Scaling Readiness Case for IT13K-1308-5 (SAMPEA 21)

Prepared by Patrick O. Ongom and Ousmane Boukar

1. Overview

- Candidate Variety Name: IT13K-1308-5 (SAMPEA 21)
- Standard (Benchmark) Variety Name: IT07K-318-33 (SAMPEA 17)
- Crop: Cowpea
- Market Segment (e.g., food-grade, processing, fodder): Short duration white cowpea for food [boiled grain]
- Target Population of Environments (TPEs): Sudan Savanna and Sahel Savanna, Northern Guinea Savanna, Forest Transition
- Breeding Program / Institution: IITA
- Year of Evaluation: Two years

2. Justification for Standard Variety Selection

- Standard variety adoption rate (% of market share or acreage): NA
- Reasons for widespread adoption (e.g., yield, quality, stress tolerance): Early maturing, high yielding and drought tolerance
- Known limitations of standard variety (e.g., disease susceptibility, low resilience to climate change): Susceptible to striga.

3. Trial Design Summary

- Type of Trials: *multi-environment trials*
- Number of Locations: *Ten (10) Locations*
- Number of Seasons/Years: *Two (2) years*
- Replications: *Three (3)*
- Design (e.g., RCBD, Alpha-lattice): *Alpha-lattice*

4. Performance Data Summary

The candidate variety IT13K-1308-5 (SAMPEA 21) was tested alongside other lines, including a standard check, SAMPEA 17, for 2 years across a total of 10 locations. Results presented in Table 1 show yield performance during the 2019 cropping season, where IT13K-1308-5 ranked 3rd with a yield advantage of 17% over the standard check.

A similar analysis was conducted for the 2020 cropping season, which showed the candidate variety ranking first with a yield advantage of 25% (Table 2). When the two years' data were combined, the candidate variety IT13K-1308-5 was still the best performer in terms of grain yield, maintaining a 25% yield advantage over the check (Table 3).

Results from farmer-managed on-farm trials showed IT13K-1308-5 to maintain high yield performance above tested lines (Table 4). In this on-farm trial, IT13K-1308-5 was tested alongside SAMPEA 17, a farmer's variety, and an improved line (IT13K-1079-3) across 15 cowpea growing villages in Northern Nigeria. The candidate variety IT13K-1308-5 outperformed the check, the farmer variety and the improved line with a yield advantage of 27% over SAMPEA 17 and 128% over the farmer's variety (Table 4).

Additional data from recent cowpea advanced yield trials (AYT), which included IT13K-1308-5 (SAMPEA 21), is presented in Table 8. The AYT was established using a row-column design and 3 replications per location. Based on the combined AYT data from five locations, IT13K-1308-5 outperformed other lines with over a 37% yield advantage over one of the checks, IT08K-150-12. When considering the average of all checks in the trials, IT13K-1308-5 demonstrated a 45% yield increase over the mean of the checks. As a result, it had a yield difference of 323.70 Kg/ha from the check mean, which was significantly greater than the LSD value of 280.92 Kg/ha (Table 5).

Table 1: Grain yield performance of cowpea lines evaluated together with a commercial check across four locations during the 2019 cropping season in Nigeria

Genotypes	Ibadan	Makurdi	Samaru1	Samaru2	Comb_Mean	%Yield_advantage
IT10K-817-7	1133.10	1386.20	2031.27	1365.13	1478.93	25.40
IT13K-1079-3	1245.15	1397.70	2136.20	1114.27	1473.33	24.93
IT13K-1308-5	1408.75	1080.93	1644.07	1377.57	1377.83	16.83
IT10K-817-3	1007.10	1535.83	1654.53	1040.23	1309.43	11.03
IT13K-1427-3	1134.85	959.73	1833.83	1291.10	1304.88	10.64
IT10K-837-1	1147.40	854.37	2135.90	1026.63	1291.08	9.47
IT13K-1288-1	1015.45	872.17	1672.17	1592.67	1288.11	9.22
IT13K-1144-11	1159.90	913.33	1767.20	1106.03	1236.62	4.86
IAR-09-1030-6	979.50	672.30	2034.81	1062.63	1187.31	0.68
SAMPEA-17 (Standard Variety)	1242.65	1114.43	1199.33	1160.97	1179.35	0.00
IT10K-832-2	890.30	1439.20	1269.63	1103.67	1175.70	-0.31

IT10K-863-11	980.40	1096.80	1712.40	879.13	1167.18	-1.03
IT13K-1000-3	1415.40	812.50	1280.63	1117.00	1156.38	-1.95
IT07K-243-1-10	1038.80	995.30	1648.63	923.00	1151.43	-2.37
IT10K-836-3	1129.80	847.73	1581.43	1029.57	1147.13	-2.73
IT14K-1424-12	1086.40	833.63	1316.07	1171.77	1101.97	-6.56
IT07K-291-69	676.50	750.33	1854.07	1024.30	1076.30	-8.74
IT08K-150-27	751.55	879.93	1362.27	1173.13	1041.72	-11.67
IT07K-230-2-9	602.10	728.73	1821.63	951.43	1025.98	-13.00
IAR-09-1151-2-1	567.10		1065.00	1273.13	968.41	-17.89
IAR-011-151	28.40		1416.67	1281.07	908.71	-22.95
IAR-09-1009-6	299.10	353.57	1535.75	1313.17	875.39	-25.77
IAR-09-11064-4	713.30	890.87	935.50	658.03	799.42	-32.21
IAR-07-1032	75.15		880.70	1054.20	670.02	-43.19
Min	28.40	353.57	880.70	658.03	670.02	
Mean	905.34	972.17	1574.57	1128.74	1141.36	
Max	1415.40	1535.83	2136.20	1592.67	1478.93	
Heritability	0.83	0.75	0.76	0.53	0.53	
LSD	450.24	405.28	494.22	373.80	288.52	
CV	24.04	25.36	18.98	20.15	26.95	
P-value G	0.00	0.00	0.00	0.01	0.00	

