AGQ Labs & Technological Services

Central Coast Water Board

May 2018

for a better and safer world

AGQ Labs ALIMENTARIA

AGQ Labs AGRONOMIA

AGQ Labs M. AMBIENTE

AGQ Labs MINERIA

AGQ Labs SALUD Y SEGURIDAD

Technological service platform

AGQ Labs is a chemical technological center, with over 20 years of experience, based on analysis laboratories, advanced assays and specialized chemical engineering. AGQ Labs provides solutions and services for agro-food, environmental, industrial and mining sectors. It is a synchronized process between technology and knowledge, between analytical chemistry and applied chemistry.

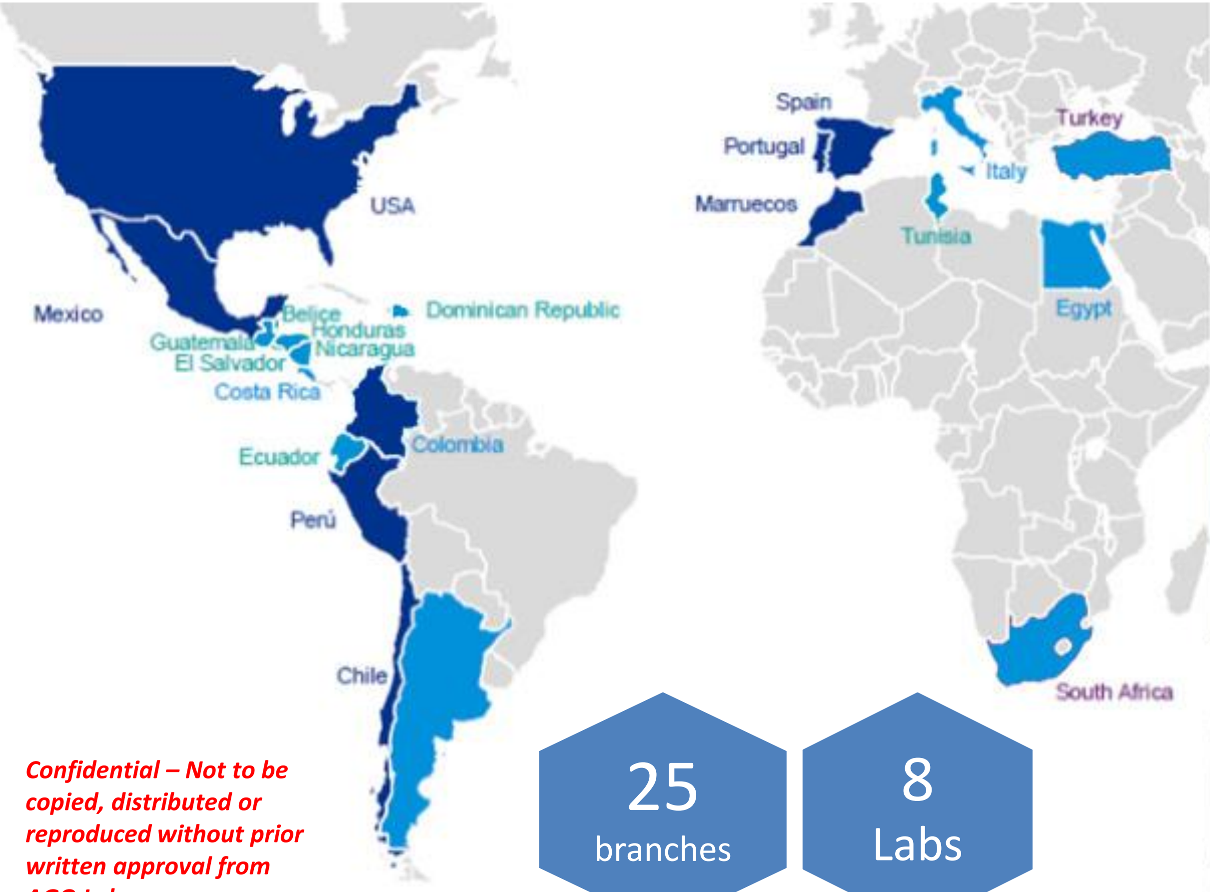
Technological Center

Control Laboratory

Consulting / Specialized Engineering

Inspection and Control

- Agronomy
- Food Safety
- Environmental control
- Mining
- Health & Safety



25 branches

8 Labs

+600 staff

+500 k samples a year

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Notes:

- Subsidiary entities and laboratories.
- Subsidiaries entities with commercial and technical stru

Qualification, Accreditations and Permits

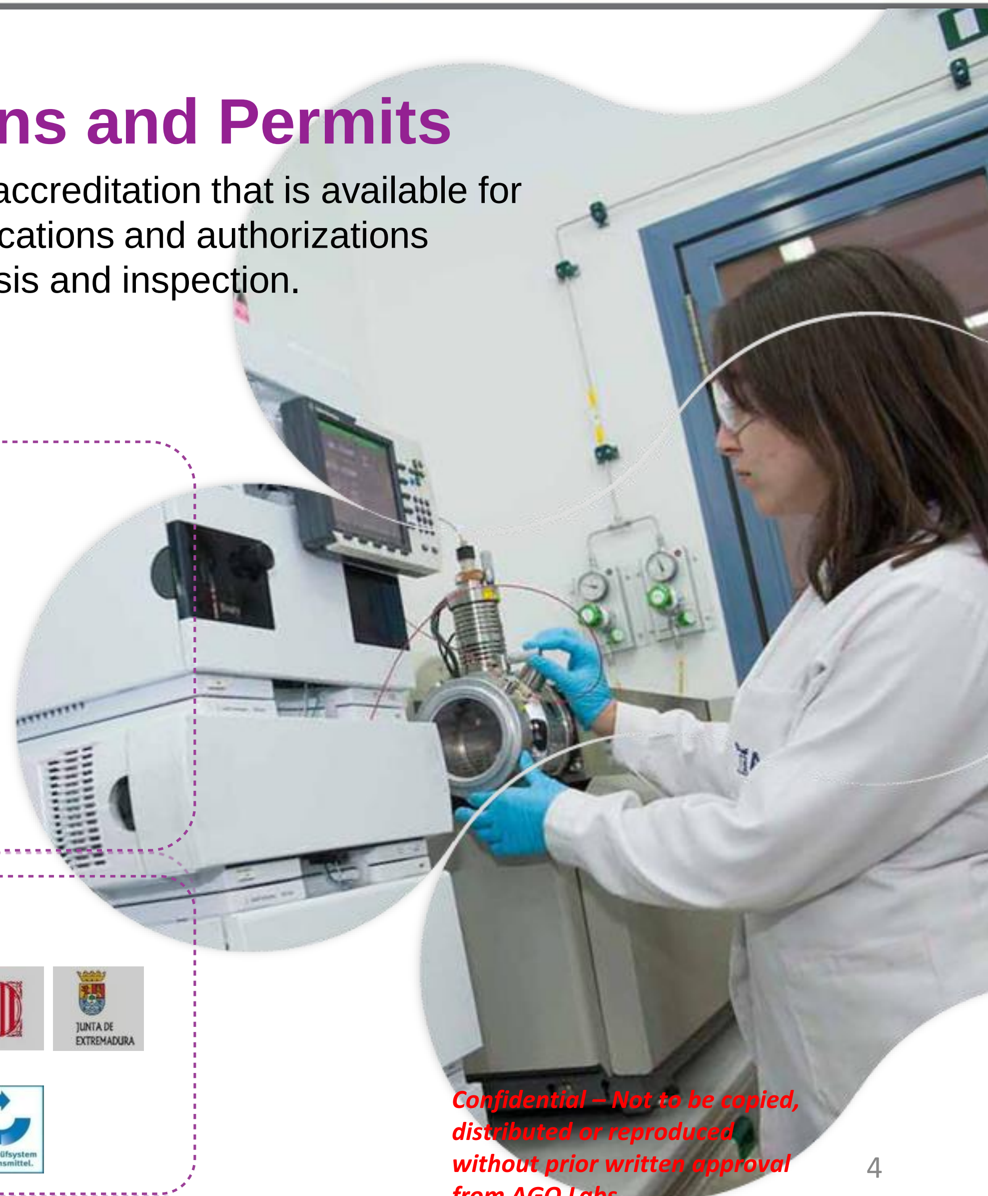
AGQ Labs has the highest level of international accreditation that is available for assays laboratories. These accreditations, certifications and authorizations guarantee our developments and works in analysis and inspection.

