

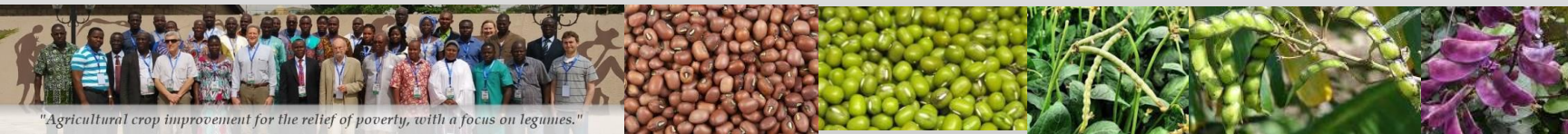


Stress Tolerant Orphan Legumes (STOL)

Annual planning meeting

28-31 August, 2024, New Delhi (India)

- Rationale
- Main achievements
- What's next?



"Agricultural crop improvement for the relief of poverty, with a focus on legumes."

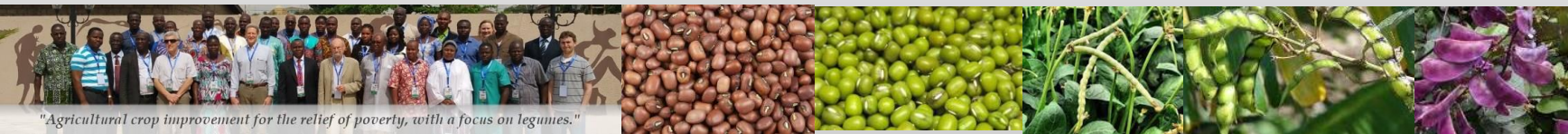
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Rationale

- ✓ Legumes are main sources of proteins for people in rural zones
- ✓ In Senegal, more than 17% of children are facing severe acute undernutrition (WB, 2018)
- ✓ Rural area are more affected than urban area, undernutrition in children reaching 25%

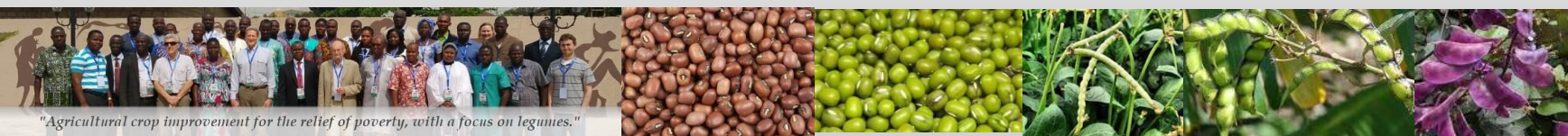


"Agricultural crop improvement for the relief of poverty, with a focus on legumes."



