Malting quality of South African sorghum cultivars.

Final Report 2015

DETAILS

Project number		M102/03 (100049)
Project title		Malting quality of South African sorghum cultivars
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Co-workers(s)	Internal	NC Phundulu, GD Moloto, MJ Sebidi, Dr AEJ du Toit
	External	Seed industry, SAGL
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Final abstract

Eight local malting sorghum cultivars (Avenger, Dominator, Enforcer, PAN 8906, PAN 8911, PAN 8923, PAN 8924 and PAN 8933) were tested for malt ability at six localities (Leeuwkraal, Weiveld, Platrand, Amersfort, Pederkop & Holmdene). In this study four important malt characteristics were evaluated to conclude on the malt potential of the cultivars included. Two checks for condensed- tannin malting sorghum (GH) ((PAN 8625 & NS 5511) and condensed-tannin free malting sorghum (GM) (PAN 8816 and NS 5655) were included respectively. From the results it is evident that from this preliminary study Avenger showed potential since the cultivar performed well in three of the four parameters tested. More attention must be given to dormancy and water sensitivity that may influence the germination energy performance of the cultivars tested. Therefor more testing on malt ability is needed as well as data on the agronomical performance of the cultivar before final conclusions can be made on whether this cultivar can positively contribute to the opaque beer industry of South Africa and Southern Africa.

INTRODUCTION

The project commenced in April 2014 as a result of the need to supply high malt quality local sorghum varieties to brewers. Currently the malt quality is low of the cultivars used that resulted in substantial losses to the sorghum brewing industry.

Sorghum quality evaluation on an annual basis is a quality control tool to ensure that new and existing cultivars comply with industry needs. Throughout Sub-Saharan Africa sorghum is largely used to produce opaque beers of which sorghum malt is a key ingredient as a source of hydrolytic enzymes, starch (the source of fermentable sugars), yeast nutrients, beer flavour and colouring substances (Taylor and Dewar, 2001).

An estimated 200 000 tonnes of sorghum are commercially malted annually in southern Africa and some 3 million hectolitre litres of sorghum beer are brewed each year (Taylor and Dewar, 2001). A small amount of the malt is used for production of the sorghum-malt breakfast cereal Maltabela. The agricultural departments and sorghum breeders develop sorghum cultivars for malting purposes and it is only through malt quality evaluation that good malt quality cultivars can be identified.

The primary criterion is their potential to produce malt with high Diastatic power (amylase activity). Other factors that define malt quality are free amino nitrogen content and grain cultivar type.

In South Africa sorghum cultivars are divided into three types *viz.* condensed, tannin-free, non-malting sorghum (GL), condensed tannin-free malting sorghum (GM) and condensed-tannin sorghum (GH) (Department of Agriculture, Forestry and Fisheries, 2008).

Therefore, there is a need to screen cultivars for good quality malt production for the local industry as well as for Sub Sahara Africa. Seasonal malting-quality evaluation is a key aspect of quality control in order to ensure and maintain the viability of existing and candidate sorghum cultivars from the national cultivar trials. The quality evaluation process is not only important to the local sorghum breeders and seed industries, but is also a determinant in the end-use and acceptability of cultivars by industry.

Information of the suitability of sorghum cultivars for malt and meal production ensures that products comply with the standards set by the different industries. The grading system for sorghum is based on the malt quality of sorghum cultivars. Identification of cultivars with good malting performance ensures that farmers make the correct cultivar choice and produce grain that complies with the set standards for sorghum processors, with the ultimate goal to satisfy the consumers.

To stay competitive against other cereal crops it is of the utmost importance that the cultivated cultivars have a high malt quality performance as well as a very good adaptability to local production environments

MATERIALS AND METHODS

Materials:

Twelve cultivars PAN 8816, NS 5655, PAN 8625, NS 5511, Avenger, Dominator, Enforcer, PAN 8906, PAN 8911, PAN 8923, PAN 8924, PAN 8933 were included in the 2014 trials of which to were check cultivars for condensed-tannin malting sorghum (PAN 8625 & NS 5655) and two checks for condensed-tannin free malting sorghum (PAN 8625 & NS 5511).

Methods:

Field trials:

Trials were planted at six localities (Leeuwkraal, Weiveld, Platrand, Amersfort, Pederkop & Holmdene) for evaluation in a randomised complete block design with 3 replicates.

Malt analysis:

Samples of each sorghum cultivar included in the 2014 trials germination energy were determined as follow:

a) Germination performance:

i. Germination was performed in the laboratory on 100 seeds for a 72h incubation period. Germination values were determined at 48h and 27h. The two values were added to get the final germination energy value as a percentage.

ii. Water absorption was determined by using the initial dry sample weight. Steeping the grain for 24h at 25°C. Weighting the steeped sample. Deduct the initial weight from the steeped weight and determined the % water uptake as a percentage of the initial weight.

b) Malting:

Grain samples were malted in the laboratory by steeping grain for 24h at 25°C and then malted for five days at 25°C.

i. Sorghum Diastatic power (DP) of the 5 day malt cycle was measured according to South African Bureau of Standards Method 235 (SABS 1970), using peptone extracts and expressed as Sorghum Diastatic Units (SDU/g).

c) Thousand kernel weight:

ii. The thousand kernel weigh (TKW) was determined by weighing 1000 sound grain kernels of a representative sample and kernel size by the number passing through 2.36 mm, 3.25 mm, 3.36 mm and 4.00 mm rounded grid sieves.

RESULTS

Four important parameters for successful malting of sorghum for opaque beer production were tested and presented in the following sixteen graphs. The data were subdivided and tested against the condensed-tannin sorghum characteristic of PAN 8625 and NS 5511 as well as the condensed- tannin free sorghum cultivars PAN 8816 and NS 5655.

