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ART Wheat Variety Performance Report W25

Season	**Winter 2025**
Crop	**Wheat**
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1 Introduction

Choosing the right crop variety is one of the most fundamental and important agronomic considerations in crop production. It can significantly impact characteristics including pest and disease resistance, drought tolerance, grain quality, and ultimately, yield. The choice of cultivar subsequently has a great effect on the bottom line of the producer. Seed houses and producers alike must therefore carefully consider a range of conditions in selecting the right cultivar for an environment. These include agro-ecological zone, soil type and pH, fertilisation capacity, pest and disease control capacity, harvest time requirements, irrigation capacity, and intended use. Selecting the right cultivar is a complex procedure. The use of scientific research is a highly important tool for producers and seed houses in order to make a reliable choice or recommendation.

The objective of this report is to compare the performance of commercially available grain crop cultivars in Winter and Summer seasons. It's intended use is to help farmers choose a suitable variety, and to help seed houses in making reliable recommendations to customers.

2 Site Management

10 Sites were planted during the Winter 2025 season. Sites comprised farms and research stations described at locations shown in Figure 2.1. Cultural practices at each site are described in table 2.1. The ratio of each cereal blend was variable, but differed only by a maximum of 2% for each nutrient. Top dressing was done by hand at various rates depending on farmer management. Trials were kept weed-free throughout using a combination of herbicide and hand weeding. Irrigation relied on the management of the host farm, and consequently the total amount and distribution varied greatly with farmer preference, soil hydrological characteristics, water supply, and most crucially electricity supply.

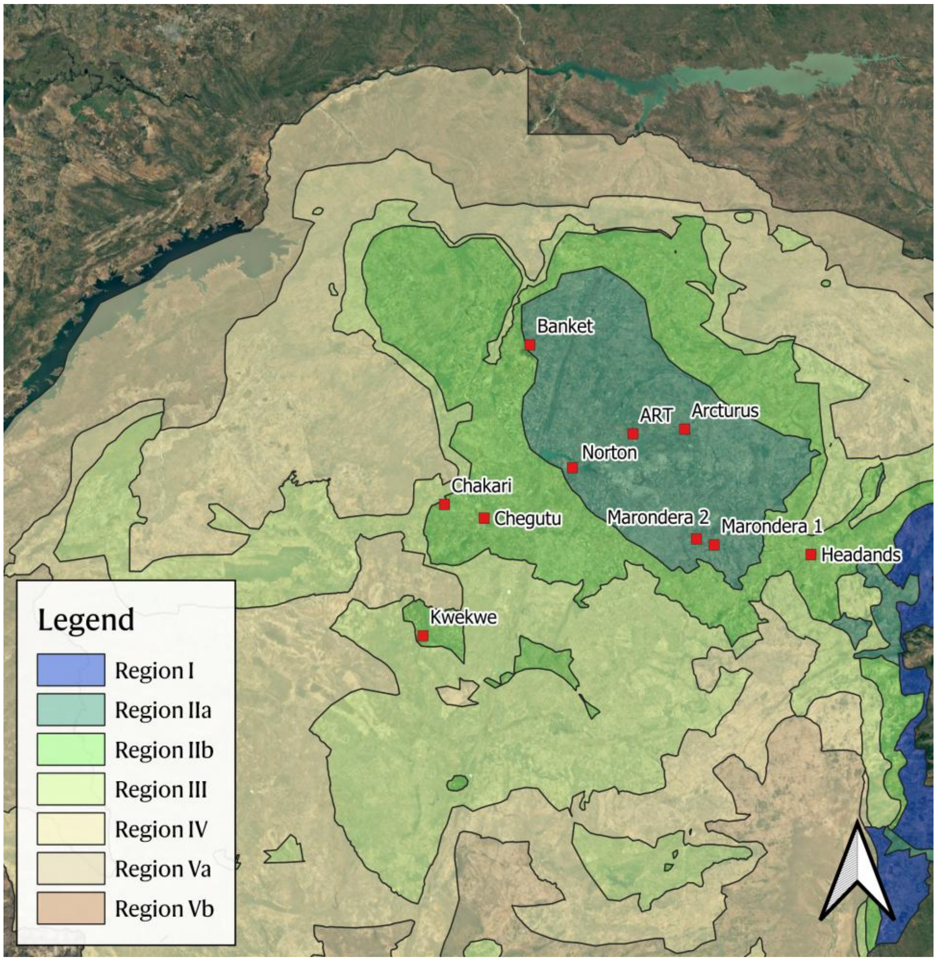

Figure 2.1: Map of all sites used in the trial and their position within the agro-ecological zones in Zimbabwe.

Table 2.1: List of Sites and General crop management

Site	Effective Planting Date	Total Irrigation (mm)	Basal Nitrogen (N) Kg/ha	Basal Phosphorus (P2O5) Kg/ha	Basal Potassium Kg/ha	Topdressing Nitrogen Kg/ha
ARCTURUS	09 - May	366	186	61	61	108
ART	15 - May	536	162	92	92	184
BANKET	10 - May	300	208	92	92	184
CHAKARI	14 - May	321	170	92	92	184
CHEGUTU	12 - May	492	162	92	92	184
HEADLANDS	25 - Apr	560	170	92	92	184
KWEKWE	19 - May	323	127	46	46	115
MARONDERA 1	30 - Apr	540	204	92	92	126
MARONDERA 2	02 - May	609	164	98	98	138
NORTON	29 - Apr	467	208	92	92	184

3 Results

Results of the variety trial are presented for released cultivars across all sites, and yield is presented by site. Site-specific results for all varieties and traits tested, including experimental varieties, can be downloaded in excel format from our website.

