Food and Agriculture Organization of the United Nations

FAO SCIENCE AND INNOVATION FORUM

Innovations in Soil and Plant Nutrient Management

Technological alternatives for increasing nutrient use efficiency in plants and soils

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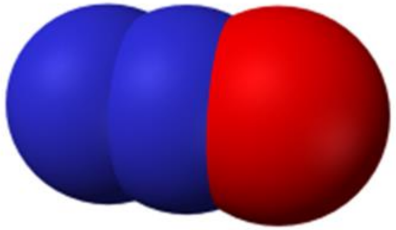
GLOBAL SOIL PARTNERSHIP

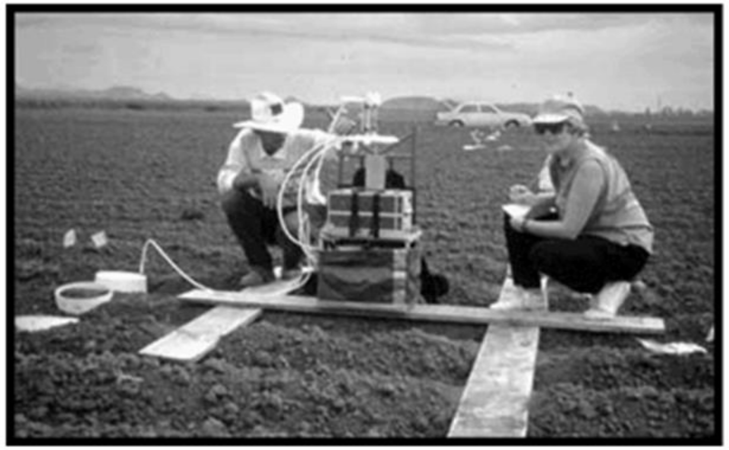

Yaqui Valley


Yaqui Valley
230,000 has
160,000 wheat
Safflower, maize, garbanzo, alfalfa, vegetable crops y citrus trees
Agro ecologically representative of environments where 40% of the wheat in developing countries is produced



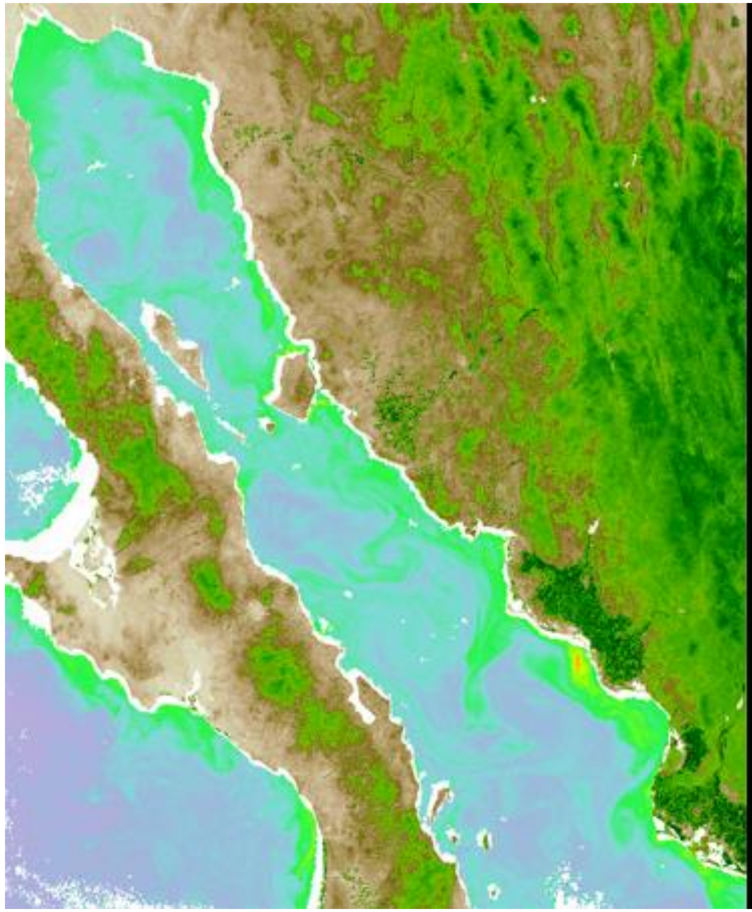
Nitrous oxide

N_2O



Work in Yaqui, emissions could be reduced by 50% with improved N management practices

Matson et al., 1998
Science



The Golf of California is vulnerable nitrogen (N) coming from agricultural runoff

N from the Yaqui Valley causes large algae blooms which are visible from satellites