Condensed-tannin sorghum (GH)

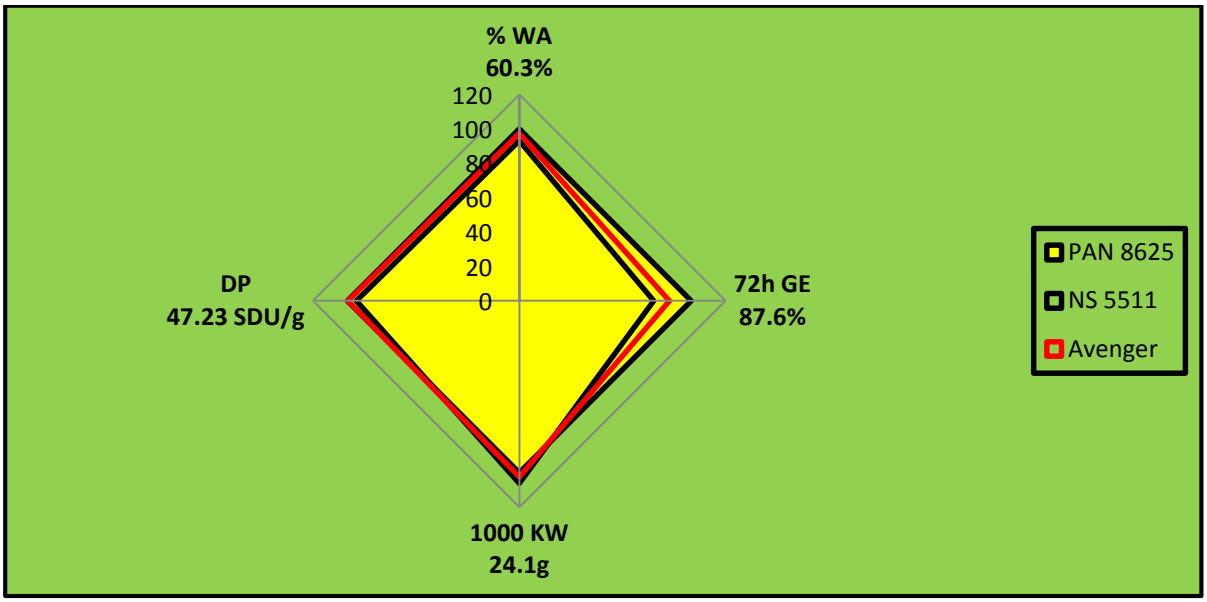

Figure 1 Comparison of the cultivar **Avenger** with the two condensed-tannin check cultivars **PAN 8625** and **NS 5511** for malting performance.

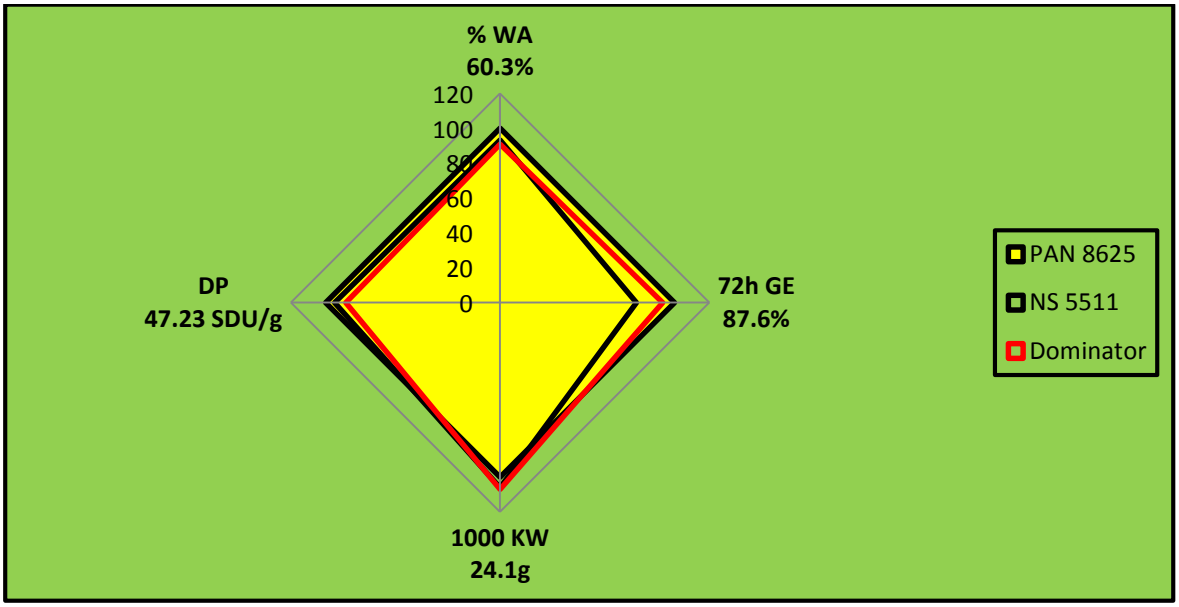

Figure 2 Comparison of the cultivar **Dominator** with the two condensed-tannin check cultivars **PAN 8625** and **NS551** for malting performance.

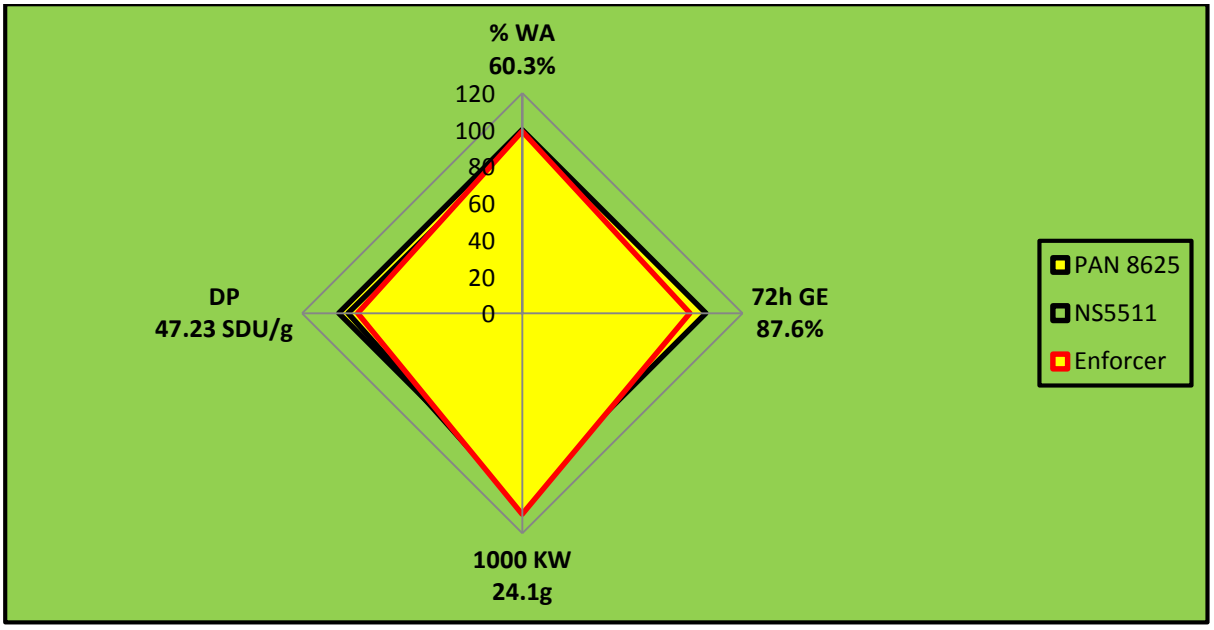

Figure 3 Comparison of the cultivar **Enforcer** with the two condensed-tannin check cultivars **PAN 8625** and **NS551** for malting performance.