Table 2: Grain yield performance of cowpea lines evaluated together with commercial check across 8 locations during the 2020 cropping season in Nigeria

Genotypes	Bakura	Borno	Makurdi	Malamadori	Minjibir	Mokwa	Samaru1	Samaru2	Comb_Mean	%Yield_advantage
IT13K-1308-5	1283.9	1001.6	1520.1	723.1	420.1	723.8	2137.3	1016.7	1134.72	24.50
IT10K-837-1	863.7	979.9	1528.4	702.4	604.6	827.6	2152.2	1273.5	1113.14	22.14
IT14K-1424-12	473.4	807.3	2132.0	807.9	443.9	897.8	1619.2	958.9	1062.36	16.57
IT13K-1427-3	713.0	650.2	1507.1	768.7	555.8	632.2	2116.3	971.5	1048.84	15.08
IT13K-1079-3	932.4	944.7	1815.9	315.8	383.1	585.8	2235.7	1641.0	1044.77	14.64
IT10K-832-2	639.0	1133.1	1773.1	687.9	495.8	835.0	1826.1	912.4	1042.84	14.42
IT13K-1288-1	650.8	1028.9	1783.4	54.9	148.2	764.3	2704.9	969.0	1041.39	14.26
IT08K-150-27	702.3	527.9	1558.8	182.7	428.4	737.3	2545.7	1195.6	1025.86	12.56
IT10K-863-11	503.2	751.6	1274.9	550.4	496.8	469.4	2710.3	976.8	1005.17	10.29
IT10K-817-3	535.3	1118.1	1852.3	823.3	601.9	663.8	1255.6	1062.3	955.38	4.83
IT13K-1144-11	548.5	864.0	1581.9	868.0	315.4	680.6	1730.2	1175.2	952.43	4.50
IT07K-243-1-10	449.8	1054.3	1404.8	724.4	439.1	633.0	1909.5	1006.6	926.76	1.69

SAMPEA17 (Standard Variety)	635.4	807.9	1339.9	824.5	495.8	610.2	1562.5	1194.8	911.39	0.00
IT07K-291-69	613.5	972.0	1261.3	417.9	243.3	586.7	2093.5	934.1	868.78	-4.68
IAR-09-1009-6	183.5	1045.6	1165.5		156.4	788.9	2259.5	972.8	839.47	-7.89
IT10K-817-7	567.9	777.7	1548.4	688.7	395.2	654.4	1100.5	1046.6	825.86	-9.38
IAR-09-1030-6	634.9	804.7	514.3		107.1	758.9	2313.2	1269.9	799.51	-12.28
IT13K-1000-3	607.4	590.9	1151.9	426.0	319.7	523.1	1574.1	715.7	767.03	-15.84
IT07K-230-2-9	613.6	465.9	883.9	250.3	341.6	660.2	1446.8	1495.3	699.39	-23.26
IT10K-836-3	540.5	412.8	1194.6	658.2	480.3	737.1	377.8	1137.3	657.49	-27.86
IAR-09-1151-2-1	403.9	829.8	1057.6	158.8	121.9	392.2	1708.8	1324.4	638.72	-29.92
IAR-09-11064-4	733.6	883.7	942.8	119.2	155.1	677.4	1083.8	1467.4	618.65	-32.12
IAR-07-1032	228.7	1014.1	278.4		335.0	756.0	1769.4	894.8	591.40	-35.11
IAR-011-151	277.1	870.2	351.0			1055.6	1028.3	1387.0	456.68	-49.89
Min	183.5	412.8	278.4	54.9	107.1	392.2	377.8	715.7	456.68	
Mean	597.3	847.4	1309.3	537.6	368.9	693.8	1802.5	1125.0	876.17	
Max	1283.9	1133.1	2132.0	868.0	604.6	1055.6	2710.3	1641.0	1134.72	
Heritability	0.7	0.1	0.7	0.5	0.3	0.6	0.9	0.2	0.42	
LSD	361.2	503.4	770.6	551.6	242.0	242.0	628.0	584.2	384.53	
CV	35.2	35.7	34.3	60.8	21.2	21.2	21.2	31.6	34.95	
P-value G	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.02	

Table 3: Combined analysis for grain yield performance of cowpea lines evaluated together with commercial check during 2019 and 2020 cropping seasons

