

With support from the Soybean Innovation Lab (SIL), the International Institute of Tropical Agriculture (IITA), and the African Agricultural Technology Foundation (AATF), SeedCo and the Crop Breeding Institute (CBI) conducted the Pan-African Soybean Variety Trials at nine sites in Zimbabwe (Table 1; Figure 1): Agricultural Research Trust (ART Farm), Rattray Arnold Research Station (RARS), Stapleford Research Center, Banket, Mutare (Africa University), Harare Research Station, Kadoma Research Station, Chisumbanje Experiment Station, and Panmure Experiment Station .

The 2019/2020 trials in Zimbabwe tested 30 lines from four countries: Malawi, Nigeria, Zambia, and Zimbabwe. There were three replications at each location in field plots that were 4-rows wide by 5 m long, with 50-cm row spacing. The planting and harvest dates for each location are listed in Table 1.

The 30 entries in this group are from seven different seed sources: twelve lines from Seed Co (Zimbabwe), three lines from CBI (Zimbabwe), seven lines from IITA (Zambia), two lines from ZamSeed (Zambia), one line from K2 Seed (Zambia), one line from IITA (Nigeria), and four lines from DARS (Malawi).

Table 1: Site locations and respective planting and harvest dates, Zimbabwe 2019/2020

Site Name	SeedCo					Crop Breeding Institute			
	ART Farm	Rattray Arnold	Stapleford	Banket	Mutare	Harare	Kadoma	Chisumbanje	Panmure
Planting Date	Dec 18, 2019	Dec. 16, 2019	Dec. 17, 2019	Dec. 18, 2019	Dec. 17, 2019	Dec. 16. 2019	Jan. 10, 2019	Jan. 22, 2020	Jan. 8, 2019
Harvest Date	May 12, 2020	May 18, 2020	May. 18, 2020	Apr. 14, 2020	May. 12, 2020	May 26, 2020	Jun 3, 2020	May. 29, 2020	Jun. 5 2020
Site Latitude	17° 43' 12" S	17° 38' 60" S	17° 43' 48" S	17° 38' 24" S	18° 53' 24" S	17° 28' 48" S	18° 11' 24" S	20° 28' 12" S	17° 4' 12" S
Site Longitude	31° 4' 48" E	31° 14' 24" E	30° 52' 48" E	30° 23' 60" E	32° 36' 36" E	31° 1' 48" E	29° 31' 12" E	32° 8' 24" E	31° 6' 36" E
Site Altitude	1500 m	1341 m	1448 m	1260	1200 m	1504 m	1142 m	423 m	962 m