Accreditations

ENAC ENSAYOS
IAS ACCREDITED
INN - CHILE
IPAC acreditação
ECA Ente Costarricense de Acreditación
INACAL Instituto Nacional de Calidad
ONAC ORGANISMO NACIONAL DE ACREDITACIÓN DE COLOMBIA
ema entidad mexicana de acreditación, a.c.

Certifications and Authorizations

JUNTA DE ANDALUCIA
Xunta de Galicia
JUNTA DE EXTREMADURA
Castilla-La Mancha
SENASA
GENERALITAT VALENCIANA
ISP INSTITUTO DE SALUD PÚBLICA DE CHILE
EPSAR
ERSAR
QS. Ihr Prüfsystem für Lebensmittel.



Qualification, Accreditations and Permits

USA

IAS ACCREDITED

ELAP Environmental Laboratory Accreditation Program
STATE WATER RESOURCES CONTROL BOARD

Memberrship

American Society of Agronomy

Soil Science Society of America

ALP

Western Growers

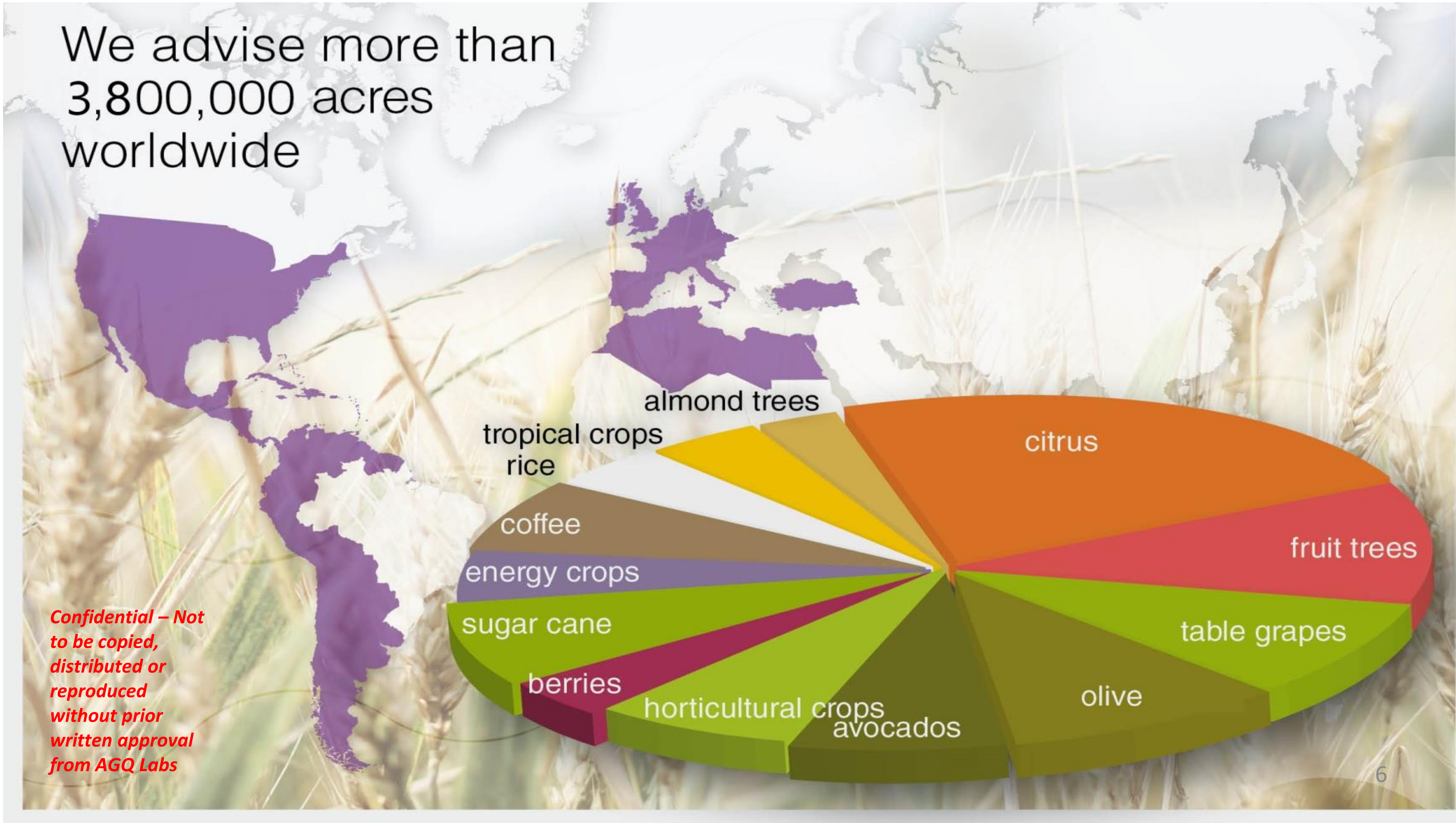
AOAC International

CAPCA

Crop Science Society of America

pma

Agriculture was our origin. Most of our differentials have been developed In this area, such as Crop Nutritional Monitoring (patented)



Nitrates leaching in Europe

The Nitrates Directive (91/676/CEE) aims to protect water quality across Europe by preventing nitrates from agricultural sources polluting ground and surface waters and by promoting the use of good farming practices.

Limits of pollution in groundwater

Nitrates < 50 mg/l (Nitrate Nitrogen < 11.3 mg/l)
Pesticides and metabolites < 0.1 µg/l.
Pesticides and metabolites (total sum) < 0.5 µg/l.

