

# Tolerance to Combined Low Phosphorus and Drought Stress in Small-seeded Common Bean

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# Introduction and Rationale

- Abiotic stress limits yields of bean across the tropics
  - Drought is occasional
  - Low fertility, especially low P, is every year
- The interaction of these stresses is especially limiting
- Optimal use of fertilization or irrigation is often limited by cost, so a combination of agronomic and genetic solutions is desirable
- This effort seeks to identify genotypes with multiple stress tolerance in on-farm trials

# Previous Results, 2009-10\*



Line	Low P, Darien Kg/Ha	Low P, Santander Kg/Ha	Drought, Palmira Kg/Ha	Drought, Palmira Kg/Ha	Stressed ave.	Non- stressed, Palmira Kg/Ha
BFS 10	1793	1871	1240	2196	1775	3742
BFS 67	1738	1167	1394	2345	1661	3298
BFS 27	2002	1823	1380	1412	1654	3523
BFS 29	1883	1364	1434	1873	1639	3651
BFS 32	1919	1737	1182	1630	1617	3591
BFS 35	1892	1589	1282	1532	1574	3260
BFS 34	1809	1452	1300	1644	1551	2949
BFS 30	1870	1375	1322	1635	1550	3116
BFS 39	1741	1691	1152	1564	1537	3619
BFS 55	2061	1524	1184	1375	1536	3559
SXB 412	1980	1408		1174	1521	4132
SER 16	1755	1187	1225	1417	1396	3023
Tio CAN. 75 (CH)	1764	852	733	1058	1102	3034
LSD (0.05)	328	308	302	505		471

\*Plant Breeding Reviews (2012), V. 36, p. 357-426.

# Materials and Methods

# **Low P Breeding Plots**

## Santander de Quilichao, Colombia



ENE 17 2013

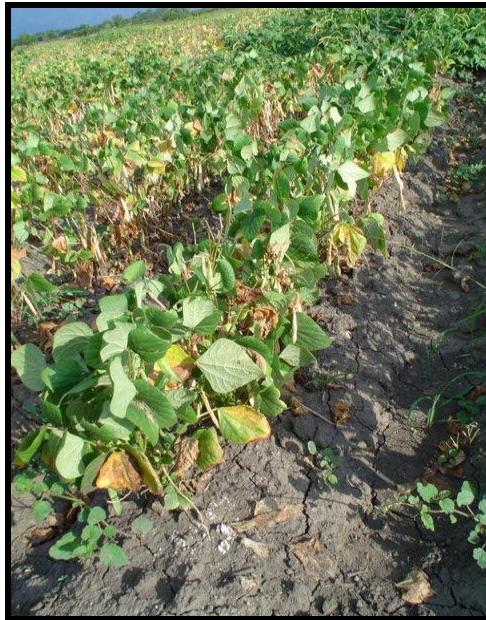
# Soil Characteristics

	Depth. - cm	pH	% O.M.	Al - meq/ 100g	K - meq/ 100g	Ca - meq/ 100g	Mg - meq/ 100g	å Bases	% Sat Al	Ca/ Mg	P ppm	Zn ppm	B ppm	CEC - meq/ 100g
<b>Critical level</b>		< 5.5 > 6.5	1,7 a 2,6	> 1.0	< 0.15	< 4.5	< 2.0	1-5	>10 S. Min; > 50 S. Org	4,0	< 15	< 0.8	0,4 a 0,6	
Lote C-4-11	10	<b>5,31</b>	5,34	0,30	0,26	7,26	2,49	10,3	2,9	2,9	<b>6,5</b>	5,7	0,7	16,1