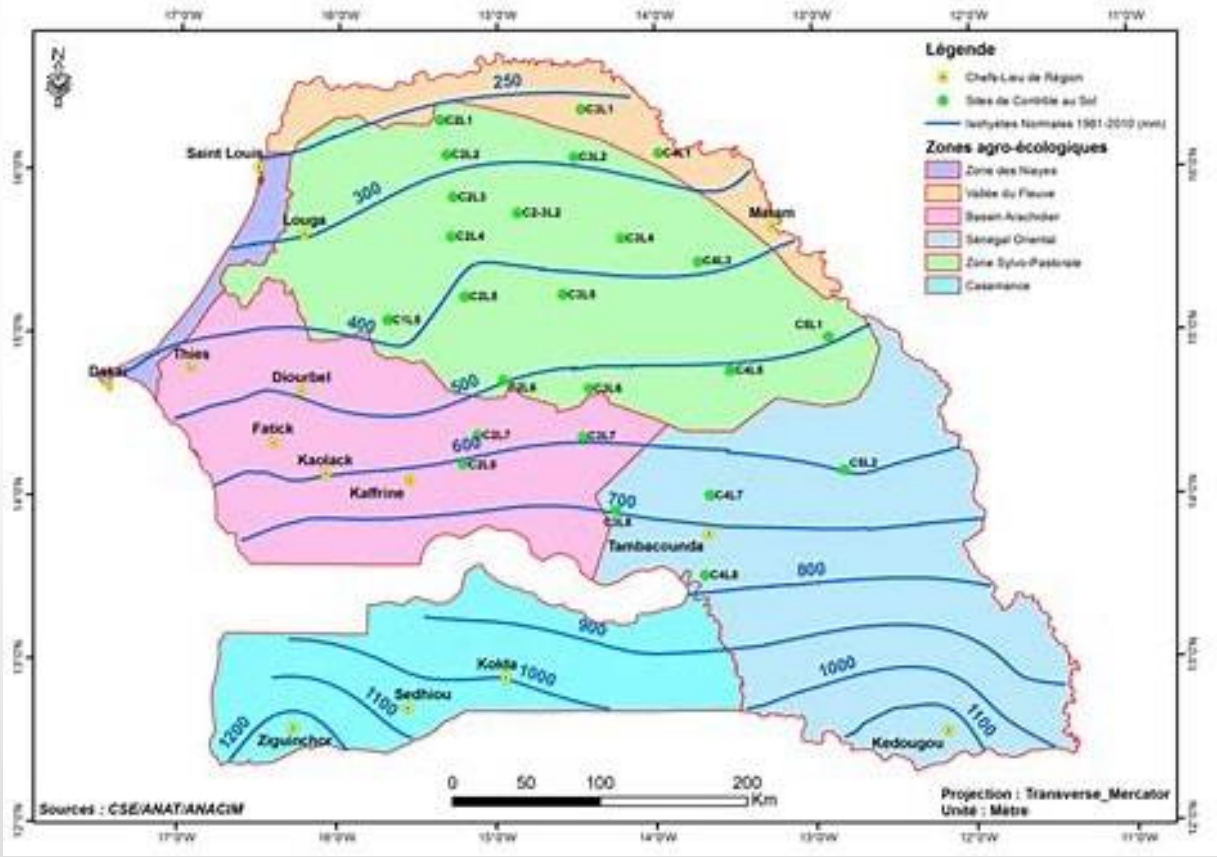
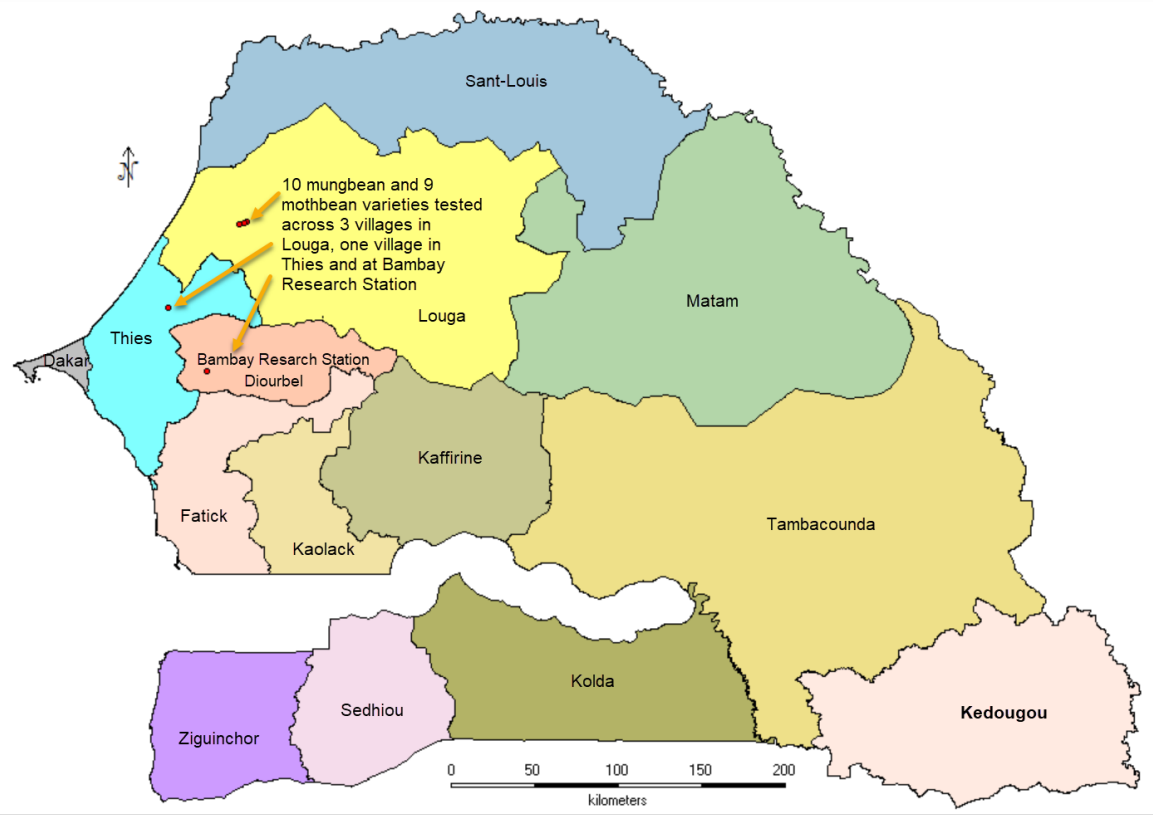
Rationale