3.1 Plant Height

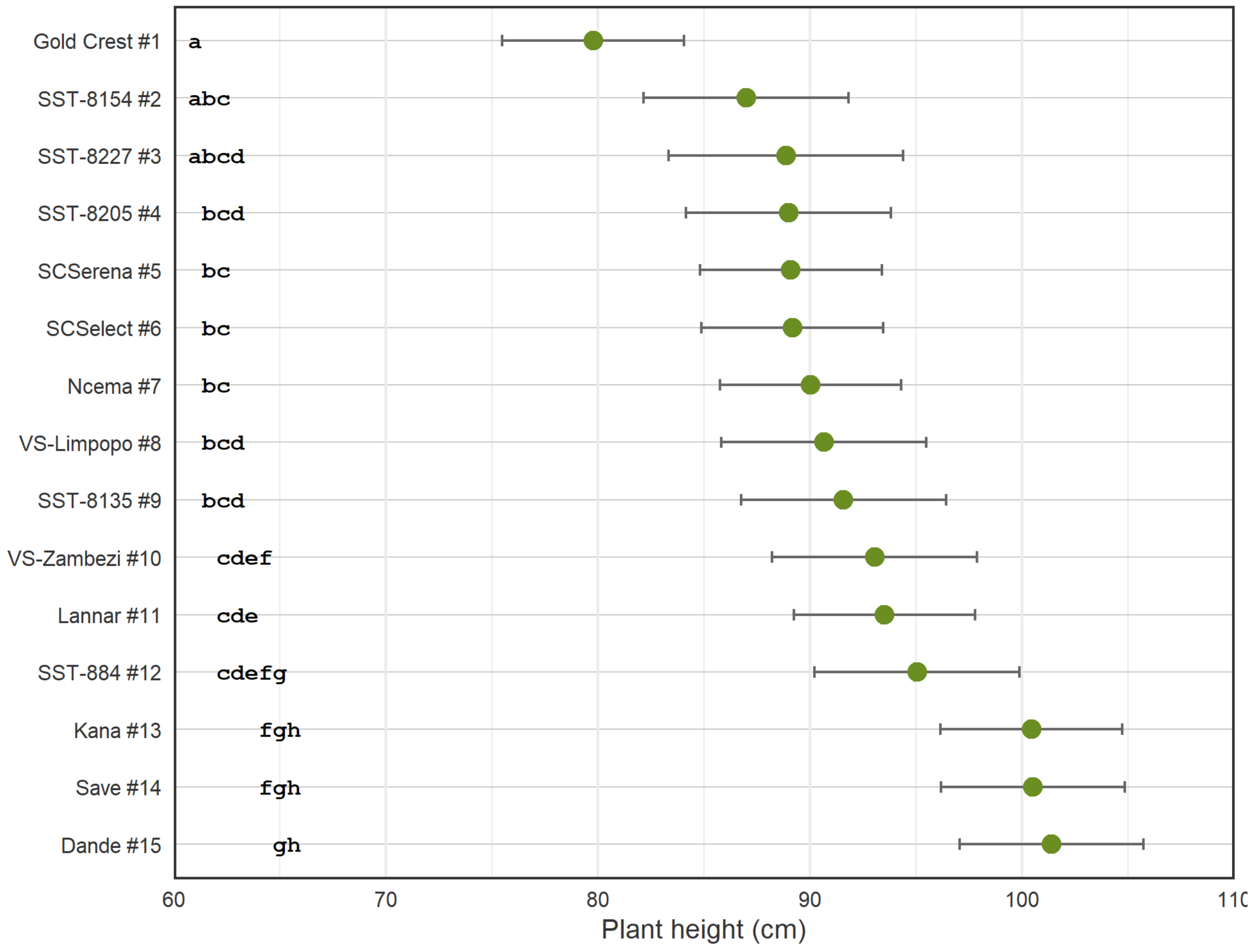

Figure 3.1: Average plant heights across sites.

3.2 Diseases

There are several diseases of wheat in Zimbabwe which are which can cause economically significant, and resistance to these diseases can be bred into crop varieties. Wheat Leaf Rust (*Puccinia triticina*), Wheat stem rust (*Puccinia graminis*), wheat yellow rust (*Puccinia striiformis f. sp. tritici*), and powdery mildew (*Blumeria graminis f. sp. tritici*) were assessed. Records were taken at sites ART, Norton, and Arcturus. Powdery Mildew and Leaf rust had no occurence in any varieties.