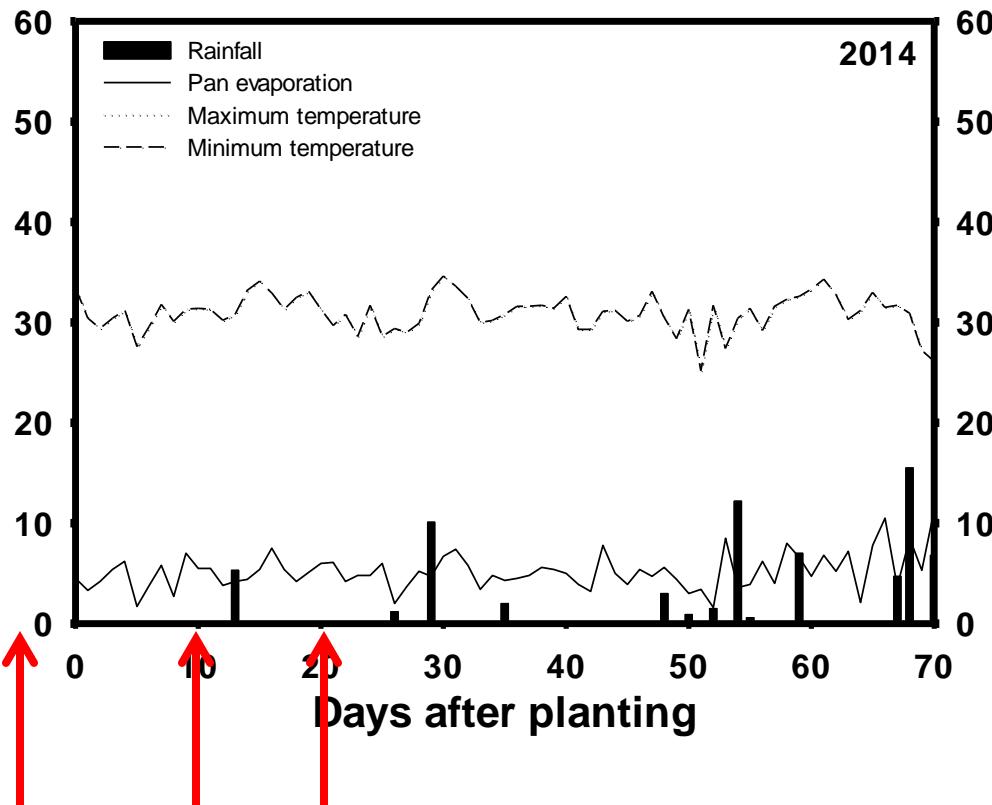


# Drought trials in Palmira, Colombia

- **Mollisol** (Aquic Hapludoll), pH = 7.7
- **No limitations of soil fertility**
- **Irrigated and drought treatments**
- **Lattice design with 3 replications**



# Rain fall pattern plus irrigation in Palmira, Colombia, 2014



3 Irrigations (~35 mm each)

# On-farm Yield Trials in Nicaragua

- 19 genotypes
- Two sites
  - Teustepe, Boaco
  - Santa Lucia
  - Site = repetition
- Two levels of P
  - 0
  - 40 kg
- Rainfed conditions

