Annexure A – Yield determination protocol for high-yielding lines

Background:

During a special meeting of the Research Technical Committee for Wheat, held on 15 January 2016, a set of proposed amendments to the criteria currently set for release of bread wheat lines, was discussed.

During the discussion, the following points were noted, namely:

- The protein content of wheat is a critical quality factor as it would have an impact on all other quality characteristics;
- Breeders had different opinions as to which of the quality characteristics could hamper yield;
- It was necessary to investigate what the effect of relaxing the criteria would be on bringing about an increase in the yield;
- It would be necessary to look at biological standards for high yielding cultivars;
- Trials to identify high-yielding cultivars had to be planted and evaluated independently;
- The environment determined the level of "actual" yield in comparison with "potential" yield;
- Relaxing the quality criteria without an increase in yield would not address producers' needs; and
- The grading regulations for bread wheat only refer to "red" wheat cultivars.

There was consensus among all the role players present at the meeting that if the minimum and maximum values of the criteria used to release bread wheat lines are widened to accommodate higher-yielding cultivars, then the yield of such cultivars must be significant. The committee decided that all lines proposed as high-yielding cultivars must yield at least 5% more than current commercial bread wheat cultivars.

In order to quantify and standardize the yield determination of high-yield lines a decision was taken that the breeders of the then current (i.e. 2016) active breeding companies in South Africa (Sensako, Pannar and ARC Small Grain Institute) need to jointly develop a protocol for determining the yield levels of high-yielding lines.

This protocol was developed at a workshop held on the 11th of February 2016, after the National Cultivar Evaluation Programme (NCEP) meeting.

The protocol considers the following key elements:

- Annually, the top three high-yielding commercial cultivars are identified for each wheat-producing area based on data from the past three years.
- Yield data for higher-yielding lines must come from independent, replicated trials to ensure reliability. Only trials with a coefficient of variance (CV) of less than 10% for irrigation areas and 15% for dryland areas are considered.
- Furthermore, the yield performance of lines considered for release must be at least 5% higher than the average of the three predetermined commercial cultivars (quality standards). This requirement ensures that new cultivars offer a tangible improvement in yield.

A proposed protocol for yield determination regarding higher-yielding lines

In order to set a benchmark for newly identified higher-yielding lines, it is important to determine the top three (3) high-yielding commercial cultivars in each of the wheat producing areas in South Africa over the last three years. These top three (3) cultivars will be determined on an annual basis. Once acceptable higher-yielding lines have been identified, released and commercialised, the protocol needs to be reviewed again to determine if these cultivars will be then used as standards and what the significant percentage yield increase of new lines must be in order to be considered for release.

Yield data for higher-yielding lines must originate from replicated trials. A minimum Coefficient of Variance (CV) percentage must be used as a benchmark to determine if a trial can be included in the combined yield analysis. Only trials with a CV lower than 10% can be included for the irrigation areas. For the dry land areas, only trials with a CV lower than 15% can be used. The samples from the five (5) trial sites that are submitted to the SAGL for quality evaluation must be used in the statistical analysis to determine the yield level of the lines. The biological standard must also be part of the statistical analysis. The yield performance of the lines considered for release, must be 5% significantly higher than the average of the three (3) pre-determined commercial cultivars.

The statistical trial layout should preferably be a lattice design. When analysing the data, the Least Significant Difference level must be set at 95%.

Cultivars used as standards:

The cultivars used as standards, as listed in the table below, must be determined on an annual basis, after the National Cultivar Evaluation Program (NCEP) meeting held in February every year at the ARC-SG in Bethlehem.

The selection process being a collaborative effort involving inputs from various stakeholders in the National Cultivar Evaluation Workgroup. This group includes representatives from breeders of the cultivars and other renowned industry experts who bring valuable insights to the NCEP.

Following careful considerations of all the above-mentioned points, recommendations for 2025 were made based on statistical analysis of the four-year (2021-2024) data. This data reflects cultivars' performance (yield + stability) across multiple locations representing each production region.

The current (2025) standards to be used for each production area are summarized in the following table:

Production area	**Current Quality Standard**	**Yield Standard Cultivars for 2025**	**Changes from the 2024 cultivar list**
Winter Rainfall Area	SST0117	SST056, SST0127, SST0187, SST0166	*None*
Dryland Free State Area	Elands	PAN3111, Matlabas, PAN3161	*Kubetu added*
Irrigation areas	SST806*	SST884, SST8135, SST8154	*PAN3400 removed*

*Not included in the NCEP from 2021 - 2024

No changes are proposed to the 5% higher yield requirement on the performance of lines considered for release.