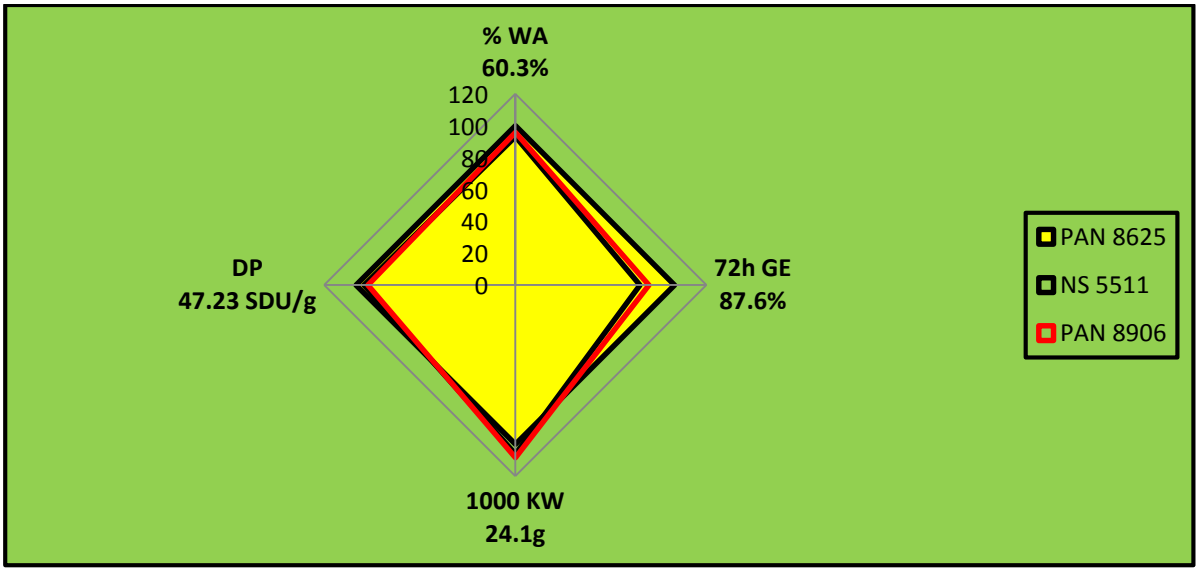

Figure 4 Comparison of the cultivar **PAN 8906** with the two condensed-tannin check cultivars **PAN 8625** and **NS 5511** for malting performance.

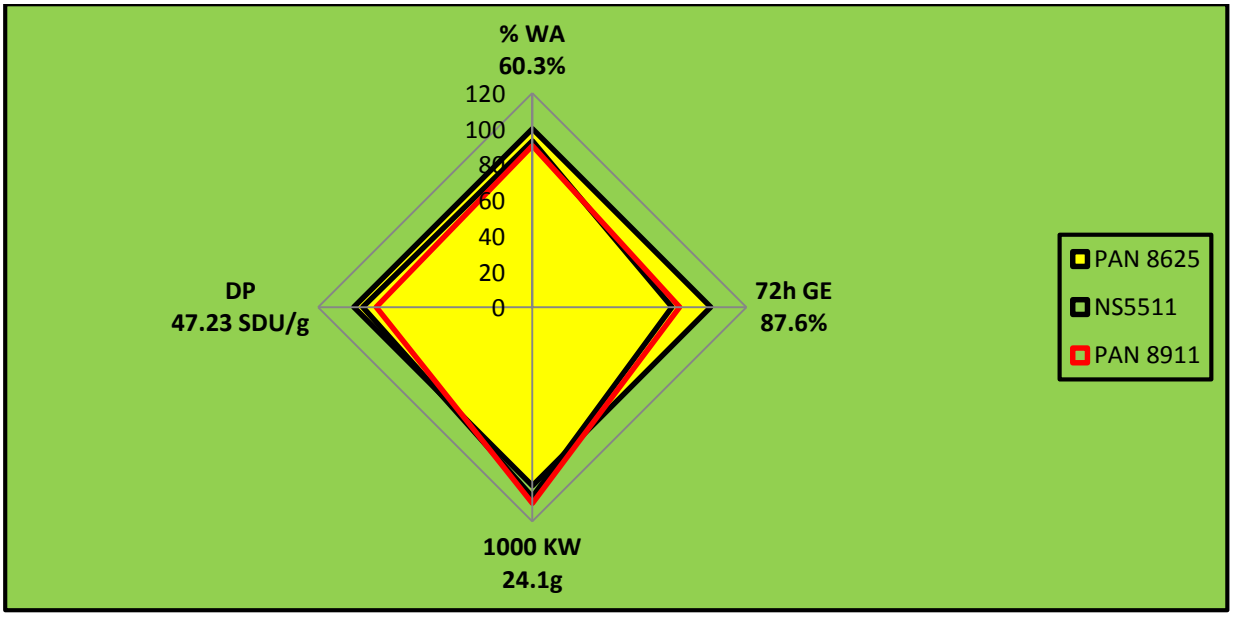

Figure 5 Comparison of the cultivar **PAN8911** with the two condensed-tannin check cultivars **PAN 8625** and **NS 5511** for malting performance.