Beman, et al. 2005

Nature

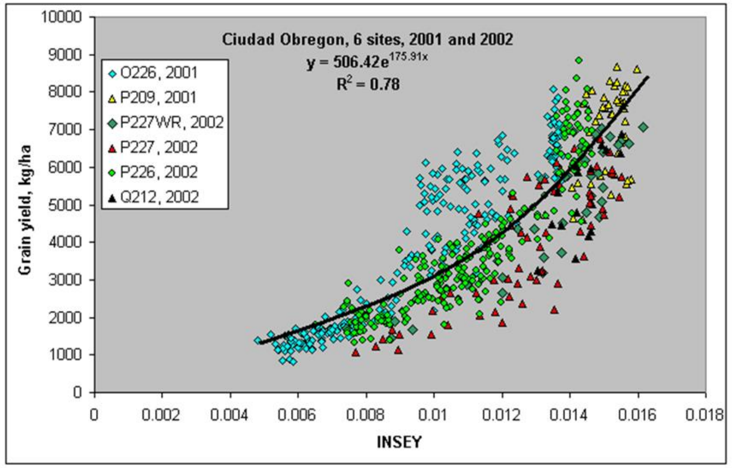
Sensor Technology

Diagnostic tool that allows us to establish N fertilization needs for each individual field

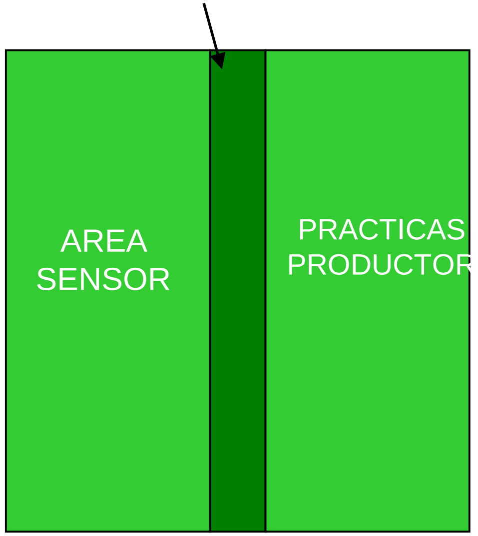
SITE SPECIFIC

Collaboration since 1998 with Oklahoma State University
Bill Raun

Use of Optical Sensors for Nitrogen Management



1. Establish a N Rich Strip



2. Collect NDVI data at key growth stage

3. Use Algorithm

Algoritmo de la Fertilización del Trigo Ajust	
Trigo de Primavera	N.Salimor 23ha N
PROPORCIONAR datos	
Rend. Max: kg/ha	10000
Fecha de siembra:	22-nov-20
Fecha, medidas:	03-ene-21
	mes/dia/año
NDVI (FRN)	0.887
NDVI (PDA)	0.829
NUE anticipado	0.35
RESULTADOS	
Rend. Potencial sin N, kg/ha	10000.00
Rend. Potencial, con N, kg/ha	11082.39
Dias desde la siembra:	42
Fert de N kg/ha	75.77
Fert.de N, kg UREA/ha	168

GLOBAL SOIL PARTNERSHIP

Increased profits and reduced GHG emissions with the GreenSeeker in the Yaqui Valley

Table 1. GreenSeeker handheld initial results: additional profits and avoided greenhouse gas emissions, by year

Year	Additional profits (USD/ha)	Avoided emissions (tCO_2e/ha)	Total area (ha)	Total profits (USD)	Total avoided emissions (tCO_2e)
2006-2007	$6.69	0.19	2,445	$16,352	464
2007-2008	$(5.66)	0.20	4,232	$(23,952)	861
2008-2009	$99.39	0.23	6,662	$662,182	1,557
2009-2010	$60.42	0.23	7,724	$466,669	1,752
2010-2011	$37.85	0.14	8,877	$336,010	1,211
2011-2012	$30.36	0.24	5,671	$172,174	1,373
2012-2013	$18.66	0.22	5,665	$105,713	1,264
2013-2014	$10.56	0.16	7,149	$75,476	1,163
Total	$37.39	0.20	48,425	$1,810,623	9,646

ha = hectare; tCO_2e = tonnes of carbon dioxide emissions.

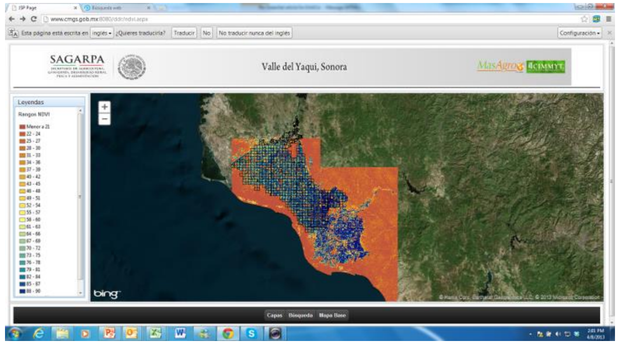
Note: Based on 971 observations. Values are in US 2014 dollars. Emissions were calculated using a N_20 Global Warming Potential of 310. Results are from an initial analysis of CIMMYT data conducted by RTI International. More complete manuscript is under development.

