A Multiple interventions Approach to Increasing Technology Adoption(MITA):

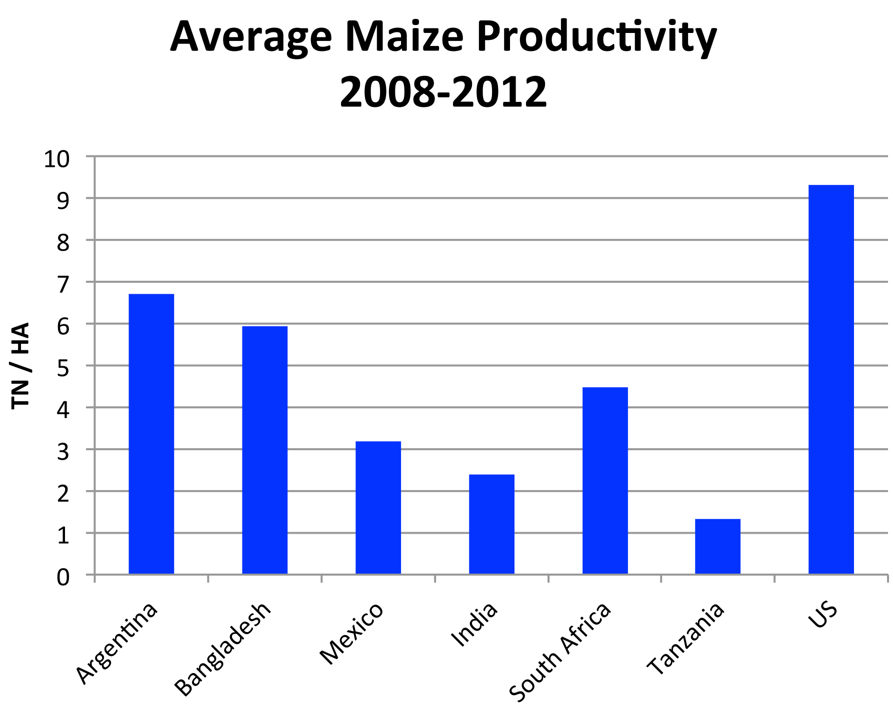
Evidence from Mexico

Carolina Corral (J-Pal)
Xavier Giné (WB)
Aprajit Mahajan (UC Berkeley)
Enrique Seira (ITAM)

BASIS Technical Committee, November 7, 2014

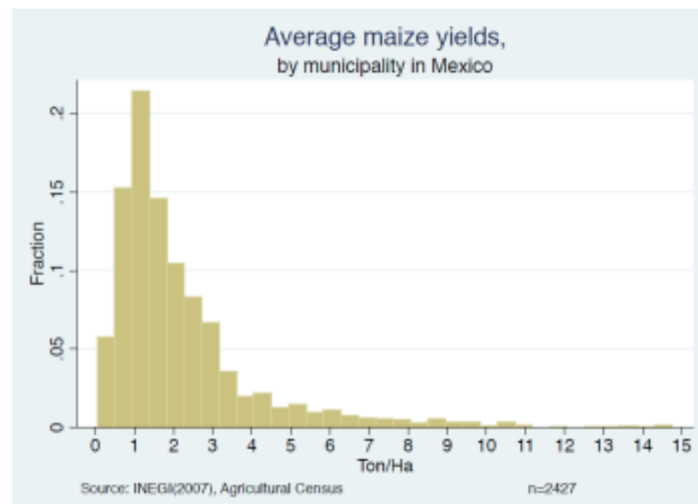
Low Productivity

Although yields have been improving in Mexico since the 80's, they are as low as those in much poorer countries , particularly among small land holders.



*** Includes irrigated and non irrigated plots**

Source: FAO STATISTICS http://faostat3.fao.org/faostat-gateway/go/to/home/E



Scope of Work

- There is some debate about whether observed variation in yields reflects:
  - Essential heterogeneity (e.g. Suri (2006) Barrett, Marenya and Barrett (2009))
  - Constraints (e.g. Information, access to credit, etc)
- MITA aims to understand both the nature of the essential heterogeneity (measurement) and constraints (interventions).

