South African Sorghum crop

Quality Report
2017/2018 season

Index

Compiled and issued by:
The Southern African Grain Laboratory NPC

Grain Building - Agri-Hub Office
477 Witherite Road
The Willows
Pretoria
SOUTH AFRICA

PostNet Suite # 391
Private Bag X 1
The Willows
0041

Tel: +27 (12) 807 4019
Fax: +27(12) 807 4160
E-mail: info@sagl.co.za
Website: www.sagl.co.za

South African Commercial sorghum quality for the 2017/2018 Season

Acknowledgements
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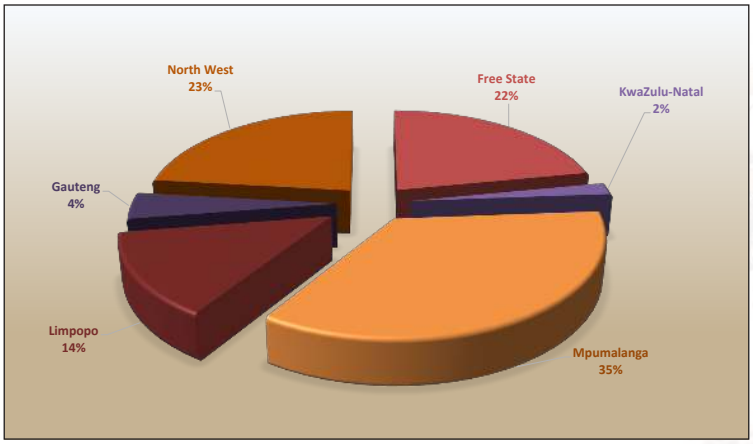
- ***The Sorghum Trust for its financial support in conducting this survey.***
- *Agbiz Grain and its members for their cooperation in providing the samples to make this survey possible.*
- *The Crop Estimates Committee (CEC) of the Department of Agriculture, Forestry and Fisheries for providing production related figures.*
- *South African Grain Information Service (SAGIS) for providing supply and demand figures relating to sorghum.*
- *The Bureau for Food and Agricultural Policy (BFAP) for providing research based market analysis.*

Introduction

The final commercial sorghum crop figure of the 2017/2018 season as overseen by the National Crop Estimates Liaison Committee (CELC) is 115 0000 tons. This figure represents an upward adjustment of 4.68% or 5 145 tons, compared to the final crop estimate figure. The crop decreased by 24% (37 000 tons) year on year. Mpumalanga, the major sorghum producing province, contributed 35% of the total crop. Yield figures showed a 11% increase year on year, from 3.59 t/ha to 3.99 t/ha.

Graph 1: Contribution of the provinces to the production of the 2017/2018 sorghum crop



Figures provided by the CEC.

During the harvesting season, a representative sample of each delivery of sorghum at the various grain intake points, was taken according to the prescribed grading regulations. The sampling procedure for the samples used in this survey is described on page 31. Forty-two (42) composite sorghum samples, representing the different production regions, were analysed for quality.

The samples were graded and test weight and thousand kernel mass determined. Sub-samples were milled and analysed for moisture, crude protein and starch. After sieving and dehulling by means of a Barley pearler, the fraction of the sample above the 1.8 mm slotted sieve were milled and Hunter Lab colour analyses conducted. Multi-mycotoxin analyses as well as Image analyses (kernel size distribution, length, width and roundness on the whole kernels) were also performed on the samples.

This is the first annual sorghum crop quality survey performed by The Southern African Grain Laboratory NPC (SAGL). SAGL was established in 1997 on request of the Grain Industry. SAGL is an ISO 17025 accredited testing laboratory and participates in a number of proficiency testing schemes, both nationally and internationally, as part of our ongoing quality assurance procedures to demonstrate technical competency and international comparability.

The goal of this crop quality survey is the compilation of a detailed database, accumulating quality data collected over several seasons on the national commercial sorghum crop. The data reveal general tendencies and highlight quality differences in the commercial sorghum produced in different local production regions. A detailed database containing reliable analytical data collected over several seasons is essential to enable industry to comment on proposed legislative levels and to supply reliable data for targeted research projects.

In addition to the quality information, production figures (obtained from the Crop Estimates Committee (CEC)) relating to hectares planted, tons produced and yields obtained on a national as well as provincial basis, over an eleven season period, are provided in this report. SAGIS (South African Grain Information Service) supply and demand information is provided in table and graph format. Import and export figures over several seasons are also included.

Data on sorghum imported for domestic use during the period March 2018 to February 2019 is included in the report and compared to the quality of the local crop over the corresponding period.

The national sorghum grading regulations as published in the Government Gazette of 8 January 2016 are provided as the last section of the report.

Production

Sorghum is a tropical grass grown primarily in semi-arid regions of the world. Sorghum can grow in areas too dry for maize and is deemed to be the fifth most important grain crop grown in the world (after maize, wheat, rice and barley).

World sorghum production for the 2018/2019 season to date, stands at 58,4 million tons with the United States being the largest contributor (9,3 million tons). Please see Table 1a and 1b for the world sorghum trade (import and export) as well as production and consumption figures.

The local area utilized for sorghum production decreased by 32%, compared to the 42 350 hectares of the 2016/2017 season. The 28 800 hectares planted this season, is the lowest area seen in a steady decline in area over the last number of seasons.

Table 1a: World Sorghum Trade
October/September Trade Year

	2014/15	2015/16	2016/17	2017/18	2018/19 Dec	2018/19 Feb
Exports (1 000 MT)						
Argentina	954	772	457	296	500	200
Australia	1,701	717	542	449	1,500	1,300
Ethiopia	75	75	75	75	75	75
India	122	74	24	140	50	50
Kenya	73	41	73	136	50	50
Nigeria	100	50	100	100	100	100
Ukraine	156	119	164	123	80	120
Others	138	115	229	212	102	102
Subtotal	*3,319*	*1,963*	*1,664*	*1,531*	*2,457*	*1,997*
United States	*9,269*	*7,928*	*6,022*	*4,961*	*3,000*	*3,000*
World Total	*12,588*	*9,891*	*7,686*	*6,492*	*5,457*	*4,997*
Imports (1 000 MT)						
Chile	98	134	54	49	100	100
China	10,162	8,284	5,209	4,436	2,000	1,700
European Union	131	119	194	486	800	800
Japan	903	649	561	594	600	600
Kenya	117	54	146	141	150	150
Korea, South	6	4	5	62	70	70
Mexico	29	661	548	98	500	500
Somalia	20	70	60	80	100	100
South Sudan	87	19	36	148	150	150
Sudan	120	200	120	150	200	200
Others	390	669	381	542	504	504
Subtotal	*12,063*	*10,863*	*7,314*	*6,786*	*5,174*	*4,874*
Unaccounted	*498*	*-1,070*	*328*	*-345*	*283*	*123*
United States	*27*	*98*	*44*	*51*	*0*	*0*
World Total	*12,588*	*9,891*	*7,686*	*6,492*	*5,457*	*4,997*

Table 1b: World Sorghum Production and Consumption Local Marketing Years

	2014/15	2015/16	2016/17	2017/18	2018/19 Dec	2018/19 Feb
Production (1 000 MT)						
Argentina	3,500	3,375	3,400	3,000	3,150	2,800
Australia	2,209	1,791	994	1,439	2,200	2,000
Brazil	2,055	1,032	1,865	2,136	1,800	1,800
Burkina	1,708	1,436	1,663	1,366	1,800	1,800
Cameroon	1,150	1,217	1,339	1,400	1,400	1,400
Chad	922	835	991	946	950	950
China	2,885	2,750	2,985	3,200	3,450	3,450
Ethiopia	4,339	4,766	4,752	4,050	4,100	4,100
India	5,445	4,238	4,570	4,950	4,600	4,600
Mali	1,272	1,527	1,394	1,705	1,300	1,300
Mexico	6,270	5,587	4,638	4,545	4,600	4,600
Niger	1,426	1,918	1,808	1,944	1,700	1,700
Nigeria	6,883	7,005	6,939	6,300	6,800	6,800
Sudan	6,281	2,744	6,466	3,743	4,000	4,000
Tanzania	883	677	756	800	800	800
Other	7,948	7,309	6,614	7,005	7,026	7,032
Subtotal	*55,176*	*48,207*	*51,174*	*48,529*	*49,676*	*49,132*
United States	*10,988*	*15,158*	*12,199*	*9,192*	*9,238*	*9,271*
World Total	*66,164*	*63,365*	*63,373*	*57,721*	*58,914*	*58,403*
Total Consumption (1 000 MT)						
Argentina	2,800	2,900	2,900	3,200	2,700	2,700
Brazil	2,000	1,150	1,700	2,100	1,900	1,900
Burkina	1,700	1,465	1,640	1,400	1,700	1,700
Cameroon	1,175	1,232	1,369	1,415	1,425	1,425
Chad	930	850	950	1,000	980	980
China	12,900	11,000	8,300	7,800	5,500	5,300
Ethiopia	4,100	4,700	4,700	4,200	4,100	4,100
European Union	995	800	790	970	1,520	1,520
India	5,100	4,600	4,500	4,700	4,600	4,600
Mali	1,200	1,500	1,400	1,650	1,400	1,400
Mexico	6,600	6,300	5,300	4,700	5,000	5,000
Niger	1,450	2,000	2,000	1,850	1,800	1,800
Nigeria	6,833	6,905	6,850	6,250	6,700	6,700
South Sudan	1,050	830	760	800	850	850
Sudan	6,000	3,100	6,450	1,400	4,250	4,250
Other	8,800	8,689	7,588	8,541	8,411	8,401
Subtotal	*63,453*	*57,691*	*57,507*	*54,409*	*52,559*	*52,189*
United States	*2,459*	*6,130*	*6,282*	*3,997*	*6,604*	*5,969*
World Total	*65,912*	*63,821*	*63,789*	*58,406*	*59,163*	*58,158*

Notes:
Total consumption reflect total utilisation, including food, seed, industrial, feed and waste, as well as differences in local marketing year imports and exports.
Consumption statistics for indivual countries reflect food, seed, industrial, feed and waste only.

Source: United States Department of Agriculture, Foreign Agricultural Service (USDA-FAS), Grain: World Markets and Trade report, February 2019.

According to *The Bureau for Food and Agricultural Policy (BFAP) Baseline, Agricultural Outlook 2018 – 2027*, one of the reasons for this decline is the fact that yield levels have failed to increase at the same rate as particularly yellow maize. Sorghum yields have remained fairly stagnant over the last ten years, while yellow maize yields have increased annually on average by more than 3%. This increase can be attributed to an increasing share of irrigated production, improved cropping practices and genetically modified (GM) technology traits.

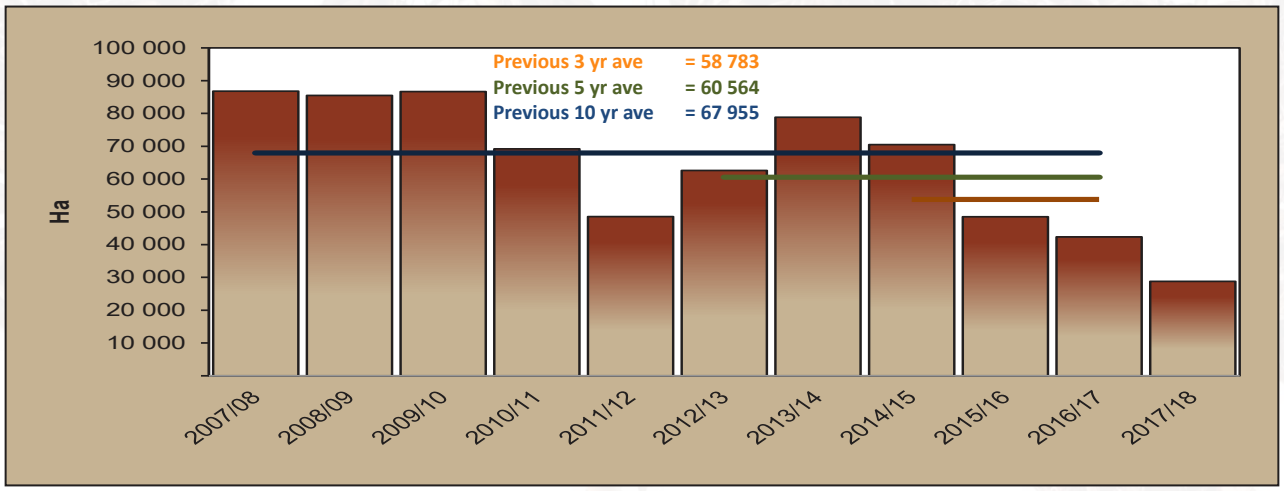
Please see Table 2 for an overview of sorghum production under dry land conditions versus irrigation in the 2017/2018 season, compared to the 2016/2017 season. Graphs 2 to 4 provide national figures with regards to hectares planted, tons produced and yields obtained over the last 11 seasons. Graphs 5 to 10 on page 6 provide similar figures for the major sorghum producing provinces, namely Mpumalanga, North West and the Free State.

Table 2: Sorghum production overview over two seasons

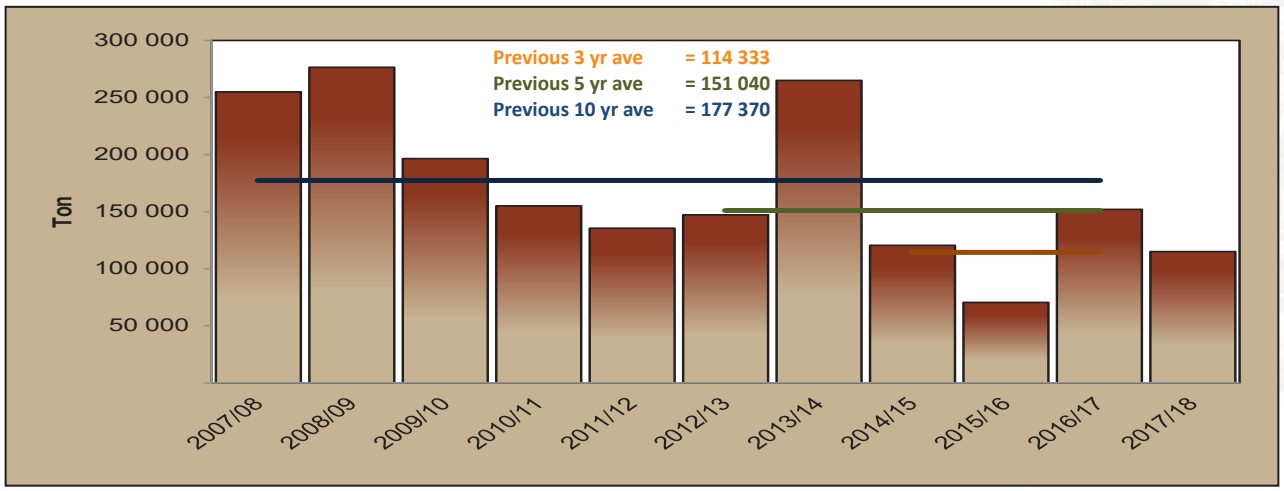
Province	Type of production	2017/2018			2016/2017		
		Hectares planted, ha	Production, tons	Yield, t/ha	Hectares planted, ha	Production, tons	Yield, t/ha
Western Cape	Dryland	-	-	-	-	-	-
	Irrigation	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Northern Cape	Dryland	-	-	-	-	-	-
	Irrigation	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Free State	Dryland	6 000	23 600	3.93	7 400	23 000	3.11
	Irrigation	300	1 600	5.33	300	1 640	5.47
	Total	6 300	25 200	4.00	7 700	24 640	3.20
Eastern Cape	Dryland	-	-	-	-	-	-
	Irrigation	-	-	-	-	-	-
	Total	-	-	-	-	-	-
KwaZulu-Natal	Dryland	500	2 200	4.40	400	1 520	3.80
	Irrigation	-	-	-	-	-	-
	Total	500	2 200	4.40	400	1 520	3.80
Mpumalanga	Dryland	7 500	40 500	5.40	12 000	62 400	5.20
	Irrigation	-	-	-	-	-	-
	Total	7 500	40 500	5.40	12 000	62 400	5.20
Limpopo	Dryland	5 000	15 500	3.10	17 650	48 500	2.75
	Irrigation	-	-	-	350	1 900	5.43
	Total	5 000	15 500	3.10	18 000	50 400	2.80
Gauteng	Dryland	1 500	4 950	3.30	750	2 400	3.20
	Irrigation	-	-	-	-	-	-
	Total	1 500	4 950	3.30	750	2 400	3.20
North West	Dryland	7 700	25 050	3.25	3 300	9 600	2.91
	Irrigation	300	1 600	5.33	200	1 040	5.20
	Total	8 000	26 650	3.33	3 500	10 640	3.04
RSA	Dryland	28 200	111 800	3.96	41 500	147 420	3.55
	Irrigation	600	3 200	5.33	850	4 580	5.39
	Total	28 800	115 000	3.99	42 350	152 000	3.59

Figures provided by the CEC.