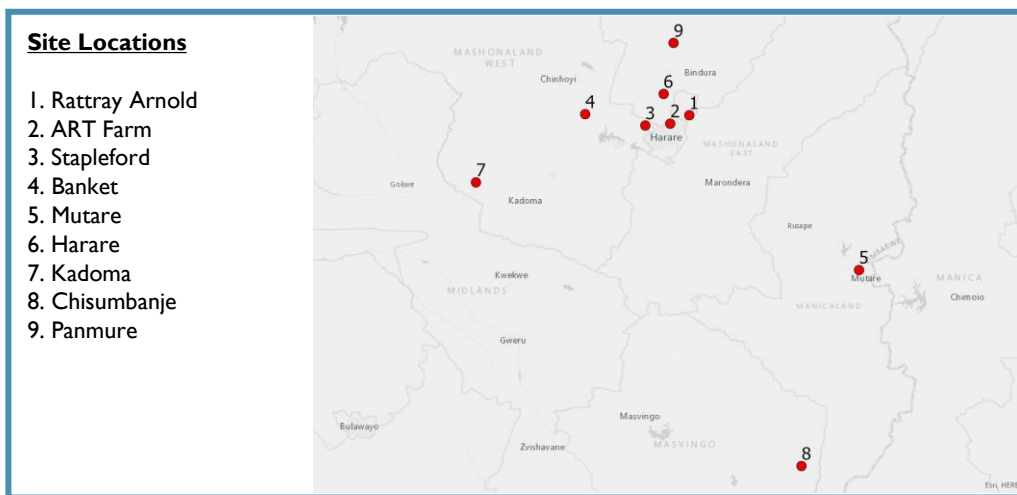


Figure 1: Trial sites in Zimbabwe, 2019/2020

All soils from Seed Co are slightly to moderately acidic, and thus would benefit from small additions of lime. Soils are severely P deficient at Rattray, deficient at Barket, and just on the border of adequate at ART and Stappleford (i.e., build applications may be useful). Barket soils are severely K deficient, and thus K applications are the most needed input at this site. In contrast, the other sites are well above adequate in K, and not even maintenance applications are needed in the near future. All sites have relatively high OM, though there is no absolute value for a minimum or maximum.

Soils from CBI are mildly acidic with exception of Chisumbanje, which is highly alkaline. Despite this high alkalinity, P appears adequate, though it should be noted that Mehlich-3 test will underestimate P in these high pH soils. All sites are adequate in P, being above the 25 mg/kg critical value, though two sites are close this value. Kadoma is severely excessive in available P and this represents an environmental (water quality) risk. All sites have relatively high OM, though there is no absolute value for a minimum or maximum.

Table 2: Late-season soil properties of 2019/2020 trial sites in Zimbabwe

Site Name	Units	SeedCo						Crop Breeding Institute (CBI)		
		ART Farm	Rattray Arnold	Stappleford	Barket	Mutare	Harare	Kadoma	Chisumbanje	Panmure
Soil pH		6.1	5.3	6.1	6.2	5.9	6.4	5.8	8.3	6.5
Phosphorous (P)	ppm	25	6	23	11	139	27	208	41	27
Potassium (K)	ppm	259	179	398	26	331	98	624	469	305
Organic matter	%	3.57	4.68	4.26	4.05	3.33	3.3	3.81	4.49	2.91

Table 3: Recommendations on soil nutrient concentrations of Mehlich III extraction, an appropriate soil test in soils with pH < 7 (Mehlich, 1984, Sawyer and Mallarino, 1999). Values are in part-per-million (mg kg⁻¹) on a soil basis.

Nutrient	Low	Adequate	High
P	<25	26-50	>51
K	<60	61-175	>175



Figure 2: Mutare (left) and Panmure (right) trial sites, Zimbabwe, 2019/2020

Environmental conditions (cumulative rainfall and average minimum and maximum temperatures throughout the growing season) are presented in Tables 4 and 5. Total rainfall throughout the growing season ranged from 382 mm (Ratray Arnold Research Station) to 565 mm (Kadoma Research Station). Minimum temperatures were lower at the Seed Co trial sites, which were based in the Mashonaland Central and East Provinces, as well as eastern Mashonaland West Province. Temperatures were higher at the Crop Breeding Institute Research Station sites compared to the Seed Co Research Station sites.

Table 4: Total monthly rainfall (mm) for the trial sites in Zimbabwe, 2019/2020

Location	SeedCo					Crop Breeding Institute			
	ART Farm	Ratray Arnold	Stapleford	Banquet	Mutare	Harare	Kadoma	Chisumbanje	Panmure
Nov.	95	82	98	93	176	53	126	111	76
Dec.	63	30	67	34	61	31	47	32	67
Jan.	134	157	116	187	88	128	180	125	172
Feb.	101	90	105	130	157	132	169	126	168
Mar.	29	20	26	38	19	31	24	16	12
Apr.	11	2	13	61	51	21	19	6	4
May	0	0	0	0	0	0	0	1	0

Table 5: Average minimum and maximum temperatures (°C) for the trial sites in Zimbabwe, 2019/2020

