Clubroot status in Colombia

Andrea Botero-Ramírez,Fabian Padilla-Huertas, Lina Tarazona, Camilo Gómez, Juan Sebastián Navas, Celsa García

Colombia

- 1 141 748 km²
- Gate of South America
- 32 departments= Provinces
- Agriculture : 6.4% of GDP in 2017 (World bank, 2018)

http://conociendomiriquezaculturalcolombiana.blogspot.com/2015/04/mapa-colombiano.html

Cruciferous crops in Colombia

Cabbage	Broccoli	Cauliflower
45734.34 t	14966.9 t	10359.70 t
1242 ha	804.66 ha	553.6 ha
25.5 t/ha	19.28 t/ha	18.72 t/ha

3.5% of the cropped area in vegetable crops

Major constrains in cruciferous crops production

Clubroot disease

Plasmodiophora brassicae Woronin

First report 1969

Disease effect over yield?

Disease distribution in Colombia?

Pathogen in-field distribution?

Pathogen spread among fields?

First clubroot survey (2017)

Determine the prevalence of the disease in the main producing areas of cruciferous crops in Colombia.

Evaluate the correlation between soil characteristics, weather and agronomic management practices with the prevalence of the disease.

Sampling and surveying

8 departments

Departments with largest cropped area in cruciferous species

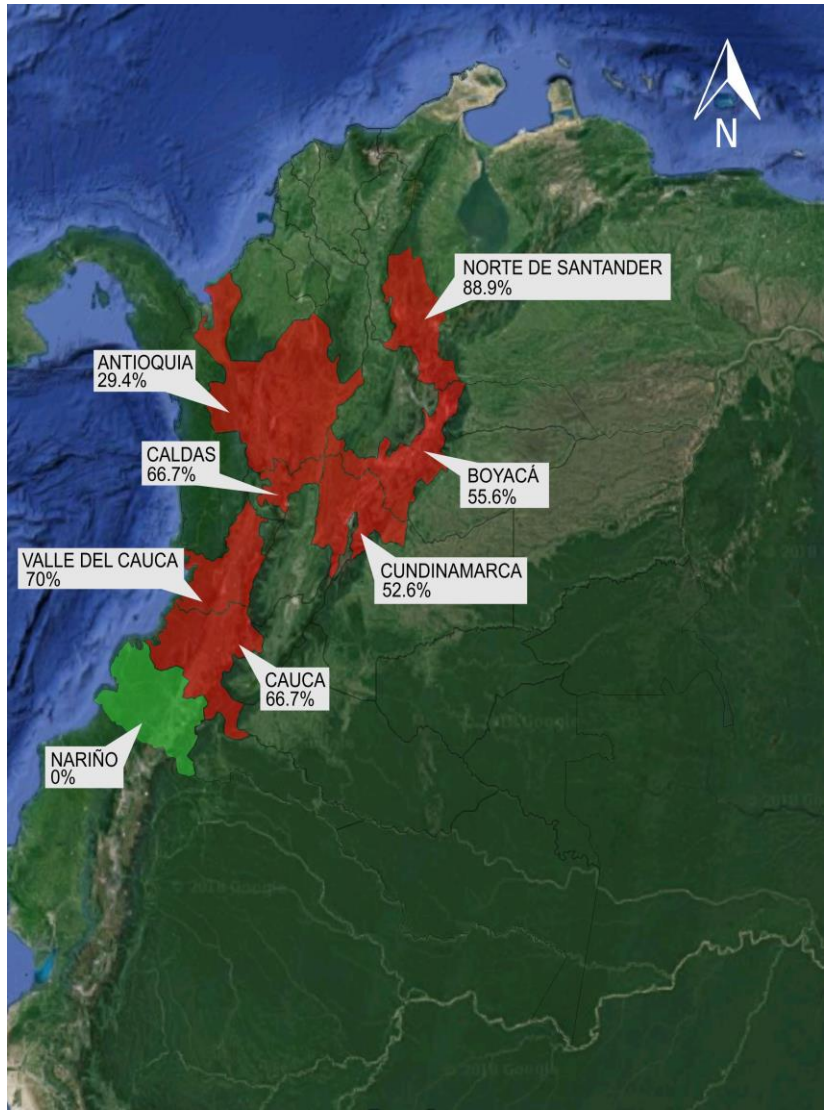
Cundinamarca
Antioquia
Boyacá
Valle del Cauca
Cauca
Nariño
Norte de Santander
Caldas

