South African Sorghum Crop

Quality Report 2021/2022 Season

Index

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South African

Commercial sorghum quality for the 2021/2022 Season

Acknowledgements
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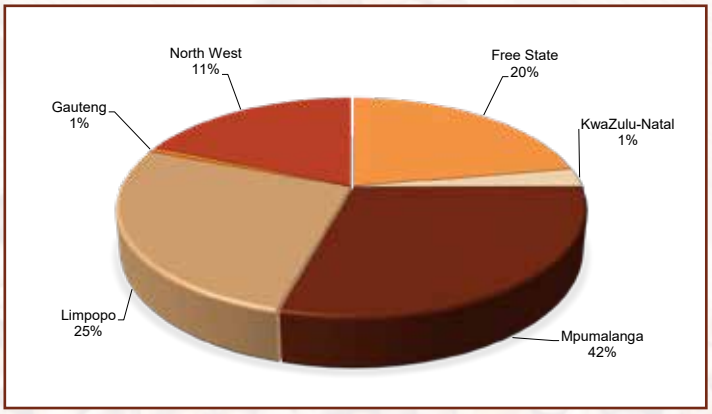
- The Sorghum Trust for its financial support in conducting this survey.
- Agbiz Grain and its members for their cooperation in providing the samples to make this survey possible.
- The Crop Estimates Committee (CEC) of the Department of Agriculture, Land Reform and Rural Development (DALRRD) for providing 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 2021/22 production season as overseen by the National Crop Estimates Liaison Committee (CELC) is 103 140 tons. This figure represents a year-on-year decrease of 52% (111 860 tons) and the smallest crop since the 2015/16 season. Mpumalanga, the major sorghum producing province this season, contributed 42% of the total crop, followed by Limpopo with a contribution of 25%. The national yield decreased by almost 37%, from 4.37 t/ha in the 2020/21 season to 2.77 t/ha this season.

Graph 1: Provincial contribution to the production of the 2021/22 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 27. Twenty-one (21) 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 content. The crude fat content was also included in the scope of analysis for the first time this season. 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, relative roundness and volume to surface ratio on the whole kernels) were also performed on these samples.

This is the fifth 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 various 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 in enabling 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.

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 2022/23 season to date, stands at 57.7 million tons with the United States being the largest contributor (4.8 million tons). Please see Table 1a for the world sorghum trade (import and export figures) as well as production and consumption figures in Table 1b.

Table 1a: World Sorghum Trade
October/September Trade Year, Thousand Metric Tons

	2018/19	2019/20	2020/21	2021/22	2022/23 Mar	2022/23 Apr
Exports						
Argentina	254	426	1 973	1 900	1 700	1 700
Australia	91	102	1 235	2 267	2 200	2 200
Bolivia	18	8	30	5	25	25
China	49	29	4	5	30	30
India	53	31	56	40	50	50
Kenya	53	31	80	50	60	60
Nigeria	100	50	50	50	50	50
Others	306	305	198	208	122	122
Subtotal	***924***	***982***	***3 626***	***4 525***	***4 237***	***4 237***
United States	**2 410**	**5 404**	**6 926**	**7 351**	**2 250**	**2 250**
World Total	***3 334***	***6 386***	***10 552***	***11 876***	***6 487***	***6 487***
Imports						
China	652	3 709	8 669	10 991	4 800	4 800
Eritrea	60	35	60	95	70	70
Ethiopia	6	61	5	12	50	50
European Union	666	89	13	168	80	80
Japan	449	426	299	258	200	200
Kenya	109	52	181	79	150	150
Mexico	546	567	133	362	200	200
Somalia	85	80	50	50	50	50
South Sudan	26	81	71	55	50	50
Sudan	160	150	125	75	50	50
Others	488	378	351	384	330	335
Subtotal	***3 247***	***5 628***	***9 957***	***12 529***	***6 030***	***6 035***
Unaccounted	**86**	**757**	**594**	**- 654**	**456**	**451**
United States	**1**	**1**	**1**	**1**	**1**	**1**
World Total	***3 334***	***6 386***	***10 552***	***11 876***	***6 487***	***6 487***

Table 1b: World Sorghum Production and Consumption Local Marketing Years, Thousand Metric Tons						
	2018/19	2019/20	2020/21	2021/22	2022/23 Feb	2022/23 Mar
Production						
Argentina	2 500	2 500	3 320	3 400	3 400	3 400
Australia	1 160	397	1 639	2 648	2 500	2 500
Bolivia	949	1 019	1 481	1 375	1 400	1 400
Brazil	2 177	2 498	2 084	3 042	2 940	2 940
Burkina Faso	1 930	1 872	1 840	1 644	1 900	1 900
Cameroon	1 200	1 217	1 200	1 200	1 200	1 200
Chad	988	973	970	896	950	950
China	2 909	3 137	2 970	3 000	3 000	3 000
Ethiopia	5 024	5 266	5 058	4 450	4 500	4 500
India	3 480	4 772	4 812	4 150	4 400	4 100
Mali	1 470	1 511	1 823	1 239	1 500	1 500
Mexico	4 700	4 328	4 348	4 840	4 850	4 850
Niger	2 100	1 897	2 132	1 207	1 900	1 900
Nigeria	6 721	6 665	6 590	6 725	7 000	7 000
Sudan	5 435	3 714	5 150	3 530	5 000	5 000
Others	7 219	7 276	7 900	7 231	6 817	6 777
Subtotal	***49 962***	***49 042***	***53 317***	***50 577***	***53 257***	***52 917***
United States	**9 271**	**8 673**	**9 474**	**11 375**	**4 770**	**4 770**
World Total	***59 233***	***57 715***	***62 791***	***61 952***	***58 027***	***57 687***
Total Consumption						
Argentina	2 150	2 050	1 150	1 450	1 550	1 550
Bolivia	980	980	1 400	1 350	1 400	1 400
Brazil	2 200	2 400	2 100	3 000	2 900	2 900
Burkina Faso	1 800	1 870	1 900	1 650	1 850	1 850
Cameroon	1 225	1 222	1 225	1 215	1 230	1 230
Chad	1 000	1 000	1 000	950	980	980
China	3 600	6 800	11 400	14 000	7 800	7 800
Ethiopia	5 000	5 300	5 200	4 650	4 600	4 600
India	3 550	4 500	4 550	4 450	4 450	4 150
Mali	1 470	1 500	1 700	1 400	1 500	1 500
Mexico	5 100	5 000	4 500	5 000	5 100	5 100
Niger	2 100	2 000	2 050	1 400	1 850	1 850
Nigeria	6 650	6 650	6 550	6 650	6 800	6 800
South Sudan	685	780	810	810	820	820
Sudan	5 300	4 350	5 100	3 700	4 950	4 950
Others	9 328	7 675	7 905	7 438	7 090	7 049
Subtotal	***52 214***	***54 986***	***60 043***	***58 398***	***55 654***	***55 308***
United States	**6 212**	**4 365**	**2 638**	**3 214**	**3 048**	**3 048**
World Total	***58 426***	***59 351***	***62 681***	***61 612***	***58 702***	***58 356***

Notes:
World totals for consumption reflect total utilisation, including food, seed, industrial, feed and waste, as well as differences in local marketing year imports and local marketing year exports.
Consumption statistics for regions and indivual countries, however, 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, April 2023.

The local area utilised for sorghum production decreased by 24%, from 49 200 hectares in the 2020/21 season, to 37 200 hectares this season.

According to *The Bureau for Food and Agricultural Policy (BFAP) Baseline, Agricultural Outlook 2022 – 2031*, when looking at the outlook for field crops, specifically summer grains and oilseeds, sorghum area is projected to decline by around 15% by 2031 compared to the 2019-2021 base period. Yields are projected to increase almost 10% over the same period. Sorghum consumption is expected to increase by 7% over the coming decade after declining by 18% over the past decade.

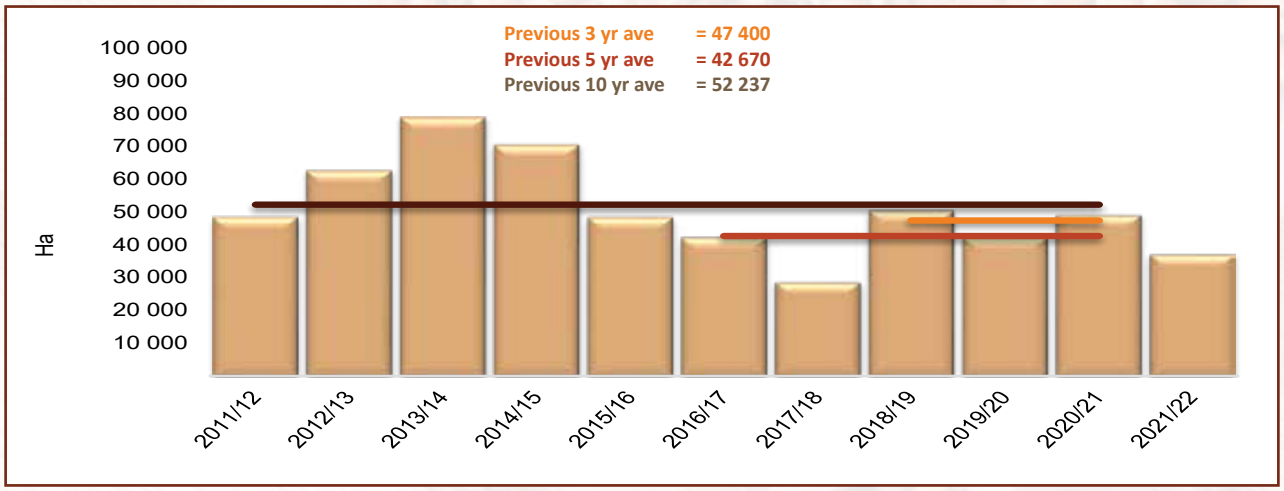
Please see Table 2 for an overview of sorghum production under dry land conditions versus irrigation in the 2021/22 season, compared to the 2020/21 season. Graphs 2 to 4 provide national figures with regards to hectares planted, tons produced and yields obtained over the last 11 seasons. Graphs 5 to 10 on page 6 provide similar figures for the major sorghum producing provinces this season, namely Mpumalanga, Limpopo and the Free State.

Table 2: Sorghum production overview over two seasons

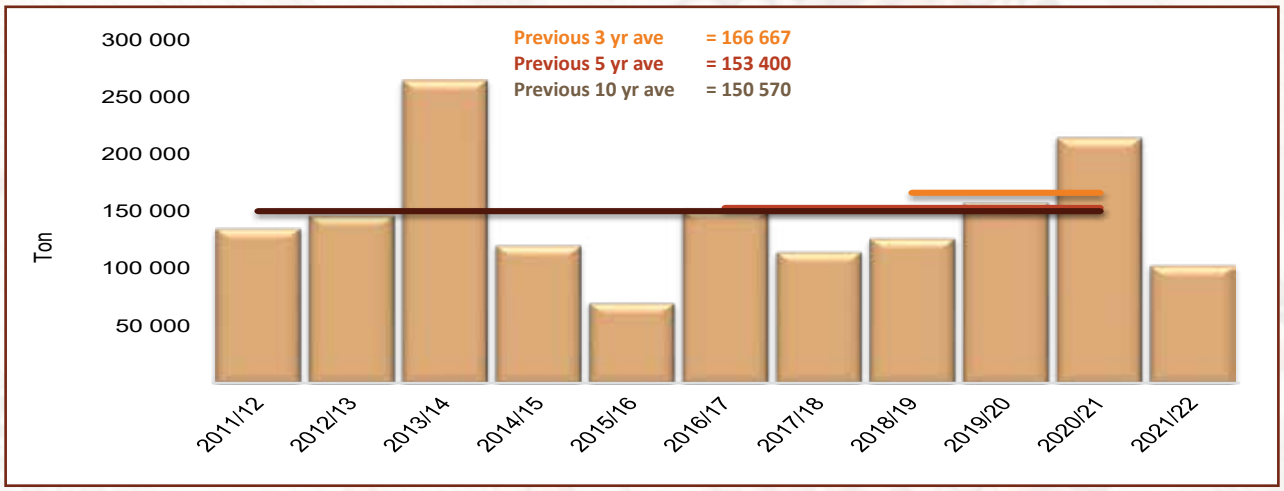
Province	Type of production	2021/22			2020/21		
		Hectares planted, ha	Production, tons	Yield, t/ha	Hectares planted, ha	Production, tons	Yield, t/ha
Western Cape	Dryland	-	-	-	-	-	-
	Irrigation	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Northern Cape	Dryland	-	-	-	-	-	-
	Irrigation	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Free State	Dryland	7 800	20 700	2.65	10 450	45 445	4.35
	Irrigation	-	-	-	50	230	4.60
	Total	7 800	20 700	2.65	10 500	45 675	4.35
Eastern Cape	Dryland	-	-	-	-	-	-
	Irrigation	-	-	-	-	-	-
	Total	-	-	-	-	-	-
KwaZulu-Natal	Dryland	200	740	3.70	450	1 980	4.40
	Irrigation	-	-	-	50	320	6.40
	Total	200	740	3.70	500	2 300	4.60
Mpumalanga	Dryland	9 000	43 650	4.85	9 400	57 325	6.10
	Irrigation	-	-	-	-	-	-
	Total	9 000	43 650	4.85	9 400	57 325	6.10
Limpopo	Dryland	12 600	19 300	1.53	16 300	57 800	3.55
	Irrigation	2 400	6 950	2.90	700	3 400	4.86
	Total	15 000	26 250	1.75	17 000	61 200	3.60
Gauteng	Dryland	200	800	4.00	300	1 350	4.50
	Irrigation	-	-	-	-	-	-
	Total	200	800	4.00	300	1 350	4.50
North West	Dryland	4 400	9 200	2.09	10 800	43 400	4.02
	Irrigation	600	1 800	3.00	700	3 750	5.36
	Total	5 000	11 000	2.20	11 500	47 150	4.10
RSA	Dryland	34 200	94 390	2.76	47 700	207 300	4.35
	Irrigation	3 000	8 750	2.92	1 500	7 700	5.13
	Total	37 200	103 140	2.77	49 200	215 000	4.37

Figures provided by the CEC.

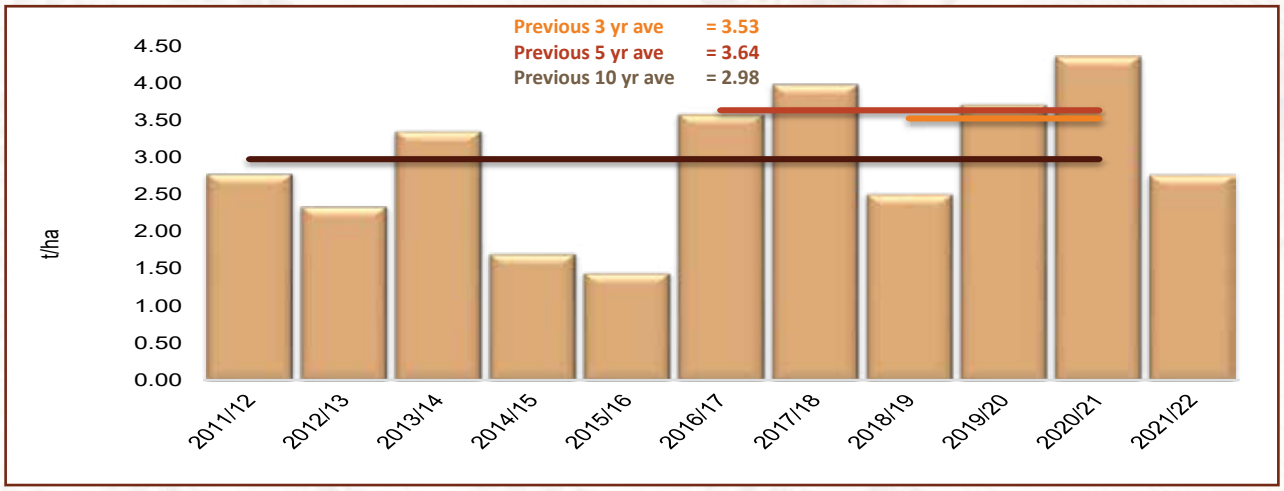
Graph 2: Total RSA area utilised for sorghum production from 2011/12 to 2021/22



Graph 3: Sorghum production in RSA from 2011/12 to 2021/22

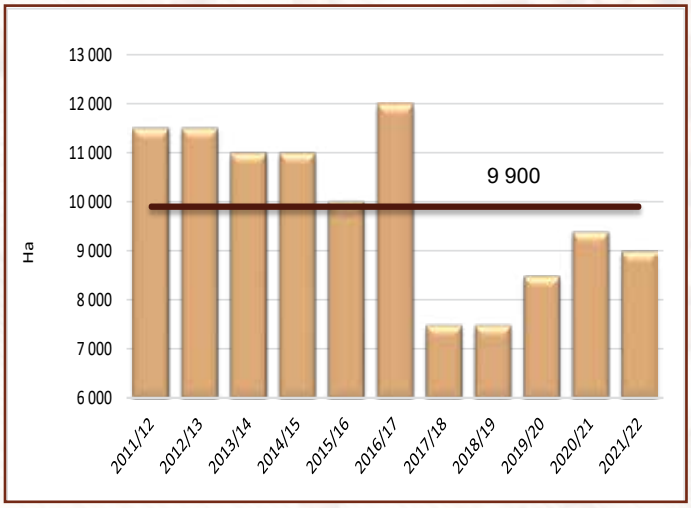


Graph 4: RSA Sorghum yield from 2011/12 to 2021/22

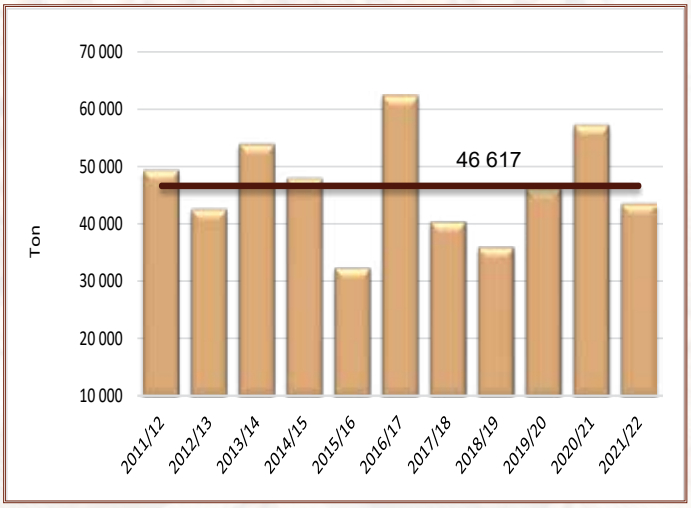


Figures provided by the CEC.

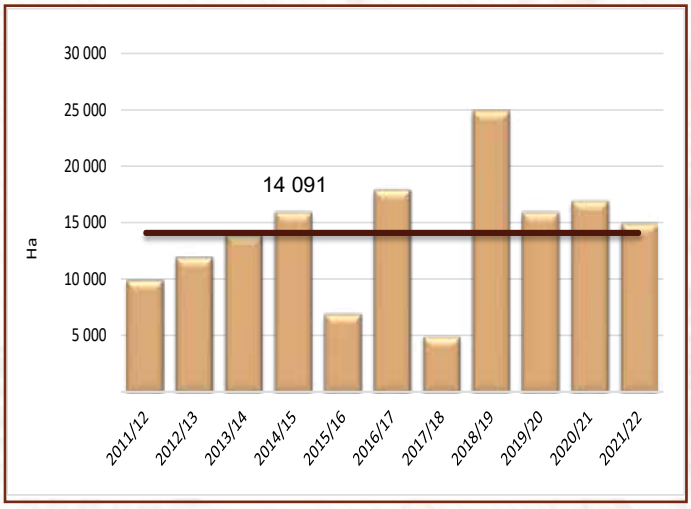
Graph 5: Area utilised for sorghum production in Mpumalanga since 2011/12



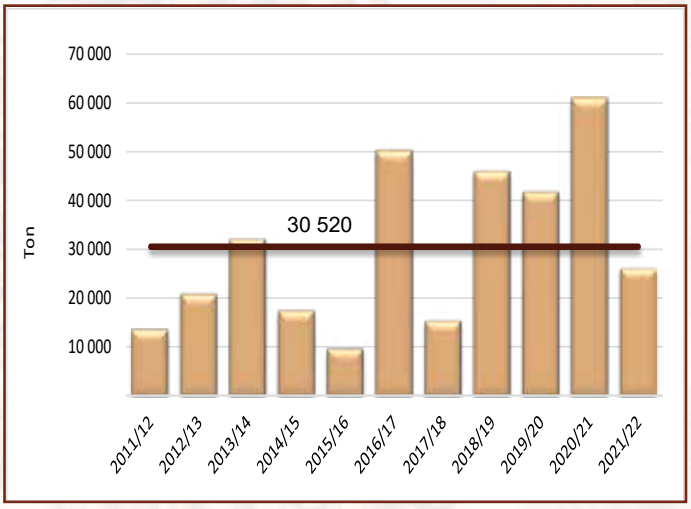
Graph 6: Sorghum production in Mpumalanga since 22011/12



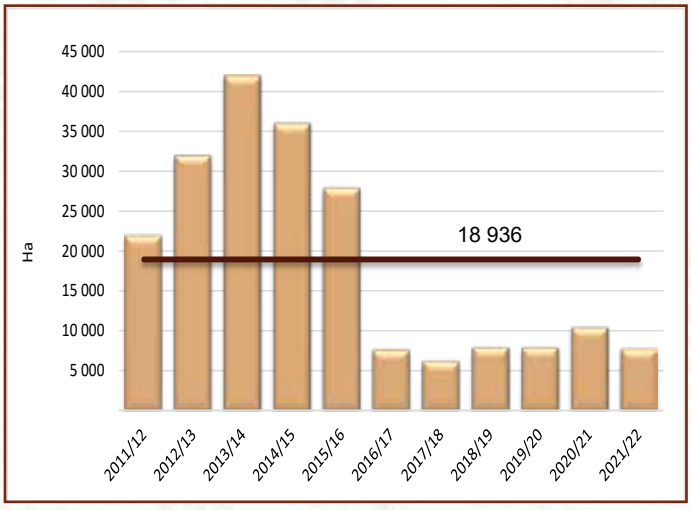
Graph 7: Area utilised for sorghum production in Limpopo since 2011/12



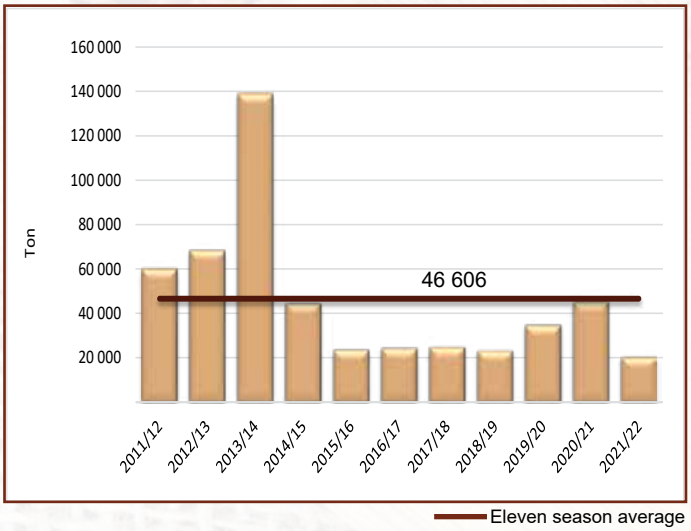
Graph 8: Sorghum production in Limpopo since 2011/12



Graph 9: Area utilised for sorghum production in the Free State since 2011/12



Graph 10: Sorghum production in the Free State since 2011/12



Figures provided by the CEC.

Supply and Demand

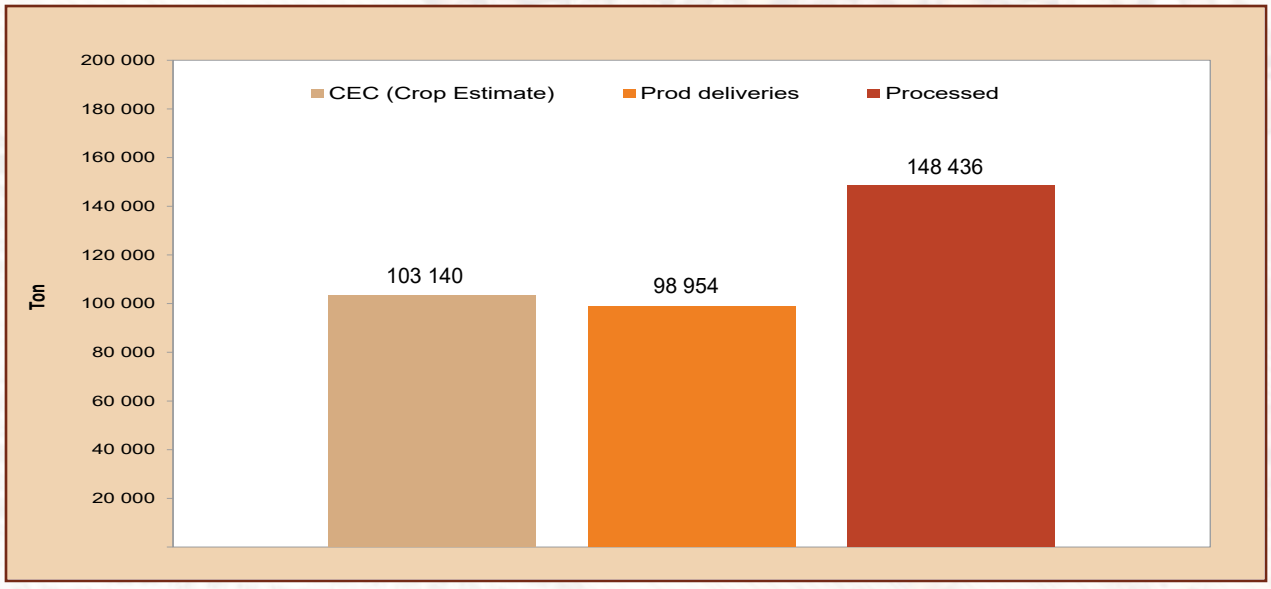
The sorghum marketing season dates from March to February. According to SAGIS supply and demand figures for the 2022/23 marketing season to date (March 2022 to January 2023), opening stock increased by 105% compared to the previous marketing season and is also 68% higher than the ten-year average.

To date, only 706 tons of sorghum have been imported, compared to the 4 147, 6 546 and 59 253 tons of the previous three seasons respectively. The ten-year import average is 39 434 tons. China is the main importer of sorghum in the world and imported 10 991 thousand metric tons (92.5% of all imports) during the 2021/22 season. To date (2022/23 season), China has imported 4 800 thousand metric tons of sorghum *(United States Department of Agriculture, Foreign Agricultural Service (USDA FAS), April 2023 report).*

Of the 148 436 tons of sorghum processed in South Africa so far this season, 39% was used for malting purposes and of this 21% was indoor malting and 79% floor malting. Sorghum processed as meal, rice and grits amounted to 44%. The remainder of the sorghum was processed for pet food, as well as poultry and livestock feed. The previous season 152 058 tons of sorghum was processed. The ten-year average is 162 330 tons.

Local exports to date amount to 10 425 tons, compared to 9 058 tons and 5 380 tons of the last two seasons respectively. The ten-year export average of 15 157 tons. Globally, the United States was by far the largest exporter of sorghum up to the 2021/2022 season. During the 2022/23 season to date, the USA exported 2 250 thousand metric tons of the total amount of 6 487 thousand metric tons. Australia is a close second with 2 200 thousand metric tons, followed by Argentina with 1 700 thousand metric tons *(USDA FAS, April 2023 report).*

Graph 11: Sorghum supply and demand overview for the current marketing season (Mar 2022 - Jan 2023)



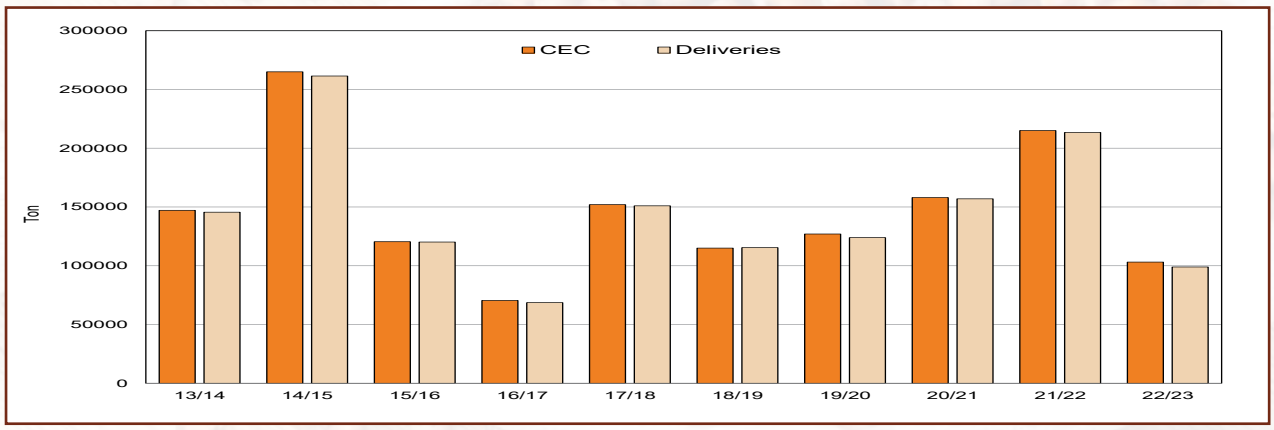
Information provided by SAGIS.

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

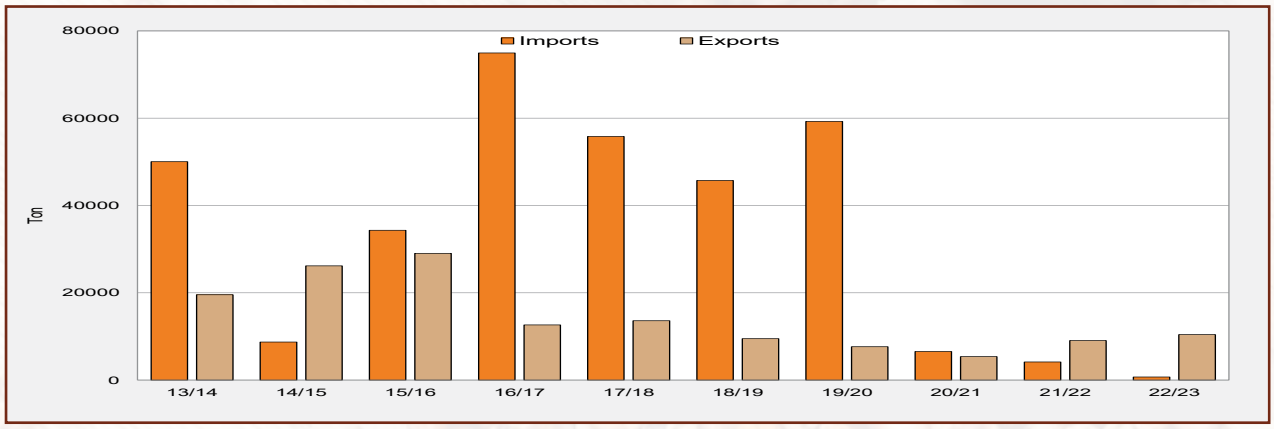
SORGHUM: SUPPLY AND DEMAND TABLE BASED ON SAGIS' INFO (TON) — **Publication date: 2023/02/27**

	Season (Mar - Feb)																Current Season Mar-Jan	10 Year average
	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	19/20	20/21	21/22	22/23	2012/13-2021/22
																		***	
																		11	
CEC (Crop Estimate)	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	127 000	158 000	215 000	103 140	150 570
SUPPLY																			
Opening stock (1 Mar)	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	51 860	60 423	51 795	106 157	63 210
Prod deliveries	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	115 394	123 925	156 966	213 458	98 954	148 963
Imports	5 000	9 900	31 700	0	4 000	0	57 800	54 800	50 033	8 725	34 316	74 957	55 824	45 739	59 253	6 546	4 147	706	39 434
Surplus	0	300	0	1 700	0	2 200	2 800	0	0	0	1 354	0	0	0	0	2 114	235	9 229	370
Total Supply	**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**	**220 379**	**235 038**	**226 049**	**269 635**	**215 046**	**251 977**
DEMAND																			
Processed	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	154 744	164 130	165 908	152 058	148 436	162 330
-Indoor malting	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	9 739	9 524	9 793	14 104	11 846	11 628
-Floor malting	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	46 613	50 857	49 285	50 864	45 569	51 065
-Meal, rice & grits	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	87 715	94 286	94 902	72 492	65 849	90 338
-Pet Food	1 300	900	900	900	900	1 100	1 200	800	924	1 113	1 029	1 001	818	850	555	634	633	1 689	836
-Poultry Feed	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	6 600	7 011	8 550	9 026	8 685	5 491
-Livestock feed	2 900	1 300	3 800	3 100	1 900	2 700	500	600	634	2 101	5 436	4 723	3 423	3 227	1 897	2 744	4 939	14 798	2 972
Bio-fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Withdrawn by producers	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	1 032	957	2 055	1 937	1 035	2 762
Released to end-consumers	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	766	613	990	585	163	1 592
Net receipts(-)/disp(+)	3 700	3 400	1 900	1 800	-1 100	- 300	1 600	1 600	70	932	531	1 101	94	883	1 036	- 79	- 160	210	601
Deficit	800	0	1 600	0	100	0	0	300	3 143	4 978	0	5 521	3 816	1 612	236	0	0	0	1 961
Exports	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	9 482	7 643	5 380	9 058	10 425	15 157
Total Demand	**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**	**168 519**	**174 615**	**174 254**	**163 478**	**160 269**	**184 403**
Ending Stock (28 Feb)	**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**	**51 860**	**60 423**	**51 795**	**106 157**	**54 777**	**67 574**
- processed p/month	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	12 895	13 678	13 826	12 672	13 494	13 528
- months' stock	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	4.0	4.4	3.7	8.4	4.1	5

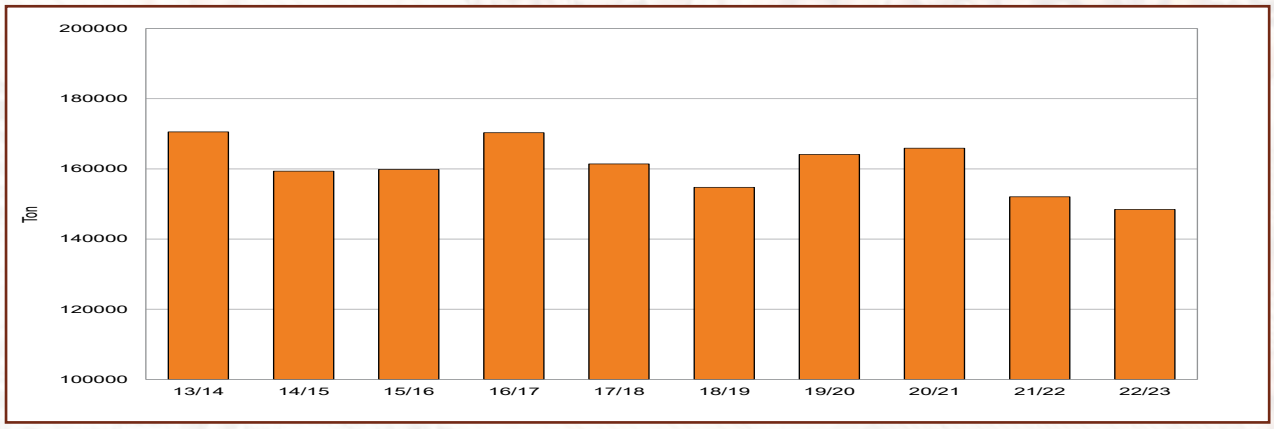
Graph 12: Sorghum: CEC Estimate vs SAGIS deliveries over 10 marketing seasons



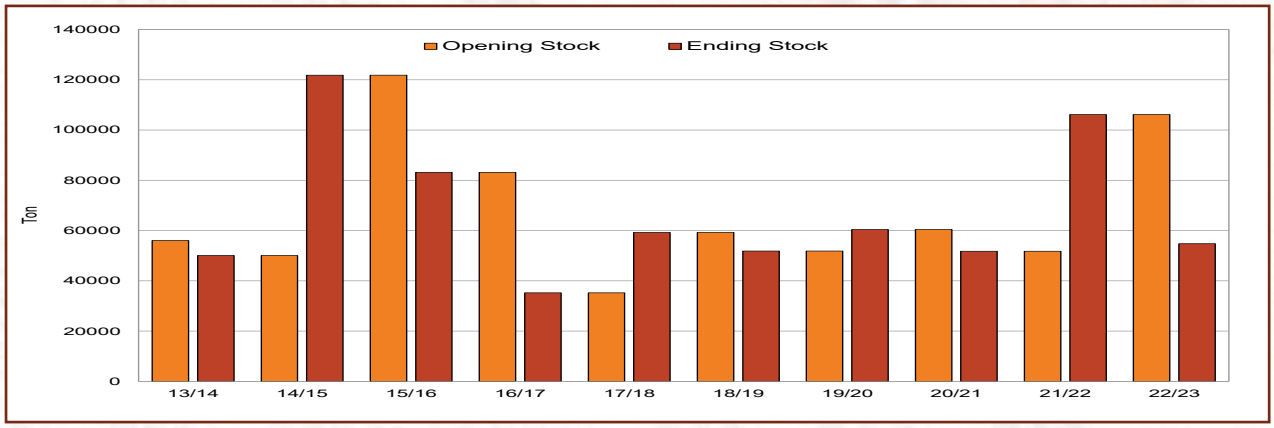
Graph 13: Sorghum: Imports and Exports over 10 marketing seasons



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	Turkey	Total
2017/18	0	0	6	0	20	55 798	0	0	55 824
2018/19	2 093	0	0	132	187	42 525	802	0	45 739
2019/20	2 165	0	0	0	470	55 820	798	0	59 253
2020/21	6 372	0	0	0	174	0	0	0	6 546
2021/22	3 805	0	0	242	100	0	0	0	4 147
2022/23	628	0	0	13	42	0	0	23	706

Season	SORGHUM: IMPORTS PER HARBOUR (Tons)					
	Harbours					
	East London	Durban	Cape Town	Port Elizabeth	Richards Bay	Total
2008/09	0	34 633	0	0	0	34 633
2009/10	0	34 082	0	0	0	34 082
2010/11	0	28 837	0	0	0	28 837
2011/12	0	74 514	0	0	0	74 514
2012/13	0	140 227	0	0	0	140 227
2013/14	0	76 278	0	0	0	76 278
2014/15	0	17 292	0	0	0	17 292
2015/16	0	65 143	0	0	0	65 143
2016/17	230	142 629	50	0	0	142 909
2017/18	0	68 689	20	0	0	68 709
2018/19	138	47 521	49	0	0	47 708
2019/20	368	76 848	102	0	0	77 318
2020/21	0	9 284	123	0	0	9 407
2021/22	0	10 045	100	0	0	10 145
2022/23*	0	14 642	0	0	0	14 642

* Progressive March 2022 - January 2023
Note: Includes Imports for RSA and Other Countries

Season	WHOLE SORGHUM: RSA EXPORTS PER COUNTRY (Tons)							
	Botswana	Chad	Namibia	Eswatini (Swaziland)	Tanzania	Zambia	Zimbabwe	Total
2017/18	6 591	0	32	1 731	912	200	0	9 466
2018/19	1 189	0	20	3 811	0	0	0	5 020
2019/20	388	0	411	3 448	0	0	0	4 247
2020/21	0	0	68	3 489	0	0	995	4 552
2021/22	4 692	0	134	3 011	0	0	0	7 837
2022/23	6 605	0	34	1 953	0	0	0	8 592

Season	SORGHUM: EXPORTS PER HARBOUR (Tons)					
	Harbours					
	East London	Durban	Cape Town	Port Elizabeth	Richards Bay	Total
2008/09	0	0	0	0	0	0
2009/10	0	7 911	0	0	0	7 911
2010/11	0	5 072	0	0	0	5 072
2011/12	0	23 087	0	0	0	23 087
2012/13	0	23 706	0	0	0	23 706
2013/14	0	19 250	0	0	0	19 250
2014/15	0	25	0	0	0	25
2015/16	0	5 300	0	0	0	5 300
2016/17	0	35 034	0	0	0	35 034
2017/18	0	6 502	0	0	0	6 502
2018/19	0	6 944	0	0	0	6 944
2019/20	0	0	0	0	0	0
2020/21	0	0	0	0	0	0
2021/22	0	5 033	0	0	0	5 033
2022/23*	0	14 570	0	0	0	14 570

* Progressive March 2022 - January 2023
Note: Includes Imports for RSA and Other Countries

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.

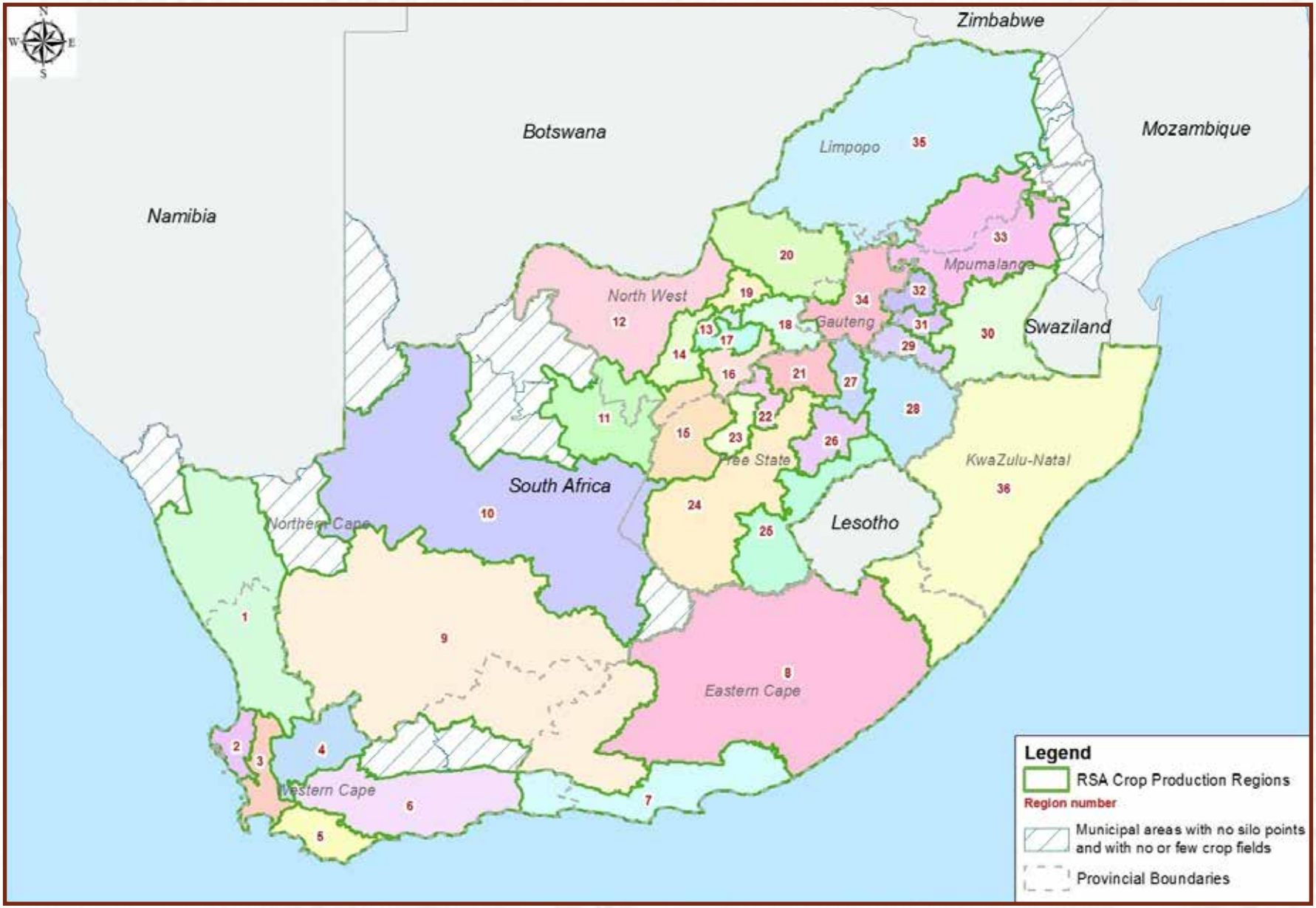
The 9 provinces are divided into 36 grain production regions.

The regions are distributed as follows:
Region 1: Namakwaland
Regions 2 to 4: Swartland
Regions 5 and 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 2021/22 production season, are named and described on page 19. All the silo/intake stands as well as the type of storage structure, situated in a particular region, are provided.

Figure 2: RSA Crop Production Regions



Regional map with gratitude to Agbiz Grain and SiQ.

Sorghum Crop Quality 2021/22 – Summary of results

Seventy-one percent (15) of the 21 samples analysed for the purpose of this survey was determined to be class GM. Of these, 10 samples (67%) were graded as Grade GM1. Two samples were graded GM2 and three samples were graded Class Other Sorghum (COS). Of the six samples determined to be class GH, 83% (5 samples) was graded GH1 and the remaining sample was graded GH2. No white sorghum samples were received this season for inclusion in the survey.

Certain varieties of sorghum contain tannins (strictly-speaking condensed tannins) in the seed coat layer beneath the pericarp (commonly referred to as the testa layer) of the grain. These varieties are variously referred to as: tannin, high-tannin, brown, bird-proof, bird-resistant, or bitter sorghums.

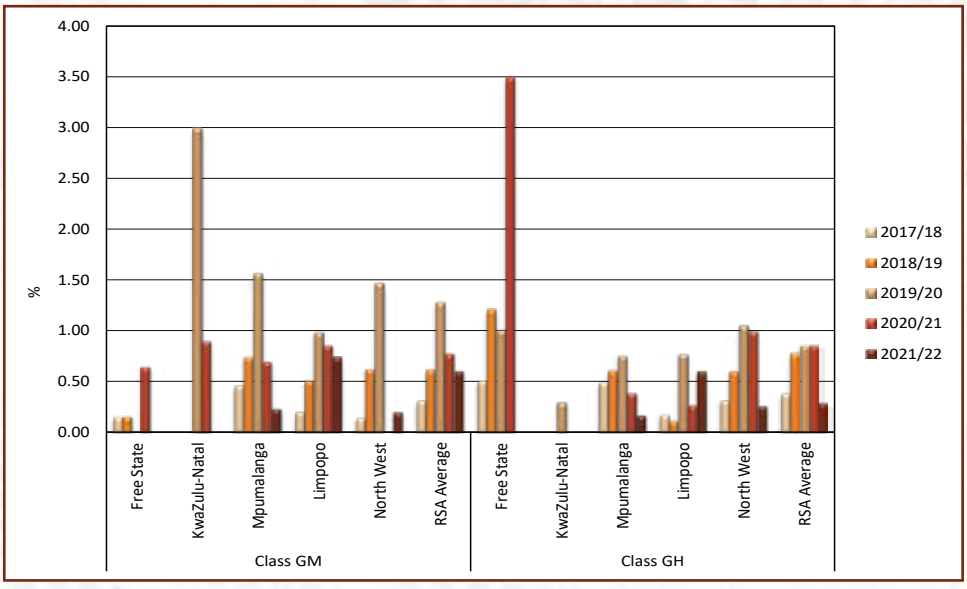
Varieties of sorghum not containing tannins are various referred to as: non-tannin, low-tannin, condensed tannin-free, or sweet sorghums.

According to the national Grading Regulations (Government Notice NO. R.15 of 08 January 2016, Regulation 4. Standards for classes), a consignment of sorghum shall be classified as Class GM Sorghum if it consists of malt sorghum that does not have a dark testa and complies with the standards for the grades. A consignment of sorghum shall be classified as Class GH Sorghum if it consists of malt sorghum that has a dark testa and complies with the standards for the grades.

The detection of tannin in sorghum grain for grading purposes is done by SAGL by means of the bleach test. Please refer to the methodology followed under Methods on page 27.

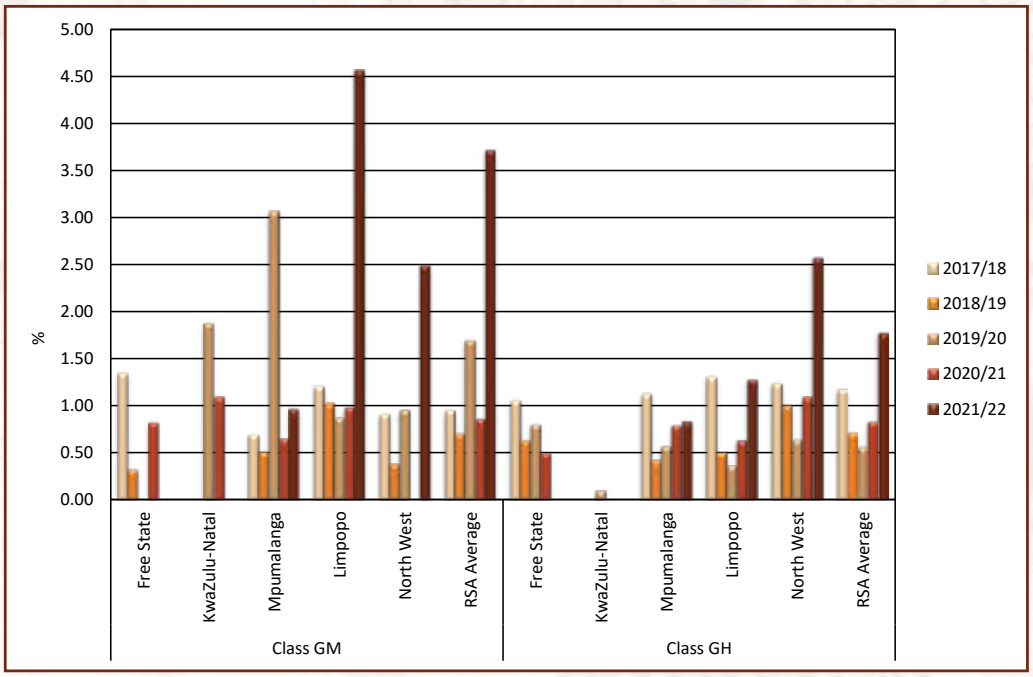
Please see Graphs 16 to 18 for the weighted average percentages foreign matter, defective sorghum and small kernel sorghum per class per province over five seasons. The 11 samples received from Limpopo had the highest average percentage foreign matter (0.74%) for GM sorghum. A single GH sorghum sample also from Limpopo showed the highest foreign matter percentage (0.60%). The national weighted averages were 0.60% and 0.29% for GM and GH sorghum respectively.

Graph 16: Average percentage foreign matter per class per province

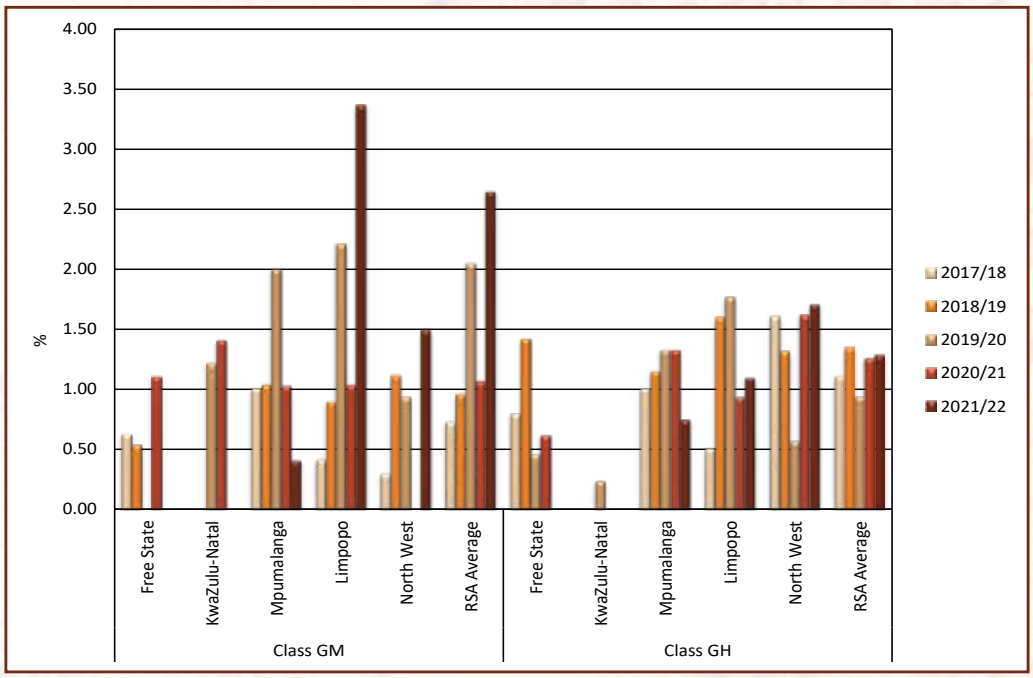


The percentage defective GM sorghum was the highest (4.57%) in Limpopo. North West (3 samples) had the highest percentage defective GH sorghum, namely 2.58%. The national averages were 3.72% for GM and 1.78% for GH. GM sorghum showed the highest percentage small kernels (national average 2.65%), with the samples from Limpopo having the highest percentage namely 3.37% and the Mpumalanga samples (N=3) the lowest with 0.41%. GM sorghum had the lowest percentages small kernels in Mpumalanga (two samples) with 0.75% and the highest in North West (1.71%), the weighted average for the class was 1.29%.

Graph 17: Average percentage defective sorghum per class per province



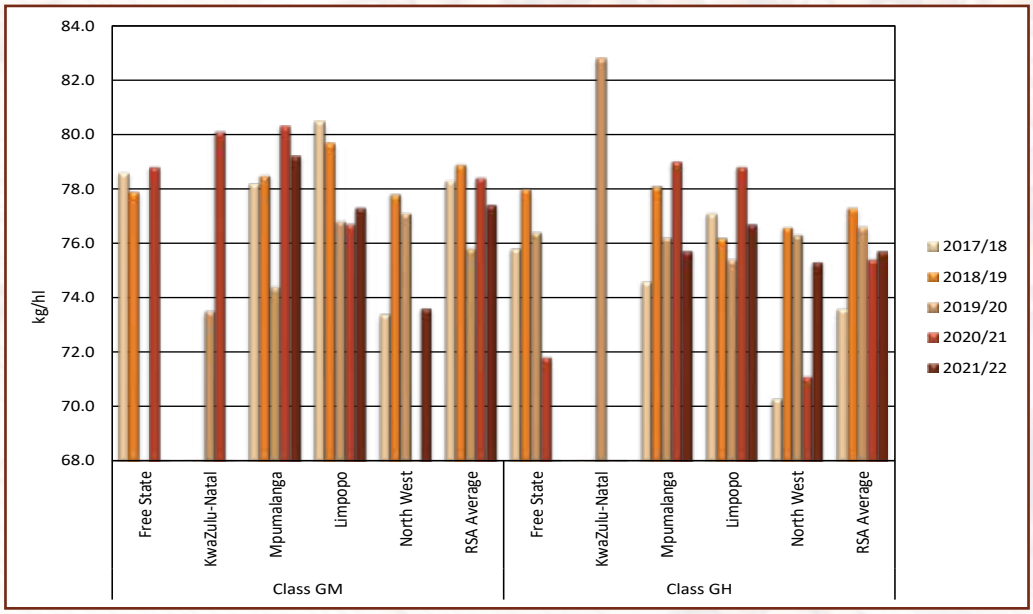
Graph 18: Average percentage small kernel sorghum per class per province



GM sorghum had the highest weighted average test weight, namely 77.4 kg/hl, while GH sorghum averaged 75.7 kg/hl. Please refer to Graph 19. Test weight values for GM sorghum ranged between 72.9 kg/hl and 80.3 kg/hl, with Mpumalanga reporting the highest average and North West the lowest. GH values varied from 73.5 kg/hl to 76.7 kg/hl. The sample from Limpopo reported the highest value with the lowest GH average reported in North West. Test weight was determined on unscreened samples.

GM sorghum also had the highest 1 000 kernel mass values, ranging between 16.4 g and 27.9 g (14% moisture basis) and averaging 23.9 g. GH sorghum averaged just 0.6 g lower at 23.3 g and varied between 20.4 g and 26.7 g. Last season these averages were 27.3 g and 26.2 g respectively.

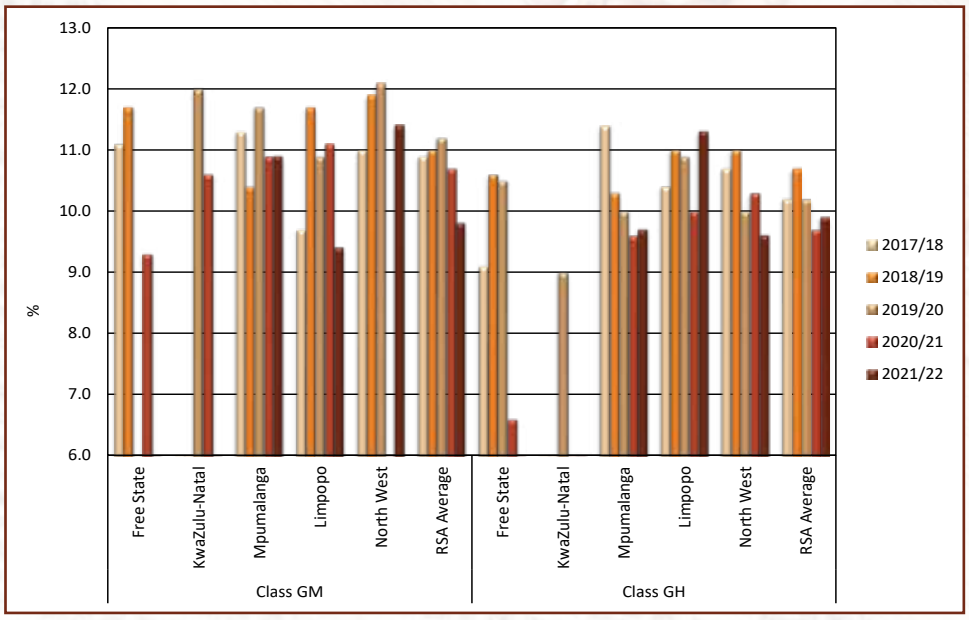
Graph 19: Average test weight per class per province



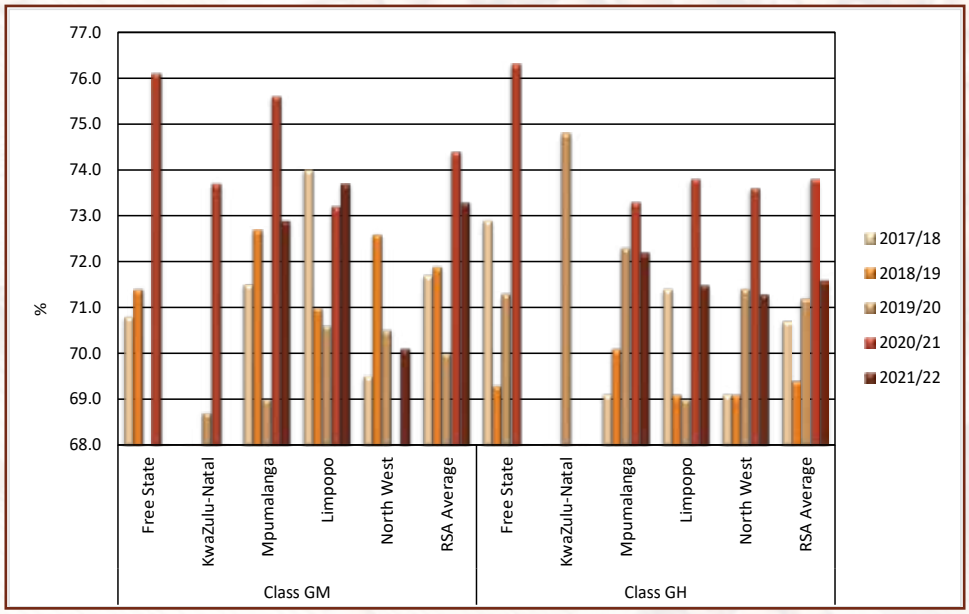
The image analysis results showed that the GM sorghum on average had longer kernels and also slightly wider kernels than the GH sorghum. The variation (indicated by the standard deviation) in these parameters is similar for both GM and GH sorghum. Kernel elongation, defined as W/L% (width divided by length, expressed as a percentage) showed a wider variation as the length and width parameters as can be expected, with average standard deviations of 5.4% for GM and 5.0% for GH sorghum. A totally round kernel will have a W/L% of 100. GM sorghum's volume to surface ratio was over the last five seasons on average 3% higher than that of GH sorghum.

The crude protein, total starch and crude fat contents of the samples were calculated and reported on a dry basis. North West had the highest protein average of 11.4% for GM sorghum, while Limpopo averaged the lowest with 9.4%. For GH sorghum, the sample from Limpopo had the highest protein content with 11.3% and North West averaged the lowest with 9.6%. Nationally, GM and GH sorghum averaged 9.8% and 9.9% respectively. The highest average total starch content for GM sorghum was reported in Limpopo (73.7%) and the lowest (70.1%) in North West. The highest average total starch content for GH sorghum, namely 72.2%, was reported in Mpumalanga. The weighted total starch content of GM sorghum was 73.3% and that of GH sorghum 71.6%. Please see Graphs 20 and 21.

Graph 20: Average percentage crude protein per class per province



Graph 21: Average percentage total starch per class per province



The crude fat content of the crop samples was determined for the first time this season. The national average for GM sorghum was 3.5% and that for GH sorghum 3.0%. There was just a slight variation of 0.1% in average fat content between provinces for both GM and GH sorghum.

Hunterlab colour determinations were done on a milled fraction of dehulled sample above the 1.8 mm slotted sieve. The Hunterlab spectrophotometer separates the components of reflected color into a three-dimensional colour scale, namely the Hunter L, a, b scale where L represents lightness (100 being white and 0 being black), a represents green to red variation and b represents variation from blue to yellow.

Please see Graphs 22 to 27 for a comparison of the ranges in the L, a, b values obtained on GM and GH sorghum over five seasons. The minimum and maximum values are based on a single composite sample's result in a specific season.

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 determine the end product colour.

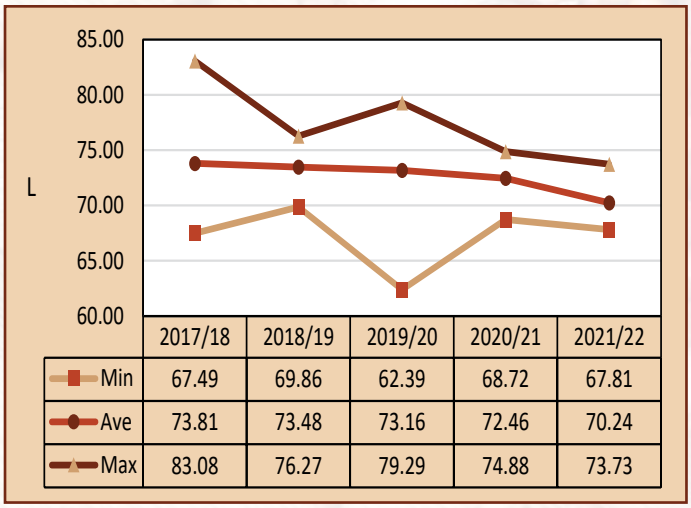
Mycotoxin analyses were performed on all 21 sorghum crop samples. The samples were tested by means of a SANAS ISO/IEC 17025 accredited multi-mycotoxin method using UPLC-MS/MS. With this technique simultaneous quantification and confirmation of Aflatoxin B_1; B_2; G_1; G_2, Fumonisin B_1; B_2; B_3, Deoxynivalenol, 15-ADON, HT-2 Toxin, T-2 Toxin, Zearalenone and Ochratoxin A is possible in one run.

One sample from Limpopo tested positive for Fumonisin B_1 residues. Fumonisin, Deoxynivalenol (DON) and Zearalenone residues were found on some of the samples of the 2018/19 season. None of the levels however raised any concerns. None of the samples tested positive for any of these mycotoxins in the 2017/18, 2019/20 and 2020/21 seasons.

Please see mycotoxin results in Table 10 on page 26.

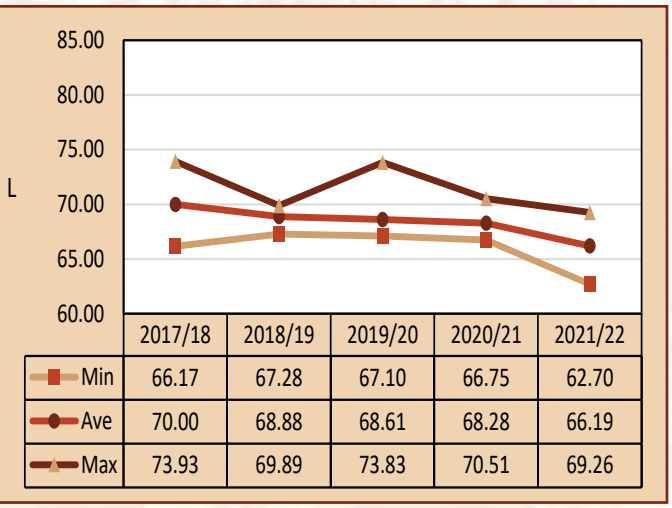
The Methods section of this report on pages 27 to 29 provide a description of the procedures and methodologies followed.

Graph 22: Range of Hunterlab L values on GM sorghum over five seasons



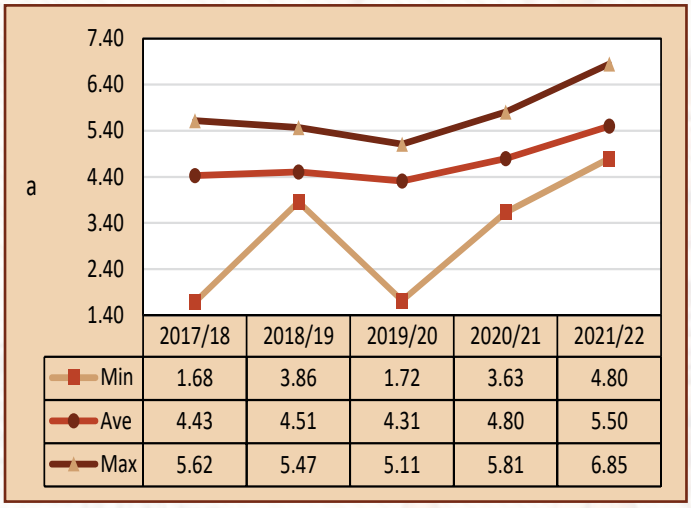
	2017/18	2018/19	2019/20	2020/21	2021/22
Min	67.49	69.86	62.39	68.72	67.81
Ave	73.81	73.48	73.16	72.46	70.24
Max	83.08	76.27	79.29	74.88	73.73

Graph 23: Range of Hunterlab L values on GH sorghum over five seasons



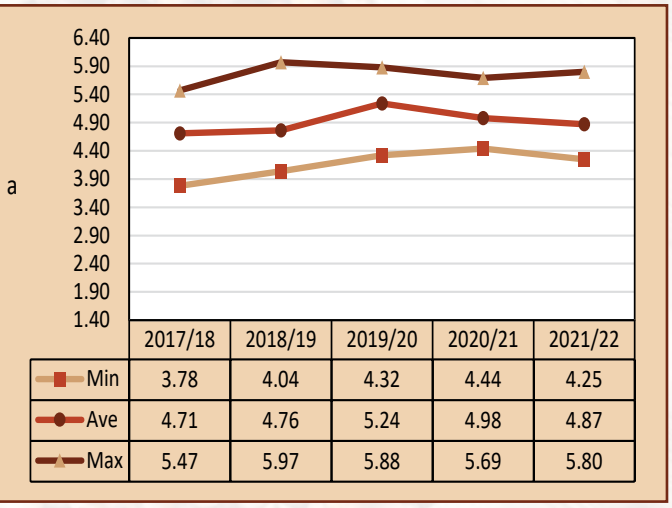
	2017/18	2018/19	2019/20	2020/21	2021/22
Min	66.17	67.28	67.10	66.75	62.70
Ave	70.00	68.88	68.61	68.28	66.19
Max	73.93	69.89	73.83	70.51	69.26

Graph 24: Range of Hunterlab a values on GM sorghum over five seasons



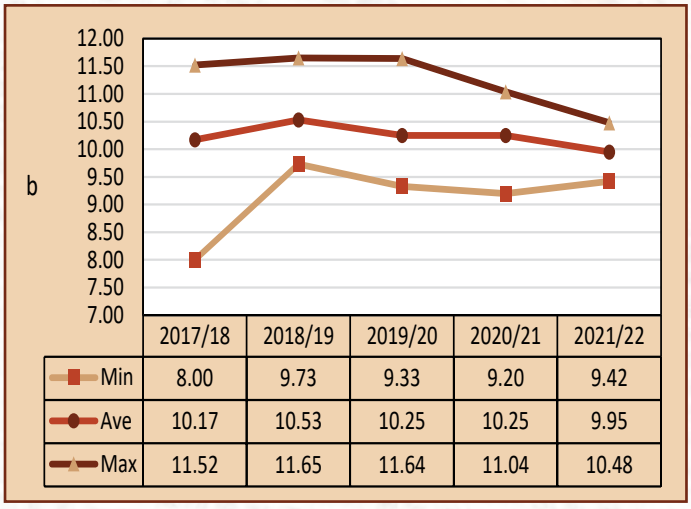
	2017/18	2018/19	2019/20	2020/21	2021/22
Min	1.68	3.86	1.72	3.63	4.80
Ave	4.43	4.51	4.31	4.80	5.50
Max	5.62	5.47	5.11	5.81	6.85

Graph 25: Range of Hunterlab a values on GH sorghum over five seasons



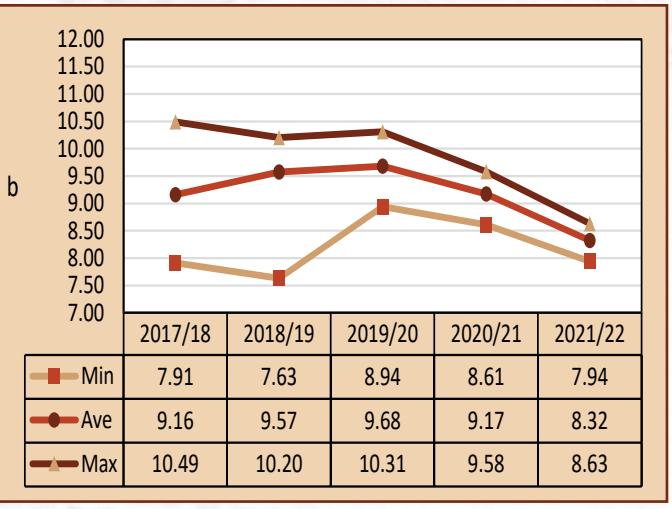
	2017/18	2018/19	2019/20	2020/21	2021/22
Min	3.78	4.04	4.32	4.44	4.25
Ave	4.71	4.76	5.24	4.98	4.87
Max	5.47	5.97	5.88	5.69	5.80

Graph 26: Range of Hunterlab b values on GM sorghum over five seasons



	2017/18	2018/19	2019/20	2020/21	2021/22
Min	8.00	9.73	9.33	9.20	9.42
Ave	10.17	10.53	10.25	10.25	9.95
Max	11.52	11.65	11.64	11.04	10.48

Graph 27: Range of Hunterlab b values on GH sorghum over five seasons



	2017/18	2018/19	2019/20	2020/21	2021/22
Min	7.91	7.63	8.94	8.61	7.94
Ave	9.16	9.57	9.68	9.17	8.32
Max	10.49	10.20	10.31	9.58	8.63

Table 3: South African Sorghum Crop Quality Averages 2021/22 season								
Class and grade sorghum		**GM**				**GH**		
		GM1	**GM2**	**COS**	**Weighted Average**	**GH1**	**GH2**	**Weighted Average**
Grading								
Foreign matter, %		0.33	1.55	0.87	0.60	0.28	0.30	0.29
Unthreshed sorghum, %		1.11	1.45	1.97	1.33	1.54	0.38	1.34
Defective sorghum, %		1.52	2.32	11.97	3.72	1.50	3.22	1.78
Small kernel sorghum, %		1.21	1.20	8.43	2.65	1.18	1.80	1.29
Total defective sorghum and small kernel sorghum, %		2.73	3.52	20.40	6.37	2.68	5.02	3.07
Sorghum of another group, %		0.28	0.00	0.56	0.30	0.00	0.00	0.00
White sorghum, %		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total of sorghum of another group and white sorghum, %		0.28	0.00	0.56	0.30	0.00	0.00	0.00
Weather-stained sorghum, %		1.48	0.65	1.40	1.35	0.58	0.72	0.60
Physical parameters								
Test weight, kg/hl		78.6	76.0	74.5	77.4	76.1	73.5	75.7
1000 Kernel Mass, g (14% moisture base)		24.7	24.0	21.2	23.9	23.9	20.4	23.3
# Image analysis	Length, mm	4.61	4.57	4.40	4.56	4.17	4.02	4.14
	Standard Deviation	0.34	0.32	0.35	0.34	0.27	0.28	0.27
	Width, mm	3.95	3.74	3.55	3.84	3.78	3.58	3.74
	Standard Deviation	0.30	0.28	0.33	0.30	0.24	0.25	0.24
	Elongation, %	85.83	81.99	80.89	84.33	90.74	89.26	90.50
	Standard Deviation	5.29	5.07	5.86	5.37	4.71	6.21	4.96
	Surface Area, %	72.6	70.6	67.6	71.3	67.0	64.2	66.5
	Standard Deviation	4.9	4.6	5.3	4.9	4.0	3.9	4.0
Nutritional analysis								
Milled Sorghum Moisture, %		12.5	12.4	12.0	12.4	12.6	13.0	12.7
Crude Protein content, % (db)		9.6	8.9	11.3	9.8	9.7	11.2	9.9
Total Starch content, % (db)		73.7	73.8	71.6	73.3	72.1	69.1	71.6
Crude Fat content, % (db)		3.5	3.6	3.4	3.5	2.9	3.0	3.0
Hunterlab colour (fraction of dehulled sample above the 1.8 mm slotted sieve milled on Retch mill through 0.5 mm sieve)	L	70.60	69.21	69.72	70.24	66.12	66.56	66.19
	a	5.57	5.81	5.05	5.50	4.91	4.65	4.87
	b	10.00	9.70	9.95	9.95	8.27	8.53	8.32
Number of samples		***10***	***2***	***3***	***15***	***5***	***1***	***6***

Grain Production Regions

Silo/Intake stands per region indicating type of storage structure

Region 13: North-West Central Region (Sannieshof)			
NWK	Biesiesvlei (Bins)	NWK	Oppaslaagte (Bins)
NWK	Bossies (Bins)	NWK	Sannieshof (Bins)
NWK	Gerdau (Bins)		

Region 19: North West Central Region (Lichtenburg)			
Afgri	Lichtenburg (Bunkers)	NWK	Lottie Halte (Bins)
NWK	Grootpan 1 (Bins)	NWK	Lusthof (Bins)
NWK	Grootpan 2 (Bins)	NWK	Lichtenburg Silo 5 (Bins)
NWK	Halfpad (Bins)	NWK	Lichtenburg Silo 3 (Bins)
NWK	Hibernia (Bins)	NWK	Mafikeng (Bins)

Region 20: North-West Eastern Region			
Afgri	Battery Silo (Bins)	NWK	Derby (Bins)
Afgri	Beestekraal (Bins)	NWK	Koster (Bins)
Afgri	Brits Silo (Bins)	NWK	Swartruggens (Bins)
NWK	Boons (Bins)	NWK	Syferbult (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	Vaaldrift (Bunkers)
Afgri	Holmdene (Bins)	Afgri	Val (Bins)

Region 33: Mpumalanga Northern Region			
Afgri	Arnot (Bins)	Afgri	Middelburg (Bins)
Afgri	Driefontein (Bins)	Afgri	Pan (Bins)
Afgri	Lydenburg (Bins)	Afgri	Stoffberg (Bins)
Afgri	Marble Hall (Bins)	Afgri	Wonderfontein (Bins)

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

TABLE 4: GRADING RESULTS OF SORGHUM ACCORDING TO GRADE (2021/22)

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																												
1	Region 20	0.20	-	-	0.48	-	-	2.50	-	-	1.50	-	-	4.00	-	-	0.00	-	-	0.00	-	-	0.00	-	-	3.10	-	-
3	Region 29	0.23	0.10	0.40	0.68	0.34	1.00	0.97	0.70	1.32	0.41	0.14	0.88	1.38	0.84	1.78	0.93	0.00	2.80	0.00	0.00	0.00	0.93	0.00	2.80	2.87	2.00	4.60
6	Region 35	0.41	0.18	0.70	1.43	0.10	2.84	1.63	1.00	2.25	1.56	0.34	3.60	3.19	1.34	5.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.00	1.00
10	**Ave. GM1**	**0.33**			**1.11**			**1.52**			**1.21**			**2.73**			**0.28**			**0.00**			**0.28**			**1.48**		
	Min. GM1		**0.10**			**0.10**			**0.70**			**0.14**			**0.84**			**0.00**			**0.00**			**0.00**			**0.00**	
	Max. GM1			**0.70**			**2.84**			**2.50**			**3.60**			**5.72**			**2.80**			**0.00**			**2.80**			**4.60**
GRADE: GM2																												
2	Region 35	1.55	1.20	1.90	1.45	0.50	2.40	2.32	0.64	4.00	1.20	1.20	1.20	3.52	1.84	5.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.65	0.40	0.90
2	**Ave. GM2**	**1.55**			**1.45**			**2.32**			**1.20**			**3.52**			**0.00**			**0.00**			**0.00**			**0.65**		
	Min. GM2		**1.20**			**0.50**			**0.64**			**1.20**			**1.84**			**0.00**			**0.00**			**0.00**			**0.40**	
	Max. GM2			**1.90**			**2.40**			**4.00**			**1.20**			**5.20**			**0.00**			**0.00**			**0.00**			**0.90**
GRADE: COS																												
3	Region 35	0.87	0.28	1.84	1.97	1.02	3.60	11.97	2.70	18.22	8.43	1.88	18.30	20.40	20.10	21.00	0.56	0.00	1.68	0.00	0.00	0.00	0.56	0.00	1.68	1.40	0.80	2.00
3	**Ave. COS**	**0.87**			**1.97**			**11.97**			**8.43**			**20.40**			**0.56**			**0.00**			**0.56**			**1.40**		
	Min. COS		**0.28**			**1.02**			**2.70**			**1.88**			**20.10**			**0.00**			**0.00**			**0.00**			**0.80**	
	Max. COS			**1.84**			**3.60**			**18.22**			**18.30**			**21.00**			**1.68**			**0.00**			**1.68**			**2.00**
GRADE: GH1																												
1	Region 13	0.22	-	-	1.64	-	-	2.72	-	-	1.76	-	-	4.48	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.30	-	-
1	Region 19	0.26	-	-	0.40	-	-	1.80	-	-	1.56	-	-	3.36	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.28	-	-
2	Region 33	0.17	0.16	0.18	2.62	1.84	3.40	0.84	0.70	0.98	0.75	0.70	0.80	1.59	1.50	1.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.80	1.20
1	Region 35	0.60	-	-	0.40	-	-	1.28	-	-	1.10	-	-	2.36	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.30	-	-
5	**Ave. GH1**	**0.28**			**1.54**			**1.50**			**1.18**			**2.68**			**0.00**			**0.00**			**0.00**			**0.58**		
	Min. GH1		**0.16**			**0.40**			**0.70**			**0.70**			**1.50**			**0.00**			**0.00**			**0.00**			**0.28**	
	Max. GH1			**0.60**			**3.40**			**2.72**			**1.76**			**4.48**			**0.00**			**0.00**			**0.00**			**1.20**
GRADE: GH2																												
1	Region 20	0.30	-	-	0.38	-	-	3.22	-	-	1.80	-	-	5.02	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.72	-	-
1	**Ave. GH2**	**0.30**			**0.38**			**3.22**			**1.80**			**5.02**			**0.00**			**0.00**			**0.00**			**0.72**		
	Min. GH2		**-**			**-**			**-**			**-**			**-**			**-**			**-**			**-**			**-**	
	Max. GH2			**-**			**-**			**-**			**-**			**-**			**-**			**-**			**-**			**-**

TABLE 5: GRADING RESULTS OF SORGHUM ACCORDING TO CLASS (2021/22)

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.
CLASS: GM																												
1	Region 20	0.20	-	-	0.48	-	-	2.50	-	-	1.50	-	-	4.00	-	-	0.00	-	-	0.00	-	-	0.00	-	-	3.10	-	-
3	Region 29	0.23	0.10	0.40	0.68	0.34	1.00	0.97	0.70	1.32	0.41	0.14	0.88	1.38	0.84	1.78	0.93	0.00	2.80	0.00	0.00	0.00	0.93	0.00	2.80	2.87	2.00	4.60
11	Region 35	0.74	0.18	1.90	1.58	0.10	3.60	4.57	0.64	18.22	3.37	0.34	18.30	7.94	1.34	21.00	0.15	0.00	1.68	0.00	0.00	0.00	0.15	0.00	1.68	0.78	0.00	2.00
15	**Ave. GM**	**0.60**			**1.33**			**3.72**			**2.65**			**6.37**			**0.30**			**0.00**			**0.30**			**1.35**		
	Min. GM		**0.10**			**0.10**			**0.64**			**0.14**			**0.84**			**0.00**			**0.00**			**0.00**			**0.00**	
	Max. GM			**1.90**			**3.60**			**18.22**			**18.30**			**21.00**			**2.80**			**0.00**			**2.80**			**4.60**
CLASS: GH																												
1	Region 13	0.22	-	-	1.64	-	-	2.72	-	-	1.76	-	-	4.48	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.30	-	-
1	Region 19	0.26	-	-	0.40	-	-	1.80	-	-	1.56	-	-	3.36	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.28	-	-
1	Region 20	0.30	-	-	0.38	-	-	3.22	-	-	1.80	-	-	5.02	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.72	-	-
2	Region 33	0.17	0.16	0.18	2.62	1.84	3.40	0.84	0.70	0.98	0.75	0.70	0.80	1.59	1.50	1.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.80	1.20
1	Region 35	0.60	-	-	0.40	-	-	1.28	-	-	1.10	-	-	2.36	-	-	0.00	-	-	0.00	-	-	0.00	-	-	0.30	-	-
6	**Ave. GH**	**0.29**			**1.34**			**1.78**			**1.29**			**3.07**			**0.00**			**0.00**			**0.00**			**0.60**		
	Min. GH		**0.16**			**0.38**			**0.70**			**0.70**			**1.50**			**0.00**			**0.00**			**0.00**			**0.28**	
	Max. GH			**0.60**			**3.40**			**3.22**			**1.80**			**5.02**			**0.00**			**0.00**			**0.00**			**1.20**

TABLE 6: PHYSICAL PARAMETERS & IMAGE ANALYSIS OF SORGHUM ACCORDING TO GRADE (2021/22)

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			Elongation (%) Average			Elongation (%) 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																														
1	Region 20	73.6	-	-	23.2	-	-	4.27	-	-	0.28	-	-	3.82	-	-	0.25	-	-	89	-	-	4.5	-	-	68	-	-	4.2	-	-
3	Region 29	79.2	78.2	80.0	25.0	23.7	26.4	4.51	4.36	4.62	0.30	0.26	0.34	4.00	3.89	4.08	0.26	0.25	0.27	89	89	89	5.2	4.8	5.4	72	70	74	4.3	4.0	4.7
6	Region 35	79.2	76.8	80.3	24.8	21.9	27.9	4.72	4.67	4.76	0.36	0.30	0.41	3.95	3.83	4.03	0.32	0.24	0.38	84	82	85	5.5	4.7	6.8	74	72	75	5.3	4.1	6.2
10	**Ave. GM1**	**78.6**			**24.7**			**4.61**			**0.34**			**3.95**			**0.30**			**86**			**5.3**			**73**			**4.9**		
	Min. GM1		**73.6**			**21.9**			**4.27**			**0.26**			**3.82**			**0.24**			**82**			**4.5**			**68**			**4.0**	
	Max. GM1			**80.3**			**27.9**			**4.76**			**0.41**			**4.08**			**0.38**			**89**			**6.8**			**75**			**6.2**
GRADE: GM2																														
2	Region 35	76.0	75.6	76.3	24.0	21.5	26.4	4.57	4.56	4.57	0.32	0.31	0.34	3.74	3.69	3.78	0.28	0.27	0.28	82	81	83	5.1	4.9	5.3	71	70	71	4.6	4.5	4.8
2	**Ave. GM2**	**76.0**			**24.0**			**4.57**			**0.32**			**3.74**			**0.28**			**82**			**5.1**			**71**			**4.6**		
	Min. GM2		**75.6**			**21.5**			**4.56**			**0.31**			**3.69**			**0.27**			**81**			**4.9**			**70**			**4.5**	
	Max. GM2			**76.3**			**26.4**			**4.57**			**0.34**			**3.78**			**0.28**			**83**			**5.3**			**71**			**4.8**
GRADE: COS																														
3	Region 35	74.5	72.9	76.9	21.2	16.4	24.3	4.40	4.27	4.52	0.35	0.33	0.39	3.55	3.43	3.74	0.33	0.33	0.34	81	79	83	5.9	5.6	6.2	68	65	70	5.3	5.0	5.7
3	**Ave. COS**	**74.5**			**21.2**			**4.40**			**0.35**			**3.55**			**0.33**			**81**			**5.9**			**68**			**5.3**		
	Min. COS		**72.9**			**16.4**			**4.27**			**0.33**			**3.43**			**0.33**			**79**			**5.6**			**65**			**5.0**	
	Max. COS			**76.9**			**24.3**			**4.52**			**0.39**			**3.74**			**0.34**			**83**			**6.2**			**70**			**5.7**
GRADE: GH1																														
1	Region 13	76.6	-	-	24.0	-	-	4.03	-	-	0.26	-	-	3.71	-	-	0.23	-	-	92	-	-	4.2	-	-	65	-	-	3.8	-	-
1	Region 19	75.8	-	-	22.9	-	-	4.08	-	-	0.26	-	-	3.68	-	-	0.23	-	-	90	-	-	4.8	-	-	65	-	-	3.7	-	-
2	Region 33	75.7	75.3	76.0	24.2	21.7	26.7	4.26	4.13	4.39	0.25	0.25	0.25	3.84	3.71	3.97	0.21	0.20	0.23	90	90	90	4.7	4.5	4.9	68	66	71	3.5	3.4	3.6
1	Region 35	76.7	76.7	76.7	24.3	24.3	24.3	4.20	4.20	4.20	0.34	0.34	0.34	3.81	3.81	3.81	0.34	0.34	0.34	91	91	91	5.1	5.1	5.1	68	68	68	5.5	5.5	5.5
5	**Ave. GH1**	**76.1**			**23.9**			**4.17**			**0.27**			**3.78**			**0.24**			**91**			**4.7**			**67**			**4.0**		
	Min. GH1		**75.3**			**21.7**			**4.03**			**0.25**			**3.68**			**0.20**			**90**			**4.2**			**65**			**3.4**	
	Max. GH1			**76.7**			**26.7**			**4.39**			**0.34**			**3.97**			**0.34**			**92**			**5.1**			**71**			**5.5**
GRADE: GH2																														
1	Region 20	73.5	-	-	20.4	-	-	4.02	-	-	0.28	-	-	3.58	-	-	0.25	-	-	89	-	-	6.2	-	-	64	-	-	3.9	-	-
1	**Ave. GH2**	**73.5**			**20.4**			**4.02**			**0.28**			**3.58**			**0.25**			**89**			**6.2**			**64**			**3.9**		
	Min. GH2		**-**			**-**			**-**			**-**			**-**			**-**			**-**			**-**			**-**			**-**	
	Max. GH2			**-**			**-**			**-**			**-**			**-**			**-**			**-**			**-**			**-**			**-**

TABLE 7: PHYSICAL PARAMETERS & IMAGE ANALYSIS OF SORGHUM ACCORDING TO CLASS (2021/22)

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			Elongation (%) Average			Elongation (%) 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.
CLASS: GM																														
1	Region 20	73.6	-	-	23.2	-	-	4.27	-	-	0.28	-	-	3.82	-	-	0.25	-	-	89	-	-	4.5	-	-	68	-	-	4.2	-	-
3	Region 29	79.2	78.2	80.0	25.0	23.7	26.4	4.51	4.36	4.62	0.30	0.26	0.34	4.00	3.89	4.08	0.26	0.25	0.27	89	89	89	5.2	4.8	5.4	72	70	74	4.3	4.0	4.7
11	Region 35	77.3	72.9	80.3	23.7	16.4	27.9	4.60	4.27	4.76	0.35	0.30	0.41	3.80	3.43	4.03	0.32	0.24	0.38	83	79	85	5.5	4.7	6.8	71	65	75	5.2	4.1	6.2
15	**Ave. GM**	**77.4**			**23.9**			**4.56**			**0.34**			**3.84**			**0.30**			**84**			**5.4**			**71**			**4.9**		
	Min. GM		**72.9**			**16.4**			**4.27**			**0.26**			**3.43**			**0.24**			**79**			**4.5**			**65**			**4.0**	
	Max. GM			**80.3**			**27.9**			**4.76**			**0.41**			**4.08**			**0.38**			**89**			**6.8**			**75**			**6.2**
CLASS: GH																														
1	Region 13	76.6	-	-	24.0	-	-	4.03	-	-	0.26	-	-	3.71	-	-	0.23	-	-	92	-	-	4.2	-	-	65	-	-	3.8	-	-
1	Region 19	75.8	-	-	22.9	-	-	4.08	-	-	0.26	-	-	3.68	-	-	0.23	-	-	90	-	-	4.8	-	-	65	-	-	3.7	-	-
1	Region 20	73.5	-	-	20.4	-	-	4.02	-	-	0.28	-	-	3.58	-	-	0.25	-	-	89	-	-	6.2	-	-	64	-	-	3.9	-	-
2	Region 33	75.7	75.3	76.0	24.2	21.7	26.7	4.26	4.13	4.39	0.25	0.25	0.25	3.84	3.71	3.97	0.21	0.20	0.23	90	90	90	4.7	4.5	4.9	68	66	71	3.5	3.4	3.6
1	Region 35	76.7	-	-	24.3	-	-	4.20	-	-	0.34	-	-	3.81	-	-	0.34	-	-	91	-	-	5.1	-	-	68	-	-	5.5	-	-
6	**Ave. GH**	**75.7**			**23.3**			**4.14**			**0.27**			**3.74**			**0.24**			**91**			**5.0**			**67**			**4.0**		
	Min. GH		**73.5**			**20.4**			**4.02**			**0.25**			**3.58**			**0.20**			**89**			**4.2**			**64**			**3.4**	
	Max. GH			**76.7**			**26.7**			**4.39**			**0.34**			**3.97**			**0.34**			**92**			**6.2**			**71**			**5.5**

TABLE 8: NUTRITIONAL VALUES OF SORGHUM ACCORDING TO GRADE (2021/22)

Number of samples	Region	Moisture, %			Crude Protein content, % (db)			Total Starch content, % (db)			Crude Fat 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.	ave.	min.	max.
GRADE: GM1																						
1	Region 20	12.9	-	-	11.4	-	-	70.1	-	-	3.5	-	-	68.14	-	-	5.77	-	-	9.42	-	-
3	Region 29	12.3	12.2	12.3	10.9	10.8	11.0	72.9	72.4	73.5	3.4	3.3	3.4	69.06	67.81	70.29	6.35	5.72	6.85	9.88	9.72	10.05
6	Region 35	12.6	11.8	13.1	8.6	7.4	9.9	74.7	73.5	76.6	3.6	3.4	3.8	71.77	71.08	73.73	5.14	4.80	5.36	10.16	9.87	10.48
10	**Ave. GM1**	**12.5**			**9.6**			**73.7**			**3.5**			**70.60**			**5.57**			**10.00**		
	Min. GM1		**11.8**			**7.4**			**70.1**			**3.3**			**67.81**			**4.80**			**9.42**	
	Max. GM1			**13.1**			**11.4**			**76.6**			**3.8**			**73.73**			**6.85**			**10.48**
GRADE: GM2																						
2	Region 35	12.4	12.3	12.5	8.9	8.7	9.1	73.8	73.4	74.1	3.6	3.5	3.6	69.21	68.85	69.56	5.81	5.72	5.89	9.70	9.68	9.71
2	**Ave. GM2**	**12.4**			**8.9**			**73.8**			**3.6**			**69.21**			**5.81**			**9.70**		
	Min. GM2		**12.3**			**8.7**			**73.4**			**3.5**			**68.85**			**5.72**			**9.68**	
	Max. GM2			**12.5**			**9.1**			**74.1**			**3.6**			**69.56**			**5.89**			**9.71**
GRADE: COS																						
3	Region 35	12.0	11.8	12.2	11.3	8.8	13.4	71.6	68.9	74.0	3.4	3.3	3.6	69.72	69.31	70.50	5.05	4.85	5.40	9.95	9.70	10.31
3	**Ave. COS**	**12.0**			**11.3**			**71.6**			**3.4**			**69.72**			**5.05**			**9.95**		
	Min. COS		**11.8**			**8.8**			**68.9**			**3.3**			**69.31**			**4.85**			**9.70**	
	Max. COS			**12.2**			**13.4**			**74.0**			**3.6**			**70.50**			**5.40**			**10.31**
GRADE: GH1																						
1	Region 13	12.1	-	-	9.1	-	-	71.8	-	-	2.9	-	-	62.70	-	-	5.17	-	-	7.94	-	-
1	Region 19	13.1	-	-	8.6	-	-	73.0	-	-	2.9	-	-	69.26	-	-	4.25	-	-	8.03	-	-
2	Region 33	12.7	12.6	12.7	9.7	9.7	9.7	72.2	71.9	72.4	3.0	2.9	3.0	66.86	66.75	66.96	4.68	4.62	4.73	8.38	8.36	8.40
1	Region 35	12.6	-	-	11.3	-	-	71.5	-	-	3.0	-	-	64.92	-	-	5.80	-	-	8.63	-	-
5	**Ave. GH1**	**12.6**			**9.7**			**72.1**			**2.9**			**66.12**			**4.91**			**8.27**		
	Min. GH1		**12.1**			**8.6**			**71.5**			**2.9**			**62.70**			**4.25**			**7.94**	
	Max. GH1			**13.1**			**11.3**			**73.0**			**3.0**			**69.26**			**5.80**			**8.63**
GRADE: GH2																						
1	Region 20	13.0	-	-	11.2	-	-	69.1	-	-	3.0	-	-	66.56	-	-	4.65	-	-	8.53	-	-
1	**Ave. GH2**	**13.0**			**11.2**			**69.1**			**3.0**			**66.56**			**4.65**			**8.53**		
	Min. GH2		**-**			**-**			**-**			**-**			**-**			**-**			**-**	
	Max. GH2			**-**			**-**			**-**			**-**			**-**			**-**			**-**
21	**Ave. sorghum**	**12.5**			**9.9**			**72.8**			**3.3**			**69.08**			**5.32**			**9.48**		
	Min. sorghum		**11.8**			**7.4**			**68.9**			**2.9**			**62.70**			**4.25**			**7.94**	
	Max. sorghum			**13.1**			**13.4**			**76.6**			**3.8**			**73.73**			**6.85**			**10.48**

TABLE 9: NUTRITIONAL VALUES OF SORGHUM ACCORDING TO CLASS (2021/22)

Number of samples	Region	Moisture, %			Crude Protein content, % (db)			Total Starch content, % (db)			Crude Fat 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.	ave.	min.	max.
CLASS: GM																						
1	Region 20	12.9	-	-	11.4	-	-	70.1	-	-	3.5	-	-	68.14	-	-	5.77	-	-	9.42	-	-
3	Region 29	12.3	12.2	12.3	10.9	10.8	11.0	72.9	72.4	73.5	3.4	3.3	3.4	69.06	67.81	70.29	6.35	5.72	6.85	9.88	9.72	10.05
11	Region 35	12.4	11.8	13.1	9.4	7.4	13.4	73.7	68.9	76.6	3.5	3.3	3.8	70.75	68.85	73.73	5.24	4.80	5.89	10.02	9.68	10.48
15	**Ave. GM**	**12.4**			**9.8**			**73.3**			**3.5**			**70.24**			**5.50**			**9.95**		
	Min. GM		**11.8**			**7.4**			**68.9**			**3.3**			**67.81**			**4.80**			**9.42**	
	Max. GM			**13.1**			**13.4**			**76.6**			**3.8**			**73.73**			**6.85**			**10.48**
CLASS: GH																						
1	Region 13	12.1	-	-	9.1	-	-	71.8	-	-	2.9	-	-	62.70	-	-	5.17	-	-	7.94	-	-
1	Region 19	13.1	-	-	8.6	-	-	73.0	-	-	2.9	-	-	69.26	-	-	4.25	-	-	8.03	-	-
1	Region 20	13.0	-	-	11.2	-	-	69.1	-	-	3.0	-	-	66.56	-	-	4.65	-	-	8.53	-	-
2	Region 33	12.7	12.6	12.7	9.7	9.7	9.7	72.2	71.9	72.4	3.0	2.9	3.0	66.86	66.75	66.96	4.68	4.62	4.73	8.38	8.36	8.40
1	Region 35	12.6	-	-	11.3	-	-	71.5	-	-	3.0	-	-	64.92	-	-	5.80	-	-	8.63	-	-
6	**Ave. GH**	**12.7**			**9.9**			**71.6**			**3.0**			**66.19**			**4.87**			**8.32**		
	Min. GH		**12.1**			**8.6**			**69.1**			**2.9**			**62.70**			**4.25**			**7.94**	
	Max. GH			**13.1**			**11.3**			**73.0**			**3.0**			**69.26**			**5.80**			**8.63**

TABLE 10: MYCOTOXIN RESULTS - SORGHUM CROP QUALITY 2021/22

Region	Class	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	Total	B_1	B_2	B_3	Total						
		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
13	GH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
19	GH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20	GH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
33	GH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
33	GH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	GM	ND	ND	ND	ND	ND	35	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total number of samples		**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
Average of total number of samples		**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Number of positive results		**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Average of positive results		-	-	-	-	-	**35**	-	-	-	-	-	-	-	-	-
Maximum of positive results		-	-	-	-	-	**35**	-	-	-	-	-	-	-	-	-

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)

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 34 to 43 of this report.

Detection of tannin in sorghum grain by the bleach test

This method is applicable to whole grain sorghum.

Sorghum grain is immersed in a sodium hypochlorite solution (bleach) containing alkali. The solution dissolves away the outer pericarp layer of sorghum grain, revealing the presence of a black pigmented testa layer in the case of tannin sorghums, or its absence in the case of non-tannin sorghums.

Bleaching Reagent

- Prepare a 5.25% sodium hypochlorite solution by mixing 250 mL bleach (Jik) with 750 mL tap water.
- Weigh 10.0 g potassium hydroxide and dissolve this in 50 mL of 5.25% sodium hypochlorite solution.

Note: Prepare fresh when the tannin test is conducted. The 50 mL solution is enough for one sample.

Apparatus

- Glass beakers (50 mL)
- Tea strainer
- Aluminum foil
- Paper towel

Procedure

- The test must be performed in duplicate.
- *Known tannin sorghum and non-tannin sorghum standards must be included each time the test is performed.*
- Weigh 25.00 g sound sorghum grains of the sample in a beaker or smal glass bottle.
- Add the bleaching reagent to just cover the sorghum grains and close the beaker with aluminum foil. Too much bleaching reagent will cause over bleaching and give false negative results. If in doubt repeat using less reagent.
- Incubate beaker at room temperature (20-30°C) for 20 minutes, swirling contents of beaker every 5 minutes. White sorghum is incubated for only 5 minutes.
- Empty contents of beaker into tea strainer, discarding bleaching reagent. Rinse sorghum grains in tea strainer with tap water.
- Empty contents of tea strainer onto sheet of paper towel. Spread grains out into a single layer and gentle

blot them dry with another piece of paper towel.

- Remove the tannin sorghum grains in the sample and weigh them. T**annin sorghum grains are those grains that are black over the entire surface of the grain.**
- Weigh the non-tannin sorghum grain (remainder of the sample after removing the tannin sorghum grains). **Non-tannin sorghum grains are those which are either completely white or are brown over part of the surface of the grain.**

Calculation of results

Calculate tannin sorghum grains as percentage of total sorghum grains as follows:

- Percentage tannin sorghum = Mass of non-tannin sorghum / mass total sample) x 100
  Example: % tannin sorghum = (23.85 g tannin/25.00 g sample) x 100
  = 95.4% tannin sorghum
- Duplicate determinations should not differ by more than 5% (1.25g), for example first determination 90%, second determination 85%, or 95%. The mean of the duplicate determinations should be calculated.

Reporting of results

- Results should be expressed as: Percentage tannin sorghum, e.g. 90% tannin sorghum.
- Classification:
  - Sample containing ≥ 95% tannin sorghum is classified as Tannin sorghum
  - Sample containing ≥ 95% non-tannin sorghum classified as Non-tannin sorghum.
  - Sample containing < 95% tannin sorghum and > 5% non-tannin sorghum, the sample is classified as Mixed Tannin
  - Sample containing < 95% non-tannin sorghum and > 5% tannin sorghum, the sample is classified as Mixed Tannin

Test weight

Test weight, providing a measure of the bulk density of grain and oilseeds, was determined according to ISO 7971-3:2019, by means of the Kern 222 instrument.

To calculate the bulk density p, expressed in kilogram per hectolitre (kg/hl), the following equation was applied: p = 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.

Determination 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:

- Length, measured in millimeters (mm)
- Width, calculated at a 90% angle from the maximum length of an object, measured in millimeters (mm)
- Elongation (% Width/Length or W/L%)
- Surface:Volume ratio (calculated from length and width data)

Milling

All samples requiring milling were 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, % protein and % fat content on a dry basis (db).

Crude Protein Content

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.

Crude fat Content

In-House method 024 was used for the determination of the crude fat content in the samples. After sample preparation, the fat is extracted by petroleum ether with the aid of the Soxhlet extraction apparatus, followed by the removal of the solvent by evaporation and weighing the dried residue thus obtained. The residue is expressed as % crude fat.

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:
> 1.8 mm slotted sieve
< 1.8 mm slotted sieve and > 2.38 mm round hole sieve, and
< 2.38 mm round hole sieve.
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 ColorFlex EZ 45°/0° spectrophotometer with key parameters set on a 10° observer angle and daylight illuminant 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.

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 facility
provided that all 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 17025:2017

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

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

Mr R Josias
Chief Executive Officer

Effective Date: 01 November 2019
Certificate Expires: 31 October 2024

ANNEXURE A

SCHEDULE OF ACCREDITATION

Facility Number: **T0116**

Permanent Address of Laboratory:

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Technical Signatories:

Ms J Nortje (All Methods excl. In-house method 029)
Ms M Bothma (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)
Mrs H Meyer (All Chemical, Nutrients and Contaminants & Grading Methods)
Ms J Kruger (All Chemical Methods)
Ms M Motlanthe (In-house Methods 001, 003 & 026)
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Issue No.: 32
Date of Issue: 19 November 2021
Expiry Date: 31 October 2024

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 are sugar coated)	Moisture (Oven Method)	AACCI 44-15.02, Latest Edition (1 hour; 130˚C) (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

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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