## **Soil Analysis, vicinity of Teustepe**

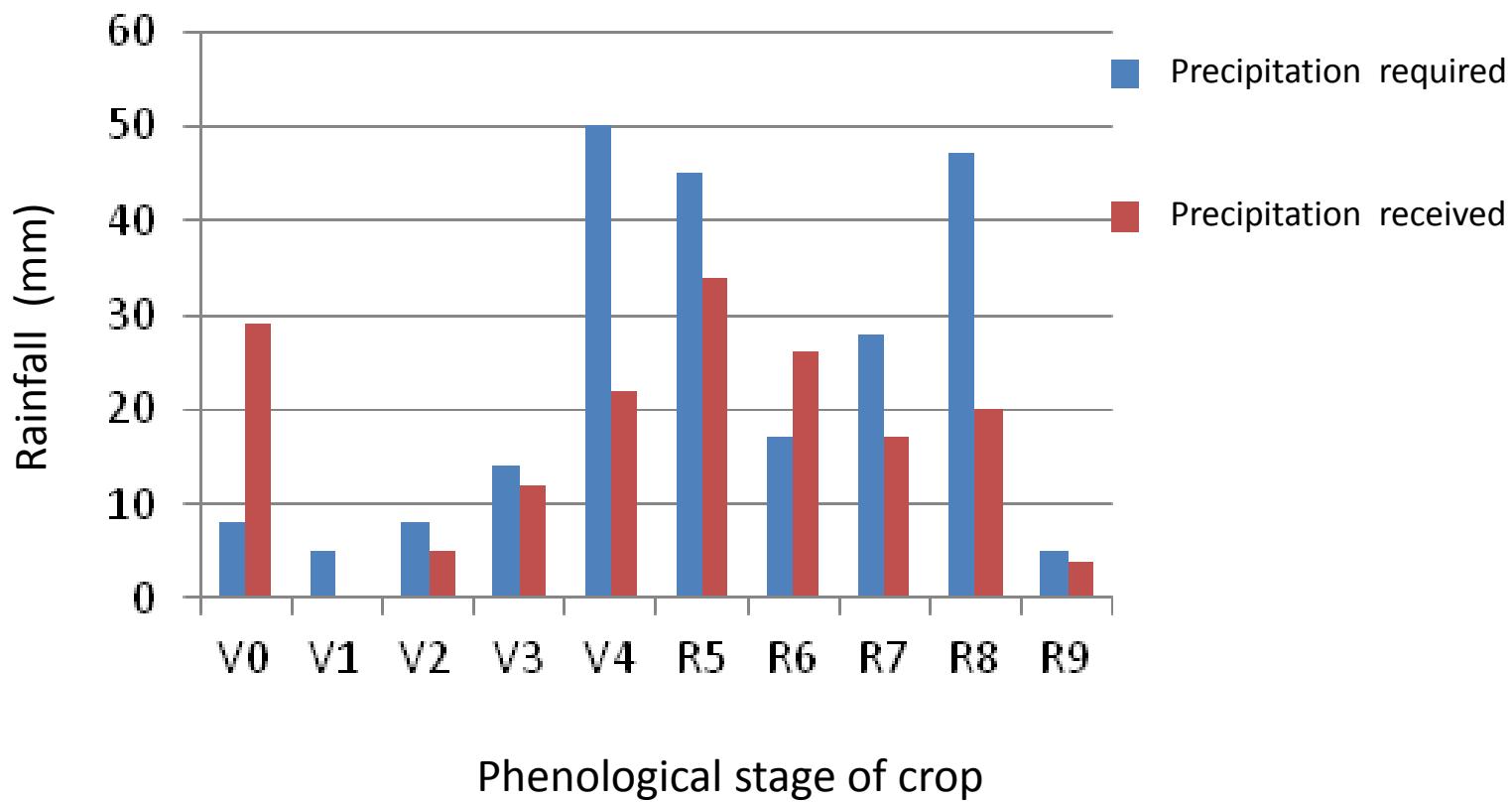
<b>PH</b>	<b>OM</b>	<b>NT</b>	<b>P</b>	<b>K</b>	<b>Ca</b>	<b>Mg</b>
<b>H2O</b>	%	%	<b>ppm</b>		meq/100g	
5.9	4.7	0.28	4.48	0.76	19.3	3.73

## **Soil Analysis, vicinity of Santa Lucia**

<b>PH</b>	<b>OM</b>	<b>NT</b>	<b>P</b>	<b>K</b>	<b>Ca</b>	<b>Mg</b>
<b>H2O</b>	%	%	<b>ppm</b>		meq/100g	
6.5	3.2	0.18	6.5	0.60	15.3	2.97

