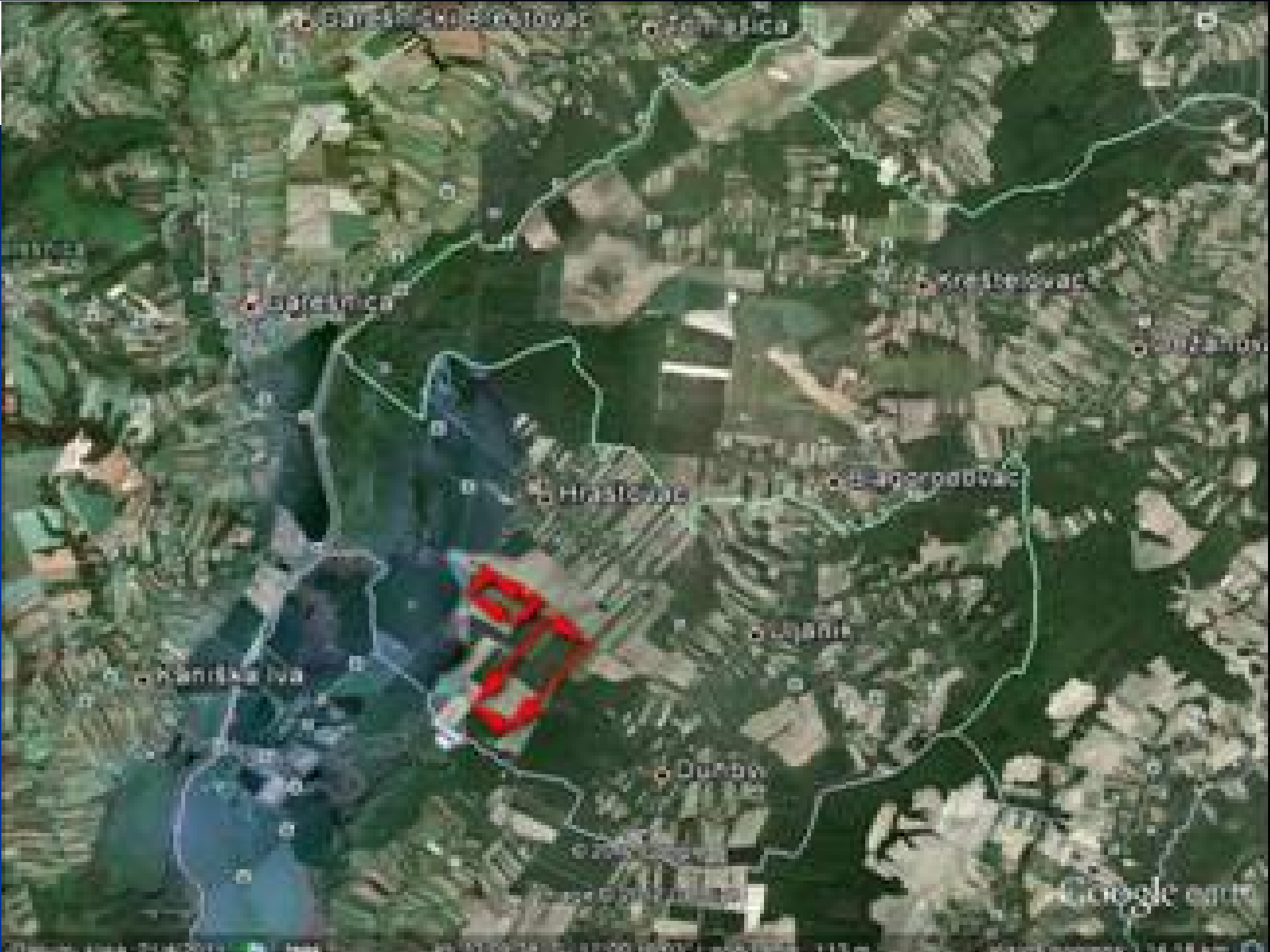
Patent pending:  PCT/HR2011/000021 Rotary Soil Sampling Assembly

# 3. Work with new soil probe

# 3. Work with new soil probe

# 4. Methodology

- The goal of work was to get clear information about spatial variability of soil potassium content in arable layer of the 84 ha field.
- Sampling - grid sampling (50 x 50 m, at grid intersections)
- Field size - 84 ha
- Total number of samples – 330
- Precise location of sampling at grid intersection was set up Trimble GeoExplorer GeoXH 6000 with accuracy +- 10 cm.