Genotype	Grain_Yield (kg/ha)	HSWT	Days_95%_ Maturity	Fodder_Yield (Kg/ha)	Bacterial_ Blight	Striga _score	%Yield_advantage
IT13K-1308-5	1128.7	18.3	72.4	2266.7	1.5	0.06	25
IT13K-1079-3	1095.5	15.3	74.1	2960.3	1.9	0.06	21
IT10K-837-1	1069.6	19.5	72.9	2323.5	1.9	0.11	18
IT10K-817-3	1034.8	15.8	70.6	1793.8	1.8	0.28	15
IT13K-1427-3	1028.0	18.5	72.8	2087.2	2.0	0.17	14
IT14K-1424-12	1001.7	19.6	73.3	3072.9	1.6	0.11	11
IT13K-1144-11	986.3	20.0	73.1	2938.1	2.0	0.24	9
IT13K-1288-1	984.3	14.6	74.5	2618.2	1.7	0.11	9
IT10K-832-2	982.5	14.4	71.6	2726.5	1.5	0.11	9
IT10K-817-7	960.0	17.5	72.4	2433.5	1.8	0.11	6
IT10K-863-11	935.3	15.0	74.8	2266.2	1.6	0.17	3
IT08K-150-27	915.0	19.5	76.1	3255.0	1.1	0.11	1
IT07K-243-1-10	908.8	16.0	71.5	3274.6	2.1	0.44	1
SAMPEA-17 (Standard Variety)	903.7	17.3	73.7	2607.3	1.7	0.28	0
IAR-09-1030-6	853.7	16.3	76.4	4104.3	1.8	0.11	-6
IT07K-291-69	839.5	13.9	73.9	3482.0	1.6	0.33	-7
IT13K-1000-3	801.8	17.2	72.7	2771.4	1.8	0.22	-11
IT10K-836-3	767.7	18.8	71.7	3035.5	1.6	0.06	-15

IT07K-230-2-9	728.4	15.2	73.0	2064.4	1.5	0.33	-19
IAR-09-1009-6	715.2	16.3	77.0	4074.4	1.6	0.50	-21
IAR-09-11064-4	632.9	14.2	74.4	2830.1	1.5	0.22	-30
IAR-09-1151-2-1	577.1	14.1	78.2	3249.2	1.3	0.28	-36
IAR-011-151	534.9	20.9	78.8	3927.5	1.7	0.28	-41
IAR-07-1032	434.7	15.6	76.0	4447.7	1.5	0.39	-52
Min	434.7	13.9	70.6	1793.8	1.1	0.1	
Mean	867.5	16.8	74.0	2942.1	1.7	0.2	
Max	1128.7	20.9	78.8	4447.7	2.1	0.5	
Heritability	0.7	0.9	0.5	0.2	0.1	0.4	
LSD	285.5	1.3	3.8	1772.4	0.6	0.42	
CV	42.2	11.2	9.3	60.7	33.6	-	
P-value Genotype	0.0	0.0	0.0	0.2	0.3	0.0	
P-value GxE	0.0	0.0	1.0	0.0	0.0	-	

Table 4: Grain yield (kg/ha) of cowpea varieties evaluated in farmer-managed on-farm trials conducted at nine locations in Kano State and six locations in Jigawa State, Nigeria in 2021.

Variety	State			%Yield_advantage over farmer variety	%Yield_advantage over standard check
	Kano	Jigawa	Across locations		
IT13K-1308-5	1218	1083	1164	127.79	27.35
SAMPEA 17 (Standard check	1037	730	914	78.86	0.00
IT13K-1079-3	930	860	902	76.52	-1.31
Farmers' variety	448	605	511	0.00	-44.09
SED	137.9	218.5	120.9		

Table 5 Combined analysis for the performance of cowpea lines evaluated in advanced yield trials (AYT) together with checks across 5 locations during 2024 cropping season in Nigeria

