With support from the Soybean Innovation Lab (SIL), the International Institute of Tropical Agriculture (IITA), and the African Agricultural Technology Foundation (AATF), the Crop Breeding Institute (CBI) conducted the Pan-African Soybean Variety Trials at two sites in Zimbabwe (Table 1, Figure 1): Chisumbanje and Shamva (Panmure).

The 2019 winter trials tested 29 soybean lines; all the lines originated from Africa. Thirteen lines were from Zimbabwe (CBI, SeedCo), four from Malwawi (DARS), two from Ethiopia (EIAR), one from Nigeria (IITA), seven from Zambia (IITA, MRI/Syrgenta, ZamSeed), one from Uganda (Makerere University), and one from South Africa (Sensako).

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.

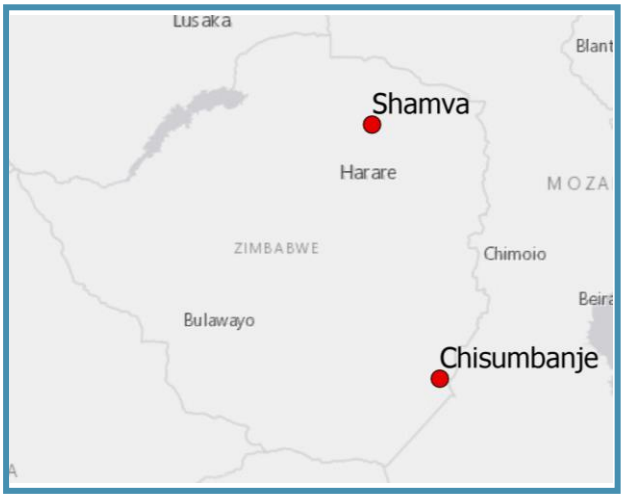


*Figure 1: Trial Locations, Winter 2019*

*Table 1: Site locations and respective planting and harvest dates, winter 2019*

| **Partners** | **Crop Breeding Institute** | |
|---|---|---|
| Country | **Zimbabwe** | |
| Location | Chisumbanje | Shamva (Panmure) |
| Planting Date | Aug 8, 2019 | Jul 30, 2019 |
| Harvest Date | Feb 3, 2020 | Jan 20, 2020 |
| Site Latitude | 21° 3' 11.0016" S | 17° 4' 9.0012" S |
| Site Longitude | 17° 4' 9.0012" E | 31° 6' 38.88" E |
| Site Altitude | 423 m | 962 m |

*Table 2: Total monthly rainfall (mm) and average minimum and maximum temperatures (°C) for the trial sites in Zimbabwe, Winter 2019.*

| Partners | Crop Breeding Institute | | | | | | |
|---|---|---|---|---|---|---|---|
| Site | Chisumbanje | | | Shamva (Panmure) | | | |
| | Rainfall (mm) | Min (°C) | Max (°C) | Rainfall (mm) | Irrigation (mm) | Min (°C) | Max (°C) |
| July | 0 | 12.6 | 26.3 | 0 | 0 | 9.6 | 25.3 |
| August | 0 | 16.1 | 30.0 | 0 | 159 | 13.0 | 27.3 |
| September | 10.4 | 16.4 | 28.5 | 1.2 | 169.6 | 14.7 | 28.9 |
| October | 20.9 | 20.0 | 31.7 | 25.2 | 137.6 | 19.1 | 33.0 |
| November | 111.3 | 21.8 | 32.6 | 76 | 84.8 | 20.4 | 31.9 |
| December | 32.5 | 21.6 | 31.4 | 67.3 | 0 | 20.1 | 30.5 |
| January | 124.9 | 22.7 | 30.9 | 172 | 0 | 19.7 | 28.4 |
| February | 126.3 | 21.9 | 29.9 | 167.8 | 0 | 19.2 | 27.9 |

Trials were irrigated during the growing season. The site at Chisumbanje was flood irrigated every three weeks. Overhead irrigation was used at Shamva (Table 2).

The soil at Chisumbanje is moderately alkaline and at Shamva the soil is slightly acid (Table 3). Therefore, the Shamva site would benefit from small additions of lime to increase pH. The target soil pH for ideal soybean production is 6.5. At Chisumbanje, the soil is deficient in P and the soil at Shamva is on the border of adequate. Therefore, both sites could benefit from fertilizer input. Both sites are well above adequate in K and not even maintenance applications are needed in the near future.