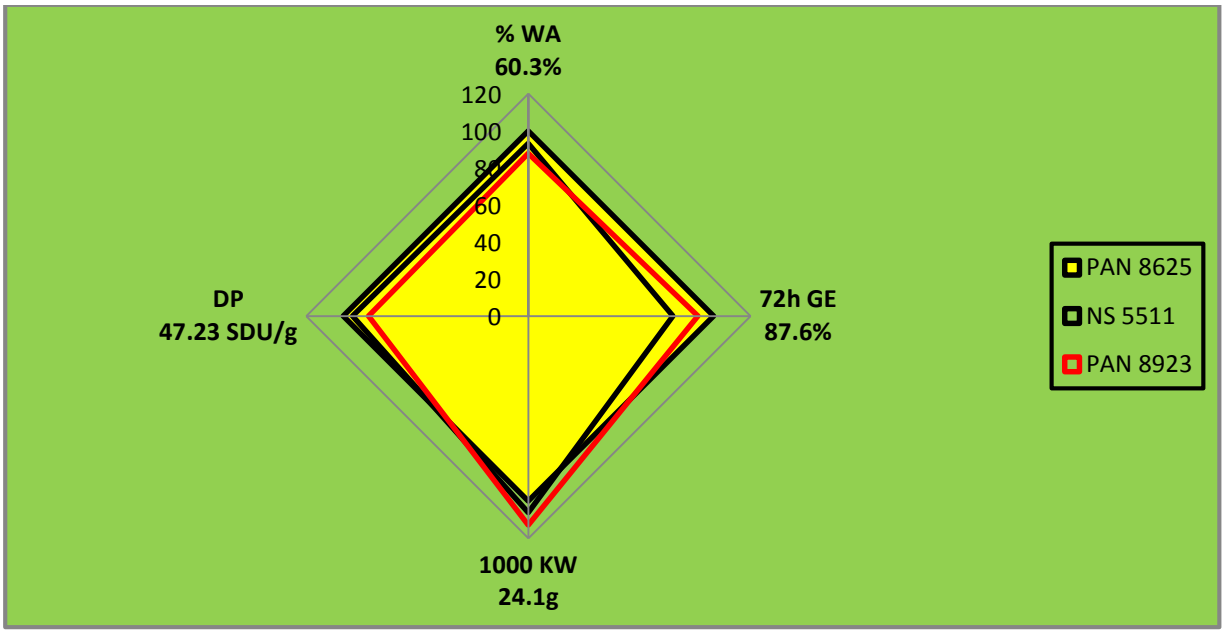

Figure 6 Comparison of the cultivar **PAN 8923** with the two condensed-tannin check cultivars **PAN 8625** and **NS 5511** for malting performance.

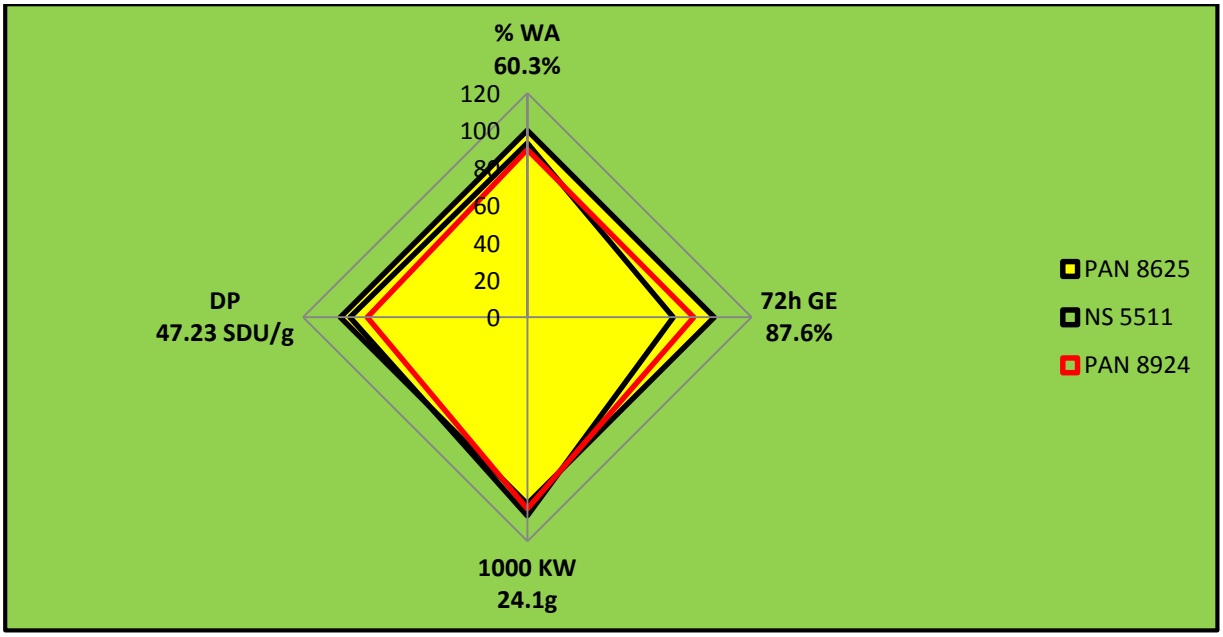

Figure 7 Comparison of the cultivar **PAN 8924** with the two condensed-tannin check cultivars **PAN 8625** and **NS 5511** for malting performance.

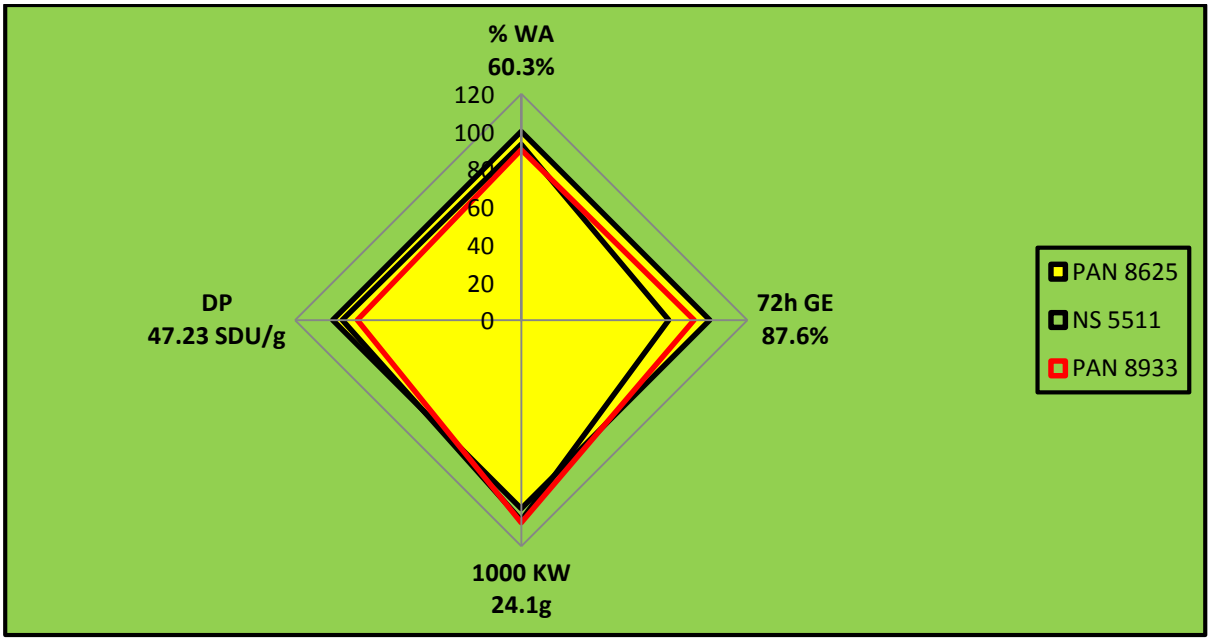

Figure 8 Comparison of the cultivar **PAN 8933** with the two condensed-tannin check cultivars **PAN 8625** and **NS 5511** for malting performance.