- Detailed measurement of land quality and inputs
- Interventions:
  - Improved information
    - **Land (Soil Analysis and recommendations)**
    - **Best Practices (Frequent AEW visits)**
  - Relaxing credit constraints

Productivity determinants

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Farmer's characteristics: age experience, gender, education, monthly income	x					x	x
AEW		x					x
Plot non-observable characteristics: SA results			x		x	x	x
Plot observable characteristics: soil type, slope , past productivity				x	x	x	x
R-squared	0.066	0.098	0.129	0.238	0.314	0.3696	0.375

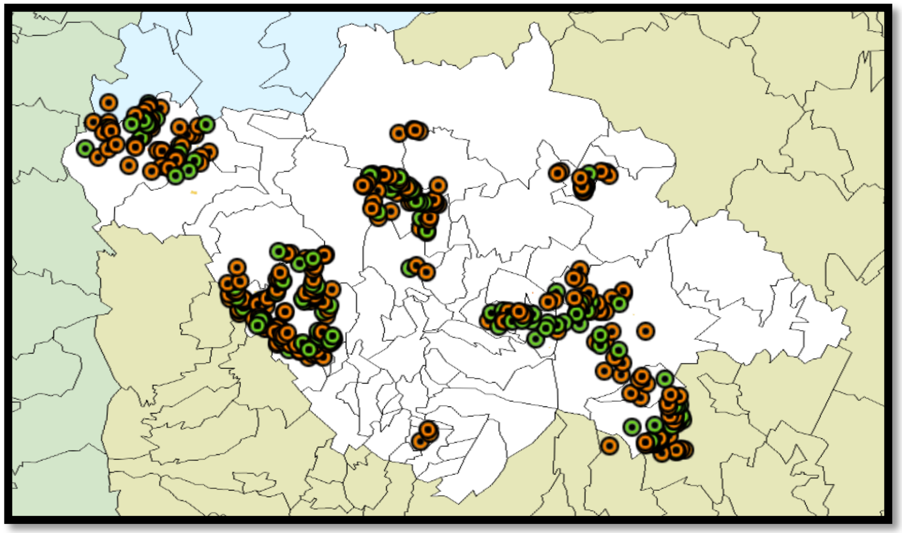
Theory

- Consider a production function with 2 sources of uncertainty:
  - (unobserved) quality of the land
  - weather shocks (rains and frost)

- An informative signal of any source should decrease overall uncertainty and increase overall investment