Nitrates leaching in Spain

The European Directive is transposed in 1997, after continued pressure from the European Union. It was the last country to comply with the guidelines of the Commission. Only Denmark met the deadlines

In Spain there was always the debate that this directive did not take into account the Spanish conditions of recurrent drought and fruit and vegetable production (the biggest in Europe)

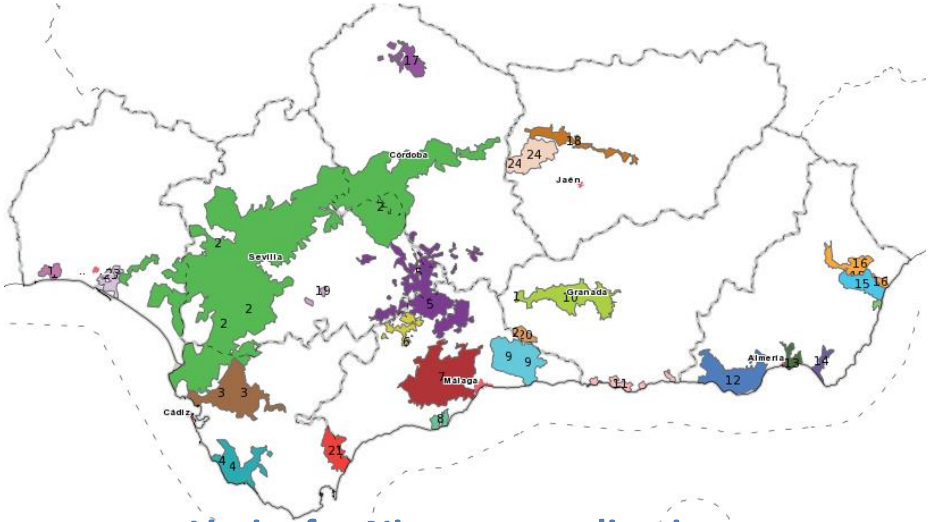
Limits for Nitrogen application (recommendation)

100 Kg per ha/year

50 Kg en vulnerable areas (Doñana, Daimiel)

Nitrates leaching in Andalucia

Vulnerable areas map



Decreto 36/2008 establishes measures against pollution by nitrates of agricultural origin. Includes training, dissemination, research and experimental development actions,

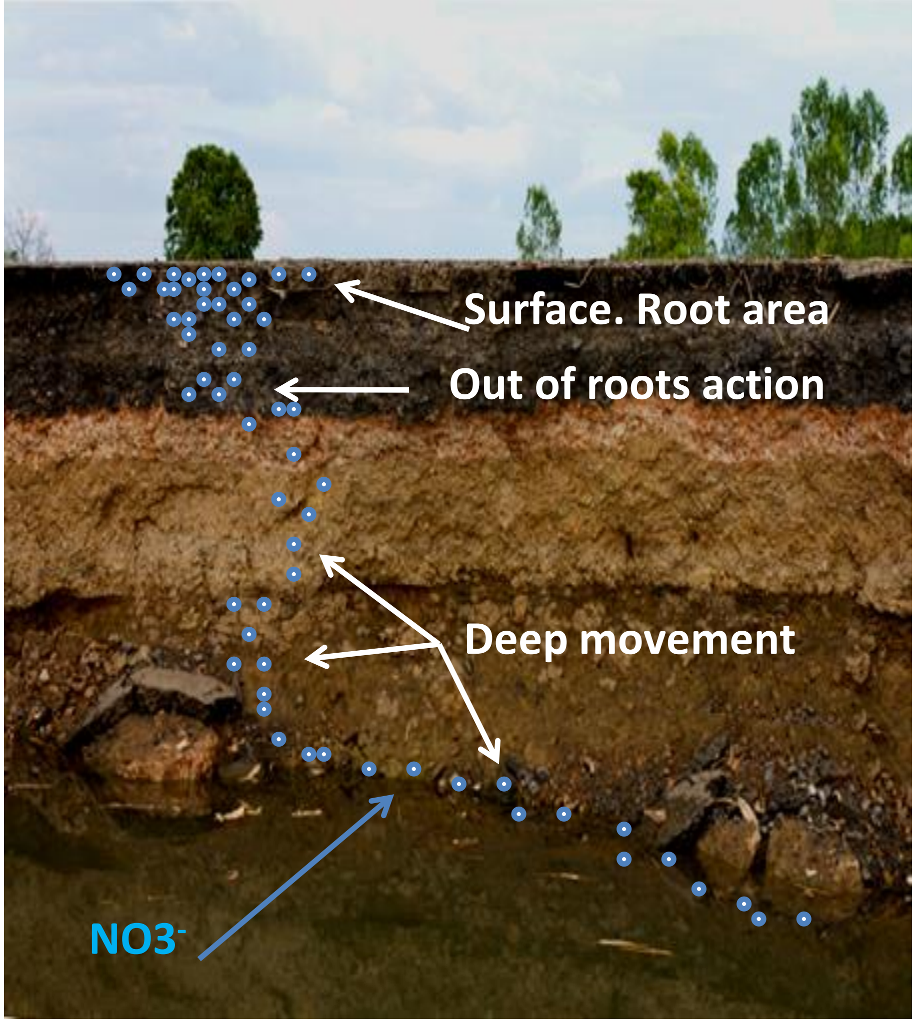
Limits for Nitrogen application

100 - 170 Kg per ha/year, depending on the crop and soil type

30-50 Kg en vulnerable areas

There is a table of nitrogen units per crop

WHAT AFFECTS NITRATE LEACHING



Regardless of where pollution appears, its origins are defined and concentrated in certain risk areas