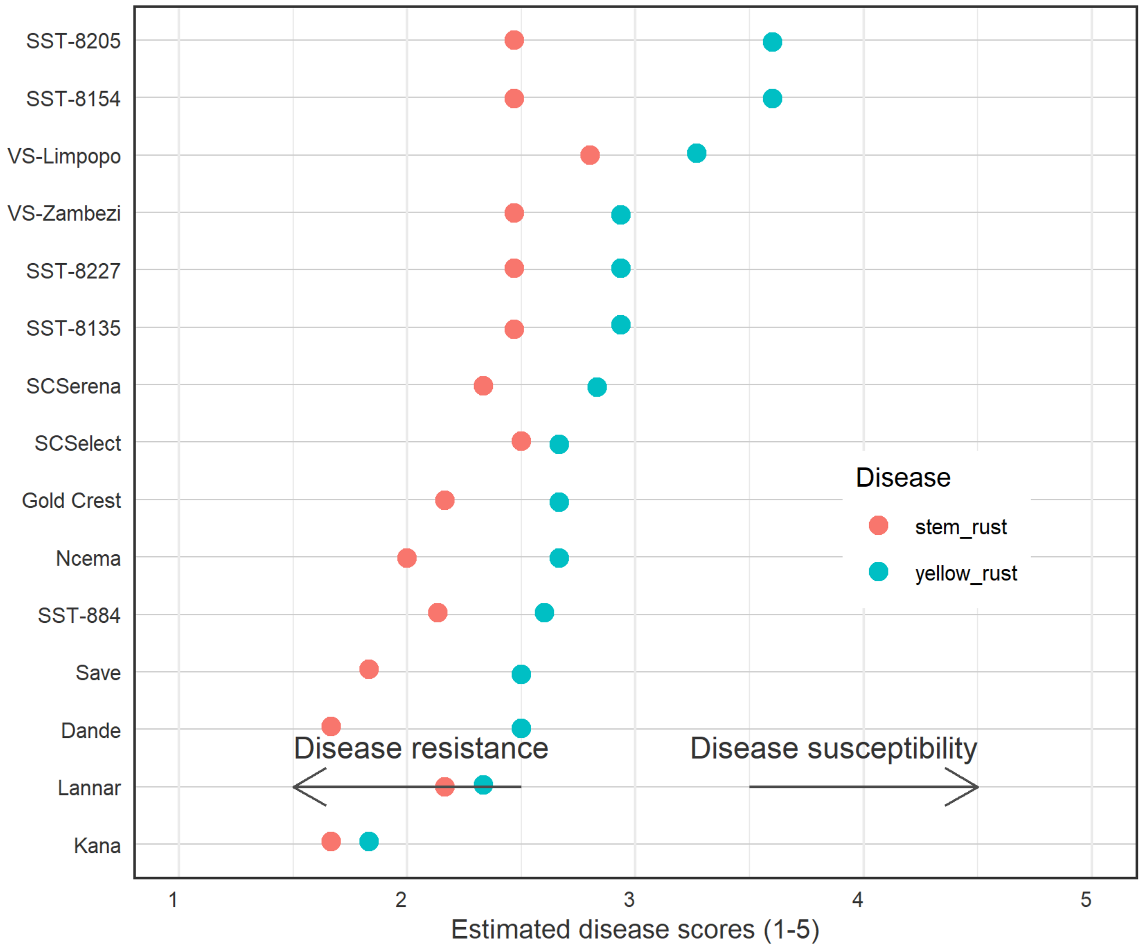

Figure 3.2: Estimated disease scores (1-5 scale; 1 = No symptoms observed, 5 = severe symptoms observed)

3.3 Days to maturity

Figure 3.3 displays a chart of the days to maturity of the varieties tested in this seasons trials. This trait can vary widely based on environmental conditions, so it is recommended to check the days to maturity for site with similar agro-ecological conditions. Days to maturity was measured at ART, Norton, and Arcturus.