Design & Sample

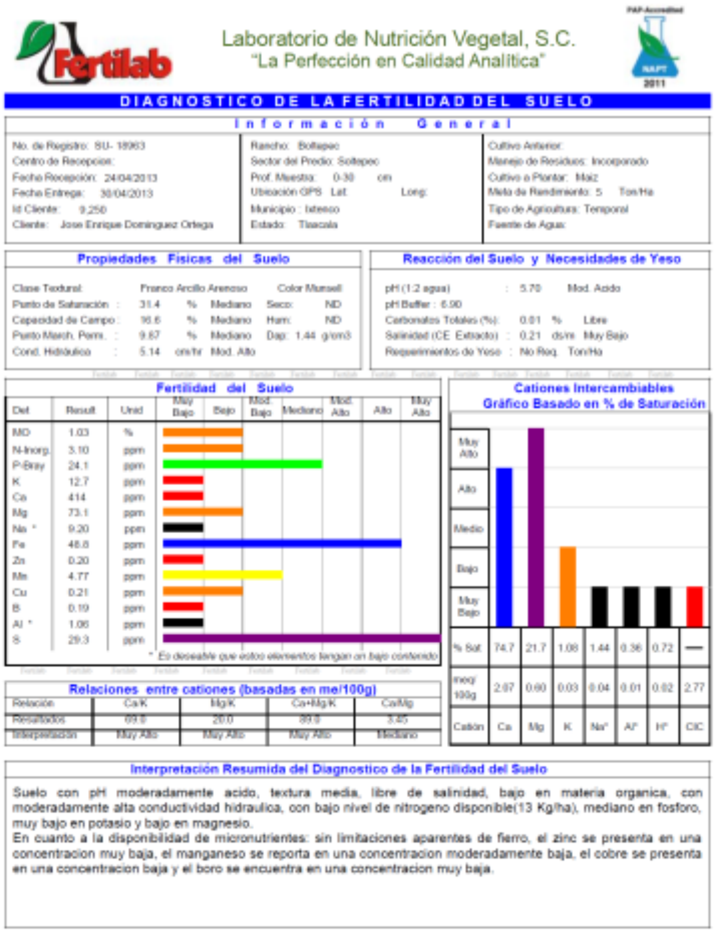
- In 2013 we followed 430 farmers in Tlaxcala.
- 155 farmers were part of the control, while 275 were equally divided into 3 treatments
  - **Free Soil Analysis and recommendations**
  - **Free Soil Analysis and recommendations** + AEW + Free Foliar Fertilizers
  - **Free Soil Analysis and recommendations** + AEW + Costly Foliar Fertilizers

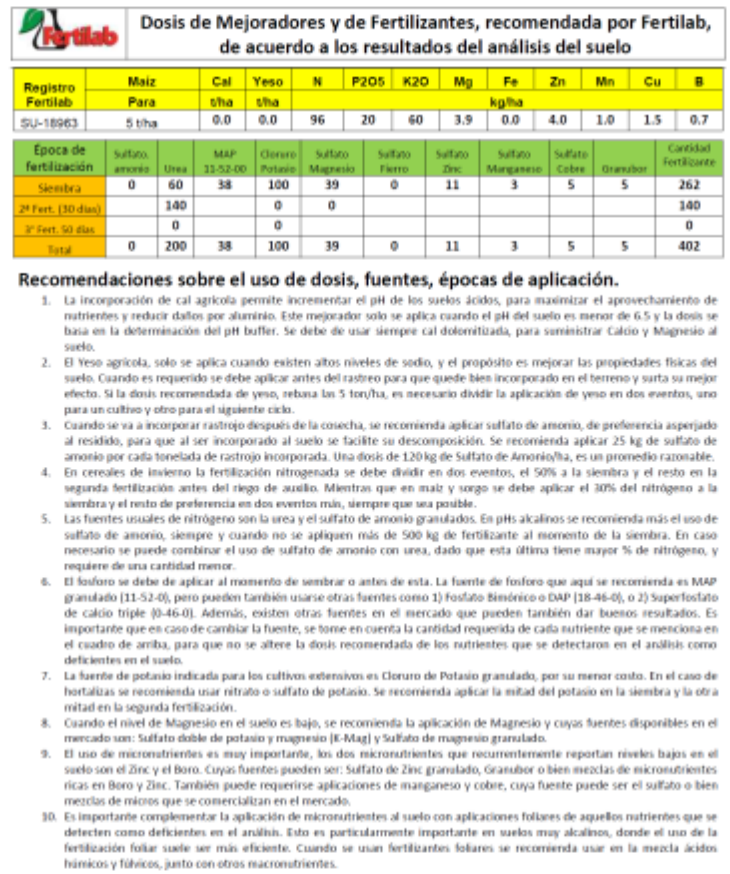


Soil Analysis Intervention

Soil Analysis and Recommendations

- Determinants of soil characteristics: PH, electrical conductivity, , type of soil, saturation point, cationic interchange
- Nutrients: OM, N, P, K, Ca, Mg, Na, Fe, Zn, Mn, Cu, B, S