Condensed tannin-free malting sorghum (GM)

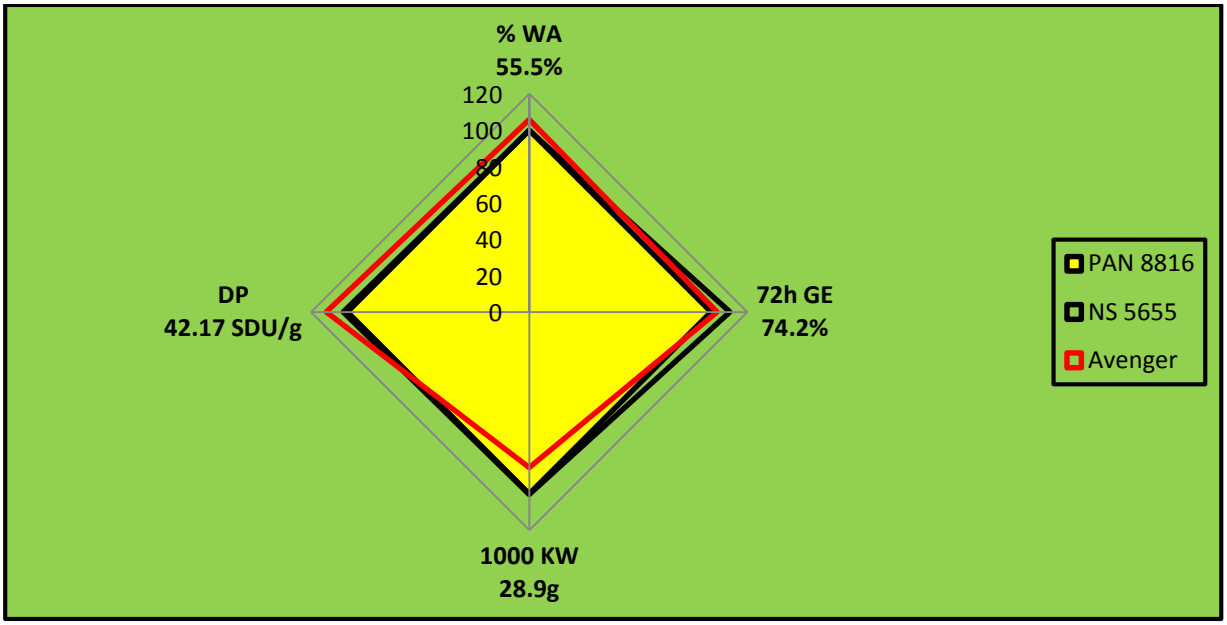

Figure 9 Comparison of the cultivar **Avenger** with the two condensed-tannin free check cultivars **PAN 8816** and **NS 5655** for malting performance.

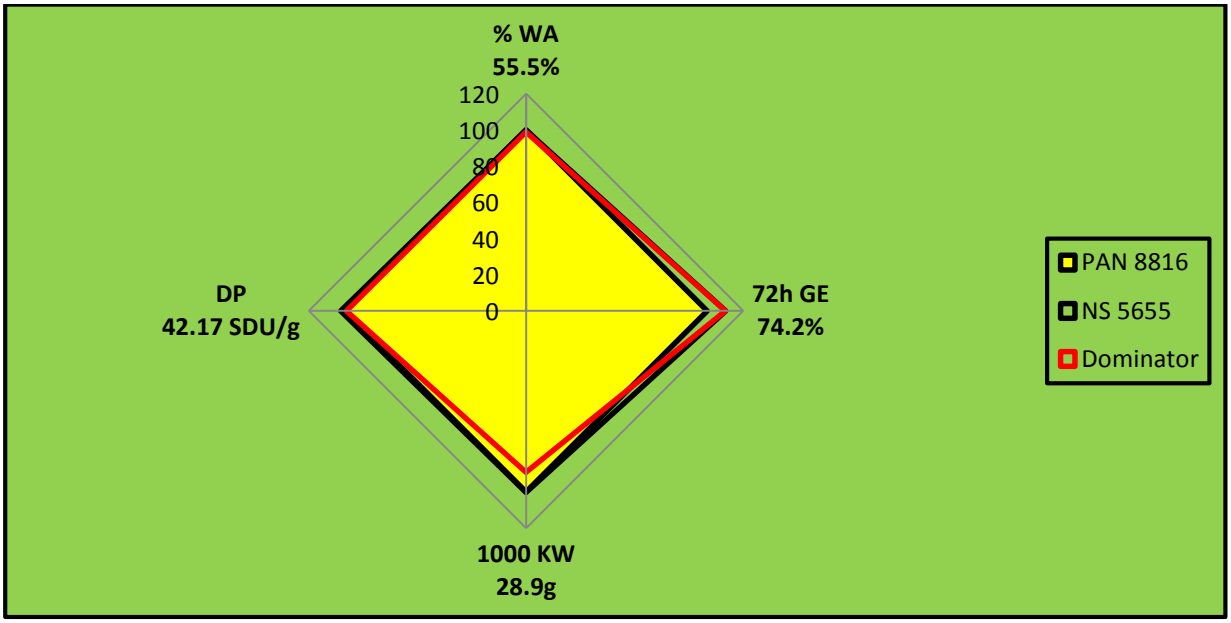

Figure 10 Comparison of the cultivar **Dominator** with the two condensed-tannin free check cultivars **PAN 8816** and **NS 5655** for malting performance