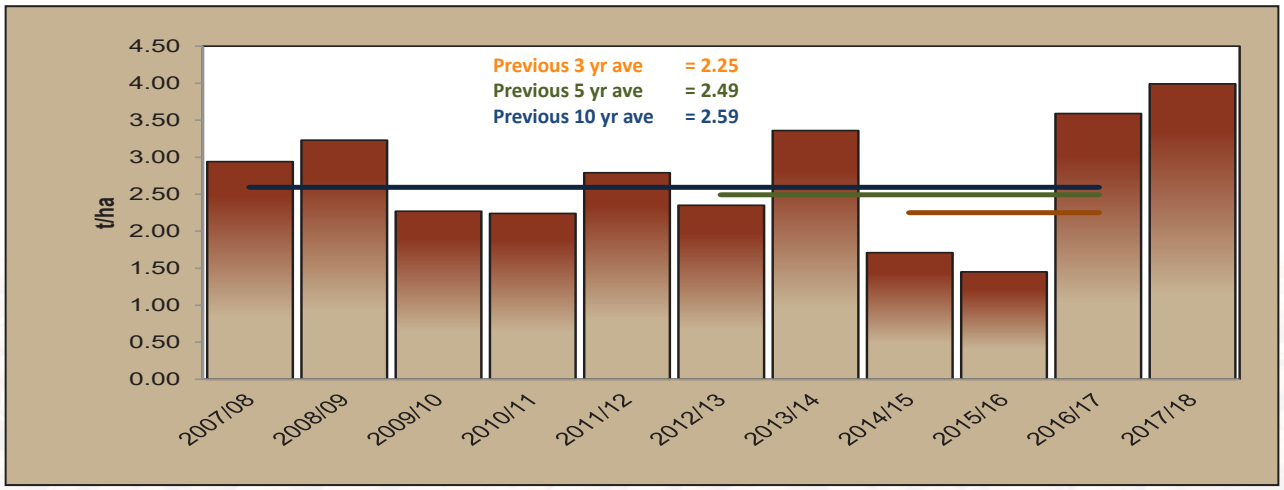
Graph 2: Total RSA area utilised for sorghum production from 2007/08 to 2017/18



Graph 3: Sorghum production in RSA from 2007/08 to 2017/18

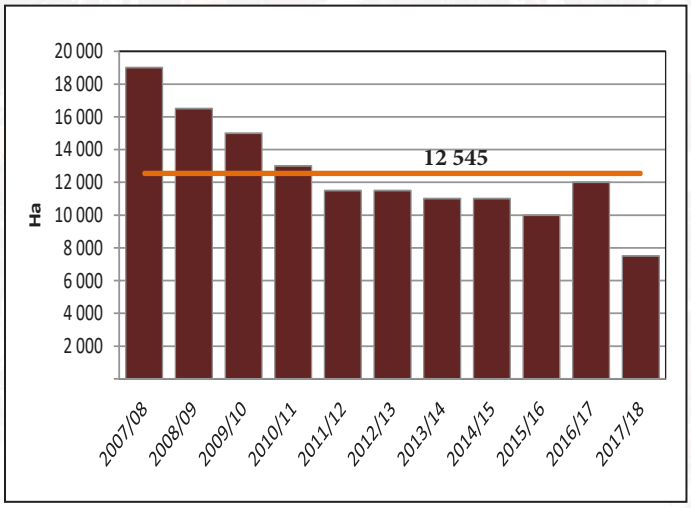


Graph 4: RSA Sorghum yield from 2007/08 to 2017/18

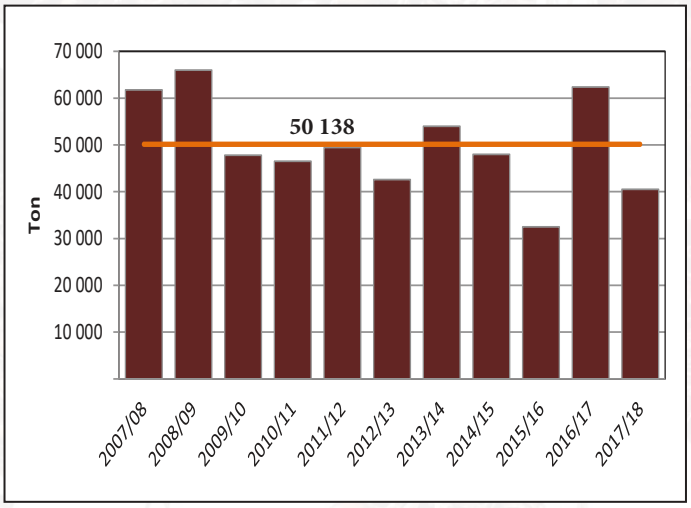


Figures provided by the CEC.

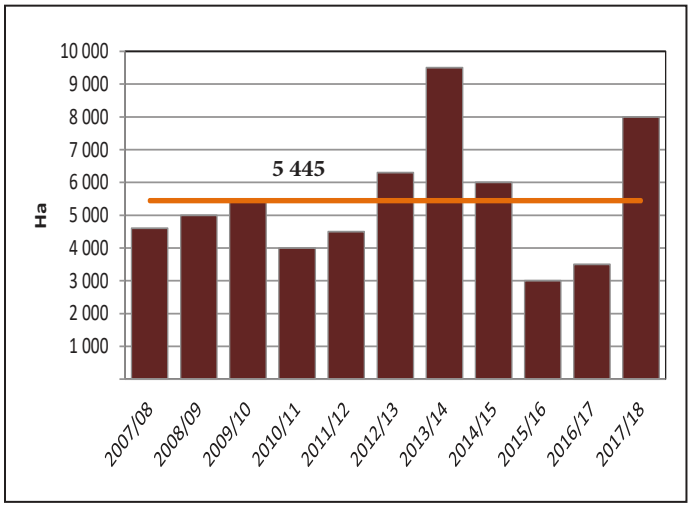
Graph 5: Area utilised for sorghum production in Mpumalanga since 2007/08



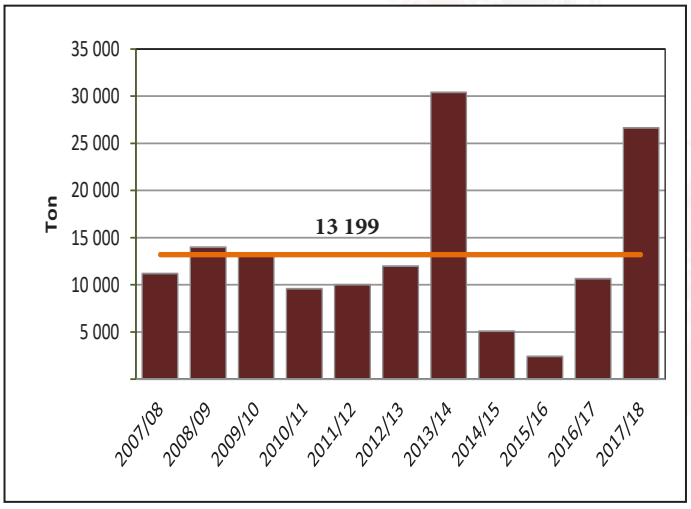
Graph 6: Sorghum production in Mpumalanga since 2007/08



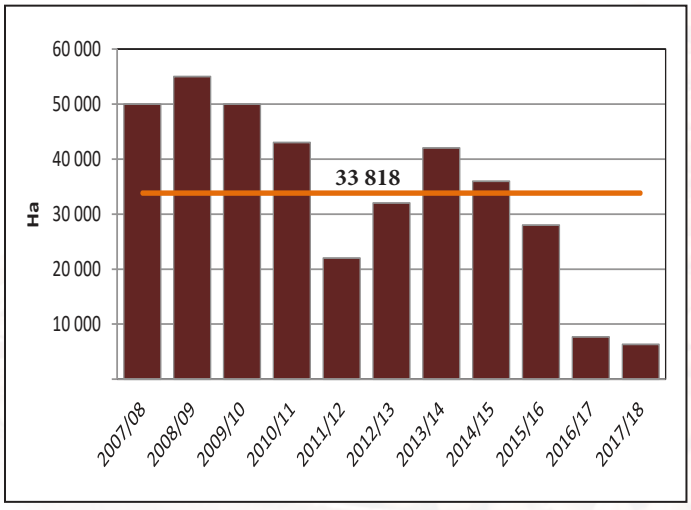
Graph 7: Area utilised for sorghum production in North West since 2007/08



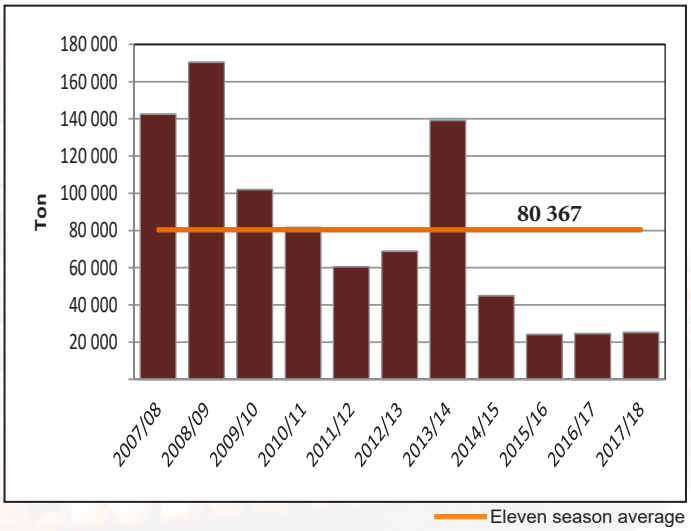
Graph 8: Sorghum production in North West since 2007/08



Graph 9: Area utilised for sorghum production in Free State since 2007/08



Graph 10: Sorghum production in Free State since 2007/08



Figures provided by the CEC.

Eleven season average

Supply and Demand

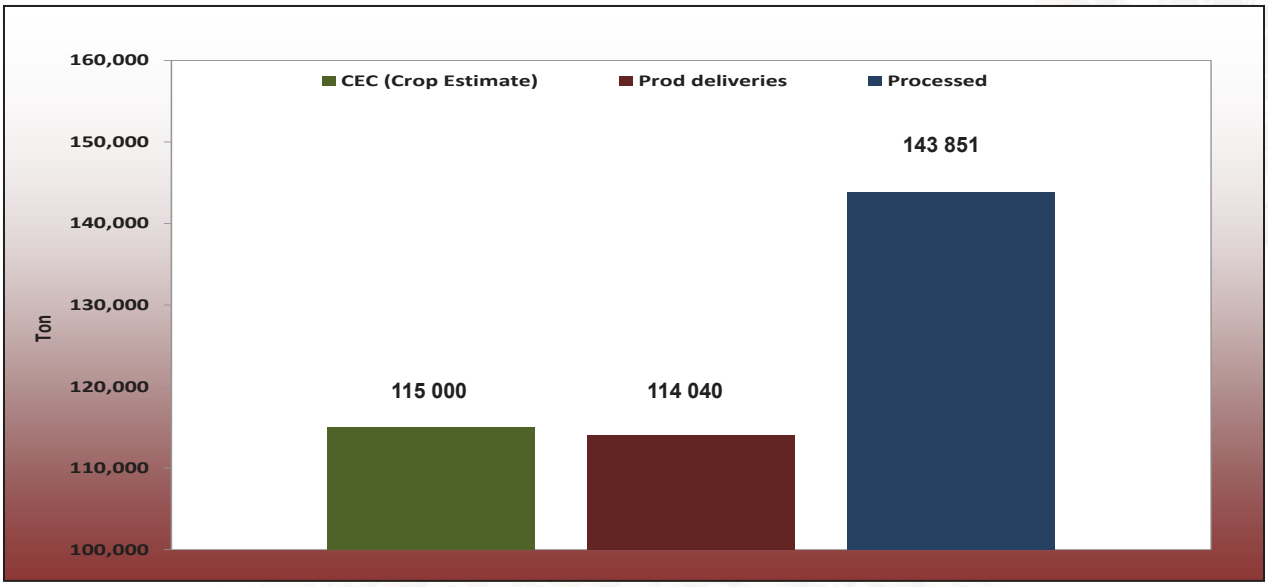
The sorghum marketing season dates from March to February. According to SAGIS supply and demand figures for the 2018/2019 marketing season to date (March 2018 to January 2019), opening stock increased by 68% compared to the previous marketing season, but is still 20% lower than the ten-year average.

To date, 27 803 tons of sorghum have been imported, compared to the 55 824 and 74 957 tons of the previous two seasons respectively. South Africa is expected to remain a net importer of sorghum during the period 2018 to 2027, according to BFAP.

Of the 143 851 tons of sorghum processed so far, 36% was used for malting purposes and 57% was processed as meal, rice and grits. This ratio has remained steady for the last five years. The remainder of the sorghum was processed for pet food and animal feed.

Exports to date amount to 8 962 tons, compared to 13 599 tons last season and the ten-year average of 25 811 tons. Globally, the United States are by far the largest exporter of sorghum, followed by Australia *(United States Department of Agriculture, Foreign Agricultural Service (USDA FAS), February 2019 report).*

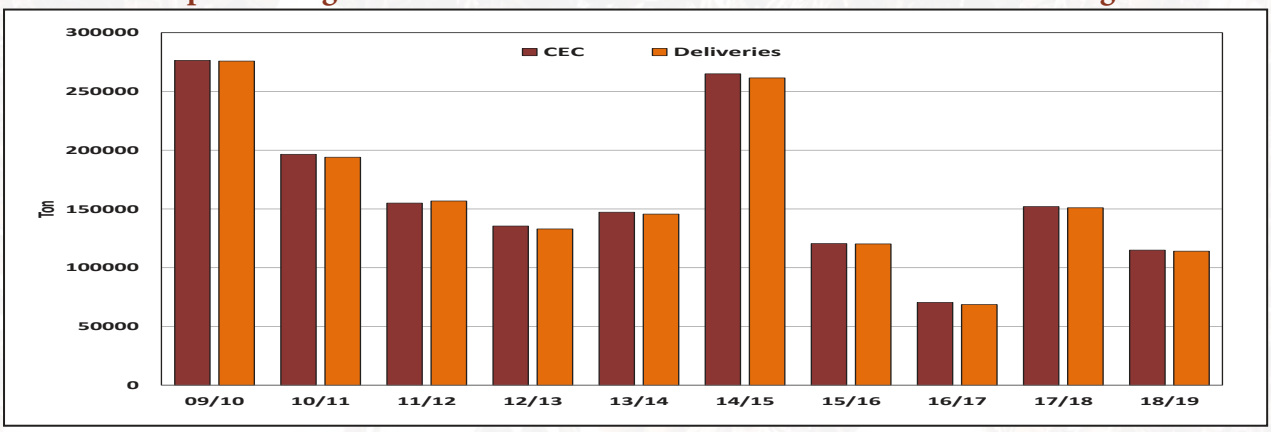
Graph 11: Sorghum supply and demand overview for the current marketing season (Mar 2018 - Feb 2019)



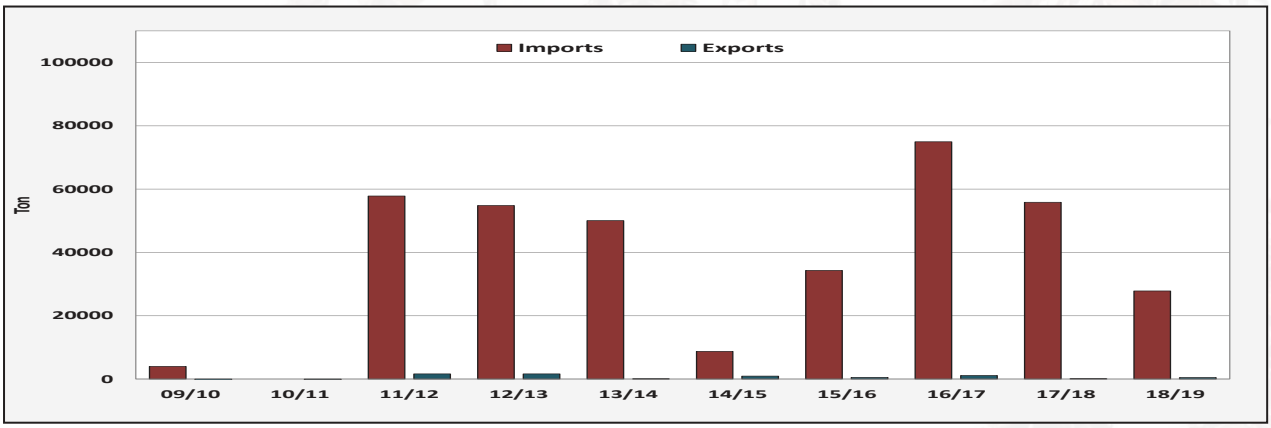
Information provided by SAGIS.

SORGHUM: SUPPLY AND DEMAND TABLE BASED ON SAGIS' INFO (TON)																		Publication date: 2019-02-26	
	Season (Mar - Feb)																	Current Season Mar-Jan	10 Year average
	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	2008/9-2017/18
																		***	
																		11	
CEC (Crop Estimate)	175 600	197 300	219 500	373 300	260 000	96 000	176 000	255 000	276 500	196 500	155 000	135 500	147 200	265 000	120 500	70 500	152 000	115 000	177 370
SUPPLY																			
Opening stock (1 Mar)	155 900	44 500	56 100	65 500	201 200	204 800	91 000	59 300	87 300	112 400	73 400	62 500	56 015	50 069	121 812	83 142	35 238	59 246	74 118
Prod deliveries	170 900	211 000	219 200	369 700	250 400	100 600	171 900	251 200	275 900	194 000	156 800	133 000	145 604	261 507	120 231	68 578	150 967	114 040	175 779
Imports	400	72 200	31 700	5 400	5 000	9 900	31 700	0	4 000	0	57 800	54 800	50,033	8 725	34 316	74 957	55 824	27 803	34 046
Surplus	400	0	0	0	0	300	0	1 700	0	2 200	2 800	0	0	0	1 354	0	0	0	805
Total Supply	**327 600**	**327 700**	**307 000**	**440 600**	**456 600**	**315 600**	**294 600**	**312 200**	**367 200**	**308 600**	**290 800**	**250 300**	**251 652**	**320 301**	**277 713**	**226 677**	**242 029**	**201 089**	**284 747**
DEMAND																			
Processed	205 200	200 800	179 900	187 800	201 600	189 100	196 200	184 300	192 400	194 300	189 900	165 000	170 536	159 364	159 824	170 315	161 422	143 851	174 736
-Indoor malting	28 400	21 000	21 200	25 200	24 300	25 400	24 900	22 700	20 400	18 000	16 900	13 100	12 093	13 710	11 105	11 706	11 404	9 154	15 112
-Floor malting	84 200	76 400	75 200	77 400	76 900	70 900	64 300	63 600	71 400	66 400	64 400	57 600	56 928	48 504	50 265	51 026	48 709	43 119	57 883
-Meal, rice & grits	75 000	81 300	73 300	75 400	88 300	84 800	95 800	88 800	92 500	101 300	101 400	88 600	96 409	90 346	88 041	97 872	92 719	81 805	93, 99
-Pet Food	1 400	1 200	1 300	900	1 300	900	900	900	900	1 100	1 200	800	924	1 113	1 029	1 001	818	772	979
-Poultry Feed	9 600	14 300	4 900	6 000	7 900	5 800	6 500	5 200	5 300	4 800	5 500	4 300	3 548	3 590	3 948	3 987	4 349	6 074	4 452
-Livestock feed	6 600	6 600	4 000	2 900	2 900	1 300	3 800	3 100	1 900	2 700	500	600	634	2 101	5 436	4 723	3 423	2 927	2 512
Bio-fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Withdrawn by producers	17 600	10 500	3 600	6 900	3 700	2 900	4 200	3 800	7 400	7 600	7 800	5 800	5 577	4 683	2 569	644	2 370	932	4 824
Released to end-consumers	2 500	700	1 500	1 400	2 100	2 000	2 300	1 600	4 400	5 300	4 200	2 600	2 707	2 363	2 608	1 209	1 482	724	2 847
Net receipts(-)/disp(+)	10 800	1 100	1 600	3 600	3 700	3 400	1 900	1 800	-1 100	-300	1 600	1 600	70	932	531	1 101	94	443	633
Deficit	0	-4 600	4 500	2 400	800	0	1 600	0	100	0	0	300	3 143	4 978	0	5 521	3 816	1 116	1 786
Exports	47 000	63 100	50 400	37 300	39 900	27 200	29 100	33 400	51 600	28 300	24 800	19 000	19 550	26 169	29 039	12 649	13 599	8 962	25 811
Total Demand	**283 100**	**271 600**	**241 500**	**239 400**	**251 800**	**224 600**	**235 300**	**224 900**	**254 800**	**235 200**	**228 300**	**194 300**	**201 583**	**198 489**	**194 571**	**191 439**	**182 783**	**156 028**	**210 637**
Ending Stock (28 Feb)	**44 500**	**56 100**	**65 500**	**201 200**	**204 800**	**91 000**	**59 300**	**87 300**	**112 400**	**73 400**	**62 500**	**56 000**	**50 069**	**121 812**	**83 142**	**35 238**	**59 246**	**45 061**	**74 111**
- processed p/month	17 100	16 733	14 992	15 650	16 800	15 758	16 350	15 358	16 033	16 192	15 825	13 750	14 211	13 280	13 319	14 193	13 452	13 077	14 561
- months' stock	2.6	3.4	4.4	12.9	12.2	5.8	3.6	5.7	7.0	4.5	3.9	4.1	3.5	9.2	6.2	2.5	4.4	3.4	5