125 points visited

Prevalence: observed/reported

93 surveys were applied

Results



National prevalence=53.6%

- Norte de Santander:88.9%
- Valle del Cauca: 70%
- Caldas: 66.7%
- Cauca: 66.7%
- Boyacá: 55.6%
- Cundinamarca: 52.6%
- Antioquia: 29.4%
- Nariño: 0%

Soil and weather characteristics

Variable	Point-biserial correlation/disease' prevalence	p-value
Soil attributes		
pH	0.272	0.0037*
ECEC[a]	0.259	0.0058*
Elements contents in soil		
Calcium[b]	0.268	0.004*
Aluminum[b]	-0.259	0.030*
Phosphorus[b]	0.413	<0.0001**
Copper[b]	0.268	0.0042*
Boron[b]	0.289	0.002*
Weather		
Days with rain per year	-0.297	0.002*

[a] Effective cation Exchange capacity.

[b] Determination of the content of the elements in the soil.

[c] Historical anual averages (1981-2010).

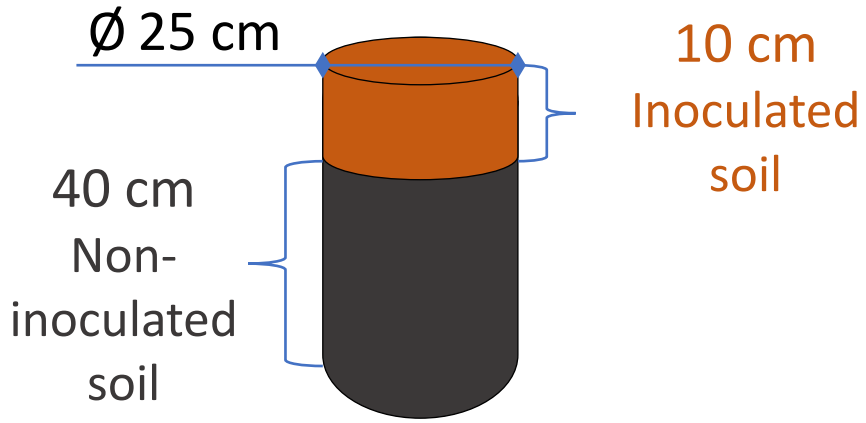
Management practices

Variable	Point-biserial correlation/disease' prevalence	*p*-value
Sowing crucifers	0.763	<.0001*
Resistance	-0.489	0.0006*

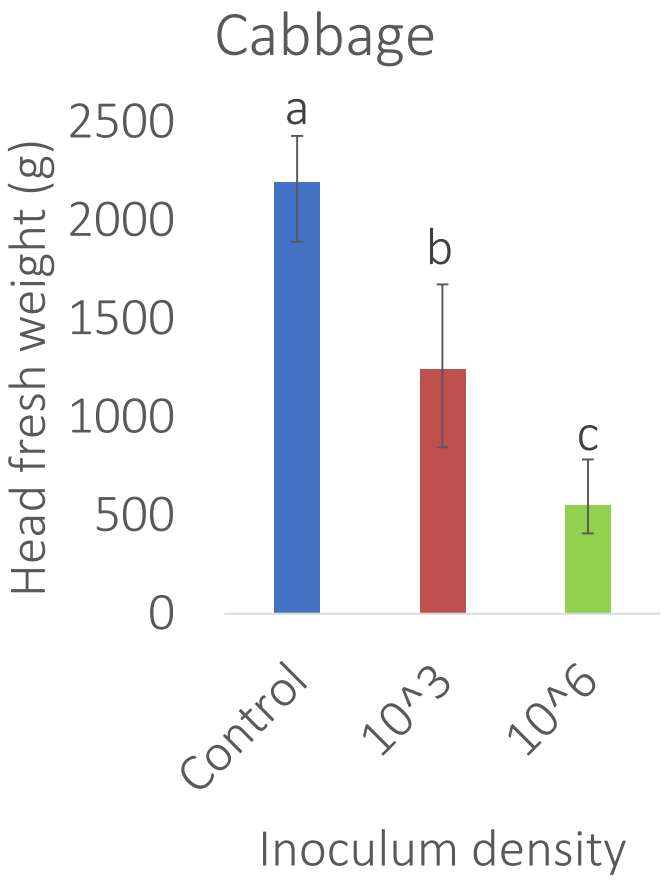
Effect of inoculum density of *P. brassicae* on yield of cabbage, cauliflower and broccoli yield