Chisumbanje has a good soil organic matter level, though there is no value for a minimum or maximum. Shamva however has a low level of organic matter. This may indicate a sandy soil texture.

*Table 3: Pre-planting soil properties of trial sites in Zimbabwe, Winter 2019*

| Test | Units | Chisumbanje | Shamva (Panmure) |
|---|---|---|---|
| Soil pH | | 7.8 | 6.1 |
| Phosphorus (P) | ppm | 14 | 25 |
| Potassium (K) | ppm | 339 | 236 |
| Organic Matter | % | 3.9 | 1.6 |

*Table 4: 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 |

Data were collected for seed yield, days to flowering, days to maturity, lodging, plant height and seed size (Table 5) and a statistical analysis was completed across environments and for each individual environment (Table 6).

*Table 5: Methods and units for traits measured in the Winter 2019 soybean trials*

| 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 |
| 100 Seed Weight | grams / 100 seeds | 100 seeds are randomly selected and weighed |

The top three yielding lines across locations were the local commercial variety Bimha, the variety Lukanga, and the experimental line S1187/5/37 (Table 6). The majority of the top performing lines originated from Zimbabwe as six of the top eight yielding lines were from Zimbabwe. Lukanga and S1187/5/37 significantly outperformed the other commercial variety Mhembwe.

The mean yield across the two sites ranged from 1.5 tons/ha (S1079/6/7) to 2.5 tons/ha (Bimha, Lukanga) with an average yield of 2.0 tons/ha. The greatest average yield across lines at an environment occurred at Shamva (mean of 2.2. tons/ha). Chisumbanje held a mean yield of (1.8 tons/ha), (Table 6).

Across environments, days to flowering ranged from 64 to 83 days after planting, while days to maturity ranged from 112 to 150 days after planting (Table 3). The earliest maturing line was SSS500 from Sensako (South Africa) and the latest maturing line was SC SENTINEL (Zimbabwe). Plant lodging ranged from 1.2 to 3.8 with an even score distribution across lines. Plant height ranged from 42.7 cm (Mhembwe) to 92.7 cm (S1140/5/4). Seed weight ranged from 13.5 g/100 seeds (TIKOLORE) to 22.2 g/100 seeds (TGX 2002-9FM, MAKSOY 5N) (Table 6).

Data from winter trials can hasten the process of identifying new high-yielding varieties, as well as provide valuable data on how the varieties perform in the shorter days and lower temperatures during winter. Planting a winter soybean crop can be of interest to farmers, allowing them to have a second growing season, and providing companies an opportunity to increase seed availability of new, high-yielding cultivars.

*Figure 2: Shamva (Panmure) Research Station, September 2019*

*Table 6: Average grain yield, days to flowering, days to maturity, plant height, plant lodging, and100-seed weight across locations and grain yield at each site in Zimbabwe, Winter 2019.*