1. Nitrogen input

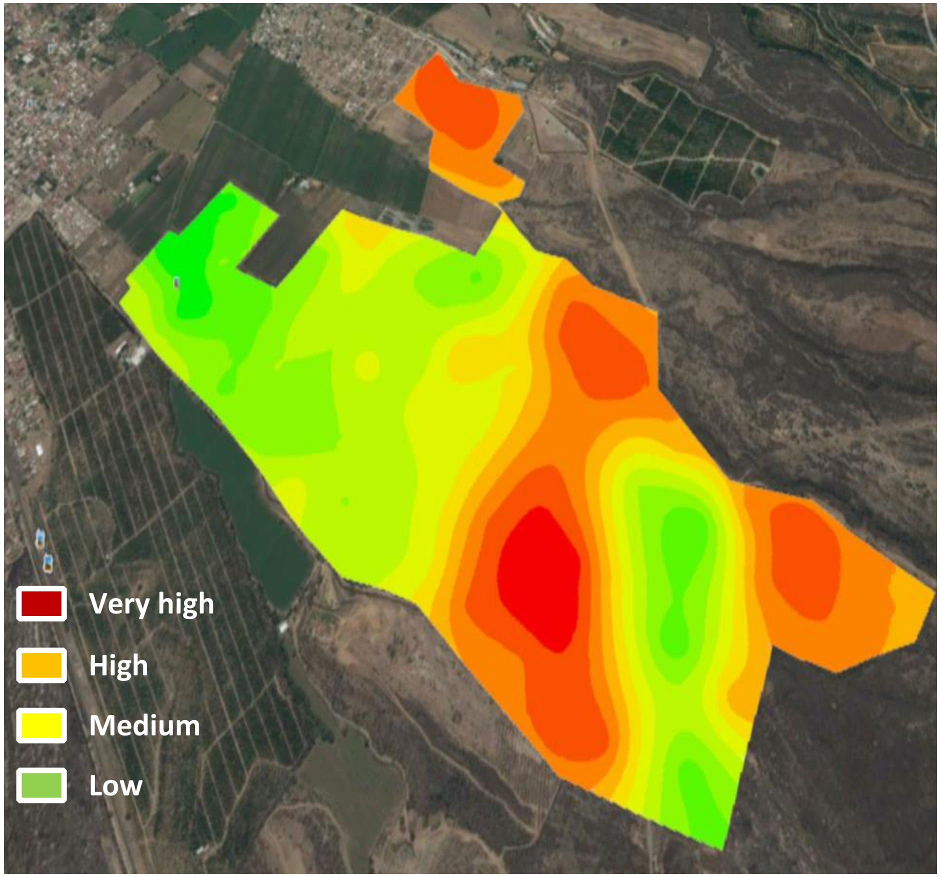
2. Plant activity

3. Soil type

4. Nitrate and water movement

HOW TO IDENTIFY RISK AREAS

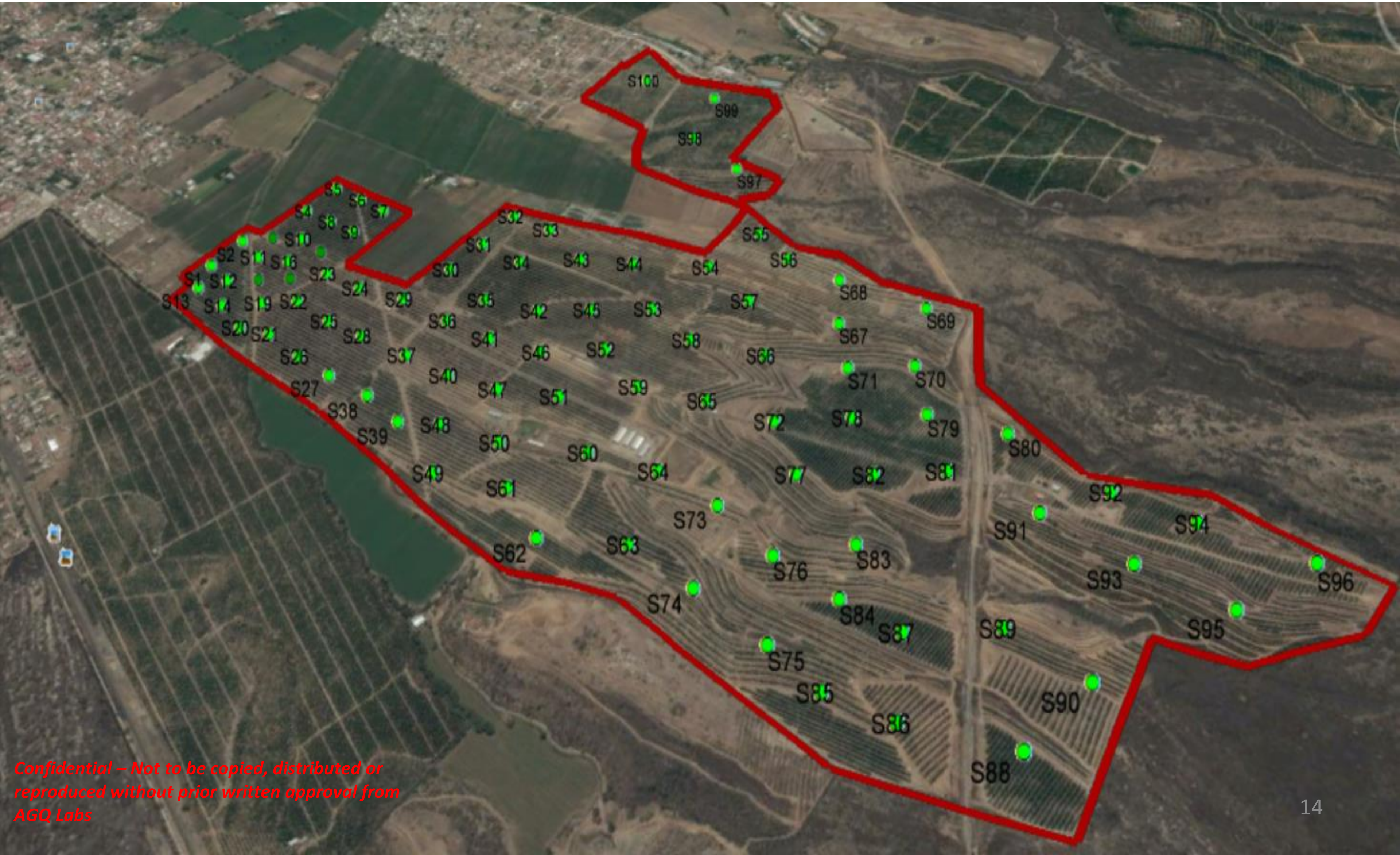
NLR-map (Nitrate Leaching Risk map)



With specific soil analysis and farm information we can develop a NLR map to identify where are the most risky zones

According to:
* Physical soil characteristics: Clays, silts, sands, bulk density
* Presence of nitrogen sources
* Organic matter
* Farm topography