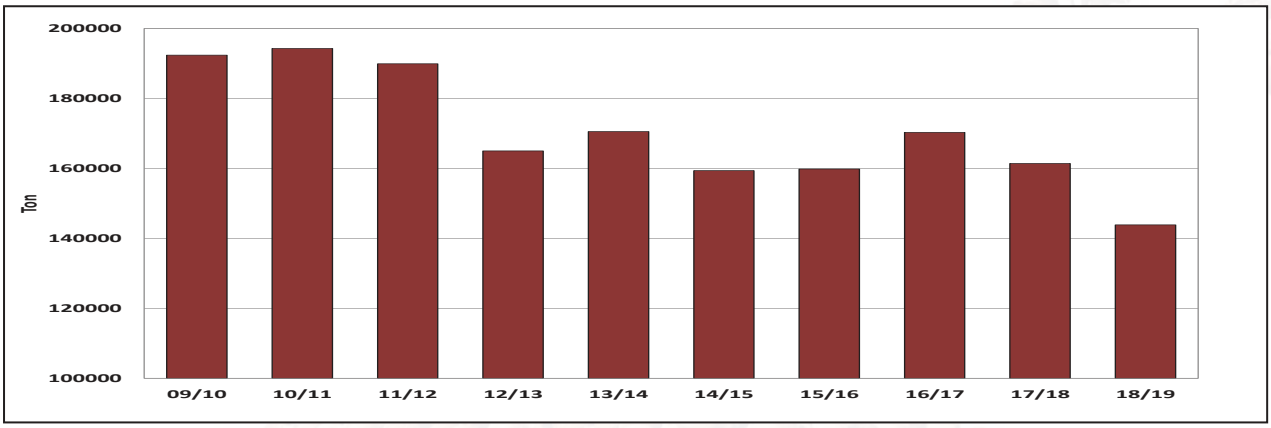
Graph 12: Sorghum: CEC Estimate vs SAGIS deliveries over 10 marketing seasons



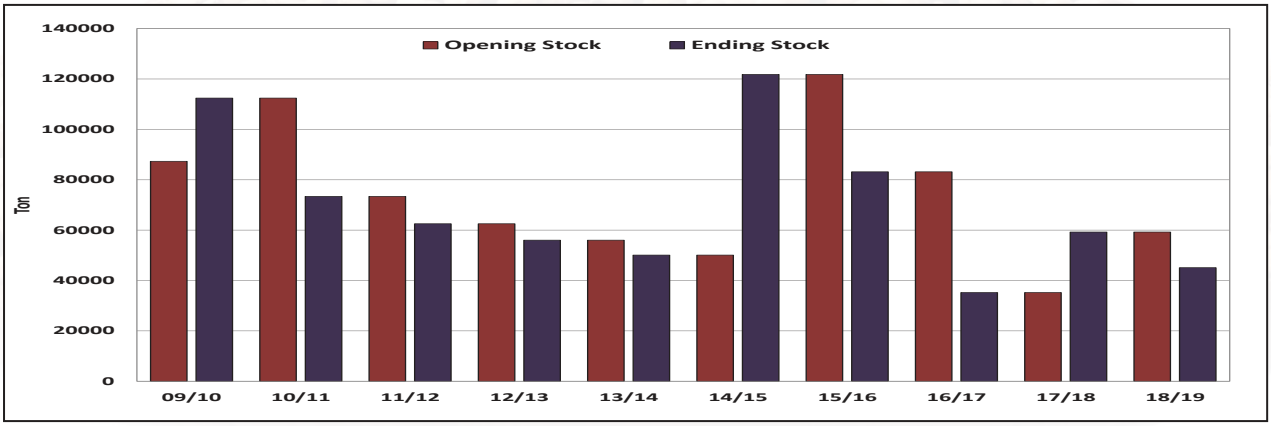
Graph 13: Sorghum: Imports and Exports over 10 marketing seasons



Graph 14: Sorghum: Processed over 10 marketing seasons



Graph 15: Sorghum: Opening and closing stock over 10 marketing seasons



Information provided by SAGIS.

SAGIS South African Grain Information Service NPC
Suid Afrikaanse Graaninligtingsdiens NWM
Reg no. 1997/019186/08

Season	WHOLE SORGHUM: IMPORTS FOR RSA PER COUNTRY (Tons)							
	Botswana	Brazil	Lesotho	Malawi	Ukraine	United States	Zimbabwe	Total
2014/2015	0	0	0	56	0	8 669	0	8 725
2015/2016	0	27 200	0	0	0	7 116	0	34 316
2016/2017	0	0	0	0	280	74 677	0	74 957
2017/2018	0	0	6	0	20	55 798	0	55 824
2018/2019	2 059	0	0	132	187	24 724	701	27 803

Season	SORGHUM: IMPORTS PER HARBOUR (Tons)					
	Harbours					
	East London	Durban	Cape Town	Port Elizabeth	Richards Bay	Total
2005/2006	0	50 222	0	0	0	50 222
2006/2007	29 216	30 971	0	0	0	60 187
2007/2008	0	59 192	0	0	0	59 192
2008/2009	0	34 633	0	0	0	34 633
2009/2010	0	34 082	0	0	0	34 082
2010/2011	0	28 837	0	0	0	28 837
2011/2012	0	74 514	0	0	0	74 514
2012/2013	0	140 227	0	0	0	140 227
2013/2014	0	76 278	0	0	0	76 278
2014/2015	0	17 292	0	0	0	17 292
2015/2016	0	65 143	0	0	0	65 143
2016/2017	230	142 629	50	0	0	142 909
2017/2018	0	68 689	20	0	0	68 709
2018/2019*	138	29 720	49	0	0	29 907

* Progressive March 2018 - January 2019
Note: Includes Imports for RSA and Other Countries

Season	WHOLE SORGHUM: RSA EXPORTS PER COUNTRY (Tons)						
	Botswana	Chad	Namibia	Swaziland	Tanzania	Zambia	Total
2014/2015	20 019	25	33	2 422	0	0	22 499
2015/2016	21 209	0	68	3 129	0	0	24 406
2016/2017	5 425	0	0	2 017	0	0	7 442
2017/2018	6 591	0	32	1 731	912	200	9 466
2018/2019	1 137	0	20	3 641	0	0	4 798

Season	SORGHUM: EXPORTS PER HARBOUR (Tons)					
	Harbours					
	East London	Durban	Cape Town	Port Elizabeth	Richards Bay	Total
2005/2006	0	1 640	0	0	0	1 640
2006/2007	0	2 005	0	0	0	2 005
2007/2008	0	0	0	0	0	0
2008/2009	0	0	0	0	0	0
2009/2010	0	7 911	0	0	0	7 911
2010/2011	0	5 072	0	0	0	5 072
2011/2012	0	23 087	0	0	0	23 087
2012/2013	0	23 706	0	0	0	23 706
2013/2014	0	19 250	0	0	0	19 250
2014/2015	0	25	0	0	0	25
2015/2016	0	5 300	0	0	0	5 300
2016/2017	0	35 034	0	0	0	35 034
2017/2018	0	6 502	0	0	0	6 502
2018/2019*	0	6 944	0	0	0	6 944

* Progressive March 2018 - January 2019

RSA Production Regions

The RSA is divided into 9 provinces as illustrated in Figure 1.

Figure 1: RSA Provinces

Regional map with gratitude to SiQ.

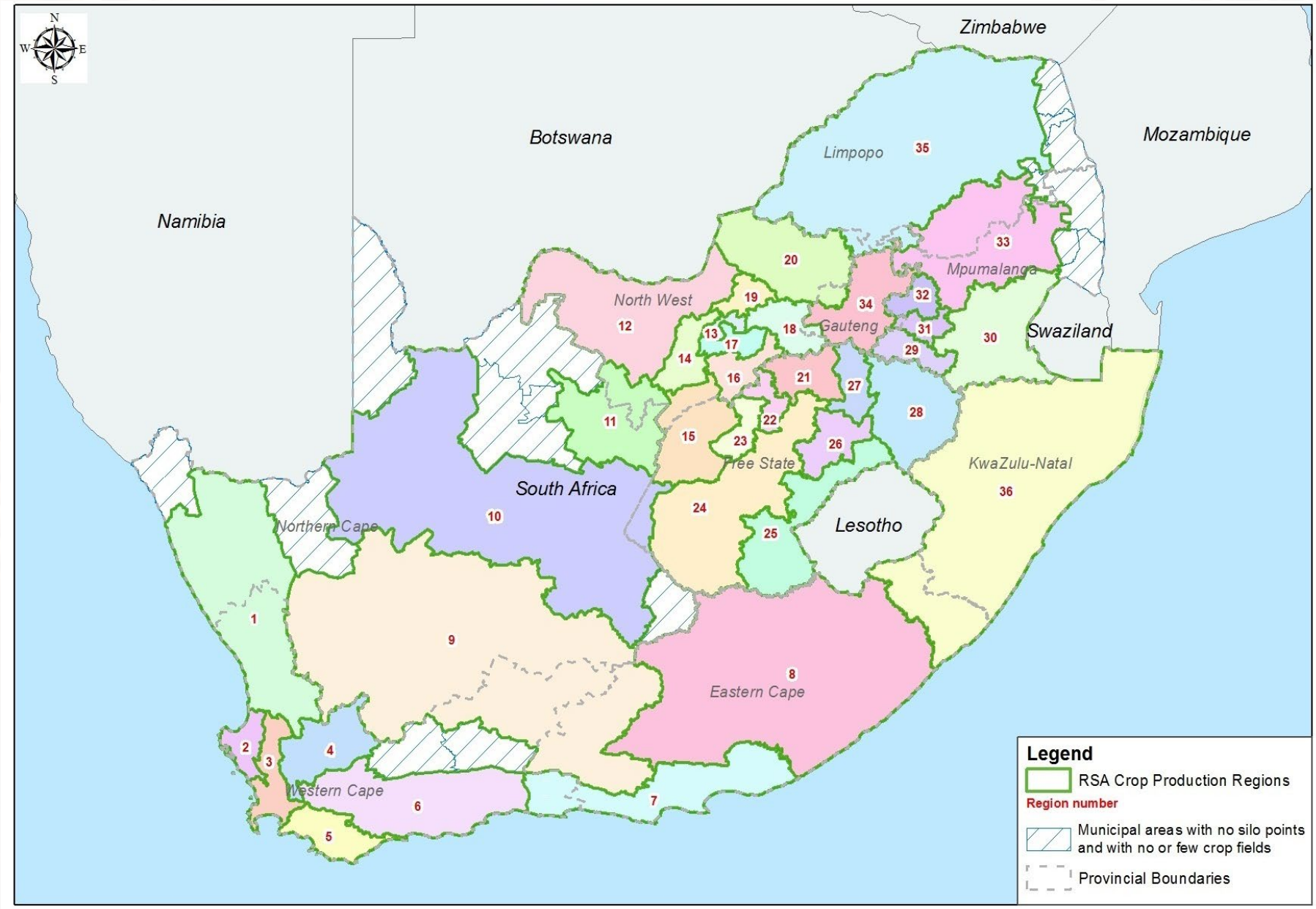
The 9 provinces are divided into 36 grain production regions.

The regions are distributed as follows:
Region 1: Namakwaland
Regions 2 and 3: Swartland
Regions 4 to 6: Rûens
Regions 7 and 8: Eastern Cape
Region 9: Karoo
Region 10: Griqualand West
Region 11: Vaalharts
Regions 12 to 20: North West
Regions 21 to 28: Free State
Regions 29 to 33: Mpumalanga
Region 34: Gauteng
Region 35: Limpopo
Region 36: KwaZulu-Natal

Please see the Crop Production Regions map on the next page.

The production regions from which sorghum samples have been received for the crop quality survey of the 2017/2018 production season, are named and described on pages 13 to 14. The silo/intake stands per region as well as the type of storage structure are provided.

Figure 2: RSA Crop Production Regions



Regional map with gratitude to Agbiz Grain and SiQ.

Grain Production Regions

Silo/Intake stands per region indicating type of storage structure

Region 17: North-West Central Northern Region (Ottosdal)			
NWK	Boschpoort (Bags/Bins/Bulk)	NWK	Vermaas (Bins)
NWK	Kleinharts (Bins)	Senwes	Hartbeesfontein (Bins)
NWK	Ottosdal (Bins)	Senwes	Melliodora (Bins)
NWK	Rostrataville (Bins)	Senwes	Werda (Bins)

Region 18: North-West Central Region (Ventersdorp)			
NWK	Bodenstein (Bins)	Senwes	Makokskraal (Bins)
NWK	Coligny (Bins)	Senwes	Potchefstroom (Bins)
Senwes	Buckingham (Bins)	Senwes	Ventersdorp (Bins)
Senwes	Enselspruit (Bins)		

Region 19: North-West Central Region (Lichtenburg)			
Afgri	Lichtenburg (Bunkers)	NWK	Lottie Halte (Bins)
NWK	Grootpan (Bins)	NWK	Lusthof (Bins)
NWK	Halfpad (Bins)	NWK	Lichtenburg Silo 3 (Bins)
NWK	Hibernia (Bins)	NWK	Lichtenburg Silo 5 (Bins)

Region 20: North-West Eastern Region			
Afgri	Battery (Bins)	NWK	Koster (Bins)
Afgri	Brits (Bins)	NWK	Swartruggens (Bins)
NWK	Boons (Bins)	NWK	Syferbult (Bins)
NWK	Derby (Bins)		

Region 21: Free State North-Western Region (Viljoenskroon)			
Senwes	Attie (Bins)	Senwes	Vierfontein (Bins)
Senwes	Groenebloem (Bins)	Senwes	Viljoenskroon (Bins)
Senwes	Heuningspruit (Bins)	Senwes	Vredefort (Bins)
Senwes	Koppies (Bins)	Senwes	Weiveld (Bins)
Senwes	Rooiwal (Bins)		

Region 24: Free State Central Region			
Senwes	Bloemfontein (Bins)	Senwes	Petrusburg (Bins)
Senwes	Brandfort (Bins)	Senwes	Theunissen (Bins)
Senwes	De Brug (Bins)	Senwes	Van Tonder (Bins)
Senwes	Geneva (Bins)	Senwes	Welgeleë (Bins)
Senwes	Hennenman (Bins)	Senwes	Winburg (Bins)
Senwes	Kroonstad (Bins)		

Grain Production Regions (continue)

Silo/Intake stands per region indicating type of storage structure

Region 26: Free State South-Eastern Region			
Afgri	Kaallaagte (Bins)	Afgri	Monte Video (Bins)
Afgri	Libertas (Bins)	Afgri	Senekal (Bins)
Afgri	Marquard (Bins)	Senwes	Arlington (Bins)
Afgri	Meets (Bins)	Senwes	Steynsrus (Bins)

Region 27: Free State Northern Region			
Senwes	Gottenburg (Bins)	Senwes	Mooigeleë (Bins)
Senwes	Heilbron (Bins)	Senwes	Wolwehoek (Bins)
Senwes	Hoogte Grainlink (Bins)	VKB	Petrus Steyn (Bins)

Region 29: Mpumalanga Southern Region			
Afgri	Balfour (Bins)	Afgri	Leeuspruit (Bins)
Afgri	Greylingstad (Bins)	Afgri	Platrand (Bins)
Afgri	Grootvlei (Bins)	Afgri	Standerton (Bins)
Afgri	Harvard (Bins)	Afgri	Val (Bins)
Afgri	Holmdene (Bins)		

Region 31: Mpumalanga Central Region			
Afgri	Bakenlaagte (Bunkers)	Afgri	Leslie (Bins)
Afgri	Bethal (Bins)	Afgri	Palmietfontein (Bunkers)
Afgri	Brakfontein (Bunkers)	Afgri	Trichardt (Bins)
Afgri	Devon (Bins)	Afgri	Vaalkrantz (Bunkers)
Afgri	Kinross (Bins/Bunkers)		

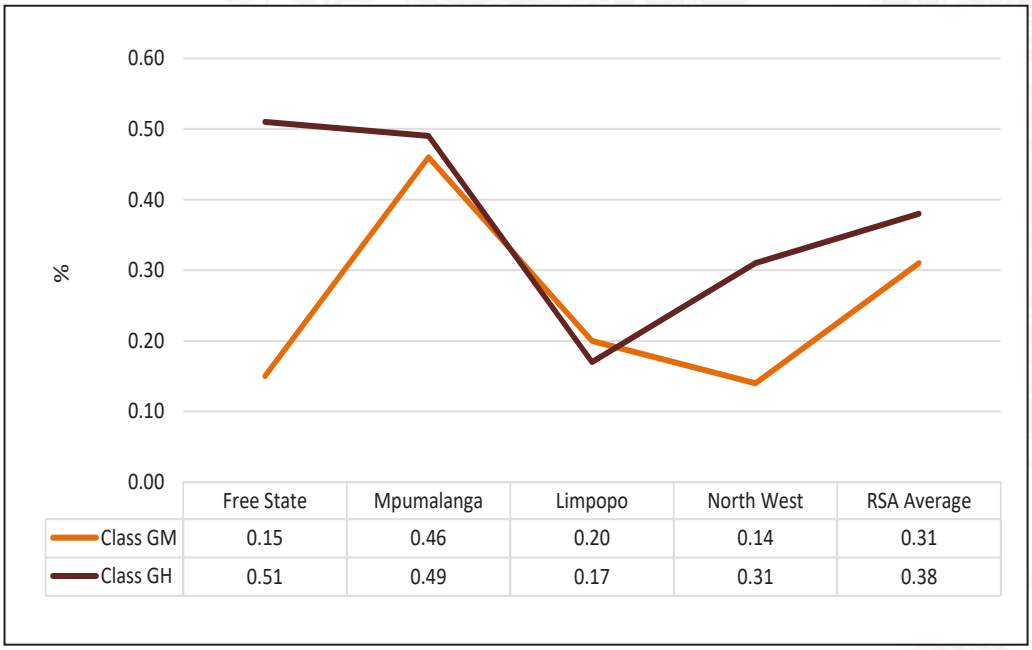
Region 35: Limpopo Region			
Afgri	Northam (Bins)	NTK (VKB)	Nylstroom (Modimolle) (Bins)
NTK (VKB)	Alma (Bins)	NTK (VKB)	Potgietersrus (Mokopane) (Bins)
NTK (VKB)	Lehau (Bins)	NTK (VKB)	Roedtan (Bins)
NTK (VKB)	Naboomspruit (Mookgophong) (Bins)	NTK (VKB)	Settlers (Bins)
NTK (VKB)	Nutfield (Bins)	NTK (VKB)	Warmbad Bela-Bela (Bins)

Sorghum Crop Quality 2017/2018– Summary of results

Sixty-four percent (27) of the 42 samples analysed for the purpose of this survey were determined to be class GM. Of these, 82% were graded as Grade GM1, 7% GM2 and 11% GM3. The remaining 15 samples were all class GH. Eleven (73%) of these samples were graded GH1 and four were graded GH2.