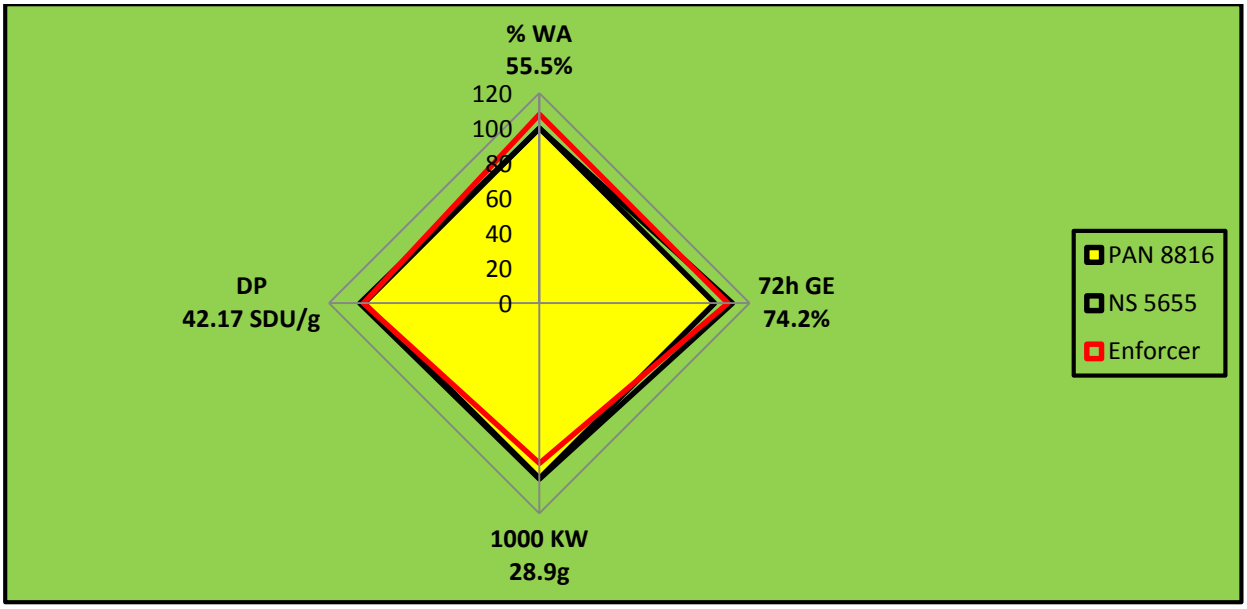

Figure11 Comparison of the cultivar **Enforcer** with the two condensed-tannin free check cultivars **PAN 8816** and **NS 5655** for malting performance

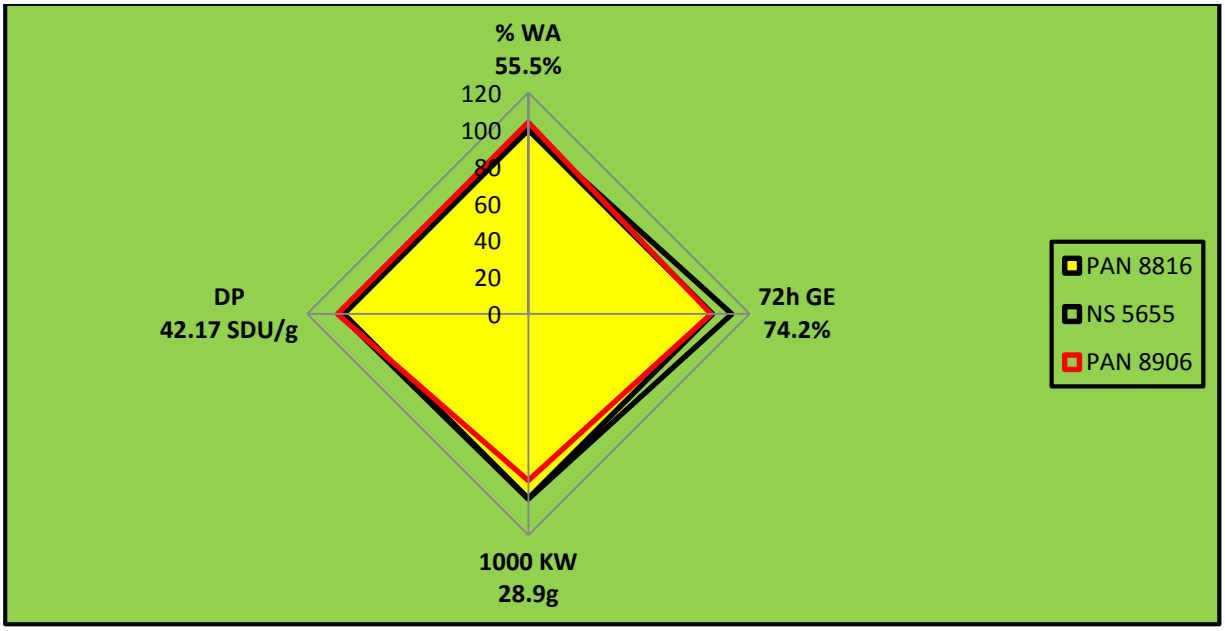

Figure 12 Comparison of the cultivar **PAN 8906** with the two condensed-tannin free check cultivars **PAN 8816** and **NS 5655** for malting performance