- ✓ Very few legume crops are grown in Senegal - groundnut & cowpea only
- ✓ Mungbean, mothbean and bambara groundnut are nutrient-rich crops well adapted to marginal environments
- ✓ Crop diversification is key to enhance farmer's resilience to CC and improve their incomes



"Agricultural crop improvement for the relief of poverty, with a focus on legumes."

STOL project sites in Senegal: 300 to 500 mm



"Agricultural crop improvement for the relief of poverty, with a focus on legumes."

Main achievements in Senegal

Table 2: Pod and seed weight means (BLUEs) over harvests and its cumulative values for the mungbean varieties at Agricultural Research Station (ARS), Bambey - *Plot size : 45 m²*

Genotypes	PW_har1	SW_har1	PW_har2	SW_har2	TPW	TSW
IC-39383	275	166	366	196	619	362
Berken	418	301	305	180	799	481
IC-39375	500	318	457	251	1048	569
IC-39352	583	343	547	294	1038	637
Mam	656	429	307	173	1103	601
MH-421	936	586	1062	634	2137	1220
IPM2-14	1035	652	239	164	1275	816
Ganga 8	1072	678	1037	620	2037	1297
MH2-14	1288	832	85	44	1376	876
GAM-5	1398	867	558	318	1874	1185
Mean LSD	411	273	295	181	527	0.9
Heritability	0.87	0.85	0.90	0.90	0.91	0.84
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001



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Table 1: Mungbean varieties : main characteristics

Variety name	Institution/Origin	Main characteristics
Berken	USA	big seed size, spreading plant habit, green leaves, curved pods
Mam	USA	big seed size, spreading plant habit
IC-39352	CCSHAU-Hisar, India	Medium seed size, semi-erect, pods under canopy
IC-39375	CCSHAU-Hisar, India	Medium seed size, semi-erect, pods under canopy
IC-39383	CCSHAU-Hisar, India	Medium seed size, semi-erect, pods under canopy
MH2-14	ICAR-IIPR, Kanpur, India	Determinated growth, erect
IPM 2-14	ICAR-IIPR, Kanpur, India	Small and straight pods
MH-421	ICAR-IIPR, Kanpur, India	Indeterminated growth, semi-erect
Ganga 8	SKRAU-ARS, Sriganaganagar, India	Black pods and curved
GAM 5	AAU - Anand, India	Curved pod



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Table 2: Pod and seed weight means (BLUEs) over harvests and its cumulative values for the mungbean varieties at Agricultural Research Station (ARS), Bambey - *Plot size : 45 m²*