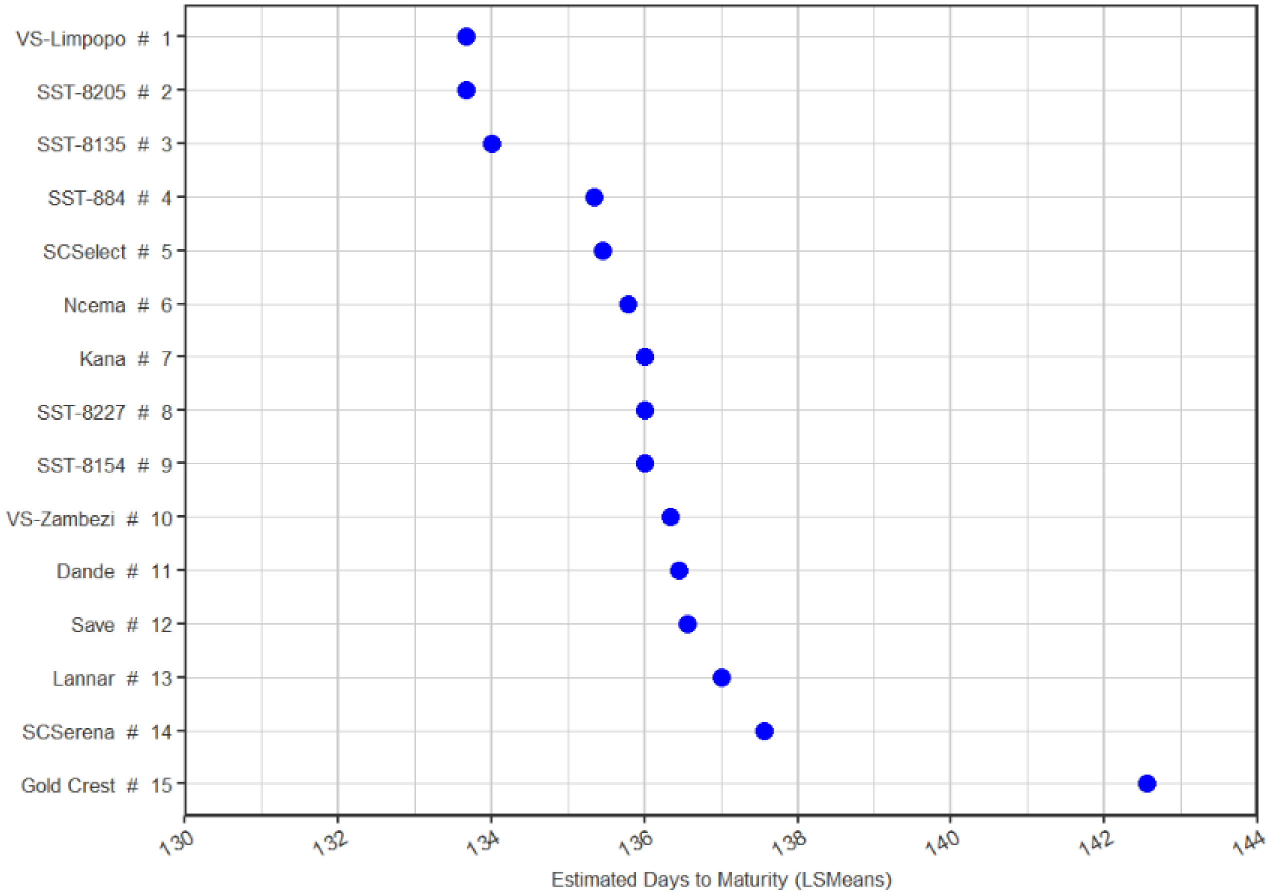

Figure 3.3: Days to maturity across ART, Norton, and Arcturus.

3.4 Lodging

Lodging is an important factor in determining yield and harvestable grain. A summary of lodging across all sites is displayed below.

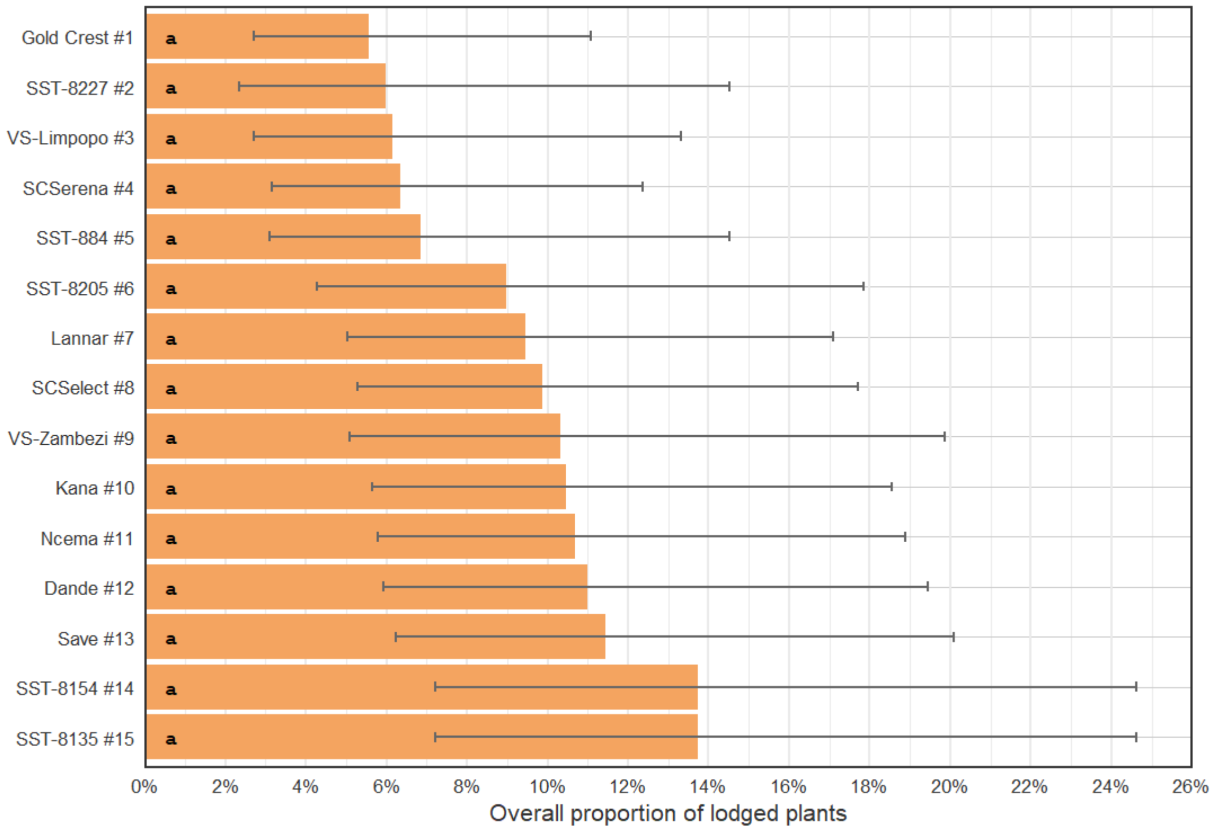

Figure 3.4: Lodging percentage. Letters above columns represent significance groups. If any of the letters are the same for cultivars, they are not significantly different.

3.5 Grain quality

1000 seed weight gives an indication of grain size. A high 1000 seed weight shows large grains, and vice versa. Figure 3.5 displays a summary of these figures across all sites. Test density is another indicator of grain quality (Figure 3.6. Higher test density indicates better milling quality.