| Entry | Source | Across Location | Chisumbanje | Shamva (Panmure) | Days to Flowering | Days to Maturity | Plant Height† | Seed Weight | Lodging |
|---|---|---|---|---|---|---|---|---|---|
| | | Grain Yield | | | | | | | |
| | | ton/ha | | | days | days | cm | g | 1 to 5 |
| **Bimha** | **CBI (Zimbabwe)** | 2.5 | 2.3 | 2.6 | 64 | 121 | 52.0 | 16.0 | 2.3 |
| Lukanga | ZamSeed (Zambia) | 2.5 | 2.3 | 2.7 | 64 | 133 | 59.0 | 17.2 | 2.0 |
| S1187/5/37 | SeedCo (Zimbabwe) | 2.3 | 2.0 | 2.6 | 69 | 127 | 59.3 | 19.0 | 2.2 |
| S1146/5/25 | SeedCo (Zimbabwe) | 2.1 | 2.1 | 2.2 | 77 | 133 | 59.3 | 19.0 | 1.8 |
| SC SIGNAL | SeedCo (Zimbabwe) | 2.1 | 1.8 | 2.5 | 67 | 140 | 74.7 | 18.5 | 2.0 |
| SC SAGA | SeedCo (Zimbabwe) | 2.1 | 2.2 | 2.1 | 64 | 132 | 70.3 | 19.8 | 2.2 |
| CLARK-63K | EIAR (Ethiopia) | 2.1 | 1.9 | 2.3 | 67 | 129 | 47.3 | 20.3 | 1.8 |
| SC SPIKE | SeedCo (Zimbabwe) | 2.1 | 2.0 | 2.2 | 66 | 141 | 75.3 | 19.5 | 1.8 |
| TGX 2002-9FM | IITA (Zambia) | 2.1 | 2.0 | 2.2 | 65 | 137 | 60.7 | 22.2 | 1.5 |
| SCS-1 | EIAR (Ethiopia) | 2.0 | 2.0 | 2.1 | 70 | 134 | 64.3 | 16.7 | 1.5 |
| TGX 2014-21FM | IITA (Zambia) | 2.0 | 1.7 | 2.2 | 67 | 138 | 59.7 | 17.8 | 1.8 |
| **Mhembwe** | **CBI (Zimbabwe)** | 2.0 | 1.7 | 2.3 | 65 | 123 | 42.7 | 17.7 | 2.2 |
| NASOKO | DARS (Malawi) | 2.0 | 1.7 | 2.2 | 68 | 128 | 74.7 | 19.0 | 2.5 |
| TGX 2001-24FM | IITA (Zambia) | 2.0 | 2.0 | 2.0 | 65 | 143 | 86.7 | 17.5 | 3.7 |
| Mhofu | CBI (Zimbabwe) | 1.9 | 1.7 | 2.2 | 64 | 120 | 53.3 | 15.0 | 1.3 |
| S1150/5/22 | SeedCo (Zimbabwe) | 1.9 | 2.2 | 1.6 | 65 | 128 | 56.0 | 18.5 | 1.3 |
| TGX 1987-62F | IITA (Nigeria) | 1.9 | 1.9 | 2.0 | 65 | 138 | 73.0 | 13.8 | 3.8 |
| S1140/5/4 | SeedCo (Zimbabwe) | 1.9 | 1.9 | 2.0 | 72 | 146 | 92.7 | 17.5 | 2.2 |
| SSS500 | Sensako (South Africa) | 1.9 | 1.3 | 2.4 | 64 | 112 | 47.7 | 20.7 | 1.2 |
| S1180/5/54 | SeedCo (Zimbabwe) | 1.9 | 1.3 | 2.4 | 70 | 130 | 51.7 | 21.0 | 1.8 |
| Makwacha | DARS (Malawi) | 1.9 | 1.6 | 2.1 | 68 | 134 | 61.7 | 18.5 | 2.7 |
| TGX 2002-35FM | IITA (Zambia) | 1.9 | 1.7 | 2.0 | 65 | 132 | 66.3 | 14.0 | 3.5 |
| MRI DINA | MRI/Syngenta (Zambia) | 1.8 | 1.6 | 2.1 | 83 | 142 | 59.7 | 18.7 | 2.2 |
| TIKOLORE | DARS (Malawi) | 1.8 | 2.0 | 1.7 | 65 | 131 | 81.3 | 13.5 | 2.8 |
| TGX 2014-16FM | IITA (Zambia) | 1.8 | 1.8 | 1.8 | 65 | 133 | 70.3 | 16.5 | 3.2 |
| SC SENTINEL | SeedCo (Zimbabwe) | 1.8 | 1.4 | 2.1 | 69 | 150 | 61.7 | 16.3 | 2.0 |
| MAKSOY 5N | Makerere U. (Uganda) | 1.7 | 1.6 | 1.9 | 65 | 122 | 53.3 | 22.2 | 1.8 |
| TGX 1991-22F | DARS (Malawi) | 1.7 | 1.4 | 2.0 | 64 | 127 | 65.3 | 15.0 | 3.0 |
| S1079/6/7 | SeedCo (Zimbabwe) | 1.5 | 0.7 | 2.3 | 67 | 144 | 74.3 | 15.7 | 3.5 |
| Mean | | 2.0 | 1.8 | 2.2 | 67 | 133 | 63.9 | 17.8 | 2.3 |
| LSD | | 0.3 | 0.5 | 0.4 | 3 | 11 | 11.0 | 1.1 | 0.8 |
| CV(%) | | 13.4 | 15.3 | 11.9 | 3.6 | 7.4 | 10.5 | 5.5 | 30.3 |
| Genotype significance | | ** | ** | ** | ** | ** | - | ** | ** |
| G x E significance | | ** | - | - | ** | ** | - | ** | ** |

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

† Data from one location (Chisumbanje)

For further information on where to obtain seed of available registered varieties or companies/organizations interested in registering varieties, please contact:

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