These maps are also used to find out where to install soil solution probes to better understand the nitrate movement along the soil profile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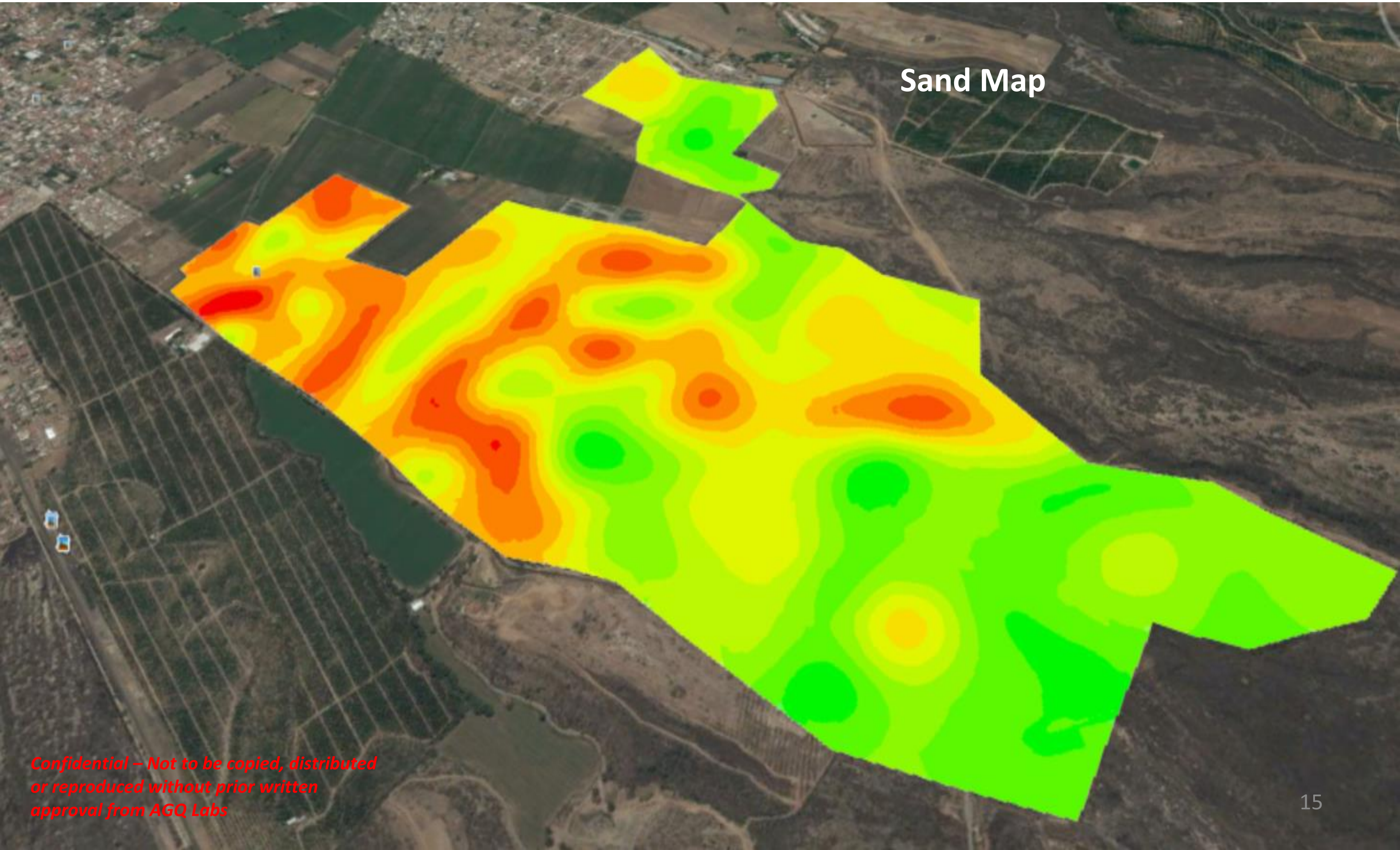
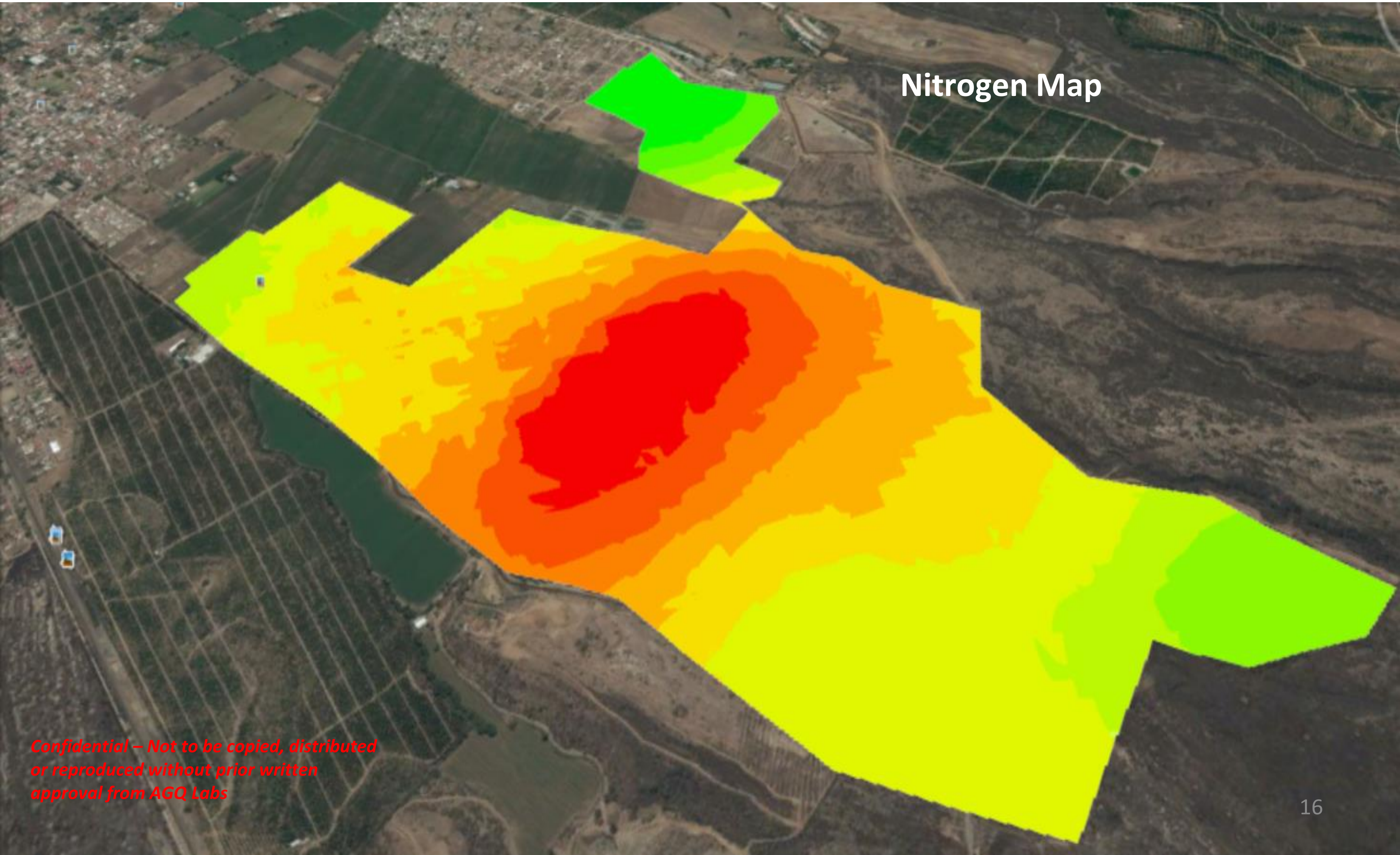

Sand Map


Nitrogen Map

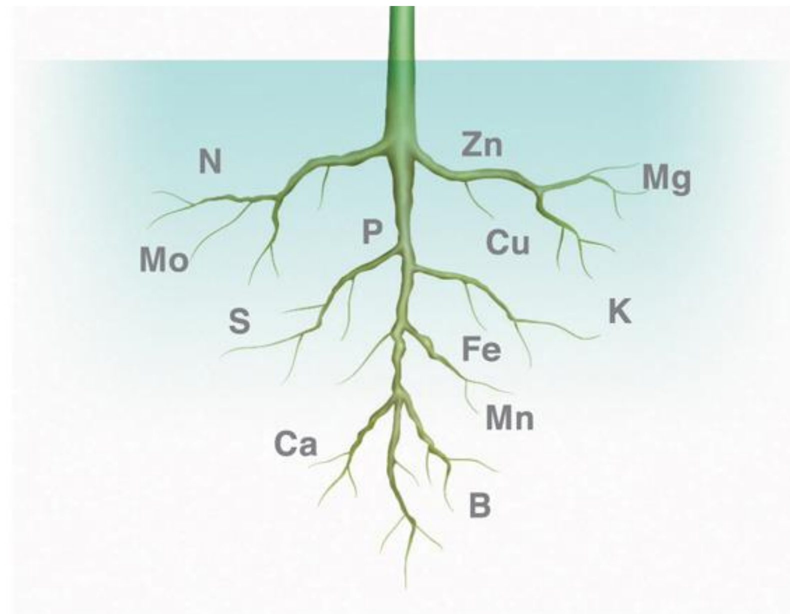
Crop Nutritional Monitoring®

Evaluation of farm, plot and soils. Installation of probes for extraction of soil solution