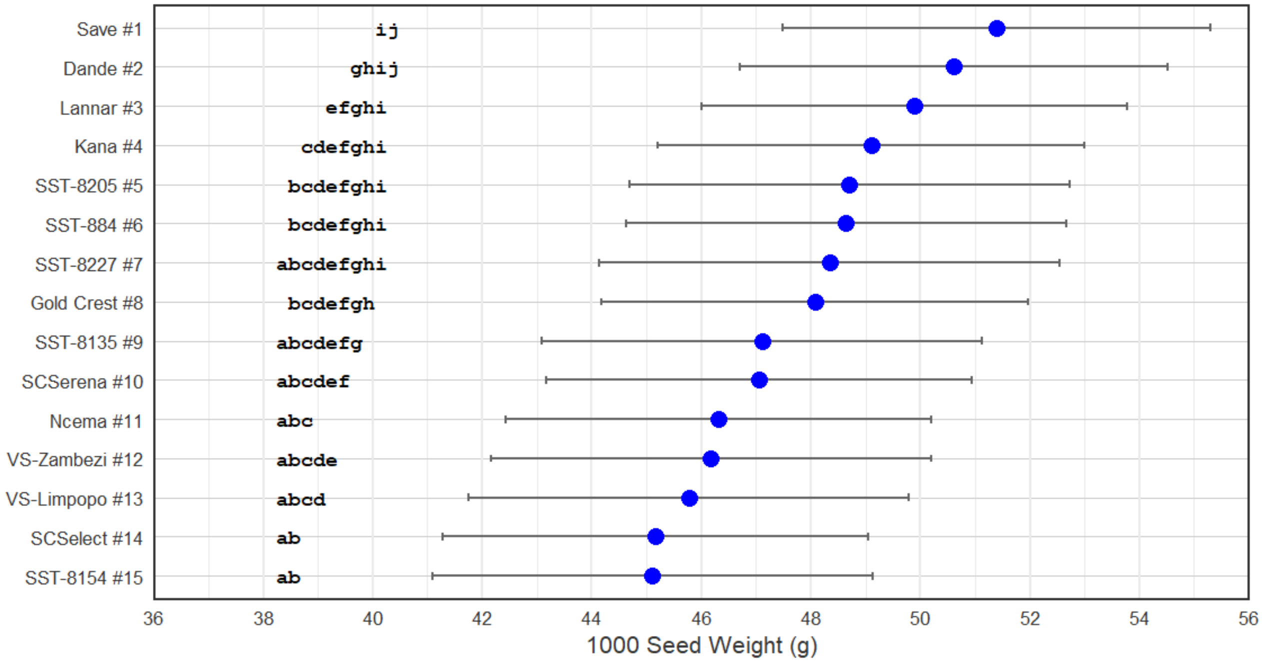

Figure 3.5: 1000 seed weight at each site. Letters above columns represent significance groups. If any of the letters are the same for cultivars, they are not significantly different.

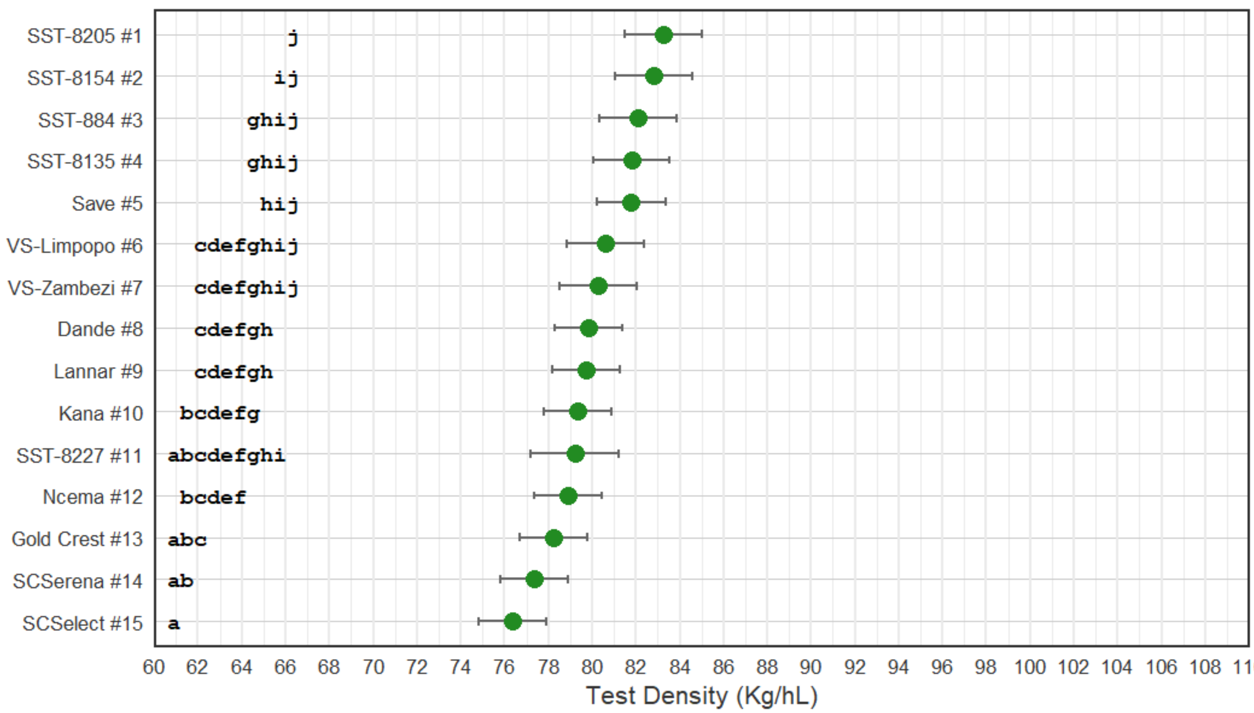

Figure 3.6: Test density at each site. Letters above columns represent significance groups. If any of the letters are the same for cultivars, they are not significantly different.