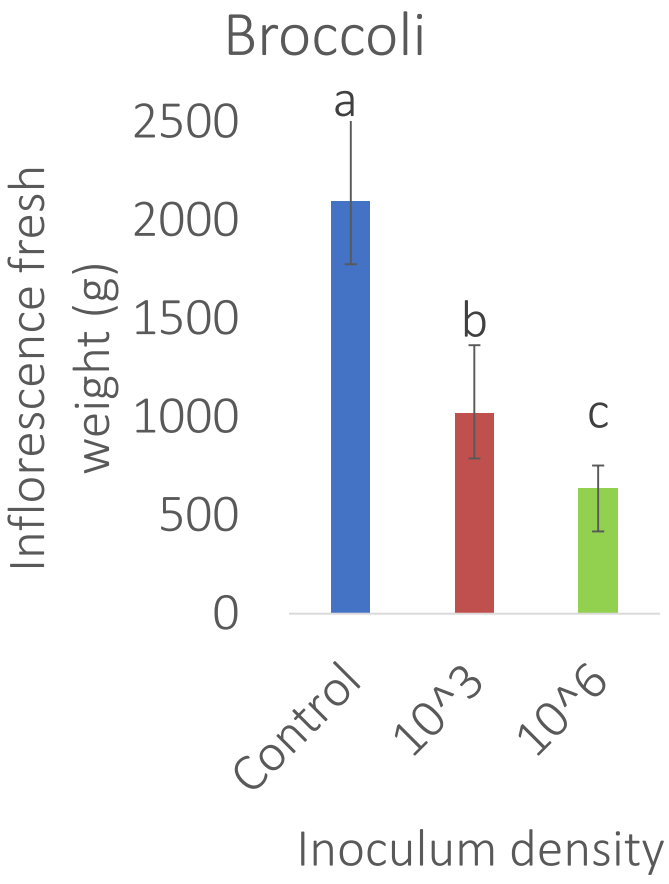
- CRD
  - Inoculum densities
    - Control
    - 10^3 resting spores per gram of soil
    - 10^6 resting spores per gram of soil
  - Plant material
    - Cabbage ‘Delus’
    - Broccoli ‘Calabrese’
    - Cauliflower ‘Snowball’

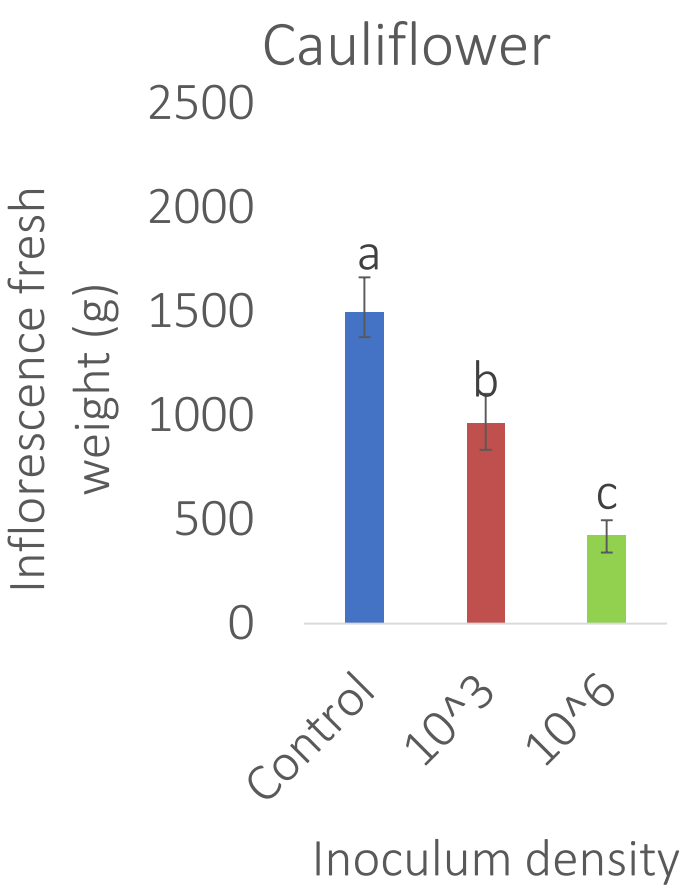
- Substrate→ soil:sand (2:1)
- Inoculation first 10cm
- Outdoors