Genotype	DFF	D50F	D95M	HSWT	Fodder(Kg/ha)	Yield(Kg/ha)	%Yield advantage over IT08K-150-12 check	%Yield advantage over mean of checks	Diff. from Check Mean	LSD Comparison
IT20K-23-17	45.96	50.80	83.32	17.24	1573.28	1128.32	49.26	58.32	415.62	> LSD 280.92 SIG.
IT21K-68-54	46.70	50.96	82.21	15.87	1304.90	1042.47	37.90	46.27	329.77	> LSD 280.92 SIG.
IT13K-1308-5	46.93	50.41	80.83	17.07	1476.62	1036.40	37.10	45.42	323.70	> LSD 280.92 SIG.
IT20K-1300-4	48.84	52.31	79.12	13.39	1283.19	1014.58	34.21	42.36	301.88	> LSD 280.92 SIG.
IT20K-3-2	44.60	49.16	79.99	16.29	1420.66	1010.22	33.64	41.75	297.52	> LSD 280.92 SIG.
IT19K-811-3	46.40	50.19	83.28	19.01	1293.53	995.93	31.74	39.74	283.23	> LSD 280.92 SIG.
IT20K-2802-8	44.40	48.79	79.47	15.39	1392.54	990.12	30.98	38.93	277.43	< LSD 280.92 NS
IT21K-22-2	46.21	50.14	81.68	15.51	1300.21	978.14	29.39	37.24	265.44	< LSD 280.92 NS
IT19K-40-1-1	47.17	51.68	83.62	14.68	1413.37	962.11	27.27	35.00	249.41	< LSD 280.92 NS
IT18K-311-1-1	48.52	53.26	82.94	14.51	1178.03	950.62	25.75	33.38	237.92	< LSD 280.92 NS
IT19K-658-2-1	46.61	50.98	83.88	18.53	1581.98	946.31	25.18	32.78	233.61	< LSD 280.92 NS
IT20K-201-22	43.23	47.52	78.67	14.69	1107.00	933.67	23.51	31.00	220.97	< LSD 280.92 NS
IT20K-2101-2	45.99	50.27	80.53	15.15	1116.27	934.45	23.61	31.11	221.75	< LSD 280.92 NS
IT17K-1107-4-1	44.14	48.12	80.28	16.02	1457.03	933.60	23.50	30.99	220.90	< LSD 280.92 NS
IT19K-771-2-1	46.79	51.28	82.07	15.10	1637.84	928.17	22.78	30.23	215.47	< LSD 280.92 NS
IT18K-821-1	47.81	52.07	83.80	19.77	1519.92	929.91	23.01	30.48	217.22	< LSD 280.92 NS
IT20K-15-9	46.65	51.07	81.66	15.45	1173.07	914.58	20.98	28.33	201.88	< LSD 280.92 NS
IT20K-200-1	45.68	50.25	79.65	16.03	1421.42	918.41	21.49	28.86	205.71	< LSD 280.92 NS
IT17K-1259-1-1	45.98	50.29	83.39	17.66	1354.03	907.85	20.09	27.38	195.15	< LSD 280.92 NS
IT20K-29-29	46.12	50.12	81.05	15.21	1374.58	889.59	17.68	24.82	176.89	< LSD 280.92 NS
IT20K-26-19	43.65	48.43	77.60	14.21	1307.65	890.65	17.82	24.97	177.95	< LSD 280.92 NS
IT19K-78-2-3	43.59	47.76	77.73	15.85	1349.15	886.40	17.26	24.37	173.70	< LSD 280.92 NS
IT19K-755-5	45.68	49.88	81.79	17.34	1606.25	853.92	12.96	19.81	141.22	< LSD 280.92 NS
IT19K-182-1-1	46.36	50.73	83.51	14.73	1277.99	848.62	12.26	19.07	135.92	< LSD 280.92 NS
IT19K-26-2-3	46.49	50.97	83.66	16.94	1233.16	839.27	11.02	17.76	126.57	< LSD 280.92 NS
IT21K-70-88	45.44	49.52	81.13	17.84	1178.54	837.21	10.75	17.47	124.51	< LSD 280.92 NS
IT21K-76-6	44.85	49.34	78.14	14.02	1160.57	836.37	10.64	17.35	123.67	< LSD 280.92 NS
IT19K-536-4	49.82	54.13	84.06	14.07	1458.39	832.91	10.18	16.87	120.21	< LSD 280.92 NS
IT21K-20-91	44.33	48.93	79.80	14.49	1489.92	820.83	8.58	15.17	108.13	< LSD 280.92 NS
IT20K-23-20	46.67	51.29	83.18	16.80	1272.23	814.18	7.70	14.24	101.48	< LSD 280.92 NS
ALOKALOCAL (Check)	46.36	51.04	83.95	14.91	449.74	795.83	5.27	11.66	83.13	< LSD 280.92 NS
IT19K-226-1-3	48.38	52.45	82.78	14.03	1368.88	798.08	5.57	11.98	85.38	< LSD 280.92 NS
IT20K-1401-6	45.87	50.08	81.38	14.76	1297.42	790.98	4.63	10.98	78.28	< LSD 280.92 NS
IT08K-150-12 (Check)	45.30	49.80	82.87	16.13	1316.69	755.96	0.00	6.07	43.26	< LSD 280.92 NS
IT19K-224-1-2	45.88	50.19	81.74	12.10	1228.21	751.03	-0.65	5.38	38.33	< LSD 280.92 NS
IT20K-3-13	46.05	50.11	82.17	18.99	1056.04	719.19	-4.86	0.91	6.50	< LSD 280.92 NS
IT07K-297-13	47.15	51.69	83.29	17.09	1159.98	708.85	-6.23	-0.54	-3.85	< LSD 280.92 NS
IT20K-100-10	42.84	47.56	82.65	18.06	1363.18	682.10	-9.77	-4.29	-30.60	< LSD 280.92 NS
IT17K-1580-1-1	46.43	51.01	82.59	15.48	1536.61	666.63	-11.82	-6.46	-46.06	< LSD 280.92 NS
IT19K-720-1	50.17	54.02	84.35	18.61	1089.83	665.16	-12.01	-6.67	-47.54	< LSD 280.92 NS
IT17K-1514-1-2	44.32	48.49	79.86	15.41	1196.21	633.33	-16.22	-11.14	-79.37	< LSD 280.92 NS
IT07K-292-10	46.94	51.26	83.11	16.29	1296.03	618.72	-18.15	-13.19	-93.98	< LSD 280.92 NS
Achishuru (Check)	43.85	47.81	73.09	8.29	554.55	586.31	-22.44	-17.73	-126.39	< LSD 280.92 NS
IT19K-654-1	47.52	51.89	84.08	18.60	1158.56	589.30	-22.05	-17.31	-123.40	< LSD 280.92 NS
IT20K-23-16	44.37	48.75	81.14	15.38	898.23	574.57	-23.99	-19.38	-138.13	< LSD 280.92 NS
Check mean						712.7				
Heritability	0.80	0.80	0.76	0.93	0.34	0.46				
Grand Mean	46.07	50.37	81.58	15.84	1281.86	847.60				
LSD	2.07	2.00	3.08	1.55	458.38	280.92				
CV	3.93	3.55	2.62	11.78	38.27	36.85				
n Replicates	3.00	3.00	3.00	3.00	3.00	3.00				
n Environments	5.00	5.00	5.00	6.00	5.00	6.00				
Genotype significance	0.00	0.00	0.00	0.00	0.02	0.00				
GenxEnv significance	0.00	0.00	0.00	0.00	0.00	0.00				