1. **Monitoring and control of crops under technified irrigation**
2. **Optimization of fertilizer usage and water requirements**
3. **Optimization of the leaching fraction (Minimize environmental impact)**

Essential Mineral Nutrients

- Macro Elements: required in large amounts (80 – hundreds Lbs/acre)
- Secondary Elements: required in large amounts (20-80 Lbs/acre)
- Micro Elements: required in small quantities (a few or less Lbs/acre)
- Others in study/discussion: Nickel, Chlorine, Cobalt, Vanadium



Macro Elements
N - Nitrogen
P - Phosphorous
K - Potassium

Secondary Elements
Ca - Calcium
Mg - Magnesium
S - Sulphur

Micro Elements
Fe - Iron
B - Boron
Zn - Zinc
Cu - Copper
Mn - Manganese
Mo - Molybdenum

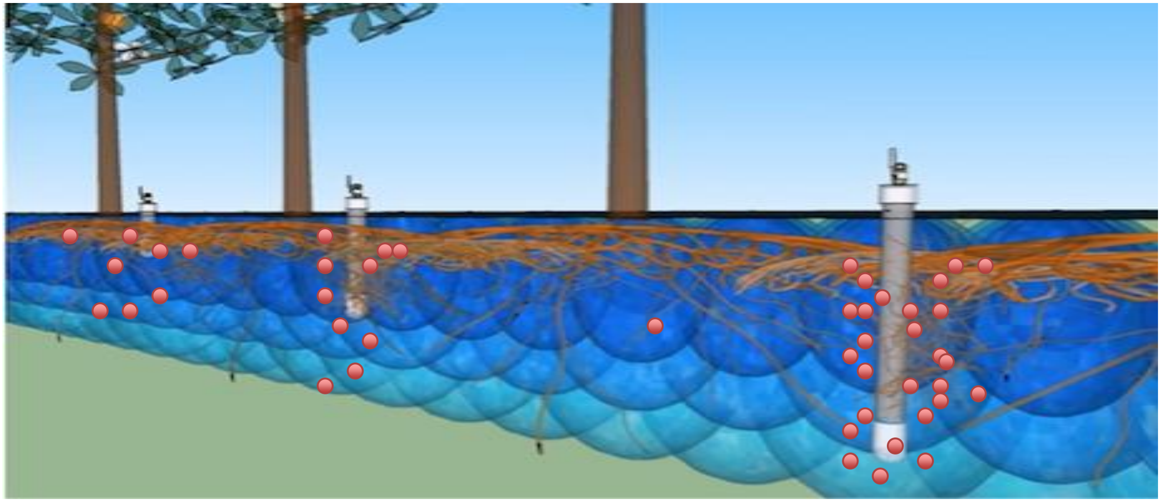
Mineral Nutrients

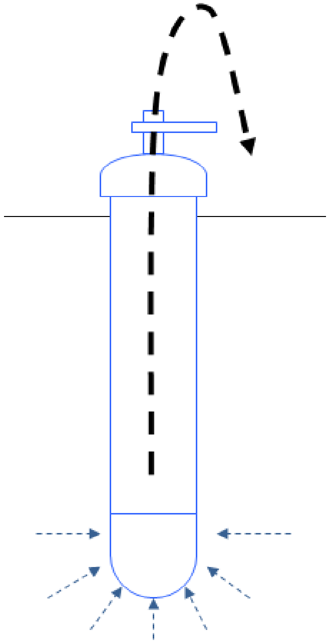
Elements	Symbol	% Dry weight
HIDROGENO	H	6
CARBONO	C	45
OXIGENO	O	45
NITROGENO	N	1,5
POTASIO	K	1
CALCIO	Ca	0,5
MAGNESIO	Mg	0,2
FOSFORO	P	0,2
AZUFRE	S	0,1
CLORO	Cl	0,01
BORO	B	0,002
HIERRO	Fe	0,01
MANGANESO	Mn	0,005
CINC	Zn	0,002
COBRE	Cu	0,0006
MOLIBDENO	Mo	0,00001

Macronutrientes

Micronutrientes

HOW TO EVALUATE EACH RISK AREA

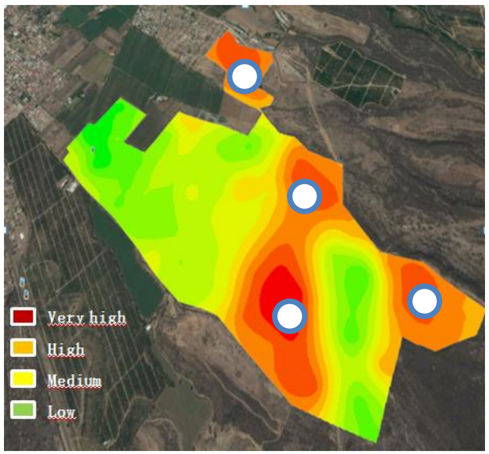


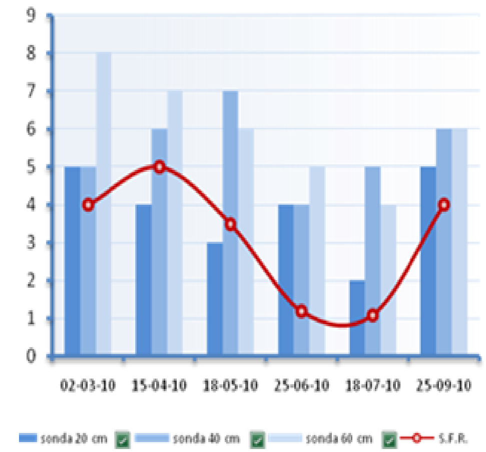


With this soil solution probes we can evaluate everything related with nitrogen movement in depth

Surface level. Input
Nitrogen forms
Plant activity
Nitrate movement and leaching
Evolution along the time

3D COMPLETE METHODOLOGY





X,Y
Spatial evaluation

Z. Understanding movement in depth

Time
Evolution along the time

This technology allows us not only to evaluate nitrate pollution, but also helps to develop good agricultural practice to minimize the risk, while keeping the crop in optimal and sustainable conditions

Report example

Strawberry – Oxnard data

Water Samples *Sampling Date:* 2-nov

Description	*NO3- (meq/l)*	*NI' (m*	*Zn (mg/l)*
RFS	<0,16	<	0,05
TUBE 20 cm	0,23	<	0,05
TUBE 40 cm	1,32	<	0,05