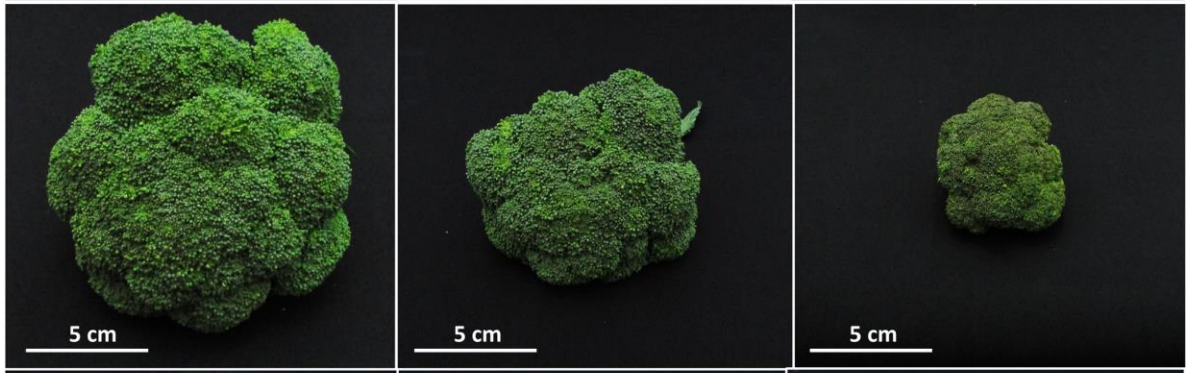
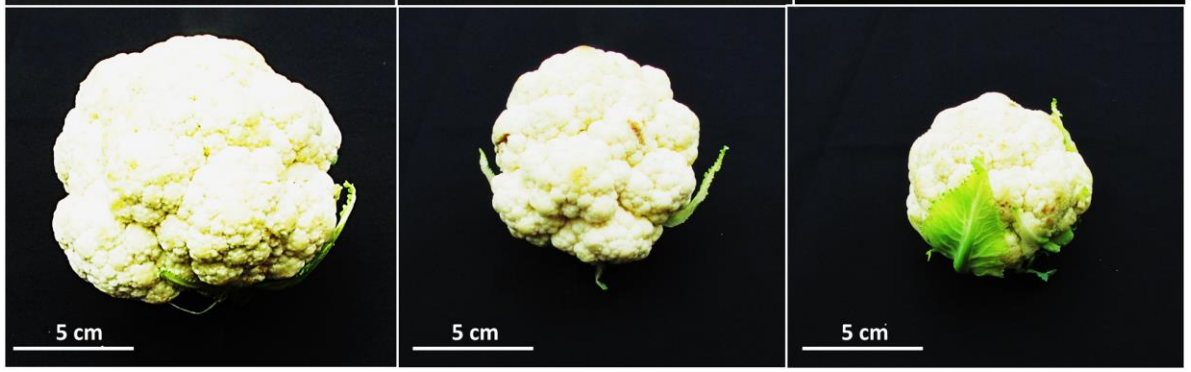