Lapidus et al. 2017

- Average N savings over 8 years (2006-2014) 37 USD/ha. ~ 50 kgN/ha
- 9600 t CO_2e = removing 2000 automobiles from circulations for a y ear
- 48,425 ha in 8 years

Sensor technology for nutrient management different costs and scales

Satellite



Manned Airplane

Drone- UAV

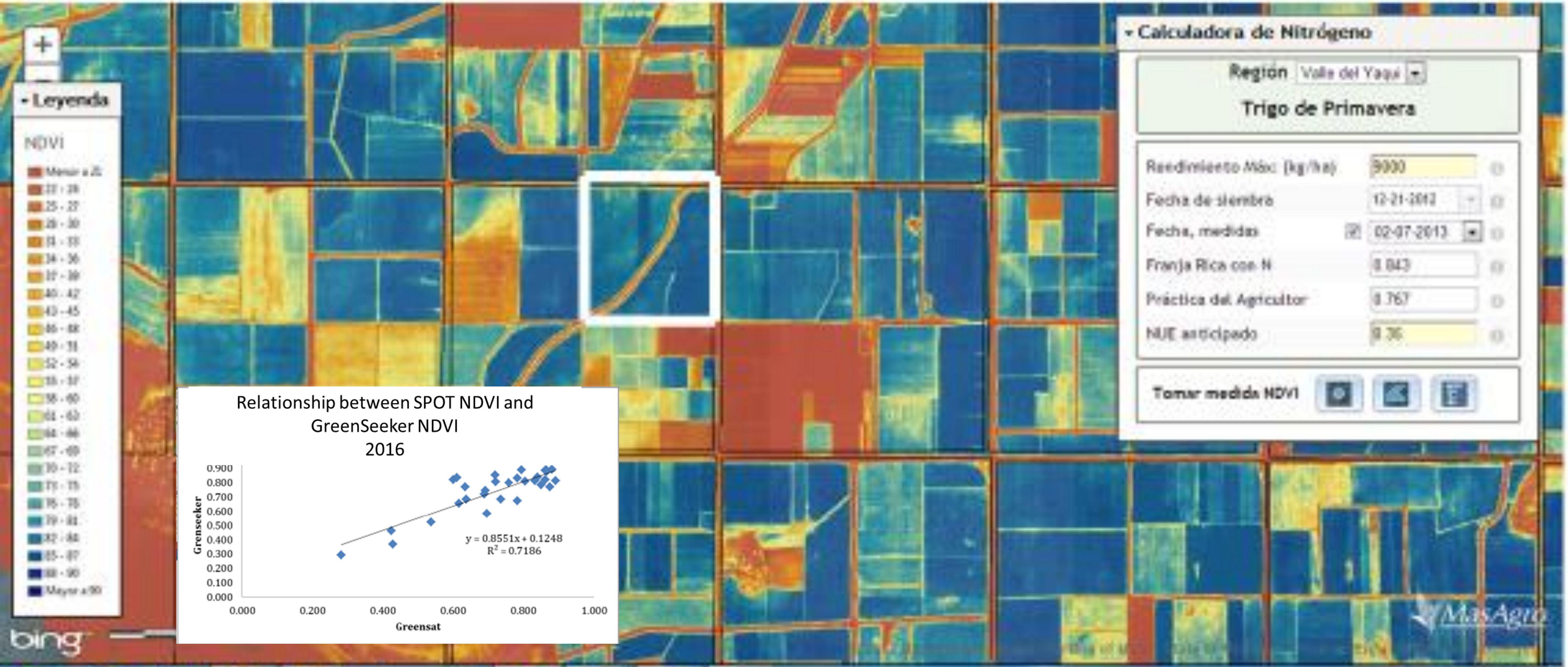
120,000 USD

30,000 USD