Please see Graphs 16 to 18 for the weighted average percentages foreign matter, defective sorghum and small kernel sorghum per class per province. Mpumalanga (13 samples) had the highest percentage foreign matter for GM sorghum, while both the Free State (5 samples) and Mpumalanga (2 samples) showed high foreign matter percentages for GH sorghum.

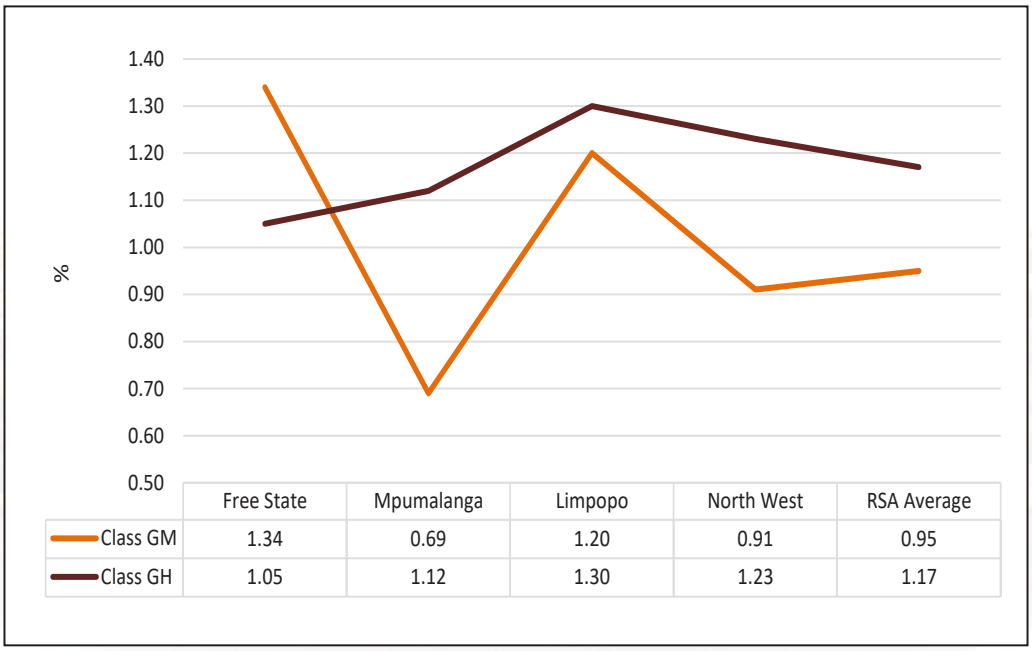
Graph 16: Average percentage foreign matter per class per province



	Free State	Mpumalanga	Limpopo	North West	RSA Average
Class GM	0.15	0.46	0.20	0.14	0.31
Class GH	0.51	0.49	0.17	0.31	0.38

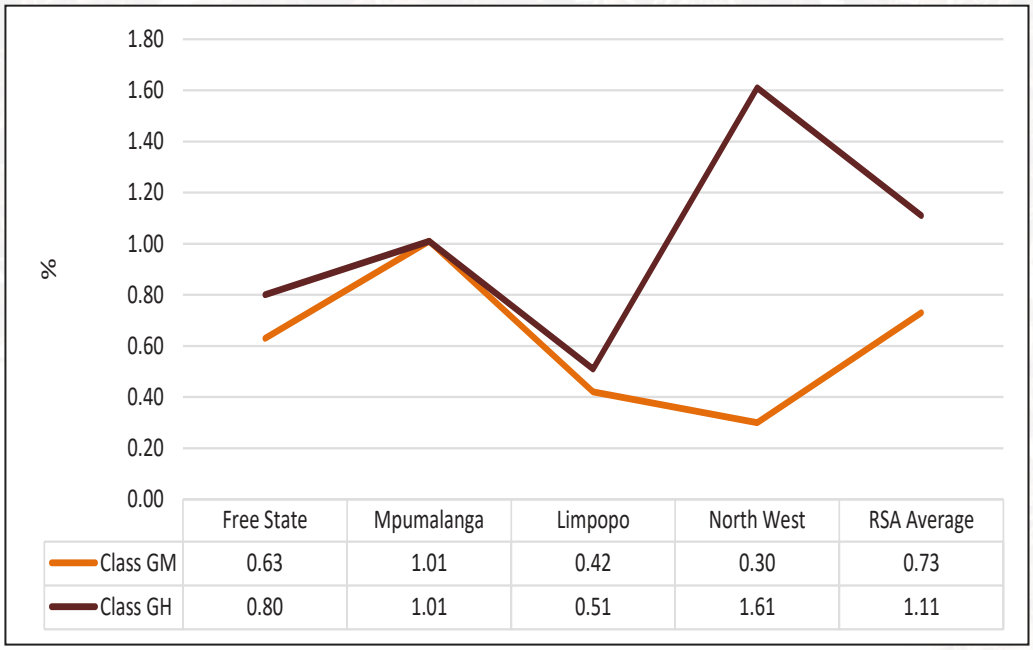
The percentage defective GH sorghum was the highest in all the provinces except for the Free State. GH sorghum also showed the highest percentages small kernels, with the six samples from North West having the highest average of 1.61%. GM sorghum had the lowest percentage small kernels in North West.

Graph 17: Average percentage defective sorghum per class per province



	Free State	Mpumalanga	Limpopo	North West	RSA Average
Class GM	1.34	0.69	1.20	0.91	0.95
Class GH	1.05	1.12	1.30	1.23	1.17

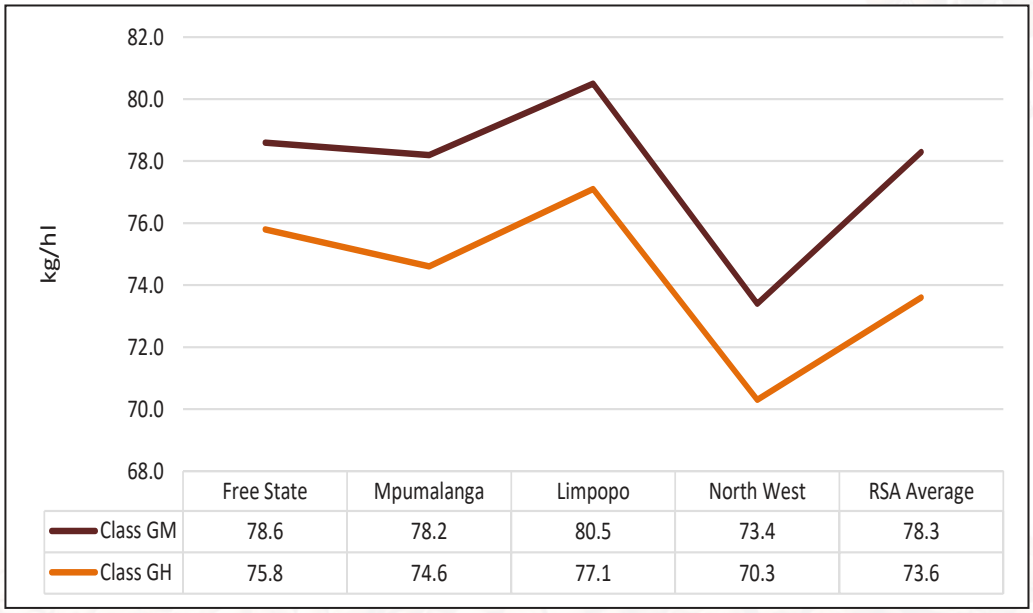
Graph 18: Average percentage small kernel sorghum per class per province



	Free State	Mpumalanga	Limpopo	North West	RSA Average
Class GM	0.63	1.01	0.42	0.30	0.73
Class GH	0.80	1.01	0.51	1.61	1.11

Although GM sorghum had the highest average test weights in all of the provinces, the distribution of the values for both GM and GH showed the same trend over provinces. Please refer to Graph 19. Test weight values for GM sorghum ranged between 71.7 and 82.3 kg/hl, while GH values ranged between a low of 54.1 kg/hl (one sample from North West province) to a high of 79.4 kg/hl. Test weight was determined on unscreened samples.

Graph 19: Average test weight per class per province



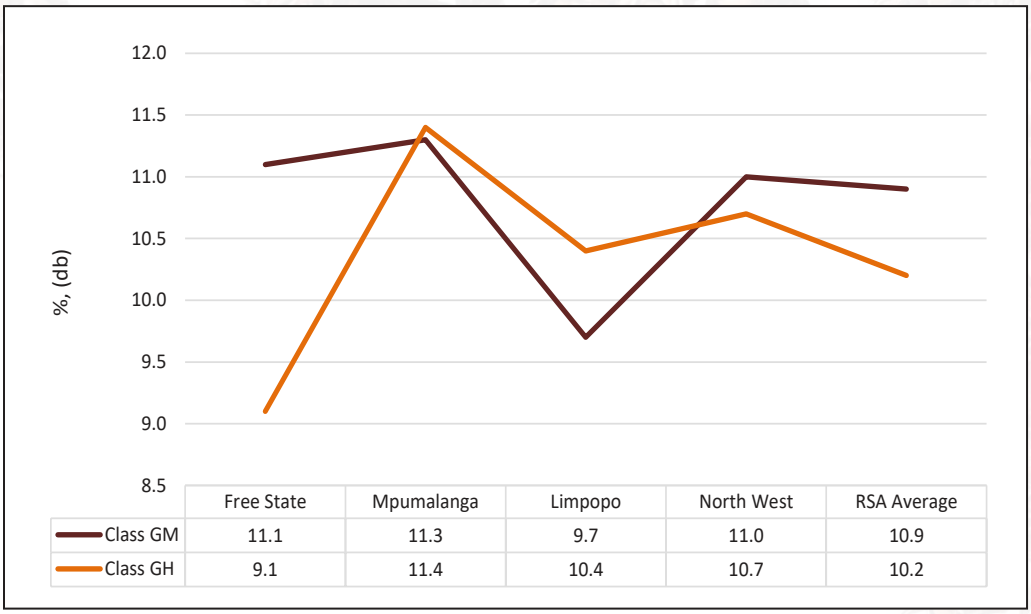
	Free State	Mpumalanga	Limpopo	North West	RSA Average
Class GM	78.6	78.2	80.5	73.4	78.3
Class GH	75.8	74.6	77.1	70.3	73.6

GM sorghum also had the highest 1 000 kernel mass values on average, ranging between 19.9 and 31.3 g (14% moisture basis) and averaging 25.5 g. GH sorghum averaged 22.3 g and varied between 17.0 and 27.8 g.

The image analysis results showed that the GM sorghum has slightly longer and wider kernels than the GH sorghum. The variation (indicated by the standard deviation) in these parameters is similar for both GM and GH sorghum. Kernel roundness, defined as W/L% (width divided by length, expressed as a percentage) showed a wider variation. A totally round kernel will have a W/L% of 100.

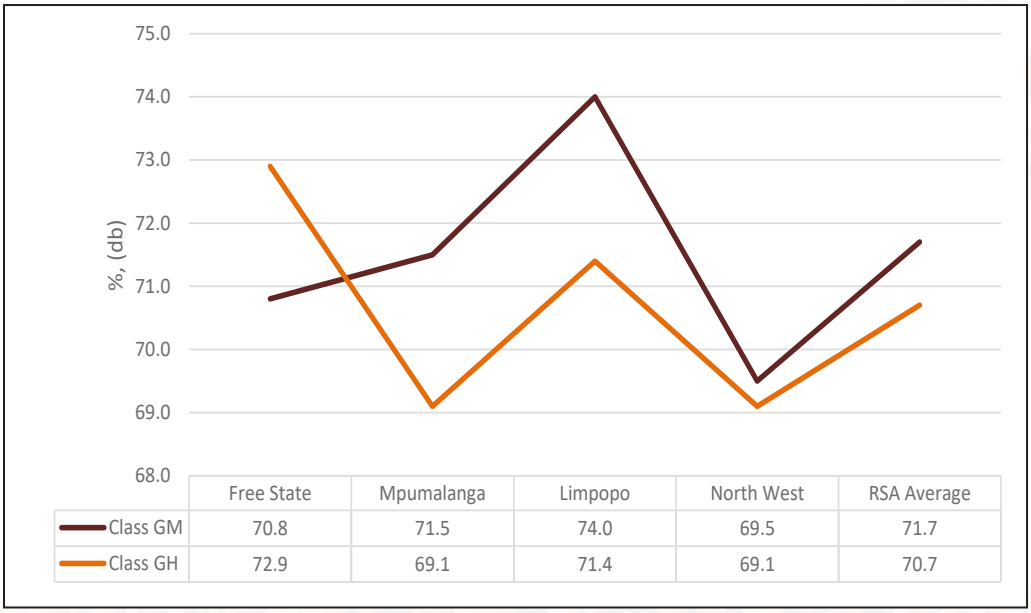
The crude protein and total starch contents of the samples were calculated and reported on a dry basis. Mpumalanga had the highest protein averages for both GM and GH sorghum. The highest total starch content for GM sorghum was reported in Limpopo, while the Free State had the highest total starch content for GH sorghum. Please see Graphs 20 and 21.

Graph 20: Average percentage crude protein per class per province



	Free State	Mpumalanga	Limpopo	North West	RSA Average
Class GM	11.1	11.3	9.7	11.0	10.9
Class GH	9.1	11.4	10.4	10.7	10.2

Graph 21: Average percentage total starch per class per province



	Free State	Mpumalanga	Limpopo	North West	RSA Average
Class GM	70.8	71.5	74.0	69.5	71.7
Class GH	72.9	69.1	71.4	69.1	70.7

Hunterlab colour determinations were done on a milled fraction of dehulled sample above the 1.8 mm slotted sieve. Please see the comparison of the Hunter L a b values obtained below. The average and range (in brackets) are provided:
GM sorghum: L 73.81 (67.49 – 83.08), a 4.43 (1.68 – 5.62) and b 10.17 (8.00 – 11.52)
GH sorghum: L 70.00 (66.17 – 73.93), a 4.71 (3.78 – 5.47) and b 9.16 (7.91 – 10.49)
Although there are currently no acceptable ranges for these parameters defined, the colour must be within the consumer-acceptable range, which traditionally are products with a slightly pink hue. Not only the dehulling process, but also other traits such as pigmentation differences determines the end product colour.

Mycotoxin analyses were performed on all 42 sorghum crop samples. The samples were tested by means of a SANAS ISO/IEC 17025 accredited multi-mycotoxin screening method using UPLC-MS/MS. With this technique simultaneous quantification and confirmation of Aflatoxin B_1; B_2; G_1; G_2, Fumonisin B_1; B_2; B_3, Deoxynivalenol, 15-ADON, HT-2 Toxin, T-2 Toxin, Zearalenone and Ochratoxin A is possible in one run. None of the samples tested positive for any of these mycotoxins. Please see mycotoxin results in Table 10 on pages 28 to 29.

The Methods section of this report on pages 31 to 32 provide a description of the procedures and methodologies followed.

Please see Table 3 on page 19 for a summary of the South African crop quality averages per class and grade.

The Sorghum Trust requested SAGL to also monitor the quality of all sorghum imported into South Africa. A subsample of all samples drawn by inspectors of the South African Agricultural Food, Quarantine and Inspection Services (SAAFQIS) of the Department of Agriculture, Forestry and Fisheries (DAFF) is forwarded to the SAGL for analysis. To assist with quality comparisons between local and imported sorghum, the same scope of analysis is used for both sets of samples.

SAGL received four sorghum samples that were sampled from May to August of 2018. Please see Table 11 on page 30 for a comparison of the quality of imported and local sorghum.