3.6 Yield

Yield is the most important agronomic trait crop can have, and variety significantly affects yield. Figure 3.7 shows the variety yields at each site. Figure 3.8 displays average yields per variety across all sites. Where varieties were missing from some sites (either due to non-entry or bird damage), the statistical model has corrected for this imbalance. It is important to note that the ART site was not protected against rust for disease assessment, and so varieties with poor tolerance are disproportionately affected.

Figure 3.7: Grain yield per site.

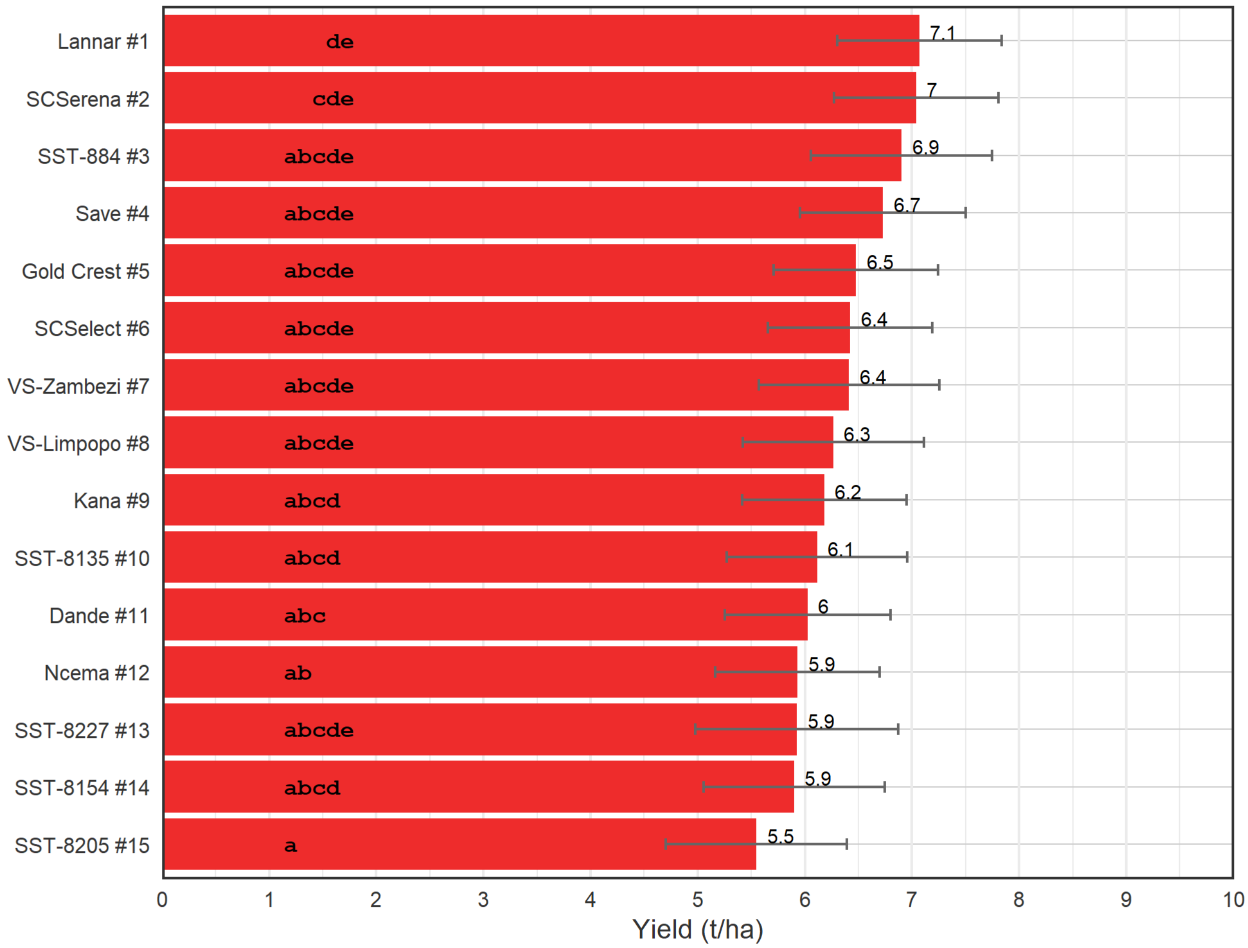

Figure 3.8: Model estimated mean of Grain yield across all sites.

Figure 3.9 shows the yield mean rank. This takes the yield rank for a variety, averaged (mean) across all sites. This is one of the best indicators of variety yield performance, because it is not biased towards varieties which yield well only at high-yielding sites. This can skew the average yield upwards but not reflect potentially poor performance compared to other varieties at lower potential sites.