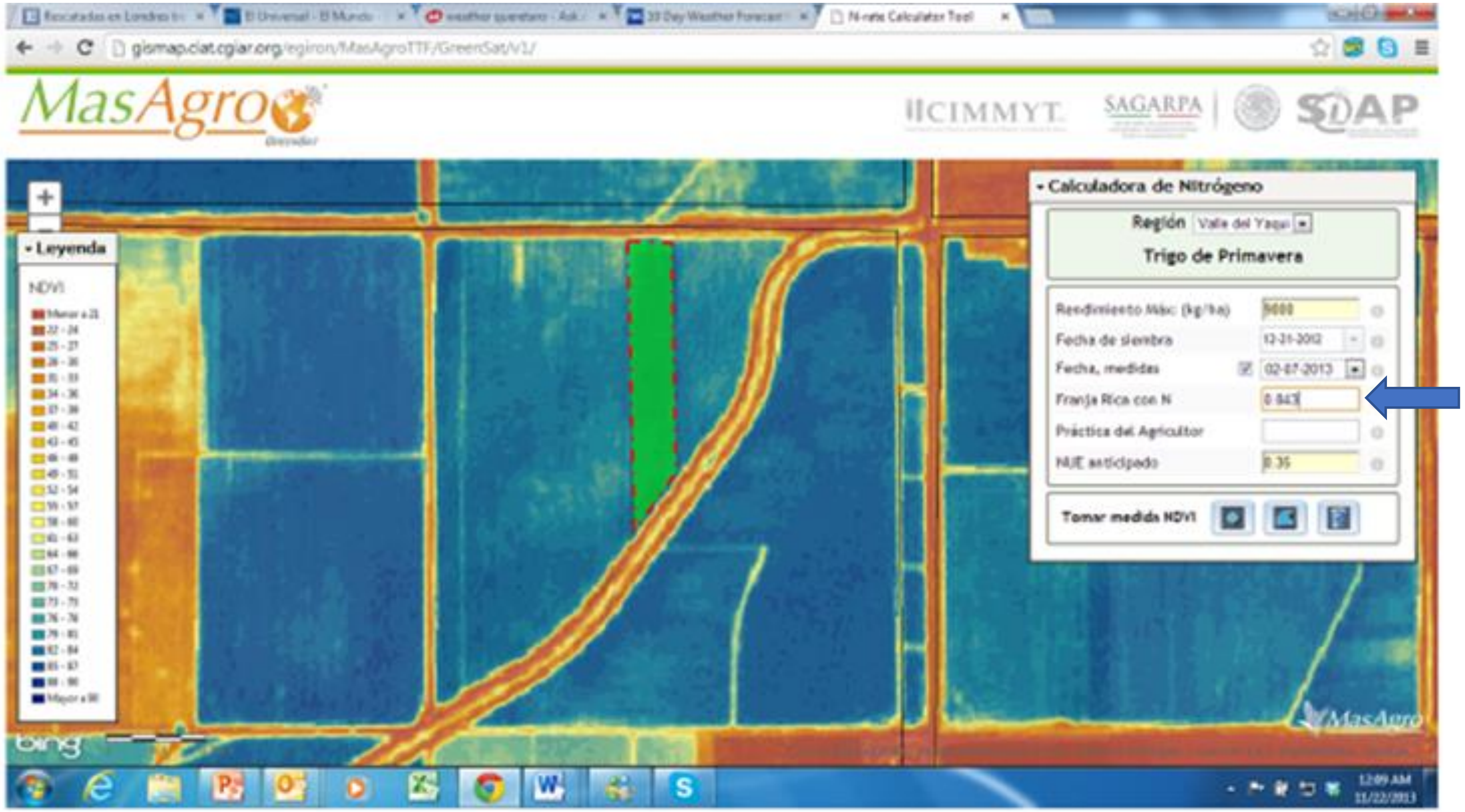
5,000 USD

500 USD

GreenSat


Calculadora de Nitrógeno
Región Valle del Yaqui
Trigo de Primavera
Rendimiento Máx (kg/ha)
Fecha de siembra
Fecha, medidas
Franja Rica con N
Práctica del Agricultor
NUE anticipado
Tomar medida NDVI
Leyenda
NDVI
Relationship between SPOT NDVI and GreenSeeker NDVI 2016
y = 0.8551x + 0.1248
R² = 0.7186
Grenseeker
Greensat
MasAgro