5. Adaptation and Stability Analysis

- GxE Analysis Summary (e.g., AMMI, GGE biplot interpretation):
  The AMMI1 Biplot revealed the candidate variety IT13K-1308-5 as being among the varieties closer to the x-axis, suggesting that its performance is stable across environments (Figure 1). In terms of adaptation, the AMMI2 Biplot showed the candidate variety to be more adapted to three environments in Northern Nigeria, namely Makurdi, Bakura, and Badeggi, spanning the Sahel and Sudan Savanna agro-ecological zones (Figure 2). In addition, the GGE Stability plot in Figure 3 revealed IT13K-1308-5 as being the highest yielding and a moderately stable variety.

- Stability Index / Regression Coefficient:
  - *Based on Lin and Bins stability model, IT13K-1308-5 was ranked second as measured by superiority index (Pa_i) across all environments (Table 4). This indicated that IT13K-1308-5 performed better compared to the best-performing genotype in each environment. In this model, a lower superiority index indicates a more stable and superior genotype (Table 6). Interestingly, when IT13K-1308-5 was tested in favorable and unfavorable environments, it still ranked high under both conditions (Table 4), suggesting its resilience under different environmental conditions.*

Table 6: Stability analysis based on Lin and Bins superiority index

GEN	Y	Pi_a	R_a	Pi_f	R_f	Pi_u	R_u
IT13K-1079-3	1088.17	69671.63	1	48587.30	1	86329.14	2
IT13K-1308-5	1051.90	90552.93	2	115080.43	4	96202.64	4
IT10K-837-1	1038.47	90707.67	3	100255.58	3	88372.09	3
IT13K-1427-3	990.98	100824.56	4	121060.99	5	104183.57	5
IT13K-1288-1	1001.07	113808.25	5	79037.00	2	73549.87	1
IT13K-1144-11	974.77	120248.07	6	159868.41	7	117667.04	12
IT10K-832-2	964.05	134371.02	7	225598.56	12	111229.14	9
IT08K-150-27	924.17	137091.27	8	147479.26	6	115384.96	11
IT14K-1424-12	984.50	140444.91	9	217818.47	11	104255.23	6
IT10K-817-3	1005.76	148807.93	10	269421.38	13	109444.42	7
IT10K-863-11	911.79	149285.62	11	171143.13	8	189843.69	22
IT07K-243-1-10	900.46	152532.67	12	200046.66	9	163469.74	19
SAMPEA-17	931.19	153916.90	13	269822.10	14	111015.18	8
IT10K-817-7	957.40	162721.67	14	285658.43	17	113399.47	10
IT07K-291-69	851.66	176044.88	15	215584.73	10	155270.64	18
IAR-09-1030-6	885.52	212824.83	16	282214.62	16	119914.08	14
IT13K-1000-3	805.71	223618.86	17	338832.50	18	166373.33	20
IAR-09-1009-6	887.84	246928.63	18	274531.03	15	149569.37	17
IT07K-230-2-9	780.68	250686.09	19	362258.13	19	185471.76	21
IAR-09-1151-2-1	726.28	298620.94	20	364045.76	20	233434.62	24
IT10K-836-3	822.96	308904.57	21	606604.02	22	130242.85	15
IAR-09-11064-4	705.32	321275.87	22	574818.67	21	118783.86	13
IAR-011-151	833.81	451354.88	23	717015.52	24	132562.13	16
IAR-07-1032	661.77	453432.23	24	711696.92	23	224992.86	23

`Pi_a`: superiority index across all *environments; `Pi_f`: superiority index across* favorable *environments; `Pi_u`: superiority index across* unfavorable *environments. Smaller values of superiority index indicate high stability across environments.*

- Mega-environments where candidate outperforms standard:
  Based on the GGE model, the candidate variety IT13K-1308-5 was the winning variety in a mega-environment that covers three testing sites: Makurdi, Samaru1, and Ibadan (Figure 4). It outperformed all other lines, including the standard check, in this mega environment.

6. Economic and Risk Assessment

- Input Cost Comparison (e.g., fertilizer, pest control): *NA*
- Net Return ($/ha): *NA*
- Farmer Risk Exposure (e.g., risk of total crop failure, market rejection): *NA*
- Seed Multiplication / Commercialization Readiness: *Over 1000kg of breeder seeds have been produced for this variety, and the seed system is prepared to generate more foundation seeds for distribution.*

7. Adoption Potential

- Farmer Feedback Summary (include gender/region disaggregation if available):
- Market Demand Alignment:
- Policy or Certification Status (e.g., DUS/NPT status, variety release process stage):
  IT13K-1308-5 has been released in Nigeria as SAMPEA 21 after passing all the release regulations and standards.