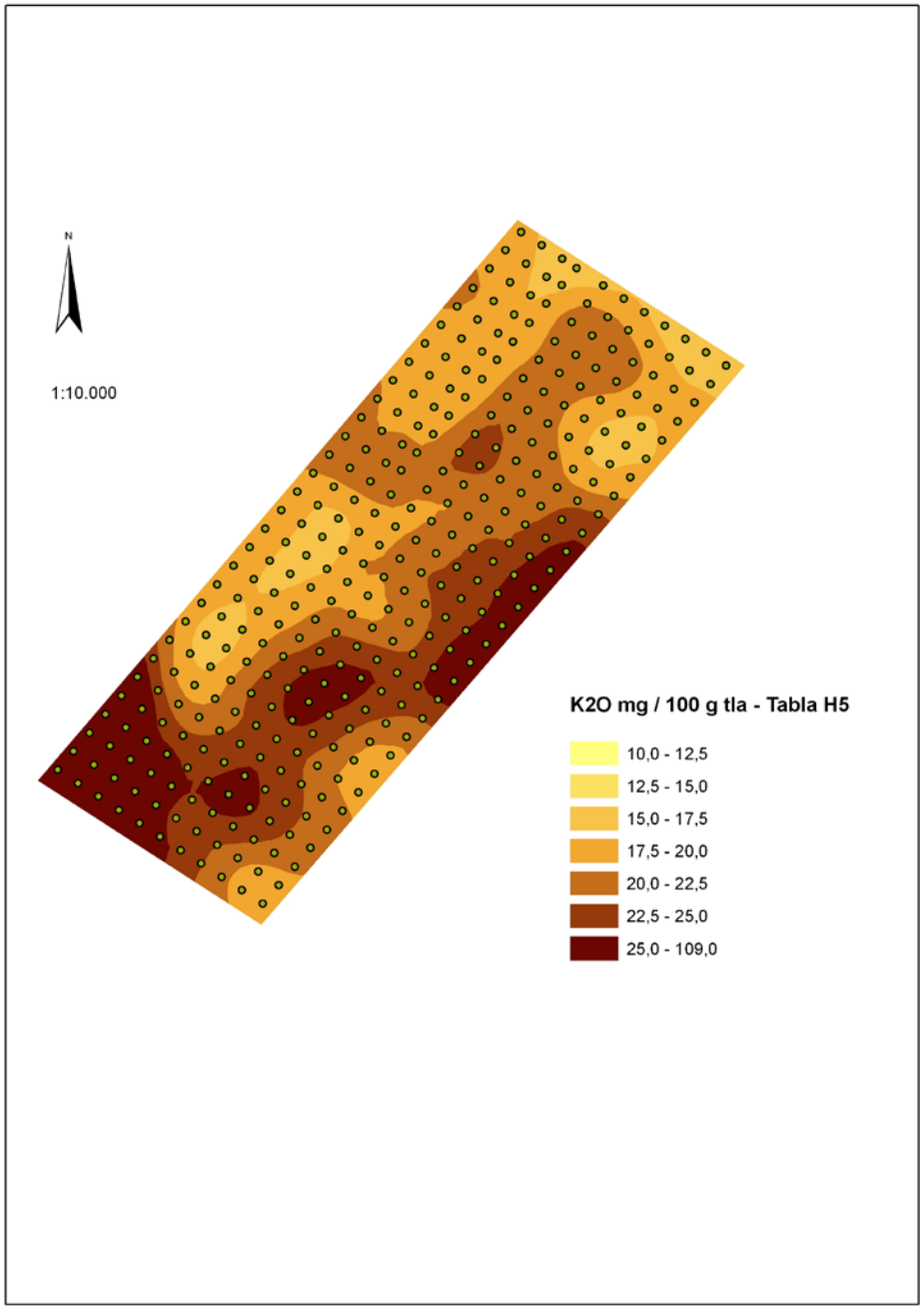

Hrastovac
Dunav
Google earth

H5 - 002
H5 - 024
H5 - 023
H5 - 026
H5 - 048
H5 - 021
H5 - 028
H5 - 181
H5 - 029
H5 - 044
H5 - 248
H5 - 241
H5 - 007
H5 - 125
H5 - 238
H5 - 300
H5 - 301
H5 - 031
H5 - 126
H5 - 302
H5 - 299
H5 - 009
H5 - 041
H5 - 244
H5 - 303
H5 - 011
H5 - 187
H5 - 304
H5 - 035
H5 - 129
H5 - 247
H5 - 294
H5 - 305
H5 - 013