<i>Genotypes</i>	<i>PW_har1</i>	<i>SW_har1</i>	<i>PW_har2</i>	<i>SW_har2</i>	<i>TPW</i>	<i>TSW</i>	<i>Genotypes</i>	<i>PW_har1</i>	<i>SW_har1</i>	<i>PW_har2</i>	<i>SW_har2</i>	<i>T</i>
Mam	1189	807	310	196	1499	1002	Mam	1189	807	310	196	1
IC-39383	1241	829	1075	780	2316	1609	IC-39383	1241	829	1075	780	2
MH2-14	1384	937	108	61	1492	997	MH2-14	1384	937	108	61	1
GAM-5	1616	1069	446	293	2062	1362	GAM-5	1616	1069	446	293	2
IC-39375	1737	1188	1150	733	2887	1921	IC-39375	1737	1188	1150	733	2
IC-39352	1998	1318	1375	562	3373	1880	IC-39352	1998	1318	1375	562	3
Berken	2051	1437	517	345	2568	1781	Berken	2051	1437	517	345	2
IPM2-14	2230	1504	311	194	2541	1697	IPM2-14	2230	1504	311	194	2
MH-421	2277	1519	166	99	2443	1618	MH-421	2277	1519	166	99	2
Ganga 8	2470	1651	579	590	3049	2241	Ganga 8	2470	1651	579	590	3
Mean LSD	1259	891	697	503	1464	1004	Mean LSD	1259	891	697	503	1
Heritability	0.52	0.50	0.71	0.58	0.59	0.60	Heritability	0.52	0.50	0.71	0.58	0
p-value	NS	NS	0,01	0,05	NS	NS	p-value	NS	NS	0,01	0,05	
<i>Genotypes</i>	<i>PW_har1</i>	<i>SW_har1</i>	<i>PW_har2</i>	<i>SW_har2</i>	<i>TPW</i>	<i>TSW</i>	<i>Genotypes</i>	<i>PW_har1</i>	<i>SW_har1</i>	<i>PW_har2</i>	<i>SW_har2</i>	<i>T</i>
Mam	1189	807	310	196	1499	1002	Mam	1189	807	310	196	1
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GAM-5	1616	1069	446	293	2062	1362	GAM-5	1616	1069	446	293	2
IC-39375	1737	1188	1150	733	2887	1921	IC-39375	1737	1188	1150	733	2
IC-39352	1998	1318	1375	562	3373	1880	IC-39352	1998	1318	1375	562	3
Berken	2051	1437	517	345	2568	1781	Berken	2051	1437	517	345	2
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MH-421	2277	1519	166	99	2443	1618	MH-421	2277	1519	166	99	2
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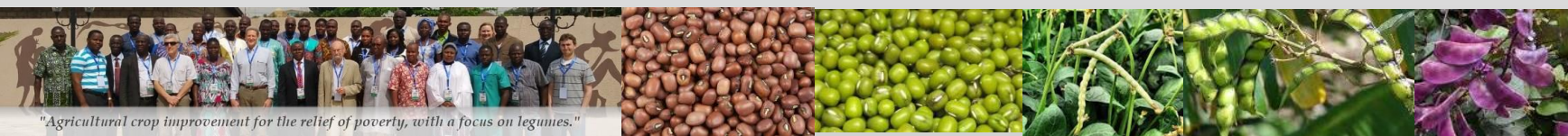
Table 3: ANOVA table for AMMI model of the total cumulative pod (A) and seed (B) weight

A

Source	d.f	s.s.	m.s.	v.r.	F pr
Genotypes	9	3613819	401535	2.58	0.0272
Environments	3	22644420	7548140	48.56	<0.001
Interactions	27	4196764	155436		
IPCA 1	12	3036261	253022	3.61	0.0831
IPCA 2	10	809898	80990	1.15	0.4639
Residuals	5	350606	70121		