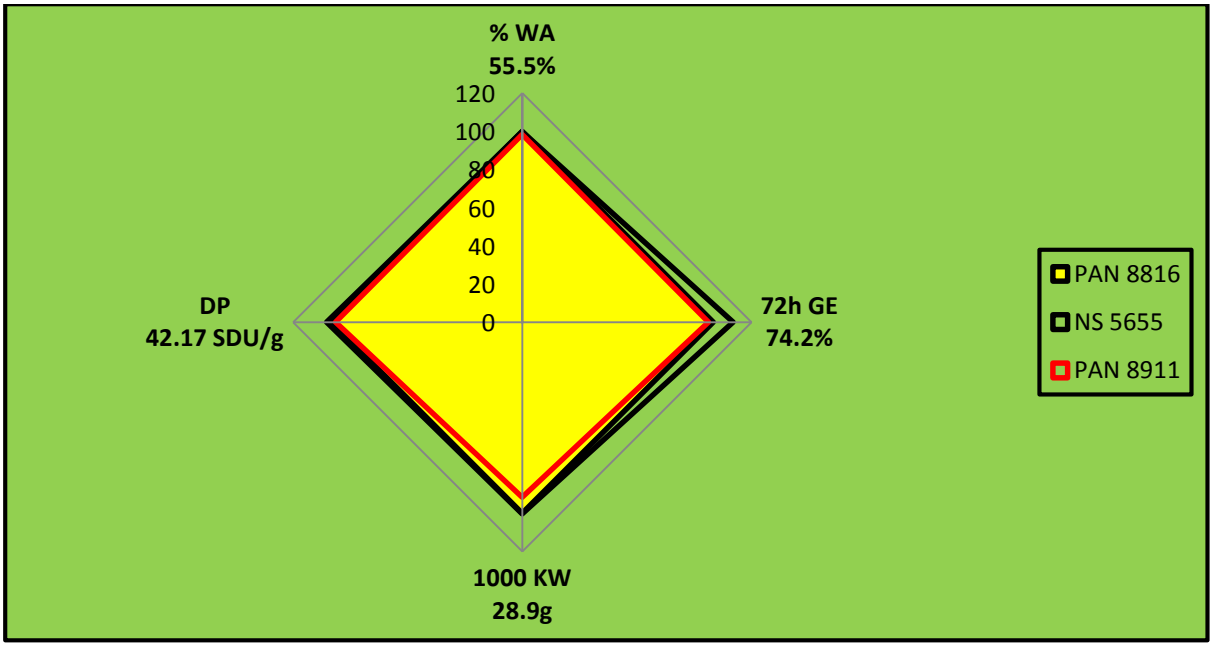

Figure 13 Comparison of the cultivar **PAN 8911** with the two condensed-tannin free check cultivars **PAN 8816** and **NS 5655** for malting performance

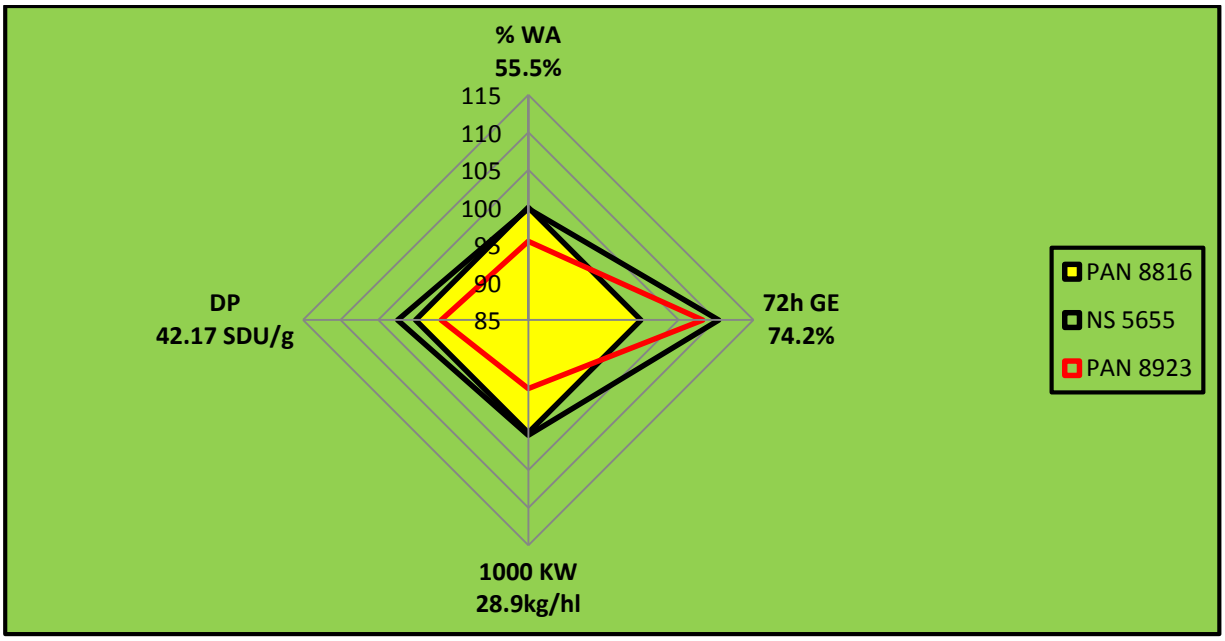

Figure 14 Comparison of the cultivar **PAN 8923** with the two condensed-tannin free check cultivars **PAN 8816** and **NS 5655** for malting performance

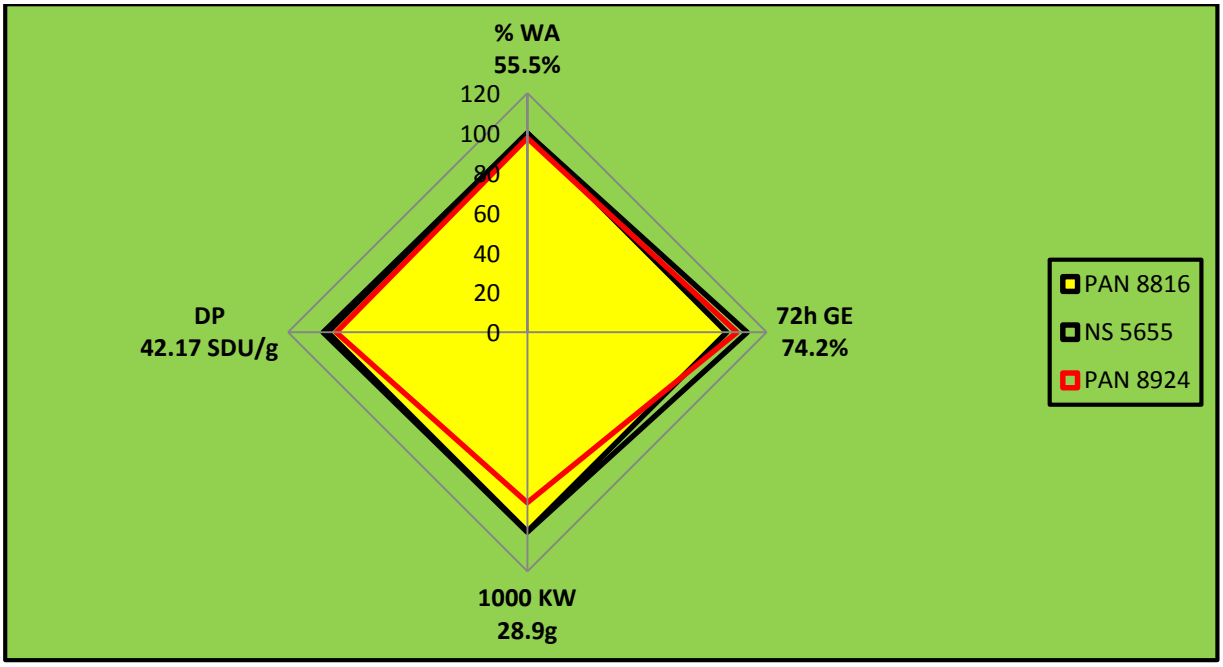

Figure 15 Comparison of the cultivar **PAN 8924** with the two condensed-tannin free check cultivars **PAN 8816** and **NS 5655** for malting performance