Fresh weight

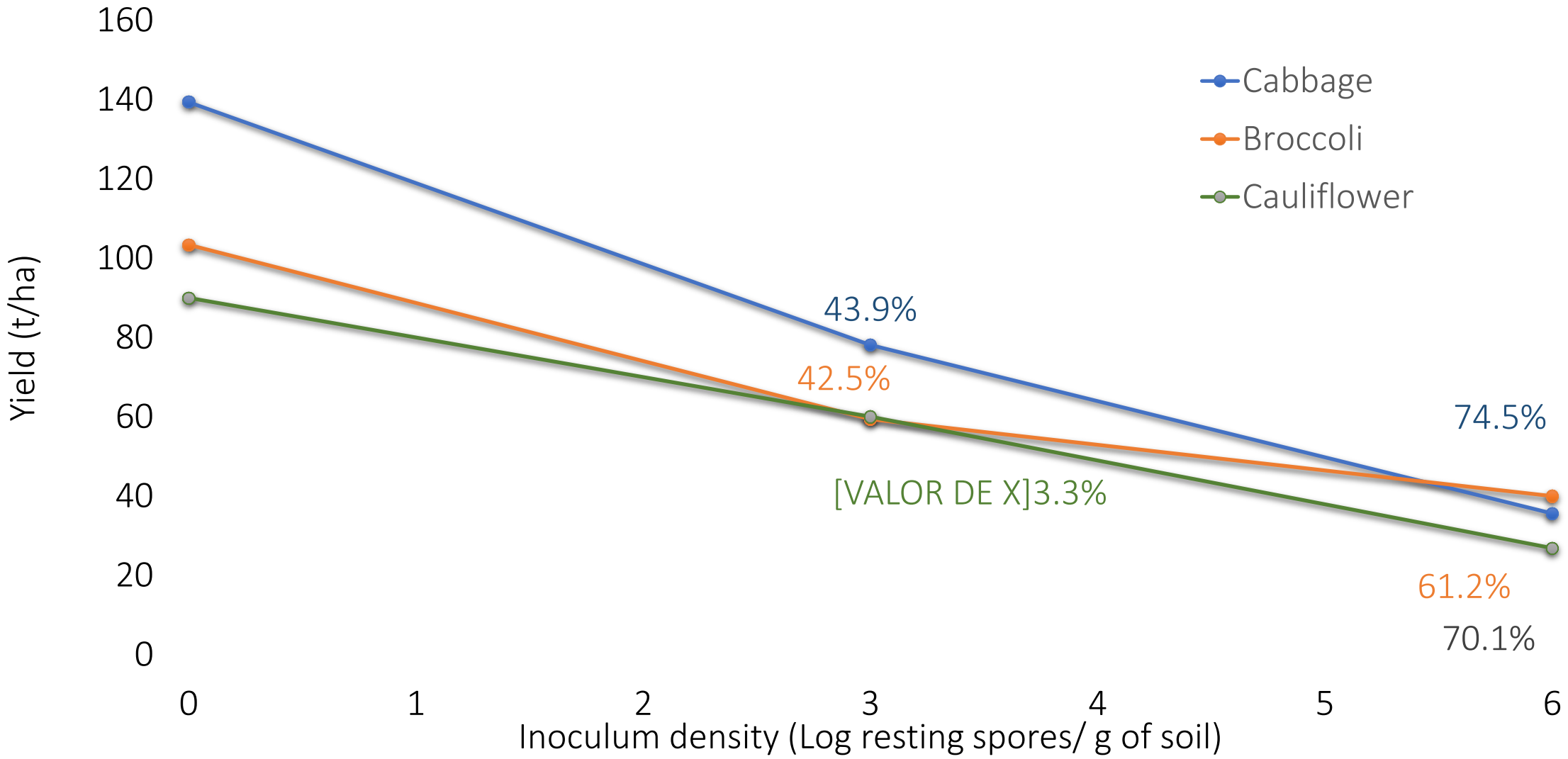






	Control	10^3 resting spores per gram of soil	10^6 resting spores per gram of soil
Cabbage			
Broccoli			
Cauliflower			

YIELD REDUCTION



Assessment of vertical and horizontal distribution of *Plasmodiophora brassicae* in soil

- Assess the vertical and horizontal distribution of *Plasmodiophora brassicae* in soil to identify spatial patterns