Water Samples *Sampling Date:* 28-nov

Description	*NO3- (meq/l)*	*NI' (m*	*Zn (mg/l)*
RFS	13,7	:	),33
TUBE 20 cm	2,14	<	),15
TUBE 40 cm	2,88		),30

Case Study

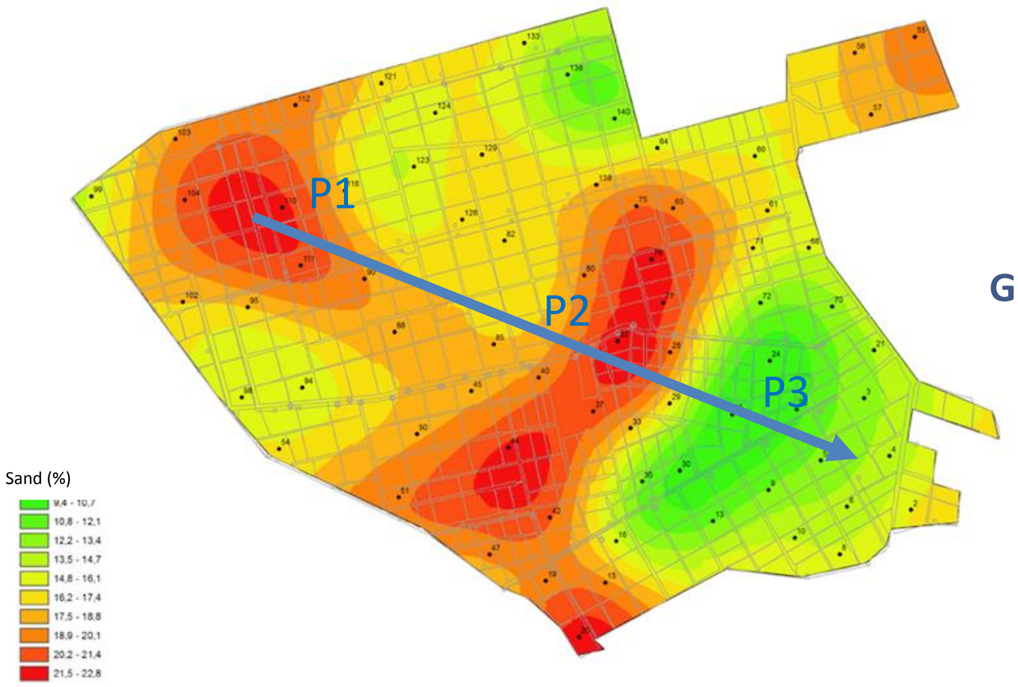
Modeling of leaching profile in agricultural farms

Objectives

Evaluate nitrates lost depth and propose **corrective measures**.

The efficiency objectives of nutrient absorption were situated in values **close to 90%**

Location of control points. Defining control points

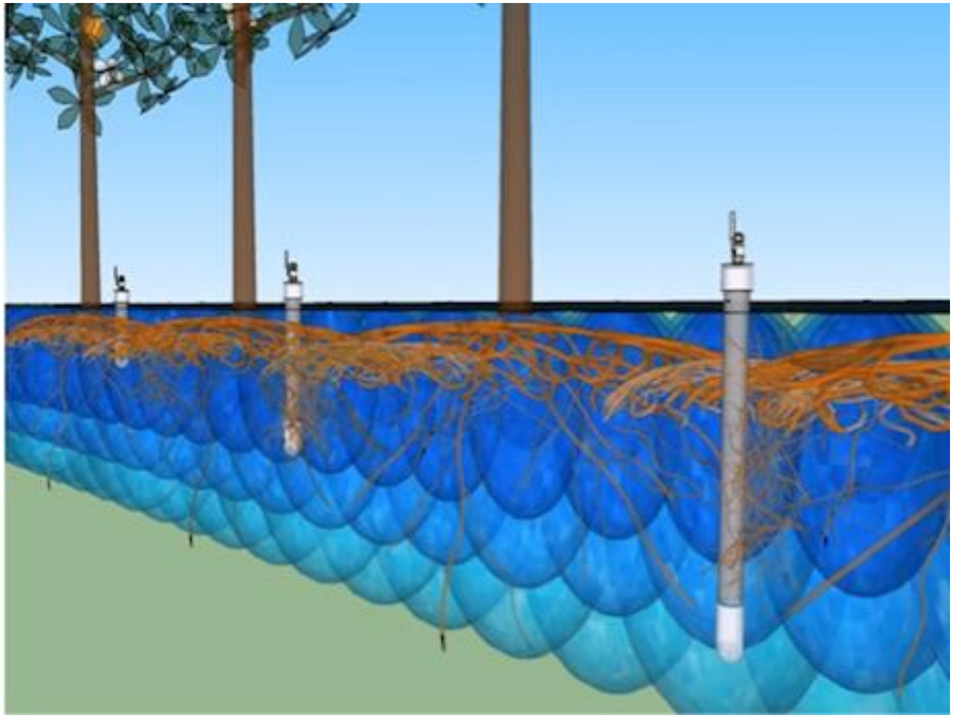


GIS maps to assess risk points

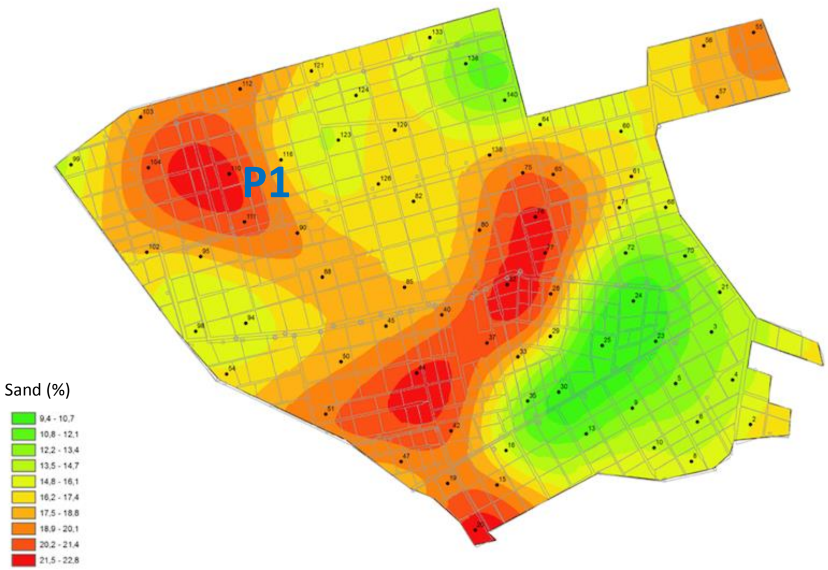
- Textural clasification
- Chemical characteristics

Characterization of control points

Three probes will be installed at each point at depths of 20 cm, 40 cm and 60 cm. These probes will collect a sample of soil solution to which a complete physicochemical analysis will be performed with the following parameters. At the points of maximum risk of 100 cm probes will be installed.