8. Decision Summary

- Replacement Recommendation: Replace
- Basis for Recommendation (bullet points, referencing key data above):
  - *New variety is high yielding ~ 2 t/ha*
  - *New variety is super resistant to Striga*
  - *It matures early (72-76 days)*
  - *It has an attractive seedcoat color and a medium seed* size acceptable to most farmers

9. Supporting Visuals

- GGE biplots for performance and stability

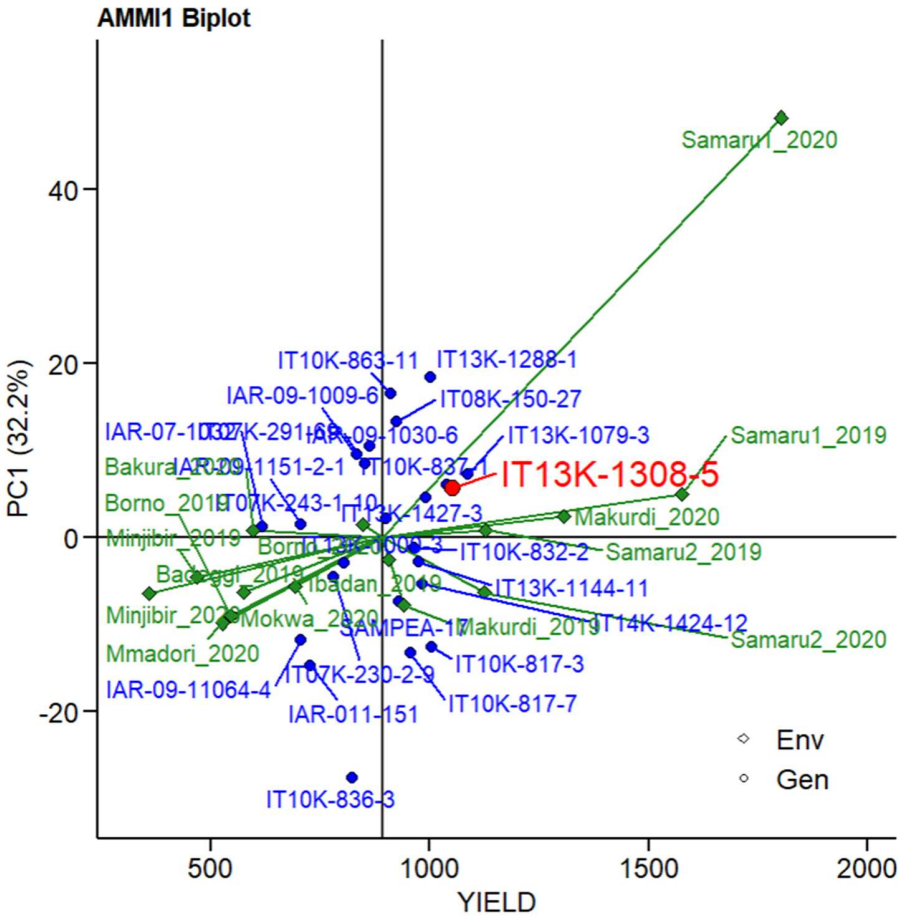

Figure 1. AMMI1 Biplot depicting genotype mean performance (x-axis) against IPCA1 (y-axis); genotypes near the x-axis are most stable across environments