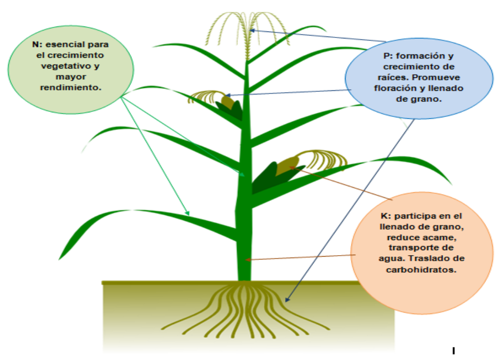


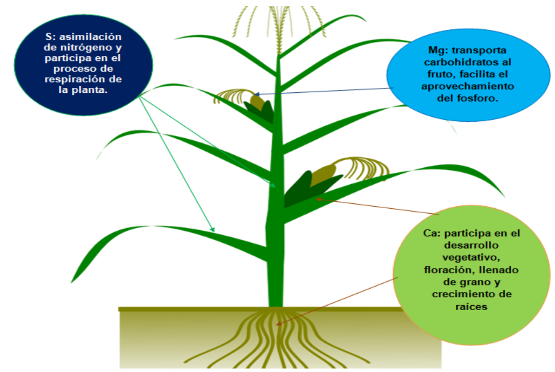


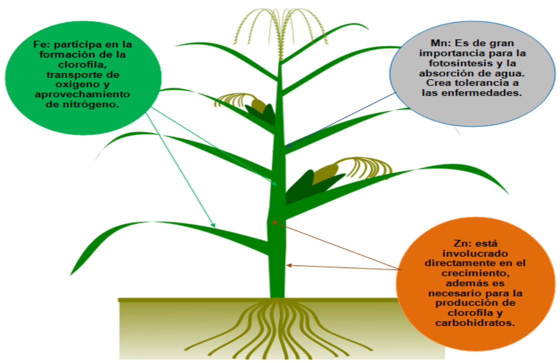
Soil Analysis Intervention

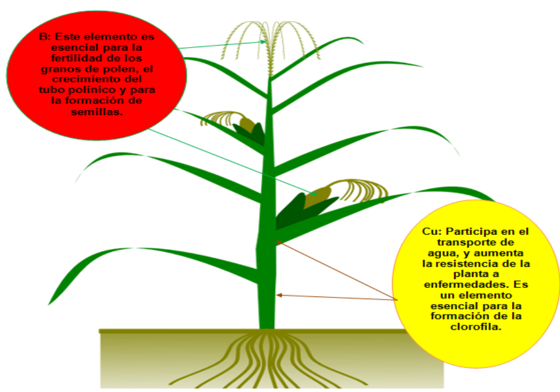
Farmers Trainings (45 minutes to 1 hour and a half)

- How to understand the soil analysis
- Importance of each nutrient during each stage of crop development
- Importance of following the recommendations to follow increase productivity