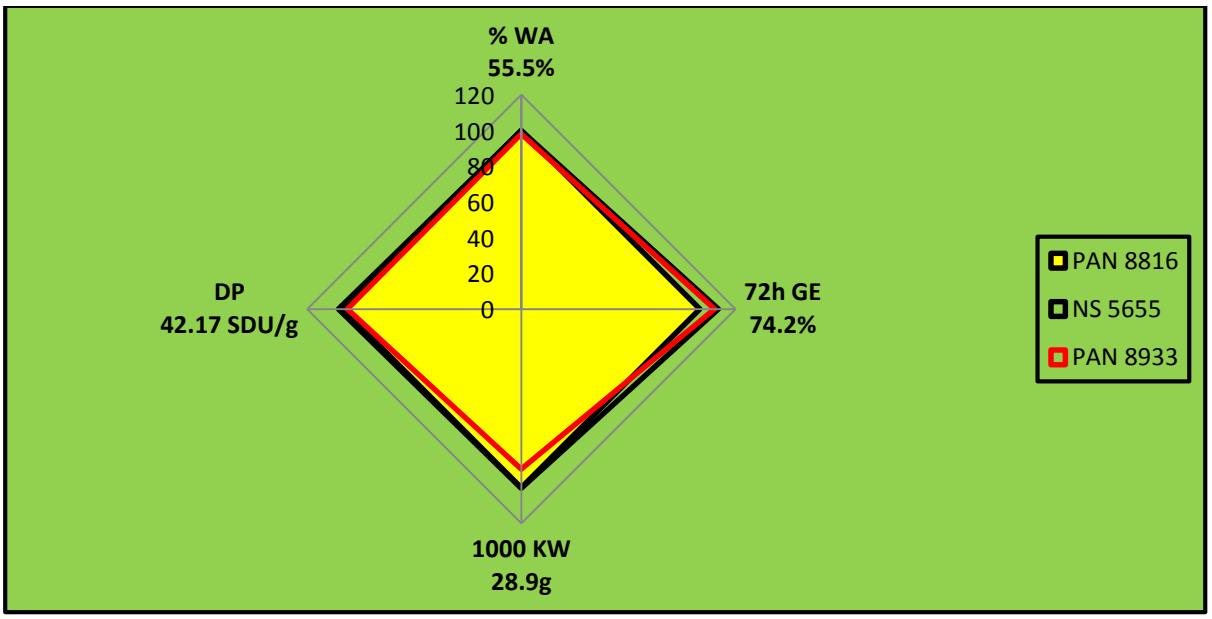

Figure 16 Comparison of the cultivar **PAN 8933** with the two condensed-tannin free check cultivars **PAN 8816** and **NS 5655** for malting performance

DISCUSSION

Condensed-tannin sorghum:

Water absorption:

Comparing the cultivars against the two condensed-tannin sorghum checks showed that the water absorption is lower than the two checks included except for Avenger and Enforcer that compare favourably with the check results. The checks water absorption ranged from 56.2% to 60.3%.

Germination energy at 72h:

None of the average germination percentages comply with the preferred malt specification of above 90%. The check cultivar PAN 8627 germination energy was the highest with an average germination value of 87.6%. In the raw data it was evident that the environment plays a major role in the performance of the cultivars. Temperature and water availability is critical during the kernel fill period and these factors determined in which ratio the proteins and starches were produces and impregnated in the grain. These ratios play a vital role in the ability to absorbed water during steeping that directly influenced the germination ability of the grain.

Secondly dormancy may also play a role in the germination energy values obtained in the study. This is a genetic trait and needs further investigation.

Thousand kernel mass:

The thousand kernel mass of the GH check cultivars ranged between 24.1g and 24.7g. The cultivars Dominator, Enforcer, PAN 8906, PAN 8911, PAN 8923 and PAN 8933 had higher thousand kernel mass values than the checks. This is an indication of good grain quality for malting.

Diastatic power:

The two GH checks included showed DP values that ranged from 44.28 SDU/g to 47.23 SDU/g. Most of the cultivars tested showed comparable results to the lower end of the range. Only Avenger compared well at the higher end of the range with a value of 47.9 SDU/g. Diastatic power values is very important due to the fact that this value gives an indication of the malt ability of the grain as well as the amount starting energy available that is important in the brewing process. Therefore Avenger is statistically a better malt variety than the rest.

Condensed-tannin free sorghum:

Water absorption:

Comparing the cultivars against the two GM checks showed that the water absorption is comparable with the two checks included. The check cultivars water absorption ranged from 55.4% to 55.5%. The water absorption of all the cultivars tested was in the range of the two check cultivars, except for Avenger (58.7%) and Enforcer (59.8%) that were significantly higher.

Germination energy at 72h:

None of the average germination percentages comply with the preferred malt specification of above 90%. All the cultivars had germination values of about 80% and lower. The cultivar PAN

8911 showed that lowest germination energy value of 72.3%. Temperature, water availability during the kernel fill period may play a role as earlier described.

Thousand kernel mass:
The thousand kernel mass values of the GM check cultivars ranged between 28.9g and 29.0g. All the cultivars tested had significantly lower thousand kernel mass values than the two check cultivars.

Diastatic power:
The two GM checks included showed DP values that ranged from 42.17 SDU/g to 43.18 SDU/g. All the cultivars results were comparable to the two check cultivars with Diastatic power values that ranged from 40.43 SDU/g to 43.76 SDU/g. Only Avenger was significantly higher than the rest of the cultivars tested with a DP value of 47.9 SDU/g.

CONCLUSION

The two GH check cultivars (PAN 8625 & NS 5511) showed higher water absorption than the two GM check cultivars (PAN 8816 and NS 5655). Three of the cultivars tested Avenger, Enforcer and PAN 8906 showed the same water absorption ability as the GH check cultivars.

None of the check cultivars as well as the cultivars tested comply with malt specifications regarding germination energy values of above 90%.

The two GM check cultivar showed the highest thousand kernel mass values, with the test cultivar PAN 8923 the closest on 27.2g.

The check cultivar PAN 8625 showed the highest DP value of 47.23 SDU/g and in the second place was the cultivar Avenger.

From this preliminary study Avenger show potential since the cultivar performed well in three of the four parameters tested. More attention must be given to dormancy and water sensitivity that may influence the germination energy performance of the cultivars tested. Therefor more testing on malt ability is needed as well as data on the agronomical performance of the cultivar is needed to make final conclusions on whether this cultivar can positively contribute to the opaque beer industry of South Africa and Southern Africa.

ACKNOWLEDGEMENTS

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