GreenSat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MasAgro
CIMMYT
SAGARPA
SIAP
Leyenda
NDVI
Calculadora de Nitrógeno
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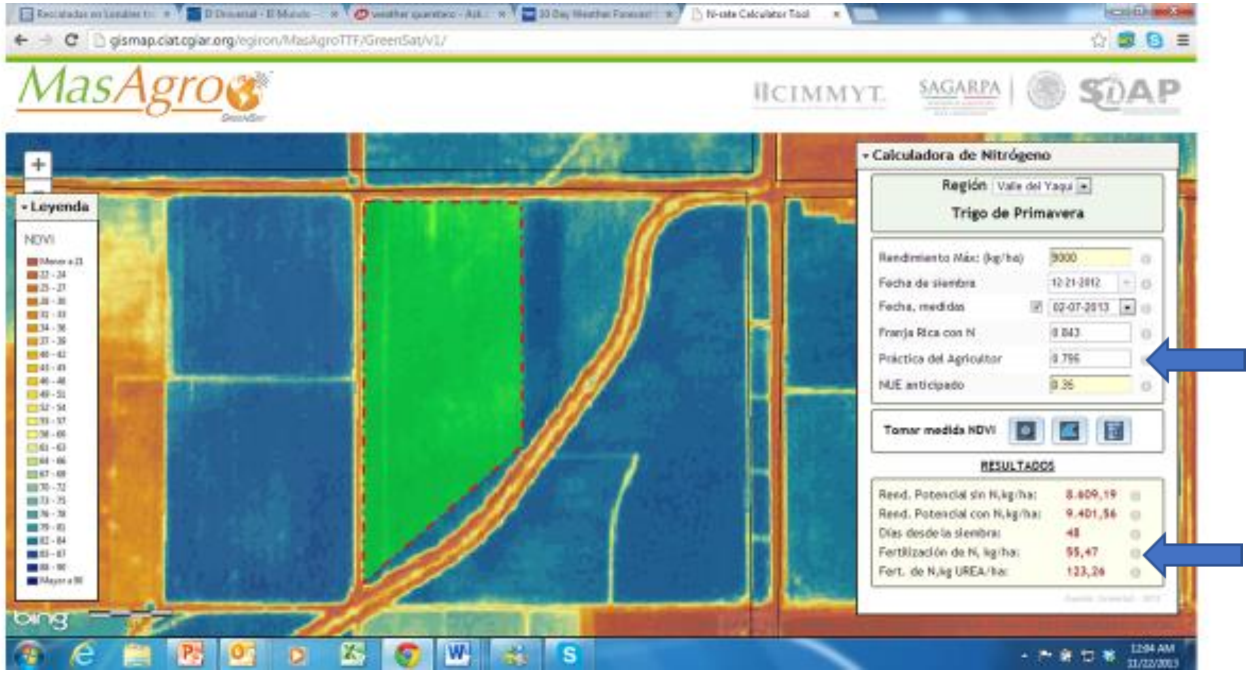
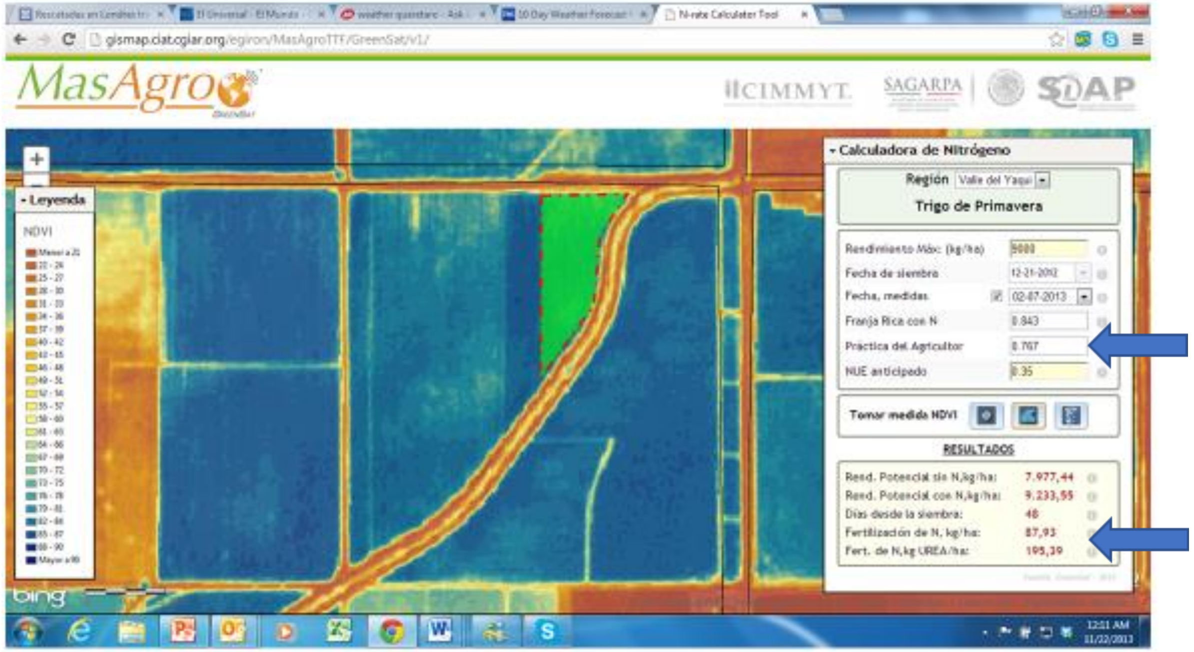
NUE anticipado
Tomar medida NDVI
bing

GreenSat


gismap.ciat.cgiar.org/egiron/MasAgroTTF/GreenSat/v1/
MasAgro
CIMMYT
SAGARPA
SIAP
Leyenda
NDVI
Calculadora de Nitrógeno
Región Valle del Yaqui
Trigo de Primavera
Rendimiento Máx: (kg/ha) 9000
Fecha de siembra 12-21-2012
Fecha, medidas 02-07-2013
Franja Rica con N 0.843
Práctica del Agricultor 0.796
NUE anticipado 0.36
Tomar medida NDVI
RESULTADOS
Rend. Potencial sin N,kg/ha: 8.609,19
Rend. Potencial con N,kg/ha: 9.401,56
Días desde la siembra: 48
Fertilización de N, kg/ha: 55,47
Fert. de N,kg UREA/ha: 123,26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MasAgro
CIMMYT
SAGARPA
SIAP
Leyenda
NDVI
Calculadora de Nitrógeno
Región Valle del Yaqui
Trigo de Primavera
Rendimiento Máx: (kg/ha)
Fecha de siembra 12-21-2012
Fecha, medidas 02-07-2013
Franja Rica con N 0.843
Práctica del Agricultor 0.767
NUE anticipado 0.35
Tomar medida NDVI
RESULTADOS
Rend. Potencial sin N,kg/ha: 7.977,44
Rend. Potencial con N,kg/ha: 9.233,55
Días desde la siembra: 48
Fertilización de N, kg/ha: 87,93
Fert. de N,kg UREA/ha: 195,39

Manned Airplane Piper PA-16

Cameras:

- Multispectral
- Hyperspectral
- Thermal

UAV Drone:
eBee

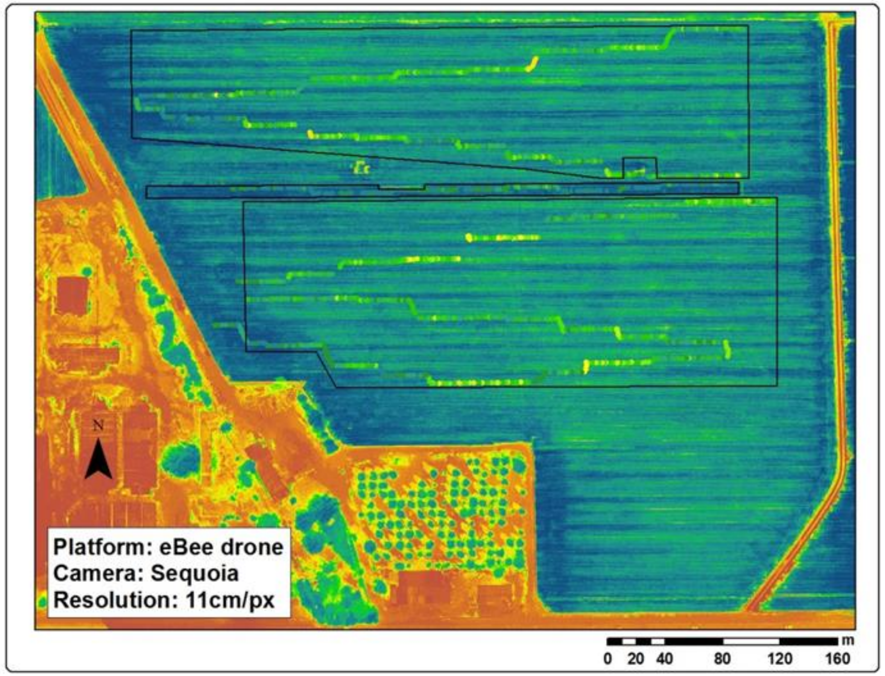
Cameras:

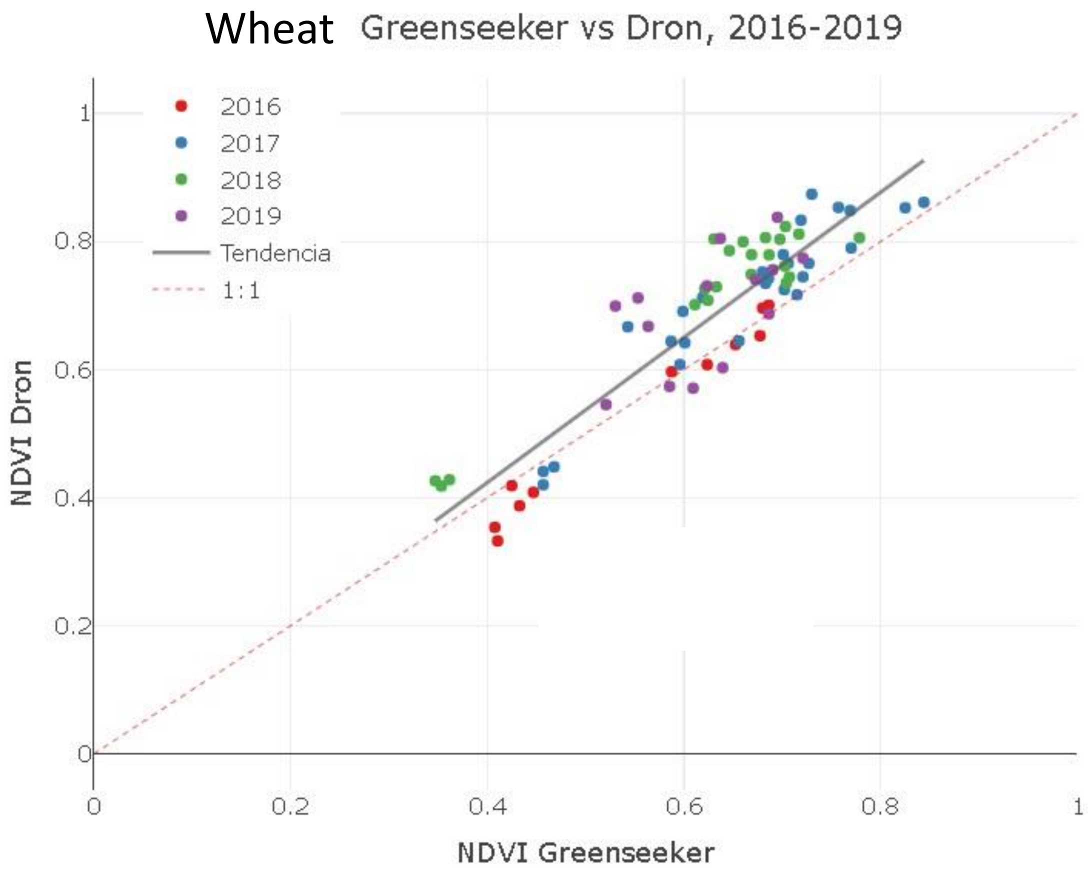
- Multispectral
- Canon S110 NIR
- Canon Power shot
- **Sequoia**