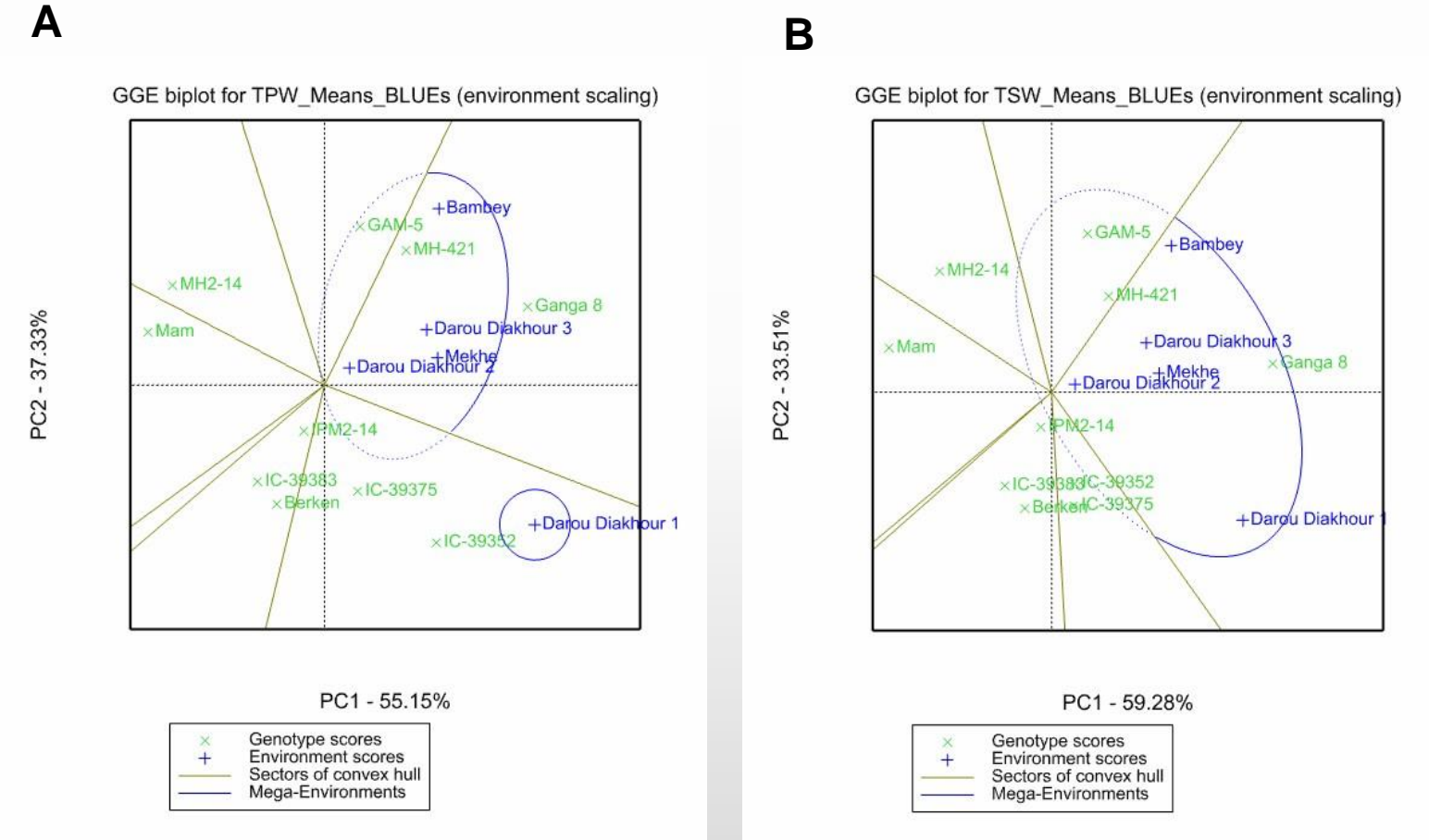
B

Source	d.f.	s.s.	m.s.	v.r.	F pr
Genotypes	9	1587003	176334	2.91	0.0151
Environments	3	10124161	3374720	55.76	<0.001
Interactions	27	1634052	60520		
IPCA 1	12	1130080	94173	3.22	0.1026
IPCA 2	10	357868	35787	1.22	0.4356
Residuals	5	146103	29221		



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Figure 1: GGE biplots for a) cumulative total pod weight and b) cumulative total seed weight



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Table 4: Protein, magnesium and iron content in seeds of the different mungbean varieties

Variety	Protein (g/100 g)	Mg (mg/100g)	Fe (mg/100g)
IC 39352	19.7 ± 0.4 bcd	165	7.10
IC39383	18.7 ± 0.4 e	194	8.80
Berken	19.5 ± 0.4 cde	212.5	9.0
IC 39375	19.1 ± 0.0 de	198.5	7.11
MH 421	21.1 ± 0.4 a	175.3	6.65
Gam-5	20.3 ± 0.4 abc	177	7.25
Ganga-8	20.7 ± 0.0 ab	185	8.5
MH-14	20.3 ± 0.4 abc	205.5	6.85
IPM2-14	19.9 ± 0.4 bcd	166.5	7.75
Mam	18.7 ± 0.4 e	175.5	6.55