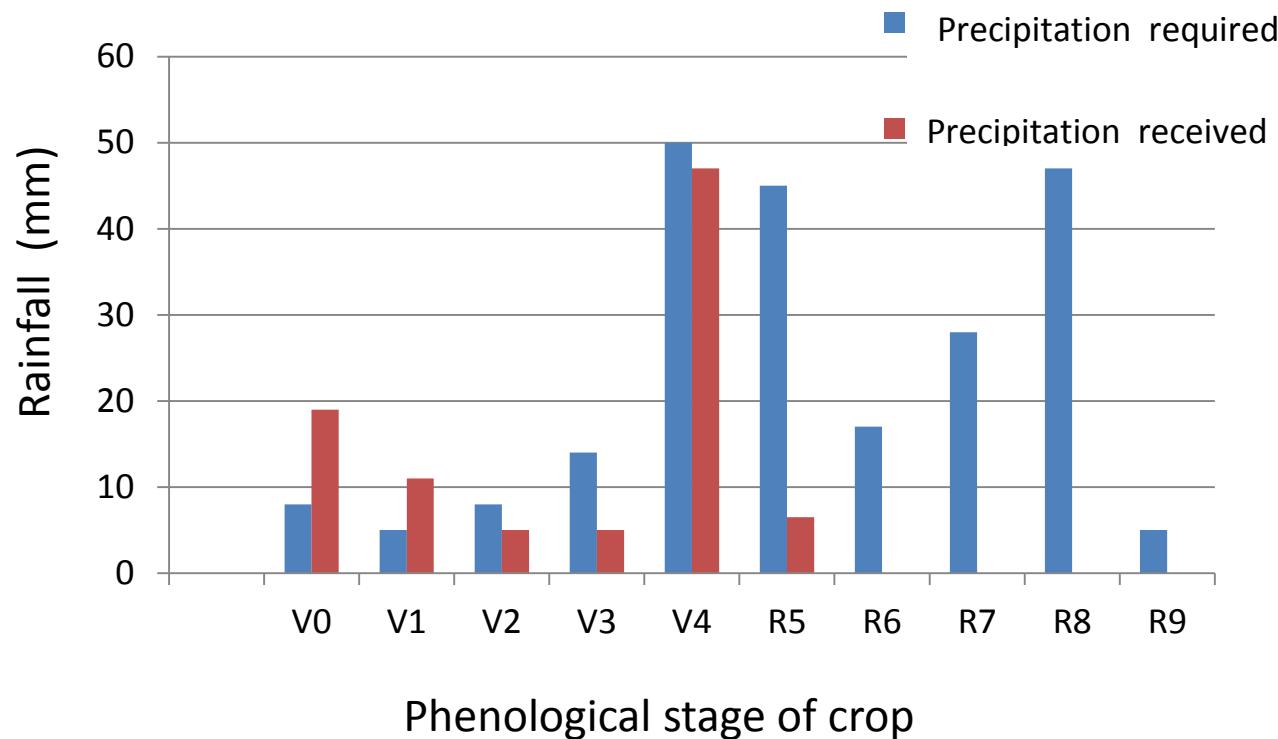
(Yield trials in Nicaragua

## Rainfall in Teustepe (150 mm)



(Yield trials in Nicaragua

## Rainfall in Sta Lucia (87 mm)



# Results and Discussion

# Yields of Small Red and Black Beans in CIAT under drought (BASE, 2014)

Line	Drought Yield (kg/ha)	Rank among 80	Irrigated Yield (kg/ha)	Rank among 80
BFS 81	2321	1	2889	35
SEN 46	2206	2	3082	17
BFS 29	2181	3	3045	21
BFS 142	2174	4	3102	13
INTA Sequia	1995	5	2995	27
Checks				
INTA Rojo	1647	38	2757	52
TIO CANELA 75	1558	43	2799	47
JAMAPA	1238	56	2434	71
DOR 390	1229	58	2829	42
DOR 364	1128	63	2654	58
ICA PIJAO	983	67	2866	41
Mean	1542		2813	

41% difference

LSD =

392

487

# Maize in Sta Lucia (87 mm)



# The trial in Sta Lucia (87 mm)



# Yields of Small Red Beans in Nicaragua under drought, with/without Fertilizer

Línea	Yield , no fert.	Rank, no fert	Yield with fert.	Rank, with fert.	Yield, combined
BFS 81	1014	1	1418	3	1216
INTA CENTRO SUR	851	5	1459	2	1155
BFS 85	994	2	1287	4	1140
INTA SEQUIA	786	7	1478	1	1132
BFS 140	967	3	1171	5	1069
CUARENTEÑO	646	14	829	14	737
BFS 10	652	13	721	16	687
INTA ROJO	465	17	791	15	628
BFS 141	508	16	661	17	584
BFS 143	389	18	542	18	465
RECREO 1	380	19	526	19	453
Average	713		980		847



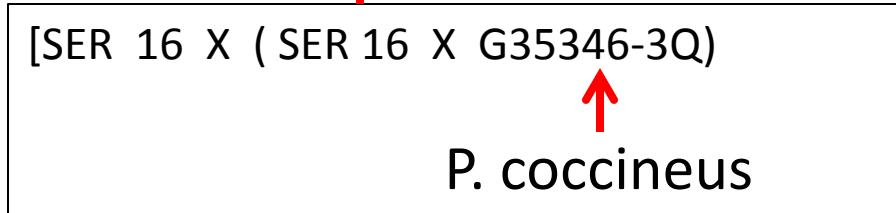
# Fertilizer Response of Small Red Beans in Nicaragua under drought

Línea	Yield , no fert.	Yield with fert.	Fert. response
BFS 81	1014	1418	404
INTA CENTRO SUR	851	1459	608
BFS 85	994	1287	293
INTA SEQUIA	786	1478	692
BFS 140	967	1171	204
CUARENTEÑO	646	829	183
BFS 10	652	721	75
INTA ROJO	465	791	326
BFS 141	508	661	153
BFS 143	389	542	153
RECREO 1	380	526	146
Average	713	980	267

# Pedigrees of Elites lines

- BFS 81, BFS 85 =
  - (SER 16 x RCB 593)F1 X (BFS 32 x ALB 91)F1

- BFS 140 =
  - (BFS 32 x ALB 91)



**Asante Sana!**