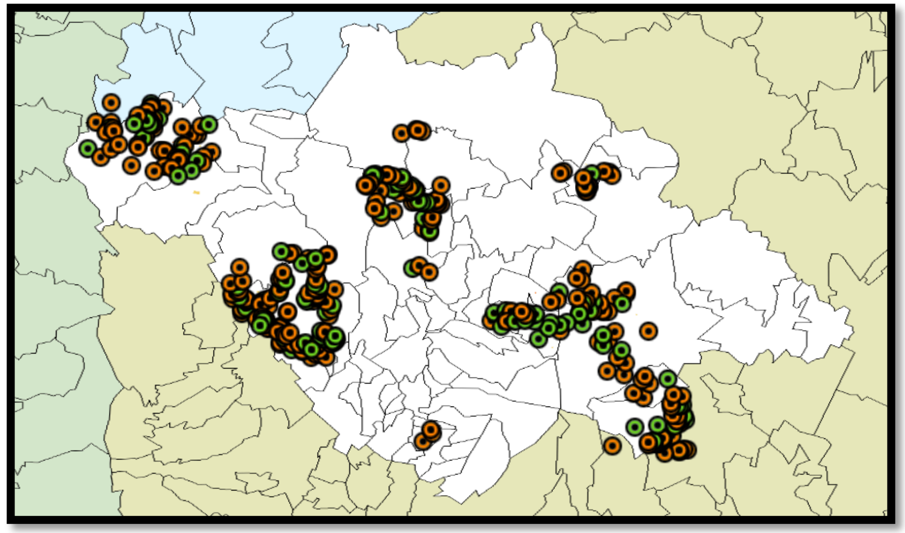






Sample & Design

- In 2013 we followed 430 farmers in Tlaxcala.
- 155 farmers were part of the control, while 275 were equally divided into treatments
  - Free Soil Analysis and recommendations
  - Free Soil Analysis and recommendations + **AEW** + Free Foliar Fertilizers
  - Free Soil Analysis and recommendations + **AEW** + Costly Foliar Fertilizers

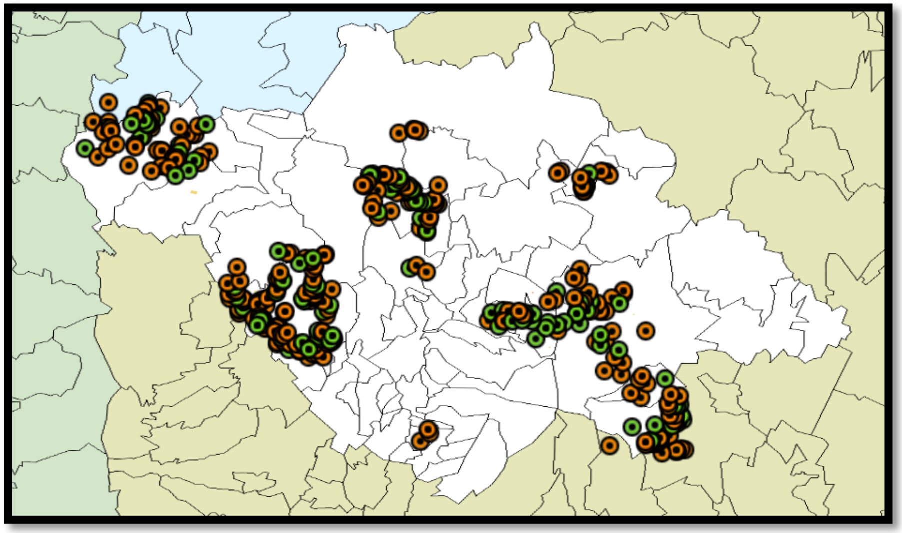


Agricultural Extension Workers Intervention

- 7 Agricultural Engineers specialized in Crop Sciences from Chapingo and Tlaxcala University
- Trained in CIMMYT's Conservation Agricultural Protocols to perform 6 visits during the spring/summer cycle
- Equipped with digital tablets programmed with CIMMYT AEWs Maize Surveys for Mexico's soil. The tablets are also equipped with GPS locators and cameras to monitor the crop development and that the visits were in fact realized.