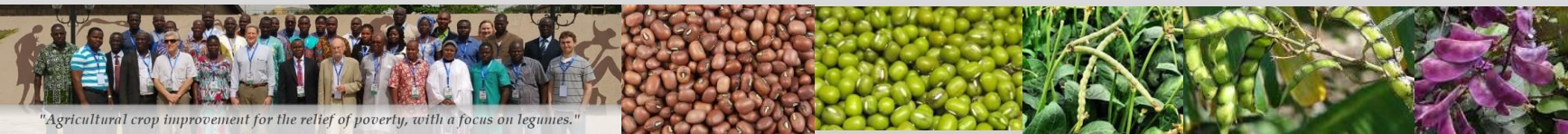


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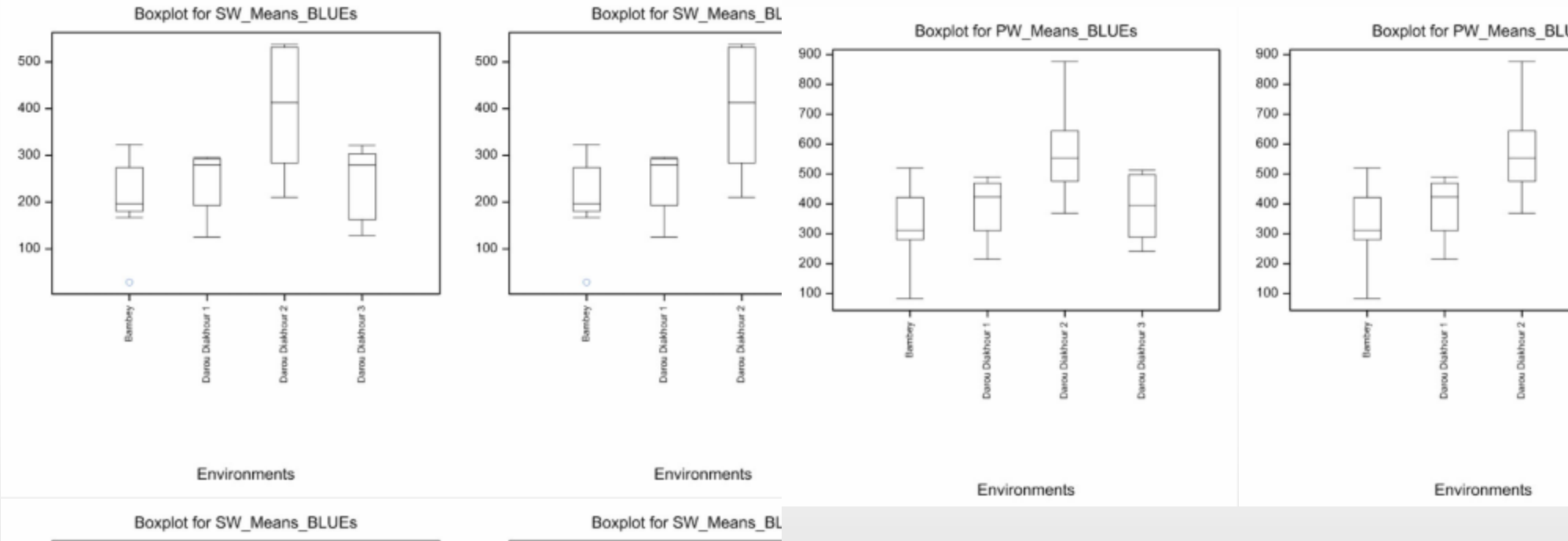
9 Mothbean varieties: extra-early maturing - 57 to 62 days

- ▶ **GMO 2 - Shallow lobing of the terminal leaflet**
- ▶ **Maru Moth : Deep lobing of the terminal leaflet**
- ▶ **RMB - 28 : Deep lobing of the terminal leaflet**
- ▶ **RMO 257 : Deep lobing of the terminal leaflet**
- ▶ **RMO 437 : Deep lobing of the terminal leaflet**
- ▶ **RMO 225 - Shallow lobing of the terminal leaflet**
- ▶ **RMO - 25 : Deep lobing of the terminal leaflet**
- ▶ **RMO- 3-5-70 - Shallow lobing of the terminal leaflet**
- ▶ **RMO- 4-1-6-9 - Shallow lobing of the terminal leaflet**



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Figure 2 : Boxplots for a) cumulative total pod weight and b) cumulative total seed weight across the sites



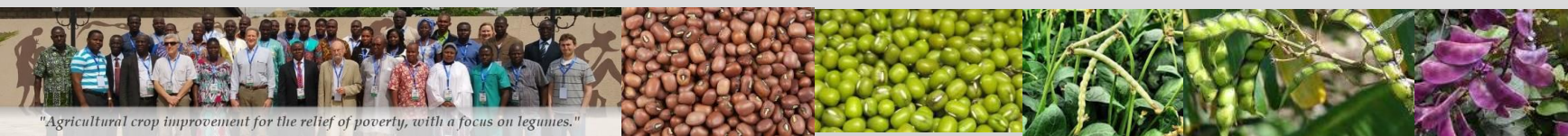
"Agricultural crop improvement for the relief of poverty, with a focus on legumes."