Soil samples collection in a commercial field

- 0-15 and 15-30 cm
- Regular grid 20x30m
- Field 2.3ha
- 30 samples

Inoculum density quantification

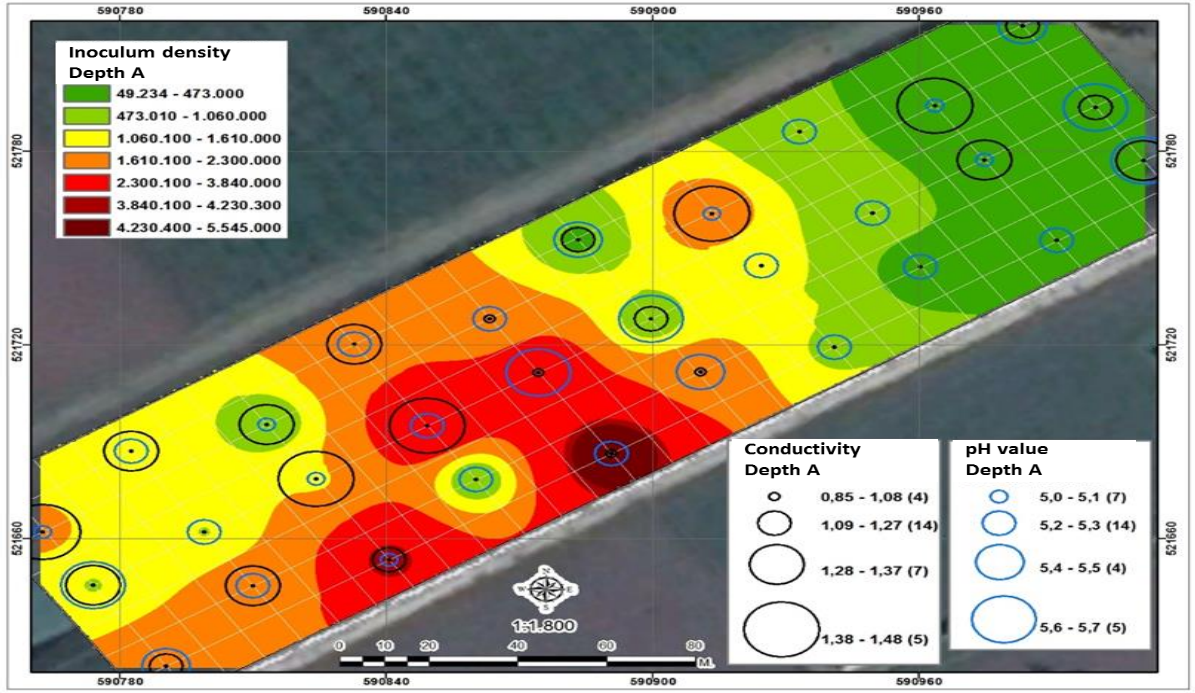
- Extraction of resting spores from soil (Takahashi & Yamaguchi, 1987)
- Quantification with Neubauer chamber in light microscope

Spatial patterns

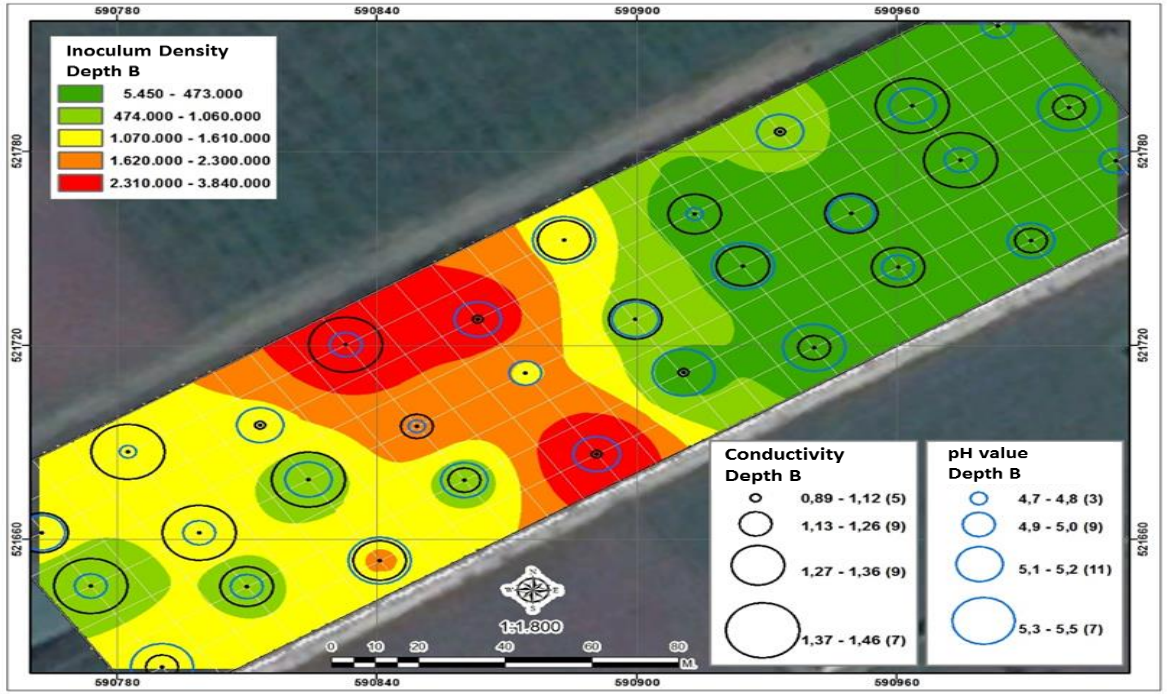
Parameter	A	B
Range	77.14	34.96
Structural variance	95%	100%
Model adjustment	Spherical	Spherical

- Patchy pattern
- Mean inoculum density (resting spores · g of soil $^{-1}$):
  - 0-15 cm = $1x10^{6}$
  - 15-30 cm = $7x10^{5}$.
- Anisotropic trend at 45°
- Patch size
  - 0-15cm: 77.14 m between
  - 15-30 cm: 34.96 m
- Almost 100 % of the variance was explained by spatial variance.