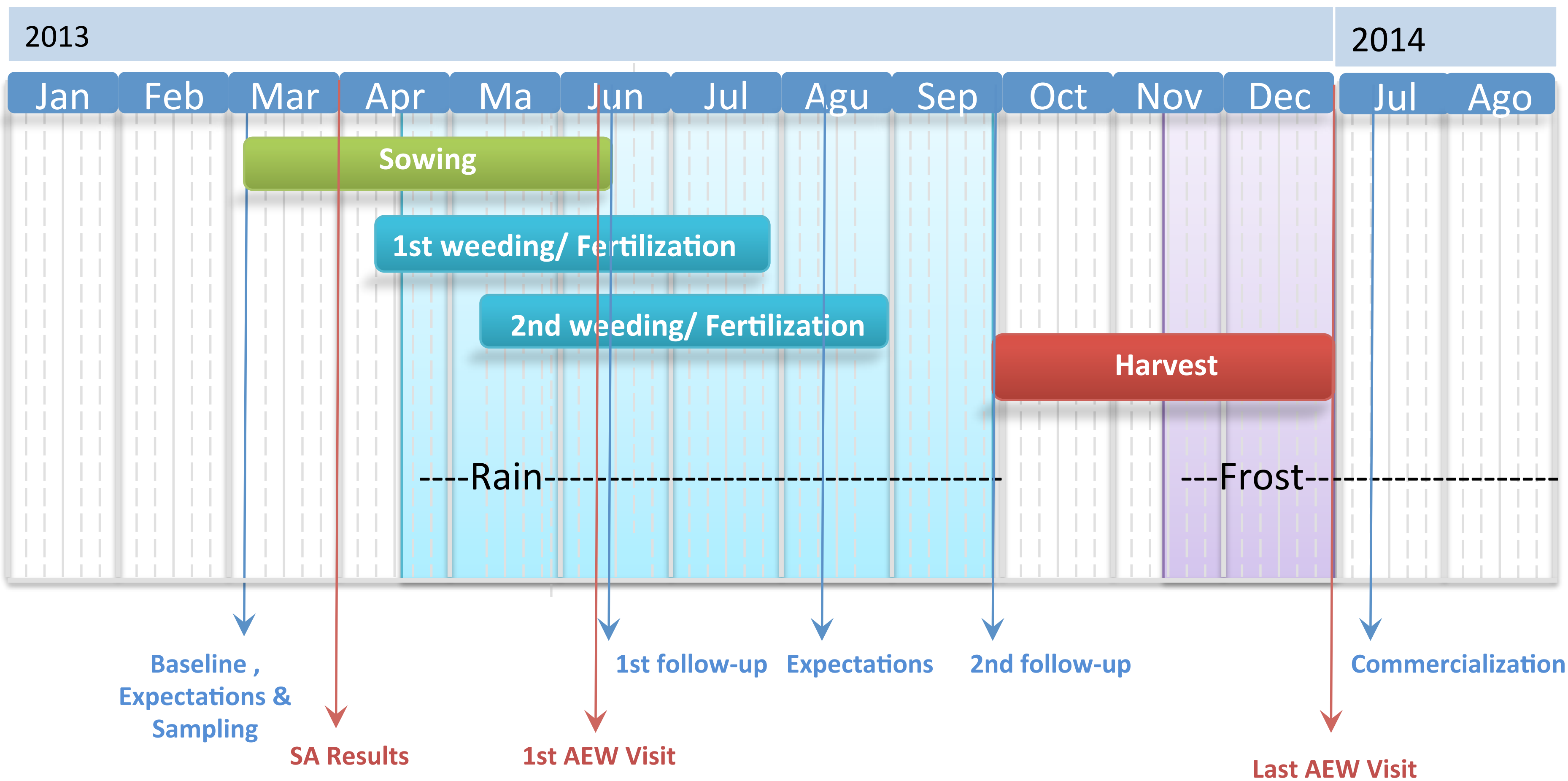
Sample & Design

- In 2013 we followed 430 farmers in Tlaxcala.
- 155 farmers were part of the control, while 275 were equally divided into treatments
  - Free Soil Analysis and recommendations
  - Free Soil Analysis and recommendations + AEW + Free Foliar Fertilizers
  - Free Soil Analysis and recommendations + AEW + Costly Foliar Fertilizers



- The sample was stratified based on:
  - Climactic zones
  - Farmer landholdings size
  - Whether farmer had attended promotion meeting

Calendar



2013
2014
Jan
Feb
Mar
Apr
Ma
Jun
Jul
Agu
Sep
Oct
Nov
Dec
Jul
Ago
Sowing
1st weeding/ Fertilization
2nd weeding/ Fertilization
Harvest
----Rain----------------------------------
---Frost-------------------
Baseline , Expectations & Sampling
SA Results
1st AEW Visit
1st follow-up
Expectations
2nd follow-up
Last AEW Visit
Commercialization

Attrition

- By last survey only 282 farmers, 32% of the original sample, remain in the program.
- The principal source of attrition (64% of drop-outs) were farmers who didn't sow maize in the sampled plot due to late arrival of rains in Tlaxcala.
- Besides the high percentage of drop-outs, no differential attrition is observed across treatments.