Main achievements

Table 5: ANOVA table for AMMI model of the cumulative pod weight of mothbean varieties

A						B					
Source	d.f.	s.s.	m.s.	v.r.	F pr	Source	d.f.	s.s.	m.s.	v.r.	F pr
Genotypes	8	234523	29315	2.65	0.0306	Genotypes	8	75257	9407	1.12	0.3865
Environments	3	307213	102404	9.27	<0.001	Environments	3	177631	59210	7.04	0.0015
Interactions	24	265085	11045			Interactions	24	201965	8415		
IPCA 1	10	162826	16283	4.21	0.0460	IPCA 1	10	161561	16156	6.85	0.0143
IPCA 2	8	79068	9884	2.56	0.1345	IPCA 2	8	26254	3282	1.39	0.3533
Residuals	6	23191	3865			Residuals	6	14149	2358		

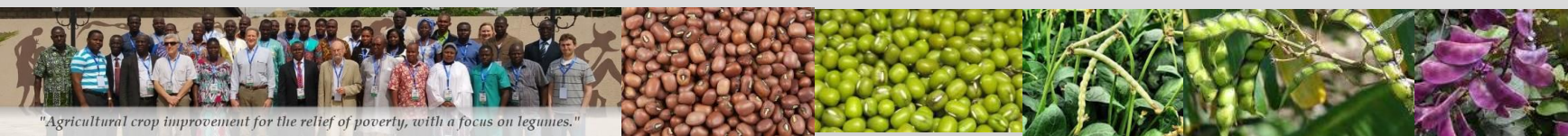


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Main achievements

Table 7: Protein, magnesium and iron content in seeds of the different mothbean varieties

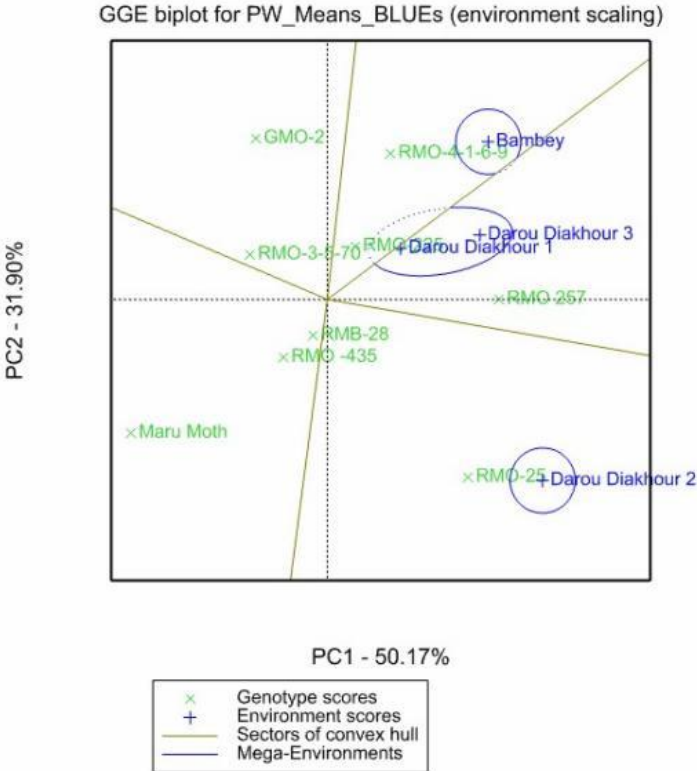
Variety	Protein (g/100g)	Mg (mg/100g)	Fe (mg/100g)
RMO-4-1-6-9	16.4±0.4 cd	145	8.85
RMO 25	17.9±0.3 ab	210	7.50
RMO 225	18.7±0.4 a	178	8.88
RMO 435	17.2 ±0.4 bc	169	10.0
Maru Moth	15.6±0.4 d	155	6.75
GMO 2	14.4±0.4 e	125	11.5
RMO 3-5-70	16.4±0.4 cd	119	7.90
RMO- 257	16.9±0.4 bc	135	8.56
RMB 28	16.4±0.4 cd	132	8.70