Table 3: South African Sorghum Crop Quality Averages 2017/2018 season								
Class sorghum		**GM**				**GH**		
Grade sorghum		**GM1**	**GM2**	**GM3**	**Weighted Average**	**GH1**	**GH2**	**Weighted Average**
Grading								
Foreign matter, %		0.28	0.94	0.09	0.31	0.34	0.50	0.38
Unthreshed sorghum, %		0.40	2.58	2.68	0.82	0.90	2.23	1.25
Defective sorghum, %		0.91	0.78	1.35	0.95	1.08	1.40	1.17
Small kernel sorghum, %		0.76	0.95	0.37	0.73	0.65	2.39	1.11
Total defective sorghum and small kernel sorghum, %		1.67	1.73	1.72	1.68	1.73	3.79	2.28
Sorghum of another group, %		0.17	0.08	0.00	0.14	0.07	13.77	3.72
White sorghum, %		0.02	0.00	66.72	7.43	0.01	0.00	0.01
Total of sorghum of another group and white sorghum, %		0.21	0.08	66.72	7.59	0.08	13.77	3.73
Weather-stained sorghum, %		0.99	1.45	2.17	1.15	0.64	1.12	0.77
Physical parameters								
Test weight, kg/hl		78.4	78.0	77.6	78.3	75.5	68.3	73.6
1000 Kernel Mass, g (14% moisture base)		25.5	25.7	25.0	25.5	23.1	19.9	22.3
# Image analysis	Length, mm	4.50	4.59	4.31	4.48	4.17	4.27	4.19
	Standard Deviation	0.34	0.33	0.30	0.33	0.33	0.36	0.34
	Width, mm	3.97	4.04	3.86	3.97	3.77	3.76	3.77
	Standard Deviation	0.31	0.31	0.28	0.31	0.30	0.30	0.30
	Roundness, %	89	88	90	89	91	88	90
	Standard Deviation	5.1	5.2	5.0	5.1	5.0	6.7	5.5
	Surface Area, %	72	73	69	71	67	68	67
	Standard Deviation	5.1	5.0	4.5	5.0	5.0	4.9	5.0
Chemical composition								
Moisture, %		11.4	11.6	11.2	11.4	11.7	11.5	11.6
Protein, % (db)		11.0	11.9	9.0	10.9	10.1	10.3	10.2
Starch content, % (db)		71.6	70.6	73.3	71.7	71.4	68.5	70.7
Hunterlab colour (fraction of dehulled sample above the 1.8 mm slotted sieve milled on Retch mill through 0.5 mm sieve)	L	73.59	70.49	77.70	73.81	69.73	70.75	70.00
	a	4.55	5.07	3.12	4.43	4.69	4.78	4.71
	b	10.12	9.79	10.86	10.17	9.01	9.58	9.16
Number of samples		***22***	***2***	***3***	***27***	***11***	***4***	***15***

TABLE 4: GRADING RESULTS OF SORGHUM ACCORDING TO GRADE (2017/2018)

Number of samples	Region	Foreign matter			Unthreshed sorghum			Defective sorghum			Small kernel sorghum			Total of defective sorghum and small kernel sorghum			Sorghum of another group			White sorghum			Total of Sorghum of another group and White Sorghum			Wheather-Stained Sorghum		
		ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.
GRADE: GM1																												
3	Region 18	0.14	0.12	0.16	0.79	0.26	1.08	0.91	0.70	1.02	0.30	0.26	0.34	1.21	1.00	1.36	0.29	0.00	0.64	0.00	0.00	0.00	0.29	0.00	0.64	1.92	0.70	3.15
1	Region 24	0.32	-	-	0.12	-	-	1.66	-	-	0.62	-	-	2.28	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.44	-	-
1	Region 26	0.10	-	-	0.12	-	-	1.72	-	-	2.04	-	-	3.76	-	-	0.00	-	-	0.00	-	-	0.10	-	-	0.32	-	-
2	Region 27	0.08	0.06	0.10	0.28	0.16	0.40	1.19	0.94	1.44	0.17	0.16	0.17	1.36	1.11	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.97	1.70	2.23
9	Region 29	0.43	0.06	0.94	0.30	0.08	1.36	0.65	0.12	1.48	1.07	0.21	2.85	1.71	0.68	3.15	0.12	0.00	0.40	0.01	0.00	0.08	0.16	0.00	0.40	0.95	0.08	3.10
1	Region 31	0.16	-	-	0.56	-	-	0.16	-	-	1.14	-	-	1.30	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.40	-	-
5	Region 35	0.23	0.08	0.42	0.48	0.32	0.72	1.09	0.98	1.22	0.42	0.22	0.82	1.51	1.30	1.80	0.35	0.00	0.72	0.07	0.00	0.36	0.42	0.00	1.08	0.47	0.18	0.62
22	**Ave. GM1**	**0.28**			**0.40**			**0.91**			**0.76**			**1.67**			**0.17**			**0.02**			**0.21**			**0.99**		
	Min. GM1		**0.06**			**0.08**			**0.12**			**0.16**			**0.68**			**0.00**			**0.00**			**0.00**			**0.08**	
	Max. GM1			**0.94**			**1.36**			**1.72**			**2.85**			**3.76**			**0.72**			**0.36**			**1.08**			**3.15**
GRADE: GM2																												
1	Region 27	0.18	-	-	4.84	-	-	0.92	-	-	0.19	-	-	1.11	-	-	0.16	-	-	0.00	-	-	0.16	-	-	1.10	-	-
1	Region 29	1.70	-	-	0.32	-	-	0.64	-	-	1.70	-	-	2.34	-	-	0.00	-	-	0.00	-	-	0.00	-	-	1.80	-	-
2	**Ave. GM2**	**0.94**			**2.58**			**0.78**			**0.95**			**1.73**			**0.08**			**0.00**			**0.08**			**1.45**		
	Min. GM2		**0.18**			**0.32**			**0.64**			**0.19**			**1.11**			**0.00**			**0.00**			**0.00**			**1.10**	
	Max. GM2			**1.70**			**4.84**			**0.92**			**1.70**			**2.34**			**0.16**			**0.00**			**0.16**			**1.80**
GRADE: GM3																												
2	Region 29	0.09	0.08	0.10	3.44	0.16	6.72	1.16	0.92	1.40	0.37	0.21	0.52	1.53	1.44	1.61	0.00	0.00	0.00	50.08	0.16	100.00	50.08	0.16	100.00	2.60	0.80	4.40
1	Region 35	0.08	-	-	1.16	-	-	1.72	-	-	0.39	-	-	2.11	-	-	0.00	-	-	100.00	-	-	100.00	-	-	1.30	-	-
3	**Ave. GM3**	**0.09**			**2.68**			**1.35**			**0.37**			**1.72**			**0.00**			**66.72**			**66.72**			**2.17**		
	Min. GM3		**0.08**			**0.16**			**0.92**			**0.21**			**1.44**			**0.00**			**0.16**			**0.16**			**0.80**	
	Max. GM3			**0.10**			**6.72**			**1.72**			**0.52**			**2.11**			**0.00**			**100.00**			**100.00**			**4.40**

TABLE 4: GRADING RESULTS OF SORGHUM ACCORDING TO GRADE (2017/2018) (continue)

Number of samples	Region	Foreign matter			Unthreshed sorghum			Defective sorghum			Small kernel sorghum			Total of defective sorghum and small kernel sorghum			Sorghum of another group			White sorghum			Total of Sorghum of another group and White Sorghum			Wheather-Stained Sorghum		
		ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.
GRADE: GH1																												
1	Region 18	0.20	-	-	2.20	-	-	0.92	-	-	0.68	-	-	1.60	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.62	-	-
1	Region 19	0.26	-	-	0.64	-	-	0.98	-	-	0.24	-	-	1.22	-	-	0.16	-	-	0.00	-	-	0.16	-	-	0.32	-	-
1	Region 20	0.16	-	-	0.22	-	-	0.36	-	-	0.22	-	-	0.58	-	-	0.16	-	-	0.00	-	-	0.16	-	-	0.54	-	-
1	Region 21	0.32	-	-	1.02	-	-	1.28	-	-	1.02	-	-	2.30	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.48	-	-
3	Region 24	0.50	0.38	0.60	0.79	0.76	0.84	1.17	1.08	1.24	0.65	0.34	0.86	1.83	1.54	2.00	0.09	0.00	0.16	0.04	0.00	0.12	0.13	0.00	0.24	0.61	0.50	0.84
2	Region 29	0.49	0.08	0.90	1.44	1.04	1.84	1.12	1.00	1.24	1.01	0.24	1.77	2.13	1.48	2.77	0.08	0.00	0.16	0.00	0.00	0.00	0.08	0.00	0.16	1.25	0.80	1.70
2	Region 35	0.17	0.06	0.28	0.28	0.18	0.38	1.30	0.82	1.78	0.51	0.25	0.76	1.81	1.58	2.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.24	0.48
11	**Ave. GH1**	**0.34**			**0.90**			**1.08**			**0.65**			**1.73**			**0.07**			**0.01**			**0.08**			**0.64**		
	Min. GH1		**0.06**			**0.18**			**0.36**			**0.22**			**0.58**			**0.00**			**0.00**			**0.00**			**0.24**	
	Max. GH1			**0.09**			**2.20**			**1.78**			**1.77**			**2.77**			**0.16**			**0.12**			**0.24**			**1.70**
GRADE: GH2																												
1	Region 17	0.98	-	-	2.88	-	-	3.64	-	-	7.06	-	-	10.70	-	-	0.00	-	-	0.00	-	-	0.00	-	-	1.58	-	-
1	Region 18	0.16	-	-	1.14	-	-	1.12	-	-	0.18	-	-	1.30	-	-	32.46	-	-	0.00	-	-	32.46	-	-	1.97	-	-
1	Region 20	0.12	-	-	4.52	-	-	0.36	-	-	1.28	-	-	1.64	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.32	-	-
1	Region 27	0.74	-	-	0.38	-	-	0.48	-	-	1.02	-	-	1.50	-	-	22.60	-	-	0.00	-	-	22.60	-	-	0.62	-	-
4	**Ave. GH2**	**0.50**			**2.23**			**1.40**			**2.39**			**3.79**			**13.77**			**0.00**			**13.77**			**1.12**		
	Min. GH2		**0.12**			**0.38**			**0.36**			**0.18**			**1.30**			**0.00**			**0.00**			**0.00**			**0.32**	
	Max. GH2			**0.98**			**4.52**			**3.64**			**7.06**			**10.70**			**32.46**			**0.00**			**32.46**			**1.97**
42	**Ave. sorghum**	**0.33**			**0.97**			**1.03**			**0.87**			**1.89**			**1.42**			**4.78**			**6.21**			**1.02**		
	Min. sorghum		**0.06**			**0.08**			**0.12**			**0.16**			**0.58**			**0.00**			**0.00**			**0.00**			**0.08**	
	Max. sorghum			**1.70**			**6.72**			**3.64**			**7.06**			**10.70**			**32.46**			**100.0**			**100.00**			**4.40**

TABLE 5: GRADING RESULTS OF SORGHUM ACCORDING TO CLASS (2017/2018)

Number of samples	Region	Foreign matter			Unthreshed sorghum			Defective sorghum			Small kernel sorghum			Total of defective sorghum and small kernel sorghum			Sorghum of another group			White sorghum			Total of Sorghum of another group and White Sorghum			Wheather-Stained Sorghum		
		ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.
GRADE: GM																												
3	Region 18	0.14	0.12	0.16	0.79	0.26	1.08	0.91	0.70	1.02	0.30	0.26	0.34	1.21	1.00	1.36	0.29	0.00	0.64	0.00	0.00	0.00	0.29	0.00	0.64	1.92	0.70	3.15
1	Region 24	0.32	-	-	0.12	-	-	1.66	-	-	0.62	-	-	2.28	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.44	-	-
1	Region 26	0.10	-	-	0.12	-	-	1.72	-	-	2.04	-	-	3.76	-	-	0.00	-	-	0.00	-	-	0.10	-	-	0.32	-	-
3	Region 27	0.11	0.06	0.18	1.80	0.16	4.84	1.10	0.92	1.44	0.17	0.16	0.19	1.27	1.11	1.60	0.05	0.00	0.16	0.00	0.00	0.00	0.05	0.00	0.16	1.68	1.10	2.23
12	Region 29	0.48	0.06	1.70	0.83	0.08	6.72	0.73	0.12	1.48	1.00	0.21	2.85	1.74	0.68	3.15	0.09	0.00	0.40	8.35	0.00	100.00	8.47	0.00	100.00	1.30	0.08	4.40
1	Region 31	0.16	-	-	0.56	-	-	0.16	-	-	1.14	-	-	1.30	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.40	-	-
6	Region 35	0.20	0.08	0.42	0.60	0.32	1.16	1.20	0.98	1.72	0.42	0.22	0.82	1.61	1.30	2.11	0.29	0.00	0.72	16.73	0.00	100.00	17.02	0.00	100.00	0.61	0.18	1.30
27	**Ave. GM**	**0.31**			**0.82**			**0.95**			**0.73**			**1.68**			**0.14**			**7.43**			**7.59**			**1.15**		
	Min. GM		**0.06**			**0.08**			**0.12**			**0.16**			**0.68**			**0.00**			**0.00**			**0.00**			**0.08**	
	Max. GM			**1.70**			**6.72**			**1.72**			**2.85**			**3.76**			**0.72**			**100.00**			**100.00**			**4.40**
GRADE: GH																												
1	Region 17	0.98	-	-	2.88	-	-	3.64	-	-	7.06	-	-	10.70	-	-	0.00	-	-	0.00	-	-	0.00	-	-	1.58	-	-
2	Region 18	0.18	0.16	0.20	1.67	1.14	2.20	1.02	0.92	1.12	0.43	0.18	0.68	1.45	1.30	1.60	16.23	0.00	32.46	0.00	0.00	0.00	16.23	0.00	32.46	1.30	0.62	1.97
1	Region 19	0.26	-	-	0.64	-	-	0.98	-	-	0.24	-	-	1.22	-	-	0.16	-	-	0.00	-	-	0.16	-	-	0.32	-	-
2	Region 20	0.14	0.12	0.16	2.37	0.22	4.52	0.36	0.36	0.36	0.75	0.22	1.28	1.11	0.58	1.64	0.08	0.00	0.16	0.00	0.00	0.00	0.08	0.00	0.16	0.43	0.32	0.54
1	Region 21	0.32	-	-	1.02	-	-	1.28	-	-	1.02	-	-	2.30	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.48	-	-
3	Region 24	0.50	0.38	0.60	0.79	0.76	0.84	1.17	1.08	1.24	0.65	0.34	0.86	1.83	1.54	2.00	0.09	0.00	0.16	0.04	0.00	0.12	0.13	0.00	0.24	0.61	0.50	0.84
1	Region 27	0.74	-	-	0.38	-	-	0.48	-	-	1.02	-	-	1.50	-	-	22.60	-	-	0.00	-	-	22.60	-	-	0.62	-	-
2	Region 29	0.49	0.08	0.90	1.44	1.04	1.84	1.12	1.00	1.24	1.01	0.24	1.77	2.13	1.48	2.77	0.08	0.00	0.16	0.00	0.00	0.00	0.08	0.00	0.16	1.25	0.80	1.70
2	Region 35	0.17	0.06	0.28	0.28	0.18	0.38	1.30	0.82	1.78	0.51	0.25	0.76	1.81	1.58	2.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.24	0.48
15	**Ave. GH**	**0.38**			**1.25**			**1.17**			**1.11**			**2.28**			**3.72**			**0.01**			**3.73**			**0.77**		
	Min. GH		**0.06**			**0.18**			**0.36**			**0.18**			**0.58**			**0.00**			**0.00**			**0.00**			**0.24**	
	Max. GH			**0.98**			**4.52**			**3.64**			**7.06**			**10.70**			**32.46**			**0.12**			**32.46**			**1.97**

TABLE 6: PHYSICAL PARAMETERS & IMAGE ANALYSIS OF SORGHUM ACCORDING TO GRADE (2017/2018)

Number of samples	Region	Test weight, kg/hl			1000 Kernel mass, g			Image Analysis Length (mm) Average			Image Analysis Length (mm) Std Dev			Width (mm) Average			Width (mm) Std Dev			Relative Roundness (%) Average			Relative Roundness (%) Std Dev			Volume to surface ratio (%) Average			Volume to surface ratio (%) Std Dev		
		ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.
GRADE: GM1																														
3	Region 18	73.4	71.7	75.8	21.7	19.9	24.5	4.60	4.48	4.69	0.36	0.33	0.38	3.95	3.78	4.17	0.29	0.26	0.32	86	82	89	5.3	5.0	5.7	72	71	75	4.9	4.3	5.3
1	Region 24	80.3	-	-	25.1	-	-	4.29	-	-	0.32	-	-	3.91	-	-	0.32	-	-	91	-	-	4.2	-	-	69	-	-	4.9	-	-
1	Region 26	80.7	-	-	22.3	-	-	4.15	-	-	0.35	-	-	3.80	-	-	0.34	-	-	92	-	-	5.5	-	-	67	-	-	5.5	-	-
2	Region 27	78.2	77.5	78.9	26.1	25.0	27.2	4.61	4.59	4.63	0.30	0.29	0.31	4.13	4.06	4.19	0.28	0.23	0.32	90	89	91	4.7	4.7	4.7	74	73	74	4.5	4.0	4.9
9	Region 29	78.5	76.0	82.3	25.6	23.2	29.5	4.48	4.12	4.71	0.34	0.28	0.42	3.98	3.73	4.20	0.33	0.28	0.40	89	87	91	5.1	4.4	5.7	71	66	75	5.2	4.4	6.6
1	Region 31	77.5	-	-	26.0	-	-	4.57	-	-	0.37	-	-	4.01	-	-	0.31	-	-	88	-	-	5.1	-	-	73	-	-	5.4	-	-
5	Region 35	80.6	78.9	82.1	28.0	21.6	31.3	4.52	4.32	4.80	0.33	0.28	0.38	3.96	3.75	4.17	0.30	0.23	0.43	88	84	91	5.3	4.3	6.1	72	68	75	4.9	4.1	6.5
22	**Ave. GM1**	**78.4**			**25.5**			**4.50**			**0.34**			**3.97**			**0.31**			**89**			**5.1**			**72**			**5.1**		
	Min. GM1		**71.7**			**19.9**			**4.12**			**0.28**			**3.73**			**0.23**			**82**			**4.2**			**66**			**4.0**	
	Max. GM1			**82.3**			**31.3**			**4.80**			**0.42**			**4.20**			**0.43**			**92**			**6.1**			**75**			**6.6**
GRADE: GM2																														
1	Region 27	75.7	-	-	24.4	-	-	4.67	-	-	0.30	-	-	4.07	-	-	0.29	-	-	87	-	-	5.2	-	-	74	-	-	4.5	-	-
1	Region 29	80.3	-	-	27.0	-	-	4.51	-	-	0.36	-	-	4.01	-	-	0.33	-	-	89	-	-	5.3	-	-	72	-	-	5.4	-	-
2	**Ave. GM2**	**78.0**			**25.7**			**4.59**			**0.33**			**4.04**			**0.31**			**88**			**5.2**			**73**			**5.0**		
	Min. GM2		**75.7**			**24.4**			**4.51**			**0.30**			**4.01**			**0.29**			**87**			**5.2**			**72**			**4.5**	
	Max. GM2			**80.3**			**27.0**			**4.67**			**0.36**			**4.07**			**0.33**			**89**			**5.3**			**74**			**5.4**
GRADE: GM3																														
2	Region 29	76.4	75.3	77.5	24.7	24.3	25.0	4.27	4.18	4.36	0.31	0.30	0.31	3.87	3.83	3.91	0.30	0.27	0.33	91	90	92	5.2	4.9	5.6	69	67	70	4.7	4.5	5.0
1	Region 35	80.1	-	-	25.8	-	-	4.40	-	-	0.27	-	-	3.85	-	-	0.24	-	-	88	-	-	4.5	-	-	70	-	-	4.0	-	-
3	**Ave. GM3**	**77.6**			**25.0**			**4.31**			**0.30**			**3.86**			**0.28**			**90**			**5.0**			**69**			**4.5**		
	Min. GM3		**75.3**			**24.3**			**4.18**			**0.27**			**3.83**			**0.24**			**88**			**4.5**			**67**			**4.0**	
	Max. GM3			**80.1**			**25.8**			**4.40**			**0.31**			**3.91**			**0.33**			**92**			**5.6**			**70**			**5.0**