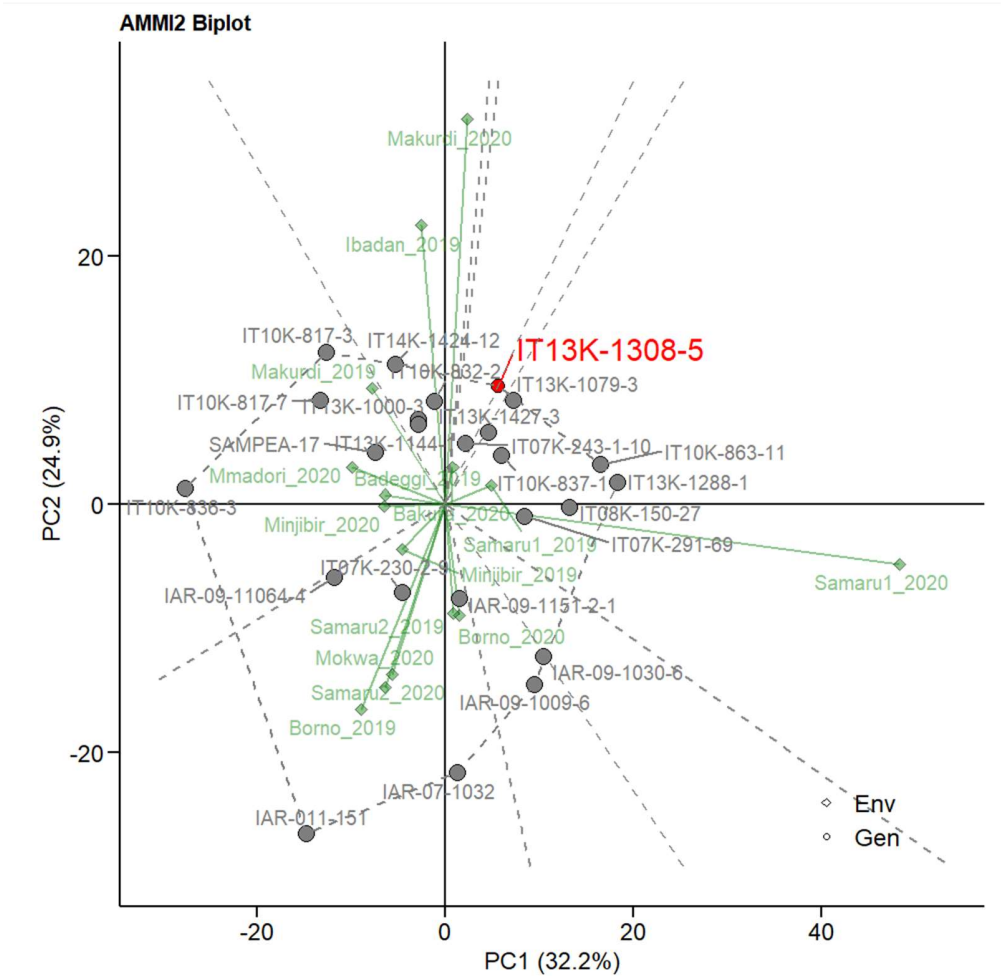

Figure 2. AMMI2 Biplot Displays interaction patterns (PC1 vs PC2) and aids in identifying genotypes with specific adaptability to certain environments (Makurdi_2020, Bakura_2020, Badeggi_2019)

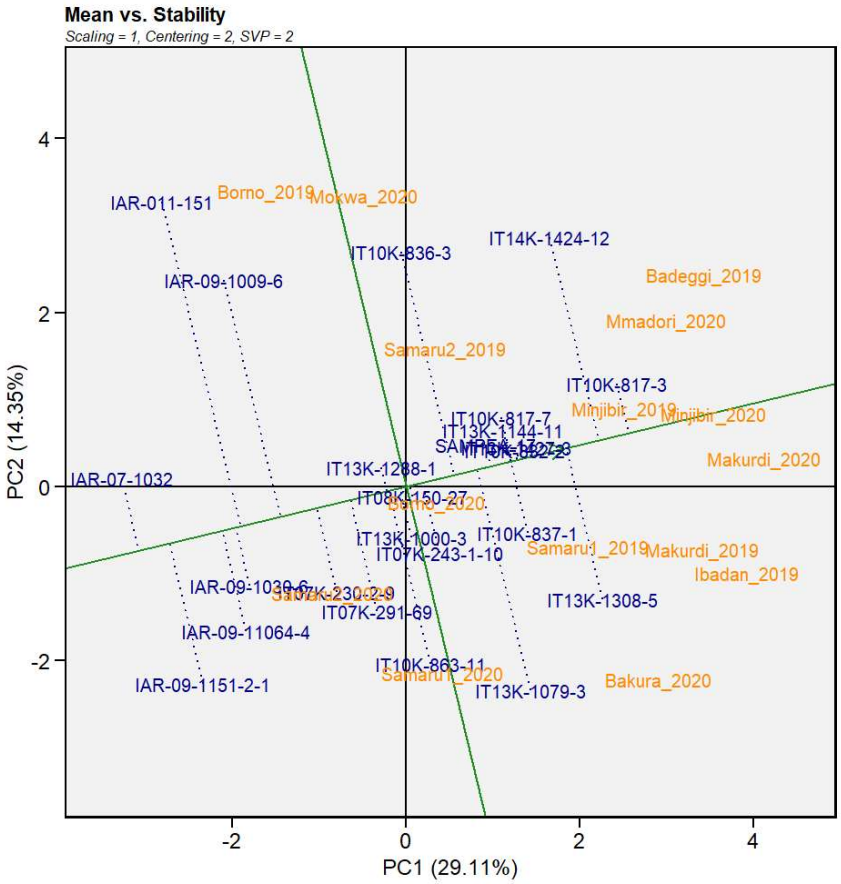

Figure 3: Stability analysis for the candidate line tested along with other lines, including the standard check