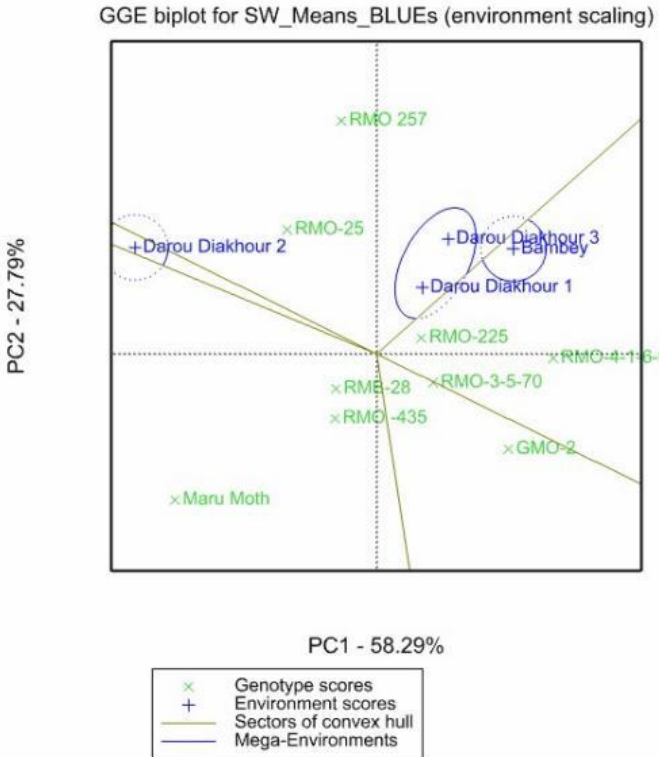
Main achievements

Figure 3: GGE biplots for pod weight (PW) and seed weight (SW)

A



B



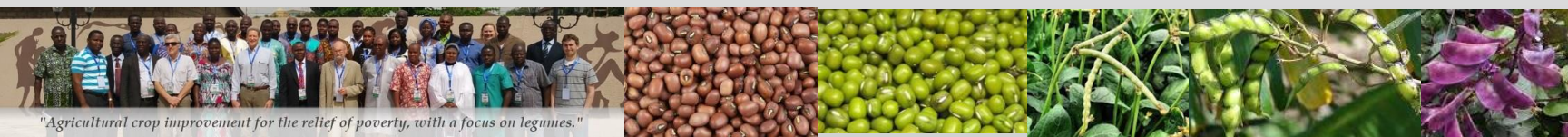
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Main achievements

Table 6: Seed weight (SW) of each mothbean variety across the sites

Genotypes	Bambey	Darou Diakhour 1	Darou Diakhour 2	Darou Diakhour 3	Mean
GMO-2	259	291	217	188	239
Maru Moth	29	125	531	129	204
RMB-28	185	280	420	164	262
RMO 257	318	295	537	322	368
RMO -435	197	202	413	161	243
RMO-225	254	166	354	303	269
RMO-25	191	296	534	279	325
RMO-3-5-70	167	292	306	288	263
RMO-4-1-6-9	323	231	211	305	267
Mean LSD	172	154	212	72	-
Heritability	0.54	0.43	0.70	0.90	-
P-value	0.078	0.17	0.01	0.001	-

Most stable varieties are GMO - 2, RMO-4-1-6-9, RMO-3-5-70 and RMO-225



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Main achievements

Field day organized in 2024 in collaboration with farmer's cooperatives in Louga



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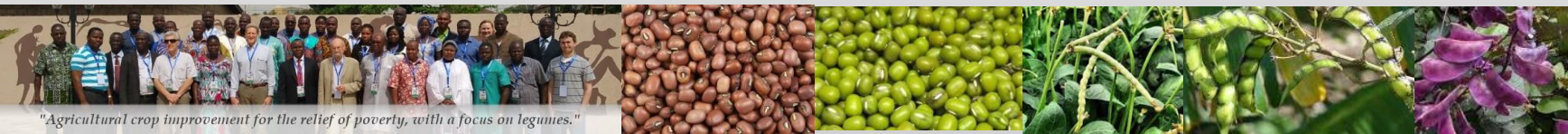


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What's next ?

- Repeat trials to confirm the best varieties based on yield and nutritional traits
- Pursue the description of varieties for release in Senegal
- Produce nucleus and breeder seed of released varieties to provide ISRA's Seed Unit with enough seeds
- Maintain all the germplasm including the bambara groundnut in our cold room
- Finalise and publish 2 or 3 papers in peer-reviewed journals



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Thank you so much



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