TABLE 6: PHYSICAL PARAMETERS & IMAGE ANALYSIS OF SORGHUM ACCORDING TO GRADE (2017/2018) (continue)

Number of samples	Region	Test weight, kg/hl			1000 Kernel mass, g			Image Analysis Length (mm) Average			Image Analysis Length (mm) Std Dev			Width (mm) Average			Width (mm) Std Dev			Relative Roundness (%) Average			Relative Roundness (%) Std Dev			Volume to surface ratio (%) Average			Volume to surface ratio (%) Std Dev		
		ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.
GRADE: GH1																														
1	Region 18	75.4	-	-	23.0	-	-	4.19	-	-	0.37	-	-	3.80	-	-	0.37	-	-	91	-	-	5.2	-	-	67	-	-	5.8	-	-
1	Region 19	74.7	-	-	24.4	-	-	4.22	-	-	0.29	-	-	3.87	-	-	0.22	-	-	92	-	-	4.4	-	-	68	-	-	4.2	-	-
1	Region 20	75.6	-	-	27.8	-	-	4.36	-	-	0.29	-	-	4.06	-	-	0.29	-	-	93	-	-	4.6	-	-	71	-	-	4.6	-	-
1	Region 21	75.6	-	-	21.8	-	-	4.01	-	-	0.30	-	-	3.68	-	-	0.29	-	-	92	-	-	4.0	-	-	65	-	-	4.4	-	-
3	Region 24	75.4	73.8	77.2	21.8	20.7	23.4	4.14	4.11	4.18	0.36	0.30	0.41	3.72	3.70	3.74	0.31	0.27	0.37	90	90	91	5.4	4.8	5.8	66	66	67	5.3	4.7	5.8
2	Region 29	74.6	74.2	74.9	22.3	20.3	24.2	4.09	4.05	4.14	0.30	0.28	0.32	3.71	3.65	3.77	0.27	0.25	0.30	91	90	91	4.9	4.5	5.3	66	65	67	4.5	4.2	4.8
2	Region 35	77.1	74.7	79.4	23.7	23.3	24.1	4.22	4.20	4.23	0.36	0.34	0.37	3.76	3.74	3.77	0.33	0.26	0.40	89	88	90	5.6	5.3	5.9	67	67	67	5.4	4.7	6.2
11	**Ave. GH1**	**75.5**			**23.1**			**4.17**			**0.33**			**3.77**			**0.30**			**91**			**5.0**			**67**			**5.0**		
	Min. GH1		**73.8**			**20.3**			**4.01**			**0.28**			**3.65**			**0.22**			**88**			**4.0**			**65**			**4.2**	
	Max. GH1			**79.4**			**27.8**			**4.36**			**0.41**			**4.06**			**0.40**			**93**			**5.9**			**71**			**6.2**
GRADE: GH2																														
1	Region 17	54.1	-	-	17.0	-	-	4.15	-	-	0.45	-	-	3.64	-	-	0.32	-	-	88	-	-	8.4	-	-	66	-	-	5.0	-	-
1	Region 18	70.9	-	-	19.7	-	-	4.54	-	-	0.39	-	-	3.95	-	-	0.28	-	-	87	-	-	5.9	-	-	72	-	-	5.2	-	-
1	Region 20	71.0	-	-	19.7	-	-	4.11	-	-	0.29	-	-	3.65	-	-	0.30	-	-	89	-	-	5.8	-	-	66	-	-	4.5	-	-
1	Region 27	77.0	-	-	23.2	-	-	4.28	-	-	0.33	-	-	3.78	-	-	0.32	-	-	89	-	-	6.5	-	-	68	-	-	4.8	-	-
4	**Ave. GH2**	**68.3**			**19.9**			**4.27**			**0.36**			**3.76**			**0.30**			**88**			**6.7**			**68**			**4.9**		
	Min. GH2		**54.1**			**17.0**			**4.11**			**0.29**			**3.64**			**0.28**			**87**			**5.8**			**66**			**4.5**	
	Max. GH2			**77.0**			**23.2**			**4.54**			**0.45**			**3.95**			**0.32**			**89**			**8.4**			**72**			**5.2**
42	**Ave. sorghum**	**76.6**			**24.3**			**4.38**			**0.33**			**3.90**			**0.31**			**89**			**5.2**			**70**			**5.0**		
	Min. sorghum		**54.1**			**17.0**			**4.01**			**0.27**			**3.64**			**0.22**			**82**			**4.0**			**65**			**4.0**	
	Max. sorghum			**82.3**			**31.3**			**4.80**			**0.45**			**4.20**			**0.43**			**93**			**8.4**			**75**			**6.6**

TABLE 7: PHYSICAL PARAMETERS & IMAGE ANALYSIS OF SORGHUM ACCORDING TO CLASS (2017/2018)

Number of samples	Region	Test weight, kg/hl			1000 Kernel mass, g			Image Analysis Length (mm) Average			Image Analysis Length (mm) Std Dev			Width (mm) Average			Width (mm) Std Dev			Relative Roundness (%) Average			Relative Roundness (%) Std Dev			Volume to surface ratio (%) Average			Volume to surface ratio (%) Std Dev		
		ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.
GRADE: GM																														
3	Region 18	73.4	71.7	75.8	21.7	19.9	24.5	4.60	4.48	4.69	0.36	0.33	0.38	3.95	3.78	4.17	0.29	0.26	0.32	86	82	89	5.3	5.0	5.7	72	71	74.9	4.9	4.3	5.3
1	Region 24	80.3	-	-	25.1	-	-	4.29	-	-	0.32	-	-	3.91	-	-	0.32	-	-	91	-	-	4.2	-	-	69	-	-	4.9	-	-
1	Region 26	80.7	-	-	22.3	-	-	4.15	-	-	0.35	-	-	3.80	-	-	0.34	-	-	92	-	-	5.5	-	-	67	-	-	5.5	-	-
3	Region 27	77.4	75.7	78.9	25.5	24.4	27.2	4.63	4.59	4.67	0.30	0.29	0.31	4.11	4.06	4.19	0.28	0.23	0.32	89	87	91	4.8	4.7	5.2	74	73	74.4	4.5	4.0	4.9
12	Region 29	78.3	75.3	82.3	25.5	23.2	29.5	4.44	4.12	4.71	0.33	0.28	0.42	3.96	3.73	4.20	0.33	0.27	0.40	89	87	92	5.2	4.4	5.7	71	66	75.0	5.2	4.4	6.6
1	Region 31	77.5	-	-	26.0	-	-	4.57	-	-	0.37	-	-	4.01	-	-	0.31	-	-	88	-	-	5.1	-	-	73	-	-	5.4	-	-
6	Region 35	80.5	78.9	82.1	27.7	21.6	31.3	4.50	4.32	4.80	0.32	0.27	0.38	3.94	3.75	4.17	0.29	0.23	0.43	88	84	91	5.2	4.3	6.1	71	68	75.0	4.8	4.0	6.5
27	**Ave. GM**	**78.3**			**25.5**			**4.48**			**0.33**			**3.97**			**0.31**			**89**			**5.1**			**71**			**5.0**		
	Min. GM		**71.7**			**19.9**			**4.12**			**0.27**			**3.73**			**0.23**			**82**			**4.2**			**66**			**4.0**	
	Max. GM			**82.3**			**31.3**			**4.80**			**0.42**			**4.20**			**0.43**			**92**			**6.1**			**75**			**6.6**
GRADE: GH																														
1	Region 17	54.1	-	-	17.0	-	-	4.15	-	-	0.45	-	-	3.64	-	-	0.32	-	-	88	-	-	8.4	-	-	66	-	-	5.0	-	-
2	Region 18	73.2	70.9	75.4	21.4	19.7	23.0	4.37	4.19	4.54	0.38	0.37	0.39	3.87	3.80	3.95	0.32	0.28	0.37	89	87	91	5.5	5.2	5.9	70	67	72	5.5	5.2	5.8
1	Region 19	74.7	-	-	24.4	-	-	4.22	-	-	0.29	-	-	3.87	-	-	0.22	-	-	92	-	-	4.4	-	-	68	-	-	4.2	-	-
2	Region 20	73.3	71.0	75.6	23.8	19.7	27.8	4.24	4.11	4.36	0.29	0.29	0.29	3.86	3.65	4.06	0.30	0.29	0.30	91	89	93	5.2	4.6	5.8	68	66	71	4.5	4.5	4.6
1	Region 21	75.6	-	-	21.8	-	-	4.01	-	-	0.30	-	-	3.68	-	-	0.29	-	-	92	-	-	4.0	-	-	65	-	-	4.4	-	-
3	Region 24	75.4	73.8	77.2	21.8	20.7	23.4	4.14	4.11	4.18	0.36	0.30	0.41	3.72	3.70	3.74	0.31	0.27	0.37	90	90	91	5.4	4.8	5.8	66	66	67	5.3	4.7	5.8
1	Region 27	77.0	-	-	23.2	-	-	4.28	-	-	0.33	-	-	3.78	-	-	0.32	-	-	89	-	-	6.5	-	-	68	-	-	4.8	-	-
2	Region 29	74.6	74.2	74.9	22.3	20.3	24.2	4.09	4.05	4.14	0.30	0.28	0.32	3.71	3.65	3.77	0.27	0.25	0.30	91	90	91	4.9	4.5	5.3	66	65	67	4.5	4.2	4.8
2	Region 35	77.1	74.7	79.4	23.7	23.3	24.1	4.22	4.20	4.23	0.36	0.34	0.37	3.76	3.74	3.77	0.33	0.26	0.40	89	88	90	5.6	5.3	5.9	67	67	67	5.4	4.7	6.2
15	**Ave. GH**	**73.6**			**22.3**			**4.19**			**0.34**			**3.77**			**0.30**			**90**			**5.5**			**67**			**5.0**		
	Min. GH		**54.1**			**17.0**			**4.01**			**0.28**			**3.64**			**0.22**			**87**			**4.0**			**65**			**4.2**	
	Max. GH			**79.4**			**27.8**			**4.54**			**0.45**			**4.06**			**0.40**			**93**			**8.4**			**72**			**6.2**

TABLE 8: CHEMICAL COMPOSITION OF SORGHUM ACCORDING TO GRADE (2017/2018)

Number of samples	Region	Moisture, %			Protein, % (db)			Starch content, % (db)			Hunterlab Colour								
											L			a			b		
		ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.
GRADE: GM1																			
3	Region 18	11.7	11.3	12.0	11.0	10.1	12.5	69.5	69.2	70.1	68.35	67.49	69.56	5.25	4.81	5.47	8.66	8.00	9.30
1	Region 24	11.2	-	-	9.8	-	-	73.1	-	-	73.57	-	-	4.75	-	-	9.65	-	-
1	Region 26	11.3	-	-	9.1	-	-	77.3	-	-	76.39	-	-	4.41	-	-	9.90	-	-
2	Region 27	12.4	12.1	12.7	12.3	11.6	13.0	67.8	67.5	68.0	70.69	69.51	71.87	5.06	4.50	5.62	9.64	8.94	10.34
9	Region 29	11.3	11.2	11.4	11.5	9.6	12.8	71.5	69.6	73.3	73.19	71.39	77.36	4.63	4.01	5.02	10.42	10.10	10.84
1	Region 31	11.6	-	-	12.1	-	-	70.2	-	-	76.10	-	-	4.00	-	-	10.11	-	-
5	Region 35	11.2	10.9	12.0	10.3	9.2	11.3	73.4	72.4	75.4	77.54	76.07	79.06	3.89	3.67	4.14	10.76	10.22	11.27
22	**Ave. GM1**	**11.4**			**11.0**			**71.6**			**73.59**			**4.55**			**10.12**		
	Min. GM1		**10.9**			**9.1**			**67.5**			**67.49**			**3.67**			**8.00**	
	Max. GM1			**12.7**			**13.0**			**77.3**			**79.06**			**5.62**			**11.27**
GRADE: GM2																			
1	Region 27	12.0	-	-	12.0	-	-	68.1	-	-	69.87	-	-	5.14	-	-	9.39	-	-
1	Region 29	11.2	-	-	11.7	-	-	73.1	-	-	71.10	-	-	4.99	-	-	10.19	-	-
2	**Ave. GM2**	**11.6**			**11.9**			**70.6**			**70.49**			**5.07**			**9.79**		
	Min. GM2		**11.2**			**11.7**			**68.1**			**69.87**			**4.99**			**9.39**	
	Max. GM2			**12.0**			**12.0**			**73.1**			**71.10**			**5.14**			**10.19**
GRADE: GM3																			
2	Region 29	11.1	11.1	11.1	10.0	10.0	10.0	71.4	70.9	71.9	75.02	71.92	78.11	3.84	2.32	5.35	10.54	9.59	11.48
1	Region 35	11.3	-	-	6.9	-	-	77.2	-	-	83.08	-	-	1.68	-	-	11.52	-	-
3	**Ave. GM3**	**11.2**			**9.0**			**73.3**			**77.70**			**3.12**			**10.86**		
	Min. GM3		**11.1**			**6.9**			**70.9**			**71.92**			**1.68**			**9.59**	
	Max. GM3			**11.3**			**10.0**			**77.2**			**83.08**			**5.35**			**11.52**
GRADE: GH1																			
1	Region 18	11.4	-	-	9.1	-	-	71.5	-	-	67.41	-	-	5.16	-	-	9.95	-	-
1	Region 19	12.0	-	-	10.9	-	-	73.3	-	-	73.19	-	-	3.78	-	-	8.73	-	-
1	Region 20	11.9	-	-	11.5	-	-	70.9	-	-	66.90	-	-	5.47	-	-	9.51	-	-
1	Region 21	12.4	-	-	9.7	-	-	71.3	-	-	69.78	-	-	4.35	-	-	7.91	-	-
3	Region 24	11.6	11.5	11.9	8.9	8.6	9.3	72.6	71.2	74.5	70.46	69.51	71.87	4.66	4.21	4.93	8.46	8.13	8.65
2	Region 29	11.5	11.4	11.6	11.4	11.3	11.5	69.1	69.0	69.2	68.20	66.17	70.22	4.93	4.46	5.39	9.33	8.78	9.87
2	Region 35	11.5	11.4	11.6	10.4	8.6	12.3	71.4	67.6	75.1	71.00	68.46	73.54	4.50	3.87	5.12	9.49	9.06	9.92
11	**Ave. GH1**	**11.7**			**10.1**			**71.4**			**69.73**			**4.69**			**9.01**		
	Min. GH1		**11.4**			**8.6**			**67.6**			**66.17**			**3.78**			**7.91**	
	Max. GH1			**12.4**			**12.3**			**75.1**			**73.54**			**5.47**			**9.95**
GRADE: GH2																			
1	Region 17	10.5	-	-	11.3	-	-	60.1	-	-	69.92	-	-	4.93	-	-	10.49	-	-
1	Region 18	12.3	-	-	12.0	-	-	66.2	-	-	67.95	-	-	4.74	-	-	9.49	-	-
1	Region 20	11.3	-	-	9.1	-	-	72.3	-	-	71.19	-	-	4.29	-	-	8.43	-	-
1	Region 27	11.8	-	-	8.9	-	-	75.5	-	-	73.93	-	-	5.15	-	-	9.92	-	-
4	**Ave. GH2**	**11.5**			**10.3**			**68.5**			**70.75**			**4.78**			**9.58**		
	Min. GH2		**10.5**			**8.9**			**60.1**			**67.95**			**4.29**			**8.43**	
	Max. GH2			**12.3**			**12.0**			**75.5**			**73.93**			**5.15**			**10.49**
42	**Ave. sorghum**	**11.5**			**10.6**			**71.3**			**72.45**			**4.53**			**9.81**		
	Min. sorghum		**10.5**			**6.9**			**60.1**			**66.17**			**1.68**			**7.91**	
	Max. sorghum			**12.7**			**13.0**			**77.3**			**83.08**			**5.62**			**11.52**

TABLE 9: CHEMICAL COMPOSITION OF SORGHUM ACCORDING TO CLASS (2017/2018)

Number of samples	Region	Moisture, %			Protein, % (db)			Starch content, % (db)			Hunterlab Colour								
											L			a			b		
		ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.	ave.	min.	max.
GRADE: GM																			
3	Region 18	11.7	11.3	12.0	11.0	10.1	12.5	69.5	69.2	70.1	68.35	67.49	69.56	5.25	4.81	5.47	8.66	8.00	9.30
1	Region 24	11.2	-	-	9.8	-	-	73.1	-	-	73.57	-	-	4.75	-	-	9.65	-	-
1	Region 26	11.3	-	-	9.1	-	-	77.3	-	-	76.39	-	-	4.41	-	-	9.90	-	-
3	Region 27	12.3	12.0	12.7	12.2	11.6	13.0	67.9	67.5	68.1	70.42	69.51	71.87	5.09	4.50	5.62	9.56	8.94	10.34
12	Region 29	11.3	11.1	11.4	11.2	9.6	12.8	71.6	69.6	73.3	73.32	71.10	78.11	4.53	2.32	5.35	10.42	9.59	11.48
1	Region 31	11.6	-	-	12.1	-	-	70.2	-	-	76.10	-	-	4.00	-	-	10.11	-	-
6	Region 35	11.2	10.9	12.0	9.7	6.9	11.3	74.0	72.4	77.2	78.46	76.07	83.08	3.52	1.68	4.14	10.89	10.22	11.52
27	**Ave. GM**	**11.4**			**10.9**			**71.7**			**73.81**			**4.43**			**10.17**		
	Min. GM		**10.9**			**6.9**			**67.5**			**67.49**			**1.68**			**8.00**	
	Max. GM			**12.7**			**13.0**			**77.3**			**83.08**			**5.62**			**11.52**
GRADE: GH																			
1	Region 17	10.5	-	-	11.3	-	-	60.1	-	-	69.92	-	-	4.93	-	-	10.49	-	-
2	Region 18	11.9	11.4	12.3	10.6	9.1	12.0	68.9	66.2	71.5	67.68	67.41	67.95	4.95	4.74	5.16	9.72	9.49	9.95
1	Region 19	12.0	-	-	10.9	-	-	73.3	-	-	73.19	-	-	3.78	-	-	8.73	-	-
2	Region 20	11.6	11.3	11.9	10.3	9.1	11.5	71.6	70.9	72.3	69.05	66.90	71.19	4.88	4.29	5.47	8.97	8.43	9.51
1	Region 21	12.4	-	-	9.7	-	-	71.3	-	-	69.78	-	-	4.35	-	-	7.91	-	-
3	Region 24	11.6	11.5	11.9	8.9	8.6	9.3	72.6	71.2	74.5	70.46	69.51	71.87	4.66	4.21	4.93	8.46	8.13	8.65
1	Region 27	11.8	-	-	8.9	-	-	75.5	-	-	73.93	-	-	5.15	-	-	9.92	-	-
2	Region 29	11.5	11.4	11.6	11.4	11.3	11.5	69.1	69.0	69.2	68.20	66.17	70.22	4.93	4.46	5.39	9.33	8.78	9.87
2	Region 35	11.5	11.4	11.6	10.4	8.6	12.3	71.4	67.6	75.1	71.00	68.46	73.54	4.50	3.87	5.12	9.49	9.06	9.92
15	**Ave. GH**	**11.6**			**10.2**			**70.7**			**70.00**			**4.71**			**9.16**		
	Min. GH		**10.5**			**8.6**			**60.1**			**66.17**			**3.78**			**7.91**	
	Max. GH			**12.4**			**12.3**			**75.5**			**73.93**			**5.47**			**10.49**