Location	SeedCo										Crop Breeding Institute							
	ART Farm		Ratray Arnold		Stapleford		Banquet		Mutare		Harare		Kadoma		Chisumbanje		Panmure	
	Min (°C)	Max (°C)	Min (°C)	Max (°C)	Min (°C)	Max (°C)	Min (°C)	Max (°C)	Min (°C)	Max (°C)	Min (°C)	Max (°C)	Min (°C)	Max (°C)	Min (°C)	Max (°C)	Min (°C)	Max (°C)
Nov.	18.6	30.4	18.2	30	18.6	30.4	19.2	31	29.7	18.6	20.1	31.7	21	32.9	21.8	32.6	19.7	31.9
Dec.	18.4	29	17.9	28.7	18.4	29.1	18.9	29.7	28.6	18.6	19.8	30.3	20.8	31.7	21.7	31.4	19.7	30.5
Jan.	18.2	27.2	17.7	26.8	18.2	27.3	18.8	27.8	27.2	18.8	19.5	28.4	20.9	30	22.7	30.9	19.1	28.4
Feb.	17.5	26.6	17.1	26.4	17.5	26.6	17.9	27	27.2	18.5	18.9	27.7	19.8	28.6	21.9	29.9	18.5	27.9
Mar.	16.2	27.2	15.8	26.9	16.2	27.2	16.7	27.6	27	16.9	17.7	28.4	18.6	29.1	20.4	29.8	18.5	28.8
Apr.	15.1	27.3	14.8	26.9	15	27.3	15.4	27.9	26.5	16	16.6	28.6	16.8	29.6	19.1	29.2	17	29
May	10.8	24.5	10.5	24.2	10.7	24.5	11	25.1	24	12.1	12.3	25.8	12.2	26.8	15.3	26.9	13.1	26.2

Data were collected for seed yield, days to flowering, plant maturity, plant height, lodging, shattering, and seed size. Units and measurement methods for each trait are shown in Table 6.

Table 6: Methods and units for traits measured in the 2019/2020 soybean variety test

Trait	Units	Measurement Method
Seed Yield	tons/hectare	Plants harvested and threshed, seed winnowed and weighed at 13% moisture
Days to Flowering	days	Days until 50% of the plants in a plot have at least 1 open flower
Days to Maturity	days	Days until 85% of the pods have turned their maturity color
Plant Height	centimeters	Distance from soil surface to the top node on the main stem at maturity
Lodging Score	1 – 5 score	Visually estimated; 1 = plants fully erect and 5 = plants prostrate
Shattering Score	1 – 5 score	Visually estimated; plots rated 2 weeks after maturity; 1 = no shattering and 5 = 100% shattered.
100 Seed Weight	grams/100 seeds	100 seeds are randomly selected and weighed

Table 7 gives average grain yield across locations and at each location, days to flowering, days to maturity, plant lodging score, shattering score, plant height, and 100-seed weight across all locations. The highest yields were reported at Seed Co sites (RARS, ART Farms, Stapleford, Banket, and Mutare). Low yields were reported at CBI sites (Kadoma, Panmure, Chisumbanje, and Harare Research Stations). All sites were affected by a dry spell during the season, however the trials received supplementary irrigation with exception of Kadoma, resulting in very low yields at that location. Management practices may have played a role in differing yields among trial sites. Seed Co applied pesticides on its site locations while no pesticides were used at the CBI sites. Therefore, pest or disease incidence may have further contributed to lower yields at some sites.

The top six yielding lines across locations were **MHEMBWE (2.9 tons/ha)**, **SC SIESTA (2.8 tons/ha)**, **BIMHA (2.8 tons/ha)**, **SI 195-6-105 (2.7 tons/ha)**, **MWENEZI (2.7 tons/ha)**, and **SI 079-6-7 (2.7 tons/ha)**. Among these lines, only SI 195-6-105 and SI 079-6-7 are not commercially available in Zimbabwe. Across all locations, days to flowering ranged from 46 (Mhofu) to 57 (Kaleya) days after planting, while days to maturity ranged from 110 days (Tikolore) to 125 days (Kaleya). Plant lodging scores ranged from 1.1 to 2.5: MWENEZI, TGX 2002-14DM, TGX 2014-5GM, SI 146-5-25, and LUKANGA had the lowest lodging score. Shattering scores ranged from 1.0 to 2.4, with the lowest seed shattering scores recorded for MHEMBWE. Plant height ranged from 60 cm (SC SIESTA) to 100 cm (SC SIGNAL). Seed size ranged from 13.3 g/100 seeds (TGx 1987-62F and TGx 1991-22F) to 23.5 g/100 seeds (Bimha). These trial results can help growers make decisions on which varieties to grow during the production season and which varieties show promise for eventual registration and release.