Team Collecting:

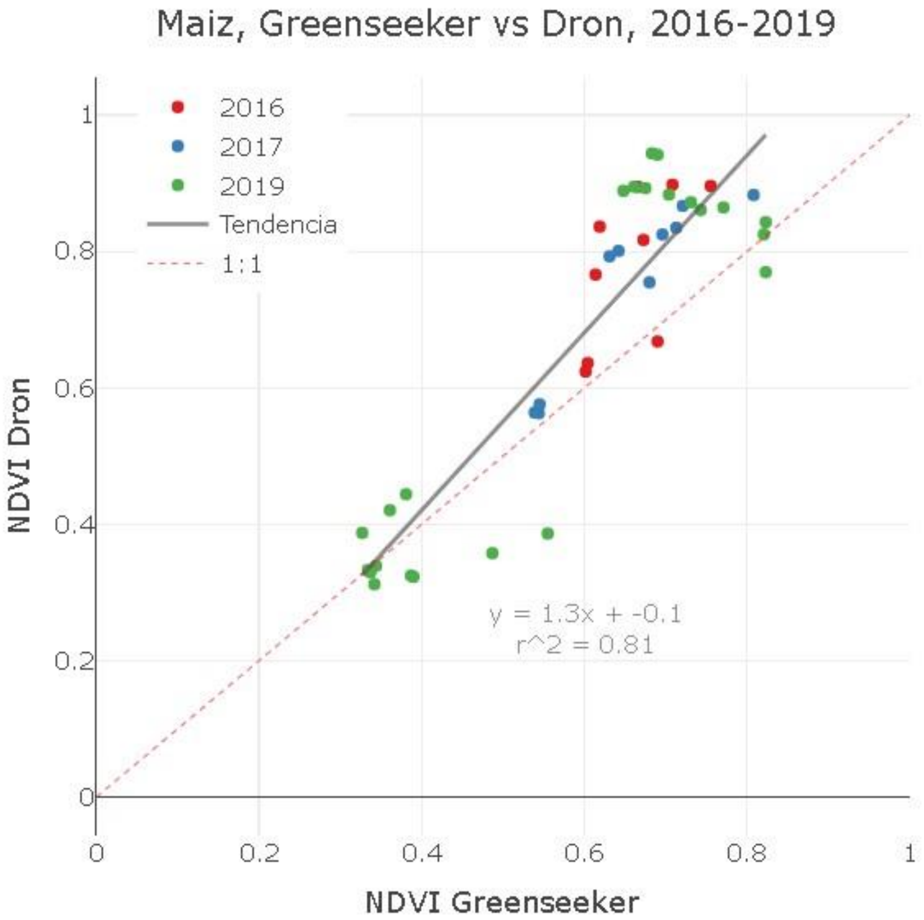
- NDVI readings with GreenSeeker and RTK
- NDVI readings with eBee Drone using a Sequoia Camera