Spatial patterns of the pathogen 0-15 cm



Spatial patterns of the pathogen 15-30 cm



Clubroot disease dissemination by the irrigation system

- Evaluate the presence of viable resting spores of the pathogen in superficial water and sediments along different points of one of the main irrigation districts in the Savanah of Bogotá

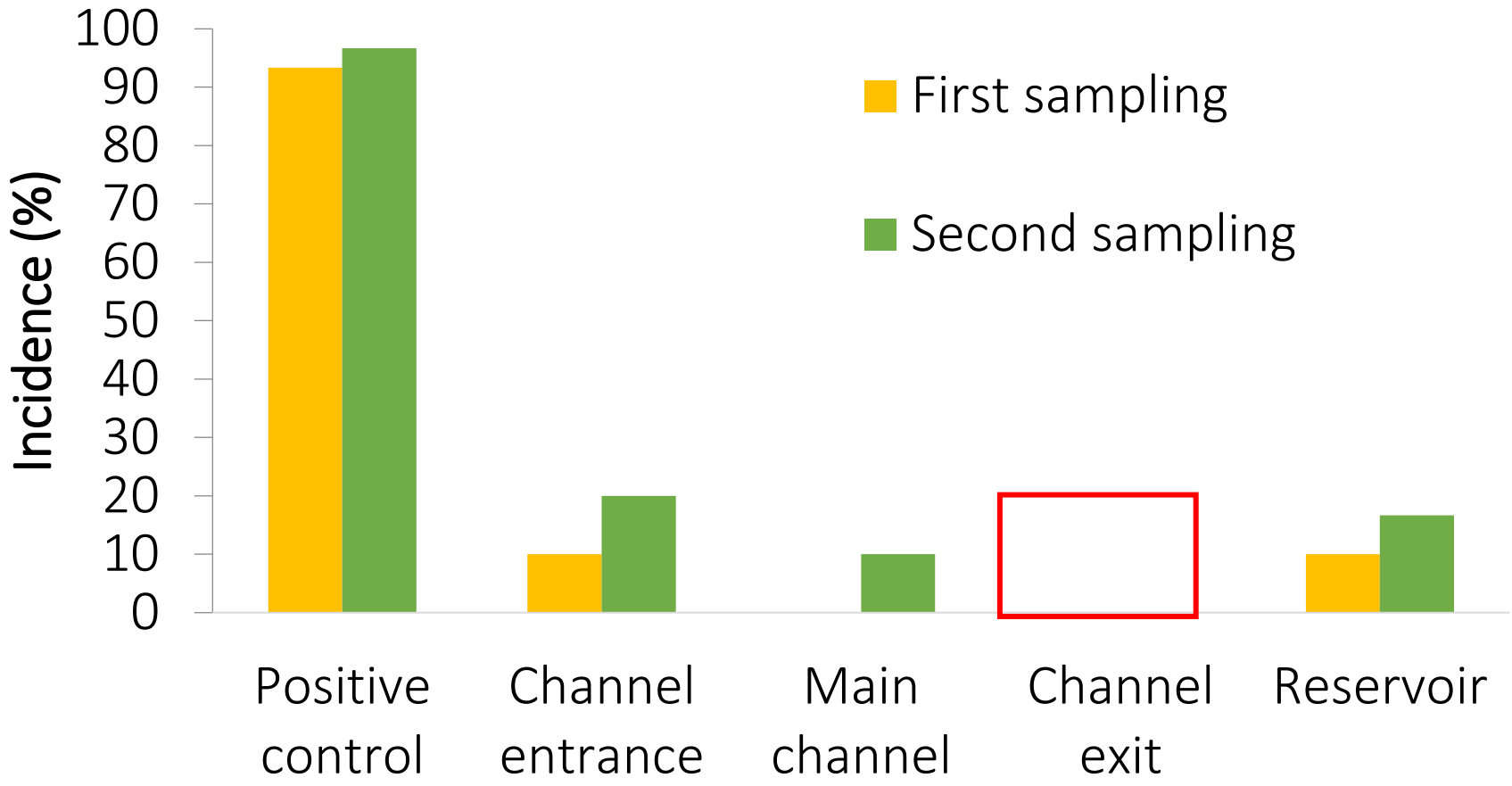
Materials and methods

Irrigation channel sediments and irrigation water collection	
San Isidro farm reservoir	University experimental farm (CAM)