SI 195-6-105 and **SI 079-6-7** significantly outperformed SC Saga and SC Squire that are commercial varieties in Zimbabwe. Therefore, these two soybean lines from Seed Co have potential to be registered in the country.

Table 7: Average grain yield, days to maturity, plant lodging score, shattering score, plant height, and 100-seed weight across locations and grain yield at each site in Zimbabwe, 2019/2020

Entry	Source	Across † locations	tons/ha									Days to Flowering ‡	Days to Maturity ‡	Seed Weight	Plant Height §	Lodging ¶	Shattering ¶
			RARS	ART Farm	Stapleford	Banket	Mutare	Harare	Kadoma	Chisumbanje	Panmure						
MHEMBWE	CBI (Zimbabwe)	2.9	4.2	3.2	3.6	4.2	3.9	1.6	0.3	1.0	1.1	47	113	17.0	64.3	1.5	1.0
SC SIESTA	SeedCo (Zimbabwe)	2.8	4.6	4.6	3.1	3.3	3.2	1.0	0.3	1.2	1.8	49	119	22.2	60.0	1.3	1.2
BIMHA	CBI (Zimbabwe)	2.8	4.1	4.1	3.1	4.0	3.6	1.0	0.2	1.2	1.4	49	115	23.5	66.2	1.3	1.1
S1195-6-105	SeedCo (Zimbabwe)	2.7	4.0	3.7	2.8	3.6	3.5	1.2	0.2	1.1	1.6	52	119	16.0	77.7	1.2	1.0
MWENEZI	Klein Karoo (Zambia)	2.7	3.6	4.0	3.0	3.7	3.2	1.5	0.2	1.2	1.3	53	119	18.5	70.6	1.1	1.2
S1079-6-7	SeedCo (Zimbabwe)	2.7	4.4	3.8	2.8	2.9	3.0	1.2	0.2	1.3	1.8	53	121	19.6	84.1	2.1	1.1
MHOFU	CBI (Zimbabwe)	2.6	3.9	3.7	2.9	3.9	3.3	1.1	0.3	1.1	1.2	46	114	21.3	66.9	1.3	1.5
SC SPIKE	SeedCo (Zimbabwe)	2.6	3.9	3.6	3.0	3.8	2.5	1.1	0.2	1.4	1.8	50	120	19.1	99.3	1.4	1.2
SC STATUS	SeedCo (Zimbabwe)	2.6	3.5	3.6	2.9	3.5	3.2	1.3	0.2	1.0	1.6	51	117	14.4	69.8	1.3	1.1
TGX 2002-14DM	IITA (Zambia)	2.6	3.8	3.9	2.5	3.0	2.7	1.5	0.3	1.3	1.7	48	117	22.0	63.4	1.1	1.1
TGX 2001-3FM	IITA (Zambia)	2.6	4.3	3.3	2.7	3.4	2.8	1.2	0.2	1.3	1.5	48	114	20.7	90.9	1.4	1.1
TGX 2002-9FM	IITA (Zambia)	2.5	4.1	3.8	2.6	2.8	3.2	1.5	0.2	0.8	1.5	50	119	23.0	79.9	1.3	1.0
S1150-5-22	SeedCo (Zimbabwe)	2.5	3.8	4.3	2.8	3.0	3.5	0.8	0.3	0.7	1.3	52	119	19.0	65.8	1.3	2.4
TGx 2014-5GM	IITA (Zambia)	2.4	4.2	3.6	2.9	2.7	3.1	1.1	0.3	0.6	1.3	48	116	21.7	69.0	1.1	1.5
S1180-5-54	SeedCo (Zimbabwe)	2.4	3.5	3.7	2.5	2.2	3.0	1.6	0.2	1.2	1.6	52	123	17.1	65.9	1.3	1.3
SC SIGNAL	SeedCo (Zimbabwe)	2.4	3.6	2.5	2.4	3.0	3.5	1.3	0.1	0.9	2.0	52	124	17.1	100.0	1.9	1.1
S1146-5-25	SeedCo (Zimbabwe)	2.4	2.9	3.5	2.4	3.0	3.3	0.9	0.2	1.2	1.9	56	122	18.4	87.2	1.1	1.0
SC SAGA	SeedCo (Zimbabwe)	2.3	2.9	3.3	3.0	3.2	3.0	0.8	0.2	0.7	1.6	48	114	19.2	83.2	1.8	2.4