TABLE 10: MYCOTOXIN RESULTS - SORGHUM CROP QUALITY 2017/2018

Region	Grade	Aflatoxin µg/kg				Fumonisin µg/kg			DON µg/kg	15-ADON µg/kg	Ochratoxin A µg/kg	Zearalenone µg/kg	HT-2 µg/kg	T-2 µg/kg
		B_1	B_2	G_1	G_2	B_1	B_2	B_3						
		LOQ: 5 µg/kg	LOQ: 5 µg/kg	LOQ: 5 µg/kg	LOQ: 5 µg/kg	LOQ: 20 µg/kg	LOQ: 20 µg/kg	LOQ: 20 µg/kg	LOQ: 100 µg/kg	LOQ: 100 µg/kg	LOQ: 5 µg/kg	LOQ: 20 µg/kg	LOD: 20 µg/kg	LOQ: 20 µg/kg
17	GH2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
18	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
18	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
18	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
18	GH1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
18	GH2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
19	GH1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20	GH1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20	GH2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
21	GH1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24	GH1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24	GH1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24	GH1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
26	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
27	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
27	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
27	GM2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
27	GH2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 10: MYCOTOXIN RESULTS - SORGHUM CROP QUALITY 2017/2018 (continue)

Region	Grade	Aflatoxin µg/kg				Fumonisin µg/kg			DON µg/kg	15-ADON µg/kg	Ochratoxin A µg/kg	Zearalenone µg/kg	HT-2 µg/kg	T-2 µg/kg
		B_1	B_2	G_1	G_2	B_1	B_2	B_3						
		LOQ: 5 µg/kg	LOQ: 5 µg/kg	LOQ: 5 µg/kg	LOQ: 5 µg/kg	LOQ: 20 µg/kg	LOQ: 20 µg/kg	LOQ: 20 µg/kg	LOQ: 100 µg/kg	LOQ: 100 µg/kg	LOQ: 5 µg/kg	LOQ: 20 µg/kg	LOD: 20 µg/kg	LOQ: 20 µg/kg
29	GM3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GH1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GH1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
31	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GH1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GH1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total number of samples		**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**
Average of total number of samples		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Number of positive results		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Note:
Limit of quantitation (LOQ) means the lowest concentration level that can be quantified with acceptable precision and accuracy by the LC-MS/MS.
A concentration measured below the LOQ is reported as <LOQ.
Limit of detection (LOD) is the lowest concentration level that can be detected but not quantified and is 50% of the LOQ of each mycotoxin.
A concentration measured below the LOD is reported as not detected (ND).
µg/kg = ppb (parts per billion)

TABLE 11: IMPORTED SORGHUM QUALITY

Quality of sorghum imported from March 2018 to February 2019 compared to RSA crop quality of the 2017/2018 season

Country of origin		USA		RSA Crop Average	
Class sorghum		**GM**		**GM**	
Grade sorghum		**GM2**	**GM3**	**GM2**	**GM3**
Grading					
Foreign matter, %		2.03	1.43	0.94	0.09
Unthreshed sorghum, %		1.40	1.40	2.58	2.68
Defective sorghum, %		1.72	1.22	0.78	1.35
Small kernel sorghum, %		2.90	2.40	0.95	0.37
Total defective sorghum and small kernel sorghum, %		4.62	3.62	1.73	1.72
Sorghum of another group, %		0.00	0.00	0.08	0.00
White sorghum, %		4.90	11.59	0.00	66.72
Total of sorghum of another group and white sorghum, %		4.90	11.59	0.08	66.72
Weather-stained sorghum, %		5.52	4.61	1.45	2.17
Physical parameters					
Test weight, kg/hl		78.2	78.5	78.0	77.6
1000 Kernel Mass, g (14% moisture base)		22.9	23.8	25.7	25.0
# Image analysis	Length, mm	4.32	4.34	4.59	4.31
	Standard Deviation	0.34	0.31	0.33	0.30
	Width, mm	3.71	3.74	4.04	3.86
	Standard Deviation	0.33	0.29	0.31	0.28
	Roundness, %	86	86	88	90
	Standard Deviation	6.0	4.9	5.2	5.0
	Surface Area, %	68	68	73	69
	Standard Deviation	5.2	4.7	5.0	4.5
Chemical composition					
Moisture, %		12.6	12.7	11.6	11.2
Protein, % (db)		9.52	9.88	11.9	9.0
Starch content, % (db)		72.9	72.9	70.6	73.3
Hunterlab colour (fraction of dehulled sample above the 1.8 mm slotted sieve milled on Retch mill through 0.5 mm sieve)	L	76.43	74.74	70.49	77.70
	a	3.92	4.16	5.07	3.12
	b	10.73	10.89	9.79	10.86
Mycotoxins (µg/kg)					
Aflatoxin B_1		ND	ND	ND	ND
Aflatoxin B_2		ND	ND	ND	ND
Aflatoxin G_1		ND	ND	ND	ND
Aflatoxin G_2		ND	ND	ND	ND
Fumonisin B_1		ND	ND	ND	ND
Fumonisin B_2		ND	ND	ND	ND
Fumonisin B_3		ND	ND	ND	ND
Deoxynivalenol		ND	ND	ND	ND
15-ADON		ND	ND	ND	ND
Ochratoxin A		ND	ND	ND	ND
Zearalenone		ND	ND	ND	ND
HT2		ND	ND	ND	ND
T2		ND	ND	ND	ND
Number of samples		***1***	***3***	***2***	***3***

Methods

Sampling procedure

A working group determined the procedure to be followed to ensure that the crop quality samples sent to the SAGL by the various grain silo owners, were representative of the total crop.

Each delivery was sampled as per the grading regulations for grading purposes.

After grading, the grading samples were placed in separate containers according to class and grade, per silo bin at each silo.

After 80% of the expected harvest had been received, the content of each container was divided with a multi slot divider in order to obtain a 3 kg sample.

If there were more than one container per class and grade per silo bin, the combined contents of the containers were mixed thoroughly before dividing it with a multi slot divider to obtain the required 3 kg sample.

The samples were marked clearly with the name of the depot, the bin/bag/bunker number(s) represented by each individual sample as well as the class and grade and were then forwarded to the SAGL.

Grading

Full grading was done in accordance with the Regulations relating to the Grading, Packing and Marking of Sorghum intended for sale in the Republic of South Africa (Government Notice NO. R. 15 of 08 January 2016).

See pages 37 to 46 of this report.

Test weight

Test weight, providing a measure of the bulk density of grain and oilseeds, was determined according to ISO 7971-3, by means of the Kern 222 instrument.

To calculate the bulk density ρ, expressed in kilogram per hectolitre (kg/hl), the following equation was applied: $\rho = 0.1002\ m + 0.53$. This is the equation used for wheat, since an equation for sorghum is not available.

The test weight analyses were done on unscreened sorghum samples.

Thousand kernel mass

This is the weight in grams of one thousand kernels of grain and provides a measure of grain size and density. This determination does not include kernels that are broken or chipped and is done according to Industry Accepted Method 008 using a seed counter. Thousand kernel mass is reported on a 14% moisture basis.

Determiniation of sorghum kernel size by means of image analysis

Sorghum kernels were photographed on a Panasonic Lumix digital camera (DNC-LX3). Photos were analysed afterwards, using Digimizer version 4.0 software supplied by Medcalc (www.digimizer.com), to measure the size of the sorghum kernels. Photos of the samples are stored in a database. The following measurements were taken:

- Maximum length (indicated as “Length”)
- Minimum length (indicated as “Width”)
- Roundness (% Width/Length or W/L%).

Milling

All samples requiring milling was milled on a Retch ZM 200 mill fitted with a 0.5 mm screen.

Moisture

The moisture content of the milled grain was determined using ICC Standard 110/1 (latest edition). This method determines moisture content as a loss in weight of a sample when dried in a hot air ventilation oven at 130 °C for 2 hours. Moisture content results were used to report % starch and % protein on a dry basis (db).

Crude Protein

The Dumas combustion analysis technique was used to determine the crude protein content, according to AACCI method 46-30.01, latest edition.

This method prescribes a generic combustion method for the determination of crude protein. Combustion at high temperature in pure oxygen sets nitrogen free, which is measured by thermal conductivity detection. The total nitrogen content of the sample is determined and converted to equivalent protein by multiplication with a factor of 6.25 to obtain the crude protein content.

Total Starch Content

Determination of the total starch content was according to the SAGL In-house method 019, a polarimetric method based on the modified Ewers method. The starch content is released from the sample by boiling in dilute hydrochloric acid. The starch solution in the filtrate is determined by measuring the angle of polarisation or optical rotation of the filtrate with a polarimeter. The acid also helps to break down the endosperm tissue, ensuring complete release of the starch granules from the protein matrix. Substances, which may interfere with the measurement, are removed by filtration.

Mycotoxin analyses

Mycotoxins are fungal metabolites, toxic to animals and humans, that are produced by moulds commonly found in almost all types of grain. Aside from health risks, mycotoxin contamination can also reduce the value of the crops. Environmental factors such as temperature, humidity, soil and storage conditions influence toxin production.

SAGL implements a validated SAGL In-house multi-mycotoxin screening method using UPLC - MS/MS. A sub-sample of each sorghum sample was milled and tested for Aflatoxin B_1; B_2; G_1; G_2, Fumonisin B_1; B_2; B_3, Deoxynivalenol, 15-ADON, HT2 Toxin, T-2 Toxin, Zearalenone and Ochratoxin A.

Dehulling of samples

Each sorghum sample was sieved and the fraction below the 4 mm and above the 3.55 mm sieve was dehulled by means of a Barley pearler. This fraction was selected to obtain an indication of comparative hardness and to eliminate difference due to kernels size. Tests were conducted using 150 g of sample with a dehulling time of 70 seconds. These parameters are based on results obtained on the outcomes of a processing application project funded by the Sorghum Trust. Barley pearler fractions are sieved into three fractions namely > 1.8 mm, > 2.38 mm and < 2.38 mm. The colour determinations for this project was done on the first fraction (> 1.8 mm).

Determination of colour

The Barley pearler fraction above the 1.8 mm slotted sieve was milled on a Retch mill through a 0.5 mm sieve. The milled samples' colour was determined with the Hunterlab Color-Flex 45/0 spectrophotometer on 10°/D65 according to SAGL Industry accepted method 004. The spectrophotometers operate in the Hunter L, a, b scale where:

L measures lightness and varies from 100 for perfect white to zero for black, approximately as it would be evaluated by the eye. The chromaticity dimensions (a and b) give understandable designations of colour as follows:

- a measures redness when positive, grey when zero, and greenness when negative.
- b measures yellowness when positive, grey when zero, and blueness when negative.

sanas
South African National Accreditation System

CERTIFICATE OF ACCREDITATION

In terms of section 22(2) (b) of the Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice Act, 2006 (Act 19 of 2006), read with sections 23(1), (2) and (3) of the said Act, I hereby certify that:-

SOUTHERN AFRICAN GRAIN LABORATORY NPC

Co. Reg. No.: 1997/018518/08

Facility Accreditation Number: **T0116**

is a South African National Accreditation System accredited Testing laboratory provided that all SANAS conditions and requirements are complied with

This certificate is valid as per the scope as stated in the accompanying schedule of accreditation Annexure "A", bearing the above accreditation number for

CHEMICAL AND PHYSICAL ANALYSIS

The facility is accredited in accordance with the recognised International Standard

ISO/IEC 17025:2005

The accreditation demonstrates technical competency for a defined scope and the operation of a laboratory quality management system

While this certificate remains valid, the Accredited Facility named above is authorised to use the relevant SANAS accreditation symbol to issue facility reports and/or certificates

Mr R Josias
Chief Executive Officer
Effective Date: 01 November 2014
Certificate Expires: 31 October 2019

ANNEXURE A

SCHEDULE OF ACCREDITATION

Facility Number: **T0116**

Permanent Address of Laboratory:

South African Grain Laboratory (NPC)
Agri-Hub Office Park - Grain Building
477 Witherite Road
The Willows
Pretoria
0040

Technical Signatories:

Ms J Nortje (All Methods excl. In-house method 029)
Ms M Bothma (All Chemical Methods)
Ms M Hammes (All Chemical Methods)
Ms A de Jager (Nutrients & Contaminants Methods)
Ms W Louw (In-house Methods 001, 002, 003, 010 & 026)
Ms D Moleke (Rheological Methods)
Ms I Terblanche (Rheological Methods)
Ms H Meyer (All Chemical, Nutrients and Contaminants & Grading Methods)
Ms J Kruger (All Chemical Methods)
Ms P Modiba (All Chemical Methods)
Ms M Motlanthe (In-house Methods 001, 003 & 026)
Mr B van Der Linde (Grading)
Ms M Ramare (All Chemical Methods Excl. In-House Method 012 and SOP MC23)
Ms Z Skhosana (In-house Method 026)
Ms T de Beer (Rheological Methods)

Postal Address:

Postnet Suite # 391
Private Bag X1
The Willows
0041

Tel: (012) 807-4019
Fax: N/A
E-mail: Paulina.Modiba@sagl.co.za

Nominated Representative:

Ms PM Modiba

Issue No.: 28
Date of Issue: 20 December 2018
Expiry Date: 31 October 2019

Material or Products Tested	Type of Tests / Properties Measured, Range of Measurement	Standard Specifications, Techniques / Equipment Used
CHEMICAL		
Ground Barley	Moisture (Oven Method)	Analytical EBC Method 3.2, latest Edition (2 hour; 130^{0}C)
Cereal and cereal products specifically-wheat, rice, (hulled paddy), barley, millet, rye, and oats as grain, semolina and flour	Moisture (Oven Method)	ICC Std No.110/1, Latest Edition (90 min; 130˚C) (2 hour; 130˚C)
Flour, semolina, bread, all kind of grains and cereal products and food products (except those that	Moisture (Oven Method)	AACCI 44-15.02, Latest Edition (1 hour; 130˚C)

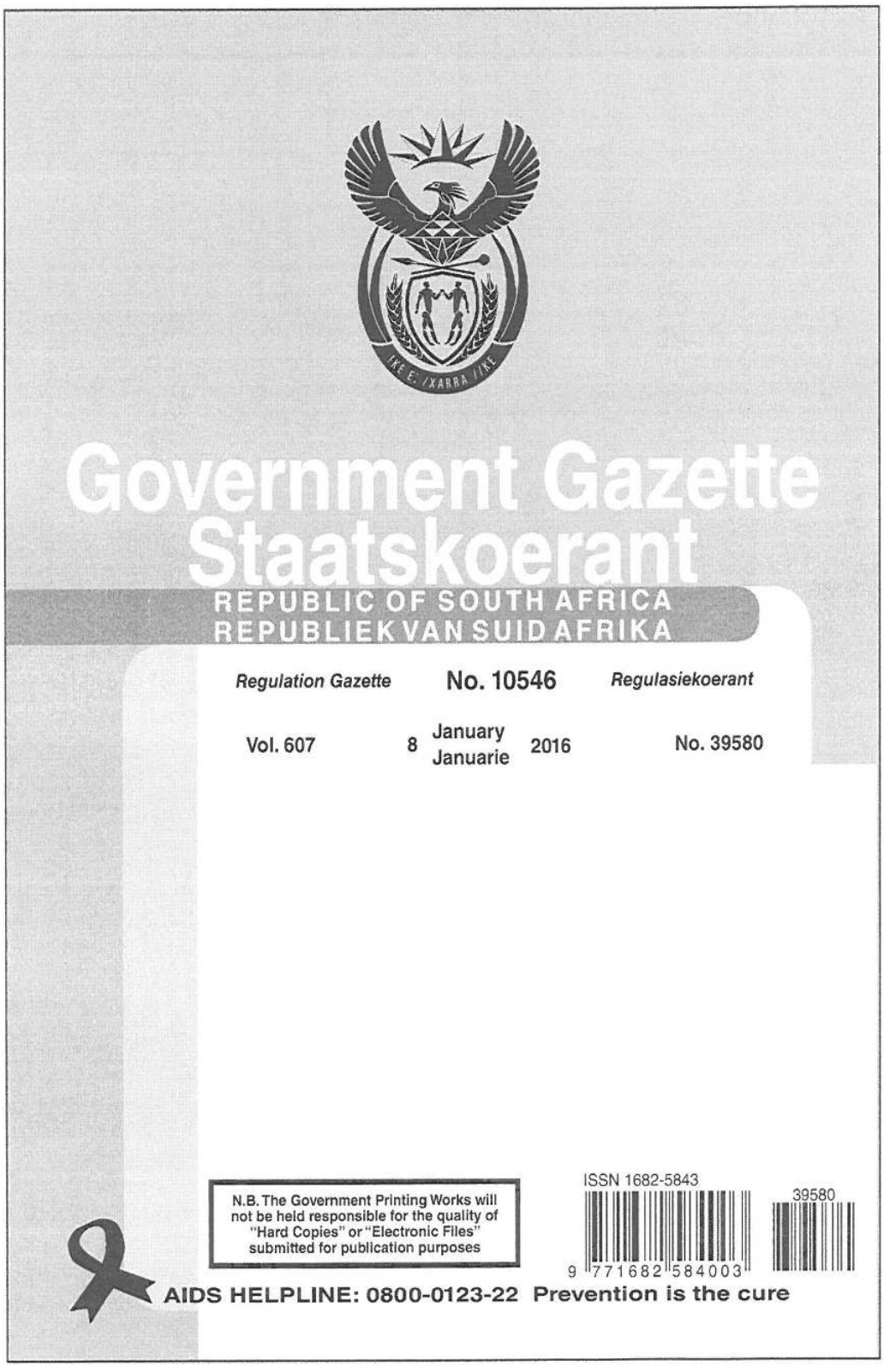
are sugar coated)		(72 hour; 103˚C)
Maize Grits	Moisture (Oven Method)	Analytical EBC Method 6.2.2, latest edition (4 hours, 130^{0}C)
Animal feed, Plant tissue and Sunflower (Milled)	Moisture (Oven Method)	AgriLASA 2.1, Latest Edition (5 hours, 105^{0}C)
All flours, cereal grains, oilseeds and animal feeds	Nitrogen and protein (Combustion method - Dumas)	AACCI 46-30.01, Latest Edition
Cereal based food stuff	Dietary fibres (Total)	In-house method 012
Food stuff and feeds	Carbohydrates (by difference) (calculation) Energy value (calculation) Total digestible nutritional value (calculation)	SOP MC 23
Food Stuff and feeds	Determination of Ash	In-house method 011
Wheat Kernels	Moisture (Oven Method)	Government Gazette Wheat Regulation, Latest Edition (72 hour, 103˚C)
Flours of grains e.g. barley, oats, triticale, maize, rye, sorghum and wheat; oilseeds like soybeans and sunflower, feeds and mixed feeds and foodstuffs	Crude fat (Ether extraction by Soxhlet)	In-house method 024
Meal and flour of wheat, rye, barley, other grains, starch containing and malted products	Falling number	ICC Std 107/1, Latest Edition
NUTRIENTS AND CONTAMINANTS		
Vitamin fortified food and feed products and fortification mixes grain based	Vitamin A as all trans Retinol (Saponification) (HPLC)	In-house method 001
	Thiamine Mononitrate (HPLC) Riboflavin (HPLC) Nicotinamide (HPLC) Pyridoxine Hydrochloride (HPLC)	In-house method 002
	Folic Acid (HPLC)	In-house method 003
Grain based food and feed products (fortified and unfortified) and fortification mixes	Total Sodium (Na) Total Iron (Fe) Total Zinc (Zn)	In-house method 010
Yeast and Bread	Vitamin D_2 (HPLC)	In-House method 029