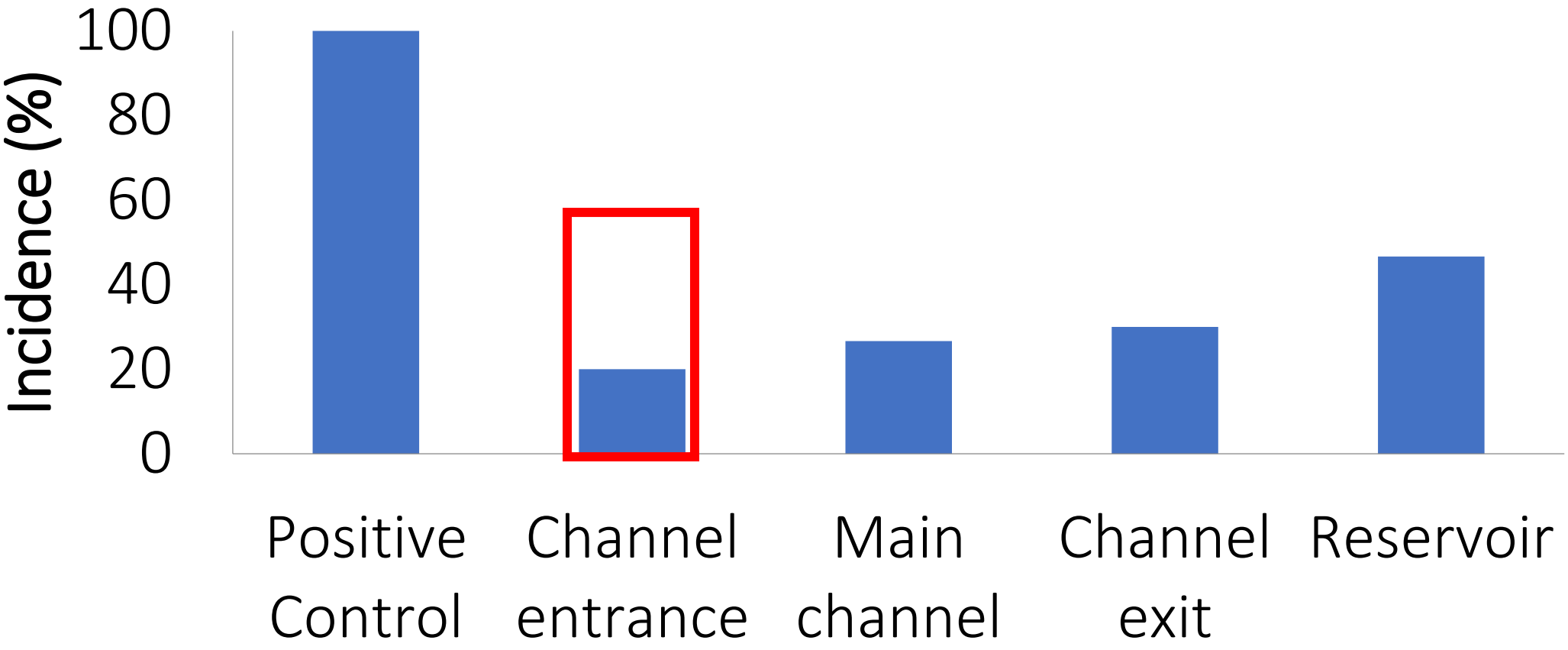
Hydroponic bioassays

Root hairs observation	
21 days after inoculation	Optical microscope (40X – 100X) (Voorips, 1992)

Viable inoculum in irrigation water



Viable inoculum in sediments



Conclusions

- Clubroot disease is widely spread in Colombia
- Clubroot disease loses are related with the pathogen inoculum density. Mild infestation levels cause loses from 30-43% and high infestation levels cause loses from 60-75%
- Disease behaviour shows some differences compared with what has been observed in other regions of the world (in-field distribution, soil properties + disease prevalence)
- More efforts are required to understand the disease behaviour in tropical areas such as Colombia where weather and production conditions differ

THANK YOU