H5 - 131
H5 - 189
H5 - 307
H5 - 306
H5 - 083
H5 - 249
H5 - 191
H5 - 133
H5 - 087
H5 - 309
H5 - 308
H5 - 053
H5 - 251
H5 - 291
H5 - 168
H5 - 229
H5 - 310
H5 - 055
H5 - 089
H5 - 166
H5 - 227
H5 - 312
H5 - 311
H5 - 091
H5 - 137
H5 - 225
H5 - 313
H5 - 077
H5 - 139
H5 - 197
H5 - 224
H5 - 256
H5 - 314
H5 - 075
H5 - 315
H5 - 112
H5 - 258
H5 - 060
H5 - 200
H5 - 257
H5 - 284
H5 - 118
H5 - 160
H5 - 260
H5 - 282
H5 - 318
H5 - 072
H5 - 143
H5 - 219
H5 - 261
H5 - 098
H5 - 220
H5 - 064
H5 - 156
H5 - 218
H5 - 320
H5 - 106
H5 - 262
H5 - 217
H5 - 322
H5 - 086
H5 - 104
H5 - 215
H5 - 278
H5 - 102
H5 - 139
H5 - 214
H5 - 324
H5 - 266
H5 - 103
H5 - 274
H5 - 323
H5 - 151
H5 - 211
Google earth

# 5. Results

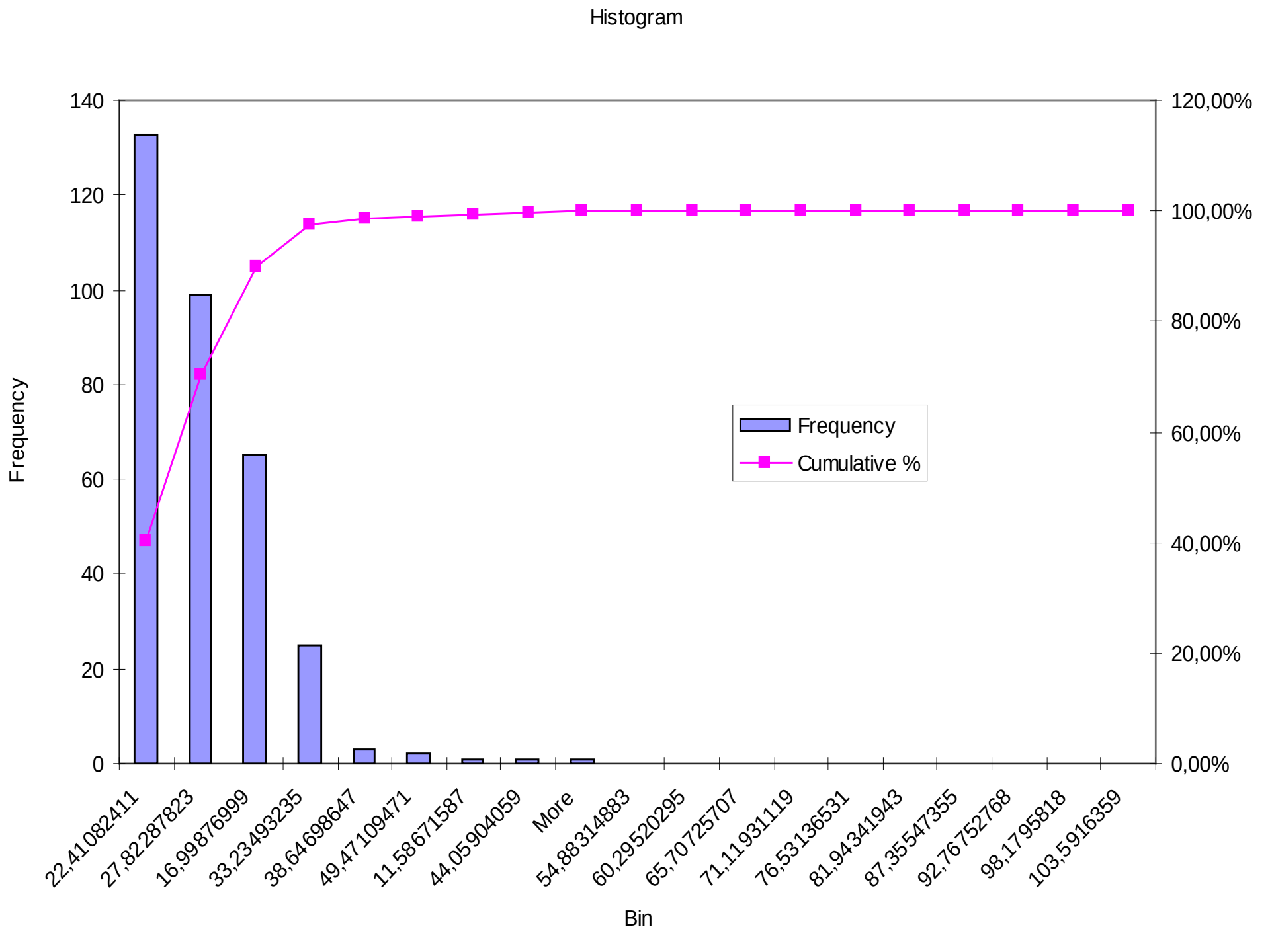
- Regarding $K_2O$ content:

- 20 % of the field has good level of supply,
- 40 % - rich in phosphorus,
- 40 % - very rich in phosphorus




- K2O content in soil - on a larger scale
- – **84 ha field**
- – grid 50 x 50 m
- - **4 samples / 1 ha**
- - 336 samples taken in 3 days
- - each sample is recorded very precisely by GPS – can be repeated in a future

| K2O, mg/100 g tla | |
|---|---|
| Mean | **21,67** |
| Standard Error | 0,39 |
| Median | 20,66 |
| Mode | 17,49 |
| Standard Deviation | 7,07 |
| Sample Variance | 50,04 |
| Kurtosis | 70,42 |
| Skewness | 6,08 |
| Range | 97,42 |
| Minimum | 11,59 |
| Maximum | 109,00 |
| Sum | 7.150,96 |
| Count | 330 |
| Largest(1) | **109,00** |
| Smallest(1) | **11,59** |
| Confidence Level(95,0%) | 0,77 |

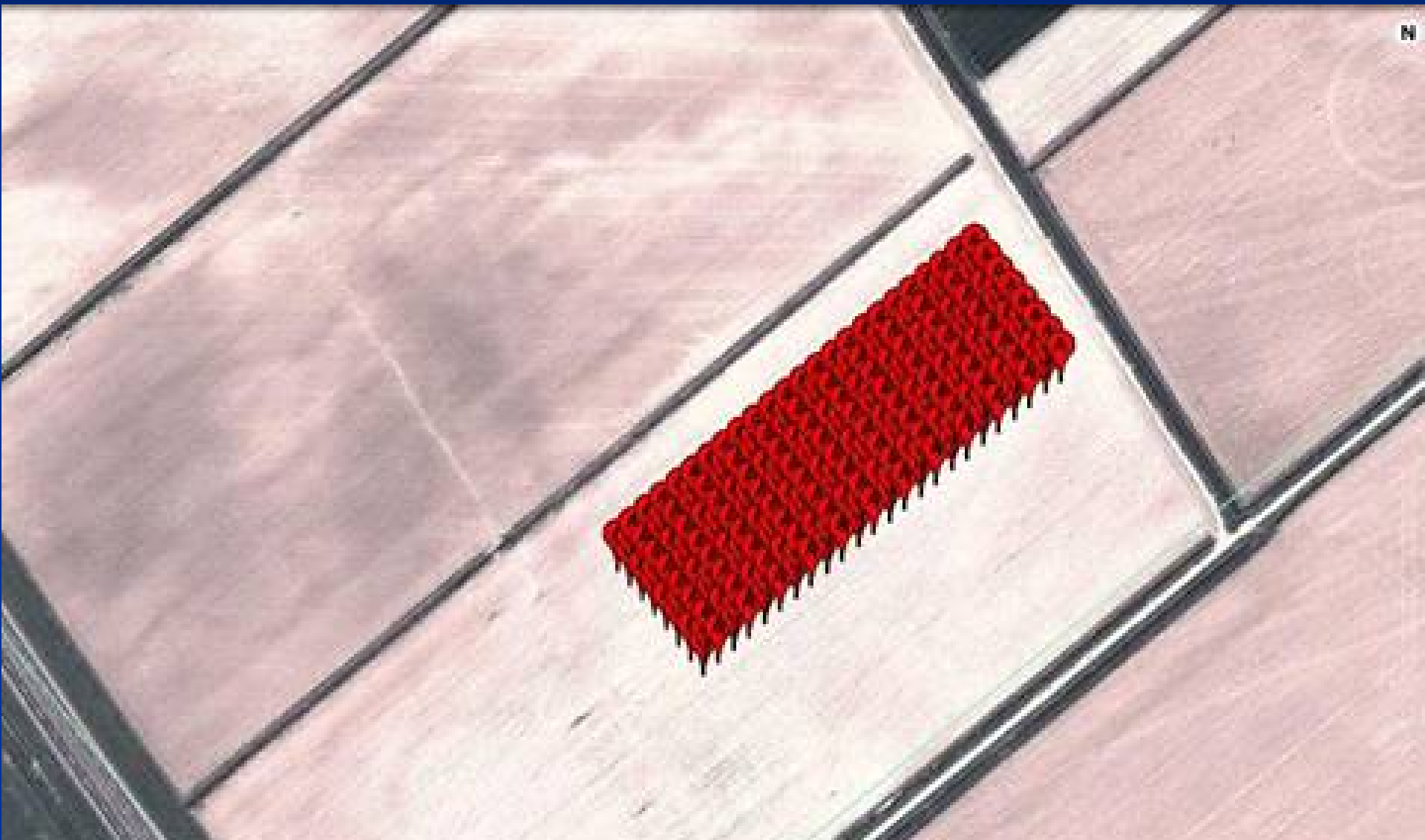

Histogram
140
120
100
80
60
40
20
0
120,00%
100,00%
80,00%
60,00%
40,00%
20,00%
0,00%
Frequency
Frequency
Cumulative %
22,41082411
27,82287823
16,99876999
33,23493235
38,64698647
49,47109471
11,58671587
44,05904059
More
54,88314883
60,29520295
65,70725707
71,11931119
76,53136531
81,94341943
87,35547355
92,76752768
98,1795818
103,5916359
Bin