VARIABLES	Drop-out
SA	-0.0516
	(0.0606)
SA+AEW	0.00515
	(0.0509)
Control Mean	0.3441
Observations	429
R-squared	0.099
P-value (SA=SA+AEW)	0.602
P-value (SA=0 SA+AEW=0)	0.338

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Balance

- To check if the randomization was balanced across treatments, we use key variables in explaining differences across plots productivity:
  - Farmers characteristics
  - Agricultural practices and
  - Soil quality

- Strata fixed effects are included and SEs are clustered by farmer (when plot level data is used).

Balance

- Farmer characteristics

VARIABLES	(1) Gender	(2) Complete Secondary education or higher	(3) Age	(4) Years of experience as a farmer	(5) Monthly income ($)
SA	-0.0217	0.0838	5.137**	1.451	8.435
	(0.0661)	(0.0847)	(2.355)	(3.455)	(1,204)
SA+AEW	-0.0165	0.00542	3.820*	4.361	-934.5
	(0.0609)	(0.0743)	(2.107)	(2.724)	(1,260)
Control Mean	0.171	0.257	58.01	37.8	4,416
Observations	203	203	202	203	166
R-squared	0.100	0.074	0.143	0.058	0.198
P-value (SA=0 SA+AEW=0)	0.941	0.562	0.0588	0.265	0.633
P-value (SA=SA+AEW)	0.934	0.350	0.587	0.379	0.378

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Balance

- Agricultural practices

VARIABLES	(1) Native maize productivity	(2) Hybrid maize productivity	(3) Total maize productivity	(4) Used fertilizer during sowing 2012	(5) Used fertilizer during crop developmen t 2012	(6) Used foliar fertilizer during crop developmen t 2012
SA	-0.205	-0.154	-0.254	-0.0799	0.00663	-0.0233
	(0.256)	(0.626)	(0.299)	(0.0739)	(0.0162)	(0.0660)
SA+AEW	0.147	-0.00243	0.221	-0.0416	-0.0357	0.00793
	(0.269)	(0.535)	(0.296)	(0.0655)	(0.0272)	(0.0595)
Control Mean	1.818	2.845	2.094	0.2307	0.989	0.1758
Observations	180	53	223	266	266	266
R-squared	0.096	0.307	0.112	0.130	0.046	0.178
P-value (SA=0 SA+AEW=0)	0.438	0.964	0.235	0.549	0.114	0.878
P-value (SA=SA+AEW)	0.205	0.808	0.0892	0.606	0.0441	0.614

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Balance

- Soil quality

VARIABLES	(1) Plot size (ha)	(2) Have ever done SA	(3) Positive Slope	(4) Black Soil	(5) Frost in last 5 years
SA	0.392	0.0485	-0.00442	-0.0532	-0.0548
	(0.513)	(0.100)	(0.0350)	(0.0776)	(0.0684)
SA+AEW	0.810*	-0.0967	0.0141	0.0663	-0.0830
	(0.445)	(0.0813)	(0.0288)	(0.0764)	(0.0595)
Control Mean	3.144	0.351	0.956	0.274	0.8901
Observations	266	266	266	266	266
R-squared	0.422	0.104	0.039	0.048	0.088
P-value (SA=0 SA+AEW=0)	0.194	0.226	0.814	0.315	0.369
P-value (SA=SA+AEW)	0.415	0.115	0.574	0.130	0.683

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Intermediate Outcomes

- Investment in fertilizers (not foliar)