SC SQUIRE	SeedCo (Zimbabwe)	2.3	3.2	3.4	2.4	3.2	2.7	1.2	0.1	1.3	0.9	50	117	20.6	90.1	1.8	1.2
S1187-5-25	SeedCo (Zimbabwe)	2.3	3.4	2.2	3.1	3.0	2.7	0.8	0.3	1.2	1.5	52	118	15.5	74.2	1.7	1.2
TIKOLORE	DARS (Malawi)	2.2	2.3	3.1	2.2	3.2	3.2	1.0	0.2	1.1	1.7	49	110	13.6	78.4	2.4	1.9
TGX 2014-16FM	IITA (Zambia)	2.2	3.2	2.5	2.4	3.3	2.3	1.4	0.2	0.8	1.6	49	118	16.8	89.3	2.4	1.2
TGx 1987-62F	IITA (Nigeria)	2.2	2.6	3.1	2.3	3.4	2.4	0.7	0.3	1.0	1.9	51	112	13.3	82.8	2.5	2.0
TGx 1991-22F	DARS (Malawi)	2.1	2.1	3.1	2.4	3.5	2.3	0.9	0.2	1.1	1.3	49	111	13.3	79.5	2.3	1.7
LUKANGA	ZamSeed (Zambia)	2.1	3.8	3.3	2.3	1.9	2.4	0.5	0.2	0.9	1.4	51	119	19.2	66.3	1.1	1.6
TGx 2014-43FM	IITA (Zambia)	2.0	3.2	2.1	2.1	3.0	2.6	0.7	0.2	1.1	1.5	54	112	13.8	82.8	2.1	1.2
TGX 2002-3FM	IITA (Zambia)	2.0	3.0	3.1	1.4	2.6	2.8	1.1	0.1	0.9	1.1	50	121	21.8	70.7	1.2	1.0
NASOKO	DARS (Malawi)	2.0	2.9	2.2	2.2	3.0	2.2	0.7	0.2	1.2	1.5	51	121	17.2	88.6	2.1	2.0
MAKWACHA	DARS (Malawi)	1.9	2.7	2.8	2.0	2.7	2.0	0.9	0.2	1.1	1.1	51	122	17.1	84.1	1.7	1.4
KALEYA	ZamSeed (Zambia)	1.8	3.2	2.2	1.6	2.2	1.6	0.9	0.1	1.2	1.5	57	125	14.2	79.0	2.3	1.0
Mean		2.4	3.5	3.3	2.6	3.1	2.9	1.1	0.2	1.1	1.5	51	118	18.2	77.7	1.6	1.4
LSD		0.4	1.0	0.8	0.7	0.9	0.7	0.6	0.2	0.6	0.4	3	4	1.2	7.6	0.7	0.5
CV (%)		4.5	16.9	15.2	15.7	16.3	15.4	33.4	43.0	30.0	16.4	6.8	6.5	5.4	14.3	8.8	4.5
Genotype significance		**	**	**	**	**	**	**	ns	ns	**	**	**	**	**	**	**
G x E significance		**	-	-	-	-	-	-	-	-	-	**	**	**	**	**	ns

NT - Not tested

*, ** There is significant differences between sources of variation at 5% and 1% level of probability; ns: not significant

† Data from 8 locations (Kadoma not included)

‡ Data from 8 locations (Mutare not included)

§ Data from 7 locations (Mutare and Banket not included)

¶ Data from 6 locations (Mutare, Banket, and Kadoma not included)

§ Data from Harare, Chisumbanje, and Panmure

For further information on where to obtain seed of available registered varieties, or for companies and organizations interested in registering varieties, please contact the variety supplier below:

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For further information on the 2019/2020 trials in Zimbabwe with Seed Co and CBI, contact the trial operators below:

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