Wheat NDVI GreenSeeker vs Drone

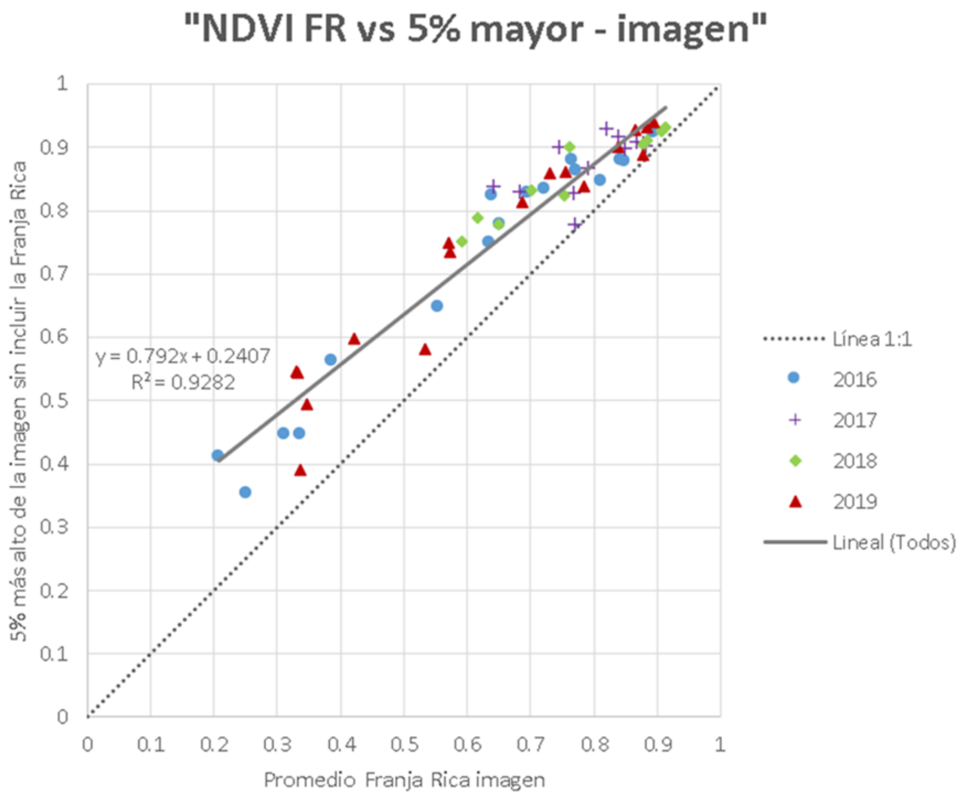


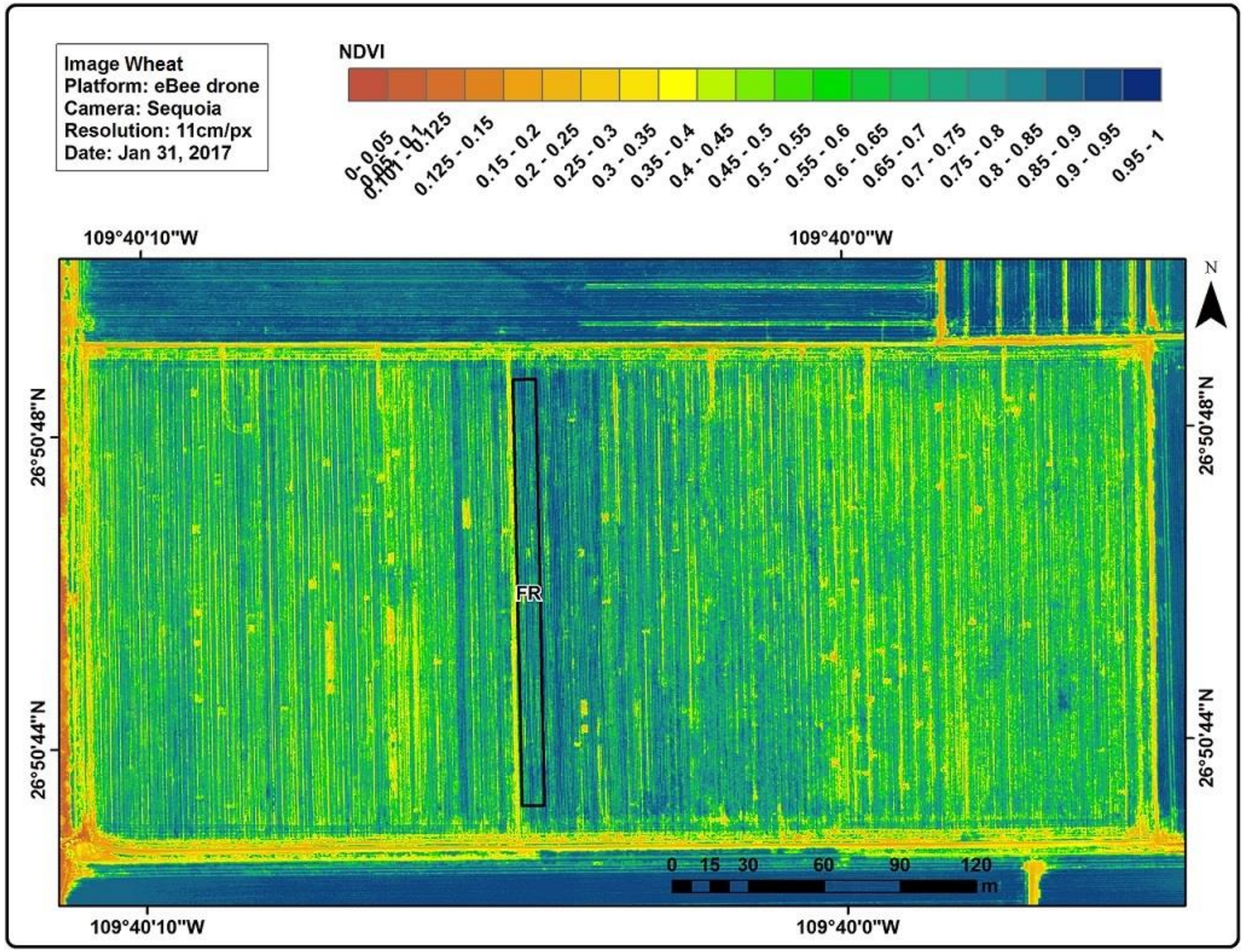


Maiz NDVI
GreenSeeker vs Drone



Wheat N Rich Strip NDVI vs 5% highest NDVI outside N Rich Strip





Currently Working with Roto Pixels Drone Company :

- Good relationship between NDVI from GS vs Sequoia
- Using the GreenSeeker Algorithm for Commercial N recommendations
- Approximately 1000 hectares being diagnosed
- Approximate cost 4 USD per flight per hectare.


Thank you!