VARIABLES	(1) Number of fertilizations	(2) Investment in fertilizers during sowing ($/ha)	(3) Investment in fertilizers during crop development ($/ha)	(5) Total investment in fertilizers ($/ha)
SA	0.165*	149.1	475.7	624.8*
	(0.0903)	(125.5)	(308.7)	(322.5)
SA+AEW	0.199**	14.23	248.7	262.9
	(0.0849)	(97.71)	(214.6)	(222.8)
Control Mean	1.559	374.7	2,035	2,409
Observations	347	361	361	361
R-squared	0.104	0.183	0.091	0.091
P-value (SA=0 SA+AEW=0)	0.0354	0.484	0.231	0.127
P-value (SA=SA+AEW)	0.735	0.317	0.482	0.279

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Intermediate Outcomes

- Investment in fertilizers relative to recommended dosage

VARIABLES	(1) N recommended - N used (kg/ha)	(2) P recommended - P used (kg/ha)	(3) K recommended - K used (kg/ha)
SA	-1.387	-22.13**	-7.891*
	(14.70)	(9.971)	(4.124)
SA + AEW	7.424	-4.379	-3.743
	(11.33)	(5.045)	(3.874)
Control Mean	-19.06	-2.317	23.55
Observations	337	336	336
R-squared	0.057	0.122	0.162
P-value (SA=0 SA+AEW=0)	0.744	0.0787	0.146
P-value (SA=SA+AEW)	0.540	0.0856	0.391

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Intermediate Outcomes

- Investment in fertilizers relative to recommended dosage

VARIABLES	(1) |N recommended - N used| (kg/ha)	(2) |P recommended - P used| (kg/ha)	(3) |K recommended - K used| (kg/ha)
SA	13.03	13.71*	-1.036
	(9.816)	(8.228)	(2.705)
SA+AEW	1.200	-0.892	3.379
	(7.180)	(3.185)	(2.887)
Control Mean	61.24	29.98	28.36
Observations	337	336	336
R-squared	0.059	0.060	0.196
P-value (SA=0 SA+AEW=0)	0.376	0.235	0.383
P-value (SA=SA+AEW)	0.206	0.0929	0.188

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Expectations and Investment

VARIABLES	(1) log (|min-max|)	(2) Investment in fertilizers ($/ha)
period = 2	-0.464***	1,660***
	(0.102)	(153.8)
Treatment 3 groups = 1, SA	0.0557	131.9
	(0.121)	(138.5)
Treatment 3 groups = 2, SA + AEW	-0.0162	9.698
	(0.100)	(108.2)
2.period#SA	-0.0470	307.8
	(0.163)	(378.1)
2.period#SA+AEW	0.0164	195.9
	(0.136)	(250.1)
Control Mean	-0.9087	1,204
Observations	642	722
R-squared	0.121	0.305
P-value(2.period#SA=0 2.period#SA+AEW=0)	0.946	0.606
P-value(2.period#SA=2.period#SA+AEW)	0.686	0.779

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Yield Estimation

The yields measurement was done using the procedure developed by CIMMYT, outlined in "Maize Doctor", the process for estimating yields consists of the following steps:

1. Selection 5-10 (depending on plots' size) sampling points
2. Measurement of plant density
3. Measurement of number of cobs per square meter
4. Measurement of number of grains per cob
5. Estimating yield based on 2-4
6. Moisture adjustment to the yield obtained in 5

Final Outcomes

VARIABLES	(1) Estimated yield (ton/ha)	(2) Self reported yield (ton/ha)
SA	0.304	-0.0969
	(0.285)	(0.223)
SA + AEW	0.494*	0.695***
	(0.264)	(0.229)
Control mean	3.923	2.08
Observations	351	361
R-squared	0.095	0.095
P-value (SA=0 SA+AEW=0)	0.172	0.001
P-value (SA=SA+AEW)	0.508	0.00134

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Conclusions

- Some confirmation of the theory…
  - Soil analysis provides new information and investment increases
- To Do:
  - Compute profits, rather than yields
  - Variation in soil analysis over time…