Food and feed	Multi-Mycotoxin: -Aflatoxin G_1, B_1, G_2, B_2 and total -Deoxynivalenol (DON), 15-ADON -Fumonisin B_1, B_2, B_3 -Ochratoxin A -T2, HT-2 - Zearalenone	In-house method 026
GRADING		
Maize	Defective kernels (White maize/ yellow maize)	Government Gazette Maize Regulation, Latest Edition
Cereal as grains (Wheat, barley, rye and oats)	Hectolitre mass (Kern222)	ISO 7971-3, Latest edition
Wheat	Screenings	Government Gazette Wheat Grading Regulation, Latest Edition
RHEOLOGICAL		
Wheat flour	Alveograph (Rheological properties)	ICC Std.121, Latest Edition
Flours	Farinograph (Rheological properties)	AACCI 54.02, Latest Edition (Rheological behaviour of flour Farinograph: Constant Flour Weight procedure)
Hard, soft and durum wheat (flour and whole wheat flour)	Mixograph (Rheological properties)	Industry accepted method 020 (Based on AACCI 54-40.02, Latest Edition Mixograph Method)

Original Date of Accreditation: 01 November 1999

ISSUED BY THE SOUTH AFRICAN NATIONAL ACCREDITATION SYSTEM

Accreditation Manager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DEPARTMENT OF AGRICULTURE, FORESTRY AND FISHERIES

NO. R. 15 **08 JANUARY 2016**

AGRICULTURAL PRODUCT STANDARDS ACT, 1990
(ACT No. 119 OF 1990)

REGULATIONS RELATING TO THE GRADING, PACKING AND MARKING OF SORGHUM INTENDED FOR SALE IN THE REPUBLIC OF SOUTH AFRICA

The Minister of Agriculture, Forestry and Fisheries acting under section 15 of the Agricultural Product Standards Act, 1990 (Act No. 119 of 1990), has

(a) made the regulations in the Schedule;

(b) determined that the said regulations shall come into operation on the date of publication; and

(c) read together with section 3(1) of the said Act, repealed the Regulations published by Government Notice No.R.532 of 16 May 2008.

SCHEDULE

Definitions

1. In these regulations any word or expression to which a meaning has been assigned in the Act shall have that meaning and, unless the context otherwise indicates --

" animal filth" means dead rodents, dead birds and dung;

"another group" in relation to --

(a) sorghum of Class GM means sorghum that has a dark testa; and

(b) sorghum of Class GH means sorghum that does not have a dark testa;

"bulk container" means any vehicle or container in which bulk sorghum is stored or transported;

"consignment" means --

(a) a quantity of sorghum of the same class, which belongs to the same owner, delivered at any one time under cover of the same consignment note, delivery note or receipt note, or delivered by the same vehicle or bulk container, or loaded from the same bin of a grain elevator or from a ship's hold; or

(b) in the case where a quantity referred to in paragraph (a), is subdivided into different grades, each such quantity of each of the different grades;

"container" means a bag or a bulk container;

"dark testa" means the testa layer of the sorghum that contains tannins of the condensed type;

"defective sorghum" means --

(a) pieces of broken sorghum kernels; or

(b) sorghum kernels --

(i) that are affected by fungi or diseases;

(ii) of which the embryo skin is cracked due to germination;

(iii) that have a green colour or shows other signs of immaturity; and

(iv) that have been damaged by insects, rodents, cold, heat or in any other manner, but does not include weather-stained sorghum;

"foreign matter" means any matter or substance other than sorghum. Coal, dung and metal shall not be present in the consignment concerned;

"insect" means any live grain insect that is injurious to stored sorghum as well as other grains, irrespective of the stage of development of the insect;

"poisonous seeds" mean seeds or part of seeds of plant species that in terms of the Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act No. 64 of 1972), may represent a hazard to human or animal health when consumed, including seeds of *Argemone mexicana L. Convolvulus spp., Crotalaria spp., Datura spp., Ipomoea spp., Lolium temulentum, Ricinus communis or Xanthium spp;*

"small kernel sorghum" means whole sorghum kernels that pass through a standard sieve;

"sorghum" means the threshed, ripe seed of plants of *Sorghum bicolor (L.)* Moench, but excludes broom sorghum, hay sorghum or cane sorghum;

"standard sieve" means is a slotted sieve --

(a) with a flat bottom of metal sheet of 1,00 mm thickness with rectangular slots of 12, 7 mm in length and 1, 8 mm in width with rounded ends. The spacing between the slots in the same row must be 2, 43 mm wide and the spacing between the rows of slots must be 2,0 mm wide. The slots must be alternately orientated, with a slot directly opposite the solid inter segment of the adjacent row of slots;

(b) of which the upper surface of the sieve is smooth;

(c) with a circular frame of suitable material with an inner diameter of at least 300 mm and maximum 310 mm and at least 50 mm high;

(d) that fits onto a tray with a solid bottom and must be at least 20 mm above the bottom of the tray;

"the Act" means the Agricultural Product Standards Act, 1990 (Act No. 119 of 1990);

"unthreshed sorghum" means sorghum or pieces of sorghum still partially covered by glumes;

"weather-stained sorghum" means sorghum kernels of which more than one-third of the surface of the pericarp is distinctly discoloured by the weather, but does not include sorghum kernels with purple anthocyanic blotches in or on the pericarp; and

"white sorghum" means sorghum of which the pericarp does not display any of the shades of brown, red or yellow irrespective of any purple anthocyanic blotches in or on the pericarp.

Restriction on sale of sorghum

2. (1) No person shall sell a consignment of sorghum in the Republic of South Africa --

(a) unless the sorghum is sold according to the classes set out in regulation 3;

(b) unless the sorghum complies with the standards for the class concerned as set out in regulation 4;

(c) unless the sorghum complies with the grades of sorghum and the standards for grades set out in regulations 5 and 6 respectively;

(d) unless the sorghum is packed in accordance with the packing requirements set out in regulation 7;

(e) unless the containers or sale documents, as the case may be, are marked in accordance with the marking requirements set out in regulation 8; and

(f) if such sorghum contains a substance that renders it unfit for human consumption or for processing into or utilisation thereof as food or feed.

(2) The Executive Officer may grant written exemption, entirely or partially, to any person on such conditions as he or she may deem necessary, from the provisions of sub-regulation (1).

PART I

QUALITY STANDARDS

Classes of sorghum

3. Sorghum shall be classified as --

(a) Class GM;

(b) Class GH; and

(c) Class Other.

Standards for classes

4. (1) A consignment of sorghum shall be classified as Class GM Sorghum if it --

(a) consists of malt sorghum that does not have a dark testa; and

(b) complies with the standards for the grade of Class GM sorghum as set out in regulation 6.

(2) A consignment of sorghum shall be classified as Class GH sorghum if it --

(a) consists of malt sorghum that has a dark testa; and

(b) complies with the standards for grades for Class GH Sorghum as set out in regulation 6.

(3) A consignment of sorghum shall be classified as Class Other if it does not comply with the standards for Class GM, and GH Sorghum

Grades of sorghum

5. Sorghum shall be graded as --

(a)	Class GM	(i)	Grade GM1
		(ii)	Grade GM2
		(iii)	Grade GM3

(b) Class GH (i) Grade GH1
(ii) Grade GH2

(c) No grades are determined for Class Other.

Standards for grades

6. (1) All grades of sorghum shall --

(a) be free from black smearing as a result of smut;

(b) not contain 10 or more smut balls or portions of smut balls which are collectively equivalent to 10 or more smut balls, per 100 g of sorghum;

(c) be free from a musty, sour or other undesirable smell;

(d) be free from any substance that renders it unsuitable for human consumption or animal consumption or for processing into or utilisation thereof as food or feed;

(e) be free from stones, glass, metal, coal or dung;

(f) not contain more poisonous seeds than permitted in terms of the Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act No. 54 of 1972);

(g) with the exception of Class Other, be free from grain insects;

(h) with the exception of Class Other, have a moisture content of not more than 14 percent; and

(i) be free from animal filth.

(2) Grades GM1, GM2, GM3, GH1 and GH2 shall not exceed the permissible deviations specified in columns 2, 3, 4, 5, and 6 of the Table in the Annexure, respectively, with regard to the nature of deviation specified in column 1 of the said table.

(3) The presence of purple anthocyanic blotches in or on the pericarp shall not be taken into consideration when determining the grade of a consignment of sorghum.

PART II

PACKING AND MARKING REQUIREMENTS

Packing requirements

7. Sorghum of different classes and grades shall be packed in different containers.

Marking requirements

8. (1) Each container or the accompanying sales documents of a consignment shall be marked or endorsed with the applicable class or grade of the sorghum or, in the case of sorghum that have been imported, the common name and the name of the country of origin thereof.

PART III

SAMPLING

Obtaining of sample

9. (1) A sample of a consignment of sorghum shall --

(a) in the case of sorghum delivered in bags and subject to regulation 10, be obtained by sampling at least ten per cent of the bags chosen from that consignment at random, with a bag probe: Provided that at least 25 bags in a consignment shall be sampled and where a consignment consists of less than 25 bags, all the bags in that consignment shall be sampled; and

(b) in the case of sorghum delivered in bulk and subject to regulation 10, be obtained by sampling that consignment throughout the whole depth of the layer, in at least six different places, chosen at random in that bulk quantity, with a bulk sampling apparatus.

(2) The collective sample obtained in sub-regulation (1) (a) or (b) shall --

(a) have a total mass of at least 10 kg; and

(b) be thoroughly mixed before further examination.

(3) If it is suspected that the sample referred to in sub-regulation (1)(a) is not representative of that consignment, an additional five percent of the remaining bags, chosen from that consignment at random, shall be emptied into a suitable bulk container and sampled in the manner contemplated in sub-regulation (1)(b).

(4) A sample taken in terms of these regulations shall be deemed to be representative of the consignment from which it was taken.

Sampling if contents differ

10. (1) If, after an examination of the sorghum taken from different bags in a consignment in terms of regulation 9(1) (a), it appears that the contents of those bags differ substantially --

(a) the bags concerned shall be placed separately;

(b) all the bags in the consignment concerned shall be sampled with a bag probe in order to do such separation; and

(c) each group of bags with similar contents in that consignment shall for the purposes of these regulations be deemed to be a separate consignment.

(2) If, after the discharge of a consignment of sorghum in bulk has commenced, it is suspected that the consignment could be of a class or grade other than that determined by means of the initial sampling, the discharge shall immediately be stopped and the part of the consignment remaining in the bulk container as well as the sorghum already in the hopper shall be sampled anew with a bulk sampling apparatus or by catching, by means of a suitable container, at regular intervals quantities from the stream of sorghum flowing in bulk.

Working sample

11 (1) A working sample shall be obtained by dividing the representative sample of the representative or deviating sample of the consignment according to latest revision of the ICC (International Association for Cereal Chemistry) 101/1 method.

PART IV

INSPECTION METHODS

Determination of class and presence of smut, undesirable smells, harmful substances, poisonous seeds, insects and animal filth

12. A consignment or a sample of a consignment of sorghum shall be sensorially assessed or chemically analysed in order to determine --

(a) the class thereof;

(b) whether it is smeared black by smut;

(c) whether it contains smut balls;

(d) whether it has a musty, sour or other undesirable smell;

(e) whether it contains any substance that renders it unsuitable for human consumption or for processing into or utilisation as food or feed;

(f) whether it contains any poisonous seeds;

(g) whether it contains any grain insects; and

(h) whether it contains any animal filth.

Determination of percentage foreign matter

13. The percentage of foreign matter in a consignment of sorghum shall be determined as follows:

(a) Obtain a working sample of at least 100 g of material from the sample of the consignment.

(b) Remove all foreign matter by hand from the working sample and determine the mass thereof.

(c) Express the mass thus determined, as a percentage of the mass of the working sample.

(d) Such percentage shall represent the percentage of foreign matter in the consignment concerned.

Determination of percentage unthreshed sorghum

14. The percentage of unthreshed sorghum in a consignment of sorghum shall be determined as follows:

(a) Obtain a working sample of at least 50 g of material from the sample from which all foreign matter has been removed.

(b) Remove all unthreshed sorghum by hand from the working sample and determine the mass thereof.

(c) Express the mass thus determined, as a percentage of the mass of the working sample.

(d) Such percentage shall represent the percentage of unthreshed sorghum in the consignment concerned.

Determination of percentage defective sorghum content and percentage small kernel sorghum

15. The percentages of defective sorghum and small kernel sorghum in a consignment of sorghum shall be determined as follows:

(a) Obtain a working sample of at least 50 g of material from a sample from which all foreign matter and unthreshed sorghum have been removed.

(b) Place the working sample on a standard sieve.

(c) Screen the working sample for 25 to 30 seconds by performing 30 movements of the standard sieve and collecting tray on an even horizontal surface and along the longitudinal axis of the slots of the sieve: Provided that each such movement shall consist of a to-and-fro movement of between 200 mm and 300 mm each.

(d) Remove all defective grain sorghum kernels from those portions of the working sample that respectively remained in or on the standard sieve and were collected in the collecting tray and determine the joint mass thereof.

(e) Express the mass thus determined, as a percentage of the mass of the working sample.

(f) Such percentage shall represent the percentage of defective grain sorghum in the consignment concerned.

(g) Determine the mass of the material that remained in the collecting tray after the removal of the defective sorghum kernels in terms of paragraph (d).

(h) Express the mass thus determined as a percentage of the mass of the working sample.

(i) Such percentage shall represent the percentage of small kernel sorghum in the consignment concerned.

Determination of percentage sorghum of another group

16. The percentage of sorghum of another group in a consignment of sorghum shall be determined as follows:

(a) Obtain a working sample of at least 25 g of material from the sample from which all foreign matter, unthreshed sorghum, defective grain sorghum and small kernel sorghum have been removed.

(b) Remove all sorghum of another group by hand from the working sample and determine the mass thereof.

(c) Express the mass thus determined, as a percentage of the mass of the working sample.

(d) Such percentage shall represent the percentage of sorghum of another group in the consignment concerned.

Determination of percentage white sorghum

17. The percentage of white sorghum in a consignment of sorghum shall be determined as follows:

(a) Obtain a working sample of at least 25 g of material from the sample from which all foreign matter, unthreshed sorghum, defective sorghum and small kernel sorghum have been removed.

(b) Remove all the white sorghum by hand from the working sample and determine the mass thereof.

(c) Express the mass thus determined, as a percentage of the mass of the working sample.

(d) Such percentage shall represent the percentage of white sorghum in the consignment concerned.

Determination of percentage weather-stained sorghum

18. The percentage of weather-stained sorghum in a consignment shall be determined as follows:

(a) Obtain a working sample of at least 10 g of material from the sample from which all foreign matter, unthreshed sorghum, defective sorghum and small kernel sorghum have been removed.

(b) Remove all the weather-stained sorghum by hand from the working sample and determine the mass thereof.

(c) Express the mass thus determined, as a percentage of the mass of the working sample.

(d) Such percentage shall represent the percentage of weather-stained sorghum in the consignment concerned.

Determination of moisture content

19. The moisture content of a consignment of sorghum may be determined according to any suitable method: Provided that the results thus obtained complies with the maximum permitted errors for a class 1 moisture meter as detailed in ISO 7700/1-1984(E), based upon result of the 72 hour, 103°C oven dried method [the latest revision of the AACCI (American Association of Cereal Chemists International) Method 44-15A]

PART V

OFFENCES AND PENALTIES

20. Any person who contravenes or fails to comply with any provision of these regulations shall be guilty of an offence and upon conviction be liable to a fine or imprisonment in terms of section 11 of the Act.

ANNEXURE A
TABLE

PERMISSIBLE DEVIATIONS SORGHUM

1	2	3	4	5	6
Nature of deviation	Maximum extent to which defects are permissible in percentages				
	Grade GM1	Grade GM2	Grade GM3	Grade GH1	Grade GH2
1. Foreign matter (Reg 13)	1,5	2,0	3,0	1,5	3,0
2. Unthreshed sorghum (Reg14)	4,0	6,0	12,0	4,0	20,0
3. Defective sorghum (Reg 15)	3,0	10,0	20,0	3,0	20,0
4. Small kernel sorghum (Reg 15)	8,0	10,0	20,0	8,0	20,0
5. Total of defective sorghum and small kernel sorghum	10,0	10,0	20,0	10,0	20,0
6. Sorghum of another group (Reg 16)	4,0	6,0	10,0	4,0	*
7. White sorghum (Reg 17)	4,0	6,0	*	4,0	*
8. Total of Sorghum of another group and White Sorghum	6,0	10,0	*	6,0	*
9. Weather-Stained Sorghum	50,0	50,0	75,0	50,0	75,0

* No specification