Sampling 1. Control Point 1



Site	Control Point 1	5,9 ha		
Sampling Date	03/10/16			
	NO3-	**NH4+**	**H3PO4-**	**Cl-**
RFS	3.2 meq/l	2.5 meq/lit	22 ppm	1.2
20 cm	2.9 meq/lit	<0.16 meq/lit	15 ppm	1.5
40 cm	4.8 meq/lit	<0.16 meq/lit	15 ppm	1.2
60 cm	7.4 meq/lit	<0.16 meq/lit	10 ppm	1.1

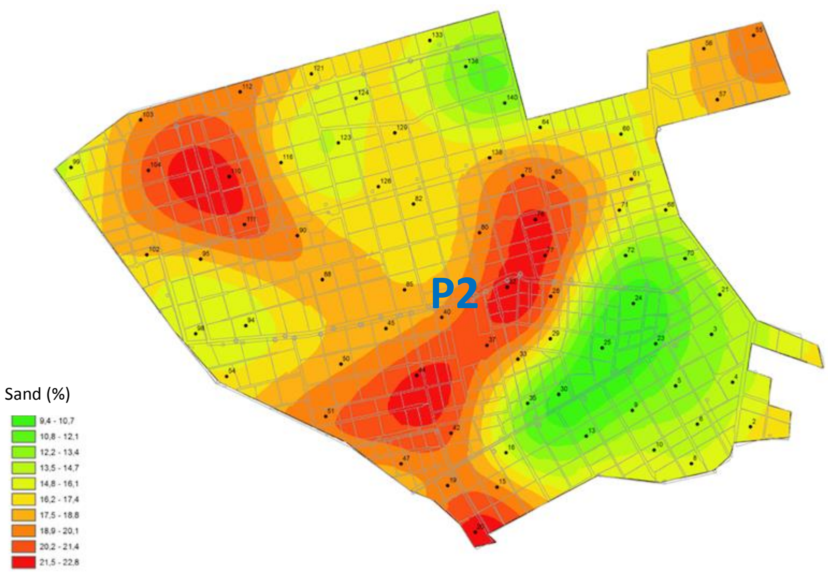
Total irrigation volume in this month in P1 area

Total Kg of N applied in this month in P1 area
Only the 60% of the irrigation volume is with fertilizers

Total Kg of N–NO3$^-$ leached in this month in P1 area
Consideriing loss of 20 % of the total irrigation volume

% of N–NO3$^-$ leached in this month in P1 area

Sampling 1. Control Point 2



Site Control Point 2 5,9 ha

Sampling Date 03/10/16

	NO_3^-	NH_4^+	$H_3PO_4^-$	Cl^-
RFS	4.8 meq/lit	2.2 meq/lit	43.0 ppm	1.2
20 cm	6.7 meq/lit	<0.16 meq/lit	32.0 ppm	1.5
40 cm	7.8 meq/lit	<0.16 meq/lit	12.0 ppm	1.4
60 cm	9.5 meq/lit	<0.16 meq/lit	4.0 ppm	1.6

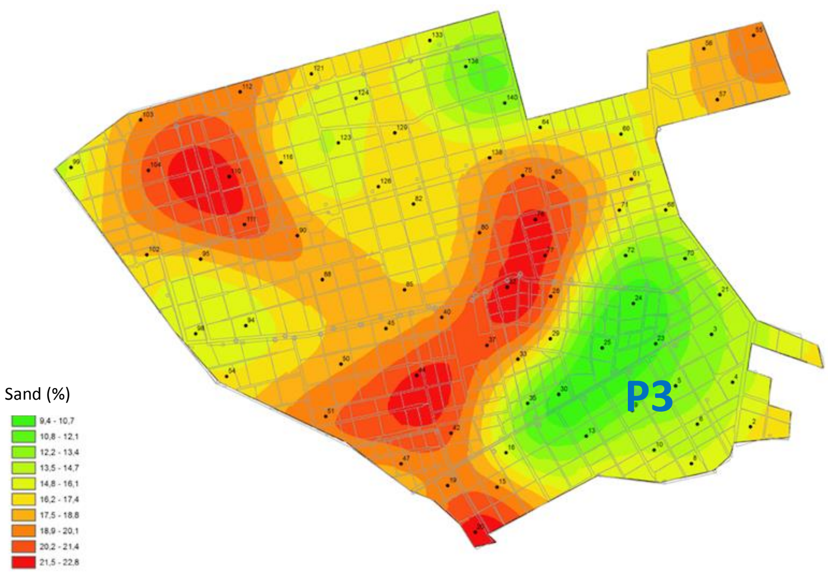
Total irrigation volume in this month in P2 area

Total Kg of N applied in this month in P2 area
Only the 60% of the irrigation volume is with fertilizers

Total Kg of N–NO_3^- leached in this month in P2 area
Consideriing loss of 15% of the total irrigation volume

% of N–NO_3^- leached in this month in P2 area

Sampling 1. Control Point 3



Site Control Point 3 5,9 ha

Sampling Date 03/10/16

	NO3-	NH4+	H3PO4-	Cl-
RFS	2.3 meq/lit	1.1 meq/lit	32.0 ppm	1.2
20 cm	.7 meq/lit	<0.16 meq/lit	12.0 ppm	1.5
40 cm	1.6 meq/lit	<0.16 meq/lit	19.0 ppm	1.4
60 cm	1.9 meq/lit	<0.16 meq/lit	10.2 ppm	1.6

Total irrigation volume in this month in P3 area

Total Kg of N applied in this month in P3 area
Only the 60% of the irrigation volume is with fertilizers

Total Kg of N–NO_3^- leached in this month in P3 area
Consideriing loss of 5 % of the total irrigation volume

% of N–NO_3^- leached in this month in P3 area

Corrective measures

During the next cycle, the following corrective and control measures are proposed:

1. Keep the size of the irrigation wetting pattern. So the moisture reaches the leaching point.
2. Control the fertilizer injection and the sources of them. At peak need, concentrate and maximize injection in the first 40 cm, where the active root are.

GOAL: to reach 90% of fertilization efficiency

Crops	Acres
Avocado	*11,624*
Blackberry	*4,119*
Blueberry	*565*
Broccoli	*156,565*
More veg	*109,051*
Pepper	*6,637*
More berries	*6,036*
Spinach	*9,772*
Strawberry	*58,902*
Grape	*146,840*
TOTAL	*510,111*

Improving fertilization efficiency

If we improve the fertilization efficiency, the amount of the applied fertilizer can be reduced.

Reducing 5 lbs N/acre

- 5 lbs/acre * 510,111 acres = **2.5 Million lbs N**

Reducing 10 lbs N/acre

- 10 lbs/acre * 510,111 acres = **5 Million lbs N**

Things to remember

*** Crop Nutritional Monitoring goals are:**

- Monitoring and control of crops under technified irrigation
- Optimization of fertilizer usage and water requirements
- Optimization of the leaching fraction (Minimize environmental impact)

- **Improve the final product quality**
- **Increase yield (lbs/acre)**
- **Be more efficient with the fertilizer injections (lbs N/acre)**
- **Reduce the Nitrates leaching**