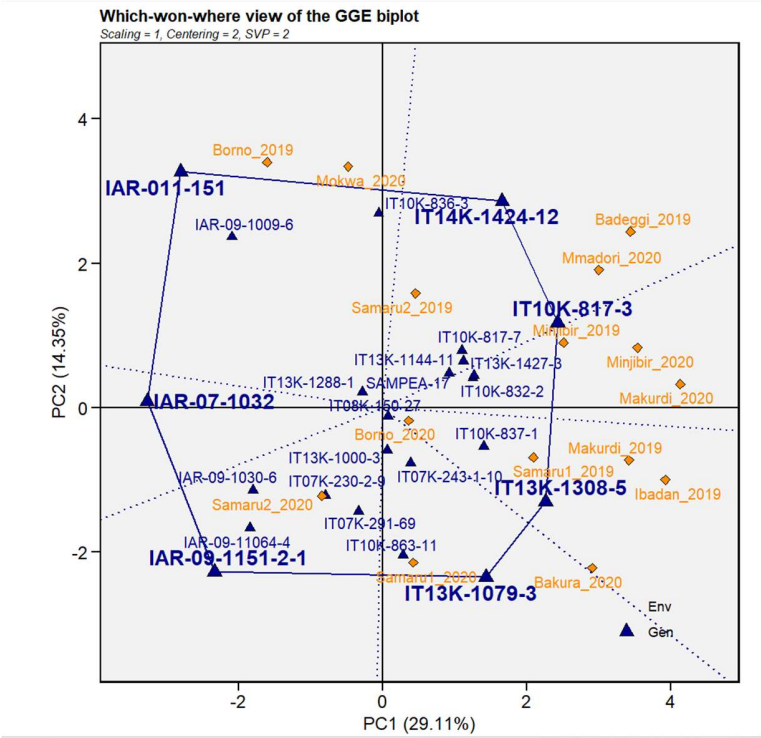

Figure 4. The which-won-where view of the GGE Biplot

- Boxplots or bar charts comparing key traits

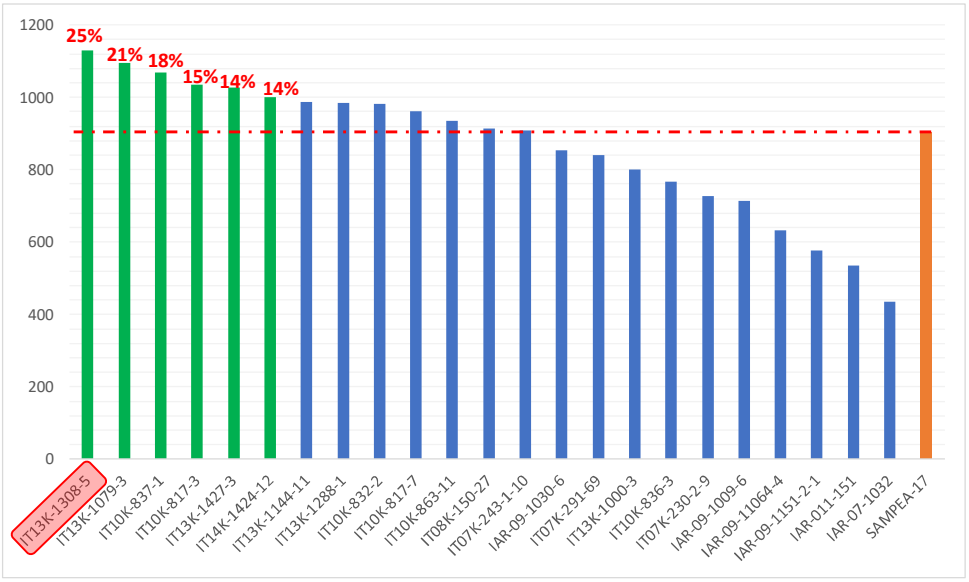

Figure 5. Yield advantage of IT13K-1308-5 (SAMPEA 21) compared to other candidate lines and the standard check SAMPEA 17

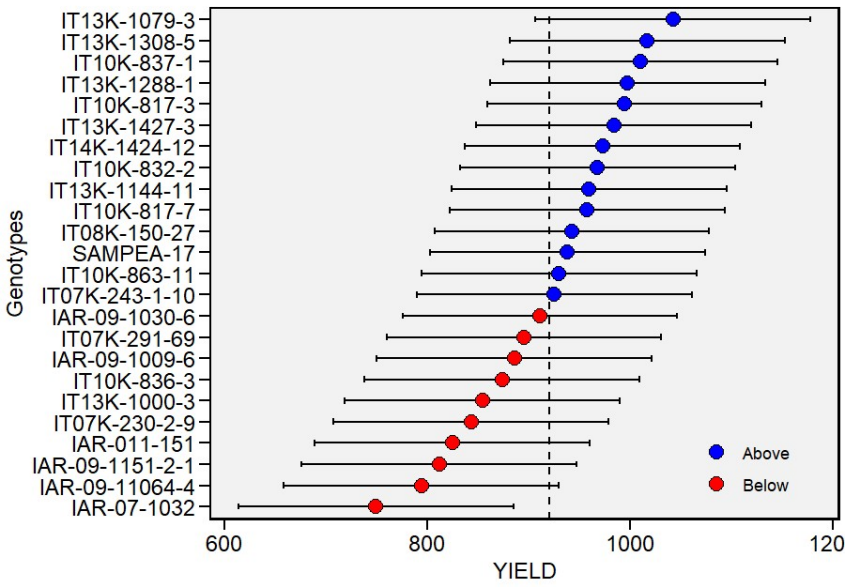

Figure 6. Summary performance of genotypes based on BLUP model

- Farmer preference table

Table 6: Preference ranking of cowpea lines by farmers in Yaryasa Community in Tudun Wada LGA of Kano State, Nigeria in 2021

S/N.	Criterion	Cowpea variety			
		SAMPEA 17	IT13K-1308-5	Farmers' variety	IT13K-1079-3
1	High grain yield	4	5	0	1
2	Early maturity	4	4	0	2
3	Big grain size	2	3	3	2
4	Drought tolerance	3	4	0	3
5	High fodder yield	2	3	4	1
6	Insect tolerance	3	4	0	3
7	Erect Type	4	3	0	3
8	Good cooking quality	3	3	1	3
9	Processing quality	3	3	1	3
10	Resistance to striga	3	4	0	3
	Total Scores	31 (31%)	36 (36%)	9 (9%)	24 (24%)
	Ranking	2nd	1st	4th	3rd

Note: These criteria were determined by twenty-five participating farmers

Performance Data Summary Table

Trait	Candidate Variety (IT13K-1308-5)	Standard Variety (SAMPEA 17)	% Gain/Loss	Significance (p-value)
Grain Yield (Kg/ha)	1128.7	903.7	25	0.112
Disease Resistance (Bacterial blight)	1.5	1.7	11	1.000
95% Maturity Duration (days)	72.4	73.7	2	0.419
Striga resistance	0.06	0.28	80	0.059
100 seed weight	18.3	17.3	6	0.0036
Farmer Preference Score (1–5)	1	2	50	-