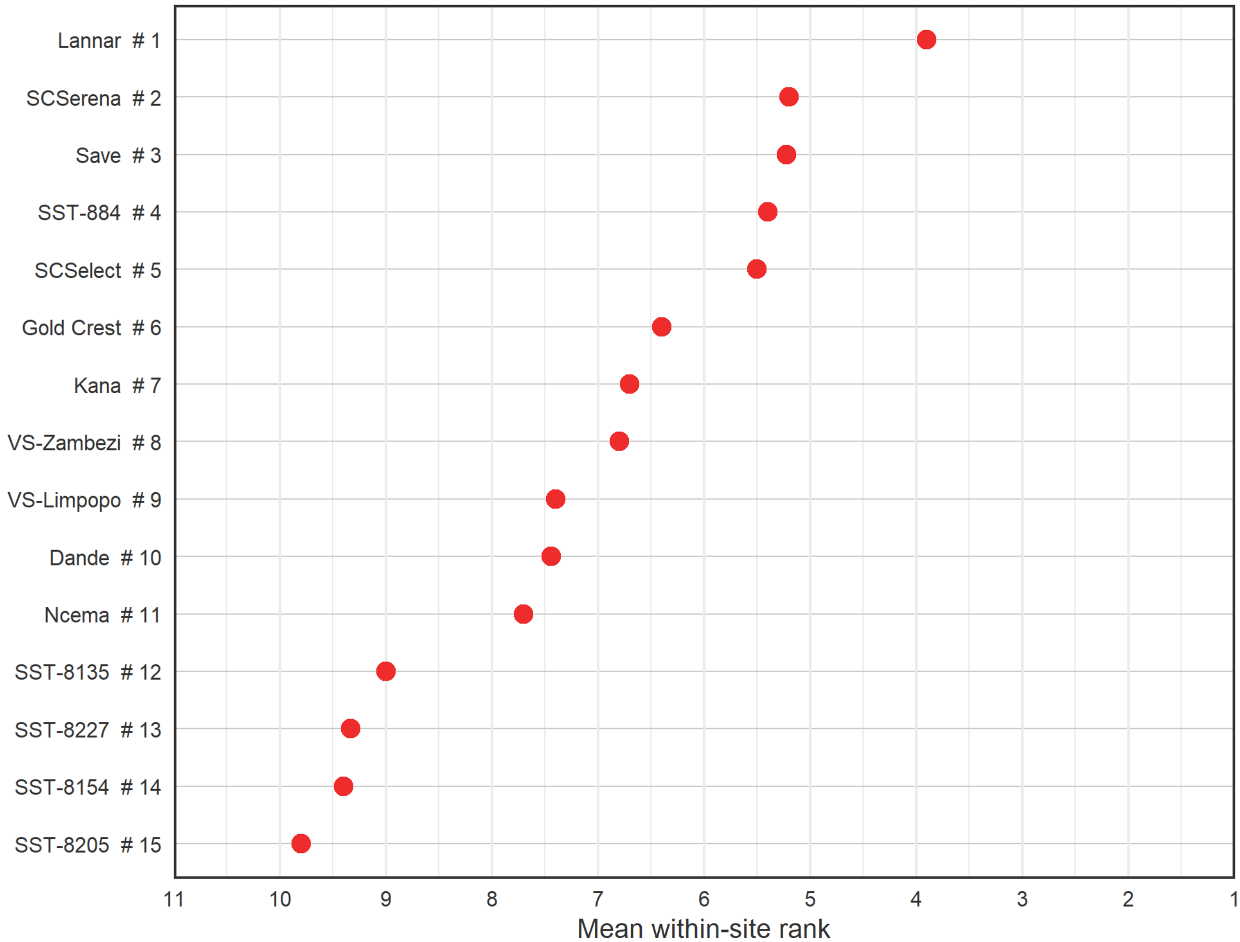

Figure 3.9: Average Grain yield rank across all sites.

Yield stability analysis tells us how consistently a variety performs across a range of environments. The most stable varieties have a flatter slope, meaning that they yield the most consistently across sites, despite mostly having lower yields overall. Figure 3.10 displays each variety individually.