# New field trials:

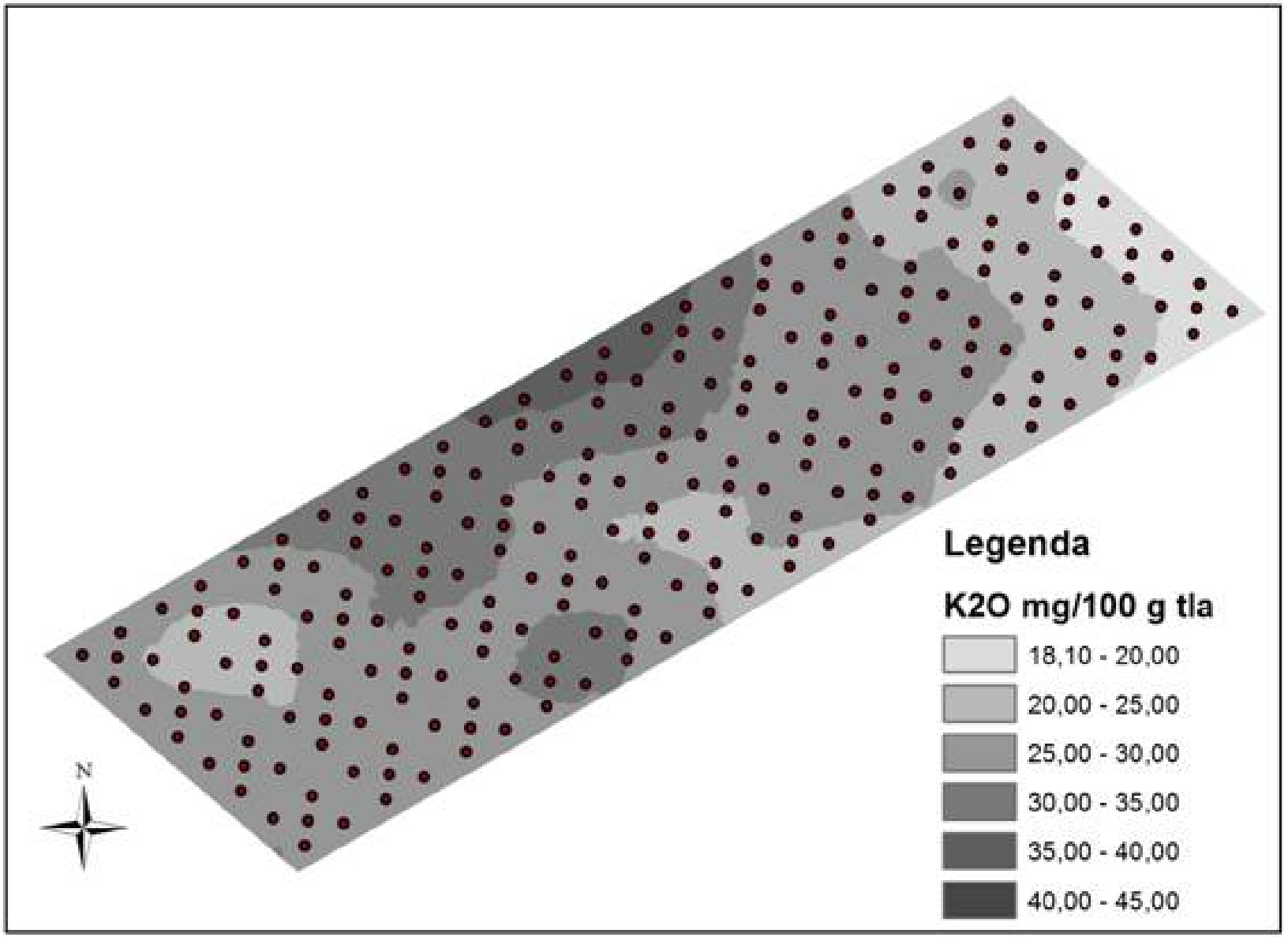
- 1. Popovaca
- 2. Vukovar
- 3. Vinkovci

| | | | |
|---|---|---|---|
| 1. Check – no fertilisation | | | 0 |
| 2. N150 | P100 | K0 | NP |
| 3. N150 | P0 | K100 | NK |
| 4. N0 | P100 | K100 | PK |
| 5. N150 | P100 | K100 | NPK |
| 6. N150 | P50 | K100 | NP50K |
| 7. N150 | P150 | K100 | NP150K |
| 8. N150 | P200 | K100 | NP200K |
| 9. N150 | P100 | K50 | NPK50 |
| 10. N150 | P100 | K150 | NPK150 |
| 11. N150 | P100 | K200 | NPK200 |
| 12. N150 | P100 | K250 | NPK250 |

# Soil sampling scheme on a 2,5 ha area



# 240 samples/ 28800 $m^2$ = 1 sample/120 $m^2$



| | | | |
|---|---|---|---|
| 37 **8** | 36 **5** | 13 **6** | 12 **12** |
| 38 **1** | 35 **7** | 14 **3** | 11 **11** |
| 39 **4** | 34 **8** | 15 **2** | 10 **10** |
| 40 **6** | 33 **10** | 16 **4** | 9 **9** |
| 41 **3** | 32 **2** | 17 **1** | 8 **8** |
| 42 **11** | 31 **9** | 18 **12** | 7 **7** |
| 43 **5** | 30 **4** | 19 **9** | 6 **6** |
| 44 **7** | 29 **12** | 20 **10** | 5 **5** |
| 45 **10** | 28 **1** | 21 **11** | 4 **4** |
| 46 **2** | 27 **6** | 22 **8** | 3 **3** |
| 47 **9** | 26 **11** | 23 **7** | 2 **2** |
| 48 **12** | 25 **3** | 24 **5** | 1 **1** |

25 m

| | | | | |
|---|---|---|---|---|
| 1. | Kontrola – bez gnojidbe | | | ₡ |
| 2. | N150 | P100 | K0 | NP |
| 3. | N150 | P0 | K100 | NK |
| 4. | N0 | P100 | K100 | PK |
| 5. | N150 | P100 | K100 | NPK |
| 6. | N150 | P50 | K100 | NP50K |
| 7. | N150 | P150 | K100 | NP150K |
| 8. | N150 | P200 | K100 | NP200K |
| 9. | N150 | P100 | K50 | NPK50 |
| 10. | N150 | P100 | K150 | NPK150 |
| 11. | N150 | P100 | K200 | NPK200 |
| 12. | N150 | P100 | K250 | NPK250 |

# 6. Conclusions

- Soil sampling with new circular soil probe can provide better information because of bigger volume of sampled soil and a repeatable sampling scheme.

# 6. Conclusions

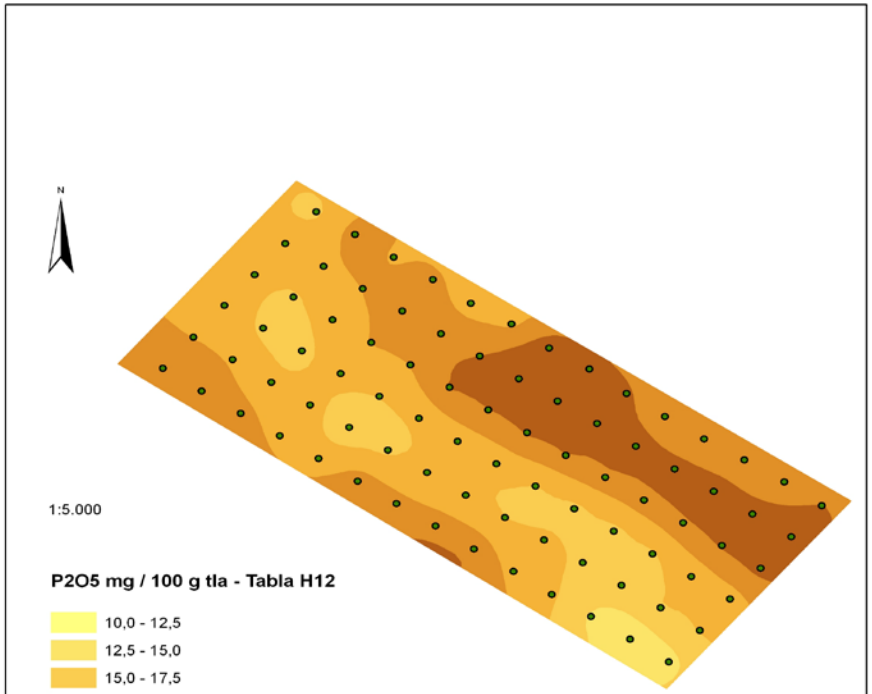
- Based on results we can recommend variable rate fertilization with potassium but also with phosphorus.

- In a field trials we can have more precise information about different soil properties

# 6. Conclusions

- With the application of VRT we can make soil fertility more homogeneous, we can save fertilizers and we can maintain or improve yields.

KONGSKILDE
WING JET


N
1:5.000
P2O5 mg / 100 g tla - Tabla H12
10,0 - 12,5
12,5 - 15,0
15,0 - 17,5

- Thank you for your attention!