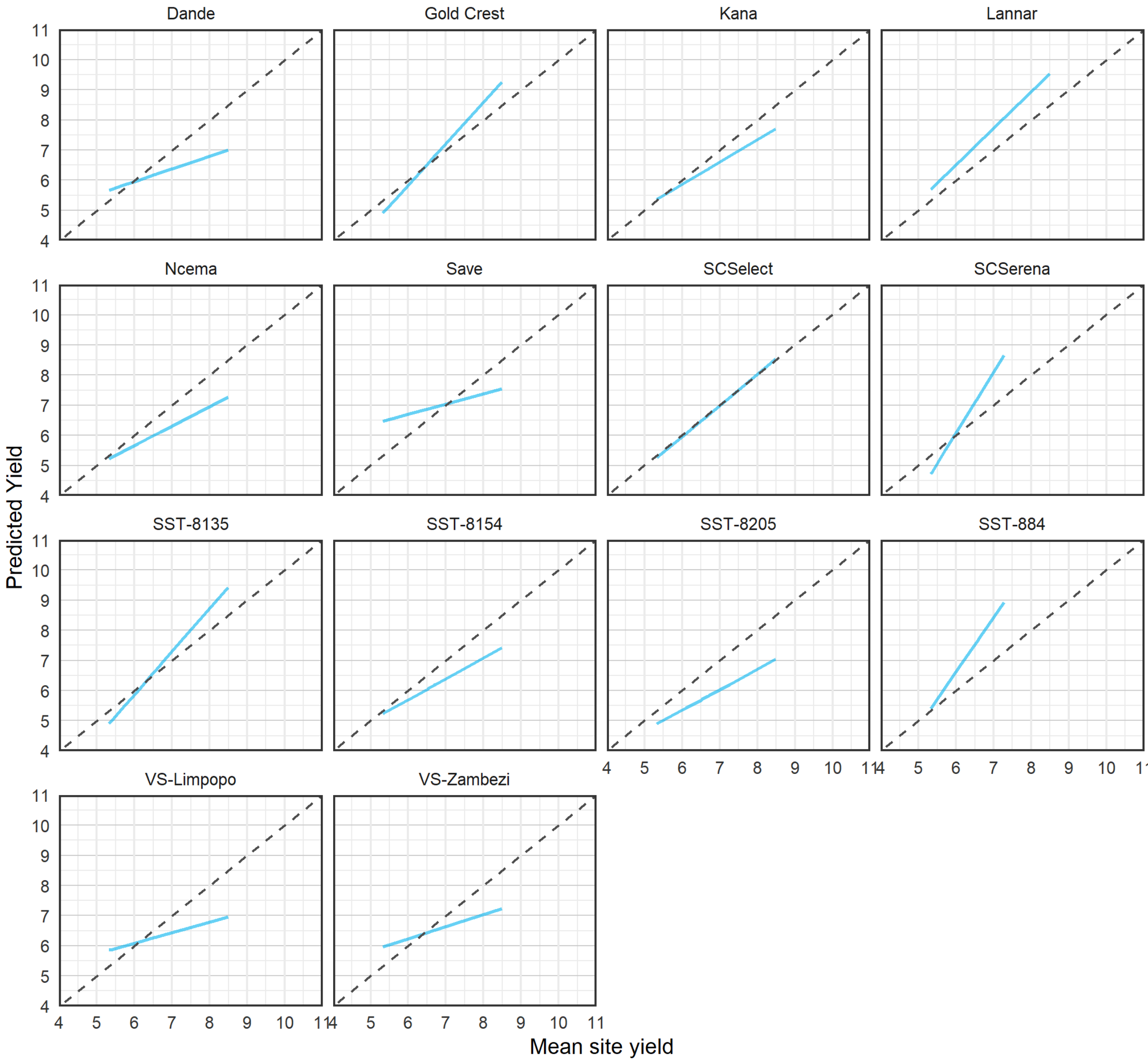

Figure 3.10: Genotype x Environment Stability analysis. Only the most and least stable released varieties shown. Black dashed line represents averahe performance at all sites. Only varietes represented at 8 or more sites were evaluated.

4 Conclusion

This trial was conducted to assess the performance of commercial and experimental wheat varieties. It included cultivars from multiple clients and check varieties. This report presents only released varieties in the experiment, with a comparison of released and experimental varieties, including site-specific analyses, available for free download online at www.artfarm.co.zw. The evaluation provided valuable insight into the agronomic potential of the tested lines under the conditions of the 2025 season. Various important traits were recorded and analyzed to support variety selection and future advancement decisions. The inclusion of both commercial benchmarks and experimental entries allowed for direct comparison of breeding progress and identification of promising new material. Results from this trial will inform variety recommendations, future breeding directions, and potential release considerations.

5 Acknowledgements

ART wishes to express their sincere gratitude to the farmers at each of the off-station sites where the trials were hosted. Furthermore, to each of the seed houses who provide the financial support to make this work possible, including Delta Beverages who were partners in Barley variety trials.

6 Methodology

6.1 Design

The trial had a complete-block randomised design with three replications. Treatments were randomised separately for each site. The gross plot was 10 rows wide at 0.2m row spacing, and 6m long, resulting in a gross plot area of 12m^2. Net plot was 6 rows wide and 5.5m long, a total of 6.6m^2 taken from the center of the gross plot. There was one Check cultivar, namely SC Select.

6.2 Data capture

Days to flowering, Days to maturity, and disease records were taken only at 3 sites, namely ART, Norton, and Arcturus. Days to flowering and days to maturity were captured using the ART Standard calendar for the Winter season (Annex 1), sites ART, RARS, and KRS. Powdery Mildew (*Blumeria graminis f. sp. tritici*), Leaf rust (*Puccinia triticina*), Stem Rust (*Puccinia graminis f. sp. tritici*), and Yellow Rust (Puccinia striiformis f. sp. tritici) scores were all assessed using a 1-5 scale of severity. All remaining variables were captured at all sites. Plant height was measured from the soil base to the ear ligule.

6.3 Data analysis

Randomisation, field plans, and data analysis was performed using the RStudio statistical analysis software.

Data were analyzed using mixed-effects models appropriate to the type and distribution of each trait. For continuous agronomic traits, linear mixed models were used to estimate variety effects while accounting for random variation due to replication and site differences. These models allowed the calculation of adjusted means for each variety at each site, followed by the assignment of rankings and comparison groupings using compact letter displays to indicate statistically distinct performance.

For traits measured on an ordinal or count scale—such as disease severity ratings—generalized linear mixed models with a negative binomial distribution and zero-inflation structure were applied. These models accounted for both overdispersion and the high frequency of zero scores observed in the data. 1-5 Disease scores were transformed to 0-4 scores for zero inflation correction.

All models included random effects to capture the hierarchical structure of the experimental design, including site and replication within site, as well as variety-by-environment interactions where appropriate. Diagnostic checks were performed to assess model assumptions, including residual distributions and variance estimates. For yield stability analysis, Finlay-Wilkinson regression was used.

For site-specific analysis, a linear model was applied to each site. Tukeys